ISOTOPIC (O, Sr, Nd, Pb) AND FLUID INCLUSION INVESTIGATIONS THROUGH VERTICAL SECTIONS OF ULTRAHIGH-PRESSURE METAMORPHIC ROCKS

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We investigated fluid inclusion and isotopic (O, Sr, Nd, Pb) characteristics on 66 selected drillcores (mainly eclogites) from the main hole and the pilot-holes of the Chinese Scientific Drilling Program (CCSD) in Donghai, East China, with depths ranging from 97 to 3000 m. The oxygen isotope data show that: (1) the rocks can be divided into two groups according to their $\delta^{18}O$ values: ^{18}O-depleted rocks (as low as $\delta^{18}O$ = -7.4 ‰ for garnet) that were produced by cold climate meteoric waters, and ^{18}O-normal rocks (with bulk $\delta^{18}O$ > +5.6 ‰) that may have preserved the O-isotopic compositions of their protoliths; (2) meteoric water/rock interaction has reached depths of at least 2700 m; (3) the oxygen isotope distribution pattern supports the hypothesis that granite intrusions were one of the heating engines which drove the hydrothermal circulation of meteoric water during the Neoproterozoic; (4) oxygen isotope equilibrium was mostly reached on a mm- to cm- scale regardless of the lithology, while isotope heterogeneity was observed between rock types at a scale of a few meters; (5) oxygen isotope distributions in the vertical sections favour an "in situ" origin of the UHP metamorphic rocks. Fluid inclusion data are related to oxygen isotopic compositions: rocks having depleted oxygen isotope compositions are dominated by high-salinity inclusions, whereas those with normal oxygen isotope composition are characterized by high density CO_2 fluids. The very negative $\delta^{18}O$ eclogites usually have higher hydroxyl-mineral contents than the higher $\delta^{18}O$ rocks, indicating higher water content during UHP metamorphism.

Sr-Nd-Pb isotopic data of eclogite and garnet peridotite demonstrate significant interactions between UHP metamorphic rocks (formerly subducted continental crust) and the eastern China mantle. Major- and trace-elements and Sr-Nd-Pb isotopic data from a continuous 3 m profile composed of amphibolite, gneiss, retrograde eclogite, and fresh eclogite show the following characteristics: (1) Eclogites and gneisses have distinct protolith sources, as indicated by their initial Nd and Pb isotopic compositions; the amphibolites, however, may be derived from either retrogressed eclogite or gneiss. (2) In the ε_{Nd}(240 Ma) vs. $^{87}Sr/^{86}Sr$ (240 Ma) diagram, most samples fall on an extension of the mantle array at the high $^{87}Sr/^{86}Sr$ end. The systematic upward decrease of ε_{Nd}(240 Ma) might indicate a systematic contamination of the mafic eclogite samples with gneiss-derived Nd. (3) Sr isotope anomalies occurring at the boundaries between eclogites and gneisses, and systematic overcorrection of in situ ^{208}Pb-growth in those samples with the highest $^{208}Pb/^{204}Pb$ suggest that retrogression after the UHP metamorphism, concentrated along the contacts, was associated with Rb-Sr fractionation and Pb-loss.