SHORT COMMUNICATION

FACETED GARNETS FROM MIDDLE PART OF BARAKAR FORMATION, GHUGUS AREA, PRANHITA- GODAVARI BASIN, MAHARASHTRA

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The sandstones and siltstones of coal bearing middle part of Barakar Formation from Ghugus area of Pranhita-Godavari basin contains uniquely etched garnets characterized by smooth, hummocky, mammary facets, as well as regularly patterned, sharply faceted grain surfaces. These facets are positive features that more or less confirm with cubic and octahedral crystallographic planes of garnet structure, developed on small grains devoid of overgrowth. The lower and upper parts of this Formation on the contrary contain unetched garnets. The facets on the garnet have been attributed to etching by dicarboxylic acid, generated during the maturation of organic matter related with the burial diagenesis of the Barakar sediments.

Introduction

The Ghugus area is located in the northernmost part of Pranhita-Godavari basin, which occupies a NW-SE trending linear tract extending from north of Ghugus to south of Khammam within the peninsular shield of India (Fig. la). The basic and pioneering work on this basin was carried out by King (1881), who established the stratigraphy. According to him, the Azoic gneisses are overlain by Pre-Palaeozoic Pakhal Series and lower Palaeozoic Sullavai Sandstones, which are unconformably overlain by Gondwana sediments, which in turn are overlain by Deccan Trap basalts (Fig.la). The rocks belonging to Barakar Formation are exposed in the central part of the area along the Wardha river and exhibit faulted contact with the Talchir Formation. These rocks exhibit gentle dips of 10° to 15° towards southwest (Fig.lb). The Barakar Formation comprises upward fining cycles of sandstone, siltstone, shale and coal. The lower, middle and upper parts of the Barakar Formation show differences in the development of lithofacies related to bedload to mixed load stream model (Soman and Kale, 1992). In the initial stages, sediments were deposited mainly in the braided streams which gradually evolved into meandering streams. Here, under humid climate coal bearing sediments were deposited. Subsequentely, the humid climate was changed into a semi-arid climate.

Petrography and Garnet Studies

The Barakar sandstone and siltstone under study can be classified as feldspathic wacke, lithic wacke and lithic arenite. In the lower and middle parts of Barakar Formation detrital matrix consisting of fine grained quartz and carbonaceous clay is present, while in the upper parts ferruginous nature of cement is dominantly observed. The heavy mineral separation of sand sized fractions of representative samples of lower, middle and upper parts of Barakar Formation was revealed dominance of garnet (av.41.54%). It is observed that middle part of Barakar Formation is characterized by low garnet content (av.25.31%) than the lower part (av.70.75%) and upper part (av.35.05%); and in particular the garnet content is very low in sediments associated with coal.

Garnets are characterized by high relief, irregular form, and conchoidal fracture pattern. Some of the garnets, particularly grains from the middle part of Barakar Formation are characterized by certain etch patterns; hence the obtained heavy mineral residue of samples was subjected to garnet separation using isodynamic separator. The separated garnets were treated with strong oxidizing solution of 1.5 g each of potassium dichromate and potassium permanganate in 15 ml of concentrated sulphuric acid, for removal of organic debris (Mclntyre and Be, 1967). The treated fractions were washed with distilled water and dried. From these fractions, 15 grains each were selected randomly for Scanning Electron Microscopic studies. The selected grains were mounted on the stub using double sticky tixo tape, coated with gold by gold sputter and fixed in Cambridge Stereoscan S-120 SEM. Each individual grain was viewed in different angles, at different magnifications and photographed.

