

Geologic Discussion
HATCH LAKE UNIT PROPOSAL
T21 & 22N, R1W
Sandoval County, New Mexico

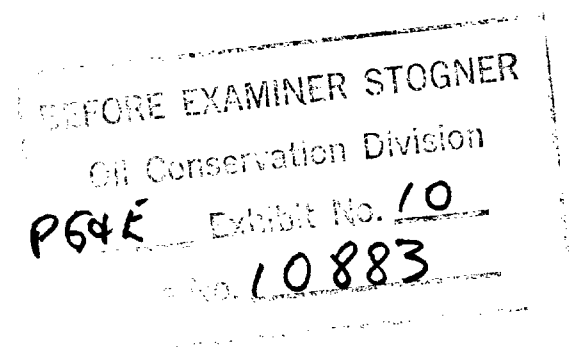
The proposed unit outline encompasses a thirty-nine section area between the towns of Cuba and Regina, New Mexico, on the eastern flank of the San Juan Basin. This is an exploratory unit with main oil objective in fractured sandy to dolomitic shale in the Niobrara member of the Mancos formation. This proposed unit outline surrounds the area of optimum natural fractures associated with the Nacimiento Uplift and thrust fault. There are no Niobrara tests within the proposed unit outline, which is on trend with fractured Mancos oil production to the west in Rio Puerco field and to the north in West Puerto Chiquito field.

The present structural configuration of the San Juan basin began with Laramide deformation in Late Cretaceous. Rimming monoclines formed during early subsidence, with regional lateral shifts that formed plunging cross-folds and sinuosity along the monoclines in Paleocene time. Subsequent crowding intensified folding along the basin margins, followed by extensional faulting related to the development of the Rio Grande Rift in Miocene time. Late Tertiary tangential compressive forces formed the Nacimiento Uplift and associated thrust fault that overrides the basin monocline on the eastern side of the Hatch Lake unit area. This sequence of deformation provides a unique situation in the Hatch Lake area for early continuous structural development, intense fracture pattern generation, high heat flow for hydrocarbon generation and a preferred direction for hydrocarbon migration out of the basin throughout time.

Accordingly, the proposed unit outline encompasses the area of optimum open fracture development in the brittle Niobrara dolomitic shale member of the Mancos formation. The proposed eastern boundary is along the surface trace of the Nacimiento thrust fault, with the southern edge defined for sufficient reservoir depth and distance from the outcrop. The western boundary is coincident with the Jicarilla Apache reservation boundary. The northern proposed unit boundary is adjacent to maximum displacement on the Nacimiento thrust near where that fault passes into a north plunging fold and northeasterly trending Gallina fault. In addition, poor fracture potential is indicated by well control just north of that boundary.

The initial unit well is a proposed 5000' test in the SW/SE Sec.4-T21N-R1W. Estimated depth to significant horizons is as follows:

San Jose	Surface
Ojo Alamo	950'
Lewis	1400'
Point Lookout	3470'
Mancos	3730
T/Gallup-Niobrara	4610'
T.D.	5000'



Geologic Discussion
Hatch Lake Unit Proposal
Page 2

In the event lease ownership limitations require an alternate location for the initial test, it would be in the NE/NE Sec.9-T22N, R1W where T.D. would be approximately 7000', but with comparable potential in fractured Mancos because of structural history and proximity to the Nacimiento thrust fault. Deepest existing well control in the proposed unit area is nearby, a 3190' test to Ojo Alamo in the SW 1/4 of Sec. 10-T22N, R1W.

Fractured Mancos potential associated with the Nacimiento thrust is present throughout the proposed unit area, and is untested. As a result, BLM approval of area and depth for the proposed Hatch Lake Unit is requested at this time.

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11/1/93