Geophysical Research Abstracts
Vol. 13, EGU2011-10132, 2011
EGU General Assembly 2011

Lu-Hf garnet geochronology reveals two high-pressure metamorphic events in the Bulgarian Rhodopes

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The convergence of the African and Eurasian plates since the Jurassic led to the closure of the Tethyan realm and the evolution of the Alpine orogen. Various microterranes of oceanic and continental affinity were incorporated in the evolving orogen and subjected to high-P or even ultra-high-P metamorphic conditions. Determining the timing of these metamorphic events as well as the nature of the protoliths involved are a prerequisite for tectonometamorphic and geodynamic reconstructions. In particular for the eclogite-facies rocks of the Bulgarian Rhodopes detailed geochronological and geochemical data addressing subduction-exhumation and nappe stacking processes operating during the Alpine orogeny in the Eastern Mediterranean are scarce.
In this context, the Lu-Hf chronometer has already been proven useful to date HP mineral assemblages in other Alpine units (e.g., Duchêne et al., 1997) and was therefore applied to four eclogite samples from different units of the Alpine nappe stack of the Bulgarian Rhodopes: (1) the (U)HP Kimi Comlex (Upper Complex) as well as (2) the Middle Complex. Furthermore, we determined whole rock Hf and Nd isotope compositions as well as major and trace element concentrations in order to constrain the nature of the eclogite protoliths.
Microprobe analyses of the garnets revealed prograde growth zoning patterns and hence, Lu-Hf ages are interpreted to reflect garnet growth. Estimated peak metamorphic temperatures of 600-700°C were below the closure temperature (TC) of the Lu-Hf system. Two major HP metamorphic events were revealed by Lu-Hf geochronology: (1) a Lower Cretaceous event in the eclogite from the Kimi Complex (126.0 $\pm$ 1.7 Ma; MSWD = 3.3) and (2) Eocene metamorphism of the rocks from the Middle Complex (44.5 $\pm$ 0.8 Ma, MSWD = 1.4; 43.5 $\pm$ 0.4 Ma, MSWD = 0.19; 42.8 $\pm$ 0.5 Ma, MSWD = 0.07).
Collectively, our new data are a direct evidence for an Eocene HP event in the Middle Complex and support previous findings of a Lower Cretaceous metamorphism of the Kimi Complex (e.g., Warwzenitz & Mposkos, 1997). Furthermore, exhumation and subsequent thrusting of the Middle Complex on the Lower Complex (Pangaion-Pirin Complex) can be narrowed down between 42 - 34 Ma.

References:
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