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1978

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Rutford, Robert H., "The Evidence for Climatic Change from Antarctica?" (1978). *Transactions of the Nebraska Academy of Sciences and Affiliated Societies*. 333.
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Transactions of the Nebraska Academy of Sciences–Volume VI, 1978

THE EVIDENCE FOR CLIMATIC CHANGE FROM ANTARCTICA?

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The stratigraphic record of the Antarctic continent records a history compatible and comparable with that of any of the other continents: a Pre-Cambrian basement truncated by a major erosion surface, a sequence of Paleozoic and Mesozoic sediments, and finally a Cenozoic record dominated by glacial deposits. Two major geologic provinces are recognized: East Antarctica, a typical continental shield or stable platform consisting of older igneous and metamorphic rocks overlain by younger, mainly flat-lying stratified sedimentary and igneous rocks; West Antarctica is composed mainly of younger rocks that are deformed and metamorphosed–abundant intrusive and extrusive rocks are present and volcanic activity continues in some areas.

The Pre-Cenozoic stratigraphic record must be carefully studied before making any guesses as to climatic change. It is necessary to recognize the fact that the stratigraphic record at a given locality may yield temperature information that could be grossly misleading if interpreted as a record of world-wide climatic change. Localized glacial deposits may reflect only a topographic effect, not a worldwide climatic change, and the differences between the features characteristic of hot or cold deserts are not well understood. A second confusion factor is the geographic location. The recent "revolution in earth sciences" and the general acceptance of the mobility of continents make it difficult to interpret the ancient record. If we assume no major shifts in the axis of rotation, etc., then one might well expect a record of a cold climate in deposits formed in polar regions. What becomes difficult is the reconstruction of the paleogeography to allow one to make paleoclimatic inferences.

Given this general background, a quick look at the worldwide stratigraphic record indicates the possibility of rather extensive glaciation in the late Pre-Cambrian, possibly in the Ordovician, certainly in the Permo-Carboniferous and in the Cenozoic.

In the stratigraphic record in Antarctica, no evidence has yet been found of a Pre-Cambrian glacial period. There is widespread evidence of a late Paleozoic glaciation as represented by tillites and/or glacio-marine deposits. Immediately overlying these sequences are carbonacious and coaly sediments that locally contain a glossopteroid flora. Similar stratigraphic sequences in other Southern Hemisphere continents lead to the conclusion that this glacial period was more than a local event.

The discovery of Triassic amphibians in Antarctica was of major significance and argues strongly for a climate change that began with a cold period in the Permo-Carboniferous and continued into the early Mesozoic. The presence of similar life forms in other Southern Hemisphere countries continues to support the argument for the existence of the super-continent Gondwanaland at least until the late Triassic.

Separation of the fragments of this continent probably began in the mid-Mesozoic. Differences in tectonic evolution and the stratigraphic record from deep-sea drilling indicate that the breakup was not synchronous. Of importance here is evidence for glaciation in both the continental and marine sedimentary record during the past 25 million years. This glaciation probably reflects geographic position and the establishment of new oceanic and atmospheric circulation following the breakup of Gondwanaland. Almost certainly there was a world-wide impact on climate at this time.

The Tertiary-Quaternary record in Antarctica is difficult to interpret. The stratigraphy on land is very restricted; the limited deep sea cores indicate major periods of erosion (or non-deposition). Interpretation of the Antarctic record may well be hindered by "Northern Hemispheritis" (i.e., an attempt to force interpretation of the Southern Hemisphere record into the Northern Hemisphere mold).

The record of glacier fluctuation as elucidated by recent work in the McMurdo Sound area is probably not due to climatic fluctuations but rather to instabilities in the ice masses themselves. There is considerable evidence for higher ice levels and greatly expanded ice boundaries. The breaks in the stratigraphic record in the deep-sea cores from the Ross Sea have been interpreted as the result of glacial erosion by an expanded ice sheet.

Interpretation of the paleoclimatic record in Antarctica is far from complete. It is complicated by:

1. Limited exposure and limited detailed study.

2. Variation in geographic position of the continent.

3. Variation in glacial cover not related to climatic change.