

## Alpine, Permian and Variscan metamorphism in the Tisza and Dacia Mega-Units: Sm-Nd garnet and U-Th-Pb monazite dating in the Apuseni and Rodna Mountains (Romania)

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The Tisza and Dacia mega-units constitute a central part of the Alps-Carpathians-Dinarides system of orogens. Polyphase medium-grade metamorphism, observed in mineral assemblages from the crystalline basement has been correlated with Variscan and pre-Variscan events. However, a mid-Cretaceous Sm-Nd garnet age ( $104\pm 2$  Ma) from the Apuseni Mountains is at odds with this interpretation. Electron-microprobe U-Th-Pb dating of monazite in samples from the Apuseni and Rodna Mountains, as well as the Șimleu Silvaniei, Ticău and Preluca inselbergs revealed a complex pattern of Alpine and pre-Alpine age clusters. Pre-Variscan and Variscan ages were obtained from the core of zoned monazite grains and from samples that apparently escaped the Alpine overprinting. Relictic monazite in the latter is often replaced by rhabdophane and/or surrounded by allanite coronas. Permian to Early Triassic monazite ages correlate with the intrusion of granitic melts and pegmatites. Early Cretaceous ages from rims of chemically zoned grains and from monazite inclusions in garnet, biotite and staurolite, represent newly formed metamorphic grains that crystallized on the prograde path during an Alpine metamorphism. Petrographic observations of prograde allanite breakdown reactions, Sm-Nd garnet analyses and thermobaric estimates (500–550 °C/5–8 kbar) from the Tisza and Dacia mega-units constrain medium-grade conditions during Early Cretaceous times. Exclusively mid-Cretaceous monazite ages from the inselbergs and Rebra-Unit of the Rodna Mountains, allow extending the Alpine prograde overprint across the Transylvanian basin. Taking together with other studies from the basement of the Pannonian basin, this implies that the Dacia Mega-Unit and parts of the Tisza Mega-Unit experienced a medium-grade metamorphic overprint and synkinematic garnet-growth during late Early Cretaceous times. The Alpine prograde overprint is distributed along the contact between the Tisza and Dacia mega-units, forming a continuous belt with the Cretaceous metamorphic imprint in the Eastern Alps, when back-rotated to its original position during the Cretaceous.