and during the dramatic transition from the Precambrian to the Cambrain and hence can be used to reconstruct the events during this important phase in earth history.

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Geodynamic significance of Algal-oncolites reported from Dras and Lamayuru area of the Indus–Tsangpo collision zone of Ladakh Himalaya, India

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Olistoliths, the enigmatic blocks of limestone, which for long have puzzled geoscientists, occupy the northern margin of Zanskar shelf sediments. They are observed within different tectonic zones of western Ladakh Himalaya, constituting a major part of Indus–Tsangpo Suture Zone. These olistoliths, which are often associated with fossiliferous and organosedimentary structures, i.e. spherical to elliptical oncolites, provide important clues for deciphering both the pre-collision sedimentation history of the Zanskar shelf and the collision-related *tectonics of the Indus–Tsangpo Suture Zone.*

THE Indus–Tsangpo Suture Zone in the NW sector of the Ladakh Himalaya decipher a complete N–S cross-section of the suture zone-related rocks and their tectonic set up. Studies[1] have demonstrated that the NW sector of the Ladakh Himalaya is sandwiched between the backthrusted Tethys Himalaya zone of the Spiti and Zanskar (Zanskar Supergroup) to the south and the Karakoram zone (Karakoram Thrust) to the north. We report here the presence of oncolite-bearing limestone olistoliths ('exotic blocks' of limestone) around Lamochun peak, south of Dras village. The limestone olistoliths are tectonically incorporated in the Dras Volcanic Formation of Cretaceous age[2–5], which is underlain by Zanskar Thrust to the south (Figure 1). These limestones, occurring as tooth-like projections, are 50–100 m thick, associated with oncolites along with fragmentary molluscan remains with it.

The limestone olistolith within the Lamayuru Formation of Triassic–Palaeogene age[6–9] also exhibits oncolite association near the village Saraks, north of Namikla pass. The limestone olistoliths are tectonically juxtaposed with the Lamayuru Formation of distal turbidites of the basin plain setting[5,6]. Macroscopic study reveals flattened spherical to ellipsoidal geometry of oncolite. They are often fragmented. Sometimes they show a mosaic-like pattern and often reflect the shape of the intraclastic nuclei (Figures 2,3). Their size ranges from 0.2 cm to 4 cm (Figures 4,5). Microscopic studies reveal that the grain supported fabric and the dolomitized sparry calcite cement occupy the inter-particle pore spaces. Some of the sections, however, show that the grains are supported by algal encrustations. Algal intraclast form the oncolitic nuclei, molluscan fragments and other skeletal particles are

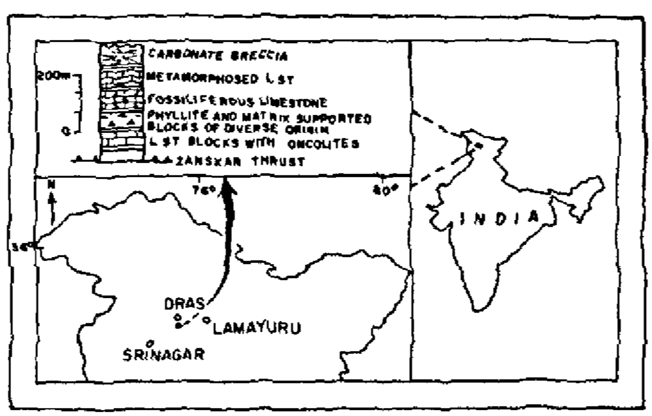

Figure 1. Location and index map with lithocolumn and oncolite locality.

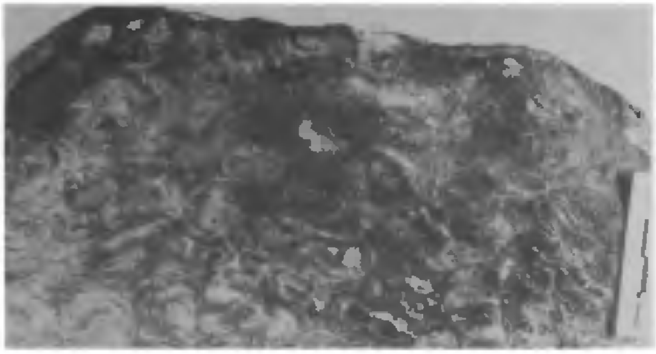

Figure 2. Very well rounded to elliptical oncolites.

