PS Assessment of Porosity and Diagenesis in the Lower Cretaceous (Aptian-Albian) Sligo Formation, South Texas*

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Abstract

Approximately 120 ft (37 m) of core from the dry Mobil McElroy-1 well in South Texas (Lower Cretaceous (Aptian-Albian) Sligo Formation) was studied to evaluate diagenetic processes resulting in porosity evolution and occlusion.

Post-depositional porosity-impacting structures in the Mc-Elroy-1 well, including stylolites and cementation in fractures and microfractures, significantly occluded porosity in Mobil McElroy-1 well. Late medium (1 mm - 3 mm) to large (> 3 mm) equant calcite and non-ferroan dolomite cement encasing compacted grains are jointly responsible for more than 10% of the primary porosity lost.

Late-stage cementation is observed to be the main porosity modification event below 14,950 ft (4557 m) core depth. Replacement dolomites in fractures and pores also considerably occluded primary and secondary porosity in the McElroy-1 well. Primary porosity loss is greatest below 16,950 ft (5166 m) core depth where pressure-solution was observed to be most intense.

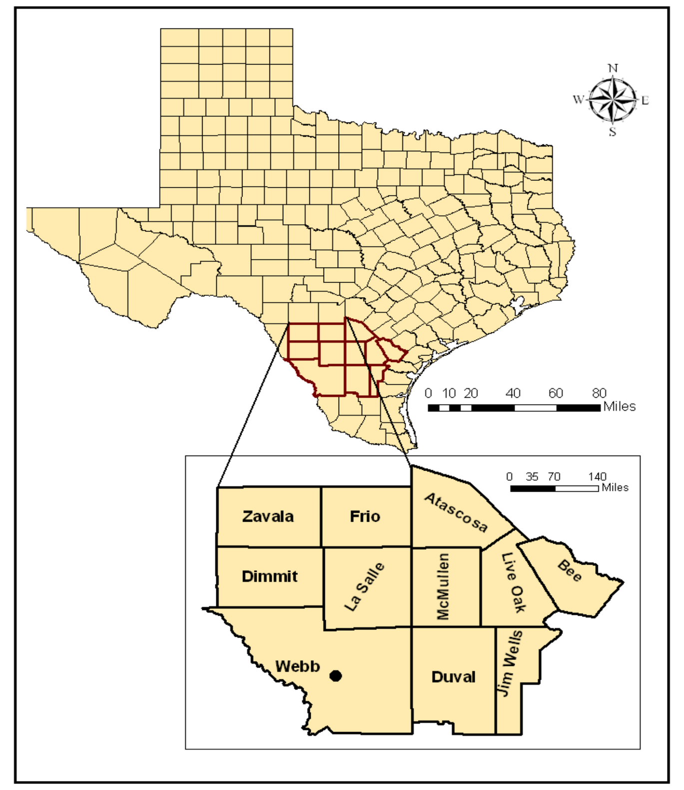
ABSTRACT

Approximately 120 ft (37 m) of core from the dry Mobil McElroy-1 well in South Texas (Lower Cretaceous Aptian-Albian, Sligo Formation) was studied to evaluate diagenetic processes resulting in porosity evolution and occlusion.

Post-depositional porosity-impacting structures in the Mc-Elroy-1 well including stylolites, and cementation in fractures and microfractures significantly occluded porosity in Mobil McElroy-1 well. Late medium (1 mm - 3 mm) to large (› 3 mm) equant calcite and non-ferroan dolomite cement encasing compacted grains are jointly responsible for more than 10% of the primary porosity lost.

Late-stage cementation is observed to be the main porosity modification event below 14,950 ft (4,557 m) core depth. Replacement dolomites in fractures and pores also considerably occluded primary and secondary porosity in the McElroy-1 well. Primary porosity loss is greatest below 16,950 ft (5,166 m) core depth where pressure solution was observed to be most intense.

STUDY AREA

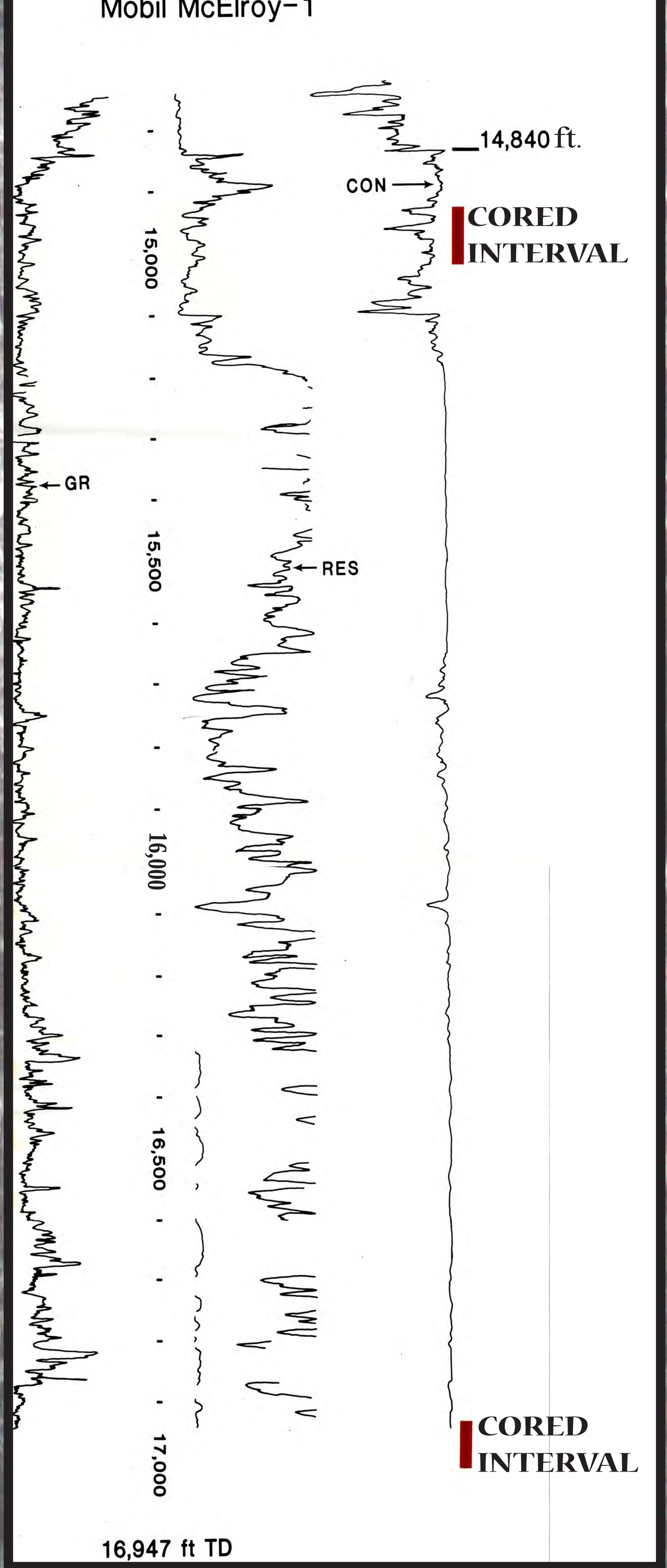


Black dot represents location of McElroy-1 Well

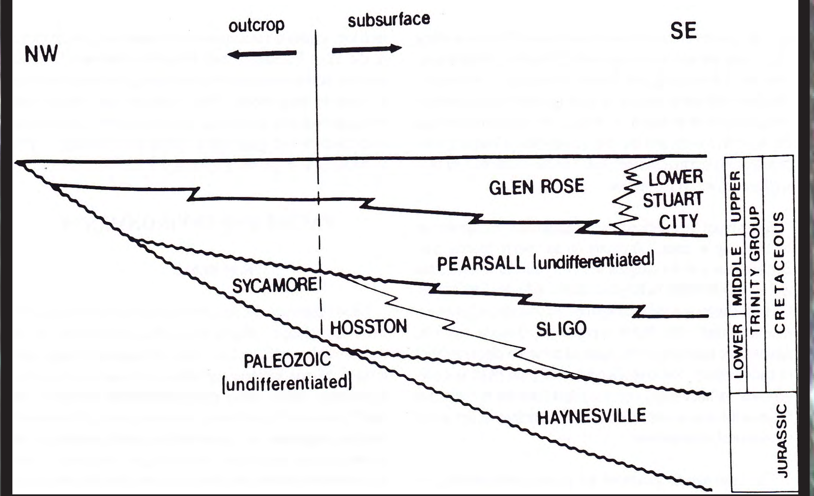
Upper Mesozoic in South Texas and Northern Mexico

