Biological Diversity and Potential in Geothermal Systems

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Geothermal environments are very small in size and distribution on Earth, however, they play strategic role in the pursuit of novel microbial activity for industrial and energy related processes. Hot springs are natural ecosystems where microorganisms have adapted to high temperatures and unique geochemical environments, over centuries, making them ideal to study for understanding extreme ecosystems. Thermal features are also “target” environments for isolating novel and robust microorganisms for biotechnology and energy applications.

Thermal environments have been a source of beneficial microorganisms, including the discovery of unique microorganisms and thermostable enzymes (e.g., Taq polymerase), for the degradation of biomass, and the production of lipases, and for algal biofuels. This presentation will include a brief overview of Yellowstone thermal areas, and results of interdisciplinary geochemical and microbial investigations in the Heart Lake Geyser Basin focused on characterization of unique microbial communities, microbes for enzyme discovery, and for algal biofuels applications.

Correlated chemical and temporal evolution of Cenozoic magmatism in SE-Germany (Heldburg region)

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Detailed petrogenetic models on the causes and sources of Cenozoic magmatism in Central Europe have been developed based on a large number of trace element and isotope data. Due to only sparsely available geochronological data, however, the timescales of the underlying processes (e.g. mantle convection and regional "plume" activity) often remain unclear.

Here, we present new high-resolution $^{40}Ar/^{39}Ar$ ages along with major and trace element data from a series of basanites and melilitites from SE-Germany (Heldburger Gangschar) in order to constrain the temporal and chemical evolution of magmatism in this region. This, in turn, provides information on the temporal evolution and dynamics of the underlying melting processes.

The ages indicate two magmatic events, an older one between ~40 and ~25 Ma, and a younger one from ~17.6 to ~13.1 Ma. The older group comprises mostly melilitites, the younger group are basanites. Although incompatible trace-element patterns (REE and multi-element diagrams) of both groups are similar and indicate enriched mantle sources, specific geochemical tracers indicate different processes involved during magma genesis. For example, the older melilitites differ from the younger basanites by having higher and more variable Nb/Ta (17.7 - 20.7 vs. 18.3 - 19.4), higher Sm/Yb, Ho/Lu and CaO, and more pronounced negative Rb and K anomalies in primitive mantle-normalized trace element diagrams. This indicates a stronger influence of residual amphibole on magma genesis during the earlier stage of magmatism, possibly in the lithospheric part of the mantle, and is consistent with the higher variability in Nb/Ta in the older rocks. La/Yb is high in the melilitites (47 - 63) and unrelated to their ages, but is inversely correlated with age in the basanites (26 to 47). This indicates (i) low degrees of partial melting during the first magmatic event, and (ii) higher but gradually decreasing degrees of partial melting over time and/or a different mantle source during the second stage of magmatism. The second event can be interpreted as a waning pulse of ascending mantle beneath the Heldburg region, active until magmatism ended at about 13 Ma.

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