

Appendix A

Clumped isotope data from the surface and subsurface of the Sultanate of Oman

A.1 Clumped Isotope Methods

9–12 mg of powder was weighed into silver capsules before being reacted at 90°C in 100% H₃PO₄ in a common acid bath. Evolved CO₂ was purified by multiple cryogenic traps including a Porapak-Q chromatograph held at -20°C before being measured on a ThermoFinnigan MAT 253 IRMS. Methods for the measurement and corrections to analyzed heated gases run during each session following [?, ?]. After corrections based on the heated gas line from a given session and an intercept shift based on the initial calibration experiment, Δ_{47} values were transformed into an absolute reference frame using a secondary transfer function following [?, ?]. The secondary transfer function for each week was calculated using any of the following available data: 25°C and 1000°C CO₂ as well as any of four carbonate standards with known absolute reference frame values (see below). Finally Δ_{47} values for carbonate samples were corrected by +0.092‰ for the 90°C acid bath reaction temperature within the absolute reference frame [?].

Values within the absolute reference frame (ARF) for two internal standards used over the course of the analyses, Yale CM (n=35) and TV01 (n=50) were calculated from 7 weeks when 1000°C CO₂ was analyzed daily and 25°C CO₂ gases were analyzed bi-weekly. The calculated values for the two standards in the

absolute reference frame are reported with 1 SD for all sessions with heated gases and equilibrated gases: Yale CM (n = 33) $\Delta_{47}\text{-ARF} = 0.404 \pm 0.022\%$, TV01 (n = 50) $\Delta_{47}\text{-ARF} = 0.730 \pm 0.018\%$. Absolute reference frame values for two other internal standards run during the analytical period were calculated from weeks where either Yale CM and/or TV01 had been run with them (GC-AZ-01 (n=12) and Carmel Chalk (n=15)). Values are reported with 1 SD for all sessions with heated gases and known standards: 102-GC-AZ01 (n = 12) $\Delta_{47}\text{-ARF} = 0.709 \pm 0.023\%$, and Carmel Chalk (n=15) $\Delta_{47}\text{-ARF} = 0.678 \pm 0.020\%$. The values of the Carrara standard and 102-GC-AZ01 in the absolute reference frame are nearly identical to those found at Johns Hopkins (UU Carrara (n = 93) $\Delta_{47}\text{-ARF} = 0.403 \pm 0.015\%$ and 102-GC-AZ01 (n = 102) $\Delta_{47}\text{-ARF} = 0.710 \pm 0.015\%$ [?]).

The reproducibility of standards for all analytical weeks are reported with 1 SD for all sessions: Yale CM (n = 98) $\Delta_{47}\text{-ARF} = 0.405 \pm 0.019\%$, 102-GC-AZ01 (n = 23) $\Delta_{47}\text{-ARF} = 0.710 \pm 0.011\%$, TV01 (n = 86) $\Delta_{47}\text{-ARF} = 0.730 \pm 0.015\%$ and Carmel Chalk (n = 17) $\Delta_{47}\text{-ARF} = 0.675 \pm 0.015\%$. For single unknown measurements the uncertainty of the measurement is reported as the standard error of the mean (SEM) of Δ_{47} measurements over 8 acquisitions. For $n \geq 2$, the error is reported as the SEM of Δ_{47} over the number of sample replicates.

Temperatures were calculated in the absolute reference frame as well as the interlab reference frame using the same calibration data from two calibration studies completed at Caltech [?, ?]. To build this calibration equation from low to high temperatures we assume that calcite and dolomite calibrations are equivalent. The two approaches do not yield the exact same temperature on a week to week basis and this is likely due to two factors: 1) conversion of the two calibration studies into the absolute reference frame is imperfect because the samples were analyzed before 25°C CO₂ gases were analyzed regularly and 2) Converting unknown samples into the absolute reference frame using both gases and carbonate standards in the transfer function will correct for standard residuals for a given week.

The mineralogy of each powder analyzed was determined by XRD analysis (see below) to properly calculate the $\delta^{18}\text{O}_{min}$ composition using unique 90°C acid

digestion fractionation factors for calcite and dolomite [?, ?]. Fluid compositions were calculated using the measured clumped isotope temperatures and separate equilibrium fractionation equations for calcite-water [?] and for dolomite-water [?]. For samples that contained mixtures of calcite and dolomite, the dominant mineralogy was used to calculate $\delta^{18}\text{O}_{min}$ and $\delta^{18}\text{O}_{water}$. Three different dolomite-water equilibrium fractionation equations were compared [?, ?, ?]. Both [?] and [?] produced $\delta^{18}\text{O}_{water}$ results in agreement with co-occurring calcite measurements lending faith in the results. The temperature range of dolomite formation from [?] most closely matched the measured temperature range so it was used to calculate the reported water compositions.

Sample ID	Minerology	Depth	Group	Group2	Replicate #	d13C	d13C SD
1H1_A1C_031	Dolomite	3399.83	Ara		2	2.80	0.03
1H1_A1C_032	Dolomite	3429.98	Ara		1	2.42	0.01
1H1_A3C_010	Dolomite	4219.54	Ara		2	-22.07	0.00
1H1_A3C_011	Dolomite	4221.56	Ara		2	-22.53	0.23
A4C_13	Dolomite	2948.57	Ara		1	-4.63	0.01
A4C_15.1	Dolomite	2946.75	Ara		1	-4.14	0.01
A4C_15.2	Dolomite	2946.75	Ara		1	-4.14	0.01
A4C_24	Dolomite	2940.13	Ara		2	-3.07	0.01
A4C_24.2	Dolomite	2940.13	Ara		3	-3.06	0.01
A4C_40.1	Dolomite	2929.37	Ara		1	-1.86	0.01
A4C_40.2	Dolomite	2929.37	Ara		1	-1.83	0.01
A4C_40.3	Dolomite	2929.37	Ara		2	-1.89	0.01
A4C_55	Dolomite	2917.67	Ara		1	-2.44	0.01
A4C_69.1	Dolomite	2908.37	Ara		1	-2.19	0.01
A4C_69.2	Dolomite	2908.37	Ara		1	-2.26	0.01
A4C_9	Dolomite	2949.92	Ara		1	-5.05	0.01
BBN_2_27	Dolomite	3904.21	Ara		1	-2.83	0.00
BBN_2_52	Dolomite	3883.73	Ara		3	-2.49	0.02
BBN_2_85	Dolomite	3856.24	Ara		1	2.15	0.00
GFR_102	Dolomite	4570.7	Ara		2	2.42	0.01
GFR_107	Dolomite	4565.8	Ara		3	2.32	0.01
GFR_18	Calcite	4148.8	Ara		1	2.52	0.00
GFR_5	Calcite	4166.6	Ara		1	2.49	0.00
GFR_7	Calcite	4164.7	Ara		1	2.46	0.00
HM19_1	Calcite	3148.7	Ara		1	0.67	0.01
HM20_1	Calcite	3163.6	Ara		2	1.18	0.32
HM21_1	Calcite	3180.5	Ara		1	-0.59	0.01
Lahan_1	Dolomite	5848	Ara		3	1.70	0.01
Lahan_11	Dolomite	5848	Ara		1	1.86	0.01
Lahan_23_5842.8	Dolomite	5842.8	Ara		3	1.68	0.05
Lahan_4	Dolomite	5848	Ara		1	2.01	0.00
Lahan_5831.8	Dolomite	5831.8	Ara		1	2.09	0.00
Lahan_9	Dolomite	5848	Ara		1	1.76	0.00
QAC	Calcite	0	Ara		1	2.54	0.00
QAD	Calcite	0	Ara		1	1.33	0.00
S11	Calcite	0	Ara		1	3.14	0.00
S24	Calcite	0	Ara		1	-1.69	0.00
S50	Calcite	0	Ara		2	3.59	0.01
S56	Calcite	0	Ara		3	3.68	0.01
S9	Calcite	0	Ara		1	1.78	0.00
ZAL_1_20	Dolomite	4962	Ara		1	-0.80	0.00
ZAL_1_33	Dolomite	4948	Ara		2	-0.79	0.00

