Porosity-Conservative, Burial-Related Diagenesis and Reservoir Quality: Upper Jurassic Hadriya Reservoir, Berri Field, Saudi Arabia*

Richard B. Koepnick[1]

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[1]Koepnick Geological Consulting, Inc., Athens, GA (rbkoepnick@hotmail.com)

Abstract

Hadriya reservoir quality is controlled by sequence stratal geometry, by depositional facies, by widespread preservation of primary porosity, and importantly, by burial-related microporosity enhancement and concomitant macroporosity cementation near the field's structural crest. Burial-related diagenetic processes are largely porosity conservative but are permeability destructive. The altered reservoir volume is definable as an upward-pluming, "sail-boat-keel", 3-D-geometry with the sailboat keel oriented parallel to the long axis of the Berri Field structure. The altered low-permeability reservoir volume crosscuts the Hadriya Reservoir sequence architecture and depositional facies patterns indicating a post-depositional origin. The orientation of the altered volume and close association with the structural crest of the field suggests formation after the onset of structural growth in Late Cretaceous time. Tilting of the Berri Field structure has caused the structural crest of the field to migrate southward from its Late Cretaceous-Pre-Neogene position to its current post-Paleogene position. The 3-D geometry of the altered reservoir volume most closely corresponds to the paleo-structural crest of the field suggesting that the processes associated with the creation of the altered reservoir volume occurred in pre-Neogene time.

Reference Cited

Koepnick, R. B., L.E. Waite, G.S. Kompanik, J.M. Al-Shammery, and M.O. Al-Amoudi, 1994, Sequence Strata Geometries and Burial-Related Microporosity Development: Controls on Performance of the Hadriya Reservoir (Upper Jurassic) Berri Field, Saudi Arabia: Gulf PetroLink Manama, Bahrain, p. 615-623.

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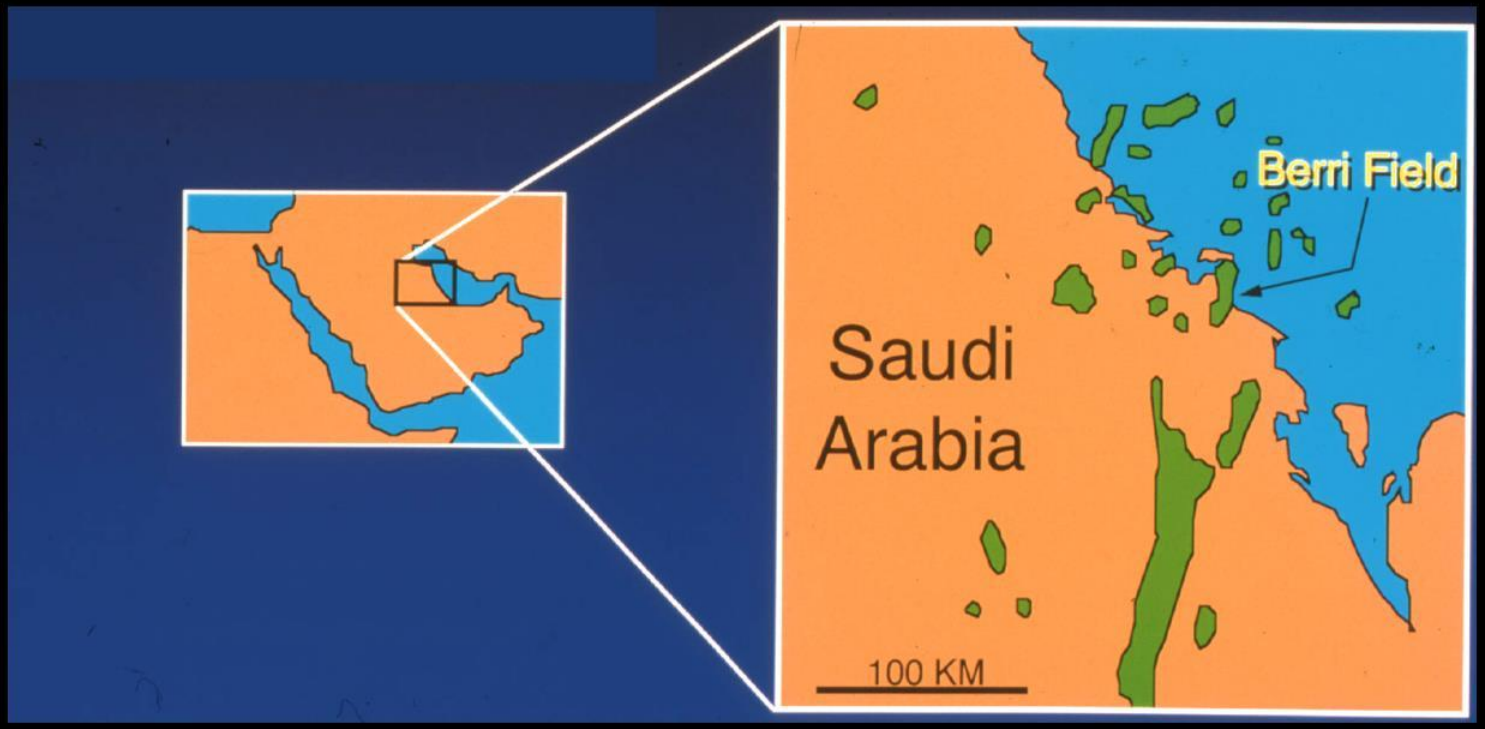


Based on--Koepnick, R. B., Waite, L. E., Kompanik G. S., Al-Shammery, M. J, and Al-Amoudi, O, 1994, Sequence Stratal Geometries and Burial-Related Microporosity Development: Controls on Performance of the Hadriya Reservoir (Upper Jurassic) Berri Field Saudi Arabia, Geo'94, p. 615-623.

