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## BOOK REVIEW

**NATIONAL SEMINAR ON EXPLORATION AND SURVEY FOR NOBLE METALS AND PRECIOUS STONES.** Special Publication no.58, Geological Survey of India, 2001, 679p., Price: Rs.390 (US\$ 22.65; £13.70)

This is a pre-seminar volume brought out by the Southern Region of the Geological Survey of India (GSI) at the time of a National Seminar on Exploration and Survey for Noble Metals and Precious Stones held at Hyderabad on 22<sup>nd</sup> and 23<sup>rd</sup> May, 2001, as part of the 150th year celebrations of the Geological Survey of India. What distinguished the publication is the range, depth and authenticity of articles prepared by specialist geoscientists with long hands-on experience in the specific fields. We can see traditional work mainly guided by ancient mine workings in the early years giving place to the study of belts and districts with drainage surveys and heavy mineral studies aided by geochemistry. In more recent years the state-of-the-art technology has entered the picture with more sensitive analytical techniques, image processing, improved data validation and so on. With the grant of large area reconnaissance permits, prospecting licences and mining leases to private sector – both national and international – the subject of the seminar is attracting many investors. Therefore, the publication is timely and will find positive response from many quarters.

There are as many as 70 articles by 156 authors out of

which except 10 from Hutti Gold Mines Co. Ltd., Bharat Gold Mines Ltd., National Geophysical Research Institute, National Metallurgical Laboratory, Wadia Institute of Himalayan Geology and Chofu (Japan), the rest are from the GSI. There are 41 articles on gold, 4 on platinum, 12 on diamond/kimberlite/lamproite, 2 on geophysics, 7 on analytical methods and validity of analyses and 4 on gemstones.

## Gold

There are 20 articles covering nationwide/statewide/regional aspects, 16 articles covering individual prospects and 6 articles covering exploration strategy.

In a synopsis of the gold exploration in the last few decades in India, S.K. Kar and S.K. Biswas trace how the earlier work was confined to known gold deposits/prospects – Kolar, Hutti, Ramagiri, Gadag, Chitradurga, Wynad, Lawa, Kundarkocha etc. (Second and Third five year plan periods) which was later extended to new areas apart from intensifying work in known belts (in the eighties and nineties) which resulted in identifying new belts (Jonmagiri, Gadwal,

Kadri, Ramagiri-Penakacherla, Sandur, Maglur, K.R. Pet and Nuggihalli in Karnataka and Andhra Pradesh; and many areas in Maharashtra, Madhya Pradesh, Uttar Pradesh and Rajasthan). The article admits that the country did not achieve a high-level of success in gold exploration. Only a few like the Yeppamana (Ramagiri, A.P.), Chigaragunta (south Kolar, A.P.), Mallappakonda (south Kolar, A.P.), Hira-Buddini, Uti, Wondalli (Hutti, Karnataka), Ajjanahalli (Tumkur, Karnataka) were commercially viable finds.

S.V.G. Krishna Rao has succinctly summarized the gold potential and geological setting in Karnataka (10 pages). K. Sreeramachandra Rao has covered gold in greenstone-granite terranes of Andhra Pradesh. B.K. Chaudhuri and R.K. Roy have reviewed the gold exploration status in Eastern India and have recognized six litho-tectonic environments favourable for gold mineralisation. S.K. Biswas and others have summarized the geology and primary and secondary gold in Dalma and Singhbhum Groups in Bihar. There are two articles on Kolar – M.M. Mukherjee covering the Eastern Dharwar craton and N. Rajendran rekindling the hope of discovery of the elusive deep-seated Champion Reef type rich gold-quartz lode in north Kolar where concerted efforts of GSI and MECL have gone abortive. He suggests locating possible suprazone of deep-seated ore body by multi-element geochemistry, using indicator supra-elements like mercury. There is an article by V. Subramanyan on exploration strategy for Karnataka gold.

