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45. SYNTHESIS OF CRETACEOUS/TERTIARY BOUNDARY STUDIES AT HOLE 807C[1]

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ABSTRACT

Paleontological, stable isotopic, trace elemental abundance, and magnetostratigraphic studies have been performed on limestones spanning the Cretaceous/Tertiary boundary transition at Ocean Drilling Program (ODP) Hole 807C. Paleontological evidence exists for considerable resedimentation, which we attribute to the fact that Hole 807C is located in a basement graben. Age estimates based on planktonic foraminiferal biostratigraphy, as well as magnetostratigraphy, indicate that sedimentation rates could have been on the order of 12–14 m/m.y. This is significantly higher than those documented in other important Deep Sea Drilling Project (DSDP) and ODP Cretaceous/Tertiary boundary sections using the same age control points (e.g., DSDP Hole 577 and ODP Hole 690B), although not as high as those documented from DSDP Hole 524. The expanded nature of this succession has resulted in the Cretaceous/Tertiary boundary $\delta^{13}C$ decrease occurring over approximately a 9-m interval. Ir analysis of these sediments do not show a single large anomaly, as has been found in other Cretaceous/Tertiary boundary sections, but trivial background levels instead. Ce data support the hypothesis that this section has been expanded by secondary sedimentological processes.

INTRODUCTION

Ocean Drilling Program (ODP) Hole 807C (3°36.39′N, 156°37.48′E) was drilled in 2805.7 m of water in a shallow basement graben on the northern rim of the high Ontong Java Plateau in the western equatorial Pacific. The selection of a graben as the drilling target was an attempt to retrieve a section minimally affected by sediment winnowing and redeposition, which is a common occurrence on the Ontong Java Plateau.

LITHOSTRATIGRAPHY, BIOSTRATIGRAPHY, AND SEDIMENTOLOGY

The Cretaceous/Tertiary (K/T) boundary in ODP Hole 807C occurs in indurated limestone facies (Fig. 1) within lithologic Subunit IIB, as identified by the shipboard sedimentologists (Shipboard Scientific Party, 1991). Chert is present as nodules or in layers in all cores of Subunit IIB, although chert abundance rarely exceeds 10% of the recovered material in the region containing the K/T boundary. Subunit IIB contains numerous ash horizons including one close to the K/T boundary itself. The precise position of the K/T boundary has been the subject of debate by various authorities (see below). However, the first occurrence (FO) of Cenozoic planktonic foraminifers occurs in Core 130-807C-55R-1, indicating that the K/T boundary must be at this level (1197.25 mbsf) or lower. The Cretaceous portion of the succession at Hole 807C occurs in homogenous limestone facies. However, a distinctly laminated interval with winnowed planktonic foraminifers starts in Core 130-807C-58R and continues across the boundary and into the Paleogene (Sliter and Leckie, this volume). Reworking of Cretaceous planktonic foraminifers occurs above the boundary between Cores 130-807C-55R-1 and -54R-2 in the basal Paleocene. Dissolution horizons also occur, resulting in the prevalence of micrite throughout this part of the succession (see Premoli Silva, this volume, and Sliter and Leckie, this volume). In addition, the occurrence of attenuated core recovery (55% at most in this part of the succession) and the ODP convention of placing core gaps at the base of core barrels means that it is not possible to identify intervals of missing section.

Based on the work of the shipboard biostratigraphers (Shipboard Scientific Party, 1991), the K/T boundary was positioned in a 16-cm interval at the base of Section 130-807C-54R-3 (1193.07 mbsf). The boundary was initially pinpointed using the *Thoracosphaera* bloom. However, more detailed shore-based studies by Premoli Silva (this volume) based on planktonic foraminifers in thin section indicate that the K/T transition occurs between Samples 130-807C-55R-1, 49–50 cm, and -55R-1, 35–36 cm (1197.39 and 1197.25 mbsf), based on the FO of Cenozoic planktonic foraminifers (e.g., *Eoglobigerina fringa* and *Chiloguembelina* spp.). Shore-based studies on the nannofossils in the section (Mao and Wise, this volume) indicate that the K/T boundary cannot be reliably located using this group because of the poor preservation of the material and the usual reworking of material across the boundary (Pospichal and Wise, 1990). Sliter and Leckie (this volume) also note the usual, globally occurring reworking of planktonic foraminifers across the K/T boundary. However, Mao and Wise (this volume) have located common *Coccolithus pelagicus* at 1192.7 mbsf, suggesting a median FO estimate for this taxon of 1193.45 mbsf. The FO of this species falls near the base of nannofossil Subzone CP1b (Pospichal, 1991), which is correlative with the lower half of foraminiferal Subzone P1a. As Figure 2 illustrates, this agrees well with the zonal assignment of this part of the section by Premoli Silva (this volume).

