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The Massive Australian Precambrian-Cambrian Impact Structure (MAPCIS) part one

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Introduction

MAPCIS is a marine oblique impact hitting the Centralian Superbasin over thick continental crust with a northeast to the southwest trajectory centered at 25°32'55.66"S 131°23'21.50"E with initial contact about 140 km to the northeast creating an approximately 600km diameter complex peak ring crater with bilateral symmetries, uprange-downrange components along with an exposed circular crater rim. MAPCIS is age constrained to end Ediacaran/early Cambrian consistent with pЄ-Є boundary. We will show panoply of mega, macro, micro and elemental evidence to support the age, size, trajectory and location of this impact with this and successive papers. We will finish with the implications of MAPCIS changing our understanding of geology and Earth history. This first paper is authored primarily by Daniel Connelly.

Dating

Known Australian impacts define the widest age constraints for MAPCIS. As expected, impacts older than 542Ma are absent from the crater. The closest known older impact craters are the highly deformed Amelia Creek crater 1660Ma to 600Ma at 600km and Acraman crater 580Ma at 800km from MAPCIS center respectively. (Figure 1) The oldest known crater within MAPCIS crater rim is Gosse Bluff 142Ma. More important than Acraman crater is its well mapped and dated ejecta layer which would be expected to be erased by an impact as large as MAPCIS. I found that the Acraman ejecta layer is absent within the MAPCIS crater rim, and the basins west and north of the Gawler craton. (Hill et al., 2007) The closest 580Ma Acraman ejecta are found in deep drill cores 300km from MAPCIS centre where the Gawler craton underlies the Officer basin. (Figure 2) (Connelly, 2009b).

The Kalkarindji large igneous province ~510Ma (Glass, L.M., Munson, T.J., 2018) in places overlie early Cambrian Sandstone formations such as the Bukalara Sandstone (Pietsch et al., 1991, Yates, K.R. et al., 1962) in the Northern Territory and overlie Ediacaran diamictite, basal well-sorted sandstone, mudstone and conglomerate of the Wahlgu formation in Officer basin Western Australia. (Stevens M., 2018) The coeval Mooracoochie volcanics ~517-510 Ma of the Warburton basin South Australia together with the Kalkarindji LIP form an early Cambrian ring of volcanics which is absent inside the MAPCIS crater rim, both dating and defining the existing central highlands of Australia equivalent to MAPCIS as being uplifted as a complete unit prior to the early Cambrian volcanic events. (Connelly, 2013) Reason being that lava did not flow uphill and over the crater rim. (Fig. 3)

The absent Acraman impact ejecta ~580Ma and the Kalkarindji/Mooracoochie volcanics ~517-500Ma constrain the age of MAPCIS from Ediacaran to early Cambrian. The size of MAPCIS suggests it would be a prime candidate for the Ediacaran extinction event ~542 Ma. The final constraint is zircon and monazite grain dating near activated faults of the Musgrave Province. Much of the Musgrave Province has protolith ages ~1.1Ba and a resetting age that approaches the pЄ-Є boundary age. The most complete resets appear to cluster around the center of MAPCIS and near known pseudotachylite breccia melts (Edgoose, C.J., Scrimgeour, I.R., Close, D.F., 2004).

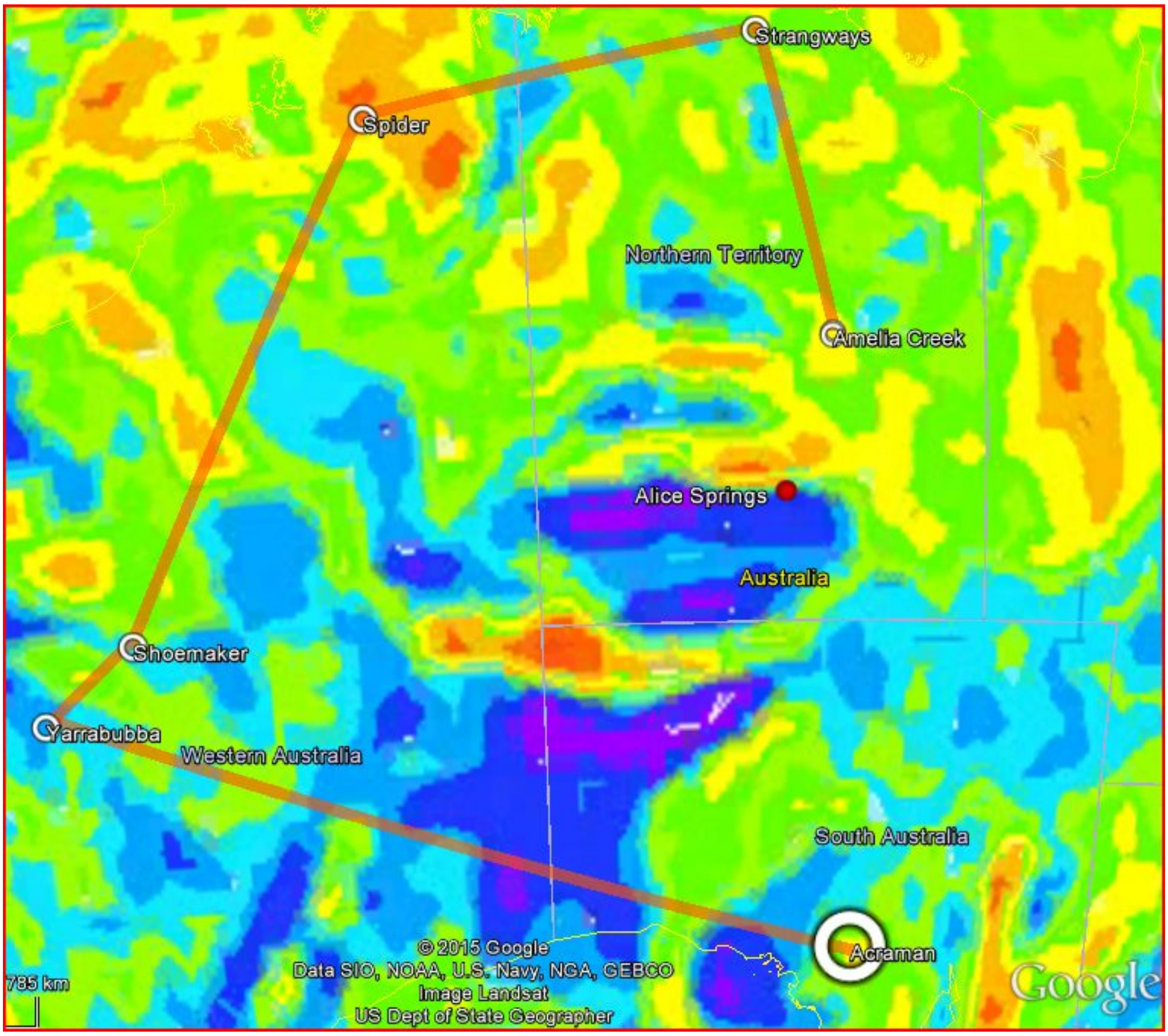

Figure 1. San Diego State University Grace Gravity Anomaly Map (2002) with impacts older than pЄ-Є boundary layered on Google Earth are outside the crater rim. (Levesque, 2015)

