

Analysis of Hydrocarbon Production in a Critically Stressed Reservoir

Connie Dodge Knight – Independent Geologist

Jennifer L. Miskimins – Colorado School of Mines

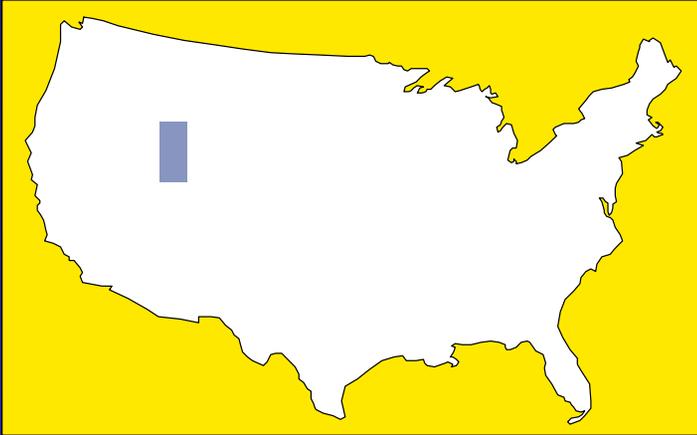
Acknowledgements

Gene Clower – EOG Resources

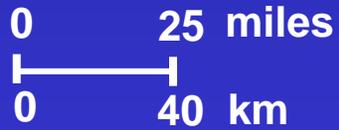
Ken Boedeker – EOG Resources

Neil Hurley – Colorado School of Mines

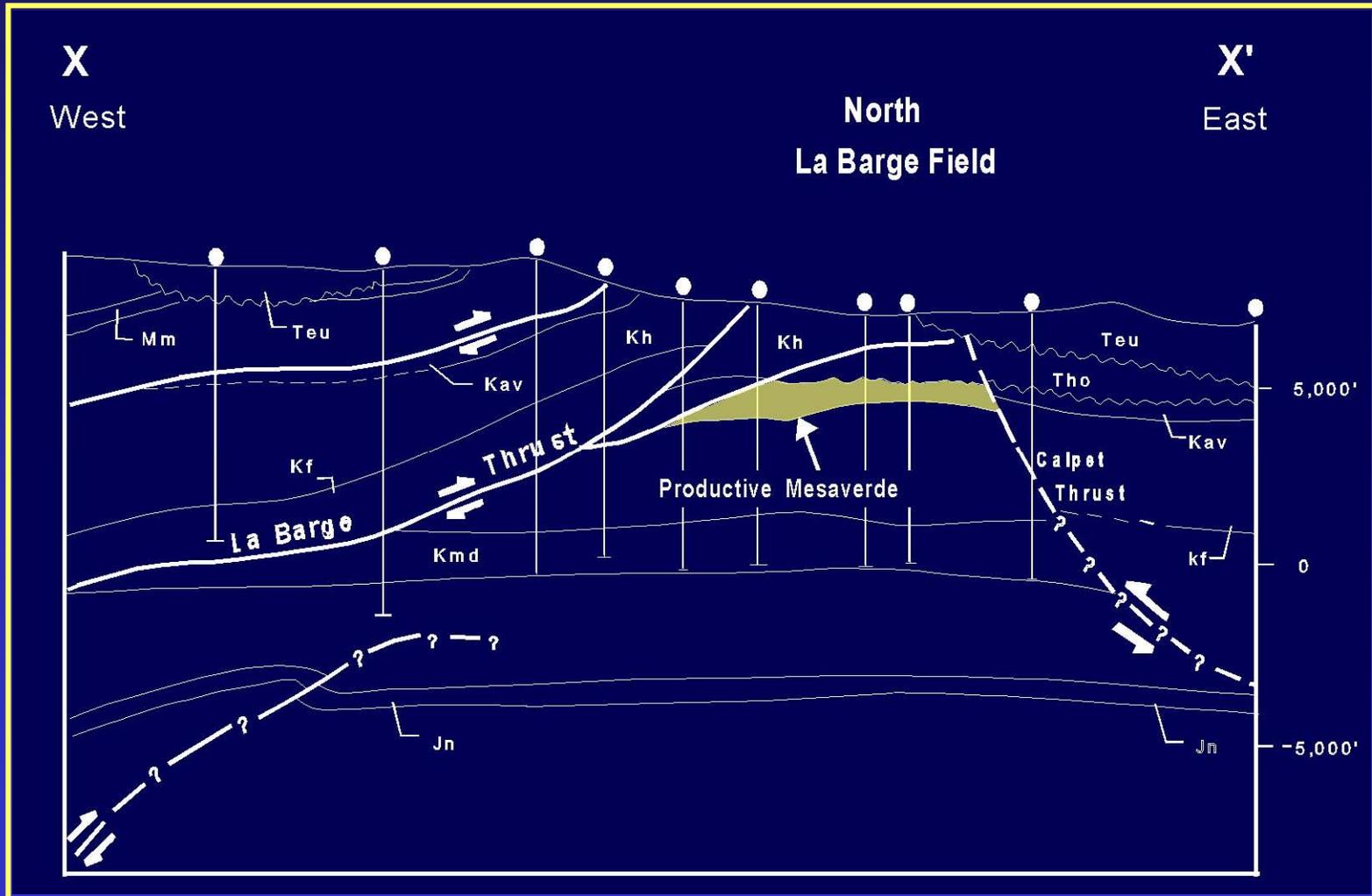
Continental United States



Southwest Wyoming

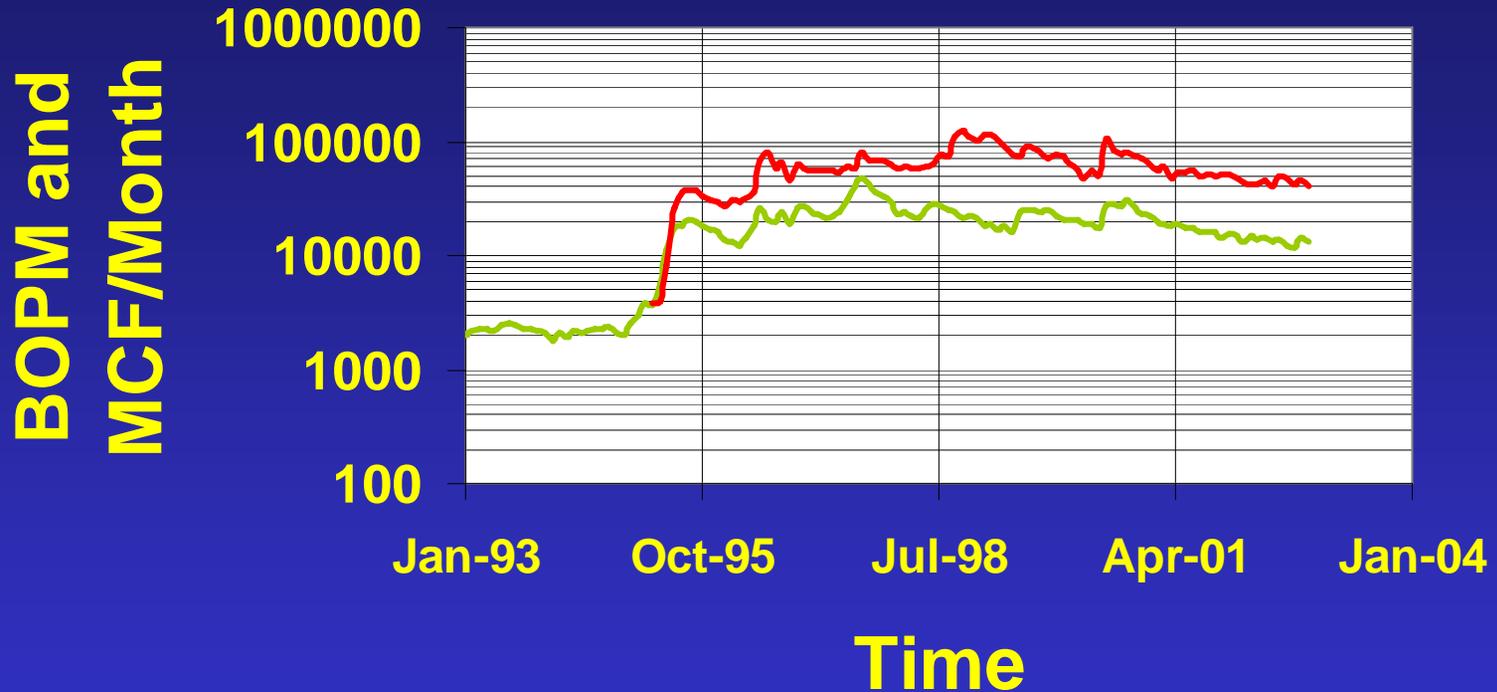


Structural Cross Section



Blackstone, 1979

NLBSU Oil and Gas Production



Cumulative Production

4.1 MMSTBO

12.3 BCF

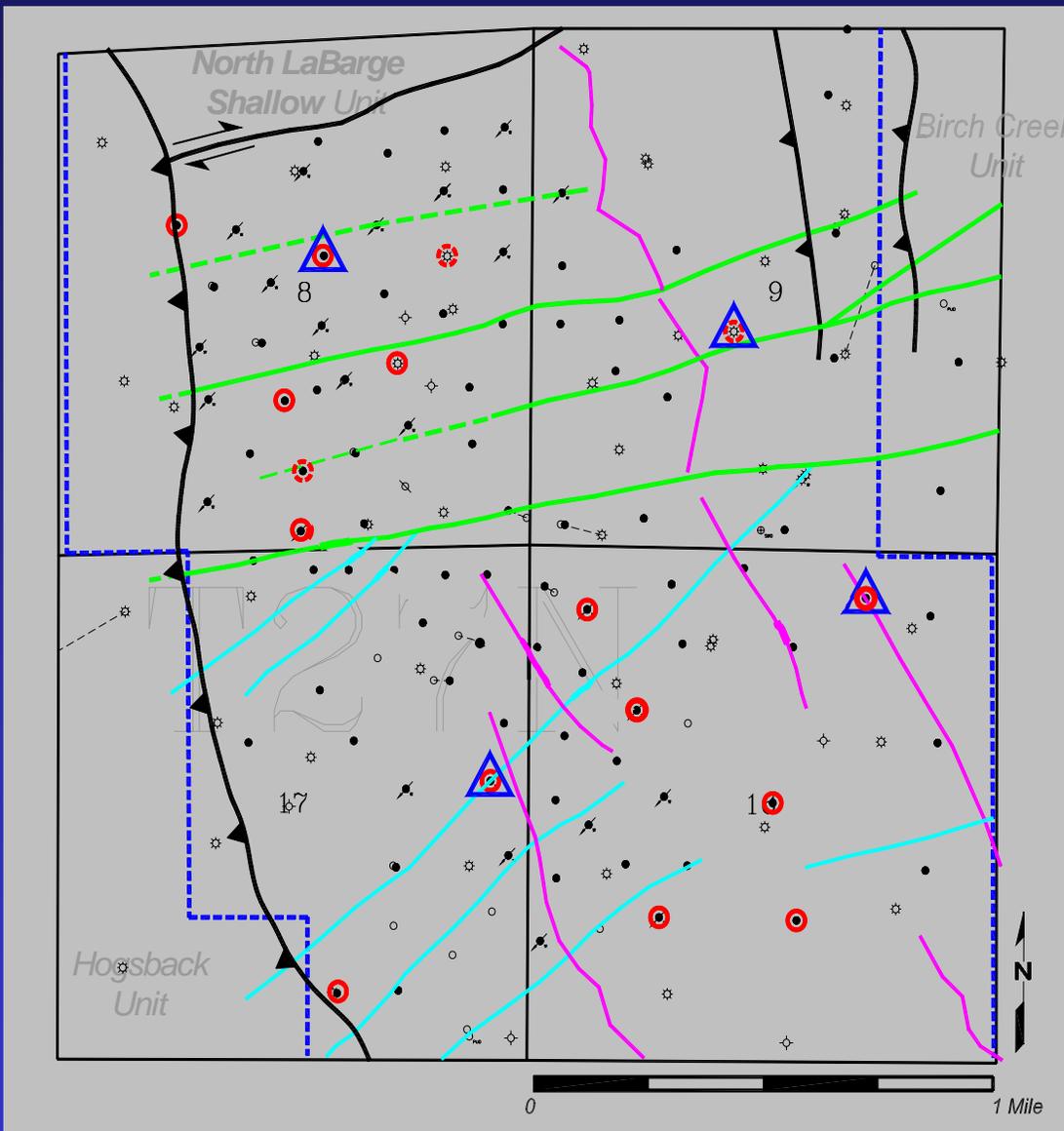
