

ECONOMIC EVALUATION OF RARE AND STRATEGIC MINERAL RESOURCES by S.N. Virnave. Published by New Academic Publishers, Delhi - 110 092, First Edition 2003, 242p, Price Rs.595 (HB); Rs.395 (PB).

Almost every product that we use for cooking, eating, drinking, wearing, driving, flying, communicating and housing depends on the mineral industry for either its production or its components or its source of energy. To ensure a continuing supply of minerals to meet the needs of a growing society, it is necessary to discover new mineral deposits. Mining has thus become an essential part of life. The occurrence of economically mineable mineral deposits is a function of geology and structure. The book under review is intended to make an evaluation of Rare earths and Rare metals/mineral resources of India. Not that their unavailability would be catastrophic. Without these metals our nuclear energy and space programmes would not run. Without rare earths we would have inferior colour television and camera lenses.

Most cigarette smokers will have held a rare earth metal in their hands since cerium is the main constituent of cigarette lighter flints. Rare earths have expanding applications in nickel-metalhydride rechargeable batteries, high temperature ceramics, supermagnets, superconductors, superior phosphor, magnetic refrigeration, optical data storage, lasers, fiber optics and glass. For more information on the applications, high tech uses, technologies and worldwide markets for these metals log on to <http://www.buscom.com/materials/GB-118R>.

'Rare earths (RE)' or Rare Earth Elements (REE) or 'Rare Earth Metals' are not truly rare. They are called such for historical reasons. Some of these metals have tongue twisting names; praseodymium, dysprosium, lanthanum, cerium, gadolinium, neodymium, terbium, holmium, thulium, erbium, promethium, ytterbium, europium, samarium and lutetium. Fortunately there is no "pandemonium" here. Yttrium is generally classed with the rare earths because of its chemical similarities and geochemical affinities.

Rare metals (RM) are also not so rare. Niobium, tantalum, lithium, beryllium, thorium, zirconium are some of these rare elements. Monazite{(Ce,La,Y,Th)PO₄} is the most common rare earth mineral. It contains ThO₂ up to 12%. Other common RE and RM bearing minerals are perovskite, bastnasite, pyrochlore, xenotime, euxenite and apatite. Apatite is not a rare earth mineral but may incorporate these elements through substitution. Certain types of pegmatites and granites, alkalic rock complexes

and related carbonatites are the principal primary sources of RE and RM.

The Atomic Minerals Directorate for Exploration and Research (AMD), Department of Atomic Energy has painstakingly explored the 6,000km long east and west coasts and inland of India and established a resource of nearly 640 million tonnes of heavy minerals. Out of this total, India has 8 million tonnes of monazite sand (ie.71% of world resources) and 348 million tonnes of ilmenite. The TiO₂ content of Chavara ilmenite deposits in the 22 km long stretch between Neendakara and Kayamkulam in Kerala is the highest in the world. AMD has also established resources of niobium-tantalum, beryl and spodumene bearing pegmatites and xenotime bearing inland placers in different parts of the country.

Dr. S.N. Virnave, the author of the book under review was one of the exploration geologists of the AMD. His book deals with the REs and RMs alright but its contents do not truly reflect the title of the book. The preface by the author is promising. It reads, "*The purpose of this volume is to highlight the importance of the study of geology of the rare metal and rare-earth's (RMRE) resources and its economic evaluation. In realization of its strategic applications in high-tech areas and innovative technologies, an attempt has been made in this compilation to disseminate and synthesize all the existing information on the subject, so as to present a comprehensive and upto-date account of the geology and geochemical environment of the formation of rare-metal and rare-earth's resources of the country.*" This purpose is not entirely served in this book.

There are 16 Chapters in this book. The first Chapter - "*Origin of Elements*" (the spelling of origin is boldly printed as "Origion") starts with Hindu mythology, the vedas and the origin of universe by Big Bang. There is no discussion of the relevance of this chapter to the evaluation of RERM. In Chapter 2 "*Genesis of ore deposits-A new approach*", the author states that "the plate tectonic model of ore genesis with current theories of crustal evolution and dynamics provide better insight to the understanding of ore formation and their distribution." Is this some thing new? Chapter 3, "*Isotope Geology*" is again an unwanted inclusion and the contents of this Chapter have nothing to do with the evaluation of rare mineral resources.

