Abstract: Florence IGC 2004

Evidence for sulfide mobility in mantle fluids beneath eastern Australia: implications for the interpretation of mantle Re-Os ages.

William Powell, Suzanne O'Reilly

Keywords: mantle sulfide, mantle, peridotite, mantle metasomatism, sulfide Re-Os isotopes

Spinel lherzolite xenoliths from Tertiary basaltic host magmas have been used to characterise the composition, architecture and evolution of sub-continental lithospheric mantle beneath the New England Orogen, Eastern Australia. Studies of their detailed mineralogy and geochemical characteristics reveal regional variations in the degree of melt extraction and type and extent of metasomatism they record.

Spinel-lherzolite xenoliths from one of the localities represent two distinct populations on the basis of their microstructure, whole-rock and mineral major-element chemistry, and clinopyroxene trace-element chemistry. One group of xenoliths are granoblastic with no evidence of deformation; the other group is generally more coarse-grained with exsolution common in clinopyroxene and orthopyroxene and kink-banding in olivine. These coarse-grained xenoliths contain trails of small sulfide grains (< 10 μm) in the silicate phases along fracture planes. No such sulfide-bearing trails are found in the granoblastic xenoliths: instead sulfides are found as relatively large polymineralic aggregates (~ 100 μm across) within melt pockets interstitial to the silicate phases. These melt pockets have not been observed in the coarse-grained xenoliths. Equilibration temperatures calculated for the granoblastic xenoliths are lower than those of the coarse-grained samples, suggesting they represent a shallower mantle volume.

In addition to the sulfide patches, the melt pockets contain variable proportions of secondary olivine ± clinopyroxene, plagioclase, K-feldspar, Mg-rich carbonate, Ca-rich carbonate, glass, ilmenite, apatite, and a titanium and chrome-rich non-silicate phase (spinel?). Mg-carbonates are dolomitic suggesting a high-pressure origin. The melt pockets are interpreted to represent crystallised volatile-bearing melt rich in CO_2 which would be highly mobile at mantle pressure and temperature. The close association between the sulfides and the melt pockets indicates that sulfides can be highly mobile under some mantle conditions. This implies that pre-existing sulfides may be mobilised or deposited during metasomatic episodes, changing the abundance of chalcophile elements such as Re and Os (thus modifying the original age information from the Re-Os system). Any Re and Os data from mantle rocks needs to be interpreted within a detailed mineralogical context and knowledge of the nature of sulfides within the rock.