— Oil Sales — Gas Sales

Objectives

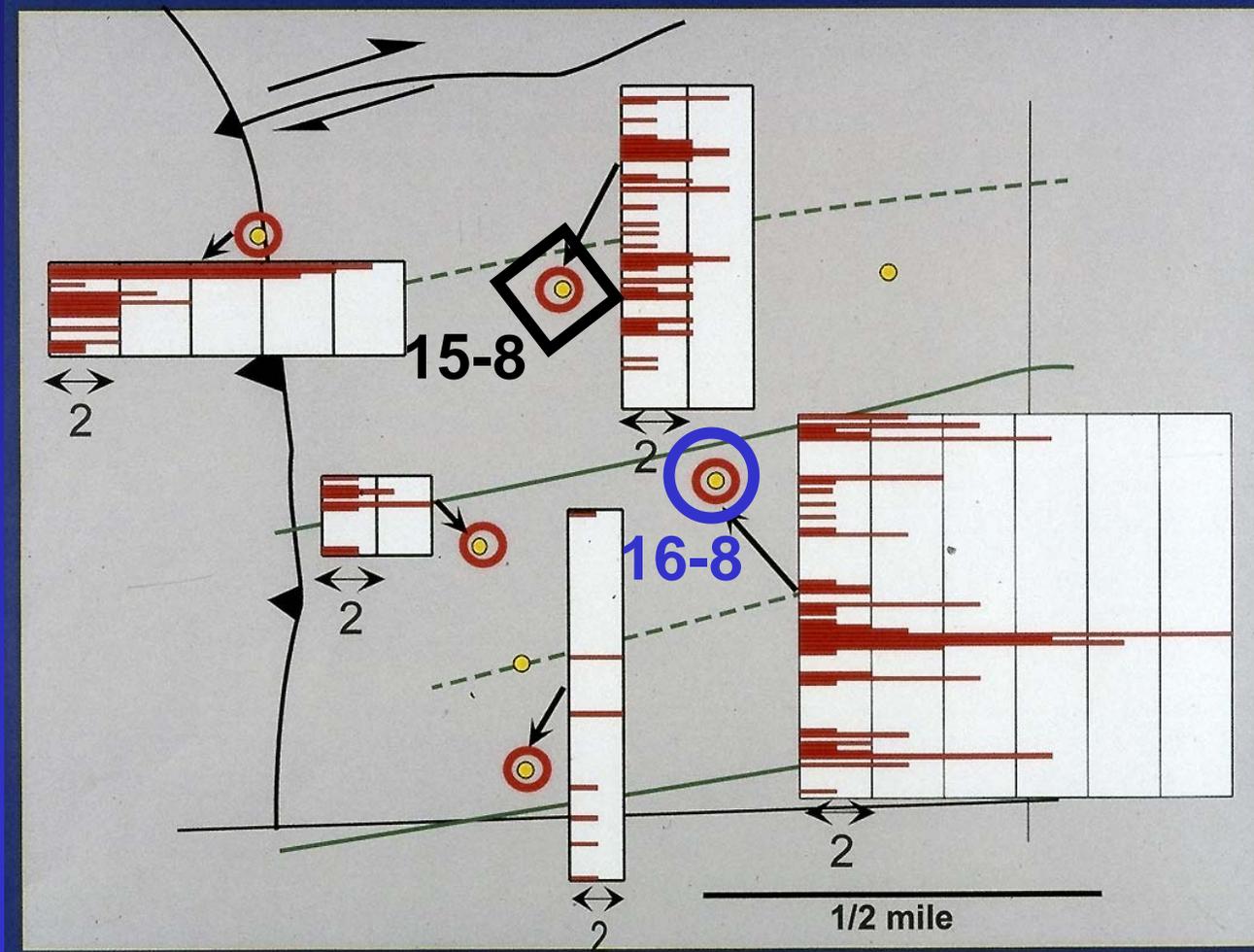
- **Demonstrate four types of production behavior**
 - Fracture dominated
 - Matrix dominated
 - Fracture / matrix combination
 - Reduced production in fault damage zones
- **Demonstrate the dual role faulting plays in reservoir characterization**
- **Demonstrate geologic controls and production characteristics in a highly stress controlled region**

North La Barge Area Sublette Co, Wyoming

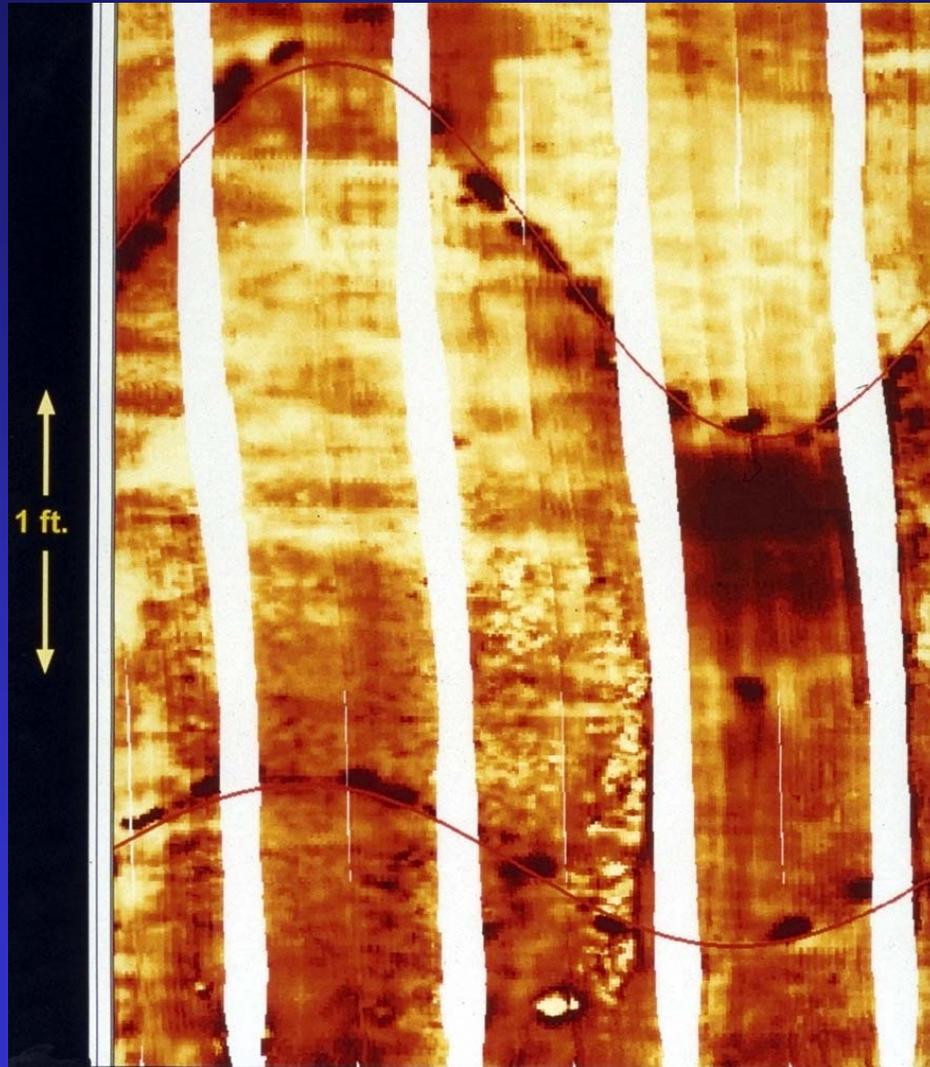
Faults
Cores
FMI, FMS, SHDT Logs
Location Map



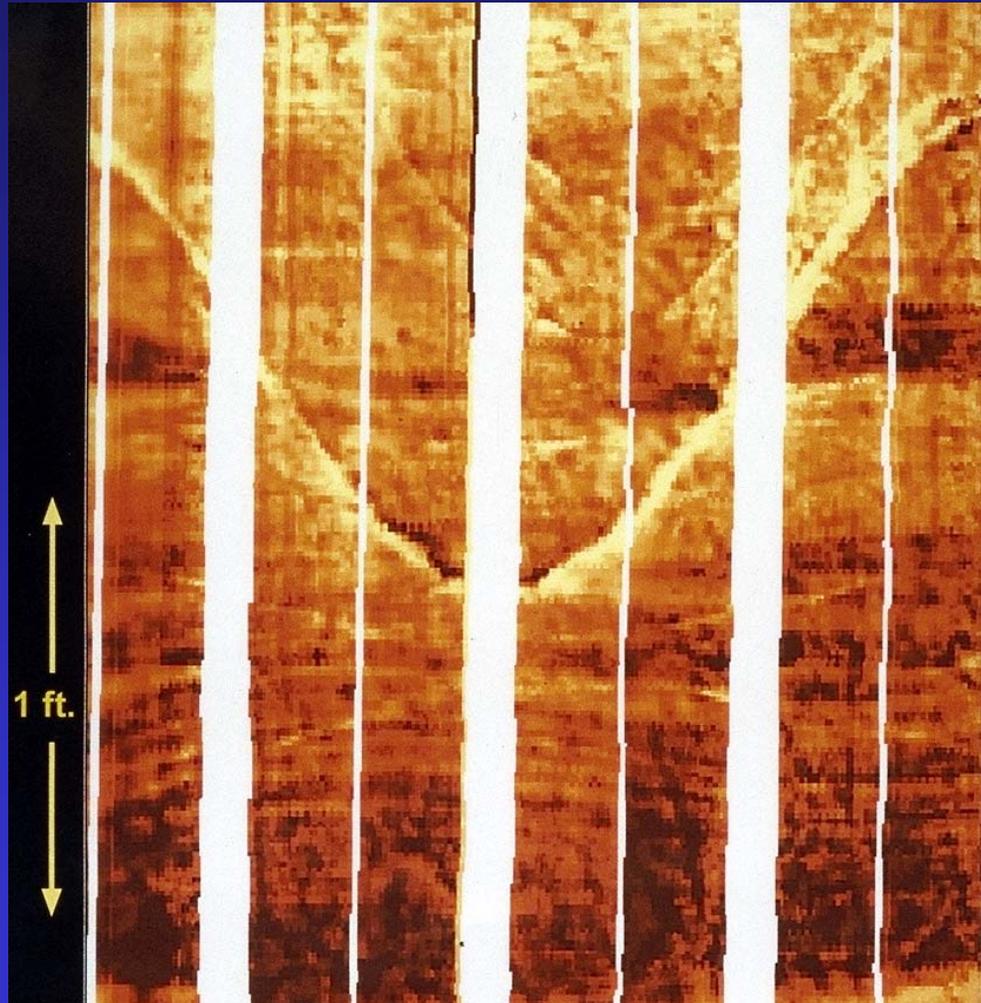
Mesaverde Fracture Frequency NW Portion North La Barge Field



