

# **Devonian Chert, Dollarhide Field, West Texas, USA\***

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## **Abstract<sup>+</sup>**

Approximately 70 million barrels of oil have been produced from the chert-dominated Thirtyone Formation (Devonian) at Dollarhide Field in west Texas. The chert reservoir contains approximately 83% of the original oil in place and consists of two different facies - laminated microporous chert and burrowed chert. The laminated microporous chert was deposited as sponge spicule sands (grainstones) in channels and fans on the slope of the Tobosa basin. The burrowed chert facies was deposited as burrowed mixtures of sponge spicules, siliceous mud, and carbonate mud in broad slope environments between fans and channels. Spicules came from the disaggregation of siliceous sponges living on the slope. Early marine and/or meteoric diagenesis dissolved sponge spicules, resulting in spicule-moldic porosity. The burrowed chert underwent small-scale differential compaction that produced short, discontinuous fractures.

Production is related to thickness of various facies. The porous chert varies in thickness from 0 to 24 m, and pore volume ( $\phi$ -h) varies from 0 to 6 pore-meters. The laminated microporous chert is very homogenous with high porosity (25-35%) and uniform permeability (5-30 mD). Areas dominated by laminated microporous chert had moderate primary recovery (200,000 barrels of oil per well; BOPW), excellent waterflood production (1-2.5 million BOPW), and poor 20-acre infill production (<20,000 BOPW). The burrowed chert has more heterogeneous porosity (5-30%) and permeability (<1-100 mD). Wells with substantial burrowed chert had moderate to good primary recovery (200,000-300,000 BOPW), moderate waterflood recovery (300,000-1,100,000 BOPW), and moderate 20-acre infill recovery (50,000-100,000 BOPW).

<sup>+</sup>Abstract prepared by the author, Brian Ball, and Steve Robertson for presentation at AAPG Annual Convention and Exhibition, Denver, Colorado, 2001 (Search and Discovery Article #90906 (2001):

<http://www.searchanddiscovery.com/abstracts/html/2001/annual/abstracts/0701.htm?q=%2BtextStrip%3Asaller+%2BtextStrip%3Adollarhide>)

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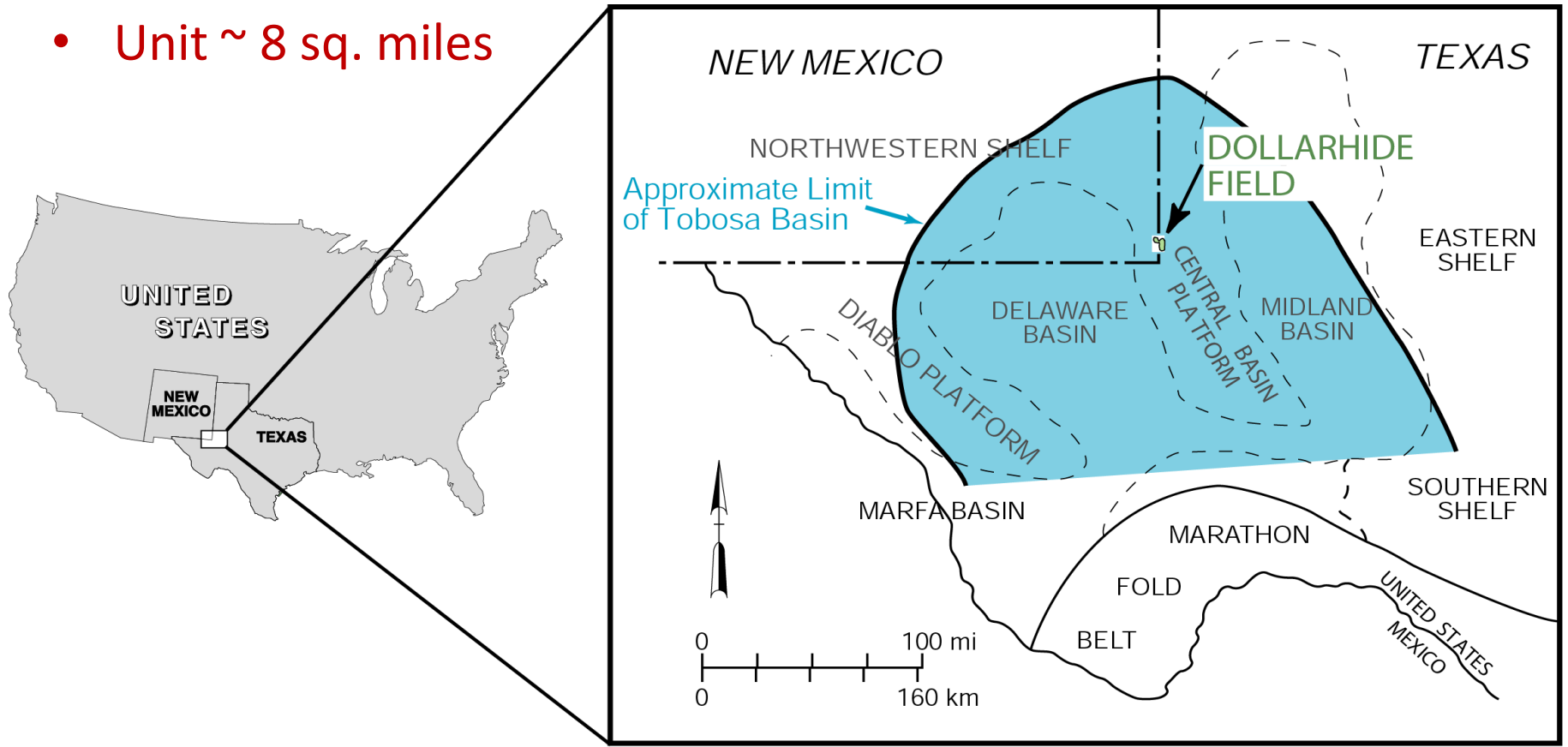
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Saller, A.H., B. Ball, S. Robertson, B. McPherson, C. Wene, R. Nims, and J. Gogas, 2001a, Reservoir characteristics of Devonian cherts and their control on oil recovery: Dollarhide field, west Texas: AAPG Bulletin, v. 85/1, p. 35-50.

