Figure 2. Ridge type of growth aligned in [110] direction when copper is deposited from acid copper sulphate bath in presence 5×10^{-16} m/l of DTE at 2 mA/cm, × 625.

Figure 3. Polycrystalline type of deposit on copper (111) face from acid copper sulphate bath at 2 mA/cm² in presence of 10^{-15} m/l of DTE at 2 mA/cm, × 625.

leading to a decrease in the overpotential values and accelerating the rate of transport of copper ions across the interface region resulting in changes in the morphology. The fact that the effect is apparent at a concentration as low as 10^{-16} M/l could be due to the presence of two −SH groups in the same compound. Such a low threshold concentration of an addition agent has not been reported earlier. The mechanism of habit modification due to DTE is under detailed investigation.

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1. Barnes, S. C., *J. Electrochem. Soc.*, 1964, **113**, 296.
2. Turner, D. R. and Johnson, G. R., *J. Electrochem. Soc.*, 1962, **109**, 798.
3. Jacquet, P., *Compt. Rend.*, 1933; **202**, 402.
4. Nageswar, S. and Setty, T. H. V., *Proc. Indian Acad. Sci.*, 1968, **A68**, 178.
5. Damjanovic, A., Setty, T. H. V. and Bockris, J. O. M., *J. Electrochem. Soc.*, 1966, **113**, 129.
6. Nageswar, S., *Electrodeposition and Surface Treat.*, 1975, **3**, 195.

LATE-PLEISTOCENE BEACH ROCK FROM URAN, MAHARASHTRA, INDIA.

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BEACH rock, popularly known as 'karal' in Konkan, is a common type of sedimentary formation in the littoral zone of the Konkan coast. Although, a good number of C-14 dates of beach rocks are available, the noteworthy beach rock formation from Uran has not been dated so far. Other beach rocks from Konkan have given a general age of Mid to Late Holocene epoch[1].

The beach rock found in the littoral zone, to the west of Uran (18°52′30″N & 72°54′56″ E) is shelley-pebbly in nature and is well consolidated. Distinct laminations with alternate bands of fine and coarse material are seen in the exposed sections.

A representative lithosection (figure 1) exhibits about 1.8 to 2 m of exposed beach rock at the base, extending upwards through parts of dune (0.9 to 1.5 m), capped by red sandy soil. The reddish sandy soil perhaps implies pedogenesis after the formation of the beach rock. The soil-forming process must have caused the gradual elimination of $CaCO_3$ through time. Subsequently, the lamination and the shells disappeared. The red colour of the top layer indicates that the sands are old or at least that the sediments have been subjected to relative intense weathering for a

Figure 1. Fossil bone from Uran. The bone cavity is filled in with shelly beach rock.

considerable time. Thus, the beach rock of Uran appears to be older than the beach rocks found to the south of Thana creek. This inference has been well supported by the relative dating of a fossil bone (figure 2) obtained from the beach rock. The bone was collected from the laminated and well consolidated beach rock about 1.6 m from the base of the section.

The fossil bone, the first bone to be reported from Konkan, was identified as the 'Long bone of a mammal' (Badam, personal Communication).

Chemical analysis carried out for the bone yields a value of 1.14% of fluorine and 22.9% of P_2O_5. The fluorine-phosphate ratio[2] ($100F/P_2O_5$) accordingly computed[3] gives a value of 4.978. The ratio value is comparable with the values of Late Pleistocene bones from Inamgoan (c 5), Manjara valley (3 to 5), Godavari valley (4.1) etc. Thus, the bone from Uran can be relatively dated to the Late Pleistocene period.

The percentage of organic carbon (0.462) and nitrogen (0.0381) for the bone suggests that the local environmental conditions were not favourable for the preservation of the bone in this area[3]. This fact perhaps explains why fossil bones have not been preserved in the Konkan region. Therefore, the Uran bone is a rare finding and is of considerable importance.

Thus, the red sandy soil and the relative age of the bone implies that the beach rock of Uran is one of the oldest known beach rocks, to the south of Thana creek in Maharashtra; and has evolved during the Late Pleistocene. As the beach rock develops in the intertidal or spray zone, it is evident that the sea was also high during the formation of the Uran beach rock.

However, as the terminal phase of the Pleistocene was marked by low sea level, the age of the beach rock suggests that either it developed in relation to a high sealevel of the last inter-glacial period, or there has been neotectonic activity in this region.

