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The early assembly of Gondwanan elements in South America: the P-T-time evolution of high-grade nappes in the Southern Brasília Belt, Brazil

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The assembly of Gondwanan elements in South America is recorded in southeast Brazil by orogenic events related to formation of the Southern Brasília and Ribeira Belts. In the southern sector of the Southern Brasília Belt, flat-lying ENE-vergent nappes record terminal collision of the Paranapanema block/Socorro–Guaxupé Arc with the subducted passive margin sedimentary succession on the west side of the São Francisco Craton. The arc-derived Socorro–Guaxupé nappe overlies passive margin-derived nappes of the Andrelândia Nappe Complex (ANC), which lie on autochthonous basement. The ANC comprises HP granulite facies rocks at the top with metamorphic grade decreasing downward to greenschist facies at the bottom. Peak metamorphic conditions in the uppermost Tres Pontas–Varginha (TPV) and Carmo da Cachoeira (CdC) Nappes were P $\sim$1.5 GPa, T 850–900°C and P $\sim$1.3 GPa, T $\geq$830°C. SIMS U-Pb zircon ages (Reno et al., 2009, JGS) constrain timing of: eclogite facies metamorphism of oceanic crust (206Pb/238U age of 678$\pm$29 Ma from a tectonic block located between the uppermost nappes in the ANC); post-peak HP granulite facies metamorphism in the TPV nappe (206Pb/238U ages of 648$\pm$12/648$\pm$8 and 647$\pm$11 Ma, from zircon that records Ti-in-zircon crystallization temperatures of 860–785°C); and, post-peak HP granulite facies metamorphism in the overlying arc-derived nappe (206Pb/238U age of 622$\pm$28 Ma, from zircon that records Ti-in-zircon crystallization temperatures of 970–820°C). The eclogite age is interpreted to record peak conditions, which constrains the timing of detachment of the overlying nappe from the subducting plate and demonstrates that craton amalgamation in West Gondwana began earlier than previously inferred. For the TPV nappe, monazite chemical dating yields ages of c. 634–630 Ma and c. 619–616 Ma from higher Y domains, interpreted to record crystallization at the solidus, the T of which varies with amount of depletion by melt loss, and c. 606–597 Ma from lower Y domains, interpreted to record a response to ingress of fluid from the underlying Carmo da Cachoeira Nappe (Reno et al., in revision, JMG). Younger monazite chemical ages of 588–578 Ma from close to the bottom of this nappe are interpreted to record growth or partial recrystallization related to ongoing displacement and/or fluid ingress during low-pressure close to isobaric cooling. A decompression step links the two close to isobaric cooling segments of the P–T path. Post decompression cooling is further constrained by Rb–Sr multi-mineral–whole rock isochron ages of c. 590 Ma from well-foliated sillimanite-bearing granulites from close to the bottom of this nappe and 40Ar–39Ar biotite ages of c. 591–567 Ma (Reno et al., 2010, AJS). For the CdC nappe, monazite chemical dating yields ages of c. 631 Ma and c. 620–617 Ma from higher Y domains, interpreted to date the high-T suprasolidus growth of foliation-forming biotite during high-pressure close to isobaric cooling following peak T, and c. 605–594 Ma from lower Y domains, interpreted to record crystallization of residual melt and release of fluid at the solidus (Reno et al., in revision, JMG). Decompression is followed by cooling that is constrained by 40Ar–39Ar ages on biotite of c. 542–510 Ma (Reno et al., 2010, AJS). Initially, the Três Pontas–Varginha Nappe cooled slowly at a rate of <1˚C Ma-1 from $\sim$800˚C at c. 648 Ma to $\sim$750˚C at c. 597 Ma, but then the rate of cooling increased dramatically to >20°C Ma-1, which is attributed to tectonically driven exhumation during orogenic collapse triggered by regional extension as a far-field effect of eastward subduction of the passive margin on the east side of the craton associated with the formation of the Ribeira Belt.