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Carbonate Cementation in a Sequence-Stratigraphic Framework: Upper Cretaceous Sandstones, Book Cliffs, Utah-Colorado

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Abstract

Three macroscopic diagenetic features can be recognized in the sandstones of the Upper Cretaceous Desert Member of the Blackhawk Formation and Castlegate Sandstone of the Mesaverde Group exposed in the Book Cliffs, Utah, each of which have distinctive form, geometry, and stratigraphic distribution. Diagenetic alterations are: (1) leached zones ("whitecaps"), up to 10 m thick, beneath coal beds; (2) large (up to 8 m) concretionary carbonate-cemented bodies in amalgamated shoreface and thin fluvial sandstones; and (3) thin (up to 2 m), laterally extensive carbonate-cemented horizons beneath major marine flooding surfaces. Each feature has distinct petrographic and geochemical signatures, and formed through discrete diagenetic processes. Large isolated carbonate-cemented bodies are composed of ferroan dolomite, most of which precipitated during early diagenesis. Field and petrographic data, coupled with stable-isotope data (early cements, $\delta^{13}C$ = -2.5 to +3.4‰ VPDB; $\delta^{18}O$ = -7.8 to -12.0‰ VPDB; $^{87}Sr/^{86}Sr$ = 0.7078; later cements, $\delta^{13}C$ = -3.1 to -5.7‰ VPDB; $\delta^{18}O$ = -12.0 to -15.1‰ VPDB; $^{87}Sr/^{86}Sr$ = 0.7093) suggest precipitation from meteoric fluids, input into sediments during times of relative sea-level fall. The source of carbonate for the dolomite cement was dissolution of detrital dolomite from beneath coals by organic acids and subsequent mobilization by meteoric fluids. Carbonate precipitation in laterally extensive cement horizons appears to have started as a result of hiatus in sediment accumulation during marine flooding events (relative sea-level rise). Cement precipitation in these horizons continued through sediment burial as a result of organic-matter oxidation reactions in overlying organic-rich mudstones. The results of this study show a link between sedimentation (related to changes in relative sea level) and diagenesis, leading to the potential for the development of process-based, predictive models of early diagenesis in depositional successions.

GeoRef Subject
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