Geochemical evidence from coesite-bearing jadeite quartzites for large-scale flow of metamorphic fluids in a continental subduction channel

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Metamorphic fluids produced by dehydration of subducting crust transport mass and energy at the slab-mantle interface in subduction channels. It is commonly assumed that fluid flow is significant in oceanic subduction channels but insignificant in continental subduction channels. This assumption is challenged by a combined study of whole-rock geochemistry, Mg and O isotopes, zircon U-Pb ages and trace elements in coesite-bearing jadeite quartzites from the Dabie orogen, China. Although the target samples were collected from different outcrops in an area of ~50 km^2, zircon U-Pb dating yields similar discordia lines with not only consistent upper intercept ages of 1.9-2.0 Ga but also consistent lower intercept ages of 224-235 Ma, indicating the same Paleoproterozoic protolith and the same Triassic metamorphism for these jadeite quartzites. The O isotope mineral separates and whole-rock yields variable $\delta^{18}O$ values (6.3-9.4‰), indicating involvement of supracrustal components. All whole-rocks give variable $\delta^{26}Mg$ values(-0.16-0.61‰), much higher than normal mantle values. In addition, the whole-rock Mg isotopes show significant positive correlations not only with MgO contents but also with Rb/La, Rb/Gd and Rb/Nb ratios, but a negative correlation with Na_2O contents. It indicates the middle Paleoproterozoic protolith of jadeite quartzites was weathered to produce a kind of sedimentary rocks in a passive continental margin and then underwent significant metasomatism by metamorphic fluids with high $\delta^{26}Mg$ during the continental subduction in the Triassic. The metamorphic fluids were produced by the breakdown of biotite in the metasedimentary rocks during their subduction to subarc depths for UHP metamorphism. They would have acquired their geochemical compositions not only from the biotite breakdown but also through leaching reaction with the TTG provenance. In view of the spatial occurrences of the target samples, the metamorphic fluids would have flowed inside the continental subduction channel on a large scale. This is the first report of the large-scale fluid flow in the continental subduction zone and therefore demonstrates that fluid flow can be significant in continental subduction channels.