Nevertheless, in the absence of other evidences of neotectonism in the region such as (a) displacement of littoral sediments of Late Pleistocene age and (b) absence of raised beaches out-side the littoral zone,

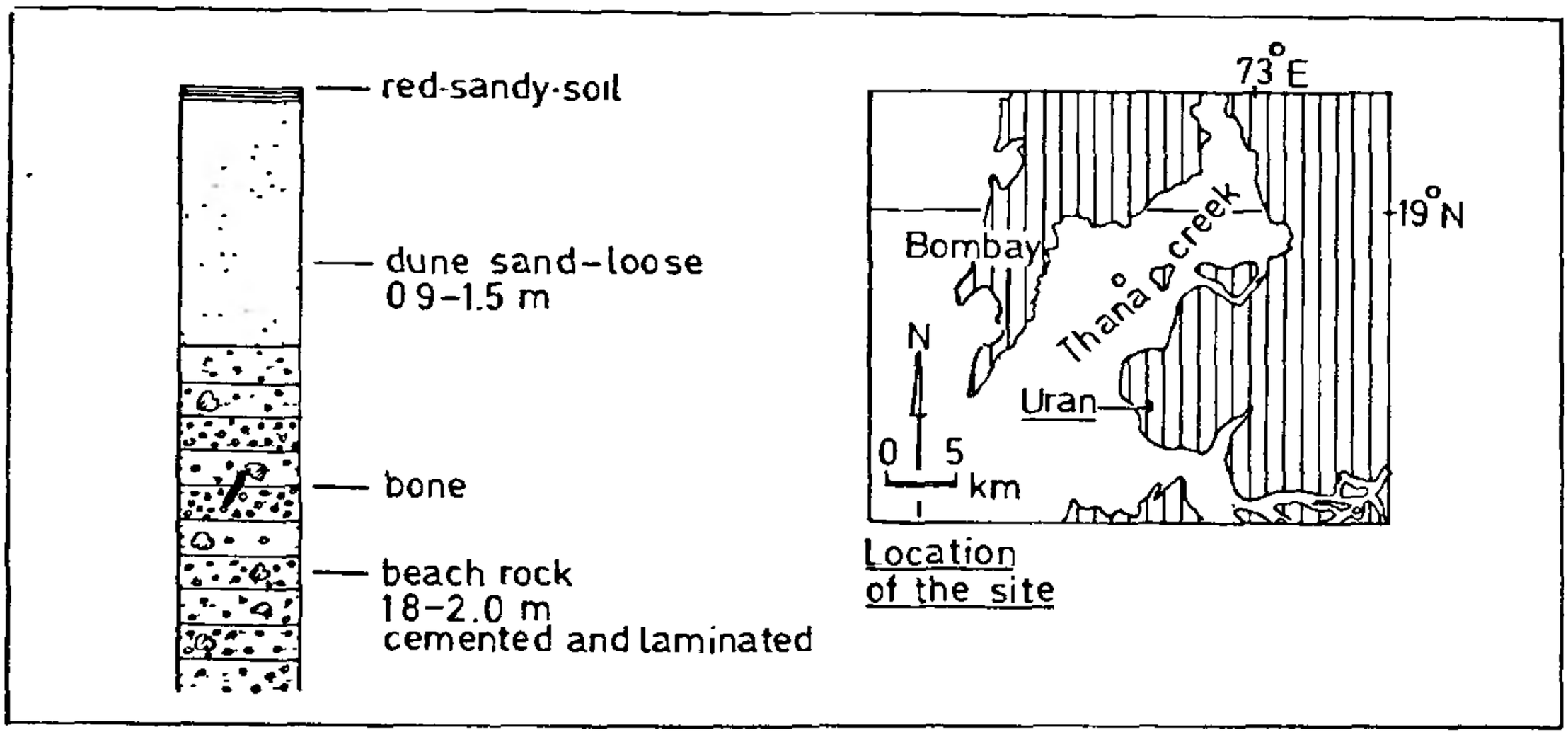

Figure 2. Litho section at Uran.

both altitudinally and spatially; it appears that the Uran beach rock developed during the last inter-glacial period of the Late Pleistocene epoch.

This inference signifies the antiquity of the Uran beach rock.

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1. Guzder, S., Deccan College, 1980.
2. Oakley, K. P., *Bull. Br. Museum (Natural History)* 1980, **34**,
3. Kshirsagar, A. A., Deccan College (unpublished) 1980.

DISCOVERY OF THE LOWER CAMBRIAN STROMATOLITES FROM THE MUSSOORIE TAL PHOSPHORITE, INDIA.

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LOWER Cambrian stromatolite is recorded for the first time from the Lower Tal Phosphorite at Durmala on the northern limb of the Mussoorie syncline, Lesser Himalaya, India. The stromatolite form reported here is *Collumnaefacta vulgaris* Sidorov, which is known from the Lower Cambrian (Tommotian) deposits of the Pestrotsvet Formation on the Lena River basin USSR[1]. Phosphatic stromatolites were generally found in Proterozoic rocks of India, USSR and China but Cambrian stromatolitic phosphorites were also reported from Georgina Basin, Australia[2]. The age of Tal Formation was considered as Middle Riphean *(Proterozoic)*[3], *Cambro-Ordovician*[4], Late Palaeozoic[5-7] and Cretaceous[8-10] by previous workers. *C. vulgaris* suggests a Lower Cambrian (Tommotian) age to the Lower Tal Formation. The recent discovery of Conodonts[11] from the Tal phosphorite also suggest a Tommotian age to the Lower Tal Formation.

