Stratigraphic sequence in the southern part of Balladilla Range, Dist. Bastar (M.P.)

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Abstract

Excavations made in connection with mine development in Balladilla Iron Ore Deposit No. 5 and surrounding areas have provided valuable information about the geology of this region. On this basis, an attempt has been made to evolve the stratigraphic sequence in the southern part of the Balladilla Range in Bastar District of M.P. In the opinion of the authors Loa conglomerate placed at the base of Balladilla Iron Ore Series (Group) by Crookshank should be placed in the middle. Some of the rock units placed in the so-called Loa Stage are considered by the authors to belong to Balladilla Iron Ore Group.

Introduction:

The only authentic account of the geology of Balladilla Iron Ore Range and its surrounding areas till date is that given by Crookshank (1963).

Geological work in Balladilla region is particularly difficult owing to contrasting topography, thick vegetation and a generally ubiquitous cap of laterite. Geological features are concealed for most part. Small sporadic outcrops usually present only fragmentary information. Against this background, excavations made by NMDC Ltd. and other agencies in connection with the development of the iron ore projects and other allied works have provided valuable information about the geology of this area (Figs. 1 & 2). Information has been collected largely from a tunnel driven by
the NMDC through the eastern ridge of Bailadila Range in addition to road cuttings, foundation excavations, several pits and other small excavations. Surface observations have been made in the part of the range between Loa village (18°38'24", 81°11'6") in the south to approximately 2 km north of Bailadila Guest House (18°44'24", 81°13'27"). Some studies have also been made near Deposit No. 1 and Jhirka Gorge (18°50', 81°14'40") in order to examine the northward continuity of the features observed.

Geology:

On the basis of the observations made, the following stratigraphic sequence for the area has been worked out:

**Upper Sub-group**

8. BHQ & Haematite Iron Ore.
7. Soft ferruginous tuffaceous shale
   -- (Dolerite (?))
6. Conglomerate.
5. Interlaminated chert and tuffaceous shale/ slate of various shades including banded ferruginous chert locally enriched to small haematite iron ore bodies.
4. Banded ferruginous silt-stone intercalated with slate and phyllite of various shades and occasional lenses of arkosic quartzite.
3. Arkosic quartzite.
2. Green, red, pink & buff tuff with some chert bands
   -- -- -- -- --
   (Dolerite (?))
1. Quartz-sericite schist, quartz-biotite schist, quartz-chlorite schist & quartz-amphibole rock.

**Lower Sub-group**

5C - banded ferruginous chert with little intercalated ferruginous phyllite.
5B - pink, white (or cream) and black slate/phyllite intercalated with chert with occasional lenses of banded ferruginous chert.
5A - pink, black, green and white slate and phyllite, sometimes micaceous.

The rocks are isoclinally folded with a N-S to NE-SW strike and easterly dip. Two sets of superimposed folds, apparently conjugate sets, are present.

Bailadila range is constituted by two parallel N-S trending ridges both of which meet at about 5 km north of Jhirka Gorge. The top of both the ridges is occupied by BHQ & iron ore. According to the map prepared by Crookshank, these two bands of BHQ meet at the same point where the two ridges meet. These two bands have also been assumed to be one and the same from the stratigraphic point of view. The eastern slope of the eastern ridge depicts the complete sequence from units 2 to 5. The sequence crops out along the roads from Deposit No. 5 to Bacheli (18°42', 81°15'10") and Bhansi (18°47'40", 81°6'40") and the float ore roads near Bacheli. The intervening area shows sporadic outcrops, but it is only in the road cuttings that the complete relationship is exposed. Further sub-division of the units mentioned are also possible. Underlying the BHQ, iron ore and ferruginous shale (unit 7 & 8) at the top of the eastern ridge is unit No. 5, the following sub-divisions of which are exposed along the Bacheli-Hilltop roads.

5C - banded ferruginous chert with little intercalated ferruginous phyllite.
5B - pink, white (or cream) and black slate/phyllite intercalated with chert with occasional lenses of banded ferruginous chert.
5A - pink, black, green and white slate and phyllite, sometimes micaceous.
This sub-sequence is less clearly developed along the Bhansi-Deposit No. 5 road, but a general preponderance of banded Fe-chert near the contact with BHQ and of slate/shale further downwards is distinctly observed. The shale/shale formations are distinctly tuffaceous and in outcrop along the Bhansi-Hilltop road small bands rich in pseudomorphs of ampoibole are noted.

Quartzite:

The arkosic quartzite unit is a persistent band in this region and can be traced for long distances. Interestingly, however, continuity of this unit on the other side of the ridge or within the tunnel due to folding is not observed. This unit is therefore assumed to have pinched in the dip direction even though it shows good persistence along the strike.

