



Depositional Model and Distribution of Marginal Marine Sands in the Chase Group, Hugoton Gas Field, Southwest Kansas and Oklahoma Panhandle

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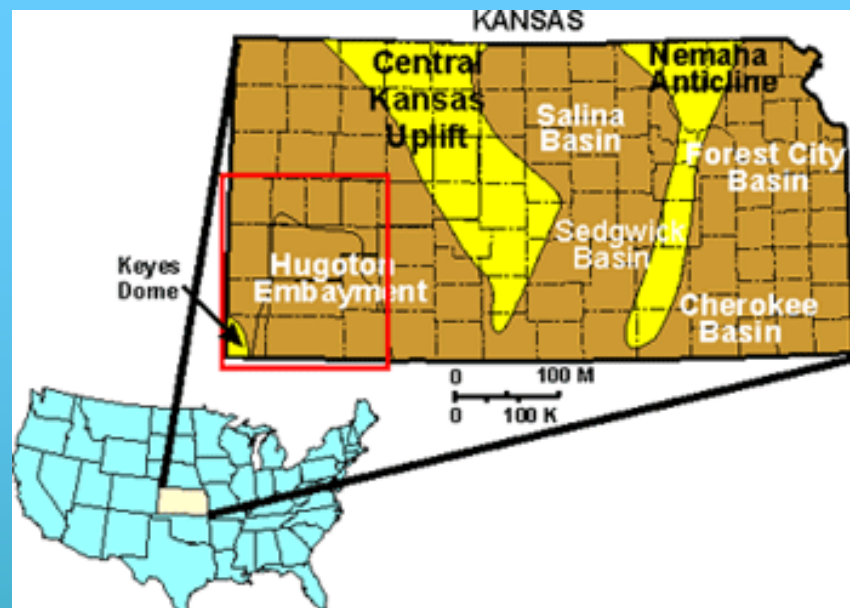
1930 Constant Ave., Lawrence, KS 66047

Introduction

- The Hugoton Gas Field has produced 29 Tcf
- Marginal marine sandstone facies recognized in industry for year, but not well documented
 - Olson et al., 1997
 - Noted that marine sandstone occur in the Chase Group and have not been published as a major reservoir facies.
- Other important reservoir lithofacies are dolomitized grainstone, carbonate packstone and grainstone.

Geologic Background

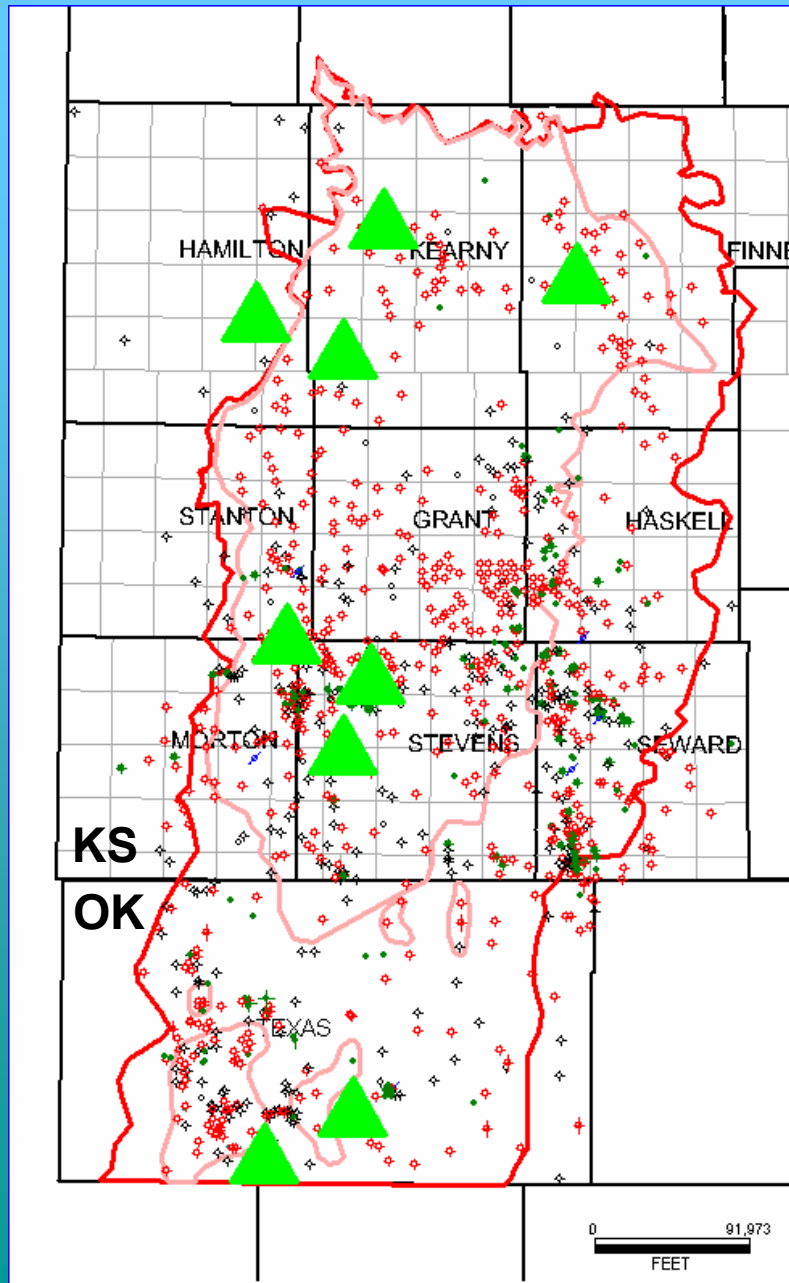
- Hugoton Gas Field
 - Hugoton Embayment
- Hugoton Embayment
 - Northern shelf extension of Anadarko Basin
 - Long-lived structure
 - Paleozoic to Cenozoic



