FERRY LAKE, RODESSA, AND PUNTA GORDA ANHYDRITE BED CORRELATION, LOWER CRETACEOUS, OFFSHORE EASTERN GULF OF MEXICO

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ABSTRACT

The Lower Cretaceous Ferry Lake and Punta Gorda anhydrite has been used as marker beds throughout the Gulf of Mexico, and divided into 9 individual anhydrite beds traceable from southern Mississippi to southern Florida. The underlying Rodessa Formation has an equally well developed anhydrite section in the offshore Eastern Gulf of Mexico and is divided into 12 basin-wide anhydrite bed groupings. The anhydrites of Ferry Lake and Rodessa Formations are traceable to the anhydrites of the Punta Gorda and Lehigh Acres Formations of South Florida.

Anhydrite beds appear to thicken in the central part of the trend interfingering with carbonates of the Lower Cretaceous shelf edge reef. Carbonates and anhydrites may be deposited simultaneously with carbonate patchreefs developing on crests of paleo highs with evaporites precipitating out of a hyper-saline solution on the flanks. Areas where poor anhydrite bed development occurs may indicate areas of patch reefs and, therefore, the best potential for hydrocarbon reservoirs.

Individual anhydrite beds have been correlated and color-coded on photocopies of compensated neutron density logs to determine their geographic distribution. Prepared cross sections show some beds to be area wide while others are more restricted. Isopach maps show the configuration of the basin in which these beds were deposited with the basin's long isopach axis parallel to the reef trend. Anhydrite deposition occurred with evaporation of restricted highstand waters behind reefs that rimmed the shelf edge.

INTRODUCTION

The Ferry Lake, Rodessa, and Punta Gorda Formations are easily distinguishable lithostratigraphic units that can be traced in the subsurface from east Texas to south Florida. These formations consist of interbedded, dark grey micrite, brown-to-tan mudstone, oolitic packstone, miliolid mudstone, grey-to-tan-to-black shale, minor white quartz sandstone, and the characteristic milky-white-to-pink sucrosic anhydrite. Interbedded anhydrite and carbonate thicknesses range from 43 meters (141 feet) in Mississippi Sound to 238 meters (779 feet) in Tampa Basin and 250 meters (820 feet) in South Florida Basin (Fig. 1). Farther offshore, the anhydrite interfingers with dense back-reef limestones behind biohermal buildups along the Lower Cretaceous shelf-edge reef trend, and updip it interfingers with sand and shales (Forgotson, 1956; Lock et al, 1983). Equivalent strata outcrop in southwest Arkansas and southeast Oklahoma and are termed the DeQueen Formation (Lock et al, 1983).

The Ferry Lake, Rodessa, and Punta Gorda anhydrites are overlain by the Mooringsport and Sunniland Formations, and underlain by the James Limestone/Pine Island Shale and Lehigh Acres Formation (Brown Dolomite)/West Felda Shale (Applegate et al., 1981) (Fig. 2). Orbitolina texana is identified throughout the carbonate sections of the Ferry Lake, Rodessa, and Punta Gorda Formations, but its occurrence is sparse within the anhydrite interval (Douglass, 1960). The foraminifer Orbitolina texana lived in a subtropical-to-tropical back-reef zone; its presence indicates an Early Albian age with normal salinities (Loucks and Longman, 1982; Applin and Applin, 1965; Conklin and Moore, 1977; Perkins, 1974). The top of the Rodessa was placed at the second occurence of Orbitolina texana, or at the lowest Ferry Lake anhydrite bed (Minerals Management Service paleontological staff, oral communication).

