New Gravity Data Over the Southwestern Portion of the Chicxulub Impact Feature, Yucatan Peninsula, Mexico.

Gary Kinsland, University of Southwestern Louisiana, Manuel Hurtado, Alejandro Ceron, Instituto Mexicano del Petroleo, Mexico, William Smythe, Adriana Ocampo, Jet Propulsion Laboratory, California Institute of Technology and Kevin Pope, Geo Eco Arc Research, La Canada California.

Gravity data have been instrumental in assessing the size of the Chicxulub impact crater in the Yucatan Peninsula, Mexico. Two opposing interpretations of the gravity data conclude that the crater has a diameter of either 170-180 km [1,2] or 280-300 km [3]. To help resolve this controversy we collected 258 Bouguer gravity values at locations on the west coast of the peninsula from Celestun to Campeche. These data define the gravity field in an area where previous investigators have had to interpolate the field. Figure 1 compares our shoreline profile and one taken from a published map [3]. At either end, the two profiles approach the same values because the distance between these new data and data from which the profile in [3] are interpolated is only a few kilometers. The profiles are clearly very different. The difference which is most important to the Chicxulub impact is that the interpolated profile shows a pronounced high of about 6 mgals amplitude extending from about 20 degrees 25 minutes to 20 degrees 45 minutes which the measured data profile does not support. This high on the map in [3] is important in defining the tenuous fourth ring of the Chicxulub impact feature with a radius of about 140 km. These data show that the high does not exist along the shoreline and cast doubt that the gravity data provide definite evidence for a fourth ring.

The area which we have surveyed had not been surveyed in the past because of inaccessibility. An area of nearly impenetrable mangrove swamp and lowland brush extending about 25 km east of our profile contained no data. Because of the broad shallow shelf extending about 100 km west of our profile, ship borne gravity collection is prohibited. The only data in that area are the low resolution, both in gravity values and in the spatial sense, satellite sea surface values. Previous maps of the region have had to rely on the low resolution satellite data and interpolation to achieve values in an area about 100 km north-south by 125 km east-west.

Most of our locations were accessed by boat and were amongst the dense tangle of mangrove roots which lines almost all of this very remote coastline. Since we were not able to tie loops very often under these conditions, we used two gravimeters simultaneously, one Worden and one LaCoste-Romberg. In reducing the data we found that variations in each instrument could be corrected because we had the data from the other. GPS receivers provided 2-D position information.
Elevations were measured from the surface of the water in the Gulf of Mexico. After adjusting the elevations for the Gulf

tidal variations, we reduced the data to simple Bouguer values using 2.0 g/cc to represent the unconsolidated sediments and weathered, porous limestones of the survey area. We also collected point magnetic data with a proton precession magnetometer. No significant features were identified in those data. Both the gravity and the magnetic data are being correlated with s synthetic aperture radar imagery (SIR-C/X-SAR) collected by the Space Shuttle in April and October 1994.

While our new measurements cast doubt on the existence of the fourth ring, they do not resolve the issue of the size of the Chicxulub crater. The most prominent feature in the gravity field is the one at approximately 170 km diameter, which correlates with surface fracture patterns and a ring of sinkholes [4,5]. This feature may reflect the crater rim [1,2]. Alternatively, this feature may represent the zone of maximum deformation, and thus corresponds to the transient crater [3] or floor of the final crater [4,5]. If this latter interpretation proves correct, then the final crater diameter is 240-300 km.

This work was supported by the NASA Exobiology Program, the JPL Summer Faculty Fellowship Program and Instituto Mexicano del Petroleo.

REFERENCES. [1] Hildebrand, A. R. et al. (1991) Geology 19:867-871. [2] Pilkington, M. et al. (1994) JGR 99:13147-13162. [3] Sharpton, V.L. et al. (1993) Science 261:1564-1567. [4] Pope, K. O. et al. (1991) Nature 351:105. [5] Pope, K. O. et al. (1993) Earth Moon and Planets 63:93-104.