- Chase Group
 - Early Permian
 - Consists of marine carbonates and non-marine siltstones and marginal marine sandstones
 - Near shore Environment

			Subsurface Units
System	Series	Group	Kansas Hugoton Field
P E R M I A N	W	C	Herrington
	O		Paddock
	L		Krider
	F	H	Odell
	C		Winfield
	A	A	Gage
	M		Towanda
	P		Fort Riley
	I	E	Lower Fort Riley
	A		Wreford
N	N	COUNCIL GROVE	

Cores Described Data Distribution



- 9 Cores Described
- 1086 E-Logs
 - The necessary logs for Neural Net facies prediction
 - GAMMA RAY
 - NPHI
 - ILD
 - DPHI
 - PE, where available

-  Cores Described
-  Hugoton (Chase Group) Field Boundary
-  Panoma (Council Grove) Field Boundary

Sandstone Facies Intervals

			Subsurface Units
System	Series	Group	Kansas Hugoton Field
P E R M I A N	W	C H A S E COUNCIL GROVE	Herrington
	O		Paddock
	L		Krider
	F		Odell
	C		Winfield
	A		Gage
	M		Towanda
	P		Fort Riley
	I		Lower Fort Riley
	A		Wreford
N	N		

- Sandstone found dominantly in the Upper Chase
 - Herrington to Ft. Riley

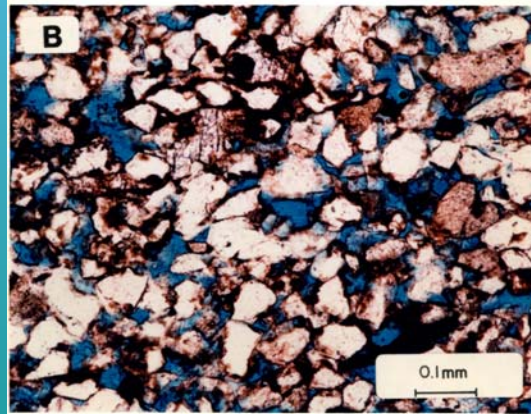
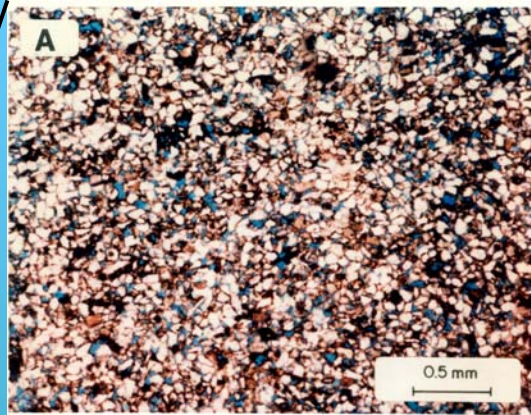
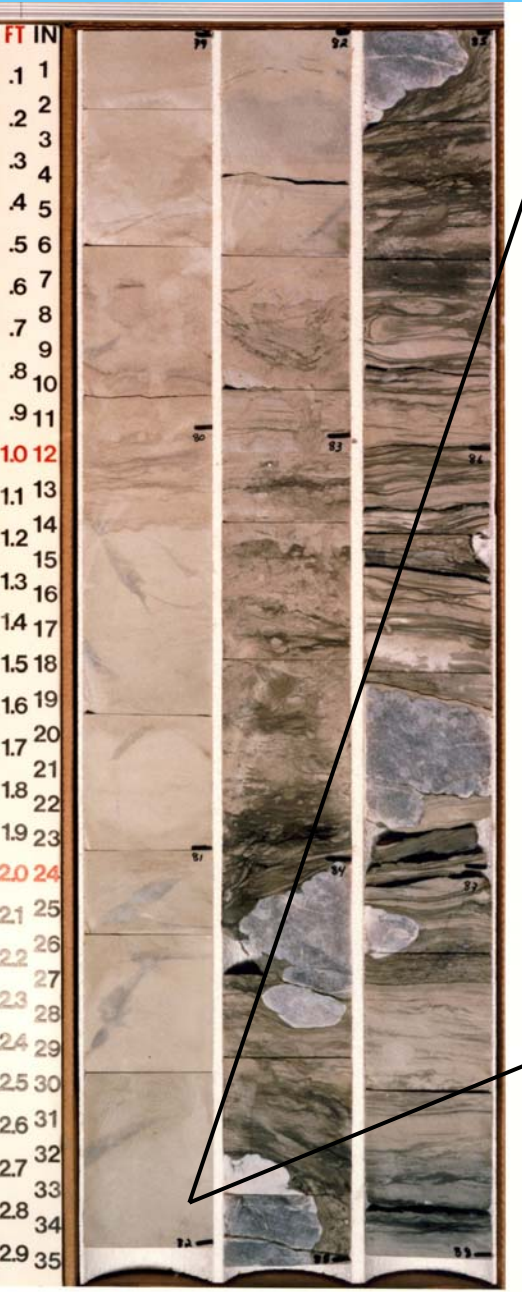
Approximate k and Φ by Lithofacies

R
E
S
E
R
V
I
O
R

Q
U
A
L
I
T
Y

- Medium to coarse-grain moldic dolomite
 - $k \approx 30-300\text{md}$ $\Phi \approx 3-25\%$
- Grainstone
 - $k \approx 15-200\text{md}$ $\Phi \approx 3-25\%$
- Marginal Marine Sandstone
 - $k \approx 10-150\text{md}$ $\Phi \approx 15-25\%$
- Packstone
 - $k \approx 1-10\text{md}$ $\Phi \approx 10-18\%$
- Non-Marine Sandstone
 - $k \approx 1-10\text{md}$ $\Phi \approx 10-18\%$
- Fine-grained moldic dolomite
 - $k \approx 0.1-2\text{md}$ $\Phi \approx 8-15\%$
- Wackestone
 - $k \approx 0.1-1\text{md}$ $\Phi \approx 5-10\%$
- Carbonate mudstone, Marine shale and silt, Non-Marine shaley Silt, and Non-Marine Silt
 - $k \approx <0.1\text{md}$ $\Phi \approx <8\%$

