Figure DR1
(Data Repository item)

DR Item 2007031

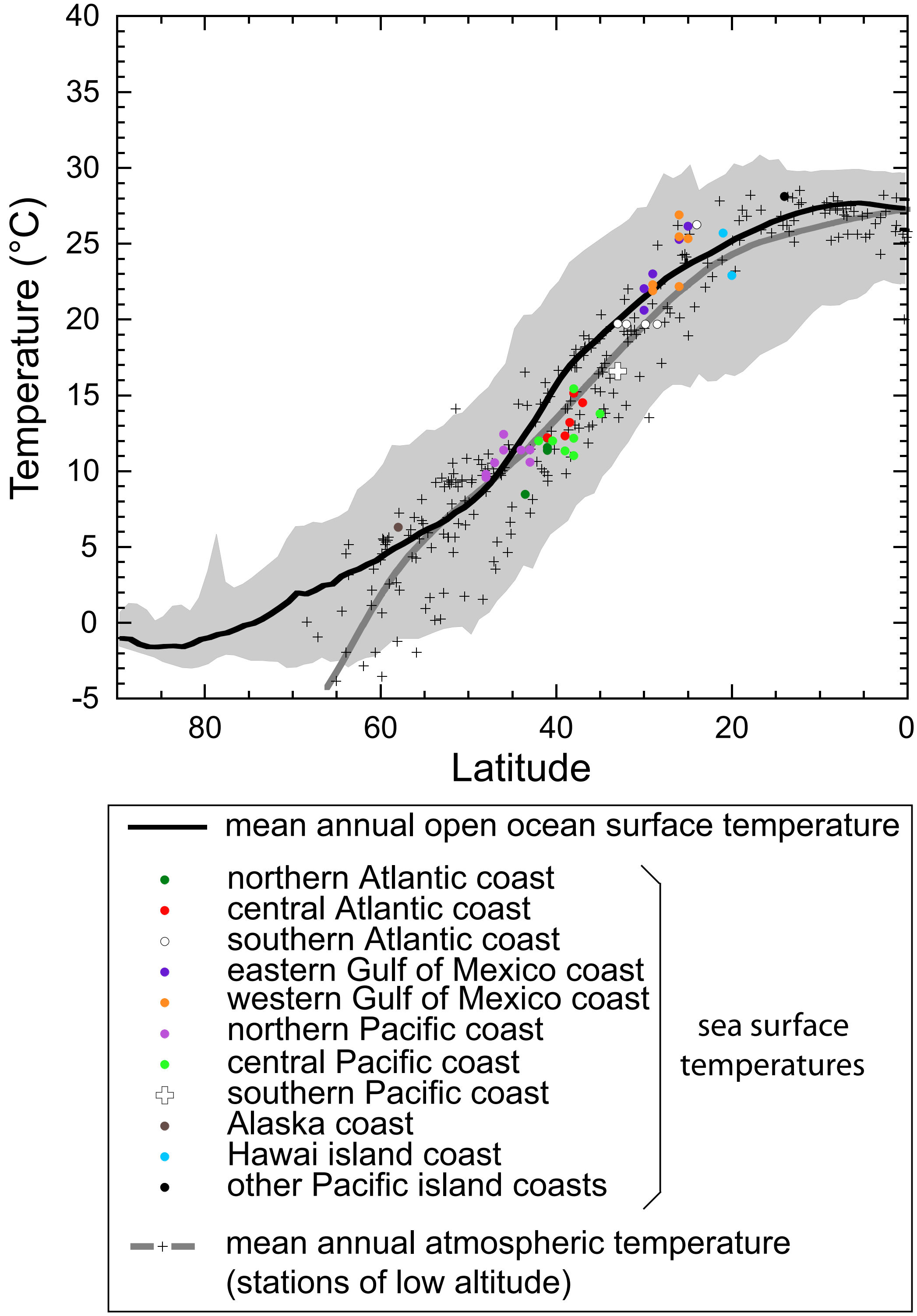

Figure DR1. Comparison of modern sea surface temperature from the open ocean to that from coastal environments, and of surface air temperature from low altitude environments. The modern SST gradient (mean annual temperatures averaged over longitude and hemispheres) is represented by the black bold solid line. The grey envelope represents the maximum range of modern seasonal SST when the whole range of longitude is considered. Modern SSTs are from the data base LEVITUS94. The coastal sea surface temperatures are mean annual temperatures calculated from monthly estimates recovered by the National Oceanographic Data Center (1983). The surface air temperatures are mean annual temperatures from the IAEA/WMO (2001) data base. Only the stations of low altitude (below 300m) have been considered.

