AGU PUBLICATIONS

Observational and Model Evidence for an Important Role for External Forcing in Driving Atlantic Multidecadal Variability over the last 600 years

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Table of Contents

Introduction

This file contains supplemental data not included in the main text.

Section 1: Dating Methods and Data

Further details of the age dating are presented along with raw data.

Section 2: Ensemble Members

A table is also included in this section which presents the total and forced variance from the CESM-LME (Community Earth System Model–Last Millennium Ensemble) model.

Section 3: Geochemical Methods and Data

Further details of the geochemical analyses and all raw data are presented.

Section 1: Details of Dating

Dating Methods

Measurements of the LSI-4 scleropsonge were performed between 2005 and 2019. For isotope dilution measurements a combined $^{233/236}U/^{229}Th$-spike was used, with stock solutions calibrated using NIST-SRM3164 (U) and NIST-SRM3159 (Th), as combi-spike calibrated against CRM-145 uranium standard solution (also known as NBL-112A) for U-isotope composition, and against a secular equilibrium standard (HU-1, uranium ore solution) for determination of the $^{230}Th/^{234}U$ activity ratio. Whole procedure blank values of this sample set were measured around 0.1 fg for ^{230}Th, around 1 pg for ^{232}Th and between 0.5 and 2 pg for U, which are in the typical range of this method and laboratory. Element separation procedure was based on Eichrom-UTEVA resin.

Table 1.1- Summary Age Data

Sample #	Distance[1] (mm)	U/Th[2] Age (yrs)	Age[3] Adjusted for Zero Age (yrs)	Error[4] (yrs)	Uncertainty[5] Distance (mm)
	0		0		
1	5	83	28	6	0.5
2	21	159	104	2	0.5
3	41	297	242	7	0.5
4	63	418	363	5	0.5
5	80	502	444	18	0.2
6	84	519	464	7	0.5
7	95	585	527	27	0.2
	110	Sample not analyzed as the material is bio-eroded			

1- Location of the samples (mm) below the oral surface of the sclerosponge. The base of the specimen was 11 cm below the oral surface, but this material was visibly bio-eroded and subsequently not analyzed.
2- The uncorrected U/Th ages.
3- The age adjusted for the age of the surface of the sponge (54 years). The non-zero age is a result of sclerosponge incorporation of a small amount of initial Th derived from atmospheric sources into its skeleton (Rosenheim et al., 2007).
4- The error of the age is based on that determined during the measurement.
5- The error on the sample distance is based on the method of sampling. Samples 1, 2, 3, 4, & 6 were cut with a diamond saw and therefore the resolution was approximately 5 mm. Samples 5 and 7 were taken using a diamond drill and therefore have a tighter spatial tolerance, but have a higher age error as a result of the smaller sample size.

Table 1.2- Raw Age Data: Data used in age calculations. Data were measured in three sessions between 2005 and 2019. Ratios from the earliest analytical session are not available but the implications of this are discussed within the main text.

Distance from Surface	+/-	Year Dated	Instrument	Uncrrected Age	±	Corrected	min-Age	max-Age	U238	±	Th232	±
mm				ky	ky		ky	ky	ppm	ppm	ppb	ppb
5	0.5	2005	Axiom / JF	0.083	0.006	0.028	0.077	0.089				
21	0.5	2009	Axiom / JF	0.159	0.002	0.104	0.157	0.161	7.479	0.011	11.701	0.029
41	0.5	2005	Axiom / JF	0.297	0.007	0.242	0.290	0.304				
63	0.5	2005	Axiom / JF	0.418	0.005	0.363	0.413	0.423				
80	0.2	2019	Neptune / VL / AH	0.497	0.018	0.444	0.426	0.462	12.338	0.110	24.404	0.189
84	0.5	2009	Axiom / JF	0.519	0.008	0.464	0.512	0.527	7.112	0.009	8.568	0.032
95	0.2	2019	Neptune / VL / AH	0.580	0.027	0.527	0.500	0.554	7.747	0.073	26.025	0.163

Distance from Surface	+/-	Th230	±	Th230/Th232	±	U238/Th232	±	Th230/U238	±	Th230excess/U238	±	U234/U238	±	U234/U238initial
mm		ppt	ppt	dpm/dpm	dpm/dpm	dpm/dpm	dpm/dpm	dpm/dpm	dpm/dpm	dpm/dpm	dpm/dpm	dpm/dpm	dpm/dpm	
5	0.5													
21	0.5	0.244	0.003	3.887	0.050	1978	6	0.0020	0.0000	0.0017	0.0000	1.1412	0.0023	1.1413
41	0.5													
63	0.5													
80	0.2	1.038	0.020	7.969	0.164	1551	19	0.0051	0.0001	0.0047	0.0001	1.1473	0.0004	1.1475
84	0.5	0.668	0.008	14.564	0.191	2569	10	0.0057	0.0001	0.0054	0.0001	1.1454	0.0022	1.1456
95	0.2	0.805	0.012	5.797	0.094	913	11	0.0063	0.0001	0.0055	0.0001	1.1489	0.0003	1.1491

