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Study of Microstylolites from Carbonate Rocks of Kurnool Group, Andhra Pradesh, South India.

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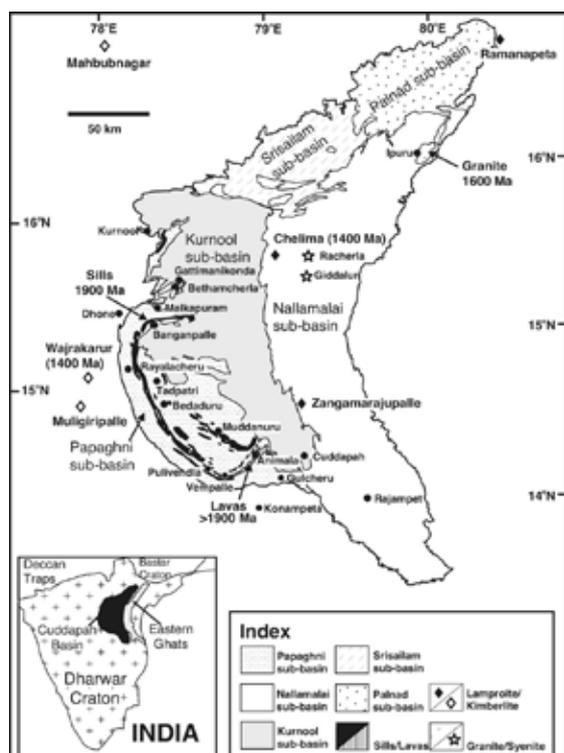
ABSTRACT

Microstylolites in the carbonate rocks of Kurnool Group (Kundair basin) are very well developed and are mostly parallel to the bedding, besides vertical and inclined orientation also occur. Based on the geometry and the bedding plane relationship, different types of microstylolites are recorded and described. They are horizontal, vertical and inclined types. The relationship with the host rock and the probable origin of these structures have been discussed.

1. Introduction:

Stylolites both macro and micro grades are very well developed in the carbonate rocks of Kurnool group, Andhra Pradesh. Generally, stylolites are recognized as irregular planes of discontinuity between two rock units; the irregularities display the shape of "Stylas" the Greek word for columns and pyramids. Consequently the two rock units appear to be interlocked or mutually interpenetrating. During the detailed microscopic study of the carbonates, different patterns of microstylolites have been identified with variable sizes and shapes. Earlier Vijayam and Reddy (1973) reported microstylolites from Kurnool group and now in the present research work more informations are added pertaining to the classification and origin of microstylolites. Besides preliminary study, comparative analysis of the microstylolite. Besides preliminary study, comparative analysis of the microstylolite patterns with that of macrostylolites is attempted.

LOCATION OF THE STUDY AREA



The Kurnool Group of rocks are well developed in Cuddapah, Kurnool, Guntur, Krishna, Nalgonda and Mahabubnagar district of Andhra Pradesh. The basin is irregular in its outline and is elongated along the NE-SW direction. The exposures can be noticed in two basins, one in the Kurnool basin and the other in the Palnad basin. The Kurnool basin, extends between the latitude 16°31" - 16°00" and longitude 77°58" -78°45", covering an area of about 14,500 sq Kms (Survey of India toposheets : 57 I/2,3,4,6,7.8,11,12, 57J/1,5,6,9,10,11,14,15 & 57 E/16) The Palnad basin which lies unconformably on the denuded edges of Cuddapah Group of rocks in the north eastern part of Cuddapah basin extends between the latitude 16°18" - 16°55" and longitude 79°15" -80°10" covering an area of about 3600 sq. Kms.

The Kurnool Group is named after the place Kurnool existing in the South Western part of Andhra Pradesh.

The area is accessible from Nandyal, Paniam, Betamcherla and Dhone railway stations which are on the Guntur-Guntakal meter gauge line and also from Cuddapah, Kamalapuram, Erraguntla, Muddanuru and Tadapatri railway stations on the Madras-Guntakal broad gauge line of the southern railway.