Table DR1 (Data Repository item). Oxygen isotope compositions of fish teeth measured in this study and compiled from the literature.

	Locality	Stratigraphic age (Ammonite Zone or horizon)	Fauna, remain	Paleolatitude	$\delta^{18}O$ (‰ SMOW)	Temperature 1 (°C)	Temperature 2 (°C)	Error on temperature 1 (°C)	Error on temperature 2 (°C)
CENOMANIAN-TURONIAN									
This work									
Jurg3	Vienenburg (Germany)	Cenomanian	selachian, Te	43.00	21.20	16.1	16.1	±1.1	±1.1
S2d1	Mokresz (Poland)	Lower Cenomanian (Mantelliceras mantelli)	*Cretolamna appendiculata*, Te	44.00	20.50	19.1	19.1	±1.1	±1.1
S4d1	Skotniki (Poland)	Lower Cenomanian	*Sphenodus* sp., Te	44.00	19.89	21.8	21.8	±1.2	±1.2
S3d1	Skotniki (Poland)	Lower Cenomanian	*Otodus appendiculatus*, Te	44.00	20.52	19.0	19.0	±1.1	±1.1
S5d1	Skotniki (Poland)	Lower Cenomanian	*Sphenodus* sp., Te	44.00	18.80	26.6	26.5	±1.4	±1.4
S6d1	Skotniki (Poland)	Lowermost Cenomanian	*Ptychodus mammillaris, Te*	44.00	17.60	31.8	31.8	±1.5	±1.5
Data from literature									
Kolodny and Luz (1991)	Angola	Cenomanian	*Cretolamna appendiculata*	-23.0	18.8	26.6	28.9	±1.4	±1.4
Kolodny and Raab (1988)	Israel	Cenomanian	*Pachyamia*	12.0	17.4	32.7	35.3	±1.6	±1.6
Kolodny and Raab (1988)	Israel	Cenomanian	*Eubiodectes*	12.0	17.8	31.0	33.6	±1.5	±1.6
Kolodny and Raab (1988)	Israel	Cenomanian	Pycnodontidae	12.0	17.9	30.5	33.1	±1.5	±1.6
Kolodny and Raab (1988)	Israel	Cenomanian	shark	12.0	17.8	31.0	33.6	±1.5	±1.6
Kolodny and Raab (1988)	Israel	Upper Cenomanian	undetermined	12.0	17.4	32.7	35.3	±1.6	±1.6
Kolodny and Luz (1991)	Israel	Cenomanian	Teleostean	12.0	17.8	31.0	33.6	±1.5	±1.6
Pucéat *et al.* (2003)	France	Cenomanian	undetermined	38.4	20.8	17.8	18.5	±1.1	±1.1
Pucéat *et al.* (2003)	France	Cenomanian	undetermined	38.4	19.0	25.7	26.4	±1.4	±1.4
Pucéat *et al.* (2003)	France	Cenomanian	Lamniform	38.4	18.6	27.5	28.1	±1.4	±1.4
Pucéat *et al.* (2003)	France	Upper Cenomanian	*Squalicorax falcatus*	38.4	19.3	24.4	25.1	±1.3	±1.3
Pucéat *et al.* (2003)	France	Upper Cenomanian	*Carcharias amonensis*	38.4	19.5	23.5	24.2	±1.3	±1.3
Pucéat *et al.* (2003)	France	Turonian	Lamniform	38.4	18.4	28.3	29.0	±1.4	±1.5
