Global Journal of Science Frontier Research: H
Environment & Earth Science
Volume 15 Issue 4 Version 1.0 Year 2015
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Occurrence of Corundum Crystals in Conglomerate Beds of Bharweli Manganese Ore Belt (Madhya Pradesh), India

By F. N. Siddiquie & Kh. Burhamuddin
Aligarh Muslim University, India

Abstract- Bharweli mine is situated at 21^{0}50′N latitude and 81°14′E longitude. It lies within the Manganese belt of Madhya Pradesh and adjoining parts of Maharashtra andforms an East-West trending arcuate belt of 150 Kms long. It is enclosed within the metasedimentary sequence of Sausar Group of rocks belonging to Precambrian age. Regionally, it is situated in Mansar Formation and rocks comprise of quartzite, sericite schist, phyllite and conglomerate. It also has some carbonate associations, containing stratiform manganese ore comprising Braunite, Bixbyte, Hollandite, Hausmannite, Pyrolusite and Psilomelane which form the largest manganese reserves in India.

Keywords: *bharweli mine, sausar group, precambrian age, mansar formation, conglomerate, corundum, malegaonmagjin, balaghat district.*

GJSFR-H Classification : *FOR Code: 059999p*

Strictly as per the compliance and regulations of :

Occurrence of Corundum Crystals in Conglomerate Beds of Bharweli Manganese Ore Belt (Madhya Pradesh), India

F. N. Siddiquie [α] & Kh. Burhamuddin [σ]

Abstract- **Bharweli mine is situated at 21^{0}50′N latitude and 81°14′E longitude. It lies within the Manganese belt of Madhya Pradesh and adjoining parts of Maharashtra andforms an East-West trending arcuate belt of 150 Kms long. It is enclosed within the metasedimentary sequence of Sausar Group of rocks belonging to Precambrian age. Regionally, it is situated in Mansar Formation and rocks comprise of quartzite, sericite schist, phyllite and conglomerate. It also has some carbonate associations, containing stratiform manganese ore comprising Braunite, Bixbyte, Hollandite, Hausmannite, Pyrolusite and Psilomelane which form the largest manganese reserves in India. Conglomerates comprising the beautiful fairly coarse crystals of corundum (precious variety) mostly of almond size and deep violet in colour, concentrated at one place are encountered on the NNE flank of canal in Malegaon Magjinarea.**

Keywords: bharweli mine, sausar group, precambrian age, mansar formation, conglomerate, corundum, malegaonmagjin, balaghat district.

I. Introduction

The Madhya Pradesh manganese belt with adjoining parts of Maharashtra make an arcuate belt of about 150 kms long and 25 to 30 meters wide and extend in the East West direction from Chindwara district in the West through Nagpur and Northern Bhandara District in the middle of the Balaghat. The entire Belt is an integral part of the once thought oldest formations of central India, with gneissic intrusions. Balaghat mine is in Balaghat district of Madhya Pradesh and is about 210 Kms from Nagpur. It is situated at 21^{0}50′N latitude and 81°14′E longitude. The strike length of ore body is 2.8 kms having a NE–SW general strike direction and dip varies from 25^0 to 85^0 W. The width of the ore body is 1.0 meter at both ends where as it increases to 30 m in the central portion and hasan average thickness of 10 metres. The manganese Ore deposit occurs in lenses of varying sizes and in persistent beds of the lower part of the sequence of meta sedimentary rocks (metamorphosed sedimentary) of the Sausar Group of Pre-Cambrian age. These manganiferrous rocks are underlain by intensely metamorphosed ore and the Para gneisses which may or may not be a part of the lower Sausar Group. Granites, gneisses and pegmatites of Precambrian ages are allemplaced in the Sausar Group of rocks.

