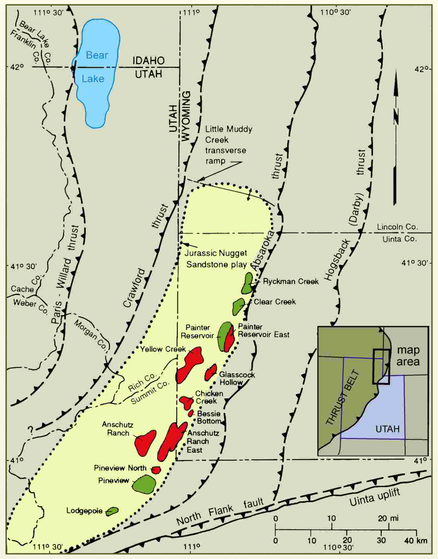
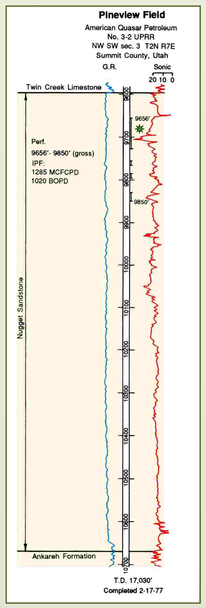
Jurassic Navajo Sandstone, Glen Canyon National Recreation Area – Outcrop Analog for the Jurassic Nugget Sandstone Reservoir, Thrust Belt



Location of reservoirs that produce oil (green) and gas and condensate (red) from the Jurassic Nugget Sandstone, Utah and Wyoming. The Nugget Sandstone play area is dotted.

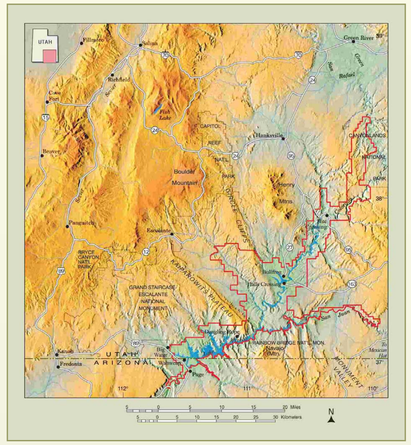
NUGGET SANDSTONE RESERVOIR CHARACTERISTICS

- Net pay – 70 to 1000 ft (21-300 m)
- Depositional environments – eolian dune (straight-crested to sinuous, coalescing, transverse barchanoid ridges), interdune/playa
- Lithology – dune deposits = sandstone (fine- to coarse-grained, subangular to subrounded sand or silt grains cemented by calcite), interdune/playa = sandstone and siltstone with some carbonate (limestone and dolomite) and evaporite
- Pore types – intergrainular, fractures
- Porosity - averages 11-15%, enhanced by natural fracture systems
- Permeability – less than 1 md to 50 md, averaging 18 md
- Framework and matrix grains in sandstone (>1/16 mm and 1/16 to 1/256 mm, respectively) and siltstone are commonly composed of more than 90 percent quartz (usually frosted) with varying amounts of K-feldspar, plagioclase, and rock fragments

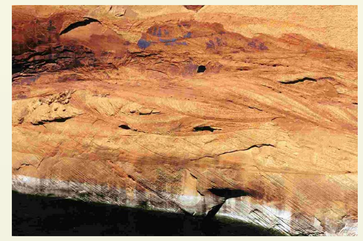


Typical gamma ray-sonic log of the Nugget Sandstone, Pineview field, Summit County, Utah.

NAVAJO SANDSTONE OUTCROP CHARACTERISTICS

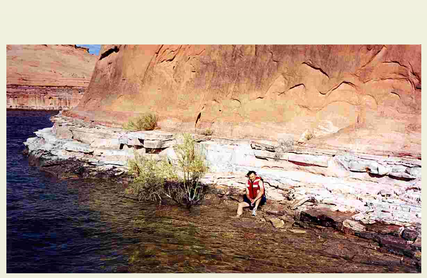


Index map to Glen Canyon National Recreation Area, Utah and Arizona (modified from Hintze, 1997; topographic relief base map modified with permission, courtesy of Chalk Butte, Inc., Boulder, Wyoming).