Open Fractures – North Ia Barge Field

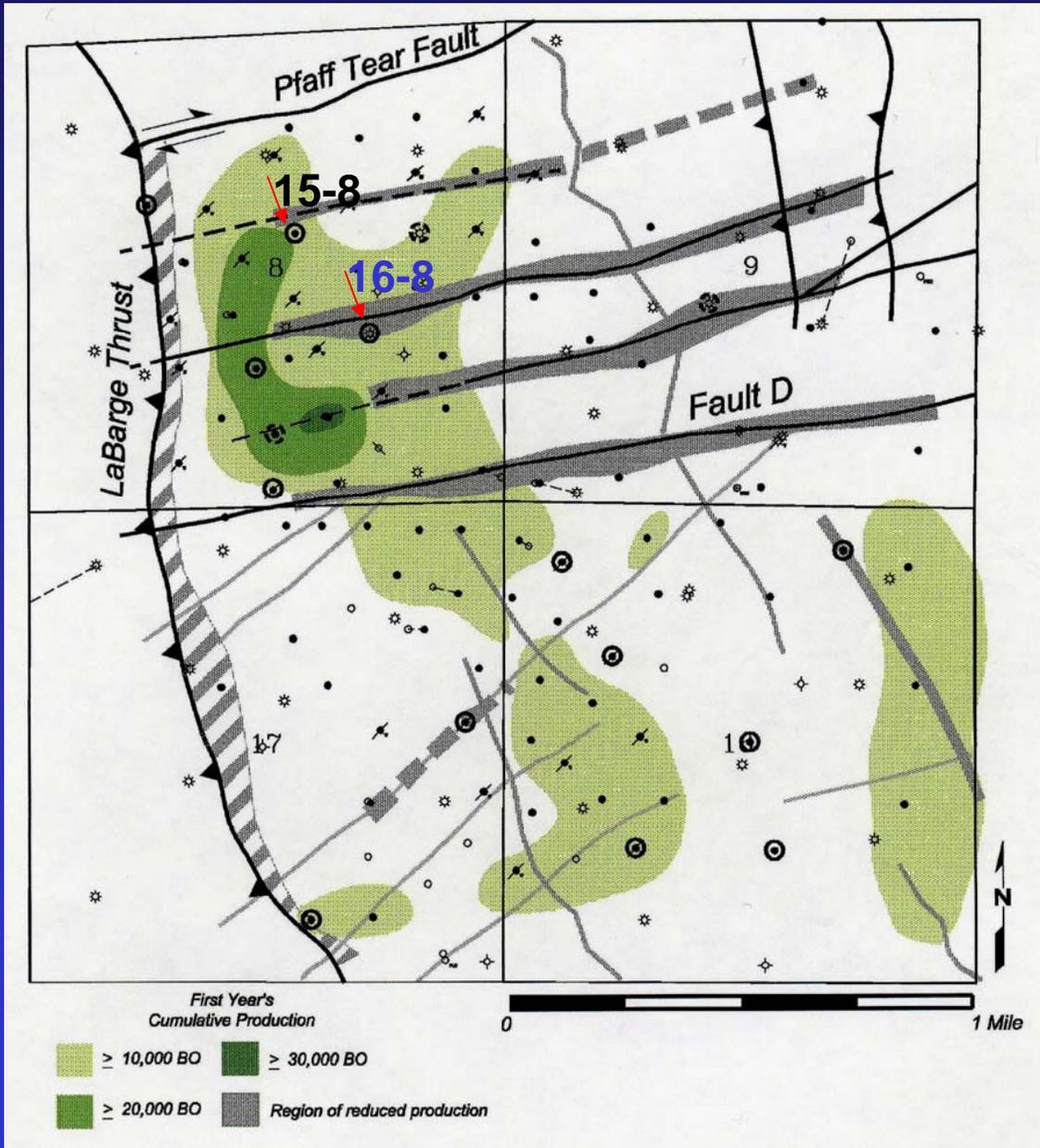


Healed Fractures – North la Barge Field



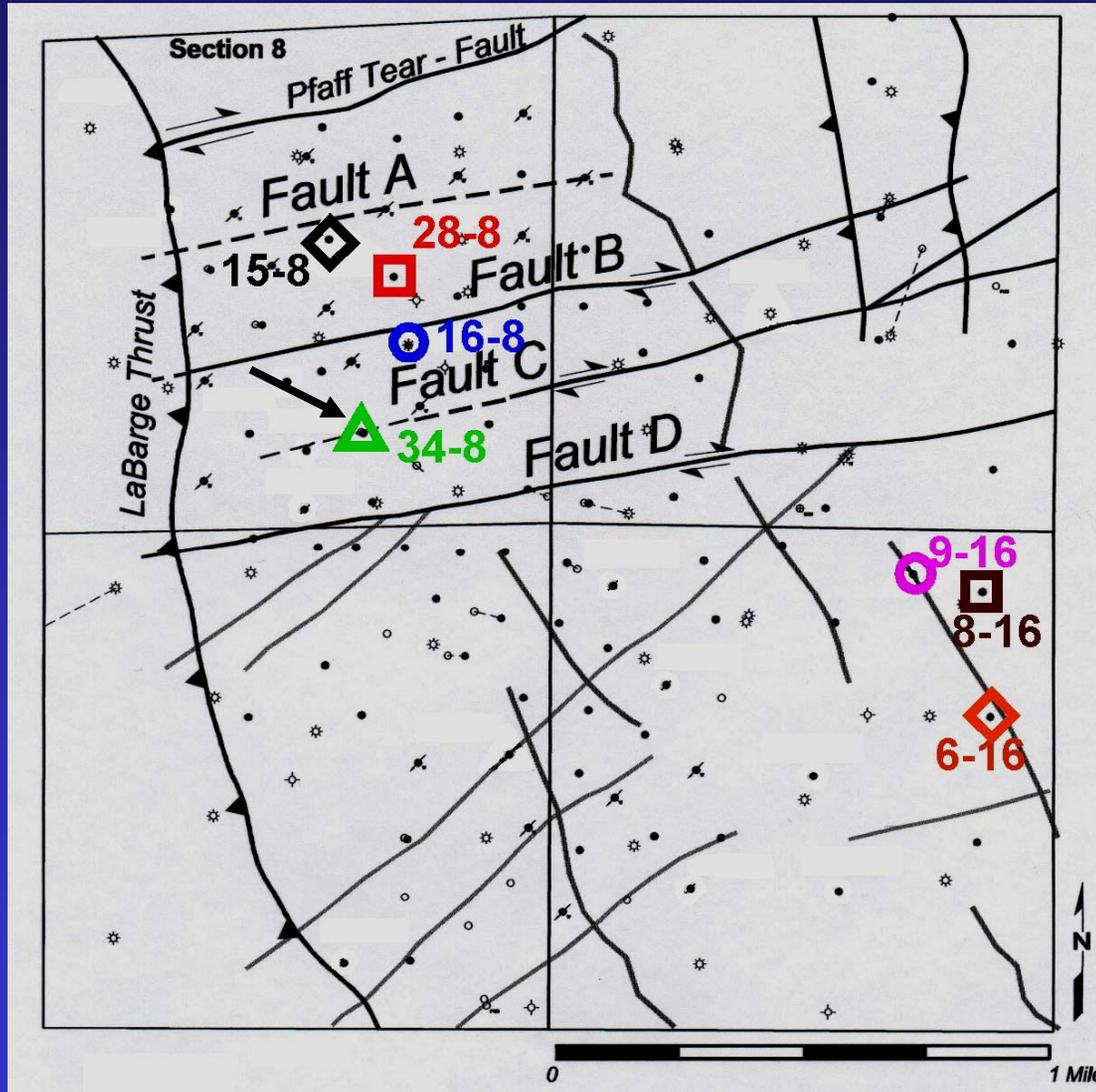
North La Barge Field

First Year Production Map

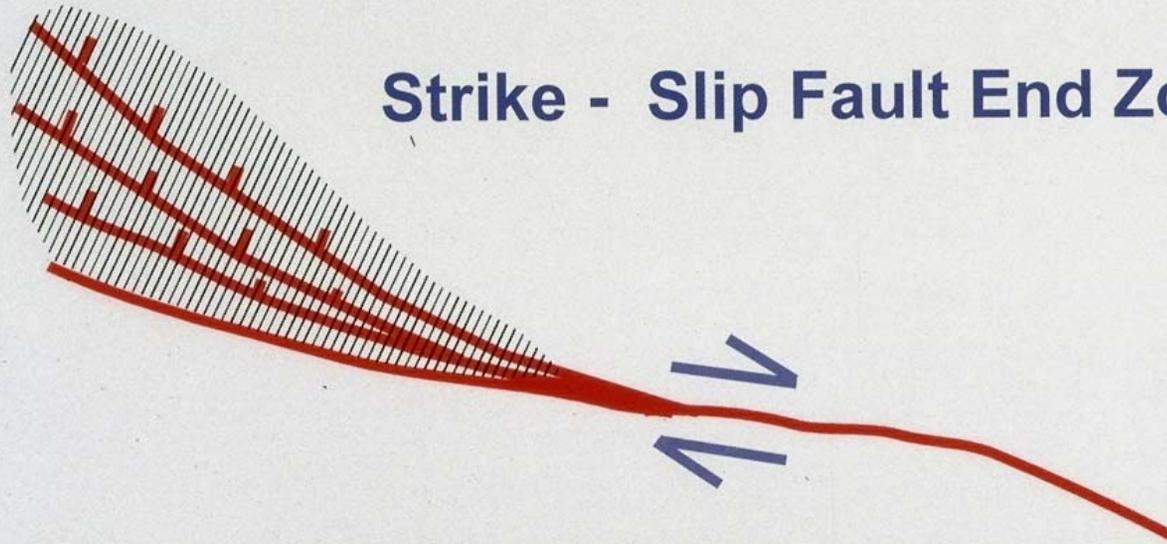


Fractured Dominated

North La Barge Field – Subject Wells



Strike - Slip Fault End Zone

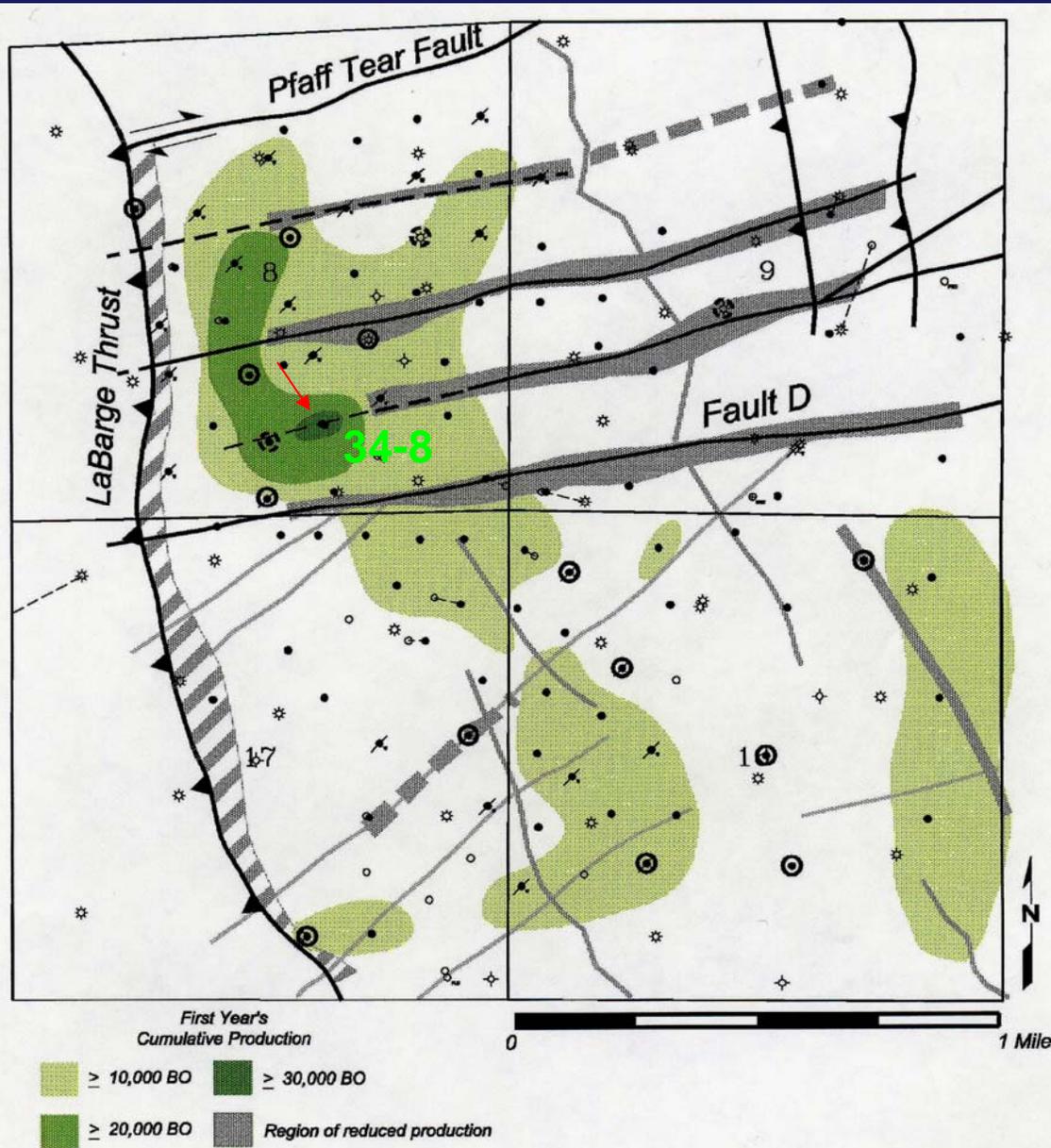


 Normal Separation Fault

 Area of Subsidence

North La Barge Field

First Year Production Map



PRODUCTION DATA

Well	Comp. Date	First 12-Month Cum. STBO	Total Cumulative (through December 2000)		
