Cooling Histories of Exhumed Footwall Fault Blocks from the Southern Rio Grande Rift and Eastern Basin and Range Using U-Th/He Thermochronology

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The Basin and Range province and Rio Grande rift (RGR) form a complex region that records a major transition in the tectonic history of North America from Laramide shortening to Cenozoic crustal extension. Driving mechanisms for this episode are still highly debated and include changes in stress field, widespread small-scale mantle convection, and growth of the San Andreas transform boundary. A suite of apatite (AHe) and zircon (ZHe) (U-Th)/He and apatite fission track (AFT) dates have been collected from across southern New Mexico and easternmost Arizona. These data were modeled with the program HeFTy to constrain the cooling history of fault-block uplifts that form the physiographic transition zone between the Basin and Range and Rio Grande Rift. AHe ages range from 3–22 Ma, ZHe ages range from 2–649 Ma, and AFT ages range from 10–34 Ma with average track length distributions of 10.8–14.1µm.

Time-temperature models created from combining AHe, AFT, and ZHe data were used to delineate the spatial pattern of the timing of rapid extension in each of the locations sampled across southern New Mexico. The Chiricahua Mountains and Burro Mountains have an onset of rapid (cooling rates exceeding 15°C/My) extension at ca. 29–17 Ma, whereas in the Cooke's Range a similar period of rapid extension is observed at ca. 19–7 Ma. In the San Andres Mountains, Caballo Mountains, and Fra Cristobal range, rapid extension is observed ca. 23–9 Ma. Measured average track lengths are longer in Rio Grande Rift samples and ZHe ages of >40 Ma have only been observed west of the Cooke's range, suggesting different exhumation conditions of the zircon partial retention zone and the AFT partial annealing zone. This supports onset of Basin and Range extension that both precedes and overlaps with the main phase of opening of the Rio Grande rift along its entire length beginning ca. 25 Ma. Additional work is being done to evaluate the impact of Mogollon-Datil and other Paleogene volcanism on samples in the Burro, Chiricahua, and Florida Mountains.

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