

THE DISCOVERY OF IMPACT CRATER IN SOUTHEAST MOROCCO

By Abderrahmane Ibhi & Morad Darbali

Laboratory of Petrology, Mineralogy and Materials, Ibn Zohr University, Faculty of science, Agadir Morocco.

Introduction

The first impact pit in Morocco has been recently discovered in the Tata region of the south-eastern Sahara Desert, Morocco. It is extremely well preserved; having a very young age. It is one of the smaller known pits, having a diameter of 3 m. The pit is located in Quaternary conglomerates and is filled with sandy silt. Estimates of the thickness of this sedimentary fill are around 10 cm. A thorough canvas of the pit and its vicinity was conducted, both visually and with the aid of a magnetic rake. While breccias are not found at Toufassour, meteoritic material can be found on the south and northeast outer part of the pit rim.

Morphologic and geologic features

The existence of an isolated pit, most likely of meteoritic origin, in Toufassour, Tata region, Morocco was brought to our attention late in 2006 by Mohamed Saharan nomad, who found many mesosiderite pieces in the vicinity.

The fall-location corresponds to a hole on a hill-side. Its diameter is 3 m and is now 1.25 m deep. The pit is located at Lat. $29^{\circ}39.135'N$, Long. $07^{\circ}44.958'W$, altitude 478 m, in an arid alluvial fan, approximately 15 km from the foot of the Bani Mountains (Fig. 1). The dominant formation in this region consists of a pelite-gritty series, attributed to lower Proterozoic with two small granitic outcrops, one of which is coarse-grained, alkaline muscovite and the other greyish with biotite and amphibole. These formations are surrounded and overlaid by Quaternary conglomerates. The Toufassour impact pit is located on these Quaternary conglomerates. Most meteorite searches were performed using 4WD vehicles or motorcycles; only in very special situations, was the search carried out by foot.

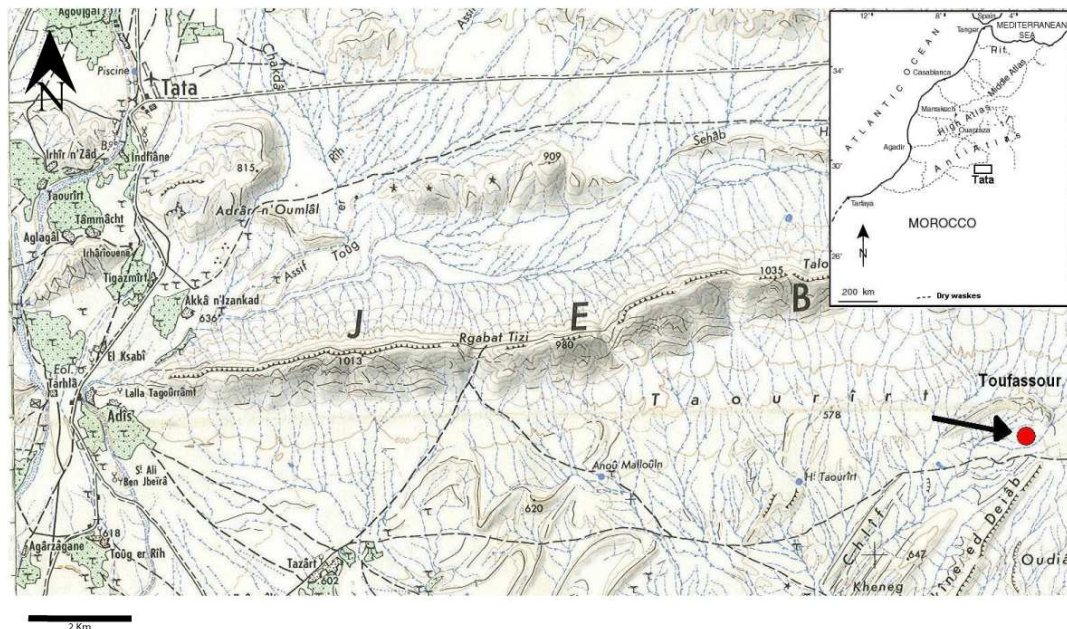


Figure 1: Map of the Toufassour meteorite impact.

Fieldwork results and evidences for an impact origin

Mesosiderite meteorite fragments have been known in the remote Tata desert of Morocco since at least the year 2003. The first masses, ranging in size from a few g to more than 5 kg, were

reported in 2003 (NWA 1827, 1879, 1882, 1912 and 1951). Shortly thereafter, stated that at least 40 kg were in the hands of collectors and it was estimated that 150 kg could easily be collected. Although the Toufassour region has been visited many times since its discovery, accurate reports of materials recovered, or their precise locations, were never recorded. Nearly 150 kg of mesosiderite meteorites were recovered from the surface of a 50 m by 100 m area elongated roughly along a southwest to northeast axis (N30). Since then, the Toufassour area has been the focus of extensive metal collecting efforts which continue even today.

In early 2009 our laboratory started on site fieldwork equipped with navigation and metal detectors, more stones (450 g) were recovered. They are mildly weathered meteorites lying well exposed on the ground. The largest piece is irregular and rounded. The lower sides are rather flattened and more corroded than the tops which never show visible cracks. The fusion crust is not visible and the appearance is dark brown, and slightly shiny. Opaquely scattering, protuberant black specks, typically 2-5 mm across, cover about one tenth of the surface. These seem to be oxide-coated metal grains. Larger nodules of metal protrude here and there, and larger inclusions of metal-free silicates can also be seen, as greenish spots. The mineralogical study shows [1] Olivine (Fa19, FeO/MnO = 35). Pyroxene (FeO/MnO = 22, from En85 Fs13 Wo02 to En59 Fs33 Wo08). Chromite [Cr/(Cr+Al) = 0.76]. Two plagioclases (Ab7 An93 and Ab82 An11 Or6). Kamacite (Ni = 6%). Merrillite with significant amounts of MgO.

Systematic metal detector sweeps revealed that remaining abundant meteorite fragments-debris are randomly distributed. They are mixed within the soil, from the surface to a depth of about 20 cm.

The aureole of small particles, which surrounded the impact pit, was picked up using permanent magnets. We also used a sieve to separate larger particles from desert sandy silt. We have picked up 420 g meteorite debris (the mass range from 1 to 5 g).

Individual fragment-debris has the characteristic appearance just mentioned for single masses. It is not clear if the separation is due to weathering or to break-up upon impact, but the latter seems more likely. Whichever the process of fragmentation, the mass-loss due to weathering must be appreciable; otherwise the multiple masses could not have achieved their rounded shapes. Many of the smaller specimens were rich in metal, the phase which has best resisted weathering. The question arises as to when this feature was formed. The exact time of formation is uncertain, but there are several scenarios to consider, among them, the feature formed much later in pre-existing Quaternary conglomerate host rocks.

Recent fieldwork in January 2010, with the aim of revisiting former find sites resulted in the discoveries of numerous additional fragments of the same fall and new meteorites were collected.

An impact pit of the size of the Toufassour depression is expected to belong to a swarm and therefore could be surrounded by a field of pits. This results from the fragmentation of brittle cosmic objects during their flight through the atmosphere, producing a cluster of pits on the surface. Within the region, plans are underway to conduct additional magnetic and geological studies of the pit and its vicinity.

References

[1] Ibbi A., Nachit H., Jambon A., Boudouma O. and Badia D. 2008. Meteoritical Bulletin, N° 94, MAPS 43, 1551-1588.