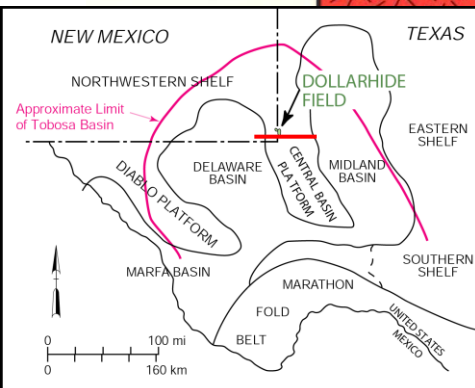
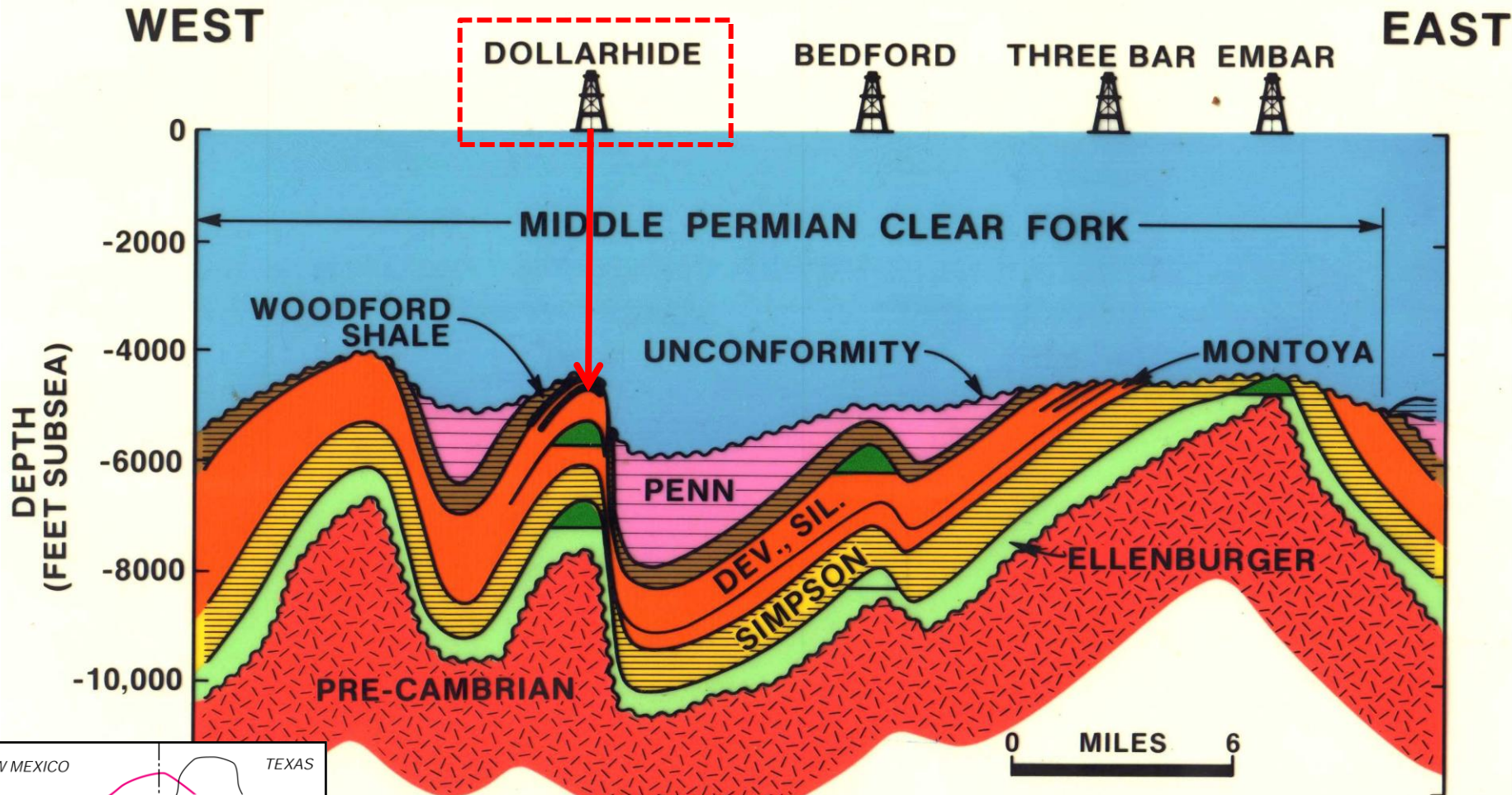
Saller, A.H., B. Ball, and S. Robertson, 2001, Reservoir characteristics of Devonian cherts and their control on oil recovery: Dollarhide Field, West Texas, USA (abstract): AAPG Annual Convention and Exhibition, Denver, Colorado, 2001b. Web accessed 28 January 2013. Search and Discovery Article #90906 (2001). <http://www.searchanddiscovery.com/abstracts/html/2001/annual/abstracts/0701.htm>

# DOLLARHIDE DEVONIAN CHERT

- Field Discovered in 1945
- Faulted Anticline
- Reservoir Interval - Devonian Thirtyone Fm
- Most Production - Flanks of Faulted Anticline
- Approximately 70 Million Barrels of Oil Produced from unit
- Unit ~ 8 sq. miles



# SCHEMATIC STRUCTURE CROSS SECTION CENTRAL BASIN PLATFORM



Pennsylvanian Erosion Truncated Much of the Upper (Dolomite) Reservoir on the Crest of the Structure, and A Lesser Amount of the Lower (Chert) Reservoir on the Crest of Structure

(after Saller et al., 1991)



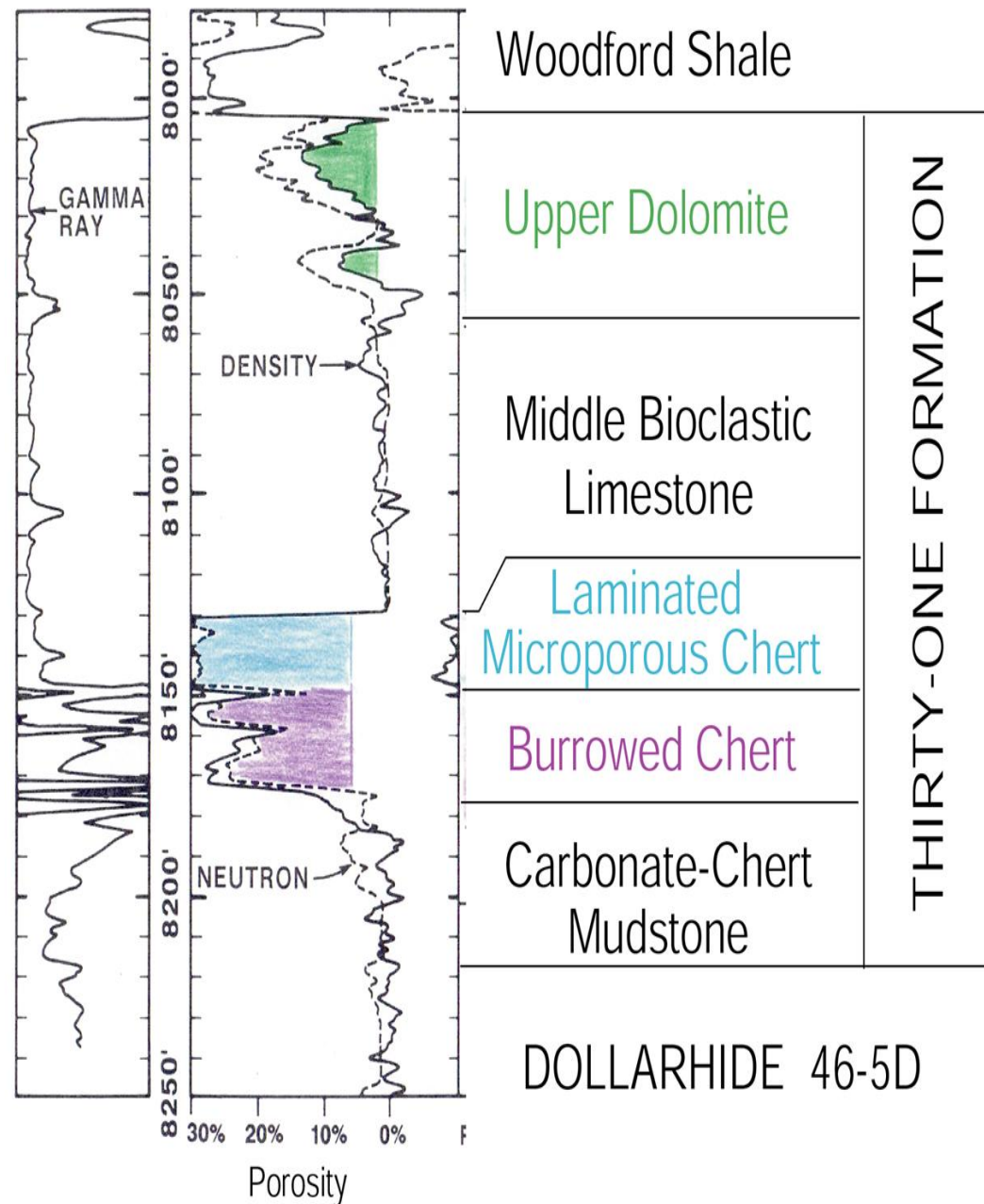
# Devonian Reservoir has 2 Parts:

Upper Dolomite  
~17% OOIP

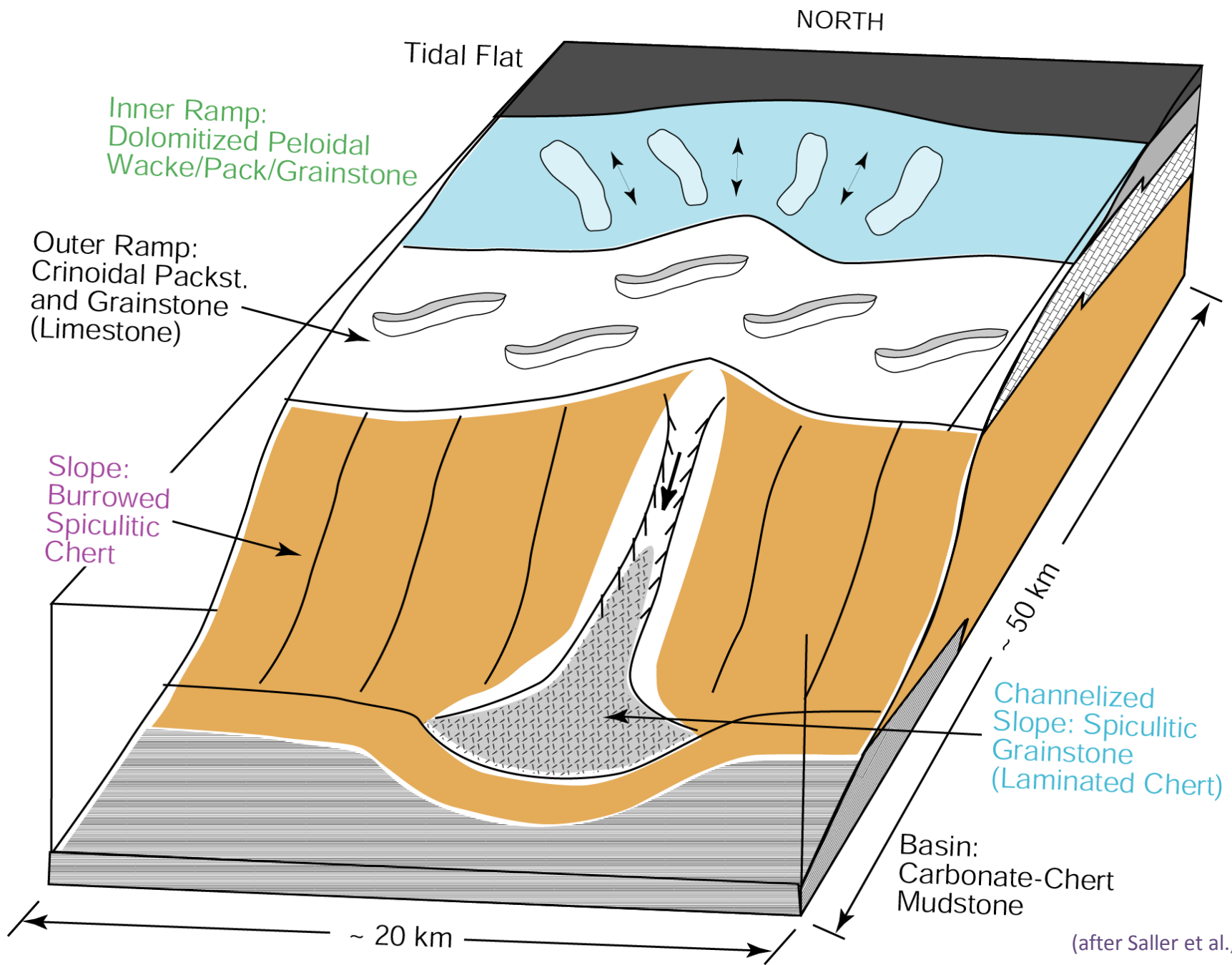
separated by a Tight  
Bioclastic Limestone

Lower Chert  
Porosity~30%;  
~83% OOIP

- Two Chert/Slope Facies
- **Laminated Microporous Chert** - Sponge Spicule Sand Deposited in Submarine Channels and Fans
- **Burrowed Chert** - Burrowed Mixture of Sponge Spicules, Siliceous Mud, & Carbonate Mud Deposited in Broad Areas between Fans and Channels



# DEPOSITIONAL MODEL



(after Saller et al., 2001a)

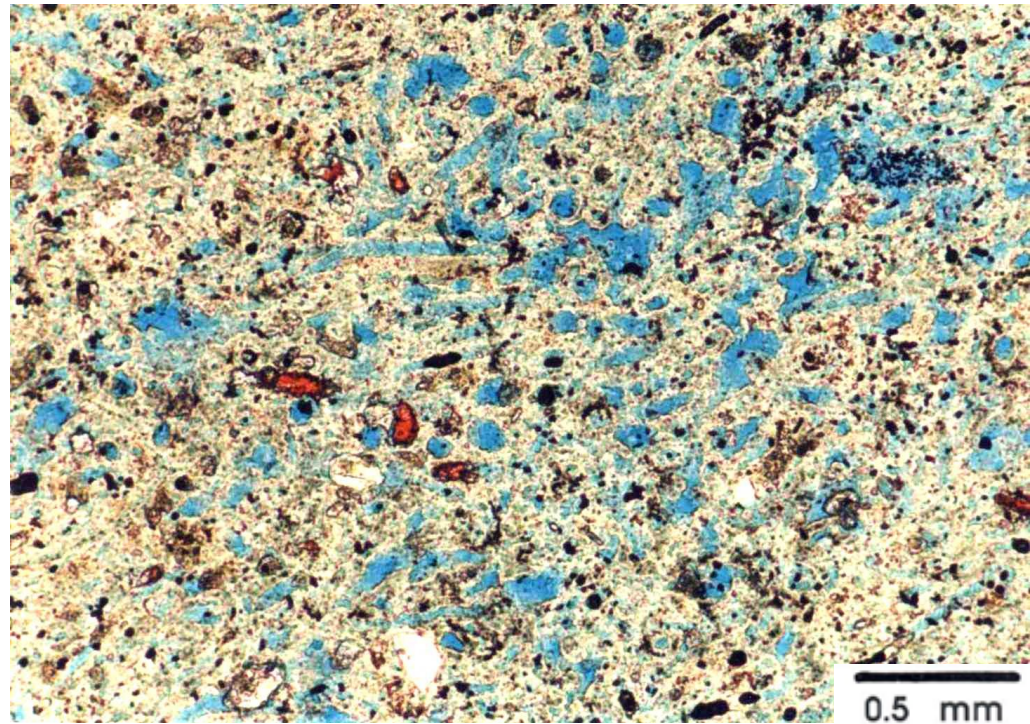


# Laminated Microporous Chert

Very Homogenous

High Porosity: 25-35%

Uniform Permeability: 5-30 mD



Most Pores (blue) are Molds of Sponge Spicules

(after Saller et al., 2001a)

