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Preliminary Assessment of Louisiana's Uranium Potential

Eocene to Miocene strata of the Gulf coastal plain in Louisiana may locally host roll-type uranium deposits at shallow depths similar to those already being developed in Texas. Shows detected by gamma-ray logs taken while drilling for lignite in Wilcox and Claiborne Groups are equivocal, but could foreshadow uranium in younger units downdip. The overall uranium potential of Louisiana may be less than that of Texas because Louisiana is farther from the silicic volcanic centers of west Texas and Mexico which supplied the ash from which uranium was leached; however, published literature suggests that Louisiana may have comparable amounts of ash in the Tertiary section. Louisiana's more humid climate may have lessened uranium potential by increasing the amount of uranium lost to surface runoff.

The main potential is in Oligocene and Miocene units. The Jackson Group has less potential because of a general facies change from favorable strand-plain and deltaic host sandstones of Texas to shelf mudstone in Louisiana. The eastern part of the Miocene outcrop belt should have greatest potential because of the presence of underlying hydrocarbon trends which are apparently essential to keep the near-surface section strongly reduced and to concentrate uranium at shallow depths. The lack of significant surface gamma anomalies does not preclude the existence of uranium deposits in the shallow subsurface; most Texas deposits not exposed at the surface had no associated local gamma anomalies before mining began.

Uranium in solution can behave unpredictably in the complex Gulf Coast stratigraphic setting. Given tens of millions of years and multiple cycles of erosion and groundwater recharge, some ore-grade deposits of substantial size could have developed in any Tertiary sandstone that was once in hydrologic communication with the surface and an ash-laden source unit. Eocene strata updip of the Jackson outcrop, regardless of its low expected potential, could host uranium accumulations in local channel-sandstone remnants. Considering the complexities of channeling, additional reduction of previously formed oxidation cells, and disequilibrium, together with the sparsity of gamma-ray log control points available for the Louisiana units known to be prospective in Texas, the presence of uranium deposits in Louisiana must be considered as a possibility.

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Exploration Analysis of Jurassic Apalachicola Embayment of Florida

A petrophysical evaluation was made of the Apalachicola embayment Jurassic rocks from all available wells, using ores, cuttings, and electric logs. From this information, I propose that the embayment was formed by basement faulting, which resulted in a grabenlike structure. Two basins were formed on either side and within the embayment, together with a structurally high area at the entrance of the bay. These structures strongly influenced the patterns of water circulation and sediment deposition throughout the Jurassic. The Louann Salt was laid down throughout the embayment but was later eroded, with some of the Eagle Mills Formation, by the Norphlet fluvial sands. These Norphlet sands were deposited in a very arid climate by braided streams and then moved into eolian dunes. The initial marine transgression of the Smackover eroded the top of most of these sand deposits and laid down, in place, a fine-grained dense carbonate throughout the embayment in a tidal-flat environment. During the late Smackover marine regression, additional sediment was deposited, which was subsequently subaerially exposed to freshwater percolation, resulting in dolomitization. Lower Haynesville Buckner anhydrite was laid over the Smackover limestone, but much of the anhydrite was eroded by the continental sediments of the Haynesville. The Haynesville sediments show that there were marine fluctuations into the embayment throughout this time. The Cotton Valley sandstones were deposited throughout the area including the embayment. As hydrocarbon potential exists in the Norphlet and Smackover, a petrologic examination was concentrated on these formations. The fluvial Norphlet sands are conglomeratic, fine grained with interbedded red shales in the updip position, but were white to red, fine grained, and quartzitic in the center and at the mouth of the embayment. The Smackover limestones and dolomites are shallow, tidal-flat marine deposits and are composed of algal-coated grains, fecal pellets, Foraminifera, echinoid spines, and mollusk shells. Porosity and permeability reduction is due to large calcite crystal growth and closely packed dolomite rhombs in the pore spaces and pore throats. From a model application of a modern analog of a carbonate tidal flat, the most favorable reservoir rock would be expected in intertidal channels and sediment buildups at the embayment mouth.

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Depositional Environment of Jurassic Smackover Sandstones, Thomasville Field, Rankin County, Mississippi

Smackover sandstones in Thomasville field represent turbidite channel deposits. These sandstones are interbedded with a few thin beds of oolitic grainstones. A total of 969 ft (296 m) of core from three wells was examined, of which 820 ft (252 m) were sandstone. Depths ranged from 20,100 to 20,649 ft (6,131 to 6,298 m). Electric logs and cores from the three wells show abrupt facies changes, which may be expected from a shifting channel deposition. Correlations were made between the wells and environments of deposition determined from an examination of core composition, texture, and sedimentary structures.

Thick, massive bedsets and massive to laminated bedsets (A and AB units, respectively) are common in all cores, although massive (A) units dominate. Quartz grain sizes decrease upward in most bedsets. Sandstones have a mean grain size of 0.23 mm (fine grained). Carbonates exhibit similar textural trends and sedimentary structures.

Porosity and permeability average 5.1% and 0.32 md for sandstone, and 1.2% and 0.01 md for carbonates. A black, opaque residue, ubiquitous in the cores, represents residue of a former oil pool. Resistivity plotted against bulk density shows distinct groups for each rock type. A plot of resistivity versus porosity suggests a gas-water contact farther down the section at a depth of about 20,500 ft (6,253 m). Based on this study, the gas column is on the order of 300 ft (92 m) for about 50% water saturation.