2. General Lithology:

A fair sequence of Kurnool group of rocks are well exposed in Kurnool and Cuddapah districts of Andhra Pradesh. The chief lithological units are arenites, argillites, carbonates and rudaceous rocks. Carbonates constitutes the major facies with subordinate arenites, argillites and rudaceous rocks. Carbonates of different colours occur as massive and flaggy types, which are cryptocrystalline in nature. These carbonate rocks exhibit both macro and microstylolites. The microstylolites have their own individual topography and distinct combination of geometrical shapes or forms. They have residual clay and sparry calcite, oriented more or less parallel to the stylolitic seams. The stylolitic seams varies with respect to source material and the composition of the host rock. The identification of individual minerals under the petrological microscope is rather very difficult, because of the fine grained nature of the carbonate rocks. The detailed study of the mineral assemblage is carried out by x-ray diffractogram and staining technique. The XRD studies revealed the presence of calcite and quartz. The results of staining indicated the presence of dolomite and calcite.

3. Classification Of Microstylolites:

Microstylolites are usually developed parallel, inclined and vertical to rock bedding. They are characterized by irregular mutually penetrating columns with unevenly distributed insoluble residue; which distinctly varies at the crest and through regions. These structures show variation in their amplitude,

wavelength and shape, thus resulting in the differentiation of patterns. They are classified based on (a) the geometry of the structures and (b) their attitude with respect to bedding.

(i) Geometric classification:

Park and Schot (1968) have classified the macrostylolite structures on the basis of their geometrical aspects into six types. Malur et al., (1988 and 1992) have reported microstylolites from Bhima basin and classified it based on the pure geometry and bedding orientation. The present investigated microstylolite patterns are broadly classified into two groups and are described below:

Simply wavy type and

Suture type: a) Suture non-parallel type
b) Suture non-parallel-down peak type

1. Simple wavy non-parallel type:

This type has gentle undulations with small amplitude and wavelength the microstylolite development is very smooth and run non-parallel to the bedding, hence it is recognized as simple wavy non-parallel type. This type is most frequently found in layered sedimentary rocks, particularly in carbonate rocks. The residual clay is distributed irregularly along the stylolites.

2. Suture type:

a) Suture non-parallel type: In this type the microstylolites in its course runs non-parallel to the bedding; hence it is named as suture non-parallel type. The crest and trough of the microstylolitic structure is having interlocking projections. The development of this type is observed in fine grained limestones. The suture junctions varies with their amplitude and wavelength by differential pressure solution phenomenon.

b) Suture non-parallel-down peak type: In this type also the microstylolites in its course runs non-parallel to the bedding; but the peaks (Figure 3) in the microstylolite orient themselves in the downward direction; hence it is named as suture non-parallel-down peak type. The above types of microstylolites are grouped under the category aggregate stylolites of Park and Schot (1968); where in amplitude of the stylolite is larger than the grain diameter of the host rock. However, the intergranular stylolites are not observed so far in the Kurnool carbonates. Since, the limestones are very fine grained it is difficult to study the crystallographic orientation of grains, grain size, shape, degree of contact, the interface energy per unit, etc.,

(ii) Classification of microstylolites in relation to bedding: The development of microstylolite seams is significant and has mostly taken place in relation to bedding, where in generally they are horizontal, inclined and vertical in attitude as exhibited by the seams.

Horizontal type: Horizontal microstylolites is always developed parallel to the bedding. It is commonly associated with all types of carbonates.

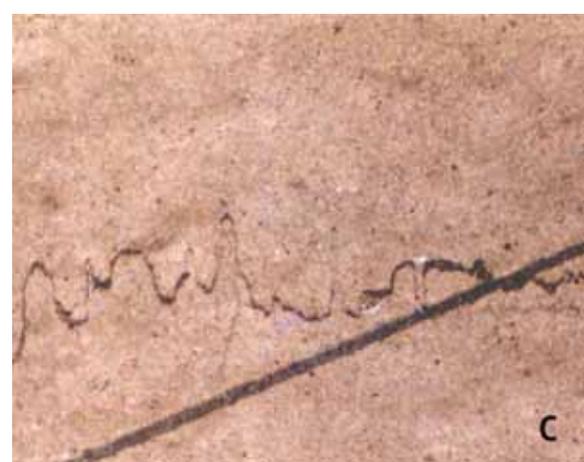
Vertical type: Vertical microstylolites developed perpendicular to the bedding, and are invariably found along the fracture planes.