MAGNETOSTRATIGRAPHY

Magnetostratigraphic analyses were performed by JAT. A reversed polarity interval is present in Cores 130-807C-54R and -55R (J.A. Tarduno, pers. comm., 1992). Accounting for the unsampled portions, the maximum (nominal) interval of reversed polarity ranges from 1191.21 to 1199.47 mbsf. This reversed polarity interval could be Chron 29R, known to contain the K/T boundary at other sites. Recently, Harland et al. (1990) have suggested a duration of 0.58 m.y. for Chron 29R. This time scale, therefore, suggests that a nominal sedimentation rate across the boundary interval at Hole 807C would

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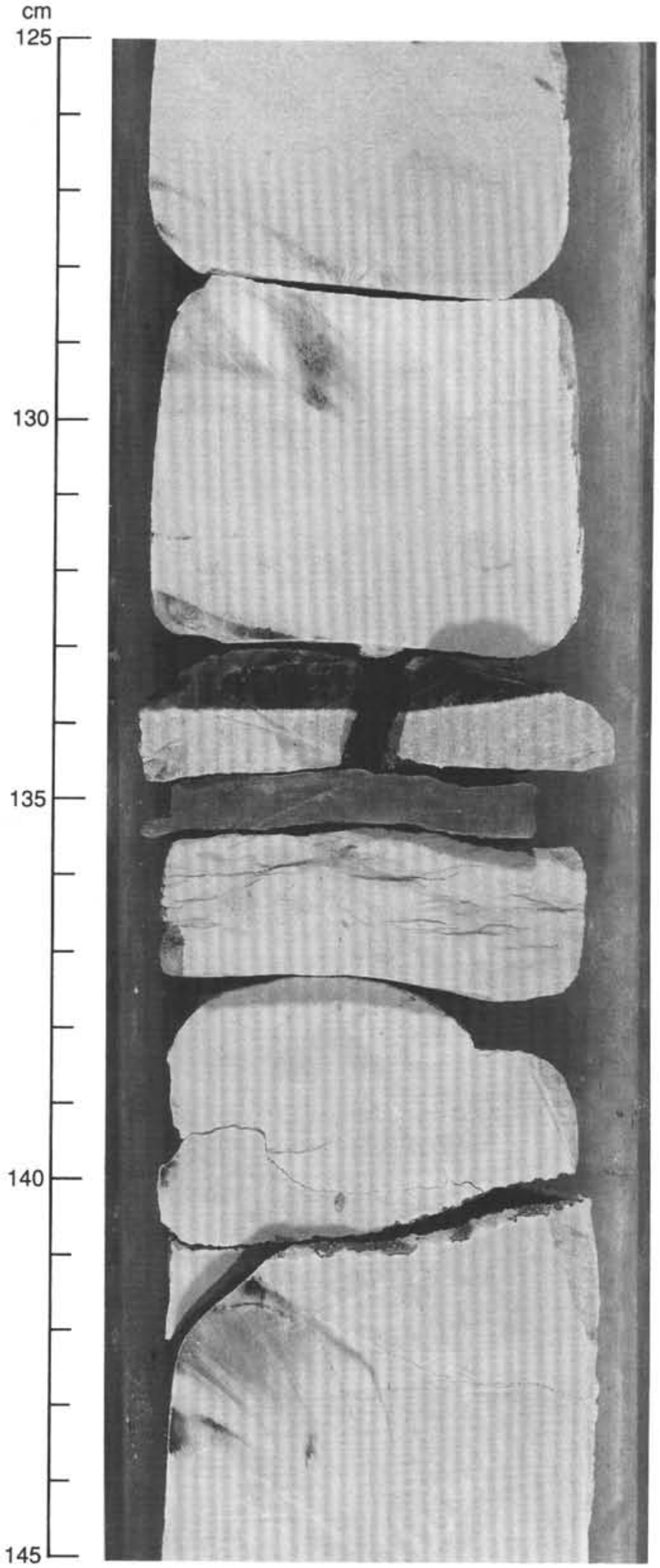

Figure 1. Photograph of the Cretaceous/Tertiary boundary interval in Hole 807C.