The geomorphology and mega evidence

In 2007, I noted a 2000km diameter circular anomaly on Australia from satellite imagery. (Fig. 4a) It appeared on post rainy season images when the outback vegetation was green and the bodies of water temporarily filled. Subsequent research showed this anomaly was quite real, enclosed a 600km diameter crater and not an artifact of the imagery (Connelly, 2009a). Bisecting the outer circular anomaly and measuring the elevations in meters above sea level every 10 km along each bisect line revealed three things. 1. The putative center of impact which was later found within 100km of the intersection. 2. There is a massive central highland in Australia made up of basins and mountain ranges. 3. The outer ring is a shallow depression only 50m to 100m deep with a width over 100km. (Fig. 4b & 4c). This was confirmed years later by the 1969 continental drainage map of Australia division of national mapping (O'Driscoll & Campbell, 1997). O'Driscoll & Campbell suggested in the same paper the existence of a multi-ring impact structure in central Australia. (Fig. 4d & 4e)

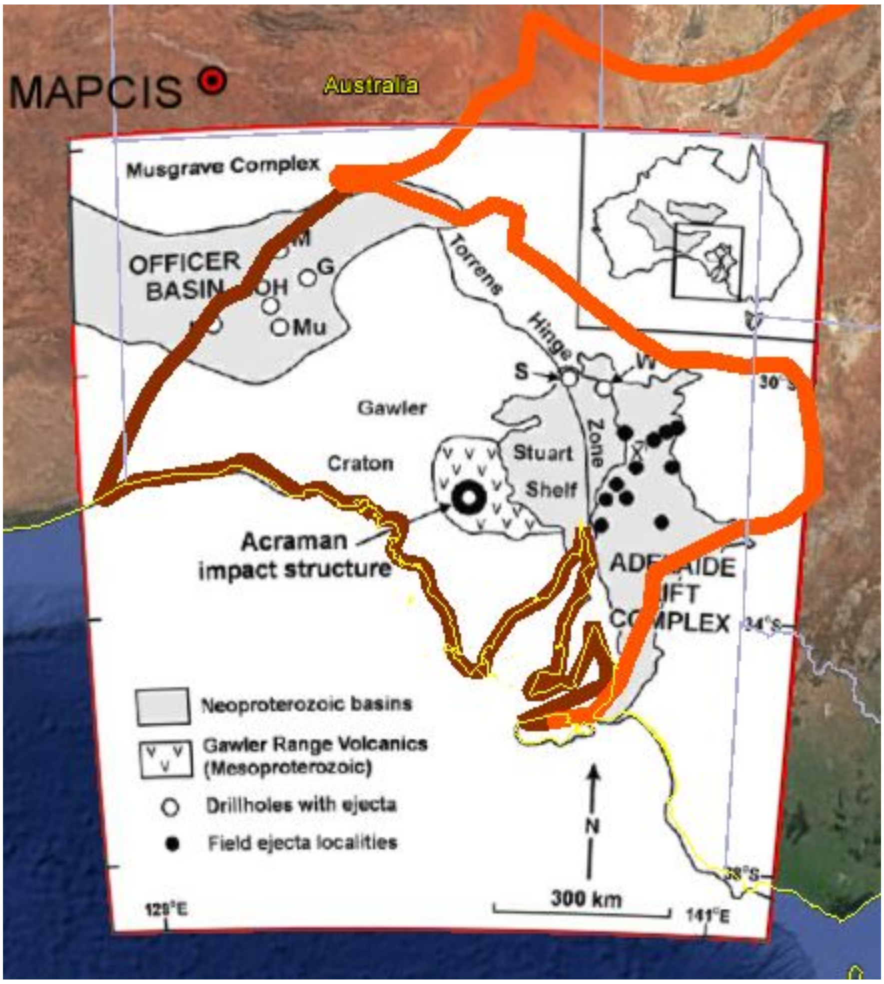

Figure 2. Map overlay showing known locations of ~580Ma Acraman ejecta are within the boundaries of the South Australia/Gawler Craton (Hill et al., 2007).

In 2008, naïve and armed with this information I came to Australia along with my wife and eldest son to hand it over to the experts of Australian impact geology in Canberra and be done with it. The meeting was brief, I was told in no uncertain terms that nothing was there and I should see for myself by taking a walk in the desert. We packed up, flew to Alice Springs either to let the land reveal itself and/or have a nice holiday with my family. Luck would have it, we had a holiday and clues to the impact were revealed. I found a book by Bert Cramer of Alice Springs with hand drawn illustrations of a large central Australian impact (Cramer, 1993). I was also given twenty-five GA 1:250,000 geology paper maps of the southern end of the Northern Territory by the Northern Territory Geological Survey office in Alice Springs.

After returning home, I purchased the adjoining maps from the Western Australia and South Australia geological survey offices. In these maps are the combined works of hundreds of geologists and cartographers spanning over 50 years. It took months to cross reference colour keys and old names with the new across time, maps and borders. The combined paper maps spread out on the floor or digitally fused on my computer revealed elements of the impact. Important elements of the impact revealed were including but not limited to: The exposed 600km diameter crater rim cutting across three state and territory borders (Fig.5). The actual impact center and trajectory shows on the Magnetic Intensity Map printed on the Ayers Rock 1:250,000 geology map. (Fig.6) The location and extent of the largest known deposits of pseudotachylite breccia that run for 300km in both arcuate and radial deposits are downrange from the impact center.

