SUPPLEMENTARY INFORMATION AND DATA

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ORGANIC CARBON – A SEEMINGLY OBVIOUS, YET INEFFECTIVE ATTEMPT TO DISTINGUISH OIL- FROM METHANE-SEEP DEPOSITS IN THE FOSSIL RECORD

One of the envisioned methods to distinguish ancient methane- from oil-dominated seep deposits in the scope of this study was to compare bulk rock total carbon (TC) and total organic carbon (TOC) contents, as well as their respective isotope values. Specifically, the $\delta^{13}C$ values in oil- and methane-seep deposits are likely to be different. Higher hydrocarbons are present as crude oil in modern seep deposits, which is preserved as metamorphosed crude oil (referred to as impsonite or pyrobitumen) in ancient seep limestones (cf. Peckmann et al., 2001, 2007). Methane on the other hand, is not preserved within the TOC fraction of seep carbonates. The TOC fraction of methane-seep deposits could therefore exhibit rather different stable carbon isotope compositions than the TOC fraction of oil-seep deposits. Furthermore, the observation that modern oil-seep carbonates exhibit much higher TOC contents than their methane-derived counterparts (Table DR1) suggests that this comparison should serve as a potent tool in identifying oil-seep deposits in the rock record. The potential of these rather simple and obvious methods to discriminate oil- from methane-seep deposits has not been tested to date and was systematically assessed as part of this study.

For total carbon (TC) measurements, 10 samples from each site were ground to fine powder, after which a fraction of each powder was decalcified by slow addition of 0.1%

hydrochloric acid (HCl). When all carbonate was dissolved, the remaining material was rinsed with dichloromethane-cleaned water, centrifuged, and dried at 70°C to obtain the non-carbonate residue. This residual powder, as well as untreated powders of each sample were heated to 1000°C at a steady rate of 20°C/min. using a LECO RC-612 Carbon Analyzer (St. Joseph, MI, USA), equipped with a solid-state infrared detector at the Department of Environmental Geosciences at the University of Vienna. We employed this two-step measurement procedure, because determining TOC contents of the Late Devonian *Dzieduszyckia* oil-seep limestones was not possible using untreated powders where TC contents well over 12% were determined (Table DR1). Pyrobitumen most likely blended with TIC measured above 550°C in these samples, as inert pyrobitumen completely converts to carbon dioxide only if heated to at least 650°C (cf. Grinko and Golovko, 2011). This precluded a straightforward determination of both TOC and total inorganic carbon (TIC) in one measurement. TC content of untreated and corresponding residue powders was determined by measuring the released carbon dioxide up to a temperature of 1000°C. Prior to sample measurements a pure calcium carbonate standard (Co. Merck) was measured three times. A standard deviation of 0.18% as well as a relative standard deviation of 1.48% were calculated. A Synthetic Carbon Leco standard (LECO-Nr. 502-029) was measured nine times prior to sample analyses and a standard deviation of 0.02% as well as a relative standard deviation of 2.5% was calculated. The TOC content of bulk samples was obtained by relating TC content of residue powder to the mass ratio of powder prior to and after decalcification.

TC and TOC, as well as respective $\delta^{13}C$ values are shown in Table DR1. Interestingly, the total non-carbonate fraction varies widely among the different seep deposits. For the Oligocene methane-seep deposit (SR4), the non-carbonate fraction greatly exceeds that of the Late Devonian *Dzieduszyckia* deposit. The non-carbonate fraction of the methane-seep deposit amounts to 20% of the total rock mass, whereas it constitutes only 1% in the putative oil-seep deposit (Table DR1). TC mean values of the non-carbonate fraction are significantly higher in the *Dzieduszyckia* deposit than in SR4 limestones. These results have a profound impact on calculated bulk rock TOC values. Due to the relatively large non-carbonate fraction of SR4 limestones, bulk rock TOC values are an order of magnitude greater than for the *Dzieduszyckia* deposit. Our analyses do not arrive at the intuitive conclusion that ancient oil-seep carbonates should yield higher bulk rock TOC values than pure methane-derived carbonates. The large non-carbonate fraction in SR4 limestones, in combination with an extraordinarily low non-carbonate fraction of the Late Devonian oil-seep carbonates, leads to contrary results than expected. It is likely that the large portion of heterogeneous microcrystalline calcite (i.e. micrite) within Oligocene samples may be responsible for this outcome. Micrite is the volumetrically most prominent mineral phase in most studied seep limestones from Cenozoic successions from Washington State (e.g. Goedert et al., 2000; Peckmann et al., 2002, 2003; Kuechler et al., 2012; Zwicker et al., 2015). This phase exhibits substantial amounts of detrital material derived from the clay-rich marine host sediments. It is likely that detrital organic matter was also incorporated and cemented as part of the bulk limestone, which would account for the relatively high bulk rock TOC contents. In contrast, microcrystalline calcite is negligible in the Late Devonian *Dzieduszyckia* deposit. Here, the only non-carbonate constituent of the bulk limestone is very fine grained particulate material, most probably pyrobitumen (own observation after decalcification with HCl), which, however, only amounts to very little of the total rock volume. Consequently, discrimination between oil- and methane-seep deposits cannot be accomplished by mere comparison of bulk rock TC and TOC data in this case.

The second unexpected observation is that bulk rock $\delta^{13}C$ values of TOC ($\delta^{13}C_{TOC}$) do not differ significantly in any of the fossil or modern samples (Table DR1). As mentioned above, methane is not part of the TOC fraction of seep limestones – a distinction that should be apparent in $\delta^{13}C_{TOC}$ of methane- and oil-seep carbonates. However, $\delta^{13}C_{TOC}$ values from all four sites are too similar as to allow for a distinction between carbon sources (Table DR1). $\delta^{13}C_{TOC}$ values of Gulf of Mexico samples are slightly higher than those of Makran, but for the ancient samples this trend is reversed. This suggests that the heterogeneity of organic carbon – especially in the ancient samples – does not allow for a distinction between oil- and methane-seep limestones. $\delta^{13}C$ values of bulk rock powders ($\delta^{13}C_{TC}$) do show a distinct trend in that oil-seep deposits are more enriched in ^{13}C than their methane-dominated counterparts (Table DR1). However, as with phase-specific stable carbon isotope determination, the varying sources of carbon cannot be distinguished for ancient samples as the degree of mixing is unknown (cf. Peckmann and Thiel, 2004).

Besides analyzing TC and TOC contents, an elegant approach to distinguish oil- from methane-seep limestones could be the analysis of fluid inclusions. Fluid inclusion studies have been successfully applied in constraining formation temperatures of carbonate cements, as well as hydrocarbon characterization (e.g. Bodnar, 1990; Orange et al., 1996; Parnell et al., 2002; Haeri-Ardakani et al., 2013; Mathieu et al., 2013). In the scope of this study, the emphasis would have to lie on the determination of the composition of hydrocarbon compounds within fluid inclusions of clear aragonite cement, since later diagenetic cements do not reflect the composition of seepage fluids. However, in the case of clear, fibrous aragonite cement this method is hampered by the small size of fluid inclusions. Natalicchio (2010) attempted to analyze fluid inclusions from fibrous aragonite and to determine their composition, but obtained conflicting results. Using conventional methods, the identification of hydrocarbon compounds in small fluid inclusions of fibrous aragonite cement remains challenging.

In summary, TC and TOC contents, $\delta^{13}C_{TOC}$ values, as well as conventional fluid inclusion analyses do not allow for the discrimination between oil- and methane-derived seep cement in the fossil record.

MATERIAL AND METHODS

Rock samples from seeps in the southern Gulf of Mexico and Makran were collected with R/V Sonne and R/V Meteor during research cruises SO174 and M74 in 2003 and 2007, respectively (Bohrmann et al., 2004, 2008). Carbonate samples from the Campeche Knolls were collected from the Chapopote asphalt volcano and are described in Naehr et al. (2009). Makran limestones were retrieved at Flare 15 (cf. Himmler et al., 2015) and are described therein. Samples from the *Dzieduszyckia* and SR4 deposits are detailed in Peckmann et al. (2007) and Peckmann et al. (2002), respectively.

In situ analyses of trace element concentrations were carried out by laser-ablation ICP-MS at the Department of Geosciences, University of Bremen, using a NewWave UP193 solid-state laser coupled to a Thermo-Finnigan Element 2 HR-ICP-MS. The full data set is presented in Table DR2. Samples and standards were ablated with an irradiance of approximately 1 GW cm^{-2}, spot sizes of 35 to 100 µm, and a laser pulse rate of 5 Hz. Plasma power was 1200 W, helium (approximately 0.8 L min^{-1}) was used as sample gas, and argon (approximately 0.8 L min^{-1}) was subsequently added as make-up gas. All isotopes were analyzed at low resolution with 5 samples in a 20% mass window and a total dwell time of 25 ms for each isotope. Blanks were measured for 25 s prior to ablation. NIST610 glass was analyzed for external calibration after every 8 to 12 samples using the values of Jochum et al. (2011).