Presentation Outline

Regional Setting

Depositional Environments and Sequence Stratigraphy

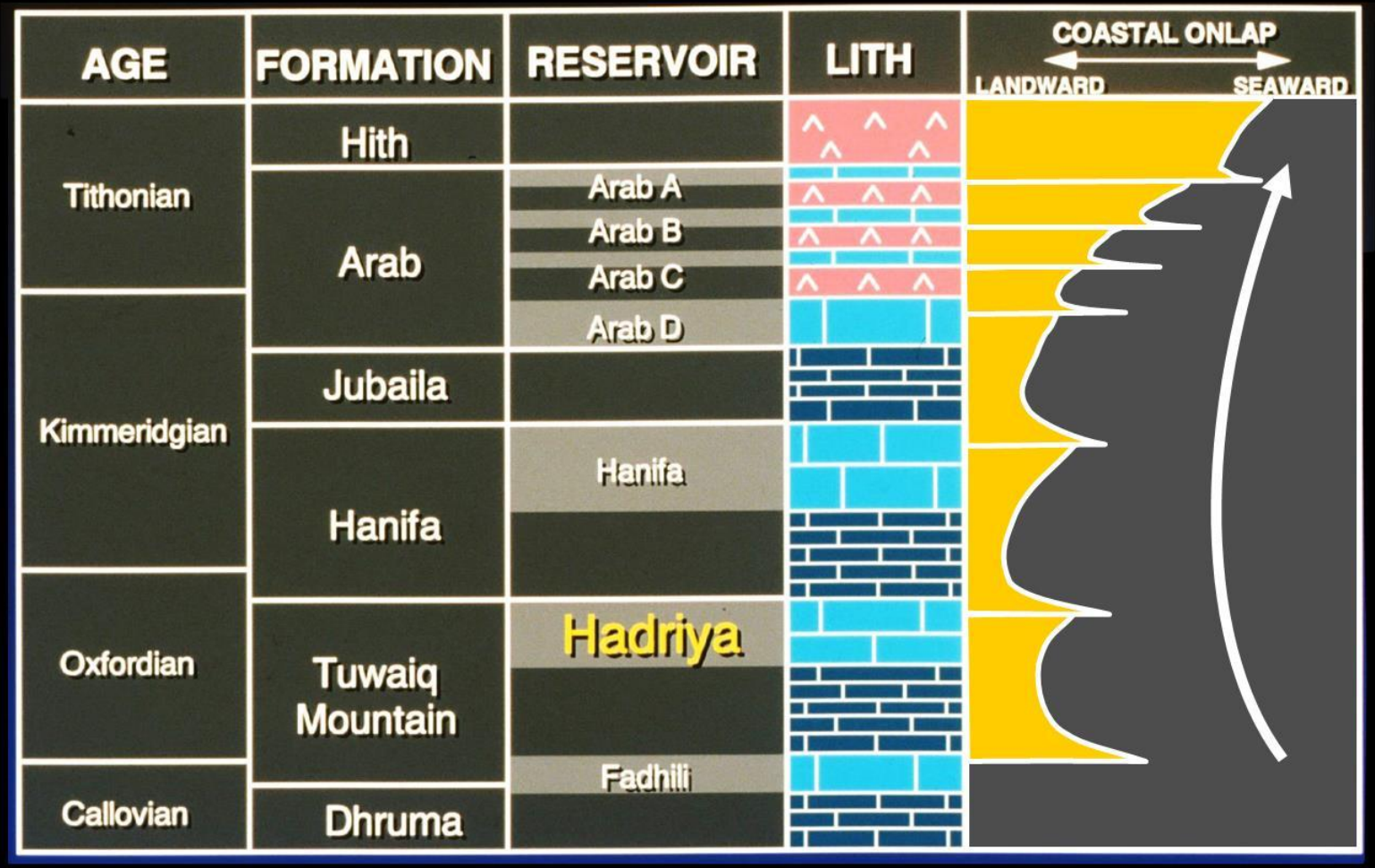
Mesogenetic Reservoir Alteration

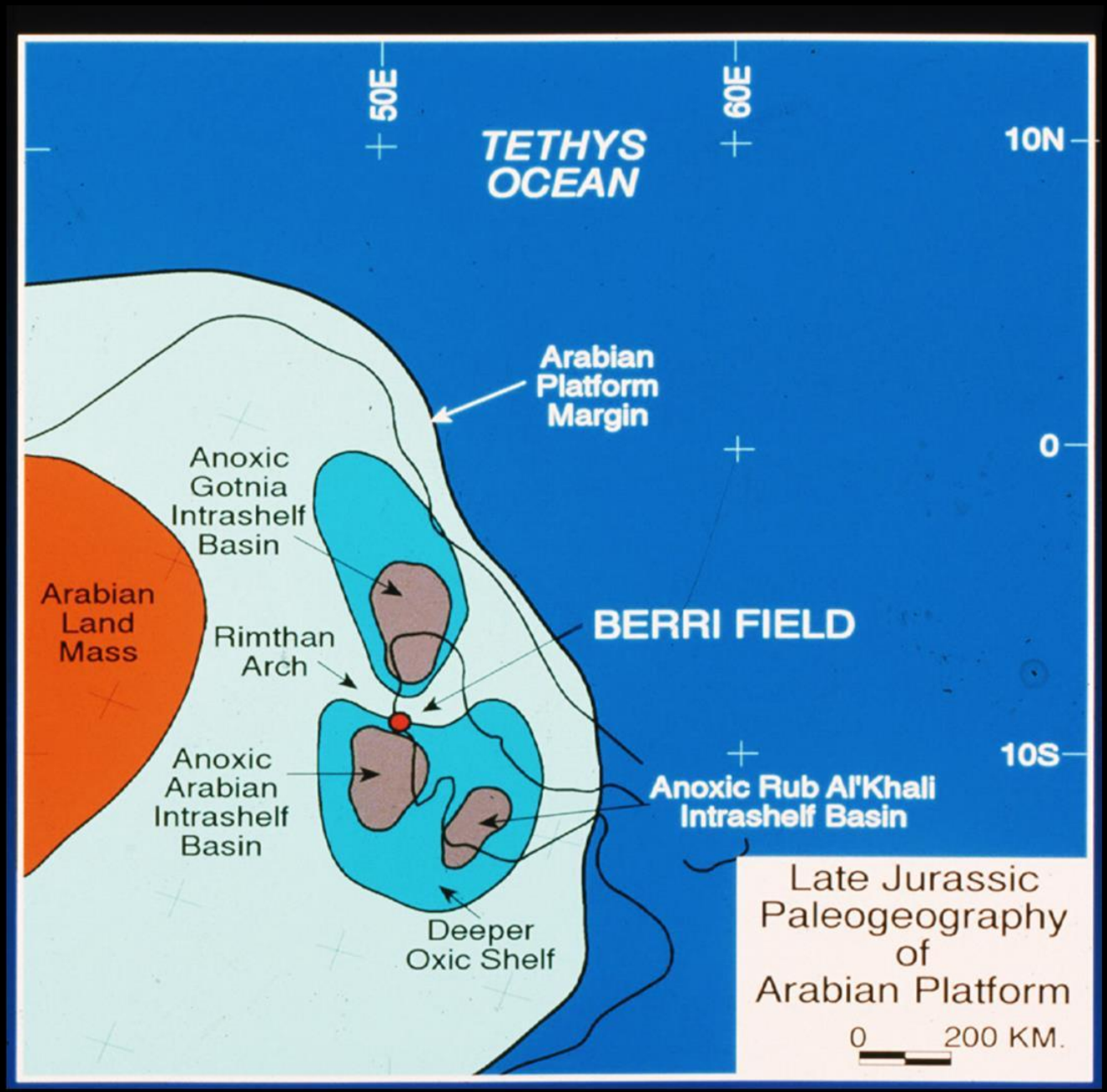
Reservoir Performance

Distribution of Mesogenetic Alteration relative to the Berri Field Structure

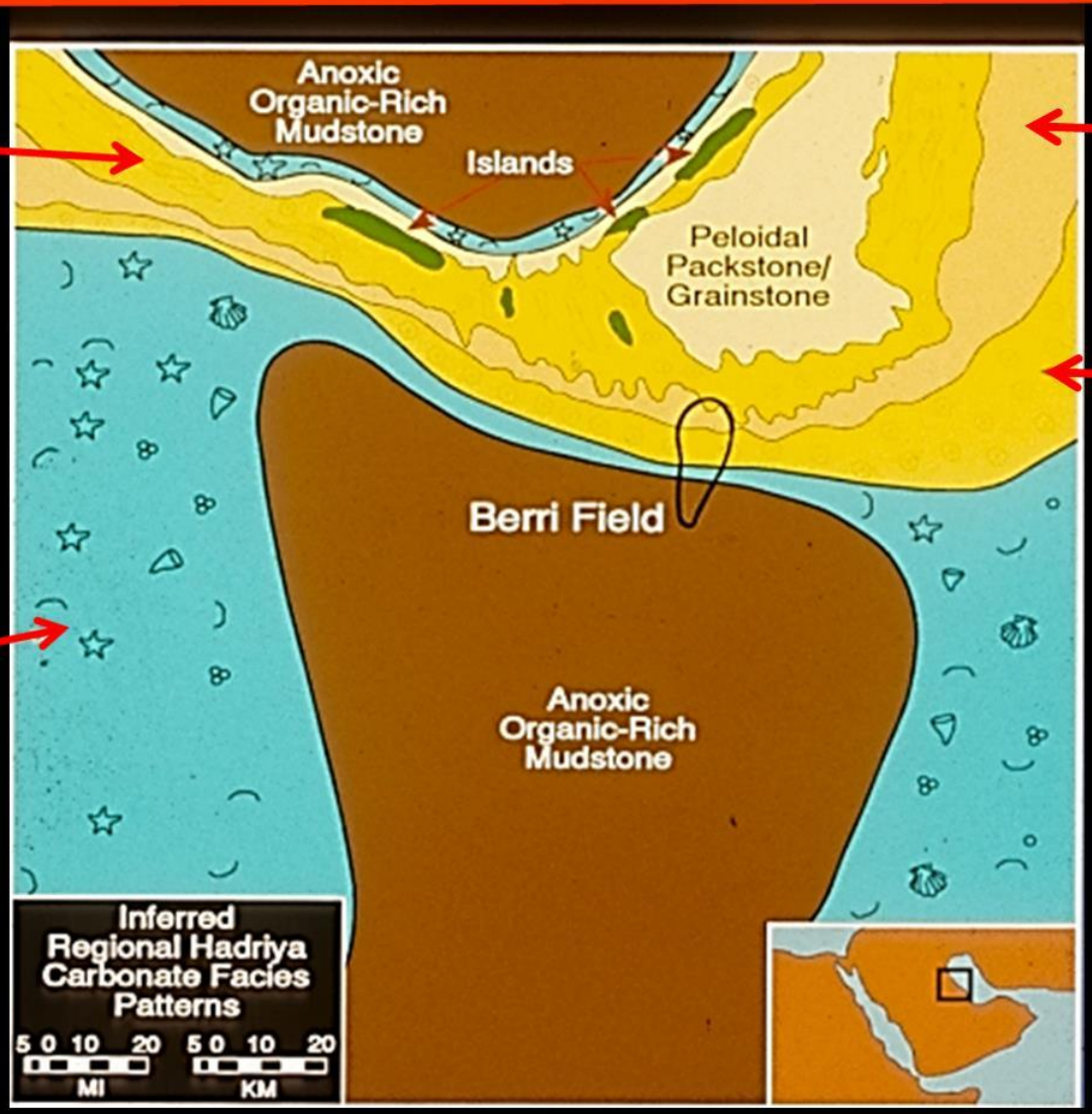
Conclusions

Berri Field Stratigraphy




50E
60E
TETHYS
OCEAN
10N
0
10S
Arabian
Platform
Margin
Anoxic
Gotnia
Intrashelf
Basin
Arabian
Land
Mass
Rimthan
Arch
BERRI FIELD
Anoxic
Arabian
Intrashelf
Basin
Anoxic Rub Al'Khali
Intrashelf Basin
Deeper
Oxic Shelf
Late Jurassic
Paleogeography
of
Arabian Platform
0
200 KM.

Inferred Hadriya Facies Distribution



Hadriya Characteristics

Reservoir Thickness—A wedge: 230 ft. to 50 ft.

Low Relief Prograding Ramp (0.06^0 Dips)