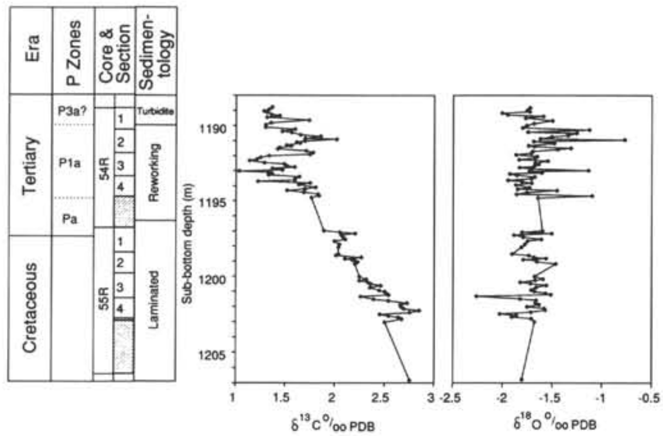

Figure 2. $\delta^{13}C$ and $\delta^{18}O$ stratigraphy of the Cretaceous/Tertiary boundary interval at Hole 807C.

be 14 m/m.y. This is similar to the sedimentation rate calculated by Corfield and Cartlidge (see table 2 in Corfield and Cartlidge, this volume).

An alternative interpretation of the magnetic data is that the reversed interval recorded in Cores 130-807C-54R and -55R is not Chron 29R but rather a younger reversed polarity chron such as Chron 28R. However, this interpretation is not compatible with either the biostratigraphy of this K/T succession (Premoli Silva; Sliter and Leckie; and Mao and Wise; all in this volume) or the carbon isotope stratigraphy (Corfield and Cartlidge, this volume).

CARBON AND OXYGEN ISOTOPE STRATIGRAPHY

Perhaps the most intriguing feature of the K/T contact at Hole 807C is the extended interval of the $\delta^{13}C$ decline (Fig. 2). Whole-rock $\delta^{13}C$ values start to decline at 1202.25 mbsf (Sample 130-807C-55R-4, 85–86 cm) and finish declining at 1193.02 (Sample 130-807C-54R-3, 122–123 cm). Hence, $\delta^{13}C$ values show a more or less monotonic decline (Fig. 3; also see fig. 3 in Corfield and Cartlidge, this volume) over a 9.23-m interval. It is likely that the K/T boundary interval at Hole 807C has been resedimented and therefore the components that contribute to the $\delta^{13}C$ signal may not be in primary position. However, the signal shows a systematic decline over this interval, indicating that it is unlikely that sufficiently large amounts of older sediment (with heavier $\delta^{13}C$ values) were transported to younger horizons. In unlithified sediments, it would be possible to test this by multiple analyses of individual sedimentary components (e.g., planktonic foraminifers). Clearly, however, this is not possible in this case.

The $\delta^{18}O$ data are relatively negative (fluctuating around −1.7‰ in the interval between the base of Core 130-807C-55R and Sample 130-807C-54R-4, 125–126 cm (1194.55 mbsf). Between this sample and Sample 130-807C-54R-1, 146–147 cm (1190.26 mbsf), $\delta^{18}O$ values become more positive. Between this sample and Sample 130-807C-54R-1, 0–1 cm (where detailed isotopic coverage ceases), values again become more negative.

TRACE ELEMENT ANALYSIS

Instrumental neutron activation analysis (INAA) of 18 carbonate samples from the K/T boundary interval in Hole 807C were made by Roman Schmitt and Yun-Gang Liu. The data are presented in Table 1. Samples were concentrated in the region of the *Thoracosphaera* bloom (on which the boundary was originally defined). In all the samples analyzed, Ir concentrations were trivial (<2% of the maximum Ir concentration found in DSDP Holes 577 and 577B on the Shatsky Rise [Schmitt et al., 1991]). It is unlikely that the Ir anomaly

Table 1. Element abundances in OJP carbonate samples from Hole 807C before, during, and after K/T time.

