Isotope and trace element geochemistry of Cretaceous igneous rocks of the Arkansas Alkaline Province, USA: constraints on their origin and evolution

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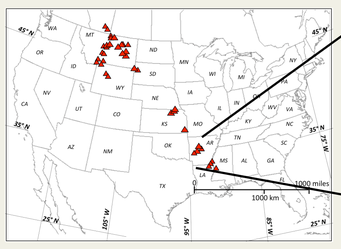
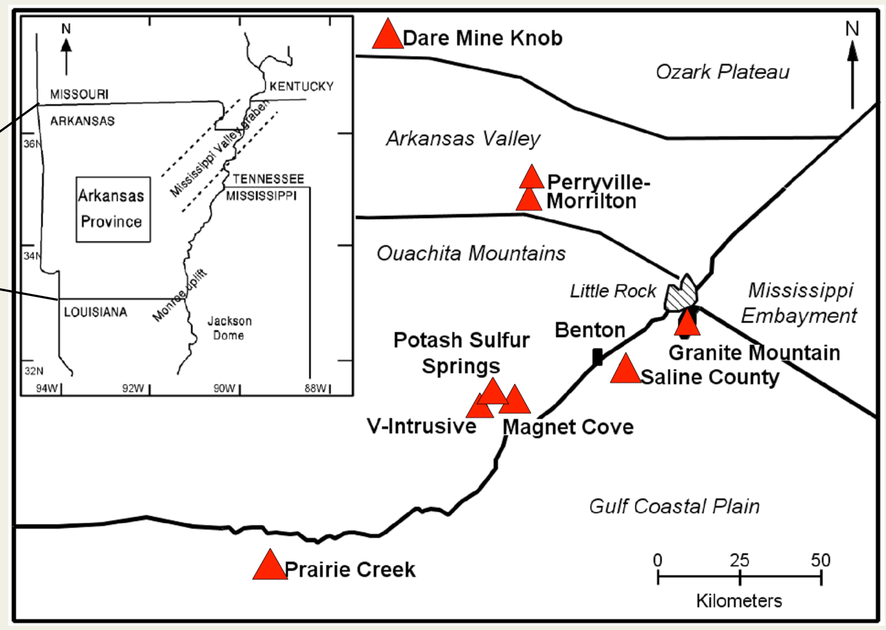
Motivation

On-going debate over the sources and causes of intraplate alkaline magmatism due to highly diverse isotope and trace element geochemistry

Study area





Map showing location of alkaline igneous rocks in the mid-continent US (exposures on the NE side of the USA are not shown). Enlarged map on the right: regional setting for the Arkansas alkaline province and locations of igneous rocks (after Eby and Vasconcelos, 2009; Duke et al., 2014).