II. Geology of the Sausar Group

The manganese deposit of the Balaghat district, M.P., occurs as NNE–SSW to ENE-WSW trending conformable bands, enclosed within the metase dimentary sequence of Sausar Group of rocks of Precambrian age (Banerjee, D.C. et. al., 2007). On regional scale, the geology is represented by the Sausar Group of rocks of central India and has been dated by Rb–Sr methods on the Tirodi Gneiss as 1525 m.y. (Sarkar, et. al., 1986). In addition, U-Th-Pb methods on pegmatites (Holmes, 1955) and K-Ar methods on micas (Sarkar, et. al., 1981) yield close ages in the range of 1000 to 850 m.y. The Sausar Group comprising of quartzite, pellite and carbonate associations contain stratiform manganese deposits which isthe largest manganese resource in India (Dasgupta, et. al., 1984; Bhowmik, et. al., 1997). Structural studies on the Sausar Group have been carried out in detail by several workers (Straczek, et. al., 1956; Narayanaswamy, et. al., 1963; Basu and Sarkar, 1966).

The Sausar Group witnesses three phases of deformation and four phases of metamorphism, where metamorphism of this group of rocks was roughly synchronous with the various stages of deformation. The first phase of deformation produced isoclinal folds, axial plane schistosity and mineral lineation. The second phase of deformation generated super folds and crenulation cleavage while the third deformational phase formed open folds with steeply dipping axial planes (Sarkar, et. al., 1977). Different workers have given the stratigraphic sequence of Sausar Belt such as West (1936), Strackzec, et. al., (1956), Shukla and Anandalwar (1959), Narayanaswamy, et. al., (1963), Rao (1979) and Bandopadhyay, et. al., (1995). Because of lateral facies changes in the area, the sequence and the names of the formations differ slightly from place to place (Roy, 1973). Stratigraphic succession of the Sausar Group of Bastar Craton (Bandopadhyay, et. al., 1995), modified from Narayanaswamy et. al., (1963) is given in the table 1.

Author α: Associate Professor, Department of Geology, A. M. U., Aligarh (U.P.)
Author σ: Research Scholar, Department of Geology, A. M. U., Aligarh (U.P.) e-mail: fnaseem2000@yahoo.com

III. Regional Geology

The Bharweli manganese mine is situated in the Mansar Formationwhichis a thin sequence of muscovite schist, muscovite biotite schist, sericite schist and phyllites, commonly garnetiferous. These rocks contain much sillimanite in the rich grade zone of metamorphism, staurolite in the middle grade zone and sericite schist occurs in the low to high grade zone (16 to 20%) indicating that the source rocks were highly argillaceous. Conglomerates along with pebbly grits and quartzites with minor amounts of quartzite-sericite muscovite schist often feldspathoids are together grouped tentatively in the Mansar Formation. The conglomerates and the pebbly grits are the most prominent outcrops forming the bottommost members of the Sausar Group as seen in the area and are in contact with the granitic gneisses to the south and manganese horizon to the north and have varying thickness.

Table 1 : Stratigraphic succession of Sausar Group (Bandopadhyay, et. al., 1995, modified from Narayanaswamy, et. al., 1963)

FORMATION	LITHOLOGY
Bichua Formation	Dolomite, Marble, Calc silicate gneiss schist.
Junewani Formation	Metapelite (Mica Schist), Quartzite, granulite, biotite-Gneiss (Reworked basement).
Chorbaoli Formation	Quartzite, feldspathicSchists, Gneisses, Autoclastic Quartz, Conglomerate.
Mansar Formation	Metapelite (mica-schists and gneisses), graphitic Schists, Phyllite quartzite, major manganese deposits and gondite.
Lohangi Formation	Calc-Silicate Schists and gneisses, marble, Manganese deposits.
Sitasaongi Formation	Quartz mica Schists, Feldspathic Schists, mica gneiss, Quartzite, Conglomerate.
Tirodi Gneiss	Biotite gneiss, Amphibolite, Calc-Silicate Gneiss (Tirodi Gneiss), Granulites, Mica Feldspathic Schists.
.....	Unconformity.....
Older Metamorphics	Charnockite, Orthogneisses and Granite Biotite Gneisses, hornblende Gneisses, Amphibolites and calc granulites

