

ZIRCON U-Pb DATING, Hf AND O ISOTOPE STUDIES OF MARBLE-ASSOCIATED ECLOGITE IN THE DABIE-SULU OROGEN OF EAST-CENTRAL CHINA: CONSTRAINTS ON THE TIMING OF FLUID ACTIVITY DURING SUBDUCTION AND EXHUMATION OF CONTINENTAL CRUST

WU, Y.-B., ZHENG, Y.-F., ZHAO, Z.-F. & GONG, B.

School of Earth and Space Sciences, University of Science and Technology of China, Hefei 203326, China
e-mail: yfzheng@ustc.edu.cn

Fluid activity during subduction and exhumation is a very important issue with respect to timing and mechanism of metamorphic zircon growth. This is elucidated by a combined study of zircon internal structure, U-Pb dating, Hf and O isotope analyses for UHP eclogite boudins enclosed in marbles from the Dabie-Sulu orogen in east-central China. CL imaging identifies two types of zircon that are metamorphically new growth and recrystallized detrital grains, respectively. Both of them have low Th and U contents with low Th/U ratios, yielding two groups of $^{206}\text{Pb}/^{238}\text{U}$ age at 243 ± 2 Ma and 225 ± 3 Ma, respectively. The metamorphically grown zircons are characterized by much lower $^{176}\text{Yb}/^{177}\text{Hf}$ and $^{176}\text{Lu}/^{177}\text{Hf}$ ratios of 0.000055 to 0.002116 and 0.000001 to 0.000033 than the detrital zircons, indicating their formation during eclogite-facies metamorphism. Therefore, the two groups of U-Pb age are responsible for timing of zircon growth with fluid availability in the HP-UHP-HP metamorphic processes. The formation of the first episode of metamorphic zircons is correlated with fluid activity during prograde HP eclogite-facies metamorphism. The growth of the second episode of metamorphic zircons is interpreted to date fluid activity during retrograde HP eclogite-facies metamorphism.

The metamorphically grown zircons in the eclogites from the Dabie terrane have negative $\epsilon_{\text{Hf}}(t)$ values of -20.9 to -12.0, suggesting that the eclogite protolith is old crustal rocks. In contrast, the metamorphic zircons in the eclogite from the Sulu terrane are characterized by uniformly positive $\epsilon_{\text{Hf}}(t)$ values of 8.1 ± 0.5 , indicating the origin of its protolith from juvenile crust derived from depleted mantle. The metamorphic zircons from the eclogites show the very different $\epsilon_{\text{Hf}}(t)$ values, suggesting they have diverse protoliths with localized fluid activities in the bulk processes of HP-UHP-HP metamorphism. Some of the newly grown and recrystallized zircons have the significant different Lu-Hf isotope compositions from each other despite their similarity in U-Pb age. All the eclogites have anomalously high $\delta^{18}\text{O}$ values, with 12.34 to 22.55 ‰ for quartz, 9.87 to 21.39 ‰ for garnet, 7.92 to 21.89 ‰ for omphacite, and 18.63 ‰ for zircon. The $\delta^{18}\text{O}$ differences between coexisting minerals are consistent with those expected from equilibrium fractionations at eclogite-facies temperatures, suggesting that the high $\delta^{18}\text{O}$ values are inherited from their protoliths. Thus the protoliths of marble-associated eclogites are a kind of marls or volcanic ash that was interlayered with the marble protolith.