For data quantification the Cetac GeoProTM software was used with ^{43}Ca as internal standard. Because of high Sr concentrations in many samples of this study, the interference of

$^{86}Sr^{++}$ on $^{43}Ca^{+}$ was corrected for all carbonate analyses using a factor derived from regular analyses of a Sr-rich carbonate standard (MACS-3). Data quality was assessed by regular analyses of USGS reference materials BCR2G and BHVO2G (basaltic glasses) along with the samples; the data are summarized in Table DR3. External precision and accuracy for these standards are better than 5% for most elements. For consecutive analyses of NIST614 and NIST616 glasses the precision for most REE is better than 5% at the 1 ppm level, and 14 to 55% at the 0.02 ppm level. In Table DR2 all quantified data are shown (except for negative values, which are marked as zero), but we note that values below approximately 0.02 ppm are close to the detection limits.

The low concentrations of Si, Al, Fe, Mn, and Mg in all analyses indicate that the amount of clay minerals, particulate matter, and Fe- and Mn-oxides analyzed together with the carbonates is negligible. For example, Si concentrations below 200 ppm as in most analyses limit the maximum amount of clay minerals (35 to 55 wt.% SiO_2) in the analyzed volume to 0.08 to 0.12 wt.%. Likewise, Mn and Fe contents below 200 ppm imply the presence of less than approximately 0.03 wt.% of Fe- or Mn-oxides.

CORRELATION COEFFICIENTS

Correlation coefficients between phase-specific ∑REE+Y, Mo, and U values and other elements were calculated to determine potential contamination from foreign sources including particulate matter, clay minerals, and Fe- and Mn-oxides (cf. Nothdurft et al., 2004). ∑REE +Y, Mo, and U do not correlate with each other, nor do they correlate with any other measured element. Correlation coefficients are shown in Table DR4.

ACKNOWLEDGMENTS

We thank Petra Körner for TC and TOC analyses, Andreas Richter and Margarete Watzka (all University of Vienna) for stable isotope analyses, and Daniel Birgel (Hamburg) for comments on TOC analyses.

REFERENCES CITED

Bodnar, R.J., 1990, Petroleum migration in the Miocene Monterey Formation, California, USA: constraints from fluid-inclusion studies: Mineralogical Magazine, v. 54, p. 295–303, doi: 10.1180/minmag.1990.054.375.15.

Bohrmann, G., Schenck S., and cruise participants, 2004, Report and preliminary results of R/V Sonne cruise SO 174 / OTEGA II, Balboa – Corpus Christi – Miami, 1 October - 12 November 2003. Investigations within the BMBF special program "Gashydrate im Geosystem": Geomar report, v. 117, IFM – GEOMAR, Kiel 2004, 130 p.

Bohrmann, G., and cruise participants, 2008, Report and preliminary results of R/V Meteor Cruise M74/3, Fujairah–Male. Cold seeps of the Makran subduction zone (Continental Margin of Pakistan): Berichte Fachbereich Geowissenschaften, Universität Bremen 2008, v. 266, 161 p.

Goedert, J.L., Peckmann, J., and Reitner, J., 2000, Worm tubes in an allochthonous cold-seep carbonate from Lower Oligocene rocks of Western Washington: Journal of Paleontology, v. 74, p. 992–999, doi: 10.1666/0022-3360(2000)074<0992:WTIAAC>2.0.CO;2.

Grinko, A.A., and Golovko, A.K., 2011, Investigation of the stability of oil pyrobitumen by means of thermal destruction: Chemistry for Sustainable Development, v. 19, p. 303–310.

Haeri-Ardakani, O., Al-Aasm, I., Coniglio, M., and Samson, I., 2013, Diagenetic evolution and associated mineralization in Middle Devonian carbonates, southwestern Ontario, Canada: Bulletin of Canadian Petroleum Geology, v. 61, p. 42–58, doi: 10.2113/gscpgbull.61.1.41.

Himmler, T., Birgel, D., Bayon, G., Pape, T., Ge, L., Bohrmann, G., and Peckmann, J., 2015, Formation of seep carbonates along the Makran convergent margin, northern Arabian Sea and a molecular and isotopic approach to constrain the carbon isotopic composition of parent methane: Chemical Geology, v. 415, p. 102–117, doi:10.1016/j.chemgeo.2015.09.016.

Jochum, K.P., Weis, U., Stoll, B., Kuzmin, D., Yang, Q., Raczek, I., Jacob, D.E., Stracke, A., Birbaim, K., Frick, D.A., Günther, D., and Enzweiler, J., 2011, Determination of reference values for NIST SRM 610-617 glasses following ISO guidelines: Geostandards and Geoanalytical Research, v. 35, p. 397–429, doi:10.1111/j.1751-908X.2011.00120.x.

Kuechler, R.R., Birgel, D., Kiel, S., Freiwald, A., Goedert, J.L., Thiel, V., and Peckmann, J., 2012, Miocene methane-derived carbonates from southwestern Washington, USA and a model for silicification at seeps: Lethaia, v. 45, p. 259–273, doi: 10.1111/j.1502-3931.2011.00280.x.

Mathieu, J., Kontak, J., and Turner, C.E., 2013, A fluid inclusion study of diagenetic fluids in Proterozoic and Paleozoic carbonate rocks, Victoria Island, NWT: Geofluids, v. 13, p. 559–578, doi:10.1111/gfl.12063.

Naehr, T.H., Birgel, D., Bohrmann, G., MacDonald, I.R., and Kasten, S., 2009, Biogeochemical controls on authigenic carbonate formation at the Chapopote “asphalt volcano”, Bay of Campeche: Chemical Geology, v. 266, p. 399–411, doi:10.1016/j.chemgeo.2009.07.002.

Natalicchio, M., 2010, Methane-derived carbonates in the Messinian sediments of the Tertiary Piedmont Basin: relation to gas hydrates formation and dissociation and to the emplacement of chaotic deposits [Ph.D. thesis]: Università degli Studi di Torino, Scuola di Dottorato in Scienza e Alta Tecnologia, Ciclo XXII, 156 p.

Nothdurft, L.D., Webb, G.E., and Kamber, B.S., 2004, Rare earth element geochemistry of Late Devonian reefal carbonates, Canning Basin, Western Australia: Confirmation of a seawater REE proxy in ancient limestones: Geochimica et Cosmochimica Acta, v. 68, p. 263–283, doi:10.1016/S0016-7037(03)00422-8.

Orange, D., Knittle, E., Farber, D., and Williams, Q., 1996, Raman spectroscopy of crude oils and hydrocarbon fluid inclusions: A feasibility study: The Geochemical Society, Special Publication, v. 5, p. 65–81.

Parnell, J., Mazzini, A., and Monghan, C., 2002, Fluid inclusion studies of chemosynthetic carbonates: strategy for seeking life on Mars: Astrobiology, v. 2, p. 43–57, doi:10.1089/153110702753621330.

Peckmann, J., and Thiel, V., 2004, Carbon cycling at ancient methane-seeps: Chemical Geology, v. 205, p. 443–467, doi:10.1016/j.chemgeo.2003.12.025.

Peckmann, J., Campbell, K.A., Walliser, O.H., and Reitner, J., 2007, A Late Devonian hydrocarbon-seep deposit dominated by dimerelloid brachiopods, Morocco: Palaios, v. 22, p. 114–122, doi: 10.2110/palo.2005.p05-115r.

Peckmann, J., Gischler, E., Oschmann, W., and Reitner, J., 2001, An Early Carboniferous seep community and hydrocarbon-derived carbonates from the Harz Mountains, Germany: Geology, v. 29, p. 271–274, doi:10.1130/0091- 613(2001)029<0271:AECSCA>2.0.CO;2.

Peckmann, J., Goedert, J.L., Heinrichs, T., Hoefs, J., and Reitner, J., 2003, The Late Eocene 'Whiskey Creek' methane-seep deposit (western Washington State) Part II: Petrology, stable isotopes, and biogeochemistry: Facies, v. 48, p. 241–253, doi: 10.1007/BF02667542.

Peckmann, J., Goedert, J.L., Thiel, V., Michaelis, W., and Reitner, J., 2002, A comprehensive approach to the study of methane-seep deposits from the Lincoln Creek Formation, western Washington State, USA: Sedimentology, v. 49, p. 855–873, doi: 10.1046/j.1365-3091.2002.00474.x.

Zwicker, J., Smrzka, D., Gier, S., Goedert, J.L., and Peckmann, J., 2015, Mineralized conduits are part of the uppermost plumbing system of Oligocene methane-seep deposits, Washington State (USA): Marine and Petroleum Geology, v. 66, p. 616–630, doi:10.1016/j.marpetgeo.2015.05.035.

TABLE DR1: Sample weights before and after decalcification and resulting non-carbonate fraction of bulk rock samples. Bulk rock total carbon (TC) and total organic carbon (TOC) results and respective stable carbon isotope values. Isotope ratios given in ‰ relative to VPDB.

