TEAGUE RING IMPACT STRUCTURE, WESTERN AUSTRALIA: GRAVITY SURVEY. J. B. Plescia, California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA 91109 (jeff@lithos.jpl.nasa.gov)

As part of an effort to better define the nature and the crustal structure of Teague Ring, a GPS controlled gravity survey was undertaken in the austral winter of 1996. The objective was to define the gravity field, identify any anomalies, and interpret that anomaly in terms of crustal structure.

Teague Ring is an impact structure in Western Australia (25° 50' S; 120° 55' E). It has a diameter of 31 km and an age of ~1630 Ma. Teague Ring was first recognized by Butler (1) and various models of origin have been proposed. The most recent detailed work was undertaken by Eugene and Carolyn Shoemaker, but it has been published only in limited form (2). Teague Ring is defined on the surface by a synclinar collar of the Frere Formation (~20 km diameter) and cored by crystalline Archean granites (~13 km diameter) (3). In map view the northwest trend of the Frere rocks (and the Frere Range itself) are interrupted and deformed at Teague Ring. The Teague Ring structure occurs near the unconformable contact between the gently northeast dipping Early Proterozoic sediments of the Nabberu Basin and the underlying crystalline rocks of the Archean Yilgarn Block. The Archean crystalline rocks consist of granitic rocks intruded into remnants of greenstone belts. Exposures of basement are quite limited as the region is characterized by widespread lake deposits and wind-blown material associated with the Lake Nabberu.

A reconnaissance gravity survey conducted in 1986 (2) defined a significant negative anomaly over Teague Ring. To better define the structure a more detailed survey was conducted in August 1996.. Gravity station positions were established by a GPS survey; positional information was collected for 10 minutes (600 readings) and differentially corrected. The typical standard deviation of the station locations were 0.2 m horizontal N, 0.2 m horizontal E, 0.6 m vertical with a vertical PDOP mean of 3.3. The datum for reduction of the GPS data was AGD 1966. Gravity values were measured using a Lacoste Romberg gravity meter (#G-1035). Approximately 140 stations were obtained over the structure.

The collected data were contoured using a 30 x 30 grid and applying a 1st order polynomial to the data for smoothing. The simple Bouguer gravity map shows a closed-contour low associated with the center of the structure with approximately 12 mGal of relief. A northeastward gravity decrease is consistent with a northward thickening wedge of the Earaheedy Group rocks into the Nabberu Basin. Isogals closely parallel the outline of the structure as defined by the 20 km diameter collar of Frere Formation. Isogals are deflected around the structure out a diameter of 31 km, consistent with the dimension of the gap of the Frere Formation. An anomaly of -12 mGal for Teague Ring, assuming only a 31 km diameter, is consistent with the anomalies associated with other features (4).

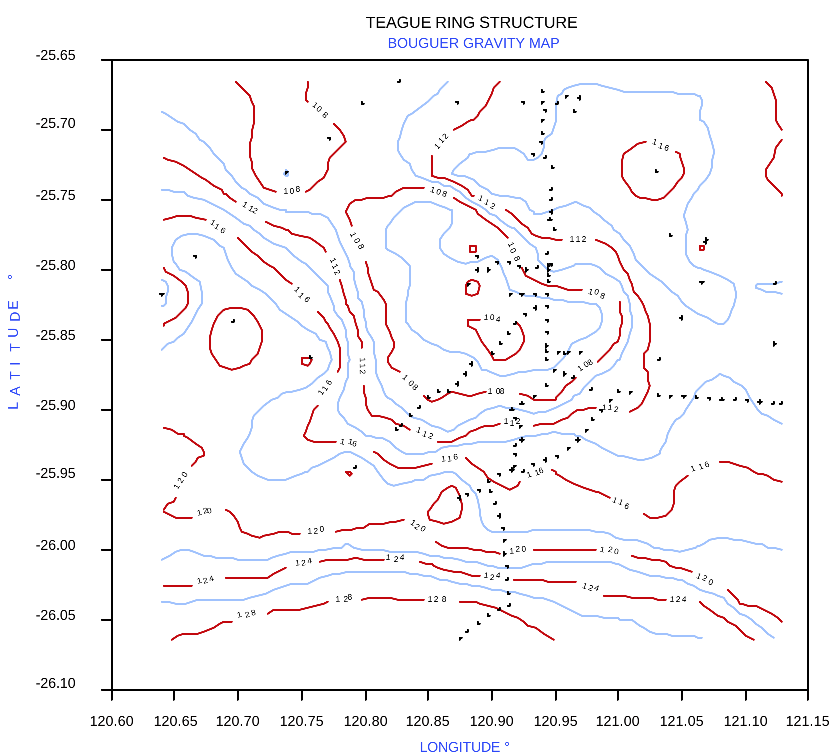

FIGURE 1. Simple Bouguer gravity map of the Teague Ring structure. Contour interval is 2 mGal. Crosses indicate station locations.

