BOOK REVIEW

NUCLEAR GEOLOGY AND ATOMIC MINERAL RESOURCES by S.N. Virnave, Bharathi Bhavan, Publishers and Distributors, Thakurbari Road, Kadamkuan, Patna - 800 003, 226p.

Extensive areas of uranium and thorium mineralisation are now known in India as a result of over 50 years of exploration for atomic minerals. Almost all genetic types of mineralisation have been located in different parts of the country. There are few exploration techniques and methods that are known and practiced in any part of the world for which expertise is lacking in the country. Viewed in this context, collegiate courses of economic geology in India are often incomplete and even rudimentary while dealing with the radioactive mineral deposits, for want of a standard text that could be followed by teachers and students. The book by Virnave, an experienced field geologist, who combines practical experience in exploration with deep academic interest, is a first attempt to fill this lacuna and is, perhaps, the only book of its kind so far published.

The introduction to the volume highlights the importance of radioactive minerals to Indian nuclear energy programmes. The second chapter outlines some of the basic principles of nuclear physics as applied to geology. The age of geological formations very closely constrains the types of mineralisation that may be expected in them. The third chapter deals with the basics of geochronology and methods of dating rocks. Chapter 4 deals with elements of the mineralogy of uranium and thorium minerals. Chapter 5 introduces some of the basic physical and chemical parameters of the enrichment of U and Th in rocks and minerals and the epochs of mineralisation. Chapter 6 deals at length with the methods of uranium exploration covering all the known methods widely practiced. The categorisation of ore reserves, world production and consumption are also included in this chapter. Classification of uranium deposits with descriptions of both world and Indian occurrences is covered in the next chapter 7. The emphasis in this chapter is on the Indian occurrences. They are well described and illustrated with maps and figures rendering the text both lucid and easily comprehensible. This chapter, covering nearly 100 pages, is justifiably the most comprehensive part of the whole book. Chapter 8 deals with thorium resources in India. The book concludes with a chapter on the challenges and prospects of the uranium industry.

A vast amount of literature has been published on geology of radioactive mineral deposits of India and their mineralogical, petrological and above all economic aspects as a result of very active exploration for some five decades in which a few hundred geologists, geochemists and geophysicists have participated. Even in the international scene, uranium geology has been transformed with the discovery of unexpectedly new types of very large uranium reserves. Writing a textbook on this subject is, therefore, no mean task and any effort made may overlook some contributions or other. Virnave has accomplished this task commendably well, highlighting the more significant scientific and technological aspects. Nowhere are the Indian uranium deposits clubbed together and so succinctly outlined as in this short publication. The book, is therefore, a welcome publication, especially for the teacher and the student. The book, however, could have paid more attention to some aspects. The section on ore reserve categorisation may have dealt with statistical approaches to reserve calculations. The chapter on thorium deposits needs to be enlarged with greater emphasis on methods of estimation of grades and reserves that have been worked out in India successfully. A chapter on rare metal and rare earth resources, which are used in the atomic mineral industry may not have been out of place. The references could be made more comprehensive. The author unwittingly errs on secondary references in several areas. Descriptions of uranium deposits

abroad could have been placed in their total geological setting and the type deposits containing the larger reserves could have been better illustrated.

Notwithstanding these apparent and not too significant shortcomings, the book should serve as a useful compendium on the geology of uranium and thorium deposits in India, that can be followed by students of economic geology and also exploration geologists who need an introduction to the subject. The book has a good get up and is well printed. Running to a total of 226 pages, it is moderately priced.

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ORE GENESIS - A HOLISTIC APPROACH by Asoke Mookherjee; Allied Publishers Ltd., 657p, Price: Rs.570/-

This magnum opus by Prof. Asoke Mookherjee, who after an illustrious career in teaching at the prestigious Indian Institute of Technology, Kharagpur, devoted five fruitful years as Emeritus Scientist (1991-95) at Jadavpur University producing this book, is unique in its uniform high cerebral quality and excellent writing. It has 582 pages of text, 53 pages of references, 54 tables and 146 text figures. The book is divided into three sections - the first, deals with background information on spatial and temporal distribution of ore bodies, geochemical features, evolution of earth's crust and ore genesis; the second section deals with mode of occurrence of ore bodies, ore textures, mineral assemblages, chemical composition of ores, organic matter and fluid inclusion in ores and the live ore forming geothermal systems; the third section deals with ore genesis categorised under (a) orthomagmatic ores of mafic-ultramafic associations, (b) ores of siliceous igneous rock association, (c) ores of sedimentary affiliations (placers and sedimentary, syn-sedimentary deposits), (d) ores of metamorphic affiliation and (e) deposits affiliated to weathering and weathered surfaces.

Going through this book is akin to mountaineering. It needs preparation (to get acquainted with the processes and terminology of plate tectonics) and acclimatisation (matter in sections I and II need slow reading). Then, the climb to top and walk on the *altiplano* (ore deposits and genesis - section III) is comfortable and, in fact, exhilarating. Most chapters start with a review of retrievable information and end with an excellent summary.

A large number of experimental results, deep understanding of physico-chemical-geologic-tectonic factors and references to a large number of world class ore bodies and theories on their origin are ably handled. More than 25 gold/gold-uranium deposits, including Witwatersrand, Kalgoorlie, Carlin, Barberton, Homestake, Kolar, Timmins, Blind River, Denison etc. are referred to. So is the case with other ores; copper, lead-zinc, nickel, bauxite, platinum group, diamond, iron ores, chromite etc. The parts dealing with liquid inclusions, REE, isotopes and organic matter in ore are uncommon and informative.

The description of and discussion on the genesis of gold in Witwatersrand (pp.406-413) make compelling reading. It highlights the special features of the basement, basin evolution and possible alternative genetic models - modified placer/ hydrothermal. Therefore, rocks in other parts of the world, similar to those at Witwatersrand, need not be auriferous unless other events that happened at Rand also took place.

Similarly, the part dealing with diamond in kimberlite rocks (pp.274-284) is interesting. How