The whole of this gritty formation as well as the gneisses at its contact show effects of intense crushing and mylonitisation and represent a thrust zone. The feldspathoids schistose pebbly grits grade into sericitic gneisses at places in the present study area. Rocks occurring below the manganese ore beds in this area consisting of conglomerates, pebbly grits and quartzites with minor amounts of quartz-sericite muscovite schist, often feldspathoids were grouped as Mansar Formation. The Bharweli outcrop above thementioned zone of conglomerates and pebbly grits is well developed in Bharweli, Malegaon and Langur areas. Thickness of this conglomerate and gritty zone at Bharweli is around 3 metres. The contact between the pebbly grits and the granitic gneisses on the hill slope, north-west of Malegaon, however runs almost North-South. The grit in the Bharweli ridge and in the Malegaon hills is feldspathic, sericitized and contains small rounded to sub rounded pebbles of quartz and fresh pink orthoclase, plagioclase and tourmaline, large microcline and albite. The grits usually grade downwards usually into coarser conglomerate with larger pebbles of quartzite and granite. Occasional pebbles of Iron-Ore (Specularite) are also found. At most of the places the conglomerate bed comprises of around 40-50 cm boulders of granites, gneisses and slates derived out of weathering of the local lithology. The dominant minerals of the boulders are quartz, orthoclase, plagioclase and tourmaline at some places.

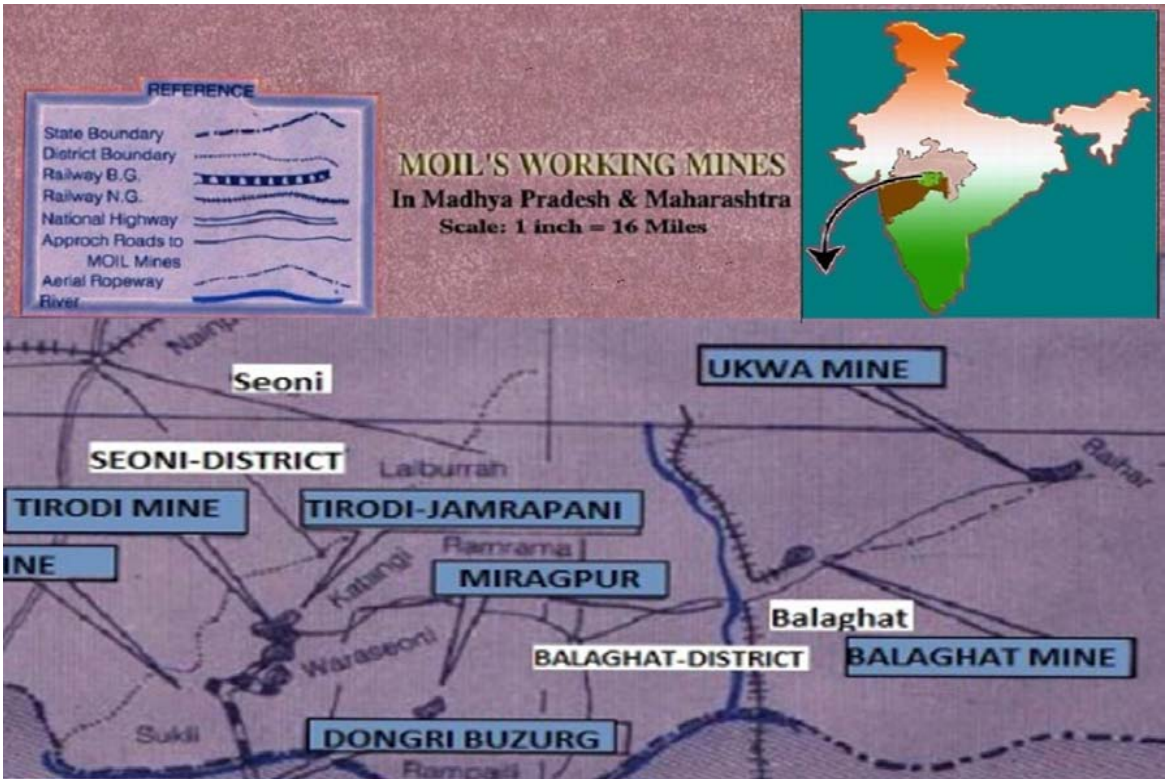
Table 2 : General stratigraphic sequence of central Belt, Sausar Group

