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Understanding and Updating the Eagle Ford East-Eaglebine

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Summary

The Eagle Ford East-Eaglebine play is an emerging resource play located in East Texas. By definition, the Eaglebine play is given to the various formations deposited between the Lower Cretaceous Buda formation (base) and the prolific Upper Cretaceous Austin Chalk (top). From the outcrop, the Eagle Ford East-Eaglebine is a combination of the Eagle Ford and the Woodbine Groups and contains local formations such as the Eagle Ford Shale, Lewisville, Woodbine, Dexter, Sub-Clarksville, Pepper, and Maness shale. Most of these formations have produced oil and gas conventionally for decades and with horizontal drilling and multi-stage stimulations, operators are “redeveloping” these conventional plays and adding more focus on the unconventional nature of the hydrocarbon rich shale sections.

In East Texas, the Eaglebine section is exceptionally thick and the unique targets are available in a wide range of depths. Historically, the Woodbine conventional production came from isolated thicker high porosity, high permeability sand lenses deposited within the organic rich silt and shale sections. Interest in the Woodbine as a horizontal play started 2008 when operators targeted the mature Kurten Woodbine sand field. As the understanding of the play potential was understood companies have expanded their focus into the organic rich shale sections below the productive more conventional reservoirs. The results are producing very favorable, economic oil and gas production and have extended the extent and life of the plays.

The current Eaglebine play contains a combination of strata from the Eagle Ford and Woodbine groups, where total thickness can add up to over 1,000 feet. Lithology is variable across the area with a combination of thick and thin sand sections combined with interbedded and thick organic rich shale sections. The northeast trending Edwards and Sligo shelf edges define the general downdip limit of the play, but the updip limits have yet to be defined.
The focus of the Eaglebine unconventional shale is driven by the significant oil and gas shows recorded on mud-logs across the area. Electric log resistivity across the zone is lower due to illite and pyrite in the formation; however, this section has the typical “hot” shale characteristics of other successful shale plays. Analysis indicates that with the high TOC (4-12 percent) and the high silica content (+-40 percent) the lower sections of the Eaglebine could have higher concentrations of hydrocarbons in place.

Introduction

The Eagle Ford East is currently referred to as the Eaglebine; the Eaglebine is a portmanteau word created by combining the Eagle Ford formation with the Woodbine formations. This blended word is not a geologic formation name, but is used to simplify and define the complex geologic section between the Buda formation (base) and the Upper Cretaceous Austin Chalk (top). Over more than the last 100 years geologist have been naming and mapping the Upper Cretaceous formations across East Texas, presently there are several locally named formations within this stratigraphic section. As in South Texas, the Eagle Ford and Woodbine groups are represented by several locally named outcrops and subsurface formation names, all named and mapped during various earlier studies. To circumvent confusion, this report will only deal with the various current Eagle Ford and Woodbine Groups and related formation names used in the subsurface. Much of the ground work for the Cretaceous of Texas can be attributed to Robert T. Hill, known as the "Father of Texas Geology", first discovering Cretaceous geology and was the first to recognize the two fold subdivision of the Cretaceous System. The names that he introduced – the Comanche Series applied to the

