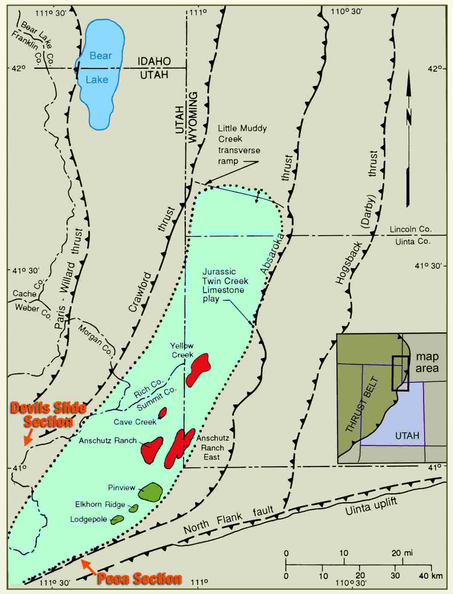
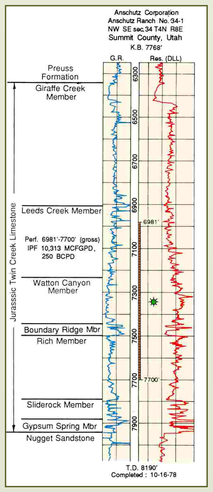
Jurassic Twin Creek Limestone Reservoir, Thrust Belt – Outcrop Analogs Near Major Fields



Location of reservoirs that produce oil (green) and gas and condensate (red) from the Jurassic Twin Creek Limestone, Utah and Wyoming; major thrust faults are dashed where approximate (teeth indicate hanging wall). The Twin Creek Limestone play area is dotted.

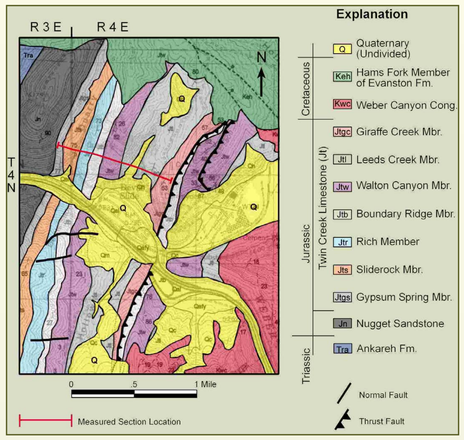
TWIN CREEK LIMESTONE RESERVOIR CHARACTERISTICS

- Net pay – 30 to 150 ft (10-50 m)
- Primary producing zones – Rich and Watton Canyon Members
- Depositional environments – primarily shallow-shelf marine embayment south of the main body of a Middle Jurassic sea; also backbank, low-energy brackish water to sabkha
- Lithology – micritic to argillaceous limestone, tightly cemented oolitic grainstone, dolomitized zones, sabkha evaporites, redbed siltstone and claystone, and thin shaly intervals
- Pore types – natural fractures (little to no matrix porosity)
- Porosity – averages 0 to 4%, enhanced by natural fracture systems
- Permeability – less than 4 md to 30 md depending on fracturing
- The seals for the producing horizons are overlying argillaceous and clastic beds, and non-fractured units within the Twin Creek Limestone

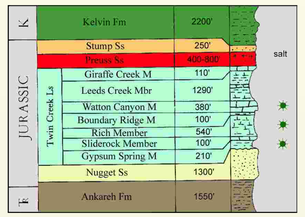


Typical gamma ray-resistivity log of the members of the Twin Creek Limestone, Anschutz Ranch field discovery well, Summit County, Utah.

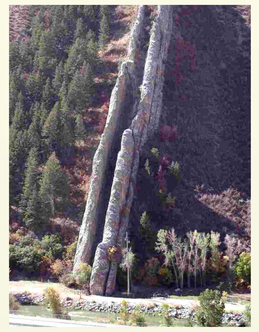
TWIN CREEK LIMESTONE OUTCROP CHARACTERISTICS



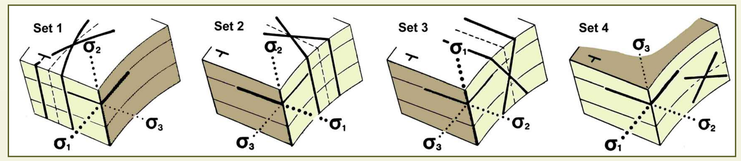
Geologic map of the Devils Slide area, Morgan and Summit Counties, Utah, showing the location of the stratigraphic measured section through the Twin Creek Limestone (modified from Coogan, 1999).



Stratigraphic column of a portion of the Mesozoic section, including members of the Jurassic Twin Creek Limestone, exposed in Weber Canyon near Devils Slide, Morgan and Summit Counties, Utah (modified from Hintze, 1993).



Devils Slide, a famous landmark along Interstate 84 in Weber Canyon, composed of resistant and non-resistant units of the Rich Member of the Twin Creek Limestone.



Fracture planes generated by four orientations of the three principal stresses during folding of sedimentary rocks (after Stearns, 1984).

Rich Member

Well-developed current ripples on bedding surface with silt-filled fractures, Devils Slide section.

Closely spaced rectilinear fracturing, Peoa section.

Rhombic fracture patterns on bedding planes, Devils Slide section.

Pencil weathering, Peoa section.

Rhombic fracture patterns on bedding planes, Peoa section.

Contact between fractured Rich Member limestone and basal siltstone with sealed fractures of the overlying Boundary Ridge Member, Peoa section.

Watton Canyon Member

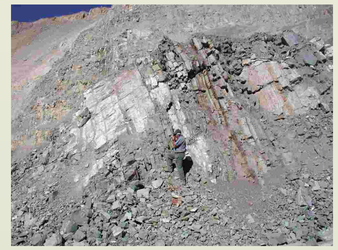
Closely spaced rectilinear fracturing in dense, micritic limestone, Devils Slide section.

Well-displayed rectilinear fracturing on top of the Watton Canyon, Peoa section.

Large-scale, well-displayed rectilinear fracturing in steeply dipping limestone, Devils Slide section.

Contact between fractured Watton Canyon Member limestone and basal argillaceous unit of the overlying Leeds Creek Member, Peoa section.

Large-scale, open fractures on bedding plane surface, Devils Slide section.



Heterogeneity within the Watton Canyon Member caused by thin-bedded siltsone, Devils Slide section.

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