Active ultra-high temperature metamorphism recorded in young lower crustal xenoliths, Rio Grande Rift, NM

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Profound questions remain concerning the mechanisms that generate temperatures in excess of 900 °C in the Earth's continental crust. Such conditions are important for the generation of large volumes of magmas and chemical differentiation and stratification of the continents. Previous work on the topic has focused on heat transfer in regions of thickened crust; in contrast, the importance of extensional environments for the formation of granulites has received little attention. Metapelitic xenoliths from Kilbourne Hole, New Mexico—a Pleistocene age maar—host abundant zircon and rutile. Here, we report that this rutile yields effectively zero-age U-Pb dates and Zr concentrations up to ~9000 ppm, consistent with (U)HT conditions (960-1030 °C) [1] at the base of the Rio Grande crust. Zircon U-Pb dates are as young as ~5 Ma and are coupled to Ti-in-zircon temperatures of 800-950 °C. Laser Ablation Split Stream depth-profiling of individual zircon grains reveals a thermal history of Rio Grande extension spanning ~50 Myr. Heating of the lower crust to ~950 °C occurred between 40 and 20 Ma followed by cooling to ~850 °C from 20-8 Ma, and rapid reheating to 960 °C by 7 Ma. These data, in conjunction with regional heat flow measurements, seismic experiments, and the occurrence of similar rocks >1000km to the south in the US-Mexico Basin and Range [2] suggest that (U)HT metamorphism is currently active in the lower crust of the SW USA and NW Mexico. Furthermore, RGR samples potentially represent the youngest (U)HT rocks discovered to date.

[1] Ferry, J. M. & Watson, E.B. (2007) *Contrib. to Mineral. Petrol.* **154,** 429-437. [2] Hayob, J.L. *et al.* (1989) *Nature* **342**, 189-92.