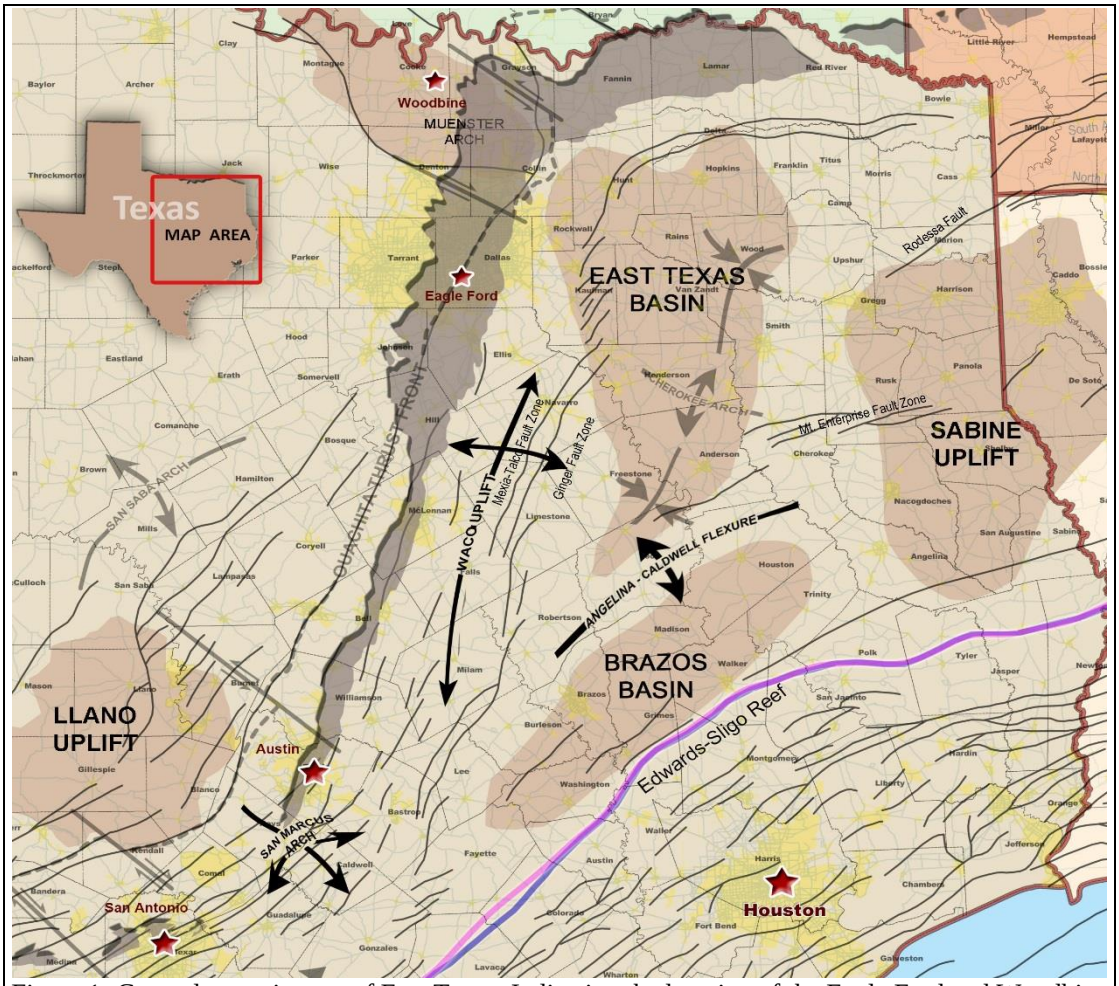

Figure 1- General tectonic map of East Texas. Indicating the location of the Eagle Ford and Woodbine outcrop along central Texas.

Formations

Lower Cretaceous, named after his adopted home town of Comanche, Texas, and the Gulf Series applied to the Upper Cretaceous – remain the standard for stratigraphic nomenclature in the Gulf Coast region. To understand the stratigraphy of the Eagle Ford East-Woodbine section, it is important to look at the bounding formations above and below, namely the Buda Limestone and the Austin Chalk.

Buda Formation, Upper Cretaceous (Cenomanian): The Buda Limestone is a geological formation in the High Plains and Trans-Pecos regions of West Texas. Timothy W. Vaughan (1900) first applied the term "Buda Limestone" to outcrops of a distinctive limestone along Shoal Creek in west-central Austin, Travis County, Texas. The name was derived from exposures of the limestone near the town of Buda, in eastern Hays County, Texas. The Buda-Woodbine contact is a submarine discontinuity in north Texas and marks the Comanche-Gulf series boundary. In the subsurface, this discontinuous boundary is a little more uncertain, in areas of the subsurface in areas of East Texas the discontinuous boundary appears to be at the top of the formation locally named as the False Buda. The False Buda appears be the discontinuous boundary and would mark the submarine discontinuity and would be the Comanche-Gulf series boundary.

Woodbine, Upper Cretaceous (Cenomanian): Until Hill (1901) proposed the term Woodbine, taken from the town of Woodbine in eastern Cooke County, the eastern timbered belt of the Cross Timbers (topographically lower than the western belt on the Trinity sands) had been mapped or described as the Lower Cross Timbers, Hill ("Broadside sheet," 1886) ; Timber Creek group, Hill (1887, p. 298), name preoccupied; Timber Creek beds, C. A. White (1887b), name

preoccupied ; “Dakota” of various authors (apparently not type Dakota) ; and as the Silo formation of Oklahoma by Taff (1902).

