High-grade sperrylite zone reveals primitive source in the Sudbury impact structure

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Earth's largest impact craters had transient craters that penetrated 30-40 km depth and collapsed to form ~200 km impact craters with perturbations of the Moho [1]. The Sudbury impact structure is the eroded remnant of a larger 150-200 km multi-ring crater and uniquely revealing at present-day surface the crustal impact structures in the crater floor below the igneous complex [2].

The Paleoproterozoic Broken Hammer Cu-Ni-PGE deposit, is hosted by impact-induced pseudotachylitic breccias in the crater floor within Neoarchean gneiss and granites. A high-grade PGE-only zone is composed of major coarse epidote-quartz, minor chlorite-sperrylite-merenskyite, with sperrylite crystals up to 4 mm, and trace michenerite. Isolated sperrylite grains in epidote or quartz contain inclusions of gold, petzite, galena and aleskite, whereas complex intergrowths of Pd-, Bi- and Ag-tellurides are associated with specular hematite and cassiterite, suggesting high fO2 conditions. *in situ* trace element analyses of euhedral epidote and chlorite precipitated along growth zones in hydrothermal quartz reveal increasing Mg, Zn, Fe and Ni towards the rims. Late-stage Cpy-millerite penetrates the core of extensional epidote-quartz-sperrylite veins.

Early formed epidote that hosts coarse sperrylite analyzed by TIMS yielded a narrow range of low age corrected $^{86}Sr/^{86}Sr$ ratios from 0.705948 to 0.706457 with a primitive non-radiogenic source supporting a mantle origin [3,4]. This implies that initial impact destabilized the crust-mantle boundary resulting in rapid fluid-gas release and transport of precious metals from the mantle along deep-seated faults to the footwall environment of the SIC.

In situ LA-MC-ICP-MS Sr isotope analysis of epidote and calcite in early syn-PGE ore, later Ni-Cu and Cu-PGE vein ores and post-mineralization phases will be used to trace the evolution of fluids in the Sudbury crater.

[1] Christenson *et al* (2009), *EPSL*. 284, 249-257. [2] Ames *et al* (2008), *Econ. Geol*. **103**, 1057-1077. [3] Kerr and Hanley (2011) *Min. Mag*. **75**, 1174. [4] Hanley and Ames (2012) *PACROFI-XI,* **11**, 39-40.

Trace elements in olivine characterize the mantle source of subduction-related potassic magmas

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Trace elements in olivine have recently been shown to provide useful means to investigate the upper mantle, allowing identification of olivine-free (pyroxenitic) reservoirs in the source of OIBs [1]. But few studies are available of magmatic rocks at destructive plate margins [2]. Here we present the first comprehensive set of major and trace element analyses on olivine from subduction-related Plio-Quaternary magmatism of the Italian Peninsula.

16 rock samples covering the full compositional range from calc-alkaline to ultrapotassic occurring within the Italian magmatic region were selected for their primitive character (Mg# = 60-80) and the presence of olivine at the liquidus. 200 olivine crystals were analyzed for major and trace elements (Ca, Mn, Ni) using EPMA, and more than 100 have been analyzed for trace elements using LA ICP-MS.

Olivine phenocryst cores show a large compositional variability among the different magmatic suites. Olivine from the Lucanian region has the highest Na and Al, whereas most elements have lower concentrations compared to the other Italian regions and fall within typical mantle values. The olivine crystals from the lamproite-like samples (Tuscan Region) bear evidence of an olivine-depleted, pyroxenite-bearing source resulting from Si- and K-rich metasomatism of previously depleted mantle: the olivine crystals are remarkably enriched in Ni (up to 5,000 ppm) with high Cr and low Mn and Ca contents. Olivines from plagio-leucititic rocks of the Roman Region show trace element contents that differ from those of the lamproite-shoshonite suite (extremely low Ni, low Cr and elevated Mn and Ca). This could be explained by a metasomatic reaction in the presence of excess Ca. Li enrichment (up to tens of ppm) in olivine from the Tuscan and the Roman Province indicate the recycling of crustal material into the mantle wedge as a primary cause of the metasomatism [2].

[1] Sobolev *et al* (2005) *Nature* **434**, 590-597. [2] Prelević *et al* (2013) *Earth & Planet. Sci. Lett*. **362**, 187-197.

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