GRAVITY SIGNATURE OF THE SANTA MARTA CRATER, A NEW CONFIRMED IMPACT STRUCTURE IN BRAZIL. M.A.R. Vasconcelos[1], A.P. Crósta[1], E. P. Leite[1]. [1]Institute of Geosciences, University of Campinas, Campinas, SP, Brazil (vasconcelos@ige.unicamp.br,).

Introduction: Santa Marta crater is centered at 10°10'S/45°14'W, in the county of Corrente in the Piauí State, northeastern Brazil. This circular structure was previously named as "Gilbués" by [1]. However, [2] suggested the name Santa Marta as it is part of the Santa Marta mountain range. The structure has a diameter of ~10-12 km with an irregularly shaped central elevation (Fig. 1). Although listed as a possible impact crater by [2], until recently no shock evidence had been disclosed to confirm its impact origin. A field campaign carried out by members of Unicamp´s impact crater research group unveilled the occurrence of shatter cones, polymict breccias and PDF in quartz of Santa Marta, thus confirming its impact origin [3]. A slightly positive gravity anomaly was identified at Santa Marta crater by [4] using low-resolution airborne gravimetric data and the authors pointed out Santa Marta as a potential impact structure. We present new results on the gravity signature of Santa Marta crater based on ground gravity data.

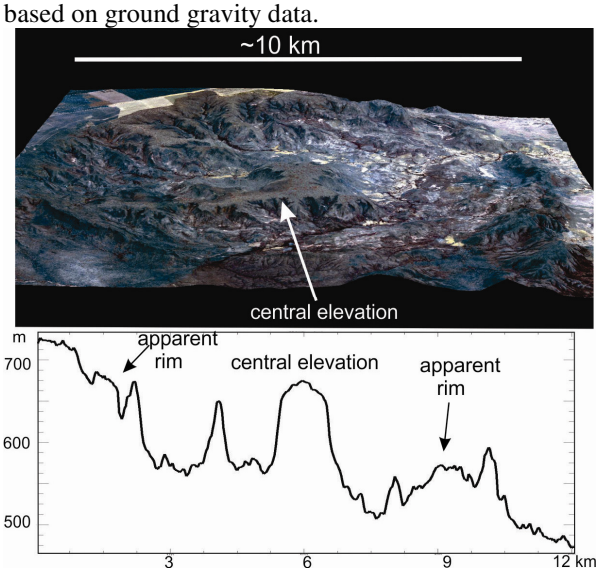

Figure 1- Top -Perspective view of Santa Marta impact crater using high-resolution WorldView-2 imagery draped over digital elevation data. Bottom - topographic profile from W to E and the difference of height between the rim and the central elevation.

Geological setting: Santa Marta was formed in Carboniferous sedimentary sequences of the Piaui and, probably, Poti formations in the Parnaíba Basin. The overall shape is slightly elliptical, possibly due to the fact that its northwestern and central portions are partially covered by younger, flat-lying, sedimentary rocks of the Cretaceous Urucuia and/or Areado formations. The actual diameter of the structure may reach up to 12 km, considering that it is partially covered. The outermost circular feature represents the rim, and there is an intermediate ring at mid-distance between the rim and the central ring (Fig. 1). The western rim is around 150 and 50 meters higher than the eastern rim and the central elevation, respectively, probably related to erosion processes occurred in the latter. The inner elevation is defined by a large *plateau* which extends from the central region towards southwest with an irregular shape, likely related to erosion processes. Polymict breccias were found in a ring-shaped elevation located between the rim and the central elevation, whereas shatter cones were in the central elevation and at some outcrops in the annular basin.

Data collection and processing: Ground gravity data acquisition was carried out in September 2012 totalizing 138 points located inside and outside the crater, with a spacing of ~300 meters. A CG-5 Scintrex digital gravimeter with 1microGal of resolution was employed for data acquisition. A gravity reference station located in the town of Gilbués was used to calculate absolute gravity values of all the data collected at the crater. Two measurements were collected for each data point and the values with the lowest standard deviations were chosen. Theoretical gravity values were calculated by using the WGS84 reference ellipsoid. Finally, free-air and Bouguer anomalies were calculated and a first degree polynomial was removed from the data.