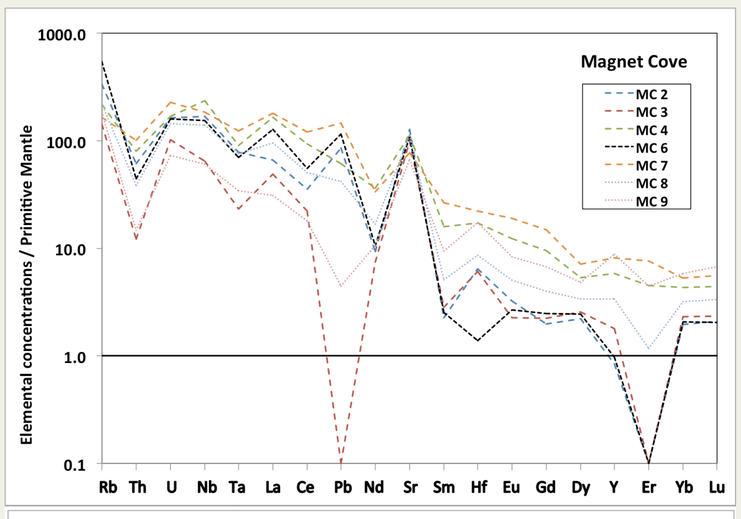
Material and Methods

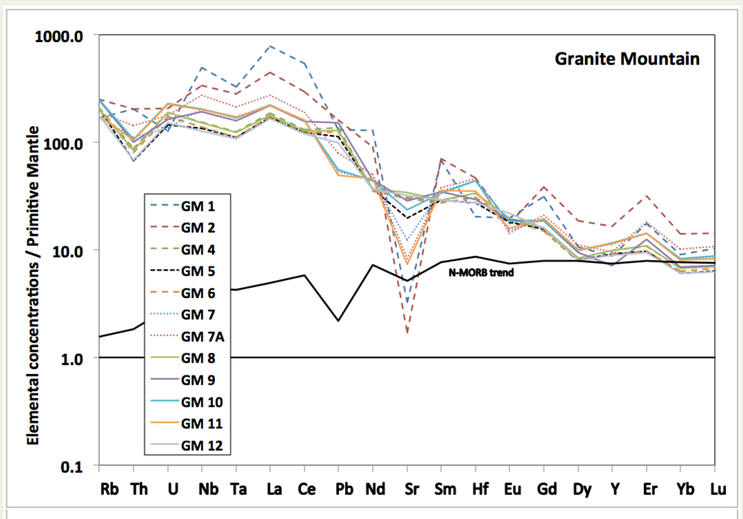
- 19 Cretaceous alkaline igneous rocks (carbonatites; syenites) from Magnet Cove and Granite Mountain
- 14 Mississippian Fayetteville shale
- 13 Devonian Chattanooga shale
- 3 Mississippian / Devonian Arkansas Novaculite

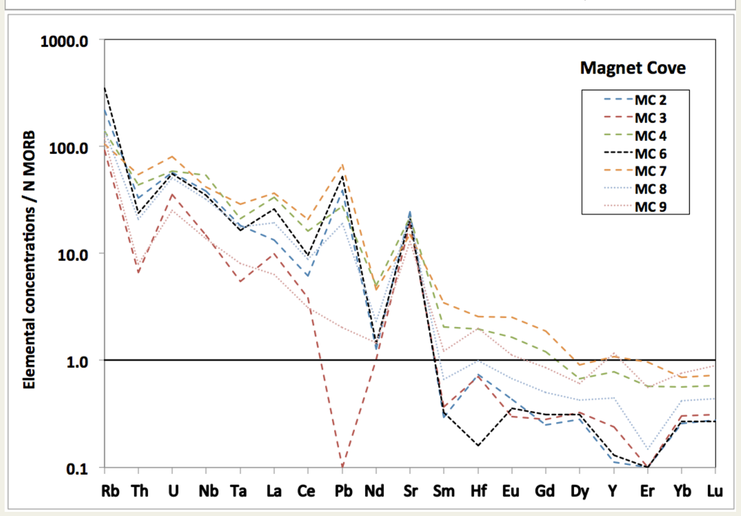
- Total chemical-dissolution procedures carried out in the Class 100 Clean Lab at Univ. Arkansas
- Pb, Sr, Nd separated using column chromatography
- Pb, Sr, Nd isotopic analyses carried out on Nu Plasma MC ICP-MS
- Trace element concentrations measured on Thermo iCAP Q ICP-MS

