

Data Repository and Supplementary Information

Pore-fluid Fe isotopes reflect the extent of benthic Fe redox recycling:**Evidence from continental shelf and deep-sea sediments**W. B. Homoky^{1,*}, S. Severmann², R.A. Mills¹, P. J. Statham¹ and G.R. Fones³¹*National Oceanography Centre, Southampton, University of Southampton, SO14 3ZH, UK*²*Department of Earth & Planetary Sciences and Institute of Marine & Coastal Sciences, Rutgers University, New Brunswick, NJ 08901, USA*³*School of Earth & Environmental Sciences, University of Portsmouth, PO1 3QL, UK*** Corresponding Author; e-mail: wbh@noc.soton.ac.uk, Tel: +44 (0) 2380 596507***Materials and Methods***1) Sample site descriptions*

Two deep-sea sites from the Southern Ocean were chosen for this study; complementary bulk sediment geochemistry is described by Marsh et al., (2007). The deep-sea sediments were collected from the Crozet Island region 44-49°S, 50-54°E within the Polar Frontal Zone (PFZ) of the Indian sector of the Southern Ocean, where mixed biogenic-volcaniclastic sediments accumulate around the Crozet Plateau. A 2-fold north-south gradient in annual integrated primary production and carbon export to the sediment is stimulated by Fe inputs from the Crozet Islands to the HNLC surface waters north of the plateau (Planquette et al., 2007; Pollard et al., 2007). Holocene mean annual organic carbon accumulation rates are 0.113 gC m⁻² yr⁻¹ north of the Plateau (M10) and 0.011 gC m⁻² yr⁻¹ south of the Plateau (M6). Sediment focusing at M10 and sediment winnowing at M6 enhances the impact of elevated primary productivity on the gradient in organic carbon accumulation rate. M10 surface sediments comprise ~10-15 % CaCO₃, ~65-85 % biogenic opal and ~10-20 % lithogenic material. M6 surface sediments from the HNLC region to the south of the Crozet Plateau comprise ~1.5-4 % CaCO₃, 60-80 % biogenic opal and ~15-20 % lithogenic material, with up to 75 % lithogenic material in turbidite layers. Calcareous and siliceous primary production in the surface waters, and turbidite and debris flow inputs from the volcanic Crozet Islands account for sediment supply to these sites, and total Fe is largely associated with lithogenic material derived from the nearby Crozet Islands (Marsh et al., 2007). Lithogenic mineralogy includes volcanic glass, clay, pyroxene, hornblende, olivine, ilmenite and amorphous Fe oxides as identified by smear slide petrography. Bioturbation and bioirrigation is apparent on macro- and micro-scale (cm to sub-mm) in the sediment structure and sites are characterised by turbiditic emplacements. All surface sediments are Holocene, with

the exception of an M6 turbidite layer (Marsh et al., 2007).). Total Sulfur content was analysed in these sediments (CHNS and ICPAES, data not shown) and can be attributed to seawater salts in the Holocene sections of these cores within the accuracy of the analysis. This is consistent with the findings of Marsh et al. (2007), who found no evidence for the onset of sulfide diagenesis in Holocene sediments around Crozet.

Continental shelf sediments were collected from the Eel River-dominated California margin of the northeast Pacific Ocean (41°N, -125°W). The Eel River is the primary source of Holocene sedimentary material to the shelf region and is typically deposited in the winter to spring months by flood events (Ogston et al., 2004). A mixture of very fine sands, silts and clays occupy the mid shelf region of 60-120 m water depth, where the mean organic carbon accumulation rate is estimated to be 17.8-35.6 g m⁻² yr⁻¹ (Sommerfield and Nittrouer, 1999). Sediment resuspension and lateral transport is wave-dominated, and bioturbation and bioirrigation is prevalent across the shelf and shelf slope break. Porewater sulfide concentration and the solid phase AVS concentration (data not shown) were found to be very low and mostly below detection limit, and it is inferred that any sulfide is confined to microniches, which are in insufficient abundance to affect the bulk chemistry.