				SOUTH TEXAS	NORTHERN MEXICO
LOWER CRETACEOUS	ALBIAN		PEARSALL	HENSEL	AURORA
	APTIAN			COW CREEK	LA PEÑA
				PINE ISLAND	
			LOWER TRINITY	SLIGO	CUPIDO
	NEOCOMIAN	BARREMIAN			
		HAUTERIVIAN		HOSSTON	TARAISES
		VALAGINIAN		SYCAMORE	
		BERRIASIAN			
UPPER JURASSIC	PORTLANDIAN			HAYNESVILLE	LA CASITA

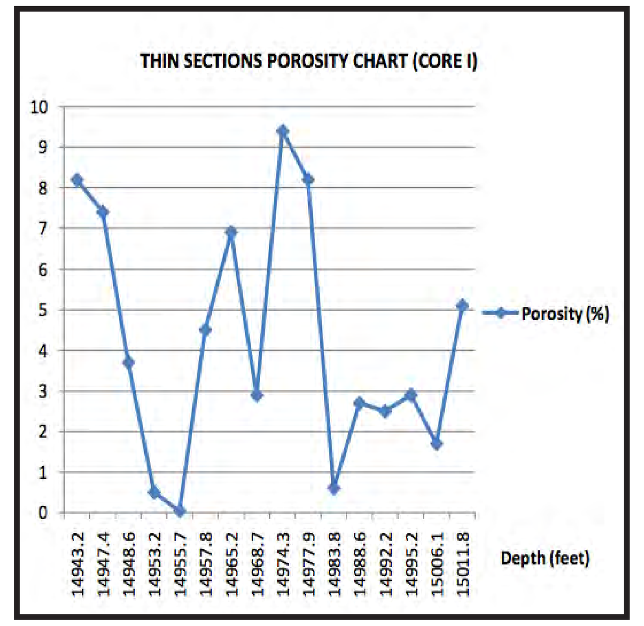
Gamma, resistivity and conductivity curves



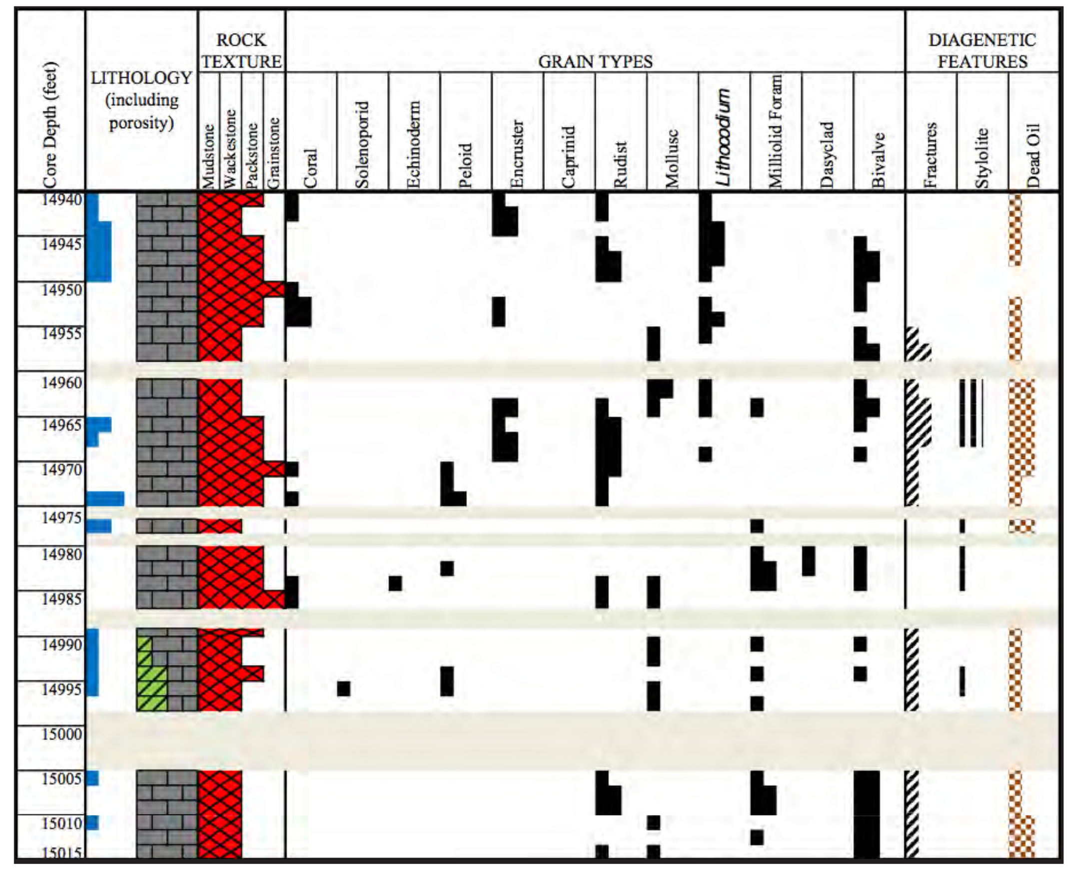
Generalized stratigraphic cross-section for the Lower Cretaceous in South Texas