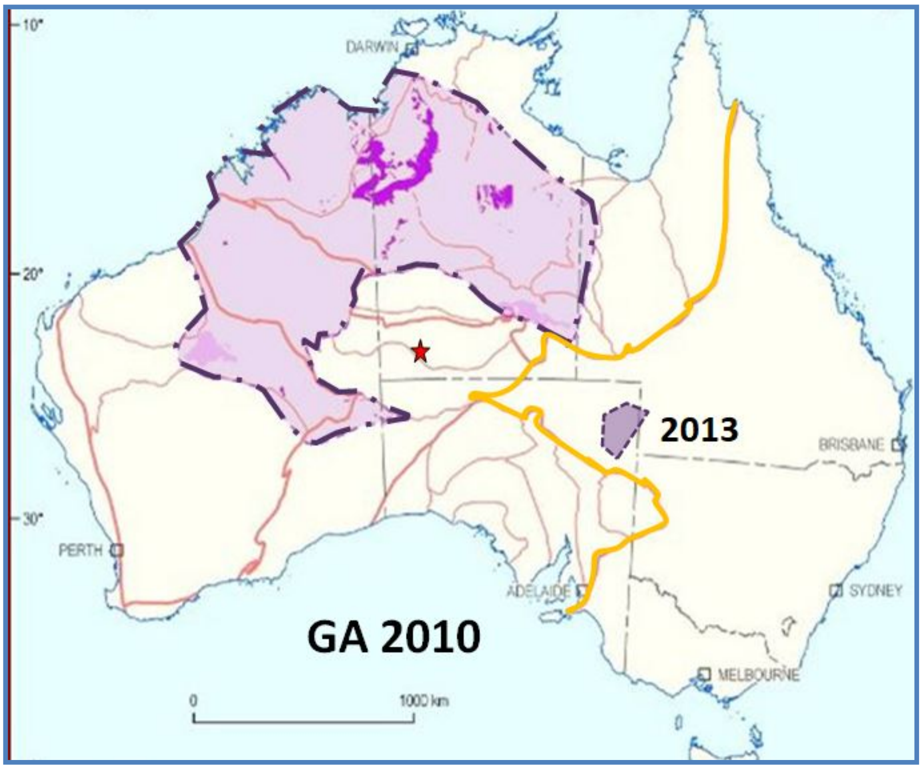

Figure 3. 2010 Geoscience Australia Map of the semicircle Kalkarindji LIP ~510Ma, the Mooracoochie Volcanics ~517Ma in the Tasman rift north of the Gawler craton with the location of MAPCIS impact center marked as the star.

Figure 4a. The original 2000 km ring anomaly from 2007 post rainy season is ephemeral disappearing with the dry season.

Figure 4b. The bisects gave a close approximation to the true center, the place to start a search.

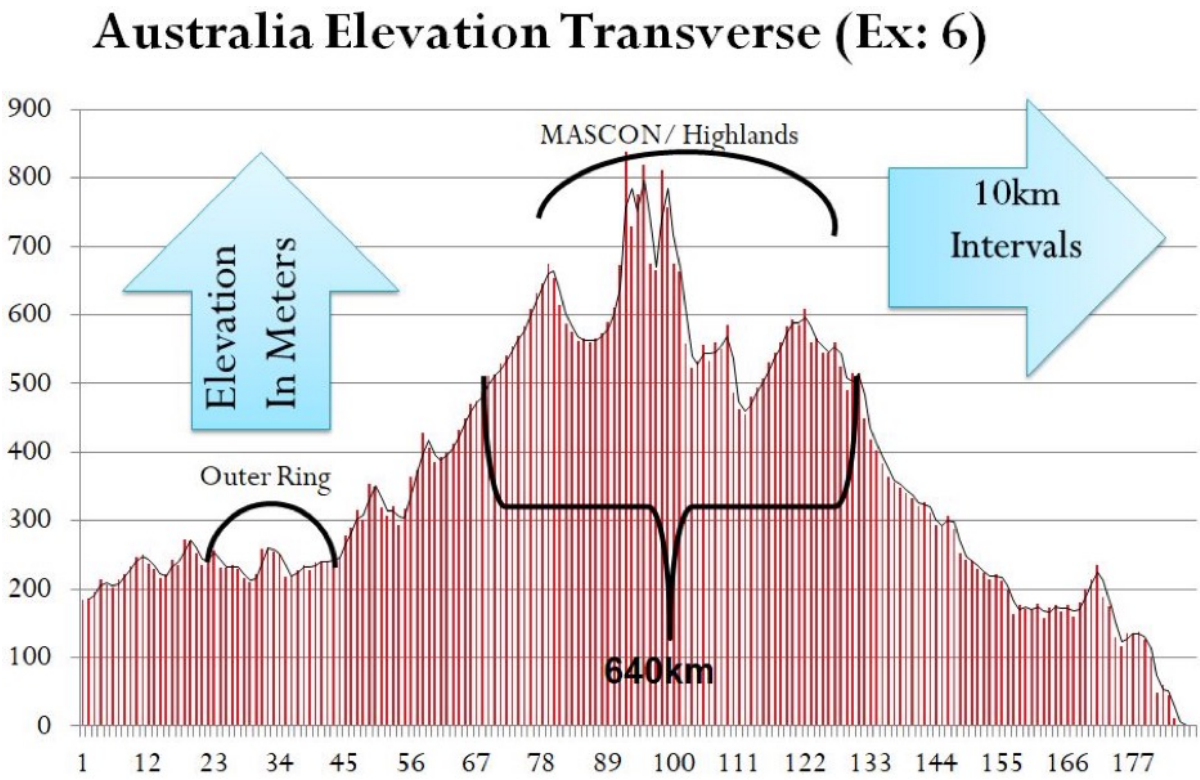

Figure 4c. Using Excel and Google Earth, I was able to plot elevations every 10km along the bisects of the outer ring anomaly. (Connelly, 2009a).