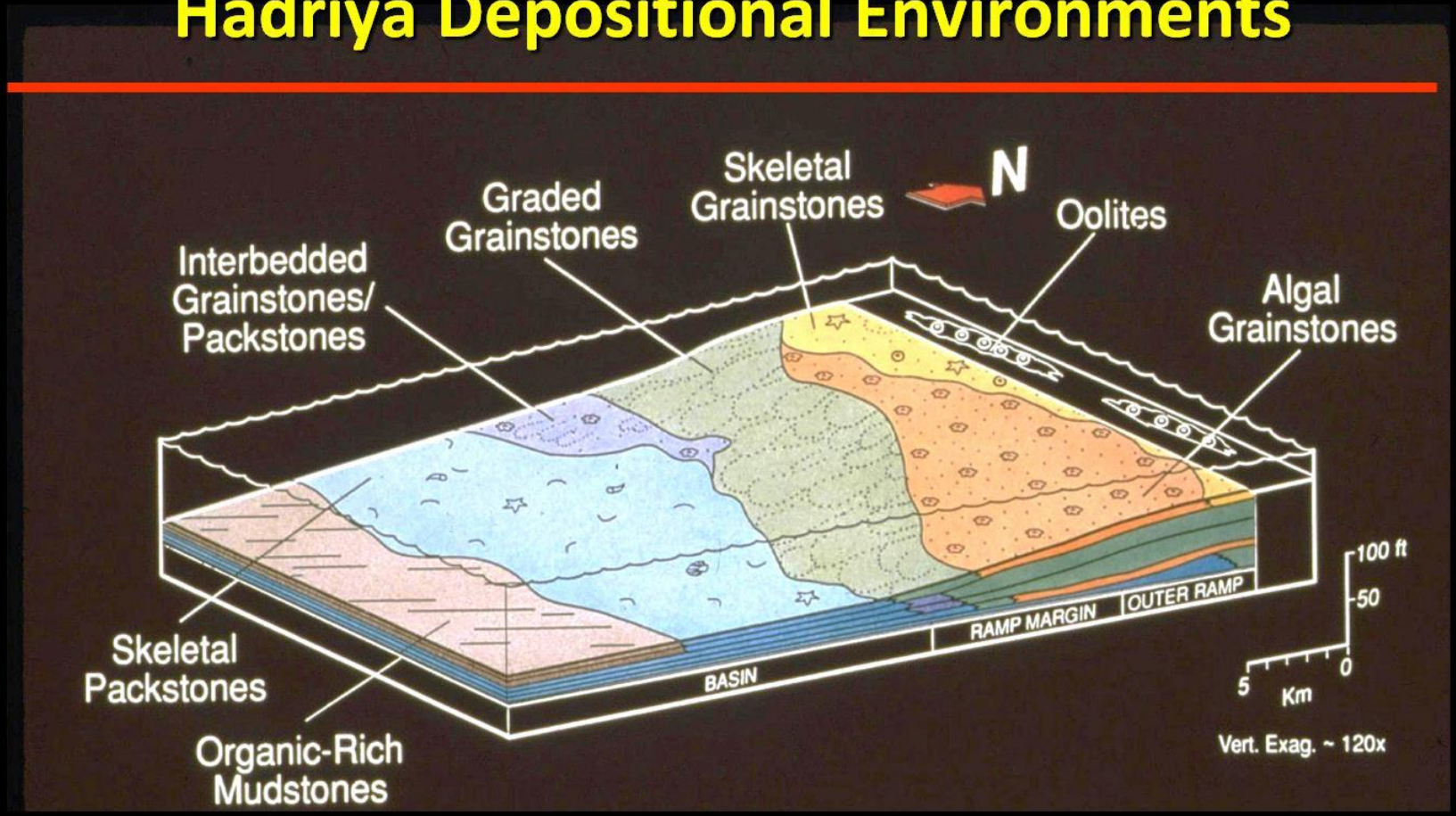
Algal/Skeletal Grainstones

Coarsening/Shallowing Upward Parasequences

No Evidence of Exposure (Type 2 SB)

