

Lateral Variation of Siliceous Sedimentary Lithofacies in the Upper Monterey Formation, South Belridge-Lost Hills Fields, Kern County, California*

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Abstract

The character of diatomaceous rocks in the Monterey Formation is significantly related to the compositional ratio of biogenic silica-to-detrital material, which has significant effects on primary and diagenetic rock and reservoir properties. Limited published studies on the Midway-Sunset, Buena Vista, Elk Hills, Belridge, and Lost Hills fields show a gradation of lithofacies from more highly siliceous sediments at the top of anticlinal paleobathymetric highs to the surrounding lows where biogenic or diagenetic silica is diluted with detritus. In the southwest (Midway-Sunset, Buena Vista, and Elk Hills), these lows were primarily sand-filled submarine channels, but farther to the north (Belridge and Lost Hills) are sand-poor. This study will be a detailed examination of the fine-grained, highly siliceous portion of the Upper Monterey Formation to better understand the lateral changes in composition from structural highs to structural lows, as well as, identify the depositional and transportation mechanisms that cause these variations. Several recent wells have been drilled across South Belridge to Lost Hills anticlines and into the surrounding Buttonwillow sub-basin which contain complete, modern well log suites as well as substantial core through much of the upper McDonald to the lower Antelope Shale – the interval of interest. Well logs will be used to calculate variations in porosity and clay content, cores and cuttings used to identify and quantify lateral variation in composition and sedimentary features, and well logs and cuttings from infilling wells used to provide better spatial resolution. Core and cuttings samples will be analyzed for mineralogy by XRD and geochemically by XRF or ICP-OES/MS and integrated with petrophysical findings. Preliminary results will be presented.

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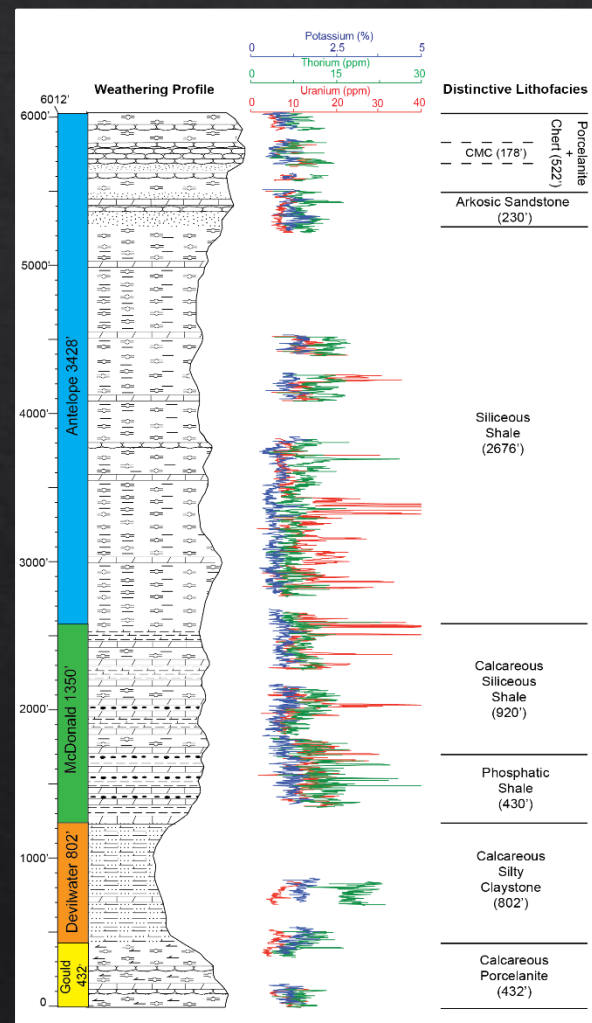
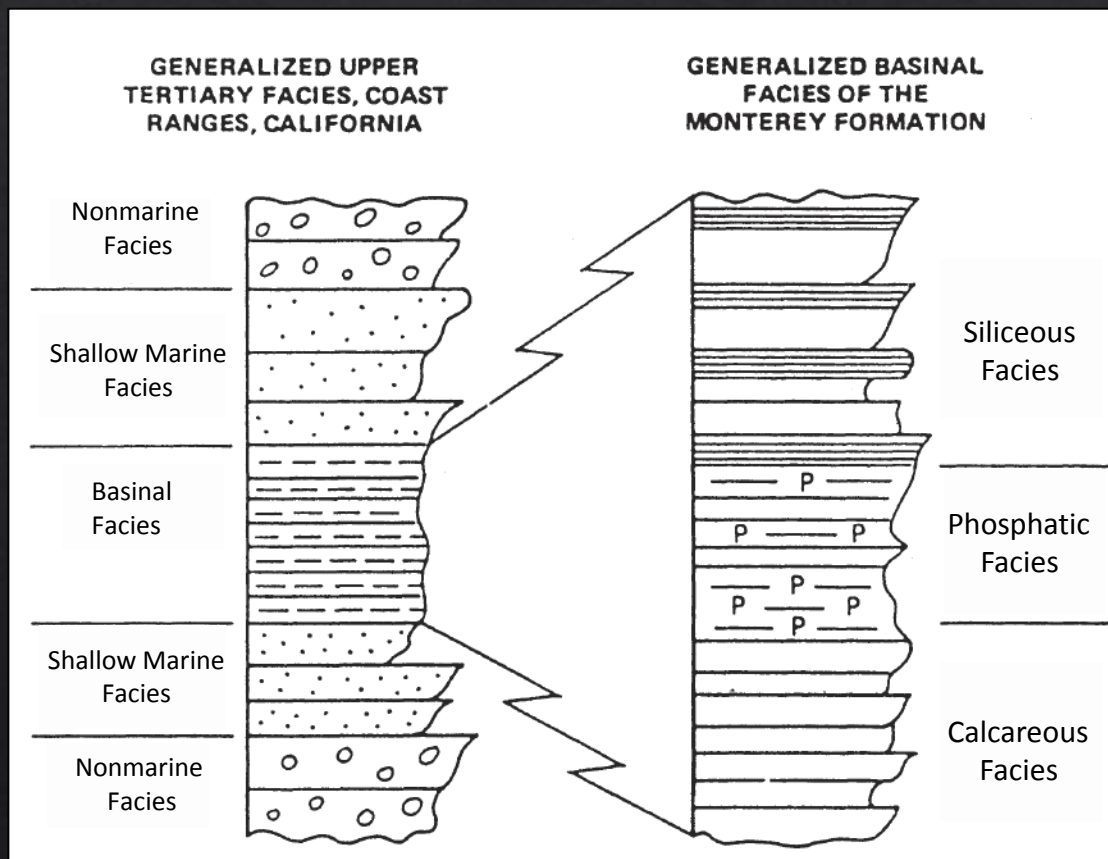
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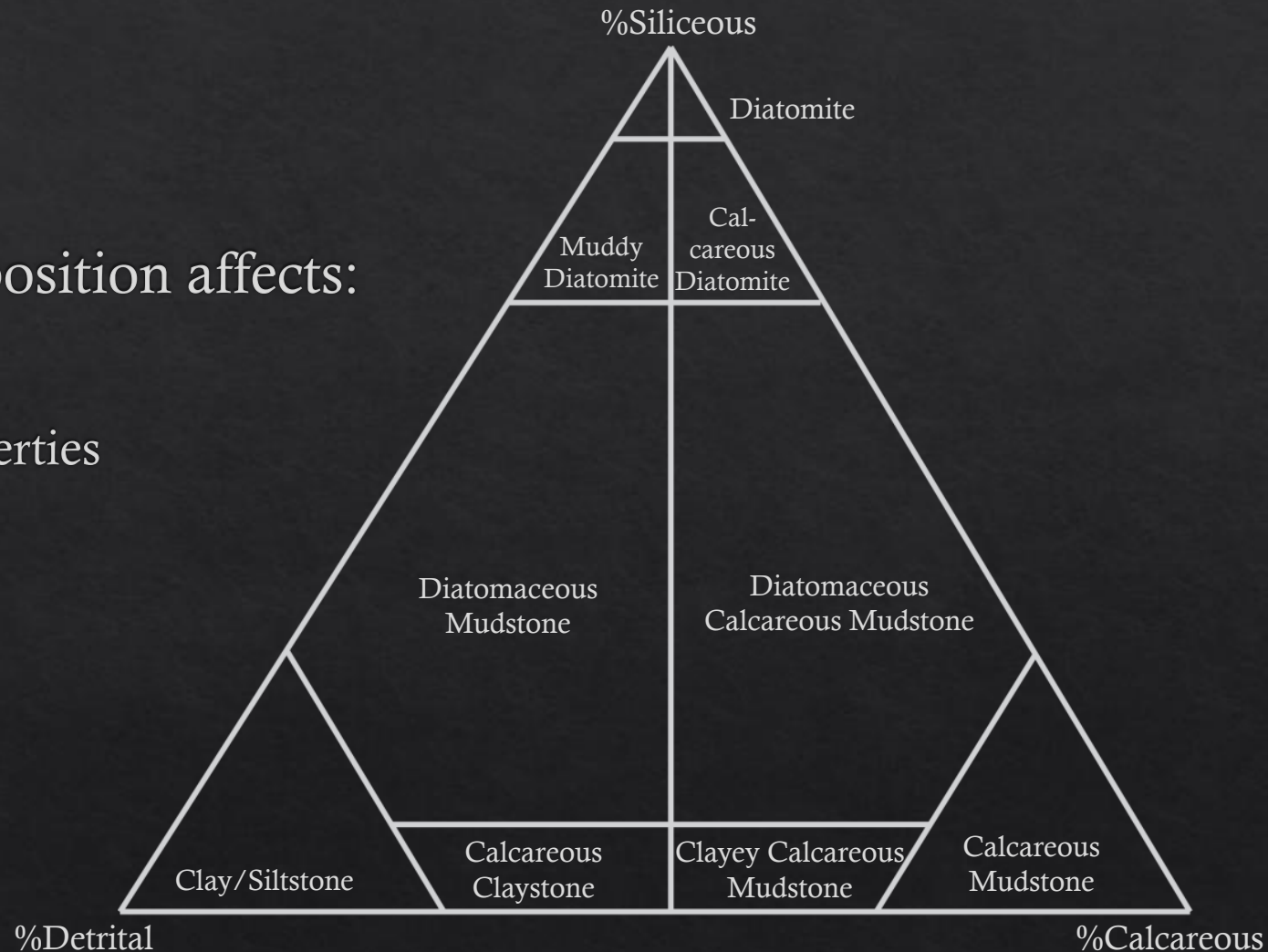
Monterey Formation



