# Contrasting rift-margin volcanism in the St. Francois Terrane of Missouri at 1.47 Ga

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Orthogonal tectonic fabric of Paleoproterozoic rocks in the mid-continent influenced development of the St. Francois Terrane (SFT) at all scales. At the largest scale, the Missouri Gravity Low (MGL) is a NW-trending rift defined by gravity and magnetic data. This 800 x 80 km structure is cut by the Reelfoot Rift (~ 0.6 Ga) and Mid-Continent Rift (~1.1 Ga). Geophysical models suggest that the MGL is filled by 12-20 km of granite, rhyolite, and clastics covered by a Paleozoic veneer. SFT uplift exposed the SE end of the MGL where two rift-margin volcanic fields erupted during strike-slip faulting. The SW rift boundary coincides with releasing bends and the Eminence-Van Buren volcanic series (EVB); the NE boundary coincides with a restraining bend and the Mudlick volcanic series (MLV). The latter is in a contractional duplex. Both boundaries are regional faults with net sinistral slip formed with $\sigma_1$= E-W (horizontal).

The EVB are caldera-erupted ignimbrites with 65-90° dips, thickness > 7 km, and volume > 360 km$^3$; these are covered by 300 m of post-collapse, sub-horizontal effusives dated at 1470 ± 2.7 Ma. Volcanicastics and air fall tuff mark the synvolcanic unconformity. The ignimbrites are crystal-poor rhyolites exhibiting alkali exchange, secondary alkali feldspar, sericite, and silicification. The MLV series (1461 ± 4 Ma) comprises > 96 km$^3$ of fissure-erupted effusive rocks produced by mingling of mafic and granitic magmas. The resulting hybrid approximates quartz latite composition and exhibits undercooling, flow structure, propylitic alteration, and intrusion by 1.35 Ga gabbro. Ages and eruptive volume > 456 km$^3$ indicate that faulting across the MGL tapped syntectonic magma and produced major intra-rift volcanic events along both margins at about 1.47 Ga. Contrast in eruptive style resulted from magma emplacement in transtensional and transpressional sites.

# Hf isotope compositions of Laurentian anorogenic granites

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Granitic rocks are commonly used as a means to study chemical evolution of continental crust. In particular, their isotopic compositions reflect the relative contributions of mantle and crustal sources in their genesis. In Laurentia, a distinctive belt of Mesoproterozoic anorogenic granites of ~1.4 Ga age was emplaced across a composite shield comprised by Archean and Proterozoic crust. Zircons are an ideal mineral to constrain the granite petrogenetic history because they are repositories of both age (U-Pb geochronology) and tracer (Lu-Hf isotopic) information.

We measured the Hf-isotope composition of zircons from 31 dated anorogenic granites intruding basement provinces from the southwest U.S. to the upper mid-continent. Hf isotopic measurements were done by MC-ICPMS both on solutions prepared by separation chemistry and on individual zircon grains using laser ablation for comparison. Hf-isotopic values are as follows:

| Province | Age (Ma) | $^{176}$Hf/$^{177}$Hf (initial) | εHf (present) | εHf (initial) |
|---|---|---|---|---|
| Penokean (2) | 1474 | 0.281845 | -33.9 | -1.2 |
| central Yavapai (6) | 1429 | 0.282027 | -27.6 | +4.2 |
| western Yavapai (5) | 1414 | 0.281976 | -29.0 | +2.1 |
| Mojave (12) | 1411 | 0.281891 | -32.3 | -1.0 |
| Granite-Rhyolite (4) | 1393 | 0.281933 | -30.4 | +0.2 |
| s. Granite-Rhyolite (2) | 1372 | 0.282109 | -23.9 | +5.8 |

Isotopic compositions for all 1.4 Ga granites are broadly similar, yet within individual crustal provinces they have distinct, low-variance Hf-isotope values independent of intrusion age. Differences between groups most likely reflect different 1.6-2.0 Ga crustal sources. Granites in the southern Granite-Rhyolite and central Yavapai provinces have the highest εHf(i), reflecting their more juvenile sources, whereas Mojave and Penokean granites show contributions from more evolved crustal sources. The Hf-isotope compositions of the 1.4 Ga granites therefore appear controlled predominantly by melting or assimilation of heterogeneous lower crust, consistent with other geochemical indicators.