MATT WILSON: AN ELLIPTICAL IMPACT CRATER IN NORTHERN TERRITORY, AUSTRALIA.

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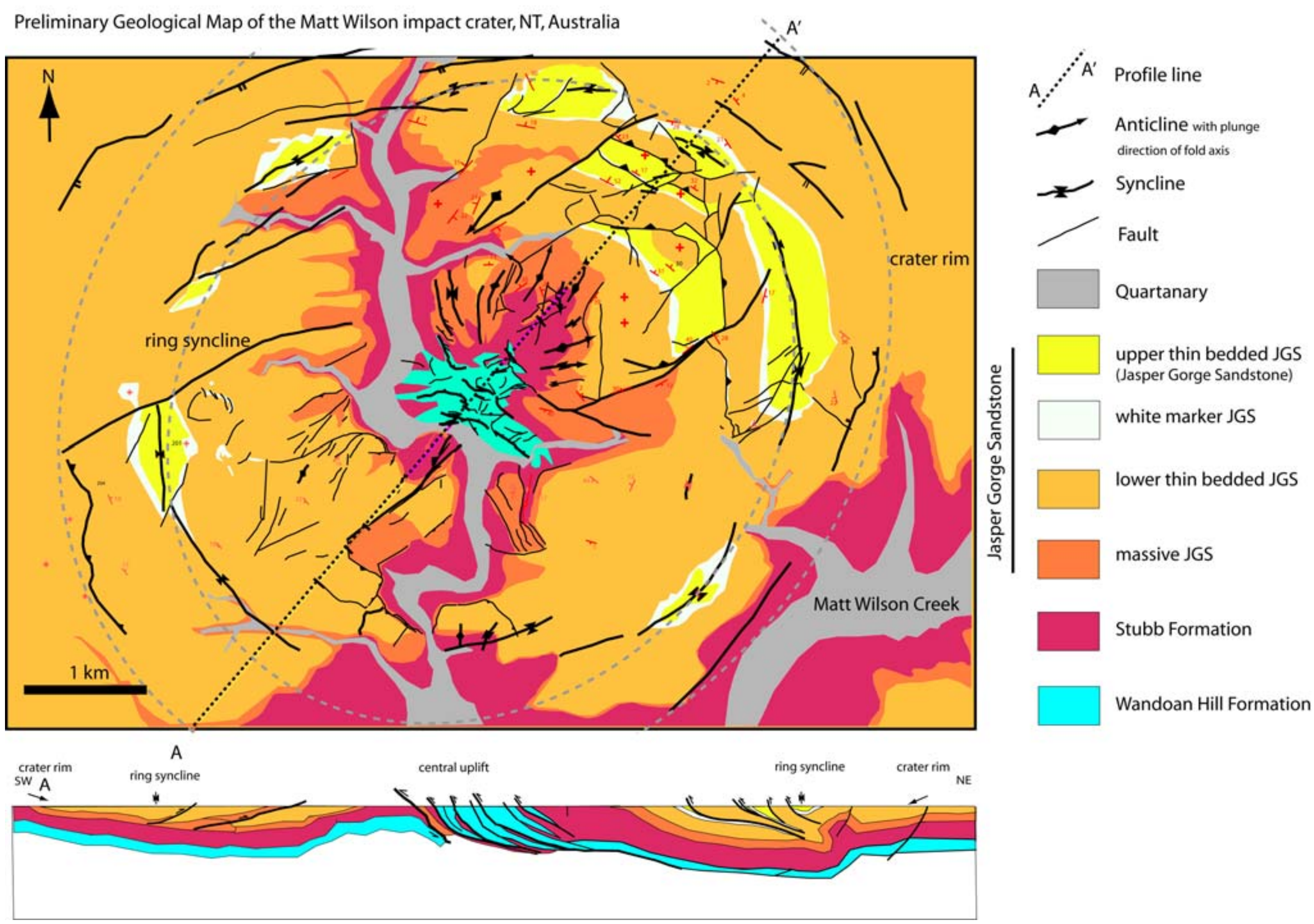
Introduction: The vast majority of impact craters is circular. Only if the impact angle is lower than 10° from the horizontal, elongated impact craters form [e.g. 1]. The crater forming process that produces elliptical shapes is poorly understood. Here we document the first elliptical crater on Earth that contains a central uplift and provides insights to the mechanisms of crater formation at a critical angle of ~10°.

