Zircon and monazite response to Paleo-proterozoic (ca 1840 Ma) UHT metamorphism in the Sulu orogen, eastern China

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Zircon and monazite are common accessory minerals in metapelites. The pelitic granulites (Sulu orogen) have a peak mineral assemblage of garnet + sillimanite + ternary-feldspar + plagioclase (antiperthite) + quartz + rutile ± biotite. Zircons from the granulite have low Th/U ratios (<0.1 mostly), flat HREE patterns with negative Eu anomalies, suggesting a typical of granulite-facies metamorphic zircon. Ti-in-zircon thermometers give very high temperatures ranging from 911 to 954 ℃ with a weighted mean of 928 ± 10 ℃, suggesting an ultrahigh temperature (UHT) metamorphism. These metamorphic zircons yield a concordant $^{206}Pb/^{238}U$ age of 1843 ± 17 Ma (MSWD=6, n=26) and an upper intercept age of 1842 ± 15 Ma (MSWD=1.7), suggesting a Paleo-proterozoic UHT granulite-facies metamorphism. The monazites in the granulite generally have zoned structure: gray core and bright rim. Compared with the gray cores (Th = 45429 - 165236 ppm; U = 2227 - 6044 ppm; and Th/U = 18 - 28), the bright rims have high Th (194616 - 285224 ppm) but low U (1145 - 3209 ppm) contents, resulting in very high Th/U ratios (69 - 217). Both the monazite cores and rims have same $^{206}Pb/^{238}U$ ages. They yield a concordant $^{206}Pb/^{238}U$ age of 1837 ± 9 Ma (MSWD=3.5, n=27) and an upper intercept age of 1846 ± 27 Ma (MSWD=3.0), which is similar to zircon $^{206}Pb/^{238}U$ ages. However, the high-Th rims generate anomalously old $^{208}Pb/^{232}Th$ ages ranging from 2280 to 2534 Ma. We suggested that the decouple of the monazite U-Th-Pb age system in the bright rims might be caused by fractionation of Th and U (reflected by an increased in Th/U ratios in rims relative to cores). The high-Th rims could be generated from incongruent breakdown of biotite to produce a melt metasomatism under UHT granulite-facies conditions.