Cross-bedded Spiculitic Grainstone  
Deposited in Deep Marine Fans & Channels



# Laminated Microporous Chert



From GIT Laboratory Journal

## Spiculitic Grainstone:

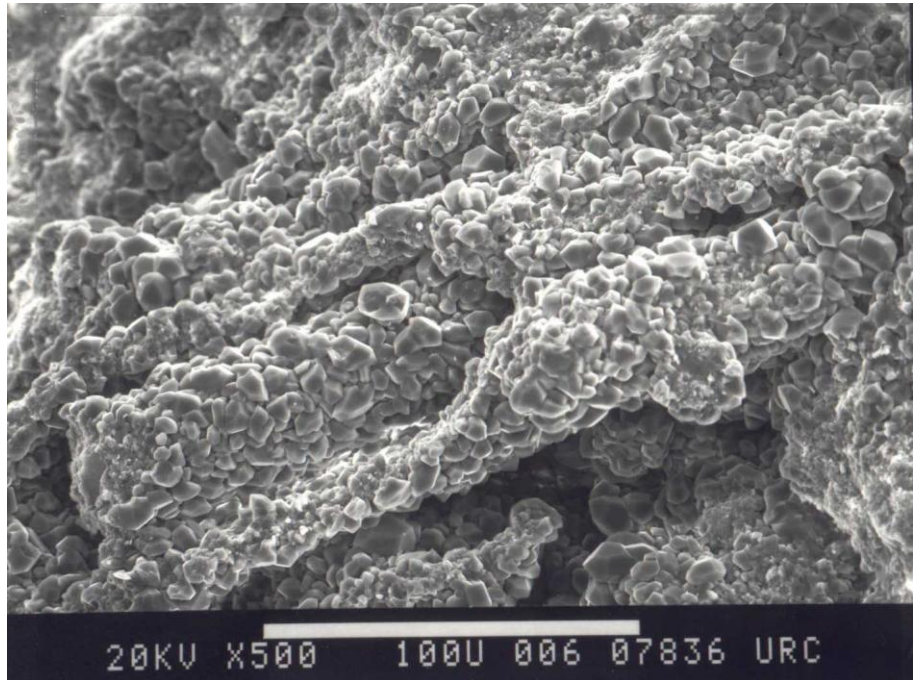
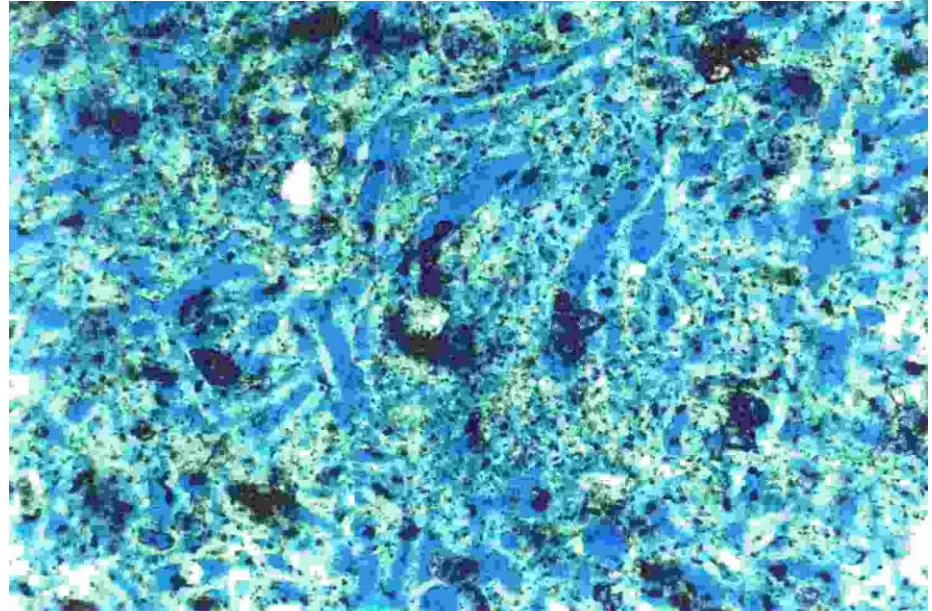
Spicules are from the Disaggregation of Siliceous Sponges on the Slope

Early Marine and/or Meteoric Diagenesis Dissolved the Spicules & Reprecipitated Silica as Microcrystalline Chalcedony & Quartz

## RESULT

Spicule-Moldic Porosity & Other Microporosity in Chert

(after Saller et al., 2001a)





7887.5

DOLLARHIDE 33-5D

Dolomite Mud  
in Burrow

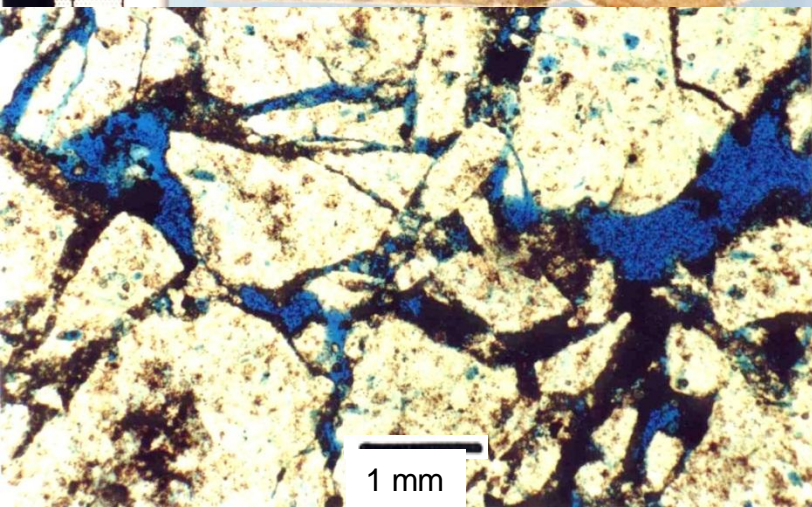
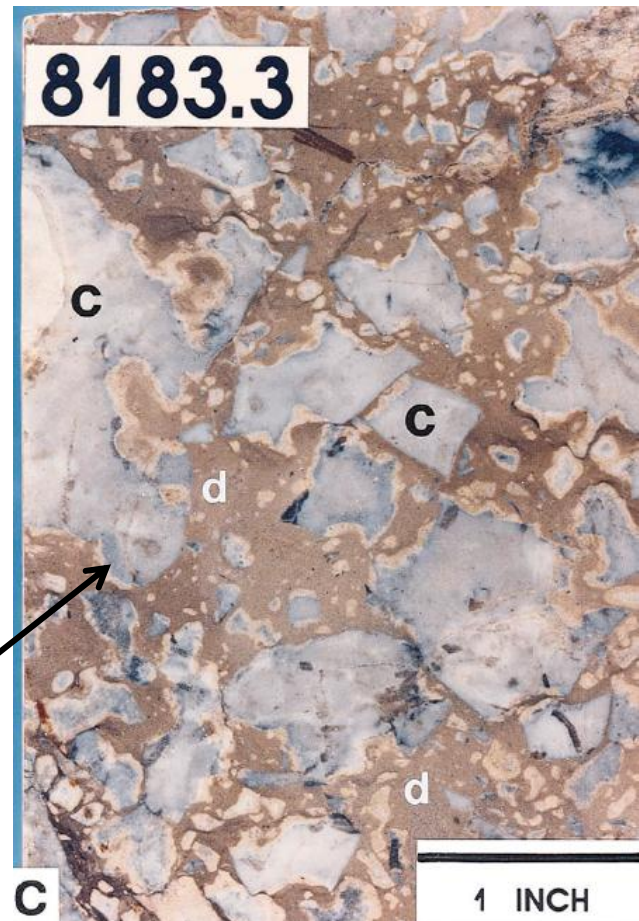
# Burrowed Chert/Dolomite

