Inert gases are present in all ground water as dissolved species, but the concentration and origin of a specific gas can be highly dependent on physical processes within and at the boundaries of a flow system. As a result, dissolved gas tracers (DGTs) have been used to evaluate a variety of processes and flow systems including (1) recharge temperature and elevation in mountainous regions (2) bulk fluid flow in complex fractured aquifers, (3) spatial variations in recharge rates, (4) groundwater ages/travel times, (5) solute transport in diffusion controlled systems, and (6) as partitioning tracers in the vadose zone. A particular strength of DGTs is that multiple tracers having independent sources can often be measured. For example, noble gases such as Ne, Kr, and Xe are of atmospheric origin and their concentrations in ground water depend on temperature, elevation, and the magnitude of water level fluctuations in recharge areas. CFCs are also present in recharging water but depend on timing because the atmospheric concentration is transient. Helium-3 is produced within an aquifer due to radioactive decay, and thus depends on travel times. Helium-4 is produced both within and external to aquifers and depends on flow rates and boundary fluxes. By combining tracers that are produced at the top, bottom and within a flow system a “tomographic” approach for unraveling ground water flow paths and rates can be taken. By collecting samples at an accessible discharge location (production well, seeps and springs, streams) it is possible to constrain processes that occur at distant boundaries as well as the manner in which travel times are integrated along complex flow paths.

The presentation will illustrate the basic concepts of using inert gas tracers along with case studies that describe their applications to real ground water flow problems.