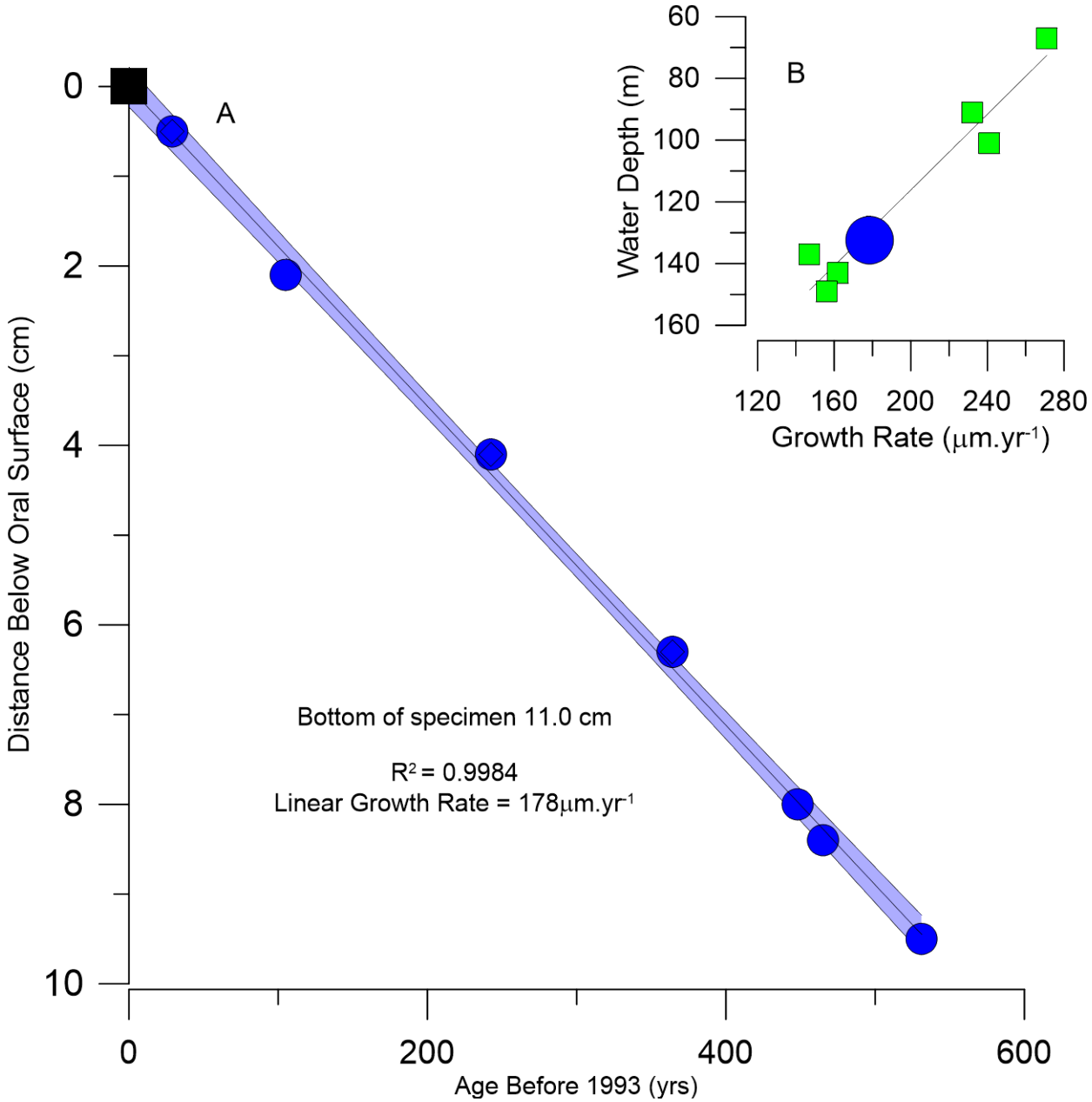

Figure S1.1: Depth Age Calibration *A) Age dates measured comprising seven U-Th measurements and the Modern surface (black square). The shaded area represents the 95% confidence limits of the age estimate. The error on the age estimate at the 95% confidence limit ranges from ±8 to ±12 years. The error bars represent the 95% confidence limits of the age calculated from the actual measurements The insert (B) shows the growth rates of other specimens of the sclerosponge Ceratoporella nicholsoni collected from different water depths from the same locality (green squares; Rosenheim et al., 2007). The growth rate of the LSI specimen from this study is indicated by the large blue circle.*