Core, section Interval (cm)	52R-1 20–22	54R-1 85–87	54R-2 62–64	54R-2 107–108	54R-3 88–90	54R-3 116–117	54R-3 122–124	54R-3 139–141	54R-3 149–150	54R-4 50–52	55R-1 88–89	55R-1 132–133	55R-2 77–79	55R-3 85–87	55R-4 85–87	55R-4 85–87	69R-1 58–60	71R-3 28–30	Uncertainty[a] (%)
OSU #	OD50	OD183	OD51	OD184	OD185	OD52	OD53	OD54	OD55	OD186	OD187	OD56	OD188	OD189	OD57	OD190	OD58	OD59	–
Wt (g)	0.889	0.808	0.846	1.066	1.076	1.045	0.924	1.007	1.060	1.188	1.160	0.855	0.994	1.019	0.786	1.039	0.805	0.748	–
Fe (%)	0.110	0.220	0.790	0.059	0.085	0.086	0.094	0.037	0.094	0.068	0.050	0.110	0.061	0.078	0.094	0.062	0.250	0.430	2
Ca	35.0	18.4	15.8	36.5	36.1	34.4	35.5	38.1	35.5	38.3	37.1	35.5	37.2	37.8	35.9	37.4	33.5	27.5	3
Na	0.100	0.220	0.324	0.041	0.050	0.065	0.057	0.033	0.059	0.061	0.056	0.074	0.049	0.060	0.085	0.065	0.117	0.200	2
K (%)	0.057	0.140	0.350	–	–	0.055	0.047	0.011	0.054	–	–	0.094	–	–	0.060	–	0.141	0.420	5–10
Sc (ppm)	1.39	2.73	6.31	1.35	1.18	0.97	2.11	0.63	1.08	0.81	0.88	1.16	1.12	1.63	1.68	1.39	1.68	4.23	2
Cr (ppm)	1.81	2.60	8.50	1.43	1.43	1.69	1.64	0.94	1.58	1.39	1.02	2.20	1.08	1.31	1.80	1.32	3.15	5.38	2–5
Co (ppm)	0.90	1.80	6.70	0.60	0.80	0.74	0.90	0.32	0.70	0.60	0.80	2.36	1.00	1.10	1.56	1.20	2.39	11.20	2
Ni (ppm)	2.6	9.5	39.2	–	–	3.3	4.5	1.2	3.2	–	–	4.7	–	3.9	4.5	–	11.1	36.4	5–20
Zn (ppm)	6.4	–	24.9	–	–	15.9	16.2	4.4	6.7	–	–	7.0	–	–	5.1	–	8.6	25.9	5–10
Rb (ppm)	2.05	3.30	11.80	–	1.60	1.90	1.26	0.30	1.45	1.50	0.75	2.50	1.00	1.90	1.66	1.00	4.95	14.40	5–25
Sr (ppm)	958	390	734	400	430	520	526	504	465	530	500	750	470	520	599	640	497	239	5–15
Cs (ppm)	0.125	0.160	0.580	0.039	0.087	0.088	0.074	0.022	0.078	0.083	0.035	0.115	0.035	0.088	0.077	0.061	0.250	0.890	3–10
Ba (ppm)	508	346	56	56	112	110	80	42	82	148	83	429	304	381	152	157	40	37	3–10
La (ppm)	9.0	13.9	37.5	11.4	13.9	14.9	19.2	11.9	13.8	11.8	14.2	13.8	12.5	15.0	18.1	15.9	22.5	37.1	2
Ce (ppm)	3.1	7.1	19.4	3.9	4.1	5.1	6.1	3.8	4.4	3.5	3.8	3.8	3.0	3.6	4.5	3.6	8.7	28.6	2–5
Nd (ppm)	8.1	15.9	41.1	9.4	11.7	12.6	15.6	8.2	10.5	11.1	12.2	12.1	10.8	12.0	16.5	13.4	22.1	38.1	2–5
Sm (ppm)	1.54	2.90	8.66	1.79	1.98	2.11	2.91	1.68	2.03	1.75	1.94	2.08	1.63	2.12	2.79	2.27	4.25	7.10	2
Eu (ppm)	0.41	0.74	2.24	0.47	0.52	0.58	0.80	0.45	0.55	0.46	0.51	0.51	0.44	0.52	0.72	0.57	1.10	1.77	2
Tb (ppm)	0.27	0.45	1.52	0.29	0.33	0.43	0.56	0.33	0.39	0.30	0.33	0.37	0.30	0.35	0.50	0.39	0.69	1.02	2–5
Yb (ppm)	0.93	1.60	3.70	1.60	1.50	1.44	1.98	1.36	1.41	1.10	1.40	1.28	1.30	1.40	1.67	1.50	1.66	2.81	2–5
Lu (ppm)	0.11	0.26	0.41	0.28	0.22	0.16	0.21	0.17	0.16	0.18	0.22	0.15	0.20	0.21	0.19	0.22	0.18	0.32	2–5
Hf (ppm)	0.062	0.200	0.610	0.051	0.067	0.077	0.082	0.017	0.072	0.055	0.035	0.090	0.043	0.058	0.080	0.060	0.166	0.540	2–10
Ta (ppm)	0.011	0.044	0.180	0.005	0.020	0.018	0.018	0.007	0.019	0.015	0.014	0.027	0.011	0.022	0.024	0.009	0.064	0.170	5–30
Th (ppm)	0.210	0.420	1.380	0.140	0.160	0.170	0.150	0.042	0.140	0.130	0.069	0.240	0.085	0.150	0.190	0.130	0.480	1.540	2–10
Ir (ppb)	0.06	<0.18	0.20	<0.25	0.15±0.07	0.10	0.16	0.18	0.09	0.13±0.06	<0.10	0.12	<0.16	<0.19	0.10	<0.17	0.16	0.16	10–30
[b] $CaCO_3$ (%)	88	46	39	91	90	86	89	95	89	96	93	89	93	95	90	93	84	69	–
[c] Detritus (%)	1.7	3.2	11.0	0.8	0.8	1.3	1.2	0.3	1.1	0.8	0.7	1.8	0.8	1.4	1.5	1.0	3.3	12.0	–
[d] Ce^{A*}	0.11	0.17	0.16	0.15	0.13	0.15	0.14	0.16	0.14	0.12	0.12	0.10	0.10	0.09	0.10	0.09	0.15	0.29	–