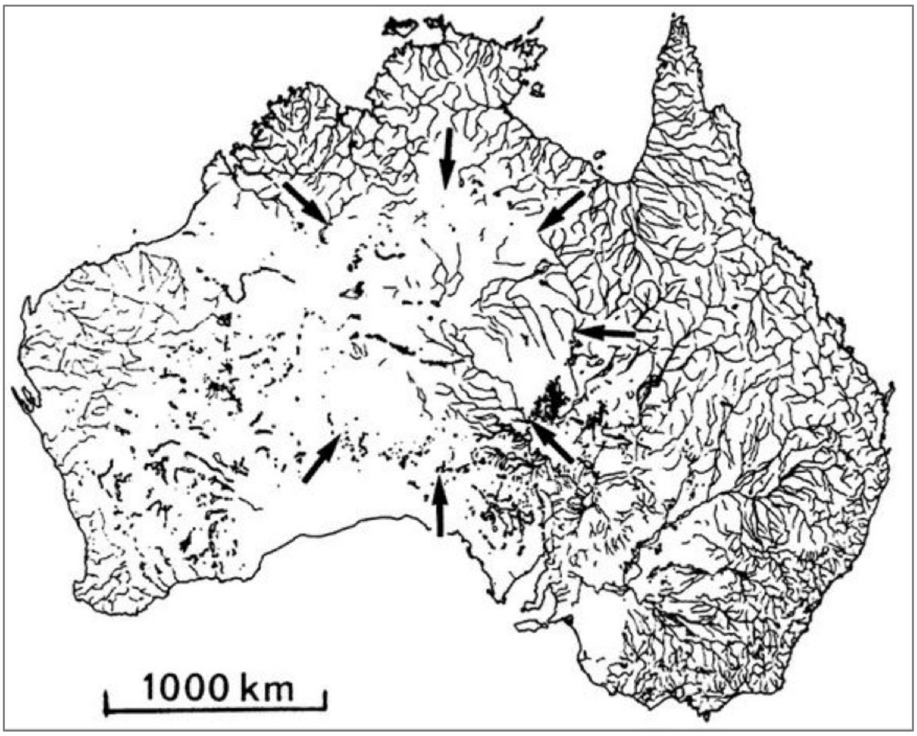

Figure 4d. The 1969 National drainage map was confirmation of the outer ring. (O'Driscoll & Campbell, 1997)

Figure 4e. CAR =Central Australia Ring was noted by O'Driscoll & Campbell in 1997 as a possible multi-ring impact basin but without follow-up (O'Driscoll & Campbell, 1997).

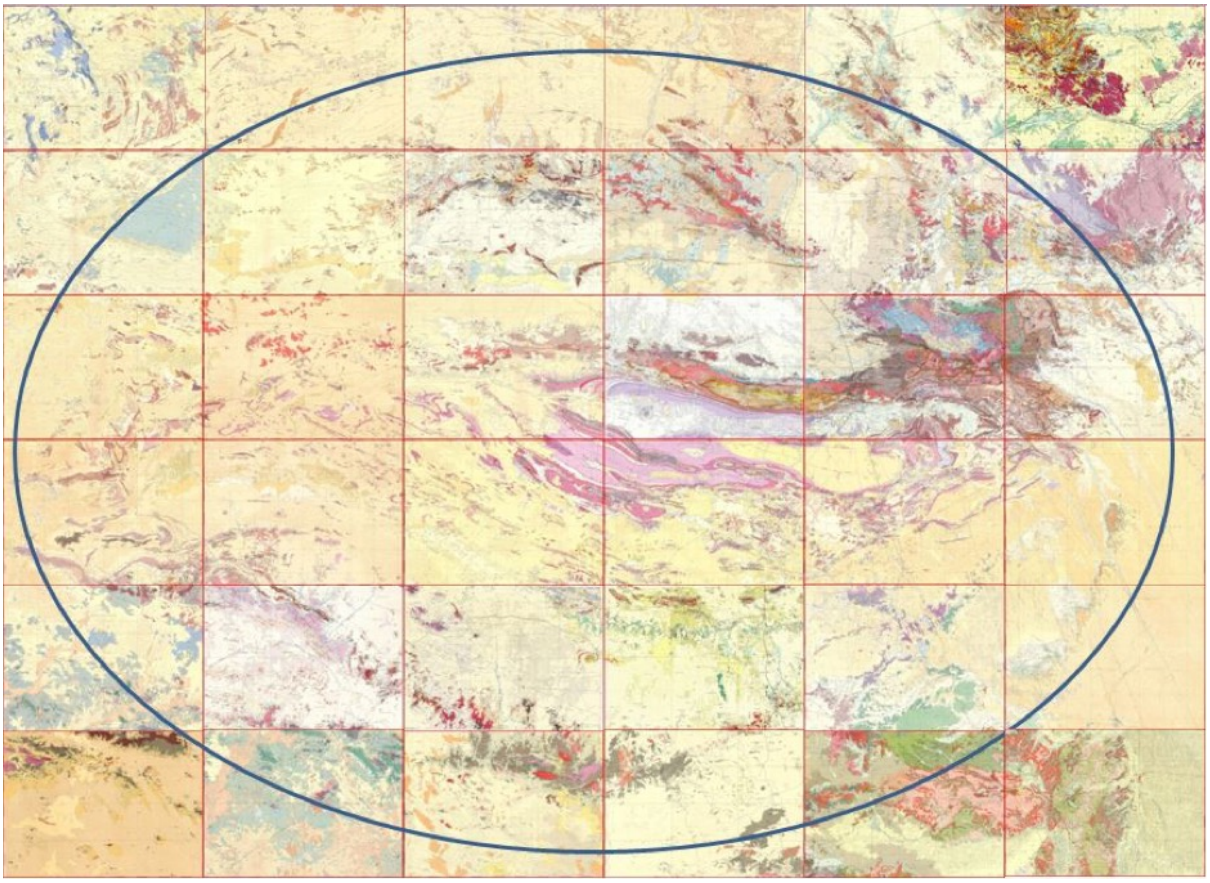

Figure 5. I made a composite geology map of 36 GA 1:250,000 surface geology maps from SA, NT and WA enclosed in the oval shows exposed portions of the impact structure with the expected ~100 km north- south compression from the Alice Springs Orogeny ~450Ma-300Ma (Haines et al., 2001).

The relationship between the impact center as seen on (Fig. 6) and the massive pseudotachylite breccia deposits south of MAPCIS center(D.P., 2012) can best be understood using the Vredefort Impact as a model for MAPCIS. (Fig.7, Figure 8).

A map of elements of Vredefort impact to scale and rotated to line up with MAPCIS reveal compelling similarities. First, the Witwatersrand basin nestles nicely in the Amadeus basin and neither is circular. Second, pseudotachylite breccias not buried under the impact center are mostly down range and proportionally distanced from the center. Third, there are bilateral areas for both Vredefort and MAPCIS that experienced less impact forces that are angled slightly behind the oblique impact centers. In Vredefort, these areas mapped have no Pt. breccia. In MAPCIS, is found intact Neoproterozoic layers in the teardrop form of Mount Conner and layers near or under Uluru/Ayers Rock.

MAPCIS in the gravimetric lens

The recognition of impact structures in planetary bodies is an entertaining task for the eyes and easy to detect when focused on distant optical objectives. This is rare or difficult on planets with an active and dynamic geology like Earth. In the last few years much progress has been made in the knowledge of the characteristics of impact structures in the Moon, Mars, and other celestial bodies, thanks to the efforts of NASA and other agencies.