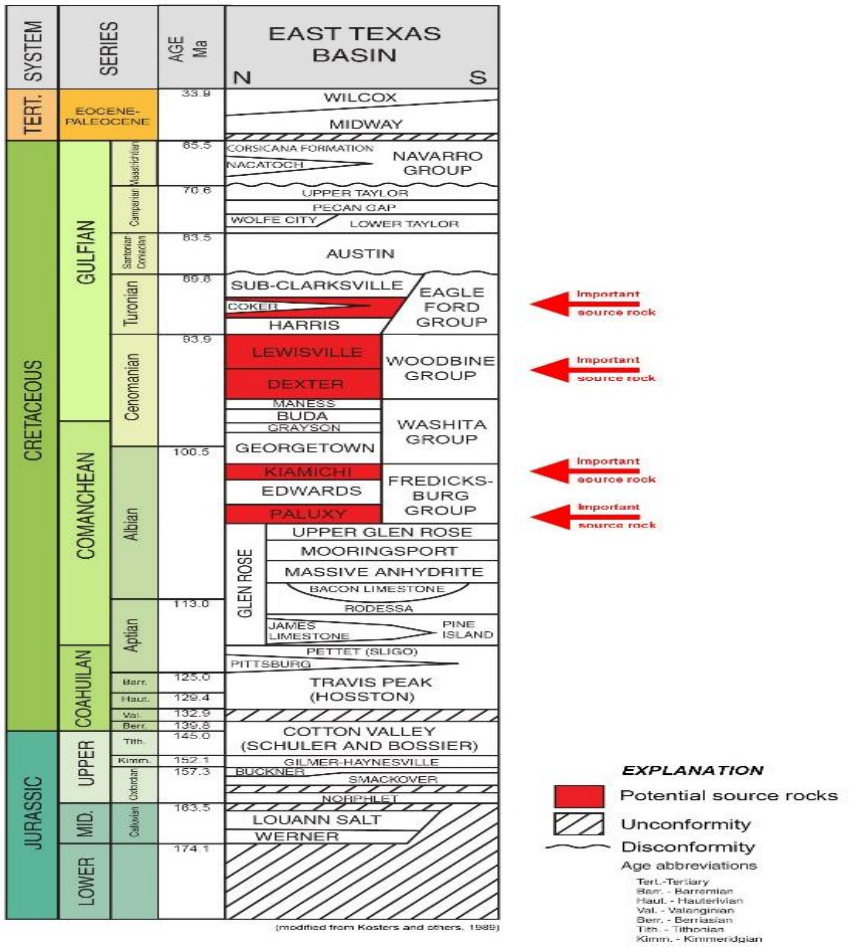

Figure 2- Stratigraphic Column for East Texas Basin.

Eagle Ford, Upper Cretaceous (Cenomanian-Turonian): It is named for the town of Eagle Ford, Texas where it can be seen on the surface as clay soil. Eagle Ford, Texas is approximately 6 miles west of Dallas, Texas. Regionally, in the western portion of the East Texas Basin along the outcrop in the San Antonio-Austin-Waco-Dallas area, the Eagle Ford Formation has been described as consisting of two major depositional units. The upper regressive unit shows interstratified (high-frequency cycles) shales, limestones, and carbonaceous quartzose siltstones. The lower transgressive unit consists of dark laminated shales showing almost no bioturbation, an indicator of an anoxic depositional environment. C. A. White’s usage of the term Eagle Ford in 1887 (p. 40) antedated that of R. T. Hill (1887, pp. 296, 298). The type locality is in Dallas County near the village of Eagle Ford. Prior to the above reference, the outcrop shale had been called the “Marly Clay or Red River Group,” “blue marl with Inoceramus problematicus,” and “Fish bed shale” by B. F. Shumard (1860) and Marcou (1862). Roemer, (1852) included the Eagle Ford as a portion of “formations at the foot of the highland” in the faulted New Braunfels region.

Austin Chalk, Upper Cretaceous (Coniacian): It is named after type section outcrops near Austin, Texas. The formation is made up of chalk and marl. The outcrop of the Austin Chalk or “White Rock” was named by R. T. Hill who in his preliminary work called the formation the Dallas-Austin chalk. Later when he fully described the formation as it occurs around the city of Austin, he gave it the single title, Austin Chalk. The formation consists of a thick series, about 500 feet, of alternating beds of chalk and shaly limestone and marls which have a blue color when saturated with underground water, but which are cream-colored or glaring white upon exposure to weathering. The chalk is a reservoir, producing petroleum from the matrix and from fractures in the rock. In addition, the lower part of the Austin Chalk contains 0.5 to 3.5% organic matter, with some localized zones containing 20% organic matter.

Stratigraphy

Along the outcrop in the western side of East Texas, the Eagle Ford is overlain by the Austin Formation and underlain by the Buda Formation, thickening as it moves northward away from the San Marcos Arch. As the Eagle Ford moves eastward across the East Texas Basin it thickens to as much as 700 ft in Hopkins County before thinning as it approaches the Sabine Uplift. In general the Eagle Ford is between 100 ft and 300 ft thick throughout East Texas. While the Eagle Ford becomes thinner it is gradually underlain, first by the Pepper Shale, which then grades further eastward into the siliclastic-rich Woodbine Formation. Underlying the Woodbine Formation the Pepper Shale also grades into a darker hydrocarbon-rich source rock zone named the Maness Shale. The Buda Formation underlies the Maness Shale. To further complicate the regional picture, in the Dallas area the Eagle Ford becomes sand-rich, locally changing into an oil-producing reservoir rock called the Sub-Clarksville Sandstone.

