

BOOK REVIEW

GEOLOGY AND GEOCHEMISTRY OF THE MAGMATIC ROCKS OF THE MALANI IGNEOUS SUITE AND TERTIARY ALKALINE PROVINCE OF WESTERN RAJASTHAN by S.K. Bhushan and V. Chandrasekaran. Memoirs of the Geological Survey of India, Volume 126, 2002. Published by the Director General, Geological Survey of India, 27 Jawaharlal Nehru Road, Kolkata - 700 016. Pages: x+181, Price: Rs.310/-

This Memoir (No. 126) of the Geological Survey of India is an excellent presentation on a very interesting, but a complex and challenging association of volcanic and plutonic alkaline rocks of contrasting ages. The term Malani was coined after Mallinath Rawat - the ruler of the Banner, Jasol, Nagaur and Sindhari regions in 14th century, and the earliest mention of the Malanis was made by H. J. Carter in 1881.

The Malani igneous province (51,000 km²) lies west of the Proterozoic Aravalli-Delhi fold belt from Phalodi to Sirohi, and from Jodhpur to the international border. The province is composed of acidic, intermediate, basic, ultrabasic and alkaline intrusives and extrusives besides sedimentaries in western Rajasthan in the districts of Jodhpur, Pali, Sirohi, Jalore, Barmer and Jaisalmer. The igneous rocks of the province were earlier believed to be the result of a single magmatic event of the Late-Proterozoic period (ca 750 Ma) but the recent work has recognized yet another younger event of the Cretaceous-Tertiary period.

Polyphase magmatic activities of the Malani alkaline province span over two major periods of crustal extension. The first magmatic event resulted in the emplacement of the Erinpura granite (under orogenic conditions) and eruption of the felsic and peralkaline volcanics (under anorogenic conditions); and this event probably was due to pre-drift tectonics related to the Gondwana taphrogenesis of which India was a part during the Pan-African thermal event. The second magmatic event is marked by the alkaline magmatism of the Tertiary period and is related to the rejuvenation of taphrogenic activity along the dominant feeder fractures/lineaments during a period when the Indian Peninsula was getting welded to the Asian continent.

The authors have studied the province for more than a decade and the present Memoir incorporates the results of their study and also of other scientists who have been actively engaged in this province. Systematic mapping of the province by GSI began in 1955 and was completed by 1989. The publication has been brought out with the objective

of presenting a synthesis of the available data on the Malani igneous suite and the younger mildly alkaline and hyperalkaline rocks of western Rajasthan. The book deals with the classification and stratigraphy of the Malanis, their petrography, geochemistry and origin. The true relationship between basic and acidic flows has been evaluated, and their proper stratigraphic position assigned. The genesis of igneous rocks in relation to parent magmas, role of volatiles, viscosity, oxygen fugacity and temperature of crystallization has been evaluated. Comprehensive account of the Malani magmatism and its role in the cratonisation of the northern parts of the Indian Peninsular shield in the Late-Proterozoic times, and also of younger alkaline rocks of the province in terms of geochronology, tectono-magmatic setting and economic aspects have been thoroughly discussed.

The Memoir (x+181 pages) incorporates 233 references spanning about 123 years (1877-2000) of pioneering research work. There are three impressive and high quality coloured lithostratigraphic (Fig. 1A), sketch geological (Fig. 2) and volcano-stratigraphic (Fig. 3) maps kept in the pouch of the Memoir, and four geological maps in the running text. In addition to these, the accrued stratigraphic information and chemical data are incorporated in 23 Tables, and illustrated in 32 Figures. There are 43 field photographs and five photomicrographs. The authors have organised the text under ten main headings as detailed below:

1. Aspects of geomorphology and climatic conditions of the region to the west of the Aravalli mountain range (i.e. Malani Igneous Province) are described in "Introduction". Also incorporated here is a fruitful review of the literature of around 40 dedicated researchers, touching the salient aspects of individual work.
2. "Regional geological setting" provides a broad framework of the stratigraphic position of the Malanis, geochronology and a modified general stratigraphic succession of the western Rajasthan (Jaisalmer and

Barmer basins)- the objectives of the publication are also presented.

