From magma to hot springs:
Geochemical modeling of hydrothermal processes

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Hydrothermal fluids beneath the sea floor react with their basaltic host rocks to form chlorite, quartz, epidote, and albite, then emerge in 400°C hot springs that we know as black smokers. The smoker fluid compositions carry a story of how deep they penetrated beneath the sea floor and how hot they got – a story we can extract by geochemical modeling of black smoker waters. Similarly, beneath terrestrial volcanoes, magmatic fluids initially at 700°C rise, decompress, cool and react with their host granite to form an enormous range of minerals from a single initial magmatic fluid composition – minerals ranging from feldspars to micas and topaz – all by reaction with what was once granite. This is another story we can extract from the rocks by geochemical modeling of fluid-rock reactions.

In the short course presentations, we will explore and demonstrate the methods of geochemical modeling applied to boiling, rock reactions, fluid-fluid mixing and adiabatic decompression acting on geothermal waters, black smokers, and porphyry copper ore systems, and thereby develop a picture of the thermochemical constraints on how hydrothermal systems work.

1. Concepts of simultaneous geochemical equilibrium modeling and how it is useful for understanding hydrothermal systems.
2. Equations and methods
3. How do we know equilibrium modeling applies to the real world?: geothermal systems, diagenesis, reproducibility of mineral assemblages
4. Hydrothermal alteration and adiabatic decompression in magmatic hydrothermal systems, e.g. Butte, Montana
5. Seawater-basalt reaction and the origin of black smoker fluids
6. Boiling and mixing of waters in geothermal and epithermal systems and consequent precipitation of scale, which clogs pipes, or precipitation of gold ore, which clogs fractures.