2) Sampling and analytical procedures

Deep-sea sediments were collected north and south of the Crozet Islands during RRS *Discovery* cruise D286 (Pollard et al., 2007). Pore-fluids were extracted from surface sediment mega-cores collected at sites M6 (48°59.98'S 51°20.03'E, 4222 m) and M10 (44°31.45'S 49°59.86'E, 3227 m). Crozet sediment pore-fluids were extracted by centrifugation under a nitrogen atmosphere at 4°C and filtered through a Whatman 0.2 µm cellulose nitrate membrane for trace metals and a separate aliquot for nutrients. A sub-sample was sequentially filtered through a Whatman Anotop 25 mm 0.02 µm aluminium oxide membrane for size-fractionation analysis of trace metals. Eel River shelf sediments (40°43.70'N 124°28.50'W, 120 m) were collected on RV *Wecoma* by Multi-core during 2 cruises in May and September 2007. Pore-fluid extraction for Fe and Mn followed the Crozet sediment protocol with the exception of using a single 0.45 µm cellulose acetate filtration step instead of sequential filtration. During our second cruise in September 2007 Eel River shelf pore-fluids were also collected by 0.2 µm Rhizon samplers from additional cores of the same site, following the procedure of Seeberg-Elverfeldt et al. (2005). The Eel River shelf nitrate data

presented in this study was collected by Rhizon sampling during the September cruise, while the Fe, Mn and Fe isotope data presented was collected by centrifugation and filtration in May of the same year (see below for more details).

Fe and Mn pore-fluid concentrations were measured on an Agilent 7500 Octopole Inductively Coupled Plasma Mass Spectrometer (ICP-MS) equipped with a collision cell to suppress argide interferences. Procedural blanks for the pore-fluid extraction procedure were $<0.1 \mu\text{M}$ for Fe and $<0.001 \mu\text{M}$ for Mn. For isotope analysis, pore-fluid Fe samples ($<0.2 \mu\text{m}$ filter fractions only) were purified following a standard anion exchange protocol (e.g., Beard et al., 2003). 1-5 ml of acidified but otherwise untreated porewater were mixed with ultra-pure concentrated HCl to make an acid-porewater solution with a molarity of 6M HCl, which was loaded onto anion exchange column with a 0.6 ml resin bed. Following the initial processing through these large ion exchange columns, purified samples were dried down, re-dissolved in 0.2 ml of 6M HCl and processed through a second, smaller column with a 0.2 ml resin volume. For isotope analysis samples were dried down again and re-dissolved in 2% ultra-pure nitric acid. To test for matrix effects we prepared a synthetic porewater by spiking 2-5 ml of trace metal free seawater with a small amount ($\sim 1 \mu\text{g}$ Fe) of IRMM-014 isotope standard reference material. The ratio of IRMM-14 Fe to seawater matrix in our synthetic sample matched the lowest Fe to seawater ratio in our porewater samples. The measured isotope composition of our synthetic porewater samples was analytically indistinguishable from pure IRMM-14 Fe standard (Table DR2)

Iron isotope ratios were measured on a Thermo Finnigan High Resolution Multi-Collector ICP-MS (Neptune) at the University of California, Santa Cruz, following the procedure described in Arnold et al. (2004). Purified samples were introduced into the mass spectrometer as 1-2 ppm Fe solutions, mixed with equal amounts of Cu standard of known isotope composition, which was measured simultaneously for mass bias correction. In addition, samples were normalized to the average of two bracketing standards. Isotope ratios of $^{56}\text{Fe}/^{54}\text{Fe}$ and $^{57}\text{Fe}/^{54}\text{Fe}$ are reported using standard delta notation. Measured ratios are normalized relative to the average igneous rocks, which have an isotope composition of $\delta^{56}\text{Fe} = 0 \pm 0.05 \text{‰}$ (Beard et al., 2003). On this scale the isotope composition of the international Fe isotope reference material IRMM-014 is -0.09‰ for $\delta^{56}\text{Fe}$. The average analytical precision and the external precision for $\delta^{56}\text{Fe}$ (2-STD) are very similar at 0.13‰ and

0.06 ‰, respectively. Several standard reference materials of known isotope composition, including IRMM-014, BCR-2 (a basalt standard reference material) and TAG (an in-house standard), were measured routinely for each sample batch. TAG is a hydrothermal metalliferous sediment with an average isotope composition of -0.98 ± 0.10 ‰ (2-SD, n=28).

