Radiogenic Isotopes and Trace Elements Constraints on the Sources and Evolution of Alkaline Igneous Rocks from Arkansas

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Introduction

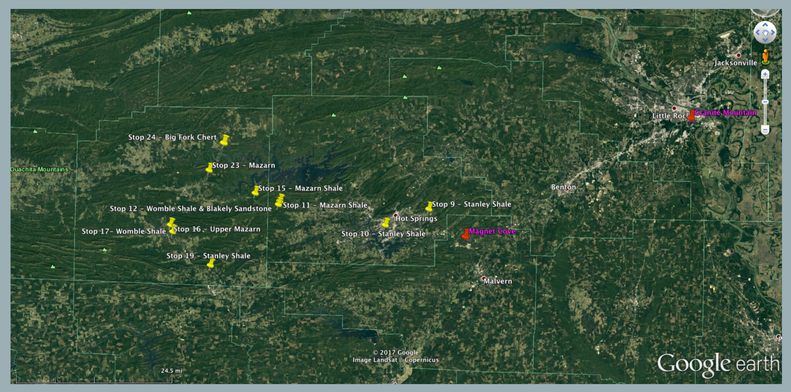
Many dark, organic-rich shale samples, including samples from the Womble, Mazarn, and Stanley Shale units, were collected from the Ouachita Mountains in Central Arkansas in the area surrounding Magnet Cove. Trace element concentrations and Pb, Sr, and Nd isotope analysis will be carried out in the Radiogenic Isotope Laboratory at the University of Arkansas. The results will be compared to available geochemical data on Magnet Cove carbonatites, Granite Mountain syenites, and Prairie Creek and Dare Mine lamproites in order to determine if the shales could have contaminated the alkaline magmas on their way to the surface.

Objectives

Determine if the shales surrounding Magnet Cove contaminated the alkaline magmas on their way to the surface

Geologic Setting

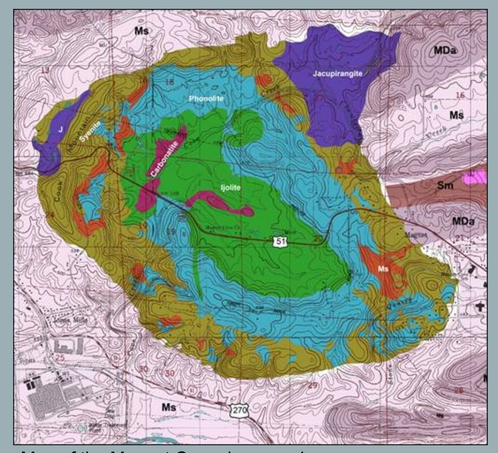
Magnet Cove is a Mesozoic igneous alkalic ring complex lying roughly 1.5 miles west of where Tertiary Gulf Coastal Plain sediments onlap folded Paleozoic rock of the Ouachita Mountains. The sedimentary rocks outcropping in the area surrounding Magnet Cove range from Late Devonian to Mississipian in age. These sedimentary rocks consist of predominantly shale and sandstone. The Mississipian Stanley Shale overlies the Arkansas Novaculite, the oldest major unit present in the area. Other units include Womble, Mazarn, and Jack Fork. The intrusion itself is a basin with an area of roughly 5 square miles, with a rim consisting of nepheline syenites and an inner belt of phonolites-trachites and carbonotite.



Map of locations from which samples were collected

Methods

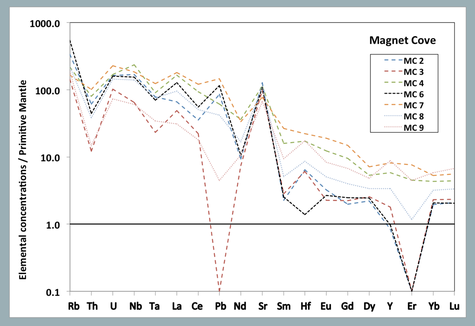
- Total chemical-dissolution procedures carried out in the Class 100 Clean Lab at Univ. Arkansas
- Pb, Sr, Nd will be separated using column chromatography
- Pb, Sr, Nd isotopic analyses will be carried out on Nu Plasma MC ICP-MS
- Trace element concentrations will be measured on Thermo iCAP Q ICP-MS

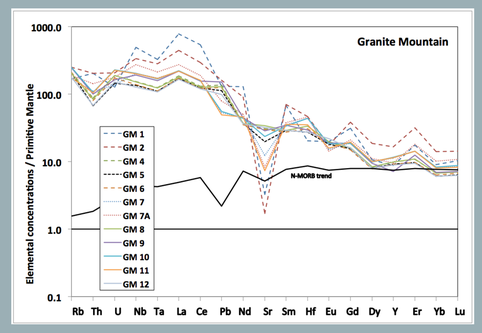


Map of the Magnet Cove ring complex.

Shale outcrop in the Ouachita Mountains from which samples were collected.

Stanley shale and carbonatite samples.





Trace element concentrations in Magnet Cove Carbonotite and Granite Mountain Syenite

Preliminary results

Trace Element Concentrations – Magnet Cove

- Overall negative Th, Ta, Ce, Nd, Sm, Er anomaly
- Overall positive U, La, Pb, Sr anomaly

Trace Element Concentrations – Granite Mountain

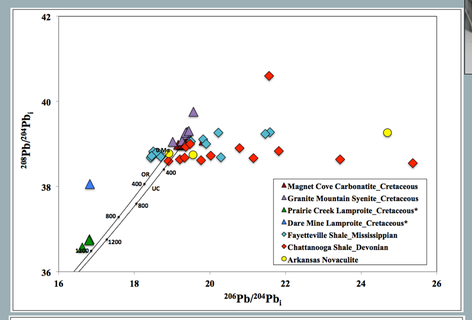
- Highly incompatible element enrichment
- Overall negative Th, Sr anomaly
- Overall positive U, La, Sm, Gd, Er anomaly

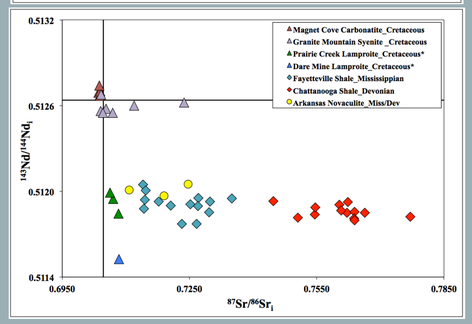
Pb Isotopes

- Magnet Cove carbonatite and Granite Mountain syenite more radiogenic than Prairie Creek and Dare Mine lamproites
- Chattanooga and Fayetteville shale did not supply Pb to Magnet Cove carbonatite and Granite Mountain syenite
- Magnet Cove carbonatite and Granite Mountain syenite close to radiogenic end of MORB-EPR

Sr, Nd Isotopes

- Prairie Creek, Dare Mine lamproites – enriched sources
- Magnet Cove carbonatite – depleted sources
- Granite Mountain syenite – 2 trends: depleted and enriched source





Radiogenic isotope ratios of alkaline igneous rocks and shales corrected to 100 Ma (age of intrusion)

References

J. M. Howard and A. Chandler (2007)
Magnet Cove: A synopsis of its geology, lithology, and mineralogy. Arkansas Geological survey, p.1-4, 10.

Potra A., Hardisty L., Philbrick J., and Bottoms B. (2017)
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