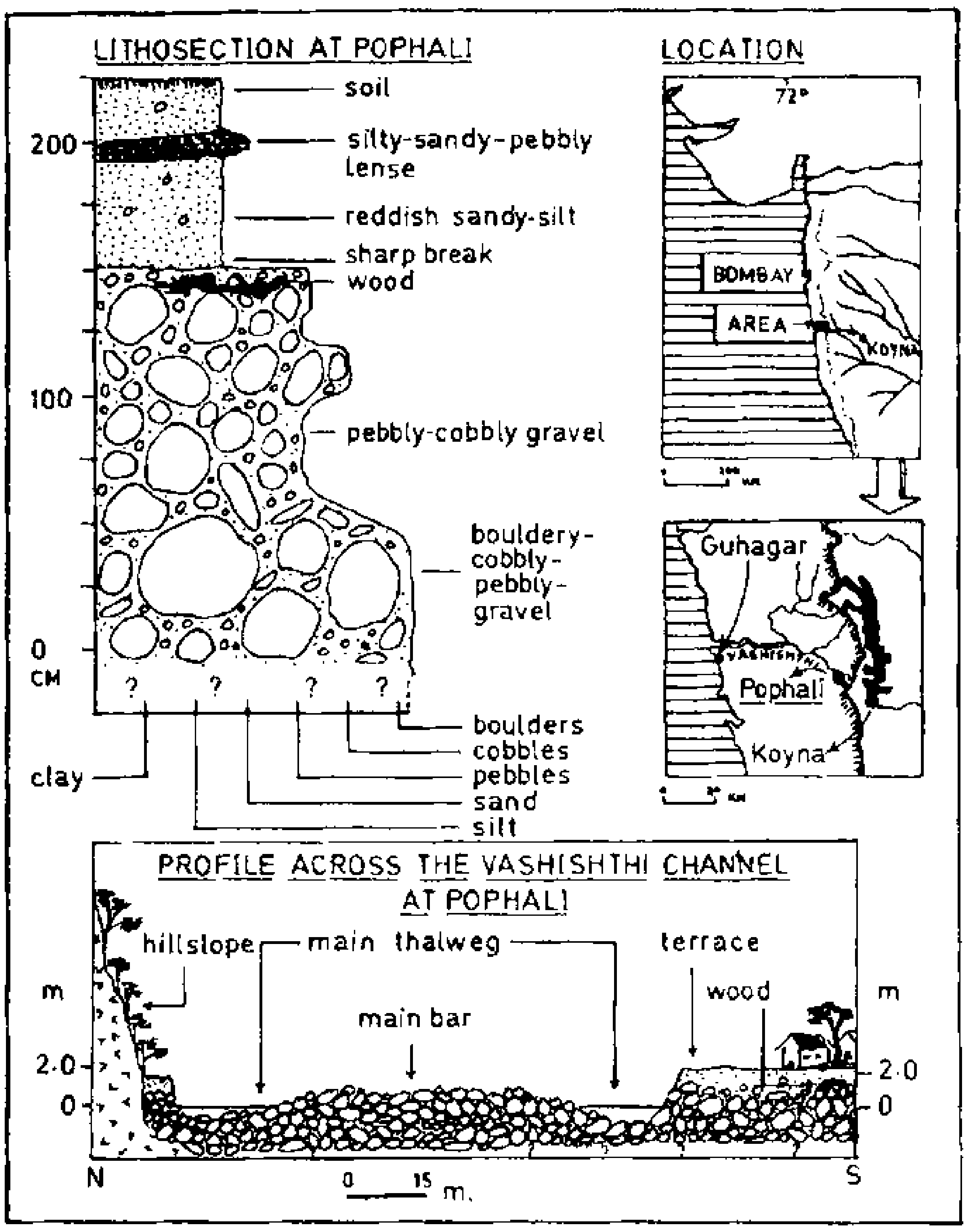

Figure 1. Location and the lithosection of the Pophali site.

from what was apparently a bedload or mixed-load channel to a suspended load channel. On the other hand, large scale landslides, following hillslope failures will contribute debris flows with a predominent component of angular material. Evidences of such changes, although seen on the hillslopes, are not revealed by the channel sediments[4]. In such circumstances, the probability of a tectonic control is considerably increased. Flume experiments have indicated the development of braided pattern, as a result of aggradation in response to excesses sediment supply, from valley slopes deformed by active tectonic movements[5]. The experiments have further shown that the main feature of braid-stream response to tectonic movements is incision and terrace formation[5]. Indications of such changes are available in the channel and, therefore, the transformation of the channel can be attributed to great influx of coarse sediments in response to neotectonic activity.

