# In-situ mantle sulfide geochemistry: a brief review and new perspectives

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*In-situ* techniques such as LA-ICP-MS, PIXE, at the end of the 90's, unfolded large platinum group elements (PGE) fractionations (e.g., 0.001<Pd/Ir< 1000) between different sulfide populations. Demonstrating that while the overall abundance of PGE was inherited from planetary scale events (i.e. core segregation, late veneer), the PGE pattern of individual samples was related to mantle processes (ie. melting, metasomatism). Despite the strongly compatible nature of PGE, their geochemistry is driven by the highly reactive behaviour of sulfide. Thus, sulfide geochemistry offers a different but complementary vision of mantle processes relative to silicate (e.g., cpx).

The development of Re-Os isotopic methods allowing to measure individual sulfide grains either by micro-chemistry or in-situ LA-MC-ICP-MS have also uncover an extreme isotopic variability in sulfides. Both unradiogenic Os compositions, indicative of ancient (up to ≈3.5 Ga) melting events, and radiogenic sulfides (long term high Re/Os) coexist at the micrometre scale within the same sample. These showed that (i) despite their highly reactive nature sulfides could preserve ancient information –confirmed by the preservation of Archean S-isotopic signature ($\Delta^{33}S \neq 0$); (ii) Sulfide Os model ages predate almost systematically whole rock model ages, which is often older than the oldest crustal age; (iii) these various sulfide populations where derived from very different reservoirs; and (iv) isotopic reservoirs could be micrometric in size. This last observation imply that the transfer of the Os isotopic signature to the melt will be incongruent.

Now, correlative in-situ geochemistry between SIMS (S-isotopes) and Laser Ablation Split Stream (LASS) system coupling MC-ICP-MS and ICP-MS [1] open the possibility to further constrain the origin of each individual sulfide grains in a rich and multidimensional geochemical matrix (trace elements, radiogenic and stable isotopes).

[1] Gréau, Alard & O'Reilly, (2019), *In-situ laser abalation split stream MC-ICPMS for simultaneous determination of Re-Os isotopes and siderophiles-chalcophile elements in sulfides*. **Goldschmidt 2019, session 03e**.