DATA REPOSITORY ITEM: APPENDIX

AGE MODEL

The age models for Holes 865B and 865C are derived from benthic and planktic foraminifers and calcareous nannofossils (Table DR1). The time scale follows the Geological Time Scale (GTS) 2012 (Gradstein et al., 2012). Although previous studies have been used the shape of foraminifer carbon-isotope ($\delta^{13}C$) curves to date and correlate the Paleocene-Eocene Thermal Maximum (PETM) sediments in high resolution (e.g., Bains et al., 1999; Röhl et al., 2007), we do not use the $\delta^{13}C$ curves for dating the PETM sediments. At Site 865, the difference in the shape of the $\delta^{13}C$ curves between foraminifer taxa was recognized (e.g., Dunkley Jones et al., 2013).

Table DR1. Horizons and geological ages for the datum events. Abbreviation: LO = the last occurrence and FO = the first occurrence.

Datum event	Age (Ma)	Depth (mbsf)		Reference
		Hole 865B	Hole 865C	
FO: *Discoaster sublodensis*	49.11	79.6	79.4	Kozdon et al. (2011)
LO: *Tribrachiatus orthostylus*	50.5	83.2	79.4	Bralower et al. (1995), Kozdon et al. (2011)

FO: *Discoaster lodoensis*	53.7	89.6	87.4	Bralower et al. (1995), Bralower and Mutterlose (1995)
LO: *Tribrachiatus contortus*	54.14	91.61	91.74	Kozdon et al. (2011)
LO: *Morozovella velascoensis*	55.2	97.85	98.3	Bralower et al. (1995), Kelly et al. (2001)
Paleocene/Eocene boundary; Benthic foraminifer extinction event	55.96	103.6	103.02	Bralower et al. (1995), Kelly et al. (2001), Dunkley Jones et al. (2013)
FO: *Discoaster multiradiatus*	57.21	116.21	114.6	Bralower et al. (1995)

METHODS AND MATERIALS, CONTINUED

Sediment samples of 10–20 cc volume from the cores were washed through a sieve with 63 µm opening and then were dried in an oven at 50°C. Ostracodes were picked from the >125 µm fraction of the sediment samples. We obtained ostracode specimens from 117 samples and identified 42 taxa, observing specimens with a binocular microscope and scanning electron microscopy, JSM-6500F (JEOL Ltd.) at Kochi Core Center, Kochi University. Fragments of valves are included in the dataset only if ≥1/2 of the valve was present. Our identification has not completely harmonized with the taxonomy of Boomer and Whatley (1995) yet. In this study, we refer to only data about abundance and species richness of Boomer and Whatley (1995). We counted the number of carapace and valve specimens in each species and sample and considered the number of both specimens as ostracode abundance. We store the dataset on the ostracode taxonomic composition and SEM images of selected ostracode taxa in the PANGAEA database (http://doi.pangaea.de/10.1594/PANGAEA.836086).

To examine temporal changes in ostracode fauna with statistically valid sample sizes, we binned samples in each 500 kyr interval from 55.96 Ma as the starting point. The dataset to make the binned samples does not include data of Boomer and Whatley (1995). We calculated rarefaction at a cutoff of 20 and 30 individuals and their standard errors in nine binned samples, following Hurlbert (1971) and Heck et al. (1975). Calculating rarefied indexes, we used the free software GNU R (http://www.r-project.org/) and its software package, vegan (Oksanen et al., 2013). The count of species richness is highly sensitive to the number of individuals sampled.

To assign statistically extinction ages of taxa, we calculated the 95% confidence intervals (CIs) of the age for the LO of taxa near the PETM, following Marshall (1997)'s method. The fossil recovery potential was represented by the total abundance of ostracodes. We assigned the CIs in three of the disappearing taxa that are found in more than 10 samples. For the calculation we used the R code that was written by Gene Hunt based on Marshall (1997) as implemented by Rivandeira et al. (2009). To assign temporal changes in grain size, we weighed dry sediments in 140 samples before and after the washing with a sieve of 63-μm opening. The dataset of the grain-size is deposited in the above website of the PANGAEA database.

We calculated the percentage of coarse fraction and also estimated the sedimentation rates using the age model and benthic ostracode accumulation rate (specimens cm^{-2} $k.y.^{-1}$) using the density (g cm^{-3}) of 97 sediment samples, the sedimentation rate, and the ostracode abundance.