Analysis of Crozet pore-fluid nitrate + nitrite (hereinafter nitrate) was undertaken at sea on a Skalar Sanplus Auto-analyzer (Sanders et al., 2007). Eel River shelf pore-fluids were refrigerated at ~2°C prior to being analyzed for nutrients at Oregon State University, using a Lachat QuikChem 4200 flow injection auto-analyzer. Crozet sediment organic carbon content was measured on an Eltra CS 500 carbon analyzer. Total organic carbon (TOC) content was calculated as the difference between the measured total inorganic carbon (TIC) and total carbon (TC). The analytical precision of this procedure was ± 0.04 wt%. Eel River shelf sediment TOC content was determined by automated Coulometric titration using a UIC model 5011 CO₂ analyzer following the method of Cahill and Autrey (1988). TOC was calculated as the difference between the measured TIC and TC, with an analytical precision of ± 0.04 wt%.

Crozet region Holocene mean annual organic carbon accumulation rates were calculated from radio-carbon sediment accumulation rates (unpublished data) and the dry bulk density estimated from the empirical relationship between dry bulk density and carbonate content for southern ocean sediments (Froelich et al., 1991). Eel river shelf carbon accumulation rates were estimated from measure TOC and published bulk sediment accumulation rates (Sommerfield and Nittrouer, 1999).

Highly labile Fe (Fe_{h-lab}) was operationally defined as Fe liberated during a Na Acetate leach, and hydrous Fe oxides (HFO) was determined by a sequential Hydroxylamine-HCl extraction following the method of Poulton and Canfield (2005). In addition to surface adsorbed Fe²⁺ and freshly precipitated near-amorphous Fe hydroxides, extraction with Na Acetate will also liberate Fe from association with siderite and ankerite. We note that based on the inorganic TIC-Ca stoichiometry in these sediments (Marsh et al. 2007, and data from this study) Fe-carbonate phases are negligible in these sediments. Total Fe (FeT) was determined by HF-Perchloric sample digestion following the procedure of Marsh et al. (2007). Fe leachates and total digests were analysed by the same ICP-MS method described for pore-fluid

analysis. Tables DR1 and DR2 summarise solid phase and pore-fluid data, respectively.

3) Justification of Rhizone sampling for porewater nutrient analysis

Eel River shelf nitrate data was sampled by Rhizons as described in the section *Sampling and Methods*. Eel River shelf nitrate data from samples collected during our first cruise by centrifugation showed unreasonably high nitrate concentrations below the surface sedimentary oxic zone. These samples were considered compromised with respect to nutrient abundance, possibly due to cell lysis during centrifugation at speeds >10,000 rpm. Nutrient data for porewater samples from our second cruise that were extracted from the sediments using Rhizon samplers consistently recorded nitrate below detection limit at ≥ 5 cmbsf for a range of sites from the Oregon and California margin. Rhizons have been demonstrated to be a robust method for the sampling of pore-fluid constituents across the sediment-seawater interface (Seeberg-Elverfeldt et al., 2005), and a comparison of Fe and Mn distributions in Eel River shelf sediment pore-fluids collected by both Rhizons and the classical centrifugation and filtration method is consistent with this claim (Fig. DR1). Potential concentration differences between samples collected in May and in September are insignificant within the framework of our interpretations presented here.