Sandstone Facies

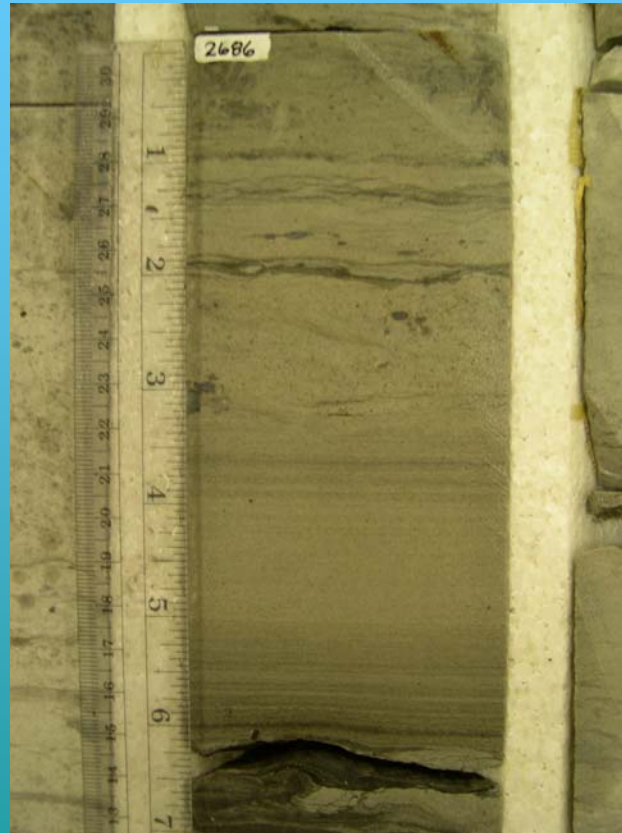


- Core Photo(2479 – 2488 feet)
- Sedimentary structures
 - Bioturbation
 - Planar bedded
 - Current ripples and minor trough cross bedding
- Thin Section(2481.8 feet)
 - $\Phi = 17.6 \%$
 - $k = 10.1 \text{ md}$
- Grain size
 - $62\text{-}125 \mu\text{m}$
- Grain shape
 - Subangular
- Petrography
 - Arkose
 - Qtz. $\approx 46\%$
 - Feldspars $\approx 42\%$

