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Morphology of zircons from the Pannonian Basin basement (Croatia) as a tracer of hot magma chambers

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Crystalline rocks of the basement in the range of the Pannonian Basin (PB) in Croatia represent research material that has experienced several orogeneses. Of particular interest among the (meta)igneous rocks are rare and small bodies of highly fractionated rocks (I- and A-type granitoids) outcropping at Mt. Papuk (Pp), Mt. Medvednica (Me) and Mt. Požeška Gora (Pg). According to literature, (pre?)-Variscan (ca. 450 Ma, 320 Ma), late Variscan (Permian) and Alpine (87-85 Ma) ages are possible protolith ages.
Accessory zircon was found in all samples (of various ages) from the highly fractionated (meta)igneous rocks. This mineral is characterized by simple and uniform external morphology. It is governed by predominantly developed {100} prisms and {101} » {211} bipyramids where the D-type after Pupin's zircon typology prevail reaching in some cases up to 50 % of the total population. The average size of the analyzed zircon grains is (length x width) 200 μm x 80 μm (Pp), 65 μm x 25 μm (Me) and 75 μm x 35 μm (Pg) with aspect ratios between 2.2-2.6. Cathodoluminescence and back-scattered electron images reveal clear signs of oscillatory growth zoning without signs of dissolution.
According to the subsequent characteristics, the geotectonic setting of the sampled granitoid rocks is related to a volcanic arc and a within-plate environment (A-type granite in the case of Pg). The geochemistry of whole rocks and zircon grains from different localities normalized to primitive mantle shows positive Th, U, Pb, P, Zr and negative K, Sr, Nd and Ti anomalies. REE patterns of zircon normalized to chondrite reveals positive Ce (Ce/Ce*= 11.8 (Pp); 22.4 (Me); 1.8 (Pg)) and negative Eu (Eu/Eu*= 0.40 (Pp); 0.21 (Me); 0.15 (Pg)) anomalies, whereas other trace element patterns of zircon and whole rock mimic each other in general. Despite similar REE patterns, there is a notable difference in total REE within the different populations of zircon grains, with the highest, medium, and lowest values detected in Me (7000 ppm), Pg (3400 ppm) and Pp (1200 ppm) rocks, respectively.
High Umean (Pp: 450, Me: 1130, Pg: 900 ppm) and Thmean= (Pp: 810, Me: 4550, Pg: 670 ppm) values and ratios of Th/U= 1.8 (Pp), 4.0 (Me), 0.7 (Pg) and Zr/Hf= 44.3 (Pp), 48.1 (Me), 55 (Pg) as well as diverse whole-rock elemental ratios suggest that zircon has crystallized at relatively high and constant temperature. The calculation of temperatures for Zr saturation of the magma and the onset of the zircon crystallization yielded values of up to 815 (Pp), 775 (Me) and 860-950 (Pg) °C.
We suggest that a particular zircon morphology might be related to a similar stage within an orogenesis and to a specific tectonic setting, where deeper parts of continental crust are influenced by mantle heat. Therefore, such simple tracer could be used, as in the here presented case, for the assignment of igneous rocks to deep crustal magma chambers in a hot crustal environment.
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