WSW - ENE

		CHHINDWARA DISTRICT	NAGPUR DISTRICT		BHANDARA DISTRICT	BALAGHAT DISTRICT		
		GOWARI WADHONA MAHARKUMO AREA	GUMGAON RAMDONGRI JUNEWANI AREA	MANSAR KANDRI JUNEWANI AREA	CHIKLA SITASAONGI DONGRI BUZURG AREA	TIRODI SITAPATHORE AREA	RAMRAMA NETRA AREA	BHARWELI UKWA AREA
SAUSAR GROUP	BICHUA FORMATION / JUNEWANI FORMATION							
	CHORBAOLI FORMATION							
	MANSAR FORMATION							
	LOHANGI FORMATION / KADBIKHERA FORMATION							
	SITASAONGI FORMATION							
	TIRODI BIOTITE GNEISS FORMATION							

LEGEND

- BICHUA AND JUNEWANI FORMATION
- CHORBAOLI FORMATION
- MANSAR FORMATION
- LOHANGI AND KADBIKHERA FORMATION
- SITASAONGI FORMATION
- TIRODI BIOTITE GNEISS FORMATION
- MANGANESE ORE
- BEDS ABSENT



(Source: MOIL)

Figure 1 : Location Map of Manganese mines in the Balaghat District, M.P., India.

IV. Observation

The present field trip was interestingas fairly coarse crystals of corundum (precious variety) were encountered in the conglomerates of the Mansar Formation. The outcrops of conglomerate are fractured with parallel siliceous veins along the NNE flanks of the canal side of Bharweli (Figure 2 and 4). This fracture is tectonic and the veins are syntectonic and syn-depositional features. The crystals are mostly of almond size and deep violet in colour (Fig. 2 and 4) and concentrated at one place in the locality. The region requires further prospecting to evaluate the total resource. The corundum crystals are of pure variety and are of meta-sedimentary origin (Burhamuddin, et. al., 2013 and Siddiquie, 2010).

Figure 2 : Photograph showing Corundum crystals in the Conglomerate bed near Malegaon Magjin, Bharweli, Balaghat dist., M.P.

Figure 3 : Photograph showing Conglomerate near Malegaon Magjin, Bharweli , Balaghat dist., M.P.

Figure 4 : Photograph showing enlarged Corundum crystals in the Conglomerate bed near Malegaon Magjin, Bharweli, Balaghat dist., M.P.

V. Discussion and Conclusion

Narayanaswami et al. (1963) considered the Tirodi gneiss as the basement ofSausar Group. Although the contact between the Tirodi gneiss complex and the Sausar is mostly tectonized at most places, recently a polymictic conglomerate has been reported at the contact of Sausar and Tirodi gneiss from the locality of Mansar (Mohanty, 1993), confirming that the Tirodi gneiss is a basement to the Proterozoic Sausar Group.Both the Tirodi gneiss complex and the Sausar Group rocks are intruded by granite pegmatite and quartz veins of different generations (Siddiquie, 2004).PitchaiMuthu (1990) previously reported corundum-bearing sillimanite schists in the Mansar formation from the Tirodi area.

