ODP PRIME SCIENTIFIC DATA: COLLECTION, ARCHIVE, AND QUALITY[1,2]

ODP Information Technology and Data Services[3]

ACRONYM LIST

The acronyms used in this *Technical Note* are defined as follows:

A/D	analog-to-digital
AF	alternating field
AMST	archive multisensor track
APC	advanced piston coring
APCT	advanced piston coring temperature tool
ARL	Applied Research Laboratories
ASCII	American Standard Code for Information Interchange
AVS	automated vane shear
DSDP	Deep Sea Drilling Project
DSV	digital signal velocimeter
DVTP	Davis-Villinger Temperature Probe
FID	flame ionization detector
GC	gas chromatography
GRA	gamma ray attenuation
GRAPE	gamma ray attenuation porosity evaluator
HI	hydrogen index
HP	Hewlett-Packard
HS	headspace gas
HVC	hue, value, and chroma

[1]ODP Information Technology and Data Services, 2007. ODP prime scientific data: collection, archive, and quality. *ODP Tech. Note,* 37 [Online]. Available from World Wide Web: <http://www-odp.tamu.edu/publications/tnotes/tn37/INDEX.HTM>. [Cited YYYY-MM-DD]
[2]See **Disclaimer,** p. 117.
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IAPSO	International Association for the Physical Sciences of the Ocean
ICP-AES	inductively coupled plasma–atomic emission spectroscopy
IODP	Integrated Ocean Drilling Program
IRM	isothermal remanent magnetization
IW	interstitial water
MAD	moisture and density
MDCB	motor-driven core barrel
MSL	multisensor logger
MST	multisensor track
NGA	natural gas analyzer
NGR	natural gamma radiation
NRM	natural remanent magnetization
ODP	Ocean Drilling Program
OG	organic geochemistry
OI	oxygen index
PARM	partial anhysteretic remanent magnetizer
PCS	pressure coring system
PI	production index
PMAG	paleomagnetism
PWL	*P*-wave logger
PWS	*P*-wave sensor
RCB	rotary core barrel
RE	rock evaluation
RSC	reflectance spectrophotography and colorimetry
SCE	spectral component excluded
TAMU	Texas A&M University
TCD	thermal conductivity detector
TCON	thermal conductivity
TOC	total organic carbon
VAC	Vacutainer gas
VCD	visual core description
WSTP	water-sampling temperature probe
XCB	extended core barrel
XRD	X-ray diffraction
XRF	X-ray fluorescence

INTRODUCTION

ODP was an international partnership of scientists and governments who joined together to explore the structure and history of Earth beneath the ocean basins. The central purpose of ODP was to provide core samples, downhole measurements, and other scientific measurements to characterize the oceans' basins. The data generated are leading to a better understanding of the processes of plate tectonics, Earth's crustal structure and composition, conditions in ancient oceans, and changes in climate through time.

As the program Science Operator, Texas A&M University (ODP/TAMU) had the responsibility to collect cores from the ocean basins, provide adequate facilities for analyses of the cores, and assure the preservation of cores and scientific data collected by shipboard scientists. This program was very successful—ODP repositories hold >220 km of core and the databases contain millions of analytical measurements made on core sections and samples. By providing the drilling platform, consistent drilling procedures, onboard laboratories equipped with analytical equipment, and standard data collection procedures, ODP has created a suite of analyses from locations throughout the world's oceans that are directly comparable.

Prime Scientific Data

One of the primary tasks of the Science Operator was to collect, archive, and disseminate scientific data collected on the core during the cruises. Table T1 contains a list of the prime data types—analyses performed on the ship during a cruise with standard data collection procedures on all cores when practical.

T1. Prime data types, p. 118.

Most of the scientific measurements are available using Web-based queries of the Janus database, an Oracle database created to serve data to the scientific community as well as maintain the prime data in a permanent archive. The Janus database is now maintained by IODP/TAMU, the U.S. Implementing Organization of IODP. The database maintains a set of queries that allows the user to extract data.

This *Technical Note* provides a general description of the prime scientific data types. For each data type, the following information is provided:

1. Description of data collection procedures and the equipment used.
2. How the data were archived before the Janus database existed.
3. How the data are stored in the Janus database.
4. Discussion of data quality including factors that may affect the quality of the data.

More detailed information about ODP data collection can be obtained from the technical notes that describe data collection for each of the different laboratories on the *JOIDES Resolution*. In addition, Explanatory Notes chapters at the beginning of each *Initial Reports* volume, Laboratory Officer's reports for each leg, laboratory technicians' reports, and log sheets provide additional information. This information can also be requested from the **IODP/TAMU Data Librarian.**

General Definitions

Leg

ODP started numbering the scientific cruises of the *JOIDES Resolution* at Leg 101 (Leg 100 was a trial run of the modified drilling ship). Leg duration was nominally 2 months. The Shipboard Science Party typically consisted of 25 scientists drawn from universities, governments, and industry around the world. During the 18+ yr of ODP, there were 110 cruises on the *JOIDES Resolution*.

Site

A site is the location where one or more holes were drilled while the ship was positioned over a single acoustic beacon. The drillship visited 656 unique sites during the course of ODP. Some sites were visited multiple times, including some sites originally visited during DSDP, for a total of 673 site visits.

Hole

Several holes could be drilled at a single site by pulling the drill pipe above the seafloor, moving the ship some distance away, and drilling another hole. The first hole was designated "A," and additional holes proceeded alphabetically at a given site. Location information for the cruise was determined by hole latitude and longitude. During ODP, 1818 holes were drilled or deepened.

Core

Cores are numbered serially from the top of the hole downward. Cored intervals are as long as 9.7 m, the maximum length of the core barrel. Recovered material was placed at the top of the cored interval, even when recovery was <100%. More than 220 km of core was recovered during ODP.

Core Type

All cores are tagged by a letter code that identifies the coring method used. Some of the more common core types are

- H – APC: The advanced piston corer is a hydraulically actuated piston corer designed to recover undisturbed core from soft sediments. It is designed to be delivered through the drill string to the sediment to be cored whether at the seafloor or hundreds of meters below it.
- X – XCB: The extended core barrel is designed to recover core samples from soft to medium formations. Typically, the XCB is deployed upon APC refusal (i.e., when a formation becomes too stiff to piston core). The XCB relies on rotation of the drill string to advance the hole and cut the formation.
- R – RCB: The rotary core barrel is designed to recover core samples from medium to hard formations. The RCB relies on rotation of the drill string to advance the hole and cut the core. The core bit trims the sample.
- W – WASH: When washing down a hole, drilling rates are higher if a core barrel is used rather than blocking the drill bit with a center bit device, even though no core is desired. The driller may wash down a hole as many meters as desired without retrieving a core.
- G – A ghost core's contents come from an already drilled part of the hole (i.e., the extent of a ghost core lies completely within the drilled or cored portion of a hole.)
- P – PCS: The pressure core sampler is capable of retrieving core samples from the ocean floor while maintaining near–in situ pressures as much as 689.7 atmospheres (10,000 psi).
- M – MISC: This represents material that could not be labeled with a standard core type. This category includes limited numbers of cores that are recovered using experimental drilling methods which, once they are established, are assigned their own core type.

Z – DIAM: Diamond coring bits are being developed to enhance recovery of core in hard rock.
N – MDCB: The motor-driven core barrel is a wireline-retrievable coring system designed for a two-fold purpose. It allows single-bit APC/XCB holes to be extended to greater depths and into more indurated formations. The can also improve recovery in difficult formations.
0–9 Interval was drilled, not cored.

Section

Cores are cut into 1.5-m sections in order to make them easier to handle. Sections are numbered serially, with Section 1 at the top of the core. Most of the scientific measurements were made on sections or discrete samples taken from the sections. Samples and measurement intervals are given in centimeters from the top of each section. After being cut into sections, several whole-core measurements were made, and then the core was split into working and archive halves. The archive halves were used for the visual descriptions, paleomagnetism, and photography. The working halves were sampled for shipboard and shore-based studies.

Core Handling, Curation, Sampling, and Analysis

As soon as core was brought on deck, a paleontology sample was usually taken from the core catcher in order to obtain an initial age assessment. It was then put into a long rack where Vacutainer gas samples could be taken from voids. Sections were marked, labeled, and cut. Whole-round samples were taken. Each section was sealed with color-coded caps glued on the top and bottom: a blue cap for top of section, a clear cap for the bottom, and a red cap for where a whole-round sample was taken.

The sections were moved to the core laboratory where they were labeled with an engraver to mark the full identification of the section. The length of core was measured for each section and core catcher and the lengths were entered into the database. The cores were equilibrated to room temperature, run through the MST, which included GRA densiometer, MSL, NGR sensor, and PWL, and thermal conductivity measurements were made.

The sections were then split into working and archive halves. The softer sections could be split with a wire, more indurated sections were cut with a saw, and harder rock cores were split with a band saw or diamond saw. The archive halves were wrapped and taken to the core description area where scientists completed VCDs. The archive halves were analyzed using the pass-through cryogenic magnetometer. The working halves were available for sampling. Routine samples for shipboard laboratory analyses were taken. In addition, scientists who requested personal samples could take samples for their own research. These could be analyzed in the shipboard laboratories or taken back to the scientists' laboratories. All samples were entered into the database and included location information (leg, site, hole, core, core type, section, and top and bottom intervals) and volume of sample.

Data Acquisition

Most of the analytical laboratories on the ship were equipped with analytical equipment that interfaced to computers. Early in the program, these programs were fairly basic, but as technology advanced, the data acquisition programs became more advanced. Sections and samples were identified by barcode after Leg 171, but the implementation of barcode readers on each of the analytical systems had not yet been accomplished.

Sources of Error

Most data collection in the shipboard laboratories involved at least one manual data entry event (e.g., sample entry into database, section or sample information entry to data acquisition program, data entry into databases, or reformatting of data tables for the *Initial Reports* volume). Core and section information were checked very closely, but verification of every sample, analysis, and run was an enormous task during the operational time of a cruise. Operator entry or typographical errors probably account for the largest number of errors.

Data Archive

Data Archive at ODP before Janus

Several of the prime data types have been captured digitally since the beginning of the program. Files were created on computers in the laboratories and transferred to the central computer for compilation and transfer back to shore at the end of the leg. ODP/TAMU retained many of the original raw files on an active server, with each new leg added after data returned from the ship. These files were maintained as an archive and are made available to the scientific community on request to the **IODP/TAMU Data Librarian**.

During the early part of ODP, the Science Operator recognized the need for a data management system to help storage and retrieval of the scientific data and consequently chose System 1032 by Computer Corporation of America, or S1032. Most of the scientific data collected on samples (e.g., MAD properties, carbonate analyses, etc.) were loaded into S1032 and the original files were not saved online. The media used to transfer data between ship and shore are obsolete, so retrieval of the original raw files for some data sets is no longer possible.

Database technologies evolved throughout the program, and ODP scientists and staff were continually looking for more efficient and effective ways to capture the information collected on the ship. S1032 was used for a variable length of time depending on the data set. Some effort was made to move some data sets (e.g., MAD properties and paleontology) into 4D, a relational database running on the Macintosh computer system. For some data types, it was decided to archive the original files. There were problems with these database engines, including software upgrades that could not read databases created with earlier versions, and some versions of these databases were easily corrupted.

Data Archive at ODP after Janus

The continuing improvement in database technology and the explosion of scientific databases accessible over the Internet convinced ODP/TAMU to create a database that would provide a permanent archive for the scientific data and could be accessed by the public through an Internet interface. Janus, an Oracle-based relational database, was created and has become the repository for all core and sample information and most of the shipboard scientific data. Janus became operational during

Leg 171, January 1997. From that point, the scientific data generated on board ship were uploaded to Janus, but the original data files were still brought back to shore and archived. Janus Web was created to provide standard data queries that allowed the public to look at or download data from Janus.

Janus Data Management and Verification

Before Janus became operational, verification of the scientific data collected during a cruise was the responsibility of the leg Scientific Party. Minimal checking or verification was done after the data were brought back to shore. However, when Janus became operational during Leg 171, more complete verification of leg-associated scientific data became necessary. The relational characteristics of the Janus database require more active oversight by database managers to ensure that integrity of the data is maintained. ODP data verification procedures include

- Data acquisition: Confirming that the data acquisition software is recording all the data necessary to document each analysis and ensuring that Janus has a place to put every piece of information that should be saved,
- Upload: Testing the upload software to verify that each datum is being put into the correct field,
- Leg Data: Checking data collected during a leg to help ensure that data are linked correctly to the sections and samples on which the analyses were performed, and
- Web Queries: Confirming that Web queries return the correct information to the user. If the relationships in the database are not correct, critical data are missing, or the query is not written properly, data values can incorrectly be associated with other samples or sections, not the core material on which the analyses were done, or the query may not work at all.

Data checking was by far the most difficult and sensitive task for database personnel. Procedures were instituted to verify that the data from a leg was properly entered into the Janus database and, at the same time, reassure the scientific community that database personnel were not changing data without the knowledge and permission of the Scientific Party. These procedures are as follows:

1. Use log sheets and laboratory notes whenever available. Log sheets had been used in many of the laboratories since Leg 100, and most log sheets were returned to shore for archiving early in the program. Most of the data entry into S1032 and data verification was done on the ship by the Scientific Party, so the practice of sending the log sheets to shore at the end of the leg was discontinued. After Janus became operational and the need for database oversight was recognized, the log sheets were returned to shore to aid the verification procedures.
2. Check the laboratory technician reports, Explanatory Notes, and other written communications to document any problem that could affect the quality of the data.
3. Interact with the Scientific Party when a question about any aspect of the data collection was identified. Database personnel attended the leg postcruise publications meeting in which the

final editing was done on the *Initial Reports* volume for that leg. Database personnel could interact with the scientists and resolve problems either in the database or the *Initial Reports* data tables.

Unfortunately, the verification of the pre-Janus migrated data was a more difficult problem. Log sheets and laboratory notebooks were not available for most of the legs' data sets. The important link of interacting with the scientists and technicians who collected the data was mostly missing. The main resource was the *Initial Reports* volumes. When there was a discrepancy, all available information was studied in order to determine the nature of the discrepancy. Data in the database were only changed when there was compelling evidence that data in the *Initial Reports* table were wrong. Some of the data-specific verification techniques and common sources of errors are discussed in the following data sections.

References

A comprehensive list of all the reports, log sheets, notebooks, conversations, hand-written notes, and so on, used to compile the information for the data summary reports is impossible. For additional information about any aspect of the ODP data collection procedures, please contact the **IODP/TAMU Data Librarian**:

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CARBON/CARBONATE GEOCHEMISTRY

Basic organic geochemical analyses were performed to support the general scientific objectives of ODP. Elemental carbon data obtained from samples contributed to a wide range of studies. Carbonate contents of cores were used for sedimentological and lithostratigraphic classification purposes. Organic carbon content (from organic matter) provided valuable evidence for ocean paleoenvironmental studies and depositional environment classification. Carbon/nitrogen ratios were used to infer the nature of the organic matter (e.g., land or aquatic plant material) preserved in cores. Molecular organic geochemical analyses such as alkenone unsaturation can be used to infer marine paleotemperature information.

One of the reasons for performing carbon analyses was to monitor for hydrocarbons. Although much of the carbon in sediments was in the form of inorganic carbon or carbonate, most of the interest was in the organic carbon—that carbon derived from marine phytoplankton, bacteria, algae, and other organic material. The *JOIDES Resolution* was not designed to drill into pressurized reservoirs of oil or gas, so constant monitoring for hydrocarbons was required. Maturation of organic material in undersea environments may result in hydrocarbon generation, so sediments were monitored for increasing amounts of organic carbon.

Data Acquisition

Many diagenetic changes occur in the uppermost 150 m of the sediment column, which was one of the reasons for higher density sampling of the uppermost 10–15 cores in a hole. During the first part of ODP, 25- to 30-cm whole-core OG samples were taken every 30 m and immediately frozen to preserve the core because of the volatile nature of organic matter. Not all analyses could be done in the shipboard chemistry laboratory, and freezing these samples slowed deterioration of the organic matter and minimized chances of contamination. Shipboard scientists stopped taking OG samples after Leg 134, probably because they were able to collect the information they needed and there were few requests for OG samples for shore-based studies.

Analyses of samples produced data as weight percentages of total carbon, inorganic carbon, and organic carbon directly or by difference. Although other carbonates may be present, all acid-soluble (i.e., inorganic) carbon was reported as calcium carbonate. In addition, analyses sometimes included data for elemental concentrations of sulfur, nitrogen, and hydrogen. These data were used to characterize the nature of the organic carbon.

Samples taken for carbon analysis were freeze-dried, crushed, and carefully weighed. If the sample was to be analyzed for carbonate, the sample was mixed with acid to convert the carbonate to CO_2 before analysis in the coulometer. Samples to be analyzed using a CHNS analyzer for total carbon, nitrogen, and sulfur were mixed with an oxidizer and combusted at 1000°C. Table **T2** briefly outlines the variety of instruments used to collect organic and inorganic carbon data during ODP.

T2. Carbon analyses instruments, p. 118.

Additional information about carbon measurements can be found in *Technical Note* 30 (Pimmel and Claypool, 2001).

Archive

Pre-Janus Archive

Early in ODP, carbonate data were collected on log sheets which were sent back to ODP/TAMU at the end of each cruise. The data were entered into an S1032 database, and the log sheets were microfilmed for archival storage. Data entry routines were implemented so that data entry could be done on the ship. Carbonate data were stored in the S1032 database until the Janus database became operational for Leg 171.

Migration of Carbonate Data to Janus

The data model for carbonate data can be found in **"Janus Carbonate Chemistry Data Model,"** p. 64, in "Appendix A." Included are the relational diagram and list of tables that contain data pertinent to carbonates, column names, and definitions of each column attribute. ODP Information Services Database Group was responsible for the migration of pre-Leg 171 data to Janus.

Janus Carbonate Data Format

Carbonate analyses can be retrieved from Janus Web using a predefined query. The carbonate query Web page allows the user to extract data using the following variables to restrict the amount of data retrieved: leg, site, hole, core, section, depth ranges, or latitude and longitude ranges.

Table T3 lists the data fields retrieved from the Janus database for the carbonates predefined query. The first column contains the data item, the second column indicates the Janus table or tables in which the data were stored, and the third column is the Janus column name or the calculation used to produce the value. **"Description of Data Items from Carbonates Query,"** p. 65, in "Appendix A" has additional information about the fields retrieved using the Janus Web carbonates query and the data format for the archived ASCII files.

T3. Carbonate query, p. 119.

Data Quality

The carbonate data in Janus represent an extensive collection of inorganic and organic carbon in sediments from ocean basins throughout Earth. More than 66,000 samples were analyzed for inorganic and organic carbon. There are few known instances where there was any major problem with data collection. Anything written or typed was a potential source of errors. Analytical results were written on log sheets. These data were then typed into S1032. Data entry programs were implemented to add the data to S1032, but these programs still required manual data entry. Data acquisition programs were later implemented to collect carbon data, but the operator manually entered the sample information. Writing or typing incorrect information occasionally happened, and some mistakes were not identified. Often the Scientific Party found errors and corrected them for the data included in the *Initial Reports* volume, but data sent back to ODP/TAMU was not corrected.

Another error found during the migration of carbon data was that samples were missing from the database. In those instances, a sample was entered into the database so that the data could be migrated. The verification of those samples and of the entire carbonate data set were not completed because of time constraints. Most data collected after the Janus database was operational for Leg 171 were verified as part of the Janus data management and verification procedures (see **"Janus Data Management and Verification,"** p. 7). Some verification was done on the pre-Leg 171 data; however, if there is a discrepancy between the database and data in the *Initial Reports* volumes, the published data should be considered more reliable.

Janus does not contain any calibration information for carbonates. Procedures for storing calibration information were not implemented during ODP.

GAS CHROMATOGRAPHY

Hydrocarbon generation is the natural result of the maturation of buried organic matter. The sources of organic matter in ocean sediments include plankton, bacteria, and land-derived material. The organic matter can be transformed into hydrocarbons, depending on burial depth and temperature. Hydrocarbons such as methane, ethane, propane, and butane are usually found in the gaseous phase in sediments close to the surface. Microbial activity is most often the source of these gases at shallow depths, but one of the exciting discoveries during ODP was evidence of microbial activity deeper in the crust.

Hydrocarbon monitoring was one of the primary reasons for gas sampling and analysis. During ODP, the *JOIDES Resolution* was not designed to drill in areas where oil or gas could be encountered. Proposed sites were intensively studied and reviewed in order to ensure those sites did not have factors conducive to hydrocarbon accumulation. Headspace gas samples and gas from expansion voids were analyzed as part of an active monitoring program. In addition to hydrocarbons, gases such as hydrogen sulfide represented a potential safety problem.

Data Acquisition

Gas analyses were conducted on headspace samples (gas obtained from sediment samples) and Vacutainer samples (void pockets within the core before the liner had been breached). Headspace samples were taken from the core immediately after the core was brought on deck. A 5-cm^3 sample was placed in a glass vial, sealed, and heated for 30 min. A 5-mL aliquot of gas was extracted and analyzed by GC.

Vacutainer samples were also taken immediately after the core came on deck if there were gas pockets, bubbling, or frothing within the liner, or bulging end caps. A liner penetrator tool equipped with a valve and needle was used to collect gas samples. A preevacuated sealed glass tube or syringe was placed on the valve and the valve was opened for a few seconds. In the laboratory, some of the gas was extracted from the tube or syringe and analyzed by GC.

Over the span of ODP, several instruments were used to analyze HS and VAC gases. Several HP gas GCs were used, from the HP 5890A GC used during the early part of ODP to the HP 6890 GC instruments in the laboratory at the end of ODP. Instrumentation in the chemistry laboratory usually included a GC with both a FID and TCD and a GC with a NGA, FID, and TCD. A Carle Series 100 analytical GC was used for rapid determinations of methane, ethane, and propane.

Preanalyzed standards were run to ensure the chromatographic responses were calibrated. The calibration measurements were not archived or entered into the Janus database. Additional information about ODP gas analyses can be found in *Technical Note* 30 (Pimmel and Claypool, 2001).

Archive

Pre-Janus Archive

Early in ODP, gas data were collected on log sheets which were sent to ODP/TAMU at the end of each cruise. The data were entered into the S1032 database, and the log sheets were microfilmed for archival storage. Data entry routines were implemented so that data entry could be done on the ship and the practice of collecting data on log sheets ended. Gas analyses were stored in the S1032 database until the Janus database became operational during Leg 171.

Migration of Gas Elements Analyses to Janus

The data model for gas elements data can be found in "Janus Gas Chromatography Data Model," p. 66, in "Appendix B." Included are the relational diagram and list of the tables that contain data pertinent to gas analyses, column names, and definition of each column attribute. ODP Information Services Database Group was responsible for the migration of pre-Leg 171 data to Janus.

Janus Gas Elements Data Format

Gas analyses can be retrieved from Janus Web using a predefined query. The gas elements query Web page allows the user to extract data using the following variables to restrict the amount of data retrieved: leg, site, hole, core, section, depth range, and latitude and longitude ranges. The gas query also gives the user the option of extracting data by sampling method, instrument used to analyze the gas, or detector type.

Table T4 contains the data fields retrieved from the Janus database using the Janus Web predefined query. The first column contains the data item; the second column indicates the Janus table or tables in which the data were stored; the third column is the Janus column name or the calculations used to produce the value. "Description of Items from Gas Elements Query," p. 68, in "Appendix B" contains additional information about the fields retrieved using the Janus Web gas elements query and the data format for the archived ASCII files.

T4. Gas elements query, p. 119.

Data Quality

The collection of gas data was vitally important to the safety of drilling operations on the drillship. Much care was taken in order to obtain rapid, accurate results. There are few known instances where there was a major problem with data collection. Anything written or typed was a potential source of error. Analytical results were written on log sheets. These data were then typed into the S1032 database. Data entry programs were implemented to add the data to the S1032 database, but these programs still required manual entry. Typographical errors from writing or typing incorrect information occasionally happened, and some mistakes were not identified. Often, the scientific party found errors and corrected them for the data included in the *Initial Reports* volume, but data sent to ODP/TAMU were not corrected.

Another error found during the migration of gas data was that samples were missing from the database. In those instances, a sample was entered into the database so that the data could be migrated. The verification of those samples and the verification of the entire gas data set were not completed because of time constraints. Most data collected after the Janus database was operational during Leg 171 were verified as part of the Janus data management and verification procedures (see "Janus Data Management and Verification," p. 7). Some verification was done on the pre-Leg 171 data; however, if there is a discrepancy between the database and data in the *Initial Reports* volumes, the published data should be considered more reliable.

Janus does not contain any calibration information for GCs. Procedures for collecting and storing calibration information in the database were not implemented during ODP. Procedures for collecting data on lipids were also not implemented during ODP.

BULK DENSITY ESTIMATION BY GAMMA RAY ATTENUATION DENSIOMETRY

Bulk density is a measure of mass per unit volume, typically expressed as grams per cubic centimeter (g/cm^3). In Earth sciences, bulk density is often an indicator of changes in lithology (mineral composition, grain size, and other physical characteristics) and porosity (the spaces between mineral grains that can be filled with gas or fluid). The correlation of bulk density and porosity to other properties of rocks and sediments led to the development of the GRAPE by Marathon Oil Company during the 1960s (Boyce, 1973). The principle is based on interaction of medium-energy gamma radiation with rock or sediment by Compton scattering. The mass attenuation coefficients for most rock-forming elements are similar; therefore, the attenuation of gamma radiation can be directly related to the density of the material.

ODP started where DSDP left off. Much of the scientific expertise and laboratory equipment were transferred from DSDP, including the GRAPE system. This allowed scientists sailing on the first ODP cruise to continue collecting this type of data, which had been measured since early in DSDP. The bulk density data set as measured by the GRA systems provide a very large, densely sampled record of bulk density for >80% of the 222 km of core collected throughout the world by ODP.

Data Acquisition

ODP started operations with the DSDP GRAPE hardware and software. Basically, the GRAPE system consisted of a drive device that moved a section of core between a shielded gamma ray source (^{133}Ba) and a shielded scintillation detector. Modifications and upgrades were made as improvements in computers and data acquisition technology became available, and scientific objectives changed. The system eventually was referred to as the GRA densiometer because the device measurements were used to calculate density rather than porosity. An MST (automated core conveying and positioning system) was installed during Leg 124E with an upgraded GRA system. This new GRA system finally retired the last of the GRAPE components as a new source (^{137}Cs) and NaI scintillation detectors were installed.

Table T5 briefly outlines the modification history of the systems used to collect bulk density data. The acronym "GRAPE" will be used when referring to measurements taken with the original ^{133}Ba source and detectors of the DSDP GRAPE system. Likewise, "GRA" will be used when referring to the ODP system with the ^{137}Cs source and NaI scintillation detectors or when referring to the bulk density data set as a whole. More detailed descriptions of both DSDP and ODP bulk density measurements can be found in Boyce (1973, 1976) and *Technical Note* 26 (Blum, 1997).

T5. GRA systems, p. 120.

Standard Operating Procedures

At the beginning of ODP, the Shipboard Scientists' Handbook (1990) instructed that the sections could be run through the GRAPE analyses while they stabilized for thermal conductivity measurements. After additional sensors whose measurements were temperature sensitive were added to the track, cores were stored on a rack to allow them to equilibrate to room temperature before analysis. The highest quality GRA data were made on core liners that were completely full. It was recommended that only APC cores be analyzed because APC coring routinely recovered soft sediment that filled the core liner. XCB and RCB cores were often disturbed, containing biscuits of core surrounded by drilling mud or irregular pieces of core that did not completely fill the core liner. With the older DSDP track, it would often take as long as 2 hr to take GRAPE measurements on one core. Considering the amount of time required to take these measurements and the poorer quality of data, hard rock cores and disturbed cores were not usually run in continuous mode. These cores were sometimes analyzed by GRAPE-2, a longer count density measurement taken on samples or discrete locations on a section.

Calibration

Two different calibration procedures were used during ODP (Table T6). Aluminum was chosen for the calibration standard because aluminum has an attenuation coefficient similar to common minerals. The calibration standard used until Leg 168 consisted of two aluminum cylinders of different thickness mounted in a liner. The thicker rod had a density of 2.7 g/cm^3 and the thinner rod had a density of 1.00 g/cm^3. With this procedure, however, the density of water was overestimated by ~11% (Boyce, 1973). A fluid correction was applied to the bulk density estimate to compensate for the overestimation of water density.

T6. GRA calibration procedures, p. 120.

Data collection and calibration procedures set up and described by Boyce (1973, 1976) were used throughout the first part of ODP even though modifications had been made to the system. Installation of the MST and new GRA system marked a major change to both hardware and software. Documentation of calibration procedures, frequency of calibration, and the calibration parameters used for the density calculations were difficult if not impossible to find before Leg 124, when the MST was installed with a major software upgrade. After that system was installed, files were created that contained the analysis of the standard; however, these files were not always saved, and the calibration history was not documented. The software upgrade during Leg 163 resulted in a major change in the data file format. The calibration date and parameters were written in the header of the data file. From this point, the calibration history of GRA data was documented.

A new calibration procedure was implemented during Leg 169. This new procedure incorporated a two-phase standard of a telescoping aluminum rod (five elements of varying thickness) and pure water. Because of the two-phase standard, the fluid correction was no longer necessary because water was used in the calibration procedure. For a full discussion of the calibration procedures see *Technical Note* 26 (Blum, 1997).

Archive

Pre-Janus Archive

Most of the original GRAPE and GRA data files were archived on the ODP/TAMU servers. There was no interim database for GRA data. In a few instances, the files for a hole were concatenated into a single file. Some of these original files are no longer available, either because the scientists who concatenated the file deleted them or they were not moved onto the ODP/TAMU servers.

Migration of GRA Bulk Density to Janus

The data model for GRA bulk density can be found in "Janus GRA Densiometer Data Model," p. 69, in "Appendix C." Included are the relational diagram and list of the tables that contain data pertinent to GRA, column names, and definition of each column attribute. ODP Information Services Database Group was responsible for the migration of pre-Leg 171 data to Janus. The migration of GRA bulk density was done in conjunction with MSL, PWL, and NGR MST data sets. Each change in format was documented and added to the MST migration program. Additional information about the migration of GRA data or original file formats can be requested from the **IODP/TAMU Data Librarian**.

As noted in the calibration section above, the raw bulk density value overestimated the density of water. The raw data files created before Leg 133 contained the uncorrected bulk density, calculated as

$$\text{GRA\_CALIBRATION.density\_M0} + \text{GRA\_CALIBRATION.density\_M1} \times \ln(\text{GRA\_SECTION\_DATA.meas\_counts}/\text{GRA\_SECTION\_DATA.actual\_daq\_period}). \quad (1)$$

After Leg 133, the Boyce density correction was applied to the density value and written in the data files. During the migration of GRA data to Janus, the Boyce density correction

$$\text{Boyce corrected density} = [(\text{density} - 1.128) \times 1.626/1.522] + 1.024 \quad (2)$$

was applied to all the bulk density values that had not already been recalculated (Legs 101–133, Site 818).

Janus GRA Data Format

GRA data can be retrieved from Janus Web using a predefined query. The GRA bulk density query Web page allows the user to extract data using the following variables to restrict the amount of data retrieved: leg, site, hole, core, section, specific run number, range in density values, depth range, or latitude and longitude range. In addition, the user can use the output raw data option in the query to extract the raw measurements and calibration parameters used to calculate the bulk density values. Because there are more than 9.2 million GRA data records in Janus, a user must restrict the amount of data requested.

Table **T7** lists the data fields retrieved from the Janus database for the predefined GRA query with output raw data option turned on. The first column contains the data item, the second column indicates the Janus table or tables in which the data were stored, and the third column is the Janus column name or the calculation used to produce the value. **"Description of Data Items from GRA Query,"** p. 71, in "Appendix C" contains additional information about the fields retrieved using the Janus Web GRA query and the data format for the archived ASCII files.

T7. GRA query, p. 120.

Data Quality

Several things can affect the quality of GRA data. The type of cored material and drilling method used to recover the core are major factors. APC coring, used to recover softer, undisturbed sediments, routinely gives the best results because the core liner is usually full. However, the sediments can also contain gas, which creates voids in the cored material. Cores cut by XCB and RCB coring are often biscuits surrounded by drilling mud or irregularly shaped pieces. Voids, smaller diameter core, irregular pieces, and thin runny mud all give low GRA density values. Table **T8** summarizes how much of the different types of core were analyzed on the GRA systems.

T8. GRA analysis statistics, p. 121.

Even though the Shipboard Scientists' Handbook (1990) specified that GRA measurements should only be made on APC cores, the addition of other sensors to the GRAPE track and eventually the MST made it more of a temptation to run less than ideal cores through the GRA system. This did not mean that GRA density analyses on XCB and RCB cores have become more accurate. GRA values on anything but APC cores should be used with some skepticism. For more information, see Chapter 3 in *Technical Note* 26 (Blum, 1997) and *Technical Note* 36 (ODP Science Services, 2006).

A couple of mechanical factors also affect the quality of GRA density measurements. The GRA systems have always been installed on a track that either moved the section past the source and detectors or moved the source and detectors along the vertical section. Sample measurements were a function of the speed of the track and sampling time. Slight variation of track speed may account for the irregular spacing of data points.

Core sections were run through the GRA system before the liners were opened and the core curated. During the curation process, core material often shifted. In sedimentary cores, voids may have closed. Gassy cores may have small voids that continue to enlarge after analysis. Sections may not be completely full, and material may have spread throughout the liner. After curation, this material was pushed up to close voids and the section's curated length was less than originally analyzed. The effects can be seen when looking at the data for a section: (1) there are reasonable density values beyond the curated length of the section (null depth values) and (2) there are negative density values within the section indicating a measurement in a void or less than full liner.

Hard rock cores can be continuous cylinders with uniform diameter or can be broken into small irregular pieces. The curation process shifts hard rock pieces, sometimes even shifting core material from its original liner section to an adjacent section liner. Where the core material was in its liner during analysis and where it was eventually placed after curation can be very different. GRA data for these types of cores should be used with caution.

Operators may also be a source of error. Throughout ODP, the operator manually entered core information into the data acquisition program. Typographical errors or entering wrong information occasionally happened, and some mistakes were not identified. Sometimes, the scientific party noticed the error and corrected it for the data included in the *Initial Reports* volume, but the original files were not corrected. A lot of effort during verification of the migrated GRA data has gone into finding sections that may have been misidentified. Some runs have been renamed to different sections. The evidence for misidentification had to be conclusive. Some of the clues used to find incorrectly identified analyses are

1. Two runs for a section and no run for the following section;
2. Run numbers out of sequence;
3. Two runs for a section, run numbers out of sequence (no data for that core and section in a different hole, but sequence of run numbers would be correct); and
4. Nature of the core material (length of core, voids, or less than full liners).

INDUCTIVELY COUPLED PLASMA–ATOMIC EMISSION SPECTROMETRY

ICP-AES is a method of qualitative and quantitative analysis for elemental composition of samples. ICP analysis is based on the measurement of wavelengths and intensities of spectral lines emitted by secondary excitation. ODP continually evaluated the analytical capabilities of the shipboard laboratories and decided to upgrade the analytical capability of the XRF system by installing the ICP-AES instrument. In addition to analyzing hard rocks, the ICP system was used to analyze interstitial waters and sediments.

The Jobin-Yvon JY2000 instrument was installed in the Chemistry Laboratory on the *JOIDES Resolution* prior to Leg 187. Extensive testing was done during Leg 187 to evaluate the ICP system, create the ODP procedures for analyzing hard rock samples, and compare the results with duplicate analyses on the XRF. Overall, the analytical results were within the margin of error. Some advantages of using ICP included: samples could be analyzed more quickly, less sample material was required, and more trace elements could be measured reliably at lower detection limits. Additional procedures were developed during Legs 188 and 189 for analyzing interstitial water samples and sediments.

Data Acquisition

ICP-AES works on the concept that excited electrons emit energy in narrow, well-defined wavelengths as they return to ground state. Characteristic wavelengths have been identified for many oxides and elements. The intensity of the energy at a given wavelength is proportional to the concentration of that element in the sample. The constituents of an unknown sample can be quantified by comparing the measured intensities to standards with known composition.

Sample Preparation

ICP-AES analysis requires that the sample be in solution. Sediments and hard rocks had to be dissolved. A method similar to XRF sample preparation was developed to avoid dealing with hydrofluoric acid in the shipboard environment. A washed and dried sample was powdered by crushing the sample between two plastic disks in a hydraulic press. Powder was produced by grinding pieces <1 cm in diameter in a Spex Shatterbox, using a tungsten carbide grinding vessel, the same procedure for producing powdered samples for XRF analyses. Typically, 0.1 g of sample powder was mixed with 0.4 g ultrapure-grade $LiBO_2$ flux and LiBr wetting agent in a Pt-Au crucible. This mixture was fused at 1050°C for 10–12 min. After the bead cooled, it was dissolved in nitric acid. A small amount of filtered solution was diluted by additional nitric acid. This method was preferable and resulted in a stable sample solution that could be safely transported to scientists' home laboratories for additional study.

Interstitial water samples were much easier to prepare. The filtered interstitial water sample was acidified with dilute nitric acid and diluted again with deionized water. Undiluted interstitial water samples could be run, but care was needed to not clog the nebulizer on the ICP-AES instrument.

Calibration

ICP-AES analytical methods are based on comparison of the unknown sample's line intensities to one or more well-characterized standard reference materials. The calibration for ICP-AES needed to be performed on each run. For hard rocks normally collected by ODP, a number of standards have been used, as the variability of sediment compositions precluded using a single standard. Sediments are often combinations of shales, carbonates, and siliceous deposits, so combinations of standards can be used to cover much of the spectral range. Table **T9** contains many of the hard rock and sediment standards used by ODP for XRF and ICP-AES analyses.

T9. ICP-AES standard reference materials, p. 121.

The standards used for calibration for interstitial water analyses must be constructed. The recommended method was to spike filtered surface seawater in order to create a master standard solution. The master standard solution could also be created using IAPSO standard seawater.

Analyses Data

The analytical run began within 10 min of the end of the calibration run. The first sample was the master drift sample, analyzed at the beginning and again at the end of the run. Preliminary results were calculated by the system software, but the complete data reduction had to be done by the scientists. Data were loaded into an Excel spreadsheet with many of the necessary calculations previously set up.

A more complete discussion on procedures for collecting ICP-AES data can be found in *ODP Technical Note* 29 (Murray et al., 2000).

Archive

Janus ICP-AES Data Format

Because the data collected on the ICP-AES system were very similar to data collected on the XRF system, ICP-AES data for hard rocks and sediments were archived in the same tables as the XRF data. Interstitial water data were entered into the tables with the other interstitial water analyses.

The data model for ICP-AES element composition can be found in **"Janus ICP-AES Data Model,"** p. 72, in "Appendix D." ICP-AES major oxide and trace element data can be retrieved from Janus Web by using a predefined query. The ICP-AES query Web page allows the user to extract data using the following variables to restrict the amount of data retrieved: leg, site, hole, core, section, depth range, or latitude and longitude range. Occasionally, replicate samples were analyzed for the major oxides. Those data, when available, were uploaded separately. The Web query reports the replicate data on separate lines. In addition, the trace element data will also be reported on a separate line, even though trace element data were collected at the same time as the major oxide data.

Table **T10** lists the data fields retrieved from the Janus database for the ICP-AES predefined query. The first column contains the data item, the second column indicates the Janus table or tables in which the data were stored, and the third column is the Janus column name or the calculation used to produce the value. **"Description of Data Items from ICP-AES Query,"** p. 74, in "Appendix D" contains additional information about the fields retrieved using the Janus Web ICP-AES query and the data format for the archived ASCII files.

T10. ICP-AES query, p. 123.

Data Quality

The quality of the ICP-AES data was considered very good, even though the ship environment was a difficult environment in which to get accurate measurements. ICP-AES analyses performed on volcanic, mafic, and ultramafic samples are the highest quality because there are standards that characterize the range of elemental concentrations most often found in these types of rocks. It is more difficult to create standards that would encompass the range of elemental concentrations found in sedimentary environments.

In order to aid the interpretation of ICP-AES analyses, an additional column of information was added to the XRF_SAMPLE table after ICP-AES data were being archived in Janus. This column, Sample_type, was added to allow scientists to describe the type of rock that was analyzed, and in turn, allow the extraction of data based on specific rock types. These data were not usually stored in the original data files, and it was necessary to extract that information from the *Initial Reports* volumes. Because of constraints of time, it was not possible to complete entering this information.

INTERSTITIAL WATER

Understanding the nature of the water in the ocean and within the rocks and sediments that create the oceans' floors is fundamental to all aspects of oceanography and Earth's evolution. Interstitial water chemistry can be used to study processes related to the deposition, decomposition, and preservation of organic matter; deposition of minerals; alteration of rock; growth of microbial communities deep in the crust; and many other scientific studies.

ODP analyzed water extracted from cores and either seawater or borehole water collected by downhole instruments. A variety of analytical instruments and methods were used to determine as many as 35 different water chemistry constituents. Nearly 13,000 IW samples were taken during 89 of the 110 ODP cruises. Among the measurements routinely collected were pH, alkalinity, salinity, and chemical elements such as chlorinity (Cl + Br), calcium, magnesium, sodium, and sulfate. Newer technology and instrumentation increased the number of chemical constituents that could be measured in the Chemistry Laboratory on the *JOIDES Resolution*.

Data Acquisition

Sampling

Whole-round samples (5–30 cm in length) were usually taken from sediment cores with a sample density of 1 sample every 10 m in the uppermost 50–100 m of the hole (first 6–10 cores), and 1 sample every 30 m below that (one sample every third core). The sample length was usually shorter at the top of the hole where sediments were less consolidated (more pore water). The deeper core sediments were often more consolidated, so more material was needed to extract enough water to analyze. The whole-round sample was cut from the section shortly after the core arrived on deck. The sample was taken to the laboratory, removed from the core liner, and cleaned by scraping the exterior surface with a spatula to remove potential contamination. It was squeezed for as long as 2 hr in a stainless steel or titanium press to extract pore water. The water could be filtered or unfiltered, stored in glass or plastic vials, acidified or subject to other treatment depending on the requirements of the Shipboard Scientific Party.

The extracted water sample was analyzed by several different techniques and instruments to complete the normal suite of elements and any additional analyses requested by the Shipboard Scientists. Table T11 lists the different instruments and analytical techniques used to measure IW samples during ODP. Note that some of the analytical results may not be associated with the correct instrument or method. Verification of IW data and samples were not completed because of time constraints.

T11. IW analysis instruments, p. 124.

Calibration

IAPSO standard seawater was the primary standard used to calibrate the instrumentation in the Chemistry Laboratory. These standards were likely run at least once during the leg. Documentation of the standardization procedures and results from the analyses of the standards were not archived.

Specific information about procedures for each measurement can be found in *Technical Note* 15 (Gieskes et al., 1991). The *Initial Reports* volumes usually have an extensive discussion of the methods used to collect IW data.

Archive

Pre-Janus Archive

Early in ODP, IW data were collected on log sheets, which were sent to ODP/TAMU at the end of each cruise. The data were entered into the S1032 database, and the log sheets were microfilmed for archival storage. Data entry routines were implemented so that data entry could be done on the ship and the practice of collecting data on log sheets ended. IW analyses were stored in the S1032 database until the Janus database became operational during Leg 171.

Migration of IW Data to Janus

The data model for IW data can be found in "Janus IW Chemistry Data Model," p. 75, in "Appendix E." Included are the relational diagram and list of the tables that contain data pertinent to IW analyses, column names, and definition of each column attribute. ODP Information Services Database Group was responsible for the migration of pre-Leg 171 data to Janus.

Janus IW Data Format

IW analyses can be retrieved from Janus Web using a predefined query. The IW query Web page allows the user to extract data using the following variables to restrict the amount of data retrieved: leg, site, hole, core, section, depth ranges, or latitude and longitude ranges. The IW query also gives the user the option of retrieving the method that was used to determine the analytical results. In some instances, two different methods were used to measure one or more constituents in a set of samples. The Web query reports both values and methods in the same record. In the archive ASCII file, additional analyses are reported in a separate record.

Table T12 contains the data fields retrieved from the Janus database using the Janus Web predefined query. The first column contains the data item, the second column indicates the Janus table or tables in which the data were stored, and the third column is the Janus column name or the calculations used to produce the value. **"Description of Data Items from IW Query with Analysis Method Option,"** p. 76, in "Appendix E" contains additional information about the fields retrieved using the Janus Web IW query and the data format for the archived ASCII files.

T12. IW query, p. 124.

Data Quality

The IW data in Janus represent an extensive collection of chemical constituents that characterize waters in Earth's crust. More than 155,000 different analyses were done on the extracted water from sediments. There are few known instances where there was any major problem with data collection. Anything written or typed could be a source of errors. Analytical results were written on log sheets. These data were then typed into the S1032 database. Data entry programs were implemented to add the data to the database, but these programs still required manual entry. Writing down or typing incorrect information occasionally happened, and some mistakes were not identified. Often, the Scientific Party found errors and corrected them for the data included in the *Initial Reports* volume, but data sent back to ODP/TAMU were not corrected.

Another error found during the migration of IW data was that samples were missing from the database. In those instances, a sample was entered into the database so that the data could be migrated. The verification of those samples and the verification of the entire IW data set were not completed because of time constraints. Most data collected after the Janus database was operational on Leg 171 were verified as part of the Janus data management and verification procedures (see **"Janus Data Management and Verification,"** p. 7). Some verification was done on the pre-Leg 171 data; however, if there is a discrepancy between the database and data in the *Initial Reports* volumes, the published data should be considered more reliable.

Janus does not contain any calibration data for any of the IW analytical methods. Procedures for storing calibration information were not implemented during ODP.

MOISTURE AND DENSITY

Moisture content and mineral density are basic physical properties that are determined most accurately through mass and volume determinations. The results of MAD measurements provide a direct estimate of porosity, void ratio, and the average density of the samples. Porosity variations are controlled by consolidation and lithification, composition, alteration, and deformation of the rocks or sediments. The physical properties can be used with other types of data to study processes in the ocean crust (e.g., fluid migration studies or analysis of seismic survey data).

The MAD data set, sometimes called "index properties," is one of the most complete sets of data collected by ODP. More than 92,000 samples were taken from cores recovered during 105 of the 110 ODP legs. MAD properties have been determined from samples starting on the first leg of DSDP, as described by Boyce (1973). Although the method for calculating MAD properties has changed since the beginning of DSDP, these data still represent a significant data set. During ODP, MAD properties were calculated using wet and dry mass measurements taken with electronic balances and wet and dry volume measurements taken with helium displacement pycnometers. Properties that were calculated from these data are wet bulk density, dry bulk density, grain density, bulk and dry water content, percent porosity, and void ratio.

Data Acquisition

Mass and volume measurements were needed in order to calculate MAD properties. Four methods of calculating the physical properties were used during ODP. Methods A, B, and C assumed the sample was saturated and all pore spaces filled with water. Method D was developed to analyze unsaturated samples. Over the course of the program, Method C was determined to more accurately estimate the MAD properties for saturated samples. A comprehensive discussion of the methods and calculations can be found in Chapter 2 of *Technical Note* 26 (Blum, 1997).

Mass measurements were made using two high-precision electronic balances. The ship environment, with constant motion and cyclically changing gravity, made mass determinations more difficult. The two-balance system allowed a reference mass to be used at the same time as the unknown sample mass in order to obtain as accurate a measurement as possible.

Volume measurements were made using a helium pycnometer. A pycnometer works on the principle that a sample displaces an amount of fluid equal to its volume. The pycnometer used had five measurement cells, and usually a sphere standard was run with four unknowns to provide a control measurement. The standard was moved through the cells to check the drift. When the drift was >0.02 cm^3, the cell was recalibrated.

Different methods of removing water from the samples were used. Freeze-drying and heating in a microwave had been used, but the most common method was drying samples in a convection oven at temperatures between 100° and 110°C for 24 hr.

Changes in MAD data acquisition procedures were due to improvements in the data acquisition software. The first programs were written in BASIC and required much operator entry. The data acquisition program used at the end of ODP required little manual entry from the operator and automated the procedures for data collection.

Standard Operating Procedures

Core samples of approximately 8 cm^3 were collected from the working half after the sections had been split. Two samples per section were usually taken for physical properties determination, but sampling density was highly variable depending on core recovery or the scientific requirements of the Shipboard Scientific Party.

The samples were put into calibrated beakers for analyses. The beakers had been previously measured to determine mass and volume. Sample mass and volume measurements were dependent on the method that would be used to calculate the properties. Wet samples were weighed; for much of the ODP, volume measurements were also taken on the wet samples. The samples were then dried for 24 hr at temperatures between 100° and 110°C in a convection oven. Drying was intended to remove interstitial water and was the most critical part of the procedure. Using this method to dry samples may have also removed a substantial portion of the interlayer water from clays, so samples with high clay content could have errors of as high as 20% in calculated porosity. After drying, the samples were weighed again and the volume determined using the helium pycnometer.

Calibration

The balances and pycnometer required periodic calibration, usually at the beginning of each leg and during the leg if there was a problem. Calibration information was not archived.

Beaker calibrations were also done, though not for every leg. Beaker volume was difficult to measure because the low volume to void ratio in the pycnometer cell gave inaccurate values. Instead, a beaker's mass was determined and the volume calculated based on the density of the material. Aluminum beakers (density = 2.78 g/cm^3) were used from Leg 101 until they were replaced with glass beakers (density = 2.2 g/cm^3) during Leg 169.

Calculations

Table T13 is a summary of the measured and calculated parameters used to calculate MAD properties with the four methods during ODP. Table T14 are other properties and formulas used for MAD density determination.

T13. MAD analysis methods, p. 126.

T14. MAD properties and formulas, p. 126.

Archive

Pre-Janus Archive

Early in ODP, MAD data were collected on log sheets that were sent back to ODP/TAMU at the end of each cruise. The data were entered into the S1032 database and the log sheets were microfilmed for archival storage. Data entry routines were implemented so that data entry could be done on the ship and the practice of collecting data on log sheets ended. MAD data were stored in the S1032 database through Leg 149. For Legs 150–166, MAD data were stored in a Macintosh 4D database. After Leg 166, data were stored in text files or Excel spreadsheets. All files were archived on ODP/TAMU servers.

Migration of MAD Data to Janus

The data model for MAD data can be found in "Janus MAD Data Model," p. 78, in "Appendix F." The relational diagram and list of the tables that contain data pertinent to MAD analyses, column names, and definition of each column attribute are included. ODP Information Services Database Group was responsible for the migration of pre-Leg 171 data to Janus.