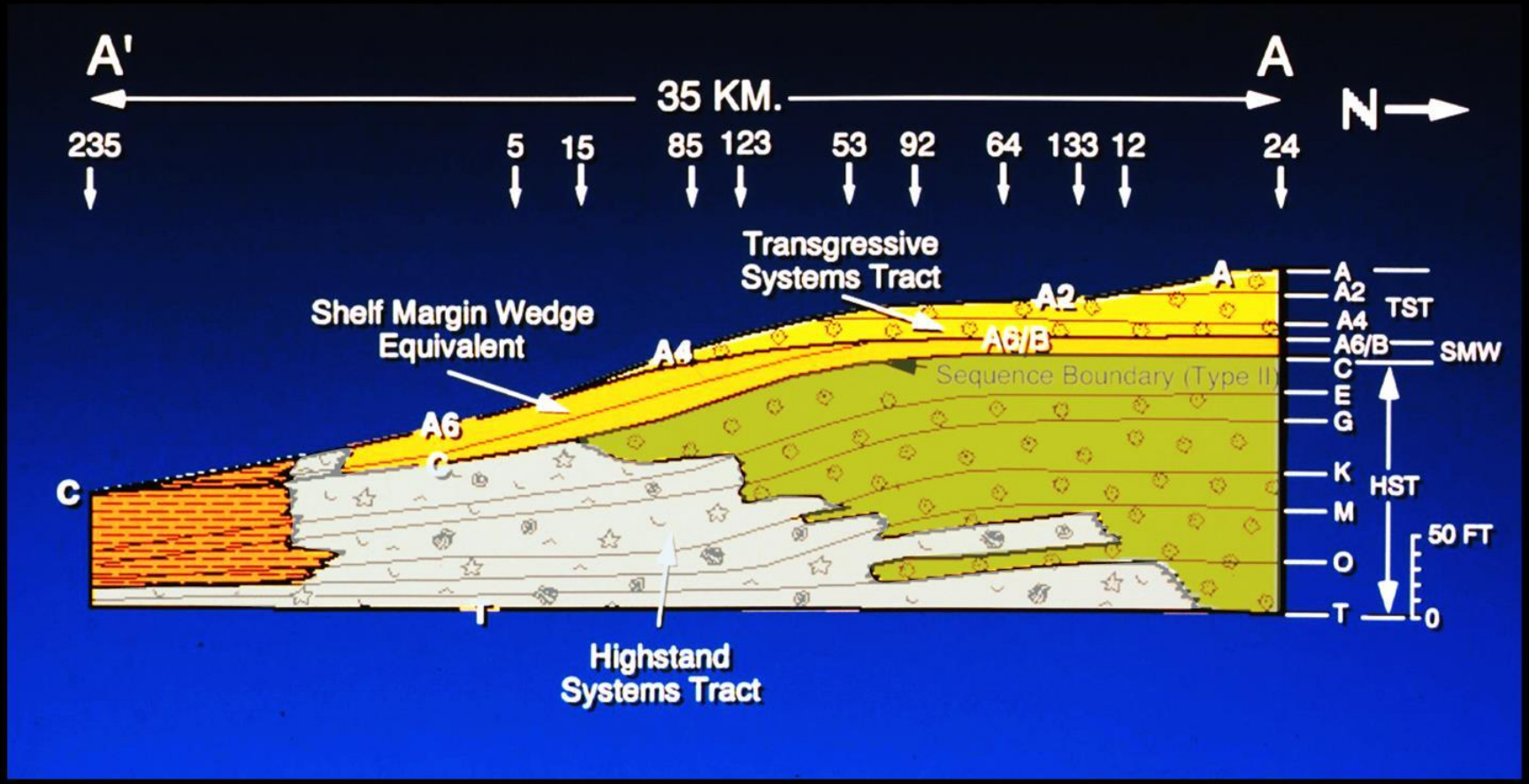
Transgressive Drowning Surface

Hadriya Depositional Environments

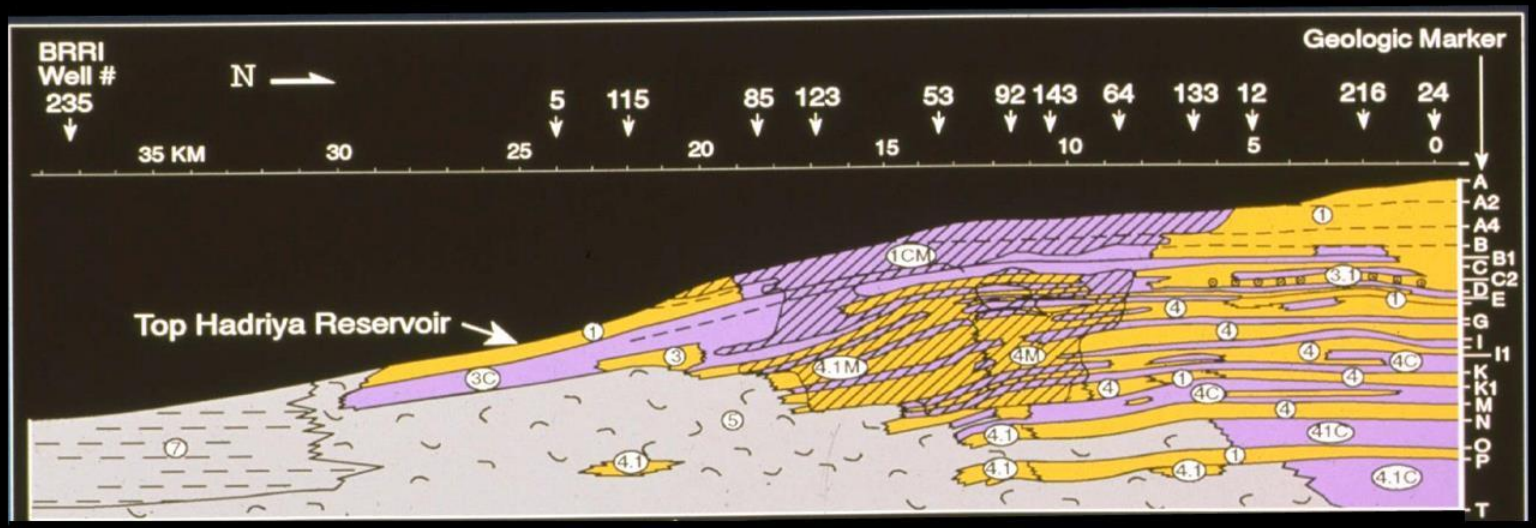


Macroporous Algal Grainstone

Hadriya Sequence Stratigraphy and Depositional Facies



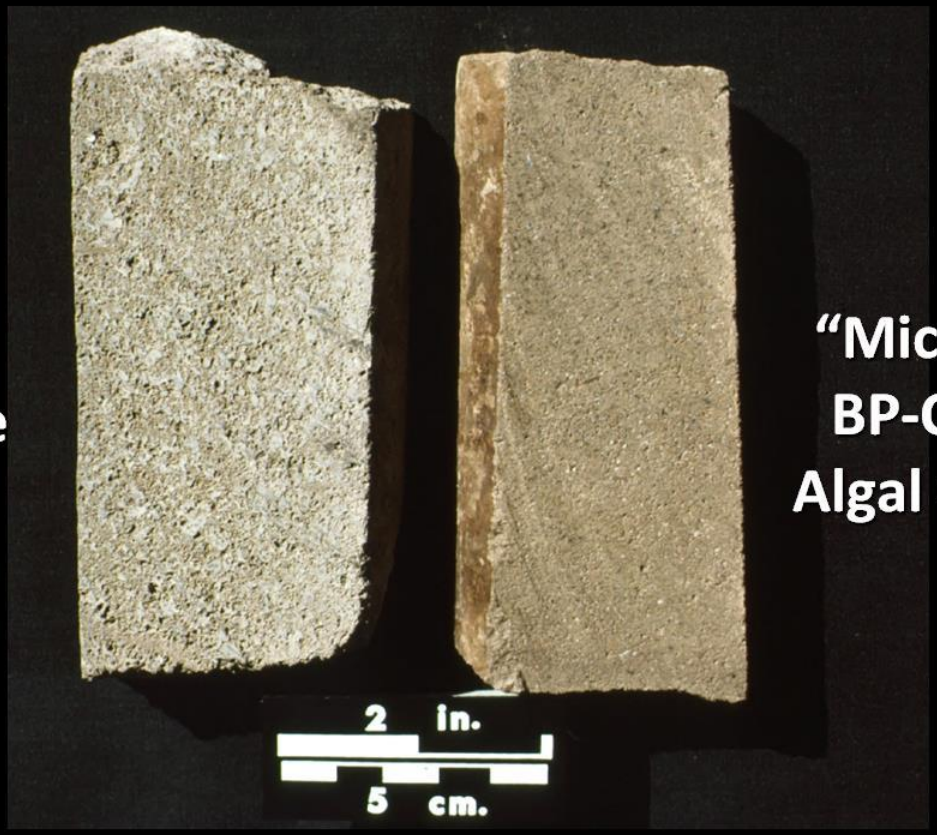
Berri Reservoir Facies Distribution



