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Changes in the Transport Properties of Well-Cement Under CO2-Sequestration Conditions

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Subsurface carbon dioxide sequestration represents a potential method to reduce emissions of CO2 into the atmosphere. If large-scale sequestration is adopted as a solution to the carbon problem the pathways that the CO2 may use to escape from the subsurface must be understood so leakage can be minimized. One potential leakage pathway is abandoned oil and gas wells. A series of experiments have been undertaken to understand the effects that subsurface carbon sequestration may have on abandoned wells. The experiments are being run under conditions that simulate the sequestration environment (carbonic acid, low pH, high salinity, and high temperature). The experiments examine the effects of sequestration on well cement, host rock and the interface between the cement and rock and they provide data on how the transport and mechanical properties (permeability and hardness) of the well cement and cement-rock interface change with exposure to sequestered CO2. As a means of understanding the mechanisms behind the physical changes microstructural techniques are employed. Environmental scanning electron microscopy (ESEM) with energy dispersive X-ray (EDX) are used to study changes in the cement phases (portlandite and calcium-silicate-hydrate) that have the largest impact on the transport and mechanical properties of the cement. These techniques are also be used to examine changes that occur at the interface between the cement and the host rock.