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Thermochronological evidence for polyphase post-rift reactivation in SE Brazil

N. Cogné (1), K. Gallagher (1), P.R. Cobbold (1), and C. Riccomini (2)

(1) Université Rennes 1, Géosciences Rennes, France (nathan.cogne@univ-rennes1.fr), (2) Instituto de Geociências, Universidade de São Paulo, SP, Brazil

The continental margin of SE Brazil shows good evidence for tectonic activity well after the break-up of Western Gondwana (see Cobbold et al., 2001 for a review). Additionally, SE Brazil ranks as an HEPM (high elevation passive margin), summits reaching 2800 m. To constrain the onshore evolution of the margin, especially during the Tertiary, we did a new thermochronological and structural study.

After an initial regional study, during which we found additional evidence for a major phase of exhumation during the Late Cretaceous to Early Tertiary (Cogné et al., 2011), we focussed on a region that was clearly subject to Tertiary tectonics. This region includes the Tertiary Taubaté basin and the adjacent Serra do Mar and Serra da Mantiqueira.

We used two thermochronolgical methods on the same samples, apatite fission tracks (AFT) and U-Th/He on apatite (AHe). AFT ages range from 129.3±4.3 Ma to 60.7±1.9 Ma with mean track lengths (MTL) from 14.31±0.24 μm to 11.41±0.23 μm, whereas AHe ages range from 519.6±16.6 to 10.1±0.1 Ma. A subset of AHe ages, selected on the basis of data consistency and geological arguments, has a smaller range (122.4±2.5 to 45.1±1.5 Ma).

We have combined inverse and forward modelling to assess the range of acceptable thermal histories. Results of inverse modelling confirm our earlier study by showing a Late Cretaceous phase of cooling. Around the onshore Taubaté Basin, for a limited number of samples, another period of cooling occurred during the Early Tertiary, around the time when the basin formed. The inferred thermal histories for most of the samples also imply a later reheating, followed by a Neogene cooling. According to forward modelling, the evidence for reheating seems to be robust around the margins of the Taubaté Basin, but elsewhere the data cannot really discriminate between this and a less complex thermal history. However forward modelling and geologically independent information support the conclusion that the whole area cooled and uplifted during the Neogene.

The synchronicity of the cooling phases with tectonic pulses in the Andes and in NE Brazil, as well as the tectonic setting of the Tertiary basins (Cogné et al., submitted) lead us to attribute these phases to a plate-wide compressive stress, which reactivated inherited structures during the Late Cretaceous and Tertiary. The relief of the margin is therefore due, more to polyphase post-rift reactivation and uplift, than to rifting itself.

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