The lithological ensemble of the Bhandara-Balaghat granulite (BBG) domain is subdivided into 4 distinct components: (i) a large migmatitic felsic gneiss terrain, locally with garnet, (ii) enclaves or isolated bands of garnet-cordierite gneiss, BIF, quartzite, corundum-bearing and felsic granulite within the Tirodi gneisses, (iii) a mafic-ultramafic magmatic suite of metagabbro-metanorite and gabbro metanorite and metaorthopyroxenite, occurring as concordant sheets in the felsic gneisses, and (iv) metabasic dykes and amphibolites. The gabbroic suite of rocks is particularly dominant in the southern part of the BBG domain where it is interlayered with felsic and aluminusgranulites. By contrast, norites and meta-orthopyroxenites are quite common in the northern part where they are associated with garnet-cordierite gneiss (Sharma, R.S., 2009)

Coglomerates and pebbly grits are the most prominent outcrops forming the bottommost member of the Sausar Group in the Bharweli mine, which also shows effects of intense crushing and mylonitisation and represents a thrust zone. Conglomerate contains small rounded to sub rounded pebbles of quartz and fresh pink orthoclase, plagioclase and tourmaline, large microcline and albite (Siddiquie et. al., 2015).At most of the places the conglomerate bed comprises boulders (40-50 cm) of granites, gneisses and slates derived fromlocal lithology. The dominant minerals of the boulders are quartz, orthoclase, plagioclase and tourmaline at some places. Beautiful crystals of corundum are also seenin the conglomerates of the Mansar formation at one place. The crystals of corundum are ofalmond size and deep violet in colour, concentrated along the NNE flank of canal in Malegaon Magjin, Bharweli mine area.

VI. Acknowledgements

The authors are grateful to Prof. Abdul Munir, Dean, Faculty of Science, A.M.U., Aligarh, and Chairman, Department of Geology, A.M.U. for providing research facilities, to Dr. S.K. Sarkar, Geologists, Bharweli Mine and to Managing Director, MOIL, Kotla Road, Nagpur for allowing field visit and providing accommodation in the guest house of Bharweli mine, Balaghat district, M.P.