Pucéat *et al.* (2003)	France	Turonian	undetermined	38.4	20.1	20.9	21.6	±1.2	±1.2
Kolodny and Raab (1988)	Sinai (Egypt)	Turonian	*Palaeobalistalum ?* sp.	8.3	17.2	33.6	36.0	±1.6	±1.7
Pucéat *et al.* (2003)	Goulmima (Morocco)	Lower Turonian	Pachyrhizodontidae	21.8	17.2	33.6	36.0	±1.6	±1.7
CAMPANIAN-MAASTRICHTIAN									
This work									
Mar1	Las Tablas (Chile)	Upper Campanian-Lower Maastrichtian	undetermined, Te	-37.05	21.00	16.9	17.8	±1.1	±1.1
Mar2bis	Algarrobo (Chile)	Upper Campanian-Lower Maastrichtian	undetermined, Te	-34.10	21.17	16.2	17.4	±1.1	±1.1
Cum7	Russell County (Alabama, USA)	Lowermost Campanian (Blufftown Formation)	*Squalicorax kaupi*, Te	36.10	19.79	22.2	23.2	±1.2	±1.3
Cum10	Bullock County (Alabama, USA)	Lowermost Campanian (Blufftown Formation)	*Squalicorax kaupi*, Te	36.10	20.87	17.5	18.5	±1.1	±1.1
Par5	Ellisdale (New Jersey, USA)	Campanian (Lower Marshalltown Formation)	*Scapanorhynchus texanus*, Te	40.70	20.77	17.9	18.3	±1.1	±1.1
Siv1	Asen (Sweden)	uppermost Lower Campanian	*Squalicorax kaupi*, Te	46.90	19.62	23.0	22.6	±1.3	±1.3
Siv2	Asen (Sweden)	uppermost Lower Campanian	*Cretolamna appendiculata*, Te	46.90	20.94	17.2	16.8	±1.1	±1.1
At2	Erguita (Morocco)	Maastrichtian	undetermined, Te	20.50	19.75	22.4	24.9	±1.2	±1.3
At4	Erguita (Morocco)	Maastrichtian	undetermined, Te	20.50	19.20	24.8	27.3	±1.3	±1.4
At5	Erguita (Morocco)	Maastrichtian	undetermined, Te	20.50	20.63	18.6	21.1	±1.1	±1.2
At6	Erguita (Morocco)	Maastrichtian	undetermined, Te	20.50	19.67	22.8	25.3	±1.3	±1.3
c2cr	Benguerir (Morocco)	Maastrichtian	*Cretolamna maroccana*, Te	22.00	18.89	26.2	28.6	±1.4	±1.4
c2cr1	Benguerir (Morocco)	Maastrichtian	*Cretolamna maroccana*, Te	22.00	19.69	22.7	25.1	±1.3	±1.3
c2sq	Benguerir (Morocco)	Maastrichtian	*Squalicorax pristodontus*, Te	22.00	20.37	19.7	22.1	±1.2	±1.2
c3cr	Benguerir (Morocco)	Maastrichtian	*Cretolamna maroccana*, Te	22.00	19.43	23.8	26.2	±1.3	±1.4
c3sq	Benguerir (Morocco)	Maastrichtian	*Squalicorax pristodontus*, Te	22.00	20.61	18.7	21.1	±1.1	±1.2
c4cr	Benguerir (Morocco)	Maastrichtian	*Cretolamna maroccana*, Te	22.00	19.51	23.5	25.9	±1.3	±1.4
