HOW MANY UPPER EOCENE MICROSPHERULE LAYERS? MORE THAN WE THOUGHT!

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Introduction.- The scientific controversy over the origin of upper Eocene tektites, microtektites and other microspherules cannot be logically resolved until it is determined just how many events are involved. The microspherule-bearing beds in marine sediments have been dated using standard biozonal techniques (e.g. 1,2,3). Although a powerful stratigraphic tool, zonal biostratigraphy has its limitations. One is that if an event, such as a microspherule occurrence, is observed to occur in a zone at one locality and then a similar event observed in the same zone at another locality, it still may be unwarranted to conclude that these events exactly correlate. To be in a zone a sample only need be between the fossil events that define the zone boundaries. It is often very difficult to accurately determine where within a zone one might be. Further, the zone defining events do not everywhere occur at the same points in time. That is, the ranges of the defining taxa are not always filled. Thus, the length of time represented by a zone (but not, of course, its chronozone) can vary from place to place. These problems can be offset by use of chronostratigraphic modelling techniques such as Graphic Correlation (4). This technique has been used to build a Cretaceous and Cenozoic model containing fossil, magnetopolarity, and other events. The scale of the model can be demonstrated to be linear with time. This model has been used to determine the chronostratigraphic position of upper Eocene microspherule layers.

Discussion.- Eighteen microspherule occurrences at twelve localities have associated fossil data sufficient to allow use of the Graphic Correlation model (Figure 1) to determine the age of the layers (Table 1). In Table 1 ages are given in model units (Cu for composite units) and mega-annums (Ma). Also given are the predicted values of the $^{87}Sr/^{86}Sr$ ratio in sea water for these points in time. This is based on a Sr ratio scale constructed by the author using published Sr data (5,6) and the Graphic Correlation model. The Chronozone column gives the placement of the microspherules in planktic foraminifer and calcareous nannofossil chronozones. For stratigraphic reference, the last three columns give the projected position of the microspherule events in three sections: Bath Cliff, Barbados, and DSDP Sites 149 and 94. That is, this is where the microspherules should be found if they indeed occur at these localities. The oldest layer is that found at DSDP Site 612 on the slope off New Jersey (7), which may correlate with the lower microspherule layer observed in Shell Core E67-128 off Florida (1,8). The youngest layer is that found in the upper Yazoo Formation in Mississippi (1), although paleontological, petrographic, and chemical studies at this site are still in progress. The Barbados microspherule layer correlates with the upper layer at Site 94 and the Barbados Ir anomaly bed is slightly older. The lower layer at Site 94 and the layer at Site 149 were caused by the same event. There are at least four eastern American microspherule layers. Further, there are at least two and perhaps more layers in the Indo-Pacific that can't be correlated with American events. The Spanish microspherules represent still another layer. Therefore, there appear to have been at least seven impact events in a two million year interval. It is not clear at the moment where the North American bediasites and georgiaites could be placed in Table 1. Also, the radiometric dates obtained on tektites or microtektites (e.g. 9) all seem too young by over 2.5 Ma and remain an enigma.

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(4) Edwards, L. M., 1984, J. Geology, 92:583-597. (5) DePaolo, D. J., and Ingram, BL., 1985, Science, 227:938-941. (6) Hess, J., et al., 1986, Science, 231:979-984. (7) Thein, J., 1987, DSDP, 95, p. 565-580. (8) Keller, G., 1983, J. Paleon., 59:882-903. (9) Glass, B. P., et al., 1986, Chem. Geology, 59:181-186.

