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Carbonate Cementation in Contrasting Foreland Basin Marine Sequences: A Quantitative Outcrop Study

Dolomite-cemented bodies are volumetrically significant features in shoreface sandstones of the Upper Cretaceous Blackhawk Formation, Book Cliffs, Utah. Previous research has shown a clear stratigraphic control on the cement distribution. Here we present quantitative spatial and geochemical data for two contrasting shoreface sequences, one with sequence boundary development (Desert Member) and one lacking sequence boundaries (Spring Canyon Member). In the Desert Member, dolomite cemented-bodies, up to 8m thick and 50m long, occur in shoreface sandstones for distances over 25km downdip of sequence boundaries. In the Spring Canyon Member, more localised, smaller dolomite cemented-bodies up to 3m thick and 10m in length, are present in shoreface sandstones up to 5km downdip of parasequence-capping coals.

Petrographic and isotopic analyses of the dolomite cements indicate early diagenetic precipitation from meteoric porewaters. It is proposed that groundwater leaching of detrital dolomite beneath organic-rich coastal plains deposits, and subsequent marine mixing, led to precipitation of dolomite cement in shoreface sandstones in both members. The marked difference in cement distribution between the two sequences are attributed to the nature of meteoric fluid migration during sequence development. Sequence boundary development led to extensive basinward meteoric-marine mixing, whereas parasequence progradation alone led to simple basinward facies migration and localised meteoric-marine mixing. This study highlights that the degree and extent of early fluid diagenesis can be significantly controlled by the nature of sequence development, having clear implications for developing predictive models for porosity-permeability evolution in sandstone reservoirs.