One of the difficulties with the migration of MAD data to Janus was the migration of the beakers and their mass and volume data. Most of the data entries recorded the beaker number that was used for each analysis; however, very often the mass and volume of the beaker were not saved in that entry. Beakers were not calibrated on each leg, so it was not always clear which beaker mass and volume file was used during the leg when no beaker file was archived at ODP/TAMU with the leg's MAD data.

Janus MAD Data Format

MAD analyses can be retrieved from Janus Web using a predefined query. The MAD query Web page allows the user to extract data using the following variables to restrict the amount of data retrieved: leg, site, hole, core, section, depth, or latitude and longitude ranges. In addition, the MAD query gives the user options to retrieve the raw data, retrieve data for a single method, and filter records based on a range of calculated values of one of the properties (e.g., bulk density, porosity, etc.).

Most of the calculated values are not stored in Janus. They are calculated from the raw data when the Web query is run. When Janus first started operations, the method used to calculate MAD properties was determined by which measurements were in the database. The method itself was not explicitly stored. After migration of MAD data started, changes to the data model became necessary because some legs were missing raw data, and some beaker mass and volume values were missing. The data model was changed to store calculated values, and a column that explicitly defined the method was added. Samples with missing raw data or beaker information were added to Janus using the calculated values reported in the *Initial Reports* volumes or calculations from the log sheets.

Table **T15** contains the data fields retrieved from the Janus database using the Janus Web predefined query with the output raw data option. The first column contains the data item, the second column indicates the Janus table or tables in which the data were stored, and the third column is the Janus column name or the calculations used to produce the value. Calculations for some of the parameters differ depending on the method used for analysis (see Table **T13**). **"Description of Data Items from MAD Query with Output Raw Data Option,"** p. 80, in "Appendix F" contains additional information about the fields retrieved using the Janus Web MAD query and the data format for the archived ASCII files.

T15. MAD query, p. 127.

Data Quality

The MAD data set is one of the most complete sets of data collected by ODP. There are few known instances where there was a major problem with data collection. The MAD properties values are calculated from the raw data stored in the MAD tables. For this reason it was very important to link the correct beaker information with each analysis record. Verification of the MAD data included (1) determining the correct beaker mass and volume set that should be associated with each leg, (2) verifying that all samples had been entered, (3) verifying that each analysis record was associated with the correct beaker number and date, and (4) verifying that each record was associated with the correct method used to calculate MAD properties.

Much of the data collected before Leg 171 used Method B to calculate bulk density, dry density, porosity, and void ratio and Method C to calculate grain density. Bulk water content and dry water content calculations are the same for both Methods B and C. In many cases, the raw data exist to use both Methods B and C to calculate MAD properties. As part of the verification, an additional record was entered so that MAD properties would be calculated by both methods. Even though the original reports may have published the Method B calculations, the Method C calculations may be better estimates.

There were two common sources of errors found during the migration and verification of the MAD data: missing samples and a generic operator error. Missing samples were a common problem, as there were no constraints that required a sample record to exist in order to analyze and save data. In those instances, a sample was entered into the database so that the data could be migrated. Anything that was written or typed was subject to operator error. Analytical results were written on log sheets. These data were then typed into the S1032 database. Data entry programs were implemented to add the data to the S1032 database, but it still required manual entry. Data acquisition programs were later implemented to collect the raw MAD measurements data, but the operator manually entered the sample information. Writing or typing incorrect information occasionally happened and some mistakes were not identified. Often, the Scientific Party found errors and corrected them for the data included in the *Initial Reports* volume, but data sent back to ODP/TAMU were not corrected.

Verification of added samples and the entire MAD properties data set were not completed because of time constraints. Most data collected after the Janus database was operational during Leg 171 were verified as part of the Janus data management and verification procedures (see **"Janus Data Management and Verification,"** p. 7). Some verification was done on the pre-Leg 171 data; however, if there is a discrepancy between the database and data in the *Initial Reports* volumes, the published data should be considered more reliable.

Janus does not contain any calibration information for the MAD instrumentation. Procedures for storing calibration information were not implemented during ODP.

MAGNETIC SUSCEPTIBILITY

Magnetic susceptibility is the degree to which a material can be magnetized in an external magnetic field. Magnetic susceptibility is used mostly as a relative indicator for changes in composition because of its high sensitivity to iron-bearing minerals. These changes can be linked to paleoclimate-controlled depositional processes. The high precision and sensitivity of susceptibility loggers makes this measurement extremely useful for core to core and core to downhole log correlations.

Early in ODP, magnetic susceptibility measurements were taken with a manually controlled susceptibility meter, so measurements on whole cores or archive halves were usually limited. The MSL was integrated into the MST to measure the susceptibility of the whole-round core sections, which significantly increased the number and density of measurements. Later in ODP, a split-core track was built to measure point susceptibilities with a magnetic susceptibility probe.

Data Acquisition

Magnetic susceptibility measurements have been taken throughout ODP, starting from Leg 101. Details about changes to the magnetic susceptibility data acquisition system are sketchy. During Leg 101, the susceptibility meter had a discrete point susceptibility sensor and a 100-

mm pass-through susceptibility loop. By Leg 115, the susceptibility meter was using an 80-mm pass-through loop with an operating frequency of 0.465 kHz. The susceptibility meter was integrated into the MST during Leg 124 and became known as the MSL. The Bartington Instruments MS2C system was installed as part of the MST upgrade during Leg 169. The 80-mm loop had an operating frequency of 0.565 kHz and an alternating field intensity of 80 A/m (0.1 mT). Table **T16** briefly summarizes known changes to the magnetic susceptibility data acquisition systems.

T16. MSL systems, p. 128.

The Bartington instrument output values are relative, volume-specific susceptibilities that must be corrected before they can be reported as absolute susceptibilities. However, no calibration or correction was implemented to volume correct the raw susceptibility values. Bulk susceptibility values were collected and reported in SI units but should be considered dimensionless.

Standard Operating Procedures

Prior to Leg 131, there is little information about data collection procedures for magnetic susceptibility. The cores were stored on a rack to allow them to equilibrate to room temperature because MSL measurements are sensitive to temperature. Starting around Leg 163, drift correction was implemented. Instrument drift may occur during the period of a section scan, which is usually ~10 min. Assuming that drift was linear over the time of interest, the Bartington instrument was zeroed at the beginning of each run, and a zero-background measurement was taken at the end. Using the elapsed time information collected at each analysis location, the susceptibility value can be drift corrected.

More complete information about ODP magnetic susceptibility measurements can be found in Chapter 4 of *Technical Note* 26 (Blum, 1997).

Archive

Pre-Janus Archive

Whole-core magnetic susceptibility data were collected digitally using computer data acquisition programs except for discrete measurements made before Leg 108. For data collected through Leg 130, the data were uploaded to the S1032 database. The discrete measurements made before Leg 108 were collected on paper forms and encoded on shore. Beginning with Leg 131, the raw data files were saved and returned to ODP/TAMU for archival on the ODP data servers.

Migration of Magnetic Susceptibility Data to Janus

The data model for magnetic susceptibility can be found in **"Janus Magnetic Susceptibility Data Model,"** p. 81, in "Appendix G." The relational diagram and list of the tables that contain data pertinent to magnetic susceptibility, column names, and the definition of each column attribute are included. ODP Information Services Database Group was responsible for the migration of pre-Leg 171 data to Janus. The migration of these data was done in conjunction with the other MST data sets (GRA, PWL, and NGR). Each change in format was documented and added to the MST migration program. Additional information about the migration of PWL data or original file formats can be requested from the **IODP/TAMU Data Librarian.**

Janus Magnetic Susceptibility Data Format

Magnetic susceptibility data can be retrieved from Janus Web using a predefined query. The MSL query Web page allows the user to extract data using the following variables to restrict the amount of data retrieved: leg, site, hole, core, section, specific run numbers, depth range, or latitude and longitude range. In addition, the user can use the output raw data option in the query to extract the raw measurements and data acquisition parameters. Because there are >4.7 million MSL data records in Janus, a user must restrict the amount of data requested.

Table T17 lists the data fields retrieved from the Janus database for the predefined MSL query with the output raw data option. The first column contains the data item, the second column indicates the Janus table or tables in which the data were stored, and the third column is the Janus column name or calculation used to produce the value. "Description of Data Items from Magnetic Susceptibility Query," p. 82, in "Appendix G" contains additional information about the fields retrieved using the Janus Web MSL query and the data format for the archived ASCII files.

T17. MSL query, p. 128.

Data Quality

There are several things that can affect the quality of MSL data. One of the most significant factors for magnetic susceptibility measurements is contamination of the cores by metal fragments. Metal shards come from drill bits, fittings, and rusty drill pipe (Sager, 1986). The nature of drilling makes it very difficult to totally eliminate this problem. Drilling method and type of cored material also have major effects. Undisturbed sediments with no drilling disruption or voids will typically give the highest quality measurements. Table T18 summarizes how much of the different types of core were analyzed on the MSL systems.

T18. MSL analysis statistics, p. 128.

Because of the lack of a calibration procedure for the MSL system, equipment problems may not be immediately identified. For example, during Leg 130 three different susceptibility loops with different diameters and frequencies were used. Data from Site 803 were collected with an 80-mm loop with a frequency of 0.47 kHz. The Site 803 data show some excessive drift, as this loop was not working properly. For Core 130-804A-3H, a change was made to a 100-mm loop with a frequency of 0.86 kHz. The loop was changed again to an 80-mm loop with a frequency of 0.565 kHz for Core 130-806B-26H. This loop was used until the end of the cruise. Susceptibilities from the three loops are different and not directly comparable.

Core sections were run through the MST system before the liners were opened and the core curated. During the curation process, core material was often shifted. In sedimentary cores, voids may have been closed. Gassy cores may have small voids that continue to enlarge after analysis. Sections may not be completely full, and material may have spread throughout the liner. After curation, this material was shoved up to close voids and the section's curated length was less than what was originally analyzed. The effects can be seen when looking at the data for a section, though the effects are not necessarily as dramatic as GRA or PWL because (1) there are reasonable susceptibility values beyond the curated length of the section (null depth values) and (2) there are zero or negative susceptibility values within the section indicating the measurement interval could be within a void or have less than a full liner.

Hard rock cores can be continuous cylinders with a uniform diameter or can be broken into small irregular pieces. The curation process shifts hard rock pieces, sometimes even shifting core material from its original liner section to an adjacent section liner. Where the core material was in its liner during analysis and where it was eventually placed after curation can be very different. MSL data for these types of cores should be used with caution.

Another important factor that needs to be considered is operator error. Throughout ODP, the operator manually entered core information into the data acquisition program. Typographical errors or entering the wrong information occasionally happened, and some mistakes were not identified. Sometimes, the Scientific Party noticed the error and corrected it for the data included in the *Initial Reports* volume, but the original files were not corrected. During verification of the migrated MSL data, a lot of effort was expended to find sections that may have been misidentified. Some runs were renamed to different sections. The evidence for misidentification had to be conclusive. The following clues were used to find incorrectly identified analyses:

- Two runs for a given section, no run for the following section;
- Run numbers out of sequence;
- Two runs for a section, run numbers out of sequence (no data for that core and section in a different hole, but sequence of run numbers would be correct); and
- Nature of the core material (length of core, voids, or less than full liners).

NATURAL GAMMA RADIATION

Gamma radiation is electromagnetic waves with frequencies between 10^{19} and 10^{21} Hz. They are emitted spontaneously from an atomic nucleus during radioactive decay. NGR measurements are used for three purposes: (1) correlation of core to core and core-downhole log; (2) evaluation of the clay/shale content of a formation; and (3) abundance estimates for radioisotopes K, Th, and U. Minerals that fix K, Th, and U, such as clay minerals, are the principal source of naturally occurring gamma radiation. Other earth materials that emit gamma radiation include rockiest silt and sandstones, potassium salts, bituminous and alunitic schists, phosphates, certain carbonates, some coals, and acid or acido-basic igneous rocks.

A new NGR system was installed on the MST during Leg 149 and began data collection during Leg 150. This represented a return of NGR data collection to scientific ocean drilling. DSDP used a similar system early in its scientific program but removed the equipment because of the excessive time required to analyze cores. Early versions of the data acquisition program collected spectral data in five energy windows compatible with the Schlumberger natural gamma downhole logging tool. After advancements in sensor efficiency and data acquisition technology allowed the downhole tools to acquire 256-channel spectral data, the MST NGR did also.

Data Acquisition

In response to requests from the scientific community to address the need for additional capability to correlate cores between holes and integrate core and downhole logging data, the NGR system was added to the MST during Leg 149. There were four gamma ray scintillation detectors mounted at 90° angles from each other and in a plane orthogonal to the core track. Each scintillation counter contained a 3-in × 3-in doped sodium-iodide crystal and a photomultiplier to produce countable pulses. The detectors and sample chamber were mounted inside a lead housing recovered from the original NGR system used during DSDP.

The well-logging industry had used NGR logging tools for many years. Their reporting units were impractical for ODP use because the NGR apparatus could not be calibrated by the same method. For that reason, ODP NGR data are reported in counts per second (cps). This measurement unit was dependent on the device and volume of the material measured. Because one of the reasons for collecting NGR data was to facilitate the comparison of the core NGR data to downhole NGR logging data, early versions of the data acquisition program collected the spectral data in the following five energy windows compatible with the downhole tools:

- Window 1: 0.2–0.5 million electron volts (MeV)
- Window 2: 0.5–1.1 MeV
- Window 3: 1.1–1.59 MeV
- Window 4: 1.59–2.0 MeV
- Window 5: 2.0–3.0 MeV

A major MST upgrade during Leg 169 implemented the change to collecting and reporting the full 256-channel data. This was a major improvement, but in order to use NGR data for spectral analysis to determine elemental abundances of K, Th and U, significantly longer counting times were required. Data acquisition hardware continued to improve and made it possible to perform either longer counts or higher density of measurements, but not both. Also, with the need to keep the core moving through the MST, especially on legs with high core recovery, data acquisition speeds had not yet reached a point where it was practical to sample long enough for spectral analysis. Data analysis indicated there was a problem with the higher channels of the detectors; during Leg 189, the software was changed to report only 248 channels of data. See Table T19 for a summary of NGR systems used during ODP.

T19. NGR systems, p. 129.

Standard Operating Procedures

By the time NGR was added to the MST, procedures for analyzing sections were well established. After the cores were brought to the Physical Properties Laboratory, they were stored on a rack to allow them to equilibrate to room temperature before analyzing them on the MST (MSL and PWL measurements are sensitive to the temperature of the core). A zero background measurement would normally be taken once a day to check potential contamination within the laboratory. Because of the need for longer count times to achieve more accurate measurements, the sample interval was often set to 20 or 30 cm. As data acquisition hardware and software improved, a higher density sampling could be performed without decreasing the counting period significantly, but ODP did not reach the goal of routinely collecting high quality spectral data that could be used for elemental abundance.

Calibration

The four scintillation counters must be tuned to return the same signal level for each emission energy. Amplification signals may drift; therefore, the counters were adjusted at the beginning of each leg. After the counters were tuned, an energy calibration was performed. K and Th standards were measured, and a linear regression returned the calibration coefficients that convert channel numbers to energy intervals. A full discussion of the NGR system and calibration procedures can be found in Chapter 5 of *Technical Note* 26 (Blum, 1997).

Archive

Pre-Janus Archive

Most of the original NGR data files were archived on the ODP/TAMU servers. There was no interim database for these data. In a few instances, the files for a hole were concatenated into a single file. Some of these original files are no longer available, either because the scientists who concatenated the hole file deleted them or they were not moved onto the ODP/TAMU servers.

Migration of NGR Data to Janus

The data model for NGR can be found in **"Janus NGR Data Model,"** p. 83, in "Appendix H." Included are the relational diagram and the list of the tables that contain data pertinent to NGR, column names, and the definition of each column attribute. ODP Information Services Database Group was responsible for the migration of pre-Leg 171 data to Janus. The migration of NGR data was done in conjunction with the other MST data sets (GRA bulk density estimation, MSL, and PWL). Each change in format was documented and added to the MST migration program. Additional information about the migration of NGR data or original file formats can be requested from the **IODP/TAMU Data Librarian**.

The structure of the NGR data tables was revised multiple times before the final version used at the end of ODP. Initially, the 256-channel spectral counts were stored in the NGR_SPECTRA_DATA table (described in the *Technical Note* 26 (Blum, 1997). This table structure rapidly became unusable. Instead, the spectral data were concatenated into a large text field that could be downloaded and the spectral counts extracted. The migration of older NGR data had already started with a table created to store the counts in the energy windows. It was decided not to reformat those data into the same field as the 256-channel data.

Janus NGR Data Format

NGR data can be retrieved from Janus Web using a predefined query. The NGR query Web page allows the user to extract data using the following variables to restrict the amount of data retrieved: leg, site, hole, core, section, specific run numbers, depth range, or latitude and longitude range. In addition, the user can use the output raw data option in the query to extract information relating to the core status, run parameters, and calibration data used to calculate the total counts and background-corrected counts. There is also the display spectra option that extracts the spectra collected at each sample location. There are more than one million NGR data records in Janus.

Table T20 lists the data fields retrieved from the Janus database for the predefined NGR query with output raw data and display spectra options turned on. The first column contains the data item; the second column indicates the Janus table or tables in which the data were stored; and the third column is the Janus column name or calculation used to produce the value. "Description of Data Items from NGR Query," p. 85, in "Appendix H" contains additional information about the fields retrieved using the Janus Web NGR query and the data format for the archived ASCII files.

T20. NGR query, p. 129.

Data Quality

There are several factors that affect the quality of NGR measurements, including background radiation, sampling period and spacing, tool response, detector efficiency and energy response, sample volume, and operational characteristics.

Background

Zero background is gamma radiation detected in the measurement area when no core material is present. Background measurements were done by measuring a core liner filled with distilled water. The background spectrum could then be subtracted from each sample spectrum. Studies over several years show that background values were relatively constant at 8–9 cps. A daily control measurement was done to check for potential contamination.

Sampling Period and Spacing

Counting statistics play an important role in the measurement of radioactive phenomena which are random and discrete. A longer time period at a sample location will give a better estimation of the amount of radioactive elements (K, Th, and U). For ODP purposes, this meant that there had to be a balance between longer counting periods and density of sampling. Because of the other sensors on the MST, high-density sampling and long counting periods were not usually possible. The ODP average total count rate was about 30 cps. With a sampling period of 30 s, the statistical error was ~3%, which gave data good enough for core to core correlations.

Tool Response

NGR measurements are dependent upon the sensitivity or efficiency of the system to detect when a gamma ray has been emitted. The sodium iodide crystals emit a single photon of light after being struck by a gamma ray. The photon then strikes a photocathode which releases a burst of electrons. The electrons are accelerated and a final electrode conducts a current through a resistor to produce the voltage pulse. Low detector efficiency or undetected electrical signals result in lower counts.

Sample Volume

Radiation counts are directly proportional to the volume of material. APC systems recover softer, undisturbed sediments that routinely give the best results because the core liner is usually full. However, the sediments can also contain a lot of gas which creates voids in the cored material. XCB and RCB systems recover cores that are often biscuits surrounded by drilling mud or irregularly-shaped pieces. Voids, smaller diameter core, irregular pieces, and thin runny mud all result in less volume per measurement interval. Table T21 summarizes how much of each core type was analyzed for NGR.

T21. NGR analysis statistics, p. 129.

Operations

The core sections were most often run through the MST system before the liners were opened and the core curated. During the curation process, core material was often shifted. In sedimentary cores, voids may have closed. Gassy cores may have small voids that continue to enlarge after analysis. Sections may not be completely full, and material may have spread throughout the liner. After curation, this material was shoved up to close voids and the section's curated length was less than what was originally analyzed. The effects can be seen when looking at the data for a section: (1) there are reasonable values beyond the curated length of the section (null depth values) and (2) there are lower values at an interval compared with adjacent measurements and GRA density values are low, indicating less volume.

Hard rock cores can be continuous cylinders with consistent diameter or can be broken into small irregular pieces. The curation process shifts hard rock pieces, sometimes even shifting core material from its original liner section to an adjacent section liner. Where the core material was in its liner during analysis and where it was eventually placed after curation can be very different. NGR data for these types of cores should be used with caution.

Another important factor to be considered is operator error. Throughout ODP, the operator manually entered core information into the data acquisition program. Typographical errors or typing in the wrong data occasionally happened, and some mistakes were not identified. Sometimes, the Scientific Party noticed the error and corrected it for the data included in the *Initial Reports* volume, but the original files were not corrected. During verification of the migrated NGR data, much effort was expended to find sections that may have been misidentified. Some runs have been renamed to different sections. The evidence for misidentification had to be conclusive. The following clues were used to find incorrectly identified analyses:

1. Two runs for a given section, no run for the following section;
2. Run numbers out of sequence;
3. Two runs for a section, run numbers out of sequence (no data for that core and section in a different hole, but sequence of run numbers would be correct); and
4. Nature of the core material (length of core, voids, or less than full liners).

PALEOMAGNETISM

Shipboard paleomagnetic scientists provided the first paleomagnetic analyses of sediments and rocks recovered by ODP. This information was used by shipboard and shore-based scientists as the basis for further sampling and study and for forming the first general conclusions about the geologic history of the drilling site. The shipboard Paleomagnetism Laboratory contained state of the art equipment that allowed scientists to perform detailed studies.

Main objectives for collecting paleomagnetic data included

- Magnetostratigraphy, the magnetic polarity timescale, and correlation techniques;
- Behavior of the geomagnetic field, polarity intervals, polarity transitions, and reversals;
- Tectonics of the ocean basins, motions of the crustal plates, and paths of the wandering poles; and
- Information about the oceanic crust, such as origin of anomalies, ridge processes, old crust, and seamounts.

Data Acquisition

Most of the PMAG data were collected with 2G Enterprises 760-R three-axis, pass-through cryogenic (superconducting) magnetometers. The 2G was equipped with an AF demagnetizer in-line with the cryogenic magnetometer, which allowed demagnetization and measurement of the remanent field on the same run. Normally, archive-half sections were run for NRM and at least one demagnetization step. Archive sections were typically not subjected to fields higher than 20 mT in the early years of ODP, but after September 1992 (Leg 147), the ODP panel overseeing scientific data collection agreed to allow the Shipboard Scientific Parties to partially demagnetize the core as high as necessary in an effort to remove drilling-induced overprint and isolate the characteristic remanence.

There were several changes in the PMAG data acquisition and data analysis software, and a series of independently written programs were used. Some of the programs were created under severe time constraints. Several programs may have been available to a Shipboard Scientific Party but there was no single preferential program defined for the analysis of data. After a new 2G 760R magnetometer was installed during the Leg 168 port call and the Janus database became operational during Leg 171, a new version of the data acquisition software was deployed at the end of Leg 172. This new program created a data file with the parameters that had been built into the Janus database.

In addition to the long-core measurements, the Paleomagnetism Laboratory on the *JOIDES Resolution* was equipped with a wide range of equipment that could be used for detailed studies of discrete samples. The available equipment included:

- Magnetometers: 2G 760-R cryogenic, Molspin Minispin spinner, Schonstedt portable three-axis fluxgate, and a Hall-effect MG-5D;
- Demagnetizers: Schonstedt alternating-field demagnetizer Model GSD-1 and Schonstedt thermal demagnetizer, Model TSD-1, DTECH Model D2000;

- Rock-magnetic equipment: Bartington susceptibility meters, Kappabridge KLY-2 magnetic susceptibility system for measuring anisotropy, ASC impulse magnetizer for measuring IRM and anisotropy of IRM, and DTECH partial anhysteretic remanent magnetizer.

Discrete samples could be demagnetized in much higher fields or by other methods and run through the cryogenic magnetometer to measure the resulting fields.

Core Orientation Tools and Data

One of the methods to help paleomagnetic scientists determine the ambient magnetic field was to measure the orientation of the core both vertically and horizontally. Two tools were used to collect core orientation data: the Eastman-Whipstock Multishot tool and the Tensor multishot tool. The older multishot tool, used during APC core drilling, required a special nonmagnetic drill collar, and orientation data were recorded on 10-mm movie film. The newer Tensor tool still required a nonmagnetic drill collar but could be used even during RCB drilling and collected the data from three magnetometers and two accelerometers digitally. The Tensor data acquisition and analysis software was a significant improvement for determining core orientation. After Janus became operational, an analysis program was developed that uploaded the analyzed data directly into the database.

Archive

Pre-Janus Archive

PMAG data were stored in the S1032 database through Leg 129. Starting with Leg 130, data were written to files which were sent back to ODP/TAMU at the end of each cruise and archived on servers. Log sheets were used to keep track of the analyses of sections and discrete samples. The log sheets were sent back to shore to be microfilmed for archival storage.

Migration of PMAG Data to Janus

The data model for PMAG data can be found in **"Janus PMAG Data Model,"** p. 86, in "Appendix I." Included are the relational diagram and the list of the tables that contain data pertinent to PMAG analyses, column names, and the definition of each column attribute. ODP Information Services Database Group was responsible for the migration of pre-Leg 171 data to Janus.

The discrete paleomagnetic data collected by shipboard paleomagnetic scientists were not migrated to the Janus database. Although data exist for the discrete sample analyses, the treatments that were applied to the samples were not well documented. It would require a significant amount of time to research each of the discrete analyses and determine whether the sample was just demagnetized in a higher intensity alternating field, thermally demagnetized, or subjected to other treatments such as PARM or IRM.

Janus PMAG Data Format

Most of the continuous paleomagnetic data are available through the cryogenic magnetometer Janus Web query. The PMAG query Web page allows the user to extract data using the following variables to restrict the amount of data retrieved: leg, site, hole, core, section, depth range, or latitude and longitude ranges. In addition, the PMAG query gives the user options of retrieving data by treatment type, demagnetization level, core geometry (archive or working half, whole core, etc.), continuous or discrete analyses only, and excluding a user-defined interval of the ends of the sections.

Table T22 lists the data fields retrieved from the Janus database for the predefined PMAG query. The first column contains the data item, the second column indicates the Janus table or tables in which the data were stored, and the third column is the Janus column name or the calculation used to produce the value. **"Description of Data Items from PMAG Query,"** p. 88, in "Appendix I" contains additional information about the fields retrieved using the Janus Web cryogenic magnetometer query and the data format for the archived ASCII files.

T22. PMAG query, p. 130.

Some of the post-Leg 172 discrete sample data are also available. These discrete data have the same problem as the pre-Leg 172 discrete data—the treatments applied to the samples were not well documented. The Janus data model was modified to allow more formal documentation of discrete sample analyses. The treatments often used for studies on discrete samples were added so that scientists could document the treatment and demagnetization level in the data file without needing to put that information into a comment field. The changed database was deployed during Leg 191.

Although the post-Leg 172 uncorrected paleomagnetic intensity and uncorrected and corrected moment data are in the Janus database, the query currently does not have an option of retrieving those data. For additional information, contact the **IODP/TAMU Data Librarian**. Additional information about ODP PMAG data measurements can be found in *Technical Note* 34 (Richter et al., 2006).

Data Quality

A tremendous amount of PMAG data were collected by shipboard scientists during ODP. Almost 7.4 million measurements were made on cores recovered during 94 legs (discrete analyses not included), with >5 million of those measurement made since Leg 172 when the Janus database was operational and the new 2G Enterprises 760R magnetometer had been deployed. These numbers reflect the stabilization of PMAG data collection that allowed scientists to collect higher density measurements on sections and more reliable analytical tools for the analyses of data.

Several things can affect the quality of PMAG data. Type of cored material and the drilling method used to recover the core are major factors. The APC system used to recover softer, undisturbed sediments routinely give the best results because the core liner is usually full. The sediments, however, can also contain large quantities of gas, which creates voids in the cored material. Cores cut by XCB and RCB are often biscuits surrounded by drilling mud or irregularly shaped pieces. Voids, smaller diameter core, irregular pieces, and thin runny mud all affect the quality of the measurements.

Operator error may also be a source of errors. Throughout ODP, the operator manually entered core information into the data acquisition program. Typographical errors or entering wrong information occasionally happened, and some mistakes were not identified. Sometimes, the scientific party noticed the error and corrected it for the data included in the *Initial Reports* volume, but the original files were not corrected. Much effort expended during verification of PMAG data has gone into finding sections that may have been misidentified or the demagnetization level was wrong. Scientists used log sheets to document what was being analyzed. The log sheets were not routinely returned to ODP/TAMU until Leg 181 and were very helpful when analyses were properly documented. Some runs have been renamed to different sections. The evidence for misidentification had to be conclusive. The following clues were used to find incorrectly identified analyses:

1. Two runs for a section and no run for the following section;
2. Run numbers out of sequence;
3. Nature of the core material (length of core and voids or less than full liners);
4. Two runs for a section, run numbers out of sequence, but same demagnetization level. Section where run number would be in sequence missing that demagnetization level run.

ODP *Technical Note* 18 (Stokking et al., 1993) contains an extensive discussion of some of the other problems with paleomagnetic data collection. ODP *Technical Note* 34 (Richter et al., 2006) describes paleomagnetic data collection since the Janus database became operational.

Although the Janus data model and the data acquisition program allow better documentation of discrete sample analyses, most of the post-Leg 191 discrete sample data files did not contain the treatment information. It is not known whether there was a problem with the data acquisition code not writing that information in the file, or whether the scientists did not use the tools in the data acquisition program set up to add that information.

P-WAVE VELOCITY

Compressional or *P*-wave velocity (primary wave) measurements are a measure of the velocity of sound waves through Earth materials with distance vs. time. *P*-wave velocity varies with the lithology, porosity, and bulk density of the material; state of stress, such as lithostatic pressure; and fabric or degree of fracturing. In marine sediments and rocks, velocity values are also controlled by the degree of consolidation and lithification, fracturing, and occurrence and abundance of free gas and gas hydrate. Together with density measurements, sonic velocity can be used to calculate acoustic impedance or reflection coefficients, which can be used to estimate the depth of reflectors observed in seismic profiles.

P-wave velocity data were collected on marine cores during DSDP; however, these measurements were taken at discrete locations. During Leg 108, a prototype PWL system, developed by the Institute of Oceanographic Sciences in the United Kingdom, was deployed (Schulthiess et al., 1988). For the first time, higher density sampling of velocity allowed scientists to create fine-scale velocity profiles that could be used to correlate similar horizons in adjacent holes, reveal the nature of sedimentary features, and provide high-quality data for seismic interpretation.

Data Acquisition

The PWL system measures the speed of compressional waves in sediments by timing the pulses traveling across the diameter of a totally full core liner. The basic parts of the PWL system include (1) a pair of spring-loaded transducers and a transmitter and receiver mounted on opposite sides of the core and perpendicular to the core axis; (2) transducers to measure the displacement between the transmitter and receiver; (3) a track system that moves core past the sensors or moves the sensors along the core; and (4) computer control of data acquisition and data capture.

The prototype PWL system was mounted on the GRAPE track during Leg 108. The basic system consisted of two 500-kHz transducers, displacement transducers with 0.04-mm resolution, and an A/D converter which digitized the output of the peak detector. The computer data acquisition and capture programs were modified throughout ODP as newer technology and better data acquisition programs became available. There have also been some major upgrades to the PWL system during ODP. During Leg 124E the Geotek MST, an automated core conveying and positioning system, was installed. During Leg 187, a new A/D converter was installed that significantly changed the output recorded by the data acquisition program. A brief summary of changes to the PWL system is shown in Table T23. A comprehensive report on the first PWL system installed during Leg 108 can be found in Schultheiss and McPhail (1989).

T23. PWL system summary, p. 130.

Standard Operating Procedures

The basic velocity calculation is

$$v = d/t. \tag{3}$$

For laboratory measurements, the liner and characteristics of the electronics can be sources of error in the measured velocity of the cored material. A constant liner thickness of d_{liner} = 2.54 mm ($2d_{liner}$ = 5.08 mm) was subtracted from the measured diameter, though the liner thickness could vary between 2.35 and 2.82 mm. There are three types of time delays that are subtracted to correct the traveltime:

1. t_{delay}: a delay related to the transducers and electronics;
2. t_{pulse}: a delay related to the peak detection procedure; and
3. t_{liner}: the transit time through the core liner.

For routine measurements on whole cores in liners, the calculation for the velocity is

$$v_{core} = [(d'_{core} - 2d_{liner})/(t_0 - t_{pulse} - t_{delay} - 2t_{liner})] \times 1000, \tag{4}$$

where

v_{core} = corrected velocity through core (km/s),
d'_{core} = measured diameter of core and liner (mm),

d_{liner} = liner wall thickness (mm), and
t_0 = measured total travel time (µs).

The cores were stored on a rack to allow them to equilibrate to room temperature before analyzing them with the PWL. *P*-wave velocities are sensitive to the temperature of the core material. The highest quality velocity measurements were made on core liners that were completely full, APC cores, or longer continuous hard rock cores. In order to maintain close coupling of the transducers to the core liner, the outside of the liner was sprayed with water.

After the core was placed in the track, spring-loaded transducers measured the diameter of the core. A 500-kHz pulse was produced at a repetition rate of 1 kHz. The pulse was sent to the transmitter transducer which generated an ultrasonic compressional pulse. The *P*-wave propagated through the core and was received by the receiver transducer. The amplified signal was analyzed by an automatic peak detection algorithm and generated a traveltime.

Calibration

Calibration of the *P*-wave system was usually performed at the beginning of leg, but would also be done after changing equipment, when transducers were showing signs of wear, or if problems were suspected. Pulse detection settings did not usually require any adjustment unless equipment was replaced or different measurement geometry was required. Pulse time was a time constant included in the total time measurement as a result of the peak detection procedure. This constant was subtracted from raw time measurements because it allowed more precise monitoring of system performance and gave measured time values that were independent of the peak detection procedure.

Transducer displacement and travel time delay calibrations were done simultaneously. This procedure was performed at least once per leg. Displacement was measured in volts. For the displacement calibration, three to four acrylic cylinder standards were measured, and a linear least-squares regression was run to determine the coefficients that relate the voltage readings to distance. A section of liner filled with distilled water (known velocity) was measured to verify that the calculated coefficients with the traveltime delays return the correct velocity. After the hardware and software upgrade during Leg 187, the raw calibration data for displacement and time delay were stored in separate tables, in recognition that these are two different calibrations.

Archive

Pre-Janus Archive

Most of the original PWL data files were archived on the ODP servers. There was no interim database for PWL data. In a few instances, the files for a hole were concatenated into a single file. Some of these original files are no longer available, either because the scientists who concatenated the hole file deleted them, or they were not moved onto the ODP servers.

Migration of PWL Data to Janus

The data model for *P*-wave velocity can be found in **"Janus *P*-Wave Velocity Data Model,"** p. 89, in "Appendix J." Included are the relational diagram and the list of the tables that contain data pertinent to PWL, column names, and the definition of each column attribute. ODP Information Services Database Group was responsible for the migration of pre-Leg 171 data to Janus. The migration of PWL velocities was done in conjunction with the other MST data sets (GRA, MSL, and NGR). Each change in format was documented and added to the MST migration program. Additional information about the migration of PWL data or original file formats can be requested from the **IODP/TAMU Data Librarian**.

Janus PWL Data Format

The PWL data can be retrieved from Janus Web using a predefined query. The *P*-wave velocity (PWL whole-core system) query Web page allows the user to extract data using the following variables to restrict the amount of data retrieved: leg, site, hole, core, section, specific run numbers, range in velocity values, or latitude and longitude range. In addition, the user can use the output raw data option in the query to extract the raw measurements and calibration parameters used to calculate the velocity values. Because there are ~2.6 million PWL data records in Janus, a user must restrict the amount of data requested.

Table **T24** lists the data fields retrieved from the Janus database for the predefined PWL query with output raw data option turned on. The first column contains the data item, the second column indicates the Janus table or tables in which the data were stored, and the third column is the Janus column name or the calculation used to produce the value. **"Description of Data Items from PWL Query,"** p. 91, in "Appendix J" contains additional information about the fields retrieved using the Janus Web PWL query and the data format for the archived ASCII files.

T24. PWL query, p. 131.

Data Quality

Several things can affect the quality of PWL data. Type of material and drilling method used to recover the core are major factors. In addition to the requirement for good acoustic coupling between the core liner and the transducers, good coupling between the core and core liner is critical for quality measurements. Soft sediment found in the uppermost 50 m of a hole often yields good data. Below 50 m, the signal is often strongly attenuated. Less cohesion of the sediments and microcracks or gas voids make good measurements impossible. The sensitivity of PWL measurements to the quality of core material means that less of the recovered core was analyzed. Table **T25** summarizes how much of the different types of core were analyzed on the PWL systems.

T25. PWL analysis statistics, p. 131.

One other source of error to consider is operator error. Throughout ODP, the operator manually entered core information into the data acquisition program. Typographical errors will occasionally happen, and some mistakes will not be identified. Often, the Scientific Party found errors and corrected them for the data included in the *Initial Reports* volume, but the original files were not corrected. A significant amount of effort expended during verification of the PWL data has gone into finding sections that may have been misidentified. Some runs have been renamed to different sections, but the evidence for misidentification had to be conclusive before the runs were changed. Listed below are some of the clues used to find incorrectly identified analyses:

1. Two runs for a given section and no run for the following section;
2. Run numbers out of sequence;
3. Two runs for a section, run numbers out of sequence (no data for that core and section in a different hole, but sequence of run numbers would be correct);
4. Nature of the core material (length of core and voids or less than full liners).

DISCRETE *P*-WAVE VELOCITY

P-wave or sonic velocity measurements are a measure of the velocity of seismic waves through Earth materials with distance versus time. *P*-wave velocity varies with the lithology, porosity, and bulk density of the material; state of stress, such as lithostatic pressure; and fabric or degree of fracturing. In marine sediments and rocks, velocity values are also controlled by the degree of consolidation and lithification, fracturing, and occurrence and abundance of free gas and gas hydrate. Together with density measurements, sonic velocity is used to calculate acoustic impedance or reflection coefficients, which can be used to estimate the depth of reflectors observed in seismic profiles and to construct synthetic seismic profiles.

P-wave velocity data was collected during DSDP. The Hamilton frame system was first used during DSDP Leg 15 and was part of the equipment that was transferred to ODP. Discrete velocity measurements were made on split sections or samples. After the PWL was installed to collect higher density velocity data, the discrete measurements were useful for studying the anisotropy of the cored material and to fill in when the PWL was no longer able to make good measurements.

Data Acquisition

ODP modified and updated the electronics for the Hamilton frame system, but the general data collection procedures were the same as described by Boyce (1973). Discrete samples had to be prepared carefully in order to ensure good contact with the transducers. Sometimes split sections would be measured in liners when the sediments were too weak to be handled without being destroyed. Measurements could be made in three directions: (1) A or z, parallel to the core axis; (2) B or y, perpendicular to core axis and parallel to split surface; and (3) C or x, perpendicular to core axis and perpendicular to split surface. Direction designation differed between legs.

During ODP Leg 130, the DSV system, developed by Dalhousie University and Bedford Institute of Oceanography, was brought aboard the *JOIDES Resolution* to demonstrate the system and to collect velocity data on unconsolidated sediments. This system was computer-controlled and collected not only the raw data but the full waveform that could be analyzed later. ODP installed a DSV system for Leg 138. Two transducer pairs were designed to be inserted into soft and semiconsolidated sediments and were mounted orthogonal to each other to measure along the core axis (z), perpendicular to the axis, and within the split plane (y).

Both the Hamilton frame and the DSV systems were replaced by new systems during Leg 169. Hardware and software had improved significantly and the new systems were designed to take advantage of those advancements. The PWS1 and PWS2 insertion probe system on a split-core track replaced the DSV. The Hamilton frame was replaced by the PWS3 contact probe system, which maintained the capability of measuring discrete samples or split core. A major upgrade to the PWS3 system occurred during Leg 191 when new data acquisition hardware was installed. This required modifications of both the data acquisition software and the Janus PWS3 tables. The changes to the PWS3 system were modeled after the PWL system. See Table T26 for a summary of discrete *P*-wave velocity systems used during ODP.

T26. PWS systems, p. 132.

Standard Operating Procedures

See "Standard Operating Procedures," p. 13, in "*P*-Wave Velocity" for velocity calculations.

Hamilton Frame Velocimeter

Explanatory Notes in the *Initial Reports* volumes refer to Boyce (1973), in which the operating procedures for the Hamilton frame system were described. It was important to prepare the sample correctly in order to get good contact between the transducers and the core material or core liner if measuring a split core. The time delay was determined by measuring the time with the transducers in contact with each other, at zero distance. Initially, the measurements were likely logged by hand and later entered into the S1032 database. The handwritten log sheets were returned to ODP/TAMU for archival. A computer data acquisition program was implemented on Leg 138, but there is little documentation about this or subsequent programs. Calibrations of the Hamilton frame system were not documented.

DSV

The DSV had two sets of piezoelectric transducers that were inserted into unconsolidated and semisoft material. One set was separated by ~7 cm along the core axis (z). The other set was separated by ~3.5 cm perpendicular to the core axis and parallel to the split surface. All functions of this system were controlled by a dedicated computer, including creating files with velocity measurements. Thermistors monitored the temperature of the core material during measurement. Periodically, the separation was checked by running a calibration procedure in distilled water. Time delays were estimated using a series of aluminum and lucite standards.

PWS1 and PWS2 Insertion Probe Systems

The principle behind PWS1 and PWS2 was the same as the DSV. In addition to the improvement in hardware and computer control of all data acquisition, calibration procedures were implemented, and all measurement and calibration data were uploaded to the Janus database. The distance between the transducers was measured with calipers at least once per leg, more often when being heavily used. The distance values were considered constant. The t_{delay} calibration was done by inserting the probes into a container filled with distilled water of known temperature and therefore of known velocity and calculating the time delay as the difference between the measured transit time and the known transit time in water. Control measurements as described in the data model were not implemented during ODP.

PWS3 Contact Probe System

The PWS3 system was an upgraded Hamilton frame system. Improvements in hardware and computer control allowed the measurement and calibration procedures to be simplified. Rapid, precise measurement of sample thickness and pressure control on the transducers helped to ensure that the transducers contacted the split core or sample properly. Calibration procedures for the PWS3 system were equivalent to procedures for the PWL. Standards of different thickness were measured to obtain total transit times. Least-squares regression was run to determine the time delay. All data were stored in the Janus database. Control measurements as described in the data model were not implemented during ODP.

Archive

Pre-Janus Archive

From the beginning of ODP, velocity data collected on the Hamilton frame were logged by hand on log sheets. Those data were later entered into the S1032 database. The completeness of the early archive is dependent upon what was written on the log sheets or transcribed from scientists' notes. A new data acquisition code was implemented for the Hamilton frame at the same time the new DSV system was installed. Both systems created data files that were archived on the ODP/TAMU servers.

Migration of PWS Data to Janus

The data models for the discrete velocity data can be found in "Janus PWS Data Model," p. 92, in "Appendix K." Included are the relational diagram and the list of the tables that contain data pertinent to PWS, column names, and the definition of each column attribute. ODP Information Services Database Group was responsible for the migration of pre-Leg 171 data to Janus. The data collected on the Hamilton frame system were migrated to the PWS3 tables. Data collected on the DSV system were migrated to PWS1 or PWS2, with all data collected in the z (or A) direction (parallel to core axis) migrated to the PWS1 tables, and data collected in the y (or B) direction (perpendicular to core axis, parallel to split surface) migrated to the PWS2 tables.

More detailed information about ODP *P*-wave velocity measurements can be found in Chapter 6 of *Technical Note* 26 (Blum, 1997).

Janus PWS Data Format

PWS data can be retrieved from Janus Web using a predefined query. The *Prove* Velocity (PWS split-core system) query Web page allows the user to extract data using the following variables to restrict the amount of data retrieved: leg, site, hole, core, section, specific run numbers, velocity type, depth range, or latitude and longitude ranges. In addition, the user can use the output raw data option in the query to extract the raw measurements and calibration parameters used to calculate the velocity values.

Table T27 lists the data fields retrieved from the Janus database for the PWS1 and PWS2 predefined query with the output raw data option.

T27. PWS1 and PWS2 query, p. 132.

The structure of the tables for PWS1 and PWS2 are identical, so the table names are interchangeable. Table T28 lists the data fields retrieved from the PWS3 tables. The first column contains the data item, the second column indicates the Janus table or tables in which the data were stored, and the third column is the Janus column name or the calculation used to produce the value. **"Description of Data Items from PWS1 and PWS2 Queries,"** p. 96, and **"Description of Data Items from PSW3 Query,"** p. 97, both in "Appendix K," contain additional information about the fields retrieved using the Janus Web PWS query and the data format for the archived ASCII files.

T28. PWS3 query, p. 133.

Data Quality

Several things can affect the quality of PWS discrete velocity data. Type of material and the drilling method used to recover the core are major factors. There must be good acoustic coupling between the core material and the transducers. When taking a measurement through the core liner, there must be good coupling not only between the transducer and the core liner, but also between the core material and the core liner. Even in soft sediment, less cohesion of the sediments, microcracks or gas voids can make good measurements impossible. PWS measurements were often used to augment the velocity data from the PWL system when the quality of core material prevented reliable measurements. Table T29 summarizes discrete velocity measurements taken on ODP cores.

T29. PWS analysis statistics, p. 133.

One commonly occurring problem was error in the measurement location. This problem became more apparent after computer-controlled data acquisition programs were implemented. If the equipment was not properly zeroed before taking the measurement, the measurement location would not be recorded properly. Notation of the measurement interval on the log sheets could be used to correct the location error, but log sheets were not available for all legs, or locations were not always documented.

One other source of error was operator error. Anything written or typed was a potential source of error. Measurements were taken manually on the Hamilton frame with the results written on log sheets. These data were then typed into the S1032 database. Incomplete data on the log sheets prevent any verification of the older data. Typographical errors when transcribing the data into the S1032 database occasionally happened. Even when data acquisition programs were implemented to collect the velocity data, the operator manually entered the core information. Some mistakes were not identified. Often, the Scientific Party found errors and corrected the data included in the *Initial Reports* volume, but the data sent back to ODP/TAMU were not corrected.

The verification of the entire PWS data set was not completed because of time constraints. Most data collected after the Janus database was operational during Leg 171 were verified as part of the Janus data management and verification procedures (see **"Janus Data Management and Verification,"** p. 7). Some verification was done on the pre-Leg 171 data; however, if there is a discrepancy between the database and data in the *Initial Reports* volumes, the published data should be considered more reliable.

ROCK EVALUATION

RE analyses were used to evaluate type and maturity of organic matter, calculate petroleum potential, and detect oil shows. These measurements are usually done by exploration companies looking for oil and gas. The RE data were generated using the Delsi Nermag Rock-Eval II Plus TOC instrument for whole-rock or sediment pyrolysis.

Oil exploration was not the reason that rock evaluation analyses were done by ODP. There was a significant amount of planning and research done to avoid drilling in areas that had potential for oil or gas. These data were used on the ship as an interpretive tool for monitoring hydrocarbon safety levels, in addition to providing information about the organic matter in the sediments. Because of the length of time necessary to complete the analysis of a sample, RE results were not normally used as a part of the real-time hydrocarbon monitoring program.

Data Acquisition

RE data have been collected since ODP Leg 101. Samples analyzed for rock evaluation were usually subsamples of the freeze-dried and crushed material collected for carbon analyses. The RE method consisted of programmed-temperature heating to quantitatively determine any free hydrocarbons contained in the sample and the hydrocarbon- and oxygen-containing compounds that are volatilized during heating.

Five basic parameters, S_1, S_2, S_3, temperature maximum (T_{max}), and TOC, were measured:

1. S_1: amount of free hydrocarbon (gas and oil). If $S_1 > 1$ mg/g, it may be indicative of an oil show. S_1 can be contaminated by the drilling fluids and mud.
2. S_2: amount of hydrocarbon generated through thermal cracking of nonvolatile organic matter. S_2 is an indication of the quantity of hydrocarbon that the sediments could potentially produce should burial and maturation continue.
3. S_3: amount of CO_2 produced during pyrolysis of kerogen. S_3 is an indication of the amount of oxygen in the kerogen.
4. T_{max}: temperature at which the maximum release of hydrocarbons from cracking of kerogen occurs during pyrolysis. T_{max} is an indication of the stage of maturation of the organic matter.
5. TOC: total organic carbon, in weight percent, can be determined by oxidizing the organic matter remaining in the sample after pyrolysis. TOC is determined by adding this residual organic carbon to the pyrolized organic carbon.

From these measurements, four additional parameters can be calculated that describe the type and maturity of the organic matter:

1. Productivity index [$S_1/(S_1 + S_2)$]: characterizes the evolution level of the organic matter. In an ideal situation with increasing burial depth, S_1 should increase and S_2 should decrease resulting in PI increasing with depth and maturation.
2. Petroleum potential or pyrolized carbon [$0.083 \times (S_1 + S_2)$]: corresponds to carbon content, the maximum quantity of hydro-

carbons capable of being produced from the source rock given sufficient depth and time.

3. Hydrogen index [(100 × S_2)/TOC]: parameter used to characterize the origin of the organic material. Marine organisms and algae have higher H/C ratios than land plants. HI typically ranges from ~100 to 600 mg HC/g sediment in geological samples.
4. Oxygen index [(100 × S_3)/TOC]: parameter that indirectly correlates the ratio of oxygen to carbon. OI values range from ~0 to 150 mg CO_2/g sediment.

Additional information about rock evaluation measurements can be found in *Technical Note* 30 (Pimmel and Claypool, 2001).

Archive

Pre-Janus Archive

Early in ODP, RE data were collected on log sheets sent to ODP/TAMU at the end of each cruise. The data were entered into the S1032 database and the log sheets were microfilmed for archival storage. Data entry routines were implemented so that data entry could be done on the ship. RE data were stored in the S1032 database until the Janus database became operation during Leg 171.

Migration of RE Data to Janus

The data model for RE data can be found in **"Janus Rock-Eval Data Model Stored in Carbonate Tables,"** p. 98, in "Appendix L." Included are the relational diagram and the list of the tables that contain data pertinent to rock evaluation, column names, and the definition of each column attribute. ODP Information Services Database Group was responsible for the migration of pre-Leg 171 data to Janus. When the Janus data model was implemented, tables to store RE data were created. After Janus became operational, it was determined that it was more practical to store the data in the carbonate tables, especially since many of the RE analyses were done on splits of the carbonate samples.

