# OCCURRENCE OF NEPHELINE SYENITE AROUND MURUD-JANJIRA RAIGARH DISTRICT, MAHARASHTRA, INDIA.

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## ABSTRACT

The alkaline dyke rock, intrusive into the basalts around Murud-Janjira, occurs as a multiple intrusion that has been emplaced in two successive pulses. It is made up of a border zone that ranges in thickness from 1–5 m and a core that varies in thickness from 1.5–5 m. The border zone is brecciated and contains xenoliths of acidic and ultramafic material. The core is unbrecciated and free from xenoliths.

The petrography of the rocks has been described. On the basis of modal analysis and chemical analysis the rock has been classified as hypersolvus nepheline syenite of the miaskitic type.

## INTRODUCTION

THE alkaline rock suite of the Deccan volcanic province is mainly restricted to the western and northwestern part of Peninsular India, and in general to the areas to the north of Bombay. The present paper reports the occurrence of nepheline syenite from Murud-Janjira area.

The area around Murud-Janjira (18° 18′ 06″ N and 72° 58′ 02″ E) is situated about 160 km south of Bombay, in Raigarh district of Maharashtra. The area is predominantly made up of tholeiitic basalt flows, which have a total thickness of about 304 m. The basalt flows are intruded by a dyke-swarm represented by dolerites, lamprophyres and nepheline syenite.

Earlier work in the Murud-Janjira area was by Deshpande and Chakranarayana[1] who reported the occurrence of lamprophyres. Quartz monzonite plugs have been reported from the area to the north of Murud-Janjira by Deshpande and Ghate[2].

The nepheline syenite from the Murud-Janjjra area occurs as a dyke, intrusive into the basalt, and is exposed on a bay-bar beach. It trends in the north-south direction and the maximum exposed width is about 10 m. The contacts of the dyke with the country rock basalt are not very clear being concealed by beach sand. The dyke can be differentiated into two distinct parts—a central part and a border zone which exhibit a sharp contact (figure 1). The dyke is thus intruded in two successive pulses forming a multiple intrusion. The central part of the intrusion varies in width from about 1.5 m to a maximum of 5 m. The border zone ranges in thickness from 1–5 m. The border zone exhibits intense shearing and brecciation with xenoliths mainly of acidic and ultramafic material. The acid xenoliths show shearing effects. The xenoliths in general range in size from a few millimetres to a maximum of 6 cm.

## PETROGRAPHY

The fresh rock from the border zone is greyish green in colour and is fine grained as compared to the rock from the central part which is dark green in colour, coarser in grain size, hypocrystalline with megacrysts of felspar and pyroxene ranging in size from 1–5 mm in an aphanitic matrix.

In microsections the border zone rock is highly brecciated with acid and ultramafic xenoliths. The ultramafic xenoliths range in size from submicroscopic to about 2 cm in diameter and are unbrecciated. They have chilled glassy borders and are essentially made up

**Figure 1.** Nepheline syenite multiple intrusion from Murud-Janjira showing the central part bounded by a sharp contact against the border zone.

of plates and needles of clinopyroxene in a glassy matrix. The clinopyroxene is feebly pleochroic in shades of green with C:Z varying from 10 to 32°. It is optically positive with 2 V ranging between 52° and 60; hence it may be identified as aegerine-augite.

The xenoliths of the acid material are more common and they are brecciated and mylonitised. Some of them show the development of foliation due to parallel arrangement of flakes of biotite. At places augens of felspar are also seen. Biotite at places exhibits bent cleavage.

The host rock nepheline syenite is brecciated with network of crisscross veins of secondary silica and calcite. The rock is preponderently made up of microphenocrysts of alkali felspar, clinopyroxene, nepheline, apatite and opaques. The modal proportions of different constituents are shown in the following table 1.

The alkali felspar is perthitic orthoclase in which the intergrown sodic phase shows braid and flame patterns. The K-felspar phase is invariably kaolinised as compared to Na-felspar component which is relatively fresh. The mafics are represented by microphenocrysts of clinopyroxene which show reverse zoning. They have deep green rounded resorbed cores and light yellowish green to colourless border zones. The cores are strongly pleochroic in shades of green. The 2 V varies between 55 and 60° and C:Z from 5 to 15°. They are optically negative and hence may be identified as aegerines. The green portions may be sharply bound against the mantling material or they may be gradational. In some cases the cores form spongy masses. Though uncommon, the clinopyroxene also exhibits normal zoning with light green cores mantled by dark green borders. Such normal-zoned grains are found alongside colourless or neutral coloured phenocrysts in which the 2 V varies from 58 to 60° with C:Z varying between 35 and 40°. They are optically positive and hence may be identified as diopsides.

The felspathoids are represented mainly by nephelines and subordinate sodalites. Nepheline occurs as a phenocrystic phase which is invariably altered to cancrinite. Small crystals of nepheline and sodalite occur in the ground mass. Apatite is found either as rods and stumps in phenocrystic phase or as inclusions in grains of felspars, pyroxenes and opaques. The opaques are represented by magnetite when fresh, and hematite and limonite when altered.