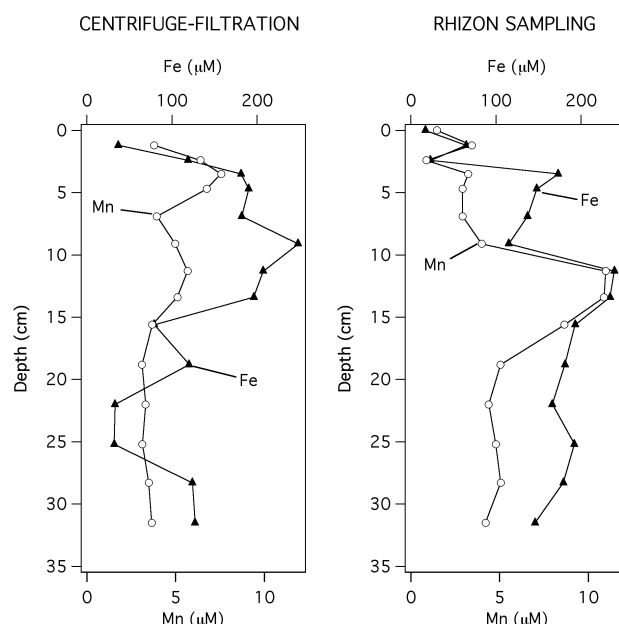


Figure DR1. Comparison of pore-fluid Fe and Mn concentrations from Eel River shelf sediments sampled by standard centrifugation and filtration, and Rhizon samplers. Sediments are from contemporaneous cores of a single multi-corer deployment. Differences in Fe and Mn distributions between cores are consistent with local heterogeneity in the surface sediments, while overall ranges and distribution profiles are comparable for the two methods. This and other studies (Seeberg-Elverfeldt et al., 2005), demonstrate the suitability of Rhizons for pore-fluid sampling in sub-oxic surface sediments.

4) Critical evaluation of Crozet region pore-fluid Fe concentrations

Crozet region pore-fluid Fe concentrations are higher than previously reported Fe from oxic deep-sea sediment pore-fluids. In order to provide an analytical check of our pore-fluid measurements from the Crozet region, additional shipboard DET (Diffusive Equilibrium in Thin-film) Gel probes were deployed in contemporaneous sediment cores collected from the same Mega-core deployment as used for pore-fluid sampling by centrifugation. DET gel probes have been demonstrated to provide a robust alternative method for high resolution sampling of pore-fluid Fe in surface sediments (Morford et al., 2003). Gel probes were allowed to equilibrate with the sediment pore-fluid for 24 hours at 4 °C. Gels were later sectioned at 2 mm depth resolution and eluted in HNO₃ prior to dilution and analysis by Graphite Furnace Atomic Absorption Spectroscopy. A selection of these data is shown here (Fig. DR2), and illustrates significant small-scale heterogeneity and a similar range of Fe concentrations in the upper 0-15cmbsf compared to the those derived by centrifugation and filtration. These observations demonstrate the concentrations of Fe and Mn presented for Crozet region pore-fluids are unlikely to have resulted from contamination or sampling artefacts. Furthermore, DET gel data are consistent with our suggestion that there are mineral scale reactions occurring in these sediments between lithogenic material and biogenic opal

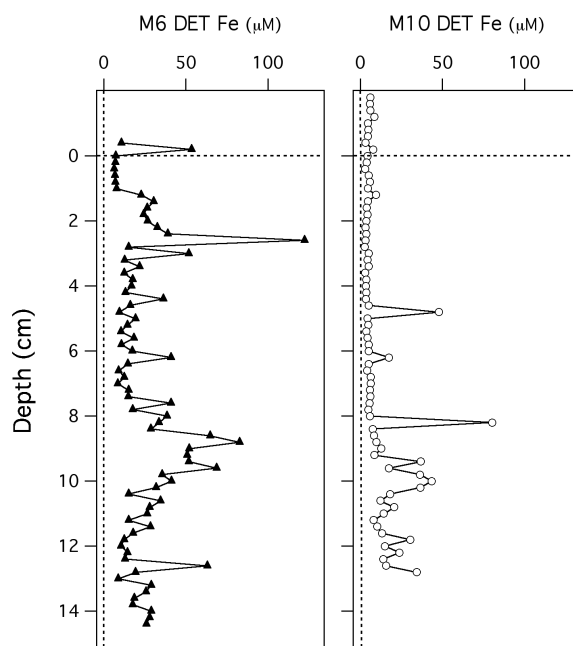


Figure DR2. Pore-fluid Fe concentrations in Crozet region sampled by DET gel probes. Fe concentrations are comparable to range of values determined in surface sediments by centrifugation and filtration in contemporaneous sediment cores. DET gel probes highlight millimeter-scale heterogeneity to pore-fluid Fe concentrations