3. "Geology of the province" outlines the following: (a) A modified magmatic geneology of the Malani igneous suite (classification); (b) A crisp account of the geology of basement rocks including meta-sedimentaries, granitoids (Erinpura granite) and Punagarh and Sindreth groups; (c) Malani igneous suite including Malani volcanics - basic and acidic lava flows of the Sirohi-Jalor, Siwana, Pokaran and Barmer sectors; and a succinct summary on the granite plutons, ring dykes and bosses - all falling under broad names such as Jalor granite (seven bodies), Siwana granite (six bodies) and Malani granite (three bodies). In addition, an effective summary is presented on the geology-cum-petrography of dykes; (d) Tertiary alkaline complex incorporates the geology of 'mildly alkaline rocks' of Samu-Dandali (Cretaceous alkali olivine basalt, hawaiiite, trachyandesite, syenodiorite, and alkali syenite), 'alkaline rocks' of the province at Mundwara alkaline complex (olivine tholeiite, picrite, olivine gabbro, gabbroic anorthosite, alkali-pyroxenite, theralite, basanite, sodalite-analcime-leucosyenite, basic and acidic dykes and carbonatite), Samu-Dandali alkaline complex (alkali olivine basalt, hawaiiite, trachyandesite, trachyte, alkali-syenite, alkali-pyroxenite, micro-melteigite, mela-nephelinite, ijolite, carbonatite, foidal syenite, phonolite and plugs/dykes - all of the Lower-Cretaceous to Tertiary age), carbonatite and cover sedimentaries of the province.
4. A comprehensive account of the textures and mineralogy of all the rock types from Malani volcanics, granites, and Tertiary alkaline complex including carbonatites, is dealt with under "Petrography". Presence of riebeckite and aegirine (in rhyolites), and arfvedsonite (in Siwana granites) generates interest for a 'true' alkaline rock researcher as these alkali-pyriboles suggest peralkaline magmatism which is generally associated with rifting.
5. "Mineral chemistry of Malani volcanics" incorporates the electron probe microanalyses of the constituent minerals of basanite, welded tuff, trachyte, peralkaline rhyolite and peraluminous rhyolite. The Na and Fe contents of alkali-pyriboles, like their distinctive pleochroism, in some of these rocks draw special attention to any intrinsic significance of chemical data. The data has been interpreted from the view point of the structural distribution of cations in the minerals, and the authors have drawn some reasonable conclusions regarding equilibrium conditions during magmatic crystallization. Chemical composition along with structural formulae of 9 plagioclases, 13 clinopyroxenes, 8 quartzes, 35 K-feldspars, 6 glasses, 5 spherulites, 9 albites, 1 titanomagnetite, 2 ilmenites, 5 aegirine-augites, 12 aegirines, 2 clino-amphiboles, 4 riebeckites and 1 biotite are presented in Table 6 (pp. 124-130). The data has been illustrated in relevant diagrams for the purpose of classification and interpretation of conditions of crystallization.
6. The topic on "Chemistry and numerical treatment of trace element data" provides a large amount of quantitative major element data for various rock types of the Malani igneous province. WR analyses along with the corresponding CIPW norms of the Malani felsic rocks are very systematically arranged in Table 7; the value of the given chemical data is enhanced as the geographic location (latVlong.) and also the lithotype for each sample are given. There are 161 WR major element analyses of felsic volcanic rocks, 25 mafic volcanics (basalts), 29 granites and 29 dyke rocks. The data includes analyses from previous workers and also those done during the first generation mapping. This chapter is divided into three parts: geochemistry of Malani igneous suite, Tertiary alkaline complex (mostly of Sarnu-Dandali and Mundwara bodies) and numerical treatment of the major element data. The data from Tertiary alkaline complex is used to depict trends of differentiation of magma. It is interesting to note that the Sarnu-Dandali rocks show enrichment of ^{18}O with ^{13}C .
7. The enrichment and depletion trends of trace elements in the volcanics, Siwana-Jalor granites, Sarnu-Dandali rocks and Mundwara alkaline rocks are illustrated, described and discussed under "Distribution and behaviour of trace elements".
8. There is a brief account on "Geochronological data and tectono-magmatic setting" of the province. Some of the interesting aspects covered here are: (a) the 100 Ma long magmatic history from 779 to 681 Ma, (b) the 50 Ma long thermal event from 500 to 450 Ma, and (c) the peralkaline magmatism (Siwana granite) preceding peraluminous magmatism (Jalor granite).
9. The topic on "Malani magmatism" incorporates detailed accounts of volcanism and plutonism. Under the head volcanism, a brief account of cycles, mode of eruption, type of eruption, origin of rhyolite melt, P-T conditions, salient chemistry of acid volcanics and tectonomagmatism have been thoroughly discussed and schematically presented in an orderly and convincing fashion. Figures 37, 38, and 39 are very simple and