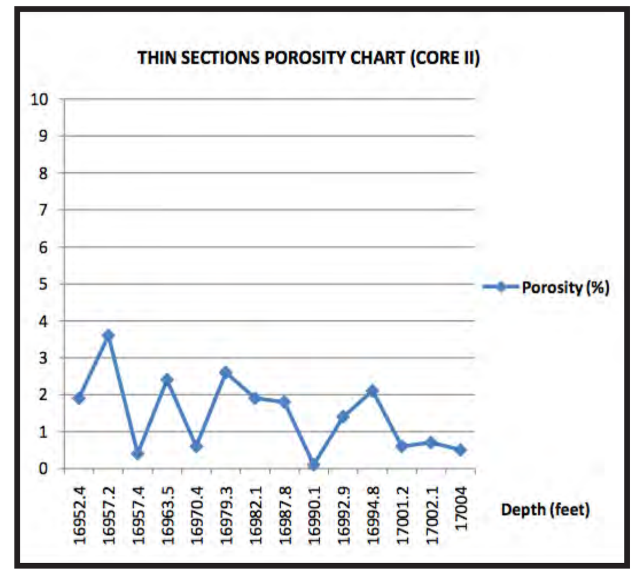


CORE DESCRIPTION CHARTS

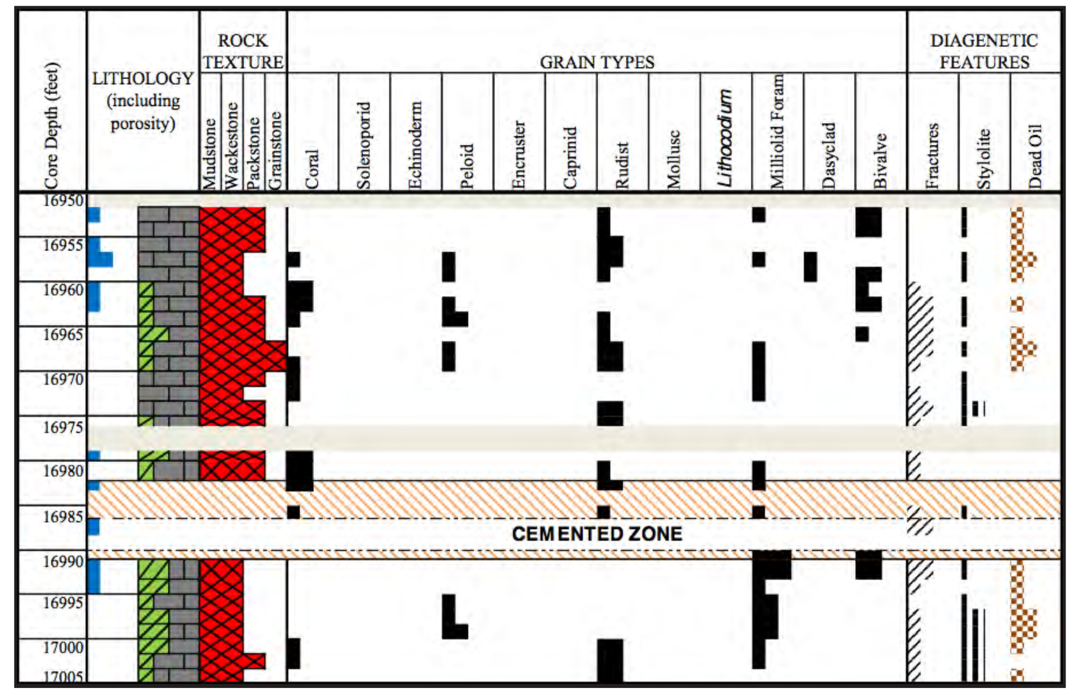


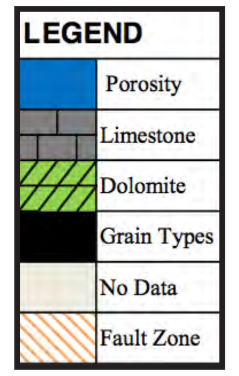
CORE I



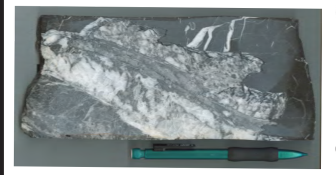


CORE II



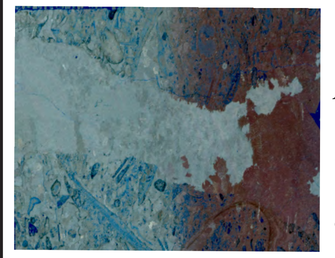


METHODS



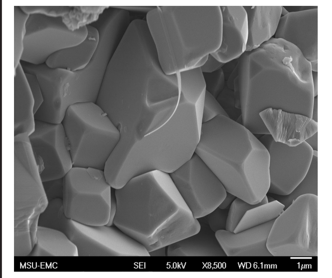
Core Description and Sample Selection

Approximately 120 ft (37 m) of core was examined under a standard petrographic microscope and carefully described.



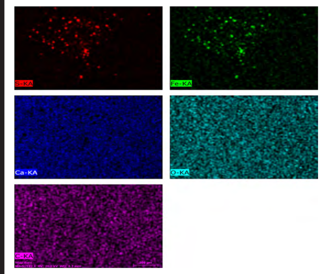
Standard Petrographic and Cathode Luminiscence Analyses

A total of 30 samples from roughly every 5 ft (1.5 m) of available core were made into standard thin sections. Each thin section was stained with alizarin red-S and potassium ferricyanide and analyzed under a standard petrographic microscope and a CL-4 Luminiscope .



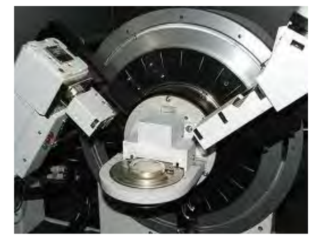
SEM Analyses

Selected samples for SEM were Au/Pd coated using the Polaron SEM coating system, for approximately 30 seconds and observed under the JEOL JSM-6500F FESEM at the MSU Institute for Imaging and analytical Technologies (I²AT).



Elemental Mapping of Thin sections

Minerals of interest in thin sections and minor element composition of e.g. Mn and Mg within different cements were analyzed and mapped using the Carl Zeiss EVO50VP Environmental SEMs attached EDX spectrometer system at the MSU Institute I²AT.



X-RAY Diffraction analyses

Bulk mineralogy of unstained cements and pore-filling materials in the core and thin section stubs were determined using x-ray powder diffraction. Cements and pore-filling materials were obtained with a dental tool and crushed to finely ground powder and analyzed at the MSU I²AT.

Stable Isotope analyses (results pending)

Carefully obtained cements from the core and thin section stubs were finely ground to powder. Approximately 50 – 100 micrograms (0.005 – 0.010 mg) of the carbonate powder was weighed using an electronic microbalance and reacted with 100% orthophosphoric acid (H_3PO_4) at 25°C, to release dry CO_2 which was analyzed with a gas-source mass spectrometer at ASIL, University of Alabama.

SIGNIFICANCE OF STUDY

- This project will positively impact the understanding of the Sligo Formation gas play.
- Successful production from the Sligo Formation could serve huge potential markets in South Texas and the Gulf Coast region at large.
- This study will contribute to the body of knowledge on porosity-impacting structures in carbonate reservoirs in the carbonate community.
- This study will be potentially applicable to other Mesozoic deposits worldwide.

ASSESSMENT OF POROSITY AND DIAGENESIS IN THE LOWER CRETACEOUS APTIAN-ALBIAN SLIGO FORMATION, SOUTH TEXAS.

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RESULTS

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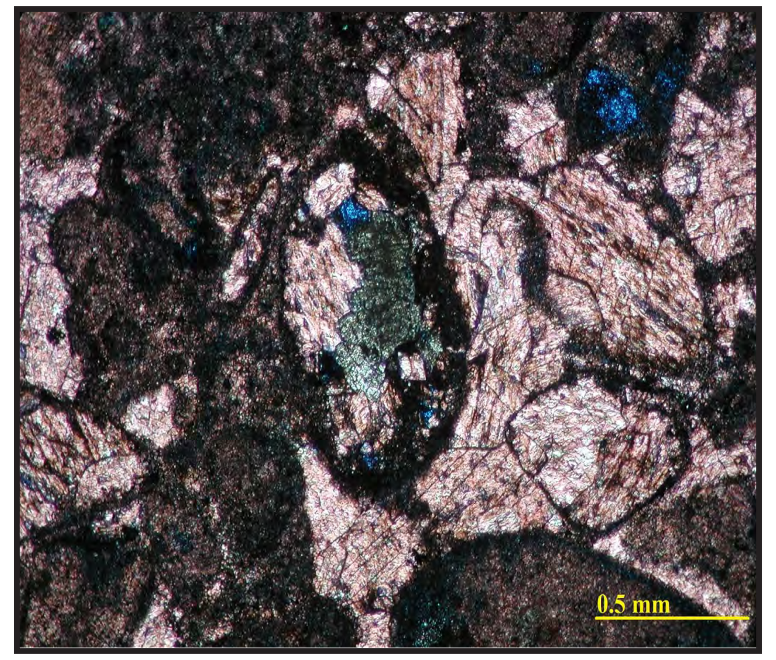

