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Collaborative Research: Locating the Mantle Component in Granite

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Principal Investigator: Lux, Daniel R.
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Title:
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Project Participants

Senior Personnel

Name: Lux, Daniel
Worked for more than 160 Hours: Yes
Contribution to Project:

Post-doc

Graduate Student

Name: Johnston, Ben
Worked for more than 160 Hours: Yes
Contribution to Project:
Ben's masters thesis was in part supported by this award. His contribution included field mapping, geochemical analysis, and interpretation.

Name: Hooks, Benjamin
Worked for more than 160 Hours: Yes
Contribution to Project:
Ben's thesis was fully supported by this award. His contributions included field mapping, geochemical analysis, isotope analysis and interpretaton

Undergraduate Student

Technician, Programmer

Other Participant

Research Experience for Undergraduates

Organizational Partners

Other Collaborators or Contacts

Dr. John P Hogan of the University of Missouri Rolla and Dr. David Gibson of the University of Maine-Farmington are co-PI's on this grant. Also, during the course of the project Ben Hooks and myself analyzed Nd and Sr isotopes at the Scottish Universities Environmental Research Centre in East Kilbride, Scotland working with Dr. Robert Ellam

Activities and Findings

Research and Education Activities:

The research involved the study of 3 granitic plutons along the Maine coast. It included geologic mapping, petrographic study of mineral textures, analysis of major and trace element compositions, electron microprobe studies and isotopic analysis of Nd and Sr isotopes. We assessed the involvement of cryptic mantle components in the evolution of these granites. Electron microprobe studies included compositional mapping of zoned plagioclase and accessory minerals, Al-in-hornblende geobarometry, and chemical characterizaton of all major mineral phases.

Findings:

The major finding are that mafic mantle derived magma are involved in the generation of all of these granites but that it is manifest in different ways in each of the plutons. In the Vinalhaven pluton, field relationships clearly demonstrate that mafic magma that was injected into a silicic magma chamber, ponded on the bottom of that chamber and there interacted with silicic magma and crystal slushes to produce a suite of enclaves that were subsequently dispersed throughout the chamber. This is the likely site of extensive magma mixing. Though similar mixing zones are not exposed at the current erosion level in the other two plutons, similar textural and chemical relationships are exposed in those plutons and we envision a similar origin. The widespread distribution of enclaves throughout the plutons is attributed to active convection, in parted fueled by the thermal inputs at the base. Plagioclase textures are consistent with active convection in the magma chamber. Isotopic composition of the granite and enclave samples are consistent with melting of a young igneous source and Nd depleted mantle ages are consistent with an Avalon source.

Training and Development:

Two graduate students, Hooks and Johnston, received extensive training in field, lab and communication skills. Both completed comprehensive field mapping, petrographic analysis, and analyzed many sample bot major and trace elements. Hooks also analyzed 12 samples for Nd and Sr isotopic composition. Both interpreted their results, wrote MS thesis and presented their results at scientific meetings.
Both also served as teaching assistants at the University of Maine and both participated in training other graduate and undergraduate students in the skills they acquired during this course of their work.

Outreach Activities:

Lead a nature walk for the Vinalhaven Land Trust in the Fall of 2003 to the granite quarries of the island. Interacted with many land owners to explain the science of the project.

Journal Publications

Gibson, D., Lux, D.R. and Choate, M.A.,, "Petrography of a cryptic mixed magma system ? the Mt. Waldo granite, coastal Maine", Atlantic Geology, p. , vol. , ( ). Accepted,

Books or Other One-time Publications

Web/Internet Site

Other Specific Products

Contributions

Contributions within Discipline:

Active magma chambers are inaccessible, but magma chambers can be studied in 2 ways. Volcanic rocks provide a snapshot of magma quenched during the eruption, whereas plutonic rocks are essentially frozen chambers. Most reseach concerning magma chamber processes focuses on the former. However, our work has shown that textural and chemical variations that provide important clues to magmatic processes are preserved in plutonic rocks as well. Difficulties arise from post-crystallization exsolution and hydrothermal alteration. In some instances these are insurmountable but in many cases these potential problems are easily over come. The benefit is that the spatial relationships that formed in the magma chamber are preserved within the pluton. Because of this we can test hypotheses related to magma chamber processes that cannot be addressed by looking at volcanic rocks.

Contributions to Other Disciplines:

Contributions to Human Resource Development:

Two graduate students, Hooks and Johnston, received extensive training in modern aspects of the Geosciences. Both learned about field mapping, textural analysis of plutonic rocks, geochemical analysis and interpretation, mineral analysis (electron microprobe) and data interpretation. Hooks also learned lab techniques and mass spectrometric techniques associated with Nd and Sr isotopic analysis.

Contributions to Resources for Research and Education:

Contributions Beyond Science and Engineering:

Conference Proceedings

Categories for which nothing is reported:

Organizational Partners

Any Book

Any Web/Internet Site

Any Product

Contributions: To Any Other Disciplines

Contributions: To Any Resources for Research and Education

Contributions: To Any Beyond Science and Engineering

Any Conference