			STBO	MCF	BW
#34-8	1996	45784	79836	92708	82198
#28-8	1996	14647	37090	81815	72978
#16-8	1995	10770	23523	43557	28441
#15-8	1995	19961	47180	84386	127909
#6-16	1963	10260	151329	142427	1506
#8-16	1963	12185	148085	59113	1971
#9-16	1995	4118	8083	47172	2021

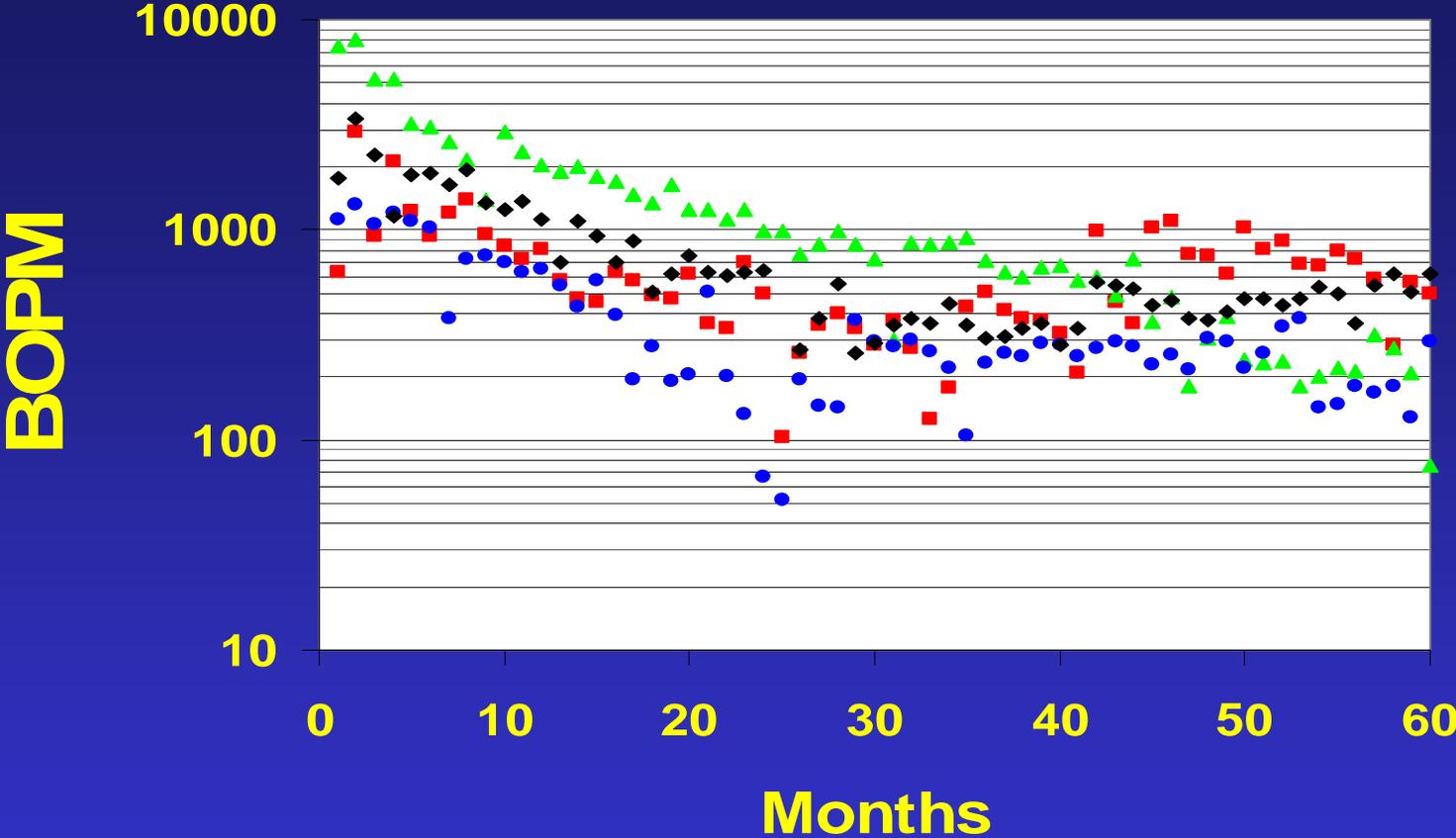


PRODUCTION DECLINE RATES

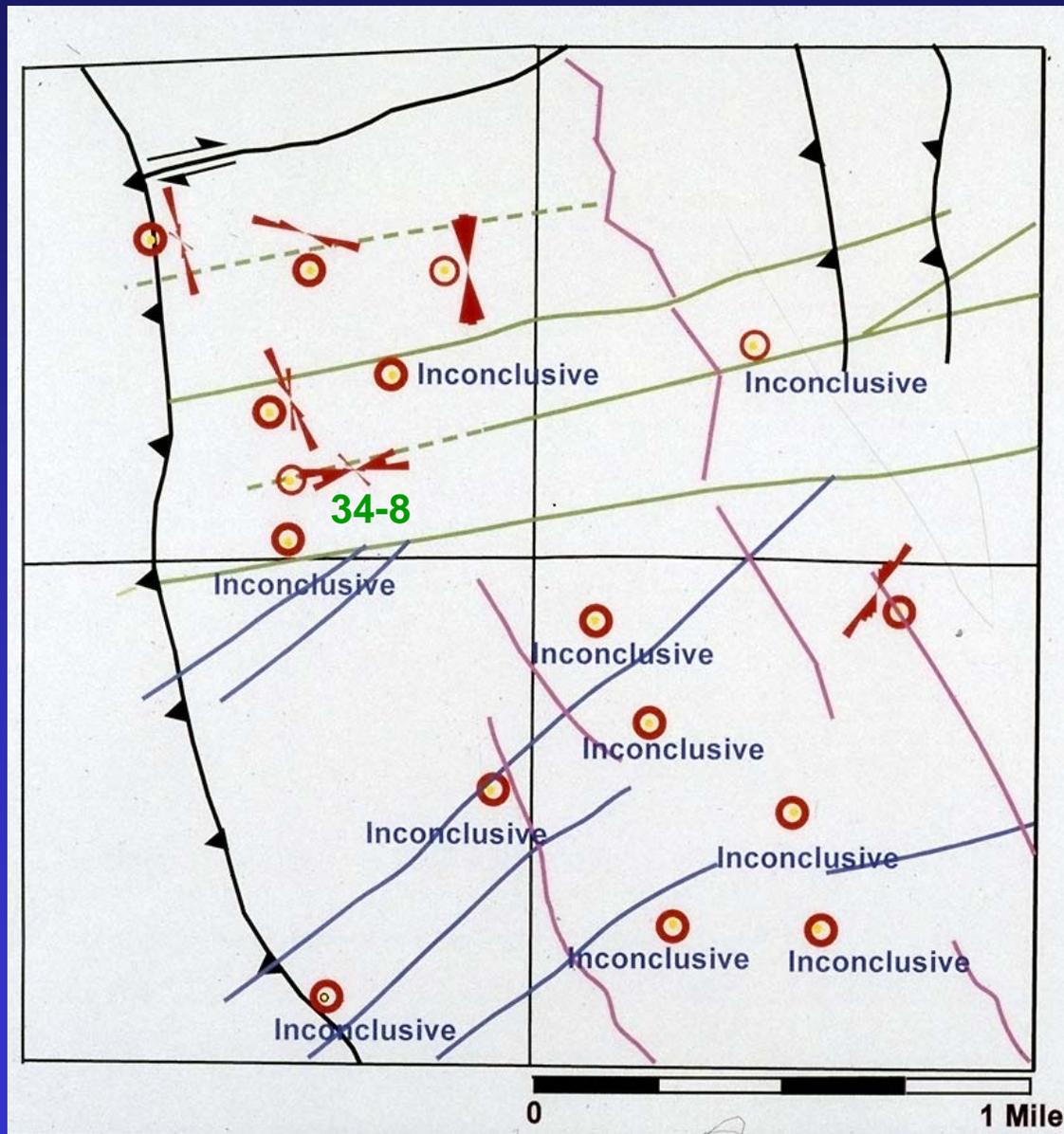
Well	Production Decline per Month	Dom. Prod. Influence
#34-8	6.2%	Fracture
#28-8	0.9%	Matrix
#16-8	2.4%	FDZ
#15-8	2.0%	Combo
#6-16	1.6%	Combo
#8-16	0.5%	Matrix
#9-16	2.5%	FDZ



