

**Supplementary Data 1.** Geochemical data of Barremian belemnites from the Speeton section (northeastern England), investigated for stable carbon and oxygen isotopes ( $\delta^{13}\text{C}$ ,  $\delta^{18}\text{O}$ ) and trace elements. Paleotemperatures reconstructed from  $\delta^{18}\text{O}$  ( $T$  °C). The samples marked in grey show high trace-element concentrations and have not been considered in Figures 4–6. Bold numbers = values above the critical thresholds; xxx = no data available.

Appendix 1:

Speeton	Zone	$\delta^{13}\text{C}$ [‰]	$\delta^{18}\text{O}$ [‰]	Fe [ppm]	Mg [ppm]	Mn [ppm]	Sr [ppm]	Mg/Ca [mmol/mol]	T°C (SMOW -1‰)
U. Barremian	<i>O. brunsvicensis</i>	3.00	-1.03	49	1055	2	1209	4.4	16
U. Barremian	<i>O. brunsvicensis</i>	1.34	-1.11	66	1910	3	1209	7.9	16
U. Barremian	<i>O. brunsvicensis</i>	2.20	-0.22	84	981	1	1268	4.1	12
U. Barremian	<i>O. brunsvicensis</i>	2.01	-0.66	18	1074	3	1129	4.5	14
U. Barremian	<i>O. brunsvicensis</i>	0.97	-0.30	143	1039	30	1118	4.3	13
U. Barremian	<i>O. brunsvicensis</i>	2.76	-0.33	46	911	4	1111	3.8	13
U. Barremian	<i>O. brunsvicensis</i>	0.88	-0.61	24	884	7	1215	3.7	14
U. Barremian	<i>O. brunsvicensis</i>	1.05	-0.16	134	1200	11	1071	5.0	12
U. Barremian	<i>O. brunsvicensis</i>	0.89	-0.27	23	953	1	1084	4.0	13
L. Barremian	<i>Aulacoteuthis</i> spp.	0.85	-1.85	<b>212</b>	2626	3	1412	10.9	19
L. Barremian	<i>Aulacoteuthis</i> spp.	0.60	-2.22	191	3586	9	1581	14.9	21
L. Barremian	<i>Aulacoteuthis</i> spp.	1.25	-1.91	58	1565	6	1223	6.5	20
L. Barremian	<i>Aulacoteuthis</i> spp.	1.71	-1.87	83	2079	1	1431	8.6	20
L. Barremian	<i>Aulacoteuthis</i> spp.	0.93	-1.69	49	977	4	1460	4.1	19
L. Barremian	<i>Aulacoteuthis</i> spp.	0.30	-0.39	11	1405	3	1246	5.8	13
L. Barremian	<i>Aulacoteuthis</i> spp.	0.98	-1.04	60	1380	5	1149	5.7	16
L. Barremian	<i>Aulacoteuthis</i> spp.	1.69	-0.32	16	1400	1	1401	5.8	13
L. Barremian	<i>Aulacoteuthis</i> spp.	1.47	-1.16	38	1461	1	1535	6.1	16
L. Barremian	<i>Aulacoteuthis</i> spp.	0.69	-0.72	19	1605	11	1283	6.7	14
L. Barremian	<i>Aulacoteuthis</i> spp.	0.87	-0.87	51	1115	5	1234	4.6	15
L. Barremian	<i>Aulacoteuthis</i> spp.	0.77	-0.47	15	1423	2	1471	5.9	13
L. Barremian	<i>Aulacoteuthis</i> spp.	2.21	-0.25	30	967	3	1113	4.0	12
L. Barremian	<i>Aulacoteuthis</i> spp.	1.21	-0.64	21	1022	3	1519	4.2	14
L. Barremian	<i>P. pugio</i>	0.40	-0.44	38	1042	7	1439	4.3	13
L. Barremian	<i>P. pugio</i>	1.14	-0.61	30	1010	4	1402	4.2	14
L. Barremian	<i>P. pugio</i>	0.46	-1.36	<b>259</b>	1991	5	1334	8.3	17
L. Barremian	<i>P. pugio</i>	1.50	-0.04	30	884	2	1377	3.7	12
L. Barremian	<i>P. pugio</i>	1.79	0.30	50	1178	8	1365	4.9	10
L. Barremian	<i>P. pugio</i>	1.80	0.47	55	971	11	1402	4.0	10
L. Barremian	<i>P. pugio</i>	1.51	0.27	93	1368	7	1202	5.7	10
L. Barremian	<i>P. pugio</i>	1.22	-0.04	47	1305	3	938	5.4	12

Appendix 2:

Letter	Zone	$\delta^{13}\text{C}$ [‰]	$\delta^{18}\text{O}$ [‰]	Fe [ppm]	Mg [ppm]	Mn [ppm]	Sr [ppm]	Mg/Ca [mmol/mol]	T°C (SMOW -1‰)
L. Barremian	<i>Aulacoteuthis</i> spp.	0.75	-1.85	47	1269	13	1293	5	20
L. Barremian	<i>Aulacoteuthis</i> spp.	0.31	-1.50	24	1647	2	1384	7	18
L. Barremian	<i>Aulacoteuthis</i> spp.	0.35	-1.51	68	1745	17	1420	7	18
L. Barremian	<i>Aulacoteuthis</i> spp.	0.76	-1.23	52	1666	13	1298	7	17
L. Barremian	<i>Aulacoteuthis</i> spp.	1.02	-2.44	100	2070	33	1374	9	22
L. Barremian	<i>Aulacoteuthis</i> spp.	0.17	-1.76	13	1416	8	1312	6	19
L. Barremian	<i>Aulacoteuthis</i> spp.	1.30	-1.68	34	1563	12	1390	6	19
L. Barremian	<i>Aulacoteuthis</i> spp.	1.29	-1.57	19	762	5	611	3	18
L. Barremian	<i>Aulacoteuthis</i> spp.	1.01	-1.36	32	1079	13	1206	4	17
L. Barremian	<i>Aulacoteuthis</i> spp.	0.25	-1.17	87	1170	31	1277	5	16
L. Barremian	<i>Aulacoteuthis</i> spp.	1.07	-1.16	50	1883	27	1286	8	16
L. Barremian	<i>Aulacoteuthis</i> spp.	-0.02	-1.14	93	1937	5	1354	8	16
L. Barremian	<i>Aulacoteuthis</i> spp.	1.06	-2.05	50	2137	15	1317	9	20
L. Barremian	<i>Aulacoteuthis</i> spp.	1.01	-0.03	<b>3689</b>	1971	42	1240	8	12
L. Barremian	<i>Aulacoteuthis</i> spp.	1.04	-2.08	40	1545	6	1378	6	21
L. Barremian	<i>Aulacoteuthis</i> spp.	0.70	-1.32	13	1692	1	1307	7	17
L. Barremian	<i>Aulacoteuthis</i> spp.	1.20	-1.43	32	1353	8	1341	6	18
L. Barremian	<i>Aulacoteuthis</i> spp.	1.20	-1.18	48	999	12	1355	4	16
L. Barremian	<i>Aulacoteuthis</i> spp.	0.93	-1.93	71	1399	20	1341	6	20
L. Barremian	<i>Aulacoteuthis</i> spp.	0.53	-1.38	59	1449	4	1365	6	17
L. Barremian	<i>Aulacoteuthis</i> spp.	0.72	-1.51	31	2350	8	1376	10	18
L. Barremian	<i>Aulacoteuthis</i> spp.	xxx	xxx	175	1692	<b>67</b>	1245	7	xxx

Appendix 3a:

Gott	Zone	$\delta^{13}\text{C}$ [%]	$\delta^{18}\text{O}$ [%]	Fe [ppm]	Mg [ppm]	Mn [ppm]	Sr [ppm]	Mg/Ca [mmol/mol]	T°C (SMOW -1‰)
U. Barremian	<i>O. depressa</i>	2.04	-0.64	67	1076	6	1125	4.5	14
U. Barremian	<i>O. depressa</i>	0.37	0.03	65	1036	13	1158	4.3	11
U. Barremian	<i>O. depressa</i>	0.59	-0.22	142	1217	34	1312	5.1	12
U. Barremian	<i>O. depressa</i>	2.55	-0.57	<b>221</b>	713	14	1118	3.0	14
U. Barremian	<i>O. depressa</i>	1.80	-0.21	157	924	4	1163	3.8	12
U. Barremian	<i>O. depressa</i>	2.82	-0.37	67	1349	4	1332	5.6	13
U. Barremian	<i>O. depressa</i>	2.49	-0.01	104	668	7	1184	2.8	12
U. Barremian	<i>O. germanica</i>	2.56	-0.17	61	1106	2	1210	4.6	12
U. Barremian	<i>O. germanica</i>	0.96	-1.04	83	1472	3	1343	6.1	16
U. Barremian	<i>O. germanica</i>	1.37	-1.01	73	1678	12	1243	7.0	16
U. Barremian	<i>O. germanica</i>	1.14	-0.59	<b>388</b>	1370	9	1141	5.7	14
U. Barremian	<i>O. germanica</i>	2.11	-0.35	97	1505	14	1116	6.3	13
U. Barremian	<i>O. germanica</i>	1.94	-0.90	63	1285	6	1174	5.3	15
U. Barremian	<i>O. germanica</i>	3.11	-0.34	47	853	2	1330	3.5	13
U. Barremian	<i>O. germanica</i>	2.12	-0.58	<b>408</b>	1269	3	1158	5.3	14
U. Barremian	<i>O. germanica</i>	1.79	-0.19	<b>291</b>	1094	31	1297	4.5	12
U. Barremian	<i>O. germanica</i>	1.11	-0.26	110	1279	5	1526	5.3	13
U. Barremian	<i>O. germanica</i>	1.82	-0.29	84	1086	10	1143	4.5	13
U. Barremian	<i>O. germanica</i>	2.07	-0.26	<b>208</b>	1370	19	1195	5.7	13
U. Barremian	<i>O. germanica</i>	2.19	-0.44	<b>235</b>	754	21	1215	3.1	13
U. Barremian	<i>O. germanica</i>	0.52	-0.66	69	1288	3	1163	5.4	14
U. Barremian	<i>O. germanica</i>	2.17	-0.66	136	1228	10	1163	5.1	14
U. Barremian	<i>O. germanica</i>	2.10	-0.69	56	1817	3	1159	7.5	14
U. Barremian	<i>O. brunsvicensis</i>	2.62	-0.42	113	1215	1	1130	5.0	13
U. Barremian	<i>O. brunsvicensis</i>	2.57	-0.59	83	992	5	1161	4.1	14
U. Barremian	<i>O. brunsvicensis</i>	1.01	-0.97	80	1065	12	1316	4.4	16
U. Barremian	<i>O. brunsvicensis</i>	2.27	-0.43	84	956	8	1158	4.0	13
U. Barremian	<i>O. brunsvicensis</i>	0.92	-0.34	<b>263</b>	3726	39	1356	15.5	13
U. Barremian	<i>O. brunsvicensis</i>	0.81	-1.06	173	1230	21	1067	5.1	16
U. Barremian	<i>O. brunsvicensis</i>	1.38	-1.26	<b>5219</b>	2027	15	1209	8.4	17
U. Barremian	<i>O. brunsvicensis</i>	-0.30	-0.78	128	1856	22	1173	7.7	15
L. Barremian	<i>Aulacoteuthis</i> spp.	0.72	-0.35	107	1551	10	1108	6.4	13
L. Barremian	<i>Aulacoteuthis</i> spp.	0.66	-1.20	<b>253</b>	1472	28	1249	6.1	17
L. Barremian	<i>Aulacoteuthis</i> spp.	1.14	-0.78	181	1054	17	1161	4.4	15
L. Barremian	<i>Aulacoteuthis</i> spp.	0.67	-1.22	180	939	7	1256	3.9	17
L. Barremian	<i>Aulacoteuthis</i> spp.	2.11	-0.60	91	1111	5	1235	4.6	14
L. Barremian	<i>Aulacoteuthis</i> spp.	2.49	-0.25	136	1109	9	1152	4.6	12
L. Barremian	<i>Aulacoteuthis</i> spp.	1.61	-0.07	110	1055	20	1101	4.4	12
L. Barremian	<i>Aulacoteuthis</i> spp.	0.98	-1.33	94	1804	6	1338	7.5	17
L. Barremian	<i>Aulacoteuthis</i> spp.	0.82	-1.60	69	1350	10	1303	5.6	18
L. Barremian	<i>Aulacoteuthis</i> spp.	1.78	-1.94	77	1261	5	1422	5.2	20
L. Barremian	<i>Aulacoteuthis</i> spp.	1.54	-1.20	74	1429	7	1285	5.9	17
L. Barremian	<i>Aulacoteuthis</i> spp.	0.88	-2.24	20	1862	1	1519	7.7	21
L. Barremian	<i>Aulacoteuthis</i> spp.	0.64	-1.95	95	1586	11	1451	6.6	20
L. Barremian	<i>P.pugio</i>	0.05	-0.55	<b>482</b>	1196	9	1654	5.0	14

Appendix 3b: stage	locality	sample		TEX 86	T°C (TEX86)
L. Barremian	Gott	100/1	Hauptblätterton	0.68	25.6
L. Barremian	Gott	100/2	Hauptblätterton	0.68	25.7
L. Barremian	Gott	100/5	Hauptblätterton	0.71	27.0
L. Barremian	Gott	100/6	Hauptblätterton	0.73	27.5
L. Barremian	Gott	100/7	Hauptblätterton	0.68	25.6
L. Barremian	Gott	100/9	Hauptblätterton	0.69	26.1
L. Barremian	Gott	100/10	Hauptblätterton	0.68	25.9
L. Barremian	Gott	100/11	Hauptblätterton	0.68	25.6
L. Barremian	Gott	100/12	Hauptblätterton	0.69	26.3

