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Possible Salt Movement in Northern Wasatch Plateau

The Jump Creek 7½-minute quadrangle in the northeastern Wasatch Plateau is an area where Late Cretaceous to early Tertiary formations are fractured by at least two complex systems of faults. Southern and eastern sections of the area are dominated by north-south–trending faults, such as the Gordon Creek fault zone, whereas the northern section is dominated by northwest-southeast–trending faults.

Strong evidence, including horst and graben structures, rim synclines, and other collapse-related features, suggests that north-south–trending faults may be related to salt movement within the underlying Jurassic sediments. Indeed, the Gordon Creek fault zone could represent part of the eastern boundary of the Arapian evaporite basin.

The northwest-southeast–trending faults appear to parallel major lineaments that cut across the Wasatch Plateau, Book Cliffs, and San Rafael swell areas and suggest origins not related to salt tectonics. This fault system, however, may be part of these lineaments that have been accentuated by the salt movement.

The possibility of the structures in the Jump Creek 7½-minute quadrangle producing excellent hydrocarbon traps cannot be overlooked. Structures similar to those found in this area are proven producers in Joes Valley and Pleasant Valley fields, both located within several miles of the Jump Creek quadrangle.

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Reactivation of Mesozoic Thrusts as Normal Faults, Humboldt Range, North-Central Nevada

Some low-angle faults in the Humboldt Range of north-central Nevada may be east-verging Mesozoic thrusts that were reactivated as normal faults with westerly displacement. Early deformation in nappes underlain by such faults produced east-verging asymmetric folds of bedding and moderate to steep northwest-dipping penetrative cleavage. These structures, as well as a shallow southeast-plunging Z finite strain axis in nappe rocks, imply west to east compression. Later deformation has younger over older juxtaposition and west-verging asymmetric folds of first foliation. These folds have shallow easterly dipping axial planes whose orientations with respect to adjacent low-angle fault planes and lineations in the fault planes indicate westerly displacement. The later deformation thus implies reactivation of the low-angle faults as normal faults. Though timing of normal fault motion is uncertain, it appears reasonable to associate it with Cenozoic extension in the Great Basin. Reactivation of thrust faults as low-angle normal faults provides further evidence in support of thin-skinned crustal extension.

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Geologic and Engineering Parameters Used in Stimulating Tight Gas-Bearing Sandstones by Modified Hydraulic Fracturing Techniques: North Douglas Creek Arch Field, Colorado

Low-permeability gas-bearing sandstones present in basins of the Rocky Mountain area are commonly bounded by lithologies that are not barriers to hydraulically induced fracture migration. Use of standard hydraulic fracture treatments commonly results in most of the induced fracture area developing outside of the pay zone. Modified hydraulic fracturing techniques may be employed to optimize placement and penetration of the induced fracture area when the geologic and in-situ stress properties of boundary and pay zone lithologies are known.

Laboratory and field efforts have been made to improve stimulation treatments in the Mancos B formation within the North Douglas Creek Arch field near Rangely, Colorado. To evaluate these efforts, a combination of core analyses and in-situ stress measurements was used in developing a modified hydraulic fracturing program. Whole core samples were taken from upper and lower boundary lithologies as well as within the Mancos B pay zone for special core tests including gas permeabilities, static elastic moduli, fracture toughness, and fluid compatibility tests measured at simulated in-situ conditions. Reservoir quality within pay zones was determined by a combination of petrography, x-ray diffraction, and scanning electron microscopy. In-situ minimal horizontal stress was determined in the field from instantaneous shut-in pressure (ISIP) data which were measured in all three lithologies.

One modified hydraulic fracturing technique that has been field tested and shows promising results is based on fracture initiation placement (perforation placement). A second technique to be tested in the near future will use lightweight additives in fracturing fluids to help seal vertical propagation of hydraulically induced fractures, thereby insuring a deep penetrating fracture into the pay zone.

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Late Cenozoic History of Safford–San Simon and Bonita Creek Structural Basins, Graham County, Arizona

Sedimentary rocks of the interconnected Safford–San Simon (S-SB) and lower Bonita Creek (BCB) basins are separated into: (1) lower Miocene volcaniclastic conglomerate, (2) upper Miocene? to Pleistocene? Gila Conglomerate, and (3) Quaternary alluvium and surficial deposits. The volcaniclastic conglomerate is locally interbedded with andesite and 19-Ma ash-flow tuff in BCB and is part of the bed rock deposited prior to formation of structural basins by Basin and Range extensional tectonics. The Gila Conglomerate consists of more than 1,200 m (3,900 ft) of basin-fill sedimentary rocks. Where exposed, most of the lower units are locally derived alluvial-fan deposits. Upper units of the Gila (Pliocene to lower Pleistocene?) include lacustrine beds interbedded with deposits of a low-gradient alluvial fan covering 730 km^2 (280 mi^2) from its apex at the mouth of Bonita Creek, southwestward across the width of the S-SB. Thick sequences of halite and gypsum penetrated in wells in the S-SB indicate playa deposits at depth. Red granite clasts in the fan deposits indicate that Bonita Creek had eroded headward to the upper BCB and captured streams draining the Point of Pines area. The youngest sediments are chiefly Quaternary alluvium deposited after the Gila River developed through-flowing drainage. The initial course of the Gila River was along the north side of the low-gradient fan. This course disrupted the depositional balance of streams draining the Pinaleno Mountains southwest of the S-SB and caused deposition of range-front alluvial fans 120 m (390 ft) thick. These fans were abandoned as the Gila River migrated to the center of the basin and are now spectacularly exposed as erosional remnants.

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Permian Paleotopography and Depositional Patterns—White Rim Sandstone, Elaterite Basin, Southeast Utah

The Permian White Rim Sandstone in the Elaterite basin (Canyonlands National Park) exhibits an unusual paleotopographic relief. The mapped portion of the exposed top of the formation indicates that the paleotopography has a prolate configuration in plan view. The major axis and crest of the relief trends N09°E. In cross section, the paleotopography is convex upward. The flanks of the structure are slightly terraced with two main levels. Dip angles on the flanks range from 0° to 16°, with the more gentle slopes located toward the crest of the topographic high and generally steepening as the structure disappears into the subsurface.

The sedimentary structures and stratigraphy in the 1-5.3 m (3-17.4 ft) upper veneer of the White Rim Sandstone indicate that the topography was affected by marine wave processes in the Elaterite basin. Small-scale features in the basal contact of the veneer include scours up to 15 cm (6 in.) deep, sharp steplike cuts up to 45 cm (18 in.) deep, and rip-ups of the lower eolian part of the White Rim Sandstone averaging 30 cm (12 in.) in diameter. Lateral changes in structures and lithologic characteristics indicate that southwest of the Elaterite basin the veneer was deposited in a fluvial environment.

The form of the paleotopographic high in the Elaterite basin is practically inherited from an eolian dune field. The uneven base and presence of chert pebbles in the veneer indicate erosion of Permian highs and an unconformable contact between the lower eolian and upper veneer of the White Rim Sandstone. Deposition of the veneer and partial reworking of the topography occurred during a marine transgression at the Permian-Triassic boundary.