the 19th century and even earlier, exploration geophysics first became important about 1922-23 with the mapping of salt domes in the United States and Mexico by torsion balance and seismic refraction methods. This paper will recount highlights of the history and will attempt to explain why events occurred when and as they did, and will speculate on what may be expected in the future.

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Comparison of Solution-Mineral Equilibria with Single-Element and Statistical Methods in Hydrogeochemical Exploration for Uranium

Hydrogeochemical data, generated by the Department of Energy’s National Uranium Resource Evaluation program, for the Millett 1° x 2° NTMS Quadrangle in Nevada can be used to identify geologic environments which might contain uranium deposits.

Saturation indices (SI) were calculated for uraninite, pitchblende, coffinite, autunite, tyuyamunite, and caravanite using a modified version of the WATEQF computer program. Uranium mineral SI’s correlated well with the logarithm of total U concentration in ground water. Ground waters from the Austin Mining District possess the highest autunite SI values, although undersaturation is indicated. A spring in the Toquima Range (Tertiary rhyolites) is supersaturated with respect to uraninite and coffinite, and has the highest (but slightly undersaturated) SI value for pitchblende.

Samples within the Austin Mining District are anomalous with respect to U, As, Cu, Mo, and U/conductivity. The Toquima Range sample is anomalous in U, Mo, As, Cd, Fe, and U/conductivity. In a factor analysis of the Millett data, water temperature (T_w), U, Eh, Si, and V load on factor 3. High factor 3 scores are found in, but are not restricted to, the Austin Mining District and the Toquima Range. Multiple regression analysis of the data resulted in the equation: U_{calc} = f(T_w, Cl, Ca, Mg). High residuals (U_{obs} - U_{calc}) are located in the Austin Mining District and in the Toquima Range.

Calculated SI’s reinforce, but are apparently not a substitute for, the standard statistical interpretation of reconnaissance ground water data, and may indicate the type of uranium mineralization present.

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Sedimentary Processes in Restricted Gulf Coast Estuarine System: Corpus Christi Bay, Texas

Corpus Christi Bay is a shallow (< 5 m), restricted estuary that is typical of estuaries on the Texas Gulf Coast. The distribution pattern of bay-floor sediments indicates that the bay’s interior is a depocenter for mud derived from multiple sources; the bay’s marginal areas are composed mainly of residual sandy deposits derived from shoreline erosion of a Pleistocene substrate (Beaumont Formation) and a modern baymouth barrier (Mustang Island).

Synoptic time-sequence measurements of the bay’s suspended sediment and hydrographic characteristics were taken by helicopter at 15 monitoring stations; the measurements represent 8 surveys conducted during a 2-year observation period. The measurements show a high degree of spatiotemporal variability and indicate a wind-dominated sediment-dispersal system. During all surveys, the bay was consistently turbid (mean baywide transmissivity <15%/m); the mean baywide concentration of suspended sediment during individual surveys ranged from 11 mg/l to 52 mg/l. The suspended-sediment concentrations were primarily controlled by wind speed which determines the extent of wave-induced resuspension of bay-floor deposits; wind direction and tidal phase controlled the sediment-dispersal patterns.

Texturally, the baywide mean grain size of suspended sediments during individual surveys ranged from very fine silt to clay (7.63 to 8.22μ), and mean silt/clay ratios were within the 0.68 to 1.38 range; the sediment was consistently poorly sorted. In contrast to suspended-sediment concentrations, which largely appear to be a short term response to recent wind conditions, sediment textures appear to be a longer term response to earlier wind conditions, thus suggesting that finer grained particulate matter has substantial residence time within the shallow water column.

