## SHORTER COMMUNICATIONS

# ON THE OCCURRENCE OF GARNET IN CHARNOCKITE

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In some papers dealing with charnockites which have appeared in recent years, statements have been made which give the impression that Holland failed to appreciate the importance of garnet in charnockite, as well as to recognise the common occurrence of this mineral in the members of his 'Charnockite Series'.

While it is true that work done in many parts of the world has greatly increased our present day knowledge of these interesting rocks, and ideas on the origin of charnockites have departed considerably from those expressed by Holland, it must be stated that his unique position as a laboratory worker and field geologist remains unassailable. It is with some concern, therefore, that one reads views such as "Holland (1900) made no mention of garnet in his list of characteristic constituents or in the detailed petrography of charnockite although he briefly described the occurrence of garnet in some basic rocks of the series and in garnetiferous leptynite' (Howie and Subramaniam, 1957, p. 565; Howie, 1964, pp. 629-630). Such statements are surprising because Holland did consider garnet as a mineral which was very common in the members of his charnockite series. In fact, the section on 'Characteristic Constituents' in Holland's classic Memoir on charnockites, commences with the sentence 'Besides *hypersthene*, which is an invariable constituent, and *garnet*, which is extremely common. . .' (Holland, 1900, p. 125).

It must be remembered that when Holland wrote his Memoir, he was of the opinion that the charnockite series was an igneous series the constituent members of which had crystallised from a magma. He did not consider garnet as a primary mineral in this sense, but described it as a secondary mineral derived from pyroxene as the result of metamorphism and he has made his meaning clear in many places in his writings (Holland, 1896, p. 21; 1900, pp. 125, 141, 147; 1901, p. 126). It is because of the belief in the igneous origin of the charnockites that, while illustrating thin sections of type rocks belonging to the acid, intermediate, basic, and ultrabasic divisions in his Memoir, Holland (1900, Plate VII, Figs. 1-4) has selected slices which do not contain garnet; whereas, as an illustration of secondary alteration, he figures a thin section containing garnet (Plate VIII, Fig. 6).

According to Holland (1900, p. 125), granulitic structure and presence of rhombic pyroxene are constant characters in what he regarded as the unaltered forms of the rocks, but in those which showed a clearly defined gneissose structure by linear arrangement of the minerals, 'signs of dynamo-metamorphism are sometimes displayed, and *pink garnets* almost invariably appear'.

Holland (1900, p. 141) did not notice garnet in the unaltered type mass near St. Thomas Mount but reports that this mineral is an invariable constituent of the varieties which have suffered from marked dynamo-metamorphism. He did find garnets in the uncrushed varieties in the neighbourhood of Salem (Holland, 1901, p. 146) as well as near Madras (1900, p. 196), and he considered such garnets as having formed as the result of 'metachemic alteration of the proxenes at a high temperature short of actual fusion'.

Subramaniam (1962, p. 30) states that 'the occurrence of garnet in charnockite was recorded by Holland but was unfortunately not mentioned in his Memoir'. On the other hand, this is what Holland (1900, p. 133) has said, 'The acid division is represented by *charnockite*, a hypersthene granite.... The garnetiferous forms resemble *leptynites* in composition'. Again, in the 'acid exposures' near Pallavaram, 'garnets appear in a rock which only differs from the charnockite in being crushed'. (Holland, 1900, p. 143). In all such cases, the distinction is made between what Holland considers as the unmetamorphosed acid charnockite which is devoid of garnet, and the garnetiferous leptynite which, according to him, is only a metamorphosed charnockite.

In describing the rocks of his intermediate division, Holland specifically states that 'the garnetiferous varieties are not taken into consideration as they nearly always show signs of having suffered from dynamo-metamorphism, and I regard the garnet as a secondary constituent'. (Holland, 1900, p. 147).

Holland finds garnet 'abundantly' in the rocks of his basic division. According to him, the reaction borders which are frequently found between the pyroxene and garnet afford 'most decisive evidence in favour of regarding the garnets as secondary in origin and derived from the pyroxene which was amongst the original constituents of the rock . . . I find it necessary to consider the garnets of secondary origin in all the pyroxenic rocks which I have so far studied in India' (Holland, 1896, p. 21). Holland describes several basic types rich in garnet in the neighbourhood of Salem, and opines that the garnet was produced from the pyroxene (Holland, 1900, pp. 160-161).

In the charnockites in the neighbourhood of Salem, Holland (1901, pp. 126, 146) reports that the garnets are found plentifully, and that there are many features in the garnetiferous basic members which indicate that 'the garnets are not simple primary constituents', and that in many cases 'there is no possible doubt about the garnets being of secondary origin'.

The statement by Howie and Subramaniam (1957, p. 566) that 'an examination of the paratype, the tombstone of Job Charnock in St. John's Churchyard, Calcutta, reveals that it itself contains easily discernible red garnets', gives the suggestion that Holland was not aware of this fact. On the other hand, in describing the petrology of Charnock's tombstone, Holland (1893, pp. 162-164) has recorded the occurrence of almandine garnet both in hand-specimen and under the microscope.

The most surprising statement, however, comes from Turner (1968, pp. 333-334) who, while dealing with the charnockite series of Madras, lists the essential mineral assemblages in the acid, intermediate, basic, and ultrabasic divisions, and concludes with the observation, 'noteworthy is the absence of garnet from all assemblages'.

The incidence of garnet in charnockites varies widely. While in some localities the whole rock is studded plentifully with this mineral, in others they are scarcely visible, if not totally absent. Howie and Subramaniam (1957, p. 582) and Howie (1964, p. 630) have shown that the presence or absence of garnet in charnockite is controlled only by the bulk chemistry of the rock. Hence, in a polymetamorphic complex such as the charnockites where there are variations in chemical composition, one should expect non-uniformity in the distribution of the mineral garnet, a fact which Holland was fully aware of when he wrote his classical papers on the charnockites occurring in Madras State.


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# ON THE CHAREOTA WINDOW STRUCTURE, DISTRICT MAHASU, HIMACHAL PRADESH


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*Introduction:* The tectonic history of the Himalayan and Trans-Himalayan zones is rather complex but fascinating. Much work has been done on the structure and tectonics of the Himalayan zone. Wadia (1938), Heim and Gansser (1939), Krishnaswamy and Swaminath (1965), Pande (1966), Pande and Saxena (1968), Fuchs (1968) have thrown light on the structure and tectonics of the Himalayan mountain range. The structure of the Himalayan zone is characterized by folds and dislocations. The Himalayas have been divided into (1) Siwalik Range (foot-hills); (2) Outer Lesser Himalaya; (3) Inner Lesser Himalaya and (4) Central Crystalline Axis and Trans-Himalayan Zone. These zones differ from one another in lithology, grade of metamorphism, structure and tectonics (Pande and Saxena, 1968). The Lesser Himalayas throughout its length is characterized by nappe structures. The older crystalline rocks (Jutoghs & Chails) are thrust over less metamorphosed younger rocks (Simla, Jaunsars, Blainis, Krols, etc.). The Simla formations form 'décollément' over which older crystalline rocks have moved and formed nappes.

The present structures of the Himalaya are characterized by tectonic windows and 'Klippes' which are in part the result of various cycles of erosion.

In Simla region, West (1939) demonstrated the occurrence of 'Shali Window'. Subsequently, Auden (1946, 1951) and Berthelsen (1951, 1953) also described similar tectonic structures from the different parts of the Himalaya. The Chareota area which lies between Nirath and Luhri is characterized by a typical nappe structure.