Locality	Hand sample designation	Sample prior to decalcification [mg]	Sample after decalcification [mg]	Non-carbonate fraction [%]	TC prior to decalcification [%]	TC after decalcification [%]	Bulk rock TOC [%]	$\delta^{13}C_{TC}$ [‰]	$\delta^{13}C_{TOC}$ [‰]
Chapopote (modern)	TVG-6	21689	1867	8.6	18.9	23.0	2.0	−26.7	−27.8
		20424	1046	5.1	24.4	43.7	2.2	−26.7	−27.6
		17981	1355	7.5	19.7	35.0	2.6	−26.9	−27.4
		17057	1451	8.5	20.8	32.5	2.8	−25.7	−27.7
		15707	1450	9.2	19.8	32.2	3.0	−26.8	−27.9
		16679	1166	7.0	18.3	30.6	2.1	−26.1	−27.1
		16760	1681	10.0	20.8	44.5	4.5	−27.3	−27.6
		18054	20.8	0.1	18.1	23.8	0.03	−26.5	−28.4
		12558	2495	19.9	20.0	17.1	3.4	−27.2	−28.1
		22272	1544	6.9	18.4	20.6	1.4	−27.3	−28.2
Average		17918	1407	8.3	19.9	30.3	2.4	−29.0	−34.4
Dzieduszyckia (Late Devonian)	2.11.5a	17000	45	0.3	13.0	13.9	0.04	−0.7	−31.4
		19500	55	0.3	12.4	15.2	0.04	−1.6	−30.7
		17000	150	0.9	12.4	4.2	0.04	−0.2	−28.2
	2.11.5b	18500	380	2.1	12.8	1.6	0.03	0.3	−29.6
		22000	245	1.1	12.5	2.6	0.03	−1.9	−31.3
		14000	218	1.6	12.9	2.4	0.04	−1.0	−31.9
	2.11.5d	18200	145	0.8	13.0	3.2	0.03	−0.7	−33.3
		13100	148	1.1	13.0	6.5	0.07	−1.7	−32.6
		15700	180	1.1	13.3	5.7	0.07	−1.4	−32.0
Average		17222	174	1.0	12.8	6.1	0.04	−1.0	−32.2
Makran (modern)	GeoB 12324-2	11200	2115	18.9	0.9	2.7	0.5	−43.3	−32.6
		12500	2373	19.0	0.8	2.4	0.5	−42.3	−30.6
		14800	4394	29.7	0.7	1.5	0.4	−34.4	−32.3
		11200	1923	17.2	0.9	2.1	0.4	−40.1	−30.8
		10000	1792	17.9	1.0	2.4	0.4	−39.4	−30.4
	GeoB 12338-13	15000	2846	19.0	0.7	2.2	0.4	−41.2	−29.9
		13900	2852	20.5	0.7	2.0	0.4	−40.7	−30.1
		10000	2255	22.6	1.0	2.0	0.5	−41.8	−30.2
		10300	1273	12.4	1.0	3.4	0.4	−41.6	−30.0
		12000	1359	11.3	0.8	3.0	0.3	−38.3	−31.3
Average		12090	2318	18.8	0.8	2.4	0.4	−40.5	−30.3
SR4 (Oligocene)	581a	10100	1935	19.2	10.9	1.5	0.3	−31.2	−31.8
		10500	2410	23.0	9.9	1.7	0.4	−35.4	−28.9
		9000	2101	23.3	9.9	1.5	0.3	−40.0	−52.9
		8200	1540	18.8	10.9	1.6	0.3	−2.7	−46.0
		9600	1859	19.4	10.1	1.5	0.3	−28.9	−28.2
		9200	1714	18.6	10.5	1.8	0.3	−32.0	−28.6
		9300	2860	30.8	9.6	1.8	0.6	−30.2	−34.2
		9300	1895	20.4	9.8	1.6	0.3	−32.4	−27.7
		9400	1705	18.1	10.5	1.9	0.3	−28.3	−31.4
Average		9400	2002	21.3	10.2	1.7	0.4	−26.9	−27.9

TABLE DR2: Trace and rare earth element contents of clear aragonite cement, all values in ppm. Chapopote samples numbers referred to as “7_1” and “7_2” represent two separate thin sections from the sample no. 7; all others referred to as “10” represent one thin section from sample no. 10. Samples "7" and "10" were both collected from TVG-6. Makran sample numbers denoted “1_1” and “2_2” represent two thin sections from one hand sample (GeoB 12353-11). For the ancient sites *Dzieduszyckia* and SR4 one thin section was analyzed, respectively. All quantified data are shown, but we note that values below ca. 0.02 ppm are close to the detection limits.