The sedimentaries of Krol belt, Nagthat-Blaini-Infra Krol-Krol and Tal represents continuous sedimentation in a single large epicontinental basin. The carbonate succession of Krol belt are tidal flat deposits where algal mat and stromatolitic facies are abundant. The Tal Formation is the uppermost unit of the Krol belt which contains potential phosphorite horizon overlies the Krol Formation. The basal Tal Member consists of black shale, chert bands, phosphate bearing carbonate, stromatolitic limestone and siltstone and quartzites in the Upper Tal. The Krol-Tal contact is gradational where algal mat carbonates of Upper Krol gradually change into the overlying black phosphatic shales and chert bands with bands of algal mat and stromatolitic carbonate. This is a facies change from oxygenated tidal flat of Upper Krol into a sheltered tidal flat or shallow lagoon of Lower Tal with restricted circulation[3].

The stromatolites, small algal structures and oncolites were reported from various localities within the Mussoorie Phosphorite Member of Upper Krol and Lower Tal Formations [5,12,13]. The *C. vulgaris* is discovered from Durmala phosphate deposit of the Mussoorie syncline (figure 1). Smaller isolated phosphatic stromatolitic columns and phosphatic oncolites have also been found in Tal Phosphorite. The systematic description of the stromatolite is given below:

Group: Collumnaefacta Korolyuk, 1960
Form: C. vulgaris Sidorov, 1969

C. vulgaris is a columnar stromatolite characterized by having spongy layers. The columns are small, upto 8 cms high, straight, parallel, vertically arranged sub cylindroids with smooth lateral surface (figure 2). Transverse sections are circular sometimes irregular in shape. The columns sub-divide into two to three new columns almost parallel to each other (figure 3). The branching does not widen the diameter of the main column. Columns are very closely-packed and grow densely. The parent columns are always 2 cm thick and the distance between them is not more than 1–3 mm. The laminae are gently convex and the convexity ratio

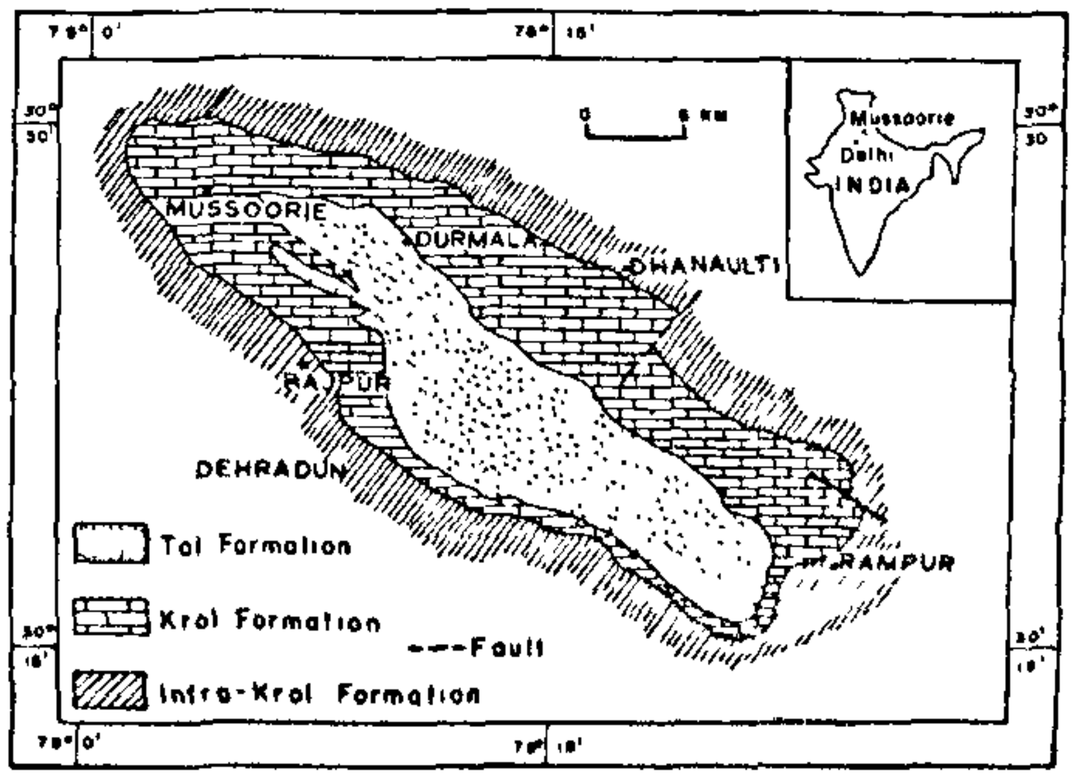

Figure 1. Geological sketch map of Mussoorie syncline showing the location of the Durmala phosphate deposit. (Modified after Rupke and Sharma).