AAPG Annual Convention
Salt Lake City, Utah
May 11-14, 2003

James W. Johnson[1], John J. Nitao[1], Stephen C. Blair[1], Joseph P. Morris[2] (1) Lawrence Livermore National Laboratory, Livermore, CA (2) Lawrence Livermore National Laboratory, Livermore,

CO_2 Reservoirs: Are They Natural Analogs to Engineered Geologic Storage Sites?

Although CO_2 reservoirs are commonly referenced as natural analogs to engineered geologic storage sites, there are important distinctions between these settings that may preclude their direct correlation. Most importantly, natural CO_2 accumulations were established over geologic time frames, while CO_2 injection at potential sequestration sites represents a dramatically telescoped and therefore very different thermal, hydrological, geochemical, and geomechanical perturbation of the reservoir/cap rock system. This distinction raises two intriguing possibilities that warrant quantitative investigation. First, the currently secure cap rock of a given natural CO_2 accumulation may have evolved into such as a function of geochemical alteration that attended some degree of initial CO_2 migration through it. Second, whether or not such evolution took place, this same cap rock may be incapable of providing an effective hydrodynamic seal in the context of an engineered injection. There are two corresponding fundamental questions. First, what is the evolution of cap-rock integrity during formation of natural CO_2 reservoirs? Second, will such evolution be similar or appreciably different in engineered storage sites; i.e., what is its dependence on the rate, focality, and duration of CO_2 influx? These questions—upon which strict validity of the natural-analog concept hinges—can be addressed using the reactive transport modeling approach. In this study, we will conduct and compare reactive transport simulations of a well-characterized CO_2 reservoir under both natural and hypothetical anthropogenic "filling" modes. Our results will reveal the dependence of long-term cap-rock integrity on filling history, and thereby shed quantitative light on appropriateness of the natural-analog concept.