Volume 66, Issue 3, 2022
Journal of Scientific Research
of
The Banaras Hindu University

Pegmatites As Decorative and Dimensional Stone Occurring in South-Central Rajasthan, India

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Abstract: **The Precambrian formations of south-central Rajasthan host the unique deposits of pegmatite popularly known as 'Alaska white'. These deposits are located mainly in Jawaja and Rajgarh areas of Ajmer, Gangapur and Jahazpur areas of Bhilwara and Amet and Deogarh areas of Rajsamand districts, Rajasthan. Field and the mineralogical study indicate that these deposits represent a compact and massive-type of pegmatite composed mainly of microcline, quartz and muscovite with subordinate amounts of albite and tourmaline. These pegmatite deposits occur as rounded to sub-rounded lenticular bodies emplaced concordantly within the rock formations of Bhilwara and Delhi Supergroups. These deposits are being developed and utilized by open-cast, fully-mechanized block-benching methods of mining for their extensive use as decorative and dimensional stones. Nearly 90% of the recovered resource is being exported mainly to U.S.A. and China in the form of well-dressed blocks of suitable sizes.**

Index Terms: **Alaska white, Decorative and Dimensional stone, Pegmatite, South-Central Rajasthan.**

I. INTRODUCTION

Pegmatite is a highly coarse grained multi-mineral plutonic igneous rock also known as "museum of minerals". Pegmatites are distributed over a large area in south-central Rajasthan. They have attracted the attention of geoscientists as well as common men not only because of their geologic significance but also due to their economic importance. Geologically, they reveal valuable information about the composition of the underlying mantle while, economically they host several industrial minerals i.e. feldspar, quartz, mica, *etc.* and gemstones (Klein *et al.*, 1993).

Earlier, the pegmatite deposits were mined to produce mica, quartz, and feldspar, but over the last decade, the compact and massive-type of pegmatite has acquired significant recognition as a decorative and dimensional stone all over the world and is used as 'Alaska granite', also known as 'Alaska white'. Geologically, it is a pegmatite, but it has developed a reputation in the marble and granite industries for its ability to quickly accept great polish and high hardness. Because of its compactness and massive nature, this massive pegmatite cannot be exploited to produce quartz, feldspar, or mica.

Choudhari (1966), Bhattacharjee (1982, 1984), Joshi *et al.* (2014), and Singh *et al.* (2016) have studied various aspects of pegmatites, especially mica-bearing pegmatites in the study area, but a detailed study on massive-type of pegmatites for their use as decorative and dimensional stone has not yet been carried out. Thus, this study was taken up to describe field and mineralogical characteristics as well as economic significance of these massive-type pegmatites of the study area. Similar type of study has been carried out by Shekhawat (2000) on serpentinite resource of southern Rajasthan.

II. GEOLOGICAL SETTING

In south-central Rajasthan, the massive-type of pegmatites are distributed mainly in Jawaja (N25°57'06" E74°16'11") and Rajgarh areas (N26°17'46.9" E74°37'30.6") of Ajmer, Gangapur (N25°13.849' E74°17.515') and Jahazpur (N26°17'46.9" E74°37'30.6") areas of Bhilwara and Amet (N25°21'40" E73°56'07") and Deogarh (N25°27'20" E73°56'53") areas of Rajsamand districts (Fig. 1).

The geology of south-central Rajasthan has been discussed by a number of researchers but a detailed account has been given by Sinha-Roy (1988), Gupta *et al.*, (1997), Roy and Jakhar (2002) and GSI (2011). Gupta *et al.*, (1997) and GSI (2011) classified the rock formations of the study area into three broad Supergroups named as Bhilwara, Aravalli and Delhi Supergroups.

