

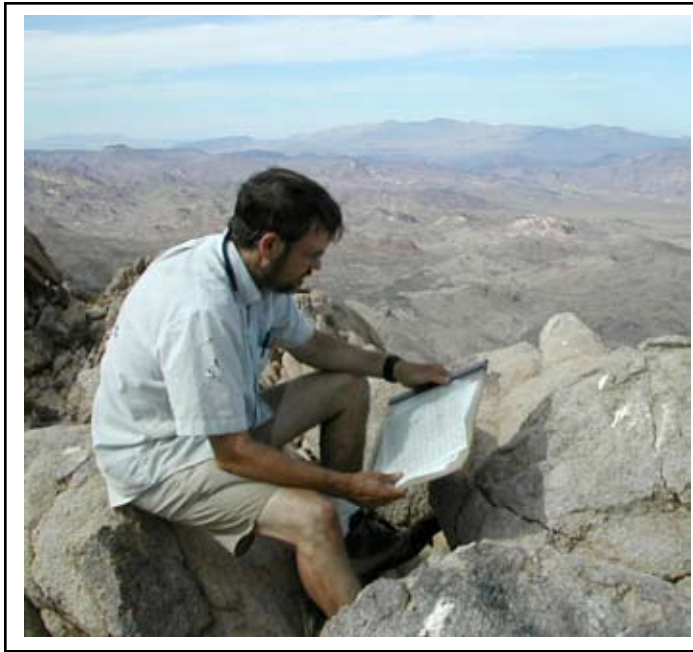
Calvin Miller

PhD UCLA, 1977

magmatic processes, crustal evolution

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General Interests

I teach courses for grad (and advanced undergrad) students in igneous geochemistry, volcanic processes, and special topics in related areas. Our research emphasis is on felsic magmatism and what it tells us about how volcanoes work and how Earth's crust is formed and modified. We are especially interested in what leads to eruptions, small to super-scale (the ultimate volcanic hazard).

Current Research

My students and I aim at the following problems:

- magma chambers: what are they? what are the materials like that reside in them?; how are materials transported into, within, and out of them? how long do they “live,” how do they vary during their lifetimes?



The growing lava dome at Mount St. Helens

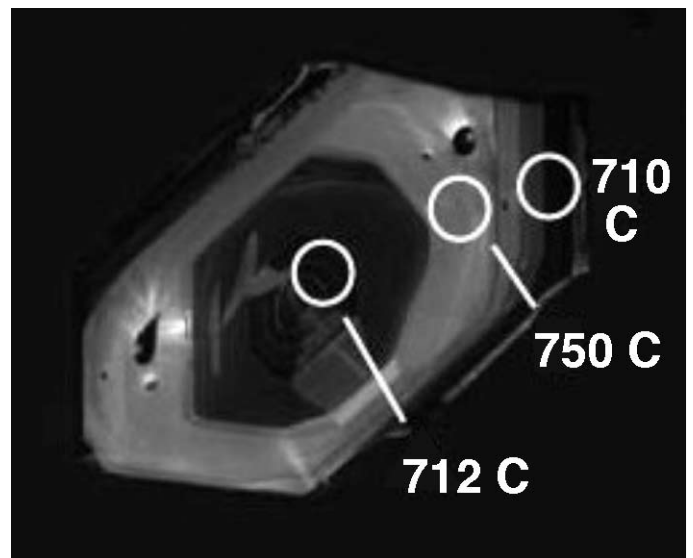
- volcano-pluton connections: what is the relationship between the processes and products at volcanoes and at plutons?

- how do these processes determine when and whether a chamber erupts? How are eruptions reflected in the plutonic products of a magma chamber?

...using the following general strategies and methodologies:

- field work in spectacularly exposed ancient plutonic and volcanic sections, as well as on modern volcanoes. Currently, we are working in tilted crustal sections in southern Nevada where entire 10-15 km cross-sections of plutons and their erupted products are exposed, at Mount St. Helens, where preliminary data indicate that modern eruptions are sampling a half-million year old system and in Iceland. (with Guil Gualda)

- accessory minerals, especially zircon: imaging of zoning and elemental analysis of zones, U-Pb and U-series dating (by USGS/Stanford SHRIMP) - documenting dramatic fluctuations in chamber conditions, long-term storage and mixing of materials (with John Ayers, Brendan Bream)



Cathodoluminescence image of zircon from Spirit Mtn batholith, NV, showing fluctuations in T and elemental chemistry during growth.

- analog experiments to evaluate magma dynamics (transport and mechanical interactions of liquids and crystals) - masterminded by David Furbish
- all supported by “classical” petrography and elemental and isotopic petrochemistry.

...and collaborations are absolutely critical!:

- at Vanderbilt, students and I work with David Furbish, Guil Gualda, John Ayers, and Brendan Bream
- we also collaborate closely with Jonathan Miller (San Jose State University), a field-based petrologist and geochemist; geochemist/geochronologists Joe Wooden and Frank

Mazdab of the USGS/Stanford SHRIMP lab; Jim Faulds of the University of Nevada-Reno (structure-tectonics-field geology, volcanic sequences); and Mike Clynne and John Pallister, USGS volcanologists

• and less formally with a host of USGS researchers and students and faculty at other institutions.