Chapopote

Hand sample designation	Sample No.	Mg	Al	Si	Mn	Fe	Ni	Zn	As	Sr	Y	Mo	Ba	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	U	∑REE+Y	Mo/U
	237_7_1	125	0.251	103	0.625	49.1	0.029	0.129	0.355	7691	0.026	0.147	7.76	0.001	0.002	0.002	0.000	0.000	0.003	0.007	0.002	0.000	0.002	0.000	0.000	0.000	0.000	5.03	0.044	0.029
	238_7_1	137	0.181	65.8	0.134	57.3	0.184	0.064	0.231	7274	0.032	0.169	8.19	0.002	0.001	0.001	0.009	0.000	0.006	0.000	0.000	0.003	0.000	0.000	0.002	0.002	0.000	4.81	0.058	0.035
	239_7_1	148	6.33	113	0.572	53.8	0.030	0.044	0.220	8463	0.074	1.16	8.68	0.001	0.014	0.005	0.011	0.006	0.003	0.006	0.001	0.008	0.002	0.000	0.001	0.002	0.000	6.14	0.136	0.188
	241_7_1	137	0.277	117	0.836	37.7	0.255	0.239	0.094	7708	0.038	0.237	8.12	0.001	0.001	0.000	0.012	0.000	0.002	0.003	0.000	0.002	0.001	0.000	0.001	0.010	0.001	5.30	0.073	0.045
	243_7_1	176	3.272	107	0.746	63.2	0.611	0.221	0.157	8866	0.131	0.554	9.73	0.088	0.073	0.013	0.044	0.026	0.004	0.062	0.003	0.006	0.005	0.010	0.000	0.008	0.002	5.91	0.475	0.094
	244_7_1	140	0.417	51.1	0.575	47.2	0.273	0.019	0.231	7236	0.059	0.181	7.41	0.002	0.004	0.001	0.004	0.005	0.004	0.002	0.001	0.000	0.000	0.006	0.001	0.006	0.000	6.10	0.096	0.030
	245_7_1	128	0.321	88.2	0.593	43.4	0.332	0.046	0.209	7136	0.026	0.085	8.44	0.008	0.005	0.000	0.003	0.000	0.004	0.004	0.000	0.002	0.000	0.001	0.000	0.002	0.000	4.30	0.055	0.020
	246_7_1	110	0.175	98.4	0.473	47.5	0.232	0.064	0.270	7224	0.047	0.256	8.50	0.004	0.005	0.001	0.003	0.004	0.000	0.003	0.000	0.000	0.000	0.002	0.001	0.002	0.002	3.27	0.074	0.078
	249_7_1	127	1.224	88.8	0.922	58.3	0.031	0.138	0.149	9510	0.117	0.378	9.59	0.014	0.045	0.003	0.033	0.011	0.004	0.004	0.000	0.018	0.005	0.015	0.002	0.005	0.000	4.27	0.277	0.089
	250_7_1	119	0.729	36.0	1.11	46.6	0.377	0.016	0.147	9311	0.107	0.380	9.14	0.006	0.010	0.001	0.006	0.005	0.009	0.002	0.001	0.002	0.002	0.008	0.001	0.008	0.002	4.29	0.169	0.089
	251_7_1	123	0.885	51.8	0.003	68.5	0.311	0.121	0.048	8944	0.126	0.546	9.19	0.029	0.050	0.005	0.025	0.015	0.004	0.043	0.005	0.040	0.004	0.010	0.001	0.005	0.001	3.69	0.362	0.148
	252_7_1	110	0.380	60.7	0.508	65.6	0.379	0.098	0.234	9342	0.086	0.405	8.01	0.003	0.007	0.000	0.000	0.004	0.003	0.006	0.002	0.011	0.000	0.005	0.000	0.000	0.001	4.76	0.129	0.085
	253_7_1	107	0.586	64.0	0.303	55.0	0.049	0.051	0.054	9218	0.054	0.289	7.78	0.002	0.004	0.001	0.000	0.000	0.003	0.002	0.001	0.000	0.000	0.000	0.000	0.002	0.000	5.06	0.070	0.057
	254_7_1	105	2.41	84.5	0.479	41.9	0.572	0.008	0.101	9523	0.160	0.466	10.2	0.009	0.011	0.002	0.000	0.014	0.004	0.000	0.001	0.003	0.001	0.006	0.003	0.033	0.001	2.41	0.247	0.193
	255_7_1	129	3.71	80.1	0.637	50.2	0.146	0.124	0.222	9213	0.095	0.664	7.57	0.017	0.020	0.004	0.003	0.016	0.002	0.004	0.001	0.005	0.002	0.012	0.002	0.003	0.001	5.07	0.189	0.131
	256_7_1	115	4.49	81.1	0.046	41.1	0.652	0.168	0.046	8467	0.093	0.499	8.74	0.031	0.048	0.007	0.044	0.000	0.000	0.026	0.005	0.022	0.002	0.006	0.000	0.003	0.002	4.11	0.289	0.121
	257_7_1	113	1.22	80.4	0.338	50.2	0.248	0.115	0.142	9615	0.121	0.519	7.38	0.004	0.018	0.003	0.006	0.020	0.000	0.007	0.002	0.024	0.003	0.007	0.001	0.003	0.001	5.06	0.220	0.103
	258_7_1	106	0.713	75.2	0.255	54.1	0.044	0.102	0.097	9512	0.113	0.535	7.66	0.015	0.036	0.005	0.012	0.001	0.005	0.010	0.001	0.010	0.000	0.006	0.001	0.001	0.001	5.51	0.218	0.097
	776_7_1	110	0.361	93.9	0.948	98.9	0.161	0.539	0.175	7094	0.074	0.120	7.20	0.000	0.010	0.001	0.000	0.000	0.010	0.000	0.001	0.007	0.001	0.009	0.002	0.012	0.001	3.85	0.129	0.031
	777_7_1	108	0.693	125	0.458	66.0	0.098	0.114	0.059	7710	0.195	0.255	9.13	0.075	0.161	0.026	0.098	0.031	0.013	0.044	0.007	0.017	0.007	0.013	0.001	0.002	0.000	3.55	0.690	0.072
	778_7_1	147	1.90	101	0.027	69.2	0.383	0.256	0.189	8299	0.413	0.694	9.35	0.164	0.320	0.062	0.241	0.030	0.017	0.067	0.015	0.061	0.011	0.041	0.003	0.025	0.004	5.66	1.475	0.123
	779_7_1	145	4.01	135	0.948	73.3	0.537	0.592	0.103	8985	0.369	1.176	9.06	0.117	0.292	0.043	0.219	0.061	0.017	0.056	0.012	0.062	0.009	0.041	0.006	0.013	0.003	5.71	1.320	0.206
	780_7_1	123	0.320	98.4	0.927	59.7	0.364	0.060	0.070	8893	0.356	0.423	8.52	0.080	0.152	0.021	0.088	0.034	0.003	0.045	0.008	0.074	0.014	0.021	0.004	0.014	0.002	5.91	0.916	0.072
	781_7_1	140	0.196	104	0.125	84.3	0.173	0.147	0.008	6637	0.040	0.047	7.77	0.004	0.003	0.001	0.000	0.011	0.008	0.000	0.002	0.000	0.000	0.000	0.001	0.002	0.000	3.65	0.073	0.013
	782_7_1	134	0.354	77.4	0.835	96.8	0.023	0.142	0.054	6599	0.043	0.042	8.28	0.001	0.002	0.000	0.005	0.000	0.000	0.003	0.001	0.000	0.002	0.002	0.000	0.000	0.000	4.22	0.059	0.010
	783_7_1	152	4.24	45.7	0.135	74.1	0.540	0.146	0.181	7369	0.056	0.553	8.25	0.011	0.018	0.000	0.006	0.007	0.000	0.000	0.001	0.007	0.001	0.002	0.001	0.000	0.002	5.06	0.111	0.109
	784_7_1	137	0.485	67.6	0.128	69.6	0.619	0.057	0.171	7101	0.044	0.160	8.65	0.004	0.000	0.003	0.005	0.000	0.004	0.015	0.002	0.004	0.001	0.000	0.003	0.005	0.000	5.34	0.090	0.030
	785_7_1	150	0.221	50.4	0.068	98.6	0.278	0.065	0.103	6439	0.038	0.192	8.92	0.003	0.004	0.001	0.000	0.000	0.000	0.003	0.001	0.006	0.000	0.001	0.001	0.000	0.001	4.41	0.058	0.043
	277_7_2	160	11.7	181	0.833	33.2	3.456	0.305	0.188	3965	0.073	0.295	17.4	0.022	0.032	0.006	0.016	0.014	0.007	0.000	0.001	0.000	0.001	0.000	0.001	0.008	0.002	8.23	0.182	0.036
	278_7_2	149	1.34	86.4	0.604	29.3	0.579	0.261	0.279	4115	0.071	0.158	21.8	0.001	0.003	0.000	0.000	0.000	0.010	0.009	0.000	0.000	0.000	0.003	0.006	0.000	0.001	8.50	0.102	0.019
	279_7_2	133	1.79	36.4	0.336	35.8	0.431	0.340	0.194	4180	0.080	0.214	30.1	0.001	0.005	0.000	0.000	0.000	0.010	0.000	0.002	0.000	0.000	0.001	0.001	0.009	0.002	6.99	0.111	0.031
	280_7_2	143	0.986	97.3	0.331	31.7	0.628	0.160	0.028	3783	0.089	0.208	19.2	0.000	0.006	0.001	0.000	0.019	0.009	0.004	0.000	0.000	0.001	0.000	0.000	0.008	0.000	7.68	0.136	0.027
	281_7_2	142	2.563	136	0.841	32.2	0.271	0.034	-0.005	4140	0.084	0.290	19.4	0.010	0.005	0.003	0.006	0.000	0.005	0.014	0.000	0.015	0.002	0.002	0.002	0.000	0.003	8.91	0.148	0.033
	283_7_2	120	1.760	61.7	1.79	146	0.286	0.345	0.153	8872	0.049	0.119	27.9	0.004	0.002	0.001	0.003	0.006	0.006	0.003	0.000	0.000	0.002	0.000	0.001	0.004	0.001	3.41	0.082	0.035
	284_7_2	160	4.30	208	2.27	307	1.202	0.692	0.131	8678	0.057	0.247	12.4	0.032	0.055	0.002	0.028	0.006	0.006	0.004	0.001	0.000	0.000	0.003	0.002	0.002	0.001	4.82	0.196	0.051
	285_7_2	128	2.18	91.8	0.620	142	0.802	0.007	0.191	9117	0.063	0.081	25.8	0.015	0.014	0.000	0.014	0.006	0.001	0.005	0.001	0.006	0.001	0.001	0.000	0.004	0.001	3.39	0.131	0.024
	286_7_2	122	5.73	72.1	0.383	126	1.08	0.365	0.008	7982	0.066	0.048	17.2	0.013	0.041	0.007	0.026	0.000	0.012	0.007	0.001	0.002	0.001	0.002	0.001	0.002	0.001	4.03	0.181	0.012
	287_7_2	137	8.35	81.8	0.393	150	2.64	0.886	0.060	8339	0.100	0.322	21.5	0.034	0.055	0.009	0.047	0.007	0.003	0.027	0.004	0.004	0.002	0.001	0.001	0.009	0.003	3.12	0.306	0.103
	302_10	161	0.460	121.7	1.05	159	0.408	0.056	0.287	9687	0.153	0.739	10.0	0.014	0.038	0.005	0.013	0.027	0.010	0.005	0.001	0.009	0.005	0.012	0.000	0.012	0.003	6.10	0.307	0.121
	303_10	177	0.986	61.4	0.570	153	0.325	0.144	0.139	10180	0.188	0.643	11.2	0.016	0.024	0.003	0.008	0.000	0.013	0.014	0.003	0.022	0.006	0.022	0.000	0.013	0.002	5.65	0.333	0.114
	304_10	152	0.715	72.3	0.828	154	0.238	0.194	0.035	10112	0.168	0.737	9.98	0.022	0.034	0.007	0.044	0.004	0.000	0.009	0.003	0.011	0.004	0.022	0.000	0.021	0.005	6.15	0.357	0.120
	305_10	152	0.695	53.8	0.307	141	0.400	0.255	0.181	10126	0.141	0.608	9.51	0.015	0.027	0.004	0.012	0.009	0.004	0.012	0.002	0.015	0.004	0.005	0.003	0.019	0.003	6.75	0.274	0.090