The rock from the central portions, in microsection exhibits porphyritic texture with euhedral microphenocrysts of perthitic alkali felspar, clinopyroxene, nepheline, biotite and apatite. The ground mass is made up of kaolinised felspar, needles of clinopyroxene, opaques and cancrinite. The clinopyroxene is strongly pleochroic in shades of dark green (X), green (Y), and yellowish green (Z), the 2 V ranges between 60° and 65° it is optically negative, and C:Z varies from 5° to 12°; it may therefore be identified as aegerine. It is invariably corroded and embayed by the ground mass along grain boundaries as well as along cleavages. Biotite is found as microphenocrysts, pleochroic from straw yellow to dark brown. Nepheline occurs as microphenocrysts which are invariably altered to cancrinite. Euhedral phenocrysts of apatite are either found discretely within ground mass or they are enclosed within felspar, clinopyroxene and biotite. Opaques are represented by haematite and limonite. Deuteric calcite is found to replace both the microphenocrysts as well as the constituents of Ground mass.

## CLASSIFICATION

The volume percentages of the minerals when plotted in the triangular diagram suggested by Sarantsina and Shinkarev[3] for the classification of alkaline rocks, fall in the field of nepheline syenite. Portions of fresh unbrecciated rock have been chemically analysed for the major elements (table 2). The data have been used to calculate the agpaitic coefficient as suggested by Sorensen[4]. From the relative proportions of alkalies and alumina and the absence of modal plagioclase, the rock can be classified as hypersolvus nepheline syenite of the miaskitic type. This is also supported by typomorphic mineralogical features of miaskitic rocks such as the presence of apatite and biotite. Again following Polanski[5] the

**Table 1** *Volume percentages of minerals from nepheline syenite from Murud-Janjira.*

| Sample No. | Felspar | Pyroxene | Nepheline | Apatite | Biotite | Opaques |
|---|---|---|---|---|---|---|
| *II/1c | 62.27 | 26.15 | 6.80 | 5.39 | 1.90 | 0.10 |
| **II/1b | 64.59 | 23.94 | 6.85 | 3.42 | 0.91 | 0.29 |

* Rock from the central part. ** Rock from the border zone

**Table 2** *Chemical composition of the nepheline syenite from Murud-Janjira*

| | II/IB | II/IC |
|---|---|---|
| $SiO_2$ | 49.50 | 49.24 |
| $TiO_2$ | 0.34 | 0.30 |
| $Al_2O_3$ | 18.55 | 18.70 |
| $Fe_2O_3$ | 4.68 | 4.69 |
| FeO | 1.12 | 1.10 |
| MnO | 0.25 | 0.20 |
| MgO | 1.85 | 1.89 |
| CaO | 6.74 | 6.72 |
| $Na_2O$ | 3.86 | 3.86 |
| $K_2O$ | 5.88 | 5.87 |
| $P_2O_5$ | 1.11 | 1.01 |
| $H_2O$ | 5.85 | 5.86 |
| Total | 99.75 | 99.34 |
| $Na^+ + K^+$ | 7.75 | 7.73 |
| $Al^{+++}$ | 9.83 | 9.91 |
| Agpaitic coefficient | 0.78 | 0.78 |
| $Na_2O + K_2O$ | 9.74 | 9.73 |
| 1/6 $SiO_2$ | 8.25 | 8.20 |

agpaitic index—$K_2O + Na_2O > 1/6\ SiO_2$ is characteristic of miaskitic nepheline syenites.

## DISCUSSION

The alkaline rocks around Murud-Janjira, as also in other parts of western India, are associated with tholeiites. Such a mixed association is more likely to develop in continental borders due to unique disposition of mantle along the transitional zone[6]. The alkaline rocks in western India in general are aligned along two major rift zones—the Narmada-Son and Cambay graben, and the faulted West Coast[7]. These rifts have been postulated to be the arms of a triple junction located near Kambat[8]. The coastal dyke swarm represented by dolerites lamprophyres and nepheline syenite from Murud-Janjira, may be a reflection of mantle wedging along the West Coast arm of the triple junction. A more detailed discussion on the petrogenesis of these dykes must await a more comprehensive knowledge of their precise extent both in space and time.

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1. Deshpande, G. G. and Chakranarayana, A. B., *Curr. Sci.*, 1973, **42**, 404.
2. Deshpande, G. G. and Ghate, N. S., *Curr. Sci.*, 1977, **46**, 243.
3. Sarantsina, G. N. and Shinkarev, N. F., *The alkaline rocks*, John Wiley, New York, 1967, 622.
4. Sorensen, H., *The alkaline rocks*, John Wiley, New York, 1974, 622.
5. Polanski, A., *The alkaline rocks*, John Wiley, New York, 1949, 622.
6. Bose, M. K., *Lithos*, 1972, **5**, 131.
7. Ghose, N. C., *Lithos*, 1976, **9**, 65.
8. Burke, K. and Dewey, J. F., *J. Geol.*, 1973, **81**, 406.

# NEWS

## WITHDRAWAL: WEAKEN US SCIENCE LEAD?

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