Table A.1: Clumped isotopic data from Oman

Sample ID	Minerology	Depth	Group	Group2	Replicate #	d13C	d13C SD
ZAL_1_36	Calcite	5012	Ara		1	2.30	0.00
ZAL_1_5012c	Calcite	5012	Ara		1	2.20	0.00
ZAL_1_51	Calcite	4997	Ara		1	2.66	0.00
ZAL_1_64	Dolomite	4984	Ara		1	5.76	0.00
MQ1_2942	Dolomite	2942	Birba		1	1.71	0.00
MQ1_2986	Dolomite	2986	Birba		1	2.25	0.00
MQ1_2994	Dolomite	2994	Birba		1	2.64	0.00
MQ1_3026	Dolomite	3026	Birba		1	1.69	0.00
MQ1_3160	Dolomite	3160	Birba		2	-0.30	0.10
SBSB_2398.78	Dolomite	2398.78	Birba		1	2.78	0.00
SBSB_2461.75	Dolomite	2461.75	Birba		1	2.05	0.00
SBSB_2765.73	Dolomite	2765.73	Birba		1	3.17	0.00
SWN_1697.24	Dolomite	1697.24	Birba		1	2.47	0.00
TM6_2000	Dolomite	2000	Birba		1	2.75	0.00
TM6_2100	Dolomite	2100	Birba		1	-3.46	0.00
TM6_2240	Dolomite	2240	Birba		1	0.42	0.00
BD_9.8	Dolomite	0	Nafun		1	2.88	0.00
BD1_243.6	Dolomite	0	Nafun		1	2.23	0.00
KDE_179.9	Dolomite	0	Nafun	Pre	1	4.34	0.00
KDE_274	Dolomite	0	Nafun	Pre	2	4.45	0.00
KDE_293.5	Dolomite	0	Nafun	Pre	1	1.83	0.00
KDW2_102B	Dolomite	0	Nafun	Pre	1	1.09	0.01
KDW2_112A	Dolomite	0	Nafun	Pre	1	1.38	0.01
KDW2_119.1A	Dolomite	0	Nafun	Pre	1	1.62	0.00
KDW2_130.9B	Dolomite	0	Nafun	Ons	1	-3.67	0.01
KDW2_131.8_A	Dolomite	0	Nafun	Ons	2	-1.16	0.01
KDW2_46.4	Dolomite	0	Nafun	Pre	1	4.10	0.01
KDW2_64.8	Dolomite	0	Nafun	Pre	2	2.43	0.07
KDW2_87.0	Dolomite	0	Nafun	Pre	1	1.48	0.00
KDWS_130.6A	Dolomite	0	Nafun	Ons	1	-1.04	0.00
MD2_10.2	Calcite	0	Nafun	Syn	1	-7.42	0.01
MD2_120.1	Dolomite	0	Nafun		1	-0.66	0.00
MD2_180.1	Dolomite	0	Nafun		1	1.97	0.01
MD2_25.8	Calcite	0	Nafun	Syn	4	-5.43	0.03
MD2_45.2	Calcite	0	Nafun	Syn	2	-6.04	0.01
MD6_10.0_K1	Calcite	0	Nafun	Low	1	4.59	0.00
MD6_10.0_K2	Calcite	0	Nafun	Low	2	3.28	0.08
MD6_258.6	Dolomite	0	Nafun	Ons	2	-2.73	0.10
MD6_259.5	Dolomite	0	Nafun	Ons	3	-4.07	0.02
MD6_S2_ts	Calcite	0	Nafun	Syn	1	-12.47	0.01
MDE_118.6	Dolomite	0	Nafun	Pre	1	3.61	0.01
MDE_156.3	Dolomite	0	Nafun	Pre	3	4.47	0.05

Table A.2: Clumped isotopic data from Oman

Sample ID	Minerology	Depth	Group	Group2	Replicate #	d13C	d13C SD
MDE_175.3	Dolomite	0	Nafun	Pre	2	2.71	0.01
MDE_182.1	Dolomite	0	Nafun	Pre	1	2.35	0.01
MDE_190	Dolomite	0	Nafun	Pre	2	2.49	0.01
MDE_203.9	Dolomite	0	Nafun	Pre	1	5.46	0.02
MDE_214.8	Dolomite	0	Nafun	Pre	1	4.35	0.01
MDE_223.8	Dolomite	0	Nafun	Pre	2	5.74	0.02
MDE_234.5	Dolomite	0	Nafun	Pre	2	4.45	0.05
MDE_246.5	Dolomite	0	Nafun	Pre	1	4.20	0.01
MDE_255	Dolomite	0	Nafun	Pre	1	2.23	0.01
MDE_266.2	Dolomite	0	Nafun	Pre	1	2.21	0.01
MDE_277.4	Dolomite	0	Nafun	Pre	2	5.03	0.06
MDE_278	Dolomite	0	Nafun	Pre	4	5.29	0.02
MDE_280.7	Dolomite	0	Nafun	Ons	2	-0.17	0.00
MDE_284.2	Dolomite	0	Nafun	Ons	2	2.00	0.06
MDE_287.5	Dolomite	0	Nafun	Ons	1	1.05	0.01
MDE_291.1	Dolomite	0	Nafun	Ons	1	-2.11	0.00
MDE_291.5	Dolomite	0	Nafun	Ons	1	-4.19	0.00
MDE_292	Dolomite	0	Nafun	Ons	1	-4.62	0.01
MDE_292.5	Dolomite	0	Nafun	Ons	2	-5.38	0.00
MDE_293.4	Dolomite	0	Nafun	Ons	2	-8.63	0.01
MDE_41.0	Dolomite	0	Nafun	Low	1	3.89	0.00
MDE_56.1	Dolomite	0	Nafun	Low	2	4.60	0.00
MDE_77.0	Dolomite	0	Nafun	Pre	1	6.23	0.01
MDE2_0.4	Dolomite	0	Nafun	Ons	2	-0.12	0.02
MDE2_1.0	Dolomite	0	Nafun	Ons	4	0.38	0.02
MDE2_1.7	Dolomite	0	Nafun	Ons	3	-0.21	0.06
MDE2_106.3	Calcite	0	Nafun	Syn	6	-11.90	0.08
MDE2_154.7	Calcite	0	Nafun	Syn	6	-11.23	0.08
MDE2_166.2	Calcite	0	Nafun	Syn	1	-10.18	0.00
MDE2_172.1	Calcite	0	Nafun	Syn	1	-9.86	0.01
MDE2_173.6	Calcite	0	Nafun	Syn	3	-9.82	0.01
MDE2_176	Calcite	0	Nafun	Syn	1	-9.75	0.01
MDE2_180.6	Calcite	0	Nafun	Syn	5	-11.03	0.14
MDE2_86.6	Calcite	0	Nafun	Syn	4	-11.95	0.12
MDE2_94.6	Calcite	0	Nafun	Syn	1	-12.02	0.00
MDE2_99.3	Calcite	0	Nafun	Syn	2	-11.88	0.00
MDS_0.0	Calcite	0	Nafun	Syn	1	-9.95	0.01
MDS_109.6	Calcite	0	Nafun	Syn	2	-8.89	0.05
MDS_180.5	Calcite	0	Nafun	Syn	1	-7.94	0.00
MDS_200	Calcite	0	Nafun	Syn	2	-7.71	0.02
MDS_213	Calcite	0	Nafun	Syn	3	-6.84	0.01
MDS_220.5	Calcite	0	Nafun	Syn	1	-5.83	0.00

