

Detailed Examination Of Transitional Zones In Eocene Lake Uinta, Piceance Basin, Using Hyperspectral Core Scanning

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ABSTRACT

Several major transitions in Eocene Lake Uinta are recorded in the oil shale deposits of the Eocene Green River Formation in the Piceance Basin of western Colorado. The Cow Ridge Member was deposited during freshwater conditions in the paleolake and transitioned into a more brackish phase that deposited the Garden Gulch Member. This sequence was followed by deposition of the saline to hypersaline Parachute Creek Member, which includes substantial deposits of nahcolite and halite as well as the regionally extensive, highly laminated organic-rich oil shales of the Mahogany zone. These distinctive zones can be readily identified from changes in organic richness and mineralogy. However, the transitional zones between these sections have not been examined in detail to assess how particular trends in paleolake chemistry affected subsequent mineralogical compositions occurring during the different stages of Lake Uinta. In this study, transitional zones between the different members of the Green River Formation and within the Parachute Creek Member were examined in two cores from the Piceance Basin center and margins. An imaging system integrating hyperspectral imagers (450- 2500 nm), an RGB camera, and a 3D laser profiler was used to characterize the mineralogy and geochemistry of core material from within these transition zones. Along the basin margins and in the basin center, spectral interpretation of the reflectance data indicates major differences in the mineralogy related to the depositional environment in different areas of the paleolake. Several authigenic indicator minerals were detected using hyperspectral analysis, including dawsonite, analcime, and buddingtonite. The presence or absence of these minerals in the basin center or margins provides information on water chemistry, particularly pH, Al mobility, and Na and Si activity. The results show similar trends to those observed in previous bulk mineralogy surveys using methods such as X-ray diffraction and elemental analysis. The Cow Ridge Member is clay-rich, transitioning to a more organic-rich section that includes some carbonate in the illitic Garden Gulch Member. The transition from the Garden Gulch Member to the dolomitic-feldspathic Parachute Creek Member marks the appearance of common dawsonite in the basin center and authigenic analcime in the basin margins. The middle part of the Parachute Creek shows the end of dawsonite as a common mineral in the basin center and the regular appearance of buddingtonite throughout the basin. In the upper part of the Parachute Creek, buddingtonite essentially disappears at the B-groove marker, which contains illite, calcite, and Mg- carbonate, while the dominant Na-Al silicate phase in the Mahogany zone is analcime. Organic matter was also readily detected in the cores due to the high concentration of aliphatic moieties in Green River oil shales, demonstrating the utility of hyperspectral imaging for examining organic richness in petroleum systems.