TEKTITE FORMATION THROUGH UPRANGE ENTRY WAKE EJECTION: AN UPDATE.
C. Koeberl1 and M. B. Boslough2, 1Department of Lithospheric Research, University of Vienna, 1090 Vienna, Austria (christian.koeberl@univie.ac.at), 2Los Alamos National Laboratory, Verification and Analysis, XCP-8, Los Alamos, NM 87545, U.S.A., and University of New Mexico, Earth and Planetary Sciences, Albuquerque, NM 87131, U.S.A. (mbeb@unm.edu).

Introduction: Tektites are a rare type of impact glass; they are found in only four distinct and geographically extended strewn fields, ranging from 0.8 to 35 million years in age. These are the Australasian, Ivory Coast, Central European, and North American strewn fields. For three of these four strewn fields (the exception being the Australasian field), the source crater has been identified. It is interesting to note that in all cases the crater is not in the center but near the limit of the respective strewn field. Microtektites (less than a mm in size) are also known from deep-sea cores at three of the four fields, in addition to normal, centimeter-sized specimens; their distribution defines the size of the various strewn fields. Tektite-like glasses have, over the past decades, been also found in a few other locations, but they have rather limited distribution, or just a few specimens have been recovered, or their sources and origins are not well understood, or a combination of these circumstances. Despite much research over the past decades, a detailed physical model of tektite origin that explains all observed attributes (see below) is still lacking. We provide an update on our recent work on this topic.

Tektite Characteristics: Tektites differ from “normal” impact glasses in that they were derived from the very surface of the target area (as is indicated by their high contents of the cosmogenic radioisotope Be-10) and may have formed and been ejected before the main crater excavation phase even began (see, e.g., [1, 2]). They have very minor meteoritic components, as indicated from, for example, Os isotopic studies. As most tektites are homogeneous glass, they must have experienced rather high formation temperatures. Recent analyses have also shown that in many tektites the elements Zn, Cu, Cd, and Sn (among some other elements) are isotopically fractionated, most likely by volatilization effects. The study of unconventional stable isotopes provides interesting clues regarding the formation, differentiation, and deposition of tektites. Tektites are clearly an interesting and unusual subtype of impact glasses. In addition to the points noted above (high Be-10 content and minor extraterrestrial component), other important properties of tektites are that (a) they are glassy (amorphous), (b) they are fairly homogeneous rock (not mineral) melts, (c) they contain abundant lechatelierite, (d) they occur in geographically extended strewn fields (not just at one or two closely related locations), (e) they are distal ejecta and are not found in or around a source crater or within typical impact lithologies (e.g., suevitic breccias, impact melt breccias), and (f) they generally have low water contents.

Origin of Tektites: A variety of glasses form in impact processes, and lots of such glasses are found within the crater, or as parts of impact breccias (suevites). However, while tektites are impact glasses, not all impact glasses are tektites, as indicated by the distribution and characteristics of tektites summarized above. The formation of tektites must involve some special conditions. Tektites are obviously the product of an impact process, but would have been produced at the very beginning of the crater-forming sequence, as indicated from the near-surface target rocks that were melted (high Be-10), as mentioned above. The asymmetric position of the crater in the strewn field, as well as differences between tektite types, indicate an oblique impact. Our hypothesis, which is based on observations made during the impact of Comet Shoemaker-Levy 9 into the atmosphere of Jupiter in 1994, is that tektites originate from the highest-velocity material in the ejecta curtain that is accelerated from near ground zero immediately after the impact - see [3] for more information. There is one direction in which there is little drag on an object launched from the surface, and that is the high-temperature, low-density, expanding wake associated with the object that traversed the atmosphere just prior to impact. Our preliminary hydrocode simulations (see [3]) provide support for and constraints on this model; in these models, crater-forming impacts with angles of about 45° relative to the Earth's surface generate ballistic plumes that agree broadly with observed ejecta distributions. The first results, while promising, still have to be refined to explain if (and how) really only the top layers of the target are involved, if there is a cut-off in terms of time and other impact parameters, and how the distribution of the different tektite types (in some of the strewn fields) can be reproduced.