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

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Archean 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 as 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 mineralized gabbro-breccia is present in between the lower ultramafic and upper gabbroic units. Similar type of gabbro-breccia is found at the south-western 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 chromitites 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 PPGE (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 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.

Long-term analogue of carbonation in Travertine from Central Jordan

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Quaternary travertine in central Jordan covers hundred of square kilometers and is the product of hyperalkaline groundwater discharges. Most of the travertine are capping the metamorphic (cement) zones and are evidences for discharges of hyperalkaline ground waters in the past. Travertine indicates a wet pluvial period during the Peistocene time [1,2]. Stable isotopes (Fig. 1) are depleted from equilibrium values.

The travertine indicates a long-term analogue of carbonation and remobilization of silica in cementitious barriers for radioactive waste repositories. The presence of Cr-rich smectites and relatively high levels of U in the associated opaline silica may suggest the use of the travertine outcrops as analogues with repository disturbed zone. Smectites and silica phases are expected to be a sink for alteration products in the late stage evolution of high pH plume.

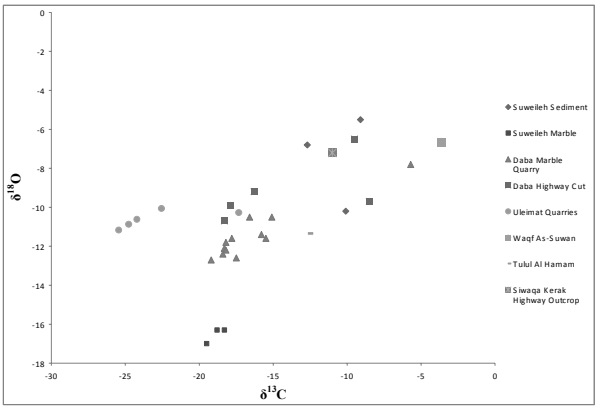

Figure 1.

[1] Clark *et al*. (1992) IAEA-SM- **319/6** 551-565 [2] Fourcade *et al*. (2007): *Applied Geochemistry*, **22**, 1293-1310.