Trace element geochemistry of Fe-Ti-oxides and sulfides from the Archean Mayurbhanj complex (eastern India)

CHIRASREE BHATTACHARJEE AND SISIR K. MONDAL

Department of Geological Sciences, Jadavpur University, Kolkata-700032, India (cbgeol18@gmail.com; sisir.mondal@gmail.com)

Archean Mayurbhanj complex in the Orissa state (eastern India) is comprised of gabbro, gabbroic anorthosite, and magnetitite bodies occuring at upper part. The mafic igneous complex is intruded by the 3.1 Ga granodioritic rocks. The gabbro has plagioclase (An_{26-69}), clinopyroxene ($En_{42-52}Fs_{4-36}Wo_{22-42}$) and orthopyroxene ($En_{67-81}Fs_{15-28}Wo_{4-5}$) as cumulus phases with Fe-Ti-oxides (magnetite: Fe_2O_3≈17–67 wt.%, FeO≈23–50 wt.%, TiO_2≈0.02-27 wt.%; ilmenite: TiO_2≈40-52 wt.%, FeO≈31-45 wt.%, Fe_2O_3≈1.4-28 wt%) and sulfides (pyrite, chalcopyrite and pyrrhotite) as disseminated phases. Two pyroxene thermometry from gabbro yields intital crystallisation temperature between 1199°C and 956°C. Sulfide minerals are commonly associated with magnetite-ilmenite assemblages in gabbro, and at places occur as inclusion within silicates. In magnetitite coarse-euhedral titanomagnetite is the major phase along with fine trellis lamellae of ilmenite. The magnetitite bodies are devoid of any sulfide mineralization. The co-existing magnetite-ilmenite pairs in gabbro and magnetitite yield 455°C-989°C temperature and fO_2 in the range of 10.5-28.3 indicating progressive cooling with sub-solidus re-equilibration, and reflects that these rocks have equilibrated at QFM±2. The gabbroic rocks of the igneous complex are however variably altered as indicated by the wide range of anorthite content ($An_{24.9-68.8}$) of plagioclase. In comparision with magnetitite ores the magnetite grains in association with sulfides from gabbro have relatively higher Ni (895-3868 ppm vs. 663-854 ppm), Mo (27-68 ppm vs. 14-37 ppm), Pb (2-10 ppm vs. 0.3-1.3 ppm) and lower V (≈3-3.5 wt.% vs. 4.94-6.49 wt.%), Sc (3.6-4.2 ppm vs. 47-81 ppm), Nb (up to 0.38 ppm vs 0.94-2.55 ppm) concentrations. Relatively higher Ni, Mo and Pb concentrations in magnetite and ilmenite from gabbroic rocks are due to the co-existing sulfides, whereas, relatively higher HFSEs in magnetite from magntitite ores are due to relatively higher oxygen fugacity of the evolved gabbroic magma. Highly variable concentration of chalcophile elements e.g., Ni (81 pmm to ≈2 wt.%), Co (40-7234 ppm), Cu (0.54-4610 ppm), Pb (7-2526 ppm), As (48-2175 ppm) in pyrite from gabbro indicate post-magmatic hydrothermal alteration of the initial magmatic-sulfide assemblages.