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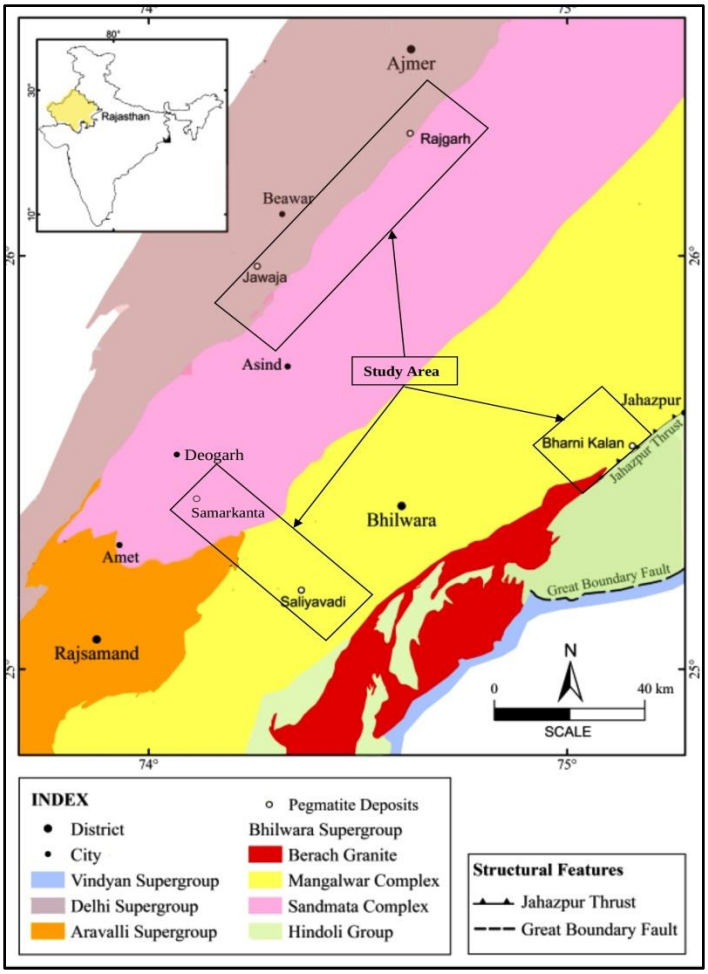

Fig. 1. Geological map of the study area showing the location of the Alaska white deposits in south-central Rajasthan (after Gupta *et al.*, 1997).

In Jawaja and Rajgarh areas, the massive pegmatite bodies occur within the metasediments of the Delhi Supergroup of lower to middle Proterozoic age (Gupta *et al.*, 1997 and GSI, 2011). These metasediments are represented mainly by calc-silicate rocks and various types of schists. In Jawaja area, cut-off pieces of calc-silicate rocks have been observed within the massive pegmatite bodies at several places which indicate that these pegmatites are of post-Delhi age (Fig. 2).

Fig. 2. Field photograph showing cut-off patches of clac-silicate rock in massive-type of pegmatite in Jawaja area, Beawar.

In the areas of Jahazpur, Gangapur, Amet and Deogarh, the massive-type of pegmatites are emplaced within the rocks of the Bhilwara Supergroup of Archaean to lower Proterozoic age (Gupta *et al.*, 1997 and GSI, 2011). The rock types exposed in the close vicinity of these pegmatites include mica schist, quartz-mica schist, biotite schist, *etc.* At several places, thin inclusions of the mica schist have also been recorded in the pegmatite bodies suggesting their post-Archaean age (Fig. 3.). The general trend of these pegmatite bodies is NE-SW with steep south-easterly dips.

Fig. 3. Field photograph showing thin cut-off patches of mica schist occurring in pegmatite of Saliyavadi area, Gangapur.

III. Field Characteristics

In the field study, the outcrops of this massive-type of pegmatite are exposed boldly in the form of rounded to sub-rounded lenticular bodies of variable length and width in the area (Fig. 4).

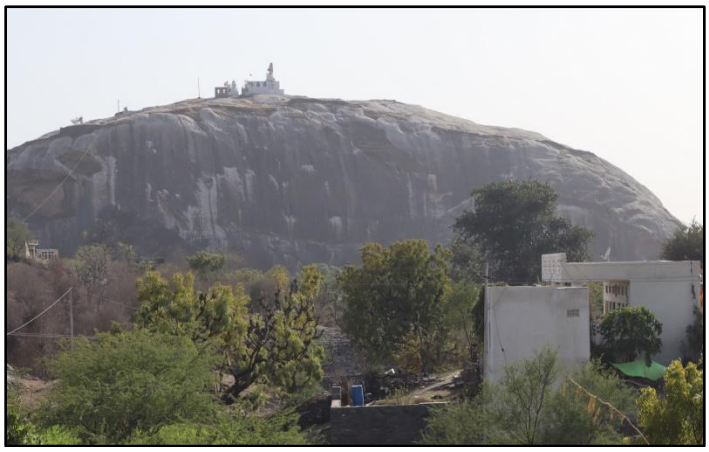

Fig. 4. Field photograph showing rounded to sub-rounded lenticular bodies of massive-type pegmatite from Sangarwas, Jawaja area.