Dating Verification

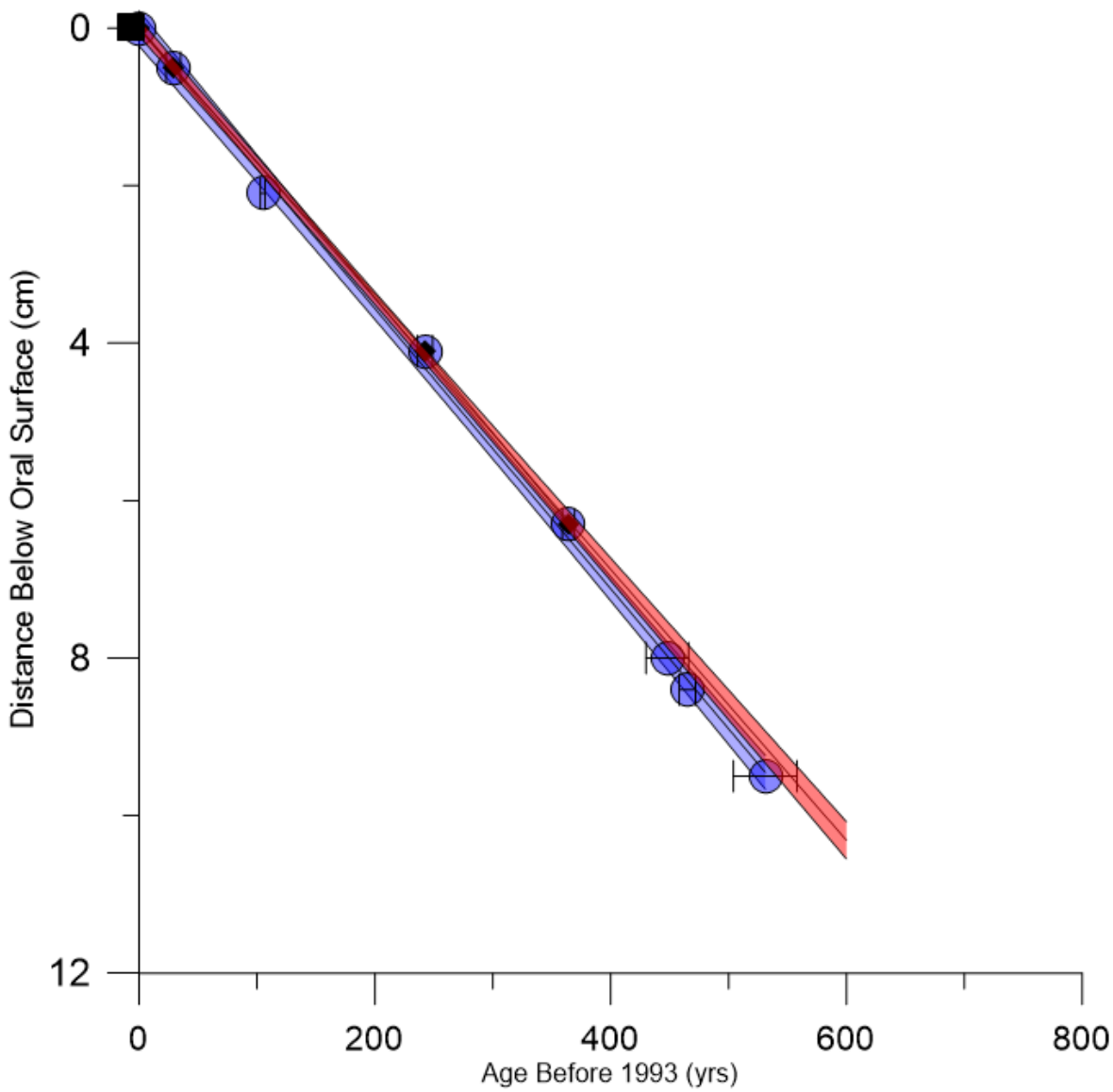

Figure S1.2- Age Model Comparison

Comparison of the relationship between the age model (Model 1; blue) using all the data (seven U-Th ages and the Modern surface) with the model in which the 2005 data were not used (Model 2; red). The correlation between the calculated age and sampling location is remarkable considering the time over which the data were analyzed.