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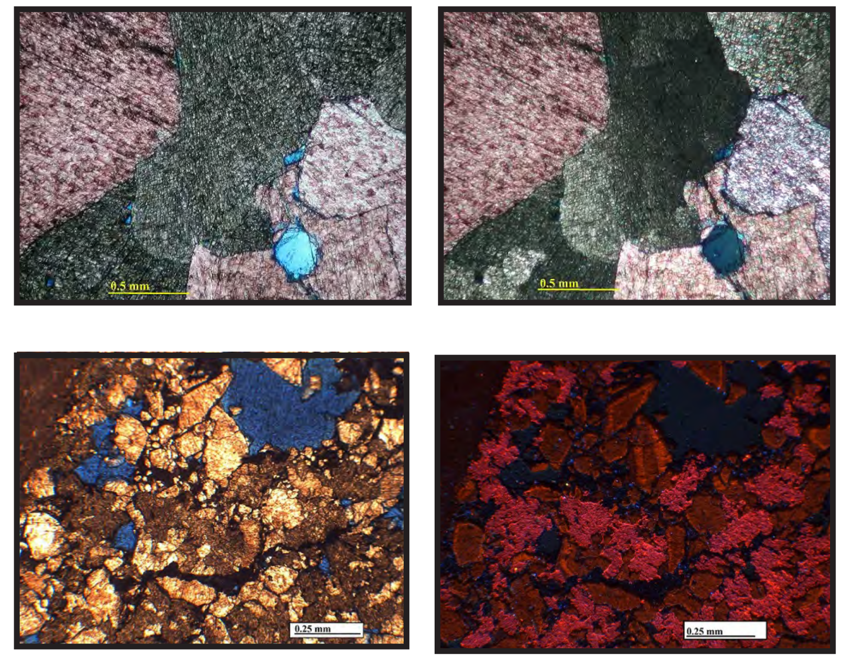

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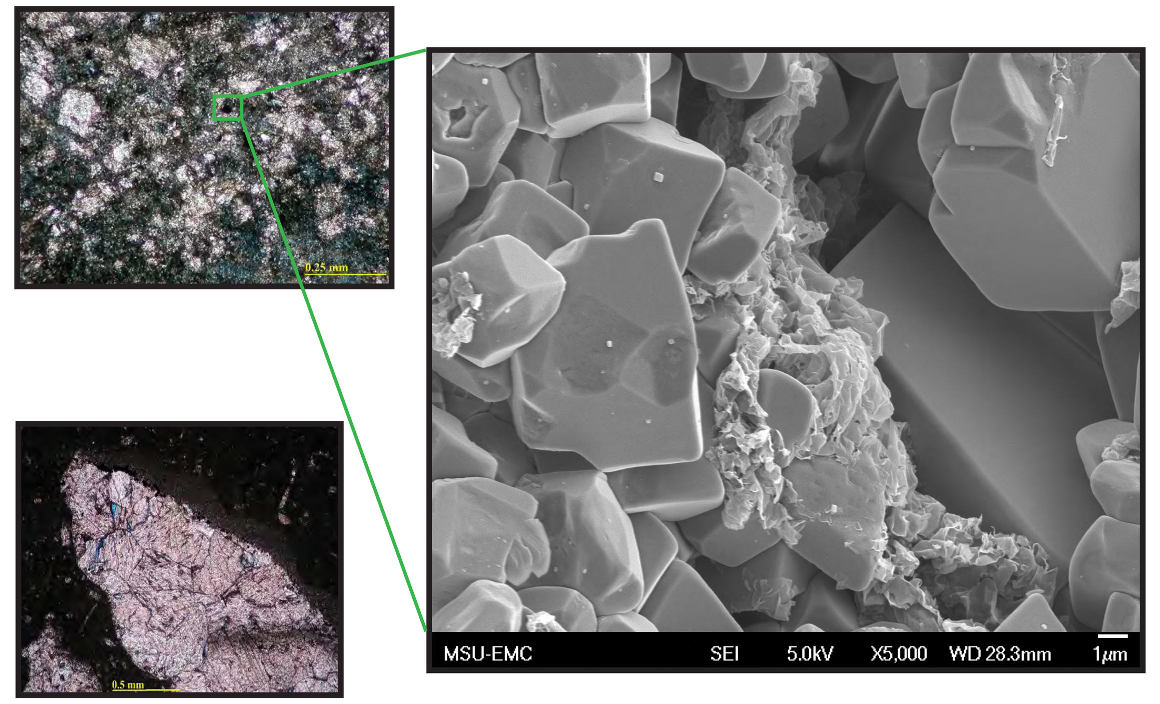
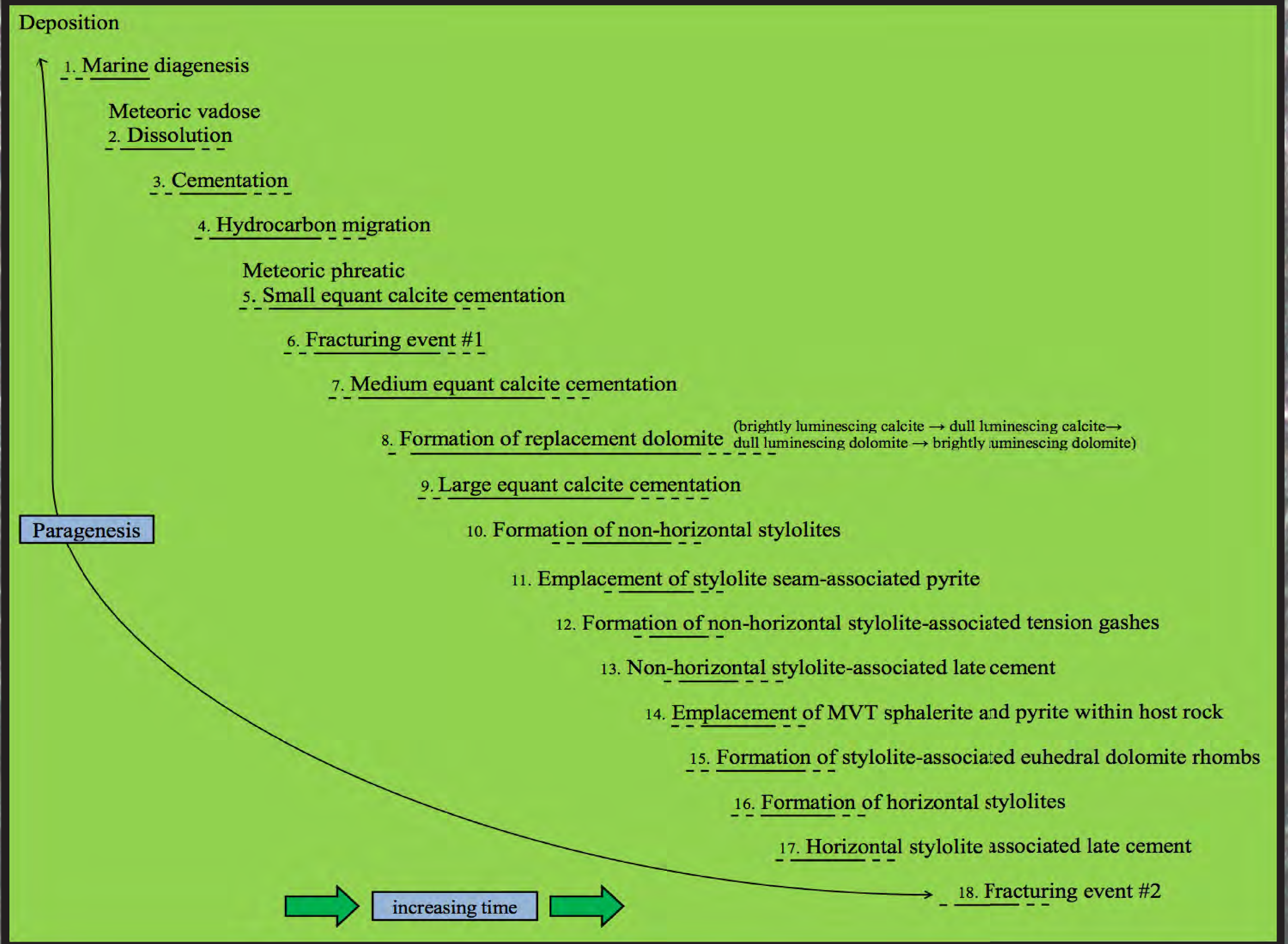


