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Slab length and slab tearing control asymmetric exhumation of the Calabrian Arc

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Slab dynamics play a fundamental role in shaping the landscape through subduction, tearing, and rollback. The Calabrian Arc, situated along the convergent margin of the Eurasian and African plates, offers a natural laboratory to investigate the interplay between rollback, slab geometry, and tearing. Building upon prior studies that have primarily focused on large-scale geophysical or tectonic data, our study incorporates insights from locally derived low-temperature thermochronology to provide a more comprehensive understanding of the long-term evolution of the Calabrian Arc. Our integrated analysis reveals a cessation of exhumation earlier in the north relative to the south, suggesting that the more extended Ionian slab segment in the north reached the 660-mantle transition zone first (~14 Ma). This event initiated a cessation of exhumation and a faster retreat in the northern region, while the shorter Ionian slab segment in the south continued to subduct for a longer period, maintaining exhumation in that domain (~9 Ma). A slab tear in the Catanzaro trough delimits the boundary between the longer and the shorter slab segments and provides further evidence to this model. This study provides an explanation for the asymmetrical exhumation of the Calabrian Arc, emphasizing the role of heterogeneous slab length and tearing dynamics in the shaping of tectonic patterns within subduction zones.

Session: *Pangeo workshop: Earth's Spheres (Crust, Mantle & Core)*

Keywords: *Thermochronology, exhumation, rollback, geodynamics, Calabrian Arc*