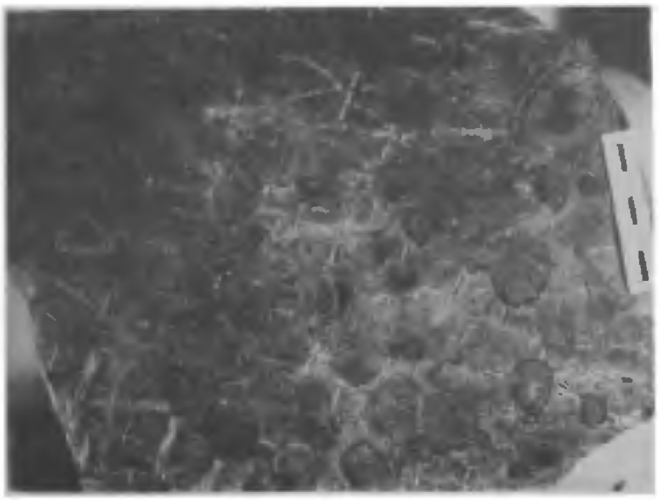

Figure 3. Oncolite showing a mosaic pattern.

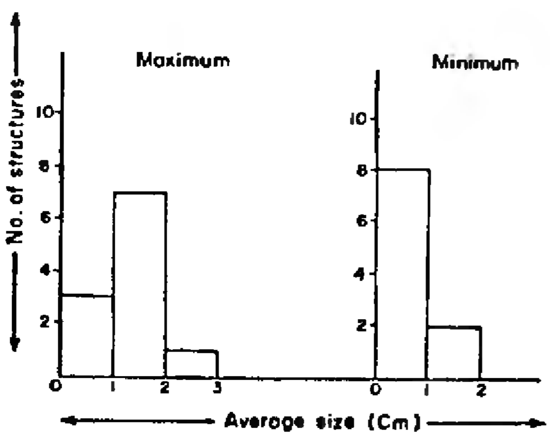

Figure 4. Histogram showing average maximum and minimum diameter of elliptical oncolites.

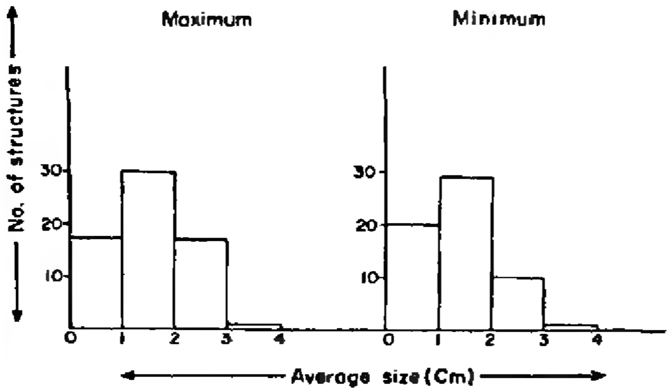

Figure 5. Histogram showing average maximum and minimum diameter of rounded-subrounded oncolites.

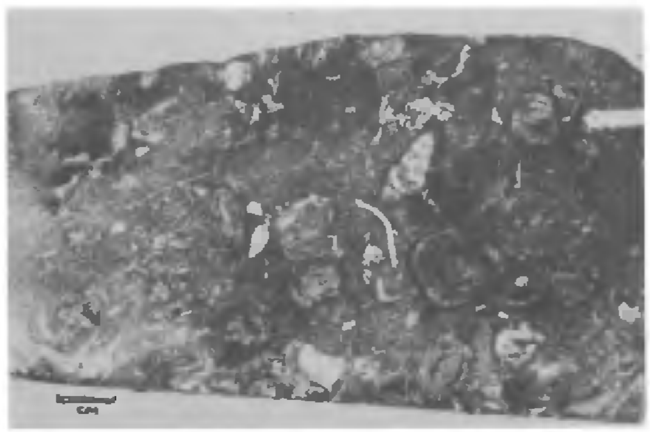

Figure 6. Rounded to elliptical oncolites having fragments of gastropods.

amongst the other associated fossils (Figure 6). X-ray diffraction studies show the dominance of calcite over dolomite with minor clay minerals. XRF studies reveal the presence of 0.14% phosphorus of the oncolite-bearing limestone.