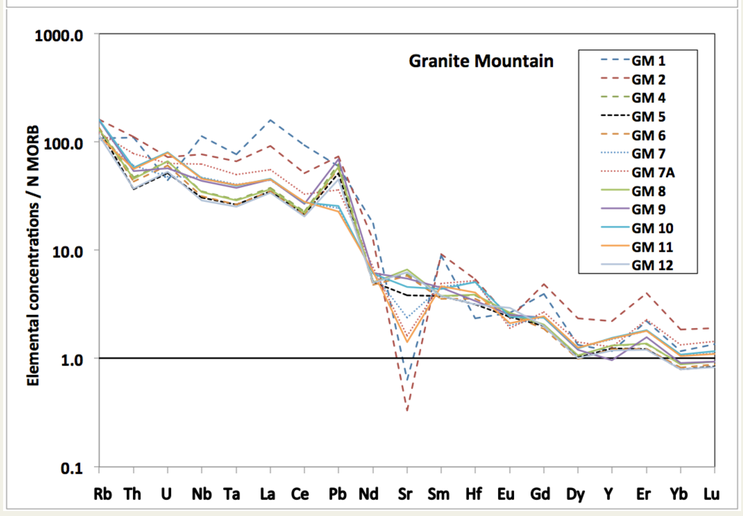
Results

Trace Element Concentrations

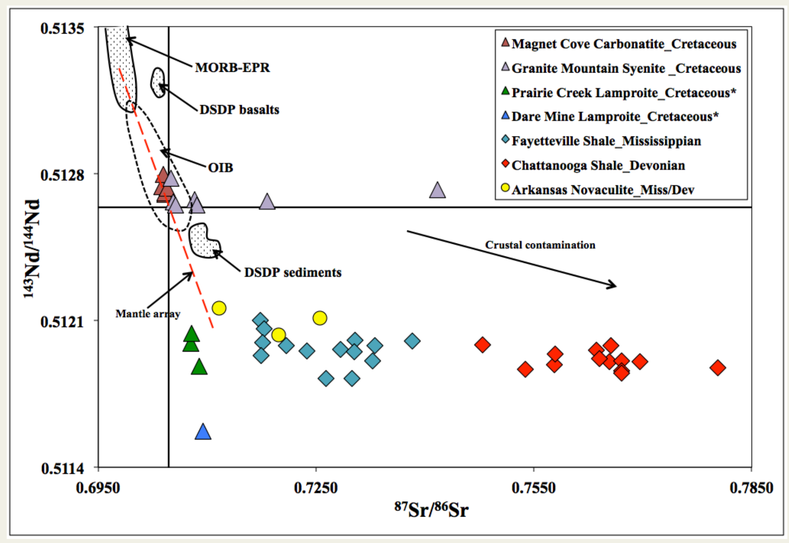


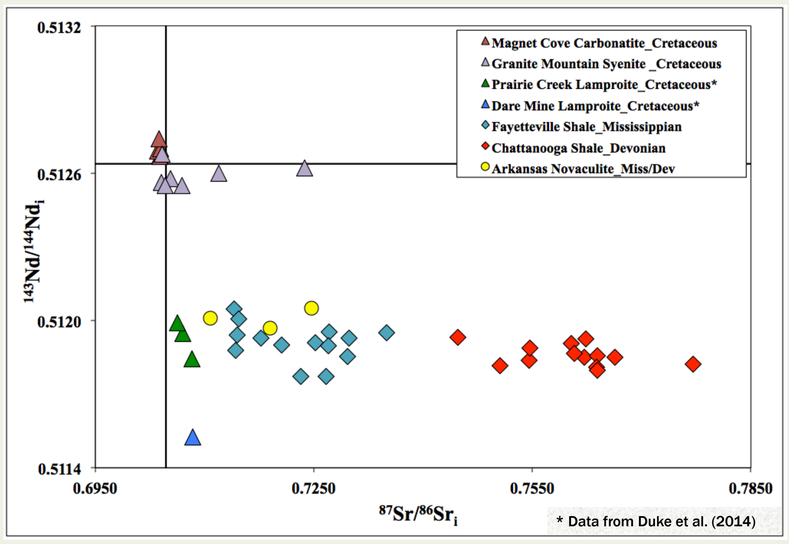




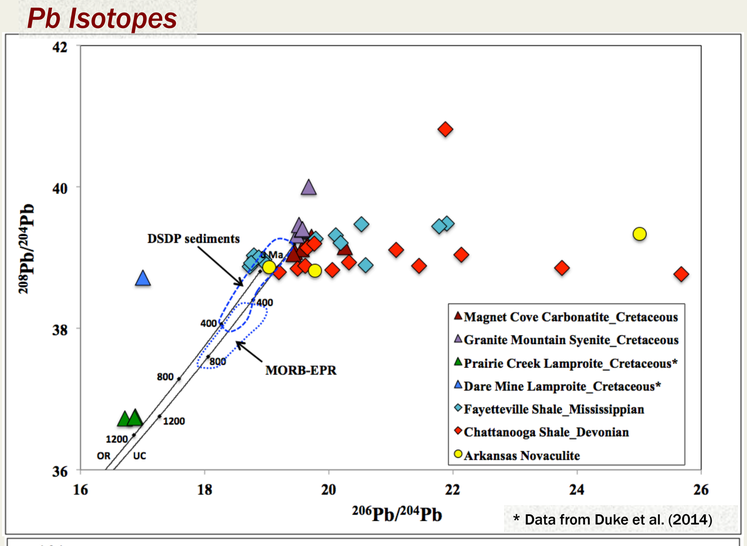


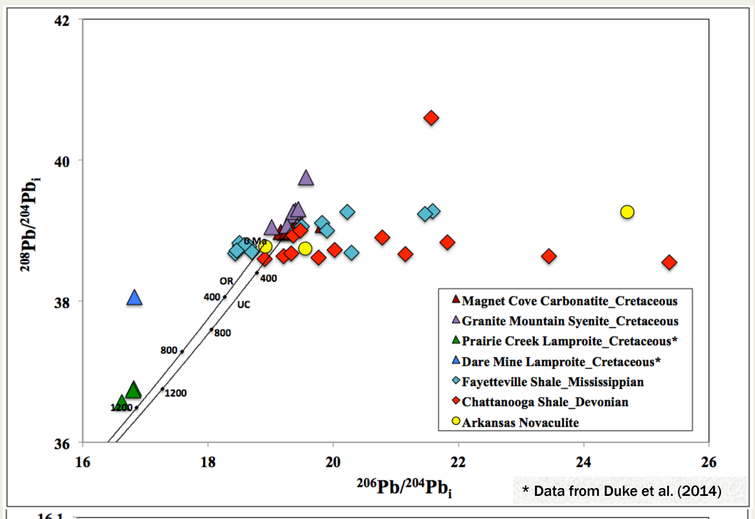
Sr and Nd Isotopes



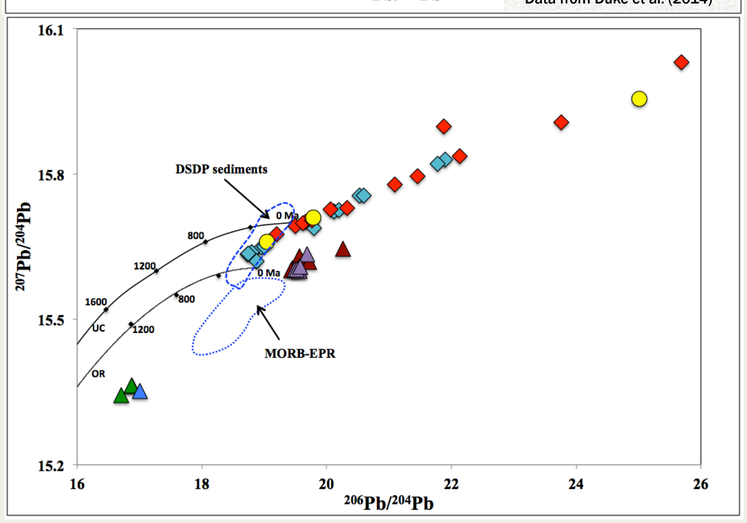