Importance of Lateral Variation

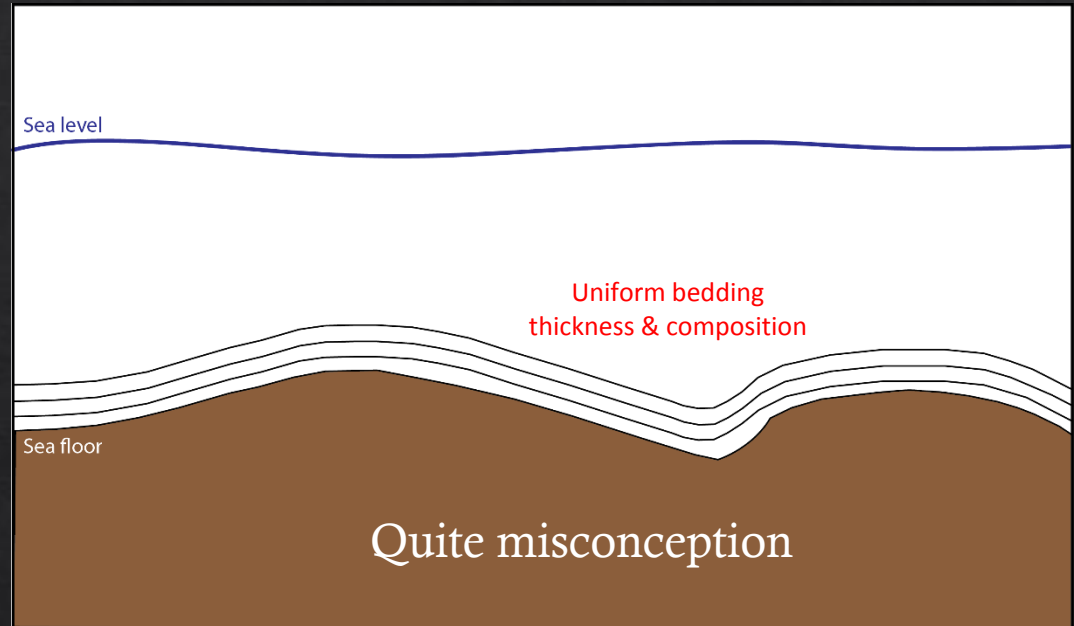
Original composition affects:

