Crystal Growth associated with Diagenesis of Limy Sediments

by

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Introduction and Acknowledgements

A small specimen of a dark limy slate with peculiar corrugations on the marginal parts of the dome-shaped central part was brought the writer's attention by Professor Miyoji SANBONSUGI of the Fukushima University, who thought it to be a fossil of some kind.

The rock specimen was collected by SANBONSUGI from a road side at Okuizumi in the village of Honkawane-machi, Shizuoka Prefecture, and is thought to have fallen down from the road side cliff. This cliff of slate is part of the Tokuyama formation distributed in this area. The formation is included into the undifferentiated Mikura group of doubtful Jurassic age and generally thought to correspond to the Shimantogawa Series in Shikoku. The group is superposed with unconformity by the Paleogene Setogawa group and superposes the Paleozoic System with unconformity. No fossils are known from the Mikura group and thus its geological age remains uncertain and its correlation with the Shimantogawa Series in Shikoku is merely upon similarity in rock facies and in the complex geological structure.

The Shimantogawa Series has recently been revised and subdivided into many formations ranging in age from Cretaceous to Oligocene from paleontological evidence by KATTO et al (Geological Map of Kochi, Scale 1:200,000, 1960) and is dropped from stratigraphical nomenclature owing its being merely a classical name with little if any geological meaning since the new classification by KATTO and his collaborators (1960). Presently correlation of the Mikura group with units of known geological age in the Japanese Islands should be considered to be premature.

According to the information from Professor SANBONSUGI the intense deformation of the Tokuyama as well as to the Mikura group makes it difficult to determine the stratigraphical succession of the different rocks. For this reason the nature of the small specimen at hand may be important because it is thought to give evidence for determining the upper or lower surfaces of the strata in which it originally occurred.

Here the writers thank Professor Miyoji SANBONSUGI of the Fukushima University for his kind offer of the specimen and for the information concerning its occurrence. Thanks are also due to Mr. Kimiji KUMAGAI for his photographic work.

Description of the Specimen

On the surface of the dome-shaped part of the specimen which measures

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nearly eight centimeters in shorter and approximately nine centimeters in longer diameters and about four centimeters in height are numerous minute, very low tubercles and pits scattered irregularly, and although few in number and with random distribution there are several irregular short and variously curved threads. On the marginal parts of the dome there are many rough corrugations, irregularly spaced, all directed towards the periphery of the dome and consist of raised ridges and depressions. These ridges may be singular, double, branched or appear more or less crumpled. Inwards they become weaker and die out on the flanks of the dome, whereas marginally they are strong. This dome-shaped part of the specimen is more limy than other parts and consists of calcite needle crystals in part and of a limy aggregation in part.

The opposite of this dome-shaped limy specimen is also of dome-shape, but less higher and less defined. There are no corrugations along the marginal parts nor tubercular or pit structures on its surface. The surface of this dome is more irregular in shape and gives the impression of being somewhat foliate.

In side view it is noticed that from the central limy part of the specimen there extend four tongues into the surrounding muddy sediments. These tongues consist of white limy material. They all extend outwards and upwards into the muddy sediments and are thicker on its inward sides but become thinner and die out outwards. No distinct needly crystals are noticed in the tongues which appear more or less amorphous. They grade into the limy core without demarcation. The limy core so far as can be seen is made of needly crystals of calcite.

Under the microscope there may be seen long, needle-like crystals of calcite, more or less parallel with one another, closely packed together, pointed at extremities and better developed away from the core than in the core of the limy materials. The crystals although more or less parallel with one another are often seen to be sub-parallel. Fine fractures traverse the crystals and some of the cracks are quite parallel with the longer axis of them. In the crystal are minute irregular xenoliths of the dark muddy sediments. At portions in contact with the surrounding muddy sediments the crystals appear as if forced

Diagnosis of Limy Sediments.
(KUMAGAI Photo.)