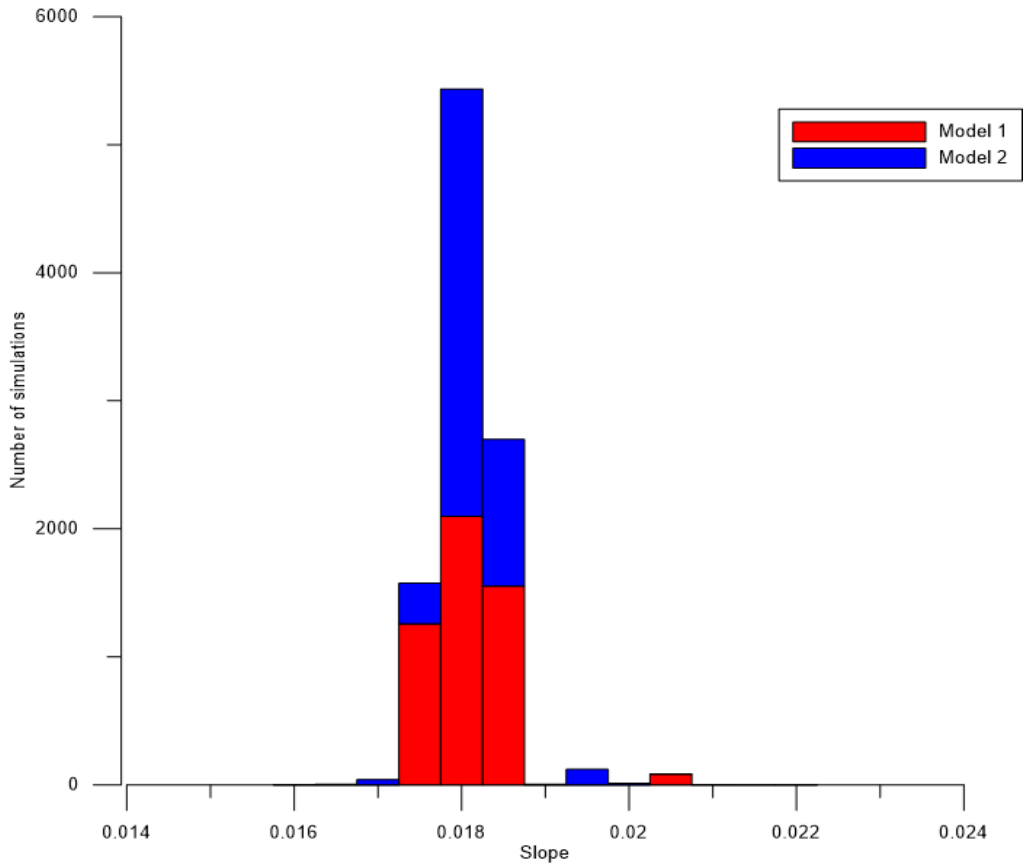

Figure S1.3- Comparison of Slopes from Age Models

Frequency distribution of the slopes of the relationships produced in the Mote Carlo simulation for Model 1 (seven U-Th ages) and Model 2 (four ages). No statistically significant differences were detected between either the slopes or the intercepts of the relationships (p< 0.00001).

The dating of the sample (seven analyses) was carried out during three session between 2005 and 2019. The first three analyses were conducted in 2005, two in 2009, and a final two in 2019. Only the uncertainties and the dates survive from the first analytical session, and not the raw ratios. This was a result of long-term data storage reorganization at Geomar. Nevertheless, we have used all the dates in the age model in this paper for completeness, maximum method reliability, result accuracy, and data precision (Fig2). The use of all the data was justified using a Monte Carlo type model involving 5000 comparisons between the age model calculated using all seven dates (Model 1; blue) and model with the three points analyzed in 2005 removed (Model 2; red). This comparison revealed that the models were statistically identically (p<<0.00001). The modeling followed the boot strapping approach of Anderson (1976) and Sohn and Menke (2002) in which one of the members of the data series was randomly removed and replaced with another member and then the slope and intercept recalculated. In some instances, it was possible that this process resulted in a single data point (if all the data were replaced by the same datum). Under such circumstances the regression calculation returns an error and these points were not used in the calculation.

Section 2: CESM Last Millennium Ensemble

Table 3.1: Total and forced variance from the CESM-LME.

	Pre-1850		Post-1850	
	Average total multidecadal AMV variance	Forced multidecadal AMV variance	Average total multidecadal AMV variance	Forced multidecadal AMV variance
All Forcings	0.014 (± 0.001)	0.010	0.014 (±0.007)	0.009
Volcanic Only	0.013 (± 0.001)	0.009	0.008 (±0.005)	0.003
PI Control	0.005	-	0.005	-
ERSST	-	-	0.023	-

"Average total multidecadal variance" is defined as the average variance of each individual ensemble member's index, plus-or-minus two standard deviations of the ensemble spread. "Forced multidecadal variance" is the variance of the ensemble mean index.

Section 3: Geochemical Methods and Data

Methods

The specimens were milled on an ESI© Micromill equipped with a 0.8 mm carbide scriber point bit (Brasseler H1621.31.008). Samples were milled with 50% drill speed, 30% approach speed, and three passes at 50 μm per pass. Each sample was located 100 μm apart providing an approximate annual resolution (1.5 samples yr^{-1}). In total 1088 samples were drilled of which 12 were discarded as a result of low sample yield. Powder was collected from the smooth surface using a dental needle and placed directly into acid-cleaned polyethylene tubes for later dissolution and measurement of the Sr/Ca ratio using an axially oriented Varian© (Agilent©) Vista Pro Inductively Coupled Plasma Optical Emission Spectrometer (ICP-OES). Each sample (~ 100 μg) was dissolved in 5 mL of a blank solution (4% Omnitrace HNO_3 and 1 ppm yttrium) in an acid washed 15 mL poly test tube and vortexed for 5 seconds (Waite, 2011; Waite et al. 2018).

Precision of Analyses and Temperature Estimates

The blank and four in-house standards, which covered the range of sample concentrations, were analyzed at the beginning of each analytical session to calibrate measured intensities to elemental concentrations. In addition, an internal lab coral standard was analyzed every four samples and used to normalize the Sr/Ca ratios. This allowed for standardization between runs and removal of any instrumental variability through time. A multi-laboratory calibration standard from the University of South Florida calibrated to Jcp-1 coral standard (Hathorne et al., 2013) was also analyzed 5 times in each run. Laboratory macros were then used to process and correct data, as well as calculate elemental concentrations.

Analytical precision based on replicate analyses (n=80) of the in-house coral standard yielded an error of < 0.01 mmol/mol at the 95% confidence limits. This translates to a precision of ~ 0.05°C (equation 1). The total error including analysis and the conversion of the Sr/Ca ratio to temperature was estimated to ~ 1°C (Waite et al. 2018). While this error is in excess of the variability in the AMV, the range of reconstructed temperatures calculated using this equation are comparable to the range of temperatures measured in the area where the sclerosponge was collected. In fact, the mean temperature calculated from the sclerosponge between 1850 and 1993 is essentially the same as the temperature measured in situ. Therefore, despite the large error estimate of the calibration, likely resulting from inadequate temperature data for the samples comprising the calibration, the calculated temperature record does appear to provide past information on water temperature at this location.