- ◇ Rock type
- ◇ Rock properties
- ◇ Diagenesis

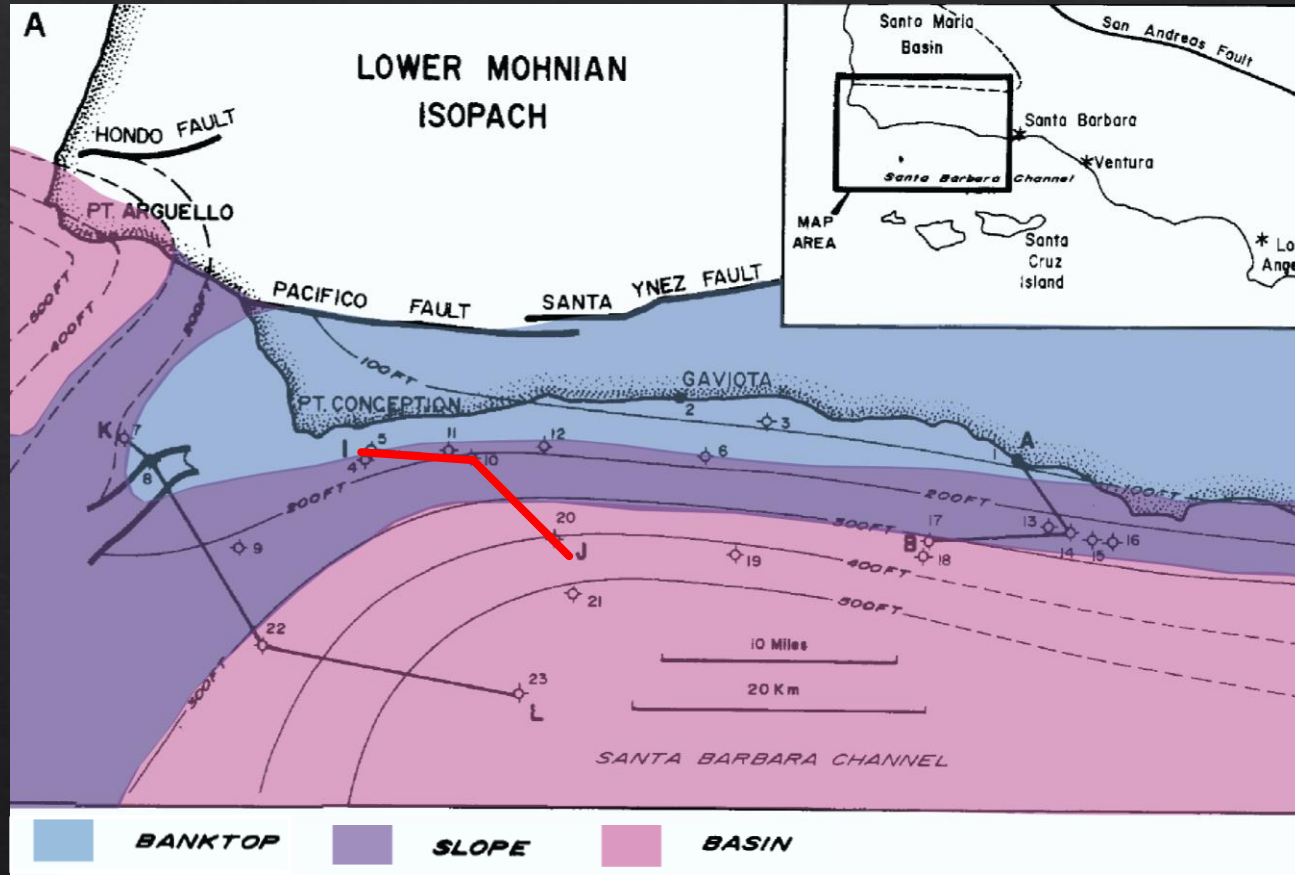


Mudrock Issues

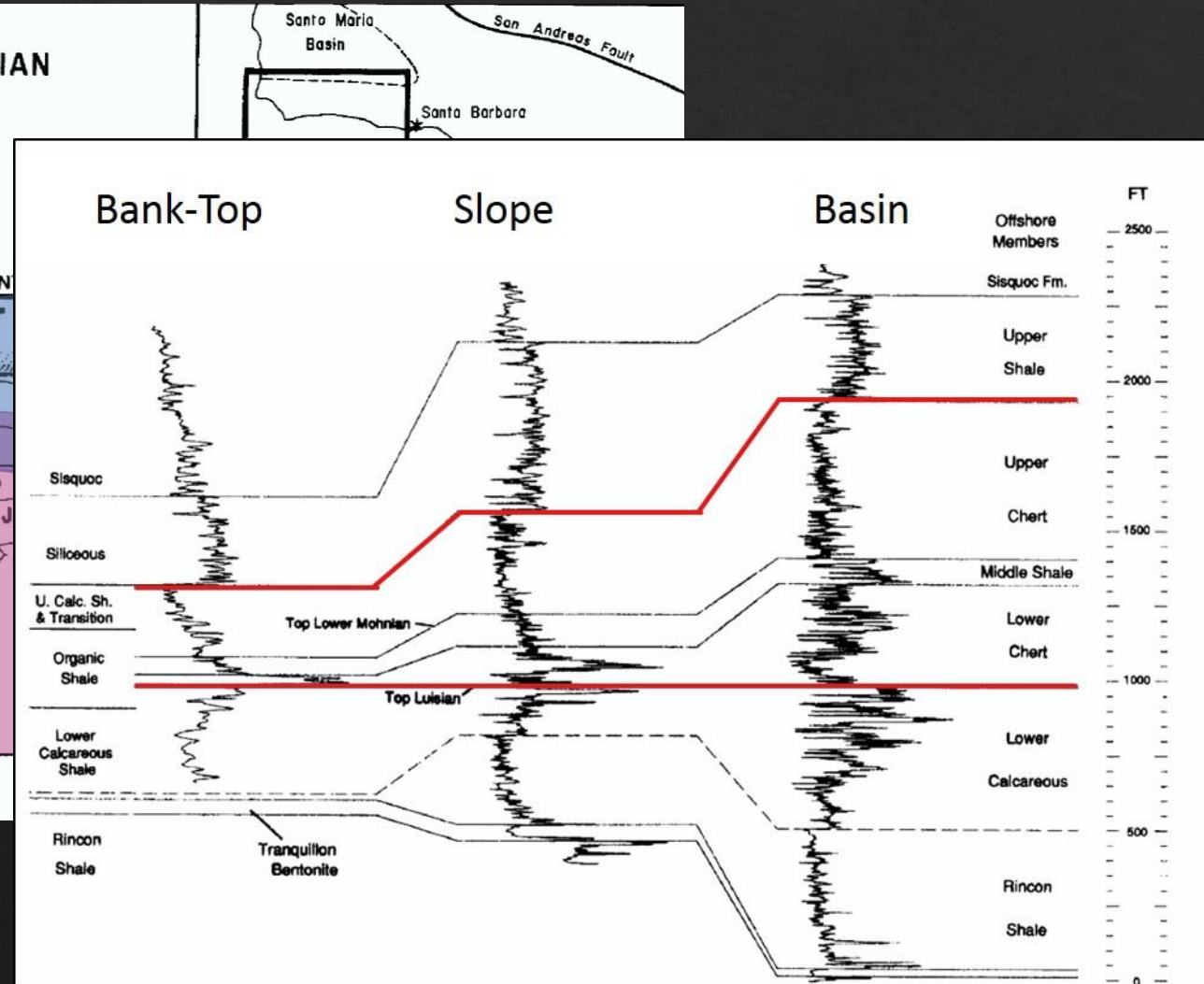
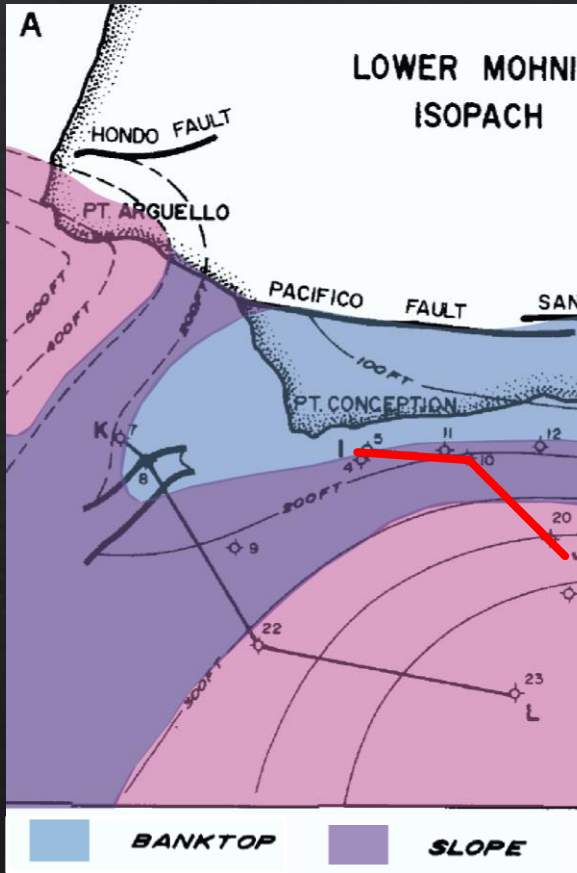
- ◆ Quite misconception
 - ◆ Hemipelagic drape
