Evolution of the Earth mantle and its possible interaction with core: view from olivine and its inclusions study

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The rate and style of mantle convection, as well as production and recycling of crust into the mantle, control the evolution of the Earth. Present knowledge of mantle evolution is mostly restricted to the Phanerozoic, for which fresh mantle-derived lavas and relevant geophysical data are available.
Information about the Precambrian mantle comes almost entirely from the compositions of altered rocks, which lack data on the contents of mobile and volatile elements and their isotopes. Such data are crucial for geodynamic reconstructions and understanding of surface rock recycling into the deep mantle. Fortunately, this information is preserved within inclusions of melt in relicts of olivine phenocrysts in komatiites.
In this presentation we will address the compositional evolution of the terrestrial mantle, from the Archean to the Phanerozoic, using compositions and temperatures of primary mantle-derived melts reconstructed from the study of melt inclusions and host olivine. We will report an extensive range of geochemical parameters, including mobile and volatile element (Pb, B, Rb, Ba, Sr, Cl, S, H2O, CO2) concentrations and isotopic compositions of H in homogenized melt inclusions and the elemental compositions of host olivines and inclusions of spinel. We will present data for komatiites and picrites that originated at different depths and cratons between 3.3 and 0.09 Ga. We will apply published and new models to constrain the temperatures and compositions of their mantle sources to relate our observations to the evolution of mantle convection and plate tectonics. We will, therefore, address the following issues: the rate of crustal growth and recycling through time; the timing of the onset of large-scale subduction and plate tectonics; the concentration and origin of H2O and halogens in the deep mantle, and the extent (if any) of core-mantle interaction.
We will present evidence of the significant excess of H2O and Cl in the mantle sources of komatiites and will show that hydrogen isotope composition of komatiites is significantly more depleted in deuterium than all surface reservoirs and typical mantle but resembles that in dehydrated subducted slabs. We will demonstrate temporal trends of Pb/Ce and oxygen fugacity of primary komatiite melts.
Our results suggest that lithosphere recycling into the deep mantle, arguably via subduction, started before 3.3 Ga and interaction of mantle and core probably took place all this time.

