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Reconstruction of P-T-t metamorphic conditions from symplectites: insights from Pouso Alegre mafic rocks (Brasília Belt, Brazil)

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Reconstructing the metamorphic history of polycyclic tectono-metamorphic mafic rocks that preserve potential relicts of high-pressure metamorphism is challenging because such rocks are commonly retrogressed and rare in supercrustal sequences. However, pressure-temperature-time (P-T-t) information is required to obtain the paleo-geothermal gradients and thus to define those units as markers for suture zones. The mafic rocks from Pouso Alegre in the Meridional Brasília Orogen (SW-Brazil) outcrop as rare lenses within Sil-Grt gneisses, Amp-Grt orthogneisses and Bt granites. They are heavily weathered. They have previously been defined as “retro-eclogites”, based on the characteristic symplectite texture and some mineralogical observations. They have been intepreted to mark the suture zone between the Paranapanema and São Francisco cratons, although no quantitative estimates of the pressure is available to support this conclusion. In this study we investigated in detail these samples to refine their P-T-t history.

As commonly observed in retrogressed eclogites, the studied mafic rock shows symplectite and corona textures overprinting the former paragenesis of Garnet (Grt) - Clinopyroxene (Cpx) 1 - Amphibole (Amp) 1 - Rutile (Rt). Phase equilibrium modelling shows that this assemblage is stable at 690°C and 13.5 kbar, in line with Zr-in-rutile thermometry (720 $\pm$30º C). Local compositions of the symplectite domains were used to retrieve the jadeite content of Cpx1. This low-Jd cpx is in line with the predictions of the model and confirms a maximum pressure of $\sim$14 kbar. The symplectite formed from the reaction Cpx1+Qz+$H_2O$$\rightarrow$Cpx2+Amp+Pl+Qz taking place at conditions of 600-750°C and <7 kbar.

Zircon and monazite U-Th-Pb geochronology was performed for the mafic and surrounding rocks. Zircon core dates from the mafic rock spread along concordia from ca. 1.7 to 1.0 Ga with a cluster at 1520$\pm$17 Ma, which is interpreted as the protolith crystallization age. Zircon rim dates are in the interval 660-590 Ma, with a weighted average of 603.5$\pm$6.8 Ma for the youngest cluster. Monazite and metamorphic zircon ages from the host rocks are older at ca. 630 Ma. Zircon rims REE patterns as well as clinopyroxene and amphibole inclusions indicate that the age of the metamorphism of 603.5$\pm$6.8 Ma is related to the decompression event. The significant time span between protolith crystallization and metamorphism (ca. 800 Ma), the lack of evidence of a collision in this period, and the bulk-rock chemistry (typical MORB) suggest a continental basalt/gabbro origin. The mafic magma intruded the 2.1 Ga granitic country rocks at ca. 1.5 Ga, and volcanoclastic sediments were deposited on this basement by 800 Ma. The sequence was involved in a collision and reached the pressure peak conditions at ca. 630 Ma. The geothermal gradient reconstructed from the Grt-Cpx amphibolite does not necessarily indicate subduction, and therefore the Pouso Alegre should not be used as suture marker.