

Role of Chromite Mineralisation in Orissa

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Chromium is one of modern industry's essential element. Its strategic importance is attributed to critical application in Defence, Aero-Space, and Aviation among others. Chromite is the only economic source of chromium and India has fairly large resources of this mineral mostly concentrated in the state of Orissa.

Introduction :

Chromite is the chief element for the production of stainless steel, refractory, ceramics, chemicals, electrode, fundry etc. It is the only economic source of chromium and Orissa has got large potential resource of this mineral. Chromite ore mostly consists of chromite with subordinate amounts of ferrichromite, magnetite, ilmenite and secondary silicates like serpentine, talc, tremolite, uvarovite and kammererite. Though the chromite grains are predominantly euhedral in nature, they exhibit two fold variations in physical, mineralogical and chemical characters which can be correlated with their formation at different stages during crystallization process. In this complex, chromites have crystallized in two stages. The chromites from two stages differ in these following aspects.

Geological Set Up :

Chromite deposit of Orissa region mainly occur as bands, lenses and pockets in the serpentinised dunite peridotite. The ultrabasin rocks are all of Precambrian age parallel or sub parallel to major tectonic zones of peninsular India and are intrusive into the pre-existing sediments and volcanics, subsequently regionally metamorphosed and tectonically deformed. The Sukinda ultramafic belt as well as igneous complex of Boula-Nuasahi are intrusive into the Precambrian metamorphites, namely the quartzites and quartz muscovite sericite schists. Both are well differentiated layered igneous complexes. Chromite deposits of Pre Cambrian (Iron Ore Group and Eastern Ghats) and Tertiary age are distributed in shield and tectonically mobile areas in India. Out of the 11 major chromite deposits distributed in 9 states of India, In Orissa, the two major deposits i. e. Sukinda Ultramafic Belt and Boula Nuasahi Igneous Complex hold around 98% of the total Indian reserve. Boula-Nuasahi Igneous complex consists of three rock units i e., the ultramafic rocks, mafic rocks and the felsic rocks. The ultramafic body, which hosts four chromite lodes, occurs as a dyke like pluton of 3 km long and 0.6 km width at the central part.

Besides chromite, the ultramafic-mafic rocks host PGE mineralisation along with sulphides (Cu-Ni-Fe-Ag).

The chromite bearing ultramafics of Sukinda area have intruded into the Precambrian metamorphites in the form of lopoliths. The intrusive has a width of 2-5 kilometers and extends for about 20 kilometers in an ENE-WNW direction from Kansa in the east to Maruabil and beyond in the west. The ultramafic body consists essentially of magnesite-rich dunite-peridotite with the chromite bands and subordinate amount of pyroxenite devoid of chromite mineralization. There are as many as six chromite seams, fairly thick and persistent both along strike direction of the intrusive and with depth as observed in the quarry and bore-hole sections from Saruabil in the east to Bhimtangar in the west. Further west at Kalarangi, Kathpal, Maruabil the chrome ore bodies do not exhibit any regular alignment, rather these are exposed in disjointed bands and lenses apparently disrupted by the emplacement of younger granite. The granite is exposed at several places around Maruabil and also encountered in the borehole sections at the western part of TISCO's quarry, Kalarangi and kathpal mines. Small exposures of diorite are found in kathpal and Bhimatangar. Besides, several dolerite dykes have intruded into the ultramafics, quartzites as well as the granites. This happens to be the last stage of igneous activity in this Precambrian terrain. Soil, alluvium and laterite of recent origin overlie ultramafics unconformably.

The area around Boula-Nuasahi consists of older quartzites which include massive, ferruginous and micaceous varieties. The intrusive into these Precambrian metasediments

are a suite of dunite-peridotite pyroxenite rocks with less magnesium and pronounced gabbroic differentiate, a younger granite and a still younger swarm of dolerite dykes.

The ultramafic body to the west of village Nuasahi extends for about 3 kilometers in a NNW-SSE direction from phuljhora Huli down to the village Jauthabahali. This is a dyke like steeply inclined body having distinct intrusive relationship with the older quartzite and epidiorite hills to the north. The ultramafic body has a maximum width of about one kilometer in the middle tapering gradually towards north and south and mainly consists of a serpentinised dunite peridotite core and a subordinate amount of pyroxenite, almost in bismalith form. The chromite bodies occur in the form of discontinuous bands and lenses, as well exposed in the mines at the central part and confined to the altered dunite peridotite. These bands have a NW-SE to NNW-SSE strike with moderate easterly dip and an average width of 5 meters¹.

Classification of Chromite Ore:

Chromite deposits have been classified broadly into two groups as stratiform and Alpine type. Stratiform deposits are sheet-like or lopolith in form, extend over large area and characterized by both rhythmic and cryptic layering, thickness of individual layers varying from a few centimeters to meters. This accounts for about 90% of the total chromite resources. The Alpine type deposits are characterized by irregular form such as pods or lenticular, limited extension, small reserve and high chromium content.

