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Meteorite finds from southern Tunisia

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Abstract–We report on the meteorite search campaign of April 2008, conducted by a joint Tunisian-Italian scientific expedition in southern Tunisia (Dahar region). Nine likely unpaired meteorites (seven H-class and two L-class chondrites) totalling ~1.3 kg were recovered by exploring an approximately 45 km^2 area, therefore demonstrating that southern Tunisia is a suitable terrain for systematic searches for meteorites.

INTRODUCTION

With nearly 7200 specimens recovered so far, the Sahara is the second most productive area worldwide for meteorite recovery after Antarctica (over 34,000 specimens) (source The Meteoritical Bulletin Database, November 2008 update). Five meteorite falls are reported to date from northern Tunisia (Fig. 1): the Tatahouine diogenite (1931), the Djoumine H5-6 chondrite (1999), the Sfax L6 chondrite (1989), the Dahmani LL6 chondrite (1981), and the Beni M'Hira L6 chondrite (Laridhi Ouazaa et al. 2004). In addition, four meteorite finds have been recently reported (Connolly et al. 2007) from the northernmost regions of southern Tunisia.

After our first collaborative work on the characterization of the most recent Tunisian fall Beni M'Hira (Laridhi Ouazaa et al. 2004), we (NO, NP, and LF) met at the Desert Meteorites Workshop held in Casablanca in August 2006 to discuss possible meteorite research within a cooperative effort. The great number of finds from the Algerian and Libyan rocky deserts (>2000) prompted us to explore analogous terrains in southern Tunisia. Between April 5 and April 11, 2008, we thus undertook a reconnaissance campaign in southern Tunisia to assess the potential for yielding high concentrations of meteorites, and although search conditions were difficult during most of the expedition due to the fairly strong April sandstorms, we were able to recover nine meteorites.

FIND LOCATIONS

We explored some areas of the eastern sector of southern Tunisia, a rocky desert region due east of the Grand Erg Oriental, about 120 km due south of the town Rémada, and close to the Bir Zar Tunisian-Lybian frontier post (Fig. 1). This region is only accessible with the permission of the Ministry of the Interior.

In the explored area, late Cretaceous sedimentary sequences form a large monocline with a very weak (<2°) westward dip. Campanian marls and limestones alternations are overlain by a layer of pale bioclastic limestones of Maastrichtian age bearing centimeter-sized nodules of black flint; no Tertiary terrains are present in the searched area. Wide plateaus extending for tens of km^2 and several mesas extending for a few km^2 dominate the landscape (Fig. 2).

Search traverses were conducted by a group of six people using four-wheel drive vehicles and on foot (Fig. 2), totalling a searched area of ~45 km^2 in seven days.

Local logistic support was kindly provided by the Compagnie Générale de Géophysique—Veritas Services Tunisie (CGG-Veritas).

RECOVERED METEORITES

Nine meteorites, ranging in mass from 5 to 630 g, and totaling 1.3 kg, were recovered and are listed in Table 1. Two meteorites were found (Fig. 1) in the Es-Souid area (~31°29′N–9°51′E), whereas the other seven were found in the Makhrouga area (~31°54′N, 10°11′E). The meteorites are named Bir Zar after the geographic name of the Tunisian-Lybian frontier post, plus have a sequence number according to the Guidelines for Meteorite Nomenclature for dense collection areas.

Meteorites show variable degrees of terrestrial weathering, ranging from minor to severe. For instance, the Bir Zar 002 and 007 meteorites show a well-preserved matte,