 - ◆ Understudied
- ◆ Complicated
 - ◆ Difficult to see (small: $<62.5\ \mu\text{m}$)
 - ◆ Sedimentary variations



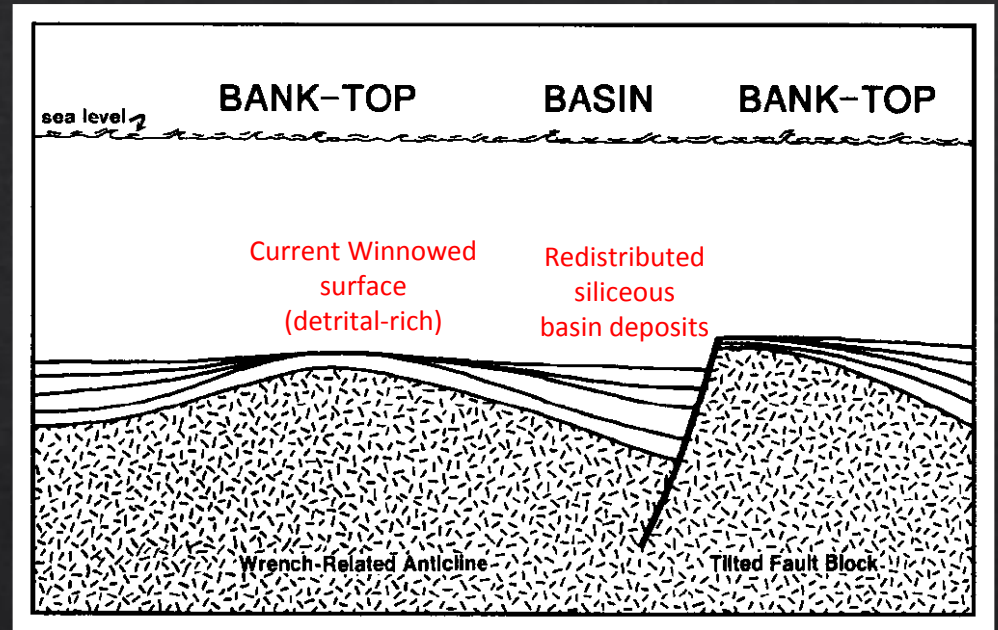
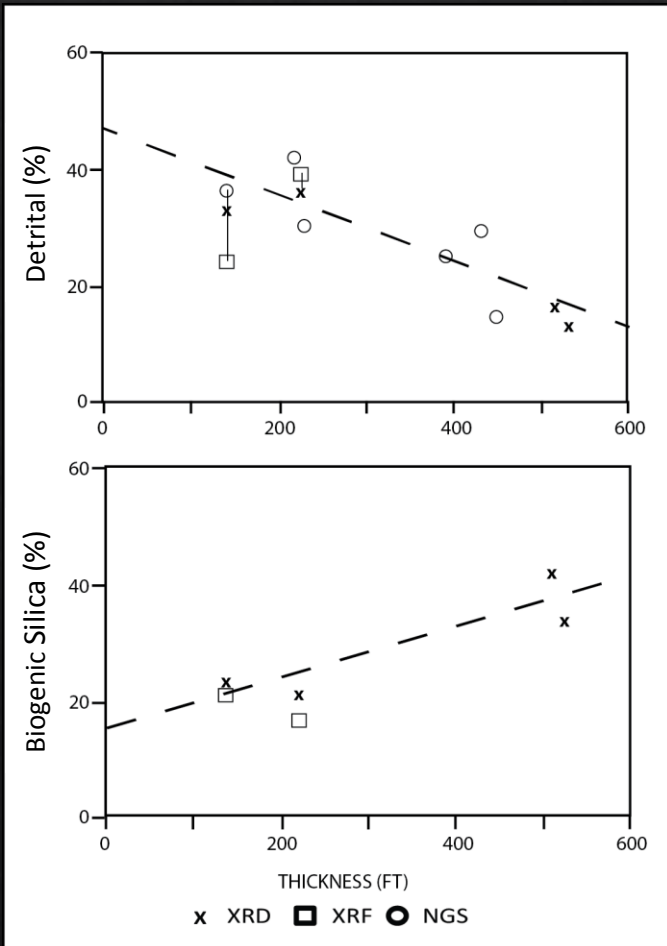
Santa Barbara Channel



