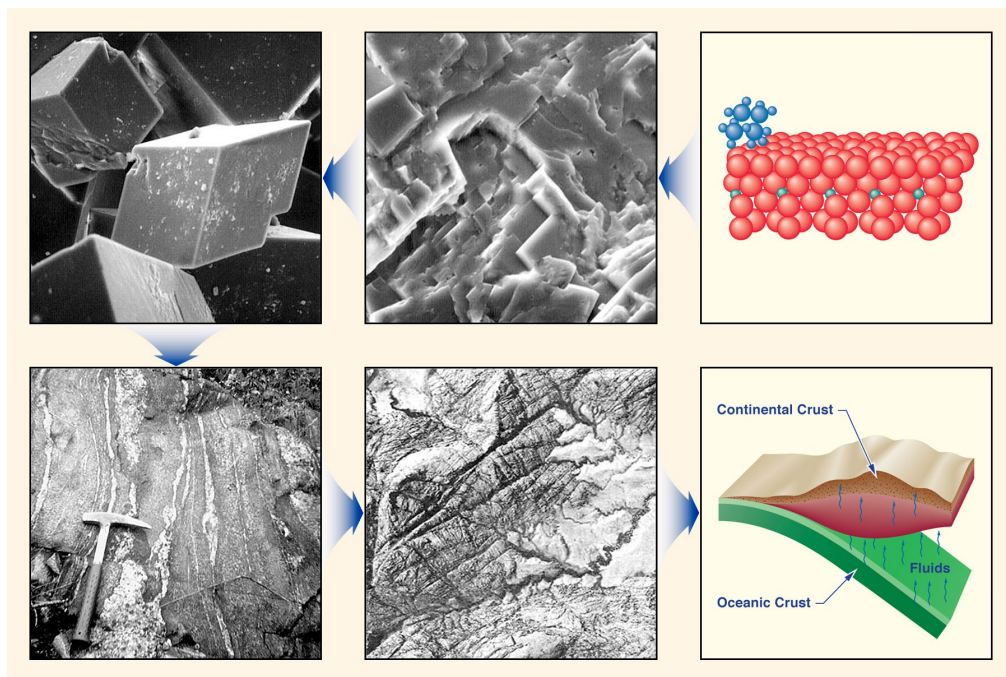


The Cole Group studies water-rock interactions across many length and time scales.



The principal research theme of the Cole group involves the geochemical behavior of fluid/mineral interactions at a variety of length and time scales with an emphasis on analytical, experimental, and theoretical aspects of interactions occurring on surfaces, within pores or along planar features such as fractures, grain boundaries or dislocations common to subsurface energy systems. Research efforts impact practical problem areas such as wastewater injection, geologic CO₂ sequestration, formation, migration and trapping of hydrocarbons in tight formations, the consequences of hydraulic fracturing of gas shale, geothermal assessment and exploitation, and interrogation of metallic and non-metallic mineral resources.

A fundamental understanding of interactions of fluids and solids within these types of structures is central to issues such as fluid transport, element mobility, initiation of recrystallization (e.g., calcite mineral trapping), natural chemical chromatography, and catalysis (both natural and engineered) to name a few. Research targets the role of pore-scale confinement on the molecular behavior of fluids (both polar and non-polar); how fluids react at interfaces in a 3-D environment, what controls the dynamics of molecular motion, reactivity, and the attainment of equilibrium.

Problems of particular interest that remain largely unsolved include: (a) the reaction mechanism(s) and speciation of C-O-H-N fluids, and their role in the formation of point defects and modification of the structural properties of the solid, (b) the wetting, adsorption, motion and reactivity of H₂O, electrolytes and hydrocarbons under confinement, (c) the mechanism(s), speciation and rates of major, minor and trace element reaction and/or transport on and within clays and non-silicates such as carbonates

and oxides, (d) rates and mechanisms of dissolution and precipitation near- and far from equilibrium, and (e) the behavior of light elements (O, H) and cation exchange during coupled reaction-diffusion in silicate and carbonate systems. Many sophisticated tools are required to quantitatively assess these problems including the ion microprobe, SEM, TEM, NMR, isotope ratio mass spectrometry, neutron and X-ray scattering, etc., some of which can take advantage of isotopic doping (at high enrichments) or labeling of the light elements and select cations. Equilibrium isotope fractionation factors and rates of isotopic exchange (via diffusion or mineral transformation mechanisms) are logical spin-offs from many of these studies. Access to facilities not available at OSU can be done via collaborative contacts already established or through instrument user proposals (neutron and X-ray scattering).