of scattering and absorption. The measured waveguide loss of 2.9 dB/cm is quite impressive to consider this material as a potential candidate in the fabrication of integrated optical circuits.

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1. Tien, P. K. *et al.*, *Appl. Phys. Lett.*, 1974, **24**, 547.
2. Reinhart, F. K. and Logan, R., A., *Appl. Phys. Lett.*, 1974, **25**, 62.
3. Smith, H. M. (ed.), *Holographic recording materials*, Springer-Verlag, New York, 1977, p. 20.
4. Tien, P. K., *Appl. Opt.*, 1971, **10**, 2395.
5. Ulrich, R. *et al.*, *Appl. Phys. Lett.*, 1972, **20**, 213.
6. Tien, P. K. *et al.*, *Appl. Opt.*, 1972, **11**, 637.

FOSSIL CHAROPHYTA — A SCANNING ELECTRON MICROSCOPIC STUDY AND DEPOSITIONAL ENVIRONMENT

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SCANNING electron microscopy (SEM) has helped to bring to light the detailed morphology of the fossil Charophyta collected from late Quaternary sediments of Calcutta. In an earlier study, the description was simple because of the limitations of the light microscope. The present investigation provides valuable documentation for identification of fossil Charophyta.

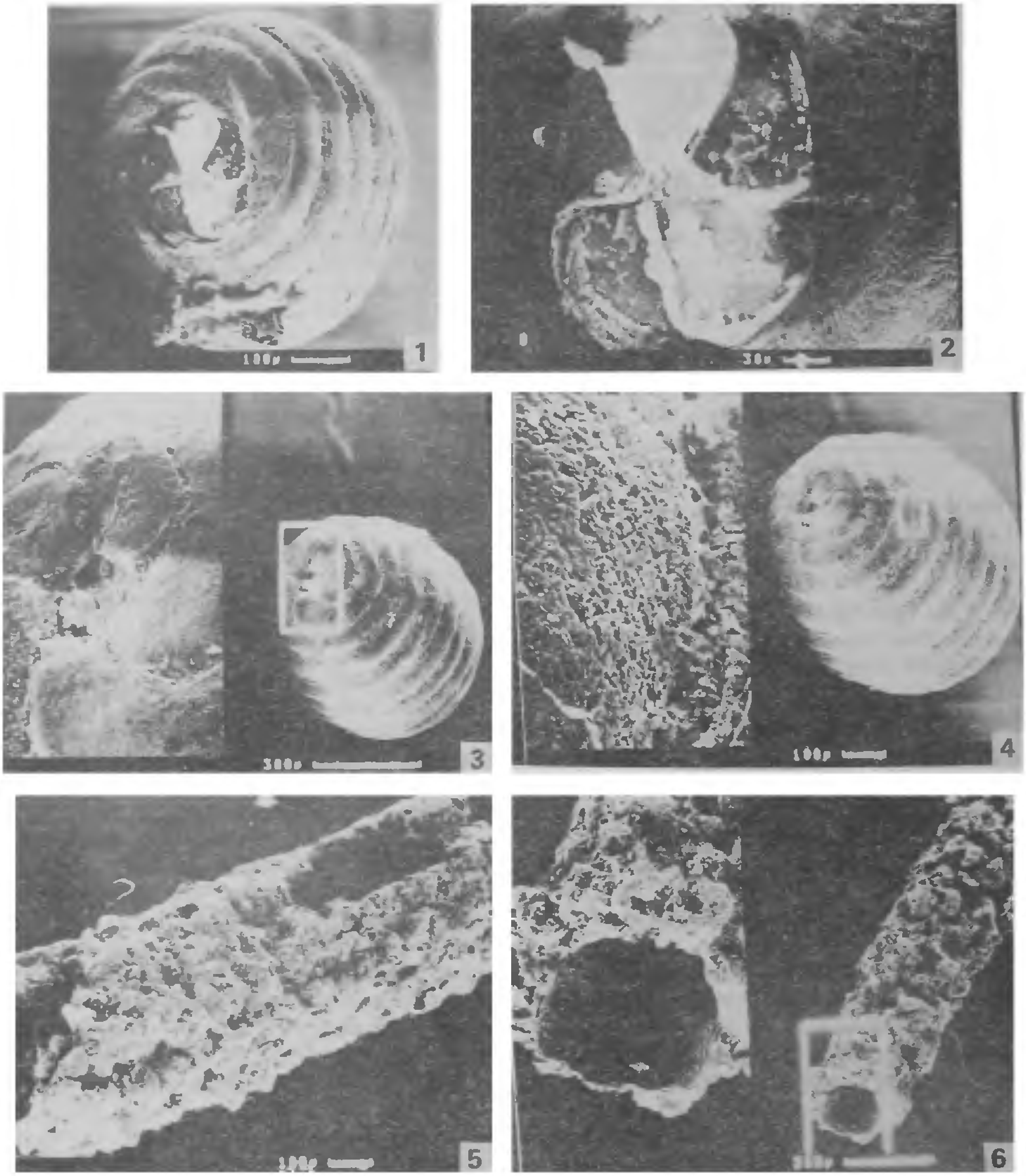
Morphometric measurements on gyrogonites and a simple morphologic description based on light microscopy[1] led to their identification as *Chara fragilis* Desvaux. The present morphologic description is in agreement with the earlier identification.