Common Sedimentary Structures of the Sandstone Facies



Bioturbation



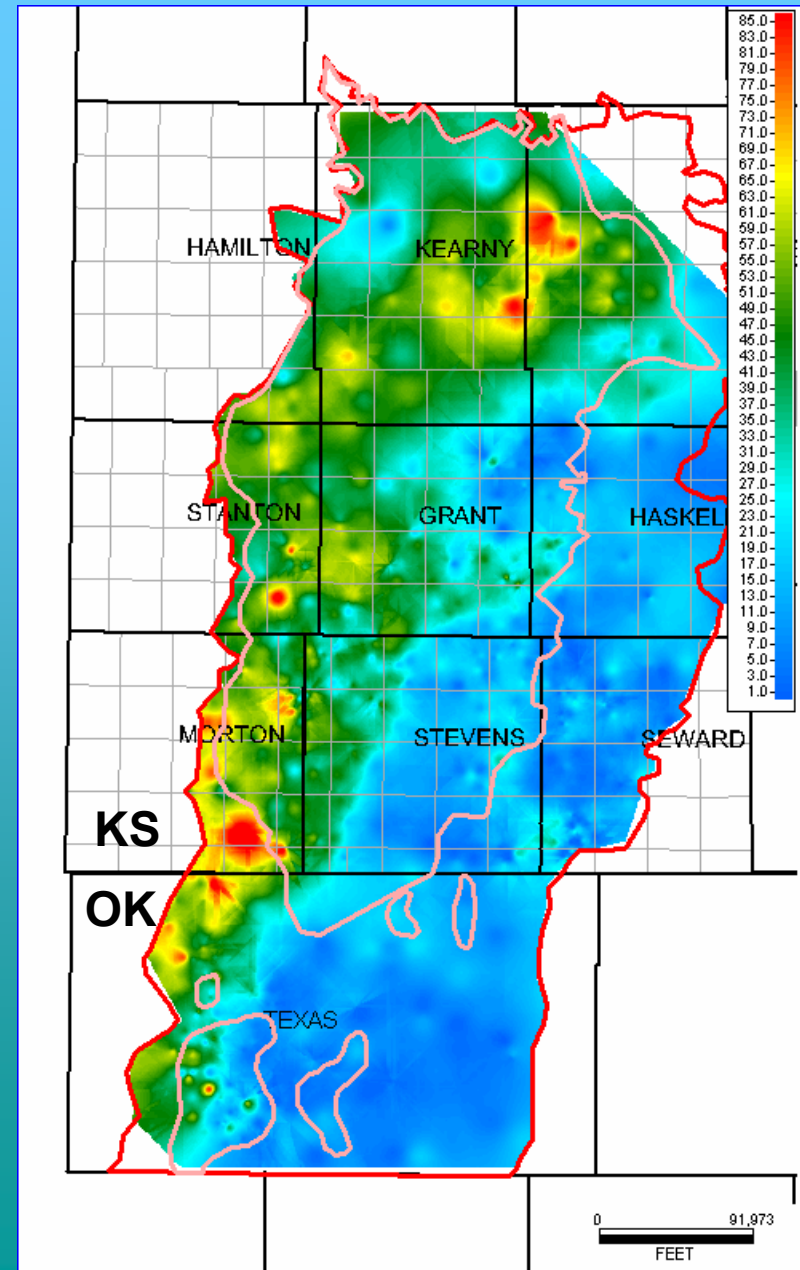
Planar Bedding



Current Ripples

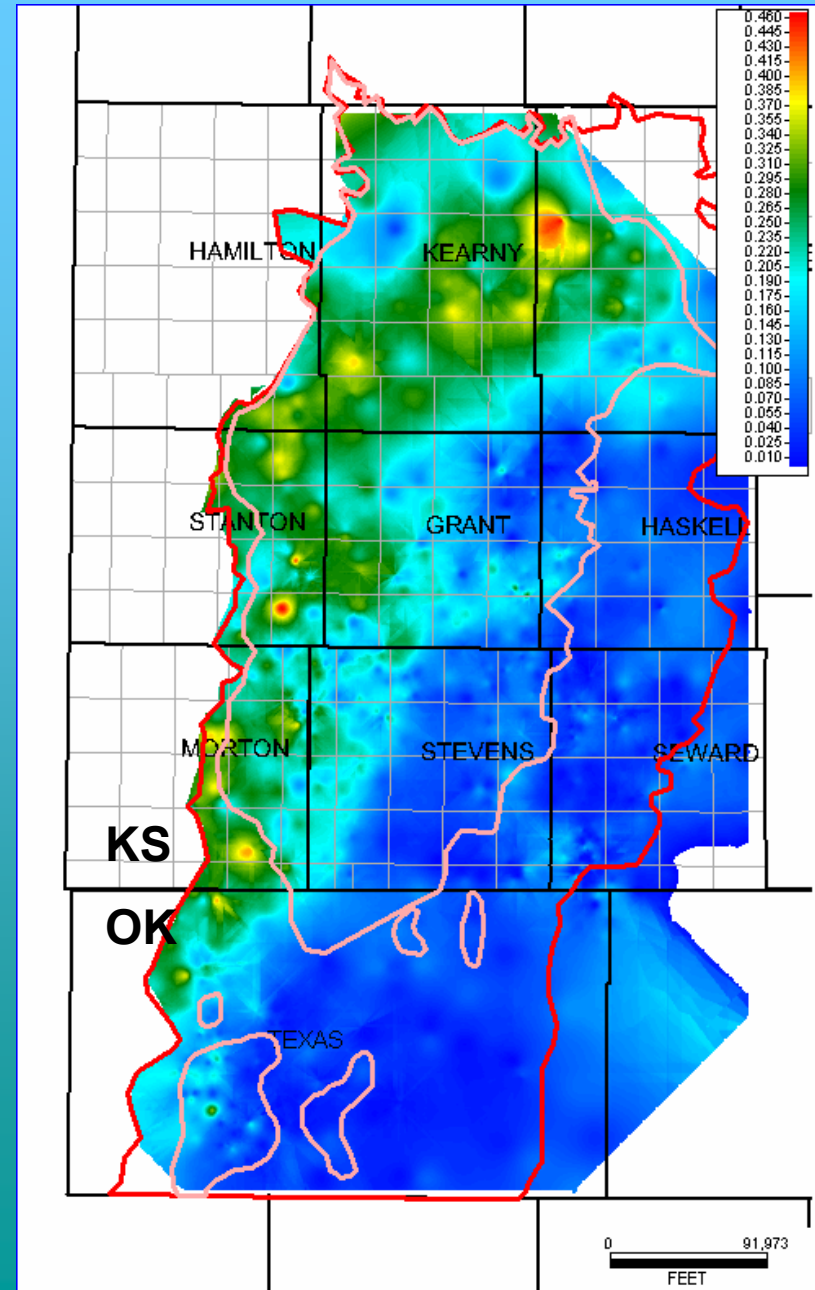
Upper Chase Net Sand thickness

- Net Sand thickness
 - 0(blue) to 85(red) feet
- Upper Chase
 - Ft. Riley to Herrington
- Position
 - Dominantly predicted on the up dip margin of the field
 - Parallels field boundary



