



ID de Contribution: 117

Type: Poster

Redox Transfer at Sub-Arc Mantle: Insights from Petrology and Transitional Metal Stable Isotope (Fe, Zn, Cu) Geochemistry of Orogenic Peridotites

jeudi 22 mai 2025 13:00 (15 minutes)

The mantle wedge above subduction zones is often considered more oxidized (i.e., exhibiting higher oxygen fugacity (fO_2)) than other mantle domains due to metasomatism by slab-derived fluids. Garnet peridotites from subduction zones, for instance, record oxygen fugacities that are 3–4 log units higher than those of garnet peridotite xenoliths from the sub-cratonic mantle. However, no direct link has yet been established between the fO_2 record and the transfer of redox-sensitive components (e.g., SO_4 , CO_2) from the subducted slab to the mantle wedge, and the fate of subducting oceanic lithosphere remains poorly constrained.

In this study, we undertake a detailed petrologic and geochemical characterization of garnet peridotites from Ulten zone and Adula-Cima-Lunga unit (Alpe Arami, Cima di Gagnone, and Monte Duria) that equilibrated at different P-T conditions. We present high precision in-situ synchrotron Mossbauer source Fe^{3+} measurements on major and metasomatic minerals (garnets, clinopyroxenes and amphiboles) in the peridotite samples. The results enable us to model the fO_2 record and constrain the redox reactions occurring during fluid/rock interactions in the context of subduction. Additionally, the trace element and non-traditional stable metal isotope (Fe, Zn & Cu) geochemistry data of the samples provide crucial clues regarding the transfer of redox sensitive elements in subduction zones, and also give more information on the geodynamic origin of the studied peridotites. Thus, we attempt to correlate the redox record of the sub-arc mantle, using Fe^{3+} measurements at the mineral scale, and whole-rock geochemical data, in order to characterize the relative effects of subduction-fluids on the composition and oxidation of the mantle wedge peridotites.

Speaker information

PhD 2nd year

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Classification de Session: Posters

Classification de thématique: Earth, Environment and Space Sciences: Geochemistry