ancestral to all artiodactyls, it becomes evident that the centre of origin for this order may lie in the region of the Tethyan Himalaya. Some of the larger raoellids, like *Pilgrimella*, *Lammidhania*, etc., are considered close to the Sirenian–Moerithere (Proboscidea) lineages. Consequently this suggestion would imply that the Himalayan Tethys was a centre of origin and radiation for not only the Artiodactyla, but also for other mammalian orders like the Sirenia, Proboscidea, Desmostyla and Cetacea.

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Anorthosite dyke from the Pasupugallu gabbro pluton, Prakasam district, Andhra Pradesh, India

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The rare anorthosite dyke from the Pasupugallu gabbro-anorthosite pluton contains 91% (by vol.) plagioclase (An_{56}), 5% hornblende, 2% biotite, 1% opaques and traces of calcite, apatite, zircon and corundum. It is relatively enriched in SiO_2, Al_2O_3 and Na_2O, and depleted in CaO, FeO and MgO compared to the massive anorthosite; the normative femics of the dyke are more iron-rich (and plagioclase more albitic) than those of the massive anorthosite. The dyke may represent the residual liquid derived from a melt parental to the massive anorthosites.

Rare occurrences of dykes of anorthosites and of gabbroic anorthosites described from peninsular India include: (i) anorthosite dyke from Nadimidoddi, Andhra Pradesh[1]; (ii) gabbroic anorthosite dyke from Nuggihalli schist-belt, Karnataka[2,3]; and, (iii) gabbroic anorthosite dyke from Hunsur, Karnataka[4]. This note records the occurrence of a minor fine-grained anorthosite dyke from the Pasupugallu gabbro(-anorthosite) pluton.

In the Prakasam district of Andhra Pradesh, both basic (gabbro-anorthositic) and alkaline bodies were emplaced at the junction zone of the Dharwar group of rocks (towards west) and granulite facies rocks (towards east). Of the many basic plutons, the oval-shaped Pasupugallu (15° 48′ N and 79° 48′ E) gabbro(-anorthosite) pluton[5,6] dominantly comprises gabbro and leucogabbro with subordinate amounts of dark-looking massive anorthosite, dykes of dolerite, lamprophyre, nepheline syenite[7], quartz syenite and rare anorthosite dyke. The pluton is enveloped by the quartzo-felspathic gneisses (± cordierite) with intercalated amphibolites.

The Pasupugallu anorthosite dyke occurs as a sharply bounded planar body which measures 100 × 0.15 m (Figure 1) and trends N80°E. It is located about 3 km west of the village Turkapalem (15° 45′ 15″ N, 79° 50′ 15″ E). The dyke is light-coloured and fine- to medium-grained, with average grain size of plagioclase ranging from 1 to 2 mm in length (Figure 2), in contrast to the massive anorthosites, which are highly coarse-grained, with average grain size ranging from 4 to 5 mm in length (Figure 3). The dyke exhibits alignment of the plagioclase crystals parallel to its strike length; it is however devoid of any perceptible chilled margins. It occurs within the dark-coloured, massive and coarse-grained leucogabbros which have very crude foliation trending NE.

The rock exhibits, under the microscope, hypidiomorphic texture, and is dominated by subhedral plagioclase (91% by volume); the accessories include hornblende (5%), biotite (2%), opaques (1%) and traces of calcite, apatite, zircon and corundum. The dyke is characterized by the total absence of olivine and clinopyroxene, which are present in the enclosing leucogabbros.