Appendix 4:

Hoheneggelsen	Zone	$\delta^{13}\text{C}$ [‰]	$\delta^{18}\text{O}$ [‰]	Fe [ppm]	Mg [ppm]	Mn [ppm]	Sr [ppm]	Mg/Ca [mmol/mol]	T°C (SMOW -1‰)
U. Barremian	<i>O. germanica</i>	1.97	-0.55	13	1208	8	1254	5.0	14
U. Barremian	<i>O. germanica</i>	2.36	-0.27	12	1148	5	1207	4.8	13
U. Barremian	<i>O. germanica</i>	0.86	-0.58	341	1247	84	1094	5.2	14
U. Barremian	<i>O. germanica</i>	1.90	-0.29	199	2046	35	1288	8.5	13
U. Barremian	<i>O. germanica</i>	1.31	-0.72	21	1144	2	1180	4.8	14
U. Barremian	<i>O. germanica</i>	1.86	0.00	40	1481	14	1161	6.2	11
U. Barremian	<i>O. germanica</i>	1.53	0.06	15	1217	9	1155	5.1	11
U. Barremian	<i>O. germanica</i>	1.47	-0.27	26	986	4	1082	4.1	13
U. Barremian	<i>O. germanica</i>	1.79	0.24	22	984	2	1259	4.1	10
U. Barremian	<i>O. germanica</i>	1.59	-0.83	30	2429	6	1348	10.1	15
U. Barremian	<i>O. germanica</i>	1.70	-0.96	2	1326	4	1325	5.5	16
U. Barremian	<i>O. germanica</i>	0.68	-0.48	120	1089	15	1218	4.5	13
U. Barremian	<i>O. germanica</i>	1.57	-0.77	14	1281	2	1271	5.3	15
U. Barremian	<i>O. germanica</i>	1.43	-0.93	12	1438	2	1143	6.0	15
U. Barremian	<i>O. germanica</i>	1.09	0.20	2	1217	2	1182	5.1	11
U. Barremian	<i>O. germanica</i>	1.09	-0.06	84	910	12	1154	3.8	12
U. Barremian	<i>O. brunsvicensis</i>	1.48	-0.60	132	1844	10	1059	7.7	14
U. Barremian	<i>O. brunsvicensis</i>	2.00	-1.04	13	1914	3	1347	8.0	16
U. Barremian	<i>O. brunsvicensis</i>	0.85	-0.62	32	1138	1	1279	4.7	14
U. Barremian	<i>O. brunsvicensis</i>	1.69	-0.11	4	1241	3	1303	5.2	12
U. Barremian	<i>O. brunsvicensis</i>	1.67	-0.82	1	1593	2	1181	6.6	15
U. Barremian	<i>O. brunsvicensis</i>	2.16	-0.13	15	1376	2	1063	5.7	12
U. Barremian	<i>O. brunsvicensis</i>	1.29	-0.45	43	1647	7	1101	6.8	13

Appendix 5:

Gliesmarode	Zone	$\delta^{13}\text{C}$ [‰]	$\delta^{18}\text{O}$ [‰]	Fe [ppm]	Mg [ppm]	Mn [ppm]	Sr [ppm]	Mg/Ca [mmol/mol]	T°C (SMOW -1‰)
U. Barremian	<i>O. depressa</i>	2.43	-0.22	31	2384	3	1227	9.9	12
U. Barremian	<i>O. depressa</i>	1.53	-0.04	<b>1114</b>	1457	6	1190	6.1	12
U. Barremian	<i>O. depressa</i>	3.27	-0.64	49	1513	2	1160	6.3	14
U. Barremian	<i>O. depressa</i>	2.91	-0.55	<b>632</b>	1325	23	1200	5.5	14
U. Barremian	<i>O. depressa</i>	2.59	-0.82	59	1705	2	1177	7.1	15
U. Barremian	<i>O. depressa</i>	2.32	-0.31	52	1009	6	1140	4.2	13
U. Barremian	<i>O. depressa</i>	0.95	-0.62	42	2297	3	1246	9.5	14
U. Barremian	<i>O. depressa</i>	1.84	-1.01	6	1870	1	1192	7.8	16
U. Barremian	<i>O. germanica</i>	1.42	-0.82	16	1138	1	1229	4.7	15
U. Barremian	<i>O. germanica</i>	1.01	-0.88	85	1138	2	1137	4.7	15
U. Barremian	<i>O. germanica</i>	1.27	-1.43	67	1841	2	1218	7.6	18
U. Barremian	<i>O. germanica</i>	2.18	-1.55	47	1529	2	1128	6.4	18
U. Barremian	<i>O. germanica</i>	1.88	-1.16	38	1561	4	1088	6.5	16
U. Barremian	<i>O. germanica</i>	1.79	-0.07	72	1398	4	1179	5.8	12
U. Barremian	<i>O. germanica</i>	1.31	-1.27	90	1688	5	1133	7.0	17
U. Barremian	<i>O. germanica</i>	0.88	-0.40	24	1612	3	1256	6.7	13
U. Barremian	<i>O. germanica</i>	1.74	-1.00	28	1467	4	1195	6.1	16
U. Barremian	<i>O. germanica</i>	1.72	-0.23	75	939	2	1118	3.9	12
U. Barremian	<i>O. germanica</i>	2.88	-0.40	18	1137	1	1222	4.7	13
U. Barremian	<i>O. germanica</i>	1.11	-0.34	121	2355	9	1282	9.8	13
U. Barremian	<i>O. germanica</i>	1.54	-0.34	<b>1859</b>	2165	21	1218	9.0	13
U. Barremian	<i>O. germanica</i>	1.88	-0.35	<b>436</b>	1236	23	1127	5.1	13
U. Barremian	<i>O. germanica</i>	3.26	0.05	137	1174	0	1096	4.9	11
U. Barremian	<i>O. germanica</i>	1.93	-0.13	63	1638	3	1102	6.8	12
U. Barremian	<i>O. germanica</i>	1.99	-1.10	33	1136	2	1235	4.7	16
U. Barremian	<i>O. germanica</i>	2.4	-0.44	52	906	3	1128	3.8	13
U. Barremian	<i>O. germanica</i>	1.62	-0.63	71	1365	3	1302	5.7	14
U. Barremian	<i>O. germanica</i>	2.27	-0.4	42	1292	1	1135	5.4	13
U. Barremian	<i>O. germanica</i>	1.90	-0.83	42	2078	1	1203	8.6	15
U. Barremian	<i>O. germanica</i>	1.98	-0.64	109	<b>832</b>	8	1214	3.5	14
U. Barremian	<i>O. germanica</i>	2.66	-0.73	133	1177	5	1189	4.9	15
U. Barremian	<i>O. germanica</i>	2.18	-1.34	107	1271	6	1137	5.3	17
U. Barremian	<i>O. germanica</i>	1.56	-0.59	29	1387	4	1080	5.8	14
U. Barremian	<i>O. germanica</i>	1.50	-0.18	32	1421	3	1094	5.9	12
U. Barremian	<i>O. germanica</i>	1.10	-0.37	24	1274	2	1197	5.3	13