Oil Production

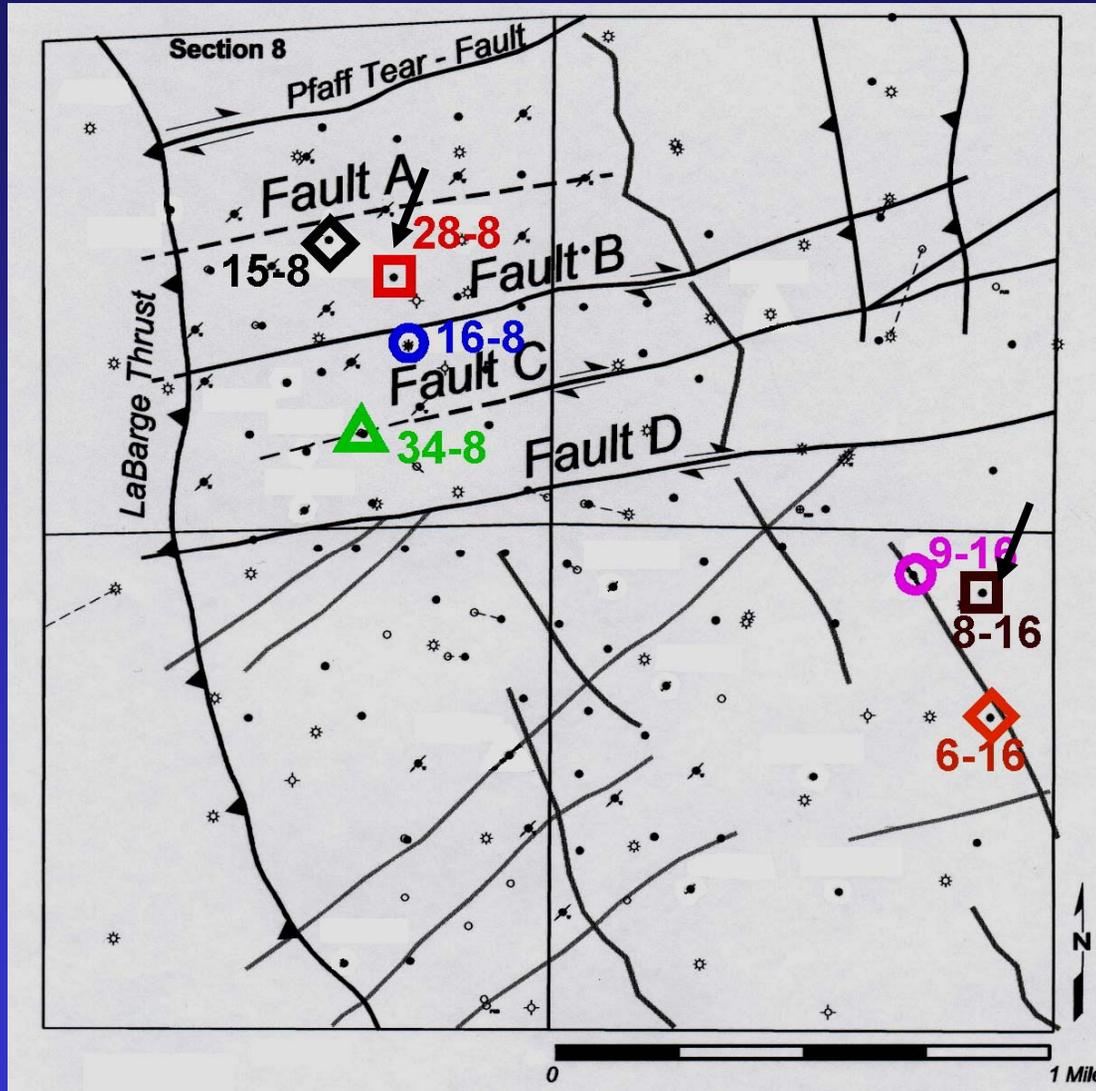


In-situ Stress Orientations



Matrix Dominated

North La Barge Field – Subject Wells



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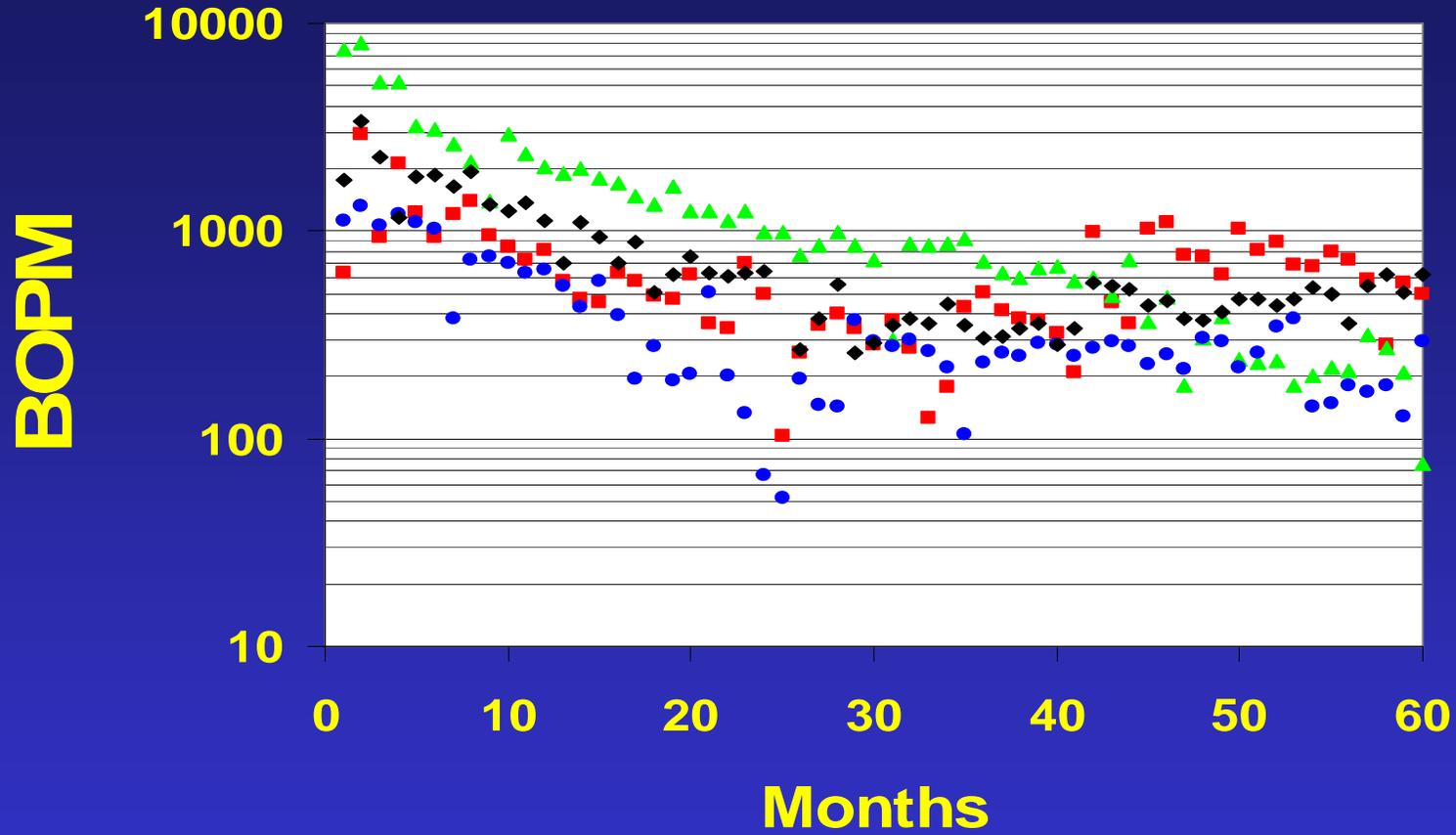


PRODUCTION DECLINE RATES

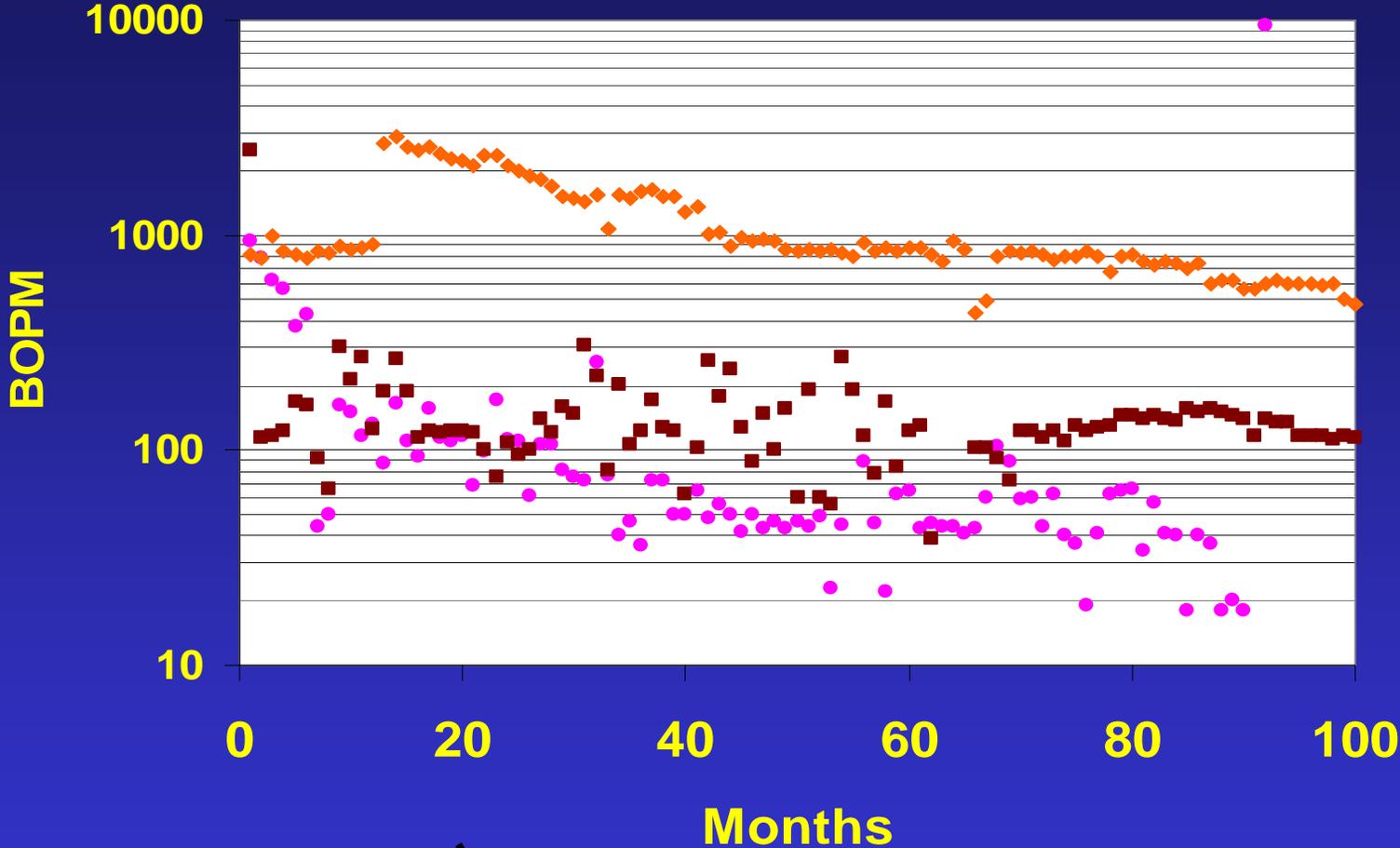
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Oil Production