Table A.3: Clumped isotopic data from Oman

Sample ID	Minerology	Depth	Group	Group2	Replicate #	d13C	d13C SD
MDS_222.5	Calcite	0	Nafun	Syn	3	-6.72	0.07
MDS_24.5	Calcite	0	Nafun	Syn	3	-8.91	0.20
MDS_36	Calcite	0	Nafun	Syn	2	-8.85	0.02
MDS_53.5	Calcite	0	Nafun	Syn	2	-7.51	0.00
MDS_6.0	Calcite	0	Nafun	Syn	1	-9.73	0.01
MQ1_3200	Dolomite	3200	Nafun		1	2.42	0.00
MQ1_3224	Dolomite	3224	Nafun		2	6.53	0.03
MQ1_3426	Dolomite	3426	Nafun		4	-4.85	0.02
MQ1_3630	Calcite	3630	Nafun	Syn	1	-8.56	0.00
MQ1_3640	Calcite	3640	Nafun	Syn	2	-6.04	0.43
MQ1_3806	Dolomite	3806	Nafun	Ons	1	-6.01	0.00
MQ1_3810	Dolomite	3810	Nafun	Ons	2	-2.98	0.03
MQ1_3818	Dolomite	3818	Nafun	Ons	1	-0.46	0.00
MQ1_4002	Calcite	4002	Nafun	Low	1	2.94	0.00
MQ1_4120	Dolomite	4120	Nafun	Low	2	5.85	0.01
SB1_CON	Dolomite	0	Nafun		2	3.24	0.08
SB1_ONC	Dolomite	0	Nafun		1	4.34	0.00
SB2_FAN	Dolomite	0	Nafun		1	2.84	0.00
SB2_STROM	Dolomite	0	Nafun		4	7.59	0.18
SWN_2573.12	Dolomite	2573.12	Nafun		2	1.95	0.03
SWT_3725.75	Dolomite	3725.75	Nafun		1	0.44	0.01
TM6_2310	Dolomite	2310	Nafun		1	-1.13	0.01
TM6_2760	Calcite	2760	Nafun	Syn	1	-8.26	0.00
TM6_2795	Calcite	2795	Nafun	Syn	1	-12.24	0.01
TM6_2820	Calcite	2820	Nafun	Pre	1	1.74	0.00
WM1_46.0	Calcite	0	Nafun		1	-8.08	0.00
WM1_59.0	Calcite	0	Nafun		3	-20.79	5.24
WS_2.8	Calcite	0	Nafun	Syn	1	-10.20	0.01
WS_4.9	Calcite	0	Nafun	Syn	1	-10.15	0.01
WS_7.7	Calcite	0	Nafun	Syn	3	-9.89	0.12
WS_8.0	Calcite	0	Nafun	Syn	1	-10.04	0.01
WS1_120.0	Calcite	0	Nafun	Pre	1	4.06	0.00
WS1_149.6	Dolomite	0	Nafun	Ons	1	-2.69	0.00
WS1_167.3	Calcite	0	Nafun	Syn	3	-9.93	0.01
WS1_184.6	Calcite	0	Nafun	Syn	2	-13.59	0.01
HM1_1	Calcite	357	Phan		3	1.38	0.02
HM10_1	Calcite	879.5	Phan		4	2.75	0.13
HM11_1	Calcite	963.2	Phan		2	1.94	0.00
HM11_2	Calcite	963.2	Phan		2	1.34	0.00
HM12_1	Calcite	1038.8	Phan		2	1.46	0.00
HM13_1	Calcite	1114.7	Phan		2	4.96	0.01
HM14_1	Dolomite	1198.5	Phan		2	4.94	0.02

Table A.4: Clumped isotopic data from Oman

Sample ID	Minerology	Depth	Group	Group2	Replicate #	d13C	d13C SD
HM15_1	Dolomite	1264.9	Phan		4	-0.16	0.03
HM16_1	Calcite	1319.1	Phan		3	4.56	0.04
HM17_1	Dolomite	1369.7	Phan		2	-0.58	0.02
HM18_1	Calcite	1420.5	Phan		2	4.61	0.02
HM2_1	Calcite	357.1	Phan		4	1.07	0.02
HM2_2	Calcite	357.1	Phan		2	1.06	0.02
HM2_3	Calcite	357.1	Phan		2	1.41	0.02
HM3_1	Calcite	414.5	Phan		2	2.31	0.01
HM4_1	Calcite	500.3	Phan		2	2.61	0.01
HM5_1	Calcite	500.8	Phan		2	2.53	0.00
HM5_2	Calcite	500.8	Phan		2	2.45	0.00
HM6_1	Calcite	583	Phan		2	1.65	0.00
HM7_1	Calcite	650	Phan		2	3.28	0.00
HM7_2	Calcite	650	Phan		3	3.26	0.01
HM8_1	Calcite	729.5	Phan		2	2.33	0.01
HM8_2	Calcite	729.5	Phan		2	3.91	0.10
HM9_1	Calcite	794.2	Phan		2	3.07	0.02
HM9_2	Calcite	794.2	Phan		3	3.19	0.01