References Références Referencias

1. Bandyopadhyay, B.K., Abhinava Roy and Huin, A.K. (1995). Structure and Tectonics of a part of the Central Indian Shield. Mem.31, Geol. Soc. India, 443-467.
2. Banerjee, D.C., Mazumdar, S., Singhai, R.K., Shrivastava, R.K. and Fulmar, M. (2007). Manganese mineralisation associated with folded shear-zones in Balaghat District, Madhya Pradesh, Journal of Economic Geology and Georesource management, 4. (1-2), 128-141.
3. Basu, K.K., and Sarkar, S.N. (1966). Stratigraphy and structure of the Sausar series in the Mahuli-Ramtek-Junawani area, Nagpur District, Maharashtra. Geol., Min. Metall. Soc. India Quart. J., 38, 77-105.
4. Bhowmik, S.K., Pal, T., Roy, A., and Chatterjee, K.K. (1997). Penecontemporaneous deformation structures in relation to diagenesis of carbonate-hosted manganese ores: an example form polydeformed and metamorphosed Sausar belt. Indian mineral. 51, 149-164.
5. Burhamuddin, Kh., Siddiquie, F.N., Bhatt, S.H. and Jawed, T. (2013). Corundum crystals encountered in conglomerate beds of Bharweli Manganese Ore Belt (Madhya Pradesh), India. Paper presented at Emerging issues and challenges in petrology and Environment Geology, National Seminar at the Department of Geology, A.M.U. 57.
6. Dasgupta, S., Banerjee, H. and Majumdar, N. (1984). Contrasting trends of mineral reactions during progressive metamorphism in interbandedpellite-manganese oxide sequence: example from Precambrian Sausar Group, India. NeuesJahib. Fur mineral. Abhandlung, 150, 95-102.
7. Holmes, A. (1955). Dating the Precambrians of peninsular India and Ceylon. Geol. Assoc. Canada Proc., 7, 81-106.
8. Mohanty, S. (1993). Stratigraphic position of the Tirodi gneiss in the Precambrian terrain of central India: evidence from the Mansar area, Nagpur district, Maharashtra. J. Geol. Soc. India, 42, 55-60.
9. Narayanaswamy, S., Chakravarty, S.C., Vemban, N.A., Shukla, K.D., Subramanyam, M.R., Venkatesh, V., Rao, G.V., Anandalwar, M.A., and Nagarajalah, R.A. (1963). The geology and manganese ore deposits of the manganese belt in Madhya Pradesh and adjoining parts of Maharashtra; Part 1. General introduction. Geol. Surv. India Bull., Ser. A. 22 (1), 69.
10. PitchaiMuthu, R. (1990). The occurrence of gabbroic anorthosites in Makrohar area, Sidhi district, Madhya Pradesh. In: Precambrian of Central India. Geol. Surv. India Spl. Publ., Nagpur, vol.28, pp. 320-331.
11. Rao, G.V. (1979). The correlation of the Dongargarh, Chilpi and Sausar Groups. Geol. Surv. India Spec. Publ. 3, pp. 9-15.
12. Roy, S. (1973). Genetic studies on the Precambrian manganese formations of India with particular reference to the effects of metamorphism. In Genesis of Precambrian Iron and Manganese Deposits, UNESCO Earth Sci. Series, 9, 229-242.
13. Sarkar, S.N., Gautam, K.V.V.S., and Roy, S. (1977). Structural analysis of a part of the Sausar Group rocks in Chikla, Sitekere area, Bhandara District, Maharashtra. Geol. Soc. India Jour., Earth Sci., 18, 627-643.
14. Sarkar, S.N., Gopalan, K., and Trivedi, J.R. (1981). New data on the geochronology of the Precambrians of Bhandara-Drug, Central India. Ind. Jour. Earth Sci., 8, 131-151.
15. Sarkar, S.N., Trivedi, J.R., and Gopalan, K. (1986). Rb-Sr whole- rock and mineral isochron age of the Tirodi Gneiss, Sausar Group, Bhandara District, Maharashtra. Geol. Soc. India Jour., 27, 30-37.
16. Sharma, R.S. (2009). In Central Indian fold belts, Chapter 5, Cratons and Fold belts of India. Springer publ., 177-204
17. Shukla, K.D. and Anandalwar, M.A. (1973). Geology and manganese ore deposits of the Balaghat-Ukwa area, Balaghat district, Madhya Pradesh, Bulletins of G.S.I., Economic Geology, Series A (22), 1-65.
18. Siddiquie, F.N.(2004). Metallogenesis of Manganese ores of Srikakulam-Visakhapatnam belt, 213 p. Icon Publication Pvt. Ltd. New Delhi. (ISBN:81-88086-08-8).
19. Siddiquie, F.N. (2010). Petrographical Characters of some important host rocks in Vizianagram Manganese Ores Belt (A.P.), India. Journal of Science and Technology, University of Mauritius, Reduit, MAURITIUS. vol. 16.
20. Siddiquie F.N., Burhamuddin, Kh.,Shaif, Mohd. &Alam, Juned. (2015). Manganese Ore Minerals assemblages and Mineral Paragenesis with the help of Ore petrography and XRD Studies of Balaghat District, (M.P.) India. Global Journal of Science Frontier Research: H, Environment and Earth Science. 15(3) version 1.0, 21-34.
21. Straczek, J.A., Narayanaswami, S., Subramanyam, M.P., Shukla, K.D., Vemban, N.A., Chakravarty, S.C., and Venkatesh, V. (1956). Manganese ore deposits of Madhya Pradesh, India. 20thInernational Geol. Cong. Rept., Mexico, Symposium on Manganese, Part 4, 63-96.
22. West, W.D. (1936). Nappe structure in the Archaean rocks of the Nagpur district. Nat. inst. Sci. Ind. Trans. 1, 98-102.