Lu-Hf zoned garnet geochronology: An example from the Menderes Massif, Turkey

ALEXANDER SCHMIDT[1*], AMAURY POURTEAU[1], OSMAN CANDAN[2] AND ROLAND OBERHÄNSLI[1]

[1]Institute of Earth - & Environmental Sciences, University of Potsdam, Germany (*correspondence: alschmid@geo.uni-potsdam.de)

[2]Dokuz Eylül Üniversitesi, Mühendislik Fakültesi, Jeoloji Mühendisliği Bölümü, Izmir, Turkey

This study applies a microsampling method on four 3-5 cm garnet porphyroblasts contained in a garnet-mica schist of the southern Menderes Massif (Turkey), to determine the rate of garnet growth for single garnet megacrysts, as well as to improve constraints of the timing of Alpine metamorphism of the Pan-African basement in this massif. The use of the Lu-Hf system to date zoned garnets is a further development of the methods commonly applied using the Rb-Sr and Sm-Nd isotope systems.

Major element profiles in the investigated garnets characterize zoning patterns indicative of prograde conditions: Rayleigh fractionated Mn and decreasing Fe/(Fe+Mg) are recorded by the garnets´ core to rim compositions. Lu-Hf ages of consecutive garnet shells are determined by two-point garnet-only isochrons using the Lu-depleted garnet-rim compositions as the lower point of the isochron. The ages show a consistent decrease from core to rim segments of individual garnet crystals, indicating a time frame between 42.6±1.9 and 34.8±3.1 Ma for early prograde growth of the garnets´ cores. Two of the large garnet crystals also yield isochron ages of 58.83±0.69 and 50.16±0.84 Ma in their innermost cores, which appear to record an early nucleation event. This view, however, is not in concordance with the observed major element profiles of these garnets, and therefore is interpreted with caution. Termination of the garnet growth period is determined through the calculation of radial growth rates based on the size of the garnets and the Lu-Hf ages obtained for consecutive shells. Extrapolation of these rates potentially constrains a total duration for garnet growth up to 31±6 Ma. Comparison of the growth rates calculated for individual crystals shows a variety of slow and fast growing garnets, similar to previous results obtained with the Rb-Sr and Sm-Nd isotope systems. The new data provides a new and precise age determination for prograde Barrovian metamorphism in the southern Menderes Massif, which so far was placed between 63 and 27 Ma on the basis of mica Rb-Sr and Ar-Ar dating.