Trace element distribution between sphalerite and pyrite in Rajpura-Dariba SEDEX deposit, India

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Sphalerite and pyrite in the Rajpura-Dariba basemetal deposit of Northwestern India occur as (i) stratiform layers and (ii) remobilized discordant veins and patches in host calc-silicate and graphite mica schist (GMS). The stratiform fine-grained sphalerite is Fe-rich (up to 7 wt %) and contains sub-micron, oval to cubic pyrrhotite/pyrite grains, wherever recrystallized. Syn-metamorphic sulfide partial melting in Rajpura-Dariba resulted in co-precipitation of sphalerite and pyrite [1], observed as large cubic pyrite in Fe-poor (<1 wt%) sphalerite. Trace element contents in these co-existing sulfides were analyzed to understand their distribution/partitioning behavior during synsedimentary precipitation and metamorphic remobilization.

Synsedimentary and remobilized sphalerites do not show any remarkable compositional variation, suggesting its ability to retain trace elements during remobilization. Concentrations of certain trace elements (Fe, Mn, In, Ga, Mo and Au) in sphalerite were found to be host rock controlled, as opposed to others (Co, Ni, Cu, Ag, Sn, Sb, Tl and Pb). While Ga, Cd, Hg, Mn and Au partitions into sphalerite, Ge partitions into pyrite in such conditions. Mn, Cd, Hg and Fe in sphalerite occur in the structure and most likely directly replace Zn. Pb, Sb, Tl and Ag show positive correlation in all generations of sphalerite and pyrite, with higher concetrations in sphalerite. Correlated disontinuous variation in their time-resolved laser ablation profiles suggest occurrence as nanoparticles. Further, Ag shows moderate correlation with Cu in sphalerite, likely indicating occurrence of Ag as rhodostannite nanoinclusions, as evident from the positive Cu-Sn and Cu-Ag correlation.

Pyrite found in the stratiform layers are trace element rich, while those crystallizing from melt during sulfide remobilization are trace element poor (except Co and Ni). The correlated undulatory laser ablation profiles of majority of the trace elements in early pyrites indicate their occurrence as nanoparticles, mostly as sulfosalts and sulfides. Most of the trace elements in later pyrites were found to be below detection limits, displaying occasional ablation segments with high counts, thereby indicating ostwald ripening of nanoparticles in recrystallized pyrite and inclusion of sulfosalts/sulfides in pyrite crystallizing from melt.

[1] Pruseth *et al* (2014), *Ore Geol Rev* 60, 50-59.