

NEW MARS METEORITE FALL IN MOROCCO: COLLECTING OBSERVATIONS AND SPATIAL DISTRIBUTION IN THE STREWNFIELD

Abderrahmane IBHI

Laboratory of Geo-heritage and Geo-materials Science, Ibn Zohr University, Agadir, Morocco

a.ibhi@uiz.ac.ma

Abstract

The existence of Martian meteorites in the region of Tata had been notified to a group of scientists of the Ibn Zohr University of Agadir, Morocco, at the beginning of January 2012 by a nomad of Tata who had found a small fragment in the region. A soon as a scientific expedition arrived at the place of the meteorite fall, the members of the laboratory of Geo-heritage and Geo-materials science collected the debris of this Martian meteorite and many information's.

The Tissint fireball is the only fireball to have been observed and reported by numerous witnesses across the South-east of Morocco. The event was extremely valuable to the scientific community; show an extraordinary and rare event and were also the brightest and most comprehensively observed fireball in Morocco's known astronomical history. Now we are in a position to draw the distribution ellipse of the fall, which starts on Jbel Al Gallab continues in the east-south-east direction above big rocky plateaus.

1 Introduction

A meteoritic body entered the earth's atmosphere in the south-east skies of Tata, Morocco, On Sunday July, 18th, 2011 at 2 o'clock in the morning. Its interaction with the atmosphere led to brilliant light flashes accompanied with detonations. The apparent magnitude of the fireball was brighter than -20. A large number of fragments survived the fireball phenomena. The saharian nomads living in the surrounding region then came together for searching the debris of this extraterrestrial rock. The first fragment had been discovered at the end of December. About a hundred persons came to the region

of Tissint (Tata, Morocco) and about fifty fragments had been collected by the nomads, traders and hunters with some knowledge about extraterrestrial rocks. This extraterrestrial debris became a source of revenue and this explains the trade value of these rocks, which appears to be reached 700 dollars for one gram, to be paid directly in cash in the desert.

Ahmed Sghiwar, a nomad who found a small block of 5 grams in the region, contacted at the beginning of January 2012 the author, Prof. Ibhi Abderrahmane, scientist and collector of meteorites at the Ibn Zohr University in order to inform him about the findings of freshly fallen meteorites in the region of Tata. Immediately a scientific expedition formed by 2 teaching researchers and two student of the Geo-heritage and Geo-materials Science Laboratory went to the fall area equipped with a modern navigation and detection instruments. The member of this team succeeded in collecting debris of this Martian meteorite and information on the fall. We present in this paper results of systematic search made over a period of one month to collect the data of this meteorite which has been named as Tissint, where a large number of fragments were found within a seven months of the fall.

2 The Martian of Tissint, collecting observations

The meteorite of Tissint is the first fall of a Martian meteorite observed in Morocco and the 5th worldwide (Nishiizumi et al., 2012). It is classified as a depleted permafic olivine-phyric shergottite (Irving et al. 2012).

Historically, watched falls took place only once in 50 years or more (1815 in France, 1865 in India, 1911 in Egypt and 1962 in Nigeria). This is once in the career of a human being. The nomads of the region of Tissint (a region in the east of Morocco, situated 60 km to the south-east of the town of Tata nearby the Moroccan-Algerian border) became to know that the pieces of rocks collected nearby their camp of the beginning of January 2012 had been in fact Martian meteorites. They started a search for the other pieces of the same fall and indeed other pieces were found in a long drawn-out zone of about 15 km in length. Most fragments have a small size, which is explained by the explosive nature of the bolide. Most fragments were found to have a well developed crust. 16 of the 51 fragments are completely crusted, 11 are partly crusted and 24 fragments have crusts only on a small fraction of the surface area (figure 1). In the sands of Oued El Myit and Oued Bou Ifasouan the men and women of the nomads used sieves in order to find debris if not even dust of this extraterrestrial rock.



Fragment is completely crusted.

Fragment is partly crusted.

Crust only on a small fraction.

Debris of Tissint meteorite.