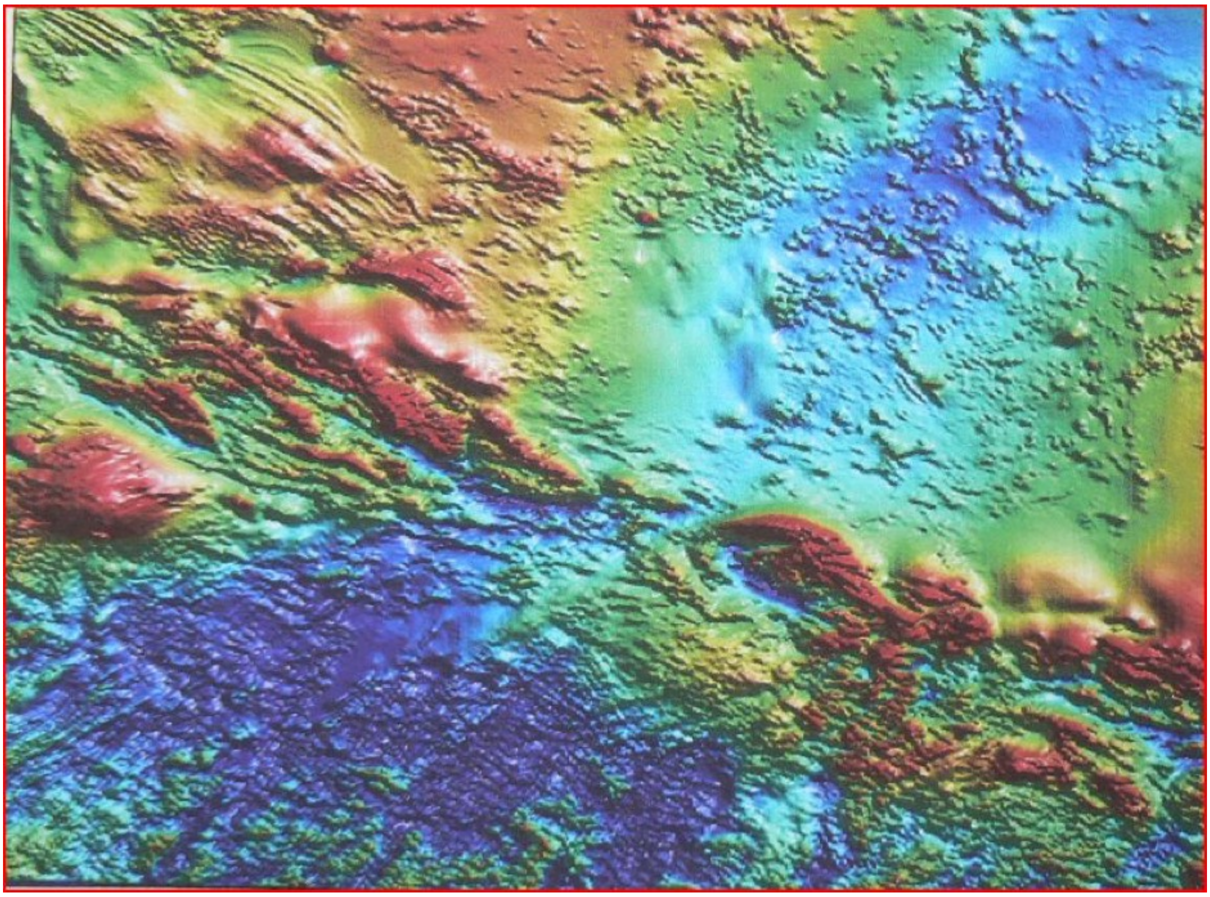

Figure 6. The total magnetic intensity (TMI) map of the 2002 Ayers Rock 1:250,000 Geoscience Australia geology map, suggests a deep trench interpreted as trajectory and final emplacement for the bolide. The TMI map is 150km west to east.

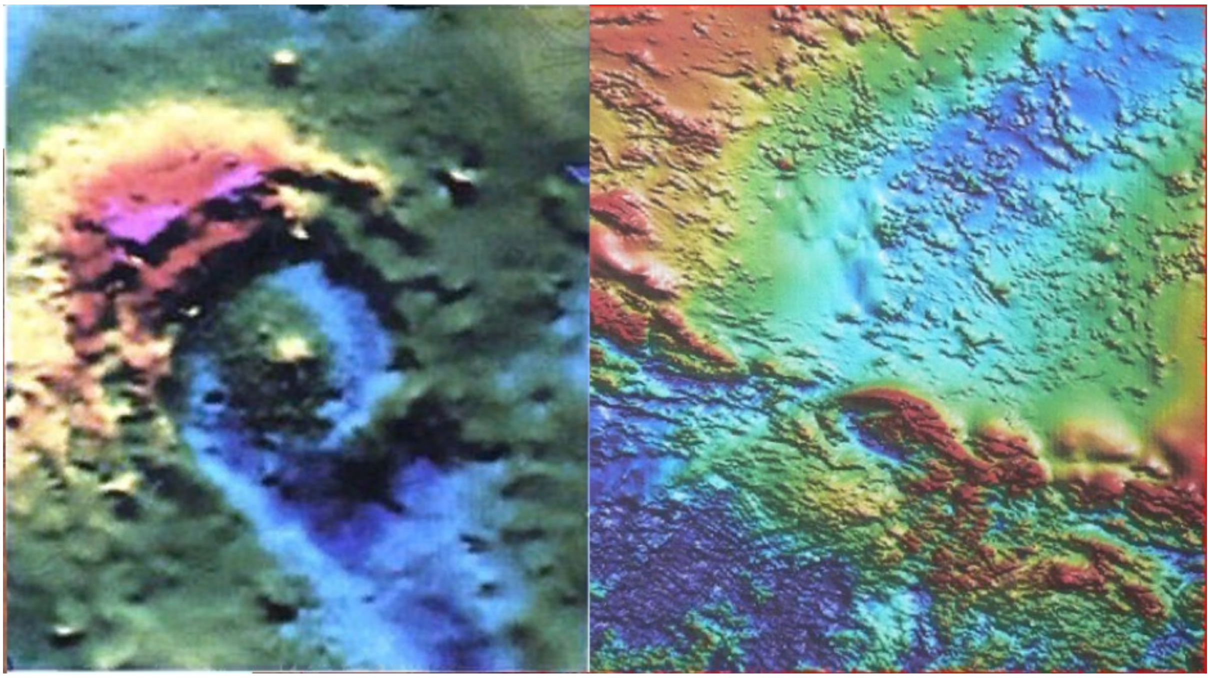

Figure 7. The Vredefort Bouguer gravity anomaly (Beals, 1995) and MAPCIS TMI anomaly are of similar size, shape and directionality.