To simplify, rocks of the Eagle Ford Group are of upper Cretaceous Gulfian Series (Fig. 2). The age of Eagle Ford rocks ranges from middle-late Cenomanian to late Turonian. Throughout most of the East Texas Basin the Eagle Ford and Woodbine are often undifferentiated and rest unconformably on the Buda Limestone. The Austin Chalk overlies the Eagle Ford throughout the basin and the contact between the two is generally unconformable along the updip margins of the basin.

The Eagle Ford East-Eaglebine Play Types

The Eagle Ford East-Eaglebine is still an emerging play East Texas that is located almost equidistant between Dallas and Houston. The Eagle Ford East-Eaglebine play is a continuation of the Eagle Ford trend. However, operators are drilling into two different formations across the play: the Upper Cretaceous sand silt play (also known as the "Woodbine" and includes the Eagle Ford) and the lower section above the Buda, called Maness by some operators, that is the laminated shale play, referred to as the Eagle Ford by the Texas Railroad Commision. There is known historical production from this area and like the Eagle Ford, companies are revisiting the area using new drilling and completion techniques to test the prospectivity. Given scattered industry activity to date, they are yet to identify a "core" area within the basin. The main concern to date about the Eagle Ford East-Eaglebine is the higher clay content, which could lead to higher well decline rates if the formation fractures close more quickly (post hydraulic fractured completions) however, the increase in silica content throughout the section may enhance the productivity and brittleness of the section. There are four primary areas where operators have drilled so far: 1) Madisonville Field located in western Madison, eastern Brazos counties, 2) Halliday Field in southern Leon and north central Madison counties, 3) eastern Madison, western Houston counties and 4) Aquila Vado Field which is the Texas Railroad commission designation for the "Eagle Ford" being the lower laminated shale play. Generally speaking, the basin

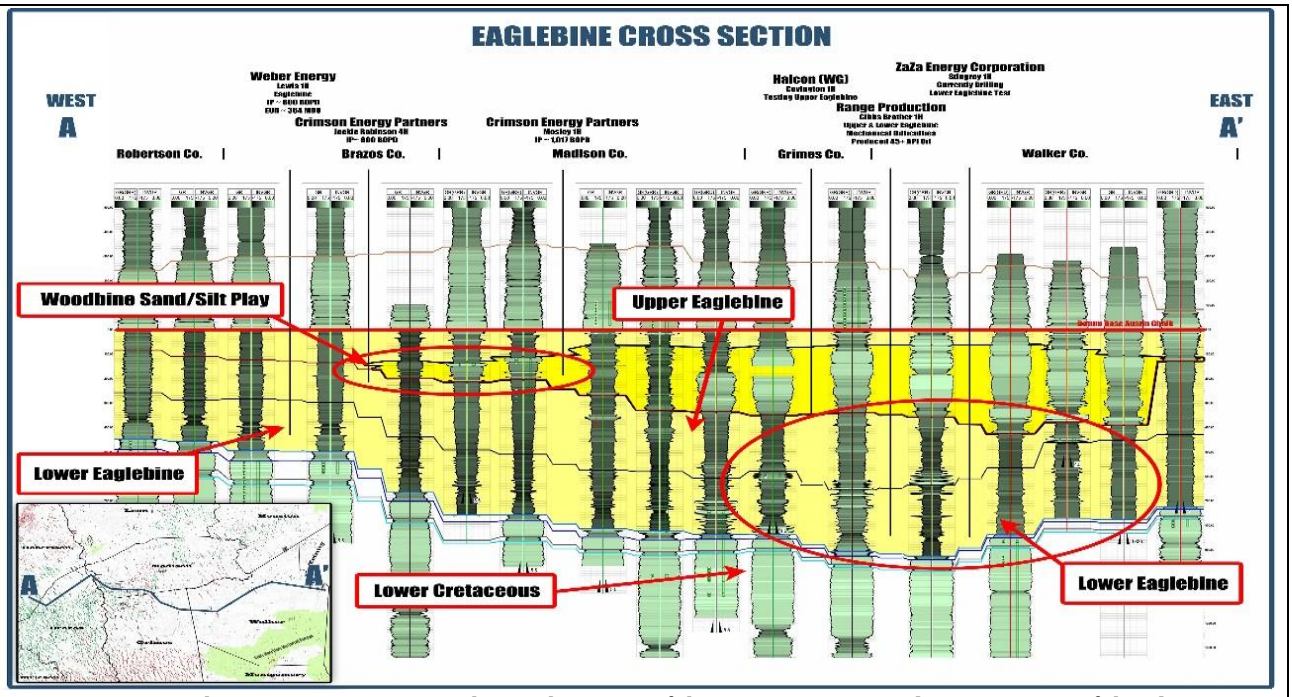

Figure 3- Stratigraphic cross Section across the southern part of the East Texas Basin depicting some of the play types.