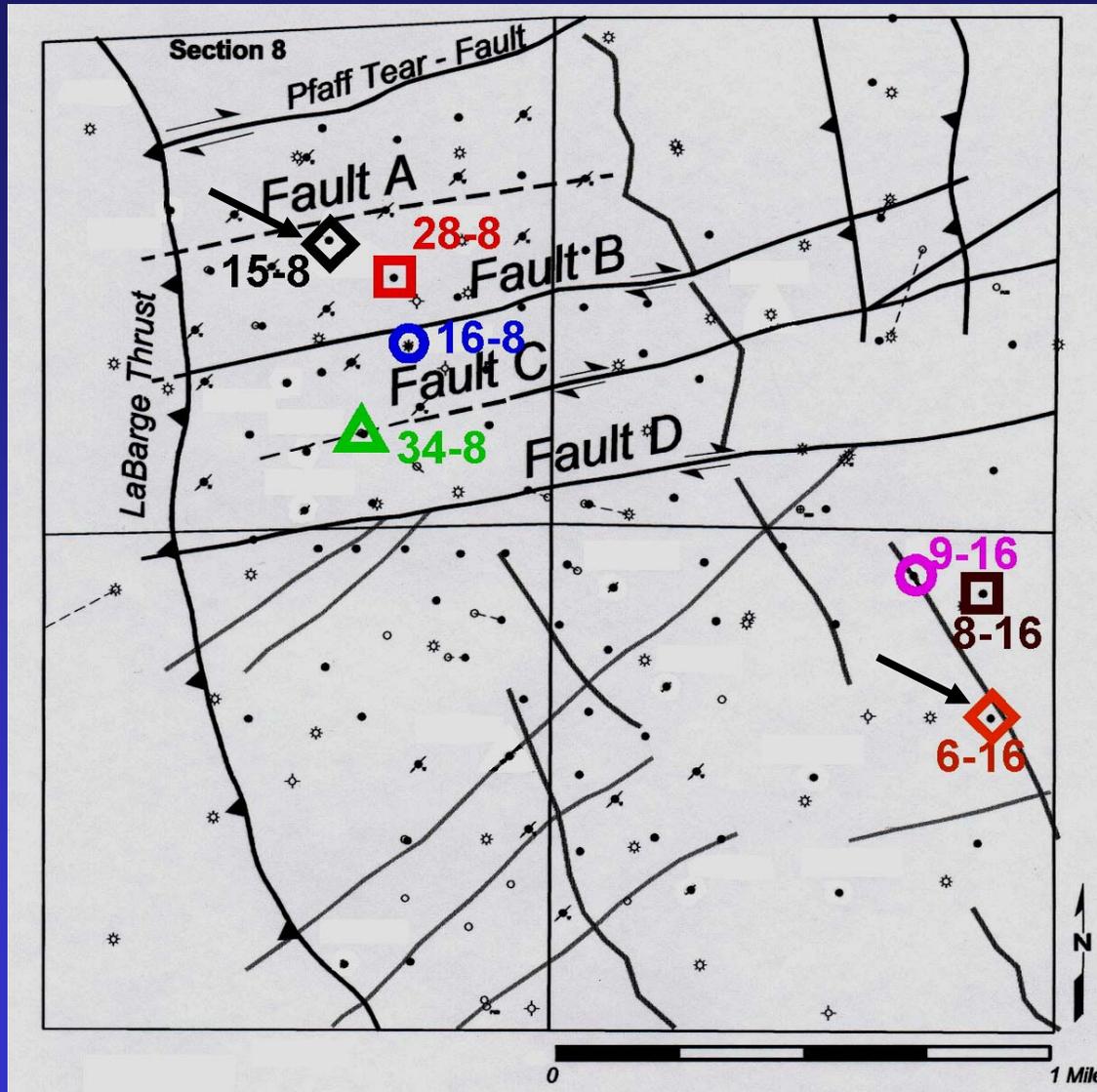
Oil Production



● NLBSU #9-16 ■ NLBSU #8-16 ◆ NLBSU #6-16

Fracture / Matrix Combination

North La Barge Field – Subject Wells



PRODUCTION DATA

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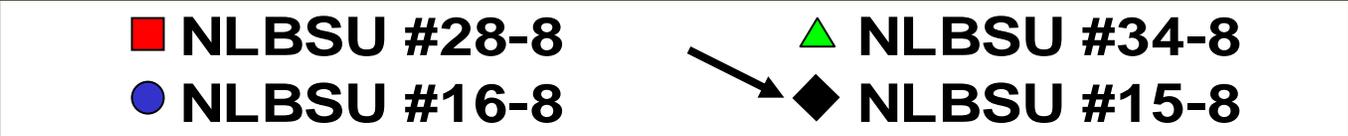
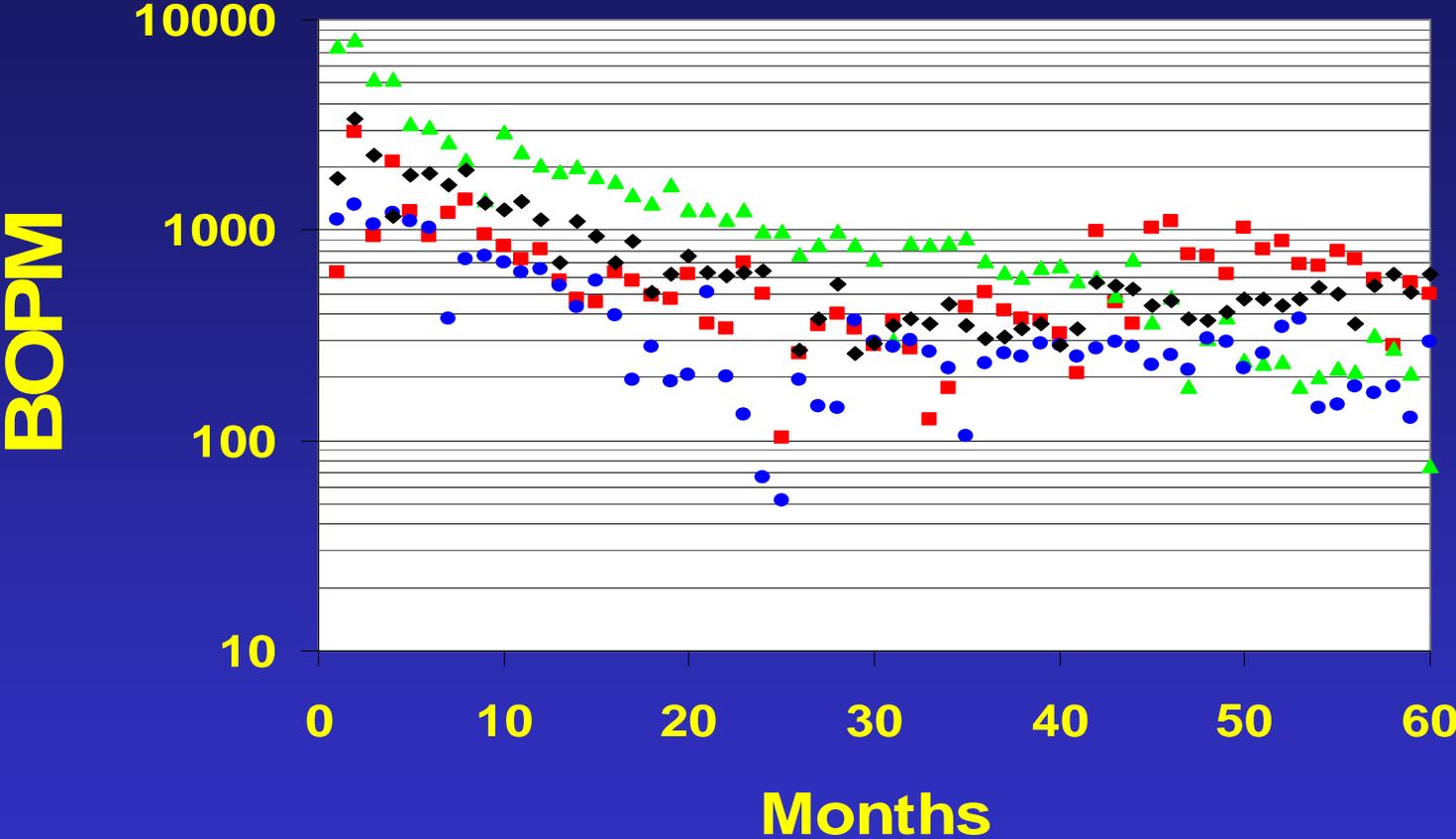


PRODUCTION DECLINE RATES

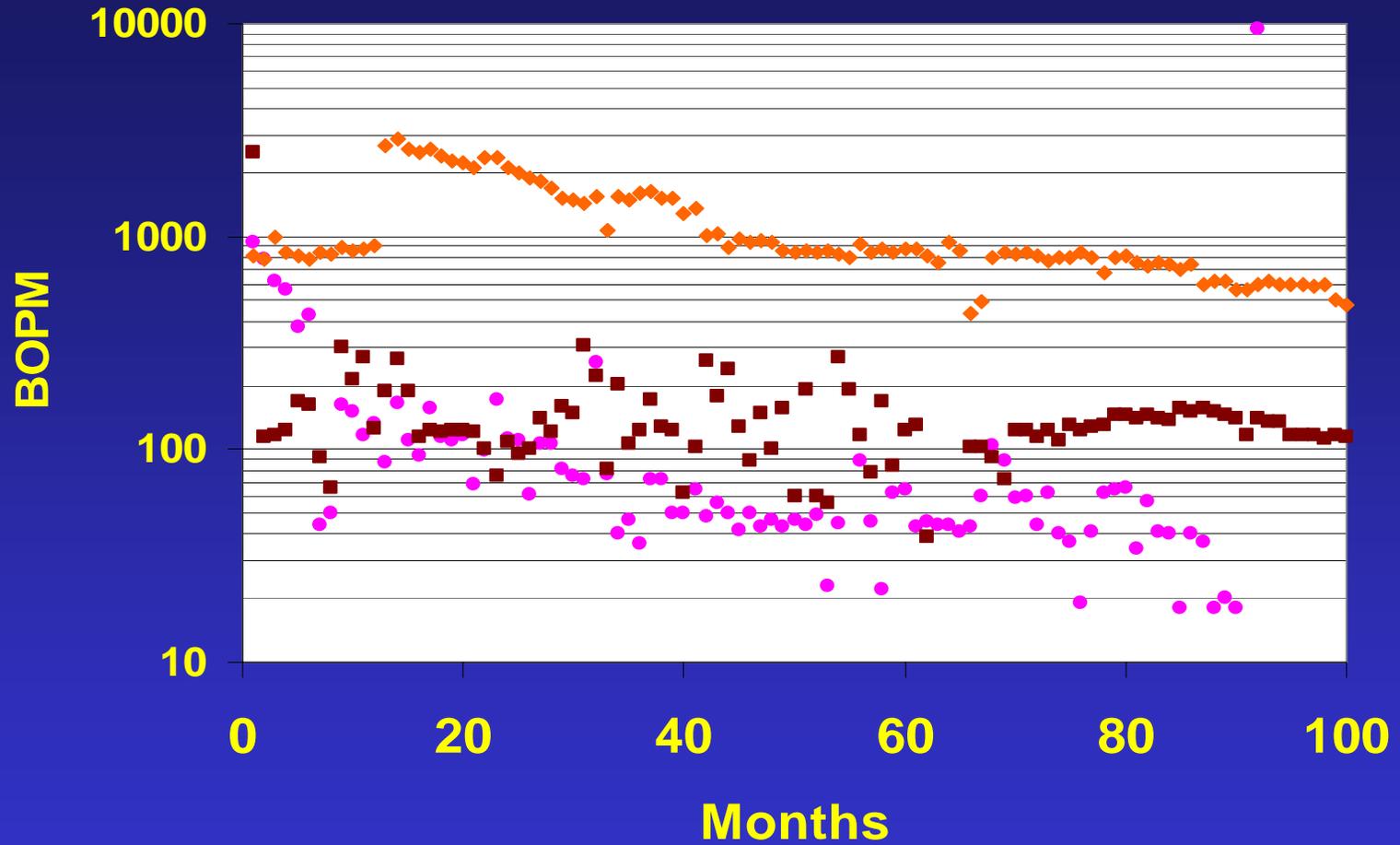
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Oil Production



