Coastal groundwater discharge near Kahekili Beach Park, Lahaina, Maui, Hawai'i

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This presentation describes a study conducted off Kahekili Beach Park, located just north of Lahaina on the west coast of Maui, Hawai'i, to better understand rates and drivers of coastal groundwater discharge and associated material transport into nearby coastal waters. This site has recently been well studied to examine how focused municipal wastewater plumes may be conveyed to the coastal waters by discharging groundwater [1, 2]. At this location there are multiple spring vents close to shore (water depth < 2m), where much lower salinity water can readily be observed discharging into the water column. There has also been a notable change in bottom type; this site was once dominated by corals and now is dominated by turf- or macro-algae [1]. This suggests a likely local nutrient imbalance that warrants further investigation. Previous reports have utilized dissolved nitrate - $\delta^{15}N$ records [1] as well as a suite of tell-tale organic pollutants [2] to infer focused municipal wastewater discharges at this location. Our study presents the first estimates of coastal groundwater discharge to this site based on the submarine groundwater discharge tracer, ^{222}Rn, and extends our understanding of the scales, magnitudes, and constituent loads conveyed by this submarine route.

[1] Dailer, Knox, Smith, Napier & Smith (2010) *Marine Pollution Bulletin*, **60**, 655-671. [2] Hunt & Rosa (2009) U.S.G.S. *Scientific Investigations Report*, 2009–5253, 166 p.

Pore scale CO_2-brine-mineral interactions in caprock

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Although the carbon sequestration capacity of the Mount Simon formation in western Ohio has been the subject of much published work, less is known about the ability of the overlying Eau Claire to serve as a caprock over geologic time. Predicting this involves a better understanding of how mineralogic heterogeneity controls the nature and extent of precipitation (pore-closing) and dissolution (pore-opening) in response to CO_2 perturbation. Preliminary study of select rock core indicates that the Eau Claire comprises subfacies on the scale of cm to m dominated by quartz-rich sandstone, shale and carbonate. At the pore scale (mm to microns), the relative abundance and pore-accessibility of reactive minerals such as illite, iron oxides, pyrite, and chlorite become key factors in controlling local geochemical regimes.

Results are presented here from *in situ*, temperature- and pressure-corrected kinetic models of CO_2-saturated brine in contact with rock that draw upon pore, rather than bulk, mineralogies. 2D mineral and pore scan raster maps of thin sections are obtained using a field emission gun scanning electron microscope (FEG-SEM) equipped with QEMSCAN software that compares backscattered electron (BSE) and characteristic x-ray signals against a database of standard mineral patterns. These methods permit the analysis of how micron-scale mineralogical heterogeneity varies over distances of tens of vertical meters. As quantifying the effective reactive pore surface area is a key step in improving the predictability of reactive transport models used to assess the fate of CO_2 in the subsurface, the surface area of pores down to micron scale is estimated by summing pore-non pore pixel edges. A sensitivity study is performed on parameters of particular relevance: CO_2 fugacity (8 – 32 MPa), mineral proportions (informed by sample composition), and brine chemistry (date, location, and depth-matched with rock samples).

Preliminary results indicate that, because of the relative abundance of Mg- and Fe-rich minerals at pore surfaces, CO_2-saturated brine-rock interactions exhibit greater reactivity and are more pH-fO_2-dependent than is predicted by models based on the same samples but considering only bulk mineralogy.

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