becomes thicker from the southwest (Madisonville field) to the east in western Houston county, with thickness from the base of the Austin Chalk to the Buda in excess of 800 feet.

Technology

The Woodbine formation has produced conventionally for decades, through vertical wells. In recent years, operators have revisited the play with horizontal drilling and hydraulic fracturing technology now used extensively across the United States. Service companies have been introducing technology which will help operators improve drilling performance in shorter amounts of time. In an emerging horizontal play such as the Woodbine sand silt play, these improvements greatly improved completions and have increased the initial production rates. While early wells still essentially serve as science projects, with operators testing various drilling and completion techniques, learnings from other tight oil plays such as the Bakken and Eagle Ford these plays are quickly moving from the exploration to development phase.

With horizontal drilling first targeting the Woodbine in 2006, early wells typically had shorter laterals than are currently being employed. Wells now incorporate laterals ranging in length from 4,500 – 7,500 feet, and between 18 and 36 hydraulic fracturing stages. Maximum lateral lengths are not necessarily driven by well design optimization, but rather they could be restricted by drilling irregular unit boundaries. Typically, operators drilling to deeper sections of the Woodbine are employing shorter laterals, with the greater reservoir energy aiding flow rates. Initial wells employed Packers Plus openhole completion technology. However, operators have now moved towards plug-and-perf completions. Zipper fracturing will probably be tested by operators, and multi-well pad drilling is likely to be employed both to improve drilling efficiency and reduce the surface footprint.

Various companies have produced from the Woodbine through conventional, vertical wells for decades. The success of horizontal drilling and modern completion techniques in other tight oil plays has renewed interest in the Woodbine. In terms of production, the play is dominated by small, often private operators. However, more recognizable players are now moving in and acquiring, or at least announcing, positions. It remains to be seen if the extent of the Woodbine as a horizontal liquids play is large enough to attract larger companies looking for opportunities to make impactful asset acquisitions.

Now operators are focusing on the deeper laminated shale portion of the play. With the majority of the development taking place in Brazos and Burleson Counties. Initial wells drilled just above the Buda formation in the Maness section appear to be out preforming the typical Woodbine sand-silt play. The combination of having the greater thickness of the section, is allowing for future development by stacking laterals across the section. The Texas Railroad Commission has allowed for the stacked laterals in the recent new field rules designated for Aquila Vado Field.

The Eagle Ford East-Eaglebine Play Types

Madisonville Field
The most activity and success has been in the Madisonville field where there have been some very prolific Woodbine horizontal wells in a concentrated area along the border of Brazos and Madison counties. Most of these successful wells were drilled by a single company, Petromax (private) who sold the acreage position to Woodbine Holdings (a private startup) in May 2011. Wells in this area of the Eaglebine averaged ~1,000 Bopd for a month or longer in some cases and produce liquids-rich gas as well. The Woodbine sands targeted in this area are in fields of well-sorted offshore bar sandstones, delivered by the Cretaceous Harris river delta that flowed into Houston/Trinity/Walker counties and transported to the west by a combination of long shore currents (for easterly fields) and storm events (for more westerly fields). The trapping mechanisms are a combination of stratigraphic and diagenetic traps. Fields prospective for horizontal Woodbine development are discrete and limited in areal extent, but where prospective, rock properties look good with porosity of 10+% and perm in the low millidarcies. Historical drilling in these fields was generally limited to vertical wells completed in single localized thicker sand sections interbedded within and sourced the organic shales. Current methodology is to drill horizontal wells in the less defined silty sand sections below the older completion sections and apply conventional hydraulic stimulationed completions resulting the higher rates and ultimate recoveries. There may be potential for the development of a more continuous zone that underlies these sandstones and that is the primary regional source (the Woodbine or Maness shale), but lithology (high clay content) and porosity can be problematic.

Halliday Field
Following on the successes in the Madisonville field, operators have moved east and north to the Halliday field where there was some known historical production. Specifically Petromax and Chesapeake Energy have tested horizontal wells into the Woodbine formation in northern Madison and southern Leon counties (updip in the oil window), but have had less success than in the Madisonville field (middip in the volatile window). This play continues to slowly develop, with the initial wells preforming below expected initial and extended rates.

