Lithospheric modification beneath the Mid-Continent Rift System: Geochemistry as a temporal probe.

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The multi-year snap-shot of the lithosphere that comprises the North America continent provides an unprecedented glimpse of the current-day lithospheric structure, however, this modern lithospheric configuration may be the result of overlapping processes that acted upon the lithosphere during its lifetime. To fully appreciate the origin of structures now imaged, the results of modern geophysical techniques can be interpreted within the temporal record of lithospheric processes preserved in the rock record. The Mid-Continent rift is a dominant geologic feature of the mid-western United States and contains a magmatic record of a plume-influenced and magma-rich rifting environment. Chemical and mechanical modification of the lithosphere is a widely acknowledged feature of continental rifting, therefore unraveling the modern structure in the region is largely dependent on establishing the lithospheric modification processes active during the development of the Mid-Continent Rift. We have undertaken a pilot study of Mid-Continent Rift-related magmatism in the most southern portion of Ontario, Canada, where a particularly complete temporal record is preserved. We have utilized the ongoing interdisciplinary studies in East Africa to place our observations within the broader context of the processes currently active there. The geochemical heterogeneity in basaltic magmas erupted in the Mid-Continent Rift largely preserves variability in contributions from the sub-lithospheric reservoirs contributing to magmatism (e.g. plume, upper mantle), however the effects of lithospheric modification by assimilation and intrusion are also evident. Rhyolites in the region preserve evidence of crustal processes such as magma hybridization/fractionation, and importantly show clear evidence for gabbroic cumulates in the local lithosphere. We also present preliminary geochemical data on newly discovered kimberlites, lamprophyres and other silica under-saturated magmas which will be used to directly probe the composition of the sub-continental lithospheric mantle. These magmas, which largely originate from areas away from the flood basalts and rift may provide key evidence of the composition of the regional lithospheric mantle and form a baseline from which the lithospheric modification associated with the Mid-Continent rift may be evaluated. The ongoing study of the magmatic products associated with the Mid-Continent Rift system will assist in unraveling the sequence of events that has led to the current lithospheric configuration and highlights the potential for future interdisciplinary studies in this region.

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