

BOOK REVIEW

ELEMENTS OF PROSPECTING FOR NON-FUEL MINERAL DEPOSITS

by P.K. Banerjee and S. Ghosh, Allied Publishers Limited, 1997, 320p.

This book by two veteran geologists, with long professional experience in the Geological Survey of India and familiarity with the nitty-gritty details of mineral prospecting is unique for the wide range of coverage and depth of information. I have not come across any other book on the subject published in India in the past five decades covering so many aspects so competently.

The book has eleven chapters – classification of mineral deposits for prospecting, host rocks for minerals, geological and geomorphological prospecting, geochemical prospecting, geophysical prospecting, geostatistical techniques, preliminary exploration, mineral reserves and resources, mine valuation, environmental impact of mining, industrial specifications and geotechnical and geohydrological measurements. There are 68 figures, 11 tables and five appendices. There are references to 100 technical articles and suggestions for further reading, listed chapter-wise, totalling 57. There are also several case histories and illustrative examples – from India and abroad.

The pre-requisite for any mineral exploitation is detailed exploration. This is required for establishing ore reserves of proper categories in appropriate proportions, for determining the shape and structure of ore bodies, for determining accurately the likely ore grade (by bulk sampling/corrections for 'regression effect' / mine feedback etc.), for understanding of detailed mineralogy and for obtaining other data on geotechnical characteristics, geohydrology, infrastructure, seismicity, land use etc. The book has adequately covered these various facets of detailed exploration. The chapter on "Preliminary exploration" can be redesignated and slightly modified to fill this need in the next edition.

The chapters on geological and geomorphological prospecting, geochemical prospecting, mineral reserves and resources and environmental impact of mining are comprehensive. All other chapters are adequate.

The authors are familiar with the subtle aspects which are important for proper exploration (for example, different mineralogy of nickel derived from different rocks, Niquelandia, Brazil; p.41).

The chapter on geochemical prospecting describes all conceivable field techniques and important instrumental analytical techniques stream sediment (for both light fraction and heavy minerals), pedogeochemistry (for secondary dispersion and for 'path finder' element), litho-geochemistry (for primary dispersion, prospecting in glacial till and moraine, fluid inclusion studies, hydrogeochemical prospecting, biochemical prospecting, geobotanical methods, photogeochemical methods, geozoological and microbiological prospecting, atmogeochemical prospecting and PEXMEL method) – are all well described with examples.

An important effort by geochemistry and by integrated methods is to devise conceptual models to locate deep seated 'blind' ore bodies. The authors have described the concept of Prof. Grigorayan, wherein multi-element data are used to demarcate different zones showing distribution of infra and supra elements. The case history of such a study at Mosabani copper mines, Bihar is given as an example. Such studies were also done in Kolar under the guidance of Prof. Grigorayan. Another method developed in Australia uses geophysical and geochemical data for developing conceptual models for deep-seated ore bodies (p.100, NABRE project).

The authors have given several case histories to illustrate the limitation and scope of concept-based exploration and to illustrate the use of the state-of-the-art, broad spectrum, massive exploration to locate and develop large ore reserves.

The first example is the exciting discovery of a giant-sized copper-uranium deposit of Olympic Dam, Australia (pp.12-13) by Western Mining Corporation. The deposit is under a rock cover of 350 m. The concept model was of Zambian type sedimentary rock-hosted copper-cobalt ore. Basaltic flows were expected to be associated with the sediments. An area of 43500 sq. km was covered for developing the model. Unexpectedly, a huge hydrothermal breccia system in granite was located. The concept was wrong but the work highly rewarding. I understand that the current ore reserves stand at 580 million tonnes at 2.1% Cu and 0.6 kg/t U_3O_8 with substantial gold and silver. A fortuitous discovery indeed!

In contrast, the location of one hundred kimberlite pipes in Northwestern Territory, Canada in remote, harsh terrain in sub-arctic climate by aeromagnetic surveys followed by ground till/boulder clay prospecting for indicator minerals (p.13) is an example of successful exploration by the use of state-of-the-art technology and excellent geological prognosis.

The third example, is the case study of sustained prospecting and exploration over a period of 16 years which resulted in location and development of 35,000 million tonnes of high grade hematite ore (66.6% Fe) in the Carajas Province, Amazon region, Brazil (pp.33-37). Photogeology to locate bald 'mesas', regional and detailed aeromagnetics, geological and geophysical traversing for both regional and detailed mapping, drilling large number of boreholes, developing several galleries, mineralogical study, XRD study, analysis of a large number of samples, pilot plant tests and other technical tests formed parts of the project. The terrain was inaccessible and a lot of support by air and road development was needed for transport of men and materials. Added to these problems, the area has high rainfall. This a unique example of massive, scientific and successful prospecting and exploration.

Finally, for the next edition, here are a few suggestions. In the review of ancient Indian mining (p.4) gold mining in South India (some mines in Hutti region are reportedly Mauryan in age; carbon dating of old mine timber at Hutti indicate these to be 1740 and 1960 years old) may be added. The Golconda mines (p.63), which yielded large gem-quality diamonds like Koh-i-Noor, were on Krishna gravels and not in kimberlite pipes of Wajrakarur etc. In the chapter on mineral reserves and resources, it will be useful if the Miscellaneous Publication 53 (1981) of the Geological Survey of India (Report of the Committee on Standardisation of Terminology and Classification of Ore and Mineral Reserves) is suggested for further reading. Similarly, the commonly used books such as Geological Prospecting and Exploration by V.M. Kreiter, Exploration Mining Geology by W.C. Peters etc., are suggested for reading. A list of publications of extensive work done by Indian geologists – in fields of geochemistry, geostatistics, fluid inclusion studies, software application, Indian major deposits – will help the readers to realise the extent of work being done.

This book is useful to students, teachers, exploration professionals and deserves to be added to the libraries of surveys, exploration and mining companies, colleges, research and scientific institutions and universities.

Bangalore

B.K. DHRUVA RAO