NOTES AND NEWS

Goldschmidt Conference 2009 at Davos

[Information on Indian chromites and associated PGE mineralization, presented at the Goldschmidt Conference, Davos by Sisir Mondal and his group should prove to be of interest – Ed.]

Origins of the magmas parental to the chromitites

Sisir K. Mondal

Major chromite deposits are genetically related to ultramafic-mafic magmatism that are restricted to specific period of time and have specific tectonic setting. For example (1) stratiform and discordant chromitites of sill-like ultramafic intrusions within greenstone belts are genetically linked to widespread komatiitic magmatism representing major crust building processes of Earth through Archaean; (2) stratiform chromitites of large layered intrusions of intracratonic rift settings representing widespread boninite-norite magmatism during the Neoarchaean-Palaeoproterozoic after the formation of a supercontinent and reflecting a period of global-scale mantle upwelling or enhanced plume activities and (3) stratiform and discordant chromitites of ophiolites are genetically linked to boninites of the convergent margin settings representing orogenies in Phanerozoic. The chemistry of chromitites of different tectonic settings strongly depends on parental melt compositions. Therefore, the process of magma generation is vital for the formation of the different types of chromite deposits in the Osmium and O isotopic studies of Archaean chromites within greenstone belts indicate that the parental magmas were crustally uncontaminated komatiite or boninite derived from the sub-continental lithospheric mantle (SCLM). In case of large layered intrusions e.g., the Bushveld complex, isotopic characters require that the parental noritic or boninitic magmas were contaminated in a lower staging chamber before emplacement into a shallow crustal chamber. Alternative theory is that the Bushveld magmas were derived from the convecting mantle and interacted with the overlying Kaapvall SCLM before emplacement into the crust. Geochemical characters of the boninites parental to the ophiolitic chromite deposits are thought to reflect incompatible trace element enrichment of a depleted upper mantle by a subduction-derived fluid or melt before remelting, typically at low pressure (<50 km) within supra-subduction zone settings.

Geochemistry of Mesoarchaean Sukinda chromite deposits (India): Implications for garbo-breccia hosted PGE mineralization

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Archaean granite-greenstone belts of the Singhbhum craton bear a continuous crustal evolution history from ~3.6 to 3.1 Ga. Within the Iron Ore Group greenstone belts 3.2 Ga ultramafic bodies are present in sill-like intrusions. Ultramafic bodies are cumulates from boninitic magma and in places associated with upper gabbroic intrusions. Dunite of the lower ultramafic unit hosts massive chromitite seams such as in Nuasahi and Sukinda areas of Orissa state. In Nuasahi area a magmatic-hydrothermal type PGE mineralizad gabbro-breccia is present in between the lower ultramafic and upper gabbroic units. Similar type of gabbro-breccia is found at the southwestern part of the Sukinda chromite belt (~35 km) named as Katpal breccia. In comparison with ultramafic (ΣPGE=10-71 ppb) and gabbroic rocks (ΣPGE=9-12 ppb), massive chromites of the Katpal breccia and from the main seams are enriched in total PGE concentrations (ΣPGE=20-221 ppb) which is similar to sulphide-poor samples of the Nuasahi breccia (ΣPGE=58-108 ppb). Gabbroic samples of the Katpal breccia display strong PGE (Pd, Pt, Rh) fractionated primitive mantle-normalized patterns (Pd/Ir=9-18) with depletion of Ni and IPGE (Ir, Os, Ru) which is due to early removal of the olivine and chromite. Massive chromitite of the Katpal breccia and from the main seams display IPGE fractionated patterns (Pd/Ir=0.1-1) with enrichment of Ru (Pd/Ru=0.03-0.3) and depletion of Ni and Cu indicating parental magma was S-undersaturated. All rocks from the Katpal breccia display negative Rb, Nb, Zr and Hf anomalies with subchondritic Nb/Ta ratios (3-6) that is similar to sulphide-poor samples of the Nuasahi breccia (2-6) and an evidence of metasomatism. The elevated PGE concentration in breccia is due to metasomatism of the ultramafic-chromitite fragments by fluid-rich evolved boninitic magma.