Organic carbon (ORG_C) determined by coulometer as part of the carbonate analyses was often used instead of the TOC measurement from the RE instrument to calculate the HI and OI parameters. One problem that recurred periodically throughout the migration was determining whether the organic carbon value was ORG_C (coulometer) or TOC (RE). The tables in the *Initial Reports* volumes often did not discriminate between ORG_C and TOC.

Janus RE Data Format

RE analyses can be retrieved from Janus Web using a predefined query. The rock-eval query Web page allows the user to extract data using the following variables to restrict the amount of data retrieved: leg, site, hole, core, section, depth, or latitude and longitude ranges. In addition, this query includes the organic carbon values obtained from the carbonate analysis. Often, this value was used in place of TOC to calculate the HI and OI parameters.

Table **T30** lists the data fields retrieved from the Janus database for the Rock-Eval predefined query. The first column contains the data item, the second column indicates the Janus table or tables in which

T30. Rock-eval query, p. 134.

the data were stored, and the third column is the Janus column name or the calculations used to produce the value. **"Description of Data Items from Rock-Eval Query,"** p. 99, in "Appendix L" contains additional information about the fields retrieved using the Janus Web Rock-Eval query, and the data format for the archived ASCII files.

Data Quality

The RE data in Janus represent an extensive collection of organic carbon analyses in sediments from ocean basins throughout Earth. More than 9300 samples were analyzed to characterize organic carbon. A common error found during the migration was that samples were missing from the database. In those instances, a sample was entered into the database so that the data could be migrated. Another common error falls in the general category of operator error. Analytical results were written on log sheets. These data were then typed into th S1032 database. Data entry programs were implemented to add the data to the S1032 database, but the programs still required manual entry. Data acquisition programs were later implemented to collect RE data, but the operator manually entered the sample information. Mistakes in logging samples, logging data, an typing data into the database occasionally happened and were not always identified. Often, the Scientific Party found errors and corrected them for the data included in the *Initial Reports* volume, but data sent back to ODP/TAMU were not corrected.

Verification of the entire RE data set was not completed because of time constraints. One result of this is that the ORG_C data is not always retrieved, even though it exists in Janus. If ORG_C data are missing from the Rock-Eval query, those data should be available through the Carbonate query. Most data collected after the Janus database was operational during Leg 171 were verified as part of the Janus data management and verification procedures (see **"Janus Data Management and Verification,"** p. 7). Some verification was done on the pre-Leg 171 data; however, if there is a discrepancy between the database and data in the *Initial Reports* volumes, the published data should be considered more reliable.

Janus does not contain any calibration information for rock evaluation. Procedures for storing calibration information were not implemented during ODP.

REFLECTANCE SPECTROPHOTOMETRY AND COLORIMETRY

Color is one of the key factors used for identification of rocks and minerals. The development of a handheld spectrophotometer that can quickly produce a detailed spectrum from the surface of a rock or sediment has given scientists a semiquantitative method of determining composition. The spectrophotometer allows higher density, noninvasive analyses that can identify changes in composition and cyclical changes and can help pinpoint where the beginning of the changes occurred. These types of data helped with core-to-core and hole-to-hole correlations. Some sediment constituents have characteristic spectral signatures that could be used to better estimate the quantity of those constituents in sediments before samples were taken for detailed analysis.

ODP began using the Minolta photospectrometer CM-2002 during Leg 154. The Minolta measured the reflected light from the surface of the core over the visible spectrum (400–700 nm). More than 2,250,000 RSC measurements were taken with the Minolta during the 39 legs in which color reflectance data were collected.

Data Acquisition

The Minolta CM-2002 spectrophotometer was used to collect RSC data during ODP. For the first few years, the Minolta was operated manually and required significant effort on the part of the scientists and laboratory technicians to collect data. The measurement of RSC was time-critical because of the changes that occurred in the surface of the split core as the sediment or rock was exposed to air. During Leg 180, the Minolta was mounted on the AMST in order to automate data acquisition. There were some problems with track operation and automated data acquisition for a few legs, but starting during Leg 188, RSC data were routinely collected with the track system instead of manually.

Standard Operating Procedures

RSC measurements were taken on the archive half, preferably ~1 hr after the core had been split. The split core was covered with cling film to protect the glass cover on the aperture of the Minolta when the instrument was set on the surface to take measurements. The film transmits light uniformly over the spectrum of visible light and has minimal effect on the spectra (Blum, 1997). Even under manual operation, the data were acquired with personal computer–based data acquisition software.

The Minolta had several options that affected the measurement and processing of reflectance data. The recommended settings for ODP cores were

- SCE: option exclude a glare component of the reflected light. The glare component did not contribute to the spectrum;
- D65 illuminant: represents average daylight throughout the visible spectrum;
- 10° standard observer or 10° field of view; and
- Output color parameters X, Y, Z, L*, a*, and b* and Munsell hue, value, and chroma (HVC) notation.

In addition to the spectral measurements downloaded from the Minolta, the camera's acquisition program also calculated standard color parameters. The Munsell HVC color system had been used by Earth scientists for many years as a way to standardize color descriptions of rocks. However, new color systems have been developed recently that relate reflectance spectra to color. The tristimulus system is based on matching a color under standardized conditions against the three primary colors red, green and blue, which are expressed as values *X*, *Y*, and *Z*. The tristimulus values can also be related to spectral wavelength. The L*a*b* color space system was recommended for sediment and rock analyses. In the L*a*b* system, L* is the lightness variable and a* and b* are chromaticity variables, with a* being the green to red axis and b* being the blue to yellow axis.

Calibration

Two types of calibration were performed on the Minolta CM-2002. A "zero calibration" was performed by aiming the aperture into a space where there were no objects within 1 m and no light source aimed at it. This calibration was performed to compensate for effects of stray light caused by the flare characteristics of the optical system. A "white calibration" was performed immediately after a zero calibration. The standard was a white ceramic cap supplied with the Minolta CM-2002 that was factory-calibrated over the 400–700 nm range. White calibrations were performed regularly. After the Janus database was operational, white calibration data were archived in the database.

Archive

Pre-Janus Archive

The original RSC data files were archived in the ODP/TAMU servers. There was no interim database for RSC data. The reflectance spectra were stored in the camera and downloaded to a file using a personal computer–based data acquisition program. The convention was to create a file after all the sections of a core were analyzed.

Migration of RSC Data to Janus

The data model for RSC can be found in **"Janus Color Reflectance Data Model,"** p. 100, in "Appendix M." Included are the relational diagram and the list of the tables that contain data pertinent to RSC, column names, and the definition of each column attribute. ODP Information Services Database Group was responsible for the migration of pre-Leg 171 data to Janus. In order to ensure that the X, Y, Z, L*, a*, and b* parameters were calculated based on the D65 illuminant and 10° standard observer, these parameters were recalculated and uploaded for the migrated data.

Janus RSC Data Format

RSC data are available through the Janus Web Color Reflectance query. The RSC query Web page allows the user to extract data using the following variables to restrict the amount of data retrieved: leg, site, hole, core, section, depth ranges, or latitude and longitude ranges. In addition, the user can use the output raw data option in the query to extract the spectral reflectance percentages for each wavelength (Table T31). Additional information about ODP RSC data can be found in Chapter 7 of *Technical Note* 26 (Blum, 1997). **"Description of Data Items from RSC Query,"** p. 102, in "Appendix M" contains additional information about the fields retrieved using the Janus Web RSC query, and the data format for the archived ASCII files.

T31. Color reflectance query, p. 134.

Data Quality

Several things affect the quality of RSC data. The type of material and the drilling method used to recover the core are major factors. Disturbed material with cracks and voids yields poor quality measurements. Factors such as surface moisture or uncontrolled drying of the material, surface roughness, particle size, oxidation, and use of the protective film also affect the quality of the data.

Data quality was also dependent on the operator. The Minolta was manually operated for several legs. The operator needed to be sure the camera was properly set up and calibrated, placed on the core surface properly, and held in contact with the surface for the required period of time for each measurement. Even a tiny crack that allowed ambient light inside could contaminate the measurement.

There were problems when the Minolta was mounted on the AMST. It was thought that the aperture could be held slightly above the split-core surface to take measurements with the data corrected by a height adjustment. This would have been beneficial for at least two reasons: the section would not have to be wrapped in plastic wrap and movement of the camera down the track would be somewhat easier. However, data collected in this configuration were very poor. Light contamination made the spectra essentially useless. Data were collected during Legs 180–183, 185, and 186 before the problems were corrected. These data were not entered into the database but can be requested through the **IODP/TAMU Data Librarian**. The Shipboard Scientific Parties for those legs indicated that the spectral data may be acceptable in a relative sense, but the absolute spectral values are damaged. Data collection during Legs 184 and 186 was performed with the older manual method.

After the track-mounted system was operational, there could still be operator errors. Throughout ODP, the operator manually entered core information into the data acquisition program. Typographical errors or entering the wrong section identification information occasionally happened, and some mistakes were not identified. An effort was made during the verification of post-Leg 171 data to find sections that were misidentified. This was done using log sheets that were often used to document the analyses on AMST and looking for clues to misidentified analyses. Some of the clues that were used to find misidentified sections include

1. Two runs for a section but no run for the following section;
2. Run numbers out of sequence;
3. Two runs for a section, run numbers out of sequence, but no data for that core number and section in a different hole. Run number sequence would be correct if placed in different hole.
4. Comparison of data, and nature of the core material (length of core, voids, etc.).

SHEAR STRENGTH

Shear strength measurements are performed to test sediments and rocks to determine their stress-strain-time behavior. Some materials are brittle and exhibit little stress when strained (rocks). Others are work-hardening (e.g., compacted clays and loose sands) or work-softening. In the clayey, soft, saturated marine sediments often measured for strength, stress decreases as the sediment is strained beyond a peak stress. The sediment yields (fails) at the peak stress, which can be defined as the sediment's strength. Shear strength or shear resistance of sediments is the most important aspect of slope stability. However, the shear strength values obtained by ODP on the *JOIDES Resolution* do not alone allow any slope stability analysis. They represent a relative strength profile.

During ODP, several different instruments were used to collect shear strength data: Motorized Torque Transducer, AVS, Wykeham-Farrance spring-type device, hand-held Torvane, and SoilTest Pocket Penetrometer. The tests were run on whole-core samples (in the end of the core), split-core samples (in the split-core surface), or remolded sediment samples.

Data Acquisition

Two types of strength tests were conducted on board during ODP: vane shear and penetrometer tests. Instruments used to conduct vane shear tests include the Motorized Torque Transducer, AVS, hand-held Torvane, and the Wykeham-Farrance device. Undrained shear strength was determined using a vane inserted into soft sediment and rotated until the sediment failed. The torque required to shear the sediment was related to the shear strength of the material. The pocket penetrometer measured compressive strength. The vertical strain measurement taken by the penetrometer can be related to shear strength; however, the strain value must be divided by 2 to obtain shear strength.

The AVS was the only shear data type that was collected by a personal computer–based data acquisition program. The first documented program for the AVS system was deployed during Leg 154. The next major revision of the AVS data acquisition program was used to collect data beginning with Leg 170. This revision was in preparation for deployment of the Janus database. Measurements made with the Torvane and the penetrometer had to be documented by the scientists or technicians doing the test.

There was no general calibration of the AVS system. However, vane dimensions and spring constants were important coefficients that were used to calculate strength. Those items were occasionally calibrated after initial calibration at purchase. The spring constant was a value relating the deflection angle to torque.

Additional information about ODP shear strength measurements can also be found in Chapter 9 of *Technical Note* 26 (Blum, 1997).

Archive

Pre-Janus Archive

Early in ODP, shear strength data were collected on log sheets which were sent to ODP/TAMU at the end of each cruise. The data were entered into the S1032 database and the log sheets were microfilmed for archival storage. Data entry routines were implemented so that data entry could be done on the ship and the practice of collecting data on log sheets ended. Strength data were stored in the S1032 database through Leg 146. Starting around Leg 144, strength data were also saved in spreadsheet files that were brought back for archival on the ODP/TAMU servers. The AVS data acquisition program generated files with the vane shear data starting around Leg 154, but Torvane and penetrometer data documentation was up the to scientists collecting those data.

Migration of Shear Strength Data to Janus

The data model for shear strength data can be found in **"Janus Shear Strength Data Model," p. 103, in "Appendix N."** Because the data collected on the different instruments were very different, there are three sets of tables that contain strength data: Automated Vane Shear (AVS), Torvane (TOR), and Penetrometer (PEN). Included are the relational diagram and the list of the tables that contain data pertinent to each of these data types, column names, and the definition of each column attribute. ODP Information Services Database Group was responsible for the migration of pre-Leg 171 data to Janus.

Janus Shear Strength Data Format

AVS, PEN, and TOR analyses can be retrieved from Janus Web using predefined queries. The shear strength (AVS/PEN/TOR) query Web page allows the user to extract data using the following variables to restrict the amount of data retrieved: leg, site, hole, core, section, run numbers, depth ranges, or latitude and longitude ranges. In addition, the Shear Strength query gives the user options to retrieve data by instrument and output the raw data. Raw data could only be retrieved if the raw data were saved during data acquisition and consists of the individual torque and strain values.

Table T32 contains the data fields retrieved from the Janus database using the Janus Web predefined query with the output raw data option. The first column contains the data item, the second column indicates the Janus table or tables where the data are stored, and the third column is the Janus column name or the calculations used to produce the value. **"Description of Data Items from Shear Strength Query with Output Raw Data Option,"** p. 105, in "Appendix N" contains additional information about the fields retrieved and the data format for the archived ASCII files.

T32. Shear strength query, p. 135.

Data Quality

Verification of all shear strength data sets was not completed because of time constraints. The variety of instruments and the lack of data acquisition programs for data collection made it more difficult to verify the measurements. To complete the verification, more research would be necessary to find the documentation about equipment and procedures used to collect these data and verify the data using log sheets and comparison with the reported data in the *Initial Reports* volumes.

Most data collected after the Janus database was operational on Leg 171 were verified as part of the Janus data management and verification procedures (see **"Janus Data Management and Verification,"** p. 7). Occasionally, Torvane and penetrometer data were collected, but data files were not transferred to ODP/TAMU at the end of the leg. Some verification was done on the pre-Leg 171 data; however, if there is a discrepancy between the database and data in the *Initial Reports* volumes, the published data should be considered more reliable.

THERMAL CONDUCTIVITY

Thermal conductivity is a measure of the rate that heat flows through material. In marine geophysics, thermal conductivity profiles of sediment and rock sections are used with temperature measurements to determine heat flow. Heat flow is not only characteristic of the material, but is an indicator of type and age of ocean crust and fluid circulation processes at shallow and great depths.

Thermal conductivity can be measured by heating a material with a known heating source and measuring the temperature change with time. Conductivity values are reported in watts per meter degrees Kelvin (W/[m·K]). Prior to Leg 109, conductivity was reported in cal·10^{-3}/cm-sec-deg but was converted to W/(m·K) before entry into the S1032 database. During ODP, ~37,000 individual measurements were collected during 104 of the 110 legs.

Data Acquisition

TCON measurements were done on both whole cores and split cores. Soft and semi-indurated sediments were usually analyzed as whole cores. Hard rocks were often measured after splitting. The sections were allowed to equilibrate after they were brought to the laboratory. TCON measurements were made after the sections were run through the MST. Small holes were drilled through the core liner to allow the full-space probes to be inserted. If the sediment was semiconsolidated, the hole was drilled into the sediment with thermal joint compound applied to ensure good contact between the probe and the sediments. For hard rock measurements, a smooth surface was prepared on a split-core specimen at least 5 cm long.

The first system used for TCON measurements was the Thermcon-85 built by Woods Hole Oceanographic Institution (WHOI). Initially, data were collected using a DEC PRO-350. As many as five needles could be connected to the system at one time: one needle was inserted into a standard material for a control measurement and the other needles were inserted into the cored material. The processed results were logged on log sheets and entered into the S1032 database. A new personal computer–based program was deployed during Leg 129 that allowed the operator to control the measurements, process the raw data, and write the results to a file. The needles had to be calibrated periodically using standard materials of known thermal conductivity. The calibration data were analyzed by linear least squares, and the coefficients were stored in a file that the program accessed during analysis. The Thermcon-85 was operational for all of ODP, though it was not used much after Leg 168, when the Teka TK04 system was deployed.

The Teka TK04 system was more automated than the Thermcon-85 system. It provided automated calibration, drift and measurement features, full-space and half-space needle configurations, and processing and graphing of results. Multiple measurements could be taken under identical conditions. Optional files could be created in addition to the file with the results. The optional files contained the measurement parameters, raw data (temperature–time series), evaluation parameters, and all valid calculated thermal conductivity values.

Additional information about ODP thermal conductivity measurements can be found in Chapter 8 of *Technical Note* 26 (Blum, 1997).

Archive

Pre-Janus Archive

Early during ODP, TCON data were collected on log sheets which were sent back to ODP/TAMU at the end of each cruise. The data were entered into the S1032 database and the log sheets were microfilmed for archival storage. TCON data were stored in the S1032 database through Leg 128. A new personal computer–based program was deployed on Leg 129 which created files that were brought back and archived on the ODP/TAMU servers.

Migration of Thermal Conductivity Data to Janus

The data model for TCON data can be found in **"Janus TCON Data Model,"** p. 106, in "Appendix O." Included are the relational diagram and the list of the tables that contain data pertinent to TCON analyses, the column names, and the definition of each column attribute. ODP Information Services Database Group was responsible for the migration of pre-Leg 171 data to Janus.

The thermal conductivity tables were yet not finalized when Janus became operational on Leg 171. After discussions about how to implement the TCON part of the database, it was decided to save only the calculated thermal conductivity measurements. Because the raw data collected on the two systems were different, the implementation of storing raw data in the database was deferred and not completed during ODP. Raw data are still archived on IODP/TAMU servers and can be requested through the **IODP/TAMU Data Librarian**.

Janus Thermal Conductivity Data Format

TCON analyses can be retrieved from Janus Web using a predefined query. The thermal conductivity query Web page allows the user to extract data using the following variables to restrict the amount of data retrieved: leg, site, hole, core, section, probe number, depth, or latitude and longitude ranges. TCON analyses made with the TK04 system often produce multiple measurements at the same interval. It became common practice to put the individual measurement values in the Comments field and the average was stored in the Thermcon_value field.

Table **T33** contains the data fields retrieved from the Janus database using the Janus Web predefined query. The first column contains the data item, the second column indicates the Janus table or tables in which the data were stored, and the third column is the Janus column name or the calculations used to produce the value. **"Description of Data Items from TCON Query,"** p. 106, in "Appendix O" contains additional information about the fields retrieved using the Janus Web thermal conductivity query, and the data format for the archived ASCII files.

T33. Thermal conductivity query, p. 136.

Data Quality

The TCON data set is one of the more complete data sets collected during ODP. A common error found during migration falls in the generic category of operator error. Analytical results were written on log sheets. These data were then typed into the S1032 database. The data acquisition programs required manual entry, and mistakes in logging intervals, logging data, typing data into the database, an so on, occasionally happened and were not always identified. Often, the Scientific Party found errors and corrected them for the data included in the *Initial Reports* volume, but data sent back to ODP/TAMU were not corrected.

Most data collected after the Janus database was operational on Leg 171 were verified as part of the Janus data management and verification procedures (see **"Janus Data Management and Verification,"** p. 7). Some verification was done on the pre-Leg 171 data; however, if there is a discrepancy between the database and data in the *Initial Reports* volumes, the published data should be considered more reliable.

DOWNHOLE TEMPERATURE

Temperature measurements are important in the study of Earth's processes. Data collected during ODP have been used to study the transfer of heat from Earth's interior, ocean lithospheric evolution, continental margin formation, subduction zones, hotspot volcanism, fluid flow, and methane hydrate formation. Most measurements were made between 20 and 250 mbsf; however, a few measurements were taken below 500 mbsf.

Several tools have been used during ODP to collect borehole and formation temperature data and include the advanced piston corer temperature tool, water-sampling temperature probe, Uyeda Temperature Tool, and Davis-Villinger Temperature Probe.

Temperature Data Acquisition

Temperature Tools

The APCT tool was a temperature tool compatible with the APC system. This tool was first used during DSDP Leg 86. ODP purchased 10 von Herzen temperature tools, but all were unusable by Leg 117. The second generation APCT tool was often referred to as "Adara" after the company that built and interfaced the tools to a personal computer. The APCT tool resided in the APC cutting shoe and measured formation temperature while the APC core was being retrieved. These measurements were usually made to ~100–150 mbsf until the coring method switched because of the need to use a different drill bit.

The WSTP was a temperature tool compatible with the XCB and RCB coring systems and could be used in formations that were too stiff for the APC system. The WSTP was a hybrid of two other tools: the Uyeda Temperature Tool and the Barnes Fluid Sampler. The first generation WSTP was actually the Uyeda tool, used until Leg 116. The second generation WSTP was deployed during Leg 110. A third version of the WSTP was deployed on Leg 139. Coring was interrupted in order to take WSTP temperature measurements.

The DVTP was designed to take heat flow measurements in semiconsolidated sediments that were too stiff for APC coring. Coring was interrupted in order to take a temperature measurement with the DVTP. The DVTP could also be run on wireline and hung below the bit as a temperature logging tool for borehole fluids. The tool was officially deployed during Leg 168.

Temperature Data Reduction

Several data reduction programs were used to determine in situ temperature during ODP. It wasn't practical to keep the temperature probe in contact with the sediment or rock for the extended period of time necessary to reach equilibrium. The data reduction programs determined the theoretical curve based on the observed data and inferred the equilibrium temperature. Factors that could affect estimates of temperature included frictional heating of the probe as a result of insertion, time interval of sampling, and in situ thermal conductivity.

Archive

Pre-Janus Archive

Temperature measurements were logged on data sheets that were collected and sent to ODP/TAMU after the cruise for microfilming and archival. No interim database was found for these data. Digital files were created and stored starting with the APCT/Adara tool during Leg 144. After that time, all tools created digital files that have been archived on the ODP/TAMU servers.

Migration of Temperature Data to Janus

The data model for downhole temperature data can be found in **"Janus Downhole Temperature Data Model,"** p. 107, in "Appendix P." Included are the relational diagram and the list of tables that contain data pertinent to temperature measurements, the column names, and the definition of each column attribute. The data model was designed for the APCT/Adara tool. An uploader was created and a couple Adara temperature runs were uploaded, but there was too much variability between data files. The format of the data files for the other tools varied significantly from the APCT/Adara files. The objective of uploading all the raw data was deferred and not completed during ODP.

As a result, only the final temperature determined by the Scientific Party was uploaded to Janus. Much of the temperature data were taken from the *Initial Reports* volumes; however, not all temperature data were analyzed and reported in the *Initial Reports*, so some temperature measurements are missing from the database.

Janus Downhole Temperature Data Format

Downhole temperatures can be retrieved from Janus Web using a predefined query. The downhole temperature query Web page allows the user to extract data using the following variables to restrict the amount of data retrieved: leg, site, hole, core, section, depth range, or latitude and longitude ranges. Table **T34** contains the data fields retrieved from the Janus database using the query. The first column contains the data item, the second column indicates the Janus table or tables in which the data were stored, and the third column is the Janus column name or the calculations used to produce the value. **"Description of Data Items from Downhole Temperature Query,"** p. 109, in "Appendix P" contains additional information about the fields and data format for the archived ASCII files.

T34. Downhole temperature query, p. 136.

Data Quality

As described above, only the final temperature values determined by the Scientific Parties were uploaded to Janus. Because of time constraints, verification of these data was not completed. Any questions about downhole temperature data or requests for raw data should be directed to the **IODP/TAMU Data Librarian**.

X-RAY DIFFRACTION

XRD analyses allow the identification of minerals based on their atomic structure. During XRD analysis, X-ray beams reflect off parallel atomic layers within a mineral over a range of diffraction angles. Because the X-ray beam has a specific wavelength, there are only specific angles which the exiting rays will be detected and counted by the detectors. Every substance has a unique diffraction pattern that can be used for identification. With this instrument, scientists can evaluate the mineralogical composition of sediments and the alteration products of ocean crust material.

XRD analyses were done on powdered samples. Quantitative analysis of a powdered sample of unknown composition is a difficult problem. An analysis program on the data acquisition computer could be run to analyze the results. After 1991, a freeware program for the Apple Macintosh platform called MacDiff was available to the scientists for a quick qualitative and quantitative analysis of samples. For more thorough analyses, scientists could take XRD files to their home institution.

Data Acquisition

Standard Operating Procedures

Samples were normally ground to a fine powder using a Spex mill or mortar and pestle when the sample was very small. The powder was pressed into a sample holder or smeared on a glass plate that was placed into the sample holder. Prior to Leg 147, XRD analyses were collected on a DEC PDP-11 and the files archived on floppy disks. Data analysis software could be used to create a printout of the diffraction peaks. Occasionally, a spectral plot or the quantitative analyses was also printed. Starting with Leg 147, the data acquisition software was moved to a personal computer–based system with the raw XRD files written to disk.

Data Analysis

The analysis and interpretation of XRD diffraction data were the responsibility of the Shipboard Scientific Party. Sometimes, the scientists on a cruise were not familiar with the interpretation of XRD data. For several ODP legs, there is no mention of XRD, even though samples were analyzed.

Archive

Pre-Janus Archive

Prior to Leg 147, XRD raw data files were copied onto DEC PDP-11 floppy disks. One copy remained on the ship, and one copy was archived at ODP/TAMU. The printouts of the diffraction peaks and any plots were brought back to shore and microfilmed for archival storage. After the transition to the personal computer–based data acquisition system, files were written to disk and transferred to shore and archived on ODP/TAMU servers.

The DEC PCP-11 system was deactivated, sent back to shore, and eventually accessed. Unfortunately, the data stored on those DEC floppies could not be retrieved, partly because the computer system was not capable of being put onto a network. The raw data for the XRD analyses before Leg 147 were no longer accessible.

Migration of XRD Data to Janus

The data model for XRD data can be found in **"Janus XRD Data Model,"** p. 110, in "Appendix Q." Included are the relational diagram and the list of the tables that contain data pertinent to XRD analyses, the column names, and the definition of each column attribute. ODP Information Services Database Group was responsible for the migration of pre-Leg 171 data to Janus.

Archival of XRD data in Janus consisted of extracting the header information into a table. The header information from the XRD data file documented the system setup and data acquisition parameters. The entire raw data file was then copied line by line into a table designed to hold the text of the data files. Migration of data for Legs 147–170 was done in the same manner.

Pre-Leg 147 data could not be uploaded because of the lack of data files. Advances in scanning technology gave ODP/TAMU Information Services the opportunity to scan the pre-Leg 147 printouts and upload those images to the database as Primedata images.

Janus XRD Data Format

XRD raw data files can be retrieved from Janus Web using a predefined query. The XRD query Web page allows the user to extract data using the following variables to restrict the list of available data files: leg, site, hole, core, section, depth, or latitude and longitude ranges. Table **T35** lists the data that are retrieved from the XRD query. To extract the data file, the user must click on the Data File link. Currently, there is no other way to download all files of interest from Janus Web. The user can contact the **IODP/TAMU Data Librarian** for help when requesting a large number of the XRD data files.

T35. XRD query, p. 137.

"Description of Data Items from XRD Query," p. 111, in "Appendix Q" contains information about the format of the archived ASCII files. Data header format differed during some legs (see **"XRD Data Header Format,"** p. 112, in "Appendix Q").

The name of the file in the archived ASCII set is the full sample identification. The first line of each data file contains an abbreviated sample identification text string. For samples from Legs 147–180, that identification was manually entered by the operator or scientist. Usually, there is no leg identification and the site number may be shortened. Starting with Leg 181, the database-assigned Sample_ID was inserted in the first line in order to ensure the data were being linked with the correct sample and to speed the upload of files to Janus,. This change made it very difficult to determine any information about the sample by looking at the first line of the file.

Data Quality

Almost 16,000 XRD analyses were done on samples during ODP. It is unknown how many have been analyzed for their mineral content.

The modification of the sample identifier in the first line of the XRD file significantly improved the accuracy and integrity of the XRD data in Janus, but after the file has been retrieved from the database, the user must be careful to document the file in such a way that its location is not lost. The Sample Report query on Janus Web does retrieve Sample_ID, but there is currently not a way to enter a Sample_ID and have the query return its location information.

X-RAY FLUORESCENCE SPECTROMETRY

X-ray secondary-emission spectrometry or XRF spectrometry is a nondestructive method of qualitative and quantitative analysis for elemental composition of samples. XRF analysis is based on the measurement of wavelengths and intensities of X-ray spectral lines emitted by secondary excitation.

An ARL 8420 XRF spectrometer was installed in the X-ray Laboratory on the *JOIDES Resolution* prior to the Leg 102 transit to Portugal. During ODP, scientists on board studied ~4000 samples from 56 legs before the spectrometer was removed from the ship after Leg 189.

Data Acquisition

The ARL 8420 was a fully automated, wavelength-dispersive spectrometer using a 3-kWh rhodium X-ray tube as the excitation for both major oxides and trace elements. Scientists and technicians on Legs 109 and 111 developed the first set of ODP XRF standard operating procedures. Few changes were made to the XRF hardware or the standard operation procedures during the period that the XRF system was on board. Table T36 is a summary of XRF data operations during ODP.

T36. XRF operations summary, p. 137.

In Table T37, the major oxides and trace elements routinely collected with the XRF are listed with an example of the operating parameters of the system (Leg 125). Parameters such as Line, Crystal, and Detector did not change except when the krypton detector was replaced by a flow-proportional counter (FPC) on Leg 136. The Collimator setup should not have changed much; however, some legs designated the settings as "fine" and "coarse," whereas others designated the settings as "fine" and "medium." Peak Angle and Background Offset changed slightly with each calibration. Background angles were adjusted to avoid overlap from other elements.

T37. XRF spectrometer parameters, p. 137.

Sample Preparation

Most samples analyzed by the ODP XRF were first powdered because of the inhomogeneity of rock and sediment samples. The powder was processed into fused glass disks to be run for major oxide analyses, and pressed pellets to be run for trace element analyses. The descriptions of sample preparation varied some between legs. The descriptions below are representative of the general procedures.

Hard Rock

Samples, ~10 cm^3 of rock, had saw marks and unwanted material removed by wet-grinding on a silicon carbide disk mill. The samples were ultrasonically washed in distilled water and then methanol for 10 min and dried at 110°C for at least 2 hr. Larger pieces were reduced to <1 cm diameter by crushing between two plastic disks in a hydraulic press. Powders were produced by grinding pieces <1 cm in diameter in a Spex Shatterbox using a tungsten carbide grinding vessel for 60–120 s, depending on the size of the vessel. The powder was transferred to clean paper and then to a sample vial and labeled. The vessel was thoroughly cleaned and prepared for another sample.

Lithified sediment

Samples were treated like hard rock samples except that the oven drying was replaced by freeze-drying for at least 12 hr. After the sample was dried, it was ground and treated in the same manner as the hard rock sample.

Unlithified Sediment (Mud)

Unlithified sediment samples were problematic. Sometimes the mud was washed to remove chloride and then freeze-dried. Other times the mud was only freeze-dried because it was believed that washing would remove other elements, not just the chloride contamination. After the sample was dried, it was ground and treated in the same manner as the hard rock sample.

Approximately 1.5 g of the rock powder was carefully weighed and ignited in an ash furnace for at least 5 hr at 1000°C for hard rock and 900°C for sediments. If the sample likely contained muscovite, biotite, amphibole, or carbonates, the sample was ignited for at least 6 hr. Because the powders were dried before ignition, the loss values resulting from the amount of adsorbed water (H_2O^-) were assumed to be negligible.

Fused glass disks were created for major oxide analysis in order to reduce matrix effects and variations in background (Claisse, 1956; Rose et al., 1962; Norrish and Hutton, 1969). These disks were made by mixing 7.20 g (20% La_2O_3) lithium tetraborate flux with 0.600 g ignited rock powder. This sample/flux mixture was melted at 1030°C in Pt-Au crucibles for 6–10 min and poured into Pt-Au molds using a modified Claisse Fluxer apparatus. The 12:1 flux to sample ratio had been found to sufficiently reduce matrix effects to the point where matrix corrections were unnecessary for normal basaltic to granitic composition ranges.

Trace Elements

Pressed pellets were used for the trace element analyses. Pressed-powder pellets were made by mixing 7 g fresh rock powder with 30 drops polyvinyl alcohol binder and pressing the mixture into an aluminum cap with 7 tons of pressure. A minimum of 5 g of sample usually guaranteed the pellet would be "infinitely thick" for rhodium K-series radiation.

To compute trace element concentrations from measured X-ray intensities, an offline calculation program was written by J.W. Sparks based on routines modified from Norrish and Chappell (1977) and Reynolds (1967). After the computer and software upgrade on Leg 149, trace element calculations were done by the data acquisition software.

Calibration

Most XRF analytical methods are based on comparison of the unknown sample's line intensities to one or more well-characterized standards. The standards must be similar to the samples in physical form, elemental concentrations, and matrix composition. The calibration for a leg was performed using standards chosen to best provide the range of values that were expected from the cored rock. Table T38 lists the standards most often used on the *JOIDES Resolution*. These standards were chosen because of their similarity to oceanic basalts, granites, and ultramafic rocks.

T38. XRF standard reference materials, p. 138.

Oceanic sediments are harder to characterize because of the variety of materials that make up the sedimentary column (e.g., organic material, calcium carbonate, clay, or silica). Developing standards that would span the expected range of values was very difficult.

Data Archive

Pre-Janus Archive

Major oxide and trace element data from XRF analyses were logged on log sheets. The log sheets were brought back to ODP/TAMU at the end of each leg, entered into the S1032 database, and microfilmed for archival purposes. The S1032 database was used to store data until Leg 134. Starting with Leg 134, the data were saved in files which were brought back at the end of each leg and archived on the ODP/TAMU servers.

Migration of XRF Data to Janus

The data model for XRF data can be found in **"Janus XRF Data Model,"** p. 114, in "Appendix R." Included are the relational diagram and the list of the tables that contain data pertinent to XRF, the column names, and the definition of each column attribute. ODP Information Services Database Group was responsible for the migration of pre-Leg 171 data to Janus. An additional column of information was added to the XRF_SAMPLE table after the migration of data. This column, Sample_type, was added to allow scientists to describe the type of rock that was analyzed. In turn, scientists would be able to extract data based on specific rock types. The sediment or rock designations were not usually stored in the original data files, and it was necessary to extract that information from the *Initial Reports* volumes. Due to constraints of time, it was not possible to complete this part of the migration.

Janus XRF Data Format

XRF major oxide and trace element data can be retrieved from Janus Web using a predefined query. The XRF query Web page allows the user to extract data using the following variables to restrict the amount of data retrieved: leg, site, hole, core, section, depth range or latitude and longitude range. Often, replicate samples were analyzed for the major oxides. Those data, when available, were uploaded separately. The Web query reports the replicate data on separate lines. In addition, the trace element data will also be reported on a separate line.

Table **T39** lists the data fields retrieved from the Janus database for the XRF predefined query. The first column contains the data item, the second column indicates the Janus table or tables in which the data were stored, and the third column is the Janus column name or the calculation used to produce the value. **"Description of Data Items from XRF Query,"** p. 116, in "Appendix R" contains additional information about the fields retrieved using the Janus Web XRF query and the data format for the archived ASCII files.

T39. XRF query, p. 140.

Data Quality

The XRF data were very high quality, even though the ship environment made getting accurate measurements more difficult. XRF analytical methods are based on comparison of the unknown sample's line intensities to one or more well-characterized standards. For this reason, XRF analyses done on volcanic, mafic and ultramafic samples are the highest quality because there are standards that characterize the range of elemental concentrations most often found in these types of rocks. It is more difficult to create standards that would encompass the range of elemental concentrations found in sedimentary environments. Migration of the sample type data was completed for 20 of the 56 legs.

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APPENDIX A

Carbonate Analyses

Janus carbonate chemistry data model. (Continued on next page.)

Table name	Column name	Column comment
Chem_Carb_Sample	run_id	Unique Oracle-generated sequence identifier that allows duplicate analyses of a sample to be entered into database.
	sequence_identifier	Number indicating order in which analyses were run when duplicate analyses are stored.
	sample_id	Oracle-generated sequence number that with *location* uniquely identifies a sample.
	location	Code that indicates which Janus application assigned the sample_id. Used with *sample_id* to uniquely identify a sample.
	carb_comments	Comment concerning a carbonate analysis.
Chem_Carb_Analysis	run_id	Unique Oracle-generated sequence identifier that allows duplicate analyses from a sample to be entered into database.
	analysis_code	Code describing type of analysis performed on a sample.
	method_code	Code for method or instrument used to analyze a sample.
	analysis_result	Numerical result of the analysis of a sample.
	cal_id	Oracle-generated sequence number for a carbonate calibration run.
Chem_Carb_Analysis_Type	carb_analysis_code	Code describing type of analysis that can be performed on a sample.
	carb_analysis_name	Full name or description of analysis type.
	analysis_units	Measurement units of analysis result.
	analysis_code_order	Number defining the order that analysis codes and results will appear on a spreadsheet or report.
Chem_Method	method_code	Code for method or instrument used for analyzing a sample.
	method_name	Name of method or instrument used for analyzing a sample.
Chem_Carb_Calib	calib_id	Oracle-generated sequence number for a carbonate calibration run.
	calib_date	Date and time of a calibration run.
	method_code	Code for method or instrument used for analyzing a sample.
	calib_method	Method used for calibrating analytical instrument.
	carb_comments	Comment concerning a carbonate calibration.
	carb_analysis_code	Code describing type of analysis for which a sample can be analyzed.
Chem_Calib_Method	calib_method	Method used for calibrating analytical instrument.
Chem_Carb_Chk_Results	calib_id	Oracle-generated sequence number for a carbonate calibration run.
	chk_sequence	Number indicating order of measurements.
	carb_std_type	Name of carbonate standard used.
	carb_analysis_code	Code describing type of analysis that can be performed on a sample.
	carb_analysis_result	Result of analysis of a sample or standard.
	carb_std_class	Code describing type of check analysis as a standard, blank, or unknown check.
Chem_Carb_Standards	carb_std_type	Name of carbonate standard used.
	carb_analysis_code	Code describing type of analysis for which a sample can be analyzed.
	carb_std_value	Value of a carbonate standard for a particular analysis code.
	carb_std_family	Name for group of carbonate standards.
	carb_std_sequence	
Section	section_id	Unique Oracle-generated sequence number to identify each section. This is done because of physical subsection/zero section problems. When adding new sections, deleting sections, or changing sections, renumbering is not necessary.
	leg	Number identifying the cruise for which data were entered into the database.
	site	Number identifying the site from which the core was retrieved. A site is the position of a beacon around which holes are drilled.
	hole	Letter identifying the hole at a site from which a core was retrieved or data were collected.
	core	Sequential numbers identifying the cores retrieved from a particular hole. Cores are generally 9.5 m in length and are numbered serially from the top of the hole downward.
	core_type	Letter code identifying drill bit/coring method used to retrieve the core.
	section_number	Cores are cut into 1.5 m sections. Sections are numbered serially, with Section 1 at the top of core.
	section_type	Used to differentiate sections of core (S) from core catchers (C). Previously core catchers were stored as section CC, but in Janus core catchers are given the next sequential number from the last section recovered.
	curated_length	Length of the section core material (meters); may be different than the liner length for the same section. Hard rock cores may have spacers added to prevent rock pieces from damaging each other.
	liner_length	Original length of core material in section (meters); recovery = sum of liner lengths of core sections.
	core_catcher_stored_in	Contains section number of the D-tube that holds the core catcher, when applicable.
	section_comments	Comments about this section.

Janus carbonate chemistry data model (continued).

Table name	Column name	Column comment
Sample	sample_id	Oracle-generated sequence number that with *location* uniquely identifies a sample.
	location	Code that indicates which Janus application assigned the sample_id: **SHI** (ship), **GCR** (Gulf Coast Repository), **ECR** (East Coast Repository), **WCR** (West Coast Repository), **BCR** (Bremen Core Repository). Used with *sample_id* to uniquely identify a sample.
	s_c_leg	Number identifying the cruise for which data were entered into the database. Foreign key used with *s_c_sampling_code* to link samples with a scientist's sample request.
	s_c_sampling_code	Code used to identify samples taken for a sample request. Used with *s_c_leg*.
	sam_archive_working	Part of section where sample was taken: **WR** (whole round), **A** (archive half), **W** (working half).
	top_interval	Distance (meters) from the top of the section to the top of the sample.
	bottom_interval	Distance (meters) from the top of the section to the bottom of the sample.
	piece	Additional identifier for hard rock samples. Each individual piece of rock within a section is numbered consecutively starting at the top of the section.
	sub_piece	Additional identifier for hard rock samples. If piece is broken, individual fragments are given consecutive letter designations. Subpiece assignments must be made in conjunction with piece numbers.
	beaker_id	Number on the moisture density beaker. Used for samples analyzed for moisture and density.
	volume	Volume of sample.
	entered_by	Indicates who entered the sample into the database.
	sample_depth	Depth of the sample.
	sample_comment	Comment about the sample.
	sam_repository	Repository where sample was taken: **SHI** (ship), **GCR** (Gulf Coast Repository), **ECR** (East Coast Repository), **WCR** (West Coast Repository), **BCR** (Bremen Core Repository).
	sam_sample_code_lab	Code to indicate the shipboard laboratory that will perform the initial analysis.
	sam_section_id	Unique Oracle-generated sequence number to identify each section. This is a foreign key that links a sample to leg, site, hole, core, section.
	timestamp	Date and time when sample was entered into database. Samples taken before November 25, 1998 and migrated samples have the timestamp 11/25/1998 12:26 PM.

Description of data items from carbonates query.

Column name	Column description and calculations	Format
Leg	Number identifying the cruise.	Integer 3
Site	Number identifying the site.	Integer 4
Hole	Letter identifying the hole.	Text 1
Core	Number identifying the serial position of the core from the top of the hole downward.	Integer 3
Coretype	Letter identifying the coring method used.	Text 1
Section	Number identifying the serial position of the section from the top of the core downward. Core catcher sections are identified as "CC."	Integer 2 or Text 2
Top Interval	Top interval of a measurement in centimeters measured from the top of a section.	Decimal F4.1
Bottom Interval	Location of the bottom of a sample in centimeters measured from the top of a section.	Decimal F4.1
Depth (mbsf)	Distance (meters) from the seafloor to the sample location.	Decimal F7.3
Inorganic Carbon Percent	Weight percent of inorganic carbon in a sample.	Decimal F15.5
$CaCO_3$ Percent	Weight percent of calcium carbonate in a sample; inorganic carbon is reported as calcium carbonate: Inorganic_Carbon_Percent x 8.33 = CaCO3_Percent.	Decimal F15.5
Total Carbon Percent	Weight percent of total carbon.	Decimal F15.5
Organic Carbon Percent	Weight percent of organic carbon in a sample, measured directly or calculated by subtracting Inorganic_Carbon_Percent from Total_Carbon_Percent.	Decimal F15.5
Nitrogen Percent	Weight percent of nitrogen in a sample.	Decimal F15.5
Sulfur Percent	Weight percent of sulfur in a sample.	Decimal F15.5
Hydrogen	Amount of hydrogen in a sample (milligrams hydrocarbon per gram of sediment).	Decimal F15.5

APPENDIX B

Gas Chromatography Analyses

Janus gas chromatography data model. (Continued on next page.)

Table name	Column name	Column comment
Chem_Gas_Sample	run_id	Unique Oracle-generated sequence identifier that allows duplicate analyses from a sample to be entered into database.
	sample_id	Oracle-generated sequence number that with *location* uniquely identifies a sample.
	location	Code that indicates which Janus application assigned the sample_id. Used with *sample_id* to uniquely identify a sample.
	sequence_identifier	Number indicating order in which analyses were run when duplicate analyses are stored.
	gas_sample_method	Method used for obtaining a gas sample: **HS** (headspace sample), **VAC** (Vacutainer sample), **O** (other).
	vol_solid	Volume of solid to be analyzed in milliliters.
	vol_hs	Volume of headspace sample to be analyzed (milliliters); = volume of vial minus volume of solid.
	cal_id	Oracle-generated sequence number for a gas calibration run.
	method_code	Code for method or instrument used to analyze a sample.
	gas_detector_signal	Type of signal: **FID** (flame ionization detector) and **TCD** (thermal conductivity detector).
Chem_Gas_Analysis	run_id	Unique Oracle-generated sequence identifier that allows duplicate analyses from a sample to be entered into database.
	gas_analysis_code	Code describing type of analysis performed on a gas sample.
	gas_analysis_result	Numerical result of analysis of a gas sample.
Chem_Gas_Analysis_Type	gas_analysis_code	Code describing type of analysis that can be performed on a sample.
	gas_analysis_name	Full name or description of gas analysis.
	analysis_units	Reported measurement units of analysis result.
	analysis_code_order	Number defining the order that analysis codes and results will appear on a spreadsheet or report.
Chem_Method	method_code	Code for method or instrument used for analyzing a sample.
	method_name	Name of method or instrument used for analyzing a sample.
Chem_Gas_Lipids	run_id	Unique Oracle-generated sequence identifier that allows duplicate analyses from a sample to be entered into database.
	sample_id	Oracle-generated sequence number that with *location* uniquely identifies a sample.
	location	Code that indicates which Janus application assigned the sample_id. Used with *sample_id* to uniquely identify a sample.
	lipid_volume	Volume of a lipid sample (microliters).
	lipid_comments	Comment concerning a sample analyzed for lipids.
Chem_Lipid_Results	run_id	Unique Oracle-generated sequence identifier that allows duplicate analyses from a sample to be entered into database.
	gas_analysis_code	Code describing type of analysis for which a gas sample was analyzed.
	lipid_analysis_level	Amount of lipids in a sample: **MAJOR, MINOR, TRACE, NOT PRESENT, NOT DETERMINED**.
	lipid_concentration	Concentration of a lipid. Derived from GC2 output.
Chem_Gas_Calib	calib_id	Oracle-generated sequence number for a gas calibration run.
	datetime	Timestamp for calibration run.
	method_code	Code for method or instrument being calibrated.
	calib_method	Method used for calibrating analytical instrument.
	gas_comments	Comments concerning a gas calibration.
Chem_Calib_Method	calib_method	Method used for calibrating analytical instruments.
Chem_Gas_Chk_Result	calib_id	Oracle-generated sequence number for a gas calibration run.
	gas_std_type	Name or type of standard used for calibration or control run.
	gas_analysis_code	Code describing type of analysis performed on a gas standard.
	gas_std_class	Defines standard as a **standard**, a **blank**, or an **unknown** check.
	chk_sequence	Identifies order of measurements.
	gas_analysis_result	Numerical result of the analysis of a gas sample.
Chem_Gas_Std	gas_std_type	Name or type of standard used for a gas calibration.
	gas_analysis_code	Code describing type of analysis for a gas standard.
	gas_std_value	Numerical value for a gas standard.

Janus gas chromatography data model (continued).

Table name	Column name	Column comment
Section	section_id	Unique Oracle-generated sequence number to identify each section. This is done because of the physical subsection/zero section problems. When adding new sections, deleting sections, or changing sections renumbering is not necessary.
	leg	Number identifying the cruise for which data were entered into the database.
	site	Number identifying the site from which the core was retrieved. A site is the position of a beacon around which holes are drilled.
	hole	Letter identifying the hole at a site from which a core was retrieved or data were collected.
	core	Sequential numbers identifying the cores retrieved from a particular hole. Cores are generally 9.5 m in length, and are numbered serially from the top of the hole downward.
	core_type	Letter code identifying drill bit/coring method used to retrieve the core.
	section_number	Cores are cut into 1.5 m sections. Sections are numbered serially, with Section 1 at the top of the core.
	section_type	Used to differentiate sections of core (**S**) from core catchers (**C**). Previously core catchers were stored as section CC, but in Janus core catchers are given the next sequential number from the last section recovered.
	curated_length	Length of the section core material (meters). This may be different than the liner length for the same section. Hard rock cores may have spacers added to prevent rock pieces from damaging each other.
	liner_length	Original length of core material in section (meters); core recovery = sum of liner lengths.
	core_catcher_stored_in	Section number of D-tube that holds the core catcher, when applicable.
	section_comments	Comments about this section.
Sample	sample_id	Oracle-generated sequence number that with *location* uniquely identifies a sample.
	location	Code that indicates which Janus application assigned the sample_id: **SHI** (ship), **GCR** (Gulf Coast Repository), **ECR** (East Coast Repository), **WCR** (West Coast Repository), **BCR** (Bremen Core Repository). Used with *sample_id* to uniquely identify a sample.
	s_c_leg	Number identifying the cruise for which data were entered into the database. Foreign key used with *s_c_sampling_code* to link samples with a scientist's sample request.
	s_c_sampling_code	Code used to identify samples taken for a sample request. Used with *s_c_leg*.
	sam_archive_working	Part of section where sample was taken: **WR** (whole round), **A** (archive half), **W** (working half).
	top_interval	Distance (meters) from the top of the section to the top of the sample.
	bottom_interval	Distance (meters) from the top of the section to the bottom of the sample.
	piece	Additional identifier for hard rock samples. Each individual piece of rock within a section is numbered consecutively starting at the top of the section.
	sub_piece	Additional identifier for hard rock samples. When a piece is broken, individual fragments are given consecutive letter designations. Note that subpiece assignments must be made in conjunction with piece numbers.
	beaker_id	Number on the moisture density beaker. Used for samples analyzed for moisture and density.
	volume	Volume of sample.
	entered_by	Indicates who entered the sample into the database.
	sample_depth	Depth of the sample.
	sample_comment	Comment about the sample.
	sam_repository	Repository where sample was taken: **SHI** (ship), **GCR** (Gulf Coast Repository), **ECR** (East Coast Repository), **WCR** (West Coast Repository), **BCR** (Bremen Core Repository).
	sam_sample_code_lab	Code to indicate the shipboard laboratory that will perform the initial analysis.
	sam_section_id	Unique Oracle-generated sequence number to identify each section. This is a foreign key that links a sample to leg, site, hole, core, section.
	timestamp	Date and time when sample was entered into database. Samples taken before November 25, 1998 and migrated samples have the timestamp 11/25/1998 12:26 PM.

Description of items from gas elements query.

