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Adding time to the P–T history of deeply subducted intergranular coesite-bearing eclogite at Yangkou Bay, central Sulu Belt, China

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To constrain rates of burial and exhumation of UHP metamorphic rocks it is essential to obtain robust P, T and t (time) information related to both the prograde and retrograde evolution. However, such information may be difficult to obtain from the most deeply buried UHP metamorphic terrains for two reasons: 1) fluid deficient conditions limit mineral growth and recrystallization during the late prograde/early retrograde evolution; and, 2) generation of fluid and/or melt during exhumation facilitates retrogressive overprinting of the earlier history.

We illustrate these issues using SS-LASS ICP-MS analysis of zircon from the intergranular coesite-bearing eclogite locality at Yangkou Bay. Previous attempts using SHRIMP, EMP and LA-ICP-MS methods to date on thin metamorphic overgrowth rims of zircon from rocks at this locality all failed to produce valid U-Pb ages. At Yangkou Bay, intergranular coesite-bearing eclogite is preserved within rootless intrafolial F1 fold noses within quartz eclogite and associated quartz-rich phengite schist. These rocks were exhumed from pressures that could have exceeded 7 GPa. To address the dating problem, we have used the SS-LASS technique on zircon from each of these three rock types. Multiple single shot ablation (100nm depth) from the surface of unbroken and unpolished zircon crystals to 1-2μm depths has allowed us to obtain robust metamorphic ages.

In polished mounts, cathodoluminescence images of zircons from all three rock types show similar oscillatory-zoned relict cores; these yield protolith ages of c. 820–780 Ma. In the coesite-bearing eclogite, the inherited zircon cores display bright blurred oscillatory zoning, either through most of the zircon core or in an extremely narrow metamorphic rim (2-5μm). These observations suggest the zircon recrystallized in the solid-state. SS-LASS analysis yielded a weighted mean age of 249 $\pm$ 5 Ma (n = 6) from these rims.

Zircon cores from quartz eclogite display clear oscillatory zoning surrounded by a zone of bright blurred oscillatory zoning ($\sim$100μm). Thin rims (5-20μm) with darker luminescence occur outside this blurred zone, indicating growth of new metamorphic zircon. Zircon from the quartz-rich phengite schist is similar to that from the quartz eclogite, but has uniformly thin rims $\sim$5μm across. SS-LASS analysis yielded weighted mean ages of 225 $\pm$ 8 Ma (n = 6) from overgrowths on zircon from quartz eclogite and 225 $\pm$ 9 Ma (n = 7) on zircons from the associated quartz-rich phengite schist.

Structural analysis indicates that the intergranular coesite-bearing eclogites were protected from fluid infiltration due to strain localization around the host intrafolial folds, whereas quartz eclogites and quartz-rich phengite schist were retrogressed due to the generation of an intergranular fluid during early exhumation. We interpret the age from the coesite-bearing eclogite to record the timing of prograde burial, whereas the ages from the quartz eclogite and the associated quartz-rich phengite schist record the timing of exhumation from the coesite to the quartz stability field. These ages are similar to those obtained from other localities in the Sulu Belt, suggesting similar rates of burial and exumation for the UHP unit(s).