Crustal Evolution of the Balkan: Episodic igneous activity and crustal recycling of Peri-Gondwana European terranes revealed from zircons and rutiles in basement rocks and river sediments

AVISHAI ABBO[1]* DOV AVIGAD [1] AXEL GERDES [2]

[1] Institute of Earth Sciences, The Hebrew University Jerusalem, Givat Ram 9190401, Israel (*correspondence: avishai.abbo@mail.huji.ac.il, dov.avigad@mail.huji.ac.il)

[2] Institute of Geosciences Goethe University, Altenhöferallee 1, Frankfurt am Main 60438, Germany (gerdes@em.uni-frankfurt.de)

The Balkan is a collage of Peri-Gondwana Cadomian and Avalonian terranes that were fondered on the late Neoproterozoic active margins of the Supercontinent, rifetd from it during consecutve opening of oceanic basins, and variably involved in Ordovician, Variscan, and Alpine orogenies. The Serbo-Macedonian (SMM) and the Rhodope massifs are major Balkan terranes that were subsequently involved in Paleozoic, Mesozoic and Cenozoic phases of magmatism and metamorphism. These terranes therefore portray the prolonged evolution of the SE European continental crust over a ~0.6Ga time scale. Here we present zircon U-Pb-Hf and rutile U-Pb data from basement rocks of the SMM and Rhodope as well as of beach placers from large river mouths draining the region towards the Aegean Sea (Axios, Strymon, Nestos and Evros Rivers). Basement igneous rocks of the SMM and circum Rhodope range in age from late Neoproterozoic (598Ma), through Ordovician (460Ma), Carboniferous (300Ma), Triassic (250Ma), Paleocene (61Ma), and Miocene (ca. 23Ma), thus demonstrating the episodic Paleo-Meso-Cenozoic crustal evolution of this terrane assembelage. Hf-in zircon shows these episodic intrusions evolve from negative $\varepsilon Hf_{(t)}$ values in the Ordovician towards positive values in the Eocene, grossly fitting the evolution trend of external ogorenic belts. This igneous trend is however only a part of the whole Balkan crustal evolution picture, as the beach placer samples indicate that together with episodic igneous crustal addition, a large portion of zircons follow a progressive recycling trend bound by evolution lines of Hf-T_{DM}=0.7-1.7Ga. This trend reflects, in our view, the ongoing recycling of the Cadomian/Avalonian basement of the SMM and Rhodope that provided the crustal ingredients for recycling, and few outcrops of it have survived. Some extent of crustal addition on this evolving Cadomian/Avalonian substrate brings about the shallow rise in $\varepsilon Hf_{(t)}$ values we observe in the igneous basement rocks. We argue that episodic recycling of Peri-Gondwana crust alongside variable igneous addition, was widespread also in other European Cadomian/Avalonian domains since the late Neoproterozoic.