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Note on The Characteristics of Malani Petrographic Province (MPP), Western India

KEYWORDS: Perographic Province, Felsic Volcanics, Rhyolites

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ABSTRACT *The Malani Petrographic Province (MPP) of western Rajasthan, India, represents the silicic volcanics spread over in an area of about 31000 sq.kms. The major rock unit of MPP is of rhyolites which are relatively more or less uniform in composition. Chemical analyses conducted by various workers in MPP suggest that the rhyolites of the MPP are characterized by high silica content and are sub-alkaline in nature. There is a general consensus that the MPP represents Neoproterozoic volcanism and having an age of ~750 + 20 Ma. The origin of the MPP is considered as an event of anorogenic felsic volcanism.*

INTRODUCTION

Judd (1886) first used the term "Petrographic Province" to a natural region within which some or all of the igneous rocks present certain well-marked peculiarities in their mineralogical and chemical composition, structure, texture, etc. The concept of petrographic province was further developed by Iddings (1892). He introduced chemical composition as one of the distinguishing character of igneous province. As such, the general characteristics of Petrographic Province include the rocks are relatively more or less uniform in composition, they were erupted or injected within a specific time period, rocks show certain common chemical characteristics and regularity in variation diagrams and the mineralogical, chemical and genetic characteristics of rocks of a province are so noticeable that it can be differentiated from the same types of rocks of other regions.

The Malani Petrographic Province (MPP) which is mainly represents the silicic volcanics is a part of Malani Igneous Suite (MIS). The rocks of MIS is covering an area of ~51,000 sq. km in the western part of India, stretching from Tosham in Haryana to Churu-Jhunjhunu in Rajasthan in the southwest and from Kirana Hills in Punjab to Barmer in Rajasthan and Nagarparkar in Sindh, Pakistan in the west. Based on field relationship, mode and type of magmatism, texture and composition, three phase of igneous activity have been recognized within MIS. The first phase commenced with the eruption of volcanics, the second phase experienced granitic intrusions and the third phase was of mafic and felsic intrusions (Bhushan 1981; Bhushan and Chandrasekaran, 2002). The general geological succession of MIS is as under:

Marwar Supergroup
----------unconformity----------
Dyke Phase
Plutons and Ring dykes
Volcanics
----------unconformity----------
Basement rocks (Delhi Supergroup)

DISTINCTIVENESS OF MALANI PETROGRAPHIC PROVINCE (MPP)

(a) Distribution:

Malani Petrographic Province (MPP) is dominated by the acid volcanic flows and tuffs. Acid flows are the most voluminous unit of MPP, spread over in an area of about 31000 sq.kms. in western Rajasthan, covering mainly three sectors i.e. Jodhpur, Pokhkran and Barmer. However, small isolated occurrences are also found at Jhunjhunu, Pali and Sirohi districts (Bhushan and Chandrasekaran, 2002; Roy and Jhakar, 2002).

(b) Rock Units:

The major rock unit of MPP is of rhyolites. However, at places pyroclastics, ignimbrites, basalts, rhyodacites and dacites are also occurred. Rhyolites occur mostly as cluster of low hills and mounds. The generally form large, flattened, dome-shaped hill rising up to an average height of 300 meters. A number of rhyolite flows can be seen in throughout the province, extending over a considerable distance without much variation. A minimum of two to three flows exist in almost every area. The thickness of individual flow varies from few meters to about 100 meters.

(c) Mineralogical Properties:

The rocks of the provinces are relatively more or less uniform in composition. On the basis mineralogical and textural characteristics the rhyolites of MPP can be grouped into (1) Aphyric rhyolites and (2) Porphyritic rhyolites. The aphyric rhyolites are fine grained showing flow structures. In the porphyritic rhyolites there is a variation on the basis of occurrence of phenocrysts i.e. rhyolites with phenocrysts of K-felspar, rhyolites with phenocrysts of quartz, rhyolites with phenocrysts of both quartz and K-felspar, rhyolites with phenocrysts of Fe-Mg minerals etc. Quartz is most common in the rhyolites and shows corroded margins. Felspars are predominantly potassic but few grains of plagioclase also present. Riebeckite and aegirine are the most common Fe-Mg minerals present in minor amount. The common accessory minerals in rhyolites are apatite, zircon, magnetite, sphene etc. The groundmass mostly is cryptocrystalline to glassy and composed mainly of quartzo-felspathic material.