Year	Temperature	Sr/Ca mmol/	Band Pass Signal		Year	Temperature	Sr/Ca mmol/mol	Band Pass Sig
1385	22.15	10.44	0.00		1434	23.87	10.19	0.24
1386	21.98	10.47	-0.08		1435	23.75	10.21	0.26
1387	21.68	10.51	-0.16		1436	23.13	10.30	0.27
1388	21.60	10.52	-0.24		1437	23.06	10.31	0.26
1389	21.92	10.48	-0.31		1438	22.97	10.32	0.25
1390	22.42	10.40	-0.38		1439	23.01	10.32	0.23
1391	22.27	10.43	-0.44		1440	23.49	10.25	0.20
1392	22.12	10.45	-0.50		1441	23.43	10.26	0.16
1393	21.81	10.49	-0.54		1442	23.19	10.29	0.12
1394	21.94	10.47	-0.57		1443	22.67	10.37	0.07
1395	21.95	10.47	-0.58		1444	22.68	10.37	0.02
1396	21.93	10.48	-0.59		1445	22.89	10.33	-0.04
1397	21.57	10.53	-0.57		1446	23.44	10.25	-0.09
1398	21.81	10.49	-0.54		1447	23.21	10.29	-0.13
1399	21.44	10.55	-0.50		1448	23.03	10.32	-0.17
1400	21.45	10.55	-0.44		1449	22.89	10.33	-0.21
1401	22.17	10.44	-0.37		1450	23.06	10.31	-0.23
1402	22.51	10.39	-0.29		1451	22.94	10.33	-0.25
1403	22.79	10.35	-0.20		1452	22.76	10.35	-0.26
1404	22.35	10.41	-0.11		1453	22.64	10.37	-0.26
1405	22.52	10.39	-0.02		1454	22.65	10.37	-0.26
1406	22.43	10.40	0.06		1455	22.73	10.36	-0.25
1407	22.75	10.36	0.14		1456	22.72	10.36	-0.24
1408	22.88	10.34	0.21		1457	22.84	10.34	-0.22
1409	22.83	10.34	0.26		1458	22.58	10.38	-0.20
1410	23.31	10.27	0.30		1459	22.72	10.36	-0.18
1411	23.12	10.30	0.33		1460	22.77	10.35	-0.16
1412	23.29	10.28	0.34		1461	23.12	10.30	-0.15
1413	23.36	10.27	0.33		1462	23.27	10.28	-0.13
1414	23.18	10.29	0.31		1463	23.26	10.28	-0.12
1415	23.09	10.31	0.28		1464	23.60	10.23	-0.12
1416	22.89	10.34	0.24		1465	23.62	10.23	-0.11
1417	22.69	10.36	0.20		1466	23.15	10.30	-0.11
1418	22.57	10.38	0.15		1467	22.76	10.35	-0.12
1419	22.95	10.33	0.10		1468	22.24	10.43	-0.12
1420	23.05	10.31	0.06		1469	22.41	10.41	-0.12
1421	23.21	10.29	0.02		1470	22.98	10.32	-0.11
1422	22.79	10.35	-0.01		1471	23.09	10.31	-0.11
1423	22.45	10.40	-0.03		1472	23.21	10.29	-0.10
1424	22.67	10.37	-0.04		1473	23.07	10.31	-0.09
1425	22.80	10.35	-0.04		1474	22.71	10.36	-0.07
1426	22.70	10.36	-0.02		1475	22.89	10.33	-0.04
1427	23.20	10.29	0.00		1476	22.94	10.33	-0.02
1428	23.31	10.27	0.03		1477	23.23	10.29	0.01
1429	23.40	10.26	0.07		1478	23.29	10.28	0.05
1430	23.09	10.31	0.11		1479	23.25	10.28	0.08
1431	22.65	10.37	0.15		1480	23.55	10.24	0.11
1432	22.70	10.36	0.18		1481	23.53	10.24	0.14
1433	23.34	10.27	0.22		1482	23.17	10.29	0.17