[a] Estimated uncertainty ranges correspond to highest to lowest abundance ranges for a given element.
[b] All Ca is assumed to be present as $CaCO_3$.
[c] Detritus is assumed to be N.A.S.C. (North American Shale Composite)-like matter.
[d] Ce^{A*} ≡ Ce anomalies relative to N.A.S.C. were calculated after subtraction of La, Ce, and Nd abundances in N.A.S.C.-like detritus.

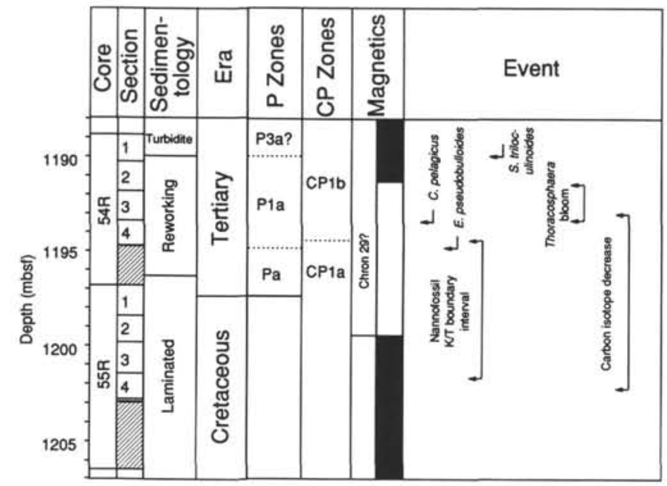

Figure 3. Biostratigraphy, stable isotope stratigraphy, and event summary diagram of the K/T boundary at Hole 807C.

is missing from this site because of the lack of cometary or asteroidal ejecta fallout in the Ontong Java Plateau area, as the Shatsky Rise sites and sites in New Zealand have appreciable concentrations of Ir at the boundary (72 and 120 ng/cm^2, respectively).

The relative abundances of K, Cr, Rb, Cs, Hf, Ta, and Th in Hole 807C samples are similar to those documented for the Shatsky Rise boundary samples and to those in the North American Shale Composite (NASC) (Gromet et al., 1984). This correlation indicates that, like the Shatsky Rise samples (Schmitt et al., 1991), the detritus is attributable to eolian transport of continental NASC-like particulates. Ce anomalies (Ce^{A*}), corrected for Ce and other rare earth elements in the detrital component, record the Ce^{A} of the parental seawater (e.g., Liu and Schmitt, 1990). The Ce^{A*}s in Hole 807C K/T carbonates are a factor of 2.6 higher than the Ce^{A*} of 0.05 for coeval samples from the Shatsky Rise. The latter value (0.05) corresponds to the Ce^{A} of the modern deep (600–5000 m) Pacific Ocean. The average K/T value of 0.13 indicates that normal background sedimentation was highly diluted by turbiditic flow from the graben margins in the K/T interval. The Ce^{A*} data suggest dilution factors of >5 throughout the interval of the δ^{13}C decline.

DISCUSSION AND COMPARISON WITH OTHER EXPANDED K/T BOUNDARY SECTIONS

Clearly, the K/T boundary in Hole 807C has some intriguing features. Chief among these is the expanded nature of the δ^{13}C decline. Potential drawbacks to this site are principally that the preservation of both foraminifers and nannofossils are inadequate to provide a refined biostratigraphic framework; the foraminifers in particular show evidence of secondary sedimentation.

Effectively, two classes of interpretation can explain the K/T boundary sequence at Hole 807C: (1) the sequence has been so disturbed by postdepositional, sedimentological phenomena (e.g., reworking, downslope sediment transport, stylolitization) that the apparent separation of events as well as the expanded nature of the K/T ^{13}C depletion is an artifact; or, (2) the section is continuous but amplified by its unique sedimentological setting, so that discrete phenomena associated with the K/T boundary (e.g., the *Thoracosphaera* bloom, the FOs of Tertiary planktonic foraminifers and nannofossils, the δ^{13}C decline) are temporally resolvable.