c4cr1	Benguerir (Morocco)	Maastrichtian	*Cretolamna maroccana*, Te	22.00	19.30	24.4	26.8	±1.3	±1.4
c4sq	Benguerir (Morocco)	Maastrichtian	*Squalicorax pristodontus*, Te	22.00	19.46	23.7	26.1	±1.3	±1.4
c4sq1	Benguerir (Morocco)	Maastrichtian	*Squalicorax pristodontus*, Te	22.00	19.50	23.5	25.9	±1.3	±1.4
c6cr	Benguerir (Morocco)	Maastrichtian	*Cretolamna maroccana*, Te	22.00	19.76	22.4	24.8	±1.2	±1.3
c6sq	Benguerir (Morocco)	Maastrichtian	*Squalicorax pristodontus*, Te	22.00	19.95	21.5	23.9	±1.2	±1.3
S8d1	Nasilov (Poland)	Maastrichtian/Danian boundary	*Squalicorax pristodontus*, Tw	40.00	21.88	13.1	13.6	±1.0	±1.0
S7d1	Nasilov (Poland)	Maastrichtian/Danian boundary	*Squalicorax* sp., Tw	40.00	22.00	12.6	13.0	±0.9	±1.0
S9d1	Nasilov (Poland)	Maastrichtian/Danian boundary	*Odontaspis* sp., Tw	40.00	20.90	17.4	17.9	±1.1	±1.1
Par1	Inversand Marl Pits (New Jersey, USA)	uppermost Maastrichtian(basal Hornerstown Formation)	*Enchodus ferox*, Te	40.30	21.58	14.4	14.8	±1.0	±1.0
Par3	Inversand Marl Pits (New Jersey, USA)	uppermost Maastrichtian(basal Hornerstown Formation)	*Enchodus ferox*, Te	40.30	21.37	15.3	15.8	±1.0	±1.0
Par4	Inversand Marl Pits (New Jersey, USA)	uppermost Maastrichtian(basal Hornerstown Formation)	*Enchodus ferox*, Te	40.30	22.46	10.5	11.0	±0.9	±0.9
Case1	Willow Brook (New Jersey, USA)	Lower Maastrichtian	*Squalicorax pristodontus*, Te	40.70	21.58	14.4	14.8	±1.0	±1.0
Case6	Hop Brook (New Jersey, USA)	Middle Maastrichtian	*Squalicorax pristodontus*, Te	40.70	21.22	16.0	16.4	±1.1	±1.1
Case9	Hop Brook (New Jersey, USA)	Middle Maastrichtian	*Squalicorax kaupi*, Te	40.70	21.40	15.2	15.6	±1.0	±1.0
Case10	Hop Brook (New Jersey, USA)	Middle Maastrichtian	*Archaeolamna kopingensis*, Te	40.70	21.52	14.7	15.1	±1.0	±1.0
Case11	Willow Brook (New Jersey, USA)	Lower Maastrichtian	*Archaeolamna kopingensis*, Te	40.70	19.09	25.3	25.7	±1.3	±1.3
Case15	Hop Brook (New Jersey, USA)	Middle Maastrichtian	*Anomgodus phasgolus*, Tw	40.70	21.89	13.0	13.4	±1.0	±1.0
Case2	Willow Brook (New Jersey, USA)	Lower Maastrichtian	*Carcharias* sp., Te	40.70	20.77	17.9	18.3	±1.1	±1.1
Col1	Maastricht (The Netherlands)	Maastrichtian	undetermined, Te	41.40	22.32	11.2	11.5	±0.9	±0.9