Burrowed Mixture of Siliceous  
Mud & Carbonate Mud

Heterogeneous  
Porosity: 5-30%  
Heterogeneous  
Permeability: <1-  
100 mD

Chert Clasts  
Floating in  
Dolomite

8183.3



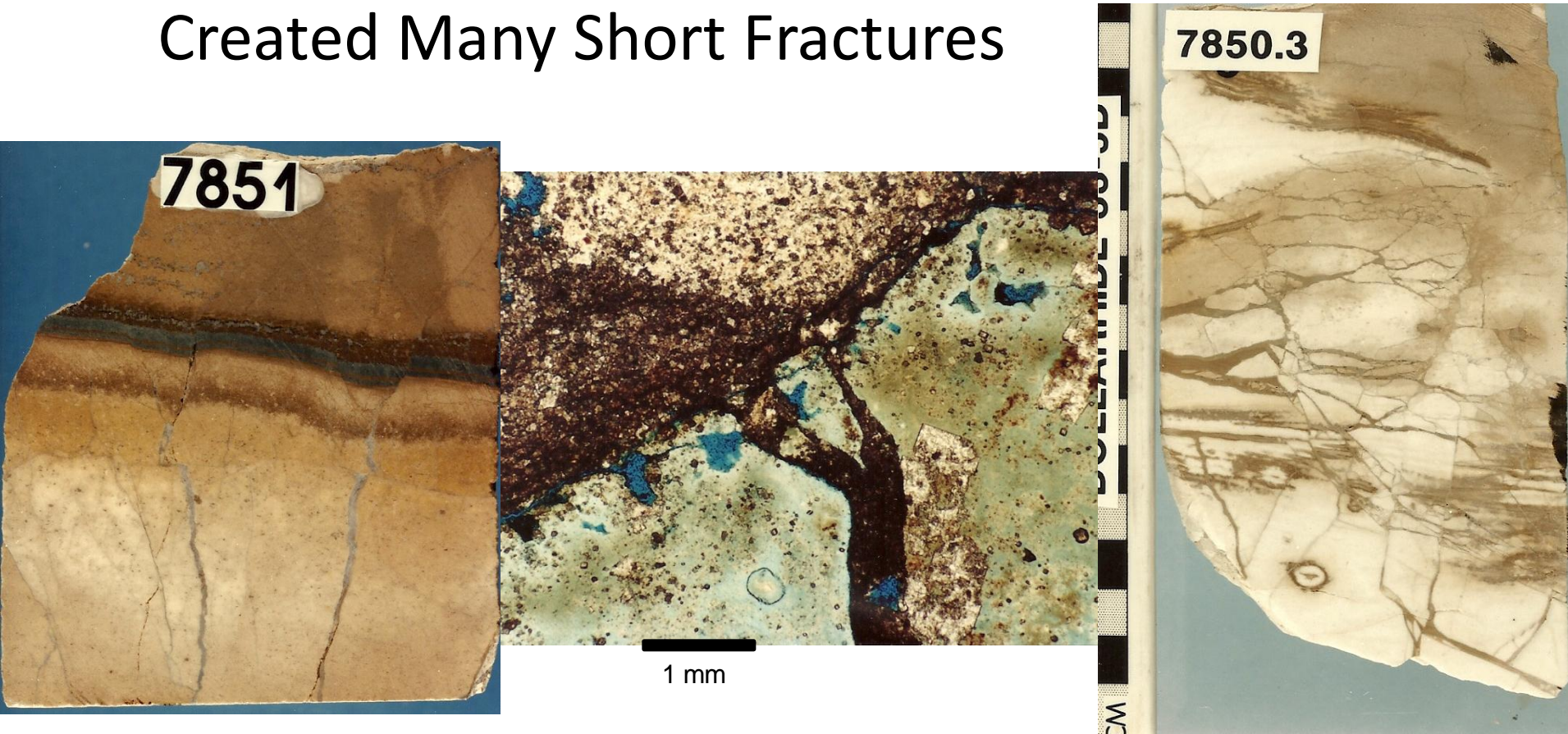
Burrowed Chert Underwent Differential  
Compaction that Produced Short,  
Discontinuous Fractures, 1-10 mm long  
& 0.1-0.5 mm wide

(after Saller et al., 2001a)

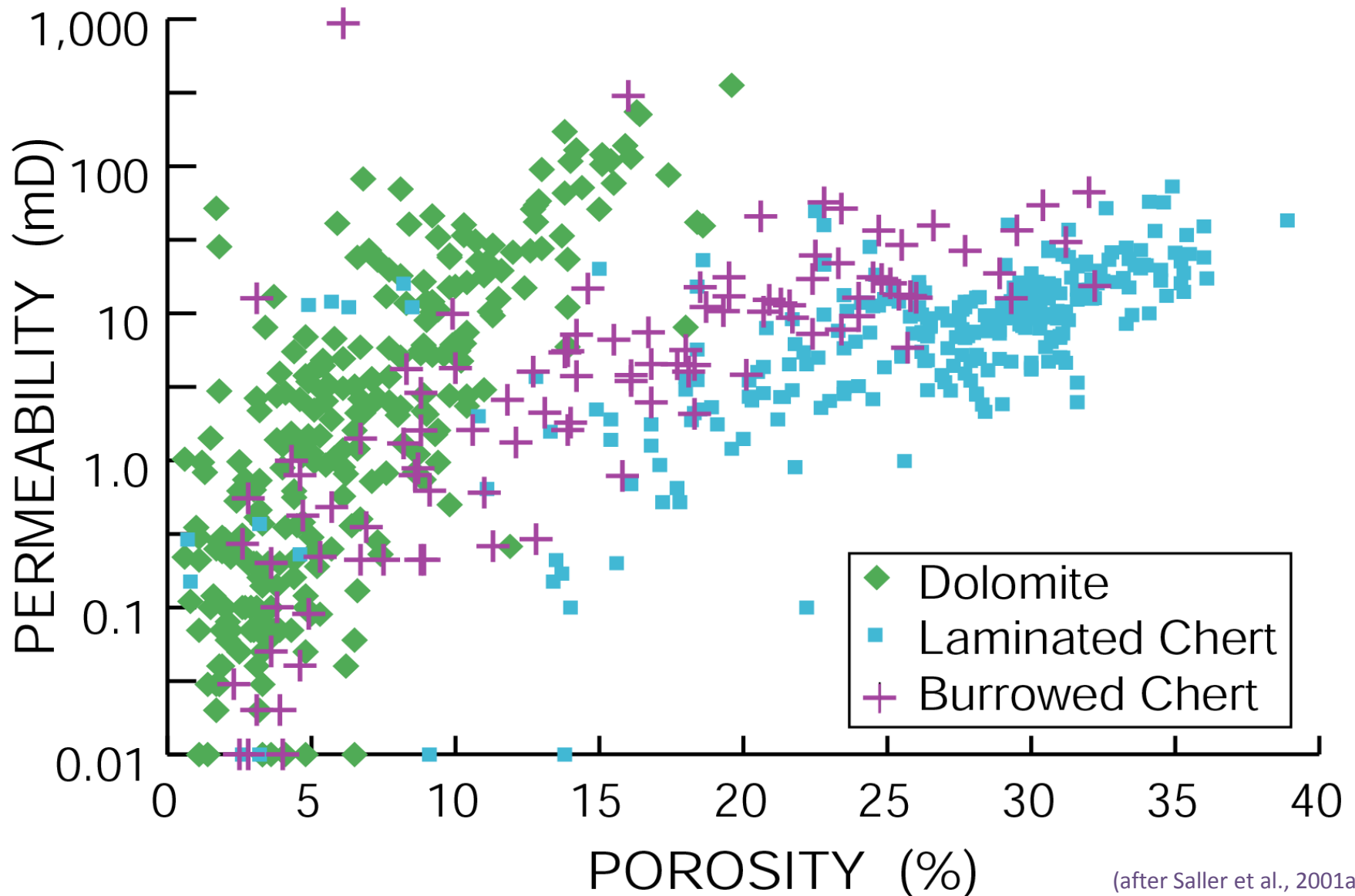


# Chert Diagenesis

- Early Marine Diagenesis Including Submarine Lithification during Deposition
- Lithification & Differential Compaction Created Many Short Fractures