The present study of the oncolite-bearing limestone olistoliths adds to the understanding of the pre-collision environmental condition and extent of the basin in which the carbonate sediments were deposited. The occurrence of oncolite-bearing olistoliths, along with the diverse nature of olistoliths reported earlier from the Indus–Tsangpo suture zone[8–11], also throw light on the convergence and syncollision tectonic processes that prevailed during the plate-tectonic interaction of the Indian and Eurasian plates. On the basis of the available age data and the depositional environment setting, the existence of the limestone olistoliths within the rocks of the Indus–Tsangpo Suture Zone, i.e. the Lamayuru Formation and the Dras Formation, depicts a contrasting lithotectonic distribution of the individual olistoliths[8–12]. Field and laboratory investigations[12] have led to the conclusion that the presence of shelf, forereef, and basin margin (slope) environment facies have been associated with these olistoliths. The presence of oncolite-bearing olistoliths is, however, supposed to be deposited only below the intertidal zone to depths of ± 10 m[13,14]. Further defined marine oncolites are typical to the deeper parts of the intertidal environment with moderate water agitation and to the area immediately below the low tide. According to their frequent occurrence in stratified limestones at the lower flank of Jurassic bioherms in southern Germany they possibly lived in water as deep as 70 m. How far they extend into deeper water is not known. In the light of the above-mentioned points it could be summarized that, the association of the oncolite-bearing olistoliths and other *in situ* and reworked fossils bearing olistoliths of the Dras and the Lamayuru formations indicate that, before the commencement of convergence, i.e. during the tectonically stable regime, the carbonate sequence was deposited at a shallow marine condition. In the Upper Cretaceous time the convergence of the Indian Plate beneath the Eurasian led to the compression of the shallow marine sediments of shelf, reef and basin margin (slope) environments. Ongoing compression of the shelf sediments led to the development of minor shelf and ramp for a shorter duration, resulted in the formation of small, isolated shallow marine basins all along the Tethyan platform margin, which enhances to the amount of reworked sediments. The process is concomitently associated with the Tethyan sedimentation which is finally ceased during the Eocene time (45 Ma) when the final collision between the Indian and Eurasian plate took place. In the tectonically active phase of subduction, i.e. during subduction accretion[15], the collapse of the Zanskar shelf margin (Tethyan zone) initiated the process of sliding down of these shallow marine sediments towards deeper levels. These sediments were ultimately kneaded[15] with the sediments of the Dras and the Lamayuru formations which were being deposited at that time at the deeper levels. The main emphasis here is to highlight the occurrence of different olistoliths of limestone and the discovery of oncolite structures in the NW sector of the Indus–Tsangpo Suture Zone of Ladakh Himalaya. The study is significant in the study of Cenozoic continent to continent tectonics and building of the Himalayan mountain.

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Plantlet production from shoot tip cultures of red sandalwood (*Pterocarpus santalinus* L.)

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Red sandalwood (*Pterocarpus santalinus* L.), belonging to the family Fabaceae, is one of the most valuable trees, and has limited distribution in India. In view of its high price, restricted distribution and usefulness as a timber tree, there is urgent need to obtain improved lines, in both quality and quantity. We have established a method for production of complete plantlets by tissue culture. We report here the successful development of red sandalwood plantlets by induction of multiple shoots from shoot tips, and successful transfer of micropropagated plants to soil.

RED sandalwood is restricted to certain forest tracts in Andhra Pradesh and Tamil Nadu in South India. In view of its value, in countries like Japan, its trade has become much more significant than what it was a few decades ago. The red colouring principle santalin is valued highly as a natural dye. The wavy and rippled grain wood is preferred to that of straight grained wood. In view of its high price, restricted distribution and usefulness as a timber tree, there is an urgent need to obtain improved lines, in both quality and quantity.

Earlier studies using conventional clonal propagation methods like grafting and rooted cuttings have not been very successful. Importance of plant tissue culture for successful mass propagation of forest tress like eucalyptus[1], sandalwood[2] and teak wood[3] has already been demonstrated. Forest trees in general and Fabaceae in particular have proved to be difficult to mass propagate by tissue culture. So far there are very few reports of timber trees of Fabaceae successfully established by tissue culture. Rosewood[4] is the only timber tree of this family successfully established by tissue culture. However, tissue culture propagation of a few fast-growing fuelwood trees like leucaena[5,6], sesbania[7], albizia[8,9] and acacia[10], belonging to this family, have been reported, both by the method of organogenesis and by multiple shoot production of