100 Ma of localized magmatism in eastern Borborema Province (NE Brazil): Evidence for a long-lived stationary heat source

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The Neoproterozoic Borborema Province of northeastern Brazil is characterized by large transcurrent shear zones that are used as domain boundaries. In the eastern part of the state of Pernambuco, the dextral East Pernambuco shear zone (EPSZ) separates the Central Domain from the Pernambuco-Alagoas (PEAL) Domain. The northern portion of PEAL Domain is composed almost exclusively of granitic rocks covering an area of c. 180 km x 40 km. These rocks range from true orthogneisses displaying a low to moderately dipping, solid-state foliation to granitic plutons locally deformed along mylonitic belts related to the EPSZ and other smaller shear zones. With exception of younger plutons composed of two-mica peraluminous granites, the majority of the plutons/orthogneisses is metaluminous to slightly peraluminous, and usually associated with a small amount of mafic to intermediate rocks. They have high-K calc-alkaline to shoshonitic affinities, with high K_2O contents (up to 7 wt.%) and high K_2O/Na_2O ratios (usually 1.4 to 2). They show enrichment in large ion lithophile elements but are also relatively enriched in high field strength elements. These characteristics make that analyses yield dubious results where plotted in tectonic discrimination diagrams. Crystallization ages range from 657 ± 3 Ma to 562 ± 6 Ma, with younger intrusions usually containing inherited zircons from previous magmatic events. The longevity of this magmatism requires the persistence of an almost stationary heat anomaly for c. 100 Ma, rather unlike the case of modern subduction zone settings, where semi-continuous magmatism shows large spatial shifts in time scales of tens of millions of years. Zircon overgrowths in some samples yielded ages ranging between 630 ± 7 and 577 ± 4 Ma, which are interpreted as metamorphic ages related to the Brasiliano Orogeny. The protoliths of orthogneisses older than c. 630 Ma are interpreted as have been generated in an extensional setting. Their petrographic and geochemical characteristics together with the association with mafic/intermediate rocks point to an origin involving partial melting of lower crustal sources and/or the lithospheric mantle. Since there is no evidence for Neoproterozoic subduction, the calc-alkaline affinity of some samples can be explained by involvement in their genesis of enriched sources formed during Paleoproterozoic subduction events. The small time span between rifting and orogenic deformation allowed maintenance of the high thermal gradients resulting from lithospheric extension, such that melting and metamorphism was possible during the early stages of shortening. Shear heating associated with development of transcurrent shear zone, beginning around 590 Ma, and accumulation of high heat producing elements-rich granites within the middle crust contributed to the persistence of elevated temperatures for a long time, leading to partial melting of crustal materials and production of the c. 575-560 Ma-old late peraluminous granites.