Diagenesis-Time Chart



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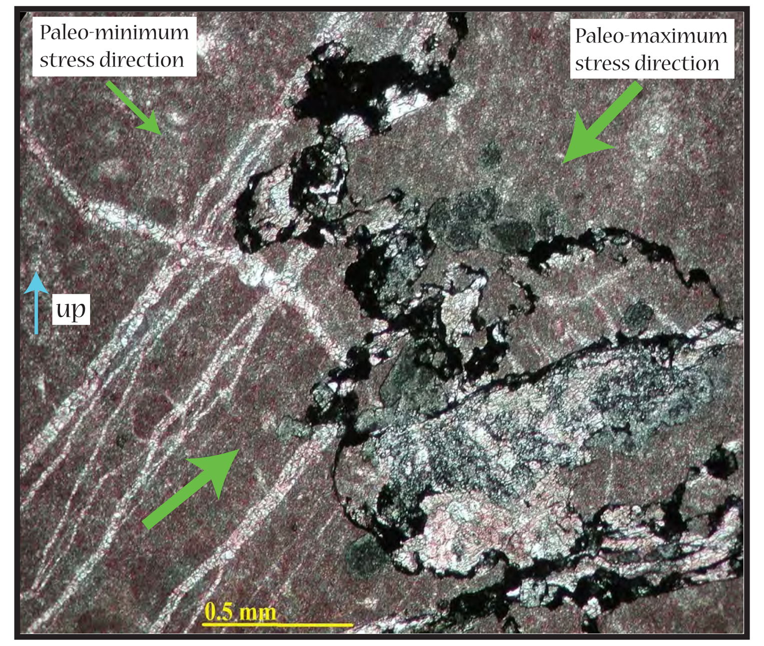

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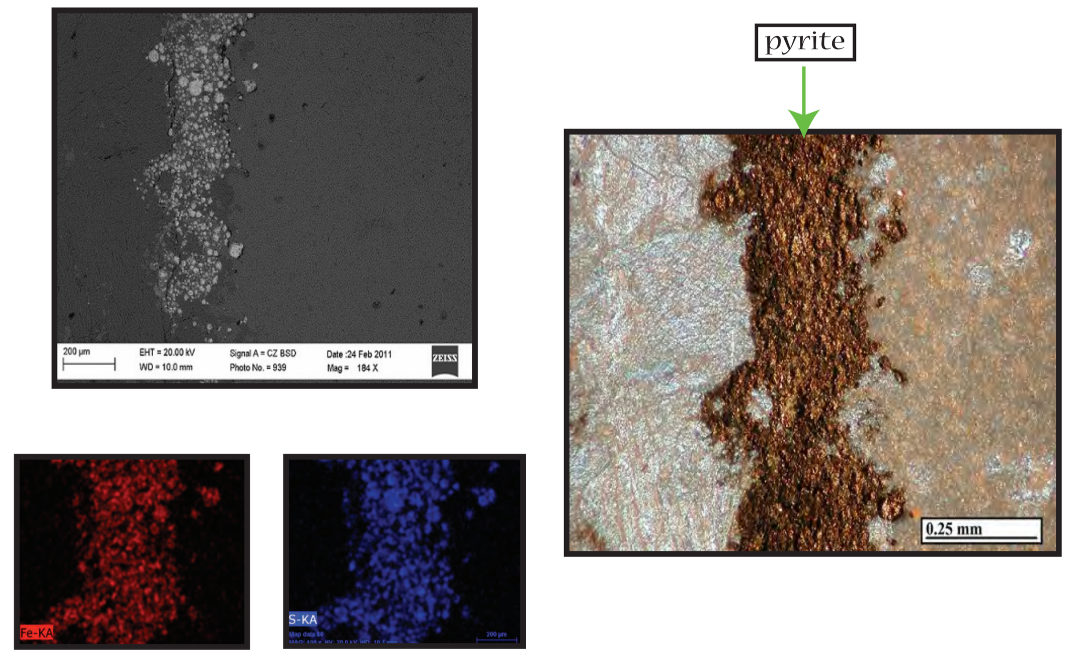

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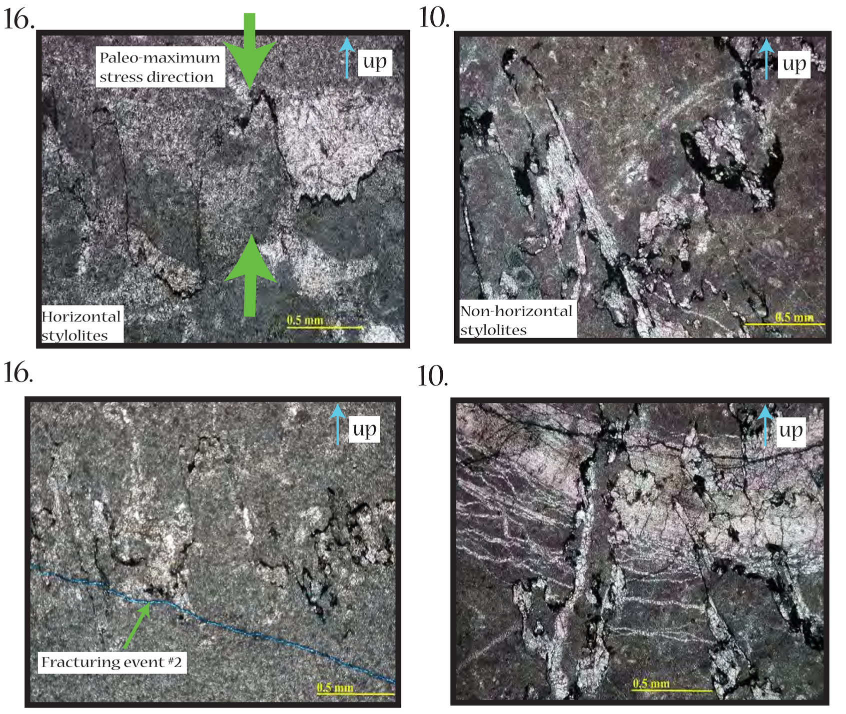