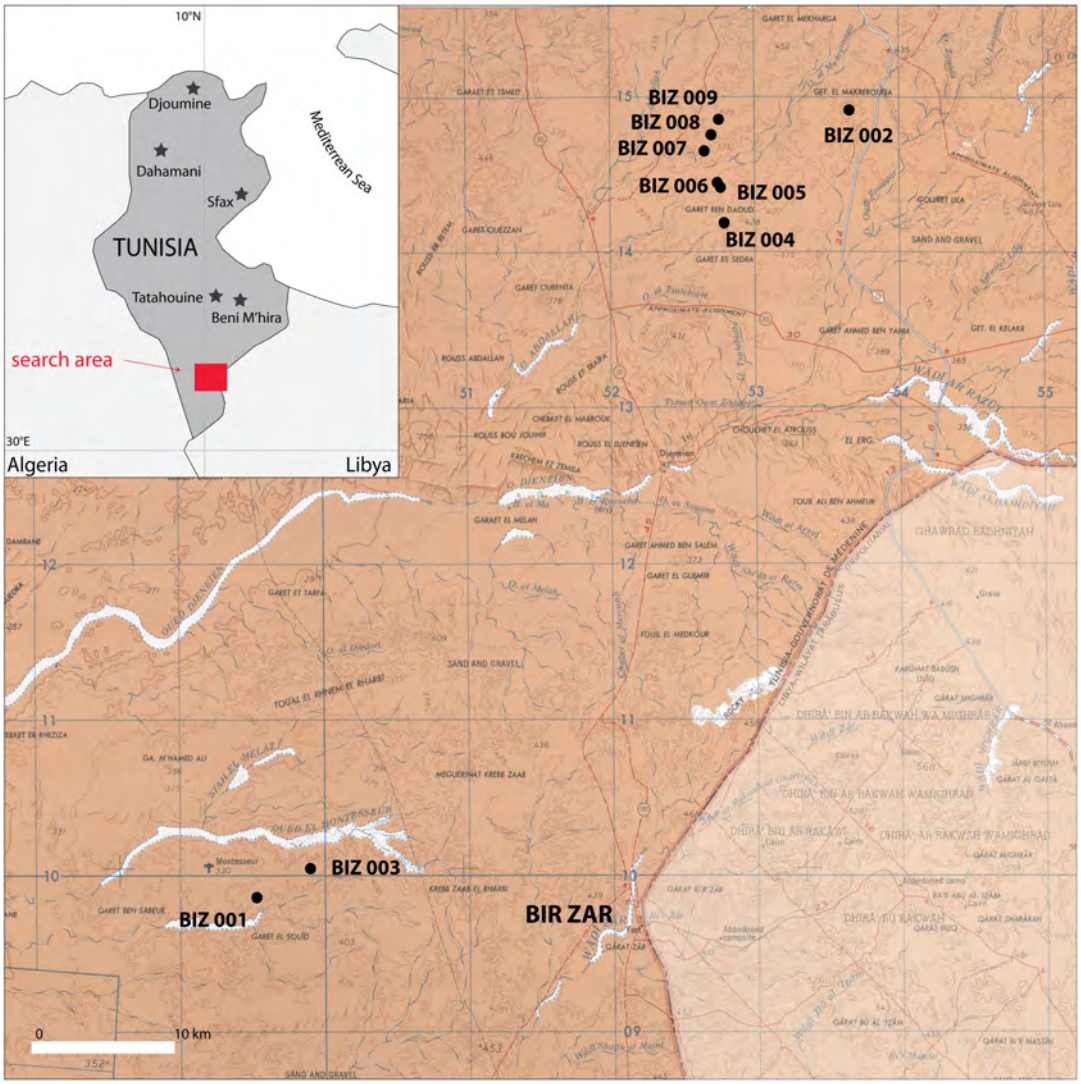

Fig. 1. Sketch map of Tunisia showing locations of the Tunisian meteorites and of the new finding zone. Map courtesy of The General Libraries, The University of Texas, Austin.

black fusion crust with minor oxide haloes, whereas Bir Zar 003 and 008 are devoid of fusion crust and are almost completely covered by a brown layer of desert varnish (Fig. 2). The variable degree of terrestrial weathering suggest different resident times on Earth, likely within the Holocene. As shown in fact by Jull (2006), the number of finds for Saharan meteorites exponentially decreases with their terrestrial age to 30 ka, with most of the meteorites having terrestrial ages younger than 20 ka. A correlation between the age distribution of meteorites and the climate change has been suggested by Jull (1990). In agreement with these observations, during our search campaign we found several Neolithic stations, with fairly abundant artefacts such as blades, flakes, scrapers, and arrow heads. Both the find locations and the surface details suggest a Neolithic age for such objects. (Abderazak Gragueb, Institut National du Patrimoine, Tunis, personal communication 2008).

In situ classification and pairing based on magnetic susceptibility measurements with a hand-held meter (SM30), following Rochette et al. (2003) and Folco et al. (2006), coupled with petrographic classification, reveals that the nine meteorite specimens belong to the ordinary chondrite group, namely, seven H-chondrites and two L-chondrites, and are likely nine distinct meteorites; although BiZ 006 and BiZ 008, found within a short distance (~3.16 km) may be paired as they share many petrographic features and have similar magnetic susceptibility (Table 1). This was later confirmed by petrographic classification based on optical microscopy and microanalytical scanning electron microscopy (Table 1; Figs. 3 and 4).

After the expedition, the specimens were split and are now maintained by the Faculté de Sciences de Tunis, Département de Géologie, and the Museo Nazionale dell'Antartide in Siena.

Table 1. Meteorites from the Bir Zar region, southern Tunisia.