Regional context: The Matt Wilson structure is situated in Gregory National Park, NT, Australia, about 17 km north of the Victoria River Roadhouse. The structure is named after a tributary creek of the Victoria river. The accessibility is difficult and requires a helicopter. The structure was first investigated by [2; 3] who proposed an impact crater origin. It is located in the Victoria Basin and is built up by Proterozoic sediments, mainly sand and siltstones that are unmetamorphosed, flat lying, and tectonically undeformed.

Stratigraphy of the structure: The lowermost outcropping rocks belong to the Wondoan Hill Formation, which is dominated by thick beds of cross bedded white sandstones that form prominent morphological ridges in the innermost part of the crater. This unit is overlain by the Stubb Formation, a sequence of brown to greenish-brown mudstones and siltstones. These sediments often form the lower part of escarpments and are mostly covered by talus. Large parts of the crater are built up by the so called Jasper Gorge Sandstone of the Auvergne Group of probable Mesoproterozoic age. This sequence is subdivided into (i) massive sandstone beds at the base forming the prominent escarpments of the National Park, (ii) lower thin-bedded siltstone-sandstone interlayers, (iii) a white marker sandstone layer that is readily visible in satellite images, and (iv) upper thin-bedded sandstone-siltstone interbeds. Younger sediments and volcanics occur outside the structure but are not preserved within the crater.

Shock indicators: Joints were observed in the in-



ner part of the dome that were oriented in an oblique angle to bedding planes and had cone-like striations. . Although they can not be regarded as a proven impact indicator yet they are believed to represent a precursor stage of shatter cones. Sweet et al [3] also reported features described as shatter cleavage. Planar fractures (PFs) are widespread in rocks of the Wondoan Hill Formation and in lithic breccias. They often show a feather structure on one side of the fractures [3] and dominantly occur parallel to the quartz basal plane (0001) and the rhombohedral planes {1011} [3]. Sets of PFs interpenetrate each other. We also found sets of narrow spaced straight lamellae that fulfill the diagnostic criteria of PDFs as well as quartz grains with reduced birefringence. A TEM analysis of the possible PDF lamellae will be carried out in the near future.

Structure: The Matt Wilson structure is outlined by a ring monocline except in the NE sector where normal faults are combined with inward dipping rocks. The monocline delineates an ellipse of 6.3 x 7.5 km with the long axis trending NE-SW. The aspect ratio of the ellipsoid of the crater rim monocline and the ring syncline is 1.18. In most parts the ring syncline has a simple geometry . It gets more complex in the NE sector where up to three NE dipping thrust planes subdivide the synform. The syncline axis is located near the monocline axis, causing a broad central uplift of great lateral extent. If the central uplift is defined as the area inside the ring syncline axis, the ratio R of the central uplift diameter to the rim diameter is R~0.8. The stratigraphic uplift of the core is ~200 m. The average steepness of the central uplifts flanks is ~5°. However, the uplift is wavy and asymmetric with a steep flank in the SW sector and in the center. In the outer part of the central uplift, strata indicate gentle folding with radially trending and outward plunging fold hinges accommodating increasing constriction in the central part. Anticlines and synclines are particularly frequent in the NE sector within rocks of the Jasper Gorge Sandstone. Amplitude and wavelength of the folds are 10-30 m and 100-200 m, respectively, in the surrounding of the inner part of the central dome. Fault zones are frequent within the ring syncline and the outer central uplift and often strike NE-SW. This direction corresponds to the long axis of the ellipsoidal outline. Most of the these faults have a transpressive character forming positive flower structures [4] that indicate a convergent inward movement. Some of the shear zones are associated with intense brecciation.

The inner part of the central uplift shows a stacking of moderately to steeply dipping thrusts of Wondoan Hill Formation. They strike NW-SE and dip to the NE. Folding of these thrust units along steeply plunging fold axes occur in the innermost part of the structure. The most prominent breccia zones (polymict & monomict lithic breccias) occur between the thrust slices.

Interpretation: The presence of possible PDFs and proven PFs in quartz grains (i), the occurrences of monomict and polymict breccias in the inner part of the dome (ii), as well as the structural inventory that indicates a convergent inward flow (iii) confirm an impact origin of the Matt Wilson structure, as was already proposed by [3]. We document here the first elliptical crater on Earth that contains a central uplift and provides insights to the mechanisms of crater formation at a critical impact angle of ~10°. We interpret the preferred stacking of thrust sheets both within the central uplift and in the surrounding ring syncline by an up range to down range transport of rock. This motion is most likely caused by remnant momentum transferred from the impacting projectile coming from the NE to the target and interferes with the characteristic inward material flow during crater collapse.

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