METHODS

Electric logs were acquired for 96 wells penetrating anhydrite beds in southern Mississippi and Alabama, State waters of Mississippi, Alabama, and Florida, and adjacent Federal waters. Simultaneous compensated neutron formation density logs and mud logs were used to identify anhydrite beds, and individual anhydrite beds were color-coded on each log and compared to nearby wells for correlation purposes. Logs from offshore wells were correlated to wells drilled in southern onshore Mississippi, and to the type well used by Pittman in his onshore correlation of Ferry Lake anhydrite beds (Fig. 3) (Pittman, 1985). Pittman defined eleven Ferry Lake and three Rodessa anhydrite beds that were traceable from east Texas to south Mississippi. From south Mississippi the beds were easily carried to offshore wells, clarifying a stratigraphic problem where operators reported all anhydrite beds as Ferry Lake.

Confusion occurs where wells in Federal waters penetrate a section of 76 meters (250 feet) of anhydrite beds followed by 46 to 61 meters (150 to 200 feet) of carbonate beds and then a second 76 meter (250-foot) section of anhydrite, all labeled as Ferry Lake or upper and lower Ferry Lake. Only Pittman's Rodessa R3, R2, and R1 correlate to offshore Rodessa RO12, RO11, and RO10 (Fig. 3, 4 and 5). Rodessa anhydrites have a thickness of 6.5 meters (20 feet) over and south of the Wiggins Arch in south Mississippi. Farther south into Alabama State waters, the Florida Panhandle, and Federal waters, the Rodessa anhydrite isopach thickness increases to 25 meters (80 feet) and can be divided into 12 bed groupings (Fig. 5).

CORRELATION AND GEOGRAPHIC DISTRIBUTION

Anhydrite beds thin to the southwest as they approach the Lower Cretaceous shelf-edge reef trend and also thin toward the updip limits along basement to the northeast. The thickest anhydrite sections are found in the middle of this distribution with their long isopach axis parallel to the reef trend (Fig. 6).

Rodessa anhydrite beds are thickest in the Destin Basin, Florida Middle Ground, Tampa Basin, and South Florida Basin where they correlate to the lower portion of the Punta Gorda Formation and the Able Member of the Lehigh Acres Formation in South Florida Basin. Anhydrite beds are thickest south of the Florida Middle Ground where reef development was more extensive and provided a barrier to open marine conditions. North of the arch, clastic sources built a prograding shelf edge that, at times, caused breaks in the carbonate buildup and limited the restricting barrier reef trend (Corso, 1987; Petty et al., 1994).

South of the Florida Middle Ground Arch, reef development was more continuous, and the Sarasota Arch prevented most clastic sediment from reaching the South Florida Basin. In south Florida, the Punta Gorda Formation has bed thicknesses that become massive making individual bed correlation difficult. Individual beds can be identified in wells drilled over the Sarasota Arch and can be correlated to anhydrites of the Ferry Lake and Rodessa Formations to the northwest. Gross isopach anhydrite intervals are comparable in thickness in Tampa Basin and onshore South Florida Basin, but beds thin over the Sarasota Arch.

THICKNESS AND DISTRIBUTION OF INDIVIDUAL ANHYDRITE BEDS

Anhydrite deposition initially occurred in the lower Rodessa in the Destin and the Tampa Basins. These eight additional sporadic anhydrite beds are confined to the James Limestone and occur just above the Sligo (lower Aptian) index fossil Choffatella decipiens (AAPG, 1987).

Isopach intervals of interbedded anhydrite and carbonate have their greatest thickness in Destin Basin, Florida Middle Ground, Tampa Basin, and South Florida Basin. Thinning takes place over the Wiggins Arch, Viosca Knoll Area, and Sarasota Arch.

Rodessa-age anhydrite beds become more numerous in eastern Mobile Bay adding to Pittman's 3 beds to make a total 12 beds that can be traced to the Sarasota Arch. The best developed anhydrite beds are equivalent to R1 (R012), R2 (R011), R3 (R010), R04, R05, R07, and R09 which have their greatest thicknesses in the center of the trend (Fig. 6a,e,f,g,h).

