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Ultra-high pressure garnet orthopyroxenite (Dabie Shan, China) as filters for Si-rich hydrous melts/supercritical liquids in deep subduction environments

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The ultrahigh-pressure (UHP) Maowu Ultramafic Complex (Dabie Shan, China) is hosted by coesite-bearing gneisses. Garnet–orthopyroxenites within the ultramafic complex derive from garnet–harzburgite precursors that have been metasomatised at peak conditions (4.0 ± 1.0 GPa, 750 ± 50 ˚C) by the addition of a silica- and incompatible trace element-rich fluid phase (hydrous melt), sourced from the associated crustal rocks. This metasomatism produced poikilitic orthopyroxene with high LREE and Ni contents and inclusion-rich garnet porphyroblasts. Solid polyphase primary inclusions within peak metamorphic garnet display negative crystal shapes and constant volume ratios of infilling mineral phases. Experimental homogenisation of these inclusions at conditions close to the estimated metamorphic peak demonstrates that the polyphase inclusions derive from trapped solute-rich aqueous fluids. The trace element characteristics of the experimentally re-homogenised inclusions include high LREE contents, a pronounced enrichment in LILE, with spikes of Cs, Ba, Pb and high U/Th.

The investigated ultra high pressure Maowu garnet–orthopyroxenites represent a natural laboratory to constrain the trace element transfer from the subducted crust to the mantle wedge at sub-arc depths. The observed textures and chemical characteristics provide evidence for the infiltration of a felsic hydrous melt into garnet–peridotite, a circumstance comparable to expected interaction of sediment-derived melts with man-

tle wedge peridotites in subduction zones. The SiO_2 and Al_2O_3 component of the hydrous melt reacted with olivine to form orthopyroxene and new garnet. The neoblastic orthopyroxene accommodates some of the LREE, whereas the H_2O and LILE component of the melt were partitioned into a residual aqueous fluid phase. Remnants of such an aqueous fluid were trapped in the garnet and formed the polyphase inclusions. The trace element pattern of these inclusions is very similar to the incompatible element enrichment observed in arc lavas.We suggest that the residual fluid produced by the peridotite/hydrous melt reaction is able to transfer the characteristic LILE signature fromthe subducted sediments to the locus of partial melting in the mantle wedge. Moreover, this study provides evidence that polyphase inclusions are important tools for constraining the nature and composition of UHP fluids.