Table DR2. Abundance and rarefied species richness of ostracodes from the 500 kyr binned samples. NA = Not applicable, SE = standard error.

Interval (Ma)	Number of samples	Number of individuals	Species richness	$E(S_{20})$ ±SE (1σ)	$E(S_{30})$ ±SE (1σ)	Even-ness
49.46–49.96	1	68	11	8.02±1.04	9.00±0.97	0.89
50.46–50.96	1	14	8	NA	NA	0.92
51.46–51.56	1	7	6	NA	NA	0.98
51.96–52.46	1	5	2	NA	NA	0.97
52.96–53.46	1	6	3	NA	NA	0.92
53.46–53.96	1	9	4	NA	NA	0.83
53.96–54.46	1	12	7	NA	NA	0.90
54.46–54.96	13	60	17	9.72±1.47	12.41±1.42	0.78
54.96–55.46	15	28	3	2.43±0.63	NA	0.28
55.46–55.96	20	79	14	6.68±1.43	8.57±1.46	0.58
55.96–56.46	28	254	19	5.77±1.36	7.07±1.51	0.53
56.46–56.96	34	374	22	6.06±1.24	7.10±1.38	0.58

Table DR3. The observed age and upper limits of the 95% confidence interval of the last occurrence in the five disappearing taxa. Abbreviation: LO = the last occurrence.

Taxon	Number of	Age of observed	Upper limit of the 95% CI

	samples	LO (Ma)	in the age of LO (Ma)
Cytherella sp.1	29	55.98	55.74
Krithe sp.A	62	55.91	55.67
Profundobythere multipunctata	18	55.96	52.12

THE SAMPLING EFFECT ON DIVERSITY LOSS

Increasing in ostracode abundance, both the number of species and the diversity loss (%) from the interval of 55.46–55.96 Ma to of 54.96–55.46 Ma increase (Fig. DR1). Not only the number of species but the diversity loss depends on the abundance. The diversity loss between the 55.46–55.96 Ma and 54.96–55.46 Ma intervals shows a plateau with a value of 64% at the abundance as many as 19–28 individuals. At abundance of more than 19, the sampling bias is less effective on the estimated diversity loss.

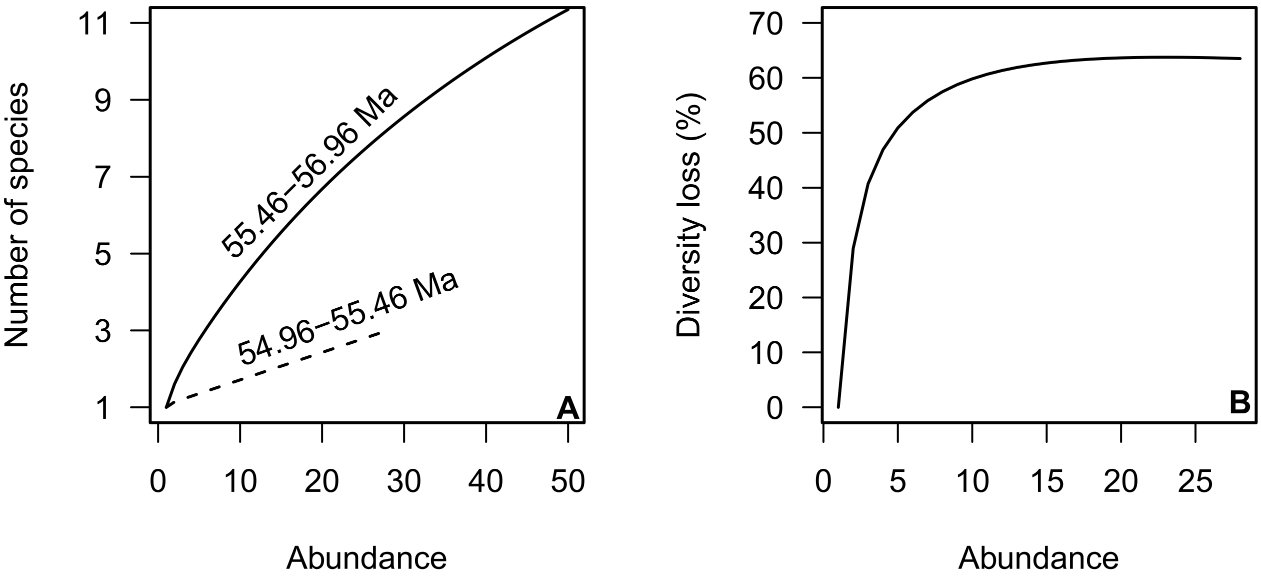

Fig. DR1. A. Species accumulation curve in the intervals of 55.46–55.96 and of 54.96–55.46 Ma. B. Diversity loss (%) from the interval of 55.46–55.96 Ma to of 54.96–55.46 Ma.

