CHICXULUB IMPACT BASIN: GRAVITY CHARACTERISTICS AND IMPLICATIONS FOR BASIN MORPHOLOGY AND DEEP STRUCTURE; Virgil L. Shapton1, Kevin Burke2, Stuart A. Hall2, Scott Lee1, Luis E. Marin3, Gerardo Suarez3, Juan Manuel Quezada-Muñeton4, and Jaime Urrutia-Fucugauchi3, 1LPI, 3600 Bay Area Blvd., Houston TX 77058 (713-486-2111), 2Dept. of Geosciences, University of Houston, Houston TX 77004, Instituto de Geofísica, 3UNAM, Mexico City, Mexico 04510, 4Gerencia de Exploración, Petróleos Mexicanos, Marina Nacional 329, Mexico City, Mexico 11311.

The K-T-aged Chicxulub Impact Structure [1-4] is buried beneath the Tertiary carbonate rocks of the Northern Yucatán Platform (Figure 1). Consequently its morphology and structure are poorly understood. Reprocessed Bouguer (onshore) and Free Air (offshore) gravity data over Northern Yucatan (Figure 2) reveal that Chicxulub may be a 200-km-diameter multi-ring impact basin with at least three concentric basin rings.

Ring Spacing and Basin Size: The positions of these rings follow the $\sqrt{2}$ spacing rule derived empirically from analysis of multi-ring basins on other planets, indicating that these rings probably correspond to now-buried topographic basin rings [5]. A forward model (Figure 3) of the gravity data along a radial transect from the southwest margin of the structure (A-A'; Figure 1) indicates that the Chicxulub gravity signature is compatible with this interpretation. We estimate the basin rim diameter to be 204 ± 16 km and the central peak ring diameter (D) is 104 ± 6 km. This ring assignment places the highly magnetic zone of [1] within the central ring (central uplift), and the weakly magnetic zone inside the basin rim, suggesting that the magnetic source is related to deep rocks uplifted and melted in the center of the structure. Steep gravity gradients located 25-40 km inside the rim could mark the outward extent of relatively deep basin excavation and deformation. Segments of an intermediate ring (D = 150 ± 16 km) are evident in Figure 2 just inside the steep gradients.

Deep Structure: Figure 2 further reveals that the weak concentric expression in the northwest quadrant of the basin is not due to post-impact truncation along an E-W fault as previously proposed [2,6] but instead may be caused by the superposition of the crater signature onto an older linear gravity high extending ~N-S through the basin. Because this linear feature is not disrupted we believe its source resides deep within the crust, and may be affected by the impact only near the crater center. During the Jurassic, the Yucatán block moved rapidly away from the U.S Gulf Coast along an anticlockwise, southward path (e.g., [7-9]). Consequently this feature...
may have resulted from earlier crustal thinning or incipient rifting associated with the opening of the Gulf of Mexico, or it could be a feature inherited from the assemblage of Pangea.

Chicxulub Basement Age and KT Boundary Implications: The pre-rift position of Yucatán, against the Florida Escarpment and south of the Suwannee-Wiggins Suture Zone [8,9] indicates that the basement under Chicxulub is Pan-African Terrane (e.g., [9,10]), like the crystalline basement of the Florida Peninsula (i.e., 500 ± 150 Ma). The major linear features in gravity and magnetic data covering the Yucatán Platform, such as the Alacran High and the Valladolid Low (e.g., [11]) are concordant with features in Florida. Furthermore, samples of crystalline basement recovered from offshore NE Yucatán in DSDP Leg 77 Holes 537 and 538A have 40Ar-39Ar metamorphic ages of ~500 Ma [12]. Consequently, the 550 Ma U-Pb ages of zircons from the upper member of the KT boundary layer in the Western US [13] may implicate Chicxulub rather than Manson in the formation of this layer.

Figure 2: Perspective view of gravity data for region shown in Figure 1. Viewing and lighting are toward North. Gravity values range from -20 to +50 mGal.

Figure 3: Forward model of radial gravity profile (A-A') of Chicxulub Impact Basin. Numbers in parentheses show \( \Delta \rho \) used in modeling. Stratigraphy is consistent with drill core data.