High pressure diffraction tomography technique for mineral physics reseraches

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The high-pressure behaviors for Olivine and selenium will be presented using synchrotron x-ray diffraction and micro-tomography techniques. The novel development for the combination of synchrotron x-ray microtomography and diffraction techniques in diamond anvil cell high-pressure conditions, which provides new insight for many mineral physics research, will be introduced. The phase transition procedure of iron was studied, and the 3-D distribution of low pressure and high-pressure phases at about 11 GPa was obtain. The deviatoric stress between the parent and new phases in the iron sample, as well as the phase transition mechanism will be discussed based on the 3 dimensional data. The potential application for the diffraction tomography development in diamond anvil cell to the mineral materials will be emphasized.

Comparative Sr-Nd-Pb-Hf-Os isotopic systematics of xenolithic peridotites from Yangyuan, North China Craton

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Trace element concentrations and Sr, Nd, Pb and Hf isotopic compositions were determined for clinopyroxenes separated from 11 well-characterized spinel peridotites, carried in the ~30 Ma Yangyuan alkali basalts from the central region of the North China Craton. Our objective was to use these isotope tracers to determine the history of initial melt depletion and later metasomatic enrichment of incompatible trace elements in the mantle. Clinopyroxenes were selected from samples for which whole-rock Re-Os isotopic compositions were previously determined, and to span a wide range of rare earth element (REE) patterns (chondrite-normalized $(La/Yb)_N$ = 0.13 to 13.5). Present-day isotopic ratios are $^{87}Sr/^{86}Sr$ = 0.70229-0.70443, ε_{Nd} = -0.6 to +24, $^{206}Pb/^{204}Pb$ = 15.74-19.08, and ε_{Hf} = +13.5 to +167). Some peridotites retain original ancient melt depletion signatures characterized by prominent depletions of light REE (LREE) relative to heavy REE and highly radiogenic Nd (ε_{Nd} up to +24) and Hf (ε_{Hf} up to +167) isotopic compositions, and very non-radiogenic Pb isotopic compositions ($^{206}Pb/^{204}Pb$ as low as 15.74). Ancient metasomatism may have occurred in a few samples, given their elevated LREE, Paleoproterozoic Nd model ages and non-radiogenic Pb isotopic compositions that, on a $^{206}Pb/^{204}Pb$ vs. $^{207}Pb/^{204}Pb$ diagram, plot just to the right of the 1.8 Ga geochron. The remaining samples with LREE-enriched patterns were likely affected by incompatible element re-enrichment more recently, as evidenced by a limited range of $^{143}Nd/^{144}Nd$ (0.5128 to 0.5132), but a large range of $^{147}Sm/^{144}Nd$ (0.13 to 0.28), as well as Pb isotopic compositions that plot along a mixing line between the host basalt and the least radiogenic samples in a plot of $^{206}Pb/^{204}Pb$ vs. 1/Pb. In spite of these re-enrichment events, both the clinopyroxene Lu-Hf isotope and whole-rock Re-Os isotope systems appear to provide robust chronologic information regarding melt depletion in these peridotites. A Lu-Hf 'errorchron' (1.66 ± 0.10 Ga) and Os model ages (1.8 ± 0.2 Ga) are both consistent with Paleoproterozoic (~1.8 Ga) melt depletion in the Yangyuan peridotites. This age is consistent with the oldest (Paleoproterozoic) Nd model ages and non-radiogenic Pb isotopic compositions observed in some samples. The younger age of the lithospheric mantle compared to the overlying Archean crust suggests the removal and replacement of original underlying lithospheric mantle during a ~1.8 Ga collision in this region of the North China Craton.