A39	Zone	$\delta^{13}\text{C}$ [‰]	$\delta^{18}\text{O}$ [‰]	Fe [ppm]	Mg [ppm]	Mn [ppm]	Sr [ppm]	Mg/Ca [mmol/mol]	T°C (SMOW -1‰)
U. Barremian	<i>O. depressa</i>	2.20	0.21	107	968	6	1225	4.0	11
U. Barremian	<i>O. depressa</i>	2.16	0.19	120	1545	6	1224	6.4	11
U. Barremian	<i>O. depressa</i>	1.53	0.21	<b>382</b>	1344	31	1158	5.6	11
U. Barremian	<i>O. depressa</i>	0.91	-0.11	119	1024	2	1366	4.3	12
U. Barremian	<i>O. depressa</i>	1.12	-0.55	149	1652	5	1436	6.9	14
U. Barremian	<i>O. depressa</i>	2.03	-0.39	95	913	33	1336	3.8	13
U. Barremian	<i>O. depressa</i>	1.62	0.22	102	1279	5	1452	5.3	11
U. Barremian	<i>O. depressa</i>	1.73	-0.15	92	1469	1	1546	6.1	12
U. Barremian	<i>O. depressa</i>	2.12	0.05	<b>254</b>	1899	2	1358	7.9	11
U. Barremian	<i>O. depressa</i>	1.37	0.22	<b>215</b>	1652	3	1411	6.9	11
U. Barremian	<i>O. depressa</i>	1.56	-0.18	198	1856	3	1404	7.7	12
U. Barremian	<i>O. depressa</i>	1.60	-0.07	149	1632	3	1595	6.8	12
U. Barremian	<i>O. depressa</i>	2.20	-0.31	81	1807	1	1465	7.5	13
U. Barremian	<i>O. depressa</i>	1.66	-1.09	186	2365	19	1824	9.8	16
U. Barremian	<i>O. depressa</i>	1.93	-1.28	99	1269	1	1446	5.3	17
U. Barremian	<i>O. germanica</i>	1.13	-1.10	108	2156	3	1450	9.0	16
U. Barremian	<i>O. germanica</i>	0.54	-0.44	197	2712	16	1839	11.3	13
U. Barremian	<i>O. germanica</i>	0.52	-0.96	99	2271	1	1491	9.4	16
U. Barremian	<i>O. germanica</i>	1.87	-0.08	198	1318	34	1466	5.5	12
U. Barremian	<i>O. germanica</i>	1.19	-0.09	83	2488	3	1734	10.3	12
U. Barremian	<i>O. germanica</i>	1.50	-0.78	131	1490	17	1777	6.2	15
U. Barremian	<i>O. germanica</i>	3.43	-0.57	<b>291</b>	1104	48	<b>1457</b>	4.6	14
U. Barremian	<i>O. germanica</i>	2.65	-0.50	105	1658	34	1547	6.9	14
U. Barremian	<i>O. germanica</i>	1.95	-0.08	119	1673	47	1573	7.0	12
U. Barremian	<i>O. germanica</i>	1.09	-0.81	<b>227</b>	2109	33	<b>1788</b>	8.8	15
U. Barremian	<i>O. germanica</i>	1.14	-0.29	9	1449	2	1725	6.0	13
U. Barremian	<i>O. germanica</i>	1.89	-0.04	76	1478	12	1675	6.1	12
U. Barremian	<i>O. germanica</i>	1.81	-0.10	<b>237</b>	2821	<b>105</b>	1803	11.7	12
U. Barremian	<i>O. germanica</i>	1.98	-0.39	105	1389	34	1486	5.8	13
U. Barremian	<i>O. germanica</i>	1.83	-0.49	182	1436	<b>107</b>	1647	6.0	14
U. Barremian	<i>O. germanica</i>	1.25	-0.38	<b>500</b>	2435	24	2435	10.1	13
U. Barremian	<i>O. germanica</i>	1.16	-0.46	56	1287	7	1687	5.3	13
U. Barremian	<i>O. germanica</i>	1.69	-0.84	<b>777</b>	1802	<b>59</b>	1520	7.5	15
U. Barremian	<i>O. germanica</i>	1.22	-1.12	<b>816</b>	1899	<b>65</b>	1427	7.9	16
U. Barremian	<i>O. germanica</i>	1.92	-0.69	<b>246</b>	1506	45	1798	6.3	14
U. Barremian	<i>O. germanica</i>	1.23	-0.58	<b>392</b>	1800	23	1731	7.5	14
U. Barremian	<i>O. brunsvicensis</i>	1.81	-0.11	37	1513	3	1655	6.3	12
U. Barremian	<i>O. brunsvicensis</i>	1.47	-0.36	86	1576	20	1603	6.5	13
U. Barremian	<i>O. brunsvicensis</i>	1.59	-0.39	38	1598	9	1723	6.6	13
U. Barremian	<i>O. brunsvicensis</i>	1.62	-0.40	31	1536	4	1627	6.4	13
U. Barremian	<i>O. brunsvicensis</i>	-0.26	-0.79	<b>170</b>	2094	<b>59</b>	2088	8.7	15
U. Barremian	<i>O. brunsvicensis</i>	1.53	-0.17	<b>318</b>	1601	26	1653	6.7	12
U. Barremian	<i>O. brunsvicensis</i>	0.43	-0.94	79	1368	10	1764	5.7	15
U. Barremian	<i>O. brunsvicensis</i>	0.29	-1.25	97	1826	16	2109	7.6	17
U. Barremian	<i>O. brunsvicensis</i>	1.46	-0.94	173	1671	27	1878	6.9	15
U. Barremian	<i>O. brunsvicensis</i>	0.35	-0.63	<b>328</b>	2441	12	1592	10.1	14
U. Barremian	<i>O. brunsvicensis</i>	0.53	-0.07	<b>232</b>	2189	<b>56</b>	1566	9.1	12
U. Barremian	<i>O. brunsvicensis</i>	0.14	-1.07	188	1623	21	1635	6.7	16
U. Barremian	<i>O. brunsvicensis</i>	-2.53	-3.17	<b>3343</b>	3331	<b>135</b>	1297	13.8	26
U. Barremian	<i>O. brunsvicensis</i>	1.07	-0.84	152	1684	4	1554	7.0	15
L. Barremian	<i>Aulacoteuthis</i> spp.	1.39	-0.83	171	885	1	1064	3.7	15
L. Barremian	<i>Aulacoteuthis</i> spp.	1.51	-1.79	92	1494	4	1903	6.2	19
L. Barremian	<i>Aulacoteuthis</i> spp.	0.69	-2.01	33	2056	1	1877	8.5	20
L. Barremian	<i>Aulacoteuthis</i> spp.	0.84	-2.03	21	2845	2	2036	11.8	20
L. Barremian	<i>P. pugio</i>	1.57	-1.16	195	1395	19	1740	5.8	16
L. Barremian	<i>P. pugio</i>	1.60	-0.77	24	1521	4	1626	6.3	15