During the field study, it has been observed that these pegmatites differ significantly from normal pegmatites which are used for the production of quartz, feldspar and these pegmatites occur as lenticular bodies of variable size and their outcrops are exposed boldly for a height of about 10 to 50 m above the ground surface. Due to their compact and massive nature, they cannot be used for the production of quartz and feldspar

separately. These pegmatites do not have a central core of quartz which can be easily produced for its industrial use. Unlike mica-bearing pegmatite, they do not show the development of a zone of sheet-mica or mica-books at their contact with wall rocks. These are also poor in having beryl and gem minerals like rosy quartz, aquamarine, *etc.*

IV. MINERALOGICAL CHARACTERISTICS

Mineralogically, the massive pegmatites of the area are consisting mainly of microcline, quartz and muscovite with small amounts of albite and tourmaline. Microcline occurs as anhedral to euhedral crystals of variable size and is found mainly in white to off-white colour. In Amet and Deogarh area, it occurs in the form of large anhedral crystals showing pink colour. Quartz is the next dominant mineral of these pegmatites it occurs as smoky to colourless, subhedral to euhedral grains of variable size and also as thin veinlets distributed in the groundmass of microcline. The microcline is also characterised by the intergrowth of quartz.

Muscovite is also a dominant mineral of massive pegmatites of the area. It occurs as small books or as aggregates of small flakes. It is closely associated with other minerals and unevenly distributed within the pegmatite bodies. In these bodies of pegmatite, albite is present as small tabular crystals and granular to massive mass and it has a white to greyish-white colour. Tourmaline occurs as disseminated black, needle-like and columnar crystals. The reddish-brown small size, perfect to imperfect, fractured crystals of garnet has also been noticed in border parts of the pegmatite bodies.

For correct identification and confirmation of minerals, two fresh and representative bulk sample of massive pegmatite was collected from Jawaja area of Ajmer district. It was prepared and analysed by using the powder X-ray diffraction method (Cullity, 1978). The analysis was carried out at the Department of Earth Sciences, IIT Powai, Mumbai by using Panalytical Empyrean, X-ray diffractometer equipped with High Score Plus software. The diffractogram and results of the analyses (Fig. 5 and 6) suggest that the massive-type of pegmatite of the area is composed mainly of microcline with subordinate amounts of albite, quartz and mica (muscovite).

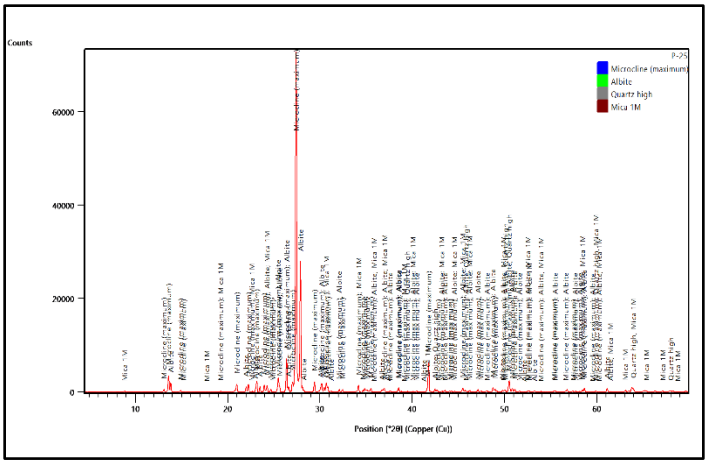

Fig. 5. X-ray diffractogram of a massive-type pegmatite sample from Jawaja area.

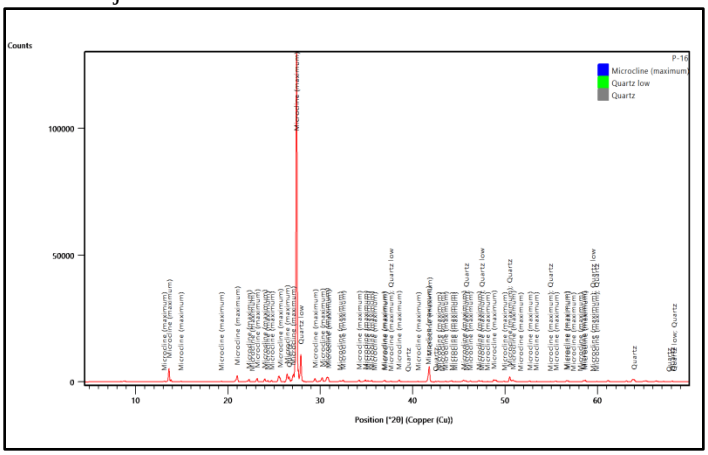

Fig. 6. X-ray diffractogram of massive-type pegmatite sample from Jawaja area.