It is clear from the foraminiferal and nannofossil evidence that reworking is pervasive at least in Core 130-807C-54R and may extend below into the Cretaceous sequence based on the laminated facies with winnowed foraminifers. However, sedimentological disturbance is also commonplace at other important DSDP and ODP K/T boundary sites. For example, in DSDP Hole 524, both reworking and turbidites are common throughout the section (Smith and Poore, 1984) and probably resulted in the extremely high sedimentation rates that were documented from this succession (30 m/m.y.); whereas in ODP Hole 690C, the K/T boundary is intensely bioturbated (Pospichal and Wise, 1990). In contrast, the K/T contacts at DSDP Hole 577 (Zachos et al., 1985; Gerstel et al., 1986) and Hole 738C (Thierstein et al., 1991; Huber, 1991; Wei and Pospichal, 1991) are apparently undisturbed. Table 2 illustrates estimates of the sedimentation rate across the K/T boundary in these sites using the same age control points. Clearly, Hole 807C is most similar to DSDP Hole 524 in terms of its high sedimentation rate as well as in the similarity of its sedimentological disturbance, and the authors of that study (Hsü et al., 1982a, 1982b; He et al., 1984) concluded that their section represented an amplified K/T boundary sequence. We note, however, that the δ^{13}C decline associated with the K/T boundary in Hole 807C is thicker than that at DSDP Hole 524, despite the lower sedimentation rates estimated for the K/T boundary interval at Hole 807C (ca. 13 m/m.y.) relative to those claimed by Hsü et al. (1982a) (ca. 30 m/m.y.) for Site 524.

It could be argued that pervasive reworking apparent at Hole 807C might affect the fidelity of the δ^{13}C decline across the boundary because the carbonate particles that carry the signal (planktonic and benthic foraminifers and nannofossils) are not in their original stratigraphic position. On theoretical grounds, this would probably only significantly degrade the signal if the ratio of reworked material to material in primary position were high and the reworked material were significantly older than the primary material. In the case of Hole 807C, primary sedimentation was probably supplemented by contemporaneous or near-contemporaneous material entering the graben by winnowing of the surrounding sediment cover. This would account for the size and shape sorting of foraminifers common throughout the K/T succession (Premoli Silva, this volume). Some support for this suggestion comes from considering the shape of the δ^{13}C curve. In Core 130-807C-54R, in which sedimentary disturbance is common, the δ^{13}C decline accelerates, suggesting that quantities of older material sufficient to impart heavy values typical of the Late Cretaceous are not being transported to this level in the succession. Hence, we suggest that, although there has been secondary sedimentation in the K/T succession at this site, it has not been enough to radically distort the carbon isotope stratigraphy of the K/T boundary interval. This inference is presumably similar to Hsü et al. (1982a) for DSDP Hole 524.

However, major differences between ODP Hole 807C and DSDP Hole 524 are that the K/T boundary of DSDP Hole 524 was subjected to only a 200-m burial depth, whereas the K/T boundary of Hole 807C was drilled at 1200 m in limestone. This would imply that Hole 807C has potentially undergone diagenetic complications affecting, in particular, the geochemical signature of the boundary. As discussed by Corfield and Cartlidge (this volume), the δ^{18}O record of this site is abnormally negative (relative to the range expected from the low-latitude Late Cretaceous and early Paleogene oceans) and probably has undergone diagenetic alteration at elevated burial temperatures. However, we note that the δ^{18}O record at DSDP Hole 516F is typically more negative than the record from Hole 807C. The authors of this study (Williams et al., 1983) chose to interpret this in terms of paleotemperatures. The δ^{13}C decline at Hole 807C, on the other hand, need not be diagenetically affected by the low-temperature effect on ^{13}C/^{12}C fractionation (Williams et al., 1988). In addition, unless significant amounts of organic matter are present, recrystallization in the presence of pore-water bicarbonate need not significantly alter the δ^{13}C of carbonate particles (Williams et al., 1988). Other studies (e.g., Stott and Kennett, 1990; S. D'Hondt, pers. comm., 1992) have noted that differences between carbonate components (e.g., different species of planktonic and benthic foraminifers as well as placoliths and calcareous dinoflagellates) may bias the signal across the K/T boundary. Zachos et al. (1985) have noted that the stable isotope values of altered carbonate sediments do not represent the isotopic composition of the originally precipitated calcite, but rather some average of the

Table 2. Comparative sedimentation rates across selected DSDP and ODP K/T boundary sections.