Underlying the arkosic quartzite unit is a thin band (a few metres) of a phyllic conglomeratic rock consisting of pebbles of chert and quartz-chlorite-amphibole rock within a green phyllitic mass. This rock is observed both along the Bacheli and Bhansi roads and may be continuous between the two.

Underlying the arkosic quartzite and the conglomeratic rock is a soft pink or buff coloured tuffaceous rock, which, near the surface, is usually highly weathered. Chert bands within this area are present but not very common.

Outcrops of quartz-amphibole rock and quartz-chlorite-amphibole schist are observed within the plain area at Bacheli, Bansi and further eastward. These rocks have also been intersected in the few boreholes drilled at the railway yard and the tailings dam site near Bacheli. The rock generally consists of plenty of quartz and green chlorite with thin slender prisms of colourless or pale green amphibole (actinolite). Within the area occupied by this rock type, some sporadic outcrops of very coarse-grained amphibole rock with large crystals of dark green hornblende is observed. Field and laboratory studies suggest that this is a hybrid rock formed by profuse introduction of green hornblende within the quartz-chlorite-amphibole rock. Any igneous intrusive which might have acted as a source to this rock is not seen within the present area.
Occurrence of quartz sericite schist and quartz-chlorite schist are observed near Jhirka Gorge where they seem to underlie the quartz-amphibole rock. There are some occurrences of quartz-mica schist near Bhansi, but their exact relationship with the quartz-amphibole rock is not clear owing to paucity of outcrops. The quartz-muscovite schist, occurring to the north of Bhansi contain, as per Crookshank, crystals of andalusite.

Absence of any excavation has precluded the observation of the complete lithological sequence on the western flank of the western ridge. However, the types present are quite similar to those on the eastern ridge. Unit 2 seems to be absent here. Unit No. 3 is represented by a white saccharoidal quartzite. Unit No. 4 has developed only in the south-western part and at Balu Meta and unit 5 is represented by red and pink tuffaceous shale/slate for the most part except at Balu Meta where carbonaceous types are also present. In this flank the quartz-amphibole rock seems to underlie the quartz-chlorite and the quartz-sericite schist.

Within the tunnel cut through the Eastern ridge, both the quartz-chlorite amphibole rock and the hybrid amphibole rock with large crystals of hornblende are observed. A variant of this rock is quartz-chlorite-biotite schist. Unit No. 2 is represented within the tunnel as green tuff and red tuff. The former is constituted by small clastic grains of quartz and small flakes of chlorite and some biotite. The masking effect of iron-oxide makes it difficult to determine the mineral composition of the latter. The two types occur in intimate association with occasional chert bands and sometimes a few bands of carbonaceous slate.

Units 3 & 4 are absent within the tunnel while unit 5 is represented by chert bands with soft clayey shale varying in colour from white to buff, red (ferruginous), black (carbonaceous) and green (chloritic). Lenses of banded ferruginous chert are common within this unit. This unit shows similar characteristics at the top and on the western slope of the eastern ridge. It is interesting to note that distinctly clastic formations (units 3 & 4) are present only at the foot of the eastern slope. Further, unit 5 on the eastern slope contains a greater proportion of clastic quartz than within the tunnel or on the western slope.

**Conglomerate:**

The most interesting formation of this area is the conglomerate. Described by Crookshank as unique in Southern Bastar region, this unit pinches near the culvert over Galli Nala on Bacheli-Hilltop road and occupies the entire valley widening southwards and also a large part of the eastern slope of the western ridge. In hand specimens, the matrix appears to be compact gritty varying in grain size to nearly shaly at places. The pebbles are generally of two types. The first type consists of pebbles of quartzite varying in colour from white to grey. These pebbles are well rounded and of large size (usually 5 cm or more and occasionally 20-25 cm). Chloritic quartzite pebbles also are present. The other type is usually subangular to subrounded pebbles of relatively small size, but occasionally also reaching larger sizes. These are pebbles of chert, banded ferruginous chert, ferruginous chert, haematite quartzite, green chloritic rock, quartz chlorite rock, red tuffaceous shale, grey carbonaceous or buff or brown tuffaceous clay, arkosic quartzite, banded ferruginous siltstone, phyllite and slate of various shades and rarely quartzose amphibolitic rock. A few pebbles of granite have also been found. These pebbles are very similar to most of the lithologic types occurring below the conglomerate in the above sequence and are probably derived from them. Pebbles of red tuff and red phylite are sometimes found in sizes as large as 30 cm and are well rounded. Well rounding of these
pebbles could be due to the soft nature of the rock, while the larger sizes suggest proximity of the source. Thin sections of the matrix have shown subrounded grains of quartz (sandy) and cherty rock fragments bounded by chloritic and ferruginous cement.

