

Petrology and Geochemistry of the Vivekananda Rock at Kanniyakumari, Tamil Nadu, Southern India – C. Bhattacharyya and U. Tickha (Department of Geology, University of Calcutta, 35, Ballygunge Circular Road, Kolkata - 700019. Email: crbc.cu.geology@gmail.com)

Introduction

The Vivekananda Rock is a roughly dome-shaped rocky island covering an area of 152.4 m x 121.4 m, about 250 m south at the southernmost tip of Kanniyakumari, Southern India (Figs. 1a, b). We present the results of petrological-geochemical studies of this rock as a tribute on the occasion of 150th Birth Anniversary of Swami Vivekananda (Fig.1a).

Petrography

These rocks are greyish green, coarse, gneissic charnockite, varying to orthopyroxene-free biotite ± hornblende granite to granodiorite gneisses. Mafic minerals occur as clots or discontinuous stringers. Average mode is typical of granitic composition (Table 1). *K-feldspar* occurs as

coarse microperthitic xenoblasts with occasional presence of micromegacrystic tabular grains containing inclusions of rounded quartz and tiny subidiomorphic plagioclase. *Plagioclase* occurs generally as subidiomorphic coarse tabular grains commonly forming aggregates in the interspaces of K-feldspars and/or quartzs. Myrmekite, when present, occurs along the contact between plagioclase and K-feldspar. *Quartz* occurs generally as coarse to medium-sized xenoblasts showing occasionally a weak dimensional parallelism with the gneissic trend. *Biotite* occurs as coarse laths, occasionally forming clusters. It appears to replace orthopyroxene and hornblende. *Orthopyroxenes* are few and not found in all slides. It occurs as (i) coarse to medium-sized equant or subequant,

subidiomorphic to almost idiomorphic grains in the interspaces of plagioclases and also plagioclase-quartz and (ii) highly irregular, thin ragged grains along the contact with quartzo-feldspathic minerals (Fig.1c). The other minerals are *ilmenite*, *apatite*, *zircon* (euhedral, elongate), *chlorite* (typically as thread-like veins through quartzo-feldspathic grains) and rarely *sphene*.

Geochemistry

The chemical analysis was done in the Michigan State University (Bruker S 4 Pioneer XRF) and at the EPMA Laboratory of the Geological Survey of India, Calcutta. The results are presented in Table 1. Anorthite % of the analysed plagioclase is 40 and orthoclase molecule is insignificant.