Plagioclase felspar shows twinning commonly on the albite law, and rarely on the combined Carlsbad-albite law; very rare pericline twinning is also noticed. Smooth planar boundaries and triple junctions between

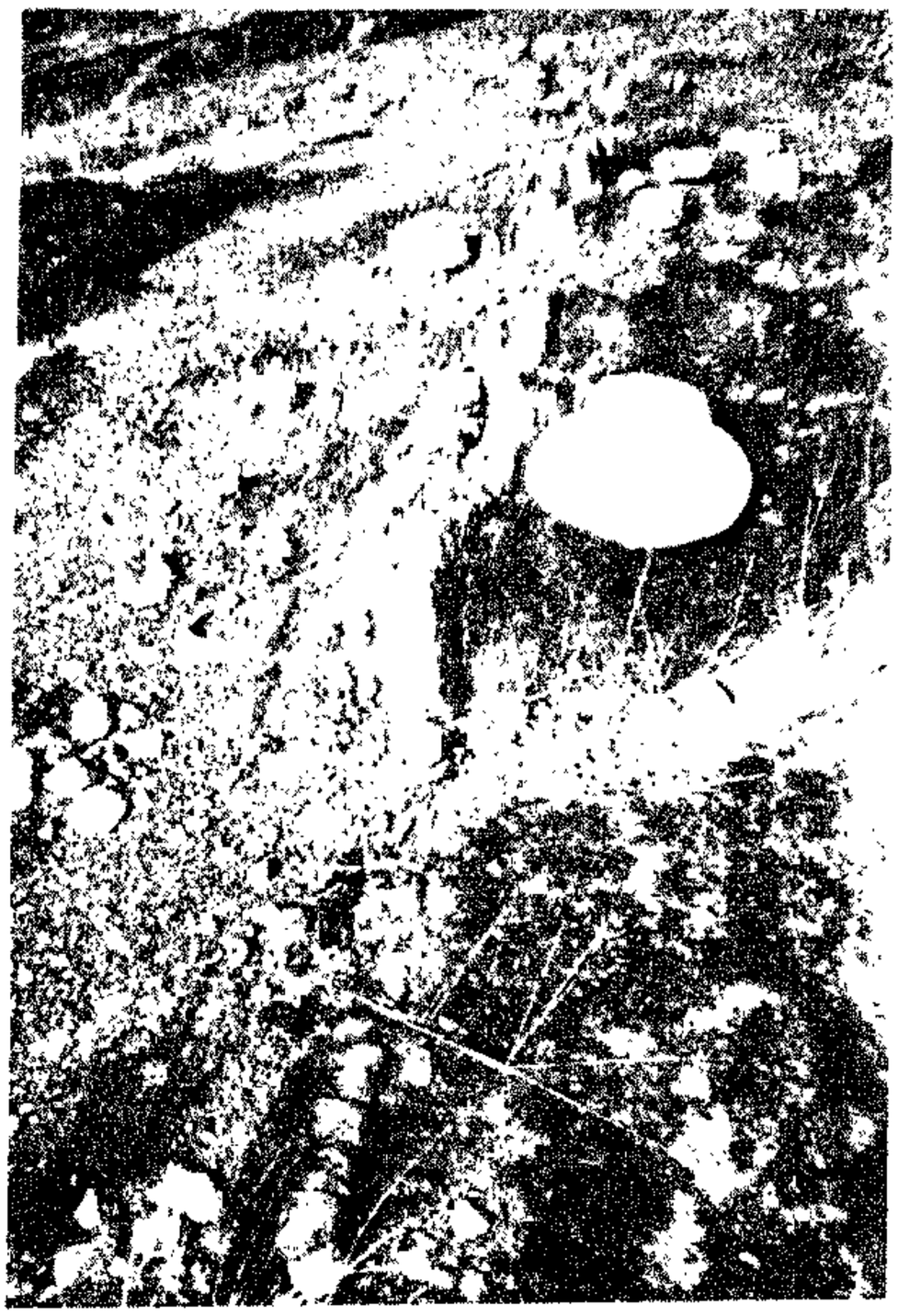

Figure 1. Field photograph showing anorthosite dyke in leucogabbro.