Appendix 7:

Roklum	Zone	$\delta^{13}\text{C}$ [%]	$\delta^{18}\text{O}$ [%]	Fe [ppm]	Mg [ppm]	Mn [ppm]	Sr [ppm]	Mg/Ca [mmol/mol]	T°C (SMOW -1‰)
U. Barremian	<i>O. brunsvicensis</i>	0.34	-0.49	41	1135	4	1189	4.7	14
U. Barremian	<i>O. brunsvicensis</i>	2.34	-0.76	40	1347	1	1233	5.6	15
U. Barremian	<i>O. brunsvicensis</i>	0.97	-0.53	52	1800	4	1134	7.5	14
U. Barremian	<i>O. brunsvicensis</i>	0.70	-0.47	186	1474	10	1095	6.1	13
U. Barremian	<i>O. brunsvicensis</i>	0.70	-1.00	112	1560	6	1118	6.5	16
U. Barremian	<i>O. brunsvicensis</i>	1.23	-1.12	77	1366	2	1211	5.7	16
U. Barremian	<i>O. brunsvicensis</i>	1.91	-0.71	62	1688	14	1260	7.0	14
U. Barremian	<i>O. brunsvicensis</i>	1.58	-0.59	66	1240	6	1169	5.2	14
U. Barremian	<i>O. brunsvicensis</i>	1.48	-0.67	<b>1776</b>	1489	9	1191	6.2	14
U. Barremian	<i>O. brunsvicensis</i>	0.33	-0.46	46	1197	3	1276	5.0	13
U. Barremian	<i>O. brunsvicensis</i>	1.11	-0.83	79	1225	4	1176	5.1	15
L. Barremian	<i>Aulacoteuthis</i> spp.	0.50	-0.88	19	1626	3	1182	6.8	15
L. Barremian	<i>Aulacoteuthis</i> spp.	0.19	-0.92	64	1270	4	1255	5.3	15
L. Barremian	<i>Aulacoteuthis</i> spp.	0.58	-1.48	48	1652	5	1242	6.9	18
L. Barremian	<i>Aulacoteuthis</i> spp.	1.87	-0.81	31	1135	2	1182	4.7	15
L. Barremian	<i>Aulacoteuthis</i> spp.	1.45	-1.01	46	1394	3	1204	5.8	16
L. Barremian	<i>Aulacoteuthis</i> spp.	0.31	-0.88	34	1684	2	1331	7.0	15
L. Barremian	<i>Aulacoteuthis</i> spp.	2.10	-0.21	8	1117	1	1227	4.6	12
L. Barremian	<i>Aulacoteuthis</i> spp.	1.37	-0.66	14	1297	2	1264	5.4	14
L. Barremian	<i>Aulacoteuthis</i> spp.	0.32	-1.05	71	2078	3	1326	8.6	16
L. Barremian	<i>Aulacoteuthis</i> spp.	2.23	-0.69	<b>521</b>	1262	3	1185	5.2	14
L. Barremian	<i>Aulacoteuthis</i> spp.	0.57	-0.21	66	1087	3	1131	4.5	12
L. Barremian	<i>Aulacoteuthis</i> spp.	2.50	-0.49	10	1074	2	1266	4.5	14
L. Barremian	<i>Aulacoteuthis</i> spp.	1.71	-1.60	<b>211</b>	1941	11	1407	8.1	18
L. Barremian	<i>Aulacoteuthis</i> spp.	0.95	-0.59	75	1431	6	1112	5.9	14
L. Barremian	<i>Aulacoteuthis</i> spp.	2.31	-0.79	8	1162	1	1252	4.8	15
L. Barremian	<i>Aulacoteuthis</i> spp.	2.61	-0.30	25	1176	2	1224	4.9	13
L. Barremian	<i>Aulacoteuthis</i> spp.	-0.88	xxx	<b>2668</b>	<b>3841</b>	<b>209</b>	1507	16.0	xxx
L. Barremian	<i>Aulacoteuthis</i> spp.	1.78	-0.48	68	926	3	1242	3.8	13
L. Barremian	<i>Aulacoteuthis</i> spp.	1.09	-1.79	33	1667	1	1482	6.9	19
L. Barremian	<i>Aulacoteuthis</i> spp.	1.62	-0.71	39	1667	1	1210	6.9	14
L. Barremian	<i>Aulacoteuthis</i> spp.	1.15	-1.32	63	1348	2	1454	5.6	17
L. Barremian	<i>Aulacoteuthis</i> spp.	0.26	-2.19	80	2172	3	1375	9.0	21
L. Barremian	<i>Aulacoteuthis</i> spp.	1.09	-1.34	85	1980	6	1325	8.2	17
L. Barremian	<i>Aulacoteuthis</i> spp.	1.46	-1.05	36	1518	2	1315	6.3	16
L. Barremian	<i>Aulacoteuthis</i> spp.	0.77	-1.71	43	1250	1	1420	5.2	19
L. Barremian	<i>Aulacoteuthis</i> spp.	0.68	-2.09	52	1467	1	1481	6.1	21
L. Barremian	<i>Aulacoteuthis</i> spp.	0.53	-2.25	51	1465	2	1426	6.1	21
L. Barremian	<i>Aulacoteuthis</i> spp.	0.58	-1.73	89	2508	5	1462	10.4	19
L. Barremian	<i>Aulacoteuthis</i> spp.	2.24	-0.70	64	1030	6	1181	4.3	14
L. Barremian	<i>Aulacoteuthis</i> spp.	0.17	-2.00	61	1413	3	1473	5.9	20
L. Barremian	<i>Aulacoteuthis</i> spp.	-0.23	-1.98	44	1356	3	1332	5.6	20
L. Barremian	<i>Aulacoteuthis</i> spp.	-0.17	-2.09	99	2399	5	1514	10.0	21
L. Barremian	<i>Aulacoteuthis</i> spp.	.34	-1.73	99	1725	3	1283	7.2	19
L. Barremian	<i>Aulacoteuthis</i> spp.	0.72	-1.98	41	2122	1	1444	8.8	20
L. Barremian	<i>Aulacoteuthis</i> spp.	0.08	-2.09	32	1339	1	1389	5.6	21
L. Barremian	<i>Aulacoteuthis</i> spp.	1.01	-1.77	76	1047	7	1511	4.3	19
L. Barremian	<i>Aulacoteuthis</i> spp.	0.61	-1.89	25	2805	1	1456	11.7	20
L. Barremian	<i>Aulacoteuthis</i> spp.	0.76	-2.03	59	3161	4	1572	13.1	20