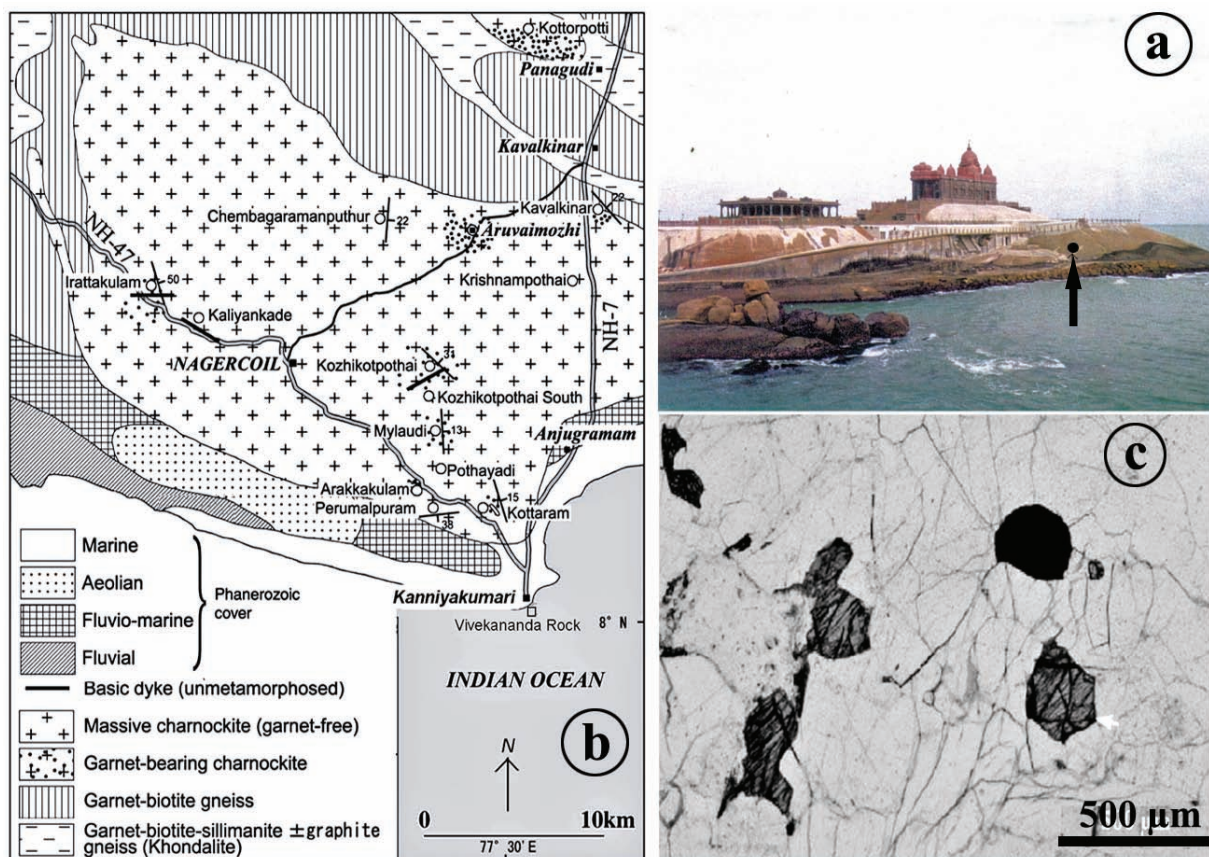


Fig.1. (a) Oval-shaped nearly flat-topped Vivekananda Rock Island on which 'Vivekananda Mandapam' is seen. Sample site (solid dot with arrow) is also shown. (b) Geological map of Nagercoil Block (after Santosh et al. 2003). (c) Subidiomorphic to idiomorphic orthopyroxene in Vivekananda Rock. Ragged orthopyroxene is also present. Note also the thin veins of chloritic minerals through quartzo-feldspathic grains. PPL.

Table 1. Mode (vol%), whole rock and mineral chemical compositions (wt %) of Vivekananda Rock

Samples	Av (n=5)		Rock*	Plag	Opx	Hbl	Bt	Ilm
K-feldspar	42.0	SiO ₂	68.78	58.15	46.94	39.21	35.79	0.04
Plagioclase	25.0	TiO ₂	0.67	0	0.18	2.38	5.14	51.28
Quartz	24.6	Al ₂ O ₃	14.65	26.33	0.73	10.96	11.98	0
Orthopyroxene	0.2	Fe ₂ O ₃ (t)	2.57	0.05	43.34	26.05	25.56	49.50
Hornblende	1.8	MnO	0.02	0.01	0.88	0.21	0.20	0.03
Biotite	4.9	MgO	0.62	0.04	5.57	4.81	7.86	0.01
Opaque	0.8	CaO	2.12	8.3	1.01	10.61	0.05	0
Apatite	0.5	Na ₂ O	2.20	6.71	1.13	1.75	0.20	0.03
Zircon	0.3	K ₂ O	6.60	0.27	0.14	2.27	9.63	0
Sphene	0.0	Cr ₂ O ₃	nd	0.07	0.09	0.04	0.12	0.13
		BaO	nd	0	0	0	0.34	0.26
		P ₂ O ₅	0.17	nd	nd	nd	nd	nd

* Zn (ppm) 30, Rb 288, Sr 190, Y 64, Zr 470, Nb 19, Ba 1178, La 83; Cr, Ni, Cu below detection limit

The orthopyroxene from Vivekananda Rock contains 43.34 % FeO(t) corresponding to eulite (Fs_{77.43}) (Deer et al. 1978) or ferrosilite (after Morimoto, 1988). Hornblende (pargasite or titanian pargasite, Deer et al., 1997) contains fair amount of TiO₂ (2.38%) and K₂O (2.27%). TiO₂ content of biotite is high (5.14 %).

local dimensional orientation of granoblastic deformed quartzs in a few thin sections may have developed by high grade metamorphism at ~500 m.y. (Pan-African event) (Santosh et al. 2003).

Acknowledgements: We are grateful to authorities of Vivekanandapuram

The Vivekananda Rock is an extension of Nagercoil charnockite block into the southern coastal area of Kanniyakumari (Fig.1b). This together with chemistry indicates magmatic protolith. The poorly developed gneissosity, indicated by impersistent somewhat preferred disposition of biotites, and the weakly developed

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References

- DEER, W.A., HOWIE, R.A. and ZUSSMAN, J. (1978) Rock-forming Minerals: Single-chain silicates, v.2A, 2nd edn., Longman.
- DEER, W.A., HOWIE, R.A. and ZUSSMAN, J. (1997) Rock-forming Minerals: Double-chain silicates, v.2B, 2nd edn., Geol. Soc. London.
- MORIMOTO, N. (1988) Nomenclature of pyroxenes. Mineral. Mag., v.52, pp.535-550.
- SANTOSH, M., TAGAWA, M., TAGUCHI, S. and YOSHIKURA, S. (2003) The Nagercoil Granulite Block, Southern India: petrology, fluid inclusions and exhumation history. Jour. Asian Earth Sci., v.22, pp.131-155.