M.M. Nair and R.V.G. Nair have described gold in the virgin, high grade terrane of Attapadi, Kerala. There is a good review paper on Tamil Nadu gold potential. S.P. Rastogi and others have covered volcano-sedimentary sequence of Mahakoshal Group in Son valley, Uttar Pradesh where 28 prospects have been located. Interesting fluid inclusion studies to surmise the pressure, temperature, salinity and other conditions for gold mineralisation form part of the article. K.G. Bhoskar describes 23 primary and several secondary prospects in Sakoli field, Maharashtra. Sumit Kumar Mitra deals with gold-silver in Shillong Group (Meghalaya) covering multi-element geochemistry, statistical analysis (mean, standard deviation, correlation coefficient) and EPMA and EDX studies from the ores of Mawmaram.

There are several articles dealing with individual prospects – Ajjanahalli, Gandikatte, Hira Buddini, Uti, Wondalli, Volgere, Amble, Nagavi-Malasamudra (Karnataka); Dona (A.P.); Koppil (Nilambur) (Kerala); Gulaldih (Son Bhadrha), Sona Pahari (U.P.) and Bhukia (Rajasthan).

The regional papers have brought out new areas for

exploration and shift from the Kolar-Hutti type gold-quartz ores to BIF hosted ores, stock works and gold in granitoids (Honnemaradi in Karnataka and Ramagiri-Penakacherla in Andhra Pradesh), Sakoli belt, Son valley, Bhukia, Attapadi, Nilambur, Wynad, Dona etc.

#### Geophysics

M. Venkateswarlu and others have attempted to use gravity data to locate possible target areas for gold and diamond exploration in the Eastern greenstone belts of Andhra Pradesh. M.P. Mathew and others have presented for the first time IGRF-corrected aeromagnetic contour maps and images for a large part of peninsular India (lat.8°N to 25°N) for helping selection of exploration targets.

#### Analytical Techniques

V. Balam (NGRI) has dealt with analytical strategies in the exploration of noble metals involving field sampling, sample preparation in laboratory, decomposition (by fire assay/wet chemical/chlorination, slurry nebulisation, alkali fusion/Carius tube dissolution, microwave digestion), pre-concentration (fire assay button/MIBK/DiBK) and analyses (chemical, fire assay, instrumental FAAS, GF AAS, ICP, AES, AMS, INAA, ICP MS, HR ICP MS etc.). K.K. Gupta and others (NML) cover Plasma Optical Emission Spectrometry. C.R.M. Rao and T.A.S Rao cover PGE contamination in various reagents in nickel sulphide fire assay method and also PGE determination by ICP MS using in-house GSI reference standard. While high accuracy is required with ultra-fine sensitivity (parts per billion) for noble metal exploration, large volume exploration projects will have to keep the cost involved in mind. F AAS and GF AAS methods with cold extraction (aqua regia, HCL; and preconcentration MIBK) have proved adequate the world over. R.K. Chopra et al. and Sekhal Mallik et al. presented interesting data.

Exploration geologists facing failures of discovery tend to blame the vagaries of chemical analysis for the failure. They are advised to read these articles and appreciate that failures and inadequacies could be from several other sources.

#### Diamond, Kimberlite, Lamproite

Out of 12 articles, 10 deal with regional studies and 2 with petrology and mineralogy of mantle xenoliths and kimberlites of Wajrakarur. Compared to gold, exploration for diamond has been more rewarding with considerable scope for new discoveries.

There are articles on diamond exploration in south India (S. Neelakantam); Bastar craton (S.K. Sarkar and

B.K. Mishra); eastern and western parts of Bastar craton (S.K. Srivastava et al. K. Shashidharan et al.); Karnataka (A.R. Nambiar et al.); Tamil Nadu (R. Srinivasan and V. Chandrasekaran) and Ib, Tel, Indravati and Ong river basins (Orissa, Chattisgarh).