Figure 1- Samples of Martian meteorites Tissint (Tata, Morocco)

The bolide broke into parts, when he entered the earth's atmosphere, throwing numerous fragments into similar tracks ending in an extended zone called the ellipse of the fall. Further the nomads and the military reported that it was at first yellow in color, and then turned green before it appeared to split into two parts. One portion appeared to fall in the valley, while another portion was seen to strike a prominent mountain (El Aglab). It is estimated that the bolide entered the Earth's atmosphere at a highly inclined angle southeast of Tata. The fireball detonated at a height of approximately 10 km above the point location 29° 31' N, 7° 36' W, close to the Oued Drâa in the Tissint Region. An accurate speed has not been obtained; however, on average, meteors and fireball move through the atmosphere at speeds up to and greater than 15 km/s.

3 The strewnfield of the Martian meteorite of Tissint

The strewnfield of Tissint is situated in about 60 km of linear distance to the south-east of Tata in the area of the rural commune of Tissint. It is covered within the topographic map 1: 100.000th of Tata (Figure 2). The Lambert coordinates are x = 280 800 and y = 280 100 and the GPS coordinates are "29° 31' 2881 N ; 7° 36' 4472 W".

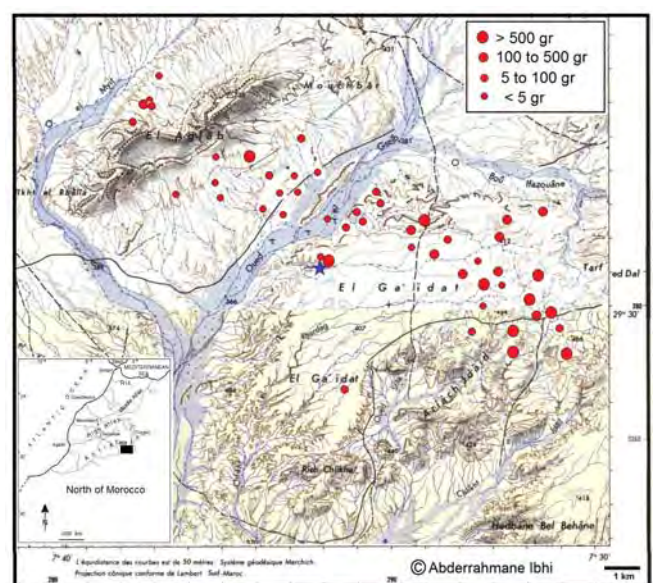


Figure 2- Dispersion of Tissint fragments in Oued Drâa. Topographic map 1:100.000th of Tata, Morocco.

In fact this fall took place in the heart of a usual prospection area of the Arabic nomads living in the military zone between Morocco and Algeria, which have some knowledge of meteorites and are looking for meteorites for the whole year on their wandering through the desert (figure 3). In several weeks of a deep search the nomads collected about 12 kg of fragments of the meteorite, some of them not passing 1 gram.



Figure 3- Nomads collecting debris of the Martian meteorite of Tissint (Tata Morocco).

We would take months to explore the entire ellipse of the fall due to the rough ground, the difficulties to access and the overall uneasy conditions. Nevertheless reliable coordinates of most of the falling places had to be got in order to determine the strewn field of the meteorite of Tata, so it had been necessary to move with 4WD cars and sometimes for narrow foot paths even with motorbikes. Additionally the nomads had to be paid for leading the scientists to the places of their findings in order to get their coordinates. Each fragment found was coded and documented with respect to its position in the field. The position of the fragments could be ascertained conveniently in the 1 x 1 km grid map with respect to local landmarks (figure 4). To date a total of nominally 50 fragments weighing about 12 kg have been found. The largest fragment weighed 1100 g and was found accidentally, near the eastern tip of the strewnfield (figure x). An important reason for the low efficiency is the similar appearance of the crusted Tissint stones and

the darkcolored sandstone fragments found extensively in the strewnfield. The nomads, however, quickly learnt to distinguish meteorite pieces from native rock fragments.

