

ANNALS OF DECCAN TRAPS STUDY AND BIBLIOGRAPHY ON DECCAN TRAPS, Special Publication No.38, Geological Survey of India, (1996). Pt.1; pp. 300 and Pt.2;pp. 92. Price Rs.260/- ; \$94.

The Deccan volcanic episode is a unique event in the geological history of India. This vast spread of lava covering over 500,000 km² and an exposed thickness of over 2 km has attracted the attention of almost every one of the veterans of Indian Geology commencing from Blanford in 1867, followed by other giants like Medlicott, Middlemiss, Foote, Pramatha Nath Bose, Hayden, Fox, Fermor and Krishnan, all of the Geological Survey of India.

The present volume entitled 'Annals of Deccan Trap Study' contains certain randomly selected papers of the early pioneers. A brief summary, introducing the volume with specific mention of the importance of each of the contribution extracted would have added to the value of the work. It nevertheless provides a guide to some of the papers which are not easily accessible to workers. The compilation therefore is particularly welcome.

The valuable part of this Special Publication is the second part which furnishes a classified list of 1230 references on Deccan volcanic activity.

BPR

METAMORPHIC PHASE EQUILIBRIA AND PRESSURE-TEMPERATURE-TIME PATHS. FRANK S. SPEAR, Mineralogical Society of America (Monograph), September, 1993; pp.799.

This is a book many metamorphic petrologists have been waiting for. Dr. Frank Spear has made an excellent presentation and integration of the diverse topics on Metamorphic Petrology, together with applications and the recent developments.

Frank Spear, who is at the Rensselaer Polytechnic Institute at Troy, New York, has organised his material into twenty one chapters. Most of the chapters begin with succinct introduction or an overview which also supplies the reason for the sequence of what follows, and ends with a concluding note. With each chapter there are well chosen examples/exercises, and a few selected references for further reading. A very valuable aspect of Spear's book is its integration of application of thermodynamics to phase equilibria, geothermobarometry, mineral zoning, fluid-rock interaction studies, thermochronology, P-T-t paths that help to constrain the evolution of metamorphic terranes. Bringing together topics that are frequently distributed among several textbooks, it helps students to take a more unified approach to their metamorphic petrology studies.

Chapter 1 is an introduction that deals with the broader aspects of metamorphism and dynamic metamorphic processes. This chapter is comprehensive and logically structured. Chapter 2 describes the progressive metamorphic facies in common rock types in the light of plate tectonic concept. Chapter 3 focuses on the fundamental principles of heat flow in the crust and makes qualitative assessment of the thermal perturbations in the crust in response to orogenic events. Basic heat flow equations used in thermal modelling are given in this chapter. Chapter 4 provides an informative review on the crystal chemistry of

some common rock-forming silicates. The text is mainly borrowed from the "Reviews in Mineralogy" published as several volumes by the Mineralogical Society of America. Chapter 5 concerns the graphical projections of the mineral equilibria and provides a systematic presentation of the matrix method necessary for analysing the composition space.

The next three chapters are devoted to the phase equilibria which is the essence of modern Petrology. Of these, chapter 6 concentrates on homogeneous equilibria and begins with definitions of phase, component, state variable, system, chemical potential, gibbs free energy etc. Further, theoretical treatment of thermodynamic equations describe equilibrium relations within a single phase. The next chapter 7 (64 pages) is related to the use of complete range of activity models (ideal as well as non-ideal) for the crystalline solutions. Chapter 8 on heterogeneous equilibria describes the analysis of equilibrium relations among sets of phases. Extension of phase rule application involving construction of petrogenetic grids based on Schrenemakers' rule is covered in this chapter. Chapter 9 describes the metamorphic phase relations in the system $\text{SiO}_2\text{-Al}_2\text{O}_3\text{-CaO-Na}_2\text{O-K}_2\text{O-H}_2\text{O}$ (CKNASH).