If the concept that alteration of fluvial regimen of the Vashisthti river will cause river metamorphosis is correct, then the effect of tectonic activity on the river should be recognized in the river channel adjustment. An evidence of such a change is available in the presence of a fossilized drift wood. The wood was discovered in a trench at Pophali (figure 1) about 30 m from the southern bank of river Vashishthi. Radiocarbon dating of the sample has revealed an age of 730 ± 100 yr BP (BS 666). The date suggests that the river not only migrated by a few tens of metres in the last 700 years or so but has subsequently incised by 2.0–2.5 metres. Such rapid alterations in the regimen of the river system, viewed together with the recent geophysical data suggest the presence of neo-tectonic movements in the region, and the Vashishthi river appears to be adjusting all aspects of its morphology to provide the correct hydraulics.

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GRAIN SIZE ANALYSIS AND SURFACE TEXTURES OF COASTAL RED SANDS AROUND MUTTOM, KANYAKUMARI DISTRICT AND THEIR IMPLICATIONS ON ENVIRONMENT OF DEPOSITION

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THE red sand (Pliestocene to Recent) seen on the coastal tract of Kerala, especially around south of Trivandrum and Kanyakumari Districts and in the North Kerala, is locally known as 'teri'. It constitutes a distinct sequence with characteristic red colour and overlies both sedimentary and crystalline rocks. The present study is concerned with the red sands in the Muttom sea shore (figure 1). These

