

Workshop 3: Application of Geochemical Techniques in MAR Studies

The objective of this course is to provide an overview of practical applications of environmental isotopes for evaluating and managing MAR operations. Topics include brief discussions of the fundamental principles of tracer geochemistry, sample collection and analysis methods, and case studies.

The main focus of the first section of the course will be practical applications of geochemical techniques for evaluating flow and transport near MAR facilities. This knowledge is needed to establish hydraulic connections and travel times between the recharge location and production wells and to evaluate *in situ* biogeochemical reactions that change the quality of the recharged water within the subsurface. During the class, a number of different geochemical techniques including geochemical fingerprinting with stable isotopes of water and conservative ions, age dating with tritium and its daughter, ^3He , and deliberate tracer experiments with sulfur hexafluoride and isotopically enriched noble gases will be examined. The latter two techniques are used to determine groundwater ages. Knowledge of the spatial age distribution is critical for delineating flow paths and, in some cases, can be used for numerical model verification.

The class will summarize detailed geochemical studies conducted at well characterized MAR operations including the Coastal Dunes of the Netherlands, the Orange County Water District, California, the Montebello Forebay, California, the Berlin Water Works, Germany, and the Bolivar ASR system, South Australia. Failures as well as successes of the geochemical studies will be discussed.

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