Daily[2] reported that fossils of *C. fragilis* are related to those of *C. globularis* in morphological features. Tappan[3] also held a similar view. But Soulie-Marsche[4] described *C. globularis* as having concave spiral rims. Interestingly, Bhatia and Mathur[5] found that immature shells of *C. fragilis* show concave spiral rims while the mature ones show convex spiral rims, and in the latter case *C. fragilis* resembles *Grambastichara*. Therefore, it seems that Daily[2] and Tappan[3] observed the immature shells of *C. fragilis*.

The morphometric characteristics of gyrogonites are given in table 1. The gyrogonites are apically somewhat rounded and slightly conical in the basal part. This structure gives rise to their anisopolarity. Both the apex and base, which are circular with pores, are somewhat truncated in the apical peripheral zone in lateral view. Five spiral rims form a hollow and a depression (figures 1 and 2) on the apex which is covered by five plates with relatively smooth, curved outline and a raised partition between plates. The apical plates radiate from a central zone which is much smaller compared to that of the base. The basal plate is however undivided and made up of a simple cell only. On the other hand five basal plates form a truncated pentagonal pyramid (figure 3). The spiral rims appear to be evolved from these basal plates and, interestingly, each of them terminates at the peripheral margin of an apical plate with a pointed end (figure 1). As evident from figures 2 and 4, the surface texture of the rims appears smooth, porous and rugose with gradual increase in magnification. Within the surface there are two sets of elongated fissures and a crack-like feature oblique to the suture line (figures 2 and 4) which is simple; occasionally fine ribs transverse to the suture line are visible. The 'stems' or utricles are like hollow tubes (diameter 300 μm) with longitudinal furrows extending from one end to the other. The longitudinal furrows give rise to plates with a rough, pitted surface not very regular in outline (figure 5). In some cases, the longitudinal furrows are not distinct and a brack-like cell seems to be present in one of the utricles

Table 1 *Morphometric characteristics of gyrogonites*

Sp. No.	Length (μm)	Width (μm)	Thickness of the rims (μm)	No. of rims from lateral view	Iniso-polarity index (ANI)	Remarks
1	600	465	75	10	1.29	Rims convex
2	450	400	60–75	8	1.12	Rims convex
3	570	525	60–75	10	1.00	Rims convex
4	510	405	45–60	10	1.26	Rims convex



Figures 1–6. 1. Gyrogonite showing the apex and spiral rims (× 100); **2.** Apical part of gyrogonite showing five thin, smooth plates with curved outline and a raised partition between plates, elongated fissures are oblique to the suture line (× 235); **3.** Basal part of gyrogonite showing five basal plates that form a truncated pentagonal pyramid (× 50; × 300); **4.** Surface texture of the spiral rims (× 60; × 600); **5.** Utricle showing longitudinal furrows with rough surface and pits (× 60), and **6.** One of the utricles showing brack-like cell and indistinct longitudinal furrows (× 45; × 135).