	306_10	138	0.212	73.3	0.090	114	0.175	0.151	0.202	9524	0.092	0.204	10.4	0.005	0.013	0.000	0.000	0.016	0.006	0.007	0.001	0.005	0.000	0.005	0.000	0.018	0.001	5.47	0.170	0.037
TVG-6	307_10	189	41.9	146	0.670	162	0.356	0.182	0.141	10466	0.235	0.921	11.3	0.051	0.063	0.013	0.083	0.021	0.011	0.017	0.001	0.039	0.008	0.017	0.005	0.021	0.004	6.57	0.589	0.140
	308_10	181	23.6	125	0.381	186	0.470	0.113	0.103	10182	0.185	1.26	10.8	0.054	0.071	0.008	0.028	0.029	0.008	0.014	0.005	0.028	0.006	0.010	0.002	0.015	0.004	5.90	0.468	0.214
	309_10	184	25.5	115	0.320	149	0.288	0.190	0.129	9954	0.162	0.935	11.3	0.049	0.068	0.011	0.035	0.009	0.000	0.010	0.002	0.017	0.006	0.017	0.003	0.013	0.003	5.93	0.404	0.158
	310_10	174	34.1	133	0.070	173	0.265	0.249	0.082	10204	0.128	1.02	11.4	0.042	0.074	0.006	0.054	0.004	0.007	0.003	0.001	0.017	0.003	0.016	0.003	0.024	0.002	6.23	0.383	0.164
	311_10	166	9.92	91.6	0.432	127	0.338	0.109	0.134	9662	0.078	0.311	10.3	0.011	0.028	0.001	0.017	0.013	0.006	0.003	0.000	0.000	0.002	0.011	0.001	0.004	0.002	5.37	0.177	0.058
	313_10	176	0.582	95.9	1.41	92.6	0.648	0.158	0.051	7252	0.286	0.305	13.2	0.307	0.499	0.067	0.341	0.071	0.020	0.072	0.003	0.040	0.009	0.027	0.002	0.005	0.000	5.03	1.75	0.061
	314_10	184	0.906	83.3	0.472	73.4	0.626	0.411	0.225	7301	0.364	0.500	14.4	0.359	0.709	0.096	0.455	0.162	0.020	0.084	0.008	0.081	0.014	0.033	0.004	0.013	0.002	5.14	2.40	0.097
	315_10	182	0.663	78.5	0.389	74.8	0.311	0.123	0.289	7117	0.328	0.473	13.3	0.259	0.434	0.073	0.318	0.093	0.013	0.057	0.008	0.058	0.012	0.020	0.004	0.011	0.002	5.07	1.69	0.093
	316_10	168	0.939	93.1	0.440	79.0	0.435	0.232	0.242	6969	0.256	0.419	12.3	0.156	0.282	0.043	0.138	0.056	0.033	0.031	0.006	0.041	0.009	0.015	0.003	0.015	0.002	5.09	1.09	0.082
	317_10	186	16.4	94.6	0.079	99.1	0.656	0.453	0.114	7235	0.452	0.836	14.1	0.611	1.116	0.227	0.635	0.201	0.048	0.189	0.018	0.082	0.013	0.054	0.006	0.035	0.006	5.53	3.69	0.151
	319_10	183	8.667	219	1.70	109	0.965	0.600	0.022	6679	0.364	0.448	9.10	0.757	1.446	0.158	0.693	0.191	0.012	0.043	0.013	0.061	0.020	0.033	0.009	0.039	0.007	2.79	3.85	0.161
	320_10	202	10.6	327	2.48	317	0.898	0.569	0.243	6947	0.454	0.586	9.29	0.957	1.885	0.243	0.861	0.128	0.035	0.117	0.014	0.062	0.021	0.052	0.010	0.013	0.005	2.98	4.86	0.197
	323_10	330	3.608	115	1.99	104	2.77	0.967	0.085	7220	0.323	3.33	9.59	0.324	0.604	0.077	0.288	0.113	0.014	0.090	0.008	0.021	0.014	0.024	0.004	0.034	0.006	2.93	1.95	1.138
	324_10	168	36.9	435	1.80	167.0	0.671	0.292	0.099	6895	0.237	0.640	10.4	0.236	0.523	0.067	0.286	0.054	0.001	0.043	0.009	0.034	0.007	0.028	0.004	0.207	0.006	2.76	1.74	0.232
	325_10	166	2.27	95.3	2.45	94.7	1.02	0.514	0.085	6240	0.268	0.268	8.97	0.474	1.033	0.130	0.427	0.080	0.030	0.054	0.008	0.045	0.010	0.026	0.002	0.024	0.002	1.55	2.61	0.173
	326_10	163	2.49	199	2.03	116	0.763	0.360	0.048	6272	0.153	1.14	9.36	0.234	0.409	0.059	0.152	0.065	0.002	0.035	0.006	0.027	0.006	0.015	0.004	0.018	0.003	1.98	1.19	0.579
	330_10	201	1.73	81.9	1.29	172	0.709	0.424	0.316	7647	0.248	0.639	10.5	0.436	0.203	0.084	0.319	0.077	0.023	0.071	0.010	0.055	0.016	0.035	0.002	0.015	0.002	5.49	1.60	0.117
	331_10	199	1.39	81.9	0.361	142	0.559	0.260	0.208	7287	0.169	0.400	12.0	0.240	0.097	0.042	0.194	0.061	0.008	0.044	0.004	0.033	0.007	0.015	0.001	0.019	0.000	5.65	0.934	0.071
	332_10	180	1.55	107	0.309	133	0.507	0.540	0.208	7198	0.259	0.422	11.4	0.210	0.102	0.042	0.223	0.031	0.011	0.045	0.010	0.042	0.008	0.026	0.002	0.015	0.001	5.63	1.03	0.075
	333_10	214	2.48	102	0.615	202	0.490	0.469	0.379	8675	0.263	0.712	11.8	0.322	0.182	0.064	0.259	0.062	0.014	0.056	0.007	0.060	0.010	0.023	0.005	0.010	0.003	5.72	1.34	0.125
	334_10	192	2.62	108	0.240	238	0.482	0.455	0.364	7925	0.271	0.775	11.6	0.397	0.177	0.084	0.364	0.071	0.015	0.063	0.006	0.051	0.010	0.035	0.007	0.042	0.003	5.88	1.60	0.132
	800_10	137	0.306	59.2	0.838	57.4	0.448	0.090	0.060	6762	0.080	0.296	9.95	0.031	0.051	0.005	0.006	0.014	0.009	0.014	0.001	0.022	0.003	0.007	0.001	0.008	0.000	5.24	0.253	0.056
	801_10	145	2.94	111	0.801	61.9	0.242	0.204	0.033	6842	0.115	0.251	10.5	0.033	0.043	0.007	0.043	0.012	0.005	0.023	0.001	0.013	0.004	0.003	0.002	0.013	0.001	5.30	0.316	0.047
	802_10	152	0.631	99.1	0.488	59.2	0.597	0.041	0.198	6728	0.114	0.272	10.3	0.027	0.039	0.002	0.034	0.000	0.005	0.001	0.001	0.009	0.006	0.007	0.001	0.021	0.002	5.38	0.270	0.051
	803_10	141	0.452	49.0	0.420	80.3	0.390	0.051	0.099	6738	0.118	0.190	10.9	0.017	0.021	0.002	0.034	0.000	0.000	0.002	0.005	0.003	0.006	0.002	0.001	0.014	0.004	5.31	0.230	0.036
	822_10	201	0.001	105	1.39	93.6	0.309	0.099	0.153	6803	0.142	0.083	9.15	0.016	0.037	0.007	0.011	0.046	0.012	0.014	0.001	0.018	0.005	0.010	0.001	0.010	0.000	4.92	0.331	0.017
	823_10	206	0.531	69.2	0.421	88.0	0.191	0.013	0.082	6827	0.215	0.119	9.61	0.063	0.109	0.018	0.083	0.014	0.008	0.016	0.006	0.031	0.004	0.028	0.001	0.015	0.002	5.30	0.612	0.022
	824_10	193	0.025	71.7	1.64	73.3	0.138	0.030	0.087	6155	0.271	0.042	8.73	0.128	0.200	0.025	0.075	0.080	0.018	0.001	0.001	0.039	0.004	0.027	0.002	0.019	0.001	1.49	0.891	0.028
	825_10	219	0.578	184	1.33	86.7	0.699	0.506	0.043	6433	0.247	0.123	9.27	0.273	0.499	0.053	0.229	0.132	0.015	0.041	0.003	0.016	0.004	0.017	0.003	0.011	0.003	1.35	1.55	0.091
	826_10	190	0.533	92.3	2.10	57.4	0.157	0.425	0.028	6210	0.308	0.113	9.46	0.327	0.615	0.083	0.334	0.053	0.017	0.065	0.010	0.049	0.008	0.034	0.000	0.019	0.005	0.81	1.928	0.139
	827_10	124	0.327	56.9	0.843	69.9	0.396	0.104	0.152	6153	0.022	0.037	9.09	0.005	0.005	0.001	0.017	0.008	0.000	0.004	0.000	0.000	0.001	0.000	0.000	0.000	0.001	4.32	0.063	0.009
	828_10	122	0.604	108	1.33	47.5	0.444	0.024	0.164	6438	0.066	0.043	9.68	0.002	0.001	0.001	0.000	0.000	0.006	0.006	0.000	0.005	0.000	0.002	0.000	0.006	0.001	5.18	0.097	0.008
	829_10	133	0.472	71.6	0.820	181	0.385	0.134	0.012	6627	0.119	0.273	10.2	0.010	0.018	0.001	0.006	0.000	0.000	0.004	0.003	0.010	0.000	0.004	0.002	0.014	0.000	5.10	0.190	0.054
	830_10	138	0.358	53.5	0.484	96.2	0.185	0.025	0.173	6679	0.163	0.307	9.48	0.018	0.029	0.005	0.004	0.000	0.015	0.009	0.001	0.167	0.031	0.108	0.041	0.251	0.003	6.43	0.846	0.048
	831_10	160	2.515	36.5	0.042	97.5	0.563	0.084	0.178	7228	0.456	0.812	10.3	0.061	0.111	0.012	0.138	0.006	0.004	0.015	0.013	0.024	0.019	0.056	0.009	0.052	0.008	6.82	0.984	0.119
	891_10	140	7.80	249	0.777	146	2.35	1.63	0.256	7754	0.220	0.514	10.9	0.174	0.316	0.042	0.216	0.025	0.019	0.033	0.004	0.040	0.011	0.031	0.003	0.015	0.004	7.87	1.15	0.065
	892_10	138	3.17	165	0.737	101	0.716	0.857	0.115	8345	0.213	0.338	11.1	0.273	0.619	0.105	0.364	0.117	0.019	0.097	0.009	0.061	0.009	0.041	0.001	0.016	0.003	5.68	1.95	0.060
	893_10	180	41.1	298	1.01	130	5.47	2.20	0.228	8942	0.367	0.777	14.1	0.485	1.057	0.122	0.414	0.103	0.030	0.101	0.014	0.109	0.014	0.034	0.003	0.022	0.005	12.5	2.88	0.062
	894_10	141	7.15	208	1.218	103	0.909	0.604	0.127	7985	0.226	0.471	11.6	0.301	0.665	0.106	0.360	0.088	0.022	0.083	0.007	0.053	0.013	0.018	0.005	0.017	0.003	6.32	1.97	0.075
	895_10	164	5.51	195	1.148	245	2.391	1.38	0.276	8047	0.267	1.34	12.5	0.308	0.625	0.093	0.287	0.085	0.025	0.048	0.006	0.047	0.010	0.029	0.000	0.011	0.005	6.45	1.85	0.208
	896_10	131	2.15	194	0.310	77.4	0.444	0.480	0.016	7570	0.156	0.297	10.1	0.083	0.185	0.022	0.125	0.030	0.010	0.020	0.003	0.042	0.004	0.025	0.003	0.010	0.002	4.93	0.719	0.060
	897_10	116	3.44	154	0.451	84.1	0.892	0.366	0.095	7429	0.126	0.372	9.87	0.078	0.143	0.015	0.116	0.044	0.008	0.015	0.005	0.024	0.004	0.011	0.001	0.000	0.002	3.96	0.592	0.094