Table DR1 (continued)

	Locality	Stratigraphic age (Ammonite Zone or horizon)	Fauna, remain	Paleolatitude	$\delta^{18}O$ (‰ SMOW)	Temperature 1 (°C)	Temperature 2 (°C)	Error on temperature 1 (°C)	Error on temperature 2 (°C)
Data from literature									
Kolodny and Raab (1988)	Israel	Maastrichtian	*Squatina ?* sp.	13.0	20.3	20.0	22.6	±1.2	±1.3
Kolodny and Raab (1988)	Israel	Maastrichtian	Teleostean	13.0	19.8	22.2	24.8	±1.2	±1.3
Pucéat *et al.* (2003)	Israel	Maastrichtian	*Cretolamna* sp.	13.0	20.0	21.3	24.0	±1.2	±1.3
Kolodny and Luz (1991)	Youssoufia (Morocco)	Maastrichtian	*Cretolamna maroccana*	22.2	19.3	24.4	26.8	±1.3	±1.4
Pucéat *et al.* (2003)	Youssoufia (Morocco)	Maastrichtian	undetermined	22.2	20.4	19.6	22.0	±1.2	±1.2
Pucéat *et al.* (2003)	Oued Zem (Morocco)	Maastrichtian	Lamniform	22.1	20.2	20.4	22.8	±1.2	±1.3
Lécuyer *et al.* (1993)	Oued Erguita (Morocco)	Lower Maastrichtian	*Cretolamna* sp.	20.5	18.9	26.1	28.6	±1.4	±1.4
Lécuyer *et al.* (1993)	Benguerir (Morocco)	Lower Maastrichtian	*Squalicorax* sp.	22.0	20.3	20.0	22.4	±1.2	±1.2
Lécuyer *et al.* (1993)	Benguerir (Morocco)	Lower Maastrichtian	*Squalicorax pristodontus*	22.0	20.3	20.0	22.4	±1.2	±1.2
Lécuyer *et al.* (1993)	Sidi Daoui (Morocco)	Upper Maastrichtian	*Cretolamna biauriculata maroccana*	22.1	20.0	21.3	23.7	±1.2	±1.3
Kolodny and Luz (1991)	California (USA)	Maastrichtian	*Enchodus*	48.4	22.1	12.1	11.5	±0.9	±0.9
Kolodny and Luz (1991)	California (USA)	Maastrichtian	*Plotosaurus tuckeri*	48.4	22.3	11.2	10.6	±0.9	±0.9
Pucéat *et al.* (2003)	Eben-Emael (Belgium)	Upper Maastrichtian	*Squalicorax pristodontus*	41.0	21.4	15.2	15.5	±1.0	±1.0
Kolodny and Luz (1991)	Agadir (Morocco)	Campanian	*Cretolamna appendiculata*	21.1	18.9	26.1	28.6	±1.4	±1.4
Kolodny and Raab (1988)	Jordan	Lower Campanian	*Squalicorax pristodontus*	11.4	18.4	28.3	30.9	±1.4	±1.5
Kolodny and Raab (1988)	Israel	Campanian	*Enchodus bursuaxi*	11.8	20.0	21.3	23.9	±1.2	±1.3
Kolodny and Raab (1988)	Israel	Campanian	*Enchodus bursuaxi*	11.8	19.7	22.6	25.2	±1.3	±1.3
Kolodny and Raab (1988)	Israel	Campanian	*Enchodus libycus*	11.8	19.1	25.3	27.9	±1.3	±1.4
Kolodny and Raab (1988)	Israel	Campanian	*Squalicorax kaupi*	11.8	18.7	27.0	29.6	±1.4	±1.5
Kolodny and Raab (1988)	Israel	Campanian	*Lamna biauriculata*	11.8	19.3	24.4	27.0	±1.3	±1.4
Kolodny and Raab (1988)	Morocco	Lower Campanian	*Lamna biauriculata*	22.1	19.5	23.5	25.9	±1.3	±1.4
Kolodny and Luz (1991)	New Jersey (USA)	Upper Campanian	*Scapanorhynchus texanus*	40.7	20.2	20.4	20.8	±1.2	±1.2
Pucéat *et al.* (2003)	France	Upper Campanian	undetermined	37.4	21.4	15.2	16.0	±1.0	±1.1
Pucéat *et al.* (2003)	France	Upper Campanian	undetermined	37.4	21.6	14.3	15.1	±1.0	±1.0
Pucéat *et al.* (2003)	France	Campanian	undetermined	37.4	19.2	24.8	25.6	±1.3	±1.3
Pucéat *et al.* (2003)	France	Lower Campanian	*Anomotodon* sp.	37.4	21.2	16.1	16.9	±1.1	±1.1
Pucéat *et al.* (2003)	France	Lower Campanian	*Squalicorax kaupi*	37.4	20.4	19.6	20.4	±1.2	±1.2
Pucéat *et al.* (2003)	France	Lower Campanian	undetermined	37.4	20.9	17.4	18.2	±1.1	±1.1
Pucéat *et al.* (2003)	France	Lower Campanian	*Scapanorhynchus* sp.	37.4	21.0	16.9	17.8	±1.1	±1.1
Pucéat *et al.* (2003)	France	Lower Campanian	*Squalicorax pristodontus*	37.4	21.1	16.5	17.3	±1.1	±1.1
Pucéat *et al.* (2003)	France	Lower Campanian	*Cretolamna appendiculata*	37.4	21.0	16.9	17.8	±1.1	±1.1
Pucéat *et al.* (2003)	France	lowermost Campanian	*Anomotodon* sp.	37.4	21.3	15.6	16.4	±1.0	±1.1

Temperature 1: calculated using the equation from Kolodny *et al.* (1983) and a $\delta^{18}O_{seawater}$ of -1‰SMOW.