Houston/Walker County (Eastern Portion of Play)
The last active area within the Eaglebine play is on the eastern portion of Madison county and western edge of Houston County. The view is that both the Upper and Lower Cretaceous formations are thickest here. Given the thickness of the formation, the view is to potentially develop the play using vertical wells that have multiple completions into different zones, similar to how a lot of Permian Basin oil fields are developed. Currently, this area has been slow to move from initial tests into development. Initial tests have gathered vary favorable hydrocarbon test, but rates have been less than expected. The current concern is with the total thickness of the section, in excess of 800', it may be too much shale section for viable completion strategies. New approaches may be necessary to allow development of the portion of the trend.

Aquila Vado Field
The Aguila Vado (Eagleford) Field was discovered in December 2009 at approximately 6,971' subsurface depth. Special field rules were first adopted in 2010. There are two operators and six completed oil wells in the field but only two are on the current proration schedule. The field has produced 41 MBO and 2.9 MMCF of casing head gas. The gross thickness of the Eagleford Shale in this field is 790 feet. The interval is thick enough to support "stacked" horizontal drilling. The Railroad Commission of Texas has amended the rule that as proposed will allow stacked lateral drainholes to be simultaneously drilled from multiple surface locations. The stacked lateral rules also require that each point of a stacked lateral horizontal drainhole be no more than 300 feet in a horizontal direction from any point along any other horizontal drainhole of the same stacked lateral well. Other Eagleford fields have thinner Eagleford Shale intervals. The Briscoe Ranch field has an interval that is 375 feet thick, and the DeWitt, Hawkville, Sugarkane, and the Eagleville field intervals are between 212 feet to 286 feet thick. (RRC Texas)

Conclusions

Although the East Texas Eagle Ford – Eaglebine play continues to see development and although the formations are not easily defined with regularity, the play is showing continued economic improvement. The boundaries of the play have not been well established, with older areas being re-developed with new completion technologies and the southern portions of the play in the gas window. The northern portion of the play has yet to be extensively explored using the same technologies that are being applied in the central portion of the play. The stratigraphy of the play will be greatly enhanced with the new micro-stratigraphy work and addition exploration sampling that is currently being completed across the East Texas Basin. As the understanding of the play potential was understood companies have expanded their focus into the organic rich shale sections below the productive more conventional reservoirs. The results are producing very favorable, economic oil and gas production and have extended the extent and life of the plays and brought additional attention to the East Texas Basin.

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References

Adams, R.L. and. Carr J.P, 2010, Regional Depositional Systems of the Woodbine. Eagle Ford and Tuscaloosa of the U.S. Gulf Coast, GCAGS, Transactions, V. 60, pp. 3-27.

Adkins, W. S. and Lozo, F. E. Stratigraphy of the Woodbine and Eagle Ford, Waco Area, Texas, Special publication Fondern Science Series, pp. 105-161.

Ambrose, W.A., Hentz, T.F., Bonnaffe, F., Loucks, R.G., Brown, L.F. Jr., Wang, F.P., and Potter, E. C. 2009, Sequence-Stratigraphic Controls on Complex Reservoir Architecture of Highstand Fluvial-Dominated Deltaic and Low- stand Valley-fill Deposits in the Upper Cretaceous (Cenomanian) Woodbine Group, East Texas Field: Regional and Local Perspectives, AAPG Bulletin V. 93, N. 2 (February 2009), pp. 231-269.

Bennett, G.E.; Main, D.; Anderson, B.K.; Peterson, R. 2011, Microvertebrate paleoecology of the Cretaceous Woodbine Formation (Cenomanian) at the Arlington Archosaur site, north-central Texas. Geological Society of America, March, 43(2), p. 89.

Blakely, R. Paleogeography and Geologic Evolution of North America, Northern Arizona University, jan.ucc.nau.edu/-rcb7/nam.

Bowman T.D. 201 1, Hydrocarbon Potential of Upper Cretaceous Shale Sections, Including the Eagle Ford, Woodbine and Maness Shale, Central Texas, AAPG, Search and Discovery Article, N.90124.

Calavan, W. C., 1985, Depositional environments and basinal setting of the Cretaceous Woodbine sandstone, northeast Texas: Baylor University, M.S. thesis, p. 214.

Charvat W.A. and R.C. Grayson Jr. 1981, Anoxic Sedimentation in the Eagle Ford Group (Upper Cretaceous) of Central Texas, GCAGS Transactions, V. 31, pp. 2257.

