Circular Feature Among Dunes of the Great Sand Sea, Egypt

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Abstract. A circular crater, about 4 kilometers in diameter and located at 24.2°N, 26.4°E, was discovered in Landsat images among the linear dunes of the Great Sand Sea, Egypt. The crater has a sharp and crenulated rim crest, a terraced wall, a discontinuous inner structure (approximately 1.5 kilometers in diameter), and a few rim blocks. Its morphological and morphometric characteristics are similar to those of meteorite impact craters and other circular structures on the moon and the terrestrial planets. Because of its interaction with windblown sand, it is particularly comparable with craters on Mars.

The Western Desert of Egypt has been the site of much of the basic research on dune classification and sand movement by the wind (1). It is part of the eastern Sahara, the driest large expanse of land on Earth, where received solar radiation is capable of evaporating 200 times the amount of rainfall (2). This vegetation-free, north-dipping plain of sedimentary rocks is crossed by numerous belts of sand dunes predominantly of the linear type; the largest accumulation of such dunes forms the Great Sand Sea (Fig.1) (1).

The southern part of the Western Desert was recently divided into two physiographic provinces, the Arba'in Desert in the east (3) and the Uweinat Desert in the west (4). The Arba'in Desert was named after the Darb El-Arba'in camel track that connects the Kharga Oasis in Egypt to El-Fasher in the Sudan. It contains numerous Paleolithic and Neolithic sites, which indicate episodic human habitation from 200,000 to 3000 years ago (3). Similar indications of former pluvial phases exist in the Uweinat Desert, which was named after the 35 by 20 km, 600-m-high mountain at the intersection of the borders of Egypt, Libya, and the Sudan (4).

Fluvial action in the geological past, followed by eolian activity under the extremely arid conditions of today, have produced a landscape in the Uweinat Desert that is comparable to that of...
Mars. Canyons and wind streaks revealed on Mars by Mariner 9, Viking 1, and Viking 2 resemble features in the Uweinat area photographed by the Apollo-Soyuz astronauts and Landsat (5).

The most imposing features of the Uweinat Desert are the linear dunes of the Great Sand Sea. This sand sea covers an area the size of Ireland—over 72,000 km². Individual dunes are often over 100 km long and 100 m high. The base of each dune, 2 km wide on the average, is usually a gently sloping, relatively stable whaleback dune. The whalebacks are commonly topped by sharp-crested, constantly shifting self dunes.

Another significant feature of the Uweinat Desert is the abundance of crater forms. Most of these craters are believed to be of volcanic origin, such as the Clayton craters, a field of some 20 (6). Furthermore, four subdued circular features approximately 130 km east-southeast of Uweinat Mountain and up to 14 km in diameter were revealed by Landsat images. These features, named Bagnold, Miskin, Shaw, and Sweeting after the explorers whose tracks came nearest to them (6), have not yet been studied in detail and remain of unknown origin.

A circular feature was discovered among the dunes of the Great Sand Sea on Landsat multispectral scanner frame 10113-08135 and return beam vidicon frame 30960-07490 (site 1 in Fig. 1, Fig. 2a). It is located at 24.2°N, 26.4°E in sandstone of the Nubia series, which covers most of the southern part of the Western Desert. This crater is about 4 km in diameter, being 3.8 km across in one place and 4.2 km at the protrusion on the southeast corner. It has a complex structure with a flat floor, a terraced wall, a crenulated rim, and the subdued remains of an inner structure, approximately 1.6 km in diameter, that may have been a central uplift. The crater is surrounded by a rough-textured deposit, particularly on the east side. This deposit, which contains large blocks, extends up to 2 km from the rim.

The morphological characteristics of the crater are similar to those of craters produced by meteorite impact (7). Its outline is similar to that of the bowl-shaped (1.2 km in diameter) Barringer (Meteor) Crater in northern Arizona (4). However, the feature in the Western Desert may have formed by a circular diorite intrusion; after erosion by the wind only the hardened and metamorphosed sandstone would remain to form the circular crater (8).

Shallow measurements show that the crater is less than 100 m deep. However, because of its location in the path of sand-carrying winds, much of the original shape could have been modified. Also, the southwestern corner of its rim appears to have been eroded and partly buried by a sand dune (Fig. 2a). Because of the lack of named features in the crater's vicinity, I will use the prerogative of the discoverer and name it El-Baz Crater.

El-Baz Crater shows similarities to flat-floored craters in the lunar highlands and on Mercury. It shows even more similarities to martian craters because of its interaction with a strong wind regime in an arid environment. Of special significance are the protrusion on the crater's southeast corner and the crenulated rim, the deflection of dunes by the crater rim and the occurrence of a sand-free zone in its lee, and the dark splash just south of the rim in the lee of the wind. All these features are common on martian craters (5), particularly in the Cerberus region (Fig. 2b). Because of this, an expedition will be organized to collect samples and to study the crater's morphology and interaction with the wind regime of the Great Sand Sea.

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References and Notes
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