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Occurrence of soda trachyte near Kudangulam village, Tamil Nadu, South India

R. Ramasamy

Tamil Nadu State Geology and Mining Department, Madras 600 032, India

I report chemical composition and petrography of a fine-grained, grey, degassed trachytic tuff from Kudangulam area, South India.

A fine-grained grey coloured trachytic tuff was collected from a pit sunk on a very coarse-grained apatite-phlogopite-bearing sovitic carbonatite¹ in charnockite about 2 km south of Kudangulam village (8° 11' N, 77° 43' E) and 20 km northeast of Cape Comorin. The trachyte occurs in a feeder dyke 15 cm wide. It cuts across the charnockite along N 80° W–S 80° E with a dip of 85° NE. The dyke contains reddish-stained chilled margins (1–5 mm). Contact aureoles (10–20 cm) have developed owing to baking effect on the wall rock of charnockite. Along nallah cuttings similar dykes of trachyte, alkali basalts, sovites (Figure 1), phlogopite-carbonatitic breccias and lavas are noted¹. An occurrence of black-coloured vesicular carbonatitic lava also is exposed, with jagged spinose fragments resembling furnace clinker with a rough irregular surface covered over a Mio-Pliocene shell limestone² which contains 1–3-cm large crystals of Icelandspars in cavities. Floats of volcanic bombs, ash-tuffs and breccias with fine three- or four-pointed splinters bounded by concave and vesicular surfaces are strewn over terri sands. These show wide variations in specific gravity from 1.35 to 2.69. The country rocks are extensively kaolinized.

In thin sections (Figure 2), trachyte shows microlites of twinned anorthoclase (carlsbad law on (010) twin plane).

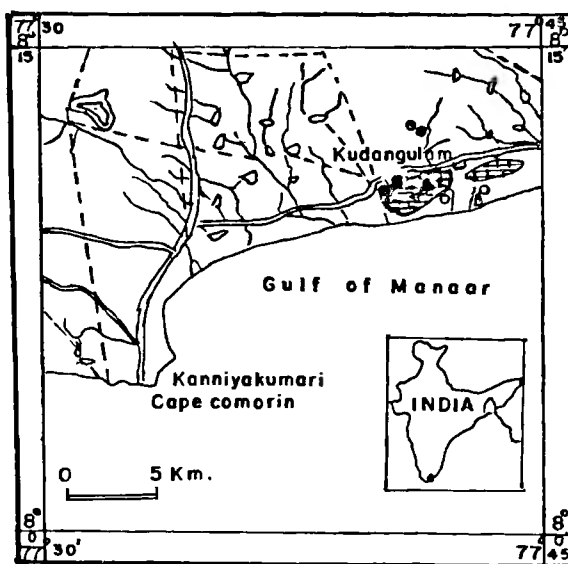


Figure 1. Map showing the location of soda-trachyte and other volcanic rocks. Δ , Soda-trachyte; \circ , sovite; \blacksquare , carbonatite-lava; \blacktriangle , cavity-filled Icelandspars; \bullet , Alkali basalt; \odot , amygdaloidal alkali basalt; \oplus , shell limestone; ---, fault.

Phenocrysts ($0.184 \times 0.025 \text{ mm}^2$) are set in an aphanitic matrix (42% vol.) composed of microgranules of carbonate and felsic materials. Slender prisms of accessory aegirine ($0.110 \times 0.010 \text{ mm}^2$) are also seen. Occasionally a few anhedral quartz grains are found in the interstitial spaces of anorthoclases. Anhedral

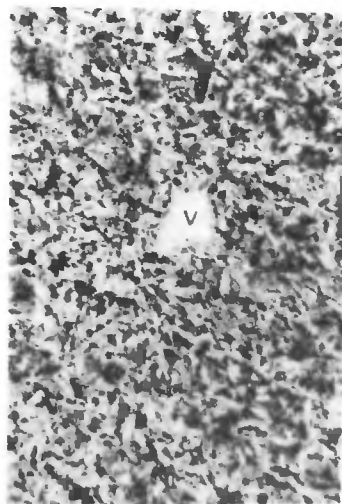


Figure 2. Photomicrograph showing anorthoclase microlites amidst a fine-grained aphanitic quartz normative matrix in a trachyte. An irregular-shaped isolated vesicle ($0.316 \times 0.210 \text{ mm}$) is found at the centre.

Table 1. Chemical composition of soda-trachyte.