Neelakantam describes 21 known diamondiferous kimberlite pipes of Wajrakarur (13), Chigicherla (5), Kalyandurg (3) and 34 pipes, so far not known to carry diamonds from Narayanpet field, as also 12 lamproite fields of Krishna region. Conglomerates and Krishna gravels are also covered. In Bastar craton, exploration started with widespread reports of diamond in stream gravels in Bahardih-Payalikhanda area, Raipur district, Chattisgarh. Four kimberlite pipes (two diamondiferous) and 40 indicator mineral anomalies were located by stream sediment surveys in Mainpur kimberlite field. Work in other areas led to the discovery of four kimberlite pipes in Indravati basin and of Tokapal kimberlite field. Several blocks are identified to airborne and detailed ground exploration.

#### Platinum Group of Elements

M.M. Mukherjee and R.N. Patra describe work done in Baula-Nausahi area, Orissa and provide future vision for

nation wide exploration. The status paper on Tamil Nadu covers ultramafics of Sitampundi complex, Mettupallyam and Torappadi. There are articles on PGE with gold in Mahakoshal Group (M.P. and U.P.) in Bhimsain and Killapahar in Maharashtra and noble metals in Ladakh.

#### Gemstones

S.K. Kar and J.K. Sinha have surveyed the gemstones of India (diamond, emerald, aquamarine, chrysoberyl and alexandrite, ruby, sapphire, garnet and agate group). The other articles deal with the gem tracts of east Godavari (A.P.), Tamil Nadu, West Bengal and Orissa. Surprisingly there is no mention of recent studies on gems in India (e.g., K.R. Karanth's book on Gems and Gem Industry in India published by the Geological Society of India).

In summary, the publication of this volume is an excellent way of celebrating the 150<sup>th</sup> anniversary of the GSI. Ravi Shanker, Director General and Dr. S.K. Mazumder, Senior Dy. Director General, along with the large team of their colleagues, deserve our appreciation and gratitude.

*Bangalore*

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## AEROMAGNETIC IMAGE OF A PART OF PENINSULAR INDIA, GEOLOGICAL SURVEY OF INDIA, 2001: A REVIEW

The aeromagnetic image map of a part of peninsular India, prepared by the Geological Survey of India, presents anomaly features between latitudes 8° N and 25° N and longitudes 74° E and 89° E, at a height of 7000 feet above mean sea level. The basic aeromagnetic data are acquired from various sources in the form of 347 analog absolute total intensity magnetic field contour maps on scales ranging from 1:30,000 to 1:250,000. Processing of data for the area south of 17° N latitude was carried out at AMSE, GSI, Bangalore and that for the area north of this latitude at NGRI, Hyderabad. Final editing, grid creation and matching was accomplished at AMSE. The original contoured maps were digitized and individually gridded at suitable resolution; the different grids were corrected for IGRF to get the anomaly values. The data were continued to 7000 ft above msl and merged to remove artifacts. The pseudo-colour-shaded relief image map at 1:2,000,000 is presented, depicting anomalies ranging in values from -1794 nT to 1166 nT. Aeromagnetic data collected at significantly

different altitudes are presented separately as four inset maps. Geological and geophysical characteristics evident on this map are very well outlined.

The map very clearly brings out the tremendous utility and potentiality of the aeromagnetic dataset. Based on the anomaly pattern, the image map has been divided into three blocks: block I (between latitudes 8° N and 12° N) and block III (between latitudes 22° N and 25° N) are relatively homogeneous blocks characterized by generally high density of anomaly distribution compared to the more heterogeneous block II (between latitudes 12° N and 22° N). Several known surface geological features are manifest in this map, and more importantly, signatures of the subsurface are also amply evident. The match with tectonic features like shear zones is spectacular. Schist belts and iron ore belts are amply evident on the map. The amazingly good match with known geological and geophysical characteristics lends credence to the main features brought out in the map. The gross features up to 17° N compares very well with the map of