Unraveling Polyphase Metamorphism in Orogens: An Example From the Neoproterozoic Brasília Belt, Brazil

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The Neoproterozoic Brasília Belt lies between the São Francisco, Amazonas and Paranapanema Cratons in central Brazil. In the southern portion of this belt, the Andrelândia Nappe Complex records metamorphic conditions from greenschist facies at the base (east) to high-pressure granulite facies at the top (west). At the top, the Socorro–Guaxupé Nappe represents part of the arc from the upper plate. Immediately below, the Três Pontas–Varginha (TPV) and Carmo da Cachoeira (CdC) Nappes comprise pelitic sediments metamorphosed during subduction-to-collision orogenesis.

A series of pseudosections was constructed for a range of compositions found in the TPV and CdC Nappes. The peak phase assemblage located in the series of pseudosections constructed for samples from a single outcrop in the TPV nappe constrains maximum P-T conditions to 12-14 kbar and 830-900˚C. A probability plot of SIMS $^{207}Pb/^{206}Pb$ dates from zircons contained within leucosome from the same samples yield two ages of zircon growth at ca. 650 Ma and ca. 605 Ma. We interpret the older age to represent the timing of crystallization in melt post subduction-related peak P. Ti-in-zircon thermometry yields temperatures consistent with crystallization from melt from ~950˚C to ~700˚C. A probability plot of SIMS $^{207}Pb/^{206}Pb$ dates from zircons associated with Ilm breakdown yields a single age of ca. 658 Ma related close-to-peak, just-peak-T metamorphism, likely associated with detachment of the highest pressure nappe from the subducting plate, and transfer to the overriding plate.

For the CdC Nappe, immediately beneath the TPV Nappe, the peak phase assemblage located in the series of pseudosections constructed for samples from a single outcrop constrains maximum P-T conditions to 11-14 kbar and 820-870˚C. Microprobe (U-Th)-Pb monazite and SIMS U-Pb monazite dating indicate two ages of growth at ca. 635 Ma and ca. 605 Ma. We interpret the older age to represent the timing of crystallization around peak T. The age of ca. 605 Ma in both nappes is interpreted to represent the timing of emplacement of the SGN on top of the nappe stack.

The cross-cutting Ribeira Belt imparts a sillimanite-grade overprint on the southern part of the Andrelândia Nappe Complex. Age domains in monazite of ca. 590-530 Ma occur throughout the sillimanite zone and to the north, where younger ages in monazite record the Ribeira Belt overprint imposed during final suturing between the São Francisco and Congo cratons in west Gondwana. In the northern part of the southern Brasília Belt, monazite ages provide the only petrologic evidence of this cryptic overprinting.