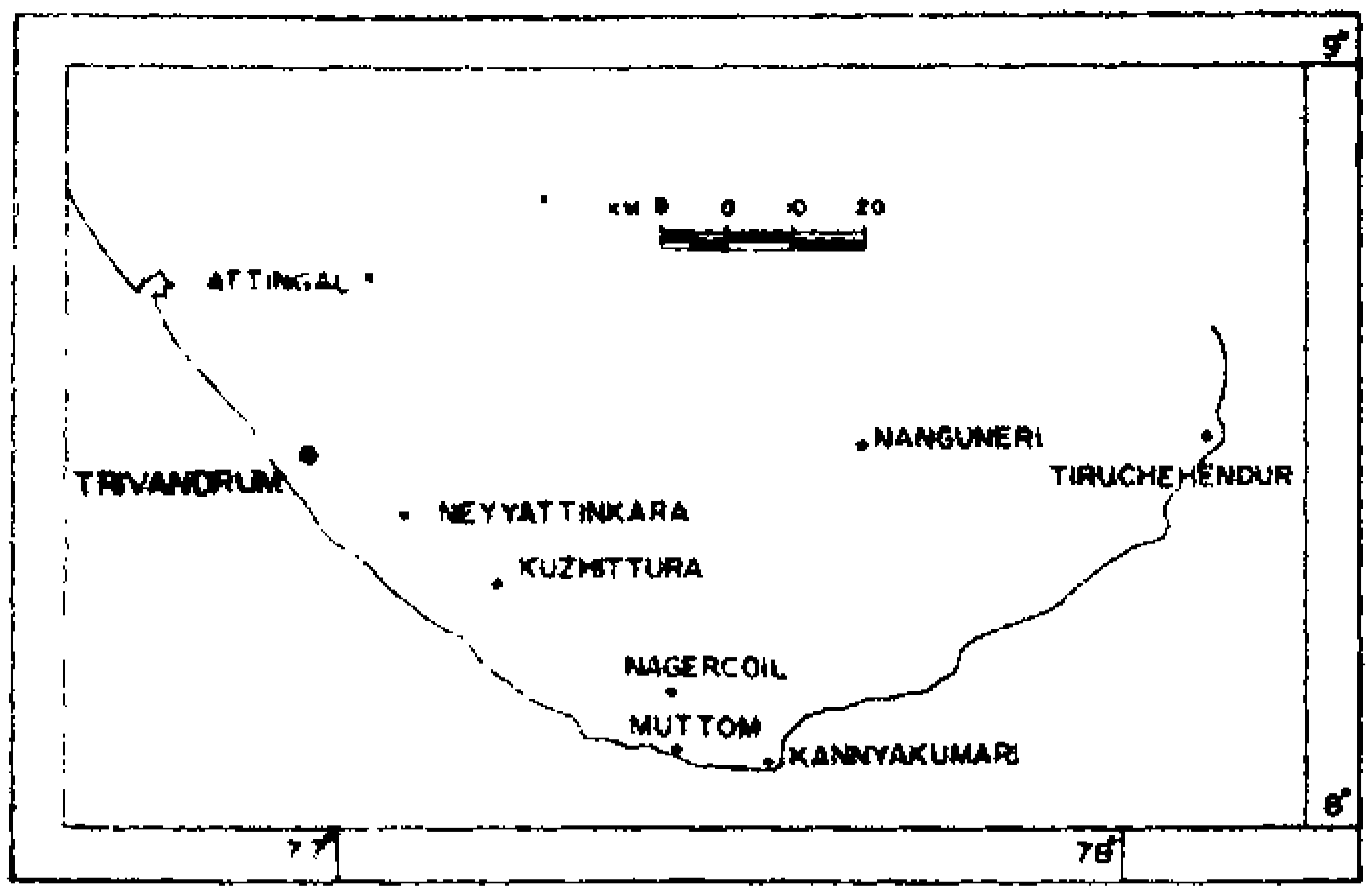


Figure 1. Location map.

deposits have a dome-shaped form and are deposited over a wave-cut rocky platform, 2 to 10 km wide belt along the coast and has a vertical thickness of 20 to 30 m. They contain fine to medium grained sands with more than 80% sand fraction containing about 22% rounded sand grains and the rest being angular grains. The red sand of this area has an average 3.4% heavy mineral weight percentage. The major heavy mineral constituents are ilmenite, iron oxide and zircon. Monazite, sillimanite, rutile, leucoxene and vermiculite constitute the minor constituents. Grain size parameters and quartz morphoscopic features of the Muttom red sands were studied to reconstruct the deposit environment.

Twelve samples from Muttom area were selected for size analysis. A hundred gram representative split (after coning and quartering) of each of the samples was run through the ASTM sieves at ½φ interval for 20 min on a Ro-Tap shaker. Quartz surface features were studied using a scanning electron microscope. Many methods for delineation of depositional environments based on grain size parameters have been proposed[1], including the multivariate method of discrimination proposed by Sahu[2]. For the present study, following Friedman[1], mean ($\bar{X}\varphi$), standard deviation ($\sigma\varphi$) and skewness ($Sk\varphi$) have been calculated based on moment measures (table 1).

The samples exhibit moderate sorting and fall in the range of 0.67φ to 0.78φ standard deviation with a mean size 2.15φ to 2.73φ and four samples showed negative skewness and the rest showed positive skewness (table 1). As the skewness is not considered very important for discrimination[2], the plot of standard deviation (sorting) against mean grain size, after Friedman[1], has been employed (figure 2). This suggests a fluvial environment of deposition and standard deviation values (table 1) are also similar to river sands which generally exceed 0.50φ, as suggested by Friedman[1]. This is further sup-

Table 1 *Grain size parameters (moment measures) of 'teri' red sands, Muttom, Kanyakumari District:*

Sample No.	Mean (1st moment)	Standard deviation (2nd moment)	Skewness (3rd moment)
MUT 0–1	2.73	0.73	−0.32
MUT 1–1	2.80	0.70	−0.86
MUT 1–2	2.67	0.75	−0.58
MUT 1–3	2.73	0.73	−0.65
MUT 1–4	2.53	0.75	−0.35
MUT 1–5	2.53	0.83	−0.42
MUT 1–6	2.41	0.77	0.01
MUT 1–7	2.50	0.75	0.07
MUT 1–8	2.64	0.78	−0.36
MUT 2–1	2.15	0.67	0.34
MUT 2–2	2.27	0.72	0.70
MUT 2–3	2.24	0.73	0.58