Oxide	Wt%	Rittmann's norm			Mode	Trace elements (ppm)			
		Calculated	Corrected						
SiO ₂	57.38	Ap	0.68	0.67	0.29	Pb	150	Sn	10
Al ₂ O ₃	17.06	Sid	4.80	4.78	—	Cu	300	Cr	20
Fe ₂ O ₃	7.17	Il	1.45	1.44	0.92	Ni	5	Co	60
FeO	1.41	Mt	0.78	0.79	0.74	V	400	Zr	300
MnO	—	Hx	—	2.48	2.14	Ba	2000	Sr	1600
MgO	—	Cord	8.82	—	—	La	40	Nb	30
CaO	0.29	Sil	0.82	—	—	Y	60	B	—
Na ₂ O	7.80	Bio	—	0.51	0.51	Ga	30		
K ₂ O	1.56	Ac	—	1.27	1.27				
TiO ₂	1.33	Qz	1.80	0.62	0.59	(hkl)	2θ	d(Å)	I/I ₀
P ₂ O ₅	0.34	A	80.85	87.44	45.60	(101)	20.230	4.3894	129 KBrO ₃
CO ₂	1.80	Mx	—	—	41.78	(201) ₁	21.011	4.2280	53 Fels
H ₂ O	2.92	Vo	—	—	6.16	(201) ₂	21.211	4.1886	40 Fels
Total	99.88					(002)	27.819	3.2069	359 Fels
A-Anorthoclase [Mx-Matrix V ₀ -Vesicles						(131)	29.400	3.0379	52 Fels
Hz- Hercynite, Normative Anorthoclase						(131)	29.700	3.0079	66 Fels
Ox ₀ = Fe ^{III} (Fe ^{II} ÷ Fe ^{III}) = 0.82 (Or ₁₃ Ab ₈₇)						(241)	35.595	2.5283	84 Fels
τ = (Al ₂ O ₃ - Na ₂ O) / TiO ₂ = 7.45						(060)	42.387	2.1359	49 Fels
σ = (Na ₂ O ÷ K ₂ O) ² / (SiO ₂ - 43) = 6.09						(403)	47.919	1.8983	168 Fels
Δ Triclinicity = 0.375 with sharply						(204)	51.516	1.7739	67 Fels
resolved (131) and (131) peaks indicating high-temperature-disordered pseudomonoclinic anorthoclase structural state ³ showing									
compositional range (Or ₉₅₋₇₀ Ab ₅₋₃₀) well within the limits of sanidine phase ⁴ on (201) resolved peaks. Anorthoclase phenocrysts at:									
(010) = 7°, 2V _a = 50°, (r-α) = 0.007.									

magnetite and dark green iron oxide (hercynite) of $0.020 \times 0.010 \text{ mm}^2$ are seen. At places occasional flakes of biotites are noted. Isolated irregular-shaped vesicles ($0.316 \times 0.210 \text{ mm}^2$) are present (6% vol.).

Chemical analysis of the trachyte is presented in Table 1. The rock is enriched in soda over potash. Plotting Rittmann's norm⁵ in the Streckisen Q₁-A₉₉-P₀-F₀ double triangle⁶, one can see that the rock falls in the field of soda-trachyte with a colour index of 11.94. The presence of excessive alumina is inferred from the appearance of cordierite in the Rittmann's norm, whereas it is absent in the mode of phenocrysts. Significant amount of iron and alumina form dark green hercynite. A high degree of oxidation Ox₀ = 0.82 is a common feature in volcanic rocks⁷. The plotted values of $\tau = 7.45$, $\sigma = 6.09$ in the Gottini-Rittmann diagram⁵ show that the rock falls in the field of alkaline derivatives linked to the lavas of volcanoes situated in non-orogenic regions due to magmatic degassing of alkalis (Na 13, K 2 atoms; 1.14% volume)⁵. The rock contains excessive CO₂, P₂O₅ and H₂O over the formation of nominal carbonates, apatite and biotite. This shows its genetic relationship with carbonatite. The σ value 6.09 is characteristic for a magma type of weak Atlantic suite⁸. A compositional plot of the trachyte in the alkali-silica diagram constructed by Nockolds falls in the field of alkali-basalt family⁷. The alkali-lime index (48.5) for trachyte-carbonatite-alkali basalt occurring in this area shows that they all belong to an alkali suite⁷. The enrichment of Ti, P, V, Zr, Ba, Sr, La, Nb, and Y over the average crustal abundance⁹ indicates that the trachyte belongs to carbonatitic kindred. However, in comparison with trace-element

distributions in carbonatitic complex⁷, the trachyte has slightly lower LREE content. This proves a volcanic exhalative origin for this rock¹⁰. According to Hyndman⁷, trachytic magmas are related to main rifting. Exposures of carbonatitic lava¹ over a Mio-Pliocene shell limestone in this area bear evidence for the surface manifestation of a volcanic activity that took place at the close of the Deccan Trap volcanism in Peninsular India owing to reactivation of the Eastern Ghats Rift System¹, which is dissected by the N 80° W-S 80° E-trending Achankoil fault plane¹¹ that just passes through this area.

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