Altered Zone

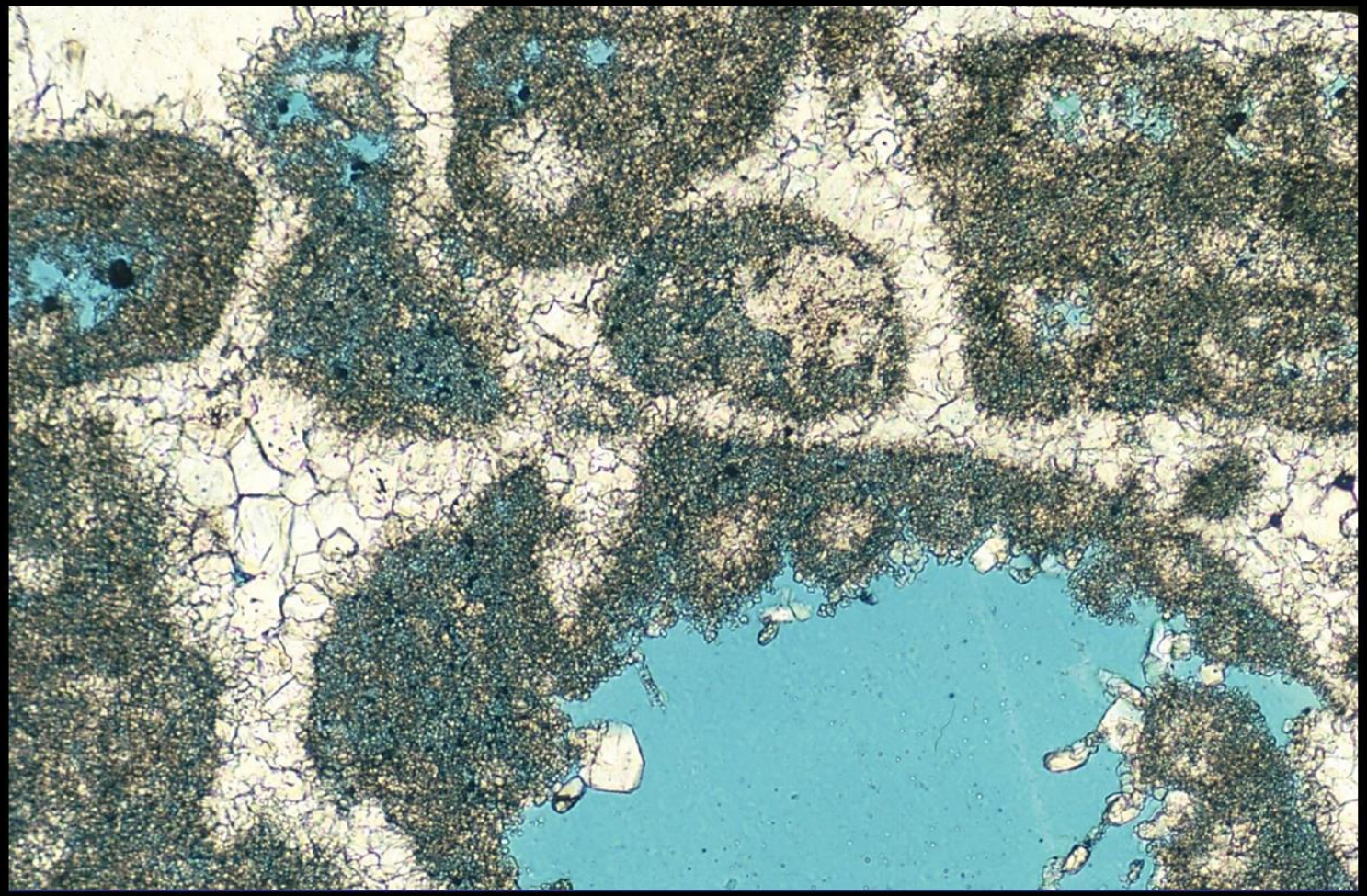
Cross-Cutting Burial-Related Diagenesis

Macroporous
Algal Grainstone



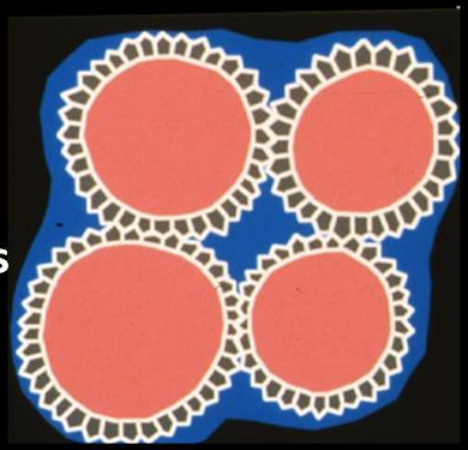
"Microporous"
BP-Cemented
Algal Grainstone

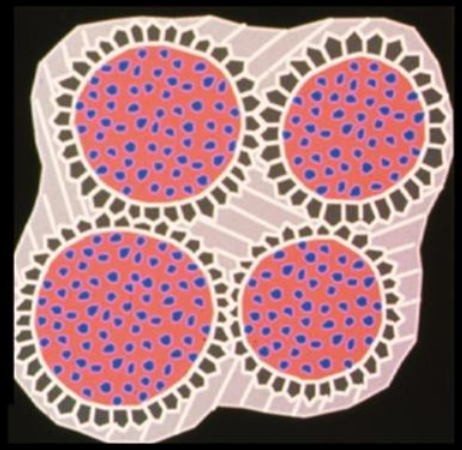
“Microporous” BP-Cemented Algal Grainstone