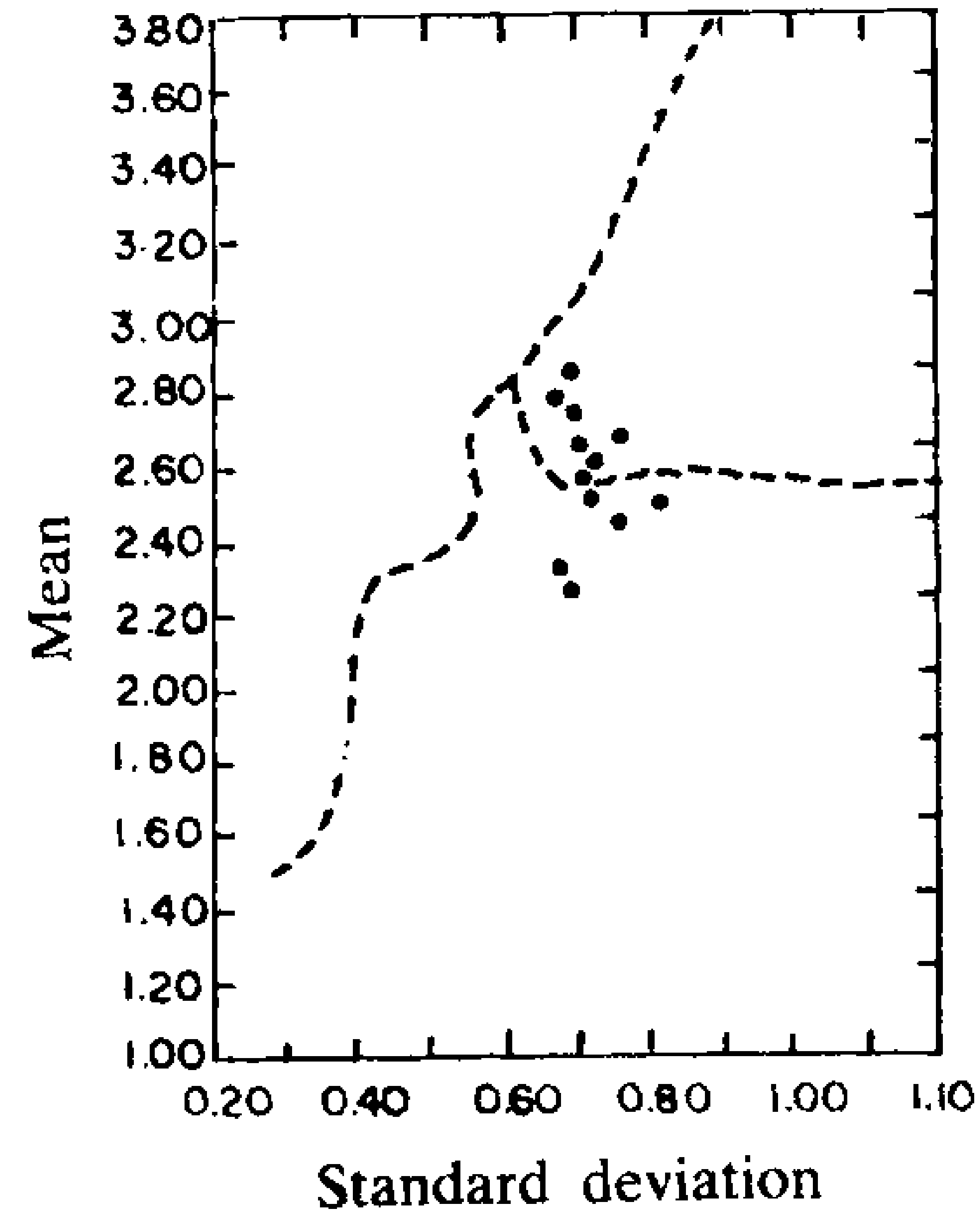


Figure 2. Plot of standard deviation and mean, after Friedman, 1961, for red sands of Muttom.

plemented by plotting the coarsest fraction C (one percentile particle diameter measured in microns) against average grain size M, following Passega[3] (table 2 and figure 3). This plot also indicates that sediments have affinity towards fluvial (bed load) environment.