Year	Temperature	Sr/Ca mmol/	Band Pass Signal		Year	Temperature	Sr/Ca mmol/mol	Band Pass Sig
1483	23.41	10.26	0.20		1532	23.65	10.22	0.19
1484	23.62	10.23	0.23		1533	23.09	10.31	0.17
1485	23.40	10.26	0.25		1534	23.07	10.31	0.14
1486	23.37	10.26	0.26		1535	23.04	10.31	0.10
1487	23.42	10.26	0.28		1536	23.03	10.31	0.07
1488	23.46	10.25	0.29		1537	23.13	10.30	0.04
1489	23.39	10.26	0.30		1538	22.79	10.35	0.02
1490	23.07	10.31	0.31		1539	23.06	10.31	0.00
1491	23.43	10.26	0.31		1540	23.03	10.32	-0.02
1492	23.51	10.24	0.31		1541	23.21	10.29	-0.02
1493	23.42	10.26	0.31		1542	23.27	10.28	-0.03
1494	23.48	10.25	0.31		1543	23.28	10.28	-0.03
1495	23.42	10.26	0.30		1544	23.38	10.26	-0.02
1496	23.23	10.29	0.29		1545	23.11	10.30	-0.01
1497	23.54	10.24	0.27		1546	23.00	10.32	0.01
1498	23.73	10.21	0.24		1547	22.80	10.35	0.03
1499	23.27	10.28	0.21		1548	22.98	10.32	0.05
1500	23.45	10.25	0.17		1549	22.91	10.33	0.07
1501	23.25	10.28	0.13		1550	23.15	10.30	0.09
1502	22.88	10.34	0.07		1551	22.95	10.33	0.11
1503	23.04	10.31	0.01		1552	23.28	10.28	0.13
1504	23.34	10.27	-0.05		1553	23.44	10.25	0.14
1505	23.31	10.27	-0.12		1554	23.40	10.26	0.16
1506	23.48	10.25	-0.19		1555	23.22	10.29	0.18
1507	23.45	10.25	-0.26		1556	22.88	10.34	0.19
1508	23.21	10.29	-0.32		1557	22.80	10.35	0.20
1509	22.61	10.38	-0.38		1558	22.85	10.34	0.20
1510	22.29	10.42	-0.43		1559	22.83	10.34	0.21
1511	22.42	10.40	-0.47		1560	23.18	10.29	0.21
1512	22.31	10.42	-0.50		1561	23.47	10.25	0.21
1513	22.60	10.38	-0.51		1562	23.34	10.27	0.20
1514	22.84	10.34	-0.51		1563	23.02	10.32	0.19
1515	22.94	10.33	-0.49		1564	22.89	10.34	0.18
1516	22.86	10.34	-0.46		1565	22.70	10.36	0.16
1517	22.53	10.39	-0.41		1566	23.23	10.29	0.14
1518	22.60	10.38	-0.35		1567	23.31	10.27	0.12
1519	22.93	10.33	-0.29		1568	23.04	10.31	0.09
1520	23.10	10.30	-0.22		1569	22.84	10.34	0.07
1521	23.03	10.31	-0.14		1570	23.13	10.30	0.04
1522	23.31	10.27	-0.07		1571	22.85	10.34	0.01
1523	23.31	10.27	0.00		1572	22.85	10.34	-0.01
1524	23.34	10.27	0.06		1573	22.85	10.34	-0.04
1525	23.43	10.26	0.12		1574	22.95	10.33	-0.06
1526	23.10	10.30	0.16		1575	22.95	10.33	-0.07
1527	23.22	10.29	0.19		1576	22.88	10.34	-0.09
1528	23.61	10.23	0.22		1577	22.60	10.38	-0.10
1529	23.73	10.21	0.22		1578	22.46	10.40	-0.10
1530	23.50	10.25	0.22		1579	22.46	10.40	-0.11
1531	23.23	10.28	0.21		1580	22.70	10.36	-0.11

Year	Temperature	Sr/Ca mmol/	Band Pass Signal		Year	Temperature	Sr/Ca mmol/mol	Band Pass Sig
1581	22.74	10.36	-0.11		1630	23.54	10.24	-0.23
1582	22.80	10.35	-0.12		1631	23.49	10.25	-0.20
1583	22.57	10.38	-0.12		1632	22.84	10.34	-0.16
1584	22.46	10.40	-0.13		1633	22.78	10.35	-0.11
1585	22.84	10.34	-0.15		1634	23.29	10.28	-0.06
1586	23.37	10.26	-0.17		1635	23.58	10.23	0.00
1587	22.78	10.35	-0.20		1636	23.33	10.27	0.06
1588	23.07	10.31	-0.23		1637	23.85	10.19	0.12
1589	22.93	10.33	-0.26		1638	23.77	10.21	0.17
1590	22.61	10.38	-0.30		1639	24.16	10.15	0.22
1591	22.48	10.40	-0.34		1640	23.96	10.18	0.25
1592	22.67	10.37	-0.38		1641	23.49	10.25	0.28
1593	22.94	10.33	-0.42		1642	23.54	10.24	0.29
1594	22.22	10.43	-0.45		1643	23.55	10.24	0.29
1595	22.30	10.42	-0.47		1644	23.22	10.29	0.27
1596	22.45	10.40	-0.48		1645	24.07	10.16	0.24
1597	22.55	10.39	-0.47		1646	23.82	10.20	0.21
1598	22.51	10.39	-0.45		1647	23.90	10.19	0.16
1599	22.76	10.35	-0.42		1648	23.88	10.19	0.11
1600	23.09	10.31	-0.36		1649	23.54	10.24	0.05
1601	22.68	10.37	-0.30		1650	23.17	10.29	-0.01
1602	22.53	10.39	-0.22		1651	22.99	10.32	-0.07
1603	22.90	10.33	-0.13		1652	23.09	10.31	-0.12
1604	23.21	10.29	-0.04		1653	23.00	10.32	-0.17
1605	23.19	10.29	0.06		1654	23.20	10.29	-0.21
1606	23.16	10.30	0.17		1655	23.07	10.31	-0.24
1607	23.70	10.22	0.26		1656	23.47	10.25	-0.27
1608	23.80	10.20	0.35		1657	23.14	10.30	-0.28
1609	23.69	10.22	0.43		1658	22.61	10.38	-0.28
1610	23.89	10.19	0.50		1659	22.55	10.39	-0.28
1611	24.26	10.13	0.54		1660	22.88	10.34	-0.27
1612	23.58	10.23	0.58		1661	22.80	10.35	-0.25
1613	24.12	10.15	0.59		1662	23.23	10.29	-0.23
1614	23.97	10.18	0.58		1663	23.33	10.27	-0.21
1615	23.71	10.21	0.56		1664	23.10	10.30	-0.19
1616	23.74	10.21	0.51		1665	22.80	10.35	-0.17
1617	23.66	10.22	0.46		1666	23.41	10.26	-0.15
1618	23.57	10.24	0.39		1667	22.92	10.33	-0.14
1619	23.47	10.25	0.31		1668	23.41	10.26	-0.13
1620	23.43	10.26	0.23		1669	23.60	10.23	-0.12
1621	23.67	10.22	0.15		1670	22.78	10.35	-0.12
1622	23.79	10.20	0.07		1671	22.20	10.44	-0.12
1623	23.34	10.27	-0.01		1672	22.60	10.38	-0.11
1624	23.29	10.28	-0.08		1673	22.98	10.32	-0.11
1625	23.30	10.27	-0.14		1674	22.33	10.42	-0.11
1626	23.65	10.22	-0.19		1675	22.93	10.33	-0.11
1627	23.30	10.28	-0.22		1676	23.08	10.31	-0.11
1628	23.20	10.29	-0.24		1677	23.05	10.31	-0.10
1629	23.25	10.28	-0.24		1678	22.56	10.38	-0.09