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**TABLE DR1. SOLID-PHASE CONSTITUENTS
OF EEL RIVER SHELF (ER) AND CROZET REGION (M6, M10) SEDIMENTS**

Site	Depth (cmbsf)	Organic C (dwt %)	Fe _{h-lab} [*] (dwt %)	HFO [†] (dwt %)	Fe _{h-lab} /[Fe _{h-lab} +HFO] (dwt %)	FeT [‡] (dwt %)
Eel River shelf (Lat: 40°43.70'N, Long: 124°28.50'W)						
ER	0-1.2	0.99	0.30	0.17	0.64	4.73
ER	1.2-2.4	0.89	0.36	0.16	0.69	4.21
ER	2.4-3.5	0.89	0.32	0.15	0.68	4.52
ER	3.5-4.7	0.87	0.32	0.15	0.68	4.25
ER	4.7-5.9	0.82	0.35	0.16	0.68	4.09
ER	5.9-7.1	0.83	-	-	-	4.09
ER	7.1-8.3	0.86	0.41	0.19	0.69	4.06
ER	8.3-9.4	0.86	-	-	-	4.07
ER	9.4-10.6	0.90	0.38	0.20	0.66	4.17
ER	10.6-11.8	0.88	-	-	-	3.96
ER	11.8-13.0	0.86	0.45	0.21	0.68	4.05
ER	13.0-14.2	0.81	-	-	-	4.16
ER	14.2-15.3	0.86	0.49	0.26	0.65	4.32
ER	15.3-16.5	0.86	-	-	-	4.10
ER	16.5-17.7	0.83	0.48	0.26	0.65	4.00
ER	17.7-18.9	0.88	-	-	-	4.12
ER	18.9-20.1	0.85	0.53	0.31	0.63	4.28
ER	20.1-21.3	0.86	-	-	-	4.32
Crozet region (Lat: 48°59.98'S, Long: 51°20.03'E)						
M6	0-1	0.52	0.01	0.25	0.04	1.87
M6	1-2	0.31	0.01	0.27	0.03	2.13
M6	2-3	0.37	0.01	0.34	0.03	2.89
M6	3-5	0.29	0.01	0.32	0.03	2.51
M6	5-7	0.34	0.01	0.30	0.03	1.96
M6	7-9	0.33	0.01	0.30	0.03	2.77
M6	9-11	0.43	0.02	0.37	0.04	3.00
M6	11-13	0.35	0.01	0.41	0.03	2.93
M6	13-15	0.40	0.01	0.45	0.02	3.08
M6	15-17	0.33	0.02	0.43	0.04	3.20
M6	17-19	0.34	0.09	0.50	0.15	3.22
M6	19-21	-	0.10	0.49	0.17	3.25
M6	21-23	-	0.09	0.50	0.15	3.40
Crozet region (Lat: 44°31.45'S, Long: 49°59.86'E)						
M10	0-1	0.58	0.034	0.185	0.15	1.37
M10	1-2	0.54	0.042	0.169	0.20	1.02
M10	2-3	0.56	0.022	0.164	0.12	1.24
M10	3-4	0.59	0.024	0.159	0.13	1.35
M10	4-5	0.41	0.017	0.160	0.10	0.97
M10	6-7	0.62	0.023	0.149	0.13	1.19
M10	8-9	0.52	0.014	0.118	0.11	1.32
M10	10-11	0.49	0.009	0.140	0.06	1.27
M10	12-13	0.46	0.007	0.126	0.05	1.17
M10	14-15	0.30	0.008	0.122	0.06	1.19
M10	16-17	0.22	0.006	0.125	0.04	1.21
M10	18-19	0.34	0.004	0.116	0.03	1.11
M10	20-21	0.25	0.004	0.170	0.02	0.95

*Highly-labile Fe extracted by Na acetate leach (including adsorbed Fe²⁺/Fe³⁺ and carbonate associated Fe oxide)
[†]Hydrous Fe oxides extracted by hydroxylamine-HCl leach.
[‡]Total Fe determined by HF-perchloric sediment digestion.
- Not determined.