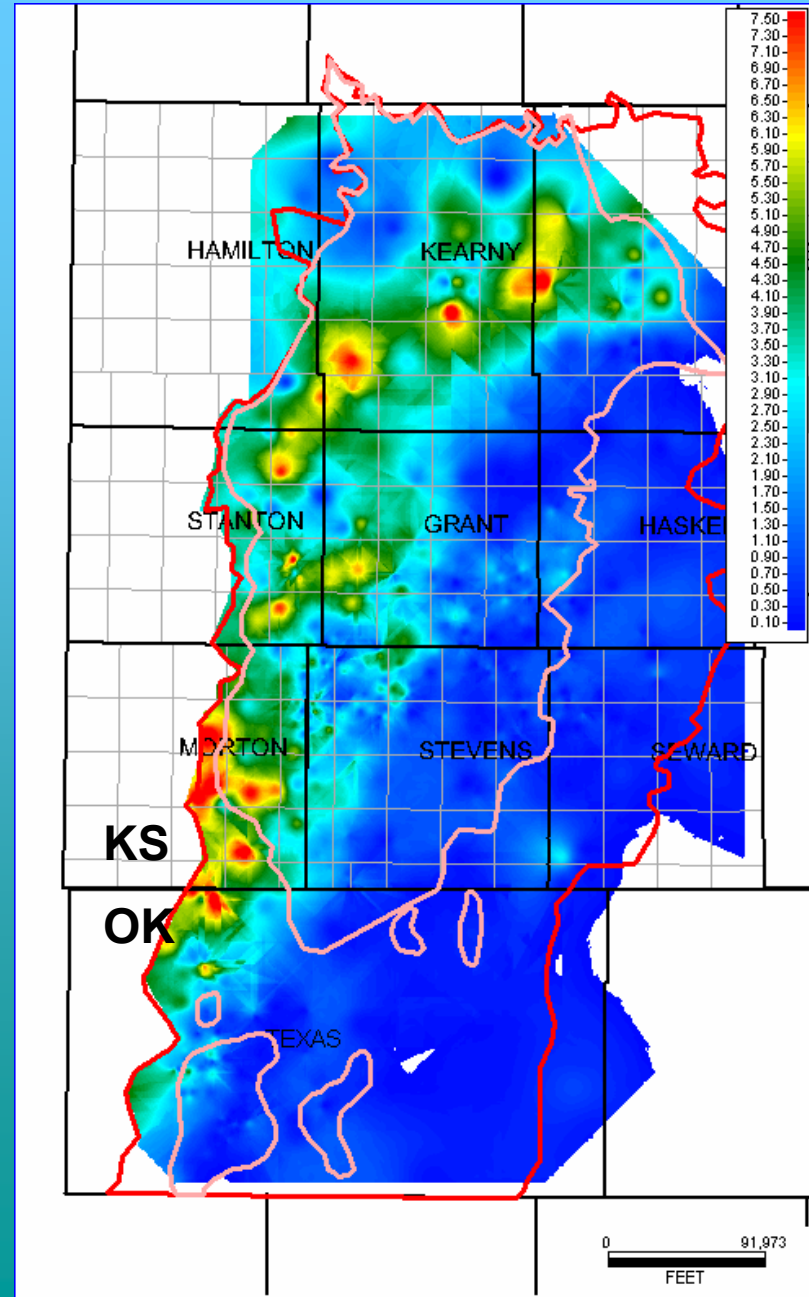
Upper Chase Net to Gross Sand

- Net to Gross Sandstone
 - 0%(blue) to 48%(red)
- Upper Chase
 - Ft. Riley to Herrington
- Position
 - Dominantly predicted on the up dip margin of the field
 - Parallels field boundary

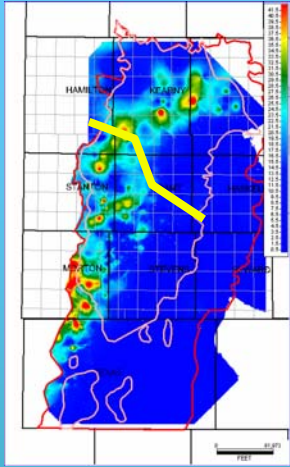


Upper Chase Sand Thickness X Porosity

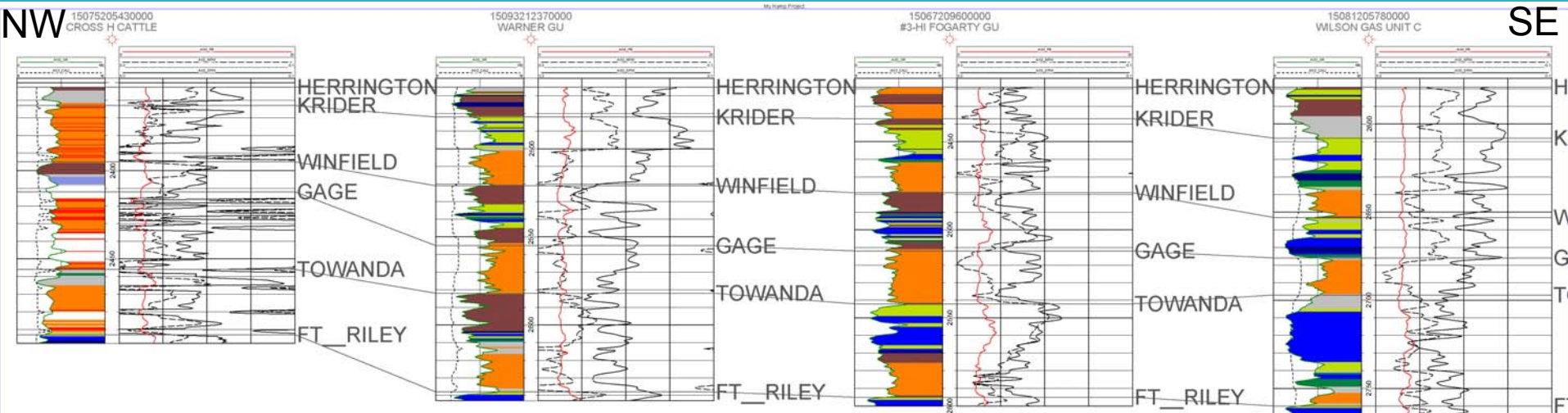
- PHIH scale
0(blue) to 7.50 (red)
- Upper Chase
Ft. Riley to Herrington