	898_10	158	5.03	155	0.481	98.8	1.12	0.597	0.205	9316	0.226	0.438	12.9	0.170	0.365	0.052	0.187	0.039	0.013	0.034	0.003	0.126	0.028	0.073	0.032	0.201	0.004	5.84	1.55	0.075
	900_10	161	12.6	153	0.078	101	3.26	0.771	0.060	8632	0.258	0.543	11.7	0.255	0.523	0.071	0.361	0.069	0.004	0.048	0.010	0.067	0.008	0.023	0.001	0.019	0.007	4.96	1.72	0.109

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	Sample No.	Mg	Al	Si	Mn	Fe	Ni	Zn	As	Sr	Y	Mo	Ba	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	U	∑REE+Y	Mo/U
	010_bbc_002	3229	6.28	63.1	294	270	0.11	0.51	0.11	316	1.25	0.045	6.86	0.453	0.209	0.087	0.401	0.113	0.026	0.148	0.026	0.157	0.044	0.105	0.009	0.105	0.017	1.45	3.15	0.031
	011_bbc_003	3084	9.05	71.8	283	543	0.42	1.81	0.20	329	1.33	0.462	7.12	0.480	0.288	0.087	0.401	0.087	0.026	0.131	0.017	0.148	0.035	0.113	0.017	0.096	0.017	1.29	3.28	0.359
	012_bbc_004	3187	6.52	58.0	322	263	0.39	0.44	0.06	321	0.861	0.054	7.34	0.270	0.139	0.052	0.218	0.061	0.009	0.070	0.017	0.061	0.026	0.052	0.009	0.070	0.009	0.779	1.92	0.070
	013_bbc_005	2318	6.22	74.5	312	200	0.46	0.61	0.03	336	0.689	0.018	7.50	0.192	0.113	0.044	0.201	0.017	0.009	0.070	0.009	0.087	0.017	0.052	0.009	0.035	0.009	0.789	1.55	0.023
	014_bbc_006	2716	10.1	97.3	285	782	0.23	1.24	0.14	307	0.715	0.281	9.40	0.218	0.113	0.044	0.244	0.044	0.009	0.078	0.009	0.070	0.017	0.061	0.009	0.061	0.009	0.516	1.70	0.544
	015_bbc_007	2765	5.63	90.8	266	171	0.11	0.70	0.05	350	0.535	0.027	8.00	0.157	0.079	0.026	0.148	0.044	0.009	0.044	0.009	0.070	0.017	0.052	0.000	0.035	0.009	0.481	1.23	0.057
	016_bbc_008	2738	8.21	96.8	268	697	0.70	1.00	0.07	319	0.861	0.091	7.84	0.244	0.122	0.044	0.209	0.052	0.026	0.087	0.017	0.087	0.017	0.061	0.009	0.044	0.009	0.870	1.89	0.104
	017_bbc_009	2485	7.26	78.2	277	273	0.49	0.48	0.04	344	0.95	0.200	7.98	0.323	0.131	0.070	0.340	0.079	0.026	0.113	0.017	0.113	0.026	0.070	0.009	0.061	0.009	0.880	2.34	0.227
2.11.5e	021_bbc_011	4682	8.17	61.1	246	275	0.27	0.36	0.00	336	0.861	0.118	8.86	0.340	0.131	0.061	0.270	0.061	0.026	0.087	0.009	0.105	0.017	0.052	0.009	0.061	0.009	1.10	2.10	0.107
	022_bbc_012	1577	1.50	45.5	74.8	84.9	0.14	0.63	0.07	614	2.23	0.046	4.09	0.973	0.221	0.150	0.708	0.195	0.053	0.248	0.035	0.265	0.053	0.159	0.018	0.142	0.018	1.31	5.47	0.035
	024_bbc_014	2176	4.63	64.0	258	187	0.45	0.68	0.08	318	0.897	0.036	7.62	0.340	0.157	0.070	0.279	0.078	0.026	0.105	0.017	0.096	0.026	0.070	0.009	0.078	0.009	1.23	2.26	0.029
	025_bbc_015	1988	6.76	86.0	349	146	0.18	0.61	0.09	289	0.859	0.018	8.12	0.305	0.157	0.052	0.209	0.052	0.017	0.096	0.009	0.104	0.026	0.070	0.009	0.061	0.017	0.841	2.04	0.022
	026_bbc_016	1743	6.64	82.4	364	112	0.40	0.48	0.04	283	1.08	0.054	6.07	0.409	0.217	0.078	0.339	0.070	0.026	0.104	0.017	0.122	0.035	0.087	0.017	0.078	0.017	1.08	2.70	0.050
	027_bbc_017	2167	5.90	89.2	304	209	0.37	2.03	0.03	353	0.726	0.073	8.47	0.253	0.122	0.052	0.210	0.044	0.017	0.070	0.017	0.070	0.017	0.052	0.009	0.044	0.009	0.653	1.71	0.111
	028_bbc_018	3149	6.85	76.8	278	351	0.44	1.59	0.08	292	1.21	0.045	7.12	0.444	0.226	0.096	0.435	0.104	0.017	0.131	0.026	0.139	0.035	0.113	0.017	0.096	0.017	0.787	3.11	0.057
	029_bbc_019	2560	6.94	88.9	277	374	0.37	2.42	0.10	313	1.04	0.091	6.63	0.383	0.183	0.087	0.331	0.096	0.026	0.148	0.017	0.148	0.035	0.096	0.009	0.087	0.017	0.471	2.71	0.192
	030_bbc_020	2533	6.59	68.4	308	222	0.45	1.22	0.12	293	1.27	0.054	6.36	0.435	0.200	0.096	0.444	0.087	0.026	0.165	0.026	0.157	0.035	0.096	0.017	0.113	0.017	0.724	3.18	0.075