PALEOECOLOGY OF OSTRACODE DOMINANT TAXA

In the ostracode faunas, the dominant taxa change from *Krithe* and *Cytherella* to *Nemoceratina (Pariceratina)* near the P/E boundary as Boomer and Whatley (1995) reported.

Nemoceratina (Pariceratina) is an extinct genus. It is found in Paleocene–Eocene sediments at 1000 to 2000 m paleodepth and in the equatorial upwelling and coastal and the subtropical and gyres zones that were associated with high export productivity (Ma et al., 2014; Table DR4). In the ocean zones, the export productivity substantially increased during the PETM (Ma et al., 2014). Throughout the PETM, *Nemoceratina (Pariceratina)* flourished under the high export productivity. After the Eocene, *Nemoceratina (Pariceratina)* is found in only the South Pacific and Mediterranean Oceans. Oligocene–Miocene taxa are found in sites out of the Pacific equatorial divergence zone (Boomer and Whatley, 1995; Alvarez Zarikian, 2014). The sites may have been below oligotrophic waters. The taxon is found in the early Paleocene sediments in the South Pacific Ocean site (Alvarez Zarikian, 2014). The site would have been under higher biological productivity, because the site is located near the continents and the export productivity in the South Pacific bloomed following the Cretaceous/Paleogene collapse of marine plankton ecosystems (Hollis et al., 2003). An early Pleistocene taxon of the Mediterranean Sea, *Nemoceratina* (*Pariceratina*) *barrieri* Sciuto, 2014 is considered to have dwelled under eutrophic conditions. The surface productivity in the Mediterranean Sea increased from the latest Pliocene to the early Pleistocene (Lourens et al., 1992). We consider *Nemoceratina* (*Pariceratina*) as an indicator of high export production. On the other hand, *Krithe* and *Cytherella* are both extant. They have been cosmopolitan taxa during the Cenozoic. Both the taxa indicate conditions of low or moderate food-supply (Didié et al., 2002; Horne et al., 2011; Stepanova and Lyle, 2014).

Table DR4. Deep-sea sites bearing late Paleocene–early Eocene taxa of *Cytherella*, *Krithe*, and *Nemoceratina* (*Pariceratina*). The plus and minus marks indicate the presence and the absence, respectively. The coordinates at 56 Ma were calculated, using an online service of the Ocean Drilling Stratigraphic Network (www.odsn.de).

Site	Modern-day		At 56 Ma		Ocean zone (Ma et al., 2014)
	Longitude	Latitude	Longitude	Latitude	
ODP 865	179.6W	18.4°N	164.1°W	3.0°S	Equatorial upwelling and coastal zone
ODP 762	112.3°E	19.9°S	87.5°E	40.6°S	Equatorial upwelling and coastal zone
ODP 1260	54.5°W	9.3°N	53.1°W	4.2°N	Equatorial upwelling and coastal zone
ODP 1261	54.3°W	9.0°N	52.8°W	4.0°N	Equatorial upwelling and coastal zone
ODP 1049	76.1°W	30.1°N	71.4°W	28.0°N	Equatorial upwelling and coastal zone
ODP 1050	76.2°W	30.1°N	71.5°W	27.9°N	Equatorial upwelling and coastal zone
ODP 1051	76.4°W	30.1°N	71.6°W	27.9°N	Equatorial upwelling and coastal zone
ODP 1052	76.6°W	30.0°N	71.9°W	27.9°N	Equatorial upwelling and coastal zone
DSDP 549	13.1W	49.1°N	25.6°W	43.0°N	Subtropical and gyres
DSDP 550	13.1W	48.5°N	25.8°W	42.4°N	Subtropical and gyres

