Site Characterization and Application of Horizontal Wells for Ground Water Remediation at The Dow Chemical Company, Louisiana Division in Plaquemine, Louisiana

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The Dow Chemical Company, Louisiana Division (Dow) manufacturing complex was constructed in Plaquemine, Louisiana in the late 1950s. Through past waste management practices and product spills, chlorinated organics and chloride contamination have entered the shallow ground water underlying several areas of the facility. Upon detection of impact, Dow implemented groundwater recovery and treatment in four areas of the facility and began a voluntary site-wide subsurface assessment.

The site-wide assessment has provided characterization of subsurface conditions at the facility as well as areal distribution and depth of groundwater contamination. A comprehensive database was prepared which incorporated the analyses of soil and ground water samples, geotechnical and electric logs, cone penetrometer test data, and electromagnetic survey data. This data base served as the basis for the development of a detailed 3-D relational model showing stratigraphy, lithology, and contaminant concentrations from which site ground water remediation strategies can be evaluated, prioritized, and implemented.

Data obtained during the site assessment along with an unsuccessful, full scale in-situ bioremediation project conducted at the site, and extensive reviews of potentially applicable remedial technologies determined the technology to be used in remediation of the site. Since treatment facilities were already a functional part of the operating facility, only the method of contaminant removal was in question. Due to low hydraulic conductivities and thin pervious zones in which the contaminants were found, directional drilling for the construction of horizontal wells provided the most advantageous mechanism for ground water recovery and hydraulic containment of the contaminated ground water.

3-D Basin Analysis Reveals Early Gulf of Mexico Origin

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A proper display of the earth's curvature as proposed by Dallmus (1958) reveals that the rifted Gulf of Mexico basin was created over a mantle plume that evidenced several major uplifting cycles. The salt of the first two episodes was deposited within a central crestal graben and around the adjacent tilted fault blocks. New oceanic crust was emplaced during its final thermal culmination, which is late Middle Jurassic (Callovian) in age. This heating and dilational fracturing sequence created an ideal set of conditions for maturing and preserving hydrocarbons. As a result, the Gulf of Mexico Basin is one of the world's most productive areas with much oil and gas remaining to be discovered.

Data used in this analysis was modified from Salvador (1991). The earth's curvature has been enlarged on cross section illustrations (e.g. cross section B-B' in Fig. 1) to match the 10-fold vertical exaggeration on Salvador's (1991) Figure 3.

Figure 1 displays a salt and crust distribution resulting from three stages of dilational thermal rifting. The first stage occurs in the region of thick transitional crust; the second in the area of thin transitional crust, and the third in the area of new oceanic crust.

Figure 2 shows the areal distribution of the four Gulf of Mexico crustal types in a quasi-concentric band around the center of the Gulf of Mexico. As seen in Figure 1, the stages are represented by thick transitional crust, thin transitional crust, and new oceanic crust. Evidence for fault blocks tilted away from the thermal dome of the earliest stage is illustrated by several arches and/or domes (Tamaulipas arch, San Marcos arch, Sabine uplift, Wiggins uplift, middle ground arch, and the Sarasota arch in Salvador's Figure 2, Fault blocks tilted away from the second stage dome are delineated within basement closures of 10 and 14 kilometers north of the new oceanic crust, at three kilometers to the south on the Yucatan block and at one kilometer on the Quintana Roo arch (refer to Sawyer, et al., 1991, Figure 1).

Salt was deposited during two stages of thermal uplift. The older salt occurs in the East Texas, North Louisiana, Mississippi, De Soto Canyon and West Florida areas (Figure 3). It is absent from the Sabine and Wiggins uplift. Younger salt was deposited in the Rio Grande, Houston, South Louisiana shelf and Mexican salt province. Salts of both ages were deposited within what was then the collapsed crestal graben of the thermal dome, which is the present site of the thickest salt deposits of Perdido and the Texas-Louisiana slope.

The final uplift created vertically intruded new oceanic crust. By this time, normal oceanic waters from the Atlantic ocean had entered the basin, ending the hypersaline conditions. Thus there was no salt deposited in the third stage.

Beneath the Gulf the distribution of continental crust, thick transitional crust, thin transitional crust, and new oceanic crust defines the approximate position and southward motion of the Gulf of Mexico thermal dome. Its symmetry indicates that it was created over a mantle plume. It is possible that its precursor thermal event formed the rifted Permian basin of West Texas and New Mexico. Our poster session analysis uses the Permian Basin as the "type dilational rift basin", and displays its structural evolution. Other areas which can be viewed in 3-D (ie, with earth curvature) are the Gulf of Suez, the North Sea, East Africa, the Anadarko Basin, and the Paradox Basin.

References

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