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Gulf of Mexico Evolution: a Basin-Wide, Well and Seismic Refraction Supported Gravity and Magnetic Interpretation

Kinematic reconstructions of tectonic plates can be facilitated by a priori knowledge of basin shapes, relative ages and extents of key horizons and structures, and geophysical constraints such as gravity, magnetic and seismic data. Still a "global view" is necessary to ensure theorized kinematic solutions are compatible with neighboring regions. Over 100 seismic refraction profiles, and over 70 basement or near-basement well penetrations, were used as control and calibration for interpreting open-file magnetic anomaly profiles over the Gulf of Mexico basin and northern Gulf coastal plain. The shape of the Gulf of Mexico basin was interpreted by estimating basement depths from these profiles. The derived basement surface was imported into 12 mega-regional gravity and magnetic modeled cross sections. These formed a skeletal network that integrated gravity, seismic, well and magnetic data into regional slices through the basin that, in turn, were modified to support the basement interpretation. In some respects, results from basement analyses reveal no surprises. The central part of the basin deepens to the west from about 9 to over 15 km, and the basin probably formed by counter-clockwise rotation of the Yucatan Block over a 20 My period between approximately 160 and 140 Ma. However, two significant results related to basin formation are revealed by the basement interpretation. First, the existence of a NW-SE Bahama fracture zone through southern Florida is not supported. Second, a NW-SE trending free air gravity anomaly high that dominates the Keathley Canyon protraction area may be evidence of a late Jurassic mantle plume.