Fracture Analysis and Risk Assessment for a "leaky" CO_2 System in the Rocky Mountain Foreland

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CO_2 sequestration in subsurface geologic formations can aid in the mitigation of anthropogenic CO_2 in the atmosphere. Supercritical CO_2 behaves similarly to hydrocarbons in the subsurface, therefore researching hydrocarbon reservoir-trap-seal systems is important for understanding deep subsurface sequestration. Hydrocarbon systems can provide excellent reservoir-trap-seal systems for storing CO_2. Hydrothermal fluid flow in the subsurface is often associated with CO_2 migration and investigating the pathways will help to understand potential CO_2 leakage problems. Many Laramide uplifts (basement-involved, tri-shear anticlines) in the Rocky Mountain foreland are hydrocarbon traps and possible sites for carbon sequestration. The Thermopolis anticline in Thermopolis, WY is a fault-controlled, Laramide anticline with an active source of thermal water and CO_2, similar to other hydrocarbon-producing Laramide structures in the region. A high-angle transverse fault zone or relay ramp bisects the anticline and is the location of the Big Horn River and a large mineral hot spring. Hot spring travertine deposits occur at the river level and along the crest of the anticline. Detailed fracture analyses were conducted on the limbs and crest of the anticline. Both hinge-perpendicular and hinge-parallel fracture sets were found, as well as two sets of conjugate fractures. Hydrothermal fluid flow to the surface is inferred to have occurred along the basement-rooted transverse fault zone and then upwards along hinge-perpendicular fractures in the stratigraphic succession. Understanding fractures in structural domes such as Thermopolis anticline aids research in carbon sequestration by more accurately assessing the integrity of possible carbon storage sites and their potential for leakage.