Item name	Column description and calculations	Format
Leg	Number identifying the cruise.	Integer 3
Site	Number identifying the site.	Integer 4
Hole	Letter identifying the hole.	Text 1
Core	Number identifying the serial position of the core from the top of the hole downward.	Integer 3
Type	Letter identifying the coring method used.	Text 1
Section	Numbered identifying the serial position of a section from the top of the core downward. Core catcher sections identified as "CC."	Integer 2 or Text 2
Top (cm)	Top interval of a measurement in centimeters measured from the top of a section.	Decimal F4.1
Bottom (cm)	Location of the bottom of a sample in centimeters measured from the top of a section.	Decimal F4.1
Depth (mbsf)	Distance (meters) from the seafloor to the sample location.	Decimal F7.3
Methane/Ethane (C_1/C_2 ratio)	Methane to ethane ratio.	Decimal F15.5
Methane (C_1) [ppm]	Methane results (parts per million).	Decimal F15.5
Ethane (C_2) [ppm]	Ethane results (parts per million).	Decimal F15.5
Ethylene ($C_{2=}$) [ppm]	Ethylene results (parts per million).	Decimal F15.5
Ethane + Ethylene ($C_2 + C_{2=}$) [ppm]	Sum of ethane and ethylene (parts per million).	Decimal F15.5
Propane (C_3) [ppm]	Propane results (parts per million).	Decimal F15.5
Propane + Propylene ($C_3 + C_{3=}$) [ppm]	Sum of propane and propylene (parts per million).	Decimal F15.5
Propylene ($C_{3=}$) [ppm]	Propylene results (parts per million).	Decimal F15.5
i-Butane (*i*-C_4) [ppm]	*i*-butane results (parts per million).	Decimal F15.5
n-Butane (*n*-C_4) [ppm]	*n*-butane results (parts per million).	Decimal F15.5
n-Pentane (*n*-C_5) [ppm]	*n*-pentane results (parts per million).	Decimal F15.5
i-Pentane (*i*-C_5) [ppm]	*i*-pentane results (parts per million).	Decimal F15.5
n-Hexane (*n*-C_6) [ppm]	*n*-hexane results (parts per million).	Decimal F15.5
i-Hexane (*i*-C_6) [ppm]	*i*-hexane results (parts per million).	Decimal F15.5
n-Heptane (*n*-C_7) [ppm]	*n*-heptane results (parts per million).	Decimal F15.5
i-Heptane (*i*-C_7) [ppm]	*i*-heptane results (parts per million).	Decimal F15.5
Nitrogen (N_2) [ppm]	Nitrogen results (parts per million).	Decimal F15.5
Oxygen (O_2) [ppm]	Oxygen results (parts per million).	Decimal F15.5
Hydrogen Sulfide (H_2S) [ppm]	Hydrogen sulfide results (parts per million).	Decimal F15.5
Carbon Dioxide (CO_2) [ppm]	Carbon dioxide results (parts per million).	Decimal F15.5
Run	Oracle-generated run identification.	Integer 9
Instrument	Instrument on which analysis was performed: **CAR** (Carle gas chromatograph), **GC1** (HP 5890A gas chromatograph), **GC2** (HP 5890A gas chromatograph), **GC3** (HP 5890 Series II gas chromatograph), **NGA** (natural gas analyzer).	Text 10
Method	Sampling method: **HS** (headspace) and **VAC** (Vacutainer).	Text 3
Detector	Detector used for analysis: **FID** (flame ionization detector) and **TCD** (thermal conductivity detector).	Text 3

APPENDIX C

Gamma Ray Attenuation Analyses

Janus GRA densiometer data model. (Continued on next page.)

Table name	Column name	Column comment
Gra_Section	gra_id	Unique Oracle-generated sequence number for each GRA analysis run.
	section_id	Unique Oracle-generated sequence number to identify each section.
	run_number	Number identifying a run generated by the data acquisition software. This number is not used to identify the run in Janus because it may not be unique.
	run_date_time	Timestamp when analysis was run.
	core_status	Indicates if a full or half (split) core is being analyzed: **FULL** or **HALF**.
	liner_status	Records if a core liner, split liner, or no liner was used: **FULL**, **HALF, NONE**.
	requested_daq_interval	Data acquisition interval requested for section analysis (centimeters).
	requested_daq_period	Data acquisition period requested (seconds).
	density_calibration_id	Unique Oracle-generated sequence number for each density calibration recorded for the GRA instrument.
	mst_gra_ctrl_2_id	Unique Oracle-generated sequence identifier for GRA control-2 runs.
	mst_gra_ctrl_3_id	Unique Oracle-generated sequence identifier for GRA control-3 runs.
Gra_Section_Data	gra_id	Unique Oracle-generated sequence number for each GRA analysis run.
	mst_top_interval	Top interval of a measurement (meters) measured from the top of a section.
	mst_bottom_interval	Bottom interval of a measurement (meters) measured from the top of a section.
	actual_daq_period	Actual data acquisition period used for measurements (seconds).
	meas_counts	Actual raw measured counts collected by a GRA instrument during a measurement.
	core_diameter	Diameter of core (centimeters).
	boyce_corrected_density	Estimated bulk density value with fluid correction factor applied. Applies to bulk density data collected before Leg 169 Site 1037.
Gra_Calibration	density_calibration_id	Unique Oracle-generated sequence number for each density calibration recorded for the GRA instrument.
	calibration_date_time	Timestamp when calibration was run.
	run_number	Number identifying a run generated by the data acquisition software. This number is not used to identify the run in Janus because it may not be unique.
	system_id	Unique identifier for a system of equipment on the ship.
	liner_status	Records if a core liner, split liner, or no liner was used: **FULL**, **HALF, NONE**.
	requested_daq_period	Data acquisition period requested (seconds).
	density_m0	Intercept (m0) determined for a GRA calibration (grams per cubic centimeter).
	density_m1	Slope (m1) determined for a GRA calibration (grams per cubic centimeter per count).
	density_mse	Mean-squared error determined for a GRA calibration.
	Comments	General comments.
Gra_Calibration_ Data	density_calibration_id	Unique Oracle-generated sequence number for each density calibration recorded for the GRA instrument.
	mst_top_interval	Top interval of a measurement (meters) measured from the top of a standard.
	standard_id	Unique identifier for a physical properties standard.
	mst_bottom_interval	Bottom interval of a measurement (meters) measured from the top of a standard.
	standard_density	Density of standard (grams per cubic centimeter).
	actual_daq_period	Actual data acquisition period used for measurements (seconds).
	meas_counts	Raw measured counts collected by a GRA instrument during a calibration measurement.
Gra_Ctrl_1	gra_ctrl_1_id	Unique Oracle-generated sequence identifier for GRA control-1 runs, used to compare a sample run to a control-1 run.
	run_number	Number identifying a run generated by the data acquisition software. This number is not used to identify the run in Janus because it may not be unique.
	run_date_time	Timestamp when analysis was run.
	core_status	Indicates whether a whole or half (split) core is being analyzed: **FULL** or **HALF**.
	liner_status	Records if a core liner, split liner, or no liner was used: **FULL**, **HALF, NONE**.
	requested_daq_interval	Data acquisition interval requested for section analysis (centimeters).
	requested_daq_period	Data acquisition period requested (seconds).
	density_calibration_id	Unique Oracle-generated sequence number for each density calibration recorded for the GRA instrument.
	standard_id	Unique identifier for a physical properties standard.
Gra_Ctrl_1_Data	gra_ctrl_1_id	Unique Oracle-generated sequence identifier for GRA control-1 runs, used to compare a sample run to a control-1 run.
	mst_top_interval	Top interval of a measurement (meters) measured from the top of a section.
	mst_bottom_interval	Bottom interval of a measurement (meters) measured from the top of a section.
	actual_daq_period	Actual data acquisition period used for measurements (seconds).
	meas_counts	Actual raw measured counts collected by a GRA instrument during a measurement.
	core_diameter	Diameter of core (centimeters).

Janus GRA densiometer data model (continued).

Table name	Column name	Column comment
Gra_Ctrl_2	gra_ctrl_2_id	Unique Oracle-generated sequence identifier for GRA control-2 runs, used to associate a sample run to a control-2 run.
	run_number	Number identifying a run generated by the data acquisition software. This number is not used to identify the run in Janus because it may not be unique.
	run_date_time	Timestamp when analysis was run.
	requested_daq_period	Data acquisition period requested (seconds).
	density_calibration_id	Unique Oracle-generated sequence number for each density calibration recorded for the GRA instrument.
	actual_daq_period	Actual data acquisition period used for measurements (seconds).
	meas_counts	Actual raw measured counts collected by a GRA instrument during a measurement.
Gra_Ctrl_3	gra_ctrl_3_id	Unique Oracle-generated sequence identifier for GRA control-3 runs, used to associate a sample run to a control-3 run.
	run_number	Number identifying a run generated by the data acquisition software. This number is not used to identify the run in Janus because it may not be unique.
	run_date_time	Timestamp when analysis was run.
	requested_daq_period	Data acquisition period requested (seconds).
	density_calibration_id	Unique Oracle-generated sequence number for each density calibration recorded for the GRA instrument.
	standard_id	Unique identifier for a physical properties standard.
	actual_daq_period	Actual data acquisition period used for measurements (seconds).
	meas_counts	Actual raw measured counts collected by a GRA instrument during a measurement.
Physical_Properties_ Standard	standard_id	Unique identifier for a physical properties standard.
	standard_name	Name of a physical properties standard.
	standard_set_name	Name for a set of physical properties standards.
	date_time_ commissioned	Date that a physical properties standard went into use.
	date_time_ decommissioned	Date that a physical properties standard's use discontinued.
	lot_serial_number	Information concerning lot and/or serial number associated with a physical properties standard.
	comments	General comments.
Section	section_id	Unique Oracle-generated sequence number to identify each section. This is done because of the physical subsection/zero section problems. When adding new sections, deleting sections, or changing sections renumbering is not necessary.
	leg	Number identifying the cruise for which data were entered into the database.
	site	Number identifying the site from which the core was retrieved. A site is the position of a beacon around which holes are drilled.
	hole	Letter identifying the hole at a site from which a core was retrieved or data were collected.
	core	Sequential numbers identifying the cores retrieved from a particular hole.
	core_type	Letter code identifying the drill bit/coring method used to retrieve the core.
	section_number	Number identifying the serial location of a section from the top of the core.
	section_type	Used to differentiate sections of core (**S**) from core catchers (**C**). Previously core catchers were stored as section CC, but in Janus core catchers are given the next sequential number from the last section recovered.
	curated_length	Length of the section core material (meters). This may be different than the liner length for the same section. Hard rock cores may have spacers added to prevent rock pieces from damaging each other.
	liner_length	Original length of core material in section (meters); core recovery = sum of liner lengths.
	core_catcher_stored_in	Section number of D-tube that holds the core catcher, if applicable.
	section_comments	Comments about this section.
System_Type	system_id	Unique identifier for a system of equipment used to collect data.
	system_comments	Comments associated with a piece of analytical equipment.
	system_commissioned	Date that a piece of equipment was deployed to collect scientific data for ODP.
	system_decommissioned	Date that a piece of analytical equipment was no longer used by ODP.
	system_model_number	Model number of a piece of equipment used for scientific analysis.
	system_name	Name for a piece of equipment used for analysis.

Description of data items from GRA query.

Column name	Column description and calculation	Format
Leg	Number identifying the cruise.	Integer 3
Site	Number identifying the site.	Integer 4
Hole	Letter identifying the hole.	Text 1
Core	Number identifying the serial position of the core from the top of the hole downward.	Integer 3
Type	Letter identifying coring method used.	Text 1
Section	Numbered identifying the serial position of a section from the top of the core downward. Core catcher sections identified as "CC."	Integer 2 or Text 2
Top (cm)	Top interval of a measurement in centimeters measured from the top of a section.	Decimal F4.1
Depth (mbsf)	Distance (meters) from the seafloor to the sample location.	Decimal F7.3
Density (g/cm^3)	Calculated bulk density at an analysis interval (Legs 169 [Site 1037]–210: calculated using calibration information and number of counts. Legs 101–169 [Site 1036] corrected for overestimation of water using Boyce correction).	Decimal F7.3
Run Number	Number generated by the data acquisition software, to identify an analysis run of a section of core.	Text 5
Run Date/Time	Timestamp when analysis was run.	Text 16 (yyyy-mm-dd hh:mm)
Core Status	Indicates whether a whole or half (split) core is being analyzed: **FULL** or **HALF**.	Text 11
Liner Status	Records if a core liner, split liner, or no liner was used: **FULL**, **HALF**, **NONE**.	Text 12
Requested Interval	Requested sampling interval (Legs 101–162 [seconds]; Legs 163–210 [centimeters]).	Decimal F5.3
Requested Period	Requested sampling period in seconds.	Decimal F7.3
Actual Period	Actual sampling period.	Decimal F7.3
Counts per Second	Measured counts collected by a shielded scintillation detector during measurement.	Integer 10
Core Diameter	Diameter of core in centimeters.	Decimal F5.2
Calibration Date/Time	Timestamp when calibration was run.	Text 16 (yyyy-mm-dd hh:mm)
Calibration Intercept	Density_M0: intercept (m0) determined for a GRA calibration (grams per cubic centimeter).	Decimal F8.4
Calibration Slope	Density_M1: slope (m1) determined for a GRA calibration (grams per cubic centemeter per count).	Decimal F8.4

APPENDIX D

Inductively Coupled Plasma–Atomic Emission Spectroscopy Analyses

Janus ICP-AES data model. (Continued on next page.)

Table name	Column name	Column comment
XRF_Sample	sample_id	Oracle-generated sequence number that with *location* uniquely identifies a sample.
	location	Code indicating the repository in which the sample data record originated. Used with *sample_id* to uniquely identify a sample: **SHI** (ship), **GCR** (Gulf Coast Repository), **ECR** (East Coast Repository), **WCR** (West Coast Repository), **BCR** (Bremen Core Repository). Used with *sample_id* to uniquely identify a sample.
	XRF_replicate	Identifier for each replicate of a sample to allow all to be entered into the database.
	XRF_run_identifier	Operator-assigned run identifier. Must be unique during a leg.
	leg	Number identifying the cruise for which data were entered into the database.
	XRF_analysis_type	Type of analysis performed on an ICP-AES sample: **MAJOR** (oxide) and **TRACE** (element).
	system_id	Unique identifier for a system of equipment used to collect data.
	sample_prep	Type of preparation used for a sample: **BEAD** (fused glass disc) or **PELLET** (pressed pellet).
	bead_loi	Weight loss experienced by a sample when it is placed in a furnace at a specific temperature and for a specific time period. Used to give a general indication of "volatile" species in a sample.: [(post_ign_sample_wt/pre_ign_sample_wt) – 1] × (–100).
	XRF_comment	General comment about sample or analysis.
XRF_Sample_Analysis	sample_id	Oracle-generated sequence number that with *location* uniquely identifies a sample.
	location	Code indicating which Janus application assigned the *sample_id*: **SHI** (ship), **GCR** (Gulf Coast Repository), **ECR** (East Coast Repository), **WCR** (West Coast Repository), **BCR** (Bremen Core Repository). Used with *sample_id* to uniquely identify a sample.
	XRF_replicate	Identifier for each replicate of a sample to allow all to be entered into the database.
	XRF_run_identifier	Operator-assigned run identifier. Must be unique during a leg.
	leg	Number identifying the cruise for which data were entered into the database.
	XRF_analysis_type	Type of analysis performed on an ICP-AES sample: **MAJOR** (oxide) and **TRACE** (element).
	XRF_analysis_code	Code for element or oxide being analyzed.
	XRF_analysis_result	Analytical result for an analysis code.
	analysis_units	Measurement units used for an analysis: **wt%** (major oxides) and **ppm** (trace elements).
	XRF_cal_name	Same description as the attribute XRF_calib_name, but allowed to be null.
XRF_Analysis_Type	XRF_analysis_code	Code for element or oxide being analyzed.
	analysis_code_order	Order that analysis codes will appear on a spreadsheet or report.
XRF_Sample_Type	sample_type_id	Identification assigned to rock type.
	sample_type	Rock type name (e.g., **Basalt**, **Granite**, **Oxide gabbro**).
XRF_Standard	XRF_std_name	Name of an ICP-AES standard.
	XRF_replicate	Identifier for each replicate of a sample to allow all to be entered into the database.
	rock_type	Description of the rock type or material of the standard.
	XRF_std_comment	Comment about an ICP-AES standard.
XRF_Calibration	XRF_analysis_code	Code for element or oxide being analyzed.
	datetime	Generic date/time. Often used for keys when multiple comments, etc., can be entered.
	XRF_Analysis_Type	Type of analysis performed on an ICP-AES sample: **MAJOR** (oxide) and **TRACE** (element).
	XRF_std_name	Name of an ICP-AES standard.
	XRF_replicate	Identifier for each replicate of a sample to allow all to be entered into the database.
	XRF_std_value	Expected results for an element in an ICP-AES standard.
	XRF_calib_name	Name associated with a particular calibration.
XRF_Chk_Result	XRF_run_identifier	Operator-assigned run identifier. Must be unique during a leg.
	leg	Number identifying the cruise for which data were entered into the database.
	XRF_std_name	Name of an ICP-AES standard.
	XRF_replicate	Identifier for analysis replicates of a standard to allow all to be entered into the database.
	XRF_analysis_code	Code for element or oxide being analyzed.
	XRF_Analysis_Type	Type of analysis performed on an ICP-AES sample: **MAJOR** (oxide) and **TRACE** (element).
	analysis_units	Measurement units used for an analysis: **wt%** (major oxides) and **ppm** (trace elements).
	XRF_analysis_result	Analytical result for an analysis code.

Janus ICP-AES data model (continued).

Table name	Column name	Column comment
Section	section_id	Unique Oracle-generated sequence number to identify each section. This is done because of the physical subsection/zero section problems. When adding new sections, deleting sections, or changing sections, renumbering is not necessary.
	leg	Number identifying the cruise for which data were entered into the database.
	site	Number identifying the site from which the core was retrieved.
	hole	Letter identifying the hole at a site from which a core was retrieved or data were collected.
	core	Sequential numbers identifying the cores retrieved from a particular hole.
	core_type	Letter code identifying the drill bit/coring method used to retrieve the core.
	section_number	Sequential numbers identifying the sections in the core.
	section_type	Differentiates sections of core (**S**) from core catchers (**C**). Previously core catchers were stored as section CC, but in Janus core catchers are given the next sequential number from the last section recovered.
	curated_length	Length of the section core material (meters). This may be different than the liner length for the same section. Hard rock cores may have spacers added to prevent rock pieces from damaging each other.
	liner_length	Original length of core material in section (meters); core recovery = sum of liner lengths.
	core_catcher_stored_in	Section number of D-tube that holds the core catcher, when applicable.
	section_comments	Comments about this section.
Sample	sample_id	Oracle-generated sequence number that with *location* uniquely identifies a sample.
	location	Code that indicates which Janus application assigned the *sample_id*: **SHI** (ship), **GCR** (Gulf Coast Repository), **ECR** (East Coast Repository), **WCR** (West Coast Repository), **BCR** (Bremen Core Repository). Used with *sample_id* to uniquely identify a sample.
	s_c_leg	Number identifying the cruise for which data were entered into the database. Foreign key used with *s_c_sampling_code* to link samples with a scientist's sample request.
	s_c_sampling_code	Code used to identify samples taken for a sample request. Used with *s_c_leg*.
	sam_archive_working	Part of section where sample was taken: **WR** (whole round), **A** (archive half), **W** (working half).
	top_interval	Distance (meters) from the top of the section to the top of the sample.
	bottom_interval	Distance (meters) from the top of the section to the bottom of the sample.
	piece	Additional identifier for hard rock samples. Each individual piece of rock within a section is numbered consecutively starting at the top of the section.
	sub_piece	Additional identifier for hard rock samples. When a piece is broken, the individual fragments are given consecutive letter designations. Note that subpiece assignments must be made in conjunction with piece numbers.
	beaker_id	Number on the moisture density beaker. Used for samples analyzed for moisture and density.
	volume	Volume of sample.
	entered_by	Indicates who entered the sample into the database.
	sample_depth	Depth of the sample.
	sample_comment	Comment about the sample.
	sam_repository	Repository where sample was taken: **SHI** (ship), **GCR** (Gulf Coast Repository), **ECR** (East Coast Repository), **WCR** (West Coast Repository), **BCR** (Bremen Core Repository).
	sam_sample_code_lab	Code to indicate the shipboard laboratory that will perform the initial analysis.
	sam_section_id	Unique Oracle-generated sequence number to identify each section. This is a foreign key that links a sample to leg, site, hole, core, section.
	timestamp	Date and time when sample was entered into database. Samples taken before November 25, 1998 and migrated samples have the timestamp 11/25/1998 12:26 PM.
System_Type	system_id	Unique identifier for a system of equipment used to collect data.
	system_comments	Comments associated with a piece of analytical equipment.
	system_commissioned	Date when a piece of equipment was deployed to collect scientific data for ODP.
	system_decommissioned	Date when a piece of analytical equipment was no longer used by ODP.
	system_model_number	Model number of a piece of equipment used for scientific analysis.
	system_name	Name for a piece of equipment used for analysis.

Description of data items from ICP-AES query.

Column name	Column description	Format
Leg	Number identifying the cruise.	Integer 3
Site	Number identifying the site.	Integer 4
Hole	Letter identifying the hole.	Text 1
Core	Number identifying the serial position of the core from the top of the hole downward.	Integer 3
Type	Letter identifying the coring method used.	Text 1
Section	Numbered identifying the serial position of a section from the top of the core downward. Core catcher sections identified as "CC."	Integer 2 (Text 2)
Top (cm)	Top interval of a measurement in centimeters measured from the top of a section.	Decimal F5.1
Bottom (cm)	Bottom interval of a measurement in centimeters measured from the top of a section.	Decimal F5.1
Depth (mbsf)	Distance (meters) from the seafloor to the measurement location.	Decimal F7.3
Run	Run identifier assigned by shipboard scientists or laboratory technician to identify a given batch of samples.	Text 5
Replicate	Split of a sample.	Text 3
Bead Loss on Ignition	Loss on ignition. The percentage of weight lost after igniting the ICP-AES bead: [(post_ign_sample_wt/pre_ign_sample_wt) – 1] × (–100).	Decimal F5.2
Silica - SiO_2 (wt%)	Analytical result for major oxide silica (weight percent).	Decimal F15.5
Titanium oxide - TiO_2 (wt%)	Analytical result for major titanium oxide (weight percent).	Decimal F15.5
Aluminum oxide - Al_2O_3 (wt%)	Analytical result for major aluminum oxide (weight percent).	Decimal F15.5
Iron oxide - Fe_2O_3* (wt%)	Analytical result for major iron oxide (weight percent).	Decimal F15.5
Manganous oxide - MnO (wt%)	Analytical result for major manganous oxide (weight percent).	Decimal F15.5
Magnesium oxide - MgO (wt%)	Analytical result for major magnesium oxide (weight percent).	Decimal F15.5
Calcium oxide - CaO (wt%)	Analytical result for major calcium oxide (weight percent).	Decimal F15.5
Sodium oxide - Na_2O (wt%)	Analytical result for major sodium oxide (weight percent).	Decimal F15.5
Potassium oxide - K_2O (wt%)	Analytical result for major potassium oxide (weight percent).	Decimal F15.5
Phosphorus pentoxide - P_2O_5 (wt%)	Analytical result for major phosphorus pentoxide (weight percent).	Decimal F15.5
Niobium - Nb (ppm)	Analytical result for trace element niobium (parts per million).	Decimal F15.5
Zirconium - Zr (ppm)	Analytical result for trace element zirconium (parts per million).	Decimal F15.5
Yttrium - Y (ppm)	Analytical result for trace element yttrium (parts per million).	Decimal F15.5
Sulfur - S (ppm)	Analytical result for trace element sulfur (parts per million).	Decimal F15.5
Strontium - Sr (ppm)	Analytical result for trace element strontium (parts per million).	Decimal F15.5
Rubidium - Rb (ppm)	Analytical result for trace element rubidium (parts per million).	Decimal F15.5
Scandium - Sc (ppm)	Analytical result for trace element scandium (parts per million).	Decimal F15.5
Molybdenum - Mo (ppm)	Analytical result for trace element molybdenum (parts per million).	Decimal F15.5
Beryllium - Be (ppm)	Analytical result for trace element beryllium (parts per million).	Decimal F15.5
Thorium - Th (ppm)	Analytical result for trace element thorium (parts per million).	Decimal F15.5
Cobalt - Co (ppm)	Analytical result for trace element cobalt (parts per million).	Decimal F15.5
Gadolinium - Gd (ppm)	Analytical result for trace element gadolinium (parts per million).	Decimal F15.5
Dysprosium - Dy (ppm)	Analytical result for trace element dysprosium (parts per million).	Decimal F15.5
Erbium - Er (ppm)	Analytical result for trace element erbium (parts per million).	Decimal F15.5
Ytterbium - Yb (ppm)	Analytical result for trace element ytterbium (parts per million).	Decimal F15.5
Hafnium - Hf (ppm)	Analytical result for trace element hafnium (parts per million).	Decimal F15.5
Lead - Pb (ppm)	Analytical result for trace element lead (parts per million).	Decimal F15.5
Gallium - Ga (ppm)	Analytical result for trace element gallium (parts per million).	Decimal F15.5
Zinc - Zn (ppm)	Analytical result for trace element zinc (parts per million).	Decimal F15.5
Copper - Cu (ppm)	Analytical result for trace element copper (parts per million).	Decimal F15.5
Nickel - Ni (ppm)	Analytical result for trace element nickel (parts per million).	Decimal F15.5
Chromium - Cr (ppm)	Analytical result for trace element chromium (parts per million).	Decimal F15.5
Vanadium - V (ppm)	Analytical result for trace element vanadium (parts per million).	Decimal F15.5
Cerium - Ce (ppm)	Analytical result for trace element cerium (parts per million).	Decimal F15.5
Barium - Ba (ppm)	Analytical result for trace element barium (parts per million).	Decimal F15.5
Cesium - Cs (ppm)	Analytical result for trace element cesium (parts per million).	Decimal F15.5
Lanthanum - La (ppm)	Analytical result for trace element lanthanum (parts per million).	Decimal F15.5
Neodymium - Nd (ppm)	Analytical result for trace element neodymium (parts per million).	Decimal F15.5
Samarium - Sm (ppm)	Analytical result for trace element samarium (parts per million).	Decimal F15.5
Sample Type	Type of rock or sediment (e.g., **Basalt**, **Gabbro**, **Sediment**).	Text 40
Comment	Comment about ICP-AES analysis or additional information about the sample type.	Text 80

APPENDIX E

Interstitial Water Chemistry Analyses

Janus IW chemistry data model. (Continued on next page.)

Table name	Column name	Column comment
Chem_IW_Analysis	sample_id	Oracle-generated sequence number that with *location* uniquely identifies a sample.
	location	Code that indicates which Janus application assigned the *sample_id*. Used with *sample_id* to uniquely identify a sample.
	analysis_code	Code describing the type of analysis performed on a sample.
	method_code	Code for method or instrument used to analyze a sample.
	analysis_result	Numerical result of the analysis of a sample.
	iw_source	Source of interstitial water being analyzed, such as an IW squeeze or pore water sampler.
	cal_id	Oracle-generated sequence number for an IW calibration run.
Chem_IW_Analysis_Type	iw_analysis_code	Code describing type of analysis that can be performed on a sample.
	iw_analysis_name	Full name or description of analysis type.
	analysis_units	Reported measurement units of analysis result.
	analysis_code_order	Number defining the order that analysis codes and results will appear on a spreadsheet or report.
Chem_IW_Source	source	Source of an IW sample, such as an IW squeeze or pore water sample.
Chem_Method	method_code	Code for method or instrument used for analyzing a sample.
	method_name	Name of method or instrument used for analyzing a sample.
Chem_IW_Calib	calib_id	Oracle-generated sequence number for an IW calibration run.
	calib_date	Date and time of a calibration run.
	iw_analysis_code	Code describing type of analysis that is being run for calibration.
	method_code	Code for method or instrument being calibrated.
	calib_method	Method used for calibrating analytical instruments.
	slope	Slope associated with calibration/method or reference standards.
	intercept	Intercept as related to slope.
	r_square	Related to intercept and slope of a calibration.
	iw_comments	Comments on IW calibration run.
Chem_IW_Chk_Result	calib_id	Oracle-generated sequence number for an IW calibration run.
	chk_sequence	Number indicating order of measurements
	iw_std_type	Name of standard (e.g., **IAPSO**, **TRIS_BIS**, etc.).
	iw_analysis_code	Code describing type of analysis that is being run for calibration.
	iw_analysis_result	Numerical result of analysis of a water sample standard.
Chem_IW_Standards	iw_std_type	Name of standard (e.g., **IAPSO**, **TRIS_BIS**, etc.).
	iw_analysis_code	Code describing type of analysis that is being run for calibration.
	iw_std_value	Published value of an interstitial water standard.
Chem_Calib_Method	calib_method	Method used for calibrating analytical instruments.
Section	section_id	Unique Oracle-generated sequence number to identify each section. This is done because of the physical subsection/zero section problems. When adding new sections, deleting sections, or changing sections, renumbering is not necessary.
	leg	Number identifying the cruise for which data were entered into the database.
	site	Number identifying the site from which the core was retrieved.
	hole	Letter identifying the hole at a site from which a core was retrieved or data were collected.
	core	Sequential numbers identifying the cores retrieved from a particular hole.
	core_type	Letter code identifying drill bit/coring method used to retrieve the core.
	section_number	Number identifying the serial position of a section from the top of the core.
	section_type	Differentiates sections of core (**S**) from core catchers (**C**). Previously core catchers were stored as section CC, but in Janus core catchers are given the next sequential number from the last section recovered.
	curated_length	Length of the section core material (meters). This may be different than the liner length for the same section. Hard rock cores may have spacers added to prevent rock pieces from damaging each other.
	liner_length	Original length of core material in section (meters); core recovery = sum of liner lengths.
	core_catcher_stored_in	Section number of D-tube that holds the core catcher, when applicable.
	section_comments	Comments about this section.

Janus IW chemistry data model (continued).

Table name	Column name	Column comment
Sample	sample_id	Oracle-generated sequence number that with *location* uniquely identifies a sample.
	location	Code that indicates which Janus application assigned the *sample_id*: **SHI** (ship), **GCR** (Gulf Coast Repository), **ECR** (East Coast Repository), **WCR** (West Coast Repository), **BCR** (Bremen Core Repository). Used with *sample_id* to uniquely identify a sample.
	s_c_leg	Number identifying the cruise for which data were entered into the database. Foreign key used with *s_c_sampling_code* to link samples with a scientist's sample request.
	s_c_sampling_code	Code used to identify samples taken for a sample request. Used with *s_c_leg*.
	sam_archive_working	Part of section where sample was taken: **WR** (whole round), **A** (archive half), **W** (working half).
	top_interval	Distance (meters) from the top of the section to the top of the sample.
	bottom_interval	Distance (meters) from the top of the section to the bottom of the sample.
	piece	Additional identifier for hard rock samples. Each individual piece of rock within a section is numbered consecutively starting at the top of the section.
	sub_piece	Additional identifier for hard rock samples. When a piece is broken, the individual fragments are given consecutive letter designations. Note that subpiece assignments must be made in conjunction with piece numbers.
	beaker_id	Number on the moisture density beaker. Used for samples analyzed for moisture and density.
	volume	Volume of sample.
	entered_by	Indicates who entered the sample into the database.
	sample_depth	Depth of the sample.
	sample_comment	Comment about the sample.
	sam_repository	Repository where sample was taken: **SHI** (ship), **GCR** (Gulf Coast Repository), **ECR** (East Coast Repository), **WCR** (West Coast Repository), **BCR** (Bremen Core Repository).
	sam_sample_code_lab	Code to indicate shipboard laboratory that will perform the initial analysis.
	sam_section_id	Unique Oracle-generated sequence number to identify each section. This is a foreign key that links a sample to leg, site, hole, core, section.
	timestamp	Date and time when sample was entered into database. Samples taken before November 25, 1998 and migrated samples have the timestamp 11/25/1998 12:26 PM.

Description of data items from IW query with analysis method option. (Continued on next page.)

Column name	Column description	Format
Leg	Number identifying the cruise.	Integer 3
Site	Number identifying the site.	Integer 4
Hole	Letter identifying the hole.	Text 1
Core	Number identifying the serial position of the core from the top of the hole downward.	Integer 3
Coretype	Letter identifying the coring method used.	Text 1
Section	Numbered identifying the serial position of a section from the top of the core downward. Core catcher sections identified as "CC."	Integer 2 or Text 2
Top Interval (cm)	Top interval of a measurement (centimeters) measured from the top of a section.	Decimal F4.1
Bottom Interval (cm)	Bottom interval of a measurement (centimeters) measured from the top of a section.	Decimal F4.1
Depth (mbsf)	Distance (meters) from the seafloor to the sample location.	Decimal F7.3
Aluminum (Al) [µM]	Aluminum results (micromoles).	Decimal F15.5
Method	Method used to analyze for aluminum.	Text 10
Ammonia (NH_4) [µM]	Ammonia results (micromoles).	Decimal F15.5
Method	Method used to analyze for ammonia.	Text 10
Boron (B) [mM]	Boron results (millimoles).	Decimal F15.5
Method	Method used to analyze for boron.	Text 10
Bromide (Br) [µM]	Bromide results in (micromoles).	Decimal F15.5
Method	Method used to analyze for bromide.	Text 10
Calcium (Ca) [mM]	Calcium results (millimoles).	Decimal F15.5
Method	Method used to analyze for calcium.	Text 10
Chlorinity (Cl) [mM]	Chloride and Bromide results (millimoles).	Decimal F15.5
Method	Method used to analyze for chloride and bromide.	Text 10
Fluoride (F) [µM]	Fluoride results (micromoles).	Decimal F15.5
Method	Method used to analyze for fluoride.	Text 10
Iodide (I) [µM]	Iodide results (micromoles).	Decimal F15.5
Method	Method used to analyze for iodide.	Text 10
Iron (Fe) [µM]	Iron results (micromoles).	Decimal F15.5
Method	Method used to analyze for iron.	Text 10
Lithium (Li) [µM]	Lithium results (micromoles).	Decimal F15.5
Method	Method used to analyze for lithium.	Text 10
Magnesium (Mg) [mM]	Magnesium results (millimoles).	Decimal F15.5
Method	Method used to analyze for magnesium.	Text 10
Manganese (Mn) [µM]	Manganese results (micromoles).	Decimal F15.5
Method	Method used to analyze for manganese.	Text 10

Description of data items from IW Query with analysis method option (continued).

Column name	Column description	Format
Nitrate (NO_3) [μM]	Nitrate results (micromoles).	Decimal F15.5
Method	Method used to analyze for nitrate.	Text 10
pH	pH results (no measurement units).	Decimal F15.5
Method	Method used to analyze for pH.	Text 10
Phosphate (HPO_4) [μM]	Phosphate results (micromoles).	Decimal F15.5
Method	Method used to analyze for phosphate.	Text 10
Potassium (K) [mM]	Potassium results (millimoles).	Decimal F15.5
Method	Method used to analyze for potassium.	Text 10
Rubidium (Rb) [μM]	Rubidium results (micromoles).	Decimal F15.5
Method	Method used to analyze for rubidium.	Text 10
Sodium (Na) [mM]	Sodium results (millimoles).	Decimal F15.5
Method	Method used to analyze for sodium.	Text 10
Strontium (Sr) [μM]	Strontium results (micromoles).	Decimal F15.5
Method	Method used to analyze for strontium.	Text 10
Sulfate (SO_4) [mM]	Sulfate results (millimoles).	Decimal F15.5
Method	Method used to analyze for sulfate.	Text 10
Silica (H_4SiO_4) [μM]	Silica results (micromoles).	Decimal F15.5
Method	Method used to analyze for silica.	Text 10
Alkalinity (ALK) [mM]	Alkalinity results (millimoles).	Decimal F15.5
Method	Method used to analyze for alkalinity.	Text 10
Salinity (SAL)	Salinity results (no measurement units).	Decimal F15.5
Method	Method used to analyze for salinity.	Text 10
Barium (Ba) [μM]	Barium results (micromoles).	Decimal F15.5
Method	Method used to analyze for barium.	Text 10
Lead (Pb) [μM]	Lead results (micromoles).	Decimal F15.5
Method	Method used to analyze for lead.	Text 10
Hydrogen (H_2) [nM]	Hydrogen results (nanomoles).	Decimal F15.5
Method	Method used to analyze for hydrogen.	Text 10
Dissolved Inorganic Carbon (DIC) [mM]	Dissolved inorganic carbon results (millimoles).	Decimal F15.5
Method	Method used to analyze for dissolved inorganic carbon.	Text 10
Formate [μM]	Formate results (micromoles).	Decimal F15.5
Method	Method used to analyze for formate.	Text 10
pH punch in	pH punch in results (no measurement units).	Decimal F15.5
Method	Method used to analyze for pH punch in.	Text 10
Dissolved Organic Carbon (DOC) [mM]	Dissolved organic carbon results (millimoles).	Decimal F15.5
Method	Method used to analyze for dissolved organic carbon.	Text 10
Acetate [μM]	Acetate results (micromoles).	Decimal F15.5
Method	Method used to analyze for acetate.	Text 10
Color (JWBL)	Color (JWBL) results.	Decimal F15.5
Method	Method used to analyze for color (JWBL).	Text 10
Nitrite (NO_2) [μM]	Nitrite results (micromoles).	Decimal F15.5
Method	Method used to analyze for nitrite.	Text 10
Total Sulfide (H_2S) [μM]	Total Sulfide results (micromoles).	Decimal F15.5
Method	Method used to analyze for total sulfide.	Text 10

APPENDIX F

Moisture and Density Analyses

Janus MAD data model. (Continued on next page.)

Table name	Column name	Column comment
MAD_Sample_Data	sample_id	Oracle-generated sequence number that with *location* uniquely identifies a sample.
	location	Code that indicates which Janus application assigned the sample_id: **SHI** (ship), **GCR** (Gulf Coast Repository), **ECR** (East Coast Repository), **WCR** (West Coast Repository), **BCR** (Bremen Core Repository). Used with *sample_id* to uniquely identify a sample.
	method	Method used to calculate index properties. Added March 21, 2002; made part of the primary key February 26, 2004.
	mad_beaker_id	Unique identification for beaker used to hold sample.
	beaker_date_time	Time stamp when calibrated beaker mass and volume data entered.
	fixed_volume	Indicates if a fixed volume method was used to determine index properties.
	mass_wet_and_beaker	Mass of wet sample plus beaker (grams).
	mass_dry_and_beaker	Mass of dried sample plus beaker (grams).
	vol_wet_and_beaker	Volume of wet sample plus beaker (cubic centimeters).
	vol_wet_and_beaker_stdev	Standard deviation of wet volume measurements.
	vol_wet_and_beaker_n	Number of measurements for wet volume.
	vol_wet_and_beaker_cell	Pycnometer cell number used for wet volume measurement: **1**, **2**, **3**, **4**, **5**.
	vol_dry_and_beaker	Volume of dry sample plus beaker (cubic centimeters).
	vol_dry_and_beaker_stdev	Standard deviation of dry volume measurements.
	vol_dry_and_beaker_n	Number of dry volume measurements taken, from **1–20**.
	vol_dry_and_beaker_cell	Pycnometer cell number used for dry volume measurement:**1**, **2**, **3**, **4**, **5**.
	comments	General comments.
	sample_date_time	Date and time of sample analysis.
	water_content_bulk	Calculated value stored only when raw measurements or valid beaker mass and volume not available. Added February 26, 2004.
	water_content_solids	Calculated value stored only when raw measurements or valid beaker mass and volume not available. Added February 26, 2004.
	bulk_density	Calculated value stored only when raw measurements or valid beaker mass and volume not available. Added February 26, 2004.
	dry_density	Calculated value stored only when raw measurements or valid beaker mass and volume not available. Added February 26, 2004.
	grain_density	Calculated value stored only when raw measurements or valid beaker mass and volume not available. Added February 26, 2004.
	porosity	Calculated value stored only when raw measurements or valid beaker mass and volume not available. Added February 26, 2004.
	void_ratio	Calculated value stored only when raw measurements or valid beaker mass and volume not available. Added February 26, 2004.
MAD_Beaker	mad_beaker_id	Unique identification for beaker used to hold sample.
MAD_Beaker_History	mad_beaker_id	Unique identification for beaker used to hold sample.
	beaker_date_time	Calibration date and time of determination of beaker mass and volume.
	beaker_type	Type of beaker. Glass, 10 mL; aluminum 12 cm^3.
	beaker_mass	Mass of beaker (grams).
	beaker_volume	Volume of beaker (cubic centimeters).
MAD_Calibration_History	mad_calibration_id	Unique Oracle-generated sequence number for a MAD system calibration.
	calibration_date_time	Timestamp when calibration was done; supplied by instrument data files.
	calibration_type	Type of calibration (e.g., **B** = balance, **P** = Pycnometer, etc.)
MAD_Control_Data	mad_control_id	Unique Oracle-generated sequence number of MAD control run.
	run_date_time	Date and time of a control run.
	ctr_standard_id	Control standard identifier (e.g., sphere 7.069 cm^3)
	control_type	Mass or volume
	expected_value	Known value of a control standard (grams or cubic centimeters).
	pyc_cell_no	Pycnometer cell number used for control measurement: **1**, **2**, **3**, **4**, **5**.
	measured_value	Value measured for a standard (grams or cubic centimeters).
	measured_stdev	Standard deviation for a standard value.

Janus MAD data model (continued).

Table name	Column name	Column comment
Section	section_id	Unique Oracle-generated sequence number to identify each section. This is done because of the physical subsection/zero section problems. When adding new sections, deleting sections, or changing sections, renumbering is not necessary.
	leg	Number identifying the cruise for which data were entered into the database.
	site	Number identifying the site from which the core was retrieved.
	hole	Letter identifying the hole at a site from which a core was retrieved or data were collected.
	core	Sequential number identifying the cores retrieved from a particular hole.
	core_type	Letter code identifying the drill bit/coring method used to retrieve the core. The core type is only reported in the post-Leg 113 processed data file.
	section_number	Number identifying the serial position of a section from the top of the core.
	section_type	Differentiates sections of core (**S**) from core catchers (**C**). Previously core catchers were stored as section CC, but in Janus core catchers are given the next sequential number from the last section recovered.
	curated_length	Length of the section core material (meters). This may be different than the liner length for the same section. Hard rock cores may have spacers added to prevent rock pieces from damaging each other.
	liner_length	Original length of core material in section (meters); core recovery = sum of liner lengths.
	core_catcher_stored_in	Section number of D-tube that holds the core catcher.
	section_comments	Comments about this section.
Sample	sample_id	Oracle-generated sequence number that with location uniquely identifies a sample.
	location	Code that indicates which Janus application assigned the sample_id: **SHI** (ship), **GCR** (Gulf Coast Repository), **ECR** (East Coast Repository), **WCR** (West Coast Repository), **BCR** (Bremen Core Repository). Used with sample_id to uniquely identify a sample.
	s_c_leg	Number identifying the cruise for which data were entered into the database. Foreign key used with s_c_sampling_code to link samples with a scientist's sample request.
	s_c_sampling_code	Code used to identify samples taken for a sample request. Used with s_c_leg.
	sam_archive_working	Part of section where sample was taken: **WR** (whole round), **A** (archive half), **W** (working half).
	top_interval	Distance (meters) from the top of the section to the top of the sample.
	bottom_interval	Distance (meters) from the top of the section to the bottom of the sample.
	piece	Additional identifier for hard rock samples. Each individual piece of rock within a section is numbered consecutively starting at the top of the section.
	sub_piece	Additional identifier for hard rock samples. When a piece is broken, the individual fragments are given consecutive letter designations. Note that subpiece assignments must be made in conjunction with piece numbers.
	beaker_id	Number on the moisture density beaker. Used for samples analyzed for moisture and density.
	volume	Volume of sample.
	entered_by	Indicates who entered the sample into the database.
	sample_depth	Depth of the sample.
	sample_comment	Comment about the sample.
	sam_repository	Repository where sample was take: **SHI** (ship), **GCR** (Gulf Coast Repository), **ECR** (East Coast Repository), **WCR** (West Coast Repository), **BCR** (Bremen Core Repository).
	sam_sample_code_lab	Code to indicate the shipboard laboratory that will perform the initial analysis.
	sam_section_id	Unique Oracle-generated sequence number to identify each section. This is a foreign key that links a sample to leg, site, hole, core, section.
	timestamp	Date and time when sample was entered into database. Samples taken before November 25, 1998 and migrated samples have the timestamp 11/25/1998 12:26 PM.

Description of data items from MAD query with output raw data option

Item name	Column description	Format
Leg	Number identifying the cruise.	Integer 3
Site	Number identifying the site.	Integer 4
Hole	Letter identifying the hole.	Text 1
Core	Number identifying the serial position of the core from the top of the hole downward.	Integer 3
Coretype	Letter identifying the coring method used.	Text 1
Section	Numbered identifying the serial position of a section from the top of the core downward. Core catcher sections identified as "CC."	Integer 2 or Text 2
Top (cm)	Top interval of a measurement in centimeters measured from the top of a section.	Decimal F4.1
Bottom (cm)	Bottom interval of a measurement in centimeters measured from the top of a section.	Decimal F4.1
Depth (mbsf)	Distance (meters) from the seafloor to the sample location.	Decimal F7.3
Water content (bulk) (%)	Water content relative to bulk mass.	Decimal F5.1
Water content (dry) (%)	Water content relative to solid mass.	Decimal F5.1
Bulk density (g/cm^3)	Mass per unit volume for sample before drying.	Decimal F5.3
Dry density (g/cm^3)	Mass per unit volume for sample after drying.	Decimal F5.3
Grain density (g/cm^3)	Ratio of mass to volume of solids, after drying.	Decimal F5.3
Porosity (%)	Percentage of pore volume or void space; that volume within rock that can contain fluids.	Decimal F4.1
Void ratio	Ratio of volume of void space to volume of solids.	Decimal F5.3
Mass (bulk + beaker) (g)	Mass of wet sample and beaker.	Decimal F6.3
Mass (dry + beaker) (g)	Mass of dried sample and beaker.	Decimal F6.3
Volume (bulk + beaker) (cm^3)	Volume of wet sample and beaker	Decimal F6.3
stdev (Volume [bulk + beaker])	Statistical value which measures how much deviation individual measurements are from the mean value.	Decimal F6.3
Number of measurements (Volume [bulk + beaker])	Number of volume measurements made.	Integer 2
cell (Volume [bulk + beaker])	Number of pycnometer cell in which the measurements were made.	Integer 1
Volume (dry + beaker) (cm^3)	Volume of dry sample and beaker.	Decimal F6.3
stdev (Volume [dry + beaker])	Statistical value which measures how much deviation individual measurements are from the mean value.	Decimal F6.3
Number of measurements (Volume [dry + beaker])	Number of volume measurements made.	Integer 2
cell (Volume [dry + beaker])	Number of pycnometer cell in which the measurements were made.	Integer 1
Date/Time	Date and time of sample analysis.	Text 16 (yyyy-mm-dd hh:mm)
Beaker	Number of the beaker in which a sample was analyzed.	Text 10
Mass beaker (g)	Mass of beaker (grams).	Decimal F6.3
Vol beaker (cm^3)	Volume of beaker (cubic centimeters).	Decimal F6.3
Mass wet (g)	Mass of wet sample minus beaker mass (grams).	Decimal F6.3
Mass dry (g)	Mass of dry sample minus beaker mass (grams).	Decimal F6.3
Mass of porewater (g)	Calculated mass of porewater (grams).	Decimal F6.3
Mass of Solids (salt corrected) (g)	Calculated mass of solid material minus salt (grams).	Decimal F6.3
Vol of Porewater (cm^3)	Calculated volume of pore water (cubic centimeters).	Decimal F6.3
Mass of Evap. Salt (g)	Calculated mass of salt (grams).	Decimal F6.3
Vol. of Evap. Salt (cm^3)	Calculated volume of salt (cubic centimeters).	Decimal F6.3
Vol. Bulk (cm^3)	Measured volume of wet sample minus beaker volume (cubic centimeters).	Decimal F6.3
Vol. Solids (cm^3)	Calculated volume of dry sample minus volume of salt (cubic centimeters).	Decimal F6.3
Vol. Dry (cm^3)	Measured volume of dry sample minus beaker volume (cubic centimeters).	Decimal F6.3
Method	Method used to calculate MAD properties.	Text 2
Comments	Comments.	Text 80

APPENDIX G

Magnetic Susceptibility Analyses

Janus magnetic susceptibility data model. (Continued on next page.)

Table name	Column name	Column comment
MSL_Section	msl_id	Unique Oracle-generated sequence number for each MSL analysis run.
	section_id	Unique Oracle-generated sequence number to identify each section.
	run_number	Number identifying a run generated by the data acquisition software. This number is not used to identify the run in Janus because it may not be unique.
	run_date_time	Timestamp when analysis was run.
	core_status	Indicates if a full or half (split) core is being analyzed: **FULL** or **HALF**.
	liner_status	Records if a core liner, split liner, or no liner was used: **FULL**, **HALF**, **NONE**.
	requested_daq_interval	Data acquisition interval requested for section analysis (centimeters).
	req_daqs_per_sample	Requested number of data acquisitions taken per sample interval.
	bkgd_susceptibility	Measurement of the background susceptibility associated with a core section analysis.
	bkgd_elapsed_zero_time	Time when zero-background measurement taken, for drift correction.
	core_temperature	Temperature of the core (degrees Celsius).
	loop_temperature	Temperature of a susceptibility loop (degrees Celsius).
	mst_msl_ctrl_3_id	Unique Oracle-generated sequence identifier for MSL control-1 run, nullable.
MSL_Section_Data	msl_id	Unique Oracle-generated sequence number for each MSL analysis run.
	mst_top_interval	Top interval of a measurement (meters) measured from the top of a section.
	mst_bottom_interval	Bottom interval of a measurement (meters) measured from the top of a section.
	meas_susceptibility_mean	Measured susceptibility value in unitless volume susceptibility.
	sample_elapsed_zero_time	Elapsed time since background measurement, for drift correction.
	actual_daq_period	Actual data acquisition period used for measurements (seconds).
	core_diameter	Diameter of core (centimeters).
MSL_Ctrl_1	msl_ctrl_1_id	Unique Oracle-generated sequence identifier for MSL control-1 runs, used to compare a sample run to a control-1 run.
	run_number	Number identifying a run generated by the data acquisition software. This number is not used to identify the run in Janus because it may not be unique.
	run_date_time	Timestamp when analysis was run.
	core_status	Indicates whether a whole or half (split) core is being analyzed: **FULL** or **HALF**.
	liner_status	Records if a core liner was used, a split liner or no liner: **FULL**, **HALF**, **NONE**.
	requested_daq_interval	Data acquisition interval requested for section analysis (centimeters).
	req_daqs_per_sample	Requested number of data measurements taken per sample interval.
	standard_id	Identifier for a physical properties standard.
	bkgd_susceptibility	Measurement of background susceptibility associated with a sample measurement.
	bkgd_elapsed_zero_time	Time when zero-background measurement taken, for drift correction.
	core_temperature	Temperature of the core (degrees Celsius).
	loop_temperature	Temperature of a susceptibility loop (degrees Celsius).
MSL_Ctrl_1_Data	msl_ctrl_1_id	Unique Oracle-generated sequence identifier for MSL control-1 runs, used to compare a sample run to a control-1 run.
	mst_top_interval	Top interval of a measurement (meters) measured from the top of a section.
	mst_bottom_interval	Bottom interval of a measurement (meters) measured from the top of a section.
	meas_susceptibility_mean	Measured susceptibility value in unitless volume susceptibility.
	sample_elapsed_zero_time	Elapsed time for measurement, for drift correction.
	actual_daq_period	Actual data acquisition period used for measurements (seconds).
	core_diameter	Diameter of core (centimeters).
MSL_Ctrl_3	msl_ctrl_3_id	Unique Oracle-generated sequence identifier for MSL control-3 runs.
	run_number	Number identifying a run generated by the data acquisition software. This number is not used to identify the run in Janus because it may not be unique.
	run_date_time	Timestamp when analysis was run.
	req_daqs_per_sample	Requested number of data acquisitions taken per sample interval.
	standard_id	Identifier for a physical properties standard.
	bkgd_susceptibility	Measurement of background susceptibility associated with a sample measurement.
	bkgd_elapsed_zero_time	Time when zero-background measurement taken, for drift correction.
	core_temperature	Temperature of the core (degrees Celsius).
	loop_temperature	Temperature of a susceptibility loop (degrees Celsius).
	meas_susceptibility_mean	Measured susceptibility value in unitless volume susceptibility.
	sample_elapsed_zero_time	Elapsed time for measurement, for drift correction.
	actual_daq_period	Actual data acquisition period used for measurements (seconds).