Chapters 4 to 10 are on RERM. There are cursory

references in these chapters to the distribution of some REs and RMs in different parts of our country. There are no district or State level maps to atleast show their locations. Much of the information come from text books on chemistry of metals and mineralogy. Chapter 11 is on *Transuranium Elements* which should not have found a place in this book. In Chapter 12 on *Exploration techniques in search of Rare metals and Minerals*, the heavy mineral technique is neatly described. Chapter 13 is on *Ore Reserve Estimation*: The categories of resources given in this chapter do not conform to the Field Guidelines for Implementation of United Nations Framework Classification (UNFC) for mineral resources in India approved by the Ministry of Mines, Government of India, May, 2001. The estimated resources of monazite and zircon in India according to the author is 4.5 and 12.4 million tonnes where as they are 8.0

and 21 million tonnes as per AMD's estimate (ERFAM, v.13, 2001). Chapter 14 entitled "*Development of Mineral based Projects for the Production of Ore and metal Concentrates*" is a highly generalized account. It does not deal with RERM. Chapter 15 on *Resource Conservation: Scope and Opportunities* and Chapter 16 on *Challenges and Prospects of Mineral Industry in the New Millennium* again gives a highly generalized account known to most geologists.

The title of the book promises a lot but does not live up to it. The book at best caters to the basic needs of the earth science students.

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PICTORIAL CATALOGUE OF SIWALIK VERTEBRATE FOSSILS FROM NORTHWEST HIMALAYA by B.C. Verma, V.P.Mishra and S.S. Gupta, Geological Survey of India, 2002 Catalogue Series no.5, Price: Rs.

The Geological Survey of India (GSI), is the premier agency for undertaking work in field mapping and stratigraphy in the country apart from its responsibilities in other core sectors. Field work entails meticulous observation, litho-logging and collection of fossils that may be either age or palaeoenvironment diagnostic, or both. The present catalogue represents the outcome of laborious field work, integration and documentation by some of GSI's senior most palaeontologists and geologists; supported and guided at the highest administrative and scientific levels within the GSI.

This catalogue is by far the best illustrated and comprehensive review of Siwalik vertebrates to come out in recent times. Based on material collected by the GSI during the last three decades from various localities, mainly in the Upper Siwaliks, it gives equal weightage to all vertebrate groups rather than concentrating only on the better studied mammalian faunas.

Unlike other Siwalik vertebrate catalogues that have been published in the past, this one clearly stands out: Firstly there is a great deal of data on the precise location of the fossils along with detailed maps, photo illustrations and other necessary data, such as repository, catalogue numbers and brief morphological descriptions. Secondly, an attempt has been made to document lower vertebrates, such as fish and

reptiles, which have been generally neglected in the past. The Catalogue therefore serves as a handy first step towards identification of fossil vertebrate material in a geologically mapped context.

The Catalogue is basically divided into five subdivisions: Introduction, Catalogue Checklist, Stratigraphic distribution of taxa, Faunal analysis and References. The introductory chapter acquaints the reader with Siwalik stratigraphy and the history of collections of Siwalik vertebrate fossils, an assemblage which is globally one of the best studied. The section on Siwalik stratigraphy has been very thoroughly covered and it will be found to be most useful as a starting base for any future research. It is worthy of note that terrace deposits have also been clearly defined, as for example the Markanda River Terraces (Fig.5). An attempt has also been made to give absolute ages wherever possible. The bulk of the Catalogue comprising of the checklist of Siwalik vertebrates recorded therein naturally deals with the morphological and photo documentation of Siwalik vertebrates starting with fish taxa, reptiles (turtles and crocodiles) including the nearly complete skeleton of a snake, a rare find indeed! Some bird bones are also illustrated.

The essence of the Catalogue of course deals with Siwalik mammals (Plate 10 to Plate 144). Some effort has