Dawson, W.C. 2000, Shale Microfacies: Eagle Ford Group (Cenomanian--Turonian) North-central Texas Outcrops and Subsurface Equivalents, GCAGS, Transactions, V. 50, pp. 607-B21.

Dawson, W.C. and W.R. Almon 2010, Eagle Ford Shale Variability: Sedimentological Influences on Source and Reservoir Character in an Unconventional Resource Unit, GCAGS, Transactions, V. 60, pp. 181-190.

Dean W.E. and M.A. Arthur. 1998, Cretaceous Western Interior Seaway Drilling Project: An overview, SEPM Concepts in Sedimentology and Paleontology, N. 6.

Dokur, M., and Hentz, T.F., 2012. Reservoir Characterization of the Upper Cretaceous Woodbine Group in Northeast Texas Field, Texas. AAPG Search and Discovery Article #20152.

Donovan, A.D. and T.S. Staerker. 2010, Sequence Stratigraphy of the Eagle Ford (Boquillas) Formation in the Subsurface of South Texas and Outcrops of West Texas, GCAGS, Transactions, V. 60, pp. 861-899.

Driskill, B., Suurmeyer, N., Rilling-Hall, S., Govert, A., Garbowics, A. 2012, Reservoir Description of the Subsurface Eagle Ford Formation, Maverick Basin Area, South Texas, USA. SPE 154528.

Dubiel, R. F., Pitman, J. K., Pearson, O. N., Pearson, K., Kinney, S. A., Lewan, M.D., Burke, L., Biewick, L. R. H., Charpentier, R. R., Cook, T. A., Klett, T.R., Pollastro, R. M., and Schenk, C. J. 2012, Assessment of Undiscovered Oil and Gas Resources in Conventional and Continuous Petroleum Systems in the Upper Cretaceous Eagle Ford Group, U.S. Gulf Coast Region, 2011. U.S. Geological Survey Fact Sheet 2012- 3003. U.S. Geological Survey, p. 2.

Duey, R. 2011, Independent Looks East for the Eagle Ford. E&P. December, V. 84, Issue 12, pp.1 0, 12.

Durham, Louise. 2012, Austin Chalk Getting Another Look. AAPG Explorer, July, V. 33, N. 7, pp. 32, 36.

Ewing, T.E. 2011, Southwest Texas Heavy Oil Province - A Review. South Texas Geological Society Bulletin, February, V. 50, N. 4, pp. 17-34.

Ewing, T.E. 2011, Southwest Texas Heavy Oil Province - A Review, AAPG Search and Discovery Article, N. 80133.

Flores, C.P.; Holditch, S.A. Ayers, W.B. 2011, Economics and Technology Drive Development of Unconventional Oil and Gas Reservoirs: Lessons Learned in the United States. SPE 146765.

Grabowski, G. J. Jr., 1984, Generation and Migration of Hydrocarbons in Upper Cretaceous Austin Chalk, South-Central Texas, AAPG Spec. Pub. Type: Studies in Geology

Halbouty, M. T., and Halbouty, J. J., 1982, Relationships between East Texas field region and Sabine uplift in Texas: AAPG Bulletin, v. 66, no. 8, pp. 1042-1054.

Harbor, R.L. 2011, Facies Characterization and Stratigraphic Architecture of Organic-Rich Mudrocks, Upper Cretaceous Eagle Ford Formation, South Texas, University of Texas, Masters Thesis, pp. v-183.

Hentz, T. F. 2010, Sequence Stratigraphy Depositional Facies and Reservoir Attributes of the Upper Cretaceous Woodbine Group East Texas Field. Bureau of Economic Geology Report of Investigations, No. 274, p. 114.

Hentz, T.F. and S.C. Ruppel. 2010, Regional Lithostratigraphy of the Eagle Ford Shale: Maverick Basin to East Texas Basin, B of EG, GCAGS, Transactions, V. 60, pp. 325-337.

Hentz, F.T. and S.C. Rupple. 2011, Regional Stratigraphic Rock Characteristics of Eagle Ford Shale in Its Play Area: Maverick Basin to East Texas Basin, AAPG, Search and Discovery Article, N. 10325.
Lee, Yuong–Nam 1997. "The Archosauria from the Woodbine Formation (Cenomanian) in Texas". Journal of Paleontology 71 (6): pp.1147–1156

Hill, R. T., 1887a, The topography and geology of the Cross Timbers and surrounding regions in northern Texas. Amer. Jour. Sci. (3), vol. 33, pp. 291-303, map.

Hill, R.T., 1887b, The Texas section of the American Cretaceous. Amer. Jour. Sci. (3), vol. 34, pp. 287-309.