Santa Barbara Channel

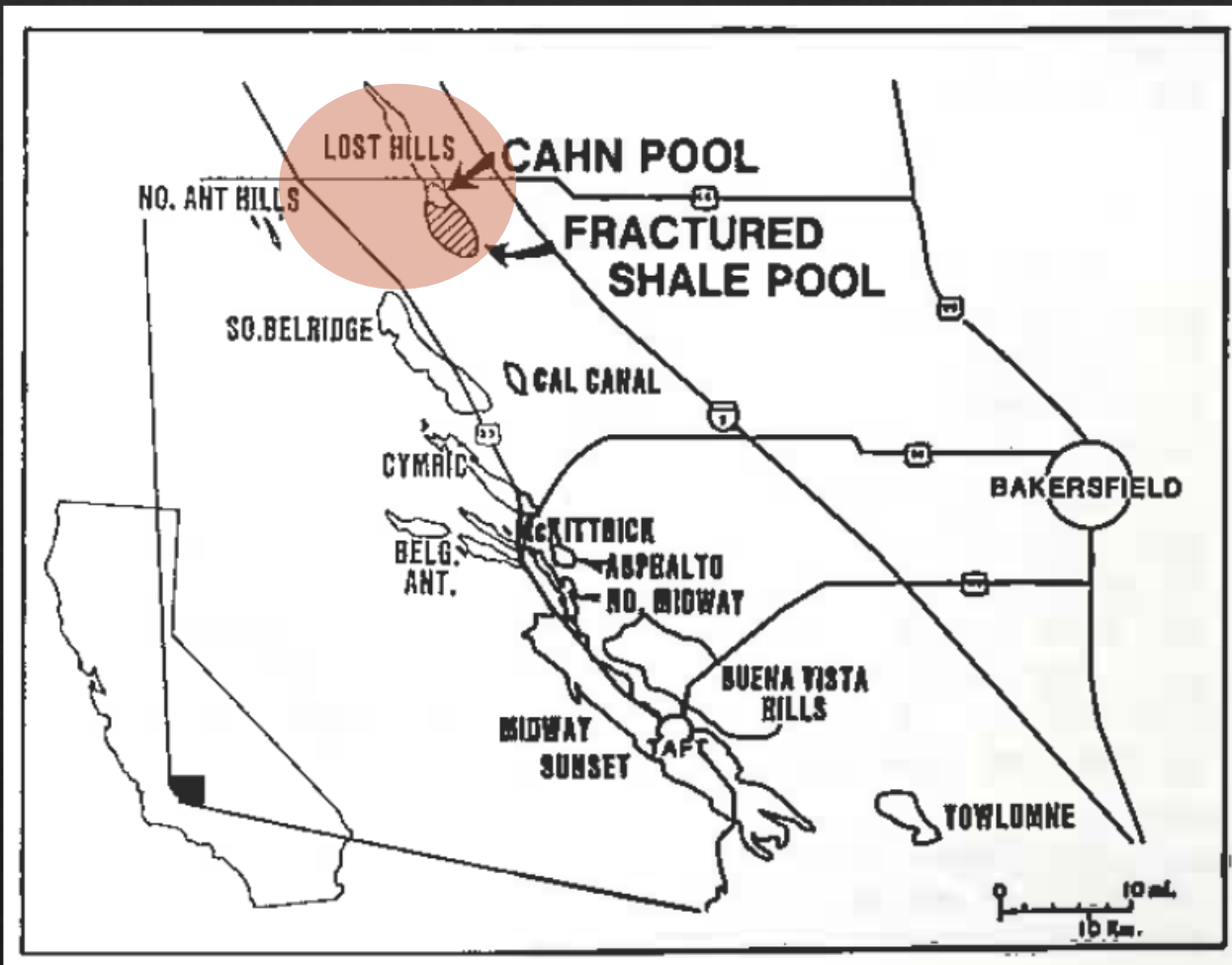


Santa Barbara Channel



- ◇ Distal basin
- ◇ Hemipelagic sedimentation
- ◇ Bathymetric highs subjected to currents
- ◇ Attenuated sedimentary sections
- ◇ Continuous sedimentation occurred in the surrounding basins

