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Reconciling depositional and sequence stratigraphic models in the Upper Cretaceous Austin Chalk of the Texas Gulf Coast and the Niobrara Formation of the Western Interior Seaway

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The Upper Cretaceous Austin Chalk in south and central Texas is the same age and has similar pelagic carbonate composition and thickness as the Niobrara Formation in the Western Interior Seaway, but the two formations have very different depositional and sequence stratigraphic models. Sequence stratigraphic interpretation is easier in the Texas Gulf Coast than in the Western Interior Seaway. The Austin Chalk is mainly pelagic carbonate, with a dip direction consistently toward the Gulf of Mexico. The Niobrara Formation has two directions of basinal dip and two types and sources of sediment: siliciclastic sediment, mainly from the west, and pelagic carbonate, from the east.
The Austin chalk was deposited as a carbonate ramp, with updip facies being thoroughly burrowed and downdip facies laminated and organic-rich. In contrast, the Niobrara stratigraphic model interprets the cleanest, most bioturbated chalk units as deposited in the deepest, most oxygenated water, and laminated and organic-rich marl units interpreted as regressive low-stand deposits. Thickness and facies variations in Niobrara sequences are attributed to structural movement, eustacy, and currents. The Austin Chalk was affected by similar controls, but the asymmetry and angular truncation of the stratigraphic sequences indicates that structural movement was more important than eustacy.
A possible model to reconcile the Austin chalk and Niobrara observations emphasizes the similarity between the Texas Gulf Coast and the eastern flank of the Western Interior Seaway. Thoroughly burrowed, shallower water facies are represented by the basal trangressive Fort Hays Member; younger oxygenated chalk on the east flank is mostly eroded. Deeper water basinal chalk and marl sediments were oxygen deficient, due to restriction across a southern sill. Periodic movement of the axis of the Western Interior Seaway caused Niobrara facies variations. The Niobrara carbonate ramp extended downdip into intermittently anoxic water when thrust loading caused the basin axis to shift westward and siliciclastic input to diminish. As western highlands were eroded, regression shifted the axis of the basin eastward. Distal marl-rich units of the middle and upper Niobrara Formation were moved by bottom currents past the basin axis up onto the east flank of the Seaway where they transgressed over the normal east flank chalk sedimentation.

Biography

Christine Griffith worked for Shell Oil as petroleum geologist and team leader in exploration and development projects onshore and offshore United States, Nigeria, and Brazil. After retirement, she received her Ph.D.in Geology from Texas A&M University with a dissertation on the regional sequence stratigraphy of the Upper Cretaceous Austin Chalk in south and central Texas. Christine's previous degrees were a BS in Geology from the University of Illinois, and a MS in Geology from the University of Wisconsin. She is a longtime member of the AAPG and House of Delegates, a member of the Houston and South Texas Geological Societies, the Rocky Mountain Association of Geologists, and a licensed professional geologist in Texas.