Upper Chase Cross Section

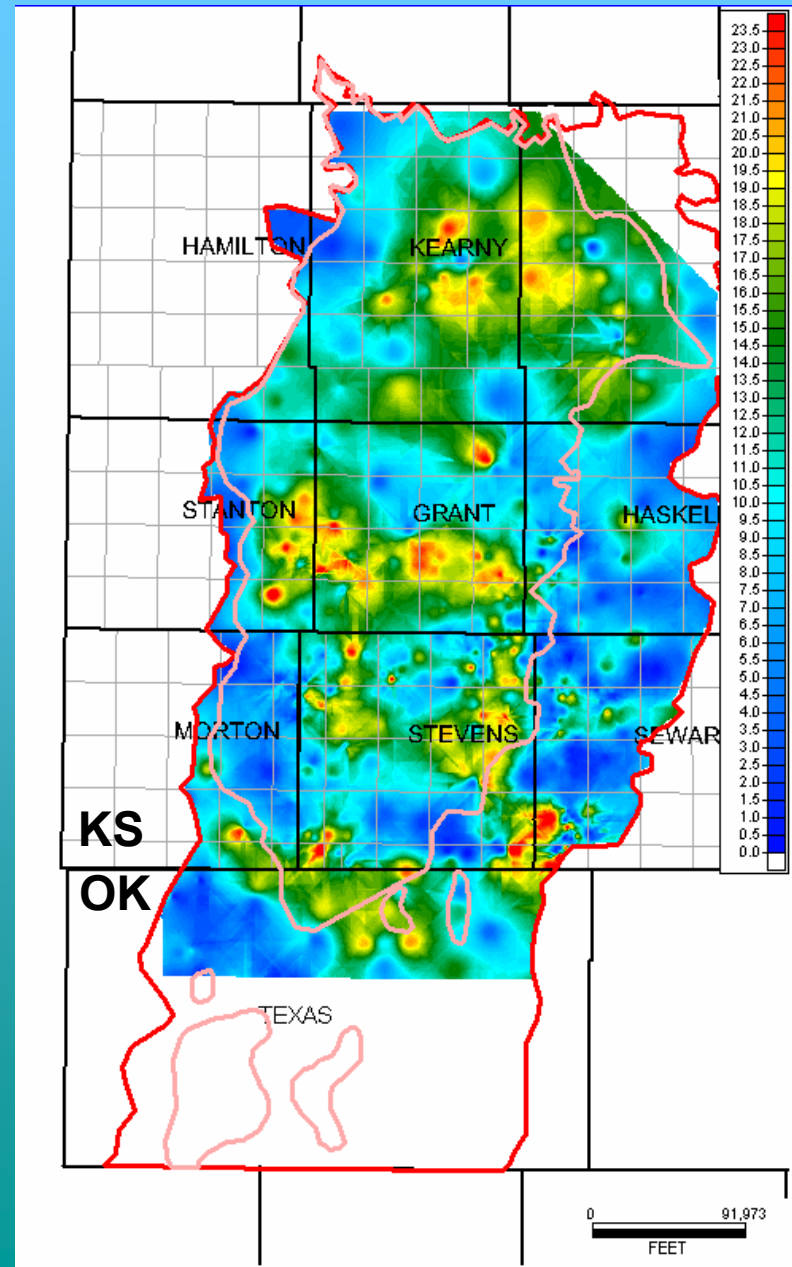


- Non-Marine Silt
- Non-Marine Shly Silt
- Marine Shale & Silt
- Mudstone/Mudstone-Wackestone
- Wakestone/Wakestone-Packstone
- Fine-crystalline Sucrosic Dolomite
- Packstone/Packstone-Grainstone
- Grainstone/Phylloid Algal Bafflestone
- Medium-Coarse Grain moldic, Medium-Coarse-crystalline sucrosic Dolomite
- Marine Sandstone
- Non-Marine Sandstone
- Bedded Anhydrite



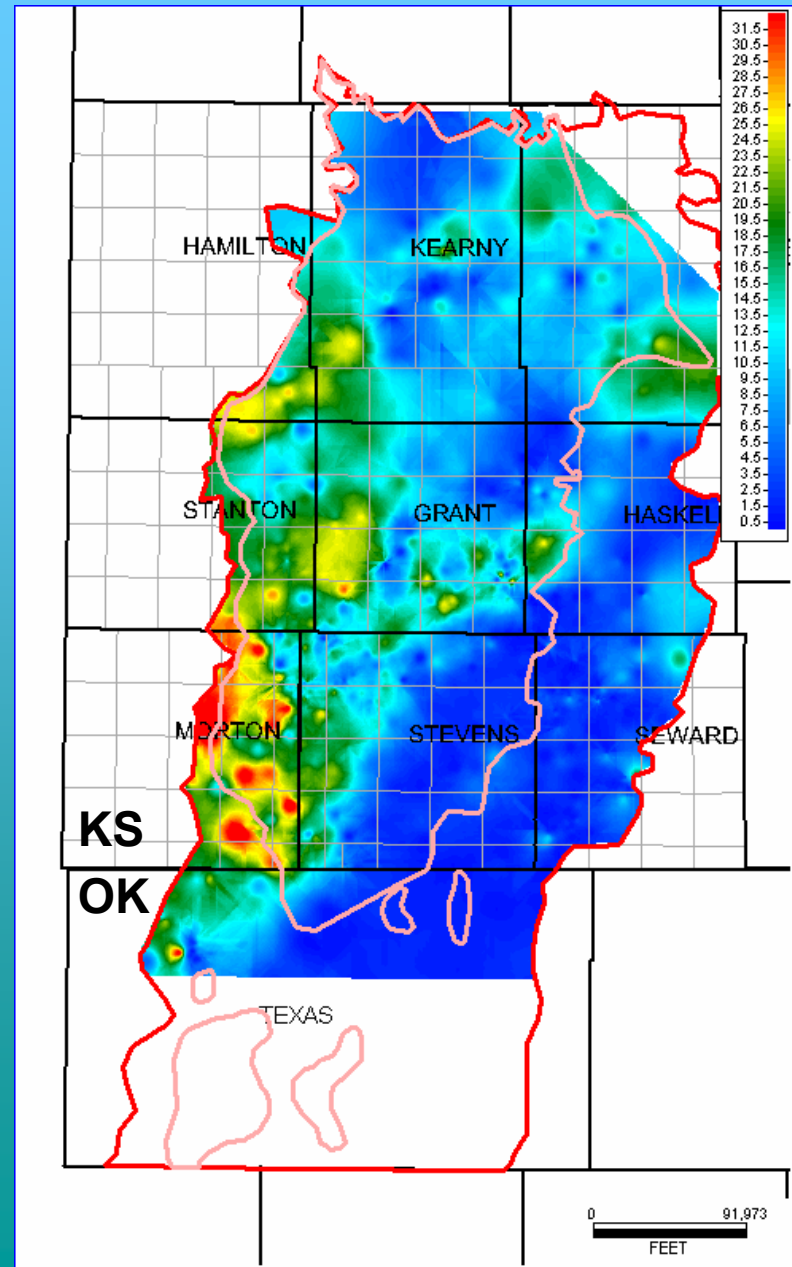
Herrington Sandstone Facies

- Net Sandstone Facies Map
 - 0(blue) to 24(red) feet
- Position
 - Predicted throughout much of the field