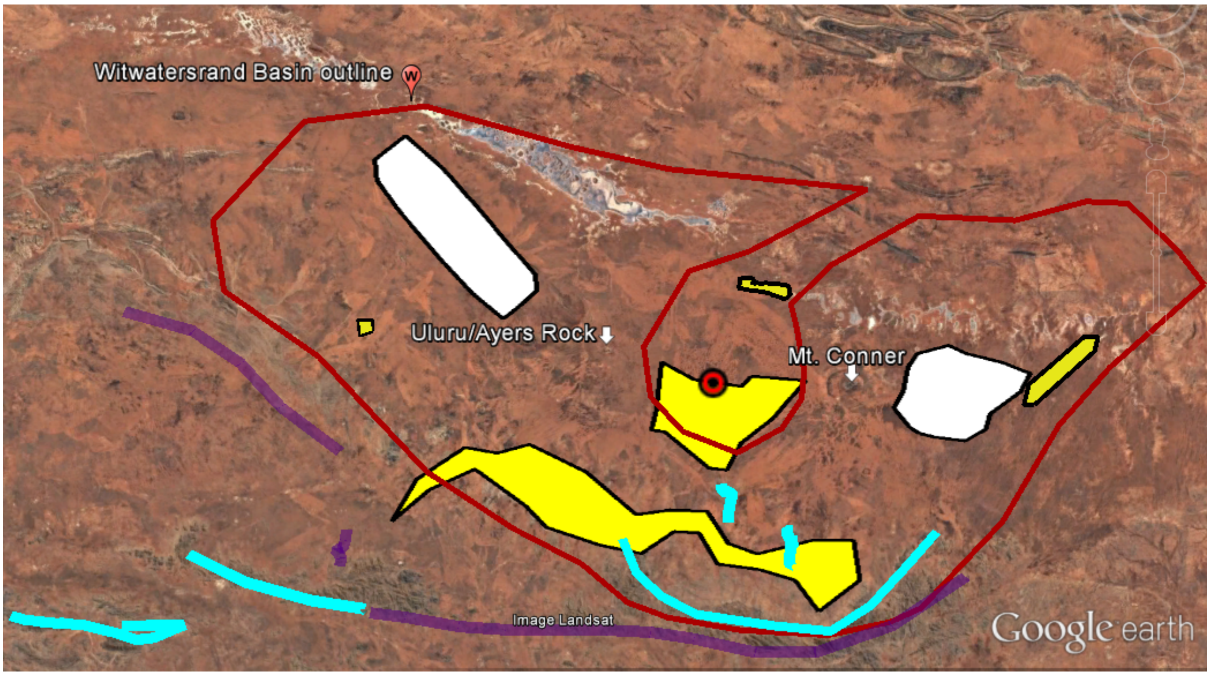

Figure 8. Key: Vredefort: Red = outline of Witwatersrand basin superimposed on Amadeus basin; Yellow= locations of Vredefort pseudotachylite breccia in relation to Vredefort center and direction; White= zones where no Vredefort Pt. breccia was found. MAPCIS: Background=Amadeus basin; Blue = locations of MAPCIS Pt. breccia in relation to MAPCIS center and direction; Violet= mylonite zones (Connelly, 2016).

The gravimetric information produced allows us to have an almost X-ray image, at suitable scale, of the configuration of the surface of the celestial body investigated and more than anything when it comes to focusing the gravimetric information on the Impact structures, pointing out these types of structures show almost exclusive characteristics. Thanks to similar systems of geophysical data collection, when terrestrial information has been imaged in detail using gravimetry, the quality and reliability of the information is currently close to the unbeatable.

Another exclusive feature of impact mega structures (terrestrial, e.g. Chicxulub; of the Moon, e.g. Orientale; Martian, e.g., Lowel; etc. for example in (Bratt, 1985); (Neuman, et al., 2004) (Christenson, et al., 2009) is the breakdown of crustal thickness (CT) that can be thousands of meters difference in relation to the CT values of the surroundings. (Fig. 9a and 9b) shows very clearly the strong CT distortion with MAPCIS, of the order of more than 10,000 meters (Fig. 10b) as is expected in a mega impact structure. Its modeling (Fig. 10a) defines the same type of modelling given in Fig. 10 a, b, c, and d; i.e. bulls eye pattern.

Applying the almost exclusive gravimetric characteristics that can be detected in the gravimetric analysis of celestial bodies such as the Moon, Mars, etc.; the very likely impact structure

MAPCIS (Connelly, 2009a & b) will now be placed in the gravimetric lens.

(Fig. 9a) shows an image of Vertical Gravity Gradient (VGG) as contrasts the MAPCIS silhouette of the rest of the Australian continent. It is known that VGG information is useful for defining structures. The MAPCIS image is also very clear in the gravimetric configuration of Free-air (Fig.10b), Bouguer (Fig. 10c) and Isostasy (Fig. 10d). MAPCIS in the gravimetric models, shows a multiple ring structure more than 600 km in diameter that seems to define an annulus of positive gravity anomaly surrounding the semi-annulus of negative gravity anomaly which in turn surrounding the semi-annulus of positive gravity anomaly in the middle of which there is a central valley with a strong negative anomaly with simplified details in the (Fig. 10e).