Ferry Lake anhydrites include FL6, FL9, and FL10 with appreciable thickness, of which FL6 and FL9 are the most widespread (Fig. 6b,c,d). FL7 and FL8 are locally confined and not widespread and were the least extensive of Pittman's Ferry Lake beds. FL1, FL2, FL3, and FL4 are more extensive but tend to pinch out between Florida Middle Ground and Sarasota Arch, as well as in the updip areas of southern Alabama (Dorothy Raymond, Geological Survey of Alabama, personal communication). Stray beds occur that do not correlate to any other bed and are confined to only a few wells.

DEPOSITIONAL SUMMARY

Ferry Lake anhydrite was deposited in a broad stratopycnal lagoon behind the Lower Cretaceous shelf-edge reef trend (Kimball, 1988; Lock et al, 1983). Stratopycnal lagoons are density stratified with horizontal layers separating normal salinity waters and denser basinal brine (Logan, 1987). Saturated waters only stay within the basin if the density layer top is below that of the top of the barrier reef; otherwise the saturated waters would flow over the top of the barrier and out of the basin. The barrier reef had its maximum growth during 107.5 and 109.5 Sequence Boundary highstands, which separated platform waters from open marine (Yurewicz et al, 1993). Initially, Lower Cretaceous anhydrites were deposited as gypsum as indicated by palmate structures of the original gypsum crystals (Loucks and Longman, 1982; 1985).

Basinwide evaporites are characteristic of the highstand systems tract of an arid carbonate-evaporite-siliciclastic rimmed shelf (Handford et al, 1993). Evaporites deposited under such conditions occur between siliciclastics on the shoreline and a large barrier reef on the oceanside. Lowstand is represented by sands and shales on the shelf with evaporites confined to evaporation ponds which were not basinwide. Stray anhydrite beds that do not conform to any numbered bed correlation may represent such evaporation ponds. Transgressive systems tracts have carbonates as their dominate lithology on the shelf and are interbedded with evaporites.

No salt was identified in this study; however, the presence of salt has been noted in the literature: a small salt stringer in the South Florida Basin (Applin and Applin, 1965) and salt hopper pseudomorphs found in outcrop in southwestern Arkansas (Lock et al, 1983).

Interbedded with the anhydrite beds are carbonates that were deposited in normal-to-slightly hypersaline lagoonal waters (Kimball et al, 1989). Shales that were deposited as the result of storms or periods of increased rainfall that caused increased runoff are also interbedded with the anhydrite beds (Hamric, 1965).

Fields associated with anhydrites of Ferry Lake age are patch reefs located on structural highs. Carbonates were deposited on the crests of these structures and were surrounded by hypersaline waters. Anhydrites were deposited on the flanks of the highs (Sams, 1982; Kimball et al., 1989). Therefore, areas that have poorly developed anhydrite beds in log sections may indicate prospects where paleo highs and potential patch reefs exist similar to those in the Waveland Field (Baria, 1981).

CONCLUSIONS

Two anhydrite intervals containing 9 and 12 individual beds are correlative to the Ferry Lake and Rodessa Formations but have been described in the past as only Ferry Lake or as upper and lower Ferry Lake. The gross anhydrite intervals of both formations are also correlative to the Punta Gorda anhydrite and anhydrites of the Able Member of the Lehigh Acres Formation in the South Florida Basin.

The Rodessa Formation offshore may be defined as the top of the carbonate unit below the basal anhydrite bed of the Ferry Lake along with the second occurrence of Orbitulina texana. Twelve anhydrite beds within the Rodessa are comparable in thickness and other characteristics with those in the Ferry Lake.

Areas that exhibit poor development of anhydrite beds may be regions where patch reefs are likely. These patch reefs provide the environment where fields of this age are most productive. Anhydrite beds are poorly developed along the Lower Cretaceous shelf-edge reef trend in Viosca Knoll, Desoto Canyon,

and Vernon Basin Areas. Areas in the central trend and updip margin would be poor areas for patch reef development due to hostile environments. Anhydrites are massive and lose individual bed characteristics in south Florida because of favorable reef growth conditions.

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