CRETACEOUS-TERTIARY BOUNDARY SPHERULES AND CENOZOIC MICROTEKTITES: SIMILARITIES AND DIFFERENCES; B. P. Glass, Geology Department, University of Delaware, Newark, DE 19716; Bruce F. Bohor and William J. Betterton, U.S. Geological Survey, Box 25046, MS 972, Denver, CO 80225

Bohor and Betterton [1] pointed out that the K-T spherules can be divided into three groups. Their Type 1 spherules appear to be found in or adjacent to North America, particularly the Western Interior and in Haiti and Mexico. The Type 1 spherules occur in the lower part of the K-T boundary clay below an Ir anomaly. It is the Type 1 spherules which are most similar to microtektites. The discovery of K-T boundary spherules in Beloc, Haiti, and Mimbral, Mexico, with residual tektite-like glass cores [2-3] supports the hypothesis that the Type 1 spherules are diagenetically altered microtektites. How similar are the Type 1 K-T boundary spherules to previously described Cenozoic microtektites and in what ways are they different?

Size and Shape. In general the Type 1 K-T spherules from the Western Interior and Haiti are similar to microtektites in size and shape. Although microtektites were originally defined as being tektites <1mm in dia., millimeter-size splash-form tektites were found in late Eocene sediments off New Jersey (DSDP Site 612). The spherical K-T spherules from the Western Interior are up to 2mm in diameter and the spherical Haitian spherules are up to 3.5 mm in size [4]. Very little data are given concerning the size distribution of the K-T spherules, but the impression is that at a given site the larger spherules are more abundant than the smaller ones. If this is the case, then the size distribution is different than for the Cenozoic microtektites which increase in number with decreasing size. Both the K-T spherules and the Cenozoic microtektites consist mostly of spheroids, with elongate forms like teardrops and dumbbells being relatively rare.

Surface Features. In contrast to the microtektites which generally exhibit a variety of surface features including pits, grooves, and mounds, the K-T spherules are generally smooth and featureless [1,3]. A few of the Western Interior K-T spherules do have pits and grooves similar those seen on Cenozoic microtektites [5], but they are rare.

Composition. The Haitian glass cores have SiO_2 contents between 60 to 68% [3,6]. This is lower SiO_2 than is generally found in tektites, but it is well within the range of SiO_2 contents observed in microtektites. In fact, all the major oxides are in the range observed for Cenozoic microtektites except for the CaO and Na_2O contents which are somewhat higher. As a group the Haitian glasses have a wide range in composition with SiO_2 between 44 and 68% [3]. The low SiO_2 (48-50%) glasses have very high CaO contents (up to 31%). Although none of the Cenozoic microtektites have this high a CaO content, some have SiO_2 contents as low as 48% and MgO as high as 24% [7]. Like Cenozoic microtektites, the more SiO_2-rich Haitian glasses are generally homogeneous; however some contain streaks of the yellow, low SiO_2, high-CaO (HCa) glass [3]. In contrast, the Cenozoic microtektites do not contain inclusions or streaks of the high MgO (HMg) glass.

Petrography. Like most Cenozoic microtektites, the more SiO_2-rich Haitian glasses contain rare vesicles, but no crystalline inclusions. Unlike most Cenozoic microtektites, the more SiO_2-rich Haitian glasses do not appear to contain lechatelierite particles. The HCa Haitian glasses are more vesicular, and contain melilite(?) crystals and relict inclusions of what appears to be a calcium sulfate mineral. In contrast, the HMg Cenozoic microtektites are devoid of vesicles and crystalline phases. Neither the HCa K-T glasses nor the HMg Cenozoic microtektites appear to contain lechatelierite.

Association with Unmelted Impact Ejecta and Iridium. The Type 1 microtektite-like spherules occur in the lower claystone layer of the K-T boundary unit below an Ir anomaly. Shocked quartz with multiple sets of shock lamellae are found associated with the Type 1 spherules, but is most abundant in the overlying Ir-rich layer [8]. Traces of stishovite have been reported in the K-T boundary layer [9], but coesite has not. In contrast, none of the Cenozoic microtektite layers are directly associated with an Ir anomaly. Furthermore, coesite is commonly found associated with the North American microtektites and with the Australasian microtektites; but, shocked quartz with multiple sets of shock lamellae appear to be quite rare.

Discussion. Aside from the fact that the Type 1 K-T boundary spherules are mostly diagenetically altered, they have many charateristics in common with Cenozoic microtektites. There are some differences, however. In contrast with Cenozoic microtektites, the K-T spherules do not appear to increase in abundance with decreasing size, they generally do not exhibit surface sculpturing (although the relict glass cores do show sculpturing), they do not contain lechatelierite particles, and they are closely associated with an Ir anomaly and shocked quartz, but not with coesite. Most of these differences may be attributed to different parent rock, to the larger size of the K-T event, and to later diagenetic alterations. The apparent dearth of small versus large spherules at a given site may be attributed to a combination of operator bias and more complete diagenetic destruction of the small spherules. The general lack of external surface sculpturing may be due to the formation of palagonite rims as the warm spherules fell into water [10]. The lack of lechatelierite particles and the apparent lack of associated coesite may be partly related to the larger size of the K-T event which may have resulted in higher average temperatures. The lack of lechatelierite may also be related to the high CaO content of the glass. The higher lime content may have acted as a flux which resulted in greater homogenization of the Haitian K-T glass.

References. [1] Bohor, B.F. and Betterton, W.J. (1990) LPSC **XXI**, 107. [2] Smit, J. et al. (1992) Geology **20**, 99. [3] Sigurdsson, H. et al. (1991) Nature **349**, 482. [4] Izett, G.A. (1990) J. Geophys. Res. **96**, 20,879. [5] Izett, G.A. (1990) GSA Spec. Paper 249, 100p. [6] Maurrusse, F.J-M.R. and Sen, G. (1991) Science **252**, 1690. [7] Glass, B.P. (1972) J. Geophys. Res. **77**, 7057. [8] Bohor, B.F. et al. (1987) Geology **15**, 896. [9] McHone, J.F. et al. (1989) Science **243**, 1182. [10] Bohor, B.F. et al. (1993) this volume.