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Sandstone diagenesis as a proxy indicator of pore fluid geochemistry: implications for fossilization of vertebrate skeletal material in the Hell Creek Formation (Upper Cretaceous), Eastern Montana

Enclosing sandstone matrix is often invoked as an entombing medium facilitating preservation of vertebrate skeletal material by isolation from contact with pore fluids. We employed optical petrography, x-ray diffractometry, and scanning electron microscopy analysis of a fossil-bearing sandstone in the Hell Creek Formation to document pore fluid geochemistry during diagenesis. Presence of fine-grained massive muddy sandstone (Sm), abundant coal stringers, and overlying and underlying floodplain mudrocks indicate a crevasse-splay origin. The channel sandstone shows evidence of secondary porosity development through acidic pore fluid migration including feldspar grain skeletonization and complete dissolution, suspended exploded-grain fabrics in biotite indicating dissolution of early calcite cement. The bone-bearing sandstone contains skeletonized and altered feldspar grains also indicating migration of acidic pore-fluids. Enclosed bones show minimal evidence of alteration; they are surrounded by a concretionary zone of calcite and iron oxide cement characterized by isopachous calcite-rims on detrital grains indicating meteoric phreatic calcite precipitation. Presence of well-preserved bone in sandstone extensively altered by acidic fluids suggests that early precipitation of surrounding concretion growth enhanced bone preservation, chemically buffering it from the later corrosive effects of acidic pore waters. This indicates that early concretionary entombment is an important factor in vertebrate skeletal preservation in sandstones.