

Solving a lower crust puzzle through in-situ U-Pb dating of garnet (Ivrea-Verbano Zone, NW Italy)

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Rates of melt production, extraction and crystallization, as well as scales of melt transfer and interaction with its residuum change continuously in migmatite and granulite, affecting the behavior of monazite and zircon as time capsules. Therefore, accessory mineral chronometers may be ambiguous and incomplete in providing an overview of the temperature–time evolution of high-grade metamorphic rocks. In this study, we applied the novel technique of *in-situ* U-Pb dating of garnet to the archetypal lower continental crust of the Ivrea-Verbano Zone (IVZ), NW Italy. In the IVZ, the temporal relationship between granulite-facies metamorphism and mafic underplating has long been debated, because of the interplay between tectonic, magmatic, metamorphic and metasomatic processes over a period of more than a hundred million years. Garnet from mafic and pelitic granulites yielded U-Pb ages between 287.4 ± 4.9 Ma and 280.1 ± 12.4 Ma, overlapping within uncertainty the time proposed for the emplacement of the Mafic Complex (286–282 Ma). These results indicate that the thermal climax in granulitic rocks was caused by mafic underplating and concomitant asthenospheric upwelling, rather than being inherited from the post-Variscan Carboniferous evolution. Providing robust dating of garnet with as low as 4 ng/g U, this study demonstrates the strength of garnet petrochronology in resolving complex tectono-metamorphic histories of high-grade terranes. It also represents a further step forward towards establishing garnet as part of the *in situ* U–Pb geochronology repertoire.