AN EVALUATION OF THE SIZE OF RAMGARH CRATER, INDIA: CLUES FROM SATELLITE GRAVITY DATA. P. K. Srivastava[1], S. Ghosh[2], A. K. Das[3], S. K. De[4], S. Misra[5] and D. Ray[6], [1]University of Petroleum & Energy Studies, Dehradun– 248007, India (pksrivastava@ddn.upes.ac.in), [2]54/3 M. B. Road, Kolkata-700060, India (sombhunath.ghosh@gmail.com), [3]128 Jai Vignaharta Colony, Katol Road, Nagpur- 440013, India (akdas.gsi@gmail.com), [4]Vidyasagar University, Midnapore, West Bengal-721102, India (sikhendra@yahoo.co.uk), [5]SAEES, University of KwaZulu Natal, Durban-4000, South Africa (misras@ukzn.ac.za), [6]Physical Research Laboratory, Ahmedabad- 380 009, India (dwijeshray@gmail.com).

Introduction: The Ramgarh structure (centered at 25º20′N, 76º38′E, rim-to-rim diameter ~2.4 km) is currently established as a third confirmed asteroid impact crater in India that was excavated in the undeformed, flat-lying Vindhyan Supergroup of sedimentary rocks of Mesoproterozoic age [1, 2]. The impact occurred into a shallow water environment and gastropod fossils found in diamictites deposited on the rim of the crater constrains an Upper middle Jurassic (Callovian) age of impact. A detail geomorphological-cum-structural analysis of this complex crater is available in [3]. Recent studies on satellite imageries, however, establish that the exposed morphology of Ramgarh Crater (RC) actually represents the remnant central peak of a large eroded impact structure, which could have a diameter of ~10 km [1]. In the present abstract, we report our preliminary observation on satellite imageries and satellite Bouguer gravity map to re-evaluate the original dimension and impact history of this crater.

Data source: Landsat 7 Satellite remote sensing image of Path/Row 146/042 and SRTM data of the area around RC (Fig. 1) have been used for the present study (http://earthexporer. usgs.gov). The image has a resolution of 30 m and it shows a detailed distribution of present drainage system and paleo-channels in and around RC. The purpose of this image is to track any possible trace of circular and radial relict fracture system around the RC to evaluate its impact history. The satellite Bouguer gravity data have been downloaded from the Global Gravity Model plus (GGMplus) Gravity Data Extraction (http://murray-lab.caltech.edu/GGMplus/) with a spatial resolution of 200 m (Fig. 2).

Satellite image: In the most recent studies on the ArcGIS 10.4 satellite imagery, the radius (~5 km) of RC was identified with some remnant, discontinuous concentric arcuate lineaments around the crater centre [1]. However, in our satellite image, distinct arcuate concentric lineament could not be identified around the RC centre (Fig. 1). This image clearly shows the remnant paleo-channel of river Parvati (and its tributaries) just to the west of RC, confirming again that the site of impact was within a hydrous river environment [3].

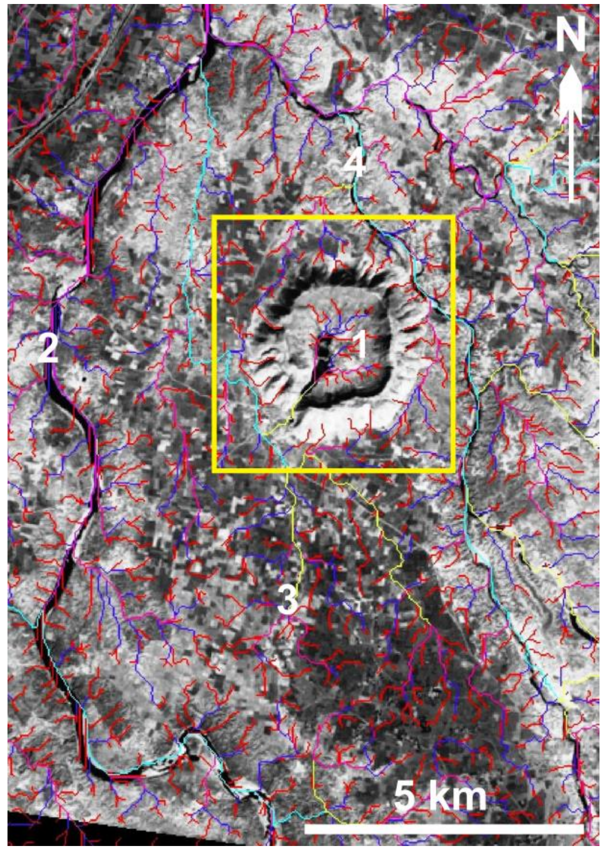

Figure 1. Landsat 7 satellite image of RC (1) [shown in yellow box] showing Parvati River (2) and its abundant paleo-channel (3), Kul River (4) and their detailed drainage system in and around RC.

Gravity Data: The satellite data shows a valley shaped distribution of Bouguer gravity of the target sedimentary rocks in and around RC (Fig. 2). The gravity anomaly is found to be lowest (> -48 mGal) to the SE and partly to the NE part of the crater. The value gradually increases to -50 mGal in the central eastern, northwestern and southwestern part, and finally to -51 mGal to the central and western part of the area. The RC is excavated within the area with higher gravity anomaly (-51 mGal). Three prominent well-spaced NW-SE gravity lineaments are identified in this area; one of these lineaments (bb) intersects the RC without any noticeable structural displacement. A part of the Parvati River channel (cc) to the southwest of the area is also controlled by this lineament. The lineament 'aa' also controls the current flow channel of Kul River to the NE of the crater (Fig. 1, 2).