Name	Locality	Date	Latitude N	Longitude E	Pieces	Mass (g)	Mag. sus. (log χ)	Class	SS	WG	Fa*	Fs*	Wo*
BiZ 001	Es-Souid	April 5	31°28′51.6″	9°50′26.5″	1	627	4.90	H6	S1	W2	17.4 ± 0.2	15.6 ± 0.3	1.4 ± 0.1
BiZ 002	Makhrouga	April 6	31°56′18.0″	10°17′02.5″	1	331	4.79	L4/5	S5	W1	22.6 ± 0.4	19.9 ± 0.8	1.5 ± 0.2
BiZ 003	Es-Souid	April 10	31°29′59.0″	9°52′38.0″	3	39	4.08	H3	S2	W3	20.0 ± 6.6	12.7 ± 5.8	1.2 ± 0.6
BiZ 004	Makhrouga	April 11	31°52′17.9″	10°11′37.0″	2	19	4.39	H6	S2	W3	17.7 ± 0.1	15.8 ± 0.4	1.6 ± 0.3
BiZ 005	Makhrouga	April 11	31°53′48.8″	10°11′44.6″	1	17	4.88	H4	S2	W2	16.8 ± 0.3	15.8 ± 1.7	1.2 ± 0.3
BiZ 006	Makhrouga	April 11	31°53′53.9″	10°11′43.0″	2	21	4.36	H6	S1	W3	16.8 ± 0.6	16.1 ± 0.6	1.5 ± 0.1
BiZ 007	Makhrouga	April 11	31°55′18.5″	10°11′15.0″	1	5	4.94	L6	S4	W1	22.9 ± 0.5	19.5 ± 0.2	1.5 ± 0.2
BiZ 008	Makhrouga	April 11	31°55′35.2″	10°11′22.6″	Many	200	4.38	H6	S1	W4	17.2 ± 0.3	15.4 ± 0.3	1.5 ± 0.1
BiZ 009	Makhrouga	April 11	31°55′35.2″	10°11′22.6″	3	21	4.53	H5–6 br	S3	W3	16.9 ± 0.3	15.2 ± 0.4	1.3 ± 0.1

SS = shock stage.

WG = weathering grade.

*Mean, esd.

Fig. 2. A) Panoramic view of the typical terrains in the Bir Zar finding locality, Dahar region, southern Tunisia. B and C) Search traverses conducted on the field. D, E, F) Recovery of meteorites on the field; in Fig. 2F, a meteorite and a flint artifact were found close together in the field.

CONCLUSIONS

Nine meteorites were found during our first reconnaissance expedition in April 2008. Besides bringing the total number of Tunisian meteorites from 9 to 18, these findings document that the rocky deserts in southern Tunisia (Dahar region) are suitable areas for systematic searches for meteorites.

Acknowledgments–The project for this meteorite search expedition had a great impulse from the meeting of the Tunisian and Italian parties at the Desert Meteorites Workshop held in Casablanca in August 2006, organized by H. Chennaoui-Aoudjehane, and sponsored by the Meteoritical Society. J. M. Houssaye, CGG-Veritas Services (Tunisie), and Pioneer Resources Tunisia Ltd., are kindly acknowledged for the permissions and for the local logistic support. N.