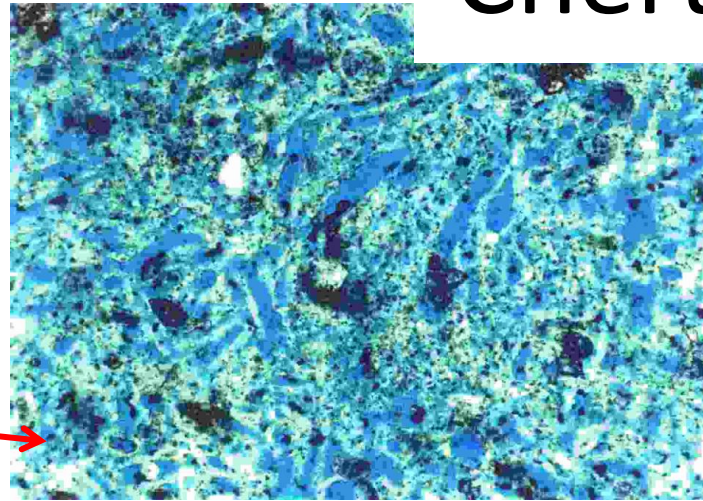
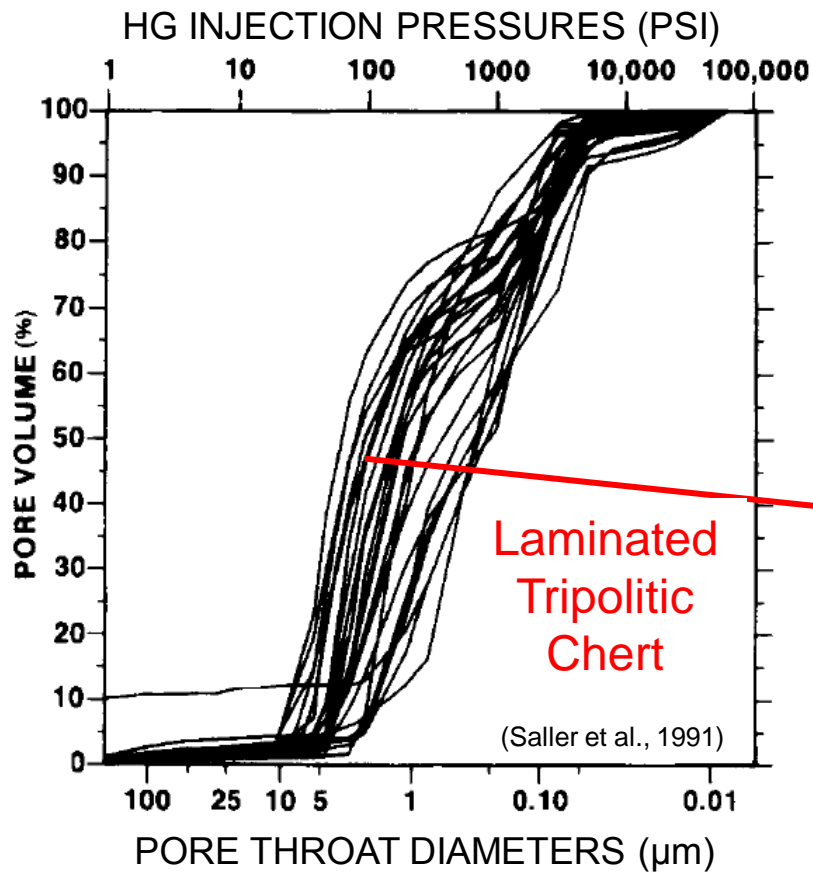


