A 2003 EXPEDITION INTO THE LIBYAN DESERT GLASS STREWN FIELD, GREAT SAND SEA, WESTERN EGYPT. Christian Koeberl¹, Michael R. Rampino², Dona A. Jalufka¹, and Deborah H. Winiarski². ¹Department of Geological Sciences, University of Vienna, Althanstrasse 14, Vienna, A-1090, Austria, (christian.koeberl@univie.ac.at), ²Earth & Environmental Science Program, New York University, 100 Washington Square East, New York, NY 10003, USA (mrr1@nyu.edu).

Introduction: Libyan Desert Glass (LDG) is an enigmatic type of natural glass that is found in an area with an extension of several thousand square kilometers. Literature values on the extent vary between about 2000 and 6500 km². This area, or strewn field, is located between sand dunes of the southwestern corner of the Great Sand Sea in western Egypt, near the border to Libya. Therefore, the name "Libyan" Desert Glass is not entirely correct, given today's geographical boundaries, but refers to the traditional name of the desert. P.A. Clayton was the first to travel the region in the early 1930s and to collect glass samples that were used to provide the first detailed scientific description of the glass and its occurrence. In addition, R. A. Bagnold visited the LDG area in the 1930s. The inaccessibility of the LDG area was the reason for a relative paucity of visits to the location. In the 1970, visits by, for example, J.R. Underwood, E. P. Fisk, and V.E. Barnes led to the collection of a large number of LDG samples and some petrographical work [1]. In addition, two impact structures were discovered just west of the LDG strewn field, just over the border in Libya: the B.P. and the Oasis impact structures, which are of interest because of a possible connection with the origin of the LDG; see below for a more detailed discussion.

Petrography and Geochemistry: In macroscopic examination, the glass shows irregular shapes with signs of sand abrasion and other erosion features. The fission track age of LDG has been determined to be about 29 Ma (e.g., [2]). LDG is a very silica-rich natural glass with about 96.5-99 wt.% SiO₂, and shows a limited variation in major and trace element abundances. So far rather few trace element studies of LDG exist, but the available data (for example, those for the rare earth elements) indicate abundances and interelement ratios that are typical for upper crustal rocks. Libyan Desert Glass has, since its discovery, been the subject of a number of studies, ranging from glass technological aspects to petrographical and geochemical work.

The origin of LDG has been the subject of a controversy (see, e.g., [1, 3]), which - in the view of some researchers - is still not settled. However, the majority of workers favor an origin by impact (see, e.g., papers in [3]). There are, however, some differences to "classical" impact glasses, which occur in most cases directly at or within an impact crater. Evidence for an impact origin includes the presence of schlieren and

partly digested mineral phases, lechatelierite (a hightemperature mineral melt of quartz), and baddeleyite, a high-temperature breakdown product of zircon.

The rare earth element abundance patterns are indicative of a sedimentary precursor rock, and the trace element abundances and ratios are in agreement with an upper crustal source. There is a similarity between LDG major and trace element abundances and Sr and Nd isotopic compositions and the respective values for rocks from the B.P. and Oasis impact structures in eastern Libva, but lack of age information for the two Libvan structures precludes a definitive conclusion. There are some good indications for the presence of a meteoritic component in LDG (e.g., [4]). Os abundances and isotopic values conform the presence of a meteoritic component in LDG [5]. This observation is difficult to reconcile with an airburst model, because it requires physical mixing between meteoritic and crustal matter in liquid form (i.e., in a melt phase).



Fig. 1. Systematic search in the LDG area for glass samples

2003 Expedition: To obtain a better understanding of the distribution of the LDG in the strewn field, to search for possible impact-related breccias in the LDG strewn field, and especially to obtain further samples with dark streaks to better and more thoroughly study the meteoritic component, we undertook a 10-day expedition into the LDG area in early 2003. During systematic searches (which also helped to obtain information on the spatial distribution of the samples; Fig. 1), a large number of LDG was found (Fig. 2, 3). About 50 kg of LDG

samples, ranging up to 2.5 kg in weight, were collected, including about two dozen specimens with dark zones, layers, or generally dark appearance. There is a large variation in color and opacity of the various LDG samples. The larger ones are usually white/cloudy and not transparent, whereas some up to 10-cm-sized samples are clear and almost of gem quality (e.g., Fig. 4). A few samples were found to contain also other types of dark inclusions. The study of these samples is in progress and will be reported on separately.



Fig. 2. One of the larger pieces of LDG recovered during the 2003 field trip.



Fig. 3. In some of the corridors between sand dunes in the LDG area, accumulations of several large specimens of different color and opacity were encountered.

Acknowledgment: CK is supported by the Austrian Science Foundation (project Y58-GEO).

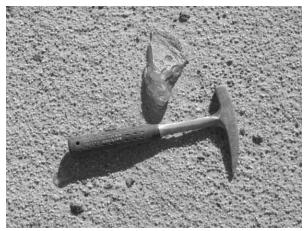


Fig. 4. A large, almost transparent LDG specimen. This samples also shows a dark layer that may contain a meteoritic component.

References: [1] Barnes V.E. and Underwood J.R. (1976) *Earth Planet. Sci. Lett.* 30, 117-122. [2] Bigazzi G and de Michele V (1996) *Meteoritics Planet. Sci.* 31, 234-236. [3] de Michele V. (ed.) (1997) Proceedings, Silica '96, Meeting on Libyan Desert Glass and related desert events. Pyramids Publ., Milan, Italy. [4] Barrat J.A. et al. (1997) *Geochim. Cosmochim. Acta* 61, 1953-1959. [5] Koeberl C. (2000) *Meteoritics Planet. Sci.* 35, A89-A90.