Fig. 1-Top view of upper surface showing corrugated margins and sculptured dome-surface.

Fig. 2-Upward projecting tongues of limy materials thinning out into the surrounding muddy sediments.

Fig. 3-Photomicrographs showing needles of calcite crystals which are more or less parallel with one another, fractured, with muddy xenoliths. Enlarged 30 times.

into the sediments in some parts, to have become stunted by the resistance of the surrounding media at the time of being forced outwards during their growth, and in one part it appears as if the limy materials were compelled to flow in-between the muddy materials which also show incipient flow structures at the very contacts. Miniature pinch-and-swell structures of limy materials, minute lenticles, and forcible projecting or injection structures of limy materials into the surrounding muddy sediments can also be observed. In the contact narrow area of the limy and muddy sediments there is observed a stylolitic structure resembling minute stylolite, the limy material being arranged in saw-like manner or pectinated in shape. This suggests that the limy materials may have been forced into minute fractures developed in the muddy sediments. The calcite crystals may be straight, somewhat curved, appear as interfingering with one another, show outgrowths from one or several, have pointed to blunt terminal parts at their outward parts.

Interpretation of the Specimen

As already mentioned in earlier lines the upper or lower surface or lower surface of the present specimen remains unknown because of being picked up from the road side. Also the intensely complicate structure of the Tokuyama formation makes it difficult to interpret the upper or under surfaces of the strata making the formation. From such reasons it is thought that the present specimen from its features may be good evidence for determining the stratigraphical upper surface of the rocks which yielded the present specimen for the following reasons.

From that inclusions of muddy sediments in the limy portions of the specimen, of limy lenticles in the muddy parts, of pointed and blunt terminal parts of the crystals, limy materials forced into the muddy surrounding sediments making stylolitic structures and saw-teeth like features as well as of flow structures are places in contact with the muddy sediments, fractured crystals, and outward extending curved tongues or branches from the central limy core, it is inferred that during compaction of the sediments there existed certain forces resulting in the features described in this article. The upward extending tongues from the limy core are thought to be due to the downward pressure of the superjacent sediments and diagenesis by which they were injected upwards and outwards. The outward thinning of the tongues and gradual change into the limy core suggests this phenomenon. That the surface of the dome-shaped portion is sculptured with minute pits and tubercles is thought to be due to different resistance owing to the impurities of the surrounding sediments, whereas the corrugations at the marginal parts which die out upwards along the flanks of the dome is thought to be due to the pressing and friction at the time of diagenesis. The non-sculptured undersurface which appears more or less foliar and buldges like a load cast is considered to have been made partially in load-cast manner related with the stress from the overlying sediments during diagenesis.

If the above given interpretation can be accepted, it may be said that the sculptured dome with corrugations at its marginal part and the upward extending tongues in side view of the specimen, all indicate the stratigraphically upper surface, whereas the non-sculptured, more or less foliate bulding opposite surface, the under surface. From this interpretation it may be possible to determine the stratigraphically upper and under surfaces of the strata of which the

specimen was originally a part.

References

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石灰質堆積物の Diagenesis に伴う結晶生成について

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(要 旨)

静岡県榛原郡本川根町奥泉で、附近に分布する三倉層群徳山層の黒色粘板岩中に生成されたと見られる石灰質団塊が転石として採集された。この団塊は上下共に dome-shape をとるが、一方の表面には多数の微小の凹凸のほか縁辺部に極めて特徴的な皺が見られるのに反し、他の面にはその様な模様は認められない。団塊内部に発生する calcite の長い針状結晶の集合状態と周囲の泥質物との境界の様子から考察して、泥質堆積物中の石灰質堆積物が diagenesis 中に結晶を生成した結果、結晶は上位に強く伸び下位には load-cast 様に働いたために上下両面で著るしい差違が生じたと考えられる。つまり、特徴的な皺をもち、微小な凹凸を有する面は層位的に上位の面であろう。