# Dollarhide Devonian Unit

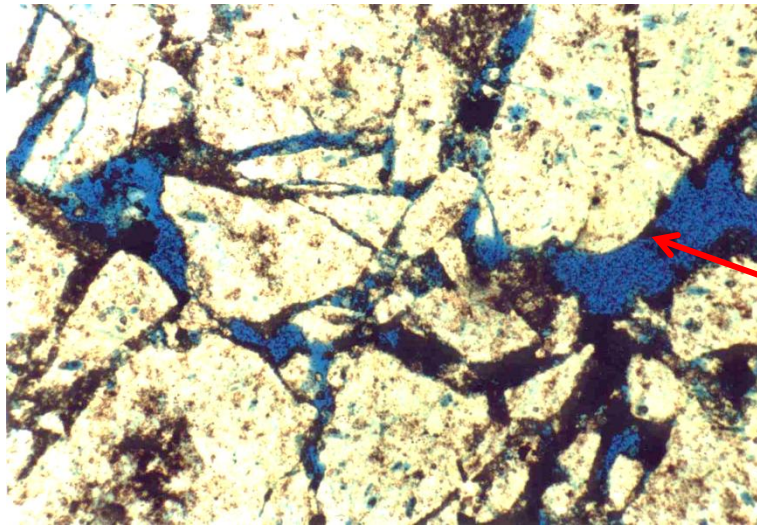




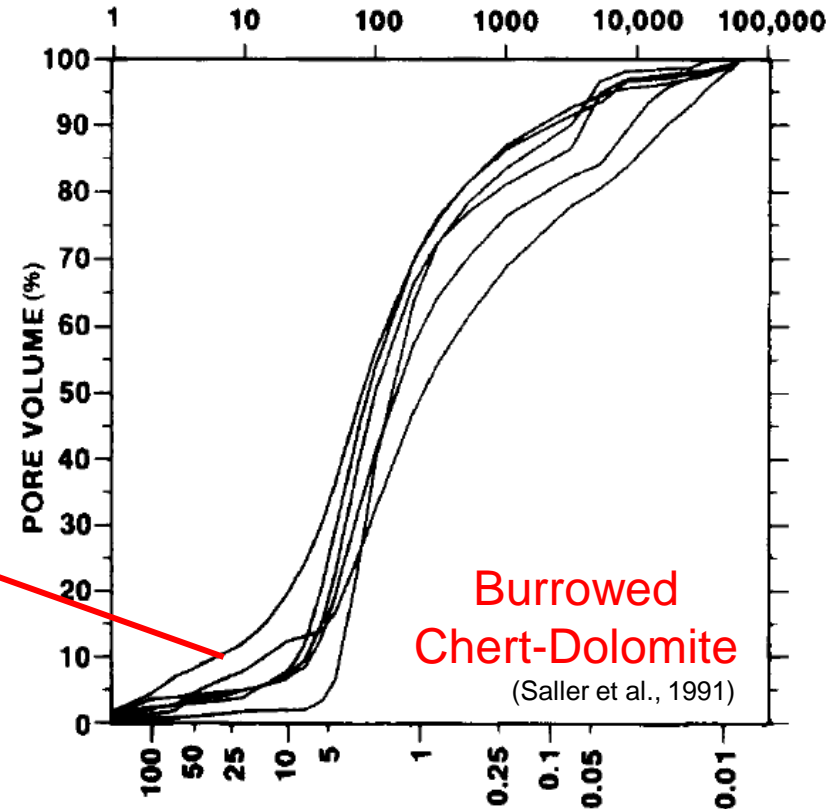
# Chert Pores



Slower, more uniform production from connected spicule molds



More rapid, less uniform production from small fractures



# DOLLARHIDE FIELD

## STRUCTURE MAP TOP DEVONIAN RESERVOIR

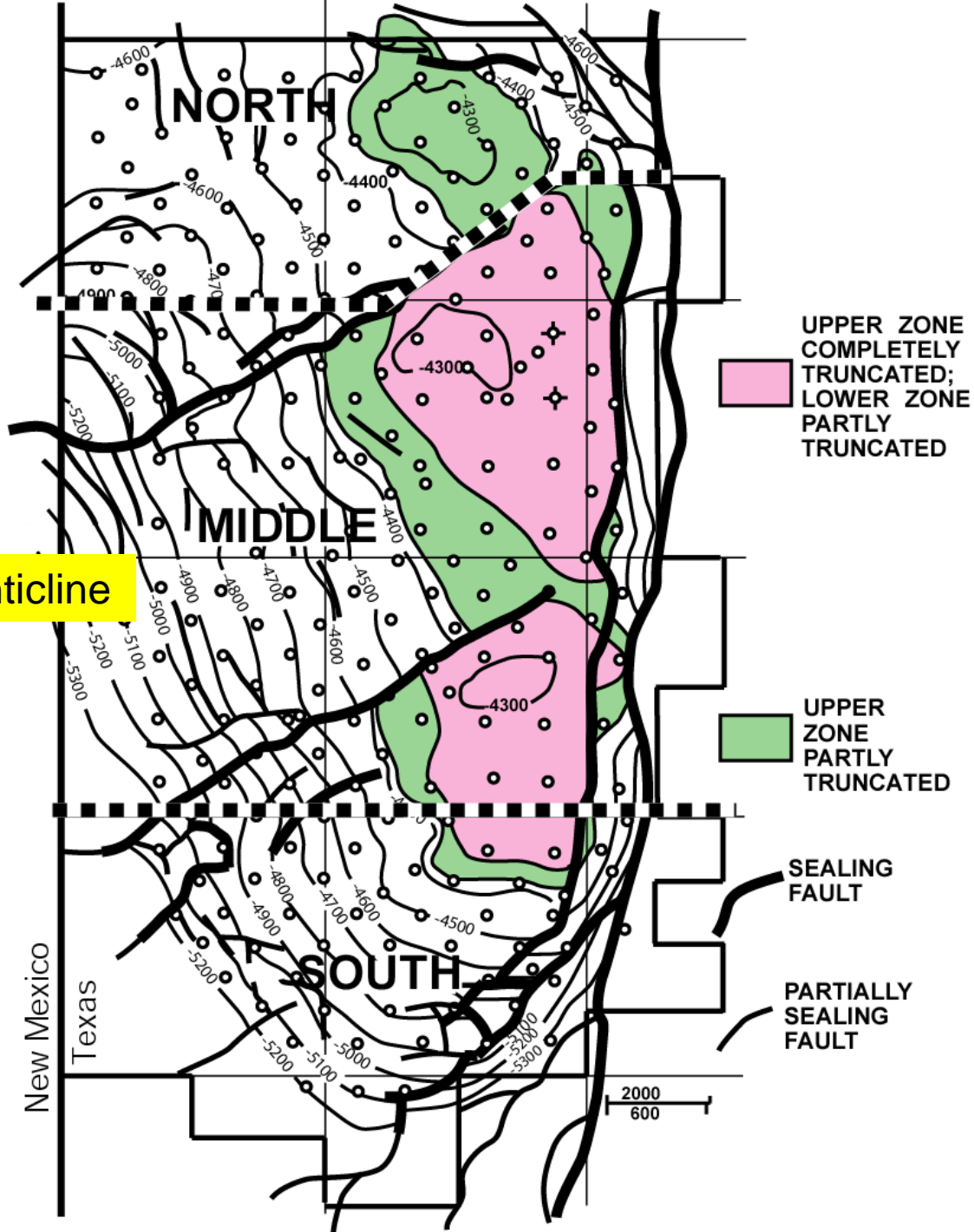
Best production is from flanks of anticline

- ■ Boundaries Between North, Middle and South Areas of the Main Dollarhide Unit

Contour Interval is 100 feet

● Well (Producer or Injector)

✦ Dry hole

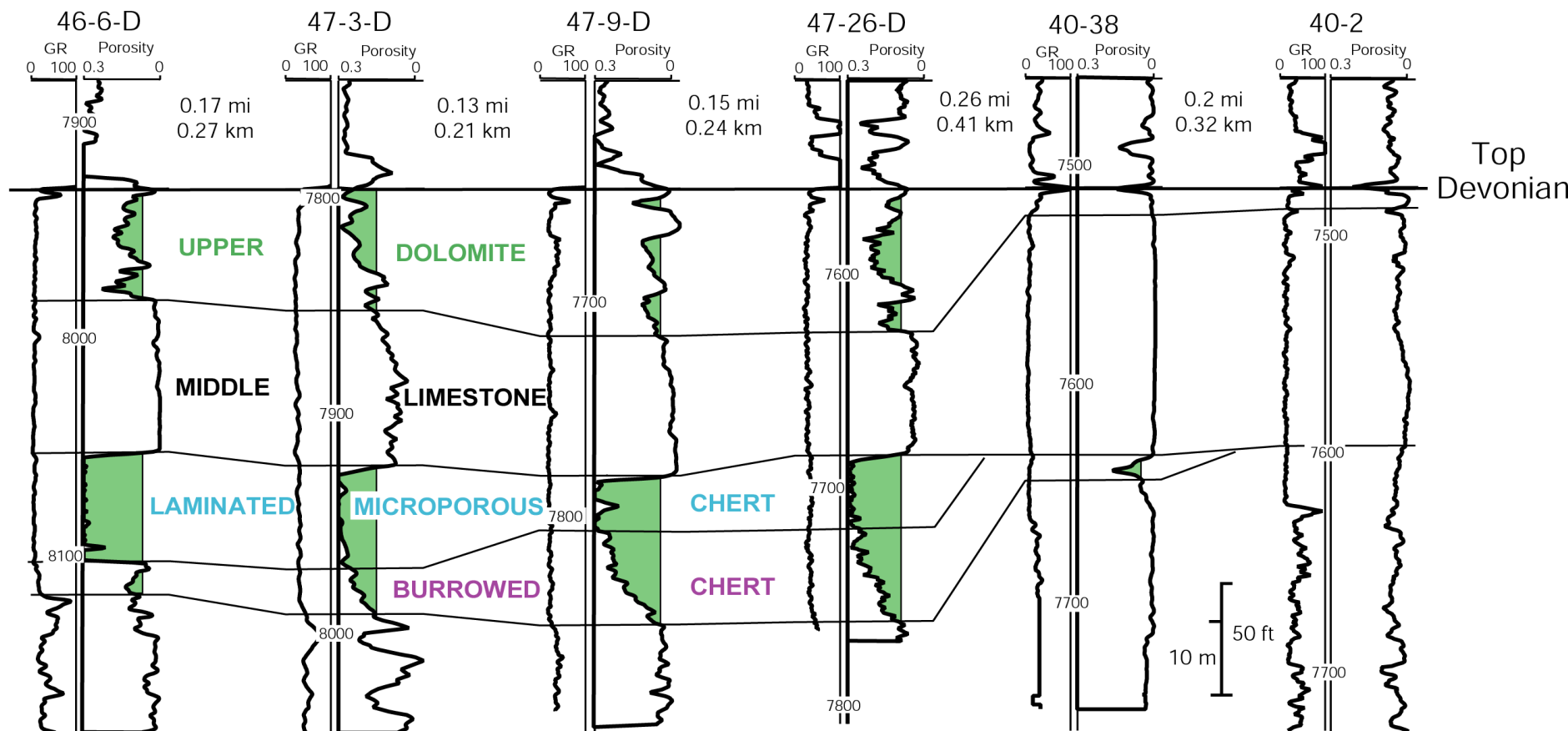


Y

Y'