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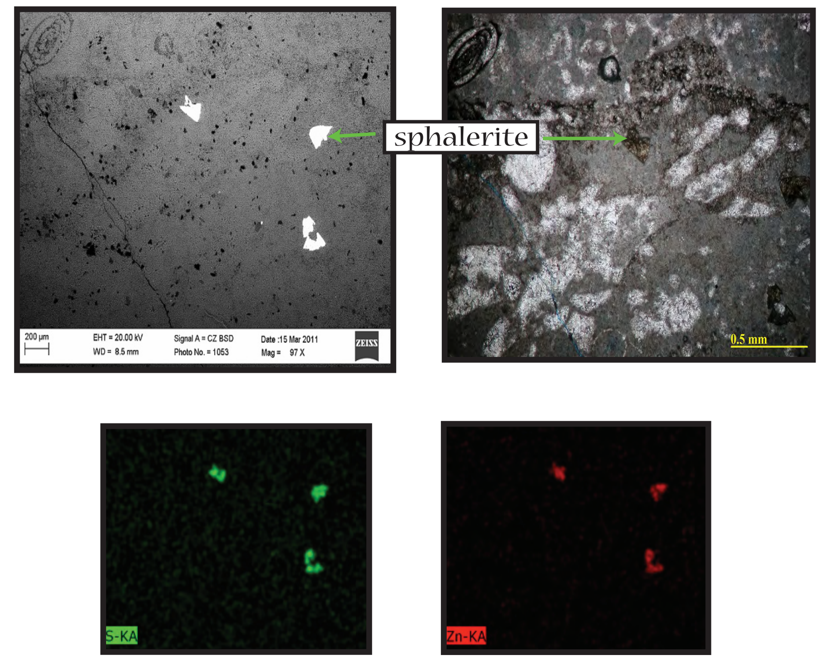
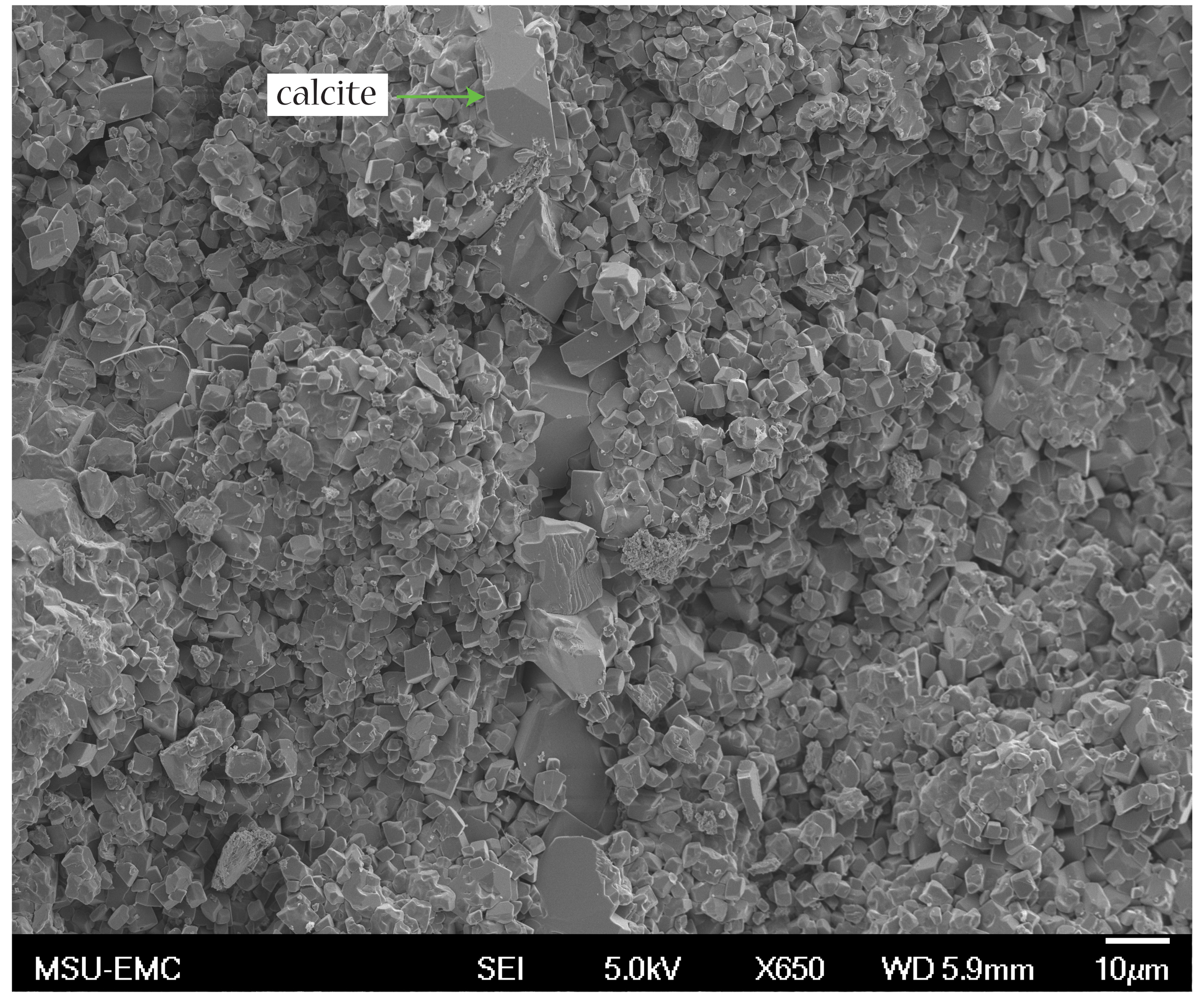
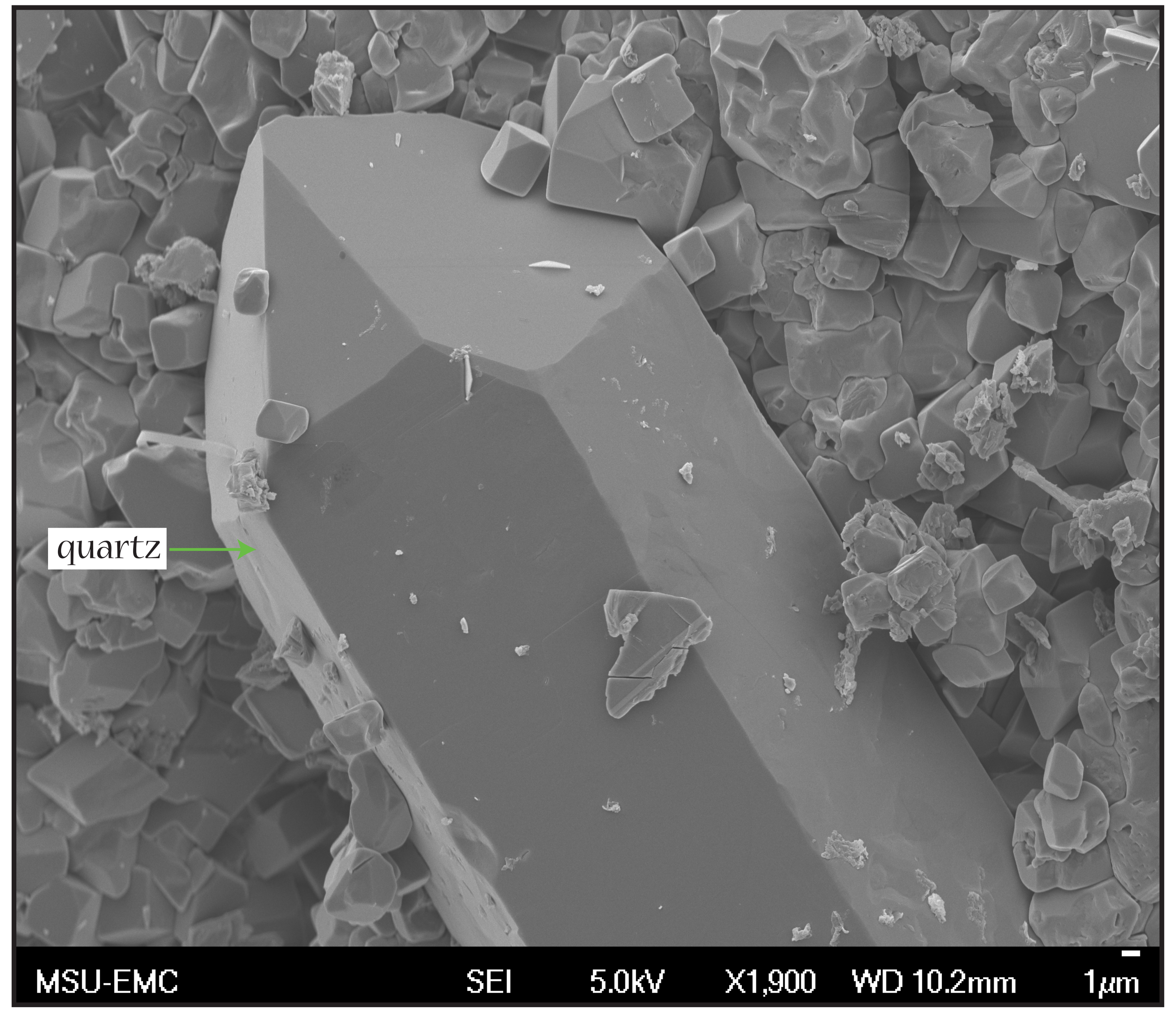
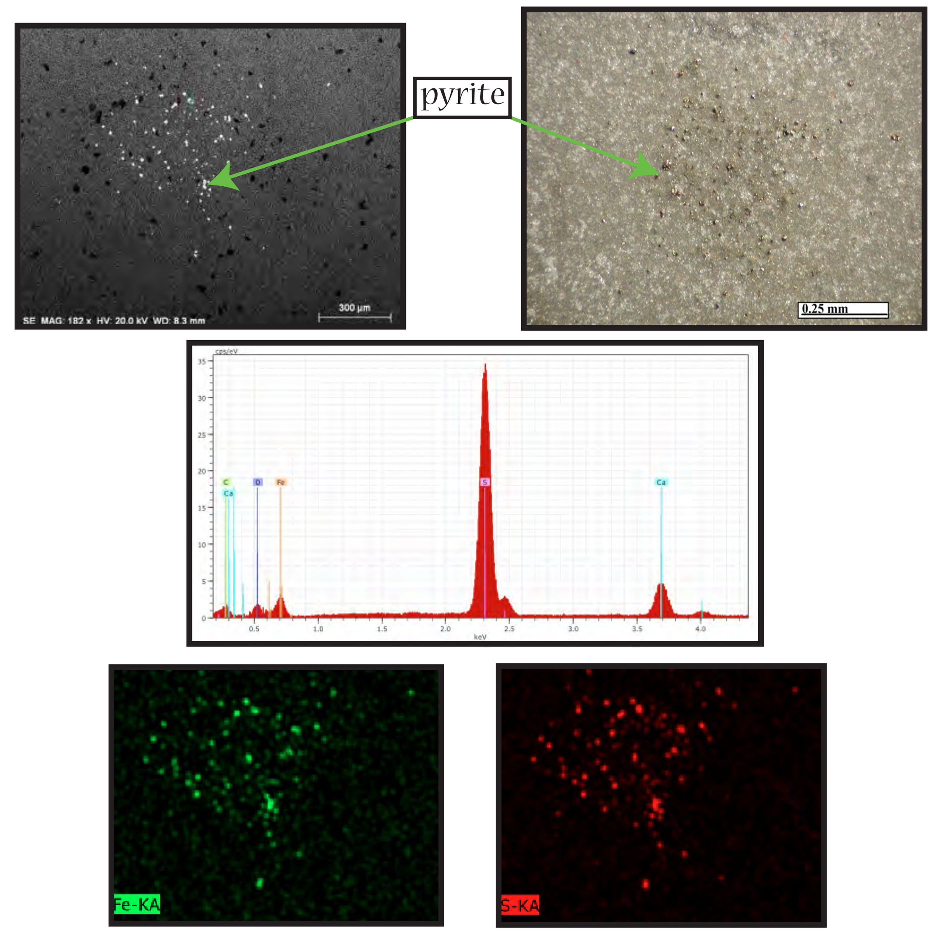