TABLE DR2. PORE-FLUID CONSTITUENTS OF THE EEL RIVER SHELF (ER) AND CROZET REGION (M6, M10)

Site	Depth (cmbsf)	Nitrate (μM)	Fe			Mn			$\delta^{56}\text{Fe}$		$\delta^{57}\text{Fe}$		n
			<0.45 μM (μM)	<0.2 μM (μM)	<0.02 μM (μM)	<0.45 μM (μM)	<0.2 μM (μM)	<0.02 μM (μM)	<0.2 μM (‰)	2-SD (\pm)	<0.2 μM (‰)	2-SD (\pm)	
Eel River shelf (Lat: 40°43.70'N, Long: 124°28.50'W)													
ER	0-1.2	23.1	7.06	-	-	14.2	-	-	-3.40	0.07	-5.08	0.39	1
ER	1.2-2.4	28.4	104	-	-	13.2	-	-	-1.69	0.06	-2.51	0.29	1
ER	2.4-3.5	15.6	157	-	-	8.75	-	-	-1.45	0.13	-1.92	0.33	2
ER	3.5-4.7	1.5	167	-	-	6.75	-	-	-1.32	0.13	-1.74	0.33	2
ER	4.7-5.9	-	146	-	-	5.71	-	-	-1.33	0.02	-1.58	0.22	1
ER	5.9-7.1	1.5	115	-	-	4.93	-	-	-1.37	0.15	-1.80	0.36	1
ER	7.1-8.3	-	104	-	-	4.02	-	-	-1.36	0.13	-2.12	0.33	2
ER	8.3-9.4	1.9	110	-	-	3.09	-	-	-0.65	0.21	-0.92	0.46	1
ER	9.4-10.6	-	106	-	-	2.63	-	-	-0.68	0.13	-1.09	0.33	2
ER	10.6-11.8	2.8	75.5	-	-	2.48	-	-	-1.54	0.05	-2.18	0.16	1
ER	11.8-13.0	-	106	-	-	2.45	-	-	-0.92	0.13	-1.05	0.33	2
ER	13.0-14.2	1.9	132	-	-	2.70	-	-	-0.80	0.08	-1.24	0.39	1
ER	14.2-15.3	-	142	-	-	2.67	-	-	-1.44	0.25	-2.01	0.09	1
ER	15.3-16.5	1.9	113	-	-	2.75	-	-	-1.46	0.09	-2.16	0.63	1
ER	16.5-17.7	-	140	-	-	2.68	-	-	-0.94	0.22	-1.25	0.39	1
ER	17.7-18.9	1.4	151	-	-	2.88	-	-	-0.80	0.13	-1.32	0.33	2
ER	18.9-20.1	-	147	-	-	3.01	-	-	-0.80	0.37	-1.22	0.19	1
ER	20.1-21.3	0.0	120	-	-	3.0	-	-	-0.74	0.13	-0.92	0.33	2
Crozet region (Lat: 48°59.98'S, Long: 51°20.03'E)													
M6	0-1	36.6	-	15.9	0.75	-	0.24	0.12	-	-	-	-	-
M6	1-2	35.3	-	19.0	1.35	-	0.35	0.04	0.01	0.02	-0.06	0.12	2
M6	2-3	32.2	-	3.52	2.24	-	0.07	0.06	-	-	-	-	-
M6	3-5	37.5	-	13.7	7.85	-	0.24	0.14	-	-	-	-	-
M6	5-7	40.5	-	4.40	-	-	0.14	-	-	-	-	-	-
M6	7-9	22.2	-	6.58	-	-	0.22	-	0.09	0.02	0.22	0.12	2
M6	9-11	13.7	-	3.19	1.10	-	0.08	0.03	-	-	-	-	-
M6	11-13	15.8	-	14.5	2.67	-	0.29	0.08	-	-	-	-	-
M6	13-15	5.5	-	31.2	5.05	-	0.58	0.12	0.12	0.04	0.15	0.03	1
M6	15-17	17.4	-	19.0	2.74	-	0.95	0.35	0.07	0.03	0.05	0.06	1