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Facies Analysis of Cretaceous Hensel Formation—Response of a Fluvial System to Marine Transgression

The Lower Cretaceous Hensel Formation in central and north-central Texas consists of predominantly terrestrial

deposits. Study of Hensel outcrops in Kimble, Gillespie, and Blanco Counties, south of the Llano uplift, reveals a facies evolution that is associated with a major marine transgression. This evolution is expressed in both a north-south facies tract and in the overall stratigraphic succession. Four major depositional systems are recognized. (1) Basal, valley-fill deposits are limited to localities proximal to the source area. (2) Low-sinuosity, bedload channel-facies overlie the valley fill and are widely distributed. (3) Low-sinuosity channel-facies evolved into more distal, somewhat finer grained, coastal-plain fluvial systems. (4) Both the fluvial and coastal-plain facies are characterized by extensive flood-basin muds and small, ephemeral arroyos. The pervasive development of calcrete, or caliche, within the overbank deposits, and the overall depositional style of the unit imply a semiarid, seasonal climate. As the marine transgression progressed, the sediment supply decreased and channel gradients lowered. Deposition of the shallow marine or lagoonal carbonates that overlie the Hensel resulted from the final inundation of the source area.

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Depositional Environments of Norphlet Formation (Jurassic) of Southwestern Alabama

The Norphlet Formation in southwestern Alabama has become a primary target for oil and gas exploration. Isopach data show that Norphlet deposition was affected by a subsiding Mississippi Interior Salt basin, early movement of the Louann Salt, and stable Appalachian ridges and paleohighs, such as the Conecuh ridge and the Wiggins arch. The formation is over 1,000 ft (350 m) thick in parts of Washington, Clarke, Baldwin, and Mobile Counties. The Norphlet thins or is absent over areas of penecontemporaneous salt movement and is absent over the stable Wiggins arch.

The Denkman Member of the Norphlet is underlain by a red-bed sequence that grades updip into a conglomerate. The Denkman consists of clean, fine-grained, well-sorted sandstone, including a lower cross-stratified unit and an upper massive unit. The red-bed sequence is mostly sandstone with shale, shaly sandstone, and siltstone at the base. The shales, present in Escambia and Choctaw Counties, were probably deposited as distal portions of alluvial fans. Wadi gravels were deposited adjacent to the Appalachian highlands and grade downdip into the red-bed sequence. Both the gravels and red beds were deposited by sediment-choked braided streams and subjected to reworking and deflation, producing the Denkman Member. The Denkman consists of eolian sands, reworked at the top by the Smackover transgression into a massive sand up to 70 ft (21 m) thick. Thin, massive and horizontally laminated units in the cross-stratified sand indicate that narrow interdunes separated the broad dune sands of the Norphlet. A generalized sequence of diagenetic events affecting porosity may have been compaction, quartz overgrowth, and carbonate cementation, and possible selective dissolution of cements followed by deep cementation.

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Geology and Log Study of Tight Gas Sandstones—Cotton Valley Group

Through a cooperative research program among Schlumberger-Doll Research (Ridgefield, Connecticut), Schlumberger Well Services (Shreveport, Louisiana, and Houston, Texas), and Delta Drilling Co. (Tyler, Texas), a whole core and a conventional (DIT*/BHC, GR/CNL*/FDC*, HDT/FIL*)[1] and experimental-prototype (Digital Sonic, CNT-G, EPT*, GST-A*, NGT*, NML*) suite of logs were examined from the lower and middle Cotton Valley sands (Upper Jurassic) of a 10,200-ft (3,100 m) well (Alice Snider 1). The well is located in the Carthage tight gas sand field, located in Panola County, about 60 mi east of Tyler, Texas. Particular attention was directed to one of the two gas-producing zones (9,354 to 9,638 ft, 2,851 to 2,938 m); a deeper gas-producing zone (9,700 to 10,027 ft, 2,957 to 3,056 m) was not cored.

A synthesis of the rock core and log data leads to the following conclusions.

1. The formation is dominantly a well-laminated and horizontally bedded unit with low-angle, planar cross-bedding, shallow-water ripple marks, and convoluted bedding. Bioturbation and diagenesis have dramatically altered these features in some parts of the core.

2. The lithology is an alternating sequence of lithic sandstones (sublitharenites) and silty shales. Minor amounts of conglomerates, coal laminae, and fossil-bearing zones are also noted.

3. The tight gas sands have low porosities (<10%) and low permeabilities (<0.1 md). Intergranular porosity (2%) is reduced by authigenic quartz and/or calcite overgrowths and/or pore-lining, filling, and bridging clay minerals—illite, chlorite, and illite-chlorite mixed layers. Relatively abundant intergranular and secondary (4%) porosity is also noted.

4. The depositional environment of the gas-producing zone is interpreted as an alternating and transgressive sequence of shallow marine water dominated by barrier bars. Interbedded with the bioturbated shoreface sediments are minor tidal-deltaic sands deposited near the northeast-southwest-trending edge of a sedimentary basin.

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"Big Look"—Future Trend of Exploration

New ideas, new techniques, and new methods of exploration must be employed in concert with the conventional methods of the past to meet the ever-increasing demands for energy and strategic minerals. The synoptic view, or "Big Look," provided by satellite imagery and augmented by high-altitude aircraft data affords the explorationist new prospectives resulting in more comprehensive interpretations on a regional basis, and assists in establishing geologic trends.

Integration of all available geologic and geophysical information with that derived from Landsat imagery and other remotely sensed data provides a method of identifying potential petroleum and mineral prospects on a regional basis. Using this consolidated information, specific areas of interest may be identified for evaluation in greater detail through additional investigation. For petroleum prospects, this may involve the designing of a detailed geophysical program. For mineral prospects, this could include a more sophisticated remote-sensing program, conventional airborne and/or ground geophysical surveys, and detailed geologic mapping.

These techniques have been applied to frontier areas as an inexpensive preliminary source to localize prospects. Prospects have also been identified by these techniques in older, mature, producing areas.

In order to integrate accurately and cost effectively the

[1]Asterisk is mark of Schlumberger.