What Students Do

My students have studied a wide range of problems in igneous and metamorphic petrology, mineralogy, and tectonics. Currently, most focus on the sort of issues listed above. Their work is almost invariably field-based and employs a variety of analytical techniques and experiments at Vanderbilt and other labs to address well-focused problems. The aim is both to produce fundamental research and to gain an understanding of research methods and problem-solving in general. Many MS students continue on for PhD's and into academia; others pursue careers in environmental science, secondary education, law, and other fields. My first student in our new PhD program, Lily Claiborne, is using zircon to track the evolution of the Mt. St. Helens magmatic system, as well as investigating construction of and melt segregation within plutonic environments. Recent MS grad Tenley Banik investigated volcano-ice interactions in Iceland, and current MS students Danny Flanagan and Lindy Colombini are studying a major period of transition in eruptive style at Mt St Helens and a rhyolite sequence that documents the final stages of a volcano-plutonic system in Nevada.

2006 Award for Excellence in Graduate Teaching in the College of Arts & Science of Vanderbilt U.

Selected Publications (*=student)

Edited volumes:

Large Silicic Magma Systems, DeSilva, S., Bachmann, O., Miller, C.F., Yoshida, T., and Knesel, K., eds., 2007, Special Issue of *Journal of Volcanology and Geothermal Research*, v. 167, nos. 1-4, 335 pp.

Supervolcanoes, C.F. Miller & D.A. Wark, eds, 2008, special issue of *Elements*, v. 4, no. 1

2005 Daly lecture (annual AGU Volc-Geochem-Petrol lecture): Miller, C.F., Furbish, D.J., Miller, J.S., & Faulds, J.E., 2005, Transport, deposition, storage, and remobilization of felsic magmas and their products in the upper crust: *Trans. AGU, Spring Meeting, EOS*, v. 86, JA521-522.

co-convener, "Dynamics & Longevity of Silicic Magma Systems: Volcanic and Plutonic Perspectives," AGU, Fall, 2007

Selected recent papers:

Bachmann, O., Miller, C.F., and de Silva, S.L., 2007, The volcanic-plutonic connection as a stage for understanding crustal magmatism: *Journal of Volcanology and Geothermal Research*, 167: 1-23.

*Walker, B.A. Jr., Miller, C.F., *Claiborne, L.E., Wooden, J.L., and Miller, J.S., 2007, Geology and geochronology of the Spirit Mountain batholith, southern Nevada: implications for

timescales and physical processes of batholith construction: *Journal of Volcanology and Geothermal Research* 167: 239-262.

*Claiborne, L.E., Miller, C.F., *Walker, B.A., Wooden, J.L., Mazdab, F.K., and Bea, F., 2006, Tracking magmatic processes through Zr/Hf ratios in rocks and Hf and Ti zoning in zircons: An example from the Spirit Mountain batholith, Nevada: *Mineralogical Magazine* 70: 517-543.

Ayers, J.C., Loflin, M., Miller, C.F., Barton, M.D., and Coath, C., 2006, In-situ oxygen isotope analysis of monazite as a monitor of fluid infiltration during contact metamorphism: Birch Creek pluton aureole, White Mountains, eastern California: *Geology* 34: 653-656.

*Harper, B.E., Miller, C.F., *Koteas, G.C., *Cates, N.L., Wiebe, R.A., Lazzareschi, D.S., & Cribb, J.W., 2005, Granites, dynamic magma chamber processes, and pluton construction: Aztec Wash pluton, Eldorado Mountains, Nevada, USA: *Geological Society of America, Special Paper* 389, 277-295.

Student meeting presentations, 2008:

*Claiborne, LL, Miller, 2008, Teaching Radioactive Decay through Hydrostatic Principles, *Transactions of the American Geophysical Union, Fall Meeting, EOS* (in press)

*Colombini, L.L., Gualda, G.A.R., Miller, C.F., Faulds, J., Miller, J., Wooden, J. Mazdab, F., 2008, Mid-Miocene rhyolite sequence, Highland Range, NV: Record of magma evolution and eruption from the Searchlight pluton magma chamber, *Trans AGU, Fall Meeting, EOS*

*Claiborne, LL, Miller, CF, Clynne, MA., Wooden, JL, Mazdab, FK, Pallister, JS, 2008, Temporal, thermal, and compositional evolution of the Mt St Helens magmatic system revealed by zircon, *IAVCEI General Assembly, Reykjavik, Iceland*

*Banik, TJ, Hoskuldsson, A, Furbish, DJ, Miller, CF, Bacon, C.R., Wallace, P.J., 2008, Magma-ice-sediment interactions and the origin of lava-hyaloclastite sequences in South Iceland, *IAVCEI General Assembly, Reykjavik*.

*Claiborne, LL, Miller, CF, Clynne, MA., Wooden, JL, Pallister, JS, Mazdab, FK, 2008, Mount St. Helens Zircon: Implications for magma storage, *Goldschmidt Conference (Geochemical Society), Vancouver, BC*

*Banik, TJ, Miller, CF, Furbish, DJ, 2008, Mechanisms of disaggregation of mafic magma in a crystal-rich granitic mush, *Aztec Wash Pluton, NV, Geol. Soc. America, Cordilleran Section Meeting, abst. with prog. 40*

