Paper Number: 1481

Geochemical evidence for the metasomatic origin of pyrope quartzite in Western Alps

Chen, Yi-Xiang[1], Schertl, Hans-Peter[2], Zheng, Yong-Fei[1], Huang, Fang[1], Zhou, Kun[1] and Gong, Yingzeng[1]

[1] CAS Key Laboratory of Crust-Mantle Materials and Environments, School of Earth and Space Sciences, University of Science and Technology of China, Hefei 230026, China (yxchen07@ustc.edu.cn)
[2] Institut für Geologie, Mineralogie und Geophysik, Ruhr-Universität Bochum, 44780 Bochum, Germany

___

Pyrope quartzite in Western Alps is important because of the coesite occurrence and extreme Mg enrichment. However, its origin still remains to be resolved. To shed light on this issue, we performed a combined study of zircon U-Pb ages, zircon O and whole-rock Mg isotopes for pyrope quartzite from the Dora-Maira Massif in Western Alps. Leucophyllite from Eastern Alps was also analyzed for comparison. Zircon U-Pb dating for pyrope quartzite yields two groups of ages at ~262 Ma and ~34 Ma, respectively. The Permian ages occur in relict magmatic domains and are consistent with the protolith age of the country rock (metagranite). The Tertiary ages occur in coesite-bearing domains, consistent with the known ultrahigh-pressure metamorphic age. Whereas the relict magmatic domains show higher $\delta^{18}O$ values of ~10‰, the metamorphic domains exhibit lower $\delta^{18}O$ values of 5.8 to 6.8‰. The significant O isotope differences between the two types of domains suggest that the protolith of the pyrope quartzite underwent metasomatism by metamorphic fluids with low $\delta^{18}O$ values. The $\delta^{26}Mg$ values for pyrope quartzite are mostly -0.07 to 0.72‰ (except two samples that are -0.46‰ and -0.26‰), considerably higher than the country rock with $\delta^{26}Mg$ of -0.54 to -0.11‰. A similar feature was found for Mg-rich crustal rocks in the Eastern Alps, where the leucophyllite shows significantly higher $\delta^{26}Mg$ of 0.05 to 0.09‰ (except one of -1.09‰) than the country rock of ~-0.2‰. All the above results, combined with previous petrological and geochemical studies, lend strong support that the protolith of the pyrope quartzite is similar to the country rocks of metagranite. Although chemical weathering can result in variably heavy Mg isotopes for the residues, such a process cannot explain the zircon O isotope distribution, the extremely Mg-rich composition and heterogeneous $\delta^{26}Mg$ values of the pyrope quartzite, as well as previously reported mineral H-O isotopes and petrological results. Instead, they require the metasomatism of the metagranites by a kind of Mg-rich fluids with heterogeneous but primarily heavy Mg isotope compositions during probably continental subduction. According to available Mg isotope data of rocks and minerals, these fluids were possibly produced by devolatilization of hydrated and carbonated peridotites in a subduction channel, and the dehydration of talc and antigorite plays a crucial role. Such a process can also explain the formation of lower pressure Mg-rich metamorphic crustal rocks in the Alps.