Table A.5: Clumped isotopic data from Oman

Sample ID	d18Omin	d18O SD	T ARF	T 1 SEM	W ARF	W SD	T IL	T 1 SEM
1H1_A1C_031	-2.78	0.03	55.68	8.93	2.11	1.60	54.50	14.28
1H1_A1C_032	-2.72	0.01	72.77	7.53	4.60	1.17	75.24	10.60
1H1_A3C_010	-4.91	0.09	72.29	1.12	2.34	0.28	74.75	2.53
1H1_A3C_011	-5.29	0.15	76.90	10.54	2.55	1.55	73.88	19.09
A4C_13	-4.00	0.01	80.23	5.65	4.27	0.85	83.07	8.52
A4C_15.1	-5.20	0.02	70.14	4.32	1.76	0.74	72.52	6.86
A4C_15.2	-5.18	0.01	79.36	6.06	2.98	0.91	82.16	9.00
A4C_24	-5.23	0.03	57.32	4.13	-0.11	0.79	59.54	5.83
A4C_24.2	-5.09	0.10	55.27	1.05	-0.28	0.32	55.37	4.16
A4C_40.1	-3.56	0.01	68.18	6.02	3.14	1.00	70.51	8.75
A4C_40.2	-3.66	0.02	69.89	7.35	3.27	1.18	72.27	10.32
A4C_40.3	-3.62	0.04	66.22	4.02	2.81	0.72	68.51	6.15
A4C_55	-3.37	0.02	75.34	4.58	4.28	0.74	77.92	7.26
A4C_69.1	-3.45	0.01	63.32	6.30	2.56	1.08	65.56	8.88
A4C_69.2	-3.58	0.01	65.09	4.15	2.69	0.75	67.36	6.50
A4C_9	-4.02	0.01	75.02	4.13	3.59	0.68	77.58	6.73
BBN_2_27	-5.46	0.00	88.32	6.24	3.77	0.87	80.55	8.45
BBN_2_52	-4.52	0.02	93.45	5.14	5.30	0.70	87.19	8.84
BBN_2_85	-0.15	0.00	77.73	5.11	7.84	0.80	69.88	7.08
GFR_102	-3.59	0.01	95.67	15.20	6.49	1.90	88.15	17.92
GFR_107	-3.34	0.13	79.98	7.08	4.90	1.04	72.21	9.24
GFR_18	-2.11	0.00	88.16	5.73	10.86	0.81	80.39	7.92
GFR_5	-2.13	0.00	84.87	5.77	10.38	0.83	77.04	7.93
GFR_7	-2.54	0.00	85.63	6.62	10.07	0.95	77.81	8.82
HM19_1	-2.87	0.02	67.41	6.07	7.02	0.97	76.87	9.50
HM20_1	-2.17	0.08	75.00	5.49	8.89	0.84	85.36	8.37
HM21_1	-4.58	0.01	68.73	6.97	5.50	1.10	78.32	10.64
Lahan_1	-2.44	0.06	98.61	11.56	7.97	1.42	91.31	14.01
Lahan_11	-1.72	0.01	80.08	3.28	6.56	0.54	72.37	5.24
Lahan_23_5842.8	-2.33	0.04	73.39	8.61	5.08	1.32	68.08	9.90
Lahan_4	-0.99	0.00	69.20	3.16	5.87	0.58	61.74	4.70
Lahan_5831.8	-2.36	0.00	90.78	7.59	7.18	1.01	83.11	9.84
Lahan_9	-2.52	0.00	78.80	4.04	5.59	0.65	71.10	6.01
QAC	-3.79	0.01	106.35	6.07	11.58	0.78	118.79	7.46
QAD	-4.02	0.01	81.40	7.24	7.96	1.07	89.15	10.68
S11	-2.31	0.00	89.45	3.00	10.83	0.42	81.71	5.03
S24	-6.91	0.00	66.73	4.41	2.83	0.70	59.12	5.86
S50	-3.35	0.06	130.93	31.19	14.95	3.78	127.47	32.07
S56	-3.13	0.05	110.07	12.10	12.72	1.55	105.38	12.39
S9	-4.01	0.00	76.39	3.97	7.24	0.60	68.55	5.85
ZAL_1_20	-2.68	0.00	63.47	6.13	3.36	1.06	55.98	7.41
ZAL_1_33	-4.45	0.00	80.17	2.25	3.81	0.41	72.31	4.13

Table A.6: Clumped isotopic data from Oman

Sample ID	d18Omin	d18O SD	T ARF	T 1 SEM	W ARF	W SD	T IL	T 1 SEM
ZAL_1_36	-2.08	0.00	90.87	2.27	11.27	0.31	83.17	4.18
ZAL_1_5012c	-2.66	0.00	89.33	4.36	10.47	0.61	81.59	6.50
ZAL_1_51	-1.90	0.00	85.94	7.72	10.76	1.12	78.12	9.95
ZAL_1_64	-3.51	0.00	87.95	4.58	5.70	0.67	80.17	6.73
MQ1_2942	-6.14	0.01	72.11	4.19	1.07	0.70	74.38	6.74
MQ1_2986	-4.54	0.01	68.42	5.00	2.19	0.85	64.21	6.94
MQ1_2994	-2.94	0.01	71.17	3.69	4.18	0.64	73.38	6.14
MQ1_3026	-3.62	0.01	55.22	6.16	1.19	1.14	51.27	7.32
MQ1_3160	-3.15	0.01	74.50	4.72	4.40	0.77	68.59	4.92
SBSB_2398.78	-1.61	0.00	73.27	7.62	5.79	1.18	80.11	11.17
SBSB_2461.75	-2.54	0.01	63.33	4.94	3.48	0.88	69.39	7.72
SBSB_2765.73	-1.24	0.00	42.75	2.91	1.54	0.69	48.18	3.99
SWN_1697.24	-3.91	0.00	63.05	5.02	2.06	0.89	69.09	7.80
TM6_2000	-4.27	0.01	58.42	6.55	1.02	1.17	54.37	7.97
TM6_2100	-2.98	0.00	65.32	4.70	3.32	0.83	61.12	6.45
TM6_2240	-1.67	0.01	56.65	3.28	3.37	0.67	52.65	4.38
BD_9.8	-2.51	0.01	50.23	4.05	1.52	0.84	43.85	4.31
BD1_243.6	-8.47	0.00	61.68	2.22	-2.72	0.47	69.14	4.43
KDE_179.9	-4.66	0.00	42.33	3.61	-1.96	0.82	48.02	4.82
KDE_274	-4.14	0.01	51.62	1.02	0.10	0.33	55.34	4.25
KDE_293.5	-3.01	0.01	37.79	2.91	-1.12	0.72	43.46	3.56
KDW2_102B	-5.31	0.01	56.77	6.01	-0.28	1.10	62.15	8.63
KDW2_112A	-2.66	0.02	64.43	6.69	3.52	1.13	70.22	9.80
KDW2_119.1A	-3.58	0.01	46.15	1.81	-0.23	0.48	51.24	2.86
KDW2_130.9B	-6.78	0.01	45.88	2.75	-3.49	0.64	50.97	4.00
KDW2_131.8_A	-5.56	0.17	46.69	10.95	-2.13	2.11	46.58	5.10
KDW2_46.4	-3.97	0.02	54.63	3.66	0.75	0.74	59.92	5.72
KDW2_64.8	-1.85	0.23	38.58	7.45	0.19	1.59	38.71	1.19
KDW2_87.0	-2.57	0.01	42.24	3.43	0.12	0.79	47.30	4.51
KDWS_130.6A	-4.88	0.01	49.80	4.74	-0.94	0.95	54.96	6.67
MD2_10.2	-7.58	0.02	47.53	4.81	-1.02	0.86	51.74	6.46
MD2_120.1	-6.28	0.01	73.89	2.80	1.17	0.51	77.15	5.18
MD2_180.1	-3.30	0.02	49.46	3.81	0.60	0.80	52.00	5.22
MD2_25.8	-7.57	0.08	48.51	5.20	-0.84	0.92	53.42	6.70
MD2_45.2	-7.31	0.06	59.54	3.76	1.28	0.62	65.65	3.39
MD6_10.0_K1	-9.03	0.01	76.50	6.53	2.18	0.98	84.30	9.92
MD6_10.0_K2	-9.19	0.14	68.81	1.04	0.86	0.16	68.22	9.92
MD6_258.6	-7.54	0.10	61.66	11.42	-1.79	1.91	65.68	11.91
MD6_259.5	-6.94	0.12	54.75	6.29	-2.22	1.16	54.84	8.36
MD6_52_ts	-8.85	0.03	58.43	7.15	-0.45	1.20	66.83	10.49
MDE_118.6	-4.09	0.02	52.41	5.23	0.28	1.01	54.95	7.06
MDE_156.3	-4.19	0.08	44.63	2.41	-1.10	0.59	49.00	3.64