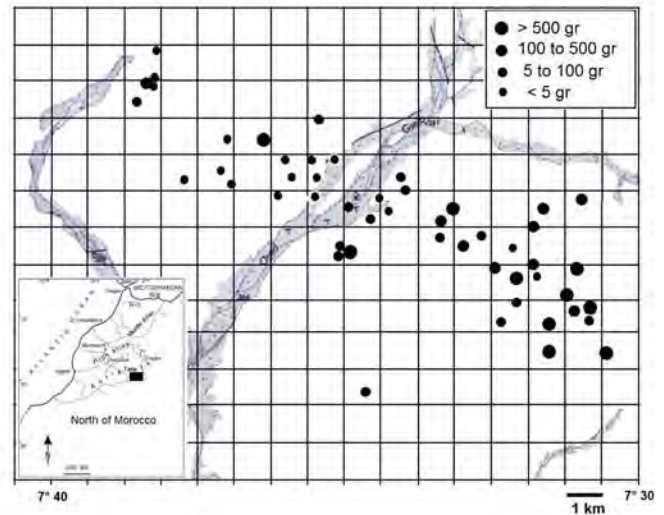


Figure 4- show the distribution of meteorites in the strewnfield and approximate size of the fragments found at different locations.

4 Discussion and conclusion

Since the year 2000 the discovering of meteorites in the hot desert of South Morocco increased steadily (Russel et al, 2005; Connolly et al 2006, 2007; Ibhi et al, 2009 and Ibhi, 2011). Some of the samples have a very high scientific value. One counts actually 20 Moroccan Martian meteorites of 61 Martian meteorites found worldwide until today (Stephen et al., 2012). Tissint represents the fifth witnessed fall of a Martian meteorite (the last one being Zagami 49 years earlier) and the first such olivine-phyric shergottite example (Irving et al. 2012).

In the field, we collected the coordinates of the most significant masses and met eyewitnesses. The coordinates are reported on the 1/100,000th map, with the inferred trajectory NW to SE. These information are in accordance with the reported testimonies.

The strewnfield of this meteorite fall extends at least 15 km from the west-north-west to east-south-east, which is also the flight direction of the meteorite after the observations of the nomads. More than 50

fragments of Tissint meteorite weighing about 15 kg have been recovered from the strewnfield of 60 km² area. Information about their position in the strewnfield is available in the case of practically all the fragments. Each fragment has been coded and information on the crusting of the surfaces has been documented.

In view of the relatively high efficiency of collection for the Tissint fragments probably higher than for any of the meteorite showers reported earlier, we have made a detailed analysis of the number and mass distribution of meteorite fragments as well as their location in the strewnfield. These data are a true heritage and has to archived.

Acknowledgements

We thank the military, Al Ho and Ahmed Sghiwar nomads for their assistance in the collection of information. Finally, we thank Hassan Nachit and Diplomphysiker Klaus Schneider for discussions.

References

Connolly H.C. Jr, Zipfel J., Folco L., Smith C., Jones R. H., Benedix G.K., Righter K., Yamaguchi A., Chennaoui Aoudjehane H. and Grossman J.N. (2007). *Meteoritic and Planetary Science*, 42, N° 3, pp. 413-466.

Connolly H.C. Jr, Zipfel J., Grossman J.N., Folco L., Smith C., Jones R. H., Righter K., Zolensky M., Russel S.S., Benedix G.K., Yamaguchi A. and Cohen B.A. (2006). *Meteoritic and Planetary Science*, 41, N° 9, pp. 1383–1418.

Ibhi A. (2011). *Les météorites du Maroc I.* eds., U. E. 152 pages, ISBN- 978-3841787590.

Ibhi A., Nachit H., Abia E.H. and Faouzi A. (2009). *Meteorite*, 15, pp. 32-36.

Irving A.J., Kuehner S.M., Tanaka R., Herd C.D.K., Chen G. and Lapen T. J. (2012). 43rd Lunar and Planetary Science Conference #2510.

Nishiizumi K., Caffee M.W. and Irving A.J. (2012). 75th Annual Meteoritical Society Meeting # 5349.

Russell Sara., Zipfel J., Folco Luigi, Jones R., Grady M.M., Mc Coy T. and Grossman J.N. (2003). *Meteoritics & Planet. Sci.*, 38, A189-A248.

Stephen N. R., Genge M. and Russell S. (2012). 75th Annual Meteoritical Society Meeting # 5234.