

Discovery of a new 12-km impact crater at Al Sail Al Kabeer, Saudi Arabia

Abdulrahman F. Toonsi

aftoonsi@icloud.com

This is a non peer reviewed preprint submitted to EarthArXiv

Discovery of a new 12-km impact crater candidate at As Sail Al Kabeer, Saudi Arabia

Abdulrahman F. Toonsi*¹

Abstract

The Arabian shield of Saudi Arabia likely has many impact craters due to the old age of its rocks, however many of them have not yet been discovered due to their resemblance to plutons. Using satellite imagery, a 12-km wide circular structure with a central peak was identified at As Sail Al Kabeer, 40 kilometers north of the city of Taif in western Saudi Arabia. Fieldwork has shown that this structure is likely an impact crater due to the presence of shocked quartz containing planar deformation features.

Introduction

Impact craters are one of the most common features in the solar system, they are present on every celestial body and provide valuable information about the history of the solar system and the objects within it. Impact craters are formed by extraterrestrial impacts caused by asteroids or comets. Impact events vaporize a large amount of the surrounding rocks creating a crater. In order to prove an impact event, certain geological features should be present such as quartz with planar deformation features (shocked quartz), shatter cones and impact breccia. Many terrestrial impact craters have been discovered however due to erosion, many of them remain hidden and yet to be discovered (French, Bevan, and Koeberl, 2009, 123-70).

Methods

This paper describes the discovery of a previously unknown impact crater candidate in western Saudi Arabia near the city of Taif. The search for terrestrial impact craters was conducted using Google Earth satellite imagery. A circular structure with a diameter of roughly 12-km was identified. Then geological maps of the area made by the Saudi Geological Survey were reviewed to understand the general geology of the area. The crater was then visited and sand samples were taken for further review under a microscope.

¹ Grade 10 student, Jeddah, Saudi Arabia.



Figure 1. The satellite image above shows the location of the impact crater candidate (google earth)



Figure 2. Satellite image showing the impact crater candidate (google earth)

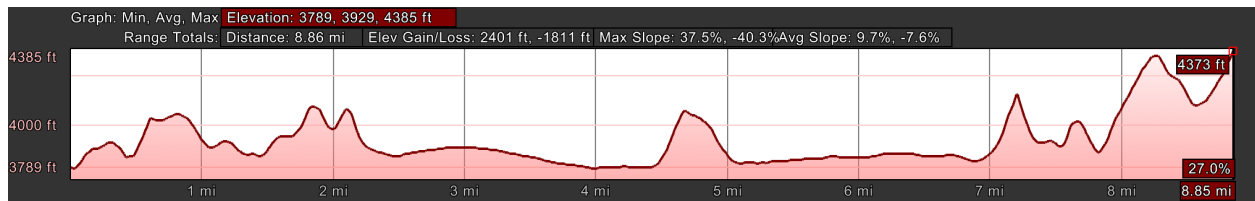


Figure 3. Elevation profile of the impact crater candidate going from northeast to southwest (left to right) showing terraced terrain, crater rim, crater floor and central peak typical of a complex crater. The crater has been filled with fluvial and aeolian deposits over time making the crater shallower. The western section of the crater has been eroded and deepened by a seasonal fluvial flow, this part was avoided in the elevation profile. (google earth)



Figure 4. An aerial image taken of the impact crater candidate showing the central peak and the circular terraced crater rim surrounding it.



Figure 5. Aerial image of exposed megabreccia that could be related to the impact event. The megabreccia is located at the coordinates: 21 41'23"N 40 22'40"E in the northwestern section of the crater rim.