M6	17-19	4.25	-	20.4	2.53	-	0.88	0.59	0.06	0.03	0.08	0.09	1
M6	19-21	3.65	-	32.5	1.15	-	1.26	0.83	0.08	0.01	0.12	0.03	1
M6	21-23	10.4	-	12.9	3.71	-	1.26	0.70	0.12	0.02	0.18	0.12	2
M6	23-25	10.3	-	68.0	1.53	-	2.28	1.17	0.19	0.02	0.32	0.22	1
M6	25-27	4.85	-	7.35	-	-	1.35	-	-	-	-	-	-
Crozet region (Lat: 44°31.45'S, Long: 49°59.86'E)													
M10	0-1	93.4	-	17.2	1.75	-	0.38	0.11	0.10	0.02	0.18	0.12	2
M10	1-2	58.7	-	6.54	2.16	-	0.17	0.06	-	-	-	-	-
M10	2-3	54.2	-	4.07	3.23	-	0.10	0.06	-	-	-	-	-
M10	3-4	43.4	-	4.66	1.38	-	0.07	0.04	-	-	-	-	-
M10	4-5	31.7	-	10.5	3.85	-	0.19	0.07	-	-	-	-	-
M10	5-6	16.6	-	10.2	2.42	-	0.24	0.05	-	-	-	-	-
M10	6-7	19.3	-	20.0	3.08	-	0.31	0.29	0.07	0.02	-0.02	0.12	2
M10	7-8	10.5	-	23.3	2.37	-	0.37	0.13	-	-	-	-	-
M10	8-9	22.5	-	11.9	2.32	-	0.17	0.05	-	-	-	-	-
M10	9-10	2.50	-	18.8	1.27	-	0.30	0.03	-	-	-	-	-
M10	10-11	7.00	-	12.3	1.11	-	0.18	0.02	0.06	0.02	0.02	0.12	2
M10	11-12	2.60	-	1.60	-	-	0.04	-	-	-	-	-	-
M10	12-13	0.90	-	2.31	-	-	BDL [†]	-	-	-	-	-	-
M10	13-14	BDL [†]	-	13.5	3.51	-	0.19	0.14	-0.01	0.02	-0.06	0.12	2
M10	14-15	BDL [†]	-	14.8	1.01	-	0.55	0.12	0.06	0.04	0.05	0.13	1
M10	15-16	1.30	-	15.1	0.29	-	0.89	0.04	-	-	-	-	-
M10	16-17	BDL [†]	-	13.4	0.09	-	1.12	0.01	-	-	-	-	-
M10	17-18	2.40	-	19.7	0.34	-	1.03	0.02	0.00	0.02	-0.05	0.12	2
M10	18-19	11.0	-	69.7	7.48	-	3.72	0.66	0.08	0.02	0.13	0.12	2
M10	19-20	6.30	-	1.88	-	-	0.71	-	-	-	-	-	-
M10	20-21	2.70	-	22.2	2.06	-	1.17	0.45	0.11	0.05	0.18	0.06	1
M10	21-23	0.80	-	32.0	0.01	-	1.66	0.00	0.07	0.07	0.13	0.35	1
M10	23-25	2.00	-	3.30	-	-	0.94	-	-	-	-	-	-
M10	25-28	4.50	-	5.77	2.86	-	0.64	0.49	-	-	-	-	-
M10	28-31	1.30	-	0.47	-	-	0.61	-	-	-	-	-	-
M10	31-35	-	-	82.0	-	-	1.69	-	-	-	-	-	-
Mean isotope standards													
IRMM-14									-0.08	0.06	-0.17	0.09	6
IRMM-14 spiked seawater [§]									-0.07	0.12	-0.13	0.05	2
BCR2									-0.18	0.05	-0.29	0.14	6
TAG									-1.01	0.1	-1.54	0.12	3

n = number of isotopic analyses

[†]Below detection limit.

[§]Fe stripped seawater samples spiked with 2 μg and 5 μg IRMM