CONCLUSIONS

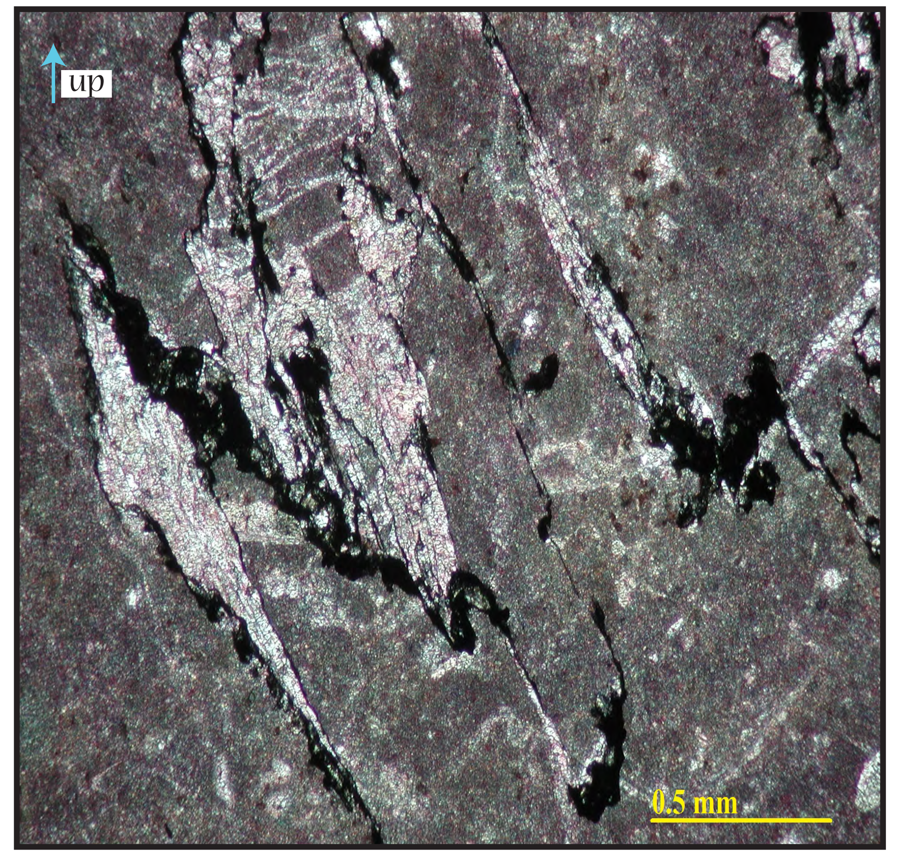




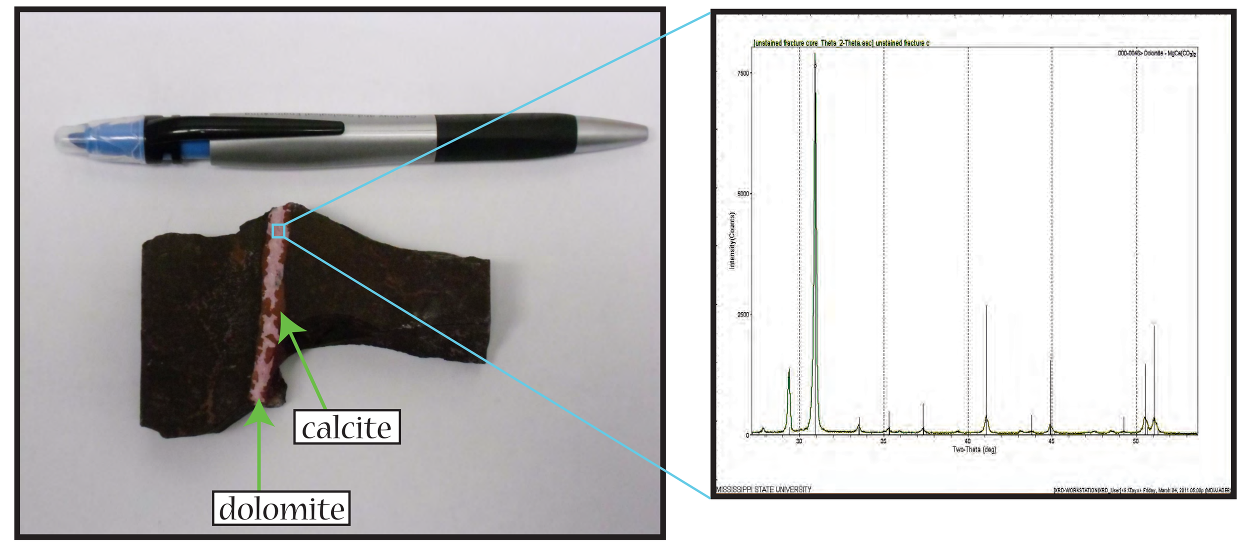
Fine quartz and calcite cements occluded porosity in micropores and microfractures throughout diagenesis



