Hf isotopic evidence for recycling of crustal sources in the Western Carpathians Variscan granitic rocks.

M. Kohút

Dionýz Štúr State Institute of Geology Bratislava; milan.kohut@geology.sk

Zircon is an accessory mineral forming a robust phase in many felsic igneous rocks and therefore is frequently used for geochemical tracing and radiometric dating. Hafnium as an important minor element in zircon is a sensitive tracer of crustal and mantle processes due to its isotopic composition. Generally, zircon U-Pb ages register episodes of magmatism and/or metamorphism related to crustal reworking, whereas zircon model Hf ages provide prime-time estimation of crustal extraction from the mantle. Combination of both methods has the potential to determine crustal growth due to reworking of ancient crust by melting and/or forming of juvenile crust and to date melts extraction. When crustal growth occurs significantly before crustal reworking (e.g. arc-continent and continent-continent collision events), then post-collisional magmatism in these regions should results in production of rocks with considerably older model Hf ages than show the U-Pb ages. The Variscan granitic rocks of the Western Carpathians were related to distinct sources and/or geotectonic position, from subduction-related I-suite (I-s), through syn-collisional S-suite (S-s) to late- and post-orogenic A-suite (A-s) and specialised ore-bearing (S_s-s) granites. The genesis and history of the local crust sampled by the granitic rocks can be traced back to the Early Palaeozoic and/or Neoproterozoic times, consistent with a derivation from the north-Gondwanan margin. The U-Th-Pb zircon dating by means of SHRIMP and in situ zircon Hf isotopic analyses using a Neptune MC-LA-ICPMS of the Western Carpathians granitic rocks were carried out at the All-Russian Geological Research Institute (VSEGEI) in St.-Petersburg. Our new U-Th-Pb zircon dating excluded significant age gap (ca 40 Ma) between the Variscan I-s and S-s granitic rocks known from conventional dating and suggests their nearly synchronous origin (365~350 Ma respectively 360~345 Ma). The A-s granites show magmatic ages 282~262 Ma, while S_s-s granites were emplaced at 270~255 Ma. Detailed zircon study exhibits dominance of magmatic zoned homogeneous grains for I-s and A-s granitic rocks with scarce restite ones, and rather complicated internal (sector) textures with frequent inherited cores, oscillatory zoned and/or newly grown domains for S-s and S_s-s granitic rocks. Generally, zircons SHRIMP spot ages in our I-s tonalites and granodiorites vary in interval 375 ~ 345 Ma, whereas in our S-s granites zircon show ages mainly 620 ~ 450 Ma and/or sporadically 2.8 ~ 1.2 Ga in cores, and rim zones provide the standard Variscan ages in interval 370 ~ 330 Ma. Hafnium isotopes measured close to zircon SHRIMP spots denoted as $\varepsilon_{Hf}(t)$ form distinct intervals with following values for I-s: -0.34 ~ 7.60 (4.06 ± 2.54; mean ± standard deviation); for S-s: -7.79 ~ 2,51 (-1.98 ± 3.19); for A-s: 0.19 ~ 9.96 (7.54 ± 2.9), and for S_s-s: -5.35 ~ -0.75 (-2.47 ± 1.6) respectively. Hafnium model ages (T_{DM}) of the studied zircons provide similarly differences in age spectra: I-s = 1109 ~ 708 Ma (864 ± 112 Ma); S-s = 1502 ~ 919 Ma (1148 ± 166 Ma);
A-s: 747 ~ 566 Ma (629 ± 73 Ma), and for S-s: 1258 ~ 1004 Ma (1098 ± 87 Ma). Taking in account results from other isotopic systems (Sr, Nd, Pb, O, S, Li) we suggest that the Western Carpathians Variscan granitic suites were melted from vertically zoned lower crust (mafic & felsic metaigneous rocks representing reworked Pan-African crust) with some metasedimentary addition. Partial contribution of the Devonian juvenile mantle was not confirmed exactly yet, indeed we cannot exclude its presence in the Variscan orogeny.

Acknowledgment*: This work was supported by the Slovak Research and Development Agency under the contract No. APVV-0549-07.*