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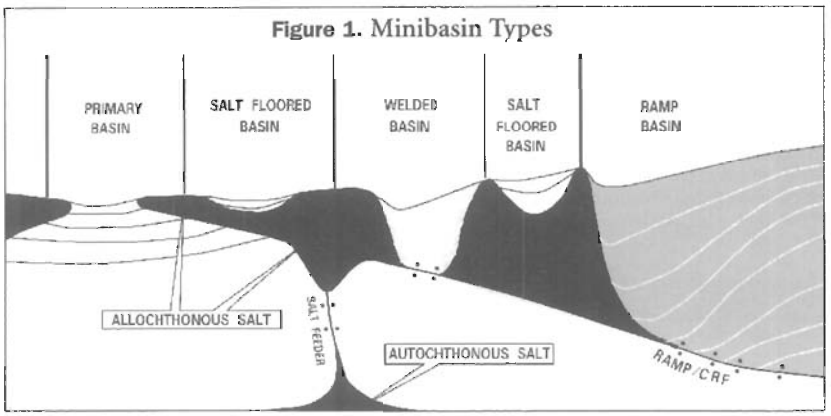
Methodology for Minibasin Ranking in the Deepwater Gulf of Mexico

Deepwater northern Gulf of Mexico is characterized by extensive allochthonous salt sheets with isolated minibasins. Assessing the exploration potential of these minibasins requires integration of all the petroleum systems elements. An analysis of minibasins in the Garden Banks, Green Canyon, Keathley Canyon and Walker Ridge protraction areas shows the relationship of stratal and structural architecture to the interaction of sedimentation and salt movement. Minibasins are broadly classified using stratal and allochthonous salt geometries into five basin types: (1) Ramp, (2) Welded, (3) Welded Listric, (4) Primary, and (5) Salt-floored (Fig. 1). Basins that lack data for classification into the five types are carried as unclassified. The five basin types vary in their efficiency to collect and trap petroleum, ramp basins being the most effective and salt-floored the least.

Figure 1. Minibasin Types



Ramp basins predominate on the slope in Garden Banks and Green Canyon. They are characterized by a south-bounding, north-dipping salt ramp. Most ramp basins have young thick depocenters adjacent to the counter regional ramp. Ramp basins tend to be asymmetric and larger in areal extent. Welded basins were previously underlain by allochthonous salt that has been fully or partially evacuated. They increase in frequency southward into the Walker Ridge and Keathley Canyon protraction areas. Welded listric (Roho) basins have south-dipping arcuate faults that sole into the evacuating salt. Welded basins have a multitude of patterns of internal faulting and sediment fill, some are symmetrical with bowl-shaped fill, others have multiple depositional axes and bi-directional stratal fill. Primary basins show no evidence of allochthonous salt and display continuous sedimentary fill from Cretaceous to Recent. Salt-floored basins are underlain by continuous allochthonous salt that shields them from the underlying petroleum kitchens. Salt-floored basins occur along the down-dip edge of allochthonous salt near the Sigsbee escarpment and above very young salt sheets in Garden Banks and Green Canyon.

As basin fill changes through geologic time, each of the basins has differing capability to receive and internally distribute the petroleum it receives via a complex plumbing system from sources at greater depths below the basin. Regional classification of the basin types combined with mapping the sequence stratigraphy framework within the basins provides a spatial and time framework for evaluating risk more effectively. In general, petroleum entry points to basin strata are controlled through time by salt movement and geometry.

Using this basin ranking method, ramp basins have attractive plumbing and enhanced trapping focus. Welded and welded listric basins are dependent on the evacuation of the salt floor for charging to occur; therefore the age and areal extent of ⇒

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the weld are factors. Primary basins appear to have access to underlying sources, but they may lack effective migration pathways and trapping geometries. Salt-floored basins are the lowest ranked basins because of separation from source. Within the four protraction areas, most discoveries have been in ramp and welded minibasins (about 1 BBOE in each basin type). Primary, salt floored, and unclassified basins have minor discoveries, with none of significant size.

Acknowledgments

This paper was presented at the September 1998 AAPG Hedberg Research Conference, Integration of Geologic Models for Understanding Risk in the Gulf of Mexico. It is a synopsis of part of the work resulting from an alliance between Mobil deep water business unit and Phillips Petroleum's North American exploration group. The alliance regional study group was charged with developing a regional framework and risk scenarios in which to evaluate prospects in the deepwater Gulf of Mexico. One of the methods was the delineation and classification of minibasins based on internal stratal geometry, salt withdrawal styles, accessibility to petroleum charge, and internal petroleum migration focus. The minibasin classification scenario presented incorporates prior published research on salt tectonics and depositional systems focused toward regional risk assessment.

Biographical Sketches

Al Koch is the petroleum system advisor for the Mobil Deep Water Business Unit in New Orleans. He has worked for the past six years in the deepwater Gulf of Mexico evaluating the regional elements of the petroleum system and developing means of risk assessment. His career with Mobil has spanned 28 years, working in both research and exploration in multiple basins worldwide, emphasizing the application of petroleum systems technology. He received a Ph.D. in geology from the University of Washington, Seattle in 1970.

Vinod Mathur is currently a senior geophysical advisor with Mobil E&P U.S. He is involved with regional analysis of the deepwater depositional systems and play concepts and is the coordinator of all regional deepwater Gulf of Mexico sequence stratigraphy projects. He holds an M.S. in geophysics from the Centre of Exploration Geophysics, Osmania University, and attended Technical University, West Berlin in graduate studies.

Rick Nagy is a senior exploration geologist in Phillips Petroleum Company Deepwater Exploration Team in Houston. He has 18 years of industry experience and joined Phillips in 1989 working in their regional studies group. Project areas include primarily the Gulf Coast, but prior experience ranged from offshore California to Alaska. He also worked in the Phillips subsalt exploration team prior to 1996. He has a degree in geology from San Diego State University and is a current member of AAPG (CPG #5364), HGS, and SPWLA.

Frank C. Snyder is currently the team leader of the Alaska exploration team, Phillips Petroleum Co., Houston. Prior to May of 1998, he was the principal geologist in charge of regional studies in the Deepwater Exploration Team. In this group, he was responsible for regional geological synthesis, play generation, and prospect evaluation in the deepwater, offshore Louisiana. Over the past 17 years he has worked a variety of geological basins in the North Sea, Norwegian Sea, Rocky Mountains, Australia, China, and Gulf of Mexico subsalt trend as an exploration and development geologist. He received his formal education at Louisiana State University, Baton Rouge, graduating with an M.S. in geology in 1981. □

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