

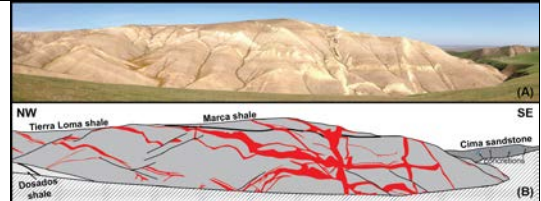
# Geopressure evolution, hydraulic fracturing, and sandstone injection in the Panoche Giant Injection Complex, California

Jason C. Sanford, *The University of Texas at Austin*

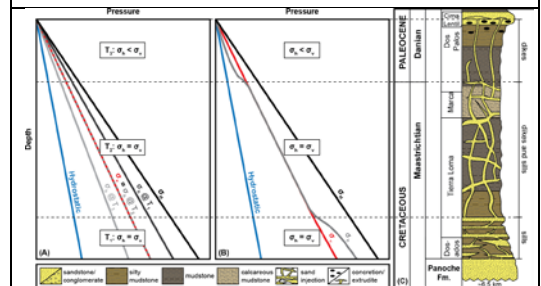
## ABSTRACT

The Panoche Giant Injection Complex (PGIC) is the world's largest known exposure of sand injections. As such, it is an ideal analog to reservoir-scale hydrocarbon-bearing injection complexes and can yield insight into fracture and proppant-transport mechanics in wellbores. 3-D characterization of the PGIC in outcrops suggests that injection style was controlled by a change in stress state with either time or depth. These alternate hypotheses have unique implications for timing and paleo-stress state of the PGIC. Ongoing fieldwork and geomechanical modeling are focused on testing these two hypotheses and understanding the mechanics of and controls on fracture initiation and propagation and fluidized sand transport during injection.

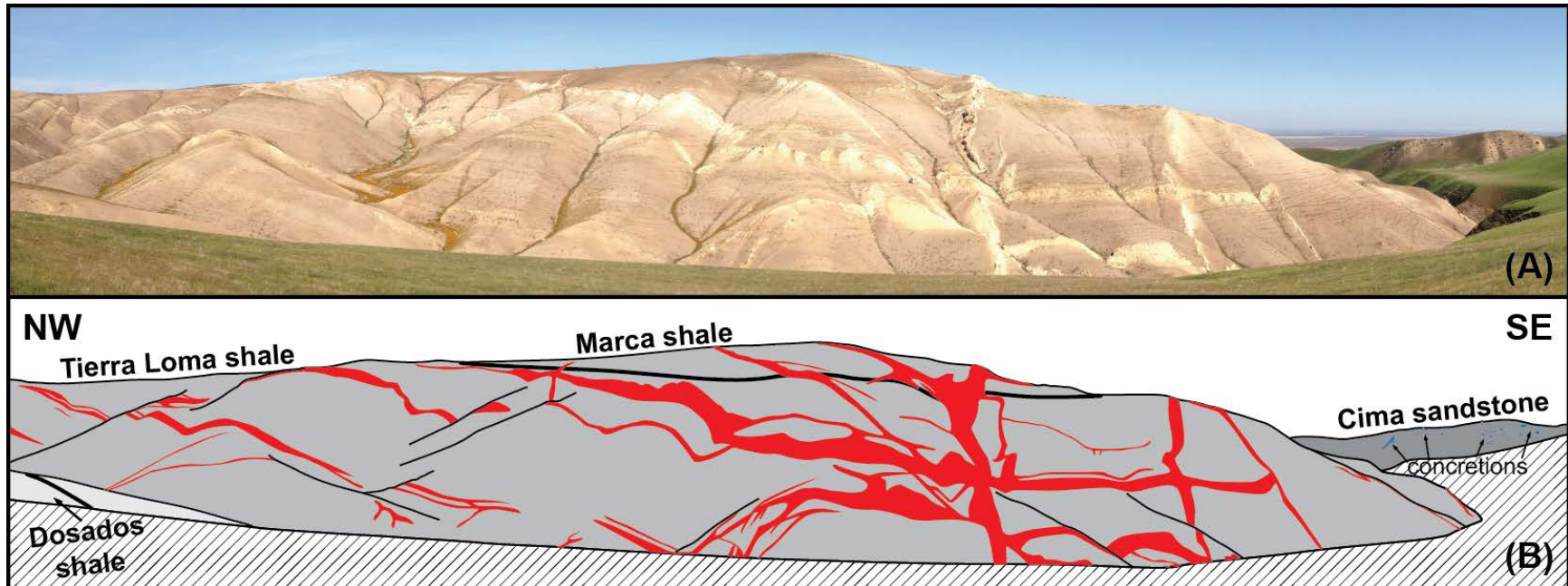
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**Fig. 1:** Sand injections in the PGIC at Marca Canyon, northern Panoche Hills. Sills and dikes are extensive throughout the exposure, and carbonate concretions in the background indicate proximity to the paleo-seafloor.

