Re-Os isotopes in sulfides of mantle peridotites from SE China: Age constraints and evolution of lithospheric mantle

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Studies on mantle-derived xenoliths in basalts are very important for understanding the composition of the upper mantle and the processes that affect it. The Re-Os isotope system contrasts markedly with other commonly used geologic isotope systems such as Rb-Sr, Sm-Nd and U-Pb, and provides unique insights into mantle evolution including partial melting and metasomatic events. Sulfide phases dominate the Os budget in mantle-derived peridotites but may have different genesis. In-situ LAM-ICPMS analysis has the advantage of distinguishing different sulfides with different Os isotopes. Alard et al. (2000) demonstrated that interstitial distributed sulfides and those sulfides enclosed in olivine from the Massif Central mantle xenoliths have different ages.

We have studied a suite of mantle-derived peridotites from several disparate locations in SE China. In situ determination of Re-Os isotopes in single grains of sulfides in the peridotites using a laser ablation microprobe attached to a multicollector-induced coupled plasma mass spectrometer (MC-ICPMS) shows that the present–day Os isotopic compositions of sulfide in these peridotites vary over a wide range ($^{187}Os/^{188}Os$=0.11872 to 0.13800), but most of them have values close to that of chondrites (0.12705). Only those samples with $^{187}Os/^{188}Os$ values significantly different from the estimated chondrite $^{187}Os/^{188}Os$ value can give meaningful ages. Some of these give minimum ages (T_{RD}) that are late Proterozoic, and give T_{MA} ages that are also Proterozoic. One enclosed sulfide in olivine shows T_{RD} and T_{MA} ages of 1232 and 1347 Ma, but coexists with an interstitial sulfide showing T_{RD} and T_{MA} ages of 289 and 487 Ma, which suggests that a Proterozoic melting event in the lithospheric mantle was overprinted by a metasomatic event during Paleozoic time. Another sulfide shows T_{RD} and T_{MA} ages of 914 and 2732 Ma, which suggests that some relict Archean material still exists beneath the SE China region. Some sulfides have elevated $^{187}Os/^{188}Os$ ratios, which may be interpreted as the result of recent addition of radiogenic Os derived from older silicate phases with high Re/Os.

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Characteristics and evolution of ore-forming fluid in Dongguashan Copper Deposit, Anhui Province, China

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The Dongguashan Copper Deposit was formed by superimposing of Yanshanian magmatic hydrotherm. Based on the study on microthermetry, composition and C, H, O isotopes of fluid inclusion in the quartz phenocrysts in quartz diorite porphyry and fluid inclusion in skarn minerals, it is suggested that the ore-forming fluid of Dongguashan Copper Deposit is dominantly magmatic water with high tempreture, high salinity. During the mineralization stages, ore-forming fluid underwent two boiling events resulted from tectonic decompression. The first boiling event occurred during quartz-magnetite-epidote stage with temperature of 430~465°C, salinity of 7.9~53.7wt% NaCl equiv. and lithostatic pressure of 40Mpa, resulting in the formation of magnetite and quartz. The second one occurred in the main mineralization stage with tempreture of 340 to 389°C, salinity of 6.6~52.1wt.% NaCl equiv. and lithsatic pressure of 24.8MPa. In the later boiling event, the ore fluid was mixed with the cooler and more dilute meteoric water from the country rocks in the processes of convective upflow migration, which is showed by the chracteristics of C and O isotope composition of inclusion fluids. Both the boiling events triggered by the tectonic decompression are much favorable to the forming of the Dongguashan Copper deposit due to the drop of tempreture, pressure, sulfur fugacity and the increase of redox potential. Furthermore, it is also showed from the study of fluid inclusion in the quartz phenocrysts that fluid boiling occurred in the early skarn stage, but the relation to the mineralization is not sure now.

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