Supplemental Data

The supplemental data for this paper consists of three parts: 1) GPS locations for sampling localities, 2) a supplemental table of stable isotope data from the Hampshire Basin, and 3) a supplemental table of paleoclimatic results from other continental sites.

1. Sample locations

In total, six locations representing different parts of the stratigraphy (Fig. 1 in main paper) were sampled for horizons containing the freshwater gastropod *V. lentus.* The complete sample list is provided in Table S1. The Totland Bay to Osborne and Seagrove Bay Members belong to the Headon Hill Formation and the Bembridge Marls, Hamstead and Cranmore Members belong to the Bouldnor Formation.

A. **Colwell Bay/Cliff End (50° 41.370'N 1° 32.327'W) [Cliff End Member, samples COL and SCO S-1, S-2]**
B. **Sconce (50° 42.372'N 1° 31.411'W) [Laceys Farm Member and Fishbourne Member, samples SCO S1 to S8]**
C. **Whitecliff Bay (50° 40.128'N 1° 5.829'W) [Seagrove Bay Member and Osborne Member; samples OSB, SEA and BEMB]**
D. **Hamstead Ledge (50° 43.482'N 1° 25.960'W) [Bembridge Marls and lower Hamstead Members; samples HAM]**
E. **Bouldnor Foreshore (50° 42.699'N 1° 27.904'W) [lower and upper Hamstead Members; samples BOULD].**
F. **Top of Bouldnor Cliff (50° 42.920'N 1° 26.908'W) [upper Hamstead Member and Cranmore Member; samples TBC]**

2. Isotopic Data

Supplemental Table S1. Isotopic Data

Age (Ma)	Sample ID	Member	Meters above base of member & (thickness of member in meters)	Bed numbers from Daley (1973)	Average $\delta^{13}C$ (‰VPDB)	StDev $\delta^{13}C$ (‰VPDB)	Average $\delta^{18}O$ (‰VPDB)	StDev $\delta^{18}O$ (‰VPDB)	Number of *V. lentus* fragments analyzed
32.41	TBC S2	Cranmore	1.8 (9.5)		-4.9	1.0	-1.6	0.6	9
32.47	TBC S1	Cranmore	1.4 (9.5)		-5.3	1.4	-0.6	0.8	10
32.53	TBC S3	Cranmore	0.9 (9.5)		-2.4	1.1	-0.5	0.8	11
32.79	TBC S4	upper Hamstead	c.39 (c.60)		-2.6	1.2	-0.8	0.9	11
32.97	BOULD S6	upper Hamstead	23.3 (c.60)		-3.3	1.5	0.1	0.5	10
33.10	BOULD S10	upper Hamstead	13.2 (c.60)	White Band	-3.1	2.2	-0.6	0.6	10
33.25	BOULD S5	upper Hamstead	2.2 (c.60)		-1.1	0.9	0.1	0.7	10
33.70	BOULD S1	lower Hamstead	9.25 (11.25)		-4.0	1.5	-1.7	0.7	10
33.71	BOULD S2	lower Hamstead	8.45 (11.25)		-3.0	1.1	-1.1	0.6	10
33.73	HAM S15	lower Hamstead	8.3 (11)		-3.9	1.4	-0.6	0.6	15
33.74	HAM S14	lower Hamstead	8 (11)		-3.9	1.3	-1.2	0.7	15
33.75	HAM S13	lower Hamstead	7.9 (11)		-3.3	1.3	-0.8	0.6	14
33.77	HAM S11	lower Hamstead	5.35 (11)		-3.7	0.6	-1.5	0.5	10
33.78	HAM S10	lower Hamstead	5.2 (11)		-3.6	0.8	-1.9	0.9	10
33.79	HAM S9	lower Hamstead	3.25 (11)		-3.4	0.6	-1.7	0.6	10
33.80	HAM S8	lower Hamstead	2.75 (11)		-3.4	0.5	-1.4	0.7	10
33.83	HAM S6	lower Hamstead	0.45 (11)		-3.3	1.4	-1.7	0.7	12
33.84	HAM S5	lower Hamstead	0.3 (11)		-3.4	0.9	-2.2	0.5	10
33.85	HAM S4	lower Hamstead	0.05 (11)	Black Band	-7.5	1.3	-1.8	0.6	10
33.88	HAM S3	Bembridge Marls	21.8 (25.45)	29	-3.2	0.7	-1.4	0.5	12
33.92	HAM S2	Bembridge Marls	18.5 (25.45)	26/27	-2.8	0.7	-1.5	0.5	12
33.98	HAM S1	Bembridge Marls	14.4 (25.45)	24	-3.3	1.1	-1.4	0.8	10
34.05	HAM S7	Bembridge Marls	11.6 (25.45)	20	-3.7	0.9	-0.8	0.4	10
34.07	HAM S0	Bembridge Marls	10.9 (25.45)	20	-4.0	0.9	-1.4	0.7	10
34.16	HAM S-2	Bembridge Marls	5.9 (25.45)	11	-2.4	0.4	-2.2	0.6	9
34.17	HAM S-3	Bembridge Marls	5.8 (25.45)	11	-2.3	0.6	-1.6	0.5	10
34.26	HAM S-4	Bembridge Marls	1.9 (25.45)	5	-2.1	0.8	-1.5	1.1	9
34.37	BEMB S3	Seagrove Bay	8.65 (8.7)		-3.7	1.2	-0.6	0.7	10
34.47	SEA S1	Seagrove Bay	0.26 (8.7)		-0.8	1.5	-0.7	0.6	10