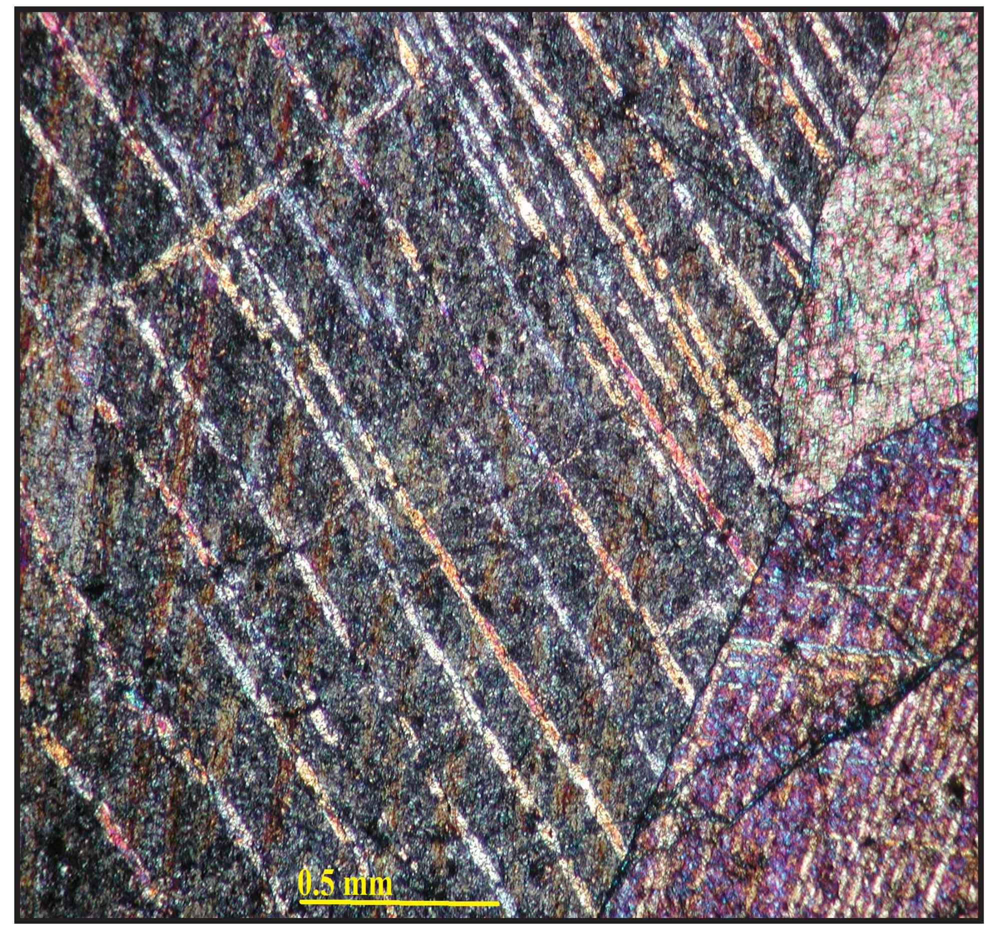
MVT sulphides are related to degrading of early hydrocarbon to bitumen



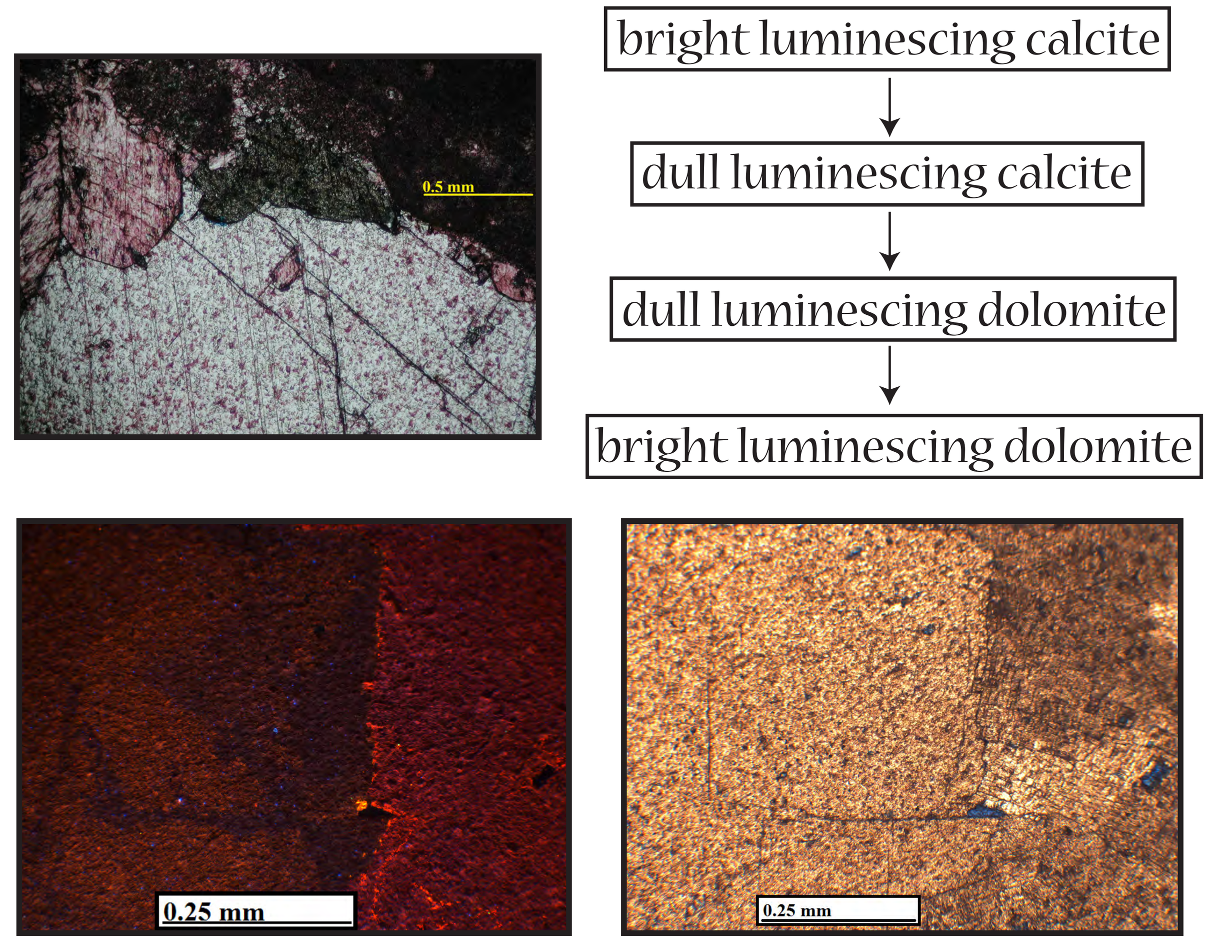
High amplitude stylolites resulted in loss of reservoir rock thickness



- Mg-rich fluids exploited fractures, microfractures, and intercrystal pore flow paths
- Late replacement dolomites contributed significantly to loss of secondary porosity



Burial loading contributed to porosity loss especially at depth



Staining, CL and standard petrographic analyses revealed stages in calcite-dolomite neomorphism

Acknowledgements

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ELECTRON MICROSCOPE CENTER

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