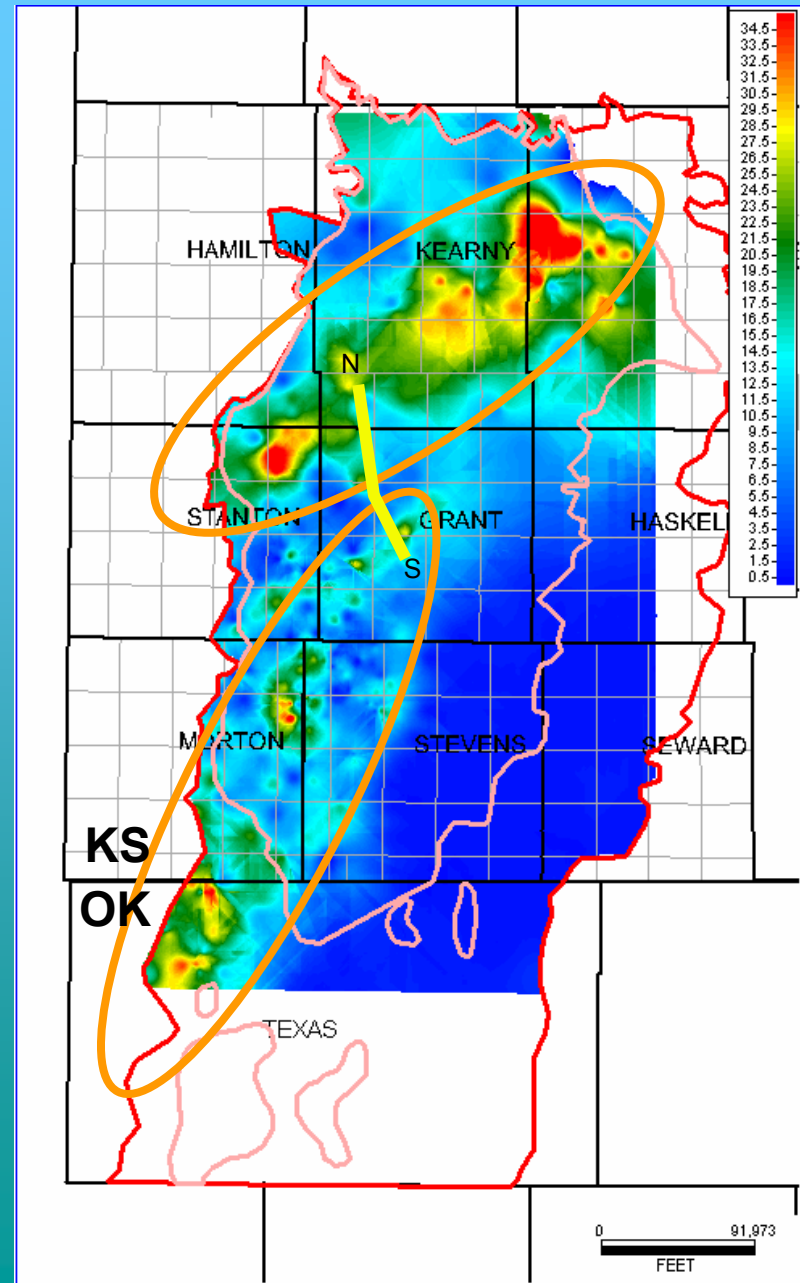
Winfield Sandstone Facies

- Net Sandstone Facies Map
 - 0(blue) to 32(red) feet
- Position
 - Dominantly predicted on the up dip west margin of the Field

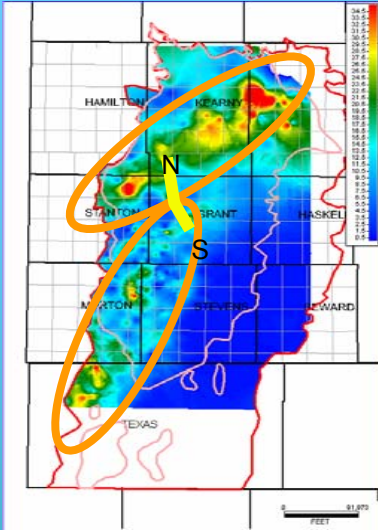


Towanda Sandstone Facies

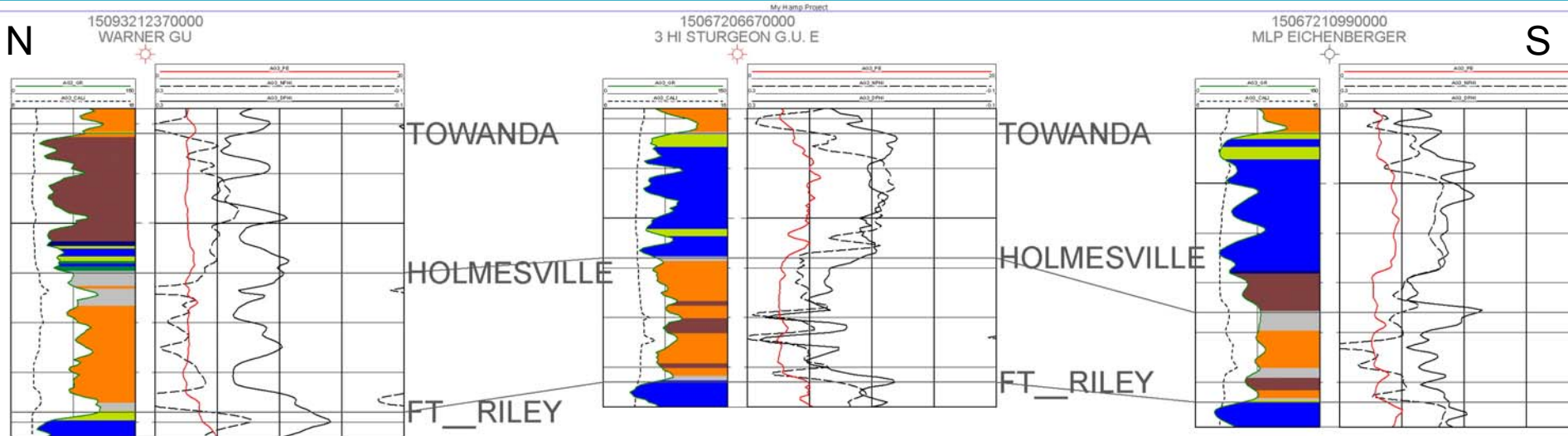
- Net Sandston Facies Map
 - 0(blue) to 35(red)
- Position
 - Dominantly predicted in two orientations
 - Northern part of field
 - Orientation
 - » approximately ENE
 - Southern part of field
 - Orientation
 - » Parallel west up dip margin of field to approximately NNE