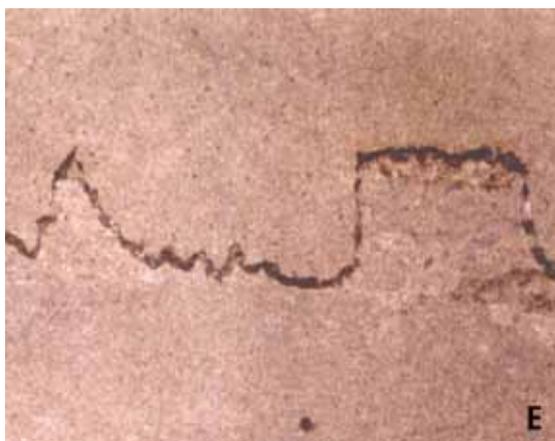
Inclined or oblique type: These type of microstylolites are inclined to the bedding and the inclination is varying. In the course of petrographic studies of carbonates 3 types of microstylolites structures with the combination of the above types have been recognized. They are systematically described in detail and classified.

Inclined type: In this type microstylolites developed small anticlines and synclines which are smooth. As the stylolitic seam is inclined to the original rock bedding, it is named as inclined type. This type of stylolites may be found in rocks both affected and unaffected by structural activity.

Inclined branching type: In this type the seams are sutured in nature and the two seams unit together to give rise to a 'single' seam. The stylolites are characterized by low amplitude before they are interconnected, but higher amplitude is seen clearly after the two seams are untied. Since the microstylolite structure is inclined to the bedding, it is named as inclined branching type.

Vertical inclined type: In this type of seams are vertical initially which are perpendicular to the original rock bedding and gradually becomes inclined one. Hence the name vertical-inclined type. The stylolite seam exhibit anticlines and synclines which are asymmetrical. The development of this type of microstylolites is observed in the fine grained limestones. Such combination was apparently due to the action of two successive differential pressure phenomenon.





PLATES

- A) Stylolite of simple wavy non-parallel type
- B) Stylolite of suture non-parallel type
- C) Stylolite of suture ridge type
- D) Stylolite of simple suture type
- E) Stylolite of suture branching type
- F) Stylolite of suture interconnecting branching type
- G) Stylolite of inclined branching type
- H) Stylolite of vertical-horizontal cross cutting type

ORIGIN OF MICROSTYLOLITES

There are three theories regarding the origin and formation of stylolites have been proposed the solution pressure theory advocated by Wagner (1913) and Stockdale (1922), the contraction pressure theory proposed by Rothpletz (1900), Shaub (1937), Marsh (1968), and Prokopovich's (1952) subaqueous solution theory.

In this type the microstylolites are inclined initially, later branches off into two where degree of the branching differs from one another. Initially microstylolites are characterized by high amplitude, but after branching developed low amplitude (figure 5). Since the microstylolite structure is inclined to the bedding, it is named as inclined branching type.

Of these solution – pressure theory and subaqueous solution theory finds serious adherents today. The great difficulty with the contraction pressure theory, is that it fails to account for and explain the presence of a film of relatively insoluble residual material in the stylolite seams and for the pressure solution effects between grains observed near and along stylolite seams (Park and Schot, 1968). Based on sample thin section observations, the majority of stylolites are of diagenetic, pre-lithification origin of the stylolites, through solution pressure during compaction, is well supported by the presence of a seam of residual, relatively insoluble material along the stylolitic surface. Thus the stylolites under consideration here may start to form relatively early during diagenesis, and act as one of the important factors in promoting induration by supplying cement (particularly with carbonate rocks). The stylolites are built in horizontal, more or less bedding plane parallel layers due to lithification of the sediments, when the layers have undergone a strong dynamic pressure effect. The prerequisites of stylolites build up are horizontality of layers and variation in composition. In some situation stylolites are form from compaction of the sediments and indeed with the pressure generated by overburden of rock mass or probable tectonic influence. Stylolite structure always concentrate around the product of dissolution process, where in easily soluble material will be pressed out of the rock and the insoluble substances at the contact remain intact as relicts relatively enriched.

CONCLUSION:

The detailed study of microstylolites in the carbonate rocks of Jammalamadugu Formation, has enable to understand the sedimentologic aspects and the diagenetic processes in the area. Besides, reveal many features and complexities which can be satisfactorily explained only by the solution pressure theory. The development of different patterns of microstylolites is generally more common in dolomitic limestones when compare with the calcitic carbonate rocks. The presence of

residual clay capping in the majority of stylolite seams is significant and it favours the solution pressure theory or origin (Park and Schot, 1968). Apart from this the combination of horizontal, vertical and inclined microstylolites evidence for the successive pressure systems during the tectonic activity and more so the direction of action of these forces. Also the classification of microstylolite structure based on geometrical aspects and orientation of stylolites in relation to bedding planes also support the influence of tectonism.

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