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

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Laboratory Studies on the Carbonation Potential of Basalt: Applications to Geological Sequestration of CO_2 in the Columbia River Basalt Group

The Albany Research Center (ARC, Albany, Oregon) conducted laboratory autoclave experiments on samples of the Columbia River Basalt Group (CRBG) as part of its studies of CO_2 sequestration by mineral carbonation. ARC has focused on development of an ex-situ process for carbonation of ultramafic rocks (those with high concentrations of Ca, Fe+2, and/or Mg) with CO_2, but because of the tremendously large volumes of CO_2 emitted from fossil-fuel power plants, an in-situ process may be preferable. Sandstone-hosted saline aquifers are candidates for geological sequestration of CO_2, but these formations have little mineral-carbonation potential due to unfavorable mineralogy. Typical ultramafic sequences do not host saline aquifers due to low porosity and permeability. The CRBG may represent a unique opportunity for geological sequestration because its multi-flow structure has great thickness, vast areal extent, mafic mineralogy, and zones of high porosity and permeability within parts of individual flows. Basalt has favorable mineralogy for mineral carbonation, with up to 25% combined molar concentration of Ca, Fe+2, and Mg cations. It ranks slightly behind olivine and serpentine in carbonation potential of large-volume silicate rocks. The structure and mineralogy of the CRBG provide potential for both hydrodynamic and mineral trapping of injected CO2, and it represents a potential reservoir for billions of tons of CO2.