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	Sample No.	Mg	Al	Si	Mn	Fe	Ni	Zn	As	Sr	Y	Mo	Ba	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	U	∑REE+Y	Mo/U
	343_1_1	262	0.058	73.8	2.36	81.6	0.240	0.156	0.047	7100	0.031	0.281	11.4	0.002	0.000	0.001	0.000	0.015	0.005	0.003	0.000	0.000	0.002	0.000	0	0.000	0.005	2.45	0.063	0.115
	344_1_1	340	0.071	53.5	2.62	70.7	0.311	0.145	0.087	7341	0.026	0.823	9.51	0.001	0.002	0.001	0.005	0.006	0.002	0.008	0.001	0.000	0.000	0.000	0.000	0.004	0.000	2.42	0.055	0.340
	345_1_1	475	0.228	97.4	2.75	89.0	0.308	0.079	0.077	6743	0.032	0.829	7.33	0.002	0.000	0.002	0.000	0.000	0.000	0.008	0.002	0.002	0.000	0.000	0.001	0.000	0.000	2.45	0.049	0.339
	346_1_1	408	0.118	70.0	2.90	74.8	0.288	0.251	0.290	7264	0.031	1.04	8.84	0.004	0.001	0.002	0.000	0.000	0.005	0.000	0.000	0.001	0.000	0.000	0.000	0.003	0.000	2.46	0.047	0.424
	347_1_1	399	0.168	54.6	2.91	90.3	0.369	0.221	0.091	6667	0.024	0.662	8.42	0.005	0.000	0.000	0.006	0.006	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	2.45	0.043	0.270
	348_1_1	623	0.262	81.1	4.65	73.6	0.332	0.036	0.012	6392	0.026	0.460	6.59	0.001	0.000	0.001	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	2.81	0.033	0.164
	349_1_1	527	0.049	97.9	5.00	68.2	0.114	0.011	0.201	6631	0.031	0.275	8.18	0.003	0.001	0.002	0.004	0.008	0.003	0.001	0.001	0.006	0.000	0.000	0.001	0.002	0.000	2.75	0.064	0.100
	350_1_1	507	0.176	70.0	4.50	78.2	0.269	0.063	0.135	6815	0.023	0.383	8.28	0.002	0.002	0.000	0.003	0.000	0.003	0.004	0.000	0.002	0.001	0.000	0.000	0.001	0.000	2.73	0.040	0.140
	351_1_1	296	0.044	45.1	1.30	68.4	0.076	0.068	0.131	7492	0.034	0.473	14.3	0.003	0.001	0.000	0.007	0.000	0.001	0.004	0.000	0.003	0.000	0.000	0.000	0.000	0.001	3.22	0.054	0.147
	352_1_1	649	0.052	67.1	4.54	78.7	0.569	0.223	0.104	6518	0.036	0.618	6.53	0.006	0.003	0.001	0.008	0.000	0.003	0.004	0.000	0.000	0.000	0.000	0.000	0.002	0.000	2.95	0.057	0.209
	354_1_1	269	0.104	61.4	1.48	92.1	0.201	0.277	0.145	8081	0.028	0.866	16.7	0.002	0.001	0.000	0.004	0.005	0.009	0.009	0.000	0.000	0.002	0.000	0.000	0.000	0.001	3.31	0.053	0.261
	355_1_1	334	0.095	72.1	2.38	83.6	0.253	0.035	0.278	7099	0.031	0.314	10.3	0.006	0.000	0.003	0.000	0.007	0.002	0.000	0.001	0.005	0.001	0.000	0.000	0.000	0.000	3.20	0.054	0.098
	356_1_1	324	0.138	94.6	2.74	78.2	0.418	0.136	0.163	7390	0.026	0.547	12.2	0.006	0.000	0.001	0.000	0.000	0.005	0.005	0.000	0.003	0.000	0.000	0.000	0.000	0.000	3.32	0.045	0.165
	357_1_1	308	0.034	108	2.01	84.6	0.416	0.289	0.251	7498	0.034	0.488	13.1	0.002	0.001	0.001	0.000	0.000	0.002	0.002	0.000	0.008	0.000	0.001	0.000	0.002	0.000	3.25	0.054	0.150
	359_1_1	537	0.117	70.8	4.61	94.8	0.274	0.105	0.146	6097	0.022	0.589	14.1	0.002	0.001	0.001	0.007	0.020	0.000	0.003	0.000	0.000	0.000	0.001	0.000	0.000	0.000	2.93	0.057	0.201
	360_1_1	291	0.097	65.2	1.06	84.3	0.162	0.151	0.057	7222	0.036	0.517	16.2	0.000	0.000	0.002	0.003	0.000	0.006	0.000	0.001	0.012	0.000	0.000	0.001	0.000	0.001	3.18	0.059	0.163
	361_1_1	450	0.079	70.2	3.61	85.2	0.213	0.200	0.137	6665	0.035	0.762	12.4	0.003	0.002	0.000	0.009	0.006	0.003	0.003	0.001	0.003	0.001	0.000	0.001	0.000	0.000	3.48	0.067	0.219
	362_1_1	477	0.037	92.1	3.85	90.0	0.271	0.391	0.157	6544	0.029	0.833	11.5	0.001	0.002	0.003	0.012	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.000	0.000	0.000	2.55	0.050	0.327
	363_1_1	691	0.027	93.7	2.51	83.5	0.073	0.218	0.094	6280	0.043	0.488	6.34	0.002	0.003	0.002	0.004	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.001	2.93	0.064	0.167
	925_1_1	459	42.8	135	2.63	119	0.576	0.362	0.069	7809	0.045	4.41	11.2	0.009	0.022	0.002	0.012	0.018	0.000	0.009	0.002	0.013	0.000	0.004	0.000	0.004	0.000	3.00	0.134	1.470
	926_1_1	413	0.447	81.3	2.35	73.7	0.604	0.169	0.173	7137	0.041	2.32	7.96	0.007	0.011	0.003	0.003	0.000	0.002	0.001	0.001	0.000	0.000	0.000	0.001	0.000	0.001	3.56	0.071	0.651
	927_1_1	422	0.457	131	1.86	116	0.751	0.416	0.167	6966	0.037	2.21	8.33	0.009	0.005	0.000	0.000	0.000	0.000	0.001	0.000	0.002	0.000	0.000	0.001	0.000	0.000	2.65	0.030	0.831
	928_1_1	386	0.290	107	2.23	53.5	0.261	0.214	0.137	6181	0.035	0.449	5.69	0.001	0.000	0.001	0.004	0.010	0.000	0.009	0.001	0.006	0.000	0.001	0.000	0.007	0.001	3.53	0.071	0.127
	929_1_1	388	0.322	82.2	1.97	75.4	0.489	0.118	0.139	6711	0.033	1.59	8.23	0.002	0.003	0.002	0.008	0.000	0.005	0.000	0.001	0.005	0.000	0.002	0.002	0.002	0.000	2.80	0.066	0.569
GeoB 12353-11	930_1_1	300	0.343	104	2.00	64.8	0.125	0.144	0.005	5988	0.025	0.153	10.6	0.006	0.001	0.000	0.000	0.016	0.000	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.001	1.06	0.039	0.144
	931_1_1	319	0.329	61.6	1.74	59.9	0.387	0.455	0.045	6759	0.021	1.26	12.4	0.005	0.001	0.000	0.000	0.000	0.010	0.000	0.001	0.000	0.000	0.001	0.000	0.003	0.001	1.68	0.041	0.750
	932_1_1	396	0.157	47.4	1.68	58.4	0.127	0.067	0.071	6581	0.034	1.11	6.01	0.002	0.001	0.001	0.002	0.000	0.002	0.002	0.000	0.002	0.001	0.000	0.000	0.001	0.000	3.01	0.049	0.370
	933_1_1	437	0.038	32.1	1.90	66.5	0.214	0.247	0.113	6844	0.034	1.33	6.44	0.005	0.007	0.002	0.006	0.004	0.000	0.003	0.001	0.000	0.001	0.000	0.000	0.002	0.000	3.20	0.062	0.414
	934_1_1	413	5.71	109	2.66	71.7	0.341	0.835	0.117	6953	0.028	2.36	9.17	0.001	0.017	0.000	0.026	0.000	0.009	0.004	0.001	0.000	0.000	0.000	0.002	0.002	0.000	2.64	0.088	0.894
	373_2_2	416	0.043	52.8	3.41	77.8	0.513	0.021	0.194	6985	0.041	0.446	7.80	0.003	0.003	0.002	0.002	0.000	0.002	0.002	0.000	0.000	0.001	0.002	0.000	0.000	0.003	3.23	0.059	0.138
	374_2_2	337	0.073	118	2.32	69.9	0.182	0.176	0.179	7771	0.041	0.695	10.8	0.002	0.002	0.002	0.003	0.006	0.000	0.002	0.000	0.006	0.001	0.000	0.001	0.004	0.001	2.99	0.070	0.233
	375_2_2	315	0.252	77.5	1.66	75.9	0.351	0.220	0.207	7415	0.030	0.737	11.5	0.001	0.004	0.000	0.011	0.006	0.009	0.004	0.001	0.002	0.000	0.000	0.000	0.000	0.001	2.89	0.067	0.255
	376_2_2	328	0.192	64.7	1.57	79.6	0.323	0.131	0.099	7242	0.032	0.844	10.0	0.005	0.002	0.000	0.007	0.005	0.003	0.003	0.001	0.000	0.000	0.000	0.001	0.000	0.000	3.03	0.053	0.279
	377_2_2	462	0.051	95.2	2.74	65.6	0.197	0.221	0.096	6949	0.030	0.789	7.72	0.007	0.002	0.000	0.007	0.015	0.001	0.002	0.000	0.000	0.000	0.003	0.000	0.000	0.001	2.86	0.068	0.276
	378_2_2	295	0.018	71.8	1.30	70.5	0.140	0.022	0.191	7282	0.039	1.62	8.07	0.003	0.003	0.000	0.012	0.000	0.000	0.004	0.001	0.000	0.000	0.002	0.000	0.002	0.000	3.51	0.066	0.461
	379_2_2	343	0.161	77.5	1.92	63.8	0.242	0.181	0.077	7204	0.047	1.79	7.21	0.005	0.006	0.002	0.000	0.004	0.002	0.002	0.001	0.002	0.000	0.000	0.000	0.004	0.001	3.48	0.077	0.513
	380_2_2	286	0.095	85.7	1.28	71.5	0.322	0.034	0.049	7134	0.040	1.16	8.71	0.005	0.001	0.001	0.014	0.005	0.000	0.006	0.001	0.000	0.000	0.002	0.001	0.002	0.000	3.43	0.078	0.339
	381_2_2	273	0.014	94.6	1.39	66.2	0.224	0.220	0.070	7100	0.040	0.865	16.5	0.005	0.000	0.000	0.000	0.000	0.004	0.000	0.001	0.003	0.000	0.000	0.000	0.000	0.000	2.93	0.054	0.295
	382_2_2	263	0.072	65.1	1.17	74.2	0.335	0.280	0.107	7346	0.024	0.611	14.3	0.001	0.000	0.002	0.002	0.007	0.002	0.003	0.000	0.002	0.000	0.000	0.000	0.000	0.000	3.03	0.043	0.202
	385_2_2	284	0.019	66.6	2.02	67.7	0.031	0.050	0.142	6733	0.024	0.338	8.57	0.004	0.001	0.001	0.005	0.008	0.003	0.011	0.000	0.015	0.002	0.000	0.001	0.003	0.000	2.97	0.076	0.114
	386_2_2	329	0.058	82.0	2.21	65.6	0.100	0.065	0.197	6684	0.019	0.688	5.17	0.005	0.001	0.002	0.005	0.000	0.004	0.004	0.000	0.000	0.001	0.002	0.000	0.000	0.000	3.08	0.043	0.223
	387_2_2	312	0.324	72.5	1.75	67.7	0.045	0.011	0.183	6701	0.029	0.577	4.30	0.002	0.001	0.002	0.006	0.000	0.000	0.004	0.001	0.000	0.000	0.000	0.001	0.006	0.000	3.29	0.052	0.175
	388_2_2	288	0.083	80.3	1.41	42.1	0.253	0.100	0.251	6558	0.033	0.411	6.71	0.003	0.000	0.001	0.000	0.002	0.005	0.002	0.001	0.000	0.000	0.002	0.000	0.000	0.001	3.26	0.049	0.126
	389_2_2	282	0.174	109	1.60	51.9	0.077	0.092	0.196	6706	0.034	0.440	4.57	0.003	0.001	0.002	0.008	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.50	0.061	0.126
	390_2_2	306	0.037	69.9	0.959	61.4	0.268	0.064	0.230	6456	0.027	0.443	12.4	0.002	0.002	0.002	0.005	0.011	0.005	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.001	3.33	0.056	0.133
	391_2_2	297	0.031	77.1	0.796	58.4	0.037	0.069	0.019	6597	0.028	0.352	13.0	0.001	0.001	0.000	0.005	0.000	0.002	0.000	0.001	0.000	0.002	0.000	0.001	0.000	0.000	2.78	0.041	0.127
	392_2_2	299	0.052	74.3	1.43	60.3	0.321	0.126	0.126	6509	0.021	0.263	13.5	0.001	0.002	0.002	0.000	0.000	0.003	0.001	0.000	0.003	0.000	0.000	0.000	0.000	0.001	2.60	0.033	0.101
	393_2_2	377	0.283	65.1	3.49	64.6	0.358	0.058	0.035	7041	0.047	5.15	9.74	0.008	0.005	0.001	0.007	0.007	0.002	0.004	0.002	0.002	0.001	0.003	0.000	0.002	0.000	3.72	0.092	1.39
	394_2_2	296	0.077	83.7	1.32	56.8	0.087	0.119	0.082	6879	0.027	0.402	3.79	0.004	0.001	0.002	0.008	0.000	0.002	0.012	0.000	0.000	0.001	0.006	0.000	0.000	0.001	3.53	0.063	0.114