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Delta-Front Shelf Storm Deposits of Subsurface Woodbine-Eagle Ford Interval (Upper Cretaceous), Damascus Field, Northern Polk County, Texas: Success from Combined Development Geology and Sedimentologic Core Analysis

Gas production from several, 6 to 23 ft (2 to 7 m), single to multistory sandstone bodies of the Woodbine-Eagle Ford interval, 160 to 200 ft (49 to 61 m) thick at 9,000 to 9,600 ft (2,743 to 2,926 m) in the Damascus field has been developed since discovery in 1976. Subsequent offset drilling resulted in a few gas wells and several dry holes. In February 1979 the entire Woodbine-Eagle Ford interval was cored in the No. 7A Dorrance well. Sedimentologic core study generated a predictive depositional model which has guided field development of the subtle stratigraphic traps at a 5 to 1 well success ratio. Present gas reserves are 40 Bcf with 440,000 bbl of condensate.

The productive area is located slightly southwest of the Sabine uplift and just updip from the Lower Cretaceous continental shelf edge. Seismic sections and foraminiferal paleoecology establish a middle-shelf depositional setting. Bioturbated, silty, shelf shales comprise the upper and lower Woodbine-Eagle Ford interval. The middle is a complex of (1) graded, medium to very fine-grained, massive to laminated sandstone beds; (2) contorted, soft-sediment-deformed intervals; (3) swirled and sheared siltstone beds; and (4) thin diamict conglomerate beds. Genetic units indicate periodic rapid deposition by debris flows and low to high-concentration density currents. The several distinct productive sandstone bodies (porosities 9 to 14%; permeabilities 2 to 10 md) are northward-thickening, dip-oriented lobes.

The localized deposition in the shelf setting was controlled by delta development slightly to the north. Periodic major storms generated delta flooding which contributed high-energy reservoir-quality deposits to the shelf. Similar shelf sand buildups should occur throughout the area; however, recognition must rely on detailed sedimentologic study of core sequences.

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Cherts in Wishart Formation (Aphelian) of Labrador: Example of Rapid Shallow-Water Silica Sedimentation

The Wishart Formation of the Labrador trough (early Pro-
terozoic) is a high-energy, terrigenous shelf deposit. Chert is a minor but widespread component of the Wishart and occurs in three main forms: (1) interstitial cements consisting of a mosaic of fine quartz crystals; (2) thin layers and lenses of very fine-grained chert lutite with finely disseminated impurities; and (3) peloids to flat pebbles of fine-grained chert lutite. The clasts of chert lutite are clearly intraformational; they are closely associated with and texturally identical to the in-situ chert layers. Chert cements are also found in intraclasts. All of the chert types are restricted to a few thin intervals which form good marker beds, and none show any signs of replacement. These observations indicate the cherts are primary siliceous deposits. Based on their textures and the sedimentary structures in which they are found, the cements must have formed as rigid precipitates; the lutites as mud-like, slack-water accumulations; and the pebbles to pebbles as rip-up clasts. The silica was probably hydrothermal in origin because the stratigraphic distribution of the chert is independent of facies and there is no evidence of basin restriction or evaporative conditions. The Fleming Formation, which lies directly beneath the Wishart, may have been the source of the postulated silica-rich hydrothermal waters. The Fleming consists mostly of brecciated and silified rocks and an abundance of crystalline, void-filling quartz. The Wishart cements offer proof that siliceous sediments and cements can accumulate rapidly in terrigenous marine environments. They provide an example of one mechanism for making the similar chert pebbles which are abundant in early Proterozoic ironformations.

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Comparative Anatomy of Cratonic Unconformities

Cratonic unconformities represent (1) coincidence of surfaces of sedimentary accumulation with depositional base level, or elevation of depositional surfaces above erosional base level and (2) renewed deposition covering surfaces of nondeposition or erosion. The chronostratigraphic record of unconformities is best displayed on Wheeler diagrams on which geographic distances are plotted against chronostratigraphic intervals or absolute time. Assessment of the lithostratigraphic significance of unconformities requires reconstruction of the pre-unconformity stratigraphy and estimation of the thickness (or volume) of the strata eroded and of their lithologic character.