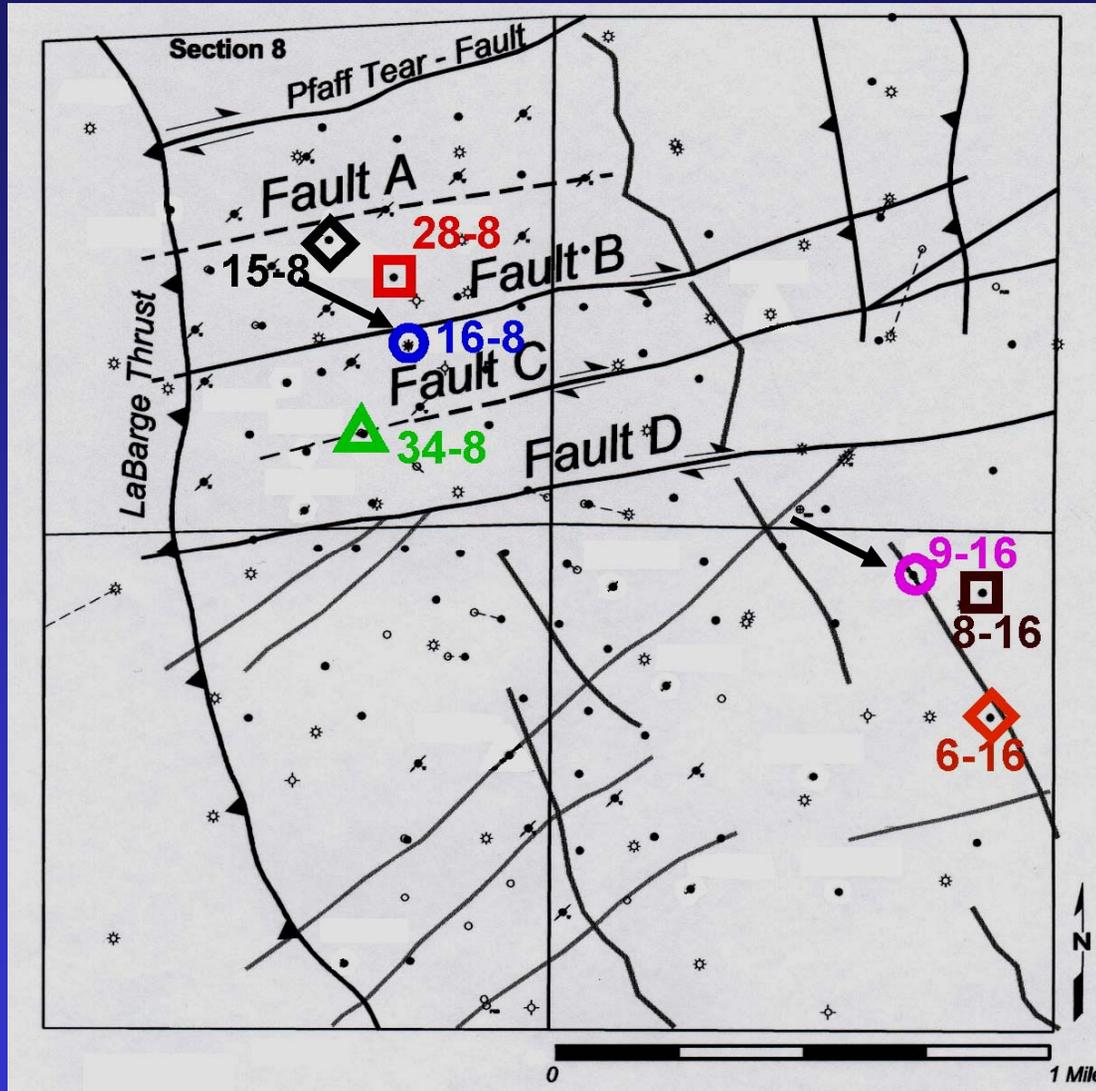
Oil Production



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Reduced Production In Fault Damage Zone

North La Barge Field – Subject Wells



PRODUCTION DATA

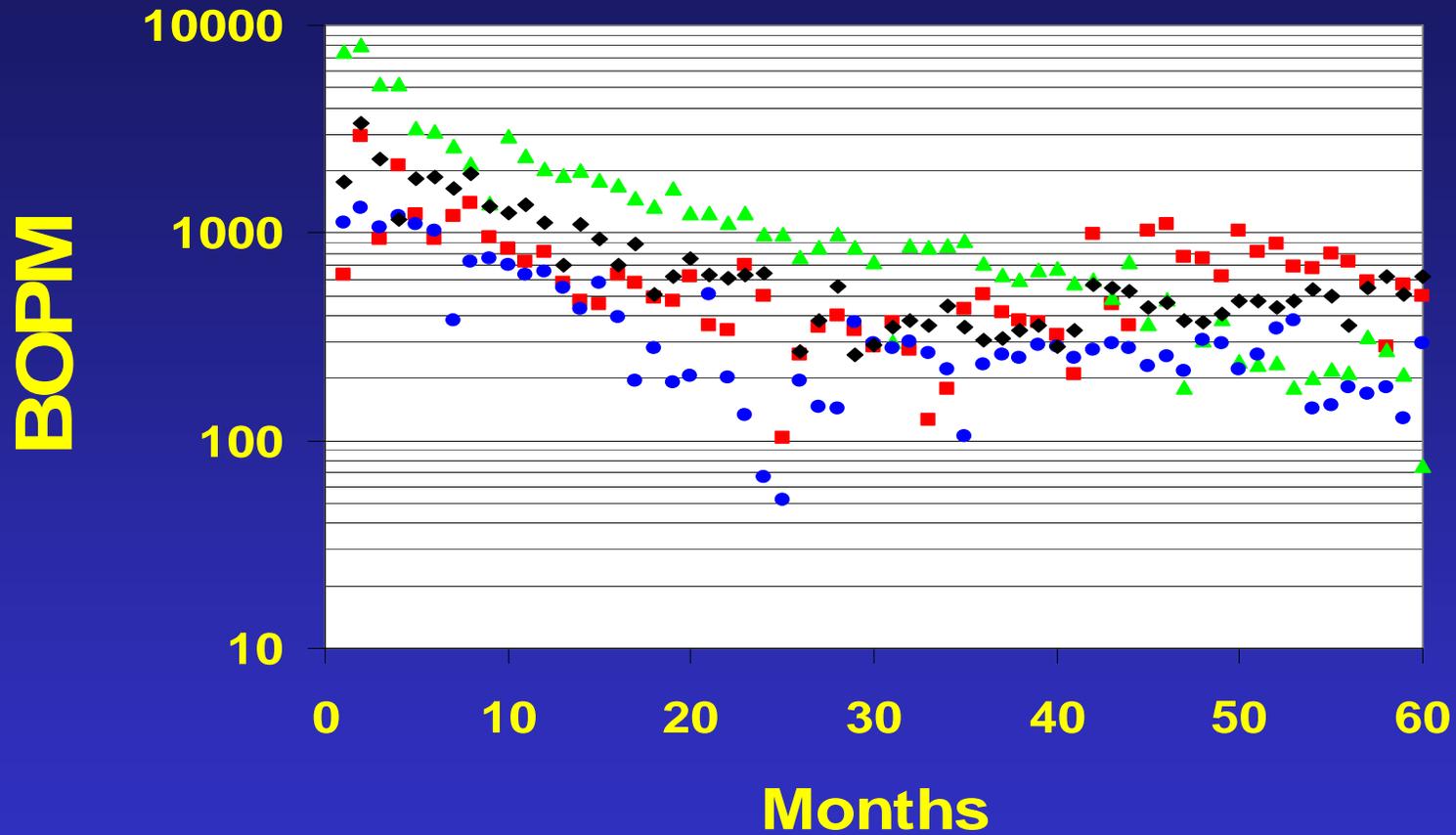
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PRODUCTION DECLINE RATES

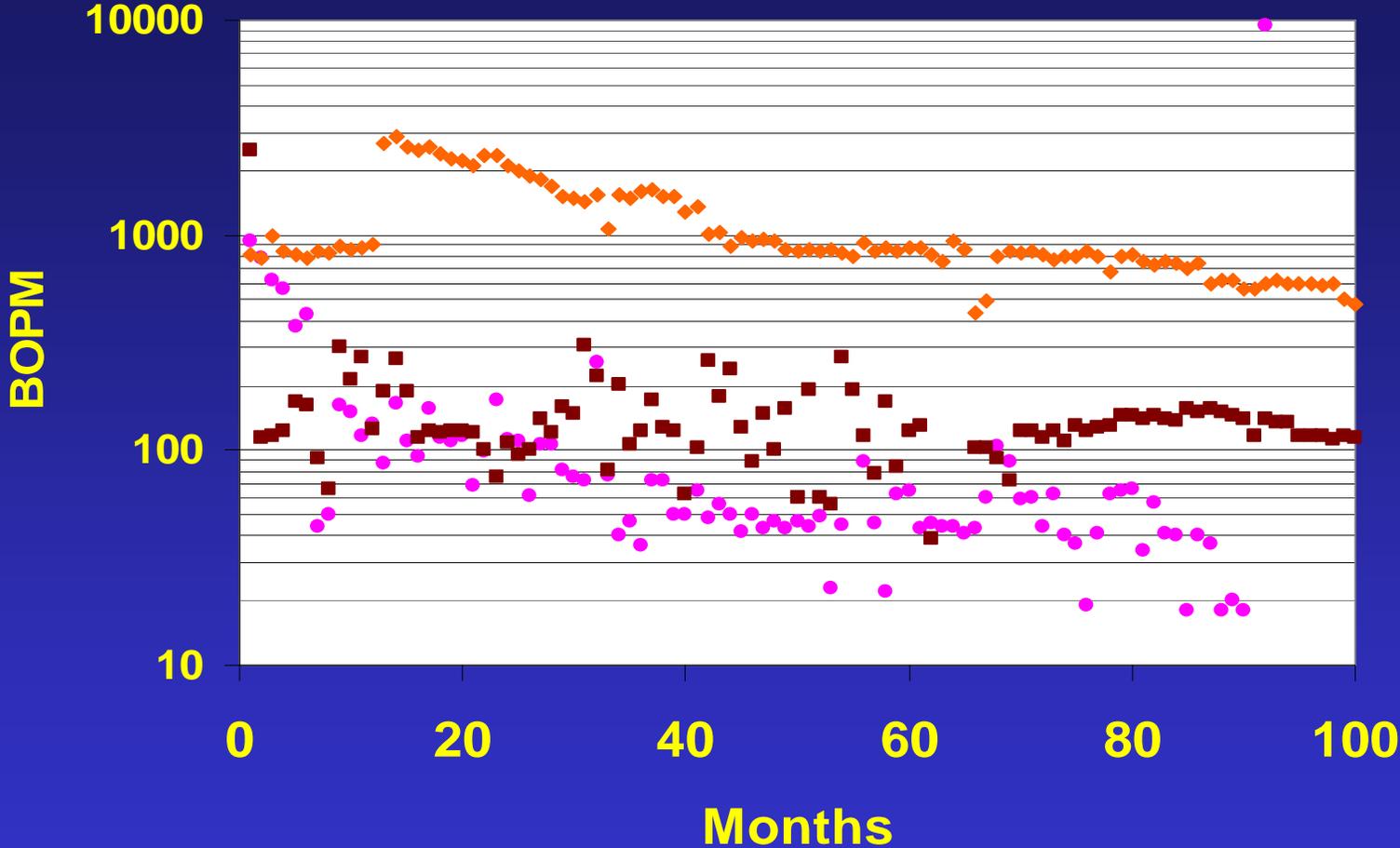
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Oil Production