Janus magnetic susceptibility data model (continued).

Table name	Column name	Column comment
Section	section_id	Unique Oracle-generated sequence number to identify each section. This is done because of the physical subsection/zero section problems. When adding new sections, deleting sections, or changing sections, renumbering is not necessary.
	leg	Number identifying the cruise for which data were entered into the database.
	site	Number identifying the site from which the core was retrieved.
	hole	Letter identifying the hole at a site from which a core was retrieved or data were collected.
	Core	Sequential numbers identifying the cores retrieved from a particular hole.
	core_type	Letter code identifying the drill bit/coring method used to retrieve the core.
	section_number	Number identifying the serial position of a section from the top of the core.
	section_type	Differentiates sections of core (**S**) from core catchers (**C**). Previously core catchers were stored as section number CC, but in Janus core catchers are given the next sequential number from the last section recovered.
	curated_length	Length of the section core material (meters). This may be different than the liner length for the same section. Hard rock cores will often have spacers added to prevent rock pieces from damaging each other.
	liner_length	Original length of core material in section (meters); core recovery = sum of liner lengths.
	core_catcher_stored_in	Section number of the D-tube that holds the core catcher.
	section_comments	Comments about this section.

Description of data items from magnetic susceptibility query.

Column name	Column description	Format
Leg	Number identifying the cruise.	Integer 3
Site	Number identifying the site.	Integer 4
Hole	Letter identifying the hole.	Text 1
Core	Number identifying the serial position of the core from the top of the hole downward.	Integer 3
Type	Letter identifying the coring method used.	Text 1
Section	Numbered identifying the serial position of a section from the top of the core downward. Core catcher sections identified as "CC."	Integer 2 (Text 2)
Top (cm)	Top interval of a measurement in centimeters measured from the top of a section.	Decimal F4.1
Bottom (cm)	Bottom interval of a measurement in centimeters measured from the top of a section.	Decimal F4.1
Depth (mbsf)	Distance (meters) from the seafloor to the sample location.	Decimal F7.3
Magnetic Suscept. (inst.units)	Measured susceptibility value (instrument units, SI).	Decimal F7.1
Drift-Corrected Suscept. (inst. units)	Measured susceptibility value with background drift correction (instrument units, SI).	Decimal F8.2
Run Number	Number generated by the data acquisition software, to identify an analysis run of a section of core.	Text 5
Run Date/Time	Timestamp identifying when analysis was run.	Text 16 (yyyy-mm-dd hh:mi)
Core Status	Indicates whether a whole or half (split) core is being analyzed: **FULL** or **HALF**.	Text 4
Liner Status	Records if a core liner, a split liner, or no liner was used: **FULL**, **HALF**, **NONE**.	Text 4
Requested Interval	Requested sampling interval (centimeters).	Decimal F5.3
Data Acquisitions per Sample	Requested number of measurements at each interval.	Integer 2
Background Suscept.	Measurement of background susceptibility associated with a core section analysis.	Decimal F7.1
Background Time	Time when zero-background measurement taken, for drift correction.	Integer 10
Core Temp.	Temperature of the core (degrees Celsius).	Decimal F4.1
Loop Temp.	Temperature of a susceptibility loop (degrees Celsius).	Decimal F4.1
Elapsed Time	Elapsed time since background measurement, for drift correction.	Integer 10
Actual Period (s)	Actual data acquisition period used for measurements (seconds).	Decimal F7.3
Core Diameter (cm)	Diameter of core (centimeters).	Decimal F5.2

APPENDIX H

Natural Gamma Radiation Analyses

Janus NGR data model. (Continued on next page.)

Table name	Column name	Column comment
NGR_Section	ngr_id	Unique Oracle-generated sequence number for each NGR analysis run.
	section_id	Unique Oracle-generated sequence number to identify each section.
	run_number	Number identifying a run generated by the data acquisition software. This number is not used to identify the run in Janus because it may not be unique.
	run_date_time	Timestamp when analysis was run.
	core_status	Indicates if a full or half (split) core is being analyzed: **FULL** or **HALF**.
	liner_status	Records if a core liner, split liner, or no liner was used: **FULL**, **HALF**, **NONE**.
	requested_daq_interval	Data acquisition interval requested for section analysis (centimeters).
	requested_daq_period	Data acquisition period requested (seconds).
	energy_calibration_id	Unique Oracle-generated sequence number for NGR calibration runs.
	energy_background_id	Unique Oracle-generated sequence number for NGR background runs.
	mst_ngr_ctrl_3_id	Unique Oracle-generated sequence identifier for NGR control-3 runs.
NGR_Section_Data	ngr_id	Unique Oracle-generated sequence number for each NGR analysis run.
	mst_top_interval	Top interval of a measurement (meters) measured from the top of a section.
	mst_bottom_interval	Bottom interval of a measurement (meters) measured from the top of a section.
	actual_daq_period	Actual data acquisition period used for measurements (seconds).
	core_diameter	Diameter of core (centimeters).
	total_counts_sec	Total combined counts per second of NGR spectrum.
	energy_windows	Flag to indicate when spectral data are found in NGR_Energy_Windows table.
	ngr_first_channel	First natural gamma ray channel number for which spectrum value is stored in the ngr_spectra.
	ngr_last_channel	Last natural gamma ray channel number for which spectrum value is stored in the ngr_spectra.
	ngr_channel_increment	Channel number increment.
	ngr_spectra	NGR spectra for channels defined by first, last, increment.
NGR_Background	energy_background_id	Unique Oracle-generated sequence number for natural gamma background runs.
	run_number	Number identifying a run generated by the data acquisition software. This number is not used to identify the run in Janus because it may not be unique.
	run_date_time	Timestamp when analysis was run.
	standard_id	Unique identifier for a physical properties standard.
	liner_status	Records if a core liner was used, a split liner or no liner: **FULL**, **HALF**, **NONE**.
	requested_daq_period	Data acquisition period requested (seconds).
	energy_calibration_id	Unique Oracle-generated sequence number for NGR calibration runs.
	total_counts_sec	Total combined counts per second of NGR spectrum.
	actual_daq_period	Actual data acquisition period used for measurements (seconds).
	energy_windows	Flag to indicate when spectral data are found in NGR_Energy_Windows table.
	ngr_first_channel	First natural gamma ray channel number for which spectrum value is stored in the ngr_spectra.
	ngr_last_channel	Last natural gamma ray channel number for which spectrum value is stored in the ngr_spectra.
	ngr_channel_increment	Channel number increment.
	ngr_spectra	NGR spectra for channels defined by first, last, increment.
NGR_Calibration	energy_calibration_id	Unique Oracle-generated sequence number for NGR calibration runs.
	calibration_date_time	Timestamp when calibration was run.
	run_number	Number identifying a run generated by the data acquisition software. This number is not used to identify the run in Janus because it may not be unique.
	system_id	Unique identifier for a system of equipment on the ship.
	channel_energy_m0	Calibration intercept m0.
	channel_energy_m1	Calibration slope m1.
	channel_energy_mse	Calibration mean squared error.
	comments	General comments about the calibration run.
NGR_Calibration_Data	energy_calibration_id	Unique Oracle-generated sequence number for NGR calibration runs.
	channel	Channel number.
	isotope	Characteristic isotope emitting at peak (e.g., K-40).
	energy	Energy of emission at peak.

Janus NGR data model (continued).

Table name	Column name	Column comment
NGR_Ctrl_1	ngr_ctrl_1_id	Unique Oracle-generated sequence identifier for NGR control-1 runs, used to compare a sample run to a control-1 run.
	run_number	Number identifying a run generated by the data acquisition software. This number is not used to identify the run in Janus because it may not be unique.
	run_date_time	Timestamp when analysis was run.
	core_status	Indicates whether a whole or half (split) core is being analyzed: **FULL** or **HALF**.
	liner_status	Records if a core liner, split liner, or no liner was used: **FULL**, **HALF**, **NONE**.
	requested_daq_interval	Requested data acquisition interval for section analysis (centimeters).
	requested_daq_period	Requested data acquisition period (seconds).
	energy_calibration_id	Unique Oracle-generated sequence number for NGR calibration runs.
	standard_id	Unique identifier for a physical properties standard.
	energy_background_id	Unique Oracle-generated sequence number for NGR background runs.
NGR_Ctrl_1_Data	ngr_ctrl_1_id	Unique Oracle-generated sequence identifier for NGR control-1 runs, used to compare a sample run to a control-1 run.
	mst_top_interval	Top interval of a measurement (meters) measured from the top of a section.
	mst_bottom_interval	Bottom interval of a measurement (meters) measured from the top of a section.
	actual_daq_period	Actual data acquisition period used for measurements (seconds).
	core_diameter	Diameter of core (centimeters).
	total_counts_sec	Total combined counts per second of the NGR spectrum.
	ngr_first_channel	First natural gamma ray channel number for which spectrum value is stored in the ngr_spectra.
	ngr_last_channel	Last natural gamma ray channel number for which spectrum value is stored in the ngr_spectra.
	ngr_channel_increment	Channel number increment.
	ngr_spectra	NGR spectra for channels defined by first, last, increment.
NGR_Ctrl_3	ngr_ctrl_3_id	Unique Oracle-generated sequence identifier for NGR control-3 runs, used to associate a sample run to a control-3 run.
	run_number	Number identifying a run generated by the data acquisition software. This number is not used to identify the run in Janus because it may not be unique.
	run_date_time	Timestamp when analysis was run.
	requested_daq_period	Data acquisition period requested (seconds).
	energy_calibration_id	Unique Oracle-generated sequence number for NGR calibration runs.
	standard_id	Unique identifier for a physical properties standard.
	energy_background_id	Unique Oracle-generated sequence number for NGR background runs.
	actual_daq_period	Actual data acquisition period used for measurements (seconds).
	ngr_first_channel	First NGR channel number for which spectrum value is stored in the ngr_spectra.
	ngr_last_channel	Last NGR channel number for which spectrum value is stored in the ngr_spectra.
	ngr_channel_increment	Channel number increment.
	ngr_spectra	NGR spectra for channels defined by first, last, increment.
NGR_Energy_Windows	ngr_id	Unique Oracle-generated sequence number for each NGR analysis run.
	mst_top_interval	Top interval of a measurement (meters) measured from the top of a section.
	roi_start_channel	First channel of the region of interest.
	mst_bottom_interval	Bottom interval of a measurement (meters) measured from the top of a section.
	roi_length_channel	Length of the channel including the first channel.
	ngr_counts_sec	NGR counts per sec measured in the energy window specified by roi_start_channel and roi_length_channel
NGR_BG_Energy_ Windows	energy_background_id	Unique Oracle-generated sequence number for NGR background runs.
	roi_start_channel	First channel of the region of interest.
	roi_length_channel	Length of the channel including the first channel.
	ngr_counts_sec	NGR counts per second in the energy window specified by roi_start_channel and roi_length_channel.
Section	section_id	Unique Oracle-generated sequence number to identify each section. This is done because of the physical subsection/zero section problems. In adding new sections, deleting sections or changing sections, don't want to have to renumber.
	leg	Number identifying the cruise for which data were entered into the database.
	site	Number identifying the site from which the core was retrieved.
	hole	Letter identifying the hole at a site from which a core was retrieved or data were collected.
	Core	Sequential numbers identifying the cores retrieved from a particular hole.
	core_type	Letter code identifying the drill bit/coring method used to retrieve the core.
	section_number	Number identifying the serial position of a section from the top of the core.
	section_type	Used to differentiate sections of core (**S**) from core catchers (**C**). Previously, core catchers were stored as section CC, but in Janus core catchers are given the next sequential number from the last section recovered.
	curated_length	Length of the section core material (meters). This may be different than the liner length for the same section. Hard rock cores may have spacers added to prevent rock pieces from damaging each other.
	liner_length	Original length of core material in the section (meters); core recovery = sum of liner lengths.
	core_catcher_stored_in	Section number of the D-tube that holds the core catcher.
	section_comments	Comments about this section.

Description of data items from NGR query.

Column name	Column description	Format
Leg	Number identifying the cruise.	Integer 3
Site	Number identifying the site.	Integer 4
Hole	Letter identifying the hole.	Text 1
Core	Number identifying the serial position of the core from the top of the hole downward.	Integer 3
Type	Letter identifying the coring method used.	Text 1
Section	Numbered identifying the serial position of a section from the top of the core downward. Core catcher sections identified as "CC."	Integer 2 (Text 2)
Top (cm)	Top interval of a measurement in centimeters measured from the top of a section.	Decimal F6.1
Bottom (cm)	Bottom interval of a measurement in centimeters measured from the top of a section.	Decimal F13.3
Depth (mbsf)	Distance (meters) from the seafloor to the sample location.	Decimal F7.3
Bkg.-Corrected Counts (cps)	Total combined counts per second of NGR spectrum with background counts subtracted.	Decimal F13.2
Uncorrected Total Counts (cps)	Total combined counts per second of NGR spectrum.	Decimal F13.2
Background Counts (cps)	Total combined counts per second of NGR spectrum of background (no core material).	Decimal F13.2
Run Number	Number generated by the data acquisition software, to identify an analysis run of a section of core.	Text 6
Run Date/Time	Timestamp identifying when analysis was run.	Text 16 (yyyy-mm-dd hh:mi)
Core Status	Indicates whether a whole or half (split) core is being analyzed: **FULL** or **HALF**.	Text 12
Liner Status	Records if a core liner, split liner, or no liner was used: **FULL, HALF, NONE**.	Text13
Requested Interval	Requested sampling interval (centimeters).	Decimal 14.2
Requested Period (s)	Requested data acquisition period (seconds).	Decimal 12.2
Actual Period (s)	Actual data acquisition period (seconds).	Decimal 12.2
Core Diameter (cm)	Diameter of the core (centimeters).	Decimal 15.1
Calib. Date/Time	Timestamp when calibration was run.	Text 16 (yyyy-mm-dd hh:mi)
Calib. Intercept (keV)	Calibration intercept m0.	Decimal F17.3
Calib. Slope (keV)	Calibration slope m1.	Decimal F13.3
Calib Error (mse)	Calibration mean squared error.	Decimal F17.3
Energy Windows	Legs 150–169 (Site 1036): Energy_windows; Legs 169 (Site 1037)–210: not used.	Integer 3
First Channel	Legs 150–169 (Site 1036): not used; Legs 169 (Site 1037)–210: NGR_first_channel.	Integer 8
Last Channel	Legs 150–169 (Site 1036): not used; Legs 169 (Site 1037)–210: NGR_last_channel.	Integer 9
Channel Increment	Legs 150–169 (Site 1036): not used; Legs 169 (Site 1037)–210: NGR_channel_increment.	Integer 9
Spectra	Legs 150–169 (Site 1036): NGR_counts_sec – 5[cps (energy keV – energy keV)]. Example: 515(80–344) 141(346–741) 31(880–1060) 12(1104–1280) 4(1600–1800) Legs 169 (Site 1037)–210: NGR_spectra – 256 Integer 4	Text 2000

APPENDIX I

Paleomagnetic Analyses

Janus PMAG data model. (Continued on next two pages.)

Table name	Column name	Column comment
PMAG_Section_Data	section_id	Unique Oracle-generated sequence number to identify each section.
	leg	Number identifying the cruise for which data were entered into the database.
	pmag_run_num	Number identifying a run generated by the data acquisition software. Must be unique for a leg.
	pmag_top_interval	Top interval of a measurement (meters) measured from the top of a section. Interval can extend 15 cm before and after section for header and trailer measurements.
	pmag_treatment_id	Unique Oracle-generated sequence number for each treatment type.
	pmag_treatment_bias	Values expected for ARM between 0.000 and 1000 mT and IRM between 1.0 and 3000.0 mT.
	pmag_treatment_demag	Values expected between 0.0 and 9999.9 mT.
	pmag_demag_id	Unique Oracle-generated sequence number for each demagnetization type.
	pmag_demag_level	Level of demagnetization: AF (milliTeslas) or thermal (degrees Celsius).
	pmag_sample_id	Oracle-generated sequence number that with *pmag_sam_location* uniquely identifies a sample.
	pmag_sam_location	Code that indicates the site where the Janus application is exercised. Used with *pmag_sample_id* to uniquely identify a sample.
	pmag_bottom_interval	Bottom interval of a measurement (meters) measured from the top of a section. Interval can extend 15 cm before and after the section for the header and trailer measurements.
	pmag_declination	Orientation of the magnetic field of the sample (field acquired at time of rock formation). Angle between geographic north and magnetic field direction (magnetic azimuth).
	pmag_inclination	Orientation of the magnetic field of the sample (field acquired at time of rock formation). Angle between horizontal and field direction measured positive downward.
	pmag_intensity	Intensity of the paleomag measurement (amperes per meter).
PMAG_Run	leg	Number identifying the cruise for which data were entered into the database.
	pmag_run_num	Number identifying a run generated by the data acquisition software. Must be unique for a leg.
	pmag_comment	Comment about section, sample, measurement or alternate treatment.
	pmag_core_length	Length of section analyzed. Does not have to match the curated length of the section.
	pmag_core_status	Status of section measured: **WHOLE**, **ARCHIVE** (archive half), or **WORKING** (working half).
	pmag_demag_x_flag	Indicator if section or sample demagnetized in x-direction: **0** (no drift correction) or **1** (drift correction).
	pmag_demag_y_flag	Indicator if section or sample demagnetized in y-direction: **0** (no drift correction) or **1** (drift correction).
	pmag_demag_z_flag	Indicator if section or sample demagnetized in z-direction: **0** (no drift correction) or **1** (drift correction).
	pmag_drift_bkgd_1_time	Time of first background measurement, usually zero (milliseconds).
	pmag_drift_bkgd_1_x	Moment of first background measurement in x-direction (amperes meters squared).
	pmag_drift_bkgd_1_y	Moment of first background measurement in y-direction (amperes meters squared).
	pmag_drift_bkgd_1_z	Moment of first background measurement in z-direction (amperes meters squared).
	pmag_drift_bkgd_2_time	Time that second background measurement was taken (milliseconds).
	pmag_drift_bkgd_2_x	Moment of second background measurement in x-direction (amperes meters squared).
	pmag_drift_bkgd_2_y	Moment of second background measurement in y-direction (amperes meters squared).
	pmag_drift_bkgd_2_z	Moment of second background measurement in z-direction (amperes meters squared).
	pmag_drift_corr_flag	Indicator if drift correction made: **0** (no drift correction) and **1** (drift correction).
	pmag_meas_type	Measurement type: **CONTINUOUS** (taken on a section) or **DISCRETE** (taken on a sample, piece or at a discrete location on a section).
	pmag_num_daqs_sample	Number of data measurements taken per sample interval.
	pmag_req_daqs_interval	Data acquisition interval requested for section analysis (centimeters).
	pmag_run_date_time	Timestamp when analysis was run.
	pmag_tray_corr_flag	Indicator if tray correction done.
	pmag_tray_date_time	Timestamp of tray calibration.
	pmag_calib_date_time	Time that SQUIDs on the magnetometer were calibrated or replaced.
	system_id	Unique identifier for a system of equipment on the ship.
PMAG_Run_Data	leg	Number identifying the cruise for which data were entered into the database.
	pmag_run_num	Number identifying a run generated by the data acquisition software. Must be unique for a leg.
	pmag_top_interval	Top interval of a measurement (meters) measured from the top of a section. Interval can extend 15 cm before and after section for header and trailer measurements.
	pmag_bottom_interval	Bottom interval of a measurement (meters) measured from the top of a section. Interval can extend 15 cm before and after the section for the header and trailer measurements.
	pmag_core_diam	Diameter of core at measurement position (centimeters). Relevant only for CONTINUOUS measurement.
	pmag_corr_intensity_x	Intensity in x-direction corrected for background and/or tray correction (amperes per meter).
	pmag_corr_intensity_y	Intensity in y-direction corrected for background and/or tray correction (amperes per meter).
	pmag_corr_intensity_z	Intensity in z-direction corrected for background and/or tray correction (amperes per meter).
	pmag_corr_moment_x	Intensity times volume in x-direction (amperes meters squared).
	pmag_corr_moment_y	Intensity times volume in y-direction (amperes meters squared).
	pmag_corr_moment_z	Intensity times volume in z-direction (amperes meters squared).

Janus PMAG data model (continued).

Table name	Column name	Column comment
PMAG_Run_Data (cont.)	pmag_data_type	Indicates data type: **CORE** (normal core measurement), **LEADER** (measurement taken before top of section), **TRAILER** (measurement taken after end of section). LEADER and TRAILER are valid only for continuous measurements.
	pmag_sample_time	Time elapsed since background measurement (milliseconds). For drift correction.
	pmag_uncorr_moment_x_mean	Mean of uncorrected moment in x-direction, not corrected for tray and/or background (amperes per meter).
	pmag_uncorr_moment_x_sd	Standard deviation of uncorrected moment in x-direction.
	pmag_uncorr_moment_y_mean	Mean of uncorrected moment in y-direction, not corrected for tray and/or background (amperes per meter).
	pmag_uncorr_moment_y_sd	Standard deviation of uncorrected moment in y-direction.
	pmag_uncorr_moment_z_mean	Mean of uncorrected moment in z-direction, not corrected for background and/or tray measurement (amperes per meter).
	pmag_uncorr_moment_z_sd	Standard deviation of uncorrected moment in z-direction.
PMAG_Calib	pmag_calib_date_time	Time that SQUIDs on the magnetometer were calibrated or replaced.
	pmag_calib_x	Converts quantum flux to emu (emu/flux quantum units) in x-direction.
	pmag_calib_y	Converts quantum flux to emu (emu/flux quantum units) in y-direction.
	pmag_calib_z	Converts quantum flux to emu (emu/flux quantum units) in z-direction.
	pmag_response_x	SQUID response length in x-direction (cubic centimeters).
	pmag_response_y	SQUID response length in y-direction (cubic centimeters).
	pmag_response_z	SQUID response length in z-direction (cubic centimeters).
PMAG_Demag_Type	pmag_demag_id	Unique Oracle-generated sequence number for each demagnetization type.
	pmag_demag_type	Abbreviation for method of demagnetization.
	pmag_demag_comment	Description of method of demagnetization.
PMAG_Treatment_Type	pmag_treatment_id	Unique Oracle-generated sequence number for each treatment type.
	pmag_treatment_type	Abbreviation of treatment type.
	pmag_treatment_comment	Description of treatment type.
Leg	Leg	Number identifying the cruise for which data were entered into the database.
	description_of_area	General description of the area where the sites are located.
	objective	General objectives and accomplishments of leg.
	ops_area	Operating area for leg.
	total_miles_transited	Total miles transited during leg.
	total_miles_surveyed	Total miles surveyed during leg.
	average_speed_transit	Average transit speed for cruise.
	average_speed_survey	Average speed during surveys done on leg.
	reentry_count	Number of hole reentries performed during leg.
	datetime	Generic date/time.
Section	section_id	Unique Oracle-generated sequence number to identify each section. This is done because of the physical subsection/zero section problems. When adding new sections, deleting sections, or changing sections renumbering won't be necessary.
	leg	Number identifying the cruise for which data were entered into the database.
	site	Number identifying the site from which the core was retrieved.
	hole	Letter identifying the hole at a site from which a core was retrieved or data were collected.
	core	Sequential numbers identifying the cores retrieved from a particular hole.
	core_type	Letter code identifying the drill bit/coring method used to retrieve the core.
	section_number	Number identifying the serial position of a section from the top of the core.
	section_type	Differentiates sections of core (**S**) from core catchers (**C**). Previously core catchers were stored as section number CC, but in Janus core catchers are given the next sequential number from the last section recovered.
	curated_length	Length of the section core material (meters). This may be different than the liner length for the same section. Hard rock cores may have spacers added to prevent rock pieces from damaging each other.
	liner_length	Original length of core material in section (meters); core recovery = sum of liner lengths.
	core_catcher_stored_in	Section number of D-tube that holds the core catcher.
	section_comments	Comments about this section.

Janus PMAG data model (continued).

Table name	Column name	Column comment
Sample	sample_id	Oracle-generated sequence number that with *location* uniquely identifies a sample.
	location	Code that indicates the site where the Janus application is exercised: **SHI** (ship), **GCR** (Gulf Coast Repository), **ECR** (East Coast Repository), **WCR** (West Coast Repository), **BCR** (Bremen Core Repository). Used with *sample_id* to uniquely identify a sample.
	s_c_leg	Number identifying the cruise for which data were entered into the database. Foreign key used with *s_c_sampling_code* to link samples with a scientist's sample request.
	s_c_sampling_code	Code used to identify samples taken for a sample request. Used with *s_c_leg*.
	sam_archive_working	Part of section sample was taken: **WR** (whole round), **A** (archive half), **W** (working half).
	top_interval	Distance (meters) from the top of the section to the top of the sample.
	bottom_interval	Distance (meters) from the top of the section to the bottom of the sample.
	piece	Additional identifier for hard rock samples. Each individual piece of rock within a section is numbered consecutively starting at the top of the section.
	sub_piece	Additional identifier for hard rock samples. When a piece is broken, individual fragments are given consecutive letter designations. Note that subpiece assignments must be made in conjunction with piece numbers.
	beaker_id	Number on the moisture density beaker. Used for samples analyzed for moisture and density.
	volume	Volume of sample.
	entered_by	Indicates who entered the sample into the database.
	sample_depth	Depth of the sample
	sample_comment	Comment about the sample.
	sam_repository	Repository where sample was taken.
	sam_sample_code_lab	Code to indicate the shipboard laboratory that will perform the initial analysis.
	sam_section_id	Unique Oracle-generated sequence number to identify each section. This is a foreign key that links a sample to leg, site, hole, core, section.
	timestamp	Timestamp when sample was entered into database. Samples taken before 11/1998 and migrated samples have datetime 11/25/1998 12:26 PM.
System_Type	system_id	Unique identifier for a system of equipment used to collect data.
	system_comments	Comments associated with a piece of analytical equipment.
	system_commissioned	Date that a piece of equipment started to be used to collect scientific data for ODP.
	system_decommissioned	Date that a piece of analytical equipment was no longer used by ODP to analyzed samples.
	system_model_number	Model number of a piece of equipment used for scientific analysis.
	system_name	Name for a piece of equipment used for analysis.

Description of data items from PMAG query.

Item name	Column description and calculations	Format
Leg	Number identifying the cruise.	Integer 3
Site	Number identifying the site.	Integer 4
Hole	Letter identifying the hole.	Text 1
Core	Number identifying the serial position of the core from the top of the hole downward.	Integer 3
Type	Letter identifying the coring method used.	Text 1
Section	Numbered identifying the serial position of a section from the top of the core downward. Core catcher sections identified as "CC."	Integer 2
Top (cm)	Top interval of a measurement in centimeters measured from the top of a section.	Decimal F4.1
Bottom (cm)	Bottom interval of a measurement in centimeters measured from the top of a section.	Decimal F4.1
Depth (mbsf)	Distance (meters) from the seafloor to the sample location.	Decimal F7.3
Treatment	Type of treatment. For continuous cores, the only treatment was NRM.	Text 20
Treatment Demag Level	Demagnetization level or biasing level of treatment.	Decimal F5.1
Demag type	Type of demagnetization. For continuous measurements, the demag type was in-line alternating field (AFD).	Text 20
Demag level	Intensity of demagnetization field.	Decimal F7.2
Declination	Orientation of magnetic field of the sample (field acquired at time of rock formation); angle between geographic north and magnetic field direction (magnetic azimuth): **0.00°–359.99°**.	Decimal F5.2
Inclination	Orientation of magnetic field of sample (field acquired at time of rock formation); angle between horizontal and field direction measured positive downward **–90.00°–90.00°**.	Decimal F4.2
Intensity	Total intensity of paleomagnetic field measurement (amperes per meter).	Number 14
Hole Inclination	Inclination of hole as determined from multishot or tensor tool analysis.	Decimal F6.2
Intensity X	North component of horizontal intensity of measured magnetic field (amperes per meter).	Number 14
Intensity Y	East component of horizontal intensity of measured magnetic field (amperes per meter).	Number 14
Intensity Z	Vertical component of intensity of measured magnetic field (amperes per meter).	Number 14
Run Number	Number generated by the data acquisition software to identify an analysis run of a section of core.	Integer 6
Comment	General comments.	Text 40

APPENDIX J

P-Wave Logger Analyses

Janus *P*-wave velocity data model. (Continued on next page.)

Table name	Column name	Column comment
PWL_Section	pwl_id	Unique Oracle-generated sequence number for each PWL analysis run.
	section_id	Unique Oracle-generated sequence number to identify each section.
	system_id	Unique identifier for a system of equipment used to collect data.
	run_number	Number identifying a run generated by the data acquisition software. This number is not used to identify the run in Janus because it may not be unique.
	run_date_time	Timestamp when analysis was run.
	core_status	Indicates if a full or half (split) core is being analyzed: **FULL** or **HALF**.
	liner_status	Records if a core liner was present, a split liner or no liner: **FULL**, **HALF**, **NONE**.
	liner_correction	Indicates if liner correction is used (**Y** or **N**).
	liner_standard_id	Nullable role of the standard identification attribute used for the liner.
	requested_daq_interval	Sampling interval requested for section analysis (centimeters).
	req_daqs_per_sample	Requested number of data measurements taken per sample interval.
	pwl_calibration_id	Unique Oracle-generated sequence number for each velocity calibration recorded for the PWL instrument.
	acoustic_signal_threshold	Strength of the acoustic signal for a velocity measurement: **0–255**. Changed from N(3) to N(4,3) by Bill Mills in February 2000 because of PWL hardware upgrade.
	core_temperature	Temperature of the core in degrees Celsius.
	mst_pwl_ctrl_3_id	Unique Oracle-generated sequence number for each PWL control_3 analysis.
PWL_Section_Data	pwl_id	Unique Oracle-generated sequence number for each PWL analysis run.
	mst_top_interval	Top interval of a measurement (meters) measured from the top of a section.
	mst_bottom_interval	Bottom interval of a measurement (meters) measured from the top of a section.
	meas_separation_mean	Average measured separation of a pair of transducers: **0–255**. Changed to N(6,3) in August 2000 because of PWL hardware upgrade and change in data acquisition software.
	meas_separation_sd	Standard deviation of the measured separation for a pair of transducers.
	meas_time_mean	Average time measured for a signal to travel between transducers for a velocity measurement (microseconds).
	meas_time_sd	Standard deviation of measured time for a signal to travel between a pair of transducers (microseconds).
	acoustic_signal_mean	Mean value of acoustic signal from a velocity measurement: **0–255** (bytes). Changed to N(6,3) in August 2000 because of a change in the data acquisition code.
	attempted_daqs	Number of attempted data acquisitions
	valid_daqs	Number of valid data acquisitions from those attempted.
	liner_thickness	Thickness of liner (millimeters). If liner correction is N then this value is set to zero or null.
	pwl_velocity	Published velocity (meters) per second. Velocity values stored when there is not enough information to calculate velocity from raw values and calibration factors.
PWL_Calibration	pwl_calibration_id	Unique Oracle-generated sequence number for each velocity calibration recorded for the PWL instrument.
	calibration_date_time	Time stamp identifying when calibration was done; supplied by instrument data files.
	run_number	Number identifying a run generated by the data acquisition software. This number is not used to identify the run in Janus because it may not be unique.
	system_id	Unique identifier for a system of equipment used to collect data.
	req_daqs_per_sample	Requested number of data acquisitions to be taken per sample interval.
	acoustic_signal_threshold	Strength of the acoustic signal for a velocity measurement used: **0–255**. This was changed from N(3) to N(4,3) by Bill Mills in February 2000 because of PWL hardware upgrade.
	pwl_frequency	Frequency of *P*-wave transducers (kilohertz).
	pulse_time_correction	Time delay related to threshold peak detection procedure, (microseconds).
	separation_m0	Calculated distance calibration constant (millimeters).
	separation_m1	Calculated distance calibration slope (millimeters per volt).
	separation_mse	Mean square error in distance calibration constant calculation.
	delay_m0	Calculated time calibration constant (microseconds).
	delay_1_over_m1	Calculated time calibration slope (microseconds per millimeter). Name changed from *delay_1_m1* to *delay_1_over_m1* in December 2000.
	delay_mse	Mean square error from time calibration line.
	Comments	General comments.

Janus *P*-wave velocity data model (continued).

Table name	Column name	Column comment
PWL_Calibration_ Data	pwl_calibration_id	Unique Oracle-generated sequence number for each velocity calibration recorded for the PWL instrument.
	standard_id	Identifier for a physical properties standard.
	standard_length	Length of standard (millimeters).
	meas_separation_mean	Average measured separation of a pair of transducers: **0–255**.
	meas_separation_sd	Standard deviation of the measured separation for a pair of transducers.
	meas_time_mean	Average time measured for a signal to travel between transducers for a velocity measurement (microseconds).
	meas_time_sd	Standard deviation of the measured time for a signal to travel between a pair of transducers (microseconds).
	acoustic_signal_mean	Mean value of the acoustic signal from a velocity measurement.
	attempted_daqs	Number of attempted data acquisitions.
	valid_daqs	Number of valid data acquisitions from those attempted.
PWL_Calib_Delay_ Data	pwl_calibration_id	Unique Oracle-generated sequence number for each velocity calibration recorded for the PWL instrument.
	standard_id	Identifier for a physical properties standard.
	calib_delay_id	Unique Oracle-generated sequence number for each delay calibration record for the PWL instrument.
	meas_length	Length of standard (millimeters).
	meas_time	Measured time (microseconds).
	meas_signal	Signal level (volts).
	daq_stack	Number of valid data acquisitions.
PWL_Calib_Dist_ Data	pwl_calibration_id	Unique Oracle-generated sequence number for each velocity calibration recorded for the PWL instrument.
	standard_id	Identifier for a physical properties standard.
	calib_dist_id	Unique Oracle-generated sequence number for each distance calibration record for the PWL instrument.
	meas_length	Length of standard (millimeters).
	meas_voltage	Signal level (volts).
	daq_stack	Number of valid data acquisitions.
Physical_Properties_ Standard	standard_id	Identifier for a physical properties standard.
	standard_name	Name of a physical properties standard.
	standard_set_name	Name for a set of physical properties standards.
	date_time_ commissioned	Date that a physical properties standard went into use.
	date_time_decommissio ned	Date that a physical properties standard's use was discontinued.
	lot_serial_number	Information concerning the lot and/or serial number associated with a physical properties standard.
	Comments	General comments.
Physical_Properties_Std_ Data	standard_id	Identifier for a physical properties standard.
	property_name	A property associated with a physical properties standard, for example 'material' or 'density.'
	property_description	A description of a property associated with a physical properties sample.
	property_value	Value of a property associated with a physical properties standard.
	property_units	Units associated with a property for a physical properties standard.
Section	section_id	Unique Oracle-generated sequence number to identify each section. This is done because of the physical subsection/zero section problems. When adding new sections, deleting sections, or changing sections renumber is not necessary.
	leg	Number identifying the cruise for which data were entered into the database.
	site	Number identifying the site from which the core was retrieved.
	hole	Letter identifying the hole at a site from which a core was retrieved or data were collected.
	Core	Sequential numbers identifying the cores retrieved from a particular hole.
	core_type	Letter code identifying the drill bit/coring method used to retrieve the core.
	section_number	Number identifying the serial position of a section from the top of the core.
	section_type	Differentiates sections of core (**S**) from core catchers (**C**). Previously core catchers were stored as section number CC, but in Janus core catchers are given the next sequential number from the last section recovered.
	curated_length	Length of section core material (meters). This may be different than the liner length for the same section. Hard rock cores may have spacers added to prevent rock pieces from damaging each other.
	liner_length	Original length of core material in section (meters); core recovery = sum of liner lengths.
	core_catcher_stored_in	Section number of the D-tube that holds the core catcher.
	section_comments	Comments about this section.
System_Type	system_id	Unique identifier for a system of equipment used to collect data.
	system_comments	Comments associated with a piece of analytical equipment.
	system_commissioned	Date that a piece of equipment started to be used to collect scientific data for ODP.
	system_decommissioned	Date that a piece of analytical equipment was no longer used by ODP.
	system_model_number	Model number of a piece of equipment used for scientific analysis.
	system_name	Name for a piece of equipment used for analysis.

Description of data items from PWL query.

Column name	Column description and calculation	Format
Leg	Number identifying the cruise.	Integer 3
Site	Number identifying the site.	Integer 4
Hole	Letter identifying the hole.	Text 1
Core	Number identifying the serial position of the core from the top of the hole downward.	Integer 3
Type	Letter identifying the coring method used.	Text 1
Section	Numbered identifying the serial position of a section from the top of the core downward. Core catcher sections identified as "CC."	Integer 2 (Text 2)
Top (cm)	Top interval of a measurement in centimeters measured from the top of a section.	Decimal F4.1
Bottom (cm)	Bottom interval of a measurement in centimeters measured from the top of a section.	Decimal F7.3
Depth (mbsf)	Distance (meters) from the seafloor to the sample location.	Decimal F7.3
Velocity (m/s)	Calculated compressional velocity (meters per second).	Decimal F10.4
Run Number	Number generated by the data acquisition software, to identify an analysis run of a section of core.	Text 5
Run Date/Time	Timestamp identifying when analysis was run.	Text 16 (yyyy-mm-dd hh:mi)
Core Status	Indicates whether a whole or half (split) core is being analyzed: **FULL** or **HALF**.	Text 4
Liner Status	Records if a core liner was used, a split liner or no liner: **FULL**, **HALF**, **NONE**.	Text 4
Liner Correction	Liner correction used: **Y** or **N**.	Text 1
Requested Interval (cm)	Sampling interval requested for section analysis (centimeters).	Decimal F5.3
Requested Sample	Requested number of data measurements taken per sample interval.	Integer 2
Signal Threshold	Strength of the acoustic signal for a velocity measurement: **0–255**. This was changed from N(3) to N(4,3) February 2000 because of PWL hardware upgrade.	Decimal F4.3
Core Temp (C)	Temperature of the core (degrees Celsius).	Decimal F4.1
Separation Mean (mm)	Average measured separation of a pair of transducers: **0–255**. Changed to N(6,3) in August 2000 because of a change in the data acquisition code.	Decimal F6.3
Separation Stdev	Standard deviation of the measured separation for a pair of transducers.	Integer 3
Time Mean (ms)	Average time measured for a signal to travel between transducers for a velocity measurement (microseconds).	Decimal F6.3
Time Stdev	Standard deviation of the measured time for a signal to travel between a pair of transducers (microseconds).	Decimal F6.3
Signal Mean	Mean value of the acoustic signal from a velocity measurement (bytes): **0–255**. Changed to N(6,3) in August 2000 because of a change in the data acquisition code.	Decimal F8.5
Data acquisitions – attempted	Number of attempted data acquisitions.	Integer 2
Data acquisitions – valid	Number of valid data acquisitions from those attempted.	Integer 2
Liner thickness (mm)	Thickness of liner (millimeters). If liner correction is N then this value is set to zero.	Decimal F5.3
Standard	Name of a physical properties standard.	Text 20
Standard Set	Name for a set of physical properties standards.	Text 20
Standard Expected	Value of a property associated with a physical properties standard.	Decimal F13.6
Calib Date/Time	Timestamp identifying when calibration was run.	Text 16 (yyyy-mm-dd hh:mi)
Calib. Separation M0 (mm)	Calculated distance calibration constant (millimeters).	Decimal F7.3
Calib Separation M1 (mm/V)	Calculated distance calibration slope (millimeters per volt).	Decimal F6.4
Calib. Separation Mean Square Error	Mean square error in distance calibration constant calculation.	Decimal F8.6
Calib. Time M0	Calculated time calibration constant (microseconds).	Decimal F6.3
Calib. Time M1	Calculated time calibration slope (microseconds per millimeter). Name changed from *delay_1_m1* to *delay_1_over_m1* in December 2000.	Decimal F6.1
Calib. Time Mean Square Error	Mean square error from time calibration line.	Decimal F8.6

APPENDIX K

Hamilton Frame Analyses

Janus PWS data model. (Continued on next four pages.)

Table name	Column name	Column comment
PWS1_Section	pws_id	Unique Oracle-generated sequence number for each PWS1 analysis run.
	section_id	Unique Oracle-generated sequence number to identify each section.
	run_num	Number identifying a run generated by the data acquisition software. This number is not used to identify the run in Janus because it may not be unique.
	run_date_time	Timestamp when analysis was run.
	system_id	Unique identifier for a system of equipment used to collect data.
	pws_calibration_id	Unique Oracle-generated sequence number for each velocity calibration recorded for the PWS instrument.
	direction	Direction of measurement relative to a section of core. Z is along the core axis.
	core_temperature	Temperature of the core (degrees Celsius).
	raw_data_collected	Raw data flag to indicate whether raw data for a measurement was saved: **Y** or **N**.
PWS1_Section_Data	pws_id	Unique Oracle-generated sequence number for each PWS1 analysis run.
	pp_top_interval	Top interval of a measurement (meters) measured from the top of a section.
	measurement_no	Number of the measurement. Used to differentiate multiple measurements taken at the same interval.
	pp_bottom_interval	Bottom interval of a measurement (meters) measured from the top of a section.
	transducer_separation	Distance between a pair of transducers (millimeters).
	measured_time	Time measured for a wave to travel between the transducers (microseconds).
PWS1_Raw_Data	pws_id	Unique Oracle-generated sequence number for each PWS1 analysis run.
	pp_top_interval	Top interval of a measurement (meters) measured from the top of a section.
	measurement_no	Number of the measurement taken, used to differentiate multiple measurements taken at the same interval.
	time	Time associated with a velocity measurement (microseconds).
	voltage	Measured voltage (millivolts).
PWS1_Calibration	pws_calibration_id	Unique Oracle-generated sequence number for each velocity calibration recorded for the PWS instrument.
	calibration_date_time	Timestamp when calibration was done; supplied by instrument.
	run_num	Run number associated with a data analysis run.
	system_id	Unique identifier for a system of equipment used to collect data.
	water_temperature	Temperature of water being measured as a standard (degrees Celsius).
	standard_velocity	Measured velocity of a standard.
	measured_time	Time measured for a wave to travel between the transducers (microseconds).
	delay	Delay used while taking a measurement (microseconds).
	freq	Frequency associated with taking a measurement (kilohertz).
	comments	General comments.
PWS1_Ctrl_1	pws_ctrl_1_id	Unique Oracle-generated sequence number for each PWS1 control_1 analysis.
	run_num	Run number associated with a data analysis run.
	run_date_time	Timestamp when analysis was run.
	system_id	Unique identifier for a system of equipment used to collect data.
	standard_id	Identifier for a physical properties standard.
	pws_calibration_id	Unique Oracle-generated sequence number for each velocity calibration recorded for the PWS instrument.
	direction	Direction of measurement relative to a section of core. Z is along the core axis.
	core_temperature	Temperature of the core (degrees Celsius).
	raw_data_collected	Raw data flag to indicate whether raw data for a measurement was saved: **Y** or **N**.
	transducer_separation	Distance between a pair of transducers (millimeters).
	measured_time	Time measured for a wave to travel between the transducers (microseconds).
PWS1_Ctrl_1_Raw_Data	pws_ctrl_1_id	Unique Oracle-generated sequence number for each PWS1 control_1 analysis.
	time	Time associated with a velocity measurement (microseconds).
	voltage	Measured voltage (millivolts).
PWS2_Section	pws_id	Unique Oracle-generated sequence number for each PWS2 analysis run.
	section_id	Unique number generated by system to identify section.
	run_num	Run number associated with a data analysis run.
	run_date_time	Timestamp when analysis was run.
	system_id	Unique identifier for a system of equipment used to collect data.
	pws_calibration_id	Unique Oracle-generated sequence number for each velocity calibration recorded for the PWS instrument.
	direction	Direction of measurement relative to a section of core. Y is perpendicular to the core axis and parallel to the split core surface.

Janus PWS data model (continued).

Table name	Column name	Column comment
PWS2_Section (cont.)	core_temperature	Temperature of the core (degrees Celsius).
	raw_data_collected	Raw data flag to indicate whether raw data for a measurement was saved: **Y** or **N**.
PWS2_Section_Data	pws_id	Unique Oracle-generated sequence number for each PWS2 analysis run.
	pp_top_interval	Top interval of a measurement (meters) measured from the top of a section.
	measurement_no	Number of the measurement taken, used to differentiate multiple measurements taken at the same interval.
	pp_bottom_interval	Bottom interval of a measurement (meters) measured from the top of a section.
	transducer_separation	Distance between a pair of transducers (millimeters).
	measured_time	Time measured for a wave to travel between the transducers (microseconds).
PWS2_Raw_Data	pws_id	Unique Oracle-generated sequence number for each PWS2 analysis run.
	pp_top_interval	Top interval of a measurement (meters) measured from the top of a section.
	measurement_no	Number of the measurement taken, used to differentiate multiple measurements taken at the same interval.
	time	Time associated with a velocity measurement (microseconds).
	voltage	Measured voltage (millivolts).
PWS2_Calibration	pws_calibration_id	Unique Oracle-generated sequence number for each velocity calibration recorded for the PWS instrument.
	calibration_date_time	Time stamp identifying when calibration was done - supplied by instrument data files.
	run_num	Run number associated with a data analysis run.
	system_id	Unique identifier for a system of equipment used to collect data.
	water_temperature	Temperature of water being measured as a standard (degrees Celsius).
	standard_velocity	Measured velocity of a standard.
	measured_time	Time measured for a wave to travel between the transducers (microseconds).
	delay	Delay used while taking a measurement (microseconds).
	freq	Frequency associated with taking a measurement (kilohertz).
	comments	General comments.
PWS2_Ctrl_1	pws_ctrl_1_id	Unique Oracle-generated sequence number for each PWS2 control_1 analysis.
	run_num	Run number associated with a data analysis run.
	run_date_time	Timestamp when analysis was run.
	system_id	Unique identifier for a system of equipment used to collect data.
	standard_id	Identifier for a physical properties standard.
	pws_calibration_id	Unique Oracle-generated sequence number for each velocity calibration recorded for the PWS instrument.
	direction	Direction of measurement relative to a section of core. Y is perpendicular to the core axis and parallel to the split core surface.
	core_temperature	Temperature of the core (degrees Celsius).
	raw_data_collected	Raw data flag to indicate whether raw data for a measurement was saved: **Y** or **N**.
	transducer_separation	Distance between a pair of transducers (millimeters).
	measured_time	Time measured for a wave to travel between the transducers (microseconds).
PWS2_Ctrl_1_Raw_Data	pws_ctrl_1_id	Unique Oracle-generated sequence number for each PWS2 control_1 analysis.
	time	Time associated with a velocity measurement (microseconds).
	voltage	Measured voltage (millivolts).
PWS3_Section	pws_id	Unique Oracle-generated sequence number for each PWS3 analysis run.
	section_id	Unique number generated by system to identify section.
	system_id	Unique identifier for a system of equipment used to collect data.
	run_num	Run number associated with a data analysis run.
	run_date_time	Timestamp when analysis was run.
	pws_calibration_id	Unique Oracle-generated sequence number for each velocity calibration recorded for the PWS instrument.
	Direction	Direction of measurement relative to a section of core: **X** (perpendicular to core axis and perpendicular to split surface), **Y** (perpendicular to core axis and parallel to split surface), **Z** (parallel to core axis).
	core_temperature	Temperature of the core (degrees Celsius).
	liner_correction	Liner correction used: **Y** or **N**.
	raw_data_collected	Raw data flag to indicate whether raw data for a measurement was saved: **Y** or **N**.
	standard_liner_id	Identifier for a physical properties standard.
	core_status	Added December 2000. Indicates whether measured section has been split: **FULL** (whole core) or **HALF** (split core).
	liner_status	Records if a core liner, split liner, or no liner was used: **FULL**, **HALF**, **NONE**.
	req_daqs_per_sample	Requested number of data acquisitions taken per sample interval.
	acoustic_signal_threshold	Strength of the acoustic signal for a velocity measurement used: **0–255**. This was changed from N(3) to N(4,3) by Bill Mills in December 2000 because of PWS hardware upgrade.

Janus PWS data model (continued).