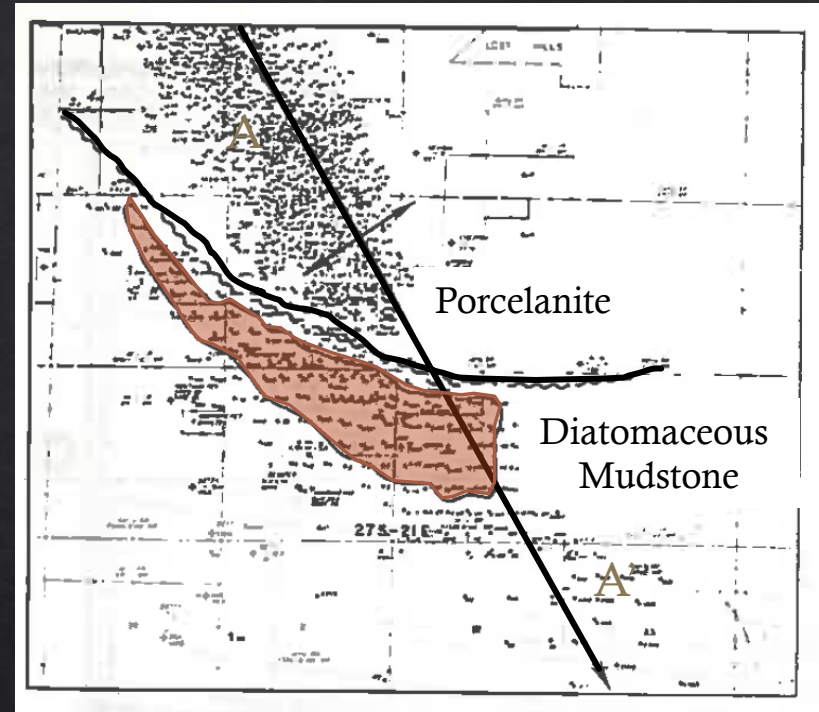
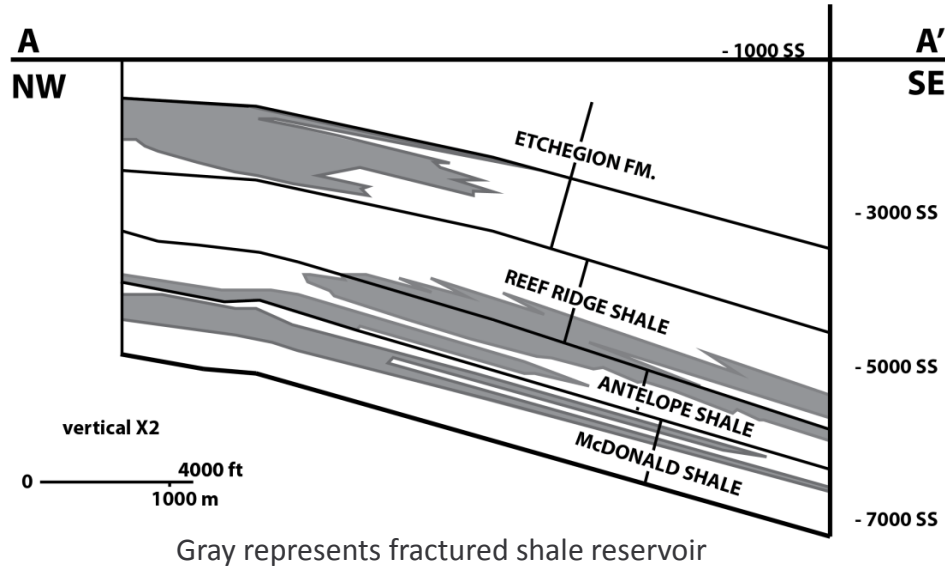
Lost Hills



- ◇ Proximal basin
- ◇ Hemipelagic & detrital sedimentation
- ◇ Turbidites
- ◇ Anticlinal folding
- ◇ Uplifted raised bank-tops
- ◇ Protected from bottom-seeking sediment gravity flows

Lost Hills

Lost Hills Cross Section A-A'



Reef Ridge Shale: Diatomaceous & siliceous mudstones lens (~36% clay)
out updip to porcelanites (~2% clay)

Deposition Patterns

- ◆ Uniform thickness/
Uniform composition



- ◆ Basinal thickening/
Uniform composition



- ◆ Basinal thickening/
Silica-rich basin



- ◆ Basinal thickening/
Detrital-rich basin



Fine-Grained Sediment Controls

- ◇ Provenance – where do the sediments originate?
- ◇ Transport – what are the mechanisms?
- ◇ Deposition – where do the rocks settle?
- ◇ Composition – what are the rocks made of?
- ◇ Diagenesis – how the rocks transform over time?

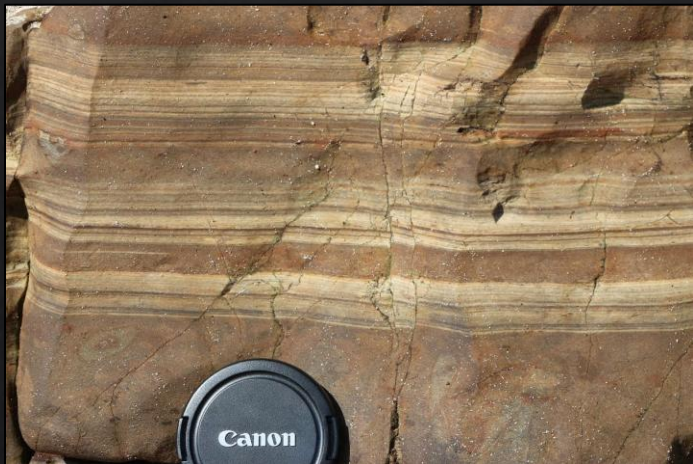
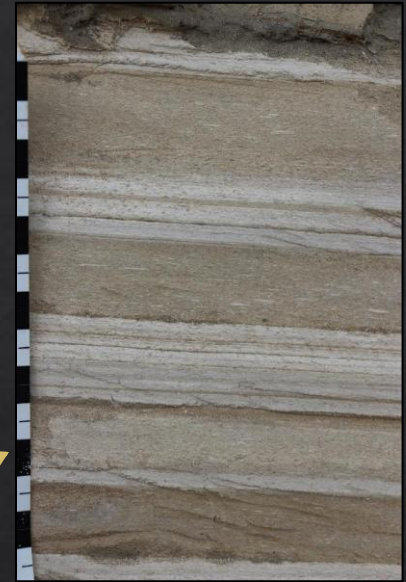
Fine-Grained Sediment Transport

Siliceous Components

- ◇ Water-column settling
 - ◇ Flocculation
 - ◇ Fecal pellets
 - ◇ Marine snow
 - ◇ Diatom mats
- ◇ Winnowing
- ◇ Downslope gravity flow