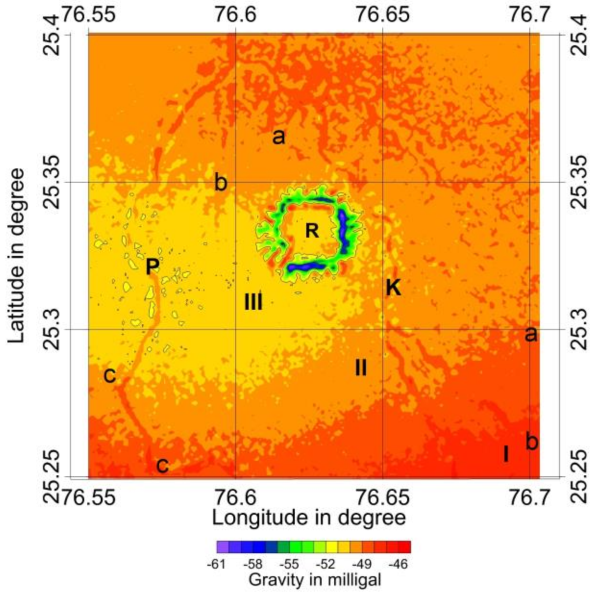

Figure 2. Satellite Bouguer gravity map of RC (R) and surrounding area, abbreviations: aa, bb, cc- NW-SE gravity lineaments, I (less than -48 mGal), II (-50 to -48 mGal) and III (-51 to 50 mGal) are areas of different Bouguer gravity, P- Parvati River, K- Kul River.

An enlarged view of Bouguer gravity map in and around RC shows no important variation of gravity anomaly at the central part of the crater with reference to the area outside this structure (Fig. 3). The maximum gravity low (less than -55 mGal) is observed above the visible rim of the crater towards its south, east and partly to the north. The central part of the crater shows almost a uniform Bouguer gravity of ~-51 to -49 mGal. However, isolated pockets of relatively high gravity anomaly (-49 to -47 mGal) are observed within the northern, western and southwestern and southeastern rim of the crater.

Discussion: In our Landsat 7 image, no trace of remnant concentric fracture outside the crater has been observed (Fig. 1). Instead, the visible rim of the crater (Fig. 1) is associated with the highest gravity anomaly (~-51 to -49 mGal) (Fig. 2) indicating the maximum extension of the crater. No concentric lineage of gravity anomaly is observed away from the visible crater rim.

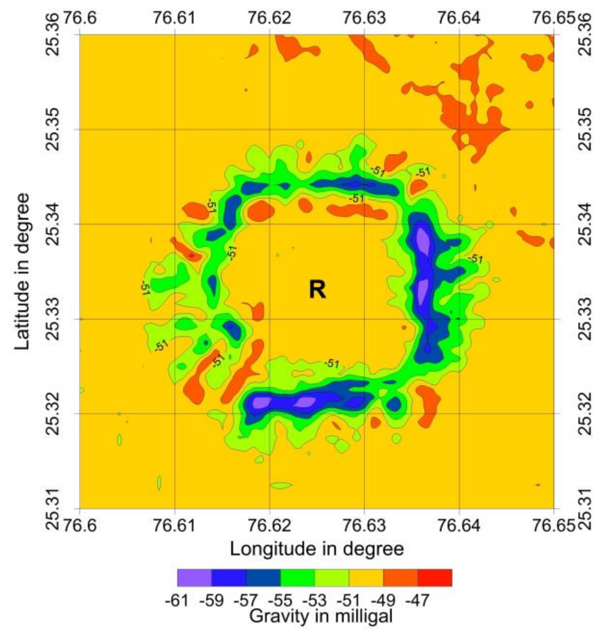

Figure 3. Satellite Bouguer gravity map close to RC, note the lowest values of gravity anomaly (-61 to -59 mGal) are observed only along the visible rim of the crater.

The target sedimentary rocks around RC show a conjugate set of NW-SE and NE-SW orthogonal fractures [3]. However, the RC shows a distinct dextral displacement only along NE-SW fracture (Fig. 1). Rectangular shape of the crater is related to dextral displacement along NE-SW set and selective post-impact movement along pre-existing fractures.

It is now established that the shape of the crater rim and distribution of ejecta around this rim are sensitive to impact angle and direction [4, 5]. However, the RC does not have a fully preserved ejecta blanket around its rim at present. If post-impact displacements of the RC rim along dextral NE-SW (major) and sinistral E-W faults (minor) [3] are ignored, the rim of the crater is almost circular, and its outer periphery can be outlined with a circle (Fig. 1). This morphology of the RC favours a near- to sub-vertical impact origin of this structure. However, more cross-sectional gravity images need to be examined to confirm the hypothesis.

References: [1] Kenkmann T. et al., (2020) *Meteoritics & Planet. Sci.*, doi:10.1111/maps.13454, 1-26. [2] Ray D. et al (2020) *J. Earth Syst. Sci.*, 129, 118, 1-25. [3] Misra S. et al. (2019) *In: Tectonics & Structural Geology, Indian context*, Springer, New York, doi:org/10. 1007/978-3-319-99341-6_11, 327-352. [4] Gault D. E. & Wedekind J. A., (1978) *9th LPSC*, 3843–3875. [5] Pierazzo E. & Melosh H. J., (2000) *Annual Rev. Earth & Planet. Sci.*, 28, 141-167.