Depositional processes and architecture of the Upper Cretaceous Eagle Ford Formation: Insights from outcrops and cores

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Abstract

The Eagle Ford Formation, exploited in South Texas as an unconventional shale reservoir, crops out as the Boquillas Formation in Val Verde, Terrell and Brewster County, West Texas. Though commonly referred to as shale because of their fine grain size, these formations comprise cyclically interbedded pelagic organic-matter-rich, globigerinid argillaceous wackestones and organic-matter poor, planktonic skeletal grainstones. Volcanic ash beds commonly co-occur with the grainstones. The Eagle Ford/Boquillas was deposited on a drowned shelf during the Cenomanian – Turonian, in dysaerobic/anaerobic water conditions and comprises part of a second order stratigraphic sequence. This study focuses on the middle member of the Boquillas, interpreted to be the analogue of the best producing facies in subsurface. alternations of the two main lithologies, though interspersed with ash beds, gives to the Eagle Ford an apparent cyclicity. The key question is: can this cyclicity be used for correlations? Literature review shows two opposing hypotheses regarding the accumulation of the grain-stone beds: deposition above storm wave base by storms or below storm wave base by reworking by bottom cur-rents.

Globigerinid argillaceous wackestones consist of laminae of tests and fragments of planktonic foraminifera, inoceramids prisms, calcispheres, and rare radiolarians, in a calcareous mud matrix of coccospheres, coccoliths, organic matter, and clay minerals. These deposits display planar bedding, very low angle laminations, abundant reactivation surfaces, scouring and filling but lack bioturbation. Larger scale, undulating erosive surfaces are also present and generally extend over several to tens of meters cutting through firm or hard grounds. Planktonic skeletal grain-stone deposits are characterized by silt to sand size pelagic bioclastic material (planktonic foraminifera, calcispheres, peloids, some saccoccomid articles and possibly inoceramid fragments), very minor clay minerals. The geometry of the planktonic skeletal grainstone deposits is variable, with laterally continuous beds and laterally discontinuous isolated deposits on a same stratigraphic horizon. Both beds and lenses have sharp bases with rare evidences of erosion. Sedimentary features include: low angle cross stratification, trough cross stratification, sigmoidal foresets, low angle foresets, low-angle tangential bottom foresets, steep foresets, planar bedding, sub-horizontal lamination and reactivation surfaces. Large current ripples have been observed at the top of the beds. Some lenses display barchanoid morphology with steep foresets. Both the globigerinid wackestones and the planktonic skeletal grainstone beds and lenses were deposited below storm wave base under the influence of bottom currents. The abundance of the coarse planktonic skeletal material derived from higher trophic level predators is a function of the reproduction of primary producers which is driven by the input of iron from the volcanic ash beds.

Boquillas cyclicity is a function of alternating periods of low-er primary productivity with lower sediment accumulation rates (globigerinid wackestones), and shorter periods of high primary productivity and higher accumulation rates (planktonic skeletal grainstones). Organic matter

content is a function of the bioclastic sedimentary dilution. The discontinuous character of the planktonic skeletal grainstone beds and lenses makes wide scale correlation using these impossible.