Interregional unconformities fall into two major types: (1) those marked by subequal values of nondeposition and erosion, commonly involving 5 to 30 Ma and the stripping of as much as 1 km over very broad areas; the sub-Kaskaskia unconformity (Early Devonian to Early Carboniferous) is an example; and (2) unconformities characterized by short-term nondeposition (< 5 Ma) and extremes of erosional valley; e.g., the sub-Abarsaroka surface (Late Carboniferous).

Conventional wisdom would suggest that episodes of cratonic nondeposition and erosion should equate with accelerated detrital deposition at continental margins and with perturbations of marine chemistry. Evidence is accumulating to indicate a degree of concomitance between cratonic events and oceanic geochemistry but no complementary pattern is clear in terms of slope/rise depositional rates. Indeed, certain major unconformities identified on continental slopes appear to have equivalents on cratons. These and related questions demand increased communication between land-based and seagoing stratigraphic and tectonic specialists.

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Geochemical Correlation of Sedimentary Rocks

A geochemical method has been developed that can provide effective regional or local correlations in sedimentary sections. This method depends on careful selection and processing of well samples followed by quantitative spectrochemical analysis for both major and trace elements; it has been used successfully in numerous field studies involving sand/shale and carbonate sections of nearly every geologic age from Cambrian to Holocene.

The method relies primarily on compositional variables in the clay component of sediments because these have the best long-range continuity in a basin. Ratios of related elements such as V/Cr and Cu/Ni are useful because they minimize the effects of lateral changes in lithology or environment. Ratios that reflect primarily basinal changes in water composition are particularly useful, although environmental or provenance influences can be used as well. Abrupt changes in element ratios commonly record the locations of unconformities that are useful in correlation, whether or not they represent a major hiatus.

This geochemical method has proved to be especially well suited to defining correlation points within late Paleozoic strata of Devonian to Leonardian age in west Texas. Spectrochemical analyses of shale drill cuttings from wells covering much of the Delaware and Juno–Val Verde basins defined regional geochemical units. They extend throughout the Delaware basin, into the Juno–Val Verde basin to the southeast, and onto the Carlsbad shelf to the northwest. Individual correlation points were identified over distances of up to 300 mi (483 km). Data from later seismic surveys support the stratigraphic concepts developed from the geochemical correlations.

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Sedimentology of Tuscaloosa Sandstones from False River and Judge Digby Fields, Pointe Coupee and West Baton Rouge Parishes, Louisiana

Significant gas reserves at depths ranging from 19,800 to 20,400 ft (6,035 to 6,218 m) have been established in Tuscaloosa sandstones at False River and Judge Digby fields (Chevron U.S.A. Inc. discoveries) located within the deep Tuscaloosa gas trend. The sandstones are within an Upper Cretaceous clastic wedge that thickens in front of, and to the south of, a Lower Cretaceous carbonate shelf.

Reservoirs at Judge Digby field are part of a thick clastic section comprised of gray shales and medium to coarse-grained sandstones, in part conglomeratic. Paleontology, textural grading, bed contacts, and sequential arrangement of sedimentary structures suggest fluvial and deltaic environments. Reservoirs at False River field are stratigraphically younger and are interpreted as part of a barrier bar sequence. These sandstones are fine to medium-grained and occur at the top of upward-coarsening gradational sequences. In both fields, the reservoirs commonly have maximum porosities above 25% and permeabilities in excess of 100 md. Although these reservoirs are presently geopressed, petrographic evidence and density of the assemblages in carbonate cements indicate that the sandstones are not undercompacted. A study of the sandstone framework suggests that burial diagenesis dramatically reduced the primary pore system, eliminating significant permeability. Leaching of the grain framework created an important contribution to effective secondary porosity and reestablished lost permeability. The secondary pores are easily identified by relic rims of authigenic, grain-coating chlorite cement which persisted after selective grain removal by dissolution. Commercial