Hill, R. T., 1889, A preliminary annotated check list of the Cretaceous invertebrate fossils of Texas, accompanied by a short description of the lithology and stratigraphy of the system. Texas Geol. Surv., Bull. 4, xxxi, 57 pp.

Hill, R. T., 1891, The Comanche series of the Texas-Arkansas region (with discussion by C. A. White and others). Geol. Soc. America Bull., vol. 2, pp. 503-528.

Hill, R. T., 1894, Geology of parts of Texas, Indian Territory and Arkansas adjacent to Red River. Geol. Soc. America Bull., vol. 5, pp. 297-338, il., map.

Hill, R. T., 1901, Geography and geology of the Black and Grand prairies, Texas. U. S. Geol. Surv., 21st Ann. Rpt., pt. 7, 666 pp., il., maps.

Hill, R. T., 192, Further contributions to the knowledge of the Cretaceous of Texas and northern Mexico [abstract]. Geol. Soc. America Bull., vol. 34, pp. 72-73.

Liro, L.M., Dawson, W.C., Katz, B.J., Robison, V.D. 1994, Sequence Stratigraphy Elements and Geochemical Variability within a "Condensed Section": Eagle Ford Group, East-central Texas, GCAGS, Transactions, V. 44, pp. 393-402.

Marcou, J., 1862. Notes on the Cretaceous and Carboniferous rocks of Texas. Boston Soc. Hist., Proc., vol. 8, pp. 86-97.

Myers, T. S. 2010, Earliest Occurrence of the Pteranodontidae (Archosauria: Pterosauria) in North America: New Material from the Austin Group of Texas. Journal of Paleontology, November 2010, Vol. 84, No. 6, pp. 1071-1081.
Oliver, W.B. 1971. Depositional Systems in the Woodbine Formation (Upper Cretaceous), Northeast Texas, B of EG, Report of Investigations N. 73, pp. 1-27.

Peschier, L. and Lock, B. Ph.D. 2010. The Boquillas (Eagle Ford) Formation of South Texas: Potential Outcrop Analogs for Nonconventional Eagle Ford Shale Reservoirs in the Subsurface. SIPES.
Petzet, A. 2011. Louisiana, Mississippi Marine Shale m Play Grows. Oil & Gas Journal, August 1, V.31. N. 8, pp. 58-60.

Reaser, D.F. 1961, Balcones Fault System: Its Northeast Extent, AAPG Bulletin V. 45, pp. 1. 759-1, 762.

Roemer, F., 1849. Texas: [with particular reference to German immigration and the physical appearance of the country], xiv, 464 pp., map, Bonn, Adolph Marcus. Translation by Oswald Mueller, printed by Standard Printing Co., San Antonio, Texas, 1935.

Roemer, F., 1852. Die Kreidebildungen von Texas und ihre organischen Einschlusse, 100 pp., il., Bonn, Adolph Marcus.

Salvador, A., and Muneton, J. M. Q. 1991, Stratigraphic correlation chart; Gulf of Mexico Basin, in Salvador, A., ed., The Gulf of Mexico Basin: Geological Society of America, The Geology of North America, v. J, plate 5, 1 sheet.

Shumard, B. F., 1859. First report of progress of the geological and agricultural survey of Texas. 17 pp., Austin.

Shumard, B. F.,1860a. Observations upon the Cretaceous strata of Texas. St. Louis Acad. Sci., Trans., vol. 1, pp. 582-590.

Shumard, B. F., 1860b. Descriptions of new Cretaceous fossils from Texas. St. Louis Acad. Sci., Trans., vol. 1, pp. 590-610.

Shumard, B. F., 1861. Descriptions of new Cretaceous fossils from Texas. Boston Soc. Nat. Hist., Proc., vol. 8, pp. 188-205.

Siemers, C.T. 1978. Submarine Fan Deposition of the Woodbine-Eagle Ford Interval (Upper Cretaceous), Tyler County. Texas, GCAGA, V. 28. pp. 493-511.

Vaughan, T. W. 1900. Description of the Uvalde quadrangle. U. S. Geol. Surv., Geol. Atlas, Folio No. 64, 7 pp., maps.

White, C. A., 1980, Descriptions of new Cretaceous invertebrate fossils from Kansas and Texas. U.S. Nat. Mus., Proc., vol. 2, pp. 292-298, il.

White, C. A., 1887a, On new generic forms of Cretaceous Mollusca and their relation to other forms. Phila. Acad. Nat. Sci., Proc. 1887, pp. 32-37, il.

White, C. A., 1887, On the Cretaceous formations of Texas and their relation to those of portions of North America. Phila. Acad. Nat. Sci., Proc. 1887, pp.