Hole	Sedimentation rate (m/m.y.)
DSDP 577	[a]1.95
DSDP 524	[b]66.60
DSDP 527	[c]5.00
ODP 690C	[d]2.50*
ODP 689B	[d]1.00*
ODP 807C	12.7

Notes: Estimates based on depth difference between the K/T boundary and the FO of *Subbotina pseudobulloides* (K/T boundary in this case is defined by the FO of Danian planktonic foraminifers except where marked with an asterisk (*), in which case the boundary is defined by the LO of Cretaceous planktonic foraminifers). Age estimate of the FO of *Subbotina pseudobulloides* from Berggren et al. (1985).

[a] Data from Gerstel et al. (1986) but also see discussion by Corfield and Shackleton (1988).

[b] This high value is almost certainly the result of the poor depth uncertainties associated with the planktonic foraminifer age control points over this interval in DSDP Hole 524. Note, however, that Hsü et al. (1982a) claimed very high rates of 30 m/m.y. for this site on the basis of other sedimentation rate constraints.

[c] Data from Boersma (1984).

[d] Data from Thomas et al. (1990).

isotopic composition of the original calcite components and the reprecipitated calcite cements and overgrowths. Clearly, in a limestone setting such as that at Hole 807C, the K/T $\delta^{13}C$ decline is an average (probably minimally altered by diagenesis as discussed above) of the original carbonate components.

Several authors have noted that the isotopic composition of carbonate particles can vary with the carbonate content of the sediment (e.g., Williams et al., 1983; Zachos et al., 1985; Thierstein and Roth, 1991), with potential degradation of the isotopic signals progressively more likely with decreasing carbonate contents. Hole 807C has relatively high $CaCO_3$ contents (>90% as measured in cores adjacent to Cores 130-807C-54R and -55R), suggesting that this factor will not have contributed to contamination of the isotopic signal. On the other hand, the K/T boundary interval in DSDP Hole 524 has relatively low $CaCO_3$ contents (between 20% and 40% in sediments adjoining the boundary, decreasing to virtually 0% at the boundary itself). Shackleton and Hall (1984) have suggested that the very negative $\delta^{13}C$ values (approximately –5‰) obtained by Hsü et al. (1982a) immediately above the boundary may have been an artifact of these very low $CaCO_3$ contents.

Thierstein and Roth (1991) also note that stable isotope compositions can vary with the proportion of nannofossil to diagenetic microcarbonate particles and to the preservational state of the microfossils. Clearly, these effects cannot be ruled out in the K/T boundary succession at Hole 807C and require further study.

Undoubtedly, there is scope for more elaborate studies of the geochemistry of the K/T transition at Hole 807C. However, of the two possibilities—(1) that the notably thick $\delta^{13}C$ decline is a primary feature or (2) that it is the product of diagenetic complications—we consider that it is more complicated to postulate a diagenetic effect or series of diagenetic effects that could have resulted in a 9.23-m-thick $\delta^{13}C$ decline as opposed to the simpler explanation that the expanded $\delta^{13}C$ decline at Hole 807C is a primary feature caused by abnormally high sedimentation rates. We currently favor, therefore, the more parsimonious interpretation that the K/T boundary interval at Hole 807C is an expanded section and that the extended $\delta^{13}C$ decline reflects this.

In many K/T boundary sections (e.g., at DSDP Hole 577; Zachos et al., 1985; Monechi, 1985), many of the events associated with the K/T boundary are not precisely contemporaneous (e.g., the origination of Tertiary planktonic foraminifers and nannofossils, the onset of the rapid $\delta^{13}C$ decline, the occurrence of the *Thoracosphaera* bloom). It is instructive to compare the sequence of events found in ODP Hole 807C with the sequence across the K/T boundary found in other sections. R.M. Corfield and R. Norris (unpubl. data, 1992) present a detailed comparison of several K/T boundary sections from the deep sea as well as on land. Figure 4 summarizes a comparison of some of the more important K/T boundary sections recovered from the deep sea. It is clear that at several of these sites (DSDP Holes 524 and 577, ODP Hole 690C), the *Thoracosphaera* bloom occurs after the onset of the $\delta^{13}C$ decline. In addition, at several of the sites, the FO of Danian nannofossils occurs after the onset of the $\delta^{13}C$ decline (at DSDP Hole 577 [data from Monechi, 1985]; at ODP Hole 690C [data from Pospichal and Wise, 1990]). Furthermore, the FO of Danian planktonic foraminifers occurs subsequent to the initiation of the $\delta^{13}C$ decline in both DSDP Hole 577 (data from Gerstel et al., 1986) and ODP Hole 690C (data from Stott and Kennett, 1990). Finally, the Ir anomaly in the sites illustrated here occurs after the onset of ^{13}C depletion (Ir data from DSDP Hole 577 from Jin and Schmitt, 1989). With the exception of the Ir anomaly, which has not yet been located in Hole 807C, this sequence of events (in which the extinctions and the *Thoracosphaera* bloom follow the $\delta^{13}C$ decline) is identical to the sequence of events at Hole 807C.