Temperature 2: calculated using the equation from Kolodny *et al.* (1983), a $\delta^{18}O$ of -1.25‰SMOW for the mean ocean, and including an adjustment for the $\delta^{18}O_{seawater}$ that takes into account average latitudinal variations in evaporation and precipitation controls on $\delta^{18}O_{seawater}$ by analogy with the modern ocean (see Material and Methods).

Error on temperature : calculated from both the analytical error derived from the reproducibility of oxygen isotope measurements (±0.2‰, introducing an uncertainty of ±0.9°C on isotopic temperatures), and from the uncertainty deriving from the choice of the fractionation equation (Longinelli and Nuti, 1973; Kolodny *et al.*, 1983; Lécuyer *et al.*, 2003).

Faunal remains: Te (tooth enameloid), Tw (whole tooth).

Table DR2 (Data Repository item). Outputs of the statistical model.

Class 1 vs Class 3

Test A: linear fits of class 1 parallel to that of class 3 (d constant)

Residuals

Minimum	1Q	Median	3Q	Maximum
-7.4322	-1.6950	-0.2377	2.5785	8.5012

Coefficients

	Estimate	Standard error	t value	Pr(>|t|)
a	33.57062	1.10234	30.454	<2e-16
b	-0.23345	0.02857	-8.170	6e-11
d	-3.78932	0.92393	-4.101	0.000142

Residual standard error : 3.274 on 53 degrees of freedom
Multiple R-Squared : 0.5741, Adjusted R-squared : 0.558
F-statistic : 35.72 on 2 and 53 degrees of freedom, **p-value** : 1.502e-10

Test B: linear fits of class 1 not parallel to that of class 3 (d variable)

Residuals

Minimum	1Q	Median	3Q	Maximum
-6.6240	-1.9974	-0.2347	3.0464	9.3710

Coefficients

	Estimate	Standard error	t value	Pr(>|t|)
a	35.40717	1.64771	21.489	<2e-16
b	-0.29496	0.05011	-5.886	2.91e-07
d	-6.25493	1.89384	-3.303	0.00174
d/b	0.09018	0.06067	1.486	0.14325

Residual standard error : 3.237 on 52 degrees of freedom
Multiple R-Squared : 0.5915, Adjusted R-squared : 0.5679
F-statistic : 25.09 on 3 and 52 degrees of freedom, **p-value** : 3.546e-10

Class 2 vs Class 4

Test A: linear fits of class 2 parallel to that of class 4 (d constant)

Residuals

Minimum	1Q	Median	3Q	Maximum
-7.0050	-2.2109	-0.4208	2.4201	7.8714

Coefficients

	Estimate	Standard error	t value	Pr(>|t|)
a	25.20498	0.82474	30.561	<2e-16
b	-0.19107	0.02441	-7.826	1.27e-11
d	-3.41641	0.82093	-4.162	7.53e-5

Residual standard error : 3.198 on 85 degrees of freedom
Multiple R-Squared : 0.5111, Adjusted R-squared : 0.4995
F-statistic : 44.42 on 2 and 85 degrees of freedom, **p-value** : 6.218e-14

Test B: linear fits of class 2 not parallel to that of class 4 (d variable)

Residuals

Minimum	1Q	Median	3Q	Maximum
-5.9551	-1.9531	-0.3995	1.7236	8.9614

Coefficients

	Estimate	Standard error	t value	Pr(>|t|)
a	28.18961	1.00748	27.980	<2e-16
b	-0.29118	0.03167	-9.194	2.41e-14
d	-9.67336	1.59986	-6.046	3.95e-08
d/b	0.19552	0.04426	4.418	2.96e-05

Residual standard error : 2.898 on 84 degrees of freedom
Multiple R-Squared : 0.6032, Adjusted R-squared : 0.5891
F-statistic : 42.57 on 3 and 84 degrees of freedom, **p-value** : <2.2e-16

Class 1 vs Class 2

Test A: linear fits of class 1 parallel to that of class 2 (d constant)