Figure 2. Photomicrograph showing overall texture of anorthosite dyke (crossed nicols); note the crude parallel alignment of plagioclase crystals.

the grains are noticed. The mineral rarely shows bent twin lamellae; alteration to sericite and feeble zoning are common in untwinned plagioclase crystals. The plagioclase felspars of the anorthosite dyke do not contain any opaque exsolutions. This is probably responsible for the light-coloured nature of the rock, in

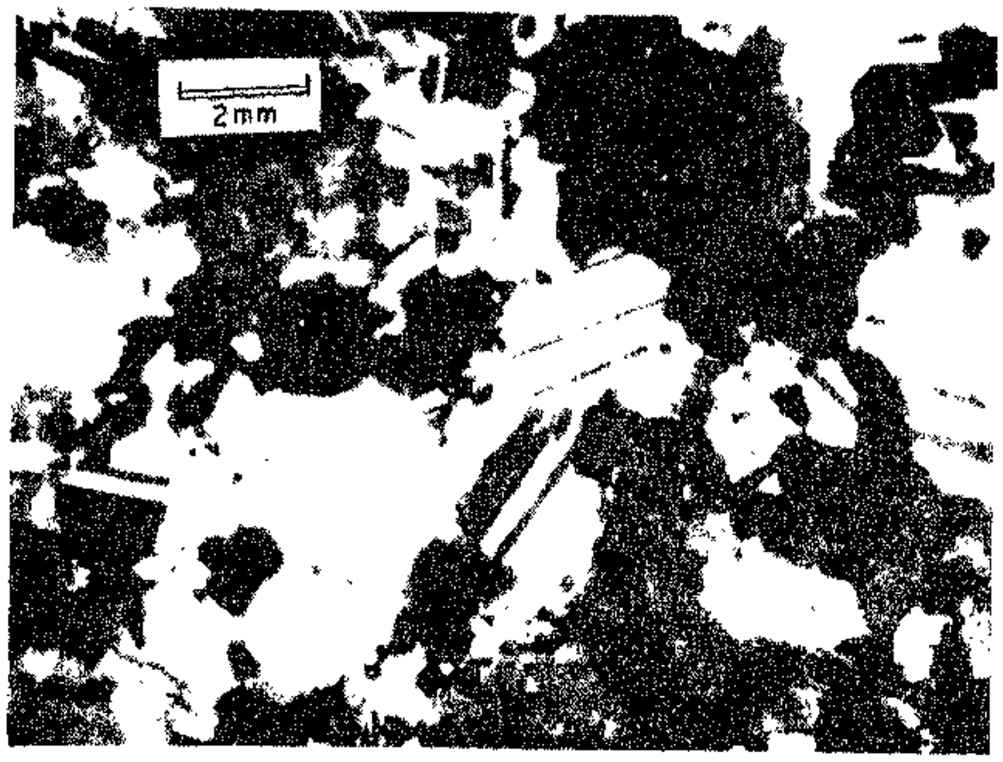

Figure 3. Photomicrograph showing overall texture of massive anorthosite (crossed nicols); note the coarse-grained nature.

contrast to the dark-coloured massive anorthosites occurring in the pluton, wherein plagioclases contain innumerable minute, rod-like, opaque exsolutions. The dyke also has somewhat more albitic (An 56) plagioclase than the massive anorthosites/gabbroic anorthosites (An 60–64). Similar variations have been observed in An contents of the plagioclases in the anorthosite dykes and enclosing leuconorites of the Nain Complex, Labrador[8,9].

Hornblende is pleochroic, from pale green to green, with extinction angle of 17°. The mineral mostly occurs as small 'veinlets' in association with biotite and other accessories; uniform distribution of discrete hornblende crystals is totally absent in the rock, suggesting that 'late-hydrous' conditions must have given rise to hornblende veinlets.

Some distinct mineralogical and textural differences are observed between the anorthosite dyke and massive anorthosite/gabbroic anorthosites. The dyke is light-coloured and fine-grained (Figure 2), with plagioclase felspars having less distinct twinning, low An content, and with relatively more untwinned plagioclase grains (some of them are weakly sericitized) compared to massive anorthosites.