Results: The Bouguer gravity map of Santa Marta does not exhibit a typical signature expected for complex impact structures formed in sedimentary targets. This signature is usually defined by either a low-gravity or a positive gravity over the central uplift [5]. The first type of anomaly is due to intense deformation (cataclasis and brecciation) wich affects the rocks from the central portions of impact craters, whereas the latter is explained by the uplift of the basement below the sedimentary cover. As Santa Marta does not appear to be a perfectly circular impact crater, it was also expected that it would show a non-concentric gravity signature. It presents indeed a low gravity anomaly that partially coincides with the central elevation, and this anomaly extends from the central region towards the southwestern rim (Fig. 2). The low-gravity in Santa Marta is continuously spread in the eastern region of the annular basin, coinciding with the area of ocurrence of the polymict breccias. A positive gravity anomaly of ~2 mGal is located in the central-eastern area of Santa Marta (Fig. 2), where less polymict breccias and shatter cones have found. The eartern outermost boundary of the crater is well marked by a positive anomaly. The

western side is not very well-defined. The overal gravity signature is rather different of the signature presented by [4]. The previous work exposed a slightly positive anomaly over Santa Marta, whereas the most detailed data presented here disclose a negative anomaly over the center and at parts of the annular basin and a positive anomaly dominanting the central-northeastern part of the crater. The positive anomaly seems to be associated with the large wavelength anomaly mapped by [4]. Therefore, the results presented here allows us to establish different regions according to their densities, likely related to different deformed materials resulting from the impact process.

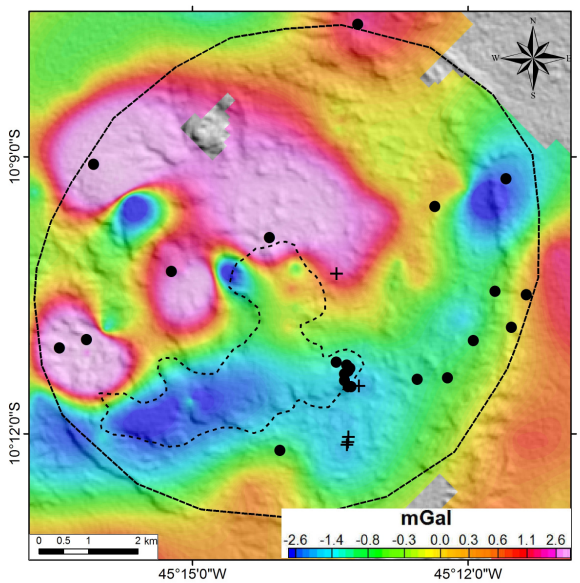

Figure 2- Gravity map of the Santa Marta impact structure. The external dashed line correspond to the outermost boundary and the internal to the central elevation of the crater. Crosses: points where shatter cones were found. Circles: points where impact breccias were found.

Conclusions:

Santa Marta shows an asymmetric morphology, with a central elevation shifted towards southwest, where shatter cones and breccias have been found and also where it exhibits a low-gravity signaturet coinciding with the occurrence of less dense rocks. The positive anomaly in the central-western side of the crater is not yet understood and a 2.5D forward and numerical modeling of the geophysical data will be carried out next, as it can be helpful to clarify this issue. The eastern side presents a well-defined positive anomaly, which may be related to the real diameter of the crater in this area, hidden under the younger sedimentary cover. Santa Marta´s elongated shape, shifted central elevation, as well as the shifted low-gravity anomaly may be related to a low-angle impact. Kinematical model supported by 3D-numerical studies shows downrange migration of the central uplift and elliptical shapes in impacts formed at angles under than 15°[6].

Acknowledgements: We aknowledge FAPESP for the finantial support for this research (Research grant #2012/50368-1) and for the post-doctoral fellowship provided to M.A.R. Vasconcelos (Grant #2012/04191-2).

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