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Influence of Tectonics, Burial History and Sediment Composition on the Temperature and Depth of Diagenetic Transition from Opal-A to Opal-CT in the Subsurface San Joaquin Basin, California

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Abstract

Previous studies of diagenetic changes in siliceous mudstones – from opal-A to opal-CT to quartz silica phases – were either performed in strata that were one-directionally buried to maximum depth or were uplifted completely to the surface. Together, these studies found large, overlapping temperature windows for phase changes that make it difficult to predict the depth of the transition zones. However, many subsurface occurrences of biosiliceous rocks with different tectonic and burial histories have experienced more complex histories of burial and uplift and have narrower temperature/depth transition zones. In the Belridge field, San Joaquin Basin, the phase change can occur as much as 2000' (610m) shallower than what would be predicted from previous studies (c.f. Keller and Isaacs, 1985) with a simple burial history with a constant heat flow. We created 1D models of the burial, uplift and erosional histories, and the paleo- and present-day heat flows in 5 different wells from three structural positions on the Belridge anticline to understand the full subsurface thermal history of these rocks and the depths, temperatures, thicknesses, and character of the opal-A to opal-CT transition zones. These wells contain opal-A to opal-CT transitions zones with tops from 1350' to 2000' in true vertical depth and that range from 80' to 170' in thickness. To characterize the diagenetic processes that occurred within phase change windows, we use SEM and XRD to identify opal-A, opal-A' and opal-CT, d-spacing, and related primary and authigenic minerals, as well as processes including fragmentation, dissolution, precipitation, and replacement.