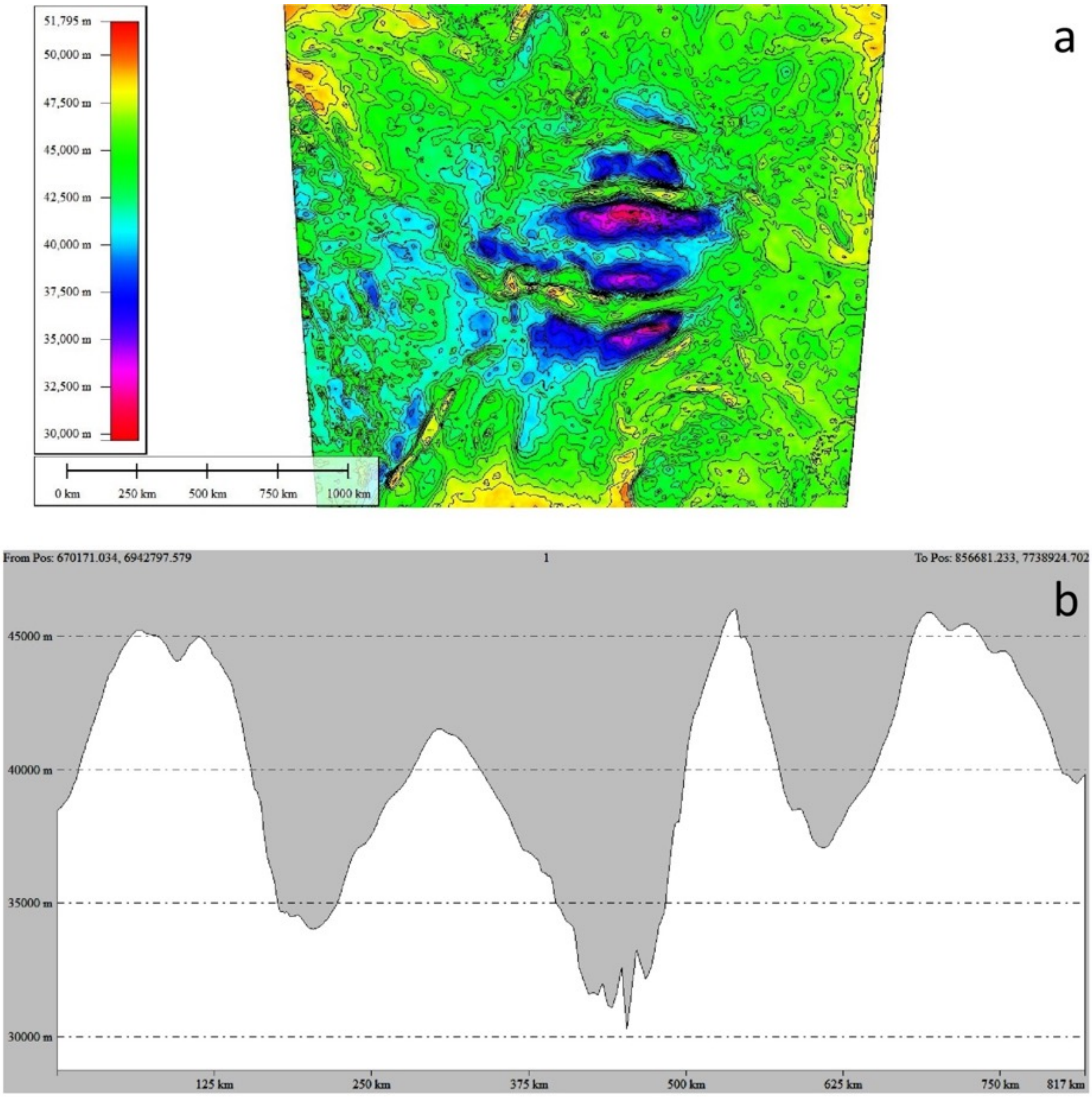

Figure 9a, b. The breakdown of crustal thickness (CT) that can be thousands of meters difference in relation to the CT values of the surroundings. (Fig. 9a and 9b) shows very clearly the strong CT distortion with MAPCIS, of the order of more than 10,000 meters.

Therefore MAPCIS from the gravimetric point of view resembles a bulls-eye as indicated by (Zuber, 2016)to be characteristic of multi rings impact basins of the moon (e.g. Mascon Basins).

Another exclusive feature of impact mega structures (terrestrial, e.g. Chicxulub; of the Moon, e.g. Orientale; Martian, e.g., Lowel; etc. for example in (Bratt, 1985), (Neuman, et al., 2004),(Christenson, et al., 2009) is the breakdown of crustal thickness (CT) that can be thousands of meters difference in relation to the CT values of the surroundings. (Fig. 9a and b) shows very clearly the strong CT distortion with MAPCIS, of the order of more than 10,000 meters (Fig. 9b) as is expected in a mega impact structure. Its modeling (Fig. 9a) defines the same type of modeling given in Fig. 10a, b, c, and d; i.e. bulls eye pattern.