The next four chapters describe the phase relations and metamorphic P-T histories of the pelites, mafic rocks, calc-silicates, ultramafic rocks in detail. A comprehensive chapter 10 on progressive metamorphism of pelitic rocks at low, intermediate and high pressure conditions is illustrated with fascinating petrogenetic grids in the KFASH, KMASH and KFMASH systems. It also includes discussion on the phase relationship in the metapelites from granulite facies metamorphism at ultrahigh temperatures under anhydrous conditions in the FMAS and KFMASH systems. Chapter 11 examines the major mineral reactions and mineralogic changes that occur during the metamorphism of mafic rocks. Chapter 12 is concerned with the metamorphism of the siliceous dolomites in the $\text{CaO-MgO-SiO}_2\text{-H}_2\text{O-CO}_2$ system. In chapter 13, the metamorphism of less common ultramafic rocks ($\text{SiO}_2\text{-MgO-CaO-H}_2\text{O}$ system) and cordierite-anthophyllite rocks ($\text{Na}_2\text{O-CaO-FeO-MgO-Al}_2\text{O}_3$ system) are described. Chapter 14 concerns with the systematic relationship between the oxides and sulphide minerals in metamorphic rocks and records the changes that take place in these assemblages during progressive metamorphism.

Subsequent chapters 15 and 16 are highly informative that basically deal with the calculation of metamorphic phase equilibria. Chapter 15 highlights the significance of geothermobarometry that helps to constrain the P-T evolution. Section on selection of thermobarometers, sources of errors, precision and accuracy involved and some worked out examples leave clear message to the reader regarding the potential pitfalls of geothermobarometry. Applications on equilibrium thermodynamics to the calculation of P-T-X-M phase relations of metamorphic rocks form the contents of 16th chapter. An extended chapter 17 on the mineral zoning and their influence on P-T history and P-T path is particularly useful to the research workers. Detailed discussion on growth zoning and diffusion zoning is explained with excellent examples using garnet zoning profiles.

Chapter 18 covers the equilibria between the metamorphic fluid and the rock in which it resides. An attempt is made here to evaluate the metamorphic fluid composition from mineral-fluid equilibria and fluid inclusion studies. The last few pages of this chapter examine the concept of entrapped fluid inclusions as geothermobarometers with caution and some basic assumptions. Significant chemical and mineralogical changes occur during metamorphism when substantial fluids are driven out of the rock. How the fluid flows through the rock and the implications of such processes for the evolution of metamorphic

belts is presented in chapter 19. Chapter 20 highlights some of the advances made in the determination of temperature-time histories in metamorphic rocks, called thermochronology. This chapter begins with the basic concept of isotope geochronology, goes through K-Ar, U-Pb dating methods and ends with discussion on thermochronology.

The last chapter 21 revolves around the main theme of the book that relates to the determination of P-T paths in a variety of metamorphic settings. Particular emphasis is placed on how such diverse P-T paths help to constrain models of tectonic evolution of metamorphic terranes. The isothermal decompression paths (ITD) and isobaric cooling paths (IBC) encountered in the granulite facies terranes are only briefly taken up. In short, in this chapter the author is able to give the reader the current status of knowledge on the controls that metamorphic P-T paths have on tectonic evolution. Throughout the text, the author has stressed the importance of art of petrography along with petrologic and tectonic details in deducing the P-T-t path. Unfortunately, an essential chapter on petrography and interpretation of reaction textures is ignored; instead the author encourages readers to use the "Atlas of metamorphic rocks and their textures", which is not a fair deal. The book ends with an impressive list of references.

Useful to the graduate students, research workers and also teachers, this book should prove extremely helpful for learning the essentials of metamorphic petrology. All up-to-date libraries should have a copy on their shelves.

*Department of Geology
Banaras Hindu University
Varanasi - 221 005*

ANAND MOHAN

* * *

Authors may also send their Papers in high density Floppy Diskettes in Standard Format (such as ASCII/Word Star/Word Perfect etc.) along with output in duplicate for faster processing – Ed.