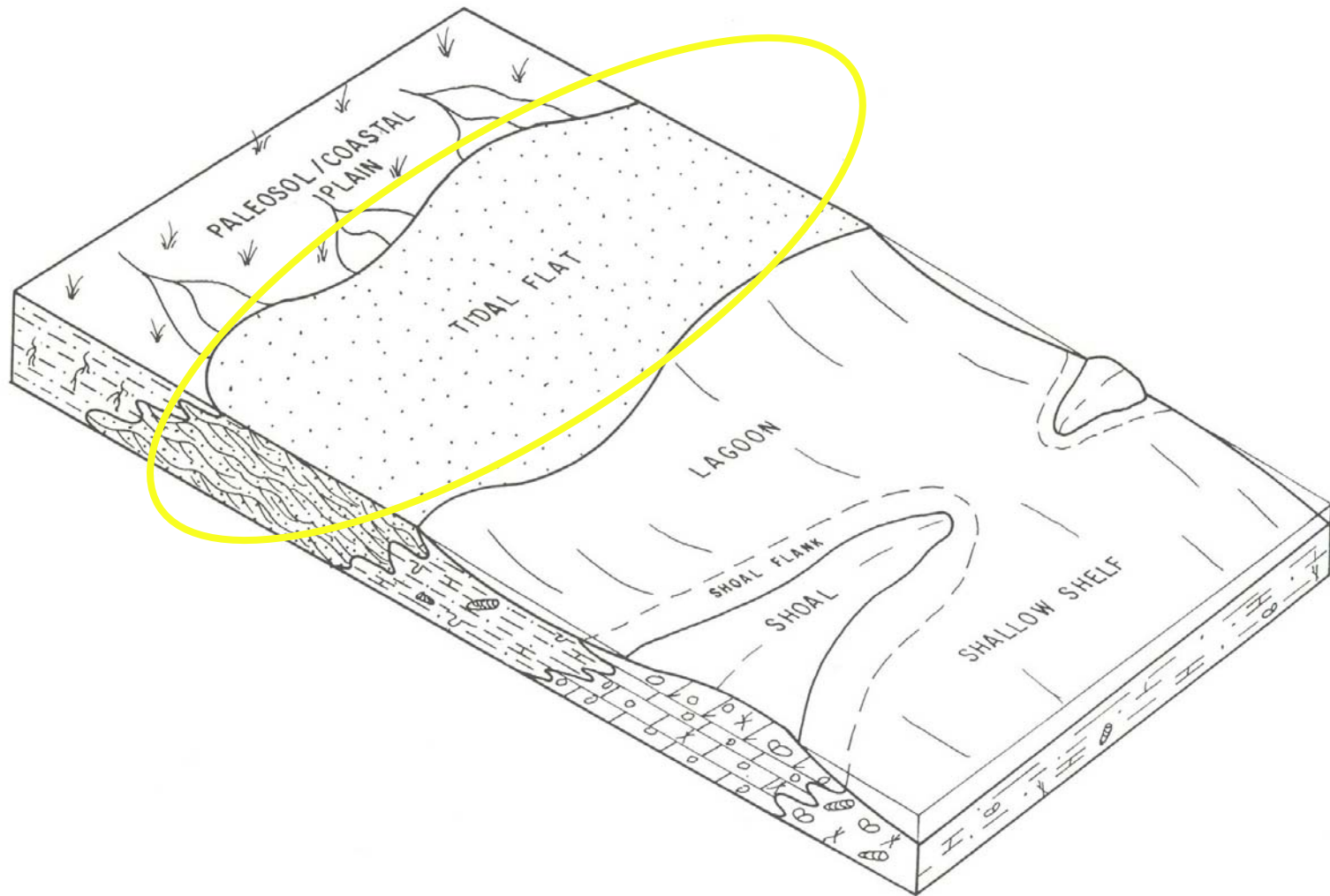
Towanda Sandstone Cross Section



- Non-Marine Silt
- Non-Marine Shly Silt
- Marine Shale & Silt
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- Wakestone/Wakestone-Packstone
- Fine-crystalline Sucrosic Dolomite
- Packstone/Packstone-Grainstone
- Grainstone/Phylloid Algal Bafflestone
- Medium-Coarse Grain moldic, Medium-Coarse-crystalline sucrosic Dolomite
- Marginal Marine Sandstone ←
- Non-Marine Sandstone
- Bedded Anhydrite



Sandstone Facies Depositional Model



Conclusions

- Upper Chase Group Sands
 - Dominantly predicted on the up dip west margin
- Found in three stratigraphic units
 - Herrington
 - Winfield
 - Towanda
- Good Reservoir Quality
 - $k \approx 10-150\text{md}$ $\Phi \approx 15-25\%$
- Deposited in a tidal flat environment
 - Parallel to field boundaries

Acknowledgement

We thank our industry partners for their support of the Hugoton Asset Management Project and their permission to share the results of the study.

Anadarko Petroleum Corporation
BP America Production Company
Cimarex Energy Co.
ConocoPhillips Company
E.O.G. Resources Inc.
Medicine Bow Energy Corporation
Osborn Heirs Company
OXY USA, Inc.
Pioneer Natural Resources USA, Inc

and

GeoPLUS for the use PETRA