Table name	Column name	Column comment
PWS3_Section_Data	pws_id	Unique Oracle-generated sequence number for each PWS3 analysis run.
	pp_top_interval	Top interval of a measurement (meters) measured from the top of a section.
	measurement_no	Number of the measurement taken, used to differentiate multiple measurements taken at the same interval.
	pp_bottom_interval	Bottom interval of a measurement (meters) measured from the top of a section.
	meas_separation_mean	Distance between a pair of transducers (millimeters). Name changed from *transducer_separation* to *meas_separation_mean* December 2000.
	meas_time_mean	Time measured for a wave to travel between the transducers (microseconds). Name changed from *measured_time* to *meas_time_mean* December 2000.
	contact_pressure	Contact pressure used during a measurement (kilopascals).
	liner_thickness	Liner thickness (millimeters).
	pws3_velocity	Added October 2000 to enter velocity results in cases where calibration information was not available.
	meas_time_sd	Standard deviation of the measured time for a signal to travel between a pair of transducers (microseconds). Added December 2000.
	acoustic_signal_mean	Mean value of the acoustic signal from a velocity measurement. Added December 2000.
	valid_daqs	Number of valid data acquisitions from those attempted.
PWS3_Raw_Data	pws_id	Unique Oracle-generated sequence number for each PWS3 analysis run.
	pp_top_interval	Top interval of a measurement (meters) measured from the top of a section.
	measurement_no	Number of the measurement taken, used to differentiate multiple measurements taken at the same interval.
	time	Time associated with a velocity measurement (microseconds).
	voltage	Measured voltage (millivolts).
PWS3_Calibration	pws_calibration_id	Unique Oracle-generated sequence number for each velocity calibration recorded for the PWS instrument.
	calibration_date_time	Time stamp identifying when calibration was done - supplied by instrument data files.
	run_num	Run number associated with a data analysis run.
	system_id	Unique identifier for a system of equipment used to collect data.
	delay_1_over_m1	Calculated time calibration slope (microseconds per millimeter). Changed name from *delay_1_m1* to *delay_1_over_m1* December 2000.
	delay_m0	Calculated time calibration constant (microseconds).
	delay_mse	Mean squared error.
	freq	Frequency associated with taking a measurement (kilohertz).
	comments	General comments.
	separation_m0	Calculated distance calibration constant (millimeters). Added December 2000.
	separation_m1	Calculated distance calibration slope (millimeters per volt). Added December 2000.
	separation_mse	Mean square error in distance calibration constant calculation. Added December 2000.
	req_daqs_per_sample	Requested number of data acquisitions to be taken per sample interval. Added December 2000.
	acoustic_signal_threshold	Strength of the acoustic signal for a velocity measurement.
	pulse_time_correction	Time correction in reference to peak detection.
PWS3_Calibration_Data	pws_calibration_id	Unique Oracle-generated sequence number for each velocity calibration recorded for the PWS instrument.
	standard_id	Identifier for a physical properties standard.
	meas_separation_mean	Distance between a pair of transducers (millimeters). Name changed from *transducer_separation* to *meas_separation_mean* December 2000.
	meas_time_mean	Time measured for a wave to travel between the transducers (microseconds). Name changed from *measured_time* to *meas_time_mean* December 2000.
	contact_pressure	Contact pressure used during a measurement (kilopascals).
	standard_length	Length of standard (millimeters). Added December 2000.
	meas_separation_sd	Standard deviation of the measurement of length of standard.
	meas_time_sd	Standard deviation of the measured time for a signal to travel between a pair of transducers (seconds).
	acoustic_signal_mean	Mean value of the acoustic signal from a velocity measurement.
	valid_daqs	Number of valid data acquisitions from those attempted.
PWS3_Calib_Delay_Data	pws_calibration_id	Unique Oracle-generated sequence number for each velocity calibration recorded for the PWS instrument.
	standard_id	Identifier for a physical properties standard.
	calib_delay_id	Unique Oracle-generated sequence number for each delay calibration recorded for the PWS instrument.
	meas_length	Length of standard (millimeters).
	meas_time	Measured time (microseconds).
	meas_signal	Signal level (volts).
	contact_pressure	Contact pressure used during a measurement (kilopascals).
	daq_stack	Number of valid data acquisitions.

Janus PWS data model (continued).

Table name	Column name	Column comment
PWS3_Calib_Dist_Data	pws_calibration_id	Unique Oracle-generated sequence number for each velocity calibration recorded for the PWS instrument.
	standard_id	Identifier for a physical properties standard.
	calib_dist_id	Unique Oracle-generated sequence number for each distance calibration recorded for the PWS instrument.
	meas_length	Length of standard (millimeters).
	meas_voltage	Signal level (volts).
	daq_stack	Number of valid data acquisitions.
PWS3_Ctrl_1	pws_ctrl_1_id	Unique Oracle-generated sequence number for each PWS3 control_1 analysis.
	system_id	Unique identifier for a system of equipment used to collect data.
	run_num	Run number associated with a data analysis run.
	run_date_time	Timestamp when analysis was run.
	standard_id	Identifier for a physical properties standard.
	pws_calibration_id	Unique Oracle-generated sequence number for each velocity calibration recorded for the PWS instrument.
	direction	Direction of measurement relative to a section of core: **X** (perpendicular to core axis and perpendicular to split surface), **Y** (perpendicular to core axis and parallel to split surface), **Z** (parallel to core axis).
	core_temperature	Temperature of the core (degrees Celsius).
	standard_liner_id	Identifier for a physical properties standard.
	raw_data_collected	Raw data flag to indicate whether raw data for a measurement was saved: **Y** or **N**.
	core_status	Added December 2000.
	liner_status	Records if a core liner, split liner, or no liner was used: **FULL**, **HALF**, **NONE**.
	liner_correction	Liner correction used: **Y** or **N**.
	req_daqs_per_sample	Requested number of data acquisitions taken per sample interval.
	acoustic_signal_threshold	Strength of the acoustic signal for a velocity measurement.
PWS3_Ctrl_1_Data	pws_ctrl_1_id	Unique Oracle-generated sequence number for each PWS control_1 analysis.
	pws3_ctrl1_top_interval	Top interval of a measurement (meters) measured from the top of a section.
	pws3_ctrl1_bottom_interval	Bottom interval of a measurement (meters) measured from the top of a section.
	meas_separation_mean	Distance between a pair of transducers (millimeters). Name changed from *transducer_separation* to *meas_separation_mean* December 2000.
	meas_time_mean	Time measured for a wave to travel between the transducers (microseconds). Name changed from *measured_time* to *meas_time_mean* December 2000.
	contact_pressure	Contact pressure used during a measurement (kilopascals).
	liner_thickness	Liner thickness (millimeters).
	meas_time_sd	Standard deviation of the measured time for a signal to travel between a pair of transducers (seconds).
	acoustic_signal_mean	Mean value of the acoustic signal from a velocity measurement.
	valid_daqs	Number of valid data acquisitions from those attempted.
PWS3_Ctrl_1_Raw_Data	pws_ctrl_1_id	Unique Oracle-generated sequence number for each PWS3 control_1 analysis.
	time	Time associated with a velocity measurement (microseconds).
	voltage	Measured voltage (millivolts).
Physical_Properties_Standard	standard_id	Identifier for a physical properties standard.
	standard_name	Name of a physical properties standard.
	standard_set_name	Name for a set of physical properties standards.
	date_time_commissioned	Date that a physical properties standard went into use.
	date_time_decommissioned	Date that a physical properties standard discontinues being used.
	lot_serial_number	Information concerning lot and/or serial number associated with a physical properties standard.
	comments	General comments.
Physical_Properties_Std_Data	standard_id	Identifier for a physical properties standard.
	property_name	Property associated with a physical property standard (e.g., “material” or “density”).
	property_description	Description of a property associated with a physical properties sample.
	property_value	Value of a property associated with a physical properties standard.
	property_units	Units associated with a property for a physical properties sample.

Janus PWS data model (continued).

Table name	Column name	Column comment
Section	section_id	Unique Oracle-generated sequence number to identify each section. This is done because of the physical subsection/zero section problems. When adding new sections, deleting sections, or changing sections renumbering is not necessary.
	leg	Number identifying the cruise for which data were entered into the database.
	site	Number identifying the site from which the core was retrieved.
	hole	Letter identifying the hole at a site from which a core was retrieved or data were collected.
	Core	Sequential numbers identifying the cores retrieved from a particular hole.
	core_type	Letter code identifying the drill bit/coring method used to retrieve the core.
	section_number	Number identifying the serial position of a section from the top of the core.
	section_type	Used to differentiate sections of core (**S**) from core catchers (**C**). Previously, core catchers were stored as section CC, but in Janus core catchers are given the next sequential number from the last section recovered.
	curated_length	Length of the section core material (meters). This may be different than the liner length for the same section. Hard rock cores may have spacers added to prevent rock pieces from damaging each other.
	liner_length	Original length of core material in section (meters); core recovery = sum of liner lengths.
	core_catcher_stored_in	Section number of the D-tube that holds the core catcher.
	section_comments	Comments about this section.
System_Type	system_id	Unique identifier for a system of equipment used to collect data.
	system_comments	Comments associated with a piece of analytical equipment.
	system_commissioned	Date that a piece of equipment started to be used to collect scientific data for ODP.
	system_decommissioned	Date that a piece of analytical equipment was no longer used by ODP to analyzed samples for scientific data.
	system_model_number	Model number of a piece of equipment used for scientific analysis.
	system_name	Name for a piece of equipment used for analysis.

Description of data items from PWS1 and PWS2 queries.

Column name	Column description and calculation	Format
Leg	Number identifying the cruise.	Integer 3
Site	Number identifying the site.	Integer 4
Hole	Letter identifying the hole.	Text 1
Core	Number identifying the serial position of the core from the top of the hole downward.	Integer 3
Type	Letter identifying the coring method used.	Text 1
Section	Numbered identifying the serial position of a section from the top of the core downward. Core catcher sections identified as "CC."	Integer 2 (Text 2)
Top (cm)	Top interval of a measurement in centimeters measured from the top of a section.	Decimal F5.1
Bottom (cm)	Bottom interval of a measurement in centimeters measured from the top of a section.	Decimal F5.1
Depth (mbsf)	Distance (meters) from the seafloor to the sample location.	Decimal F7.3
Direction	Direction of measurement relative to a section of core: **X** (perpendicular to core axis and perpendicular to split surface), **Y** (perpendicular to core axis and parallel to split surface), **Z** (parallel to core axis).	Text 2
Velocity (m/s)	Calculated compressional velocity (meters per second).	Decimal F10.4
Run Number	Number generated by the data acquisition software, to identify an analysis run of a section of core.	Text 6
Run Date/Time	Timestamp when analysis was run.	Text 16 (yyyy-mm-dd hh:mi)
Core Temp (C)	Temperature of the core (degrees Celsius).	Decimal F4.1
Raw Data	Raw data collected and saved: **Y** or **N**.	Text 1
Measurement No.	Number of the measurement at a given interval. Used to differentiate multiple measurements at the same interval.	Integer 2
Separation	Measured separation of a pair of transducers.	Decimal F7.3
Measured Time	Average time measured for a signal to travel between transducers for a velocity measurement.	Decimal F6.3
Calib Date/Time	Timestamp identifying when calibration was run.	Text 16 (yyyy-mm-dd hh:mi)
Calib. Delay	Calculated time calibration constant (microseconds).	Decimal F6.3

Description of data items from PWS3 query.

Column name	Column description and calculation	Column name
Leg	Number identifying the cruise.	Integer 3
Site	Number identifying the site.	Integer 4
Hole	Letter identifying the hole.	Text 1
Core	Number identifying the serial position of the core from the top of the hole downward.	Integer 3
Type	Letter identifying the coring method used.	Text 1
Section	Numbered identifying the serial position of a section from the top of the core downward. Core catcher sections identified as "CC."	Integer 2 (Text 2)
Top (cm)	Top interval of a measurement in centimeters measured from the top of a section.	Decimal F5.1
Bottom (cm)	Bottom interval of a measurement in centimeters measured from the top of a section.	Decimal F5.1
Depth (mbsf)	Distance (meters) from the seafloor to the sample location.	Decimal F7.3
Direction	Direction of measurement relative to a section of core: **X** (perpendicular to core axis and perpendicular to split surface), **Y** (perpendicular to core axis and parallel to split surface), **Z** (parallel to core axis).	Text 2
Velocity (m/s)	Calculated compressional velocity (meters per second).	Decimal F10.4
Run Number	Number generated by data acquisition software to identify an analysis run of a section of core.	Text 6
Run Date/Time	Timestamp identifying when analysis was run.	Text 16 (yyyy-mm-dd hh:mi)
Core Temp (C)	Temperature of the core (degrees Celsius).	Decimal F4.1
Raw Data	Raw data collected and saved: **Y** or **N**.	Text 1
Measurement No.	Number of the measurement at a given interval. Used to differentiate multiple measurements at the same interval.	Integer 2
Separation Mean (mm)	Average measured separation of a pair of transducers: **0–255**. Changed to N(6,3) in August 2000 because of a change in the data acquisition code.	Decimal F6.3
Time Mean (ms)	Average time measured for a signal to travel between transducers for a velocity measurement (microseconds).	Decimal F6.3
Calib Date/Time	Timestamp identifying when calibration was run.	Text 16 (yyyy-mm-dd hh:mi)
Liner Correction	Liner correction used: **Y** or **N**.	Text 1
Standard	Name of a physical properties standard.	Text 20
Standard Set	Name for a set of physical properties standards.	Text 20
Standard Expected	Value of a property associated with a physical properties standard.	Decimal F13.6
Contact Pressure (kPa)	Contact pressure on the transducer when in contact with core material or liner.	Decimal F5.1
Liner thickness (mm)	Thickness of liner (millimeters). If liner correction = N, then this value = 0.	Decimal F5.3
Calib Delay M0	Calculated time calibration constant (microseconds).	Decimal F6.3
Calib Delay M1	Calculated time calibration slope (microseconds per millimeter). Changed name from *delay_1_m1* to *delay_1_over_m1* December 2000.	Decimal F6.1
Calib Delay Mean Square Error	Mean square error from time calibration line.	Decimal F8.6
Calib Separation M0 (mm)	Calculated distance calibration constant (millimeters).	Decimal F7.3
Calib Separation M1 (mm/V)	Calculated distance calibration slope (millimeters per volt).	Decimal F6.4
Calib Separation Mean Square Error	Mean square error in distance calibration constant calculation.	Decimal F8.6

APPENDIX L

Rock-Eval Analyses

Janus Rock-Eval data model stored in carbonate tables. (Continued on next page.)

Table name	Column name	Column comment
Chem_Carb_Sample	run_id	Unique Oracle-generated sequence identifier that allows duplicate analyses of a sample to be entered into database.
	sequence_identifier	Number indicating order in which analyses were run when duplicate analyses are stored.
	sample_id	Oracle-generated sequence number that with *location* uniquely identifies a sample.
	location	Code that indicates which Janus application assigned the *sample_id*. Used with *sample_id* to uniquely identify a sample.
	carb_comments	Comment concerning a rock evaluation analysis.
Chem_Carb_Analysis	run_id	Unique Oracle-generated sequence identifier that allows duplicate analyses of a sample to be entered into database.
	analysis_code	Code describing type of analysis for which a sample was analyzed.
	method_code	Code for method or instrument used to analyze a sample.
	analysis_result	Numerical result of analysis of a sample.
	cal_id	Oracle-generated sequence number for a calibration run.
Chem_Carb_Analysis_ Type	carb_analysis_code	Code describing type of analysis for which a sample can be analyzed.
	carb_analysis_name	Full name or description of analysis type.
	analysis_units	Reported measurement units of analysis result.
	analysis_code_order	Number defining order that analysis codes and results will appear on a spreadsheet or report.
Chem_Method	method_code	Code for the method or instrument used for analyzing a sample.
	method_name	Name of the method or instrument used for analyzing a sample.
Chem_Carb_Calib	calib_id	Oracle-generated sequence number for a calibration run.
	calib_date	Date and time of a calibration run.
	method_code	Code for the method or instrument used for analyzing a sample.
	calib_method	Method used for calibrating the analytical instrument.
	carb_comments	Comment concerning a calibration.
	carb_analysis_code	Code describing the type of analysis for which a sample can be analyzed.
Chem_Calib_Method	calib_method	Method used for calibrating the analytical instrument.
Chem_Carb_Chk_Results	calib_id	Oracle-generated sequence number for a calibration run.
	chk_sequence	Number indicating order of measurements.
	carb_std_type	Name of standard used.
	carb_analysis_code	Code describing the type of analysis for which a sample can be analyzed.
	carb_analysis_result	Result of the analysis of a sample or standard.
	carb_std_class	Code describing type of check analysis as a standard, blank, or unknown check
Chem_Carb_Standards	carb_std_type	Name of standard used.
	carb_analysis_code	Code describing the type of analysis for which a sample can be analyzed.
	carb_std_value	Value of a standard for a particular analysis code.
	carb_std_family	Name for a group of standards.
	carb_std_sequence	
Section	section_id	Unique Oracle-generated sequence number to identify each section. This is done because of the physical subsection/zero section problems. In adding new sections, deleting sections or changing sections - don't want to have to renumber.
	leg	Number identifying the cruise for which data were entered into the database.
	site	Number identifying the site from which the core was retrieved.
	hole	Letter identifying the hole at a site from which a core was retrieved or data were collected.
	core	Sequential numbers identifying the cores retrieved from a particular hole.
	core_type	Letter code identifying the drill bit/coring method used to retrieve the core.
	section_number	Number identifying the serial position of a section from the top of the core.
	section_type	Used to differentiate sections of core (**S**) from core catchers (**C**). Previously core catchers were stored as section CC, but in Janus core catchers are given the next sequential number from the last section recovered.
	curated_length	Length of the section core material (meters). This may be different than the liner length for the same section. Hard rock cores may have spacers added to prevent rock pieces from damaging each other.
	liner_length	Original length of core material in section (meters); core recovery = sum of liner lengths.
	core_catcher_stored_in	Section number of D-tube that holds the core catcher.
	section_comments	Comments about this section.

Janus Rock-Eval data model stored in carbonate tables (continued).

Table name	Column name	Column comment
Sample	sample_id	Oracle-generated sequence number that with location uniquely identifies a sample.
	location	Code that indicates which Janus application assigned the *sample_id*: **SHI** (ship), **GCR** (Gulf Coast Repository), **ECR** (East Coast Repository), **WCR** (West Coast Repository), **BCR** (Bremen Core Repository). Used with sample_id to uniquely identify a sample.
	s_c_leg	Number identifying the cruise for which data were entered into the database. Foreign key used with *s_c_sampling_code* to link samples with a scientist's sample request.
	s_c_sampling_code	Code used to identify samples taken for a sample request. Used with *s_c_leg*.
	sam_archive_working	Part of section where sample was taken: **WR** (whole round), **A** (archive half), **W** (working half).
	top_interval	Distance (meters) from the top of the section to the top of the sample.
	bottom_interval	Distance (meters) from the top of the section to the bottom of the sample.
	piece	Additional identifier for hard rock samples. Each individual piece of rock within a section is numbered consecutively starting at the top of the section.
	sub_piece	Additional identifier for hard rock samples. When a piece is broken, the individual fragments are given consecutive letter designations. Note that subpiece assignments must be made in conjunction with piece numbers.
	beaker_id	Number on the moisture density beaker. Used for samples analyzed for moisture and density.
	volume	Volume of sample.
	entered_by	Indicates who entered the sample into the database.
	sample_depth	Depth of the sample.
	sample_comment	Comment about the sample.
	sam_repository	Repository where sample was taken: **SHI** (ship), **GCR** (Gulf Coast Repository), **ECR** (East Coast Repository), **WCR** (West Coast Repository), **BCR** (Bremen Core Repository).
	sam_sample_code_lab	Code to indicate the shipboard laboratory that will perform the initial analysis.
	sam_section_id	Unique Oracle-generated sequence number to identify each section. This is a foreign key that links a sample to leg, site, hole, core, section.
	timestamp	Date and time when sample was entered into database. Samples taken before November 25, 1998 and migrated samples have the timestamp 11/25/1998 12:26 PM.

Description of data items from Rock-Eval query.

Column name	Column description and calculation	Column name
Leg	Number identifying the cruise.	Integer 3
Site	Number identifying the site.	Integer 4
Hole	Letter identifying the hole.	Text 1
Core	Number identifying the serial position of the core from the top of the hole downward.	Integer 3
Type	Letter identifying the coring method used.	Text 1
Section	Numbered identifying the serial position of a section from the top of the core downward. Core catcher sections identified as "CC."	Integer 2 (Text 2)
Top (cm)	Top interval of a measurement in centimeters measured from the top of a section.	Decimal F5.1
Bottom (cm)	Bottom interval of a measurement in centimeters measured from the top of a section.	Decimal F5.1
Depth (mbsf)	Distance (meters) from the seafloor to the sample location.	Decimal F7.3
Organic Carbon (wt%)	Weight percent of organic carbon in a sample, from the carbonate analysis of the sample. This value can be measured directly or calculated by subtracting the *Inorganic_Carbon_Percent* from the *Total_Carbon_Percent*.	Decimal F15.5
Total Organic Carbon (wt%)	Total organic carbon (weight percent). This value is obtained from the RE-TOC apparatus.	Decimal F15.5
Free Hydrocarbons (S1) [mg HC/g]	Peak representing the quantity (in milligrams hydrocarbon per gram rock) of free hydrocarbons (oil and gas) present, which are volatilized below 300°C.	Decimal F15.5
Hydrocarbons (S2) [mg HC/g]	Amount of hydrocarbon-type compounds (in milligrams hydrocarbon per gram rock) produced by the cracking of kerogen as the temperature increases to 600°C. This also indicates the quantity of hydrocarbons which could be produced should burial and maturation continue.	Decimal F15.5
Carbon Dioxide (S3) [mg CO_2/g]	Peak showing the quantity of CO_2 (measured in milligrams CO_2 per gram rock) produced from pyrolysis of the organic matter in the rock up to 390°C.	Decimal F15.5
Temperature MAX [Leg C]	The temperature (degrees Celsius), at which maximum release of hydrocarbons from cracking of kerogen during pyrolysis occurred (measured at peak of S2).	Decimal F15.5
Productivity Index (PI) [ratio]	S1/(S1 + S2). PI characterizes the evolution level of the organic matter. PI typically increases with depth and can be used to pinpoint zones of unusually high or low amounts of hydrocarbons.	Decimal F15.5
Pyrolized Carbon (PC) [mg HC/g]	Petroleum Potential or Pyrolized Carbon = k x (S1 + S2), where k = 0.083 mg carbon/g rock. PC corresponds to the maximum quantity of hydrocarbons capable of being produced from the source rock or sediment given sufficient burial depth and time.	Decimal F15.5
Oxygen Index (OI) [ratio]	OI = (100 x S3)/TOC. OI indirectly determines the ratio of oxygen to carbon. It is also used to evaluate the type of organic matter present.	Decimal F15.5
Hydrogen Index (HI) [ratio]	Hydrogen Index = (100 x S2)/TOC. HI indirectly determines the ratio of hydrogen to carbon. It is a parameter used to evaluate the type of organic matter present.	Decimal F15.5

APPENDIX M

Color Reflectance Analyses

Janus color reflectance data model. (Continued on next page.)

Table name	Column name	Column comment
RSC_Section	section_id	Unique Oracle-generated sequence number to identify each section.
	leg	Number identifying the cruise for which data were entered into the database.
	rsc_run_num	Number identifying a run generated by the data acquisition software.
RSC_Run	leg	Number identifying the cruise for which data were entered into the database.
	rsc_run_num	Number identifying a run generated by the data acquisition software.
	rsc_num_meas	Number of measurements included in the average. Usually multiple measurements are taken at each position, these measurements are averaged.
	rsc_run_date_time	Timestamp when analysis was run.
	rsc_calib_date_time	Timestamp when calibration was run.
RSC_Run_Data	leg	Number identifying the cruise for which data were entered into the database.
	rsc_run_num	Number identifying a run generated by the data acquisition software.
	top_interval	Top interval of a measurement (meters) measured from the top of a section.
	bottom_interval	Bottom interval of a measurement (meters) measured from the top of a section.
	rsc_cielab_l_star	Lightness variable in the CIELAB system color notation: **0%–100%**.
	rsc_cielab_a_star	Chromaticity coordinate in the CIELAB system color notation: **green–red**.
	rsc_cielab_b_star	Chromaticity coordinate in the CIELAB system color notation: **blue–yellow**.
	rsc_height	Distance between surface of material and spectrophotometer aperture (millimeters).
	rsc_height_assumed_flag	Perform height correction: **0** or **1**.
	rsc_munsell_hvc	Munsell HVC color notation.
	rsc_tristimulus_x	Primary value in the CIE system. Equal values of X, Y, and Z produce white.
	rsc_tristimulus_y	Primary value in the CIE system. Equal values of X, Y, and Z produce white.
	rsc_tristimulus_z	Primary value in the CIE system. Equal values of X, Y, and Z produce white.
	rsc_first_channel	Wavelength of first channel measured for a color reflectance measurement (nanometers).
	rsc_last_channel	Wavelength of last channel measured for a color reflectance measurement (nanometers).
	rsc_channel_increment	Increment between measured wavelengths for a color reflectance measurement (nanometers).
	rsc_spectra	Spectral results for a color reflectance measurement; single comma- or space-delimited string.
RSC_Calib	rsc_calib_date_time	Timestamp when calibration was run.
	rsc_comment	Comment concerning calibration run.
	rsc_illumination_condition	Predefined conditions of the measurement such as A, C, D50 or D65.
	rsc_num_meas	Number of measurements included in the average. Usually multiple measurements are taken at each position, and these measurements are averaged.
	rsc_observer_angle	Angle of illumination at which the specimen is observed (degrees).
	rsc_reflectance_corr	Correction used to calculate data for the specular component excluded (SCE) data from the specular component included (SCI) data.
	rsc_specular_status	Identifies Specular component status. Valid values: **SCE** (specular component excluded) or **SCI** (specular component included).
	rsc_zero_calib_flag	Indicator that zero calibrated (= **1**).
	system_id	Unique identifier for a system of equipment on the ship.
RSC_Ctrl	standard_id	Unique identifier for a physical properties standard.
	leg	Number identifying the cruise for which data were entered into the database.
	rsc_run_num	Number identifying a run generated by the data acquisition software.
Physical_Properties_Standard	standard_id	Unique identifier for a physical properties standard.
	standard_name	Name of a physical properties standard.
	standard_set_name	Name for a set of physical properties standards.
	date_time_commissioned	Date that a physical properties standard went into use.
	date_time_decommissioned	Date that a physical properties standard's use was discontinued.
	lot_serial_number	Information concerning the lot and/or serial number associated with a physical properties standard.
	Comments	General comments.
Physical_Properties_Std_Data	standard_id	Unique identifier for a physical properties standard.
	property_name	A property associated with a physical properties standard, for example material or density.
	property_description	Description of the property associated with a physical properties standard.
	property_value	Value of a property associated with a physical properties standard.
	property_units	Units associated with a property for a physical properties standard.

Janus color reflectance data model (continued).

Table name	Column name	Column comment
Section	section_id	Unique Oracle-generated sequence number to identify each section. This is done because of the physical subsection/zero section problems. When adding new sections, deleting sections, or changing sections renumbering is not necessary.
	leg	Number identifying the cruise for which data were entered into the database.
	site	Number identifying the site from which the core was retrieved. A site is the position of a beacon around which holes are drilled.
	hole	Letter identifying the hole at a site from which a core was retrieved or data were collected.
	core	Sequential numbers identifying the cores retrieved from a particular hole.
	core_type	Letter code identifying the drill bit/coring method used to retrieve the core.
	section_number	Number identifying the serial position of a section from the top of the core.
	section_type	Differentiates sections of core (**S**) from core catchers (**C**). Previously core catchers were stored as section CC, but in Janus core catchers are given the next sequential number from the last section recovered.
	curated_length	Length of the section core material (meters). This may be different than the liner length for the same section. Hard rock cores may have spacers added to prevent rock pieces from damaging each other.
	liner_length	Original length of core material in the section (meters). Sum of liner lengths of all the sections of a core equals core recovery.
	core_catcher_stored_in	Section number of the D-tube that holds the core catcher.
	section_comments	Comments about this section.
Leg	Leg	Number identifying the cruise for which data were entered into the database.
	description_of_area	General description of the area where the sites are located.
	objective	General objectives and accomplishments of leg.
	ops_area	Operating area for leg.
	total_miles_transited	Total miles transited during leg.
	total_miles_surveyed	Total miles surveyed during leg
	average_speed_transit	Average transit speed for cruise
	average_speed_survey	Average speed during surveys done on leg.
	reentry_count	Number of hole reentries performed during leg.
	datetime	Generic date/time.

Description of data items from RSC query.

Column name	Column description	Format
Leg	Number identifying the cruise.	Integer 3
Site	Number identifying the site.	Integer 4
Hole	Letter identifying the hole.	Text 1
Core	Number identifying the serial position of the core from the top of the hole downward.	Integer 3
Type	Letter identifying the coring method used.	Text 1
Section	Numbered identifying the serial position of a section from the top of the core downward. Core catcher sections identified as "CC."	Integer 2 (Text 2)
Top (cm)	Top interval of a measurement in centimeters measured from the top of a section.	Decimal F4.1
Bottom (cm)	Bottom interval of a measurement in centimeters measured from the top of a section.	Decimal F4.1
Depth (mbsf)	Distance (meters) from the seafloor to the sample location.	Decimal F7.3
Run Number	Number generated by the data acquisition software, to identify an analysis run of a section of core.	Integer 4
Num Meas	Number of measurements included in the average.	Integer 1
Run Date/Time	Timestamp when analysis was run.	Text 16 (yyyy-mm-dd hh:mi)
CIELAB_L*	Lightness variable in the CIELAB system color notation: **0%–100%**.	Decimal F6.2
CIELAB_a*	Chromaticity coordinate in the CIELAB system color notation: **green–red**.	Decimal F6.2
CIELAB_b*	Chromaticity coordinate in the CIELAB system color notation: **blue–yellow**.	Decimal F6.2
Height	Distance between surface of material and spectrophotometer aperture (millimeters).	Decimal F4.2
Height Flag	Distance between surface of material and spectrophotometer aperture (millimeters).	Integer 1
Munsell_HVC	Munsell HVC color notation (ASTM D 1525-1980).	Text 15
Tristimulus_X	Primary value in the CIE system. Equal values of X, Y, and Z produce white.	Decimal F6.2
Tristimulus_Y	Primary value in the CIE system. Equal values of X, Y, and Z produce white.	Decimal F6.2
Tristimulus_Z	Primary value in the CIE system. Equal values of X, Y, and Z produce white.	Decimal F6.2
First Channel Wavelength	Wavelength of first channel measured for color reflectance (nanometers).	Integer 4
Last Channel Wavelength	Wavelength of last channel measured for color reflectance (nanometers).	Integer 4
Wavelength Increment	Increment in nanometers between measured wavelengths.	Integer 4
400 (nm)	Reflectance value at 400 nm (percent intensity).	Decimal F5.2
410 (nm)	Reflectance value at 410 nm (percent intensity).	Decimal F5.2
420 (nm)	Reflectance value at 420 nm (percent intensity).	Decimal F5.2
430 (nm)	Reflectance value at 430 nm (percent intensity).	Decimal F5.2
440 (nm)	Reflectance value at 440 nm (percent intensity).	Decimal F5.2
450 (nm)	Reflectance value at 450 nm (percent intensity).	Decimal F5.2
460 (nm)	Reflectance value at 460 nm (percent intensity).	Decimal F5.2
470 (nm)	Reflectance value at 470 nm (percent intensity).	Decimal F5.2
480 (nm)	Reflectance value at 480 nm (percent intensity).	Decimal F5.2
490 (nm)	Reflectance value at 490 nm (percent intensity).	Decimal F5.2
500 (nm)	Reflectance value at 500 nm (percent intensity).	Decimal F5.2
510 (nm)	Reflectance value at 510 nm (percent intensity).	Decimal F5.2
520 (nm)	Reflectance value at 520 nm (percent intensity).	Decimal F5.2
530 (nm)	Reflectance value at 530 nm (percent intensity).	Decimal F5.2
540 (nm)	Reflectance value at 540 nm (percent intensity).	Decimal F5.2
550 (nm)	Reflectance value at 550 nm (percent intensity).	Decimal F5.2
560 (nm)	Reflectance value at 560 nm (percent intensity).	Decimal F5.2
570 (nm)	Reflectance value at 570 nm (percent intensity).	Decimal F5.2
580 (nm)	Reflectance value at 580 nm (percent intensity).	Decimal F5.2
590 (nm)	Reflectance value at 590 nm (percent intensity).	Decimal F5.2
600 (nm)	Reflectance value at 600 nm (percent intensity).	Decimal F5.2
610 (nm)	Reflectance value at 610 nm (percent intensity).	Decimal F5.2
620 (nm)	Reflectance value at 620 nm (percent intensity).	Decimal F5.2
630 (nm)	Reflectance value at 630 nm (percent intensity).	Decimal F5.2
640 (nm)	Reflectance value at 640 nm (percent intensity).	Decimal F5.2
650 (nm)	Reflectance value at 650 nm (percent intensity).	Decimal F5.2
660 (nm)	Reflectance value at 660 nm (percent intensity).	Decimal F5.2
670 (nm)	Reflectance value at 670 nm (percent intensity).	Decimal F5.2
680 (nm)	Reflectance value at 680 nm (percent intensity).	Decimal F5.2
690 (nm)	Reflectance value at 690 nm (percent intensity).	Decimal F5.2
700 (nm)	Reflectance value at 700 nm (percent intensity).	Decimal F5.2

APPENDIX N

Shear Strength Analyses

Janus shear strength data model. (Continued on next page.)

Table name	Column name	Column comment
AVS_Section	avs_id	Unique Oracle-generated sequence number for each AVS analysis run.
	section_id	Unique Oracle-generated sequence number to identify each section.
	run_num	Number identifying a run generated by the data acquisition software. This number is not used to identify the run in Janus because it may not be unique.
	run_date_time	Timestamp when analysis was run.
	system_id	Unique identifier for a system of equipment on the ship.
	spring_calibration_id	Unique Oracle-generated sequence number for each spring calibration.
	vane_calibration_id	Unique Oracle-generated sequence number for each vane calibration.
	direction	Direction of measurement relative to a section of core: **X** (perpendicular to core axis and perpendicular to split surface), **Y** (perpendicular to core axis and parallel to split surface), **Z** (parallel to core axis).
	rotation_rate	Rate of rotation of a vane (degrees per minute).
	raw_data_collected	Raw data flag to indicate whether raw data for a measurement was saved: **Y** or **N**.
AVS_Section_Data	avs_id	Unique Oracle-generated sequence number for each AVS analysis run.
	pp_top_interval	Top interval of a measurement (meters) measured from the top of a section.
	pp_bottom_interval	Bottom interval of a measurement (meters) measured from the top of a section.
	max_torque_angle	Maximum torque angle that is achieved before shearing occurs in the sediment while performing a vane shear measurement.
	residual_torque_angle	Residual angle of the sediment after shearing has occurred for a vane shear measurement.
	avs_strength	Calculated strength value. Added July 2002 in order to enter AVS results when calibration information is not available.
	residual_strength	Calculated residual strength value. Added July 2002 in order to enter AVS results when calibration information is not available.
AVS_Raw_Data	avs_id	Unique Oracle-generated sequence number for each AVS analysis run.
	pp_top_interval	Top interval of a measurement (meters) measured from the top of the section.
	avs_record_number	Counter used to uniquely identify a strain-torque pair for AVS raw data. The counter is needed because neither torque or strain is unique.
	torque_angle	Torque angle for an AVS measurement (degrees).
	strain_angle	Strain angle for an AVS measurement (degrees).
AVS_Spring_Calibration	spring_calibration_id	Unique Oracle-generated sequence number for each spring calibration recorded for the AVS system.
	calibration_date_time	Timestamp when calibration was done.
	spring_id	Unique identifier for each spring used in vane shear analysis.
	spring_constant_m1	Slope of the linear regression when calibrating a spring used for AVS analyses (degrees per kilogram-centimeter).
	spring_m0	Intercept of the linear regression when calibrating a spring used for AVS analyses (degrees).
	spring_mse	Mean squared error calculated when calibrating a spring for AVS analyses.
	comments	General comments.
AVS_Spring_Calibration_ Data	spring_calibration_id	Unique Oracle-generated sequence number for each spring calibration recorded for the AVS system.
	torque_angle	Torque angle for an AVS measurement (degrees).
	pp_torque	Torque associated with a spring (kilogram-centimeter).
AVS_Vane_Calibration	vane_calibration_id	Unique Oracle-generated sequence number for each vane calibration recorded for the AVS system.
	calibration_date_time	Timestamp when calibration was done.
	vane_id	Unique identifier for each vane used in vane shear analysis.
	vane_constant	Area of surface of a cylinder (shear plane) that a vane creates as it rotates during a vane shear measurement.
	diameter_mean	Mean diameter of a vane shear vane (millimeters).
	diameter_sd	Standard deviation of the diameter of a vane shear vane (millimeters).
	number_of_dia_meas	Number of diameter measurements taken of a vane.
	height_mean	Mean height measured for a vane used for vane shear analysis (millimeters).
	height_sd	Standard deviation of the height measurements made on a vane used for vane shear analysis (millimeters).
	number_of_height_meas	Number of measurements made to calibrate a vane shear vane.
	comments	General comments.

Janus shear strength data model (continued).

Table name	Column name	Column comment
PEN_Section_Data	pen_id	Unique Oracle-generated sequence number for each PEN analysis run.
	section_id	Unique Oracle-generated sequence number to identify each section.
	sys_id	Identifier for the system used: **PEN**.
	run_date_time	Timestamp when analysis was run.
	direction	Direction of measurement relative to a section of core: **X** (perpendicular to core axis and perpendicular to split surface), **Y** (perpendicular to core axis and parallel to split surface), **Z** (parallel to core axis).
	core_temperature	Temperature of core (degrees Celsius).
	adapter_used	Adaptor used for penetrometer measurements in the physical properties laboratory.
	comments	General comments.
PEN_Sample_Data	pen_id	Unique Oracle-generated sequence number for each PEN analysis run.
	pp_top_interval	Top interval of a measurement (meters) measured from the top of the section.
	measurement_no	Number of the measurement taken, used to differentiate multiple measurements taken at the same interval.
	pp_bottom_interval	Bottom interval of a measurement (meters) measured from the top of the section.
	strength_reading	Value of the strength reading, no units given.
	comments	General comments.
TOR_Section_Data	tor_id	Unique Oracle-generated sequence number for each TOR analysis run.
	section_id	Unique Oracle-generated sequence number to identify each section.
	sys_id	Identifier for the system used: **TOR** (Torvane).
	run_date_time	Timestamp when analysis was run.
	direction	Direction of measurement relative to a section of core: **X** (perpendicular to core axis and perpendicular to split surface), **Y** (perpendicular to core axis and parallel to split surface), **Z** (parallel to core axis).
	core_temperature	Temperature of the core (degrees Celsius).
	range	Range of Torvane (grams per square centimeter): **200**, **1000**, or **2000**.
	comments	General comments.
TOR_Sample_Data	tor_id	Unique Oracle-generated sequence number for each TOR analysis run.
	pp_top_interval	Top interval of a measurement (meters) measured from the top of the section.
	measurement_no	Number of the measurement taken, used to differentiate multiple measurements taken at the same interval.
	pp_bottom_interval	Bottom interval of a measurement, (meters), measured from the top of the section.
	strength_reading	Value of the strength reading, no units given.
	comments	General comments.
Section	section_id	Unique Oracle-generated sequence number to identify each section. This is done because of the physical subsection/zero section problems. When adding new sections, deleting sections, or changing sections, renumbers isn't necessary.
	leg	Number identifying the cruise for which data were entered into the database.
	site	Number identifying the site from which the core was retrieved.
	hole	Letter identifying the hole at a site from which a core was retrieved or data were collected.
	Core	Sequential numbers identifying the cores retrieved from a particular hole.
	core_type	Letter code identifying the drill bit/coring method used to retrieve the core.
	section_number	Number identifying the serial position of a section from the top of the core.
	section_type	Used to differentiate sections of core (S) from core catchers (C). Previously, core catchers were stored as section CC, but in Janus core catchers are given the next sequential number from the last section recovered.
	curated_length	Length of the section core material (meters). This may be different than the liner length for the same section. Hard rock cores will often have spacers added to prevent rock pieces from damaging each other.
	liner_length	Original length of core material in the section (meters). Sum of liner lengths of all the sections of a core equals core recovery.
	core_catcher_stored_in	Section number of the D-tube that holds the core catcher.
	section_comments	Comments about this section.

Description of data items from shear strength query with output raw data option.

Column name	Column description	Format
Automated Vane Shear:		
Leg	Number identifying the cruise.	Integer 3
Site	Number identifying the site.	Integer 4
Hole	Letter identifying the hole.	Text 1
Core	Number identifying the serial position of the core from the top of the hole downward.	Integer 3
Coretype	Letter identifying the coring method used.	Text 1
Section	Number identifying the serial position of a section from the top of the core downward. Core catcher sections identified as "CC."	Integer 2 or Text 2
Top (cm)	Top interval of a measurement in centimeters measured from the top of a section.	Decimal F4.1
Bottom (cm)	Bottom interval of a measurement in centimeters measured from the top of a section.	Decimal F4.1
Depth (mbsf)	Distance (meters) from the seafloor to the sample location.	Decimal F7.3
Shear_Strength	Calculated value of the strength of the sediments.	Decimal F5.1
Max_Torque_Angle	Maximum torque angle that is achieved before shearing occurs in the sediment while performing a vane shear measurement.	Decimal F6.2
Residual_Strength	Calculated value of the residual strength of the sediments.	Decimal F5.1
Residual_Torque_Angle	Residual angle of the sediment after shearing has occurred for a vane shear measurement.	Decimal F6.2
Run_Number	Number identifying a run generated by the data acquisition software.	Integer 6
Run_Date_Time	Timestamp when the measurement was taken.	Text 16 (yyyy-mm-dd hh:mm)
Rotation_Direction	Direction of measurement relative to a section of core: **X** (perpendicular to core axis and perpendicular to split surface), **Y** (perpendicular to core axis and parallel to split surface), **Z** (parallel to core axis).	Text 2
Rotation_Rate	Rate of rotation of a vane (degrees per minute)	Decimate F4.1
Vane_ID	Descriptive name given to vanes for identification.	Text 20
Spring_ID	Descriptive name given to springs for identification	Text 20
Raw_Data_Collected	Flag indicating whether the data acquisition program saved the raw torque and strain measurements: **Y** or **N**.	Text 1
Torque	Torque angle for an AVS measurement (degrees).	Decimal F6.2
Strain	Strain angle for an AVS measurement (degrees).	Decimal F6.2
Penetrometer:		
Leg	Number identifying the cruise.	Integer 3
Site	Number identifying the site.	Integer 4
Hole	Letter identifying the hole.	Text 1
Core	Number identifying the serial position of the core from the top of the hole downward.	Integer 3
Type	All cores are tagged by a letter code that identifies the coring method used.	Text 1
Section	Numbered identifying the serial position of a section from the top of the core downward. Core catcher sections identified as "CC."	Integer 2 or Text 2
Top_Interval (cm)	Top interval of a measurement in centimeters measured from the top of a section.	Decimal F4.1
Depth (mbsf)	Distance (meters) from the seafloor to the sample location.	Decimal F7.3
Strength	Calculated value of the strength of the sediments.	Decimal F5.1
Run_Date_Time	Timestamp when the measurement was taken.	Text 16 (yyyy-mm-dd hh:mm)
Rotation_Direction	Direction of measurement relative to a section of core: **X** (perpendicular to core axis and perpendicular to split surface), **Y** (perpendicular to core axis and parallel to split surface), **Z** (parallel to core axis).	Text 2
Adapter	Adaptor used for penetrometer measurements.	Text 20
Comment	General comments.	Text 80
Torvane:		
Leg	Number identifying the cruise.	Integer 3
Site	Number identifying the site.	Integer 4
Hole	Letter identifying the hole.	Text 1
Core	Number identifying the serial position of the core from the top of the hole downward.	Core
Type	All cores are tagged by a letter code that identifies the coring method used.	Type
Section	Number identifying the serial position of a section from the top of the core downward. Core catcher sections identified as "CC."	Section
Top_Interval (cm)	Top interval of a measurement in centimeters measured from the top of a section.	Decimal F4.1
Depth (mbsf)	Distance (meters) from the seafloor to the sample location.	Decimal F7.3
Strength	Calculated value of the strength of the sediments.	Decimal F7.3
Run_Date_Time	Timestamp when the measurement was taken.	Text 16 (yyyy-mm-dd hh:mm)
Rotation_Direction	Direction of measurement relative to a section of core: **X** (perpendicular to core axis and perpendicular to split surface), **Y** (perpendicular to core axis and parallel to split surface), **Z** (parallel to core axis).	Text 2
Range	Range of torvane (grams per square centimeter): **200**, **1000**, **2000**.	Integer 4
Comment	General comments.	Text 80

APPENDIX O

Thermal Conductivity Analyses

Janus TCON data model.

Table name	Column name	Column comment
TCON_Data	section_id	Unique Oracle-generated sequence number to identify each section.
	pp_top_interval	Top interval of a measurement (meters) measured from the top of a section.
	pp_bottom_interval	Bottom interval of a measurement (meters) measured from the top of a section.
	tcon_comment	Comment recovered from measurement data files.
	tcon_probe_half_full	Needle probe: **FULL** (insertion into soft material) or **HALF** (contact with flat surface).
	tcon_proc_thermcon	Calculated thermal conductivity value, corrected using residual drift at end of drift study (watts per meters Kelvin).
	system_id	Unique identifier for a system of equipment used to collect data.
	tcon_probe_num	Unique number that identifies a probe.
TCON_Probes	system_id	Unique identifier for a system of equipment used to collect data.
	tcon_probe_num	Unique number that identifies a probe (e.g., 330, 352, 19608). This number is used internally by the instrument to associate measurements with the manufacturer's specifications for the probe.
Section	section_id	Unique Oracle-generated sequence number to identify each section so that when adding new sections, deleting sections, or changing sections, renumbering won't be necessary.
	leg	Number identifying the cruise for which data were entered into the database.
	site	Number identifying the site from which the core was retrieved. A site is the position of a beacon around which holes are drilled.
	hole	Letter identifying the hole at a site from which a core was retrieved or data were collected.
	core	Sequential numbers identifying the cores retrieved from a particular hole.
	core_type	Letter code identifying the drill bit/coring method used to retrieve the core.
	section_number	Number identifying the serial position of a section from the top of the core downward.
	section_type	Used to differentiate sections of core (**S**) from core catchers (**C**). Previously core catchers were stored as section CC, but in Janus they are given the next sequential number from the last section recovered.
	curated_length	Length of the section core material (meters). This may be different than the liner length for the same section. Hard rock cores may have spacers added to prevent rock pieces from damaging each other.
	liner_length	Original length of core material in the section (meters). Sum of liner lengths of all the sections of a core equals core recovery.
	core_catcher_stored_in	Section number of the D-tube that holds the core catcher.
	section_comments	Comments on this section.
System_Type	system_id	Unique identifier for a system of equipment used to collect data.
	system_comments	Comments associated with a piece of analytical equipment.
	system_commissioned	Date that a piece of equipment was deployed to collect scientific data for ODP.
	system_decommissioned	Date that a piece of analytical equipment was no longer used by ODP.
	system_model_number	Model number of an piece of equipment used for scientific analysis.
	system_name	Name for a piece of equipment used for analysis.

Description of data items from TCON query.

Column name	Column description	Format
Leg	Number identifying the cruise.	Integer 3
Site	Number identifying the site.	Integer 4
Hole	Letter identifying the hole.	Text 1
Core	Number identifying the serial position of the core from the top of the hole downward.	Integer 3
Coretype	Letter identifying the coring method used.	Text 1
Section	Number identifying the serial position of a section from the top of the core downward. Core catcher sections identified as "CC."	Integer 2 or Text 2
Top (cm)	Top interval of a measurement in centimeters measured from the top of a section.	Decimal F4.1
Bottom (cm)	Bottom interval of a measurement in centimeters measured from the top of a section.	Decimal F4.1
Depth (mbsf)	Distance (meters) from the seafloor to the sample location.	Decimal F7.3
Probe Type	Type of needle probe: **FULL** (insertion into soft material) or **HALF** (contact with flat surface).	Text 4
Thermcon Value	Final conductivity value (watts per meters Kelvin).	Decimal F 5.4
Ship Equipment Id	Number identifying the system used to collect data: **3** (Teka TK04) and **4** (Thermcon-85).	Integer 7
TCON Probe Num	Unique number that identifies a probe (e.g., 330, 352, 19608). This number is used internally by the instrument to associate measurements with the manufacturer's specifications for the probe.	Integer 7
Comments	Comments or remarks about the thermal conductivity test or data. Listing of individual measurements taken at the same location (*Thermcon_value* contains the average).	Text 80

APPENDIX P

Temperature Analyses

Janus downhole temperature data model. (Continued on next page.)

Table name	Column name	Column comment
DHT_APCT_Event	apct_run_id	Unique Oracle-generated sequence number to define an APCT tool run.
	apct_event_num	Number of an event associated with an APCT tool measurement.
	apct_event_increment_time	Increment time of an event for an APCT tool (seconds).
	apct_event_start_date_time	Timestamp at start of event.
	apct_event_stop_date_time	Timestamp at the end an APCT event.
DHT_APCT_Event_Data	apct_run_id	Unique Oracle-generated sequence number to define an APCT tool run.
	apct_event_num	Number of an event associated with an APCT tool measurement.
	apct_scan_num	Scan number in an event associated with an APCT tool measurement.
	apct_scan_temp	Raw temperature recorded during an event associated with an APCT tool measurement (degrees Celsius). Manufacturer values if *.dat file used or WHOI recalibrated values if *.new file is used.
DHT_APCT_Run	apct_run_id	Unique Oracle-generated sequence number to define an APCT tool run.
	apct_leg	Number identifying the cruise for which data were entered into the database.
	apct_site	Number identifying the site from which the core was retrieved.
	apct_hole	Letter identifying the hole at a site from which a core was retrieved or data were collected.
	apct_core	Sequential numbers identifying the cores retrieved from a particular hole.
	apct_core_type	Letter code identifying the drill bit/coring method used to retrieve the core.
	apct_tool_id	Unique Oracle-generated identifier for a tool. It is possible for APCT tools to have the same identifying number as a previous tool, so unique ID is necessary.
	apct_calib_date_time	Date that the APCT probe calibration was entered into the database.
	apct_run_num	Run number associated with an APC T tool run.
	apct_depth_comment	Allows the user to input the depth from the log sheet, but the actual depth will be calculated from Janus using the provided depth calculations (meters).
	apct_event_count	Number of events recorded for an APCT tool run.
	apct_data_uploaded	Date Uploaded time as recorded in the *.dat or *.new file
	apct_download_ref	Download Reference value as recorded in the *.dat or *.new file.
	apct_start_log_date_time	Start logging time as recorded in the *.dat or *.new file.
	apct_run_comment	Comment concerning the run.
DHT_APCT_TFIT_Results	apct_run_id	Unique Oracle-generated sequence number to define an APCT tool run.
	apct_best_fit_temp_t0	Calculated best fit temperature for an APCT tool run (degrees Celsius).
	apct_best_fit_error_rms	Best fit error (degrees Celsius).
	apct_mudline_temp	Mudline temperature (degrees Celsius). Added on July 9, 2002.
	apct_first_no_point_not_proc	First APCT scan number not processed.
	apct_first_record_used	First record used for an APCT tool calculation.
	apct_last_record_used	Last record used for an APCT tool calculation.
	apct_number_records_used	Number of measurements used for an APCT tool calculation.
	apct_par_a	Parameter A from an APCT tool TFIT file.
	apct_par_b	Parameter B from an APCT tool TFIT file.
	apct_par_c1	Parameter C1 from an APCT tool TFIT file, thermal conductivity of the sediment.
	apct_par_c2	Parameter C2 from an APCT tool TFIT file.
	apct_par_d1	Parameter D1 from an APCT tool TFIT file.
	apct_par_d2	Parameter D2 from an APCT tool TFIT file. Changed from NUM(12) to FLOAT(12), August 2000.
	apct_penetration_record_num	Scan number used to determine when penetration of the APCT tool occurred.