Burial-Related Diagenetic Transformation

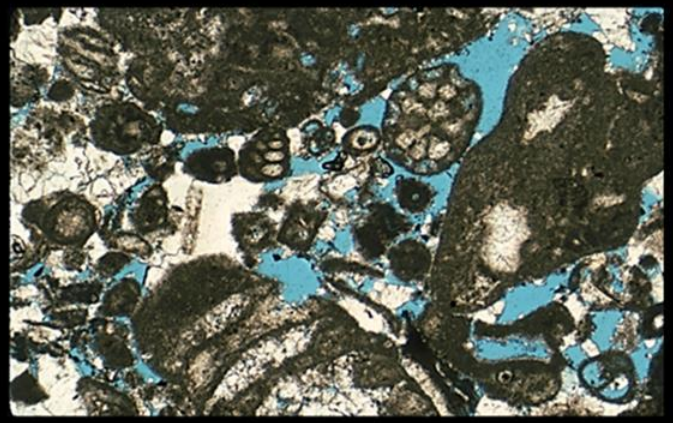
Dissolve Small Grains/Crystals





Precipitate Large Crystals

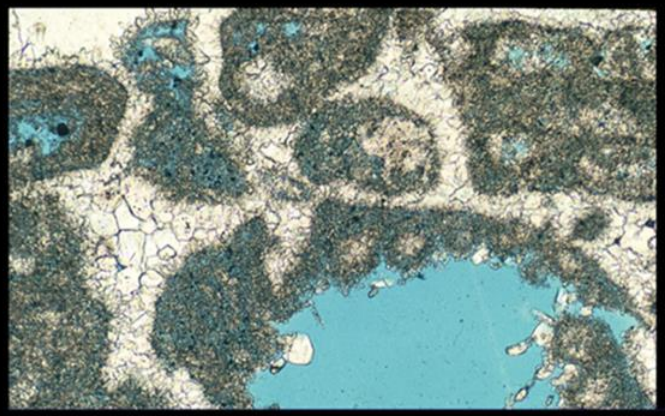
Macroporous Algal Grainstone



Avg. Φ = 19%

Avg. K = 342 md

"Microporous" Algal Grainstone



Avg. Φ = 17%

Avg. K = 10 md

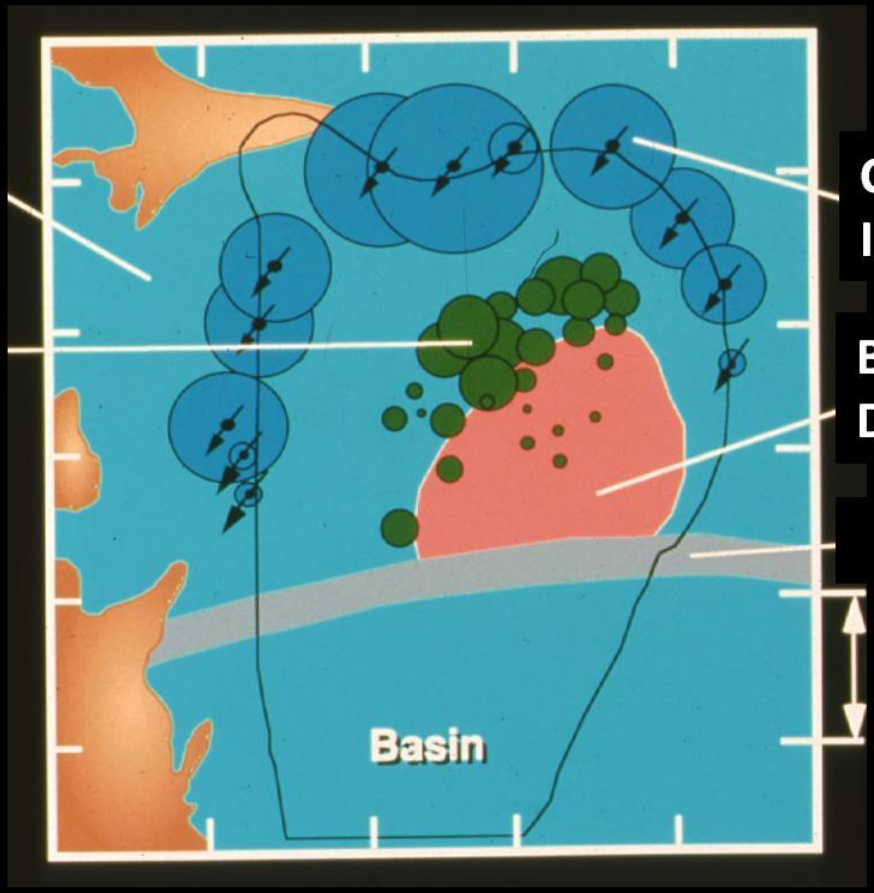
Diagenetic Attributes

Post-Dates Deposition

Occurs Late in Paragenetic Sequence (Cross-Cuts Stylolites)