Table A.7: Clumped isotopic data from Oman

Sample ID	d18Omin	d18O SD	T ARF	T 1 SEM	W ARF	W SD	T IL	T 1 SEM
MDE_175.3	-1.80	0.00	38.35	2.18	0.19	0.58	43.29	2.52
MDE_182.1	-4.07	0.01	42.05	2.52	-1.42	0.62	46.96	3.39
MDE_190	-2.97	0.03	65.03	1.08	3.29	0.30	70.58	2.57
MDE_203.9	-2.60	0.02	59.55	5.71	2.87	1.03	64.81	8.40
MDE_214.8	-1.17	0.02	40.91	3.36	1.29	0.79	45.82	4.30
MDE_223.8	-3.06	0.02	77.92	8.49	4.93	1.25	84.56	11.61
MDE_234.5	-2.04	0.20	43.74	8.03	0.91	1.62	50.54	7.59
MDE_246.5	-2.26	0.02	47.41	4.48	1.31	0.93	52.34	6.16
MDE_255	-1.50	0.02	44.01	4.57	1.49	0.98	48.92	5.98
MDE_266.2	-2.36	0.02	41.08	3.81	0.12	0.87	45.99	4.84
MDE_277.4	-6.19	0.13	59.66	1.53	-0.72	0.38	67.23	3.10
MDE_278	-6.03	0.10	46.03	2.95	-2.71	0.67	52.42	5.10
MDE_280.7	-7.04	0.15	44.13	4.05	-4.04	0.88	50.94	3.25
MDE_284.2	-5.59	0.06	50.16	0.97	-1.59	0.32	58.64	2.74
MDE_287.5	-6.37	0.01	59.68	1.50	-0.90	0.37	68.19	3.41
MDE_291.1	-6.17	0.01	55.89	3.53	-1.26	0.71	64.10	5.92
MDE_291.5	-6.23	0.02	55.99	3.33	-1.31	0.67	64.20	5.67
MDE_292	-6.26	0.03	59.46	6.04	-0.82	1.08	67.94	9.18
MDE_292.5	-6.53	0.01	55.41	0.93	-1.70	0.30	63.59	2.11
MDE_293.4	-6.63	0.05	59.54	6.91	-1.18	1.21	68.03	9.75
MDE_41.0	-5.46	0.01	66.35	3.63	0.97	0.66	69.20	5.99
MDE_56.1	-6.10	0.03	75.91	3.01	1.61	0.52	79.32	5.32
MDE_77.0	-3.22	0.02	54.99	3.59	1.56	0.73	57.54	5.36
MDE2_0.4	-6.70	0.00	61.70	0.96	-0.94	0.29	66.82	3.01
MDE2_1.0	-6.91	0.10	60.03	5.54	-1.39	0.99	65.21	9.07
MDE2_1.7	-5.22	0.07	50.70	1.88	-1.13	0.47	57.82	2.54
MDE2_106.3	-8.46	0.12	63.92	4.17	0.83	0.67	70.52	6.90
MDE2_154.7	-8.51	0.11	59.78	3.64	0.12	0.60	66.08	6.38
MDE2_166.2	-8.57	0.01	62.88	3.97	0.55	0.64	68.30	6.48
MDE2_172.1	-8.24	0.01	62.81	3.32	0.87	0.54	68.22	5.70
MDE2_173.6	-8.57	0.02	53.98	3.76	-0.91	0.64	61.02	6.87
MDE2_176	-8.39	0.01	59.20	3.69	0.14	0.61	67.66	6.28
MDE2_180.6	-8.72	0.01	69.52	5.49	1.44	0.86	76.47	8.38
MDE2_86.6	-7.83	0.06	46.24	6.04	-1.50	1.09	51.02	7.40
MDE2_94.6	-8.57	0.01	59.52	2.99	0.01	0.49	64.77	5.16
MDE2_99.3	-8.18	0.05	59.78	6.12	0.44	1.01	65.05	8.51
MDS_0.0	-8.79	0.02	48.03	4.14	-2.15	0.73	55.78	6.18
MDS_109.6	-7.33	0.06	42.86	1.01	-1.60	0.18	50.96	2.32
MDS_180.5	-7.48	0.01	45.32	2.91	-1.31	0.52	52.95	4.46
MDS_200	-7.80	0.10	41.77	1.52	-2.27	0.28	49.83	2.97
MDS_213	-7.64	0.01	53.11	5.52	-0.12	0.95	61.13	7.81
MDS_220.5	-7.86	0.01	52.23	2.73	-0.49	0.47	53.85	4.07