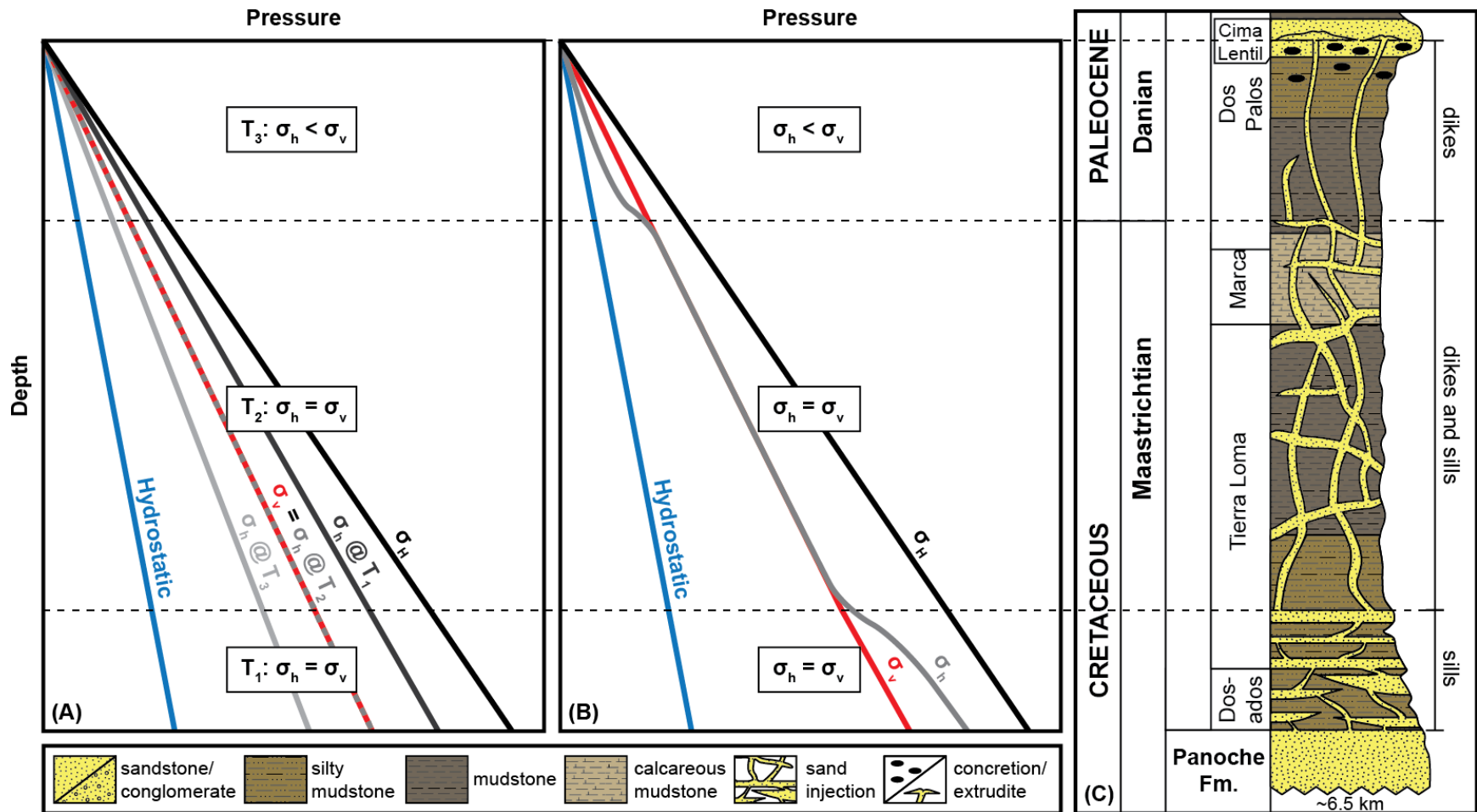


**Fig. 2:** Pressure-depth plots illustrating two proposed models of sand injection at the PGIC.



**Fig. 1:** (A) Photograph of injections in the Moreno Formation of the Great Valley Sequence in Marca Canyon, northern Panoche Hills. (B) Sketch of injections (red) in the Marca Canyon Exposure. Both sills and dikes are extensive throughout mudstones of the Moreno Formation. Carbonate concretions (blue) in the Cima sandstone lenticle of the Dos Palos shale are visible in the background and indicate proximity to the paleo-seafloor. Thick black lines demarcate stratigraphic boundaries within the Moreno Formation.

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**Fig. 2:** Pressure-depth plots illustrating two proposed models of stress state and sand injection at the Panoche Giant Injection Complex (PGIC). **(A)** Temporal change in stress state controls injection style, and injections are episodic. **(B)** Change in stress state with depth controls injection style, and injections occur within a short timeframe with no temporal change in stress state. **(C)** Schematic lithologic section of the PGIC. Injections can be classified into three units on the basis of injection style, suggesting a change in stress state.

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