DSDP 400	9.2°W	47.4°N	21.9°W	41.6°N	Subtropical and gyres
DSDP 401	8.8°W	47.4°N	21.5°W	41.6°N	Subtropical and gyres
Basque Basin	2.3°W	43.3°N	15.1°W	38.0°N	Subtropical and gyres
DSDP 516	35.3°W	30.3°N	47.8°W	27.1°N	North Atlantic and Tethys
Caravaca	1.9°W	38.1°N	14.1°W	32.8°N	North Atlantic and Tethys
ODP 689	3.1°E	64.5°S	9.7°W	65.5°S	Polar
ODP 690	1.2°E	65.2°S	11.5°W	66.2°S	Polar
DSDP 20	26.8°W	28.5°S	23.4°W	32.6°S	South Atlantic and India Ocean
DSDP 356	41.1°W	28.3°S	38.3°W	33.0°S	South Atlantic and India Ocean
DSDP 357	35.6°W	30.0°S	32.4°W	34.5°S	South Atlantic and India Ocean

TABLE DR4. (continued)

Site	Ostracode taxon			Reference
	Cytherella	*Krithe*	*Nemoceratina*	
ODP 865	+	+	+	Boomer and Whatley (1995); This study
ODP 762	+	-	-	Guernet and Gasburn (1992)
ODP 1260	+	-	-	Guernet and Danelian (2006)
ODP 1261	-	-	-	Guernet and Danelian (2006)
ODP 1049	+	+	+	Guernet and Bellier (2000)
ODP 1050	+	+	-	Guernet and Bellier (2000)
ODP 1051	+	+	+	Guernet and Bellier (2000)
ODP 1052	-	+	-	Guernet and Bellier (2000)

DSDP 549	+	+	+	Whatley and Coles (1991)
DSDP 550	+	+	+	Whatley and Coles (1991)
DSDP 400	-	+	-	Ducasse and Peypouquet (1983)
DSDP 401	+	+	-	Ducasse and Peypouquet (1979); Yamaguchi and Norris (2012)
Basque Basin	+	+	-	Rodriguez-Lazaro and Garcia-Zaraga(1996)
DSDP 516	+	-	-	Benson and Peypouquet (1983)
Caravaca	+	+	-	Guernet and Molina (1997)
ODP 689	+	+	-	Majoran and Dingle (2002)
ODP 690	+	+	-	Steineck and Thomas (1996)
DSDP 20	+	-	-	Benson (1975)
DSDP 356	-	?	-	Benson (1978)
DSDP 357	-	+	-	Benson (1978)

LIST OF SPECIES IDENTIFIED IN THIS WORK

We grouped ostracode taxa into the Range-through, Lazarus, Disappearing, Late Paleocene, and incoming taxa.

Range-through taxon occurs in most samples.

Nemoceratina (Pariceratina) ubiquita (Boomer, 1994)

Lazarus taxa are sporadically found in less ten samples from the PETM and Crisis intervals:

Cytherella sp.A

Eucythere sp.B

Hemiparacytheridea sp.A

Argilloecia sp.A

Argilloecia sp.C

Cardobairdia sp.

Cytherella sp.B

Cytheropteron sp.2 of Boomer and Whatley (1995)

Cytheropteron sp.24 of Boomer and Whatley (1995)

Cytheropteron sp.C

Eucythere sp.A

Eucythere sp.D

Eucythere sp.F

Eucytherura sp.B

Neonesidea spp.

Rimacytheropteron sp.24 of Boomer and Whatley (1995)

Disappearing taxa have their last occurrences near the onset of PETM. Their extinction is local. *Profundobythere multipunctata* is reported in the middle Eocene and Oligocene sediments in the Atlantic and Pacific Oceans (Coles and Whatley, 1989; Alvarez Zarikian, 2014).

Cytherella sp.1 of Boomer and Whatley (1995)

Krithe sp.A

Krithe sp.C

Profundobythere multipunctata Coles and Whatley, 1989

Semicytherura sp.A

Late Paleocene taxa found in only Paleocene sediments. Their last occurrences are below the PETM.

Argilloecia sp.D

Bythocythere sp.

Cytheropteron sp.A

Eucythere sp.C

Eucytherura sp.A

Hemiparacytheridea sp.C

Pennyella sp.1 of Boomer and Whatley (1995)

Propontocypris sp.

Semicytherura sp.B

Incoming taxa appeared after the end of the Crisis interval.

Argilloecia sp.B

Aversovalva sp.7 of Boomer and Whatley (1995)

Bythocypris sp.

Cytheropteron sp.B

Eucythere sp.E

Eucytherura sp.D

Hemiparacytheridea sp.B

Krithe spp.

Macrocypris sp.

Pedicythere sp.

Pennyella spp.

Pseudocythere sp.

Semicytherura sp.C

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