Surface textures produced by chemical and mechanical processes that affect quartz sand grains are typical of different environments of deposition[4]. Both angular and rounded quartz grains were selected from different size fractions. Examination of the surface textures reveals effects of both mechanical and chemical action on the grains. The v-shaped pits are common in the rounded grains and straight net like sutures are abundant in the angular grains (figures 4 and 5).

Table 2 *C and M values (in mm) of 'Teri' red sands, Muttom, Kanyakumari District*

Samples No.	C (one percentile)	M (median)
MUT 0–1	1.000	0.180
MUT 1–1	0.900	0.180
MUT 1–2	1.150	0.210
MUT 1–3	0.840	0.210
MUT 1–4	1.000	0.250
MUT 1–5	1.500	0.250
MUT 1–6	1.250	0.290
MUT 1–7	0.840	0.290
MUT 1–8	1.000	0.240
MUT 2–1	1.000	0.350
MUT 2–2	0.900	0.320
MUT 2–3	0.800	0.300

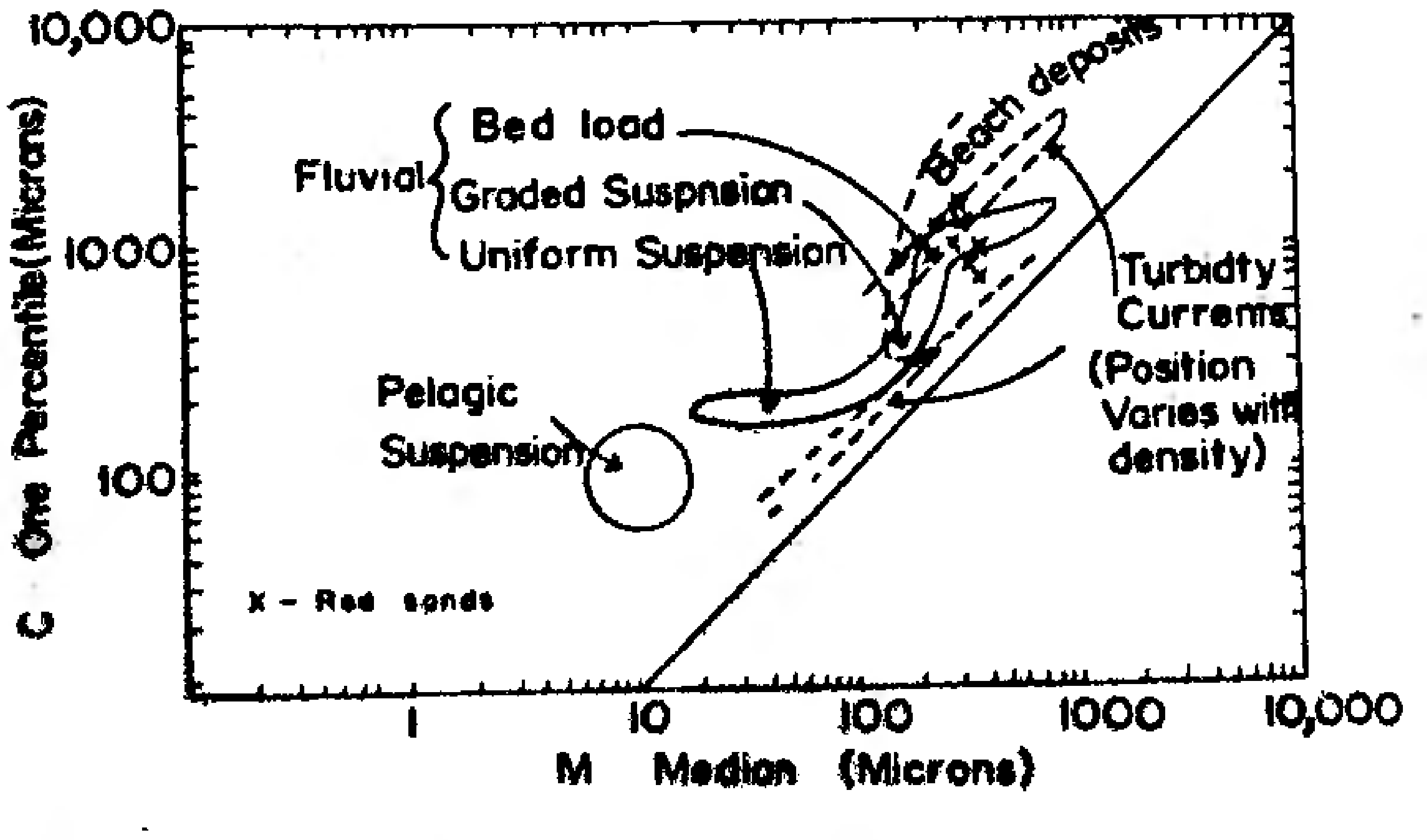
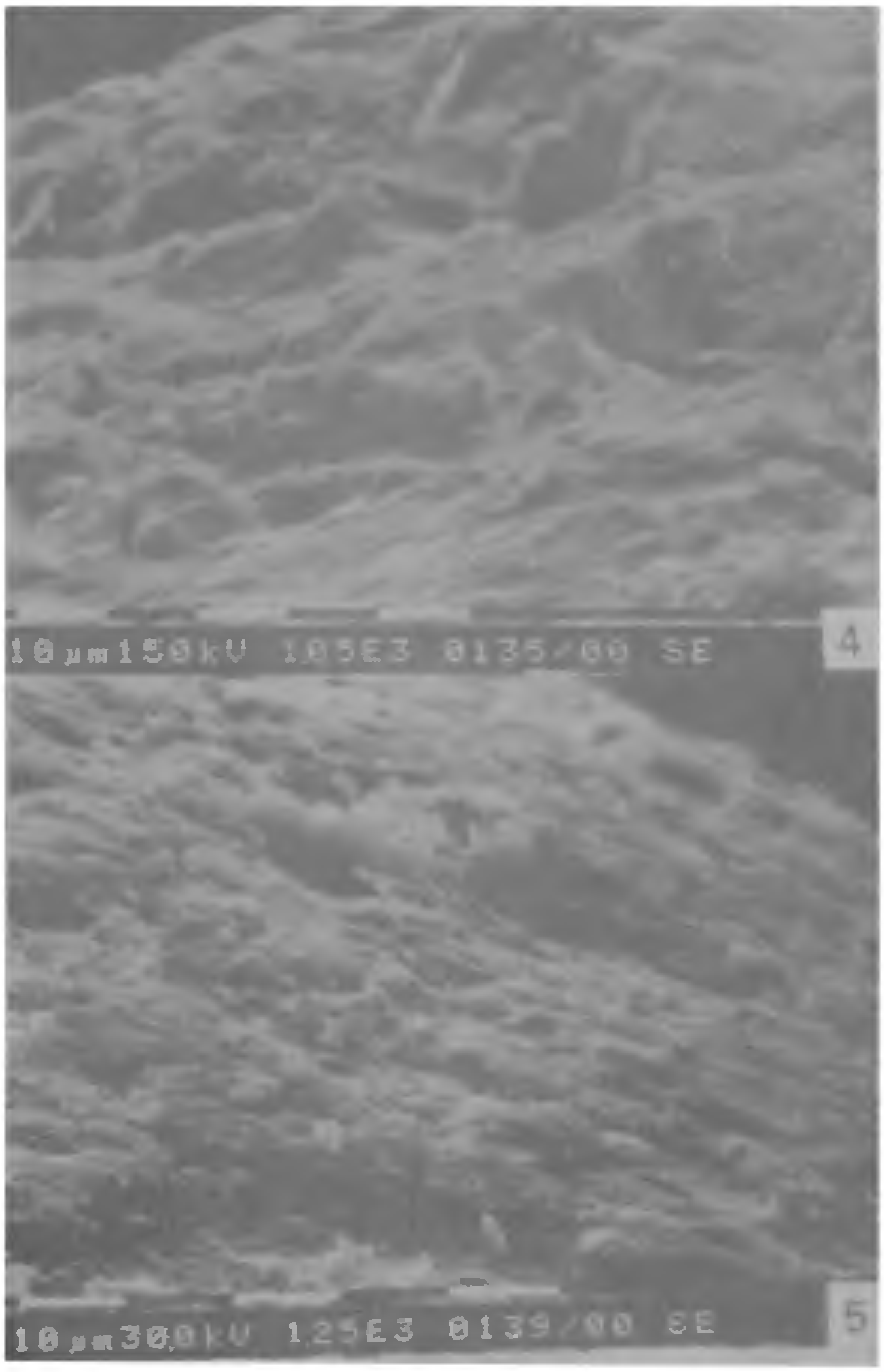