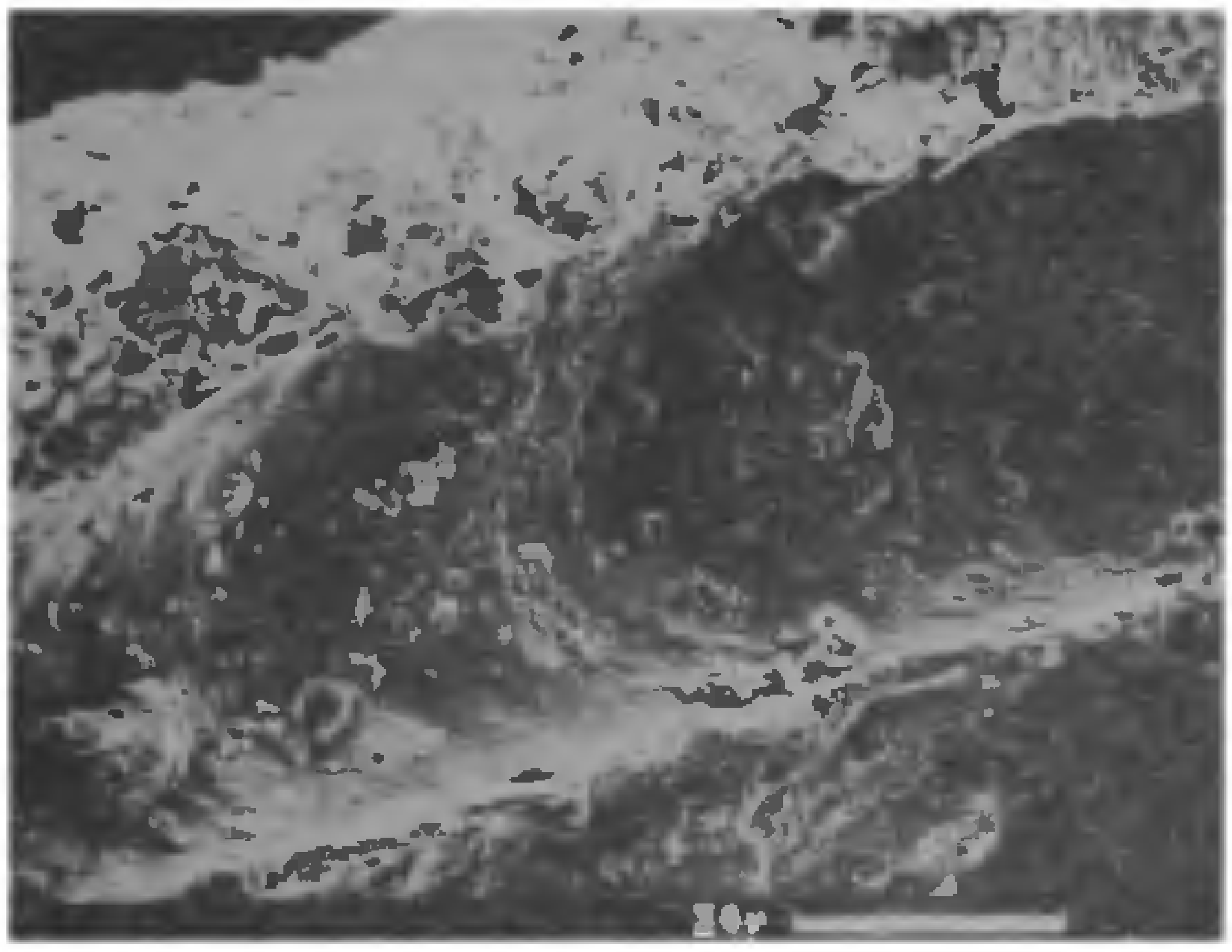


Figure 7. Transverse section of the utricle showing uniformly smooth wall (×535).

(figure 6). The transverse section of the wall is about 50 μm thick and uniformly smooth and the transverse fracture surface within it has a flaky appearance (figure 7).

The lime-encrusted utricles are very brittle and difficult to collect even with brush and needles. Besides, it is an established fact that the external calcification turns into calcareous mud readily after the death of the plant. These properties make the preservation of the utricles as fossils a rare occurrence. Therefore, their presence along with gyrogonites indicates their deposition in a very quiet and specific environment, probably in a bog or swamp. Palynological investigation of the 'Calcutta peat' by Mukherjee and Chakraborty[6] also revealed that the locus of formation of the litho-units of late Quaternary age lay within the region of broad, relatively flat alluvial plain characterized by numerous swamps clothed with hydrophytic vegetation. The abundant growth of *C. fragilis* in a pond in the Botanical Garden of the Punjab University, Chandigarh[5], and also in a similar situation in the Gangetic Bengal (Chatterjee, personal communication) is indicative of its wide occurrence in comparatively undisturbed ponds or puddles which were abundant in the area from which the fossil specimens were collected. It may also be inferred that the *C. fragilis* is of wide occurrence, as specimens (gyrogonites) have been retrieved from two areas as widely separated as Calcutta and Chandigarh.

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1. Chakraborty, K., *J. Geol. Soc. India*, 1983, **24**, 479.
2. Daily, F. K., *Am. Mid. Nature*, 1970, **84**, 365.
3. Tappan, H., *The paleobiology of plant protists*, Freeman, San Francisco, 1980, p. 979.
4. Soulie-Marsche, I., *Ann. Geol. Pays Hetten*, 1979, **3**, 1127.
5. Bhatia, S. B. and Mathur, A. K., *Geophytology*, 1978, **8**, 79.
6. Mukherjee, B. and Chakraborty, K., *Proc. X Ind. Coll. Micropal. Strat.*, 1984, p. 505.

GEOCHEMICAL DISTINCTION OF LAVA FLOWS FROM AJRA-MAHAGAON AREA

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An attempt has been made to ascertain the existence of any relation between the present height of exposure of lava flows and their chemical composition by studying the basaltic flows atop Dharwarian Schists and the Kaladgi sandstones exposed over an area of 609 km^2 around Ajra-Mahagaon townships, Kolhapur district, Maharashtra state. These flows form the southwestern fringe of the Deccan Basalts (Survey of India toposheet No. 47 L/4 and L/8) and extend between longitudes 74°12'30" and 74°30'E, and latitudes 16° and 16°15'N. Maximum elevation is 1050 m. The exposed thickness of the greenish-black, fine grained flows, 3–4 in number (apparently due to the steps produced by erosion), is around 384 m.

Representative samples (38 in number) have been chemically analysed and the results are given in tables 1–3. The analysed samples have been arbitrarily grouped into three groups corresponding to levels 667–767, 767–867, 867–967 m respectively. To establish the existence or otherwise of these groups, geostatistical *F*-test analysis has been carried out and the results are given in table 4. A triangular variation diagram (figure 1) depicting critical oxide content of the samples (TiO_2, CaO and K_2O, 99% level of confidence, table 4), has been constructed, which demonstrates that only two groups, and not three, exist amongst the rocks