High-precision U-Pb zircon Geochronology of the Wichita Igneous Province, Oklahoma

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Cryogenian-Cambrian intraplate magmatism, including emplacement of large igneous provinces (LIPs), occurred prior to and during ocean-basin formation along many parts of the northern, eastern and western Laurentian margins during Rodinia breakup. The only comparable intraplate igneous assemblage exposed along the largely buried southern margin of the craton is the bimodal Wichita Igneous province (WIP), which has an estimated volume in excess of 250,000 km^3 (based on geophysical evidence), and was emplaced within the Southern Oklahoma Aulacogen during rifting preceeding middle Cambrian opening of the southern Iapetus Ocean. In spite of its regional significance, the WIP has received only limited attention in the LIP literature, and robust published isotopic age constraints for the province are sparse. We present the first high-precision CA-ID-TIMS U-Pb zircon geochronological framework for the WIP, complemented by LA-ICP-MS analyses of zircon trace element geochemisty.

The best outcrops of the WIP occur in the Wichita Mountains in SW Oklahoma, where our new data reveal ages of 532.49 ± 0.15 Ma for anorthositic gabbro in the Glen Mountains Layered Complex and 532.26 ± 0.16 Ma for a relatively small granite pluton representing an early pulse of felsic magmatism in this part of the province. Voluminous A-type rhyolites and the extensive Mt. Scott sheet granite yield ages of 530.98 ± 0.15 to 530.45 ± 0.14 Ma. These data suggest that significant parts of the WIP were emplaced in a narrow time frame (~2 m.y.), consistent with a mantle-plume model for the province. Another rhyolite flow exposed in the Arbuckle Mountains ~100 km m to the SE has an age of 539.20 ± 0.15 Ma, slightly younger than the Cambrian-Ediacaran boundary. This result suggests that magmatism was diachronous along strike in the Southern Oklahoma Aulacogen, but additional work is needed to better constrain the overall time-space relations of rift-related igneous activity within this major tectonic feature.