Distribution Related to Paleostructure

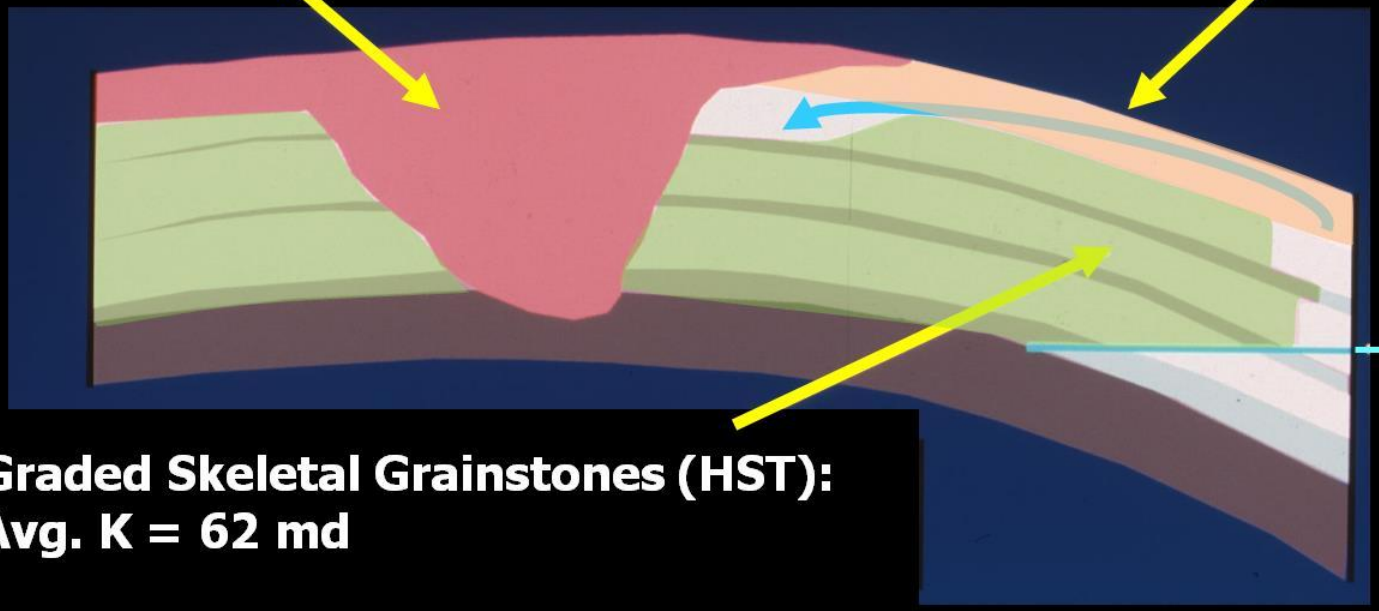
Hadriya Performance Circa 1987



Hadriya Reservoir Facies and Water Encroachment Pattern

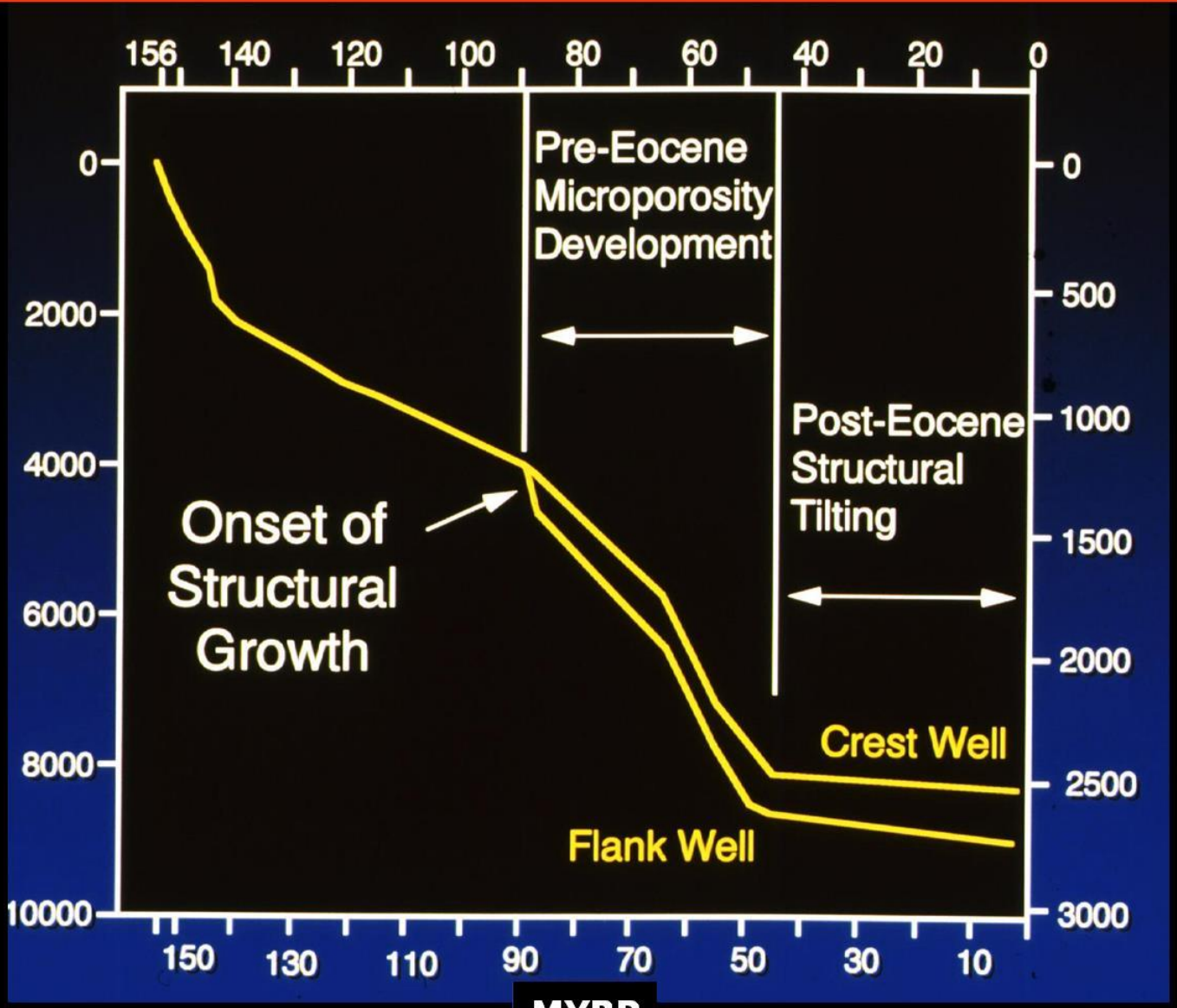
Microporosity:
Avg. K = 10 md

Algal Grainstones (TST):
Avg. K = 340 md



Graded Skeletal Grainstones (HST):
Avg. K = 62 md

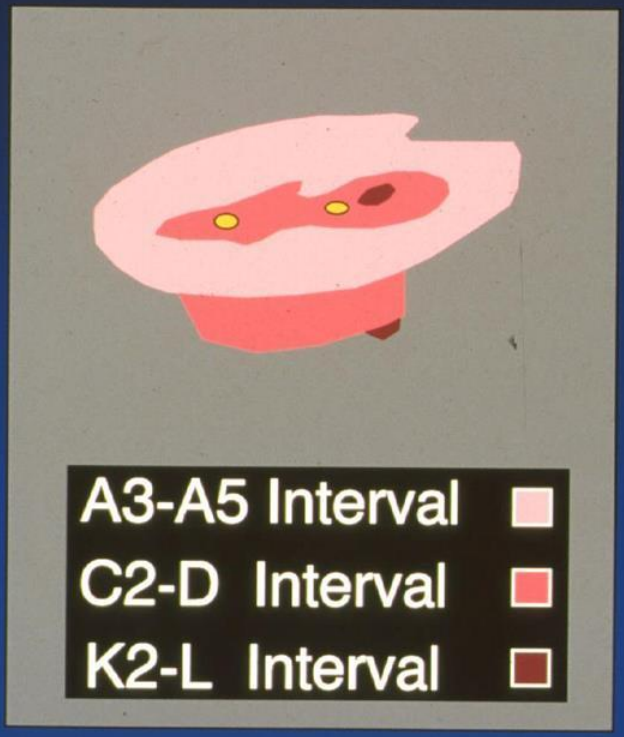
Berri Field Burial History

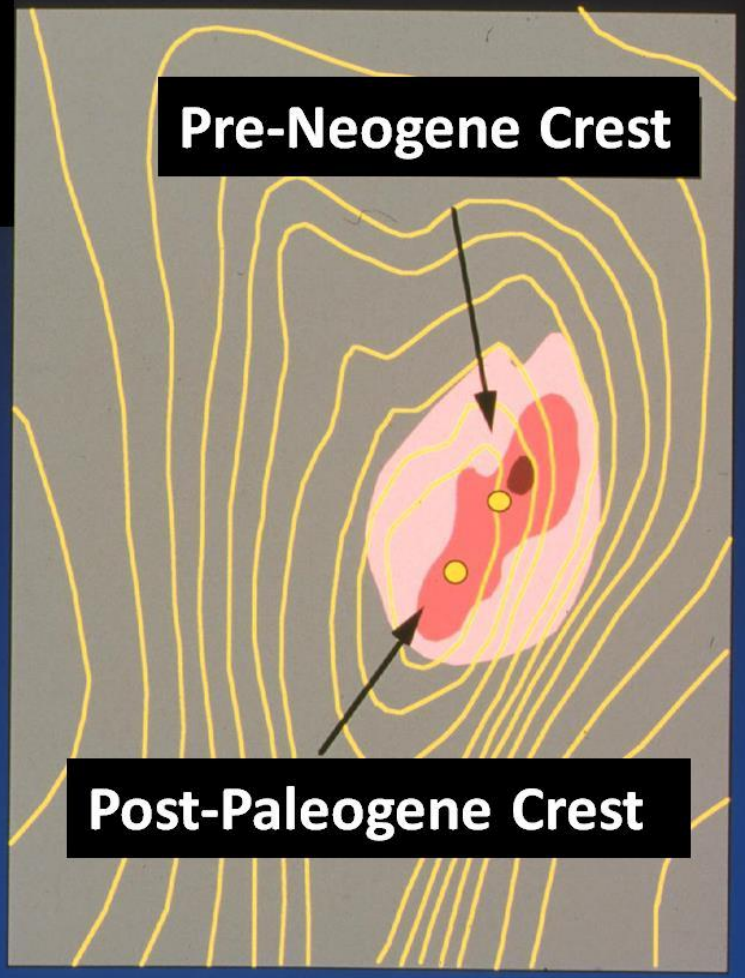


Depth Feet

Depth Meters

Distribution of Burial-Related Diagenesis





Conclusions

Porosity-conservative diagenesis : an apparent mesogenetic processes linked to the pre-Neogene structural crest of the field.

Performance controlled by facies, systems tract geometry, and porosity-conservative, burial-related diagenesis.

High flow rate & waterflood advance in algal grainstones of TST (Avg. K = 340 md).

Moderate flow rate & waterflood advance in skeletal grainstones of HST (Avg. K = 62 md).

Low flow rate in rock volume affected by burial-related diagenesis (Avg. K = 10 md).