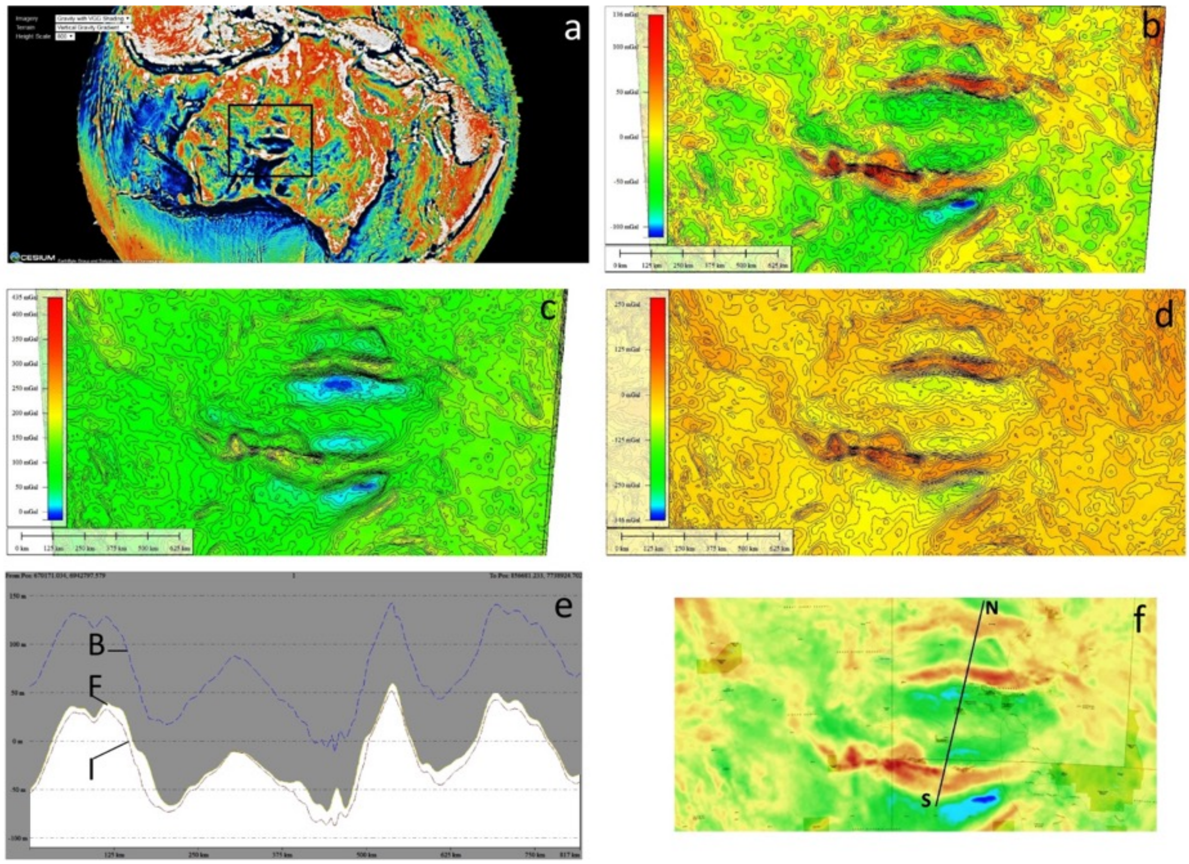

Figure 10 a-f. Strong CT distortion with MAPCIS, of the order of more than 10,000 meters.

The MAPCIS modeling looks more real in (Fig. 11a). Type of configuration that approximates the architecture of MAPCIS in its current position; a peak ring impact basin (Fig. 11a and b) mostly buried; where their rim crest would have risen more than 15,000 meters (Fig. 11b).

Discussion

The various methods of remote imaging and the use of geologic, magnetic and gravimetric maps give us the perspective of a multi-ring circular impact structure. If we were viewing the moon, this structure would be labeled a Schrödinger type impact and we would be mostly finished with the research and proof. The unique active geology of the Earth masked the evidences of impact by superficial alteration, and requires the extra steps to confirm impact origin. Current intraplate hypotheses for central Australia using terrestrial processes are to be examined and discounted. All other possible terrestrial processes can be and must be eliminated. Most importantly, the rock near the center of the impact must be examined for geochemical and petrographic indicators of impact, such as high iridium content, and shocked minerals such as quartz. These items are for the next paper in the series where Arif Sikder of Virginia Commonwealth University (VCU) and his associates find these very items in the samples collected.

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Thank you to my family for all their support, to my wife and sons who followed me into the outback for the adventure and collect the samples. Thank you to Arif Sikder and Jaime Presser for your overwhelming curiosity, guidance and support. Thank you to the people of Australia who have helped me along the way.

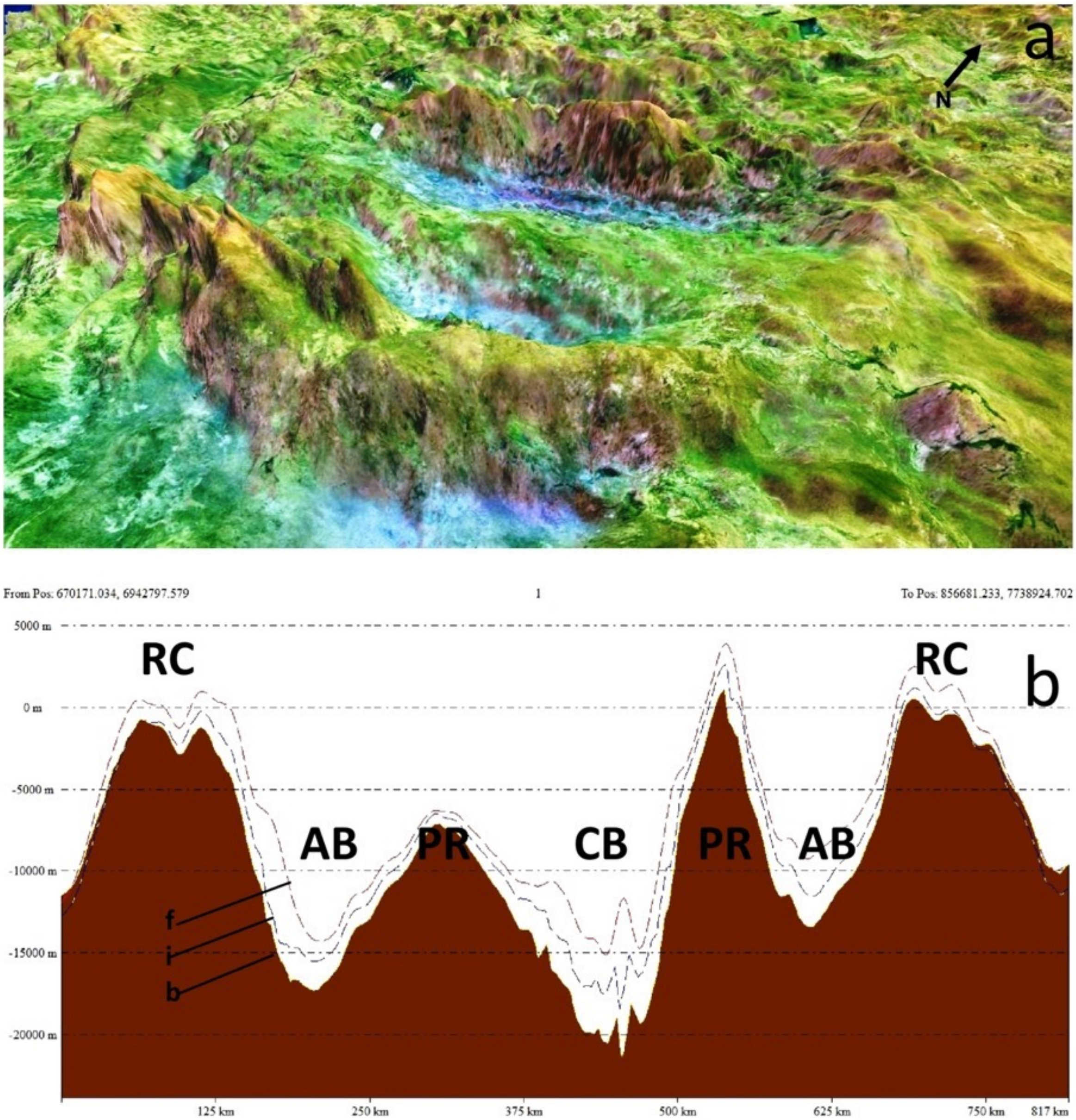

Figure 11a-b. Type of configuration that approximates the architecture of MAPCIS in its current position; a peak ring impact basin (Fig. 11a and b) mostly buried; where their rim crest would have risen more than 15,000 meters. RC= Rim Crest, AB= Annular Basin, PR= Peak Ring, CB=Central Basin.

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