Carbonate inclusions in mantle olivines: Mantle carbonatite

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Primary igneous carbonate occurs as inclusions within xenocrystic olivines in a leucitite lava from the Calatrava Volcanic Province, Spain. All olivines in the lava show xenocrystic textures including embayments and reaction rims; olivine is not a cognate phase in the lava. Xenoliths of spinel lherzolite are also present, ranging up to several centimetres in diameter. They show pervasive reaction textures against the lava and along grain boundaries within the xenoliths. Xenocrystic olivines have Mg rich cores Fo_{86-88} with iron enriched rims Fo_{72-80}. Conversly olivines from the spinel lherzolites at Calatrava have $Fo_{90.4-90.5}$, which are typical of off-craton peridotite xenoliths [1].

Carbonate compositions typically are calcite, but minor element contents vary between inclusions; notably iron, magnesium and strontium (1-5wt%). Carbonate is never seen in isolation and is often associated with other mineral phases such as Cr-spinel, apatite, phlogopite, clinopyroxene and glass.

Texturally, carbonate inclusions are fresh, with occasional examples of recrystallised carbonate. The inclusions have globular profiles and range from 700-10µm in diameter, whereas host olivines on average measure 5mm in diameter. The inclusions are not the result of the cross sectioning of embayments as they do not show the iron enrichment typical of contact with the lava seen in the embayments. Inclusions also contain euhedral Cr-spinel whereas all groundmass spinel is titano-magnetite. Finally, carbonate is not present as a groundmass phase.

Carbonate inclusions were enclosed in olivines during their growth and as such represent fresh examples of carbonate and associated mineral phases crystallising under mantle conditions.

[1] Pearson, D.G. *et al*. (2005) Mantle sample included in volcanic rocks: Xenoliths and diamonds. Carlson, R. (ed) *Treatise on Geochemistry***.** Elseiver.

Uranium precipitation and fluid composition at Maureen U-Mo-F deposit, Australia

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The expected shortage of petroleum and the growing demand for energy has refuelled the interest in uranium resources and exploitation. Unconformity-related U deposits include the largest high grade U ore bodies world wide. They provide a major and poorly explored low-cost uranium resource. Most deposits are of Proterozoic age. The general formation model comprises mixing of oxidized U bearing fluids with reduced basement-derived fluids at the intersection of the unconformity with deep-rooted faults.

Maureen deposit is the largest of a series of U occurences along the unconformity between the Proterozoic Georgetown Inlier and the Late Palaeozoic Newcastle Range Volcanic Suite in Queensland, Australia. Insights into U transport and precipitation at Maureen are obtained by combining field observation, mineral geochemistry and LA-ICP-MS analysis of fluid inclusions from this young and well-preserved deposit.

The ore forms lenticular bodies preferably along east-west striking steep faults and spreads horizontally on top of basement highs. Devonian quartz conglomerates directly overlying the unconformity are preferentially mineralized. A halo of fluorite, chamosite and dickite surrounds the high grade U and Mo mineralized zones. The ore mineral assemblage comprises an Fe-bearing molybdenum sulfide, arsenian pyrite, arsenopyrite, anatase, goyazite, fluorite, and a sub-µm scale intergrowths of U and Ti oxides.

Reduced mineral assemblages and coexistence trails of intermediate-salinity two-phase fluid inclusions and carbonic vapors indicate interaction of two coeval fluids. Fluid inclusions in fluorite and quartz homogenize at 260 ± 40°C. LA-ICP-MS results from quartz-hosted inclusions show a covariation of U and Mo in the fluid at a 1:10 ratio, indicating U and Mo co-precipitation. Primary low-salinity fluid inclusions hosted by fluorite show U-Mo ratios close to 1, corresponding most closely to the U/Mo ratio in high grade ore and probably representing the parental ore fluid.