Fluid Migration Through Thrusts of the Stewart Peak Culmination

Lynn, Helen B.[*1]; Lageson, David R.[1] (1) Earth Science, Montana State University, Bozeman, MT.

The Stewart Peak Culmination (SPC) is a topographic and structural culmination of the Absaroka thrust sheet in western Wyoming that lies structurally up dip from known subsurface accumulations of CO_2 in southeast Idaho. It is likely that the SPC was also a CO_2 trap prior to Neogene Basin-and-Range extension. The SPC has been uplifted and breached exposing the structural and lithologic elements analogous to the CO_2 traps in SE Idaho. Investigation of this exposed trap allows for characterization of migration pathways and determination of the relative timing of fluid migration episodes.

Paleozoic-Mesozoic rocks have been highly deformed by movement of the Absaroka thrust sheet and its associated imbricate thrusts. Faulting led to extensive fracturing and brecciation that locally enhanced porosity and permeability. Brecciated fault zones are up to 4 m thick. Highly fractured damage zones extend for 10s of meters into the hanging walls of large-displacement thrust faults. Fractures that developed in the culmination are the cumulative result of multiple slip events and aseismic processes. Fractures measured in the field have systematic geometric patterns associated with faulting and folding. The dominant fracture set consists of vertical to sub vertical, ENE striking fractures that generally parallel the direction of thrust transport (Mode I dilational fractures). Crack-seal vein textures and multiple overprinting breccia textures suggest episodic seismic rupture. Fluid migration in the culmination was focused through faults, fractures, and breccia zones. Hydrothermal fluids likely enhanced these conduits via the processes of dolomitization, dissolution, fracturing, and brecciation.

Late-stage breccia bodies form discrete pipes that cross-cut stratigraphy and sometimes fault damage zones. Some breccia pipes developed by dissolution and collapse along tectonic fractures. These breccia bodies are linear in map view and parallel the main thrust transport direction (ENE). Other pipes exhibit dilational, ‘floating clast’ breccia that likely developed by isothermal boiling of CO_2, which lead to hydro-fracturing of host rocks. Secondary mineralization (saddle dolomite and disseminated sulfides) and related rock fabrics suggest a low temperature hydrothermal origin for most breccia pipes. Hydrothermal dolomitization of carbonate reservoir rocks is evident in the field area, and the extent and location of dolomitized bodies appear to be controlled by thrust-related fractures. Fieldwork and petrographic evidence suggest that fracture sets kinematically associated with thrusting served as conduits for multiple episodes of fluid flow including CO_2-charged hydrothermal brines and hydrocarbons.

AAPG Search and Discovery #90126©2011 AAPG Rocky Mountain Section, Cheyenne, Wyoming, 25-29 June 2011