In an attempt to characterize the subsurface structure of Teague Ring, a series of two and half dimensional gravity models were constructed. The elements of the gravity model include: the Proterozoic basement; the shallow structural trough of Earaheedy rocks on the south side; a deeper structural trough of Earaheedy rocks along the northern edge; a core of crystalline rock in the center; and two additional bodies. Density contrasts with respect to the deeper crystalline basement are: Earaheedy rocks (horizontally lined bodies) -0.07 g cm^{-3}; material at the center of the structure (stippled body) -0.13 g cm^{-3}; body near 0 km -0.10 g cm^{-3}; body near 10 km +0.05 g cm^{-3}. The gravity model data suggest that the central low density body extends to a depth of several kilometers. A thickness of 5 kilometers is illustrated in the model.

Typical density contrasts between unfractured and fractured crystalline basement rocks at impact structures are -0.13 to -0.17 g cm^{-3} (4). Low densities (-0.04 to 0.09 g cm^{-3}) persist to a depth of ~ 5 km at the Siljan impact structure in Sweden (~40 km diameter) (5) and velocity and density values are reduced below normal to depths of as much as 6 km beneath the present structural level at the Ries (22 km diameter) crater in Germany (6). Thus a density contrast of -0.13 g cm^{-3} extending to a depth of 5 km for Teague Ring is consistent with data for other similar sized impact structures elsewhere in the world and these values seem reasonable choices for the models.

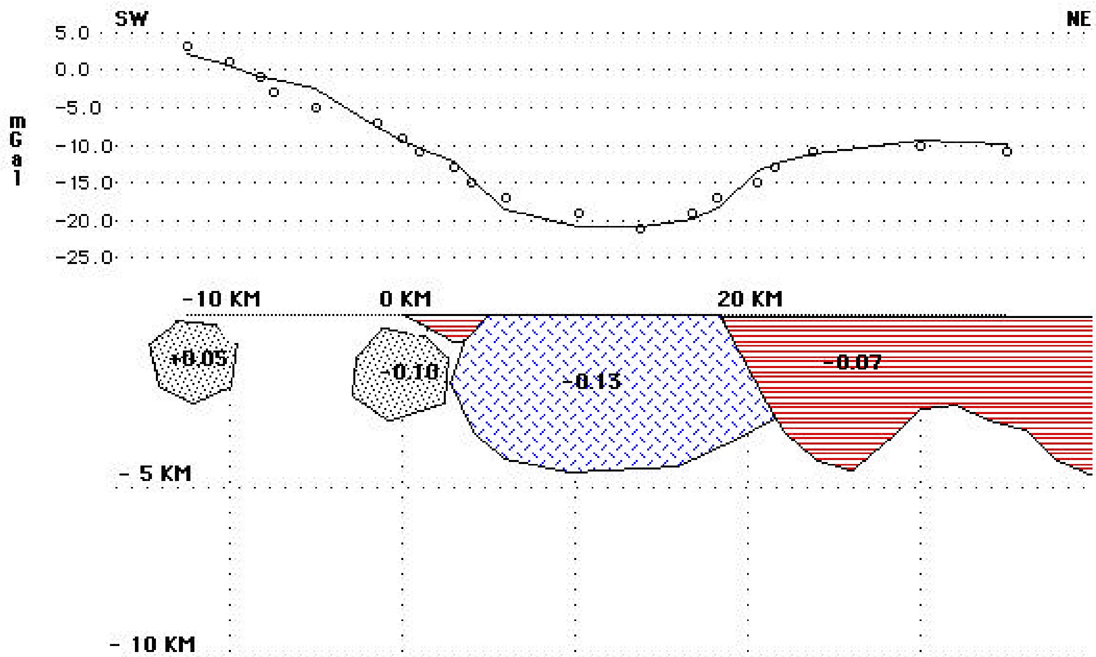

FIGURE 2. Two and half dimensional gravity model of the Teague Ring structure. Profile is oriented in a northeast-southwest direction. Small circles indicate measured gravity values; the line indicates the modeled gravity. Numbers denote the relative densities for the bodies in g cm^{-3} relative to the basement. Horizontally striped bodies are Earaheedy Group rocks; the stippled body represents the low-density core material; shaded bodies represent density anomalies within the crystalline crust. Vertical exaggeration is 2X.

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