LATE EOCENE IMPACT EVENTS RECORDED IN DEEP-SEA SEDIMENTS; B. P. Glass, Department of Geology, University of Delaware, Newark, DE 19716.

Raup and Sepkoski (1) proposed that mass extinctions have occurred every 26 Myr during the last 250 Myr. In order to explain this 26 Myr periodicity, several authors (e.g., 2-5) have proposed that the mass extinctions were caused by periodic increases in cometary impacts. One method to test this hypothesis is to determine if there were periodic increases in impact events (based on crater ages) that correlate with mass extinctions. Some authors have suggested that such a correlation exists (6-8); however, Grieve et al (9) challenge such a conclusion on statistical grounds. Furthermore they point out that siderophile element data from impact rock indicate that not all of the craters used to suggest periodic cometary showers were produced by comets. A second, and perhaps the better, way to test the hypothesis that mass extinctions were caused by periodic increases in impact cratering is to look for evidence of impact events in deep-sea deposits. This method allows one to observe directly the temporal relationship between impact events and extinctions as recorded in the sedimentary record.

The next mass extinction after the Cretaceous/Tertiary event took place in the late Eocene (1). The late Eocene was marked by the disappearance of many genera of foraminifera, nannoplankton, and dinoflagellates, a major turnover of mammalian taxa, and a major change in the flora (10,11). However, although there are major changes in the marine microfossil assemblages in middle Eocene to Oligocene sediments, they occurred in a sequential step-like manner over an interval of several million years (12). The purpose of this paper is to discuss how many late Eocene impact events have been recognized in deep-sea deposits and how those events correlate with the marine biotic record.

There is good evidence in the deep-sea record for two (possibly three) impact events during the late Eocene: 1) the North American tektite event, and 2) the clinopyroxene-bearing spherule event (13,14). North American tektites have been found in Texas and Georgia. Microtektites with similar compositions and ages have been found in late Eocene deposits in the Gulf of Mexico, Caribbean Sea, on Barbados, and more recently at DSDP Site 612 on the continental slope off New Jersey (13-15). Most authors agree that tektites were formed by terrestrial impact events (e.g., 16,17). The discovery of impact ejecta associated with North American tektite fragments at Site 612 (15) supports this conclusion. However, the North American microtektite layer is not associated with an Ir anomaly and, in fact, none of the microtektite layers are; nor is the North American microtektite layer associated with any major extinction event (13,14).

The clinopyroxene-bearing (cpx) spherules are found in late Eocene deposits from the Caribbean Sea, Gulf of Mexico, equatorial Pacific, and eastern equatorial Indian Ocean (13,14). Although the cpx spherules are found in close proximity to the North American microtektite layer in the Caribbean Sea and Gulf of Mexico, it is clear in core RC9-58 from the Caribbean Sea that

the cpx spherules belong to a somewhat older event. The unusal composition and widespread geographic distribution of the cpx spherules indicate that they were formed by an impact event. This conclusion is supported by the fact that the cpx spherule layer is associated with an Ir anomaly (13,14). The cpx spherule layer is also associated with the extinction of several radiolarian taxa (13). However, no other extinctions of marine microfossils appear to coincide with this layer.

Keller et al (14) believe that the cpx spherules at Sites 216 and 292 (core 38) in the Indian Ocean Ocean and western Pacific, respectively, occur in the Globigerapsis semiinvoluta Zone and are thus older than the cpx spherules from the central Pacific, Gulf of Mexico, and Caribbean Sea which they believe are in the Globorotalia cerroazulensis Zone. However, the cpx spherules from Sites 216 and 292 (core 38) have similar petrographies and compositions to the cpx spherules found at other sites, and they appear to be associated with the same radiolarian extinctions. Therefore, additional work is needed in order to resolve this problem (e.g., see 18).

In summary, there is evidence in the deep-sea record for two (possibly three) impact events in the late Eocene. The younger event, represented by the North American microtektite layer, is not associated with an Ir anomaly. The older event, defined by the cpx spherule layer, is associated with an Ir anomaly. However, neither of the two impact events recorded in late Eocene deposits appears to be associated with an unusual number of extinctions. Thus there is little evidence in the deep-sea record for an impact-related mass extinction in the late Eocene.

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