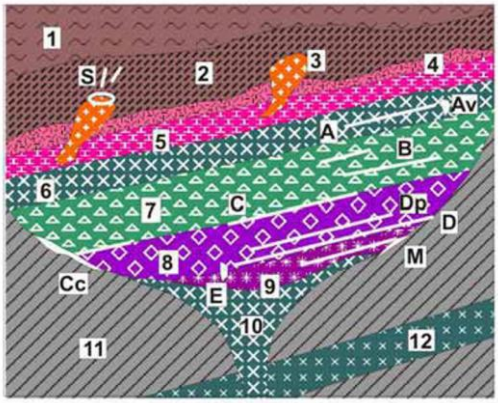
Dr. Dinesh Pandit, (M. Sc. Semester-II: Ore Geology, Course No GLM-205, Theory)

Chromite Deposits

Ore Mineralogy: Chromite (Cr_2O_3),
Ferro-chromite ($FeO.Cr_2O_3$),

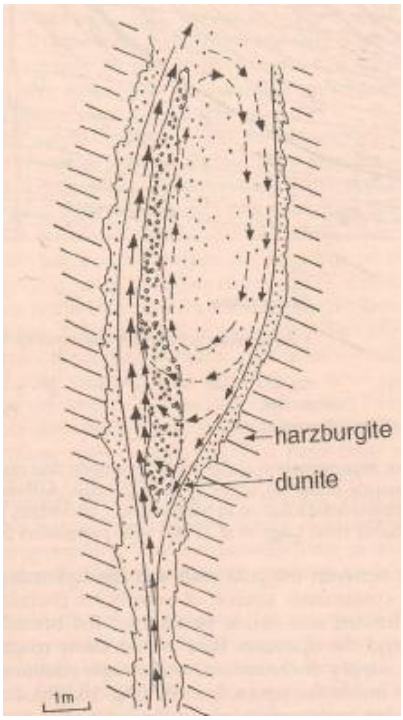
Chromite Metallogeny: The temporal distribution is equally distinctive with a bimodal pattern. Precambrian deposits (older than 2.5 – 2.0 Ga) are dominant in India, found in Orissa, Jharkhand, Karnataka, Andrha Pradesh and Maharashtra. Phanerozoic occurrences have been reported from Ladakh, Nagaland, Manipur, and Andaman and Nicobar Islands.

Chromite Ore: Types of Deposits:
A. Stratiform Chromite Ores/Layered/Banded
Example: – Bushveld type,
B. Podifrom Chromite Ores/Ophiolites complexes
Example:– Alpine type



1. Slate, phyllite; 2. Hornfelse sediments;
3. Anorogenic granite, 4. Felsite, rhyolite;
5. Granophyre, 6. Gabbro, diorite; 7. Anorthosite, ferrogabbro, norite; 8. Layered series; anorthosite, norite; 9. Ultramafics; 10. Chilled intrusive; 11. Basement rocks; 12. Gabbro dike;
A. Layered magnetite, ilmenite;
Av Discordant Fe-Ti-v pipes;
B. PGE in olivine-rich pegmatoid layers in anorthosite; C. PGE, NI, Cu in bronzitite in cyclic units; Cc. Ditto, hybrid contacts with PGE, Ni, Cu;
D. Chromite layers in ultramafic cyclic units;
Dp. High PGE in chromitite; E. PGE in dunitic pipes;
M. Ni, Cu, sulfides at basal contacts;
S. Hydrothermal Sn veins, disseminations, replacement.

Mode of Occurrences: Cr-ores in India occur mainly in two types of deposits:
1. Stratiform chromite ores: (i) layering of different scales and origins; (ii) repetitive occurrences of cyclothemic packages of lithic units and ores in the same order in all the cycle; (iii) compositional reversals where rocks become more primitive upwards; Stratiform chromite deposits are of great economic importance, yet their origin and evolution remain highly debated. Layered igneous intrusions such as the Bushveld, Great Dyke, Kemi, and Stillwater Complexes, provide opportunities for studying magmatic differentiation processes and assimilation within the crust, as well as related ore-deposit formation. Chromite-rich seams within layered intrusions host the majority of the world's chromium reserves and may contain significant platinum-group-element (PGE) mineralization. This model of stratiform chromite deposits is part of an effort by the U.S. Geological Survey's Mineral Resources Program to update existing models and develop new descriptive mineral deposit models to supplement previously published models for use in mineral-resource and mineral-environmental assessments. The model focuses on features that may be common to all stratiform chromite deposits as a way to gain insight into the processes that gave rise to their emplacement and to the significant economic resources contained in them.