Figure 3. **C M Diagram, after Passega, 1957, for red sands of Muttom.**



Figures 4 and 5. **4.** V-shaped impact pits scattered over the surface of rounded grains; **5.** Small sutures and ridges on the surface of angular grains.

The studies indicate that the coastal red sands of Muttom were largely deposited by streams. Ridges and sutures found in the surface of angular grains, (figure 5) manifested by the presence of deep grooves which could have formed mostly due to solution of silica along microfractures in an alkaline near surface diagenetic environment[5]. This suggests that these sediments were initially acted on by sea (alkaline) water. These deposits are now seen elevated above the high water mark which suggest subsequent regression of the sea either due to Pleistocene sea level fluctuations or due to tectonic movement. A small percentage of rounded grains present in the sediments with impact pits suggests limited wind action on the already deposited sediments after the regression of the sea.

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ALPHA-AMYLASE AND ISOPEROXIDASES IN DIFFERENTIATING CALLUS CULTURES OF *DATURA INNOXIA*

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REGULATION of growth and differentiation has remained a mysterious problem in plant tissue culture. Until now, only in a few species, it is possible to make the cultured tissue differentiate at will because the nutritional and hormonal requirements of different cells are not well understood. We have been studying the biochemical changes produced in plant cell cultures during differentiation with a view to identify some cellular changes, which would serve as an early indication of differentiation. This communication reports the changes produced in the enzyme activity and isoenzyme pattern of α-amylase and peroxidase during differentiation in anther derived callus cultures of *Datura innoxia*.

The calli were initiated from explants of anther derived haploid plantlets[1] on Murashige and Skoog's[2] (MS) medium supplemented with 2 mg/l of 2,4-D (2,4-dichlorophenoxyacetic acid). This medium is henceforth designated as MS_2 medium. These cultures were transferred to fresh MS_2, B_3 and MSR (MS medium + 0.1 mg/l of indoleacetic acid) media for callus growth, shoot regeneration and root differentiation respectively. All the cultures were kept in dark at 27 ± 1°C except for shoot regeneration, where they were incubated under constant illumination of 4000 lux. Alpha-amylase activity was assayed by the method of Naylor[4]. The method of Seevers *et al*[5] was followed for the enzyme assay of peroxidase. Protein was assayed by the folin-phenol method of Lowry *et al*[6]. Polyacrylamide gel electorphoresis (anionic system)[7] was performed to detect the isoenzyme pattern of α-amylase[8] and peroxidase[5].

The effect of different media on the enzyme activity of α-amylase and peroxidase is shown in table 1. The specific activity of both the enzymes increased considerably under differentiating conditions. Further, activity of these enzymes was greater in cultures incubated in MSR medium as compared to that in B_3 medium promoting shoot regeneration.

Table 1 *Alpha-amylase and peroxidase specific activities* in cultured cells of Datura innoxia after 20 days of incubation in different media*

Medium	Growth hormones	Response	α-amylase	Peroxidase
MS_2	2, 4-D (2.0 mg/l)	Callus formation	3.3 ± 0.8	48 ± 11
MSR	IAA (0.1 mg/l)	Root differentiation	20.2 ± 4.5	1842 ± 155
B_3	Kinetin (2.56 mg/l) and IAA (4.0 mg/l)	Shoot regeneration	13.6 ± 1.7	1143 ± 210

Enzyme unit = 0.1 change in optical density,
Specific activity = enzyme units × $\text{minute}^{-1} \times \text{mg}^{-1}$ protein