The SEM studies revealed different surface textures on the garnets, such as semiparallel steps, conchoidal breakage pattern and development of etch patterns. The

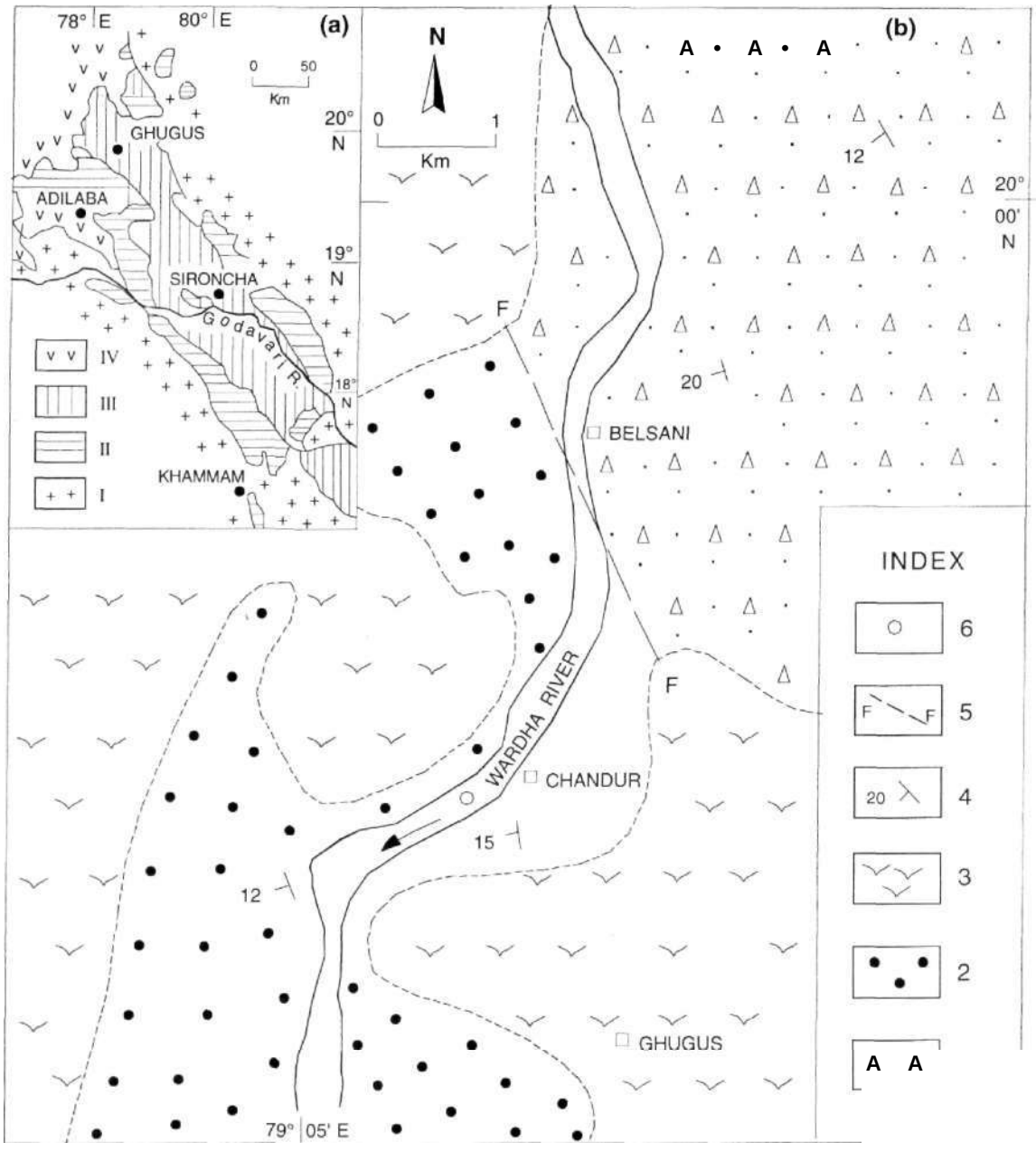

Fig.1. (a) Geological map of Pranhita -Godavari basin *{after* Roy et a!. 1962) I - Archaean, II - Proterozoic, III - Gondwana. IV - Deccan Trap, (b) Geological map of Ghugus area, Pranhita-Godavari basin, 1 - Talchir Formation, 2 - Barakar Formation, 3 - Alluvium, 4 - Dip, 5 - Fault, 6 - Sample Location.

well rounded garnet grain exhibits smooth, hummocky, mamillary facets (Fig.2a). Some garnets exhibit regularly patterned, sharply faceted surfaces (Fig.2b). Generally, these facets are observed to be large positive features, which are distributed in a regular pattern on the surface of garnet and more or less confirm to cubic and octahedral crystallographic planes in garnet structure. Thus, complete transition from slightly etched mamillary surfaces to deeply etched sharply faceted skeletal garnet is noticed in the middle part of Barakar Formation.

