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Carbon Concentrations and Isotopic Ratios of Eclogites from the Dabie and Sulu Terranes in China

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Both concentration and isotope composition of bulk carbon in apatite and host eclogites from the Dabie-Sulu ultrahigh pressure terranes in China have been determined along with their oxygen isotope composition. The results show significant ^{13}C-depletion in the apatite (δ^{13}C = -27.7 to -20.8 ºC) with the carbon concentrations of 0.59 to 1.65 wt% CO_2 despite a large variation in δ^{18}O (-6.5 to +9.5 ºC). The bulk carbon in 21 of the 24 eclogites has low d^{13}C values of -26.1 to -17.9 ºC with low carbon content of 500 to 1000 ppm, whereas the other 3 samples show high δ^{13}C values of -7.1 to -2.8 ºC with high carbon contents of 2400 to 4300 ppm. Noncarbonate carbon was measured by treating all eclogites with 5N HCl solution, yielding uniformly low δ^{13}C values of -27.9 to -24.2 ºC and carbon contents of 200 to 300 ppm. Carbonate carbon is thus calculated by mass balance to have also low δ^{13}C values of -25.6 to -15.1 ºC for the 21 samples but high δ^{13}C values of -4.3 to -1.2 ºC for the remaining 3 samples. Secondary carbonate was identified in 3 eclogites which are also depleted in ^{13}C primarily, but subjected to overprint of ^{13}C-rich CO_2-bearing fluid subsequent to the UHP metamorphism. The isotopically light carbon in both eclogite and apatite is interpreted to represent the isotope composition of carbon in eclogite precursors before plate subduction, and thus has an origin of organic carbon from the Earth's surface. The uniformly low δ^{13}C values of apatite suggest that the CO_2 of metamorphic fluid in equilibrium with the host-eclogites would be derived from the oxidation of organic carbon rather than the decarbonation of underthrust carbonates during progressive metamorphism. Protoliths of the eclogites are inferred to be of igneous origin, which underwent more extensive interaction with organic matter than with meteoric-hydrothermal fluid on the subsurface of the continental crust. The breakoff of the subducted plate containing the isotopically light carbon and subsequent interactions with the surrounding mantle could produce the mafic and/or silicic magmas which are significantly depleted in ^{13}C relative to the primary mantle carbon. This may provide evidence for a linkage of the ^{13}C-depleted mantle carbon to a surficial source via plate subduction.