Table A.8: Clumped isotopic data from Oman

Sample ID	d18Omin	d18O SD	T ARF	T 1 SEM	W ARF	W SD	T IL	T 1 SEM
MDS_222.5	-6.62	0.16	46.44	6.23	-0.24	1.12	52.16	6.10
MDS_24.5	-8.76	0.13	57.00	4.47	-0.60	0.75	65.28	6.82
MDS_36	-9.58	0.00	61.44	5.68	-0.70	0.93	70.10	8.42
MDS_53.5	-8.33	0.02	56.04	0.91	-0.32	0.15	64.25	2.01
MDS_6.0	-8.96	0.01	50.83	3.72	-1.84	0.64	56.70	5.62
MQ1_3200	-3.54	0.01	56.40	4.52	1.46	0.86	58.05	6.41
MQ1_3224	-0.40	0.02	55.51	4.55	4.47	0.88	51.55	5.67
MQ1_3426	-1.19	0.07	47.28	2.30	2.36	0.56	44.25	4.19
MQ1_3630	-7.95	0.01	50.34	4.96	-0.91	0.87	43.94	5.25
MQ1_3640	-6.00	0.36	65.82	5.61	3.61	0.90	62.87	12.87
MQ1_3806	-6.23	0.01	52.61	4.52	-1.84	0.89	48.76	5.40
MQ1_3810	-6.10	0.17	58.21	16.25	-0.85	2.80	52.65	19.69
MQ1_3818	-5.65	0.01	52.07	3.74	-1.34	0.77	48.25	4.52
MQ1_4002	-7.95	0.01	77.33	11.74	3.39	1.79	73.19	14.41
MQ1_4120	-4.68	0.02	45.29	12.18	-1.48	2.37	40.49	14.09
SB1_CON	2.11	0.05	36.29	5.65	3.73	1.27	39.75	4.18
SB1_ONC	-0.25	0.01	49.29	3.64	3.63	0.78	50.91	4.89
SB2_FAN	-1.07	0.01	58.61	3.06	4.27	0.62	60.30	4.86
SB2_STROM	-2.34	0.32	44.23	5.38	0.69	1.12	45.94	6.09
SWN_2573.12	-3.09	0.03	43.02	0.79	-0.28	0.31	48.58	0.78
SWT_3725.75	-2.46	0.01	67.73	4.84	4.18	0.83	74.09	7.74
TM6_2310	-3.42	0.03	58.73	3.03	1.92	0.61	54.67	4.26
TM6_2760	-7.45	0.01	58.38	3.86	0.95	0.64	66.78	6.45
TM6_2795	-7.45	0.01	66.54	3.16	2.26	0.50	75.71	5.84
TM6_2820	-6.60	0.01	69.90	6.91	3.64	1.08	65.68	9.03
WM1_46.0	-3.06	0.01	87.27	5.09	9.77	0.72	97.65	7.93
WM1_59.0	-6.77	0.12	117.59	6.75	9.93	0.82	135.60	5.69
WS_2.8	-8.42	0.01	63.81	4.36	0.85	0.70	69.29	6.99
WS_4.9	-8.64	0.01	71.08	4.92	1.76	0.76	77.06	7.86
WS_7.7	-8.48	0.23	50.90	6.07	-1.34	1.06	49.71	8.21
WS_8.0	-8.19	0.01	49.44	3.57	-1.30	0.62	54.40	5.23
WS1_120.0	-10.33	0.01	119.42	6.54	6.52	0.78	137.23	5.66
WS1_149.6	-4.79	0.01	121.60	7.22	7.84	0.76	140.24	6.02
WS1_167.3	-5.56	0.04	36.98	5.59	-0.90	1.06	42.41	6.46
WS1_184.6	-13.40	0.01	151.30	14.69	6.87	1.53	183.10	9.20
HM1_1	-3.64	0.02	30.25	2.18	-0.26	0.43	37.75	2.18
HM10_1	-5.46	2.04	33.90	6.56	-1.38	1.28	41.20	7.26
HM11_1	-3.57	0.00	34.67	2.44	0.66	0.47	41.97	2.11
HM11_2	-4.72	0.02	36.73	1.75	-0.11	0.33	43.47	2.05
HM12_1	-3.81	0.02	34.09	1.73	0.31	0.33	41.93	1.91
HM13_1	-4.46	0.03	41.59	4.42	1.06	0.82	48.91	6.27
HM14_1	-2.36	0.06	47.31	3.07	1.18	0.69	55.39	4.60

Table A.9: Clumped isotopic data from Oman

Sample ID	d18Omin	d18O SD	T ARF	T 1 SEM	W ARF	W SD	T IL	T 1 SEM
HM15_1	1.30	0.08	36.38	5.27	2.94	1.19	43.66	6.37
HM16_1	-3.28	0.05	32.79	3.11	0.60	0.61	39.92	2.87
HM17_1	0.42	0.05	28.74	2.23	0.60	0.65	36.09	2.45
HM18_1	-3.12	0.02	34.25	0.95	1.03	0.18	42.09	0.89
HM2_1	-3.67	0.05	36.87	4.08	0.98	0.78	43.88	4.91
HM2_2	-3.77	0.03	38.41	3.36	1.16	0.63	45.71	4.77
HM2_3	-3.47	0.04	34.53	1.94	0.74	0.37	41.29	2.06
HM3_1	-3.31	0.01	37.60	3.43	1.47	0.65	45.46	4.20
HM4_1	-3.78	0.00	38.70	7.09	1.21	1.35	45.99	8.98
HM5_1	-3.67	0.00	32.61	4.12	0.17	0.81	39.39	4.33
HM5_2	-4.37	0.02	48.27	4.13	2.34	0.73	55.74	6.52
HM6_1	-3.47	0.10	32.96	3.59	0.43	0.70	40.80	3.93
HM7_1	-4.08	0.01	37.18	4.45	0.62	0.85	44.47	5.88
HM7_2	-4.08	0.12	35.63	2.80	0.33	0.53	42.37	3.15
HM8_1	-4.25	0.01	35.00	1.15	0.04	0.22	42.29	1.79
HM8_2	-5.07	0.01	41.79	7.07	0.48	1.31	48.53	8.47
HM9_1	-4.05	0.02	33.75	1.07	0.00	0.21	41.05	1.56
HM9_2	-3.93	0.07	40.08	3.15	1.31	0.58	46.82	3.96