V. DEVELOPMENT AND UTILISATION OF RESOURCES

In the study area, several mining leases have been granted by the State Government for the production of the resources. Presently, about eighteen mining leases are under active operation. Over the past decade, the resource is being developed and produced by open-cast, fully-mechanized block-benching methods of mining (Fig. 7).

Fig. 7. Field photograph showing a well-developed, fully mechanized quarry of 'Alaska white'.

Blocks of the pegmatite are produced in two preferred sizes: (i) small size - 245 cm (8 feet) x 75 cm (2.5 feet) x 75 cm (2.5 feet) and (ii) large size – 330 cm (11 feet) x 200 cm (6.5 feet) x 200 cm (6.5 feet). The recovery of blocks varies from 60 to 70%. It varies from deposit to deposit depending upon colour, texture, mineralogical composition with the presence of fractures and cracks occurring in the pegmatite bodies. The highest recovery (about 70%) of saleable blocks is reported from Saliyawadi mines of Gangapur area. The blocks produced from the study area are sold by different trade names *i.e*. Alaska white, Alaska Azul white, Alaska gold, Alaska silver false, Alaska dapple blue, Alaska red, *etc*. Recovery of the best quality of blocks (Fig. 8) is only 20 to 25% which are being produced from Bharni Kalan mines of Jahazpur area.

Fig. 8. Field photograph showing Alaska Azul white block from Bharni Kalan mines of Jahazpur area.

These are marketed by the trade name Alaska Azul white. About 60 to 70% of recovered 'Alaska white' is being exported to different countries, especially the U.S.A. and China either in the form of well-dressed blocks (Fig. 9) or in the form of finished products as slabs or tiles of suitable sizes. A small quantity of the resource has also been used for making various types of decorative items, statues and idols (Fig. 10) due to ease of sculpting.

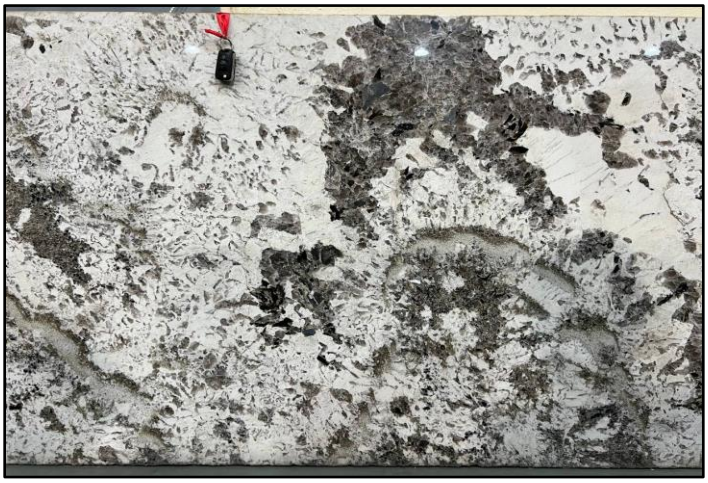

Fig. 9. Field photograph showing a polished slab of Alaska Azul white from Bharni Kalan mines of Jahazpur area.

VI. CONCLUSION

The compact and massive-type of pegmatites occurring in south-central Rajasthan are composed mainly of microcline and quartz with subordinate amounts of albite, muscovite and tourmaline. Field study suggests that these pegmatites cannot be used for the production of quartz, feldspar and mica. Their massive nature, appealing white colour and texture, desirable hardness and ability to take excellent polish for a long period make them suitable for use as a decorative and dimensional stone all over the world.

Fig. 10. Photograph of a stone of Lord Ganesa carved from massive-type of pegmatite.

ACKNOWLEDGMENTS

The authors are grateful to the Head and Coordinator SAP, Department of Geology, Mohanlal Sukhadia University, Udaipur, Rajasthan for providing the required facilities and financial support for completing this work respectively. The Director, IIT Powai, Mumbai is gratefully acknowledged for extending X-ray diffraction analysis facility.

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