SR4

	Sample No.	Mg	Al	Si	Mn	Fe	Ni	Zn	As	Sr	Y	Mo	Ba	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	U	∑REE+Y	Mo/U
	140_bbc6_103	82.7	2.51	126	0.425	36.4	0.366	0.483	0.026	10362	0.057	0.123	30.11	0.030	0.052	0.006	0.016	0.000	0.004	0.000	0.000	0.005	0.002	0.002	0.000	0.004	0.002	0.239	0.176	0.513
	141_bbc6_104	81.3	1.10	136	0.465	39.5	0.350	0.991	0.037	9990	0.048	0.142	35.51	0.013	0.021	0.008	0.017	0.000	0.011	0.008	0.001	0.003	0.000	0.002	0.001	0.003	0.001	0.141	0.137	1.01
	142_bbc6_105	87.3	1.13	139	0.227	46.3	0.754	0.933	0.046	10538	0.077	0.723	30.96	0.054	0.092	0.015	0.042	0.000	0.004	0.005	0.000	0.000	0.001	0.003	0.000	0.010	0.001	0.090	0.305	8.03
	143_bbc6_106	94.7	1.68	124	0.492	42.5	0.461	0.856	0.042	10117	0.068	0.368	47.87	0.025	0.060	0.009	0.018	0.000	0.000	0.009	0.001	0.009	0.000	0.006	0.002	0.008	0.002	0.119	0.216	3.10
	144_bbc6_107	90.3	1.31	97.3	5.95	67.9	0.363	0.678	0.057	10138	0.081	0.520	47.19	0.053	0.080	0.011	0.042	0.000	0.000	0.006	0.001	0.021	0.002	0.009	0.002	0.008	0.001	0.126	0.317	4.13
Wash_6_9	145_bbc6_108	106	1.15	113	0.732	49.5	0.213	0.688	0.034	8892	0.041	0.434	21.29	0.011	0.017	0.000	0.017	0.000	0.000	0.000	0.001	0.002	0.000	0.003	0.000	0.009	0.000	0.358	0.102	1.21
	146_bbc6_109	98.3	1.33	78.9	0.091	52.9	0.320	0.635	0.031	10574	0.095	1.74	50.68	0.055	0.083	0.016	0.024	0.004	0.006	0.017	0.006	0.013	0.001	0.008	0.002	0.008	0.001	0.166	0.339	10.5
	149_bbc6_111	91.8	3.32	98.2	0.812	68.7	0.606	0.251	0.005	11676	0.083	0.436	41.12	0.081	0.118	0.013	0.045	0.026	0.006	0.007	0.003	0.010	0.001	0.009	0.001	0.014	0.003	0.138	0.417	3.16
	150_bbc6_112	74.4	2.93	75.6	0.982	50.3	0.581	0.104	0.006	10359	0.055	0.312	34.45	0.055	0.127	0.016	0.060	0.013	0.003	0.011	0.000	0.015	0.004	0.005	0.001	0.007	0.001	0.131	0.373	2.38
	153_bbc6_115	107	3.36	64.7	24.1	416	0.502	0.254	0.047	10915	0.097	0.234	38.21	0.035	0.095	0.017	0.059	0.022	0.004	0.000	0.001	0.007	0.000	0.002	0.000	0.380	0.001	0.221	0.718	1.06
	154_bbc6_116	68.4	1.24	121	0.495	39.3	0.300	0.164	0.011	10067	0.045	0.142	26.26	0.022	0.045	0.005	0.026	0.003	0.006	0.001	0.002	0.015	0.001	0.005	0.001	0.006	0.001	0.123	0.185	1.16
	156_bbc6_118	63.4	2.15	118	0.669	40.8	0.385	0.240	0.068	10522	0.031	0.068	28.36	0.223	0.323	0.041	0.181	0.034	0.012	0.037	0.005	0.024	0.013	0.050	0.011	0.037	0.011	0.115	1.03	0.595

Table DR3: LA-ICP-MS data of reference standards analyzed along with the samples

		BHVO-2			BCR-2		
Element	Unit	Mean (N=22)	RSD%	Ref. value	Mean (N=22)	RSD%	Ref. value
Mg	wt.%	4.04	3.1	4.30	1.92	2.4	2.15
Al	wt.%	7.85	2.5	7.20	7.51	3.0	7.09
Si	wt.%	23.8	2.5	23.01	24.8	2.0	25.39
Mn	wt.%	0.134	2.9	0.132	0.149	2.9	0.155
Fe	wt.%	9.69	12.2	8.78	10.3	12.2	9.64
Ni	µg/g	125	2.2	119	12.1	6.0	18
Zn	µg/g	115	7.1	103	143	6.4	127
As	µg/g	3.71	11.0	-	4.13	9.2	-
Sr	µg/g	411	11.0	396	333	1.9	340
Y	µg/g	24.3	4.2	26	33.2	1.6	37
Mo	µg/g	4.28	5.8	3.8	250	2.4	270
Ba	µg/g	137	3.7	131	684	3.2	677
La	µg/g	15.7	2.6	15.2	25.0	3.1	24.9
Ce	µg/g	38.4	1.5	37.5	51.9	2.2	52.9
Pr	µg/g	5.36	2.3	5.35	6.61	2.6	6.7
Nd	µg/g	24.9	4.1	24.5	28.3	3.1	28.7
Sm	µg/g	6.55	5.9	6.07	6.81	5.8	6.58
Eu	µg/g	2.26	7.8	2.07	2.03	8.3	1.96
Gd	µg/g	6.40	5.0	6.24	6.78	4.5	6.75
Tb	µg/g	0.940	5.4	0.92	1.03	4.0	1.07
Dy	µg/g	5.45	6.2	5.31	6.48	4.2	6.41
Ho	µg/g	1.000	6.5	0.98	1.29	4.3	1.28
Er	µg/g	2.59	6.0	2.54	3.72	4.2	3.66
Tm	µg/g	0.349	5.8	0.33	0.508	6.9	0.54
Yb	µg/g	2.13	5.6	2.00	3.46	4.5	3.38
Lu	µg/g	0.297	8.5	0.274	0.506	6.8	0.503
U	µg/g	0.470	3.7	0.403	1.73	4.3	1.69

Reference data are preferred values from the GeoReM data base as of February 2016.
N: number of analyses; RSD%: relative standard deviation.

Table DR4: Correlation coefficients between relevant trace elements in clear aragonite cement.

Seepage system	Oil seep		Methane seep	
Age	Modern	Late Devonian	Modern	Oligocene
Locality	Chapopote	*Dzieduszyckia*	Makran	SR4
Fe:REE	0.26	−0.22	0.18	0.22
Mn:REE	0.02	−0.64	0.21	0.21
Al:REE	0.36	−0.51	0.54	−0.14
Mo:REE	0.29	0.07	0.58	−0.20
U:REE	−0.13	0.57	0.4	−0.27
Fe:Mo	0.23	0.64	0.26	−0.11
Mn:Mo	0.12	−0.02	0.05	−0.15
Al:Mo	0.06	0.61	0.54	−0.31
Fe:U	−0.09	−0.22	−0.15	0.21
Mn:U	−0.36	−0.30	−0.12	0.19
Al:U	−0.03	−0.29	−0.02	0.03
Mo:U	0.04	0.12	0.17	−0.03