Table A.10: Clumped isotopic data from Oman

Sample ID	D47	D47 SD	D47 1 SEM	D47 ARF	D47 SD	D47 1 SEM
1H1_A1C_031	0.548	0.043	0.030	0.594	0.032	0.023
1H1_A1C_032	0.500	0.045	0.016	0.552	0.045	0.016
1H1_A3C_010	0.501	0.001	0.001	0.553	0.001	0.002
1H1_A3C_011	0.503	0.044	0.031	0.543	0.030	0.021
A4C_13	0.485	0.031	0.011	0.536	0.031	0.011
A4C_15.1	0.505	0.026	0.009	0.558	0.026	0.010
A4C_15.2	0.486	0.034	0.012	0.538	0.034	0.012
A4C_24	0.535	0.014	0.010	0.590	0.015	0.011
A4C_24.2	0.546	0.012	0.007	0.595	0.003	0.003
A4C_40.1	0.510	0.038	0.013	0.563	0.038	0.014
A4C_40.2	0.506	0.045	0.016	0.559	0.045	0.016
A4C_40.3	0.514	0.012	0.009	0.567	0.013	0.009
A4C_55	0.495	0.027	0.009	0.547	0.027	0.010
A4C_69.1	0.521	0.042	0.015	0.575	0.042	0.015
A4C_69.2	0.517	0.027	0.010	0.570	0.027	0.010
A4C_9	0.495	0.024	0.008	0.547	0.024	0.009
BBN_2_27	0.489	0.032	0.011	0.520	0.032	0.011
BBN_2_52	0.477	0.019	0.011	0.511	0.015	0.009
BBN_2_85	0.511	0.029	0.010	0.542	0.029	0.011
GFR_102	0.476	0.036	0.025	0.507	0.035	0.025
GFR_107	0.506	0.024	0.014	0.537	0.024	0.014
GFR_18	0.490	0.029	0.010	0.521	0.029	0.011
GFR_5	0.496	0.030	0.011	0.527	0.030	0.011
GFR_7	0.495	0.035	0.012	0.526	0.035	0.012
HM19_1	0.497	0.039	0.014	0.565	0.039	0.014
HM20_1	0.481	0.015	0.011	0.547	0.016	0.012
HM21_1	0.494	0.044	0.015	0.562	0.044	0.016
Lahan_1	0.470	0.033	0.019	0.502	0.032	0.019
Lahan_11	0.506	0.018	0.006	0.537	0.018	0.007
Lahan_23_5842.8	0.515	0.028	0.016	0.551	0.031	0.018
Lahan_4	0.530	0.019	0.007	0.560	0.019	0.007
Lahan_5831.8	0.485	0.038	0.013	0.516	0.038	0.014
Lahan_9	0.508	0.022	0.008	0.539	0.022	0.008
QAC	0.432	0.026	0.009	0.489	0.026	0.009
QAD	0.474	0.040	0.014	0.534	0.040	0.014
S11	0.487	0.014	0.005	0.518	0.014	0.006
S24	0.536	0.028	0.010	0.566	0.028	0.010
S50	0.422	0.050	0.036	0.454	0.049	0.035
S56	0.449	0.027	0.015	0.483	0.030	0.018
S9	0.514	0.023	0.008	0.544	0.023	0.008
ZAL_1_20	0.544	0.041	0.014	0.574	0.041	0.015
ZAL_1_33	0.506	0.006	0.004	0.537	0.006	0.005

Table A.11: Clumped isotopic data from Oman

Sample ID	D47	D47 SD	D47 1 SEM	D47 ARF	D47 SD	D47 1 SEM
ZAL_1_36	0.485	0.010	0.003	0.516	0.010	0.004
ZAL_1_5012c	0.488	0.022	0.008	0.518	0.022	0.008
ZAL_1_51	0.494	0.040	0.014	0.525	0.040	0.014
ZAL_1_64	0.490	0.023	0.008	0.521	0.023	0.009
MQ1_2942	0.502	0.025	0.009	0.554	0.025	0.009
MQ1_2986	0.524	0.031	0.011	0.562	0.031	0.011
MQ1_2994	0.504	0.022	0.008	0.556	0.022	0.008
MQ1_3026	0.557	0.045	0.016	0.595	0.045	0.016
MQ1_3160	0.514	0.009	0.006	0.549	0.014	0.010
SBSB_2398.78	0.490	0.045	0.016	0.551	0.045	0.016
SBSB_2461.75	0.512	0.033	0.012	0.574	0.033	0.012
SBSB_2765.73	0.566	0.024	0.009	0.632	0.024	0.009
SWN_1697.24	0.513	0.033	0.012	0.575	0.033	0.012
TM6_2000	0.549	0.046	0.016	0.587	0.046	0.016
TM6_2100	0.531	0.030	0.011	0.570	0.030	0.011
TM6_2240	0.553	0.023	0.008	0.592	0.023	0.009
BD_9.8	0.579	0.031	0.011	0.609	0.031	0.011
BD1_243.6	0.513	0.014	0.005	0.579	0.014	0.006
KDE_179.9	0.567	0.031	0.011	0.633	0.031	0.011
KDE_274	0.546	0.010	0.007	0.605	0.002	0.003
KDE_293.5	0.580	0.026	0.009	0.647	0.026	0.009
KDW2_102B	0.529	0.043	0.015	0.591	0.043	0.015
KDW2_112A	0.510	0.044	0.016	0.572	0.044	0.016
KDW2_119.1A	0.557	0.014	0.005	0.621	0.014	0.005
KDW2_130.9B	0.558	0.022	0.008	0.622	0.022	0.008
KDW2_131.8_A	0.571	0.017	0.012	0.620	0.043	0.031
KDW2_46.4	0.534	0.027	0.009	0.597	0.027	0.010
KDW2_64.8	0.596	0.006	0.004	0.645	0.033	0.023
KDW2_87.0	0.569	0.029	0.010	0.633	0.029	0.011
KDWS_130.6A	0.547	0.037	0.013	0.610	0.037	0.013
MD2_10.2	0.556	0.038	0.014	0.617	0.038	0.014
MD2_120.1	0.496	0.016	0.006	0.550	0.016	0.006
MD2_180.1	0.555	0.030	0.010	0.611	0.030	0.011
MD2_25.8	0.551	0.027	0.014	0.614	0.029	0.015
MD2_45.2	0.521	0.005	0.003	0.584	0.013	0.009
MD6_10.0_K1	0.483	0.038	0.013	0.544	0.038	0.014
MD6_10.0_K2	0.515	0.023	0.016	0.561	0.000	0.002
MD6_258.6	0.521	0.030	0.021	0.579	0.038	0.027
MD6_259.5	0.547	0.029	0.017	0.597	0.028	0.016
MD6_52_ts	0.518	0.050	0.018	0.587	0.050	0.018
MDE_118.6	0.547	0.039	0.014	0.603	0.039	0.014
MDE_156.3	0.564	0.013	0.007	0.626	0.012	0.007