The two ferromagnesian minerals coronitic olivine and clinopyroxene, which are ubiquitous in the massive anorthosites/gabbroic anorthosites, are totally absent in the dyke; on the other hand, hornblende, which is characteristically absent in the massive anorthosites, is the chief mafic mineral in the dyke; also, the amount of apatite in the dyke is rather considerable compared to that in the massive anorthosites.

Major element chemistry, normative compositions and partial chemical analysis of plagioclase concentrates for the anorthosite dyke, along with chemical analysis of massive anorthosite from Pasupugallu and average analysis of seven anorthosite dykes from the Nain Complex (Labrador), are presented in Table 1. The

Table 1. Chemical analysis and CIPW norms of anorthosite dykes and massive anorthosite.

	1	2	3
SiO_2	52.50	50.47	55.90
TiO_2	0.17	0.15	0.60
Al_2O_3	28.65	28.11	23.23
Fe_2O_3	0.38	0.57	0.53
FeO	0.72	1.40	3.30
MnO	0.01	0.03	0.05
MgO	0.17	1.58	1.33
CaO	10.30	11.81	9.03
Na_2O	4.69	3.73	4.94
K_2O	0.68	0.45	0.90
P_2O_5	0.01	0.01	0.19
Total	98.28	98.31	100.00
Partial chemical analysis of plagioclase concentrates			
CaO	10.79	12.42	
Na_2O	5.00	4.25	
K_2O	0.59	0.48	
Or	3.49	2.83	
Ab	42.46	35.92	
An	53.56	61.65	
$\frac{An \times 100}{Ab+An}$	55.89	63.18	

		1	2	3
Q		—	—	1.85
Or		3.89	2.78	5.32
Ab		39.82	31.48	41.80
An		51.15	58.66	38.55
Diop		—	—	4.20
Hy	En	0.30	0.50	5.93
	Fs	0.66	0.13	
Ol	Fo	0.07	2.38	—
	Fa	0.10	1.12	—
Mt		0.46	0.93	0.77
Il		0.30	0.30	1.40
Ap		—	—	0.44
C		1.43	—	—
$\frac{An \times 100}{An+Ab}$ (norm.)		56.22	65.10	47.97
$\frac{FeO+Fe_2O_3}{MgO+FeO+Fe_2O_3}$ (wt %)		0.866	0.578	0.625
Fs % in opx (norm.)		68.75	20.64	—
Fa % in oliv (norm.)		58.83	33.89	—

1. Anorthosite dyke from Pasupugallu.
2. Massive anorthosite from Pasupugallu.
3. Average of 7 anorthosite dykes from the Nain Complex, Labrador[8].

dyke is relatively enriched in SiO_2, Al_2O_3 and Na_2O, and is depleted in CaO, FeO and MgO, compared to massive anorthosite. As the rocks are nearly monomineralic, CaO, Na_2O and K_2O contents of the host rocks are remarkably similar to those of the constituent plagioclase feldspars; hence the normative and chemical compositions of plagioclase feldspar are virtually the same. Though the dyke is compositionally 'not distinct' from the massive anorthosite, the normative femics are more iron-rich in the dyke (Table 1).

Occurrence of sills and dykes of anorthosites provides direct evidence for the existence of magmas, which removes the need to hypothesize large volumes of mafic and ultramafic cumulate rocks at depth[8]. However, the presence of chilled margins and fine-grained dyke rocks of varied compositions (high-Al and low-Al gabbros[10], high-Al norite or troctolite[11], leuconorite or gabbroic anorthosite[9]) indicates the existence of magmas, not necessarily completely liquid but already loaded with crystals, and also, importantly, not necessarily parental to the series[12,13].

Though the anorthosite dyke from the Pasupugallu pluton suggests the existence of a highly felspathic magma, it need not be parental to the anorthositic rocks of the Pasupugallu. On the other hand it may represent the residual (late-stage) liquid derived from a melt parental to the massive anorthosites.

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