Constraining cooling temperature and ages from zircon investigation: example of a Neoproterozoic anatexite, Araçuaí Orogen (Brazil)

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We investigated the geochronological and geochemical signature of zircon grains extracted from a 1,000 km^2-wide anatexite that crops out in the Araçuaí Orogen (SE Brazil), using LA-ICP-MS technique. It consists of a peraluminous migmatite made up Qtz + Kfs (±Pl) + Bt + Gt ± Sil ± Cd and Mz ± Rt as accessory phases. U-Pb SHRIMP ages were obtained in seven samples collected from different geographic localities, and are grouped at c. 597 - 595 Ma (northern domain), c. 585 - 582 Ma (central domain) and c. 575 - 572 Ma (southern domain). Internal structures of the analyzed zircon grains range in CL intensities, but are typically represented by igneous (oscillatory and parallel banding) growth zoning. No apparent recrystallization (metamorphic) rims were observed. Trace element signature obtained in the same dated grains shows quite uniform compositions (Lu/Sm_N 87 – 158; Ti_{av} 7.3 – 10.4 ppm; Nb 22 – 36 ppm; Hf 5.5 – 8.2%), with steep heavy-enriched REE patterns, positive Ce anomaly and negative Eu anomaly (0.018 – 0.041, av. 0.024). Their Th/U ratios are, however, mostly < 0.1 (av. 0.063). Temperatures calculated using Ti-in-zircon thermometer range from 710º to 820ºC, similar to that obtained from Titani-in-quartz thermometer (750º - 800ºC).

All data reported here indicate that the studied zircon grains are igneous in origin and, therefore, crystallized at minimum temperature of ~700ºC from the anatetic melt; consequentely, the U/Pb results represent their formation-ages. The unexpected low Th/U ratios can be explained by co-crystallization of zircon and monazite, during cooling thermal conditions.