Mineralogical, Microtextural and Geochemical Analysis of Subsurface Rocks in Southwestern, Southern, and Eastern Ohio: Initial Observations for Evaluating the Suitability of Materials for Sequestering Carbon

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In order to determine the feasibility of sequestering CO_2 in the subsurface, it is important to evaluate the suitability of rock formations for CO_2 storage. Rock samples were collected from the target interval (sandstone) and the over lying caprock of cores from Warren County, Aristech and Coshocton wells in Ohio, to evaluate their potential for both storage (pore space, connectivity and hydraulic conductivity) and long-term geochemical sequestration (chemical and mineralogical reactivity) of CO_2 in the subsurface. The sedimentary rocks samples are characterized using light and scanning electron microscopy, and powder x-ray diffraction. Mineral phase identification is facilitated by combining light and back-scattered electron imaging techniques with energy dispersive x-ray analyses. The samples show extreme heterogeneity in geochemistry, mineralogy, and texture over sub-millimeter to meter scale.

Two-dimensional porosity of core samples are estimated using image processing techniques applied to low-magnification backscattered electron (BSE) images acquired from polished thin sections. Average atomic number contrast as revealed in BSE images is used to quantify the proportions of void spaces and mineral phases present in the specimens. One goal of this analysis is to predict the storage capacity, from a hydraulic standpoint, of specific rock units for injected CO_2-rich fluids, based on estimates of porosity and permeability. Another goal is to assess the potential reactivity of mineral phases for long-term geochemical storage in the form of new minerals formed, the potential for dissolution of existing minerals, or both.

In specimens sampled from a continuously-cored hole in Warren County, Ohio, the lithology of the Eau Claire Formation includes calcareous sandstones with interbedded siltstones and shales. Within a single thin section of the Eau Claire Formation from the Warren County core, zones rich in quartz, feldspar and intergranular glauconite contrast with zones rich in dolomite and fine grained glauconite. Trace mineral phases of zircon, rutile, pyrite, and apatite have also been observed. The underlying sandstone is comprised primarily of quartz, potassium feldspar, as well as Na-rich plagioclase. Additionally, the sandstone contains regions rich in clays and iron oxide cement. These results indicate that mineral reactivity might be important in both the caprock and sandstone.

AAPG Search and Discovery Article #90131©2011 AAPG Eastern Section Meeting, Washington, DC, USA, 25-27 September 2011.