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Oxygen isotope heterogeneity of olivine crystals in orogenic peridotites from Songshugou, North Qinling Orogen: Petrogenesis and geodynamic implications

Hong Yu[1,*], Hong-Fu Zhang[2,3], Haibo Zou[4], and Ji-Feng Xu[1]

[1]State Key Laboratory of Geological Processes and Mineral Resources, and School of Earth Science and Resources, China University of Geosciences, Beijing 100083, China
[2]State Key Laboratory of Lithospheric Evolution, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing 100029, China
[3]State Key Laboratory of Continental Dynamics, Department of Geology, Northwest University, Xi'an 710069, China
[4]Department of Geosciences, Auburn University, Auburn, Alabama 36849, U.S.A.

Abstract

Olivine grains from Songshugou mylonitized peridotite massif record $\delta^{18}O$ both lower and higher than in pristine mantle samples in North Qinling Orogen, Central China. Olivines from dunites exhibit large variations in $\delta^{18}O$ (4.03–7.07‰), and some porphyroclasts display negative correlations between $\delta^{18}O$ and forsterite content {Fo; [100×Mg/(Mg+Fe^{2+})]}. The porphyroclast cores have low-$\delta^{18}O$ values, indicating that they formed in the oceanic lithospheric mantle prior to subduction. We attribute low-$\delta^{18}O$ values to seawater-peridotite interaction under high-temperature conditions. The porphyroclast rims and small olivines exhibit high-$\delta^{18}O$ values. These features suggest that high-$\delta^{18}O$ olivines formed during mylonitization in the exhumation process. Olivines reacted with ^{18}O-rich melt/fluids released from subducted altered oceanic basalts and continental sediments at low temperature (<610–680 °C). The ^{18}O-rich melt/fluids selectively affected porphyroclast rims and small olivine grains. Unlike the olivines in the dunites, the olivines and orthopyroxenes in the harzburgites show limited variations in $\delta^{18}O$ (4.21–5.45‰ and 5.5–5.8‰, respectively), due to orthopyroxene exchange with melt/fluid at a slower rate than the coexisting olivine. The preservation of the low-$\delta^{18}O$ signature in olivines indicates a short residence time (<20 Ma) for subducting peridotites to mantle depths.

Keywords: Oxygen isotope heterogeneity, olivine, orthopyroxene, Songshugou peridotites, North Qinling Orogen