Janus downhole temperature data model (continued).

Table name	Column name	Column comment
DHT_APCT_Calib	apct_tool_id	Unique Oracle-generated identifier for a tool. It is possible for APCT tools to have the same identifying number as a previous tool, so unique ID is necessary.
	apct_calib_date_time	Timestamp when the APCT probe calibration was entered into the database.
	apct_tool_serial_num	Serial number that identified an APCT tool probe. This number may not be unique over time.
	apct_tool_name	APCT name.
	apct_calib2_lsq_error	Least squares error calculated for a calibration of an APC temperature tool probe.
	apct_calib2_m0	Intercept for an APCT probe that has been recalculated by WHOI.
	apct_calib2_m1	Slope for an APCT probe that has been recalculated by WHOI.
	apct_calib2_m2	Quadratic coefficient of a secondary calibration performed on an APCT tool by WHOI.
	apct_segment_a_dig_thresh	Digital threshold for the first segment calibrated for an APCT tool probe.
	apct_segment_a_m0	Intercept for the first segment calibrated for an APCT tool probe.
	apct_segment_a_m1	Slope for the first segment calibrated for an APCT tool probe.
	apct_segment_a_temp_thresh	Temperature threshold for the first segment calibrated for an APCT tool probe.
	apct_segment_b_dig_thresh	Digital threshold for the second segment calibrated for an APCT tool probe.
	apct_segment_b_m0	Intercept for the second segment calibrated for an APCT tool probe.
	apct_segment_b_m1	Slope for the second segment calibrated for an APCT tool probe.
	apct_segment_b_temp_thresh	Temperature threshold for the second segment calibrated for an APCT tool probe.
	apct_segment_c_dig_thresh	Digital threshold calculated for the third segment of an APCT tool probe.
	apct_segment_c_m0	Intercept for the third segment calibrated for an APCT tool probe.
	apct_segment_c_m1	Slope for the third segment calibrated for an APCT tool probe.
	apct_segment_c_temp_thresh	Temperature for the third segment calibrated for an APCT tool probe.
Core	leg	Number identifying the cruise for which data were entered into the database.
	site	Number identifying the site from which the core was retrieved.
	hole	Letter identifying the hole at a site from which a core was retrieved or data were collected.
	Core	Sequential numbers identifying the cores retrieved from a particular hole.
	core_type	Letter code identifying the drill bit/coring method used to retrieve the core.
	time_on_deck	Timestamp when core was retrieved and brought on deck.
	entry_timestamp	Timestamp of entry into system.
	meter_comp_depth	Meters composite depth. Offset added to depth calculations for the core. Calculated based on all holes in area. Used to bring all cores at site to common depth.
	marine_tech_code	Code of marine technician entering core information into system.
	marine_tech_comments	Comments regarding core entered by marine technician.
	ops_tech_comments	Comments regarding core entered by operations technician.
	advancement	Core barrel advancement (meters). Advanced can be more than 9.5 m in cases of washed cores.
	top_depth	Meters below seafloor to top of core measured by drill string.
	is_pump1	Was pump 1 used: **Y** or **N**.
	is_pump2	Was pump 2 used: **Y** or **N**.
	wireline_runs	Number of wireline runs to recover the core.
	wireline_spool	Wireline spool used: **F** (fore) and **A** (aft).
	drilling_time	Drilling time (minutes).
	cc1	Type of the first core catcher used on a core barrel.
	cc2	Type of the second core catcher used on a core barrel.
	cc3	Type of the third core catcher used on a core barrel.
	shoe1	Type of the first shoe used.
	shoe2	Type of the second shoe used.
	shoe3	Type of the third shoe used.
	core_liner	Type of liner used for a core.
	orientation_tool	Type of orientation tool used with the core.
	offset	Time zone offset from Greenwich Mean Time (GMT): –12 (west of GMT) to 12 (east of GMT).
	ops_pri_lith	Primary lithology of the core as described by rigfloor operations, not scientific lithologic description.
	ops_sec_lith	Secondary lithology of the core as defined by rigfloor operations, not scientific lithologic description.
	bit_id_null	Unique bit ID number, may be null.

Description of data items from downhole temperature query.

Column name	Column description	Format
Leg	Number identifying the cruise.	Integer 3
Site	Number identifying the site.	Integer 4
Hole	Letter identifying the hole.	Text 1
Core	Number identifying the serial position of the core from the top of the hole downward.	Integer 3
Type	Letter identifying the coring method used.	Text 1
Top Depth (mbsf)	Depth at top of core. Depth comes from drillers (drill string measurement).	Decimal F5.2
Bottom Depth (mbsf)	Depth at bottom of core. Depth comes from drillers (drill string measurement plus advancement).	Decimal F5.2
Depth Comment (mbsf)	Depth recorded by marine technician.	Decimal F7.3
Temperature (°C)	Calculated temperature of core material, based on statistical fit of measured temperature data.	Decimal F6.3
Error (°C)	Error of calculated temperature.	Decimal F4.3
Mudline (°C)	Temperature measured at the seafloor.	Decimal F6.3
Tool Name	Name of the tool that was used to measure temperature.	Text 20
Notes	Comments about the temperature measurement.	Text 256

APPENDIX Q

X-Ray Diffraction Analyses

Janus XRD data model. (Continued on next page.)

Table name	Column name	Column comment
XRD_Hdr_Data	xrd_run_id	Oracle-generated sequence number that uniquely identifies an XRD analysis.
	xrd_location	Code that indicates which Janus application assigned the sample_id: **SHI** (ship), **GCR** (Gulf Coast Repository), **ECR** (East Coast Repository), **WCR** (West Coast Repository), **BCR** (Bremen Core Repository). Used with *xrd_sample_id* to uniquely identify a sample.
	xrd_sample_id	Oracle-generated sequence number that with *xrd_location* uniquely identifies a sample.
	run_type	Type of run. **Sample**, **Control-1**, **Control-2**, **Control-3** are current run types in system.
	sample_prep	Type of preparation used for a sample: **BULK SAMPLE**, **CLAY SEPARATION**, **GLYCOLATED**, **HEATED**.
	diffr_type	Type of diffractometer used for XRD analysis. ODP used Philips PW1710.
	diffr_number	Number of diffractometer. Configured to run only one diffractometer in the first position.
	anode	Anode of XRD tube, such as copper (Cu).
	labda_alpha1	Wavelength output of XRD tube (angstroms).
	labda_alpha2	Wavelength output of XRD tube (angstroms).
	ratio_alphas	Ratio of alphas for an XRD tube.
	diverg_slit	Type of divergence slit used for an XRD analysis. If an automatic divergence slit is used, the irradiated length is listed (millimeters).
	irrad_length	Irradiation length for XRD (millimeters). Only applies if an automatic divergence slit is used.
	receiving_slit	Receiving slit for XRD (millimeters)
	mono_chrom_used	Monochromator used: **Y** or **N**.
	gen_volt	Voltage applied to XRD tube (kilovolts).
	tube_current	Current applied to XRD tube (milliamps).
	datetime	Date/time stamp for XRD analysis.
	angle_start	Angle of XRD goniometer at start of an analysis (degrees).
	angle_stop	Angle of XRD goniometer at end of an analysis (degrees).
	scan_step_size	Step size of XRD goniometer during an analysis (degrees 2θ).
	scan_type	Type of scan used during an XRD analysis, either continuous or step.
	scan_step_time	Time spent counting each step of an XRD run (seconds).
	xrd_comment	Comment related to a XRD sample.
	filename	Filename of XRD file generated from the Philips system. The filename is stored along with header data for batch uploads because the barcode identifier for the sample may not be unique.
XRD_File	xrd_run_id	Oracle-generated sequence number that uniquely identifies an XRD analysis.
	line_number	Line number of XRD file.
	line_text	Text contained in a line of header or data.
XRD_DI_Data	xrd_run_id	Oracle-generated sequence number that uniquely identifies an XRD analysis.
	xrd_angle	Degrees 2θ of a peak from a XRD diffractogram.
	d_spacing_1	D-spacing associated with a mineral from an XRD analysis.
	d_spacing_2	D-spacing associated with a mineral from an XRD analysis.
	peak_width	Width of peak from a XRD diffractogram (degrees 2θ).
	peak_intensity	Intensity of a measured peak from a XRD diffractogram (counts).
	backgrd_intensity	Intensity of background from a XRD sample.
	rel_intensity	Intensity of a peak relative to highest intensity peak for the scan in an XRD analysis.
Section	section_id	Unique Oracle-generated sequence number to identify each section. This is done because of the physical subsection/zero section problems. When adding new sections, deleting sections, or changing sections, renumbering isn't necessary.
	leg	Number identifying cruise for which data were entered into the database.
	site	Number identifying site from which the core was retrieved.
	hole	Letter identifying hole at a site from which a core was retrieved or data were collected.
	core	Sequential numbers identifying cores retrieved from a particular hole.
	core_type	Letter code identifying drill bit/coring method used to retrieve the core; reported only in post-Leg 113 processed data file.
	section_number	Number identifying serial position of a section from the top of the core downward.
	section_type	Used to differentiate sections of core (**S**) from core catchers (**C**). Previously core catchers were stored as section CC, but in Janus core catchers are given the next sequential number from the last section recovered.
	curated_length	Length of section core material (meters). This may be different than the liner length for the same section. Hard rock cores will often have spacers added to prevent rock pieces from damaging each other.
	liner_length	Original length of core material in the section (meters). Sum of liner lengths of all the sections of a core equals core recovery.
	core_catcher_stored_in	Section number of the D-tube that holds the core catcher.
	section_comments	Comments about this section.

Janus XRD data model (continued).

Table name	Column name	Column comment
Sample	sample_id	Oracle-generated sequence number that with location uniquely identifies a sample.
	location	Code that indicates which Janus application assigned the *sample_id*: **SHI** (ship), **GCR** (Gulf Coast Repository), **ECR** (East Coast Repository), **WCR** (West Coast Repository), **BCR** (Bremen Core Repository). Used with sample_id to uniquely identify a sample.
	s_c_leg	Number identifying the cruise for which data were entered into the database. Foreign key used with *s_c_sampling_code* to link samples with a scientist's sample request.
	s_c_sampling_code	Code used to identify samples taken for a sample request. Used with *s_c_leg*.
	sam_archive_working	Part of section where sample was taken: **WR** (whole round), **A** (archive half), **W** (working half).
	top_interval	Distance (meters) from the top of the section to the top of the sample.
	bottom_interval	Distance (meters) from the top of the section to the bottom of the sample.
	piece	Additional identifier for hard rock samples. Each individual piece of rock within a section is numbered consecutively starting at the top of the section.
	sub_piece	Additional identifier for hard rock samples. When a piece is broken, individual fragments are given consecutive letter designations. Note that subpiece assignments must be made in conjunction with piece numbers.
	beaker_id	Number on the moisture density beaker. Used for samples analyzed for moisture and density.
	volume	Volume of sample.
	entered_by	Indicates who entered the sample into the database.
	sample_depth	Depth of sample.
	sample_comment	Comment about sample.
	sam_repository	Repository where sample was taken: **SHI** (ship), **GCR** (Gulf Coast Repository), **ECR** (East Coast Repository), **WCR** (West Coast Repository), **BCR** (Bremen Core Repository).
	sam_sample_code_lab	Code to indicate the shipboard laboratory that will perform the initial analysis.
	sam_section_id	Unique Oracle-generated sequence number to identify each section. This is a foreign key that links a sample to leg, site, hole, core, section.
	timestamp	Date and time when sample was entered into database. Samples taken before November 25, 1998 and migrated samples have the timestamp 11/25/1998 12:26 PM.
System_Type	system_id	Unique identifier for a system of equipment used to collect data.
	system_comments	Comments associated with a piece of analytical equipment.
	system_commissioned	Date that a piece of equipment was deployed to collect scientific data for ODP.
	system_decommissioned	Date that a piece of analytical equipment was no longer used by ODP.
	system_model_number	Model number of a piece of equipment used for scientific analysis.
	system_name	Name for a piece of equipment used for analysis.

Description of data items from XRD query.

Column name	Column description	Format
Leg	Number identifying the cruise.	Integer 3
Site	Number identifying the site.	Integer 4
Hole	Letter identifying the hole.	Text 1
Core	Number identifying the serial position of the core from the top of the hole downward.	Integer 3
Coretype	Letter identifying the coring method used.	Text 1
Section	Number identifying the serial position of a section from the top of the core downward. Core catcher sections identified as "CC."	Integer 2 or Text 2
Top (cm)	Top interval of a measurement in centimeters measured from the top of a section.	Decimal F4.1
Bottom (cm)	Bottom interval of a measurement in centimeters measured from the top of a section.	Decimal F4.1
Depth (mbsf)	Distance (meters) from the seafloor to the sample location.	Decimal F7.3
Filename	Name of raw data file that contains results of XRD analysis.	Text 60

XRD Data Header Format

Legs 147–164

```
SampleIdent,894A 1R2 130-135 GLY,/
DiffrType,PW1710,/
DiffrNumber,1,/
Anode,Cu,/
DivergenceSlit,Automatic, 12,/
MonochromatorUsed,YES,/
GeneratorVoltage, 40,/
TubeCurrent, 35,/
FileDateTime, 8-dec-1992 23:58,/
DataAngleRange,   2.0000, 23.9900,/
ScanStepSize,   0.010,/
ScanType,CONTINUOUS,/
ScanStepTime,    1.00,/
RawScan
   272,    240,    225,    269,    234,    243,    196,    213
   243,    231,    199,    202,    204,    188,    193,    222
   166,    185,    199,    182,    159,    169,    182,    166
          . . .
   169,    159,    193,    166,    164,    182,    177,    185
/
```

Legs 165–180

```
SampleIdent,49A10X314,/
Title1,Ocean Drilling Program,/
Title2,PC-APD Software Version 3.6f,/
DiffrType,PW1710,/
DiffrNumber,1,/
Anode,Cu,/
LabdaAlpha1, 1.54056,/
LabdaAlpha2, 1.54439,/
RatioAlpha21, 0.50000,/
DivergenceSlit,Automatic, 12,/
ReceivingSlit,0.2,/
MonochromatorUsed,YES,/
GeneratorVoltage, 40,/
TubeCurrent, 35,/
FileDateTime,22-Jan-1997 1:39,/
DataAngleRange,   2.0000, 60.0000,/
ScanStepSize,   0.020,/
ScanType,STEP,/
ScanStepTime,    1.00,/
RawScan
   17,     15,     9,      9,      18,     11,     13,     19
   15,     13,     20,     11,     18,     15,     17,     8
   19,     9,      17,     23,     18,     15,     11,     24
          . . .
   32,     19,     35,     35,     26,/
```

Legs 181–210

```
SampleIdent,ss001552434 bulk,/
Title1,,/
Title2,PC-APD Software Version 3.6f,/
DiffrType,PW1710,/
DiffrNumber,1,/
Anode,Cu,/
LabdaAlpha1,1.54056,/
LabdaAlpha2,1.54439,/
RatioAlpha21,.5,/
DivergenceSlit,Automatic,12,/
ReceivingSlit,.2,/
MonochromatorUsed,YES,/
GeneratorVoltage,40,/
TubeCurrent,35,/
FileDateTime,10-Aug-2003 06:56,/
DataAngleRange,2,70,/
ScanStepSize,.02,/
ScanType,STEP,/
ScanStepTime,1,/
Rawscan,/
  365,    342,    361,    369,    313,    361,    310,    310
  339,    313,    303,    328,    328,    350,    299,    286
  289,    256,    276,    289,    279,    313,    266,    282
      . . .
  193,/
```

APPENDIX R

X-Ray Fluorescence Analyses

Janus XRF data model. (Continued on next page.)

Table name	Column name	Column comment
XRF_Sample	sample_id	Oracle-generated sequence number that with *location* uniquely identifies a sample.
	location	Code that indicates which Janus application assigned the sample_id: **SHI** (ship), **GCR** (Gulf Coast Repository), **ECR** (East Coast Repository), **WCR** (West Coast Repository), **BCR** (Bremen Core Repository). Used with *sample_id* to uniquely identify a sample.
	XRF_replicate	Identifier for each replicate of a sample to allow all to be entered into the database.
	XRF_run_identifier	Operator-assigned run identifier. Must be unique during a leg.
	leg	Number identifying the cruise for which data were entered into the database.
	XRF_analysis_type	Type of analysis performed on an XRF sample: **MAJOR** (oxide) or **TRACE** (element).
	system_id	Unique identifier for a system of equipment used to collect data.
	sample_prep	Type of preparation used for a sample: **BEAD** (fused glass disc) or **PELLET** (pressed pellet).
	bead_loi	Loss on ignition. The percentage of weight lost after igniting the XRF bead: [(post_ign_sample_wt/pre_ign_sample_wt) – 1] × (–100).
	XRF_comment	General comment about sample or analysis.
XRF_Sample_Analysis	sample_id	Oracle-generated sequence number that with *location* uniquely identifies a sample.
	location	Code that indicates which Janus application assigned the *sample_id*: **SHI** (ship), **GCR** (Gulf Coast Repository), **ECR** (East Coast Repository), **WCR** (West Coast Repository), **BCR** (Bremen Core Repository). Used with *sample_id* to uniquely identify a sample.
	XRF_replicate	Identifier for each replicate of a sample to allow all to be entered into the database.
	XRF_run_identifier	Operator-assigned run identifier. Must be unique during a leg.
	leg	Number identifying the cruise for which data were entered into the database.
	XRF_analysis_type	Type of analysis performed on an XRF sample: **MAJOR** (oxide) or **TRACE** (element).
	XRF_analysis_code	Code for the element or oxide being analyzed.
	XRF_analysis_result	Analytical result for an analysis code.
	analysis_units	Measurement units used for an analysis: **wt%** (major oxides) or **ppm** (trace elements).
	XRF_cal_name	Same description as the attribute *XRF_calib_name*, but allowed to be null.
XRF_Analysis_Type	XRF_analysis_code	Code for the element or oxide being analyzed.
	analysis_code_order	Used to determine the order that analysis codes will appear on a spreadsheet or report.
XRF_Sample_Type	sample_type_id	Identification assigned to the rock type.
	sample_type	Rock type name (e.g., **Basalt**, **Granite**, **Oxide**, **Gabbro**).
XRF_Standard	XRF_std_name	Name of an XRF standard.
	XRF_replicate	Identifier for each replicate of a sample to allow all to be entered into the database.
	rock_type	Description of the rock type or material of the standard.
	XRF_std_comment	Comment about an XRF standard.
XRF_Calibration	XRF_analysis_code	Code for element or oxide being analyzed.
	datetime	Generic date/time. Often used for keys when multiple comments, etc. can be entered.
	XRF_Analysis_Type	Type of analysis performed on an XRF sample: **MAJOR** (oxide) or **TRACE** (element).
	XRF_std_name	Name of an XRF standard.
	XRF_replicate	Identifier for each replicate of a sample to allow all to be entered into the database.
	XRF_std_value	Expected results for a element in an XRF standard.
	XRF_calib_name	Name associated with a particular calibration, since the XRF may run multiple calibrations at any time.
XRF_Chk_Result	XRF_run_identifier	Operator-assigned run identifier. Must be unique during a leg.
	leg	Number identifying the cruise for which data were entered into the database.
	XRF_std_name	Name of an XRF standard.
	XRF_replicate	Identifier for analysis replicates of a standard to allow all to be entered into the database.
	XRF_analysis_code	Code for the element or oxide being analyzed.
	XRF_Analysis_Type	Type of analysis performed on an XRF sample: **MAJOR** (oxide) or **TRACE** (element).
	analysis_units	Measurement units used for an analysis: **wt%** (major oxides) or **ppm** (trace elements).
	XRF_analysis_result	Analytical result for an analysis code.

Janus XRF data model (continued).

Table name	Column name	Column comment
Section	section_id	Unique Oracle-generated sequence number to identify each section. This is done because of the physical subsection/zero section problems.When adding new sections, deleting sections, or changing sections, renumbering isn't necessary.
	leg	Number identifying the cruise for which data were entered into the database.
	site	Number identifying the site from which the core was retrieved.
	hole	Letter identifying the hole at a site from which a core was retrieved or data were collected.
	core	Sequential numbers identifying the cores retrieved from a particular hole.
	core_type	Letter code identifying the drill bit/coring method used to retrieve the core.
	section_number	Number identifying the serial position of a section from the top of the core downward.
	section_type	Differentiates sections of core (**S**) from core catchers (**C**). Previously core catchers were stored as section CC, but in Janus core catchers are given the next sequential number from the last section recovered.
	curated_length	Length of the section core material (meters). This may be different than the liner length for the same section. Hard rock cores may have spacers added to prevent rock pieces from damaging each other.
	liner_length	Original length of core material in section (meters). Sum of liner lengths of all the sections of a core equals core recovery.
	core_catcher_stored_in	Section number of D-tube that holds the core catcher.
	section_comments	Comments about this section
Sample	sample_id	Oracle-generated sequence number that with *location* uniquely identifies a sample.
	location	Code that indicates which Janus application assigned the sample_id: **SHI** (ship), **GCR** (Gulf Coast Repository), **ECR** (East Coast Repository), **WCR** (West Coast Repository), **BCR** (Bremen Core Repository). Used with *sample_id* to uniquely identify a sample.
	s_c_leg	Number identifying the cruise for which data were entered into the database. Foreign key used with *s_c_sampling_code* to link samples with a scientist's sample request.
	s_c_sampling_code	Code used to identify samples taken for a sample request. Used with *s_c_leg*.
	sam_archive_working	Part of section where sample was taken: **WR** (whole round), **A** (archive half), **W** (working half).
	top_interval	Distance (meters) from the top of the section to the top of the sample.
	bottom_interval	Distance (meters) from the top of the section to the bottom of the sample.
	piece	Additional identifier for hard rock samples. Each individual piece of rock within a section is numbered consecutively starting at the top of the section.
	sub_piece	Additional identifier for hard rock samples. When a piece is broken, individual fragments are given consecutive letter designations. Note that subpiece assignments must be made in conjunction with piece numbers.
	beaker_id	Number on the moisture density beaker. Used for samples analyzed for moisture and density.
	volume	Volume of sample.
	entered_by	Indicates who entered the sample into the database.
	sample_depth	Depth of the sample.
	sample_comment	Comment about the sample.
	sam_repository	Repository where sample was taken: **SHI** (ship), **GCR** (Gulf Coast Repository), **ECR** (East Coast Repository), **WCR** (West Coast Repository), **BCR** (Bremen Core Repository).
	sam_sample_code_lab	Code to indicate the shipboard laboratory that will perform the initial analysis.
	sam_section_id	Unique Oracle-generated sequence number to identify each section. This is a foreign key that links a sample to leg, site, hole, core, section.
	timestamp	Date and time when sample was entered into database. Samples taken before November 25, 1998, and migrated samples have the timestamp 11/25/1998 12:26 PM.
System_Type	system_id	Unique identifier for a system of equipment used to collect data.
	system_comments	Comments associated with a piece of analytical equipment.
	system_commissioned	Date when a piece of equipment was deployed to collect scientific data for ODP.
	system_decommissioned	Date when a piece of analytical equipment was no longer used by ODP.
	system_model_number	Model number of a piece of equipment used for scientific analysis.
	system_name	Name for a piece of equipment used for analysis.

Description of data items from XRF query.

Column name	Column description	Format
Leg	Number identifying the cruise.	Integer 3
Site	Number identifying the site.	Integer 4
Hole	Letter identifying the hole.	Text 1
Core	Number identifying the serial position of the core from the top of the hole downward.	Integer 3
Coretype	Letter identifying the coring method used.	Text 1
Section	Number identifying the serial position of a section from the top of the core downward. Core catcher sections identified as "CC."	Integer 2 (Text 2)
Top (cm)	Top interval of a measurement in centimeters measured from the top of a section.	Decimal F5.1
Bottom (cm)	Bottom interval of a measurement in centimeters measured from the top of a section.	Decimal F5.1
Depth (mbsf)	Distance (meters) from the seafloor to the sample location.	Decimal F7.3
Run	Identifier assigned by shipboard scientist or laboratory technician to identify a batch of samples.	Text 5
Replicate	Split of a sample	Text 3
Bead Loss on Ignition	Loss on ignition. The percentage of weight lost after igniting the XRF bead: [(post_ign_sample_wt/pre_ign_sample_wt) – 1] × (–100).	Decimal F5.2
Silica - SiO_2 (wt%)	Analytical result for major oxide silica (weight percent).	Decimal F15.5
Titanium Oxide - TiO_2 (wt%)	Analytical result for major titanium oxide (weight percent).	Decimal F15.5
Aluminum Oxide - Al_2O_3 (wt%)	Analytical result for major aluminum oxide (weight percent).	Decimal F15.5
Iron Oxide - Fe_2O_3* (wt%)	Analytical result for major iron oxide (weight percent).	Decimal F15.5
Manganous Oxide - MnO (wt%)	Analytical result for major manganous oxide (weight percent).	Decimal F15.5
Magnesium Oxide - MgO (wt%)	Analytical result for major magnesium oxide (weight percent).	Decimal F15.5
Calcium Oxide - CaO (wt%)	Analytical result for major calcium oxide (weight percent).	Decimal F15.5
Sodium Oxide - Na_2O (wt%)	Analytical result for major sodium oxide (weight percent).	Decimal F15.5
Potassium Oxide - K_2O (wt%)	Analytical result for major potassium oxide (weight percent).	Decimal F15.5
Phosphorus Pentoxide - P_2O_5 (wt%)	Analytical result for major phosphorus Pentoxide (weight percent).	Decimal F15.5
Niobium - Nb (ppm)	Analytical result for trace element niobium (parts per million).	Decimal F15.5
Zirconium - Zr (ppm)	Analytical result for trace element zirconium (parts per million).	Decimal F15.5
Yttrium - Y (ppm)	Analytical result for trace element yttrium (parts per million).	Decimal F15.5
Sulfur - S (ppm)	Analytical result for trace element sulfur (parts per million).	Decimal F15.5
Strontium - Sr (ppm)	Analytical result for trace element strontium (parts per million).	Decimal F15.5
Rubidium - Rb (ppm)	Analytical result for trace element rubidium (parts per million).	Decimal F15.5
Scandium - Sc (ppm)	Analytical result for trace element scandium (parts per million).	Decimal F15.5
Molybdenum - Mo (ppm)	Analytical result for trace element molybdenum (parts per million).	Decimal F15.5
Beryllium - Be (ppm)	Analytical result for trace element beryllium (parts per million).	Decimal F15.5
Thorium - Th (ppm)	Analytical result for trace element thorium (parts per million).	Decimal F15.5
Cobalt - Co (ppm)	Analytical result for trace element cobalt (parts per million).	Decimal F15.5
Gadolinium - Gd (ppm)	Analytical result for trace element gadolinium (parts per million).	Decimal F15.5
Dysprosium - Dy (ppm)	Analytical result for trace element dysprosium (parts per million).	Decimal F15.5
Erbium - Er (ppm)	Analytical result for trace element erbium (parts per million).	Decimal F15.5
Ytterbium - Yb (ppm)	Analytical result for trace element ytterbium (parts per million).	Decimal F15.5
Hafnium - Hf (ppm)	Analytical result for trace element hafnium (parts per million).	Decimal F15.5
Lead - Pb (ppm)	Analytical result for trace element lead (parts per million).	Decimal F15.5
Gallium - Ga (ppm)	Analytical result for trace element gallium (parts per million).	Decimal F15.5
Zinc - Zn (ppm)	Analytical result for trace element zinc (parts per million).	Decimal F15.5
Copper - Cu (ppm)	Analytical result for trace element copper (parts per million).	Decimal F15.5
Nickel - Ni (ppm)	Analytical result for trace element nickel (parts per million).	Decimal F15.5
Chromium - Cr (ppm)	Analytical result for trace element chromium (parts per million).	Decimal F15.5
Vanadium - V (ppm)	Analytical result for trace element vanadium (parts per million).	Decimal F15.5
Cerium - Ce (ppm)	Analytical result for trace element cerium (parts per million).	Decimal F15.5
Barium - Ba (ppm)	Analytical result for trace element barium (parts per million).	Decimal F15.5
Cesium - Cs (ppm)	Analytical result for trace element cesium (parts per million).	Decimal F15.5
Lanthanum - La (ppm)	Analytical result for trace element lanthanum (parts per million).	Decimal F15.5
Neodymium - Nd (ppm)	Analytical result for trace element neodymium (parts per million).	Decimal F15.5
Samarium - Sm (ppm)	Analytical result for trace element samarium (parts per million).	Decimal F15.5
Sample Type	Type of rock or sediment (e.g., **basalt**, **gabbro**, **sediment**).	Text 40
Comment	Comment about XRF analysis or additional information about the sample type.	Text 80

PUBLISHER'S NOTES

ODP Information Technology and Data Services, 2007. ODP prime scientific data: collection, archive, and quality. *ODP Tech. Note,* 37 [Online]. Available from World Wide Web: <http://www-odp.tamu.edu/publications/tnotes/tn37/INDEX.HTM>. [Cited YYYY-MM-DD]

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DISCLAIMER

Table T1. Prime data types.

Prime scientific data	Data availability	Leg first collected
Operations and core summary:		
Leg summary and details	Janus	101
Site summary	Janus	101
Hole operations summary	Janus	101
Core summary	Janus	101
Lithology and stratigraphy:		
Visual core description	Janus – prime data images *Initial Reports* volumes	101
Core photos	Janus – scanned photographs	101
Reentry videos	IODP/TAMU Data Librarian	
Digital scanning of sections	Janus	198
Spectral reflectance and colorimetry	Janus	154
Paleomagnetism	Janus	103
Tensor	Janus	174
Smear slides and thin sections	IODP/TAMU Data Librarian *Initial Reports* volumes	101
Biology and stratigraphy:		
Paleontology	Janus*	101
Age profile	Janus*	101
Microbiology	IODP/TAMU Data Librarian	185
Geochemistry and mineralogy:		
Carbon/Carbonate content	Janus	101
Gas chromatography (GC)	Janus	101
Inductively coupled plasma–atomic emission spectroscopy (ICP-AES)	Janus	187
Interstitial water	Janus	101
Rock-eval pyrolysis	Janus	101
X-ray fluorescence (XRF)	Janus	106
X-ray diffraction (XRD)	Janus	106
Physical Properties:		
Gamma ray attenuation (GRA) density	Janus	101
Index properties (moisture and density [MAD])	Janus	101
Magnetic susceptibility logger (MSL)	Janus	101
Natural gamma radiation (NGR)	Janus	150
P-wave velocity logger (PWL)	Janus	108
Shear strength	Janus	101
Sonic velocity (samples)	Janus	101
Thermal conductivity	Janus	101
Temperature and geophysics:		
Downhole temperature	Janus	104
Underway geophysics and bathymetry	National Geophysical Data Center IODP/TAMU Data Librarian	101
Seismic surveys	IODP/TAMU Data Librarian	101

Note: * = migration of these data to be completed by 2007. Contact **IODP/TAMU Data Librarian** for information.

Table T2. Carbon analyses instruments.

Instrument	Analytical result
Carbonate bomb	Carbonate carbon ($CaCO_3$)
Perkin Elmer 240C CHN elemental analyzer	Total carbon, nitrogen, sulfur
Coulometrics 5020 total carbon apparatus	Total carbon
Coulometrics 5030 carbonate carbon apparatus	Inorganic carbon (carbonate)
Coulometrics 5011 coulometer	Organic and inorganic carbon
Carlo Erba CNS elemental analyzer 1106	Total carbon, nitrogen, sulfur, and hydrogen
Carlo Erba NA 1500 CNS analyzer	Total carbon, nitrogen, sulfur, and hydrogen

Table T3. Carbonates query.

Item name	Janus table	Janus column name and calculation
Leg	SECTION	Leg
Site	SECTION	Site
Hole	SECTION	Hole
Core	SECTION	Core
Coretype	SECTION	Core_type
Section	SECTION	Section_number
Top Interval	SAMPLE	Top_Interval × 100
Bottom Interval	SAMPLE	Bottom_Interval × 100
Depth (meters below seafloor [mbsf])	DEPTH_MAP, SAMPLE	DEPTH_MAP.Map_interval_top + SAMPLE.Top_interval
Inorganic Carbon Percent	CHEM_CARB_ANALYSIS	Analysis_code - INOR_C::Analysis_result
$CaCO_3$ Percent	CHEM_CARB_ANALYSIS	Analysis_code - CaCO3::Analysis_result
Total Carbon Percent	CHEM_CARB_ANALYSIS	Analysis_code - TOT_C::Analysis_result
Organic Carbon Percent	CHEM_CARB_ANALYSIS	Analysis_code - ORG_C::Analysis_result
Nitrogen Percent	CHEM_CARB_ANALYSIS	Analysis_code - NIT::Analysis_result
Sulfur Percent	CHEM_CARB_ANALYSIS	Analysis_code - SUL::Analysis_result
Hydrogen	CHEM_CARB_ANALYSIS	Analysis_code - H::Analysis_result

Table T4. Gas elements query.

Item name	Janus table	Janus column name or calculation
Leg	SECTION	Leg
Site	SECTION	Site
Hole	SECTION	Hole
Core	SECTION	Core
Type	SECTION	Core_type
Section	SECTION	Section_number
Top (cm)	SAMPLE	Top_interval × 100
Bottom (cm)	SAMPLE	Bottom_interval × 100
Depth (mbsf)	DEPTH_MAP, SAMPLE	DEPTH_MAP.Map_interval_top + SAMPLE.Top_interval
Methane/Ethane (C_1/C_2 ratio)	CHEM_GAS_ANALYSIS	Calculated
Methane (C_1) [ppm]	CHEM_GAS_ANALYSIS	GAS_ANALYSIS_CODE – C1::GAS_ANALYSIS_RESULT
Ethane (C_2) [ppm]	CHEM_GAS_ANALYSIS	GAS_ANALYSIS_CODE – C2::GAS_ANALYSIS_RESULT
Ethylene ($C_{2=}$) [ppm]	CHEM_GAS_ANALYSIS	GAS_ANALYSIS_CODE – C2=::GAS_ANALYSIS_RESULT
Ethane + Ethylene ($C_2 + C_{2=}$) [ppm]	CHEM_GAS_ANALYSIS	Calculated
Propane (C_3) [ppm]	CHEM_GAS_ANALYSIS	GAS_ANALYSIS_CODE – C3::GAS_ANALYSIS_RESULT
Propane + Propylene ($C_3 + C_{3=}$) [ppm]	CHEM_GAS_ANALYSIS	Calculated
Propylene ($C_{3=}$) [ppm]	CHEM_GAS_ANALYSIS	GAS_ANALYSIS_CODE – C3=::GAS_ANALYSIS_RESULT
i-Butane (*i*-C_4) [ppm]	CHEM_GAS_ANALYSIS	GAS_ANALYSIS_CODE – I-C4::GAS_ANALYSIS_RESULT
n-Butane (*n*-C_4) [ppm]	CHEM_GAS_ANALYSIS	GAS_ANALYSIS_CODE – N-C4::GAS_ANALYSIS_RESULT
n-Pentane (*n*-C_5) [ppm]	CHEM_GAS_ANALYSIS	GAS_ANALYSIS_CODE – N-C5::GAS_ANALYSIS_RESULT
i-Pentane (*i*-C_5) [ppm]	CHEM_GAS_ANALYSIS	GAS_ANALYSIS_CODE – I-C5::GAS_ANALYSIS_RESULT
n-Hexane (*n*-C_6) [ppm]	CHEM_GAS_ANALYSIS	GAS_ANALYSIS_CODE – N-C6::GAS_ANALYSIS_RESULT
i-Hexane (*i*-C_6) [ppm]	CHEM_GAS_ANALYSIS	GAS_ANALYSIS_CODE – I-C6::GAS_ANALYSIS_RESULT
n-Heptane (*n*-C_7) [ppm]	CHEM_GAS_ANALYSIS	GAS_ANALYSIS_CODE – N-C7::GAS_ANALYSIS_RESULT
i-Heptane (*i*-C_7) [ppm]	CHEM_GAS_ANALYSIS	GAS_ANALYSIS_CODE – I-C7::GAS_ANALYSIS_RESULT
Nitrogen (N_2) [ppm]	CHEM_GAS_ANALYSIS	GAS_ANALYSIS_CODE – N2::GAS_ANALYSIS_RESULT
Oxygen (O_2) [ppm]	CHEM_GAS_ANALYSIS	GAS_ANALYSIS_CODE – O2::GAS_ANALYSIS_RESULT
Hydrogen Sulfide (H_2S) [ppm]	CHEM_GAS_ANALYSIS	GAS_ANALYSIS_CODE – H2S::GAS_ANALYSIS_RESULT
Carbon Dioxide (CO_2) [ppm]	CHEM_GAS_ANALYSIS	GAS_ANALYSIS_CODE – CO2::GAS_ANALYSIS_RESULT
Run	CHEM_GAS_SAMPLE	Run_ID
Instrument	CHEM_GAS_SAMPLE	Method_code
Method	CHEM_GAS_SAMPLE	Gas_sample_method
Detector	CHEM_GAS_SAMPLE	Gas_detector_signal

Table T5. GRA densiometer systems.

ODP leg	Equipment	Comments
101–115 (Site 713)	DSDP GRAPE	Leg 108: PWL mounted on GRAPE sample track. Leg 113: data acquisition software installed on DEC Pro350.
115 (Site 714)–124	Vertical GRAPE	GRAPE source and detectors mounted on a vertical track.
124E	MST, GRA; ^{137}Cs source, 660 KeV gamma rays, standard NaI scintillation detector	Initial installation of MST with GRA, PWL, and MSL. Not all software compatible with shipboard environment, but system operational.
125–133	MST, GRA	Minor software changes during this time.
133 (Site 818)–150	MST, GRA	Leg 133: major software upgrade. Boyce-corrected density calculated and written into the data files. Leg 149: NGR added to track.
151–162	MST, GRA	Leg 151: major software upgrade.
163–169 (Site 1036)	MST, GRA	Major software upgrade installed during Leg 163 port call.
169 (Site 1037)–187	MST, GRA	Hardware and software upgrade. Fluid density correction made within program as a result of new calibration procedure. Leg 171: Janus database operational.
188–210	MST, GRA	Minor software changes during this time.

Table T6. GRA calibration procedures.

Leg	Calibration standard	Calibration procedure
101–164	80 cm tapered aluminum rod in liner.	Run aluminum rod until density values of 2.7 and 1.0 were measured.
164–169 (Site 1036)	80 cm tapered aluminum rod in liner.	Calibration file created.
169 (Site 1037)–210	Telescoping aluminum rod, 6.6–0 cm diameter, in liner filled with distilled water.	Two-phase standard incorporates correct water density into calibration parameters.

Table T7. GRA bulk density query with output raw data option.

Item name	Janus table	Janus column name and calculation
Leg	SECTION	Leg
Site	SECTION	Site
Hole	SECTION	Hole
Core	SECTION	Core
Type	SECTION	Core_type
Section	SECTION	Section_number
Top (cm)	GRA_SECTION_DATA	MST_Top_Interval × 100
Depth (mbsf)	DEPTH_MAP, GRA_SECTION_DATA	DEPTH_MAP.Map_Interval_Top + GRA_SECTION_DATA.MST_Top_Interval
Density (g/cm^3)	GRA_SECTION_DATA	Legs 169 (Site 1037)–210: (see **Equation 2,** p. 15) Legs 101–169 (Site 1036): GRA_SECTION_DATA.boyce_corrected_density (see **Equation 1,** p. 15)
Run Number	GRA_SECTION	Run_Number
Run Date/Time	GRA_SECTION	Run_Date_Time (yyyy-mm-dd hh:mm)
Core Status	GRA_SECTION	Core_Status
Liner Status	GRA_SECTION	Liner_Status
Requested Interval	GRA_SECTION	Requested_DAQ_Interval (Legs 101–162 interval units in seconds, Legs 163–210 interval units in cm)
Requested Period (s)	GRA_SECTION	Requested_DAQ_Period
Actual Period (s)	GRA_SECTION_DATA	Actual_DAQ_Period
Counts per second	GRA_SECTION_DATA	Meas_Counts
Core Diameter (cm)	GRA_SECTION_DATA	Core_Diameter
Calibration Date/Time	GRA_CALIBRATION	Calibration_Date_Time (yyyy-mm-dd hh:mm)
Calibration Intercept (g/cm^3)	GRA_CALIBRATION	Density_M0
Calibration Slope (g/cm^3)	GRA_CALIBRATION	Density_M1

Table T8. GRA analysis statistics.

Coring method (core type)	Core recovery (m)	GRA analyzed (m)	Percent
APC	113,999	103,518	90.8
XCB	61,638	51,054	82.8
RCB	45,869	29,755	64.9
Total:	222,429	184,476	82.9

Table T9. ICP-AES standard reference materials. (**See table note.** Continued on next page.)

ICP-AES standard	Replicate	Rock type	Comment
152-11	A	MORB	
152-75	A	MORB	
AGV-1	A	Andesite	
AII-92-29-1	A	MORB/Basalt	
AII-92-29-1	X	MORB/Basalt	
AMERSIL	A	Blank for background	
BA-0500	A	Line overlap standard	
BA-1000	A	Line overlap standard	
BA-2000	A	Line overlap standard	
BAS-140	A	Diabase (504B)	
BAS-148	A	Basalt	
BE-N	A	Basalt	
BE-N (BR)	A	Alkali basalt	
BE-N (PP)	A	Basalt	Pressed pellet
BHVO-1	A	Tholeiite/Basalt	
BHVO-1	B		
BHVO-1	TR1	Pressed pellet	
BHVO-2	A	Basalt	
BIR-1	A	Basalt	
BOB-1	A	MORB	
BR-1	A	Basalt	
CaCO3	A	Blank for background	ULTREX
CE-0500	A	Line overlap standard	
CE-1000	A	Line overlap standard	
CE-2000	A	Line overlap standard	
DNC-1	A	Diabase	
DR-N	A	Diorite	Leg 173, 12:1 ratio with Flux VII, NT-2100 bead
FE2O3	A	Blank for background	
Flux IX	A	Blank bead	
G-2	A	Granite	
G-2 (PP)	A	Granite	Pressed pellet
GBM-1	A	Garnet	
JA-1	A	Andesite	
JA-2	A	Andesite	
JA-3	A	Andesite	
JB-1A	A	Basalt	
JB-2	A	Basalt	
JB-3	B	Basalt	
JF-1	A	Feldspar	
JF-2	A	Feldspar	
JG-1a	A	Granite	MAJOR
JG-1a	B	Granodiorite	TRACE
JG-2	A	Granite	
JG-3	A	Granodiorite	
JGB-1	A	Gabbro	
JP-1	A	Peridotite	
JR-1	A	Rhyolite	
JR-2	A	Rhyolite	
K1919	A	Tholeiite	
LI2B407	A	Blank for background	
MAG-1	A	Sediment	
MGO	A	Blank for background	
Mica-Fe	A	Biotite	
Mica-Mg	A	Phlogopite	
MRG-1	A	Gabbro	

Table T9 (continued).

ICP-AES standard	Replicate	Rock type	Comment
NBS-1c	A	Limestone	
NBS-278	A	Obsidian	
NBS-688	A	Basalt	
NIM-D	A	Dunite	
NIM-P	A	Pyroxenite	
PCC-1	A	Peridotite	
RB-0500	A	Line overlap standard	
RB-1000	A	Line overlap standard	
RB-2000	A	Line overlap standard	
RGM-1	A	Rhyolite	
SCo-1	A	Shale	
SCo-1	B	Cody shale	Pressed pellet
SCo-1	TR1	Pressed pellet	
SCo-1	X	Cody shale	
SDC-1	A	Mica schist	
SR-0500	A	Line overlap standard	
SR-1000	A	Line overlap standard	
SR-2000	A	Line overlap standard	
STM-1	A	Syenite	
SY-2	A	Syenite	
TI-0500	A	Line overlap standard	
TI-1000	A	Line overlap standard	
TIO2-9.3%	A	Line overlap standard	
UB-N	A	Serpentinite	Leg 173, 12:1 ratio with Flux VII, NT-2100 bead
UB-N (PP)	A	Serpentinite	Pressed pellet
V-0500	A	Line overlap standard	
V-1000	A	Line overlap standard	
V-2000	A	Line overlap standard	
W-2	A	Diabase	
Y-0500	A	Line overlap standard	
Y-1000	A	Line overlap standard	
Y-2000	A	Line overlap standard	

Note: ICP-AES = inductively coupled plasma–atomic emission spectroscopy, MORB = mid-ocean-ridge basalt.

Table T10. ICP-AES query.

Item name	Janus table	Janus column name and calculation
Leg	SECTION	Leg
Site	SECTION	Site
Hole	SECTION	Hole
Core	SECTION	Core
Type	SECTION	Core_type
Section	SECTION	Section_number
Top (cm)	SAMPLE	Top_interval × 100 cm/m
Bottom (cm)	SAMPLE	Bottom_interval × 100 cm/m
Depth (mbsf)	DEPTH_MAP, SAMPLE	Calculated by GET_DEPTH(S) function; data not stored
Run	XRF_SAMPLE	XRF_Run_Identifier
Replicate	XRF_SAMPLE	XRF_Replicate
Bead Loss on Ignition	XRF_SAMPLE	Bead_LOI
Silica - SiO_2 (wt%)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– SiO2::XRF_Analysis_Result
Titanium oxide - TiO_2 (wt%)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– TiO2::XRF_Analysis_Result
Aluminum oxide - Al_2O_3 (wt%)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Al2O3::XRF_Analysis_Result
Iron Oxide - Fe_2O_3* (wt%)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Fe2O3*::XRF_Analysis_Result
Manganous Oxide - MnO (wt%)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– MnO::XRF_Analysis_Result
Magnesium Oxide - MgO (wt%)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– MgO::XRF_Analysis_Result
Calcium Oxide - CaO (wt%)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– CaO::XRF_Analysis_Result
Sodium Oxide - Na_2O (wt%)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Na2O::XRF_Analysis_Result
Potassium Oxide - K_2O (wt%)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– K2O::XRF_Analysis_Result
Phosphorus Pentoxide - P_2O_5 (wt%)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– P2O5::XRF_Analysis_Result
Niobium - Nb (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Nb::XRF_Analysis_Result
Zirconium - Zr (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Zr::XRF_Analysis_Result
Yttrium - Y (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Y::XRF_Analysis_Result
Sulfur - S (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– S::XRF_Analysis_Result
Strontium - Sr (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Sr::XRF_Analysis_Result
Rubidium - Rb (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Rb::XRF_Analysis_Result
Scandium - Sc (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Sc::XRF_Analysis_Result
Molybdenum - Mo (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Mo::XRF_Analysis_Result
Beryllium - Be (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Be::XRF_Analysis_Result
Thorium - Th (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Th::XRF_Analysis_Result
Cobalt - Co (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Co::XRF_Analysis_Result
Gadolinium - Gd (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Gd::XRF_Analysis_Result
Dysprosium - Dy (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Dy::XRF_Analysis_Result
Erbium - Er (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Er::XRF_Analysis_Result
Ytterbium - Yb (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Yb::XRF_Analysis_Result
Hafnium - Hf (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Hf::XRF_Analysis_Result
Lead - Pb (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Pb::XRF_Analysis_Result
Gallium - Ga (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Ga::XRF_Analysis_Result
Zinc - Zn (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Zn::XRF_Analysis_Result
Copper - Cu (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Cu::XRF_Analysis_Result
Nickel - Ni (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Ni::XRF_Analysis_Result
Chromium - Cr (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Cr::XRF_Analysis_Result
Vanadium - V (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– V::XRF_Analysis_Result
Cerium - Ce (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Ce::XRF_Analysis_Result
Barium - Ba (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Ba::XRF_Analysis_Result
Cesium - Cs (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Cs::XRF_Analysis_Result
Lanthanum - La (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– La::XRF_Analysis_Result
Neodymium - Nd (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Nd::XRF_Analysis_Result
Samarium - Sm (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Sample_Code– Sm::XRF_Analysis_Result
Sample Type	XRF_SAMPLE_TYPE	Sample_Type
Comment	XRF_SAMPLE	XRF_Comment

Table T11. Interstitial water analyses instruments and methods.

Instrumentation	Analytical result	Code
Atomic absorption spectrophotometer	B, Ca, Fe, H_4SiO_4, K, Li, Mg, Mn, Na, Rb, Sr	AAS
Atomic emission spectrometer	Fe, K, Li, Mn, Na, Rb, Sr	AES
Coulometer	DIC	C
Charge balance	Na	CB
Ion exchange	pH	E
Gas chromatography	H_2, H_2S	GC4
Ion chromatography	Ca, Cl, H_4SiO_4, K, Li, Mg, Na, SO_4	I
ICP-AES	Al, B, Ba, Ca, Fe, H_4SiO_4, K, Li, Mg, Mn, Na, SO_4, Sr, Zn	ICP
Ion exchange chromatography	Acetate, formate	IEC
Ion specific electrode	F, pH	ISE
Ion specific electrode punch	ppH	ISEP
Refractometry	Salinity	R
Spectrophotometry	B, Br, Ca, Cl, F, H_2S, H_4SiO_4, HPO_4, JWBL, K, Li, Mg, Mn, NH_4, NO_2, NO_3, Na, Rb, SO_4	S
Titration	Alkalinity, Ca, Cl, H_4SiO_4, HPO_4, K, Mg, NH_4, Na, SO_4, pH	T
Total organic carbon	DIC, DOC	TOC

Note: ICP-AES = inductively coupled plasma–atomic emission spectrometry, JWBL = internal standard, DIC = dissolved inorganic carbon, DOC = dissolved organic carbon.