impressive as they portray location of rifting, hot-spot development of magma chamber in the basement, intrusion of the Erinpura and Mount Abu batholiths, mantle upwelling, rifting and eruption of Malani bimodal volcanism followed by Marwar sedimentation. Attainment of peralkaline character of acid volcanics under vapour pressure is reasonably explained.

10. In the "Economic aspects" of the area, the authors offer a brief review of the potentiality of Malani rocks for economic minerals, and the economic aspects embrace the building and ornamental stones, flourite, semiprecious stones, perlites, sulphides, Sn, W and Mo occurrences, Degana tungsten, and potentiality of Siwana, Jalor and Mungria areas. The authors feel that the alkaline complexes of Sarnu-Dandali and Mundwara deserve further detailed investigations for rare-earth elements. The text of the Memoir culminates in an impressive "Summary and Conclusions".

The text of the Malani 'magmatic material' flows in a simple and lucid style that is very characteristic of GSI publications. Except for the missing of sample numbers for rocks with serial numbers 1-74 in Table 8, magnification (scale) for photomicrographs presented in plates 44-48, and a small typographic correction for SiO₂ in Fig.9, there are no apparent mistakes in the presentation of factual data. The reader, in the first instance, may search for 'explanation to

symbols' used in Figures but soon he will find it on the last page (181).

The reader of the Memoir will surely be profited by the pains taken by the authors in bringing out the complex story of the 'Malani igneous suite and Tertiary alkaline province' in a simple and concise form. Dr. Bhushan and Dr. Chandrasekaran richly deserve compliments from all sections of the geological community for their meticulous compilation, superb presentation and flawless editing of high quality and voluminous data that is otherwise scattered and hidden in literature, resembling in this respect, the outcrops of the Malani in the Thar desert of Rajasthan.

The Memoir which comes with a beautiful coloured (front and back) cover page of columnar Malani rhyolite, could be a precious addition to any individual's personal collection, and it should be owned by all the libraries of the Earth Science Departments in the academic institutions, and professional organisations for general reference by the students, teachers, researchers and professional geologists. The publication is available in the Library of the Geological Society of India (Bangalore), and is for sale at the Geological Survey of India, Kolkata.

*Department of Geology
Post-Graduate College of Science
Osmania University
Saifabad, Hyderabad-500 004*

J. RATNAKAR

ANNOUNCEMENT'

INTERNATIONAL SYMPOSIUM ON RECENT TRENDS IN SURFACE GEOCHEMICAL PROSPECTING AND RISK REDUCTION FOR HYDROCARBON EXPLORATION AND DEVELOPMENT: National Geophysical Research Institute (NGRI) is organizing the above symposium during 6-7. **December** 2003 at NGRI, Hyderabad. The topics of the symposium are: (1) Challenges of Hydrocarbon Exploration and Development in the Coming Decades; (2) Gaseous Hydrocarbon Based Methods; (3) Bitumen and Solvent Extraction Based Methods; (4) Soil Salt Methods; (5) Trace Element Based Techniques; (6) Microbial Methods; (7) Helium Emanometric Methods; (8) Geochemical Prospecting and Data Management, Processing and Interpretation Techniques and (9) Integrated Geochemical and Geophysical Prospecting Techniques. For further details, please contact: Dr. B. Kumar, Convener and Organizing Secretary, ISGP-2003, National Geophysical Research Institute, Uppal Road, Hyderabad - 500 007, India. **Phone:** 91-40-23434608; **Fax:** 91-40-27171564, 23434651; **Email:** coisgp@rediffmail.com; csisgp@rediffmail.com