Depending on compositional variation, chrome ore can be divided into the following three categories:

Ore Type	% Cr ₂ O ₃	% Al ₂ O ₃	Cr:Fe
High Chromium	46-55	----	>2
High Iron	40-46	----	1.5-2
High Aluminium	32-38	22-34	2-2.5

Resources of high aluminum chromites are negligible. Orissa deposits are predominantly stratiform, high chromium and high iron types. Sukinda chromite is relatively rich in chromium and magnesium contents, does not exhibit pronounced variation in the spinel constituents of different horizons and invariably has Cr/Fe ratio of more than three.

Reserve and Grade :

The world resources of chrome ore are of order 7,500 million tones, of which Republic of South Africa and Zimbabwe account for 85% and 10% respectively. Although India with a resource of 186 million tonnes account for only 2.5% of world resources, chrome ores of Sukinda valley of Orissa State have a distinct edge over other major deposits of the world in terms of quality, large widths of ore bands and amenability to simple beneficiation process. Out of 186 million tones in India, Orissa accounts of 183 million tones i.e 98.39% and bulk of it are confined to Sukinda ultramafic belt.⁵

Mining :

Deposits of Chromite in Boula-Nuasahi area of Keonjhar district was discovered in 1942 and mining started from 1943. The area around Nuasahi lies at the south-eastern fringe of Boula state forest. About 70 Kms. south-west of Boula-Nuasahi lies the Chromite deposits of Sukinda Ultramafic belt of Jajpur-Dhenkanal district.

In Orissa eighteen leases have been granted for mining of chromite covering an area

of 78.39sq.kms. Of these fourteen are in operation. The leasees include TISCO, OMC, FACOR, ISPAT ALLOYS, IMFA, IDC, Mishrilal Mines, B.C Mohanty & sons etc. Except Kathpal mine of FACOR, all mines in Sukinda sector are open cast. The ore to overburden ratio ranges from 1t: 3m³ to 1t:20m³. Production of chromite in India during 2001-2002 is estimated to be 19.67 lakh tonnes out of which Orissa accounted for 19.47 lakh tonnes (99%) of total production.

Uses :

Chromite is the only Commercial ore mineral of chromium. Traditionally, chromium ores have been classified as metallurgical, chemical and refractory grades, according to the expected industrial end uses. However, recent technological advances have allowed some degree of interchange in the usage of these three product categories so that the classification has become less meaningful. Current nomenclature is based upon chromite composition in addition to end use. High-chromium ores, defined by high chromium-to-iron ratios, are used for making ferrochromium for metallurgical applications. High-iron chromites, previously limited almost entirely to the production of chromium-based chemicals, are now finding growing usage in the production of low-quality ferrochromium, refractories and foundry sands. High-aluminum chromites with relatively low iron and silica have application mainly for refractory purposes, primarily in the manufacture of magnesite-chromite and chromite-magnesite bricks³.

The principal use of chromium ferroalloys is in the production of stainless and specialty steels, such as heat-resistant and tool steels. Most applications of stainless and heat-

resistant steels or refractory metals are in corrosive environments such as petrochemical processing; in high-temperature environments, such as turbines and furnace parts; and in consumer goods, such as cutlery and decorative trim. Chromium is added to alloy and tool steels to increase their hardening ability and improve their mechanical properties such as yield strength. Super-alloys containing chromium has a high degree of resistance to oxidation and corrosion at elevated temperatures and is used in jet engines, gas turbines and chemical process equipment. Chromium-containing castings are usually used in high-temperature applications. The refractory industry uses chromite in the manufacture of refractory bricks, castables, mortars and ramming gun mixes. Refractories containing both chromite and magnesite are used in furnaces wherever basic slags and dust are encountered, such as in the ferrous and nonferrous metal industries. In the ferrous industry, a chromite-magnesite brick is used in electric arc furnaces, while basic oxygen furnaces, which operate at higher temperatures, require magnesite bricks. In general, refractory requirements in the steel industry have changed to a higher magnesite-content brick, thereby decreasing the consumption of chromite in this application. However, overall chromite refractory consumption in the steel industry is expected to stabilize in the next few years. In the nonferrous industry, chromite-magnesite bricks are used mainly in converters, while the glass industry uses a chromite-magnesite brick in the reheating chambers of glass furnaces. Most chromium chemicals are produced from sodium dichromate, which is manufactured directly from chemical-grade chromite. Chromium compounds are used as pigments, mordants and dyes in the textile industry; as

tanning agents for all types of leather; and for chromium electroplating, anodizing, etching and dipping. Chromium compounds are also used as oxidants and catalysts in the manufacture of various products such as saccharin; in the bleaching and purification of oils, fats and chemicals; and as agents to promote the water insolubility of various products such as glues, inks and gels².

Conclusion :

Orissa is endowed with vast mineral deposit of Chrome ore and hosts the largest chromite reserve of the country. Being a lion share holder of chrome ore in India, Orissa bears huge industrial potential in near future. This is one of the chief export items of the State due to which Orissa enjoys a strategic position in mineral trading in the country and has appeared on the investment map of India with a long list of investment proposals, largely backed by foreign investors due to this resource potential. As far as economic benefits of new investments and are concerned, the State government boasts that the new investments will spur growth which, in turn, will help in industrialization of the State.

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