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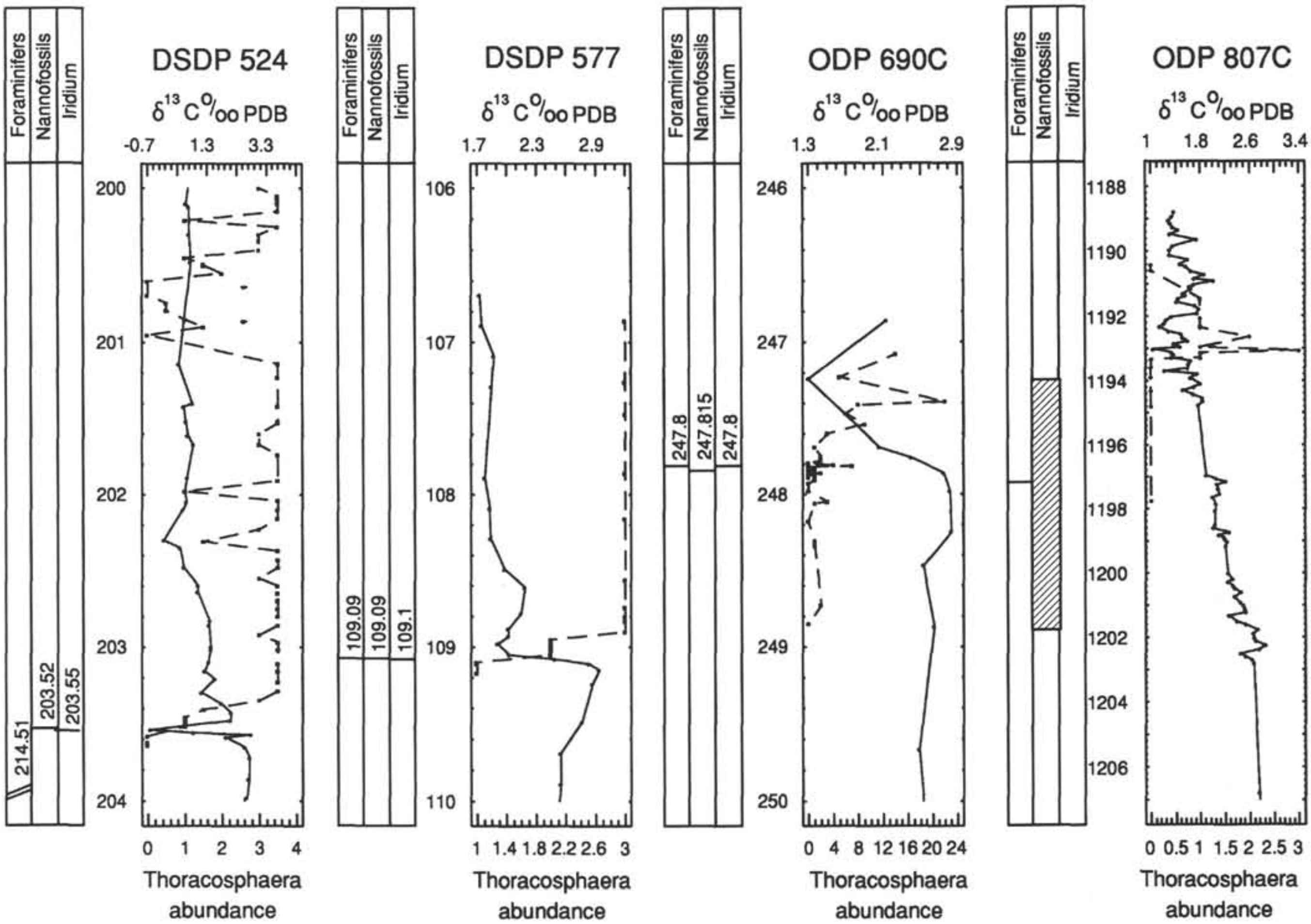

Figure 4. Comparison of some K/T boundary sequences and events from DSDP Holes 524 and 577 and ODP Hole 690C with Hole 807C. *Thoracosphaera* abundance calculated by converting qualitative abundance assessments (e.g., rare, common, etc.) to values (absent = 0, rare = 1, common = 2, abundant = 3, very abundant = 3.5), except for ODP Hole 690B, for which the quantitative abundance counts of Pospichal and Wise (1991) were used.