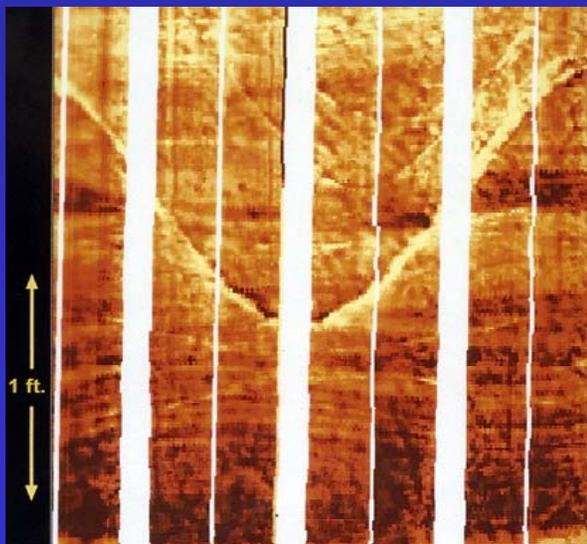
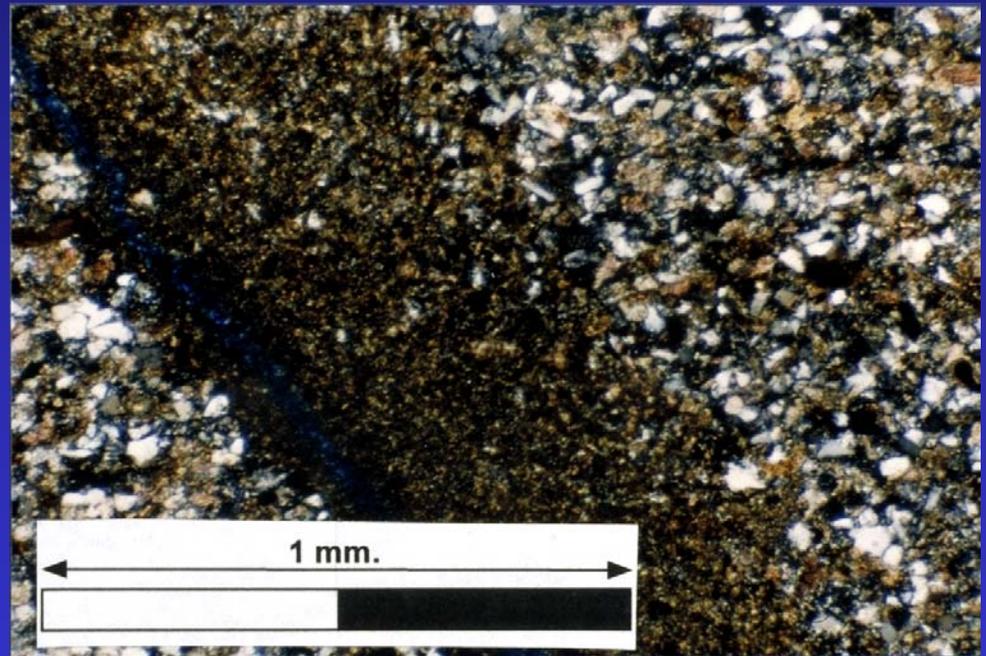


Oil Production

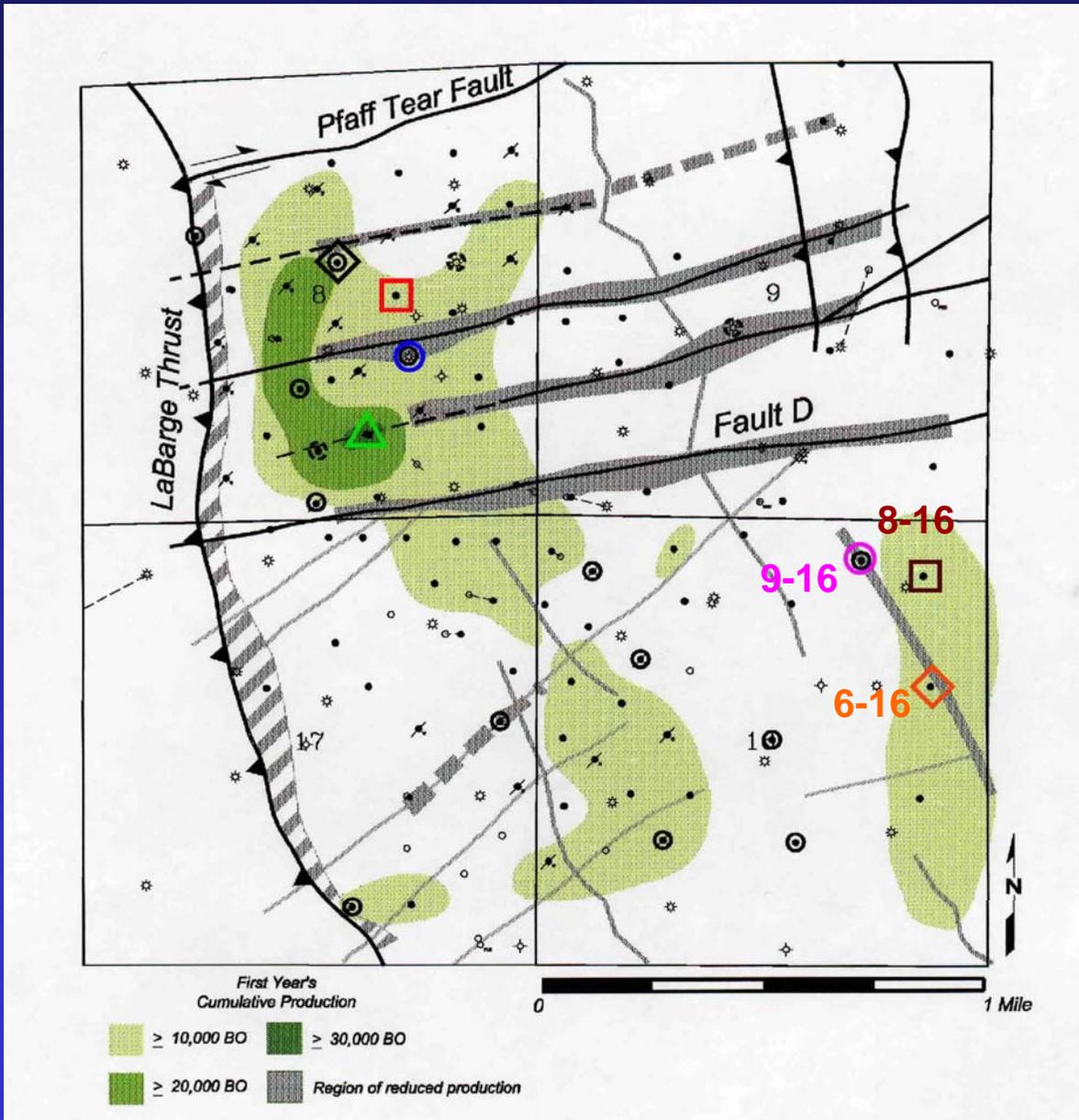


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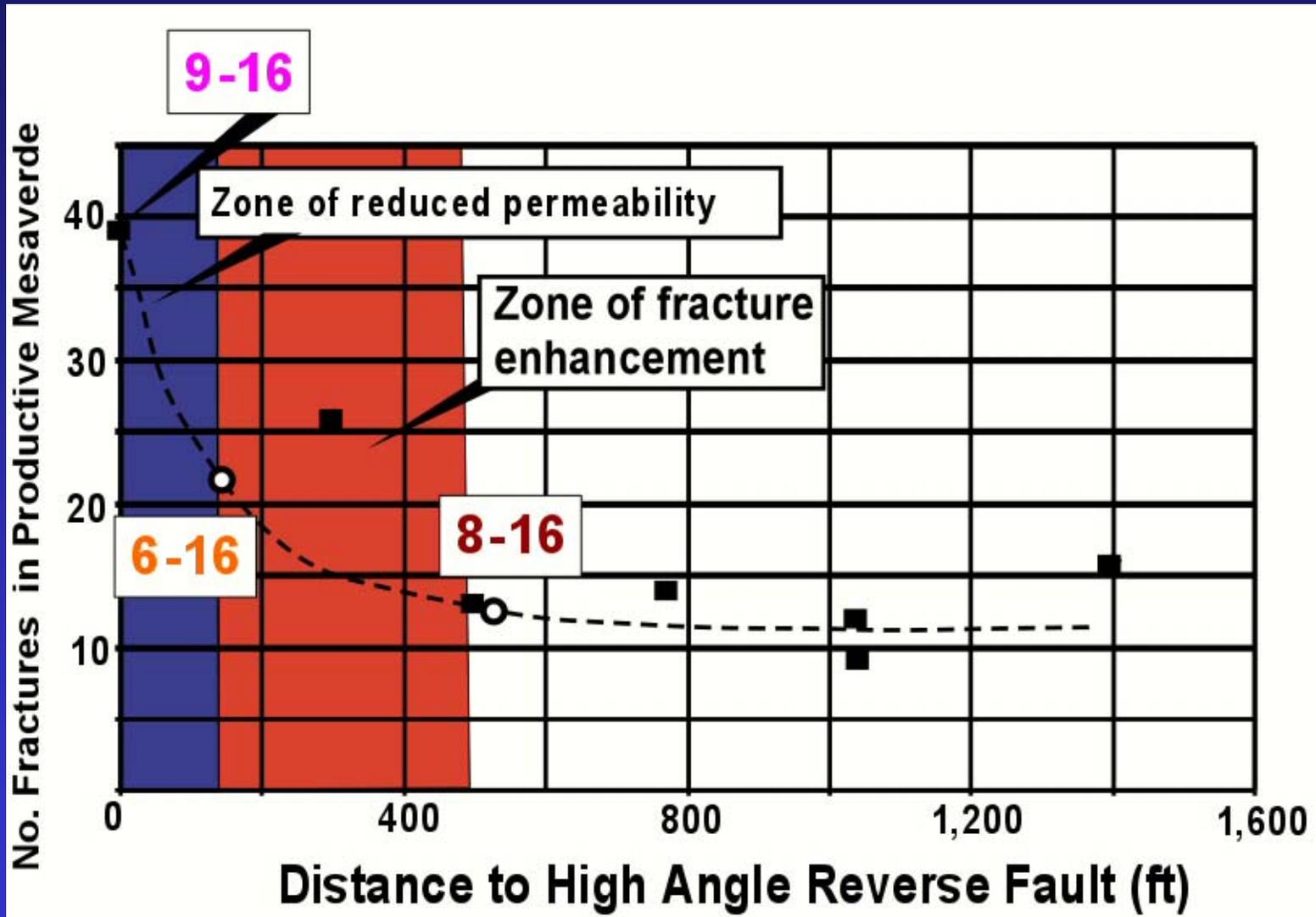
Deformation Bands in Core



First Year Production and Subject Wells



Fault Related Fracturing



Summary and Conclusions

- **Four types of production behavior have been identified at North La Barge Field.**
 - Fracture dominated
 - Matrix dominated
 - Fracture / matrix combination
 - Reduced production in fault damage zones
- **Highly critically stressed natural fractures are associated with a horse-tail splay.**
- **Faulting both enhances and reduces permeability.**