34.77	OSB S2	Osborne	0.2 (8)		1.3	0.9	-1.5	0.7	9
34.80	SCO S4	Fishbourne	1.97 (2)		-3.7	0.6	-2.4	0.9	9
34.82	SCO S3	Fishbourne	1.75 (2)		-2.9	0.7	-1.5	0.7	10
34.83	SCO S2	Fishbourne	1.65 (2)		-3.5	0.5	-2.2	0.5	10
34.85	SCO S1	Fishbourne	1.5 (2)		-1.7	1.1	-2.1	0.7	7
34.97	SCO S7	Fishbourne	0.2 (2)		-2.0	0.9	-1.7	0.5	10
35.00	SCO S6	Lacey's Farm	2.8 (3.1)		0.3	0.6	-0.7	0.3	14
35.15	SCO S8	Lacey's Farm	0.35 (3.1)		-2.1	0.8	-1.1	0.4	15
35.33	SCO S-1	Cliff End	9.2 (c.19)		-2.3	0.6	-2.5	0.5	13
35.34	SCO S-2	Cliff End	9 (c.19)		-3.3	0.9	-2.6	0.7	10
35.40	COL S1	Cliff End	5.1 (c.19)		-3.9	1.1	-2.2	0.6	14

Table S1. $\delta^{18}O$ and $\delta^{13}C$ values for each horizon produced from the analysis of *V. lentus* fragments. Stdev = standard deviation. Most samples are listed in Bugler (2011) but their stratigraphic position has been refined for this study. Age assignments are after Hooker et al. (2009) and Hren et al. (2013).

3. Continental Eocene-Oligocene Transition Site Summary

Supplemental Table S2. Continental Eocene-Oligocene Transition Sites - Paleoclimate

Locality[1]	Mean Annual Precipitation	Mean Annual Temperature
Argentina	n/a[2]	unchanged
Ebro Basin (Spain)	unchanged	unchanged
Isle of Wight (England) – paleosols	wetter	unchanged
Isle of Wight (England) – gastro.	wetter	cooler (>2° C)
Montana	unchanged	unchanged
Nebraska	dryer	cooler (<2° C paleosols; 8°C vert.)
Oregon	dryer	cooler (<2° C)

Table S2. [1] Results are based on (A) vertebrates: Argentina (Kohn et al., 2004) and Zanazzi et al. (2007) and (B) paleosols: Ebro Basin (Sheldon et al., 2012), Isle of Wight (Sheldon et al., 2009), Montana, Nebraska, Oregon (Sheldon and Retallack, 2004; Retallack, 2007; Gallagher and Sheldon, 2013).[2]Results not reported.

Supplemental References

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