COMPARISON OF THE STRATIGRAPHIC RELATIONSHIP OF THE UPPER EOCENE COUPLET OF MICROTEKTITES-MICROKRYSTITES BETWEEN HOLES 689D AND 689B. S. Liu and B. P. Glass, Department of Geology, University of Delaware, Newark, DE 19716 (shaobin@udel.edu)

Introduction: An upper Eocene couplet of microtektites-microkrystites has been found in DSDP sites 94, 149, 612, and Core RC9-58, and ODP Holes 689B and 904A [1-4]. Detailed studies showed that the peak abundance of microkrystites is 25 cm below the peak abundance of microtektites in Core R9-58 [1], 21 cm below the peak abundance of microtektites at Hole 904A, 4 cm below the peak abundance of microtektites at Hole 612 [4], but only 2 cm below the peak abundance of microtektites at Hole 689B [5]. No clear relationship could be observed at sites 94 and 149 due to core disturbance and incomplete recovery.

Montanari et al. [6] reported a positive Ir anomaly in upper Eocene sediments from ODP Hole 689B on the Maud Rise in the Southern Ocean. Later, microtektites and microkrystites were found associated with the Ir anomaly at Hole 689B [3]. It was suggested that the microtektites might belong to the North American tektite strewn field and that the microkrystites belong to the clinopyroxene-bearing spherule layer in the equatorial Indian and Pacific oceans and below the North American microtektite layer in the Gulf of Mexico, Caribbean Sea, and NW Atlantic. A detailed study showed that the peak abundance of microtektites is ~2 cm above the peak abundance of the microkrystites, and that the microtektites are more abundant than the microkrystites in samples more than 10 cm above the peak abundance and less abundant than microkrystites below the peak abundance [5].

Since Hole 689D is only about 24 meter's from Hole 689B, it offers a good opportunity to examine the stratigraphic relationship observed between microtektites and microkrystites (clinopyroxene-bearing spherules) at Hole 689B, and to determine if the calculated concentration (number/cm^2) are similar.

Methods: Samples (3 cc in volume) were obtained at 20 cm intervals, through Core 12, ODP Hole 689D. After spherules were found, more samples (either 3 cc or 2 cc) were obtained to define the spherule layer(s) in more detail. The samples were disaggregated in water using ultrasonics and sieved into 63-125 and >125 µm size fractions. Heavy liquid separations were used to concentrate the spherules in the 63-125 size fraction and make recovery easier. Spherules were then searched for using a binocular microscope with up to 50X magnification.

Result: About 345 microtektites and 1458 microkrystites (>63µm in size) were found in 17 samples between 72 and 149 cm in Core 12H, Section 2 (126.32 - 127.09 m below the sea floor). The general stratigraphic relationship between these two types of spherules match that observed at Hole 689B; that is, the peak abundance of microtektites appears to be about 2 cm's below the peak abundance of microkrystites (however, the peak is not very prominent and there is a lot of scatter in the data). The microspherules are dispersed about 20 cm downward and 60 cm upward from the peak abundance at Hole 689D, which is similar to the dispersion at Hole 689B. But the distribution pattern at Hole 689D is more rugged, compare to the relative smooth curve at Hole 689B. The abundance of microtektites at each depth is always less than that of microkrystites, which is different from that observed from Hole 689B [5].

The peak abundance of microkrystites (>63 µm in diameter) at Hole 689D is about 76 /g compared to 51 /g at Hole 689B. Their color ranges from translucent yellow to opaque brown. Crystalline structures are visible on the surface of some of the microkrystites. Most of microkrystites are broken. Only broken pieces of microkrystites larger than 125 µm were found. Most of the complete ones are spherical.

The peak abundance of microtektites (>63 µm in diameter) at Hole 689D is about 22 /g compare to 25 /g at Hole 689B. About 60% of the microtektites are spherical, and 20% are disc-shaped; the rest are cylinder, dumbbell, teardrop, or irregular (broken) shapes. A few microtektites show signs of dissolution with pitted surfaces. The majority of the microtektites are transparent colorless, but some are transparent with a pale brown color. Three large microtektites (760, 860, 1100 µm) have also been recovered; all are oblate spheres. Two of them are transparent with a light-brownish tint and smooth surfaces. The largest one has a small area of etched surface that appears to reflect an internal flow structure.

Several broken agglutinate foraminifera tests with microspherules were also found. Scanning electron microscope studies and energy dispersive x-ray analyses of one of the tests reveal that the microspherules are microkrystites.

Discussion: Based on the vertical distribution of the microtektites and microkrystites, Glass and Koeberl [5] suggested that microkrystites layer at Hole 689B may be slightly older (~3-5 ka). According to $^{87}Sr/^{86}Sr$ analysis, Vonhof and Smit suggested the microtektites at Hole 689B either reflect a chemically heterogeneous North American tektite strewn field or a possible third late Eocene impact event [7]; only one measurement was made at Hole 689B. Glass and Koeberl used the difference in depth between the peak abundance of the microtektites and the peak abundance of the microkrystites at Hole 689B to estimate an age difference of 3 to 5 ka between the two spherule layers [5]. Using the depth difference between the peak abundance of the microtektites and microkrystites at 689D gives the same age difference. Perhaps a better way to estimate the age is by first estimating the original depth of deposition for both spherule layers using the weighted mean depth[8]. This mean results that the microtektites were originally deposited 5 cm above the microkrystite layer at Hole 689B. Using the estimated sedimentation rate of 4-6 m/ma [9] for the upper Eocene section of Hole 689B suggests that the microtektites were deposited approximately 8-12 ka after the microkrystites. Using the weighted mean depth to estimate the original depth of deposition for the microtektites and microkrystites in Hole 689D suggests that they were both deposited at approximately the same time. Because the vertical distribution of the spherules is much more erratic in Hole 689D, we feel that Hole 689B probably gives a better estimate of the age difference.

The peak abundance and concentration (number/cm^2) of microtektites in Hole 689D are similar to the peak abundance and concentration found at Hole 689B. The concentration of large microtektites (>700 μm) at Hole 689D is similar to that of Hole 689B. These data indicates that the distribution of microtektites at Maud Rise, Southern Ocean, is relatively consistent.

The peak abundance of microkrystites (>63 μm) at Hole 689D is ~1.5 times that found at Hole 689B. However, the microkrystite abundance for Hole 689D are preliminary and the identification of some of the questionable microkrystites still needs to be checked. There is also the possibility that the percent recovery at Hole 689B was not as great as for 689D; the Hole 689B samples need to be re-examined to make sure that all of the microkrystites have been recovered. Even if additional studies confirms the higher number of microkrystites in Hole 689D compared with Hole 689B, the concentrations would be within a factor of 2.

Conclusion: Comparison of microtektite and microkrystite abundances between ODP holes 689D and 689B indicate that over short distances the abundances are fairly uniform. The recalculated age difference between the microtektites and microkrystites in Hole 689B is consistent with the conclusion that the microtektites and microkrystites at Site 689 are the same as the North American microtektite / clinopyroxene bearing spherule couplet found adjacent to North America.

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