Origin of faceted garnets is one of the debated topics in geological literature and the controversy concerns whether the facets are the result of chemical etching or are due to authigenic overgrowths. The garnets under study are devoid of any overgrowths and the facets occur as positive features on the garnet surface that confirm to

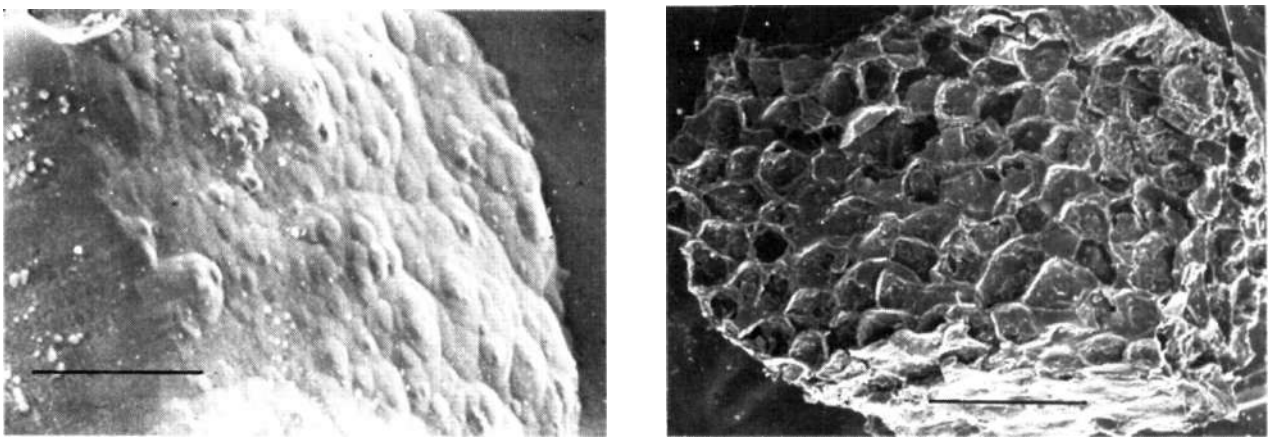

Fig.2. Scanning electron iiiicrophotograph of garnet exhibiting (a) smooth, hummocky. mammillary faceted surface (Bar represents 20 Microns), (b) sharply faceted regularly patterned surface (Bar represents 100 Microns).

crystallographic planes of garnet structure. Formation by simple overgrowth is thus ruled out. Further, smaller size of grains, observed gradation from rounded to skeletal textures, decreased garnet content in coal bearing middle part bounded by lower and upper part of Barakar Formation containing unetched garnets, suggests that facets are the result of chemical etching during burial diagenesis (Rahmani, 1973 and Morton, 1979), Similar types of faceted garnets were described by Hansley (1987) from Morrison Formation of New Mexico which were considered to be formed by etching due to organic acids generated during the maturation of organic matter (predominantly Type-Ill Kerogen). This hypothesis is corroborated by experiments in which dicarboxylic acid solutions created facets on the garnet identical to those developed on naturally etched ones. The structure of the dicarboxylic acid anions and their presence in Type-Ill Kerogen make them a strong candidate for causing etching in rocks containing terrestrial organic matter. Based on aforesaid characteristics, it is inferred that the observed faceted garnets from coal bearing middle part of Barakar Formation arc formed due to etching by dicarboxylic acid generated during the burial diagenesis of Barakar sediments.

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