

**GEOLOGY AND ORE MINERALISATION OF THE SINGHBHUM COPPER-URANIUM BELT, EASTERN INDIA.** By Sanjib Chandra Sarkar, Jadavpur University, Calcutta, 1984.

A few decades back, the classical work of Dunn and Dey was considered a landmark in the understanding of the geology and metallogeny of the Singhbhum copper belt. A major revelation of considerable economic importance in the late fifties, was the discovery of large areas of outcropping uranium mineralisation in this belt, and the association of small but significant quantities of Ni, Mo, Se, Te and Au with the sulphide-uranium ores. During the last few decades almost every aspect of the geology of this area has been restudied by numerous workers applying many modern techniques, and this has resulted in the modification of almost all aspects of geological evolution, be it related to structure, stratigraphy, metamorphism or metallogeny. The isotopic dating of rocks has been a major factor which has led to a revision of earlier concepts.

It is in the context of this large growth of knowledge that one would like to welcome the publication of Prof. S. C. Sarkar, as it provides a fairly exhaustive resume of the results of recent researches against the backdrop of the earlier concepts of Dunn and Dey.

The book is divided into six chapters. Chapter I provides a summary of the regional setting and the different interpretations of stratigraphy of the region, highlighting the status of the Older Metamorphics and the Singhbhum granite. According to the author, the Singhbhum rocks, though Archaean, do not share much of the characteristics of 'either the Archaean greenstone belts or the Archaean High grade metamorphite-' granite '-gneiss terrains'.

In Chapter II, the structure and tectonics of the Singhbhum shear zone are discussed. Detailed geological maps of the different segments of this belt are presented. It would be advantageous to view the maps, along with the original published regional map of Dunn and Dey as, then, a comprehensive picture of the stratigraphy and structures of the area, as a whole, could be obtained. Many local structural studies are reviewed. The existing tectonic models are discussed and the author opines that 'there is very little, if any, compulsive evidence at present to suggest that subduction type tectonics really took place in the Singhbhum region' (p. 44).

Chapter III reviews the new data on the petrology and petrochemistry of the major rock formations, the character of the igneous suites and the evolution of the metamorphic rocks, in some instances, in relation to the fabric of the rocks. The highlights of this chapter include a detailed discussion on the origin of soda-granite, the Arkasani granophyre, the extensive mylonites noticed along the shear zone and the prograde and retrograde metamorphic events. The author suggests that the soda granite has been formed by transformation of the Dhanjori metabasics by metamorphism and subsequent Na-Si metasomatism.

Chapter IV describes the distribution of sulphide ore bodies in the different sectors of the copper belt, the nature of the copper ore bodies, ore mineralogy, reserves of copper in the important deposits and production of copper from 1928-83. Presenting the metamorphic features of the ores, the sulphur isotope data and features of supergene alterations, the author emphasises the role of metamorphism in metallogeny. According to him, metamorphism renders the ore mineralogical criteria used for arriving at paragenetic sequences equivocal and, therefore, no attempt is made to suggest any sequence of mineral formation. Such an approach

may not find wide acceptance when there are many evidences to reveal that the mineralization in the Singhbhum belt has had more than one phase, as is exemplified by lodes of molybdenite-rich ores cross-cutting the uranium lodes. The origin of the sulphides is discussed at great length and the author suggests that the copper sulphides were first deposited by volcano-hydrothermal activity along a synvolcanic fault zone, similar to the present day manifestations in the East Pacific Rise.

Chapter V deals with the mineralisation of uranium and associated ores. The major ore bodies, grade and reserves, mineralogy of the ores, age of mineralisation and ore genesis are described. The author suggests that the hydrodynamic system that leached out copper and associated elements from the basic rocks could also have leached uranium from the underlying sediments and deposited it in more or less the same locale. He further suggests uranium from the Lower-Middle crust moved upwards along deep-rooted shear zones.

The author's remark that the 'isograde' section of Naroapahar (NARWAPAHAR) 'may be taken to be more or less representative of other uranium-bearing ore bodies of the belt' is far from true. With regard to the Jaduguda deposit (5.3.7), the publications of Venkataraman *et al* (1971, Procs. of the Indian National Science Academy, v. 37A (2) pp. 131-144 and Venkataraman and Vajpai, 1975. Jour. Geol. Soc. India, v. 16, (3) pp. 354-360 have not been cited. Regarding heap and bacterial leaching of low grade ores, a reference to Jayaram *et al.* (IAEA-AG/33-11 in 'Uranium Ore Processing', 1976) would have rendered the account more up to date. The section on mineralogy of ores is exhaustive but the presence of pyrochlore-microlite in Jaduguda and Keruadungri is, however, not established though suspected earlier. The data presented in this chapter with regard to the parameters of the uranium ore bodies, are based mainly on the only available publication of 1971 and earlier, and not represent the true picture as on today in many respects. Such information today is being treated as classified by the Atomic Minerals Division.

Chapter VI deals with apatite-magnetite mineralization. Major occurrences, their mineralogy and genesis are reviewed. The author assigns an important role to volcanogenic hydrothermal activity which led to leaching of the basic rocks (Dhanjoris) and formation of apatite-magnetite veins. Migmatization of these rocks also has played a part in some of the areas.

The overall presentation of data and the quality of geological maps, field photographs and photomicrographs maintain a high standard of reproduction. The text is not devoid of 'printers' devil', but these are few. Figs. 3.2 and 3.5 should have shown wt% scales and the komatiite field in the latter needs to be scrutinised. The source of some of the standard diagrams used in Chapter III is not indicated. Very often, where views of some workers are mentioned, no references are given, as for example in p. 15, line 13 and line 35, and p. 16 line 2. A subject index would have been a useful addition. A final chapter synthesising the results presented in the six Chapters, would have helped to bring to focus their bearing on the overall geological evolution of the Singhbhum copper-uranium belt.

The book, is a useful contribution and a welcome addition to the existing literature on Singhbhum geology. It exhaustively reviews most of the aspects of Singhbhum geology and would, indeed, be a worthy acquisition to all the libraries on Earth Sciences and would be a useful hand-book for all researchers on Singhbhum geology.