FIGURE 1
GRAPHIC CORRELATION PLOT

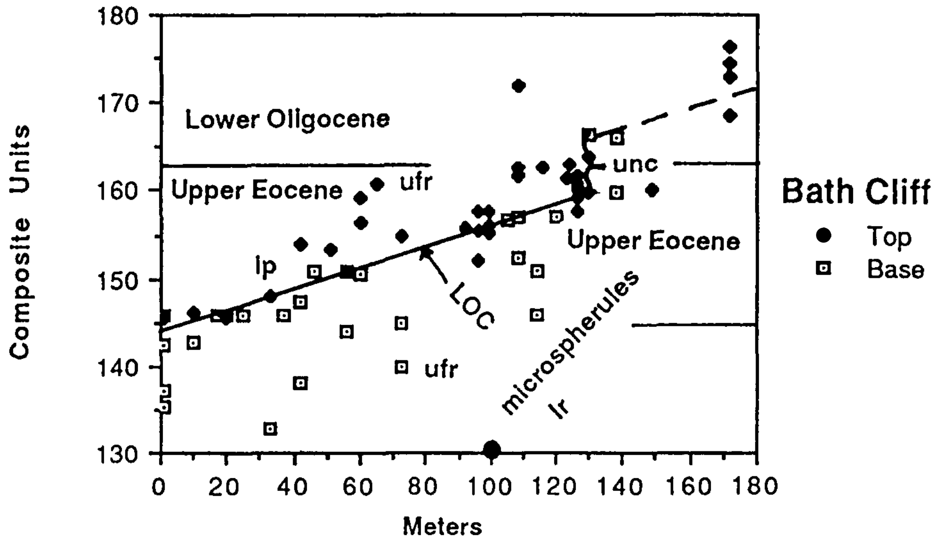

TABLE 1

CHRONOSTRATIGRAPHY of UPPER EOCENE MICROSPHERULE LAYERS

General Area	Locality Name	Suggested Cu	Age Ma	Predicted 87Sr/86Sr	Chronozones FP1/FP2/NN	Bath Cliff	Venezue. Basin	C. Gulf Mexico
Mississippi	Cynthia Pit	161.13	36.971	0.707901	16/Tc/19-20	unc or ci	266.78	407.08
• E. Gulf Mexico	E67-128	158.23	37.558	0.707884	16/Tc/19-20	119.04	268.49	412.23
• W. Pacific	DSDP 292	158.12	37.580	0.707883	16/Tc/19-20	118.12	268.55	412.42
• W. Pacific	DSDP 292	157.41	37.724	0.707879	16/Tc/19-20	112.15	268.97	413.68
Spain	Mol. de Cobo	156.28	37.952	0.707872	16/Gs/19-20	102.65	269.64	415.69
C. Gulf Mexico	DSDP 94	156.08	37.993	0.707871	16/Gs/19-20	100.97	269.75	416.04
Barbados	Bath Cliff	155.96	38.017	0.707871	16/Gs/19-20	100.00	269.83	416.26
Barbados	Bath Cliff	155.93	38.023	0.707870	16/Gs/19-20	99.71	269.84	416.31
C. Gulf Mexico	DSDP 94	155.59	38.092	0.707868	16/Gs/19-20	96.85	270.04	416.91
Venezuela Basin	DSDP 149	155.58	38.094	0.707868	16/Gs/19-20	96.77	270.05	416.93
C. Pacific	DSDP 167	154.66	38.280	0.707862	16/Gs/19-20	89.04	270.59	418.56
C. Pacific	DSDP 166	154.66	38.280	0.707862	16/Gs/19-20	89.04	270.59	418.56
W. Pacific	DSDP 462	154.54	38.305	0.707862	16/Gs/19-20	88.03	270.66	418.78
Indian Ocean	DSDP 216	153.30	38.556	0.707854	16/Gs/19-20	77.61	271.39	420.98
W. Pacific	DSDP 292	153.29	38.558	0.707854	16/Gs/19-20	77.52	271.40	421.00
C. Pacific	DSDP 167	153.10	38.596	0.707853	16/Gs/19-20	75.93	271.51	421.33
W. N. Atlantic	DSDP 612	151.40	38.940	0.707843	16/Gs/19-20	61.64	272.51	424.35
• E. Gulf Mexico	E67-128	151.39	38.942	0.707843	16/Gs/19-20	61.55	272.51	424.37

• possibly the result of contamination