Table A.12: Clumped isotopic data from Oman

Sample ID	D47	D47 SD	D47 1 SEM	D47 ARF	D47 SD	D47 1 SEM
MDE_175.3	0.581	0.009	0.006	0.646	0.009	0.007
MDE_182.1	0.570	0.021	0.007	0.634	0.021	0.008
MDE_190	0.510	0.001	0.001	0.570	0.001	0.003
MDE_203.9	0.523	0.040	0.014	0.584	0.040	0.014
MDE_214.8	0.573	0.029	0.010	0.637	0.029	0.011
MDE_223.8	0.482	0.023	0.016	0.541	0.024	0.017
MDE_234.5	0.559	0.024	0.017	0.628	0.033	0.024
MDE_246.5	0.554	0.036	0.013	0.617	0.036	0.013
MDE_255	0.564	0.038	0.013	0.628	0.038	0.014
MDE_266.2	0.573	0.033	0.012	0.637	0.033	0.012
MDE_277.4	0.517	0.003	0.002	0.584	0.004	0.004
MDE_278	0.554	0.020	0.010	0.622	0.017	0.009
MDE_280.7	0.558	0.008	0.006	0.627	0.017	0.012
MDE_284.2	0.538	0.004	0.003	0.609	0.002	0.003
MDE_287.5	0.515	0.008	0.003	0.584	0.008	0.004
MDE_291.1	0.524	0.025	0.009	0.594	0.025	0.009
MDE_291.5	0.524	0.024	0.008	0.593	0.024	0.009
MDE_292	0.515	0.042	0.015	0.584	0.042	0.015
MDE_292.5	0.525	0.001	0.001	0.595	0.001	0.003
MDE_293.4	0.515	0.023	0.016	0.584	0.024	0.017
MDE_41.0	0.513	0.023	0.008	0.567	0.023	0.008
MDE_56.1	0.492	0.008	0.006	0.545	0.008	0.006
MDE_77.0	0.540	0.026	0.009	0.596	0.026	0.010
MDE2_0.4	0.518	0.003	0.002	0.579	0.000	0.002
MDE2_1.0	0.522	0.031	0.015	0.583	0.027	0.014
MDE2_1.7	0.540	0.004	0.003	0.608	0.008	0.005
MDE2_106.3	0.510	0.024	0.010	0.573	0.024	0.010
MDE2_154.7	0.520	0.023	0.010	0.583	0.022	0.009
MDE2_166.2	0.515	0.026	0.009	0.576	0.026	0.010
MDE2_172.1	0.515	0.022	0.008	0.576	0.022	0.008
MDE2_173.6	0.532	0.020	0.012	0.599	0.017	0.010
MDE2_176	0.516	0.026	0.009	0.585	0.026	0.009
MDE2_180.6	0.497	0.026	0.012	0.560	0.027	0.012
MDE2_86.6	0.558	0.032	0.016	0.621	0.035	0.017
MDE2_94.6	0.523	0.020	0.007	0.584	0.020	0.008
MDE2_99.3	0.522	0.020	0.014	0.583	0.021	0.015
MDS_0.0	0.545	0.033	0.012	0.616	0.033	0.012
MDS_109.6	0.558	0.005	0.003	0.631	0.003	0.003
MDS_180.5	0.553	0.023	0.008	0.624	0.023	0.009
MDS_200	0.561	0.008	0.005	0.635	0.006	0.005
MDS_213	0.531	0.024	0.014	0.601	0.025	0.015
MDS_220.5	0.550	0.020	0.007	0.604	0.020	0.007

Table A.13: Clumped isotopic data from Oman

Sample ID	D47	D47 SD	D47 1 SEM	D47 ARF	D47 SD	D47 1 SEM
MDS_222.5	0.555	0.022	0.013	0.620	0.031	0.018
MDS_24.5	0.521	0.018	0.011	0.591	0.020	0.012
MDS_36	0.511	0.018	0.013	0.579	0.019	0.014
MDS_53.5	0.524	0.000	0.000	0.593	0.001	0.002
MDS_6.0	0.543	0.028	0.010	0.608	0.028	0.010
MQ1_3200	0.539	0.032	0.011	0.592	0.032	0.012
MQ1_3224	0.556	0.017	0.012	0.595	0.017	0.012
MQ1_3426	0.578	0.021	0.011	0.618	0.013	0.007
MQ1_3630	0.579	0.038	0.014	0.609	0.038	0.014
MQ1_3640	0.527	0.034	0.024	0.568	0.018	0.013
MQ1_3806	0.564	0.034	0.012	0.603	0.034	0.012
MQ1_3810	0.553	0.061	0.043	0.587	0.055	0.039
MQ1_3818	0.566	0.028	0.010	0.604	0.028	0.010
MQ1_4002	0.504	0.066	0.023	0.542	0.066	0.023
MQ1_4120	0.590	0.055	0.039	0.624	0.048	0.034
SB1_CON	0.592	0.018	0.012	0.652	0.026	0.018
SB1_ONC	0.558	0.028	0.010	0.612	0.028	0.010
SB2_FAN	0.533	0.021	0.007	0.586	0.021	0.008
SB2_STROM	0.573	0.030	0.015	0.627	0.032	0.016
SWN_2573.12	0.565	0.000	0.000	0.631	0.001	0.002
SWT_3725.75	0.502	0.031	0.011	0.564	0.031	0.011
TM6_2310	0.548	0.021	0.007	0.586	0.021	0.008
TM6_2760	0.518	0.027	0.010	0.587	0.027	0.010
TM6_2795	0.499	0.020	0.007	0.567	0.020	0.007
TM6_2820	0.521	0.043	0.015	0.559	0.043	0.015
WM1_46.0	0.460	0.026	0.009	0.522	0.026	0.010
WM1_59.0	0.413	0.015	0.008	0.472	0.016	0.009
WS_2.8	0.512	0.029	0.010	0.573	0.029	0.010
WS_4.9	0.496	0.030	0.011	0.556	0.030	0.011
WS_7.7	0.562	0.032	0.019	0.607	0.028	0.017
WS_8.0	0.549	0.028	0.010	0.611	0.028	0.010
WS1_120.0	0.412	0.024	0.009	0.470	0.024	0.009
WS1_149.6	0.409	0.026	0.009	0.466	0.026	0.010
WS1_167.3	0.584	0.030	0.017	0.650	0.031	0.018
WS1_184.6	0.376	0.025	0.018	0.430	0.021	0.015
HM1_1	0.599	0.013	0.007	0.674	0.013	0.008
HM10_1	0.588	0.041	0.020	0.661	0.043	0.022
HM11_1	0.585	0.008	0.006	0.658	0.011	0.008
HM11_2	0.580	0.007	0.005	0.651	0.007	0.006
HM12_1	0.585	0.007	0.005	0.660	0.008	0.006
HM13_1	0.564	0.020	0.014	0.635	0.019	0.014
HM14_1	0.546	0.011	0.008	0.618	0.012	0.009

Table A.14: Clumped isotopic data from Oman

Sample ID	D47	D47 SD	D47 1 SEM	D47 ARF	D47 SD	D47 1 SEM
HM15_1	0.580	0.033	0.017	0.652	0.034	0.017
HM16_1	0.592	0.015	0.009	0.665	0.018	0.011
HM17_1	0.605	0.013	0.009	0.679	0.011	0.008
HM18_1	0.585	0.003	0.002	0.659	0.003	0.003
HM2_1	0.579	0.025	0.013	0.651	0.026	0.013
HM2_2	0.573	0.016	0.012	0.645	0.015	0.011
HM2_3	0.587	0.008	0.006	0.658	0.009	0.007
HM3_1	0.574	0.014	0.010	0.648	0.015	0.011
HM4_1	0.573	0.032	0.022	0.644	0.031	0.022
HM5_1	0.594	0.018	0.013	0.665	0.020	0.014
HM5_2	0.545	0.018	0.012	0.615	0.016	0.012
HM6_1	0.589	0.016	0.011	0.664	0.017	0.012
HM7_1	0.577	0.021	0.015	0.649	0.020	0.014
HM7_2	0.584	0.015	0.008	0.655	0.016	0.009
HM8_1	0.584	0.006	0.005	0.657	0.004	0.004
HM8_2	0.565	0.028	0.020	0.635	0.030	0.021
HM9_1	0.588	0.006	0.004	0.661	0.004	0.004
HM9_2	0.570	0.016	0.009	0.640	0.017	0.010

Table A.15: Clumped isotopic data from Oman