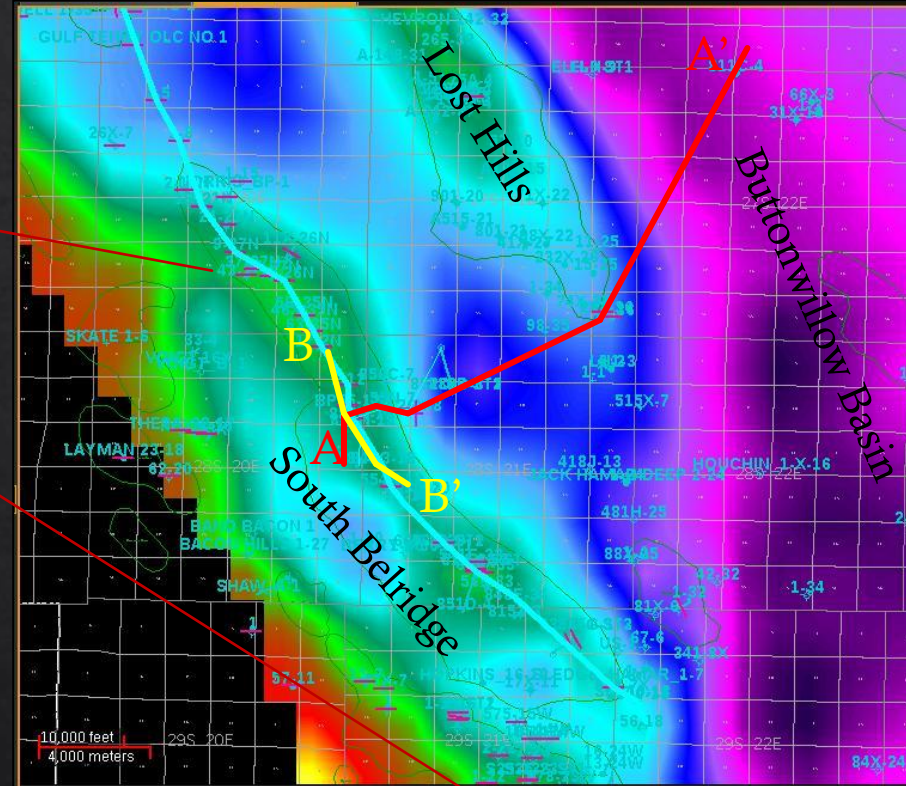
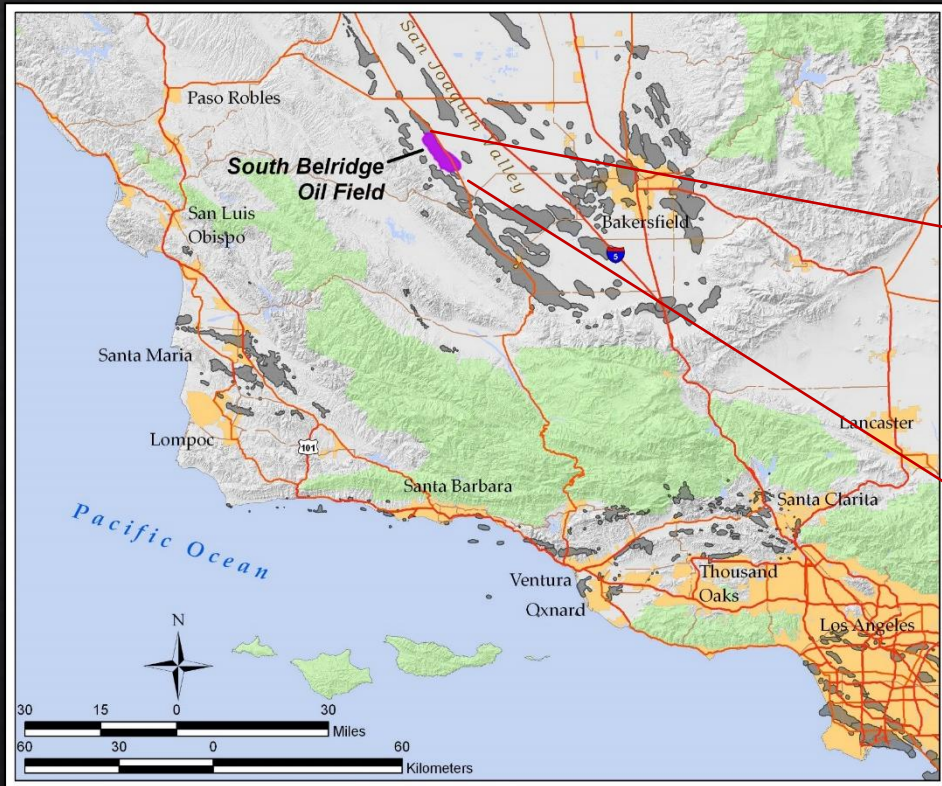
Detrital Components

- ◇ Continuous Transport
 - ◇ Hypopycnal
 - ◇ Hyperpycnal
- ◇ Episodic Transport
 - ◇ Eolian dust
 - ◇ Sandy turbidites
 - ◇ Muddy turbidites
 - ◇ Levee or channel-margin