SOUTHWEST

NORTHEAST

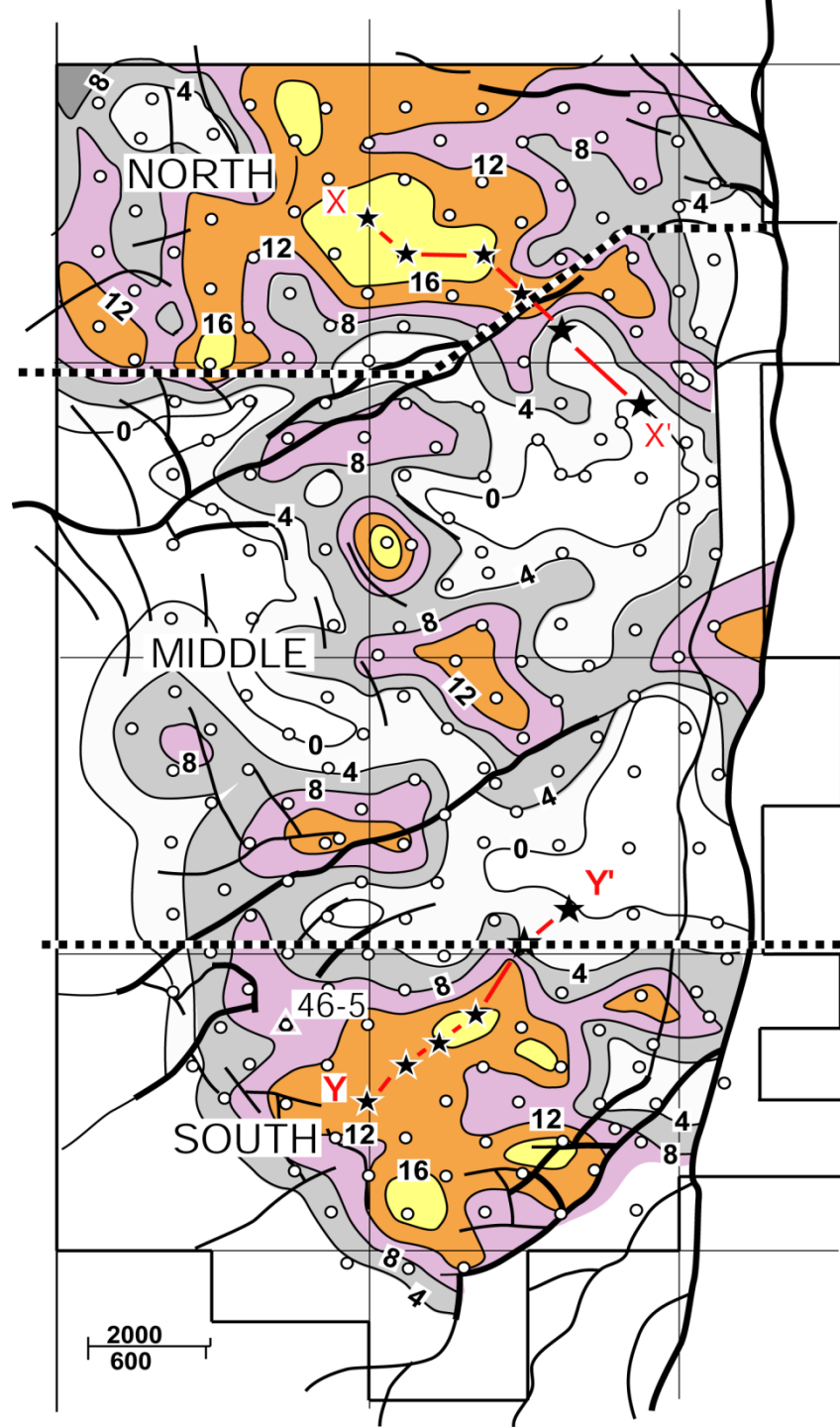


## SOUTH AREA - STRATIGRAPHIC CROSS SECTION

- (1) All 3 Porous Facies are Volumetrically Significant,
- (2) Upper Devonian Reservoir is Truncated on Crest of Structure

(after Saller et al., 2001a)

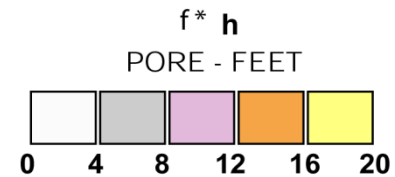




## CHERT POROSITY ( $\phi$ -h) (LOWER RESERVOIR)

..... Boundaries Between North,  
Middle and South Areas of  
the Main Dollarhide Unit

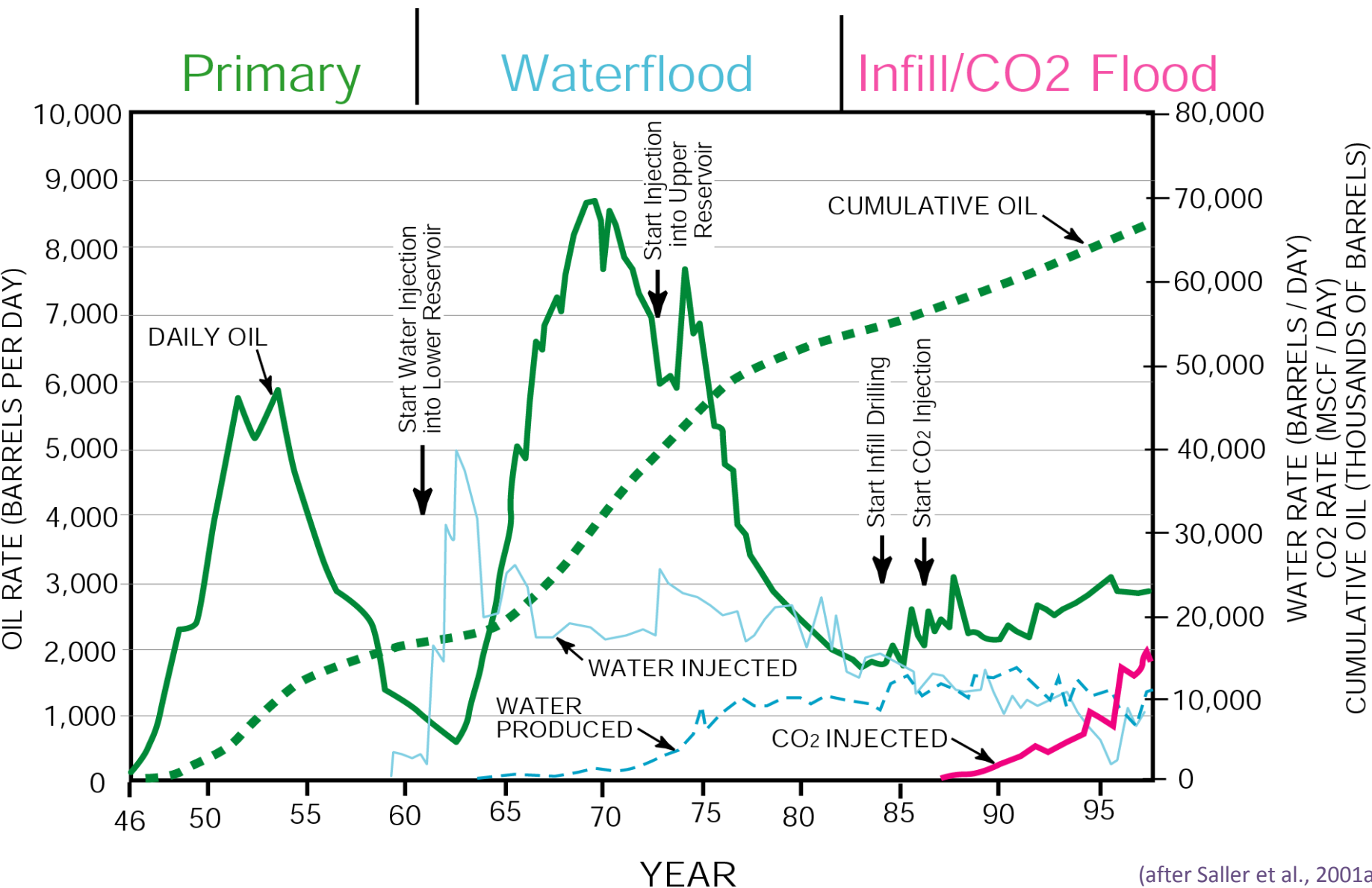
**SEALING  
FAULT** **PARTIALLY  
SEALING  
FAULT**



Thickness = 0 to 80 feet  
Pore volume ( $\phi$ -h) =  
0 to 20 pore-feet

(after Saller et al., 2001a)

# Dollarhide Devonian Unit



# Facies and Recovery Efficiencies in Different Parts of Dollarhide Devonian Unit (from Bellavance, 1996)

Area	Amount of Porosity			% Oil Recovery		
	Upper Dolomite	Laminated Chert	Burrowed Chert	Primary	Water-Flood	CO2 + Infill
North	Low	Very High	Low	12.2	39.9	16.0
Middle	Low	Low	Low	12.8	22.8	16.8
South	Moderate	High	Moderate	15.8	25.7	16.3



# ESTIMATED ULTIMATE RECOVERY DOLLARHIDE DEVONIAN UNIT

Primary	13%	19 MMBO
Waterflood	30%	44 MMBO
20-acre Infill	3.5%	5 MMBO
CO <sub>2</sub> Flood	11%	16 MMBO
<b>Total</b>	<b>57.5%</b>	<b>84 MMBO</b>