Zircon petrochronology constrains retrograde metamorphism and dike emplacement in the Gruf Complex

J. OALMANN[1], A. MÖLLER[2] AND R. BOUSQUET[3]

[12]Dept. of Geology, The University of Kansas, USA, joalmann@ku.edu, amoller@ku.edu

[3]Institute for Geosciences, Christian Albrechts Universität zu Kiel, Germany, bousquet@min.uni-kiel.de

In ultra-high temperature (UHT) metamorphic rocks, zircon is typically resorbed at peak temperatures [1], and zircon ages and Ti-in-zircon temperatures record retrograde metamorphic conditons and/or melt crystallization. The Gruf Complex in the Central Alps contains scarce, sapphirine-bearing granulites that preserve UHT mineral assemblages. Complexely-zoned zircons were analyzed for U-Pb isotopes and trace elements by LA-ICP-MS directly in thin sections. Zircons separated from leucosomes, deformed felsic dikes, and crosscutting pegmatitic dikes were also dated.

Zircons from the UHT granulites contain Permian (ca. 230–350 Ma), oscillatory-zoned cores. The cores and scarce Jurassic mantles commonly have lobate boundaries and are overgrown by Oligocene rims (weighted mean $^{206}Pb/^{238}U$ age: 32.9±0.5 Ma). Both the cores and overgrowths record Ti-in-zircon temperatures ranging from ca. 650–850°C. Chondrite normalized REE plots from garnet-rich samples exhibit slightly positive to slightly negative HREE slopes for all zircon domains, consistent with zircon growth in the presence of garnet. In the garnet-poor granulites, which contain UHT garnet breakdown textures, the HREE patterns are more steeply positively sloping for the Oligocene rims than for the Permian cores. Rims of zircons separated from the leucosome of a magmatic breccia crystallized at 32.2±0.2 Ma. Deformed biotite-bearing dikes and crosscutting garnet ± beryl ± tourmaline dikes contain zircons with ca. 29–30 Ma rims.

The lobate boundaries of Permian and Jurassic domains and <900°C Ti-in-zircon temperatures indicate zircon was resorbed at UHT conditions. Thus, the UHT event occurred during Alpine orogenesis prior to ca. 33 Ma. The deformed dikes were emplaced coevally with formation of mylonite zones, which separate the UHT rocks from lower granulite facies gneisses, providing a 29–30 Ma age constraint for the juxtaposition of these units. The crosscutting dikes were probably emplaced after ca. 29 Ma, but did not crystallize new zircon. A likely heat source for UHT metamorphism was mantle upwelling after slab breakoff. Intruding Bergell magmas helped exhume the UHT rocks to the middle crust.

[1] Harley et al., 2007, *Elements*