Year	Temperature	Sr/Ca mmol/	Band Pass Signal		Year	Temperature	Sr/Ca mmol/mol	Band Pass Sig
1679	22.68	10.37	-0.08		1827	23.17	10.29	-0.05
1680	22.79	10.35	-0.06		1828	23.29	10.28	-0.05
1681	22.95	10.33	-0.04		1829	23.17	10.29	-0.05
1682	23.29	10.28	-0.02		1830	23.23	10.29	-0.06
1683	22.91	10.33	0.00		1831	23.26	10.28	-0.06
1684	22.90	10.33	0.02		1832	23.26	10.28	-0.07
1685	22.79	10.35	0.04		1833	23.52	10.24	-0.07
1785	22.80	10.35	0.01		1834	23.08	10.31	-0.07
1786	23.05	10.31	0.04		1835	22.91	10.33	-0.07
1787	23.69	10.22	0.07		1836	22.87	10.34	-0.07
1788	23.09	10.31	0.11		1837	23.57	10.24	-0.05
1789	23.36	10.27	0.15		1838	23.43	10.26	-0.04
1790	23.51	10.24	0.19		1839	23.41	10.26	-0.02
1791	23.60	10.23	0.24		1840	23.53	10.24	0.01
1792	23.42	10.26	0.28		1841	23.53	10.24	0.03
1793	23.34	10.27	0.31		1842	23.47	10.25	0.06
1794	23.66	10.22	0.34		1843	23.61	10.23	0.09
1795	23.49	10.25	0.36		1844	23.44	10.25	0.12
1796	23.50	10.25	0.37		1845	23.66	10.22	0.15
1797	23.99	10.17	0.37		1846	23.50	10.25	0.17
1798	23.66	10.22	0.35		1847	23.32	10.27	0.19
1799	23.60	10.23	0.33		1848	23.17	10.29	0.20
1800	23.45	10.25	0.29		1849	23.64	10.22	0.21
1801	23.48	10.25	0.24		1850	23.88	10.19	0.20
1802	23.30	10.28	0.18		1851	24.09	10.16	0.20
1803	23.22	10.29	0.12		1852	23.63	10.23	0.18
1804	23.16	10.30	0.05		1853	23.63	10.23	0.16
1805	23.03	10.31	-0.02		1854	23.82	10.20	0.13
1806	22.79	10.35	-0.08		1855	23.84	10.19	0.10
1807	22.93	10.33	-0.14		1856	23.49	10.25	0.07
1808	23.11	10.30	-0.20		1857	23.36	10.27	0.03
1809	23.11	10.30	-0.25		1858	23.89	10.19	0.00
1810	22.94	10.33	-0.28		1859	23.54	10.24	-0.04
1811	22.89	10.34	-0.31		1860	23.25	10.28	-0.07
1812	23.22	10.29	-0.33		1861	23.04	10.31	-0.10
1813	23.01	10.32	-0.33		1862	23.38	10.26	-0.12
1814	22.85	10.34	-0.33		1863	23.39	10.26	-0.13
1815	23.11	10.30	-0.32		1864	23.58	10.23	-0.14
1816	22.87	10.34	-0.30		1865	23.46	10.25	-0.14
1817	22.63	10.37	-0.27		1866	23.32	10.27	-0.13
1818	22.82	10.35	-0.24		1867	23.44	10.25	-0.12
1819	22.80	10.35	-0.21		1868	23.46	10.25	-0.10
1820	23.03	10.31	-0.18		1869	23.97	10.18	-0.07
1821	23.39	10.26	-0.15		1870	23.76	10.21	-0.04
1822	23.33	10.27	-0.12		1871	23.91	10.18	-0.01
1823	23.05	10.31	-0.09		1872	23.85	10.19	0.03
1824	23.53	10.24	-0.08		1873	23.68	10.22	0.06
1825	23.04	10.31	-0.06		1874	23.69	10.22	0.10
1826	23.22	10.29	-0.05		1875	23.66	10.22	0.13

