A NEW TERM IS NEEDED TO DISTINGUISH IMPACT EJECTA IN THE FORM OF GLASSY SPHERULES CONTAINING PRIMARY CRYSTALLITES FROM MICROTEKTITES; B. P. Glass and C. A. Burns, Geology Department, University of Delaware, Newark, DE 19716.

Crystal-bearing spherules have been found in late Eocene deep-sea deposits in the Caribbean Sea, Gulf of Mexico, equatorial Pacific, and eastern Indian Ocean (1-3). These spherules have a variety of crystalline textures including dendritic, feathery, bladed, skeletal, and equant. X-ray diffraction and energy dispersive x-ray analyses indicate that the primary crystalline phase is clinopyroxene. Therefore, these spherules have been called clinopyroxene-bearing or cpx spherules. Other phases such as magnetite, chromite, olivine, cristobalite?, and Ni-, Fe-, and Cr-rich phases have also been observed. The cpx spherules have a rather wide range in composition. The SiO_2 content generally ranges from 58% to 70%, Al_2O_3 is generally between 5% and 10%, FeO between 2% and 11%, CaO between 5% and 20%, Na_2O between 1% and 2%, K_2O between 1% and 3%, and TiO_2 between 0.1 and 0.5%. Many of them also contain relatively high Cr_2O_3 and NiO contents (up to 0.4%). Because of their close association with the North American microtektite layer in the Caribbean Sea and Gulf of Mexico, the cpx spherules were originally thought to belong to the North American tektite strewn field (1,2,4,5). Because of this and because of their similarity in size, shape, and presumably origin to microtektites, the late Eocene crystal-bearing spherules have been referred to as microtektites (e.g., 6).

Similar spherules have been found in sediments from the Cretaceous/Tertiary (C/T) boundary (7-9). The C/T boundary spherules have been diagenetically altered, but many of them still show relict quench textures. These spherules have also been referred to as microtektite-like spherules or "microtektites" (8-10).

Lowe and Byerly (11) described spherules from early Archean deposits in South Africa and western Australia which they believe are melt droplets formed during an impact event. These spherules have all apparently undergone recrystallization, replacement, and metasomatism; however, like the C/T boundary spherules, many of the early Archean spherules exhibit relict quench textures.

The crystal-bearing spherules discussed above differ from microtektites in several respects in addition to the petrographic difference (Table 1). For example, the crystal-bearing spherules appear to be basic to ultrabasic in composition in contrast to microtektites which are generally acidic in composition. (The difference in composition may explain why the crystal-bearing spherules partly crystallized and the microtektites did not.) Furthermore, the crystal-bearing spherules are all late Eocene or older in age, whereas the microtektites are late Eocene or younger in age. Finally, we note that each of the crystal-bearing spherule layers appears to be associated with an iridium anomaly (3,4,12), whereas the microtektite layers are not. It is not clear why this difference exists, but it may illustrate our lack of knowledge concerning large impact events and we believe this problem merits further study.

Because of the presence of primary crystallites and absence of lechatelierite, the late Eocene cpx spherules, the C/T boundary spherules, and the early Archean spherules are not microtektites, which by definition are holohyaline. Some investigators have suggested the term crystalline microtektites to refer to the crystal-bearing spherules; however, this term is

self-contradictory and therefore unacceptable to us. Thus, we believe that a new term is needed for the crystal-bearing spherules in order to distinguish them from the microtektites and to eliminate possible confusion.

References:
(1) John, C., and Glass, B. P. (1974) Geology, 2, 599.
(2) Glass, B. P., and Zwart, M. J. (1979) Bull. Geol. Soc. Am., 90, 595.
(3) Glass, B. P., Burns, C. A., Crosbie, J. R., and DuBois, D. L. (1985) Proc. Lunar Planet. Sci. Conf. 16th, D175.
(4) Glass, B. P., DuBois, D. L., and Ganapathy, R. (1982) J. Geophys. Res., 87, 425.
(5) Glass, B. P., and Crosbie, J. R. (1982) Bull. Am. Assoc. Petrol. Geol., 66, 471.
(6) Keller, G., D'Hondt, S., and Vallier, T. L. (1983) Science, 221, 150.
(7) Montanari, A., Hay, R. L., Alvarez, W., Asaro, F., Michel, H. V., and Alvarez, L. W. (1983) Geology, 11, 668.
(8) Smit, J. (1984) Geol. Soc. Am. Abstracts with Programs 1984, 16, 659.
(9) Smit, J., and Romein, A. J. T. (1985) Earth Planet Sc. Lett., 74, 155.
(10) Anders, E., Wolbach, W. S., and Lewis, R. S. (1986) Science, 261, 263.
(11) Lowe, D. R., and Byerly, G. R. (1986) Geology, 14, 83.
(12) Alvarez, L. W. (1986) Trans. Ann. Geophys. Un., 67, 649, 653-655.

TABLE 1. Comparison between Crystal-bearing Spherules and Microtektites.

	Primary Crystallites	Lechatelierite	Composition	Associated with Iridium Anomaly	Age
Crystal-bearing spherules	present	absent	generally acidic	Yes	late Eocene and older
Microtektites	absent	common	generally basic to ultrabasic	No	late Eocene and younger