L. Barremian	<i>Aulacoteuthis</i> spp.	1.15	-1.74	86	3697	4	1524	15.4	19
L. Barremian	<i>Aulacoteuthis</i> spp.	-0.09	xxx	744	4127	21	1387	17.1	xxx
L. Barremian	<i>P. pugio</i>	0.79	-1.14	38	1090	3	1322	4.5	16
L. Barremian	<i>P. pugio</i>	1.33	-1.84	39	1106	3	1286	4.6	19
L. Barremian	<i>P. pugio</i>	0.47	-0.95	52	1985	4	1258	8.2	15
L. Barremian	<i>P. pugio</i>	0.60	-1.63	62	2025	3	1439	8.4	18
L. Barremian	<i>P. pugio</i>	0.79	-1.17	71	1080	4	1323	4.5	16
L. Barremian	<i>P. pugio</i>	0.59	-0.69	35	914	3	1155	3.8	14
L. Barremian	<i>P. pugio</i>	1.53	-1.88	65	1130	2	1395	4.7	20
L. Barremian	<i>P. pugio</i>	1.02	-0.09	38	1449	3	1346	6.0	12
L. Barremian	<i>P. pugio</i>	0.37	-1.53	30	1014	4	1306	4.2	18
L. Barremian	<i>P. pugio</i>	1.19	0.15	60	1199	6	1383	5.0	11
L. Barremian	<i>P. pugio</i>	0.69	-1.21	51	1258	3	1336	5.2	17
L. Barremian	<i>P. pugio</i>	1.74	-1.46	67	867	3	1358	3.6	18
L. Barremian	<i>P. pugio</i>	0.13	-0.89	44	1038	10	1437	4.3	15
L. Barremian	<i>P. pugio</i>	0.41	-0.52	53	1063	5	1238	4.4	14
L. Barremian	<i>P. pugio</i>	0.92	-1.05	40	1123	3	1357	4.7	16
L. Barremian	<i>P. pugio</i>	0.39	-1.10	49	1136	5	1415	4.7	16
L. Barremian	<i>P. pugio</i>	0.99	-0.37	67	1321	6	1137	5.5	13
L. Barremian	<i>P. pugio</i>	1.72	-0.79	27	1172	4	1322	4.9	15