Residuals

Minimum	1Q	Median	3Q	Maximum
-6.6571	-2.0517	-0.4271	1.7285	9.3353

Coefficients

	Estimate	Standard error	t value	Pr(>|t|)
a	35.33188	1.09485	32.271	<2e-16
b	-0.29244	0.02863	-10.213	<2e-16
d	-7.10480	0.78675	-9.031	3.89e-14

Residual standard error : 3.208 on 87 degrees of freedom
Multiple R-Squared : 0.6808, Adjusted R-squared : 0.6734
F-statistic : 92.77 on 2 and 87 degrees of freedom, **p-value** : <2.2e-16

Test B: linear fits of class 1 not parallel to that of class 2 (d variable)

Residuals

Minimum	1Q	Median	3Q	Maximum
-6.624	-2.059	-0.427	1.738	9.371

Coefficients

	Estimate	Standard error	t value	Pr(>|t|)
a	35.407173	1.642078	21.562	<2e-16
b	-0.294958	0.049937	-5.907	6.8e-08
d	-7.217559	1.988479	-3.630	0.000481
d/b	0.003778	0.061127	0.62	0.950857

Residual standard error : 3.226 on 86 degrees of freedom
Multiple R-Squared : 0.6808, Adjusted R-squared : 0.6697
F-statistic : 61.14 on 3 and 86 degrees of freedom, **p-value** : <2.2e-16

Class 1 and **Class 2** are composed of the sea surface temperatures estimated from the fish tooth $\delta^{18}O$ from the mid-Cretaceous period and from the latest Cretaceous period, respectively (circles on Fig. 2), using the equation of Kolodny et al. (1983) and a $\delta^{18}O$ of seawater of -1‰; **Class 3** and **Class 4** are composed of the sea surface temperatures estimated from the foraminifera $\delta^{18}O$ from the mid-Cretaceous period and from the latest Cretaceous period, respectively (triangles on Fig. 2), using the equation of Erez and Luz (1983) and a $\delta^{18}O$ of seawater of -1‰. The linear model used for these estimations is described below. The coefficients *a* and *b* represent the intercept and the slope of the linear fits for the fish tooth data, which appear on Fig. 2 (plain lines) and Fig. 3 (dotted lines) and *d* corresponds to the difference between the intercept of the two compared classes.

STATISTICAL MODEL DESCRIPTION

For testing the validity of a statistical model, it is classical to set and test a null hypothesis, say H0. For example, in the simplest of the several statistical models studied in this paper, H0 corresponds to the hypothesis that there is no linear relationship between our observations (e.g. temperature) and an explanatory variable like the latitude, i.e. H0 means that the slope is equal to zero. To measure how much evidence we have against H0, we compute a p-value that is defined as a probability of observing a large estimated value of the slope under the assumption that H0 is true. For example, a p-value of .01 means there is a 1 in 100 chance the result occurred by chance. In this context, the classical interpretation of the p-value is that the smaller the p-value is, the more evidence we have against H0. Hence, a very small p-value indicates a strong evidence against H0, i.e. against the hypothesis that there is no linear relationship between our variables. A similar reasoning can be used to interpret the evidence that our data bring against all the statistical models and their associated null hypothesis that we have proposed. Traditionally, researchers reject the null hypothesis if the p-value is less than 0.05, i.e. this corresponds to the classical 95% confidence level.

Our statistical model can be written as a classical linear one (Venables and Ripley, 1994; Everitt, 1994) :

$Y = X\beta + \varepsilon$

Where the noise vector ε is assumed to have a zero-mean Gaussian distribution with covariance matrix $\Sigma = \sigma^2 I$ with I being the identity matrix. Our goal is to assess if the linear functions fitting two data groups, say class 1 and class2, have the same slope or different ones. The response, i.e. the temperatures, can be described by the vector $Y_{i,j,k}$ where the subscripts *i,j*, and *k* correspond to the two classes ($i = 1,2$), the latitudes and the number of observations per latitude and group, respectively. The explanatory matrix X is equal to :

$$X = \begin{vmatrix} 1 & 0 & L_{1,1} \\ 1 & 0 & L_{1,2} \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ 1 & 0 & L_{1,n} \\ 1 & 1 & L_{2,1} \\ 1 & 1 & L_{2,2} \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ 1 & 1 & L_{2,m} \end{vmatrix}$$

