American Mineralogist, Volume 100, pages 181–194, 2015

Combined geochemistry and geochronology constrains coupled subduction of oceanic and continental crust in the Huwan shear zone, central China

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Abstract

Subduction of rocks into the mantle results in high-pressure metamorphism and the formation of eclogites from basaltic precursor rocks. In general, many kilometers of oceanic lithosphere are ultimately consumed prior to the subsequent continental slab subduction and collision. The exposure of the eclogites derived from oceanic subduction and continental subduction at the surface of Earth today record provide different *P-T-t* records of the subduction process. The Huwan shear zone in the Hong'an orogenic belt, marking a former ocean-continent transition zone, has been the focus of many studies on subduction-related high-pressure metamorphism. In this study, Lu-Hf garnet, U-Pb zircon, and Ar-Ar mica ages are combined with geochemical data to understand the origin of two coexisting eclogite bodies exposed along the Xuehe River in the Huwan Shear zone. In total, the results indicate that the two eclogites have different protoliths but experienced a similar metamorphic history. This observation requires new tectonic model for the coupled subduction of oceanic and continental crust in subduction zones. Combined geochemistry and zircon U-Pb geochronology suggest distinct oceanic and continental affinities for the eclogite protoliths. The Lu-Hf dates of 261.5 ± 2.4 Ma of the continental-type eclogite and 262.7 ± 1.7 Ma of the oceanic-type eclogite reflect garnet growth and are interpreted to closely approximate the age of eclogite-facies metamorphism. Therefore, both the geochemically oceanic- and continental-type eclogites underwent the same episode of Permian eclogite-facies metamorphism. The Permian Lu-Hf ages of ca. 262 Ma and the obtained Triassic Ar-Ar ages (~240 Ma) of the oceanic-type and continental-type eclogites imply coupled subduction and exhumation of oceanic and continental crustal materials in the Hong'an orogenic belt during the Permian and the Triassic. Though limited, the geochemical and geochronological results of this study, together with the discrepant Carboniferous dates for the nearby eclogites of previous studies, apparently suggest that the Huwan shear zone was not always a single coherent unit but instead comprises different tectonic slices that were metamorphosed at different times before final assembly. Some slices of the oceanic and continental crust underwent two subduction cycles during the Carboniferous and the Permian, whereas some eclogites registered only a single subduction-exhumation loop during the convergence between the South China Block and the North China Block in the Huwan shear zone. The consistent ages of the oceanic- and continental-type eclogites disfavor the traditional mélange model that high-pressure rocks are dismembered fragments that have been assembled and intercalated with rocks devoid of any high-pressure history at shallow crustal levels, forming a tectonic mélange.

Keywords: Lu-Hf, Huwan shear zone, eclogite, geochronology