Table T12. Interstitial water query with analysis method option. (Continued on next page.)

Item name	Janus table	Janus column name and calculation
Leg	SECTION	Leg
Site	SECTION	Site
Hole	SECTION	Hole
Core	SECTION	Core
Coretype	SECTION	Core_type
Section	SECTION	Section_number
Top Interval	SAMPLE	Top_Interval × 100
Bottom Interval	SAMPLE	Bottom_Interval × 100
Depth (mbsf)	DEPTH_MAP, SAMPLE	DEPTH_MAP.Map_interval_top + SAMPLE.Top_interval
Aluminum (Al) [μM]	CHEM_IW_ANALYSIS	Analysis_code – Al::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – Al::Method_code
Ammonia (NH_4) [μM]	CHEM_IW_ANALYSIS	Analysis_code – NH4::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – NH4::Method_code
Boron (B) [mM]	CHEM_IW_ANALYSIS	Analysis_code – B::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – B::Method_code
Bromide (Br) [μM]	CHEM_IW_ANALYSIS	Analysis_code – Br::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – Br::Method_code
Calcium (Ca) [mM]	CHEM_IW_ANALYSIS	Analysis_code – Ca::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – Ca::Method_code
Chlorinity (Cl) [mM]	CHEM_IW_ANALYSIS	Analysis_code – Cl::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – Cl::Method_code
Fluoride (F) [μM]	CHEM_IW_ANALYSIS	Analysis_code – F::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – F::Method_code
Iodide (I) [μM]	CHEM_IW_ANALYSIS	Analysis_code – I::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – I::Method_code
Iron (Fe) [μM]	CHEM_IW_ANALYSIS	Analysis_code – Fe::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – Fe::Method_code
Lithium (Li) [μM]	CHEM_IW_ANALYSIS	Analysis_code – Li::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – Li::Method_code
Magnesium (Mg) [mM]	CHEM_IW_ANALYSIS	Analysis_code – Mg::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – Mg::Method_code
Manganese (Mn) [μM]	CHEM_IW_ANALYSIS	Analysis_code – Mn::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – Mn::Method_code
Nitrate (NO_3) [μM]	CHEM_IW_ANALYSIS	Analysis_code – NO3::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – NO3::Method_code
pH [NA]	CHEM_IW_ANALYSIS	Analysis_code – pH::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – pH::Method_code
Phosphate (HPO_4) [μM]	CHEM_IW_ANALYSIS	Analysis_code – HPO4::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – HPO4::Method_code
Potassium (K) [mM]	CHEM_IW_ANALYSIS	Analysis_code – K::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – K::Method_code

Table T12 (continued).

Item name	Janus table	Janus column name and calculation
Rubidium (Rb) [μM]	CHEM_IW_ANALYSIS	Analysis_code – Rb::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – Rb::Method_code
Sodium (Na) [mM]	CHEM_IW_ANALYSIS	Analysis_code – Na::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – Na::Method_code
Strontium (Sr) [μM]	CHEM_IW_ANALYSIS	Analysis_code – Sr::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – Sr::Method_code
Sulfate (SO_4) [mM]	CHEM_IW_ANALYSIS	Analysis_code – SO4::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – SO4::Method_code
Silica (H_4SiO_4) [μM]	CHEM_IW_ANALYSIS	Analysis_code – H4SiO4::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – H4SiO4::Method_code
Alkalinity (ALK) [mM]	CHEM_IW_ANALYSIS	Analysis_code – ALK::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – ALK::Method_code
Salinity (SAL) [NA]	CHEM_IW_ANALYSIS	Analysis_code – SAL::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – SAL::Method_code
Barium (Ba) [μM]	CHEM_IW_ANALYSIS	Analysis_code – Ba::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – Ba::Method_code
Lead (Pb) [μM]	CHEM_IW_ANALYSIS	Analysis_code – Pb::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – Pb::Method_code
Hydrogen (H_2) [nM]	CHEM_IW_ANALYSIS	Analysis_code – H2::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – H2::Method_code
Dissolved Inorganic Carbon (DIC) [mM]	CHEM_IW_ANALYSIS	Analysis_code – DIC::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – DIC::Method_code
Formate [μM]	CHEM_IW_ANALYSIS	Analysis_code – Formate::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – Formate::Method_code
pH punch in [NA]	CHEM_IW_ANALYSIS	Analysis_code – pH punch in::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – pH punch in::Method_code
Dissolved Organic Carbon (DOC) [mM]	CHEM_IW_ANALYSIS	Analysis_code –- DOC::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – DOC::Method_code
Acetate [μM]	CHEM_IW_ANALYSIS	Analysis_code – Acetate::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – Acetate::Method_code
Color (JWBL) [NA]	CHEM_IW_ANALYSIS	Analysis_code – JWBL::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – JWBL::Method_code
Nitrite (NO_2) [μM]	CHEM_IW_ANALYSIS	Analysis_code – NO2::Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – NO2::Method_code
Total Sulfide (H_2S) [μM]	CHEM_IW_ANALYSIS	Analysis_code – H2S:Analysis_result
Method	CHEM_IW_ANALYSIS	Analysis_code – H2S::Method_code

Note: NA = not applicable.

Table T13. MAD property determination methods.

Property	Formula	Method A	Method B	Method C	Method D
Material		Soft, saturated	Saturated	Saturated	Unsaturated
Use recommended		No	No	Yes	Yes
Measurements					
Total mass (M_t)		M_t	M_t	M_t	
Dry mass (M_d)		M_d	M_d	M_d	M_d
Total volume (V_t)		V_t (fixed)	V_t*		V_t (geometry)
Dry volume (V_d)				V_d*	V_d*
Method-specific calculations for M_t, M_{pw}, V_t, and V_{pw}:					
Mass of pore water (saturated, M_{pw1})	$(M_t - M_d)/(1 - s/1000)$	M_{pw1}	M_{pw1}	M_{pw1}	
Volume of pore water (saturated, V_{pw1})	M_{pw1}/D_{pw}	V_{pw1}	V_{pw1}	V_{pw1}	
Total volume (V_t)	$V_d - V_{salt} + V_{pw1}$			V_t	
Dry volume (V_d)	$V_s + V_{salt}$	V_d	V_d		
Volume of pore water (unsaturated, V_{pw2})	$V_w = V_t - V_d$				V_{pw2}
Mass of pore water (unsaturated, M_{pw2})	$M_{pw2} = V_w \times D_{pw}$				M_{pw2}
Total mass (M_t)	$M_d + M_w = M_d + (V_t - V_d) \times D_w$				M_t

Note: * = pycnometer.

Table T14. MAD properties and formulas.

Property	Value or formula
Assumptions:	
Density of water (D_w)	1.000
Density of pore water (D_{pw})	1.024
Density of salt (D_{salt})	2.222
Salinity of pore water (s)	35
Additional calculations:	
Mass of salt (D_{salt})	$M_{pw} - (M_t - M_d)$
Volume of salt (V_{salt})	M_{salt}/D_{salt}
Mass of solids (M_s)	$M_d - M_{salt}$
Volume of solids (V_s)	$V_d - V_{salt}$
MAD property calculations:	
Water content (WW)	M_{pw}/M_t
Water content (WD)	M_{pw}/M_s
Bulk density (BD)	M_t/V_t
Dry density (DD)	M_s/V_t
Grain density (GD)	M_s/V_s
Porosity (PO)	V_{pw}/V_t
Void ratio (VR)	V_{pw}/V_s

Table T15. MAD query with output raw data option.

Item name	Janus table	Janus column name
Leg	SECTION	Leg
Site	SECTION	Site
Hole	SECTION	Hole
Core	SECTION	Core
Coretype	SECTION	Core_type
Section	SECTION	Section_number
Top (cm)	SAMPLE	Top_interval × 100
Bottom (cm)	SAMPLE	Bottom_interval ×100
Depth (mbsf)	DEPTH_MAP, SAMPLE	DEPTH_MAP.Map_interval_top + SAMPLE.Top_interval
Water content (bulk) (%)	MAD_SAMPLE_DATA	Calculated or *Water_content_bulk*
Water content (dry) (%)	MAD_SAMPLE_DATA	Calculated or *Water_content_dry*
Bulk density (g/cm^3)	MAD_SAMPLE_DATA	Calculated or *Bulk_density*
Dry density (g/cm^3)	MAD_SAMPLE_DATA	Calculated or *Dry_density*
Grain density (g/cm^3)	MAD_SAMPLE_DATA	Calculated or *Grain_density*
Porosity (%)	MAD_SAMPLE_DATA	Calculated or *Porosity*
Void ratio	MAD_SAMPLE_DATA	Calculated or *Void_ratio*
Mass (bulk + beaker) (g)	MAD_SAMPLE_DATA	Mass_wet_and_beaker
Mass (dry + beaker) (g)	MAD_SAMPLE_DATA	Mass_dry_and_beaker
Volume (bulk + beaker) (cm^3)	MAD_SAMPLE_DATA	Vol_wet_and_beaker
Stdev (Volume [bulk + beaker])	MAD_SAMPLE_DATA	Vol_wet_and_beaker_stdev
Number of measurements (Volume [bulk + beaker])	MAD_SAMPLE_DATA	Vol_wet_and_beaker_n
Cell (Volume [bulk + beaker])	MAD_SAMPLE_DATA	Vol_wet_and_beaker_cell
Volume (dry + beaker) (cm^3)	MAD_SAMPLE_DATA	Vol_dry_and_beaker
Stdev (Volume [dry + beaker])	MAD_SAMPLE_DATA	Vol_dry_and_beaker_stdev
Number of measurements (Volume [dry + beaker])	MAD_SAMPLE_DATA	Vol_dry_and_beaker_n
Cell (Volume [dry + beaker])	MAD_SAMPLE_DATA	Vol_dry_and_beaker_cell
Date/Time	MAD_SAMPLE_DATA	Sample_date_time
Beaker	MAD_SAMPLE_DATA	Mad_beaker_id
Mass beaker (g)	MAD_BEAKER_HISTORY	Beaker_mass
Volume beaker (cm^3)	MAD_BEAKER_HISTORY	Beaker_volume
Mass wet (g)	MAD_SAMPLE_DATA	MAD_SAMPLE_DATA.Mass_wet_and_beaker – MAD_BEAKER_HISTORY.Beaker_mass
Mass dry (g)	MAD_SAMPLE_DATA	MAD_SAMPLE_DATA.Mass_dry_and_beaker – MAD_BEAKER_HISTORY.Beaker_mass
Mass of pore water (g)	MAD_SAMPLE_DATA	Calculated
Mass of solids (salt corrected) (g)	MAD_SAMPLE_DATA	Calculated
Volume of pore water (cm^3)	MAD_SAMPLE_DATA	Calculated
Mass of evaporated salt (g)	MAD_SAMPLE_DATA	Calculated
Volume of evaporated salt (cm^3)	MAD_SAMPLE_DATA	Calculated
Volume bulk (cm^3)	MAD_SAMPLE_DATA	MAD_SAMPLE_DATA.Vol_wet_and_beaker – MAD_BEAKER_HISTORY.Beaker_volume
Volume solids (cm^3)	MAD_SAMPLE_DATA	Calculated
Volume dry (cm^3)	MAD_SAMPLE_DATA	MAD_SAMPLE_DATA.Vol_dry_and_beaker – MAD_BEAKER_HISTORY.Beaker_volume
Method	MAD_SAMPLE_DATA	Method
Comments	MAD_SAMPLE_DATA	Comments

Table T16. MSL data acquisition systems.

Leg	Equipment	Comments
101–114	MS1; 100 mm loop	Data collected under Bartington instrument control?
115–124	MS1; 80 mm loop	Data collected under Bartington instrument control?
124–130	MS1; 80 mm loop	Initial installation of MST with GRA, PWL, and MSL. Not all software compatible with shipboard environment but system operational.
131–133 (Site 817)	MST, MS1; 80 mm loop	Software upgrade? Data no longer stored in S1032. Magnetic susceptibility value in SI units, probably not volume-corrected.
133 (Site 818)–150	MST, MS1; 80 mm loop	Leg 133: Major software upgrade. Other minor software changes, data file format changes. Leg 149: NGR added to track.
151–162	MST, MS1; 80 mm loop	Leg 151 – Major software upgrade.
163–169 (Site 1036)	MST, MS1; 80 mm loop	Major software upgrade installed during Leg 163 port call. Elapsed time data for drift correction saved.
169 (Site 1037)–187	MST, MS2C; 80 mm loop	Hardware and software upgrade. Leg 171 Janus database operational.
188–210	MST, MS2C; 80 mm loop	Minor software changes.

Table T17. MSL query with output raw data option.

Item name	Janus table	Janus column name and calculation
Leg	SECTION	Leg
Site	SECTION	Site
Hole	SECTION	Hole
Core	SECTION	Core
Type	SECTION	Core_type
Section	SECTION	Section_number
Top (cm)	MSL_SECTION_DATA	MST_Top_Interval × 100
Depth (mbsf)	DEPTH_MAP, MSL_SECTION_DATA	DEPTH_MAP.Map_Interval_Top + MSL_SECTION_DATA.MST_Top_Interval
Magnetic Suscept. (inst. units)	MSL_SECTION_DATA	Meas_susceptibility_mean (in instrument units)
Drift-Corrected Suscept. (inst. units)	MSL_SECTION_DATA	Meas_susceptibility_mean – (Bkgd_susceptibility × sample_elapsed_zero_time/ bkgd_elapsed_zero_time) (in instrument units)
Run Number	MSL_SECTION	Run_Number
Run Date/Time	MSL_SECTION	Run_Date_Time (dd-mon-yy hh:mm)
Core Status	MSL_SECTION	Core_Status
Liner Status	MSL_SECTION	Liner_Status
Requested Interval	MSL_SECTION	Requested_DAQ_Interval
Data Acquisitions per Sample	MSL_SECTION	Req_DAQs_per_sample
Background Suscept.	MSL_SECTION	Bkgd_susceptibility
Background Time	MSL_SECTION	bkgd_elapsed_zero_time
Core Temp.	MSL_SECTION	Core_temperature
Loop Temp.	MSL_SECTION	Loop_temperature
Elapsed Time	MSL_SECTION_DATA	Sample_elapsed_zero_time
Actual Period (s)	MSL_SECTION_DATA	Actual_DAQ_period
Core Diameter (cm)	MSL_SECTION_DATA	Core_diameter

Table T18. MSL analysis statistics.

Coring method (core type)	Core recovery (m)	MSL analyzed (m)	Percent
APC	113,999	98,462	86.4
XCB	61,638	50,635	82.1
RCB	45,869	37,688	82.2
Total:	222,429	186,984	84.1

Table T19. NGR systems.

Leg	Equipment	Comments
149–150	MST, NGR	NGR added to MST.
151–162	MST, NGR	Leg 151: Software upgrade.
163–169 (Site 1036)	MST, NGR	Major software upgrade installed during Leg 163 port call.
169 (Site 1037)–187	MST, NGR	Major software upgrade; 256-channel counts reported. Leg 171: Janus database operational.
188–210	MST, NGR	Minor software changes during this time. During Leg 189, implemented change where only 248 of the channels reported.

Table T20. NGR query with output raw data and display spectra options.

Item name	Janus table	Janus column name and calculation
Leg	SECTION	Leg
Site	SECTION	Site
Hole	SECTION	Hole
Core	SECTION	Core
Type	SECTION	Core_type
Section	SECTION	Section_number
Top (cm)	NGR_SECTION_DATA	MST_Top_Interval × 100
Depth (mbsf)	DEPTH_MAP, NGR_SECTION_DATA	DEPTH_MAP.Map_Interval_Top + NGR_SECTION_DATA.MST_top_interval
Bkg.-Corrected Counts (cps)	NGR_SECTION_DATA NGR_BACKGROUND	NGR_SECTION_DATA.total_counts_sec – NGR_BACKGROUND.total_counts_sec
Uncorrected Total Counts (cps)	NGR_SECTION_DATA	NGR_SECTION_DATA.total_counts_sec
Background Counts (cps)	NGR_BACKGROUND	Total_counts_sec
Run Number	NGR_SECTION	Run_Number
Run Date/Time	NGR_SECTION	Run_Date_Time (mm-dd-yyyy hh:mm:ss)
Core Status	NGR_SECTION	Core_Status
Liner Status	NGR_SECTION	Liner_Status
Requested Interval	NGR_SECTION	Requested_DAQ_Interval
Requested Period (s)	NGR_SECTION	Requested_DAQ_Period
Actual Period (s)	NGR_SECTION_DATA	Actual_DAQ_Period
Core Diameter (cm)	NGR_SECTION_DATA	Core_diameter
Calib. Date/Time	NGR_CALIBRATION	Calibration_Date_Time (mm-dd-yyyy hh:mm:ss)
Calib. Intercept (keV)	NGR_CALIBRATION	Channel_energy_M0
Calib. Slope (keV)	NGR_CALIBRATION	Channel_energy_M1
Calib Error (mse)	NGR_CALIBRATION	Channel_energy_mse
Energy Windows	NGR_SECTION_DATA	Legs 150–169 (Site 1036): Energy_windows Legs 169 (Site 1037)–210: not used
First Channel	NGR_SECTION_DATA	Legs 150–169 (Site 1036): not used Legs 169 (Site 1037)–210: NGR_first_channel
Last Channel	NGR_SECTION_DATA	Legs 150–169 (Site 1036): not used Legs 169 (Site 1037)–210: NGR_last_channel
Channel Increment	NGR_SECTION_DATA	Legs 150–169 (Site 103): not used Legs 169 (Site 1037)–210: NGR_channel_increment
Spectra	NGR_ENERGY_WINDOWS NGR_SECTION_DATA	Legs 150–169 (Site 1036): NGR_counts_sec Legs 169 (Site 1037)–210: NGR_spectra

Table T21. NGR analysis statistics.

Coring method (core type)	Core recovery (m)	NGR analyzed (m)	Percent
APC	113,999	47,696	41.8
XCB	61,638	27,915	45.3
RCB	45,869	22,019	48.0
Total:	222,429	97,705	43.9

Table T22. PMAG query.

Item name	Janus table	Janus column name and calculation
Leg	SECTION	Leg
Site	SECTION	Site
Hole	SECTION	Hole
Core	SECTION	Core
Type	SECTION	Core_type
Section	SECTION	Section_number
Top (cm)	PMAG_SECTION_DATA	PMAG_top_interval x 100
Depth (mbsf)	DEPTH_MAP, PMAG_SECTION_DATA	DEPTH_MAP.map_interval_top + PMAG_SECTION_DATA.PMAG_top_interval
Treatment	PMAG_TREATMENT_TYPE	PMAG_treatment_type
Treatment Demag Level	PMAG_SECTION_DATA	PMAG_treatment_demag
Demag type	PMAG_DEMAG_TYPE	PMAG_demag_type
Demag level	PMAG_SECTION_DATA	PMAG_demag_level
Declination	PMAG_SECTION_DATA	PMAG_declination
Inclination	PMAG_SECTION_DATA	PMAG_inclination
Intensity	PMAG_SECTION_DATA	PMAG_intensity
Hole Inclination	TENSOR_TOOL_RESULTS	Hole_inclination
Intensity X	PMAG_RUN_DATA	PMAG_corr_intensity_x
Intensity Y	PMAG_RUN_DATA	PMAG_corr_intensity_y
Intensity Z	PMAG_RUN_DATA	PMAG_corr_intensity_z
Run Number	PMAG_SECTION_DATA	PMAG_run_num
Comment	PMAG_RUN	PMAG_comment

Table T23. PWL system summary.

Leg	Equipment	Comments
108–115 (Site 713)	Two 500 kHz compressional wave transducers, electronics, and computer interface	Leg 108: PWL transducers mounted on GRAPE sample track. Leg 110: upgraded data acquisition software. Leg 113: new data acquisition software installed on DEC Pro350.
115 (Site 714)–124	PWL on vertical track	PWL transducers mounted next to GRAPE source and detectors on a vertical track.
124E	MST, PWL	Initial installation of Geotek MST with GRA, PWL, and MSL. Not all software compatible with shipboard environment, but system operational.
125–162	MST, PWL	Leg 133: major software upgrade. Leg 149: NGR added to track. Leg 151: software upgrade. No major changes to PWL system or data file format.
163–169 (Site 1036)	MST, PWL	Major software upgrade installed during Leg 163 port call.
169 (Site 1037)–186	MST, PWL	Hardware and software upgrade. Leg 171 Janus database operational.
187	MST, PWL	Major hardware and software upgrade. Change in signal interface resulted in a major change in data format.
188–210	MST, PWL	Minor software changes during this time.

Table T24. PWL query with output raw data option.

Item name	Janus table	Janus column name and calculation
Leg	SECTION	Leg
Site	SECTION	Site
Hole	SECTION	Hole
Core	SECTION	Core
Type	SECTION	Core_type
Section	SECTION	Section_number
Top (cm)	PWL_SECTION_DATA	MST_Top_Interval × 100
Depth (mbsf)	DEPTH_MAP, PWL_SECTION_DATA	DEPTH_MAP.Map_Interval_Top + PWL_SECTION_DATA.MST_Top_Interval
Velocity (m/s)	PWL_SECTION_DATA	PWL_Velocity
Run Number	PWL_SECTION	Run_Number
Run Date/Time	PWL_SECTION	Run_Date_Time (yyyy-mm-dd hh:mm)
Core Status	PWL_SECTION	Core_Status
Liner Status	PWL_SECTION	Liner_Status
Liner Correction	PWL_SECTION	Liner_Correction
Requested Interval (cm)	PWL_SECTION	Requested_DAQ_Interval
Requested Sample	PWL_SECTION	Req_DAQS_per_sample
Signal Threshold	PWL_SECTION_DATA	Acoustic_signal_threshold
Core Temp (C)	PWL_SECTION_DATA	Core_temperature
Separation Mean (mm)	PWL_SECTION_DATA	Meas_separation_mean
Separation Stdev	PWL_SECTION_DATA	Meas_separation_sd
Time Mean (µs)	PWL_SECTION_DATA	Mean_time_mean
Time Stdev	PWL_SECTION_DATA	Mean_time_sd
Signal Mean	PWL_SECTION_DATA	Acoustic_signal_mean
Data acquisitions – attempted	PWL_SECTION_DATA	Attempted_DAQs
Data acquisitions – valid	PWL_SECTION_DATA	Valid_DAQs
Liner thickness (mm)	PWL_SECTION_DATA	Liner_thickness
Standard	PHYSICAL_PROPERTIES_STANDARD	Standard_name
Standard Set	PHYSICAL_PROPERTIES_STANDARD	Standard_set_name
Standard Expected	PHYSICAL_PROPERTIES_STD_DATA	Property_value
Calib. Date/Time	PWL_CALIBRATION	Calibration_Date_Time (yyyy-mm-dd hh:mm)
Calib. Separation M0 (mm)	PWL_CALIBRATION	Separation _m0
Calib. Separation M1(mm/V)	PWL_CALIBRATION	Separation_m1
Calib. Separation Mean Square Error	PWL_CALIBRATION	Separation_mse
Calib. Time M0	PWL_CALIBRATION	Delay_m0
Calib. Time M1	PWL_CALIBRATION	Delay_1_over_m1
Calib. Time Mean Square Error	PWL_CALIBRATION	Delay_mse

Table T25. PWL analysis statistics.

Coring method (core type)	Core recovery (m)	PWL analyzed (m)	Percent
APC	113,999	70,612	61.9
XCB	61,638	8,761	14.2
RCB	45,869	1,612	3.5
Total:	222,429	81,046	36.4

Table T26. Discrete *P*-wave velocity systems.

Leg	Equipment	Comments
101–138	Hamilton frame velocimeter: variable frequency (400–500 kHz) compressional wave transducers, pulse generator, and amplifier, oscilloscopes	Unknown how data were recorded. Data may have been recorded on log sheets and entered later into S1032 database.
130	Dalhousie/Bedford Institute DSV	Third-party equipment brought onboard for demonstration.
138–168	ODP DSV operational	ODP DSV installed on Leg 138. New data acquisition program initiated for Hamilton frame.
	Data acquisition program for the Hamilton frame	Various data acquisition software changes and data format changes for both Hamilton-Frame and DSV.
169–191	PWS1, PWS2, PWS3	Hardware and software upgrade. Leg 171 Janus database operational. Minor software changes.
191	PWS3	Major hardware and software upgrade. Change in signal interface resulted in a major change in data format.
192–210	PWS1, PWS2, PWS3	Minor software changes during this time.

Table T27. PWS1 and PWS2 query with output raw data option.

Item name	Janus table	Janus column name and calculation
Leg	SECTION	Leg
Site	SECTION	Site
Hole	SECTION	Hole
Core	SECTION	Core
Type	SECTION	Core_type
Section	SECTION	Section_number
Top (cm)	PWS1_SECTION_DATA	PP_Top_Interval × 100
Bottom (cm)	PWS1_SECTION_DATA	PP_Bottom_Interval × 100
Depth (mbsf)	DEPTH_MAP, PWS1_SECTION_DATA	DEPTH_MAP.Map_Interval_Top + PWS1_SECTION_DATA.PP_Top_Interval
Direction	PWS1_SECTION	Direction
Velocity (m/s)	PWS1_SECTION_DATA	PWS1_Velocity
Run Number	PWS1_SECTION	Run_Num
Run Date/Time	PWS1_SECTION	Run_Date_Time (yyyy-mm-dd hh:mm)
Core Temp	PWS1_SECTION	Core_Temperature
Raw Data	PWS1_SECTION	Raw_data_collected
Calib Date/Time	PWS1_CALIBRATION	Calibration_Date_Time (yyyy-mm-dd hh:mm)
Calib. Delay	PWS1_CALIBRATION	Delay
Measurement No.	PWS1_SECTION_DATA	Measurement_No
Separation (mm)	PWS1_SECTION_DATA	Transducer_separation
Time Mean (µs)	PWS1_SECTION_DATA	Measured_Time

Table T28. PWS3 query with output raw data option.

Item name	Janus table	Janus column name and calculation
Leg	SECTION	Leg
Site	SECTION	Site
Hole	SECTION	Hole
Core	SECTION	Core
Type	SECTION	Core_type
Section	SECTION	Section_number
Top (cm)	PWS3_SECTION_DATA	PP_Top_Interval × 100
Bottom (cm)	PWS3_SECTION_DATA	PP_Bottom_Interval × 100
Depth (mbsf)	DEPTH_MAP, PWS3_SECTION_DATA	DEPTH_MAP.Map_Interval_Top + PWS_SECTION_DATA.PP_Top_Interval
Direction	PWS3_SECTION	Direction
Velocity (m/s)	PWS3_SECTION_DATA	PWS3_Velocity
Run Number	PWS3_SECTION	Run_Num
Run Date/Time	PWS3_SECTION	Run_Date_Time (yyyy-mm-dd hh:mm)
Core Temp (C)	PWS3_SECTION_DATA	Core_temperature
Raw Data	PWS3_SECTION	Raw_data_collected
Measurement No.	PWS3_SECTION_DATA	Measurement_no
Separation Mean (mm)	PWS3_SECTION_DATA	Meas_separation_mean
Time Mean (µs)	PWS3_SECTION_DATA	Meas_time_mean
Calib. Date/Time	PWS3_CALIBRATION	Calibration_Date_Time (yyyy-mm-dd hh:mm)
Liner Correction	PWS3_SECTION	Liner_Correction
Standard	PHYSICAL_PROPERTIES_STANDARD	Standard_name
Standard Set	PHYSICAL_PROPERTIES_STANDARD	Standard_set_name
Standard Expected	PHYSICAL_PROPERTIES_STD_DATA	Property_value
Contact Pressure (kPa)	PWS3_SECTION_DATA	Contact_pressure
Liner thickness (mm)	PWS3_SECTION_DATA	Liner_thickness
Calib. Delay M0	PWS3_CALIBRATION	Delay_m0
Calib. Delay 1/M1	PWS3_CALIBRATION	Delay_1_over_m1
Calib. Delay Mean Square Error	PWS3_CALIBRATION	Delay_mse
Calib. Separation M0	PWS3_CALIBRATION	Separation_m0
Calib. Separation M1	PWS3_CALIBRATION	Separation_m1
Calib. Separation Mean Square Error	PWS3_CALIBRATION	Separation_mse

Table T29. PWS analysis statistics.

Coring method (core type)	PWS1 (m)	PWS2 (m)	PWS3 (m)
APC	9,618	8,659	26,140
XCB	1,819	1,138	21,590
RCB	306	107	53,818
Total:	11,743	9,904	102,136

Table T30. Rock-eval query.

Item name	Janus table	Janus column name and calculation
Leg	SECTION	Leg
Site	SECTION	Site
Hole	SECTION	Hole
Core	SECTION	Core
Coretype	SECTION	Core_type
Section	SECTION	Section_number
Top Interval	SAMPLE	Top_Interval × 100
Bottom Interval	SAMPLE	Bottom_Interval × 100
Depth (mbsf)	DEPTH_MAP, SAMPLE	DEPTH_MAP.Map_interval_top + SAMPLE.Top_interval
Organic Carbon (wt%)	CHEM_CARB_ANALYSIS	Analysis_code - ORG_C::Analysis_result
Total Organic Carbon (wt%)	CHEM_CARB_ANALYSIS	Analysis_code - TOC::Analysis_result
Free Hydrocarbons (S1) [mg HC/g]t	CHEM_CARB_ANALYSIS	Analysis_code - S1::Analysis_result
Hydrocarbons (S2) [mg HC/g]	CHEM_CARB_ANALYSIS	Analysis_code - S2::Analysis_result
Carbon Dioxide (S3) [mg CO_2/g]	CHEM_CARB_ANALYSIS	Analysis_code - S3::Analysis_result
Max Temperature (TMX) [Deg C]	CHEM_CARB_ANALYSIS	Analysis_code - TMX::Analysis_result
Productivity Index (PI) [ratio]	CHEM_CARB_ANALYSIS	Analysis_code - PI::Analysis_result
Petroleum Potential (PC) [mg HC/g]	CHEM_CARB_ANALYSIS	Analysis_code - PC::Analysis_result
Oxygen Index (OI) [ratio]	CHEM_CARB_ANALYSIS	Analysis_code - OI::Analysis_result
Hydrogen Index (HI) [ratio]	CHEM_CARB_ANALYSIS	Analysis_code - HI::Analysis_result

Table T31. Color reflectance query with output raw data option. (Continued on next page.)

Item name	Janus table	Janus column name and calculation
Leg	SECTION	Leg
Site	SECTION	Site
Hole	SECTION	Hole
Core	SECTION	Core
Type	SECTION	Core_type
Section	SECTION	Section_number
Top (cm)	RSC_RUN_DATA	Top_interval × 100
Depth (mbsf)	RSC_RUN_DATA	Depth_map.map_top_interval + rsc_run_data.top_interval
Run Number	RSC_RUN	Rsc_run_num
Num Meas	RSC_RUN	Rsc_num_meas
Run Date/Time	RSC_RUN	Rsc_run_date_time
CIELAB_L*	RSC_RUN_DATA	Rsc_cielab_l_star
CIELAB_a*	RSC_RUN_DATA	Rsc_cielab_a_star
CIELAB_b*	RSC_RUN_DATA	Rsc_cielab_b_star
Height	RSC_RUN_DATA	Rsc_height
Height Flag	RSC_RUN_DATA	Rsc_height_assumed_flag
Munsell_HVC	RSC_RUN_DATA	Rsc_munsell_hvc
Tristimulus_X	RSC_RUN_DATA	Rsc_tristimulus_x
Tristimulus_Y	RSC_RUN_DATA	Rsc_tristimulus_y
Tristimulus_Z	RSC_RUN_DATA	Rsc_tristimulus_z
First Channel Wavelength	RSC_RUN_DATA	Rsc_first_channel
Last Channel Wavelength	RSC_RUN_DATA	Rsc_last_channel
Wavelength Increment	RSC_RUN_DATA	Rsc_increment
400 (nm)	RSC_RUN_DATA	Rsc_spectra
410 (nm)	RSC_RUN_DATA	Rsc_spectra
420 (nm)	RSC_RUN_DATA	Rsc_spectra
430 (nm)	RSC_RUN_DATA	Rsc_spectra
440 (nm)	RSC_RUN_DATA	Rsc_spectra
450 (nm)	RSC_RUN_DATA	Rsc_spectra
460 (nm)	RSC_RUN_DATA	Rsc_spectra
470 (nm)	RSC_RUN_DATA	Rsc_spectra
480 (nm)	RSC_RUN_DATA	Rsc_spectra
490 (nm)	RSC_RUN_DATA	Rsc_spectra
500 (nm)	RSC_RUN_DATA	Rsc_spectra
510 (nm)	RSC_RUN_DATA	Rsc_spectra
520 (nm)	RSC_RUN_DATA	Rsc_spectra
530 (nm)	RSC_RUN_DATA	Rsc_spectra
540 (nm)	RSC_RUN_DATA	Rsc_spectra
550 (nm)	RSC_RUN_DATA	Rsc_spectra

Table T31 (continued).

Item name	Janus table	Janus column name and calculation
560 (nm)	RSC_RUN_DATA	Rsc_spectra
570 (nm)	RSC_RUN_DATA	Rsc_spectra
580 (nm)	RSC_RUN_DATA	Rsc_spectra
590 (nm)	RSC_RUN_DATA	Rsc_spectra
600 (nm)	RSC_RUN_DATA	Rsc_spectra
610 (nm)	RSC_RUN_DATA	Rsc_spectra
620 (nm)	RSC_RUN_DATA	Rsc_spectra
630 (nm)	RSC_RUN_DATA	Rsc_spectra
640 (nm)	RSC_RUN_DATA	Rsc_spectra
650 (nm)	RSC_RUN_DATA	Rsc_spectra
660 (nm)	RSC_RUN_DATA	Rsc_spectra
670 (nm)	RSC_RUN_DATA	Rsc_spectra
680 (nm)	RSC_RUN_DATA	Rsc_spectra
690 (nm)	RSC_RUN_DATA	Rsc_spectra
700 (nm)	RSC_RUN_DATA	Rsc_spectra

Table T32. Shear strength (AVS/PEN/TOR) with output raw data option. (Continued on next page.)

Item name	Janus table	Janus column name and calculation
AVS:		
Leg	SECTION	Leg
Site	SECTION	Site
Hole	SECTION	Hole
Core	SECTION	Core
Type	SECTION	Core_type
Section	SECTION	Section_number
Top (cm)	AVS_SECTION_DATA	Pp_top_interval × 100
Bottom (cm)	AVS_SECTION_DATA	Pp_bottom_interval × 100
Depth (mbsf)	AVS_SECTION_DATA, DEPTH_MAP	DEPTH_MAP.map_interval_top + AVS_SECTION_DATA.top_interval
Shear_Strength	AVS_SECTION_DATA	Avs_strength
Max_Torque_Angle	AVS_SECTION_DATA	Max_torque_angle
Residual_Strength	AVS_SECTION_DATA	Residual_strength
Residual_Torque_Angle	AVS_SECTION_DATA	Residual_torque_angle
Run_Number	AVS_SECTION	Run_nun
Run_Date_Time	AVS_SECTION	Run_date_time
Rotation_Direction	AVS_SECTION	Direction
Rotation_Rate	AVS_SECTION	Rotation_rate
Vane_ID	AVS_VANE_CALIBRATION	Vane_id
Spring_ID	AVS_SPRING_CALIBRATION	Spring_id
Raw_Data_Collected	AVS_SECTION	Raw_data_collected
Torque	AVS_RAW_DATA	Torque_angle
Strain	AVS_RAW_DATA	Strain_angle
Penetrometer:		
Leg	SECTION	Leg
Site	SECTION	Site
Hole	SECTION	Hole
Core	SECTION	Core
Type	SECTION	Core_type
Section	SECTION	Section_number
Top_Interval (cm)	PEN_SAMPLE_DATA	Pp_top_interval × 100
Depth (mbsf)	PEN_SAMPLE_DATA, DEPTH_MAP	DEPTH_MAP.map_interval_top + PEN_SAMPLE_DATA.pp_top_ interval
Strength	PEN_SAMPLE_DATA	Strength_reading
Run_Date_Time	PEN_SECTION_DATA	Run_date_time
Rotation_Direction	PEN_SECTION_DATA	Direction
Adapter	PEN_SECTION_DATA	Adapter_used
Comment	PEN_SECTION_DATA	Comments

Table T32 (continued).

Item name	Janus table	Janus column name and calculation
Torvane:		
Leg	SECTION	Leg
Site	SECTION	Site
Hole	SECTION	Hole
Core	SECTION	Core
Type	SECTION	Core_type
Section	SECTION	Section
Top_Interval (cm)	TOR_SAMPLE-DATA	Pp_top_interval × 100
Depth (mbsf)	TOR_SAMPLE_DATA, DEPTH_MAP	DEPTH_MAP.map_interval_top + TOR_SAMPLE_DATA.pp_top_ interval
Strength	TOR_SAMPLE_DATA	Strength_reading
Run_Date_Time	TOR_SECTION_DATA	Run_date_time
Rotation__Direction	TOR_SECTION_DATA	Direction
Range	TOR_SECTION_DATA	Range
Comment	TOR_SECTION_DATA	Comments

Table T33. Thermal conductivity query.

Item name	Janus table	Janus column name
Leg	SECTION	Leg
Site	SECTION	Site
Hole	SECTION	Hole
Core	SECTION	Core
Coretype	SECTION	Core_type
Section	SECTION	Section_number
Top (cm)	TCON_DATA	PP_top_interval
Bottom (cm	TCON_DATA	PP_bottom_Interval
Depth (mbsf)	DEPTH_MAP, TCON_DATA	DEPTH_MAP.Map_interval_top + TCON_DATA.Top_interval
Probe Type	TCON_DATA	TCON_probe_half_full
Thermcon Value	TCON_DATA	TCON_proc_thermcon
Ship Equipment Id	TCON_DATA, SYSTEM_TYPE	System_id
TCON Probe Num	TCON_DATA	TCON_probe_num
Comments	TCON_DATA	Comments

Table T34. Downhole temperature query.

Item name	Janus table	Janus column name
Leg	DHT_APCT_RUN	Apct_leg
Site	DHT_APCT_RUN	Apct_site
Hole	DHT_APCT_RUN	Apct_hole
Core	DHT_APCT_RUN	Apct_core
Type	DHT_APCT_RUN	Apct_core_type
Top Depth (mbsf)	CORE	Top_depth
Bottom Depth (mbsf)	CORE	Top_depth + Advancement
Depth Comment	DHT_APCT_RUN	Apct_depth_comment
Temperature (°C)	DHT_APCT_TFIT_RESULTS	Apct_best_fit_temp_t0
Error (°C)	DHT_APCT_TFIT_RESULTS	Apct_best_fit_error_rms
Mudline (°C)	DHT_APCT_TFIT_RESULTS	Apct_mudline_temp
Tool Name	DHT_APCT_CALIB	Apct_tool_name
Notes	DHT_APCT_RUN	Apct_run_comment

Table T35. XRD query.

Item name	Janus table	Janus column name
Leg	SECTION	Leg
Site	SECTION	Site
Hole	SECTION	Hole
Core	SECTION	Core
Coretype	SECTION	Core_type
Section	SECTION	Section_number
Top (cm)	SAMPLE	Top_interval × 100
Bottom (cm)	SAMPLE	Bottom_interval × 100
Depth (mbsf)	DEPTH_MAP, SAMPLE	DEPTH_MAP.Map_interval_top + SAMPLE.Top_interval
Data File	XRD_FILE	Line_Text
Run	XRD_HDR_DATA	XRD_run_id
Comment	XRD_HDR_DATA	XRD_comment

Table T36. Summary of XRF operations.

XRF hardware	Legs
ARL 8420, 1 goniometer, PDP-11 computer	106, 109, 111, 113–116, 118, 119
ARL 8420, 2 goniometers, PDP-11 computer	120–128, 130, 132, 134–145, 147, 148
ARL 8420, 2 goniometers, PC computer, automated data reduction	149–153, 155, 157, 158, 161, 163, 164, 166, 168, 169, 171, 173, 176, 178–180
ARL 8420, 2 goniometers, PC Pentium computer	183, 185, 187

Table T37. XRF spectrometer operating parameters.

Oxide or element	Line	Crystal	Detector	Collimator	Peak angle (°)	Background offset (°)	Count time on peak (s)	Count time on background (s)
SiO_2	K_α	PET(002)	FPC	Coarse	109.25	0	40	0
TiO_2	K_α	LiF(200)	FPC	Fine	86.14	0	40	0
Al_2O_3	K_α	PET(002)	FPC	Coarse	145.27	0	100	0
Fe_2O_3	K_α	LiF(200)	FPC	Fine	57.52	0	40	0
MnO	K_α	LiF(200))	KrSC	Fine	62.98	0	40	0
MgO	K_α	TLAP	FPC	Coarse	44.87	±0.80	200	200
CaO	K_α	LiF(200)	FPC	Coarse	113.16	0	40	0
Na_2O	K_α	TLAP	FPC	Coarse	54.71	–1.20	200	200
K_2O	K_α	LiF(200)	FPC	Fine	136.65	0	40	0
P_2O_5	K_α	GE(111)	FPC	Coarse	140.94	0	100	0
Rh	K Compton	LiF(200)	Scint	Fine	18.59	0	100	0
Nb	K_α	LiF(200)	Scint	Fine	21.37	±0.35	200	200
Zr	K_α	LiF(200)	Scint	Fine	22.53	±0.35	100	100
Y	K_α	LiF(200)	Scint	Fine	23.78	±0.40	100	100
Sr	K_α	LiF(200)	Scint	Fine	25.13	±0.40	100	100
Rb	K_α	LiF(200)	Scint	Fine	26.60	±0.60	100	100
Zn	K_α	LiF(200)	Scint	Coarse	41.79	±0.40	60	60
Cu	K_α	LiF(200)	Scint	Fine	45.02	±0.40	60	60
Ni	K_α	LiF(200)	Scint	Coarse	48.67	±0.60	60	60
Cr	K_α	LiF(200)	FPC	Fine	69.35	±0.50	60	60
Fe	K_α	LiF(220)	FPC	Fine	85.37	–0.40 + 0.70	40	40
V	K_α	LiF(220)	FPC	Fine	122.84	–0.50	60	5060
TiO_2	K_α	LiF(200)	FPC	Fine	86.14	±0.50	40	40
Ce	L_α	LiF(220)	FPC	Coarse	127.92	±1.50	100	100
Ba	L_β	LiF(220)	FPC	Coarse	128.53	±1.50	100	100

Notes: All elements measured using a rhodium X-ray tube operated at 60 kV and 50 mA. FPC = flow proportional counter using P_{10} gas, KrSC = sealed krypton gas counter; Scint = NaI scintillation counter.

Table T38. Standard reference materials for XRF. (See table note. Continued on next page.)

XRF standard	Replicate	Rock type	Comment
152-11	A	MORB	
152-75	A	MORB	
AGV-1	A	Andesite	
AII-92-29-1	A	MORB/Basalt	
AII-92-29-1	X	MORB/Basalt	
AMERSIL	A	Blank for background	
BA-0500	A	Line overlap standard	
BA-1000	A	Line overlap standard	
BA-2000	A	Line overlap standard	
BAS-140	A	Diabase (504B)	
BAS-148	A	Basalt	
BE-N	A	Basalt	
BE-N (BR)	A	Alkali basalt	
BE-N (PP)	A	Basalt	Pressed pellet
BHVO-1	A	Tholeiite/Basalt	
BHVO-1	B		
BHVO-1	TR1	Pressed pellet	
BHVO-2	A	Basalt	
BIR-1	A	Basalt	
BOB-1	A	MORB	
BR-1	A	Basalt	
CaCO3	A	Blank for background	ULTREX
CE-0500	A	Line overlap standard	
CE-1000	A	Line overlap standard	
CE-2000	A	Line overlap standard	
DNC-1	A	Diabase	
DR-N	A	Diorite	Leg 173, 12:1 ratio with Flux VII, NT-2100 bead
FE2O3	A	Blank for background	
Flux IX	A	Blank bead	
G-2	A	Granite	
G-2 (PP)	A	Granite	Pressed pellet
GBM-1	A	Garnet	
JA-1	A	Andesite	
JA-2	A	Andesite	
JA-3	A	Andesite	
JB-1A	A	Basalt	
JB-2	A	Basalt	
JB-3	B	Basalt	
JF-1	A	Feldspar	
JF-2	A	Feldspar	
JG-1a	A	Granite	MAJOR
JG-1a	B	Granodiorite	TRACE
JG-2	A	Granite	
JG-3	A	Granodiorite	
JGB-1	A	Gabbro	
JP-1	A	Peridotite	
JR-1	A	Rhyolite	
JR-2	A	Rhyolite	
K1919	A	Tholeiite	
LI2B407	A	Blank for background	
MAG-1	A	Sediment	
MGO	A	Blank for background	
Mica-Fe	A	Biotite	
Mica-Mg	A	Phlogopite	
MRG-1	A	Gabbro	
NBS-1c	A	Limestone	
NBS-278	A	Obsidian	
NBS-688	A	Basalt	
NIM-D	A	Dunite	
NIM-P	A	Pyroxenite	

Table T38 (continued).

XRF standard	Replicate	Rock type	Comment
PCC-1	A	Peridotite	
RB-0500	A	Line overlap standard	
RB-1000	A	Line overlap standard	
RB-2000	A	Line overlap standard	
RGM-1	A	Rhyolite	
SCo-1	A	Shale	
SCo-1	B	Cody shale	Pressed pellet
SCo-1	TR1	Pressed pellet	
SCo-1	X	Cody shale	
SDC-1	A	Mica schist	
SR-0500	A	Line overlap standard	
SR-1000	A	Line overlap standard	
SR-2000	A	Line overlap standard	
STM-1	A	Syenite	
SY-2	A	Syenite	
TI-0500	A	Line overlap standard	
TI-1000	A	Line overlap standard	
TIO_2-9.3%	A	Line overlap standard	
UB-N	A	Serpentinite	Leg 173, 12:1 ratio with Flux VII, NT-2100 bead
UB-N (PP)	A	Serpentinite	Pressed pellet
V-0500	A	Line overlap standard	
V-1000	A	Line overlap standard	
V-2000	A	Line overlap standard	
W-2	A	Diabase	
Y-0500	A	Line overlap standard	
Y-1000	A	Line overlap standard	
Y-2000	A	Line overlap standard	

Note: XRF = X-ray fluorescence, MORB = mid-ocean-ridge basalt.

Table T39. XRF query.

Item name	Janus table	Janus column name and calculation
Leg	SECTION	Leg
Site	SECTION	Site
Hole	SECTION	Hole
Core	SECTION	Core
Type	SECTION	Core_type
Section	SECTION	Section_number
Top (cm)	SAMPLE	Top_interval × 100
Bottom (cm)	SAMPLE	Bottom_interval × 100
Depth (mbsf)	DEPTH_MAP, SAMPLE	DEPTH_MAP.Map_Interval_Top + SAMPLE.Top_interval
Run	XRF_SAMPLE	XRF_Run_Identifier
Replicate	XRF_SAMPLE	XRF_Replicate
Bead Loss on Ignition	XRF_SAMPLE	Bead_LOI
Silica - SiO_2 (wt%)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – SiO2::XRF_Analysis_Result
Titanium Oxide - (TiO_2) (wt%)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – TiO2::XRF_Analysis_Result
Aluminum Oxide - (Al_2O_3) (wt%)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Al2O3::XRF_Analysis_Result
Iron Oxide - (Fe_2O_3) (wt%)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Fe2O3*::XRF_Analysis_Result
Manganous Oxide - (MnO) (wt%)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – MnO::XRF_Analysis_Result
Magnesium Oxide - (MgO) (wt%)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – MgO::XRF_Analysis_Result
Calcium Oxide - (CaO) (wt%)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – CaO::XRF_Analysis_Result
Sodium Oxide - (Na_2O) (wt%)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Na2O::XRF_Analysis_Result
Potassium Oxide - (K_2O) (wt%)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – K2O::XRF_Analysis_Result
Phosphorus Pentoxide - (P_2O_5) (wt%)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – P2O5::XRF_Analysis_Result
Niobium - (Nb) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Nb:XRF_Analysis_Result
Zirconium - (Zr) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Zr::XRF_Analysis_Result
Yttrium - (Y) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Y::XRF_Analysis_Result
Sulfur - (S) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – S::XRF_Analysis_Result
Strontium - (Sr) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Sr::XRF_Analysis_Result
Rubidium - (Rb) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Rb::XRF_Analysis_Result
Scandium - (Sc) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Sc::XRF_Analysis_Result
Molybdenum - (Mo) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Mo::XRF_Analysis_Result
Beryllium - (Be) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Be::XRF_Analysis_Result
Thorium - (Th) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Th::XRF_Analysis_Result
Cobalt - (Co) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Co::XRF_Analysis_Result
Gadolinium - (Gd) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Gd::XRF_Analysis_Result
Dysprosium - (Dy) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Dy::XRF_Analysis_Result
Erbium - (Er) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Er::XRF_Analysis_Result
Ytterbium - (Yb) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Yb::XRF_Analysis_Result
Hafnium - (Hf) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code -- Hf::XRF_Analysis_Result
Lead - (Pb) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Pb::XRF_Analysis_Result
Gallium - (Ga) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Ga::XRF_Analysis_Result
Zinc - (Zn) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Zn::XRF_Analysis_Result
Copper - (Cu) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Cu::XRF_Analysis_Result
Nickel - (Ni) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Ni::XRF_Analysis_Result
Chromium - (Cr) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Cr::XRF_Analysis_Result
Vanadium - (V) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – V::XRF_Analysis_Result
Cerium - (Ce) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Ce::XRF_Analysis_Result
Barium - (Ba) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Ba::XRF_Analysis_Result
Cesium - (Cs) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Cs::XRF_Analysis_Result
Lanthanum - (La) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – La::XRF_Analysis_Result
Neodymium - (Nd) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code – Nd::XRF_Analysis_Result
Samarium - (Sm) (ppm)	XRF_SAMPLE_ANALYSIS	XRF_Analysis_Code - Sm::XRF_Analysis_Result
Sample Type	XRF_SAMPLE_TYPE	Sample_Type
Comment	XRF_SAMPLE	XRF_Comment