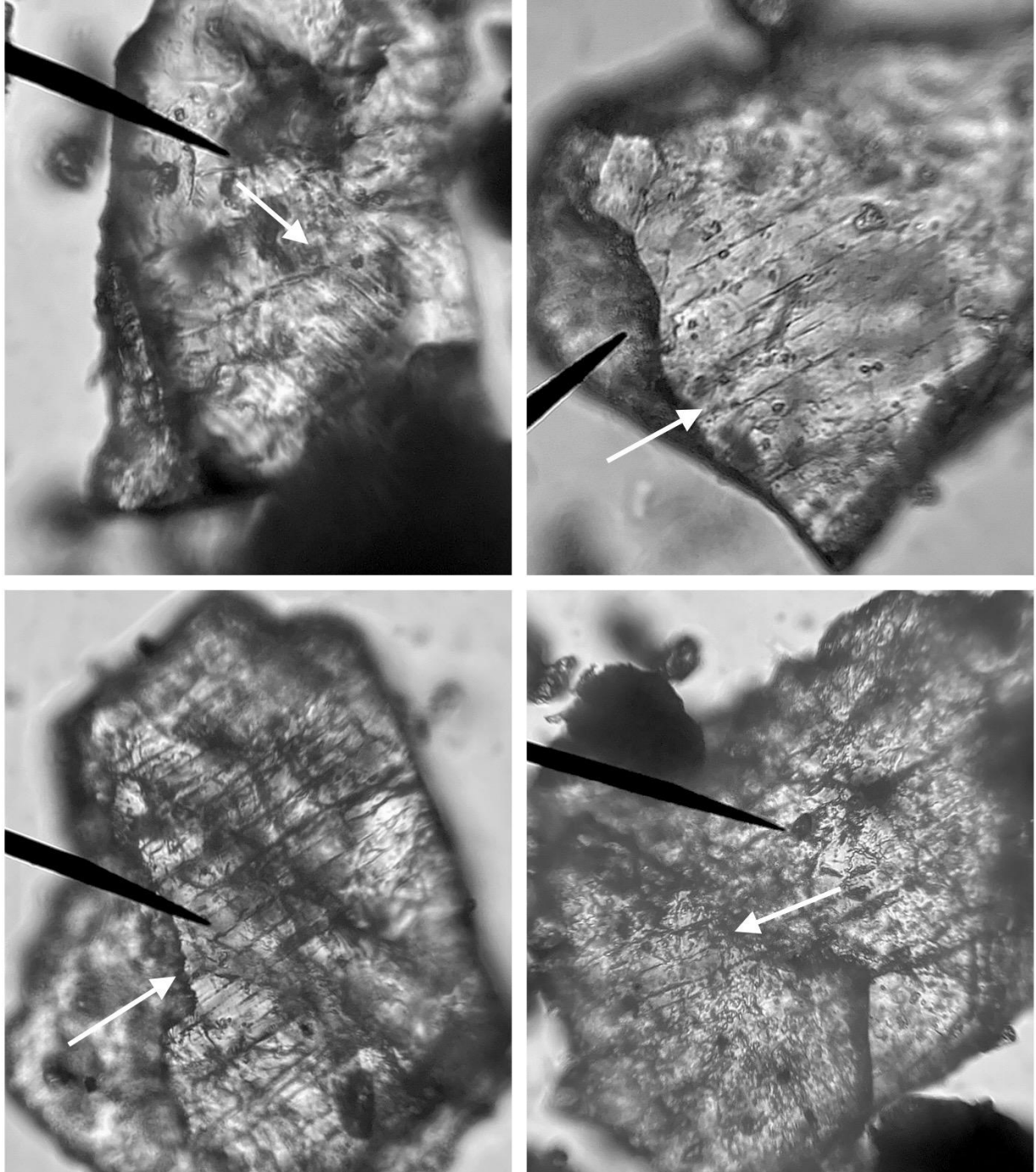


Figure 6. Images of shocked quartz grains with planar deformation features from the impact crater candidate under a microscope. Arrows show direction of planar deformation features.

Results

The impact crater candidate described in this study is situated in western Saudi Arabia, approximately 40 km from the city of Taif, and centered at the coordinates: 21 38' 23"N 40 24' 11"E.

It measures approximately 12-km in diameter however the impact structure may be larger. The central peak and terraced rim suggest that it is a complex crater. Quartz grains found at the crater show planar deformation features (figure 6) caused by shock metamorphism and are strong evidence of an extraterrestrial impact event.

Discussion

This paper describes the discovery of a new terrestrial impact crater in western Saudi Arabia, at 12-km in diameter, As Sail Al Kabeer crater could be one of the most well preserved impact craters in the region due to the strong erosion resistant crystalline rocks that it is composed of. The age of As Sail Al Kabeer crater is likely less than 700 million years as that is the approximate age of the surrounding impacted rock, though it is likely younger than that.

The size of the asteroid or comet that created this crater can be estimated using the Impact Crater Map (Imperial College London) made by Gareth Collins, Robert Marcus, H.J Melosh.

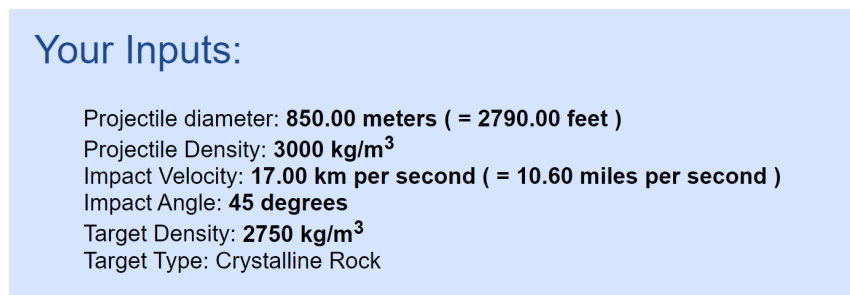


Figure 7.

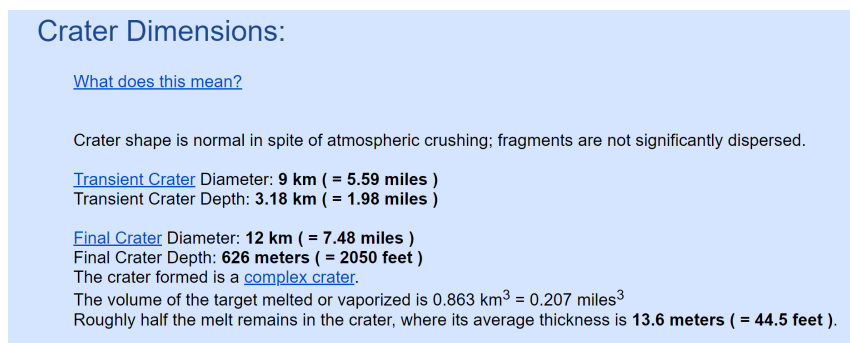


Figure 8.

As shown in figure 7 and 8, a 850 meter asteroid moving at a typical velocity of 17km/s impacting crystalline rocks would create a complex impact crater with a diameter of 12-km and a depth of 626 meters. The elevation profile in figure 3 shows structures of a complex crater with a depth of approximately 200 meters from the peak of the crater rim. The crater floor has been covered with a thick layer of fluvial and aeolian deposits making the crater shallower.

References

(French, Bevan M., and Christian Koeberl. "The Convincing Identification of Terrestrial Meteorite Impact Structures: What Works, What Doesn't, and Why." *Earth-Science Reviews* 98, no. 1-2 (2010): 123–70. <https://doi.org/10.1016/j.earscirev.2009.10.009>).