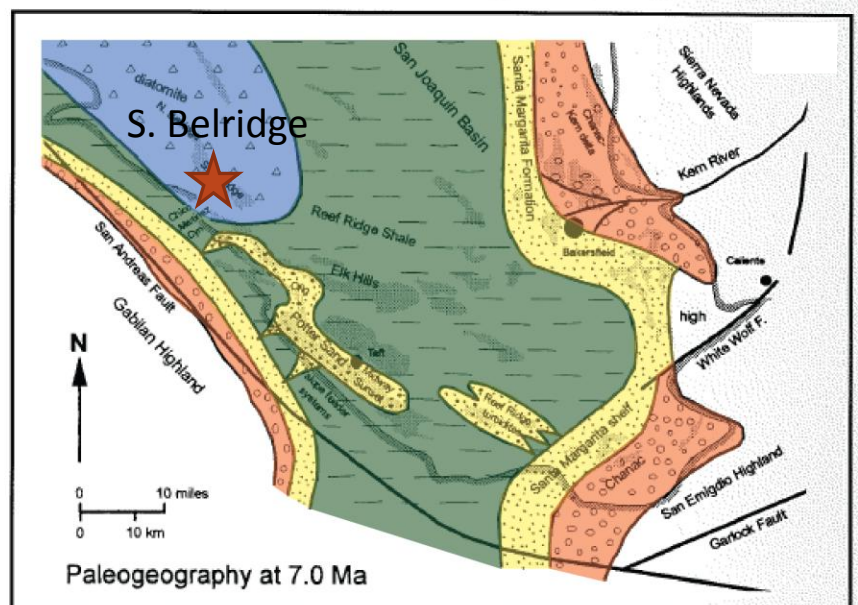
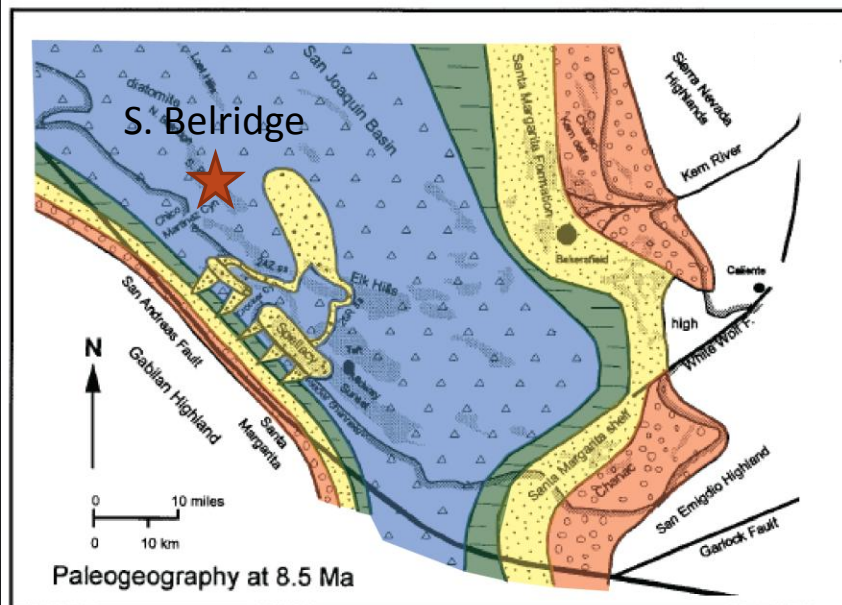
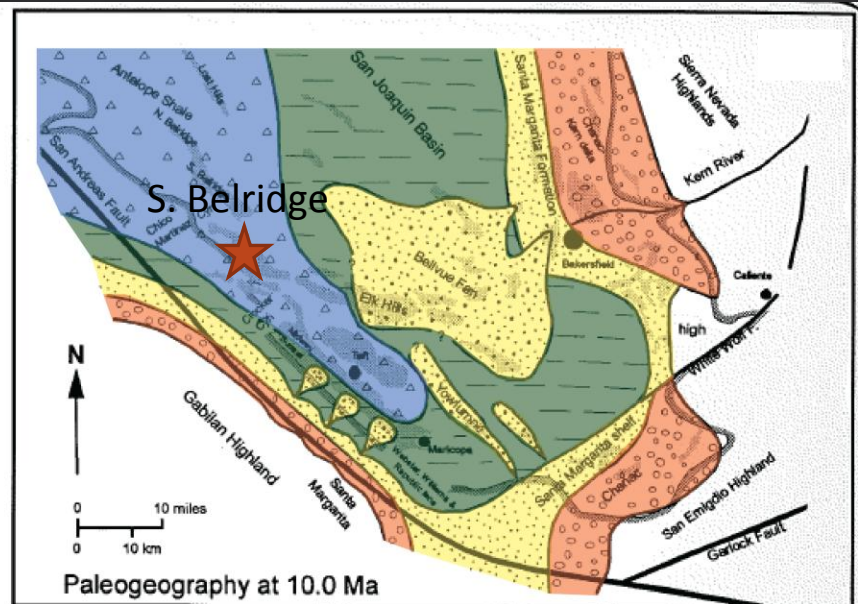
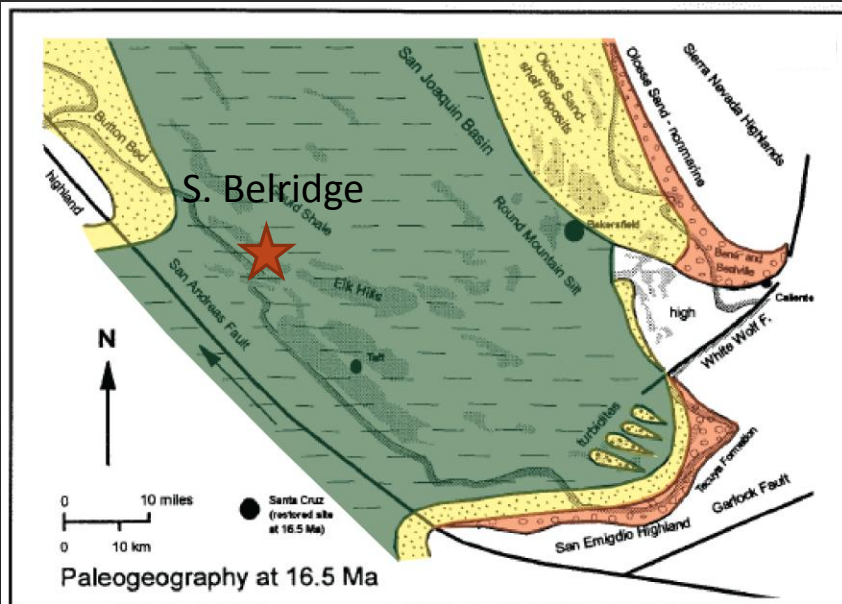


MARS Project: Monterey And Related Sediments

Study Area



Structural contour map on Top Antelope surface



A diagram showing a yellow line labeled B and a red line labeled A and B' . The yellow line B is a smooth curve. The red line A is a straight vertical segment. The red line B' is a piecewise linear approximation of the yellow line B , consisting of several segments connected at vertices.



Future Work

- ◊ Well logs for correlation and composition
- ◊ Detailed core description of sedimentary features
- ◊ Compositional analysis of rock for confirmation
- ◊ Relationship between composition and sedimentary structures

Well #	Log Type																	
	CALI	CGR	DRES	DRHO	DT	DTS	GR	MRES	NPHI	POTA	PNMR	RHOB	R XO	SP	SRES	THOR	URAN	PAELO
35N	X		X	X			X	X	X			X		X	X			
35	X		X	X	X		X	X	X			X		X	X			
N-12	X		X	X	X	X	X	X	X			X		X	X			X
N-13	X		X	X	X	X	X	X	X			X	X	X				X
C-4	X	X	X	X	X	X	X	X	X	X		X		X		X	X	
D-8	X	X	X	X	X	X	X	X	X	X		X		X		X	X	
L-13	X		X	X	X	X	X	X	X		X	X	X	X				
C-7	X	X		X	X	X	X	X	X		X	X	X	X				
C-18	X		X	X	X	X	X	X	X		X	X	X	X	X			
C-20	X		X	X	X	X	X	X	X		X	X	X	X	X			

Conclusion

Knowing controls of lateral variation helps with:

- ◊ Locations of source, reservoir, & seal
- ◊ Better understanding of paleoclimate
- ◊ Potential model for sequence stratigraphy of fine-grained siliceous sediments

Questions, Comments, Suggestions

Thanks to  for providing well data!

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