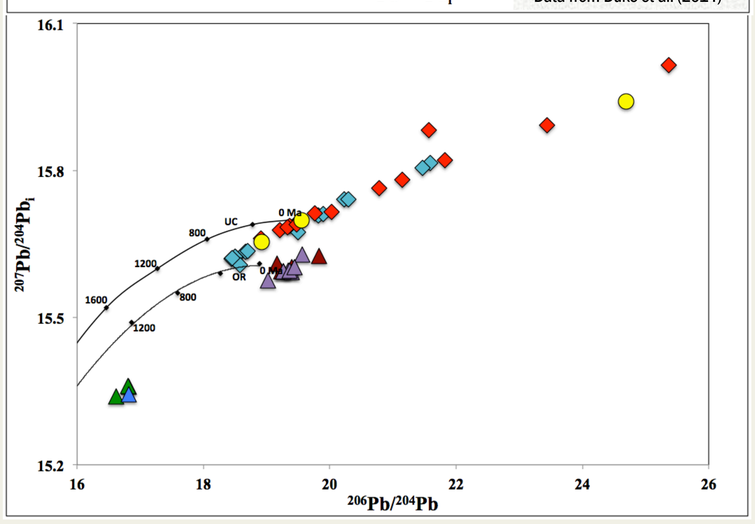
Pb Isotopes





* Data from Duke et al. (2014)





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

Acknowledgements

- The authors are grateful to E. Pollock and J. Samuelsen for their help with operating the MC ICP-MS and Q ICP-MS .