Where $L_{i,l}$ represents the latitudes. These latitudes are divided with respect to the two classes (i=1,2), a total of *n* observations from the class period 1 and a total of *m* records from the class period 2. The first column of ones in the matrix X corresponds to the intercept part. The vector β has three unknown parameters $\beta = (a,d,b)^T$ where *a* and *b* represent the intercept and the slope of the linear function fitting class 1 and *d* corresponds to the difference between the intercept of class 1 and the intercept of class 2. The zeroes in the second column indicate that the distance *d* has no effect on the first line. In comparison, the ones in the second part of the second column represent the effect of *d*.

We chose to work with this simple model, which includes only three parameters, because the scarcity of available records makes otherwise the risk of over-fitting high. The different linear models tested, as well as their fit quality, are summarized above.

REFERENCES CITED IN DATA REPOSITORY ITEMS

Erez, J. and Luz, B. Experimental paleotemperature equation for planktonic formaminifera, *Geochim. Cosmochim. Acta* **47**, 1025-1031 (1983).

Everitt, B.S., 1994, A Handbook of Statistical Analyses using S-Plus: Chapman and Hall, London.

IAEA/WMO (2001). Global network of Isotopes in Precipitation. The GNIP Database. Accessible at : http://isohis.iaea.org.

Kolodny, Y., Luz, B. and Navon, O. Oxygen isotope variations in phosphate of biogenic apatites, I. Fish bone apatite-rechecking the rules of the game, *Earth Planet. Sci. Lett.* **64**, 398-404 (1983).

Kolodny, Y. and Raab, M. Oxygen isotopes in phosphatic fish remains from Israel: Paleothermometry of tropical Cretaceous and Tertiary shelf waters, *Palaeogeogr. Palaeoclimatol. Palaeoecol.* **64**, 59-67 (1988).

Kolodny, Y. and Luz, B. Oxygen isotopes in phosphates of fossil fish: Devonian to recent, in *Stable Isotope Geochemistry: A Tribute to Samuel Epstein*, edited by H. P. Taylor Jr., J. R. O'Neil and I. R. Kaplan, *Spec. Publ. Geochem. Soc.*, *3*, 105-119, University Park, PA, USA (1991).

Lécuyer, C., Grandjean, P., O'Neil, J. R., Cappetta, H. and Martineau, F. Thermal excursions in the ocean at the Cretaceous-Tertiary boundary (northern Morocco): $\delta^{18}O$ record of phosphatic fish debris. *Palaeogeogr. Palaeoclimatol. Palaeoecol.* **105**, 235-243 (1993).

Lécuyer, C., Picard, S., Garcia, J.-P., Sheppard, S.M.F., Grandjean, P. and Dromart, G. Thermal evolution of Tethyan surface waters during the Middle-Late Jurassic: Evidence from $\delta^{18}O$ values of marine fish teeth. *Paleoceanography* **18-3**, 21.1-21.14, doi 10.1029/2002PA000863 (2003).

LEVITUS94: World Ocean Atlas 1994. Available online at http://ingrid.ldeo.columbia.edu/SOURCES/.LEVITUS94

Longinelli, A and Nuti, S. Revised phosphate-water isotopic temperature scale. *Earth Planet. Sci. Lett.* **19**, 373-376 (1973).

National Oceanographic Data Center. NODC Coastal Water Temperature Guides. US Department of Commerce, National Oceanic and Atmospheric Administration (1983) Available online at http://www.nodc.noaa.gov/dsdt/wtg12.html.

Pucéat, E., Lécuyer, C., Sheppard, S. M. F., Dromart, G., Reboulet, S., and Grandjean, P. Thermal evolution of Cretaceous Tethyan marine waters inferred from oxygen isotope composition of fish tooth enamels. *Paleoceanography* **18-2**, 7.1-7.12 (2003).

Venables, W.N., and Ripley, B.D., 1994, Modern Applied Statistics with S-Plus: Springer, New York.