Petrochronological evolution of garnet-free UHT mafic granulites in the Guaxupé nappe (SE Brazil): from subduction to collision?

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The study of high and ultra-high temperature (UHT) metamorphic rocks, esspecially their pressure-temperature-time (P-T-t) paths, is critical to distinguish between metamorphism related to subduction or collision. However, this task is challenging as the prograde to peak assemblages are often highly retrogressed and the isotopic systems are disturbed. Garnet-free mafic rocks located in UHT domains are an example of such complex rocks, in which accessory minerals (chronometers) and metamorphic index minerals (thermobarometers) are scarce.

In this study the timing of magmatism and metamorphism of mafic granulites has been investigated using U-Pb dating, Lu-Hf and trace element signatures of zircon. $^{176}Hf/^{177}Hf_{(t)}$ in zircon cores exhibiting U-Pb disturbed systems from the granulites allowed for retrieving igneous crystallization ages of 790 Ma, 690 Ma and 660 Ma. Newly formed zircon grains and rims record a long-lived metamorphic event of ~80 m.y. between ca. 670 and 590 Ma, partially coeval with the intrusion of mafic magma (ca. 660 Ma). Thermometry on zoned Cpx and Opx yields temperatures in the range of 900–1000 ºC. Distribution patterns of the metamorphic rims and newly formed grains dates enable the idenfitication of three metamorphic stages: (i) pre-collisional (670–640 Ma), (ii) subduction to collision (640–630 Ma), and (iii) decompression involving partial melting (630–590 Ma). The short time gap (10–20 m.y.) between the magmatic and metamorphic events, the association of UHT rocks with mafic enclaves, and the age distributions suggest that the UHT metamorphism in the Southern Brasília orogen was related to the development of a magmatic arc between 670 Ma and 630 Ma. The coupling of U-Pb and Lu-Hf analyses on zircon also permitted to identify the first relicts of juvenile Neoarchean basement in the Guaxupé nappe.