(d) Chemical Properties:

Chemical analyses conducted by various workers in MPP suggest that the rhyolites of the MPP are characterized by high silica content ranging from 68.38 to 75.64%. The Al_2O_3 and TiO_2 varies from 10.76 to 18.57% and 0.16 to

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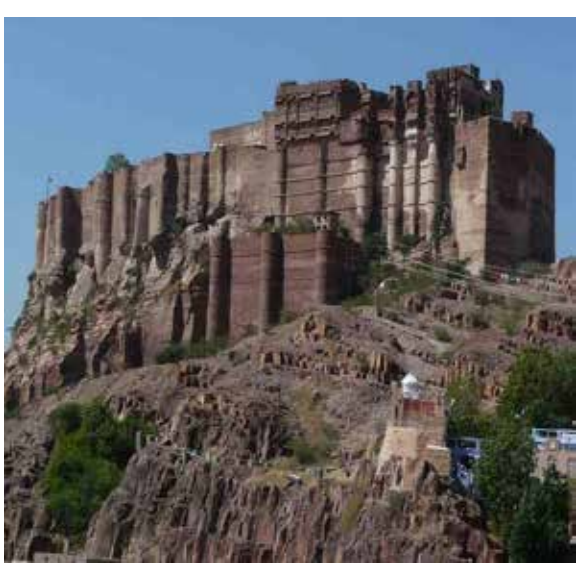
0.40% respectively. The FeO content is low in comparison to the Fe_2O_3. The FeO ranges from 0.16 to 1.48% while the Fe_2O_3 values are between 1.533 to 5.55%. The rhyolites are relatively low in MgO and CaO contents. The MgO and CaO values are ranges from 0.17 to 1.20% and 0.10 to 2.90% respectively. Similar is the case with the concentration of MnO and P_2O_5. Regarding the alkalies, the Na_2O has relatively low values but the K_2O shows vast variation. Na_2O ranges from 0.41 to 5.32% while K_2O ranges from 1.20 to as high as 9.39%. On the basis of alkali content classification (Irvine and Baragar, 1971) the rhyolites are sub-alkaline in nature. The normative compositions of these rhyolites indicate that they are Supersaturated rocks (classification as suggested by Shand, 1917 and Holmes, 1917) as they contain sufficient amount of free silica i.e. normative quartz ranges from 28.19 to 60.10. Similarly, they are also corundum normative rocks where the amount of corundum is as high as 16.12. In Total Alkali-Silica classification (Le Bas et.al., 1986) these rocks fall in the field of rhyolites and in K_2O – SiO_2 classification (Peccerillo and Taylor, 1976) they fall in the field of rhyolites and high K rhyolites.

(e) Age of MPP :

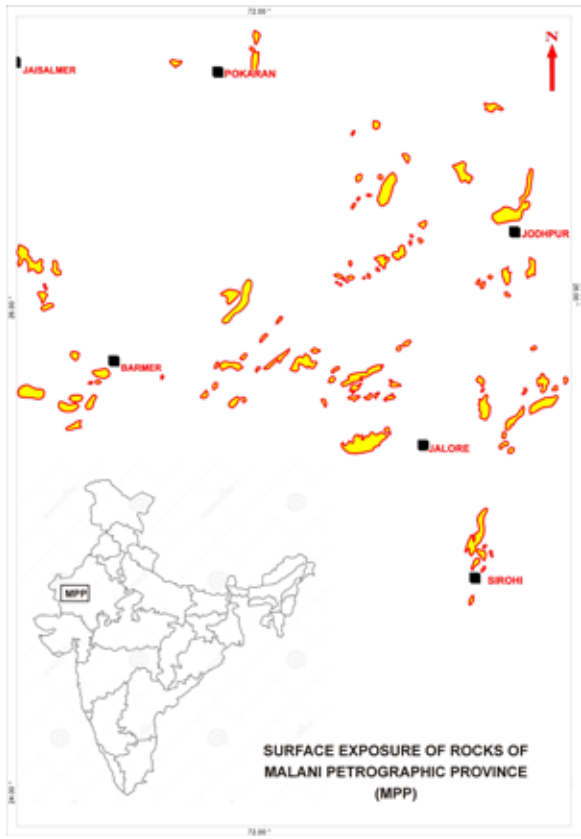
There is a general consensus that the MPP represents Neoproterozoic volcanism. The Rb-Sr isotope data (e.g., Crawford, 1975; Choudhary et al., 1984) suggested the age of ~750 Ma and had a relatively short duration of about 20 Ma. Rathore et al. (1996) have determined an age of 779 Ma.

(f) Suggested Origin :

The origin of the MPP is considered as an event of anorogenic felsic volcanism. Kochhar (1984) recognized the volcanism as a hotspot activity. Bhushan (1999, 2000), Raval (2000) and Roy (2001) also supported Kochhar's hotspot model for the anorogenic Malani magmatism. Pareek (1984) considered that the main trend of outpouring of volcanics is fissure-controlled and there is a relationship between volcanism and tectonic lineaments. Srivastava (1988) also proposed that weak lines developed parallel to the Aravalli mountain range during its uplift in late Proterozoic time, through which the Malani lavas poured.



Photograph 1 : Rhyolites of MPP exposed around the hills of Jodhpur city. The famous Mehrangarh Fort of Jodhpur is constructed over these rhyolites.



Map 1 : Showing distribution of volcanics of MPP (Volcanics buried under alluvium our sand dunes have not demarcated)

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