Year	Temperature	Sr/Ca mmol/	Band Pass Signal		Year	Temperature	Sr/Ca mmol/mol	Band Pass Sig
1876	23.88	10.19	0.16		1925	23.68	10.17	-0.11
1877	24.00	10.17	0.19		1926	23.70	10.21	-0.05
1878	23.83	10.20	0.22		1927	24.35	10.12	0.02
1879	23.42	10.26	0.24		1928	24.45	10.04	0.10
1880	23.42	10.26	0.25		1929	24.68	10.10	0.17
1881	23.85	10.25	0.25		1930	24.81	10.11	0.24
1882	24.22	10.23	0.25		1931	25.01	10.09	0.30
1883	24.23	10.16	0.24		1932	25.07	10.10	0.36
1884	24.49	10.19	0.23		1933	25.20	10.07	0.40
1885	23.94	10.21	0.20		1934	25.02	10.10	0.42
1886	24.00	10.28	0.17		1935	25.18	10.11	0.44
1887	23.54	10.25	0.13		1936	25.06	10.14	0.43
1888	23.82	10.20	0.09		1937	25.02	10.11	0.41
1889	23.89	10.24	0.05		1938	25.14	10.16	0.38
1890	24.10	10.31	0.00		1939	24.79	10.22	0.34
1891	23.59	10.30	-0.04		1940	24.75	10.09	0.28
1892	23.55	10.23	-0.09		1941	24.62	10.13	0.23
1893	23.72	10.27	-0.13		1942	24.45	10.11	0.16
1894	23.62	10.25	-0.16		1943	24.88	10.13	0.10
1895	23.71	10.26	-0.19		1944	24.83	10.08	0.04
1896	23.71	10.24	-0.21		1945	24.87	10.12	-0.01
1897	23.43	10.33	-0.22		1946	24.47	10.13	-0.06
1898	23.33	10.30	-0.23		1947	25.00	10.14	-0.10
1899	23.76	10.20	-0.22		1948	24.73	10.19	-0.14
1900	23.86	10.18	-0.21		1949	24.89	10.14	-0.16
1901	23.71	10.19	-0.19		1950	24.79	10.17	-0.17
1902	23.83	10.17	-0.17		1951	24.78	10.25	-0.17
1903	23.63	10.21	-0.14		1952	25.00	10.21	-0.17
1904	23.65	10.26	-0.11		1953	25.34	10.04	-0.16
1905	23.61	10.27	-0.09		1954	24.95	10.11	-0.14
1906	23.51	10.26	-0.06		1955	24.85	10.05	-0.13
1907	24.28	10.22	-0.04		1956	24.64	10.21	-0.11
1908	24.13	10.27	-0.03		1957	24.85	10.18	-0.08
1909	24.05	10.23	-0.02		1958	25.08	10.07	-0.07
1910	23.68	10.25	-0.02		1959	25.10	10.07	-0.05
1911	24.20	10.20	-0.03		1960	25.13	10.04	-0.04
1912	23.84	10.24	-0.05		1961	24.82	10.14	-0.03
1913	23.78	10.20	-0.08		1962	24.89	10.15	-0.02
1914	24.14	10.20	-0.11		1963	25.24	10.11	-0.02
1915	24.10	10.20	-0.14		1964	25.62	10.06	-0.03
1916	23.85	10.22	-0.17		1965	25.46	10.06	-0.04
1917	24.13	10.24	-0.20		1966	25.56	10.09	-0.05
1918	24.16	10.20	-0.23		1967	25.19	10.15	-0.06
1919	24.18	10.17	-0.25		1968	24.53	10.31	-0.08
1920	23.77	10.20	-0.25		1969	25.21	10.15	-0.09
1921	23.86	10.27	-0.25		1970	25.63	10.00	-0.10
1922	23.80	10.22	-0.23		1971	25.27	10.03	-0.11
1923	24.25	10.12	-0.20		1972	25.18	10.16	-0.12
1924	23.75	10.18	-0.16		1973	25.33	10.16	-0.12

Year	Temperature	Sr/Ca mmol/	Band Pass Signal		Year	Temperature	Sr/Ca mmol/mol	Band Pass Sig
1974	25.20	10.16	-0.12					
1975	25.10	10.17	-0.10					
1976	25.43	10.11	-0.09					
1977	25.23	10.18	-0.07					
1978	25.13	10.13	-0.04					
1979	25.10	10.18	-0.02					
1980	25.71	10.00	0.01					
1981	25.52	10.11	0.04					
1982	25.49	10.14	0.07					
1983	25.55	10.09	0.10					
1984	25.26	10.15	0.12					
1985	25.54	10.01	0.13					
1986	25.59	10.13	0.14					