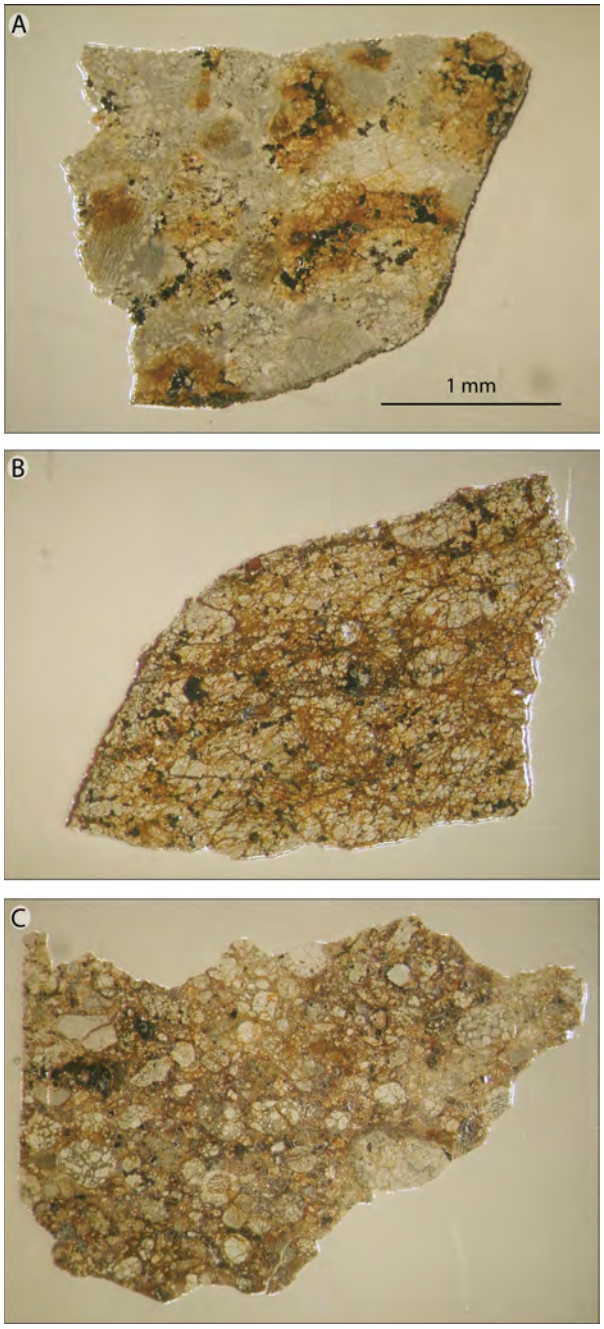

Fig. 3. Polished thin sections of selected meteorites from the Bir Zar locality, southern Tunisia, as seen under the stereomicroscope. A) A relatively fresh L4/5 chondrite (BiZ 002) showing readily delineated chondrules. B) A highly recrystallized H6 chondrite (BiZ 004). C) A H3 chondrite showing well-defined chondrules set in a fine-grained matrix.

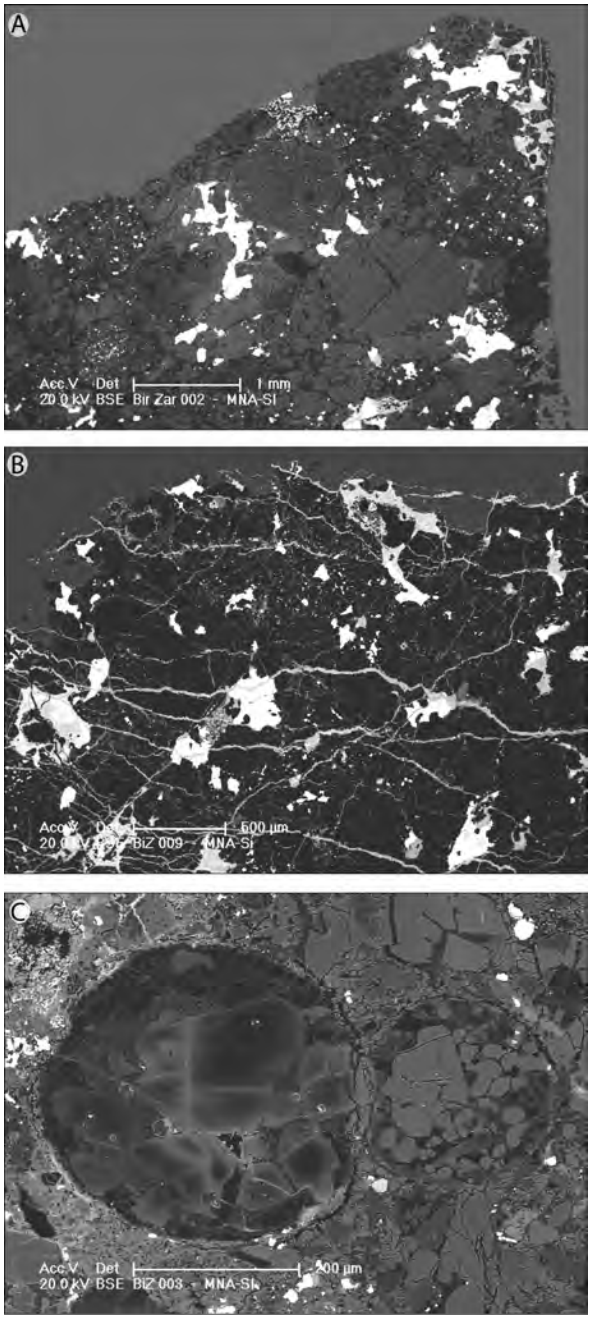

Fig. 4. Backscattered electron micrographs of selected meteorites from the Bir Zar locality, southern Tunisia. A) The fresh (W1) BiZ 001 L4/5 showing minor oxidation of metal grains. B) The H5–6 chondrite breccia showing heavy oxidation of metal and troilite (W3) and pervasive veinlets filled with limonite as a result of important weathering. C) A detail of the BiZ 003 H3 chondrite featuring two type-II porphyritic chondrules mainly composed by zoned low-Ca pyroxene and olivine microphenocrysts merged in a glassy mesostasis.

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