The stratigraphic relationship of conglomerate with respect to units 1 to 5 are established on the basis of pebbles contained within the conglomerates. In the western ridge boreholes drilled in the iron ore deposits and for foundations testing for crushing plant and a few other stray boreholes have established the stratigraphic relationship between units 8, 7 & 6. In the eastern flank of the ridge relationship between units 3, 4, 5 & 8 are established on the basis of general disposition of the formations, current bedding within arkosic quartzite and data from boreholes along tunnel alignment and within the tunnel. It is to be noted that unit 7 rests directly and conformably on 5 in this flank while in the western ridge and the valley unit 6 comes in between indicating a local unconformity.

Pebbles looking like BHQ within conglomerate have suggested to some workers (personal communication) that the conglomerate is youngest formation of the region. A similar problem was faced by Crookshank also. He however discounted this probability by suggesting that there might be some older BHQ also. To the author, however, the so called BHQ pebbles appear to be derivation of BFC.

Two occurrences of dolerite have been noted, one near Dhurli village (18°46'30", 81°17'30") intersecting the quartz amphibole rock and another in an excavation near Deposit No.5 where they have intersected the conglomerate. The two rocks look quite similar under the microscope. It is not clear whether they are one and the same. No other occurrence of similar intrusive has been observed within the area.

Discussion

The above sequence marks a differences from that suggested by Crookshank. Within the area concerned, according to Crookshank, the Bengal series is represented by Loa Stage at the top of which the conglomerates have been placed. The Loa conglomerates are thus regarded as marking the boundary between Bengal and Bailadila Iron Ore series. In this area rock horizons above the white quartzite unit (=arkosic quartzite) in the eastern flank of the eastern ridge have been considered as belonging to Bailadila Iron Ore series. Rock units in the western flank of the same ridge have generally been included within Bengal series (Loa stage). The position of conglomerate has been reviewed and fixed by the authors in the sequence proposed by them on the basis of the evidence of pebbles contained in it. It is also observed that rock types at the eastern and western flanks of the eastern ridge are correlatable on the basis of lithological similarities. The authors therefore propose to include within the Bengal group, quartzose sedimentary units showing recrystallization due to low grade metamorphism represented by unit 1 placed at the bottom of the sequence. Rock types further above (with unit 3 and part of 4) are generally tuffaceous and unrecrystallized except locally, these types are taken to represent the Bailadila Iron Ore group. The upper and lower sub-groups are differentiated on the basis of the position of conglomerate and the general preponderance of iron oxide towards the top.

It will be seen that in this sequence two terms, banded haematite quartzite (BHQ) and banded ferruginous chert (BFC) have been used. These two types look very similar and could be mistaken as identical. It is therefore, necessary to mention the important points of difference in their characteristics. It however needs to be mentioned that compositionally both types are very much alike and the two terms have
been used only to indicate the existence of two similar but separate types. The main points of difference are:

1) Individual bands in BFC are usually wider than in BHQ. While laminae in BHQ are of the order of 1-2 mm, in BFC they are generally 5-10 mm thick.
2) Haematite rich and silica rich mesobands even though present in both, are more prolific in BHQ.
3) Individual bands whether haematite or silica are finer grained and more compact in BFC than in BHQ.
4) Soft sediment deformation, structures such as slumping, microfolds etc. are common in BHQ but rare in BFC. However, fracturing of individual laminae causing local small scale development of sedimentary breccia is fairly common within BFC.
5) BFC usually occurs as small lenticular bodies in close association with tuffaceous formations of various types. BHQ generally forms wide extensive bodies and shows association only with soft ferruginous shale (unit 7). Interbedding of BFC with amphibole bearing tuffaceous types are occasionally found. This has so far not been observed in BHQ.
6) A variant of BFC is massive haematite quartzite (without any banding). This type is absent within BHQ.

Acknowledgement: The authors admit their gratitude to their colleagues in the geological section of Bailadila Iron Ore Project, Deposit No. 5 namely Shri K. P. Talib and Shri N. C. Saraogi, whose works have provided many important and valuable data. The many useful discussions with Dr. Y. Sahasrabudhe, Shri B. M. Hukku, Shri P. M. Jalote, Shri K. V. Lokras and Shri V. Balachandran of Engineering Geology Section of G. S. I. are gratefully remembered. Lastly, the authors offer their thanks to the General Manager and Senior Mining Engineer of the project for having kindly accorded permission to carry out this work and publish this paper.

Reference


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