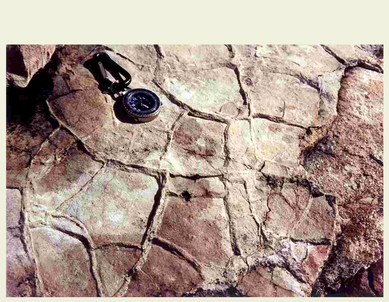


Navajo Sandstone beds display pronounced trough cross-bedding which indicates the paleowinds were from the north and northwest.

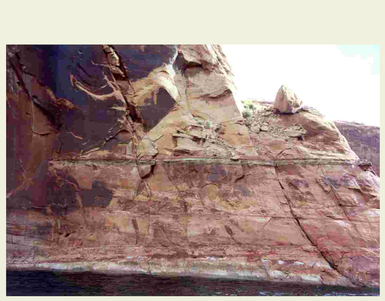
Spectacular contorted bedding in Navajo Sandstone; south side of Antelope Island in Lake Powell.



Typical limestone oasis deposit near the top of the Navajo Sandstone; Forgotten Canyon.

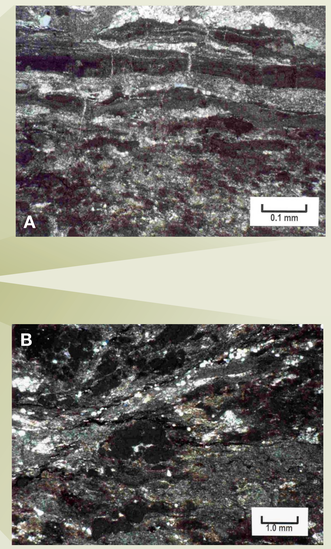


Mudcracks in oasis limestone mud above bed containing ripple marks; Forgotten Canyon.



Rapid pinch out of thin limestone bed; Moki Canyon.

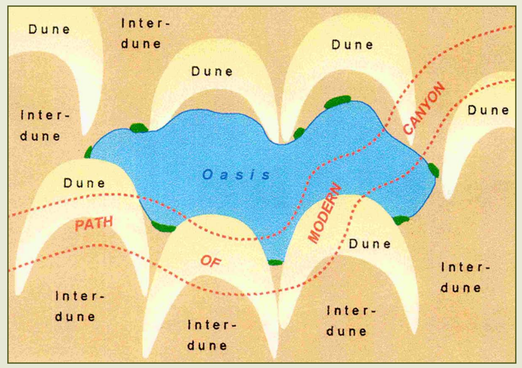
Algal laminae within the limestone oasis beds in the Navajo Sandstone; Moki Canyon.



Photomicrographs (crossed nicols) of Navajo Sandstone oasis deposits.

A - Couplets of alternating cryptalgalaminites and massive microcrystalline layers dominate the upper half of this micrograph. The laminated bands are mostly calcitic (limestones) while the lighter-colored microcrystalline bands are mostly dolomites. These mm-scale couplets are typical of organic blue-green algal or cyanobacterial mats. The lighter-colored, massive or microcrystalline bands are probably the result of dolomitized storm deposits while the microlaminated layers are the result of normal microbial mat trapping and binding activities. The lower half of this image shows a greater concentration of dark-colored rip-up intraclasts.

B - Dark-colored clots and pin cushion-like patches of micrite are surrounded by lighter-colored, partially dolomitized detrital sediments and small, white quartz grains. Several of these lumpy clots can be termed "thrombolites." They were most likely created by coccoid blue-green algal or cyanobacterial processes. Such microbial structures could have easily formed in stressed environments that were intermittently desiccated. Salinity stresses, ranging from fresh to hypersaline waters, can promote these types of microbial mini-structures. Photomicrographs and description by D.E. Eby, Eby Petrography & Consulting, Inc., written communication, 2003.



Schematic interpretation, map view, of a Navajo oasis pond surrounded by large dunes. The path of a modern canyon is superimposed to demonstrate the rapid pinch outs of limestones observed along the canyon walls; many of the limestones probably belong to the same oasis deposits.

UTAH GEOLOGICAL SURVEY
DEPARTMENT OF NATURAL RESOURCES