2. Ophiolitic/podiform chromite deposits would explain the shape and discordant orientation of pods; the dunite 'halo' surrounding the pods; the dominantly nodular texture of the ores through collision and coalescence of grains in the convection circuit; post emplacement deformation and serpentinization would also account for several other attributes of the ore bodies such as folding, re-crystallization and peripheral iron-enrichment in chromite grains. The deposits are often associated with shear zones, formed in or around zones of weakness in preexisting chromitite bodies, and may themselves be displaced by faulting and intensely deformed by tectonic processes.

Origin of Chromite Ores / Genesis:
1. Stratiform Chromite Ores is formed by accumulation of settling chromite crystals on the solidified floor of any large body of magma undergoing in-situ fractional crystallization within the crust. Orthogenetic deposits result from a linear incremental (cumulative) increase of metals concentration and accumulation within a major rock forming system. The orebodies are an integral part of such a system, and external influences on the ore formation are absent or slight. An orthomagmatic deposits, such as the layered chormitite in the Bushveld complex or the Great Dyke, results from settling of cumulate phase minerals in a preferential location within the magmatic chamber. Existence of a suitable magmatic complex is thus paramount for the occurrence of this type of deposits.

2. Podiform chromite ores: There are three types of hypothesis for the origin of podiform chromite ores: (i) physico-chemical processes of concentration of chromite, unconstrained by any consideration of the tectonic setting; (ii) presuppose derivation of ophiolites from oceanic crusts generated at spreading centres; and (iii) ultramafic intrusive complexes whose ophiolitic ancestry can not be presumed/recognized. Opinion differ as to the origin of ophiolitic chromites.
Chromium enrichment of mantle peridotites in general and the refractory peridotite in particular is visually demonstrated by the presence of ubiquitous scattered chromite grains; they locally aggregate to form podiform chromite deposits. Origin of ophiolitic chromites is clearly synmagmatic. It assumed that chromite segregation in the mantle; followed by plastic deformation then dismemberment in a MORB conduit still within the mantle. The chromite in ophiolitic cumulates probably formed as chromite olivine cumulus in basaltic magma chambers, synchronous with MORB extrusions. Apparently the largest podiform chromite deposits as in the Zambales Range in Luzon and in Kempirsai district forme din the suprasubduction setting.

Chromite Ore Deposits of India:
Eastern India: Jojohatu in Singhbhum (Jharkhand), Sukinda-Katpal in Jajpur, Baula-Nausahi in Keonjhar (Odisha),
South India: Kondapalli in Krishan (Andhra Pradesh), Sittampundi in Salem (Tamil Nadu), Byrapur-Nuggihalli in Hassan (Karnataka),
Central India: Pauni-Kankauli-Bhandara in Ratnagiri (Maharashtra),
North India: Dras in Kargil, Ladakh (Jammu & Kashmir),
North-Eastern India: Sirohi-Tengopal in Ukhrul (Manipur), Nagaland, Andaman and Nicobar Island.

Uses of Chromium:
1. Chromite is mainly used in metallurgical, refractory, and chemical purposes.
2. The metallurgical uses in a variety of alloys, mainly with iron, nickel and cobalt.
3. Ferro-chrome of different types like high carbon and silico-chrome alloys.
4. Chromite is also used for manufacturing chemicals which in turn are used in pigment, leather and textile treatment, dyeing, bleaching and oxidising agents.

Reference Books:
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3. Stanton, R.L. (1972) Ore Petrology. McGraw Hill.
4. Mihir Deb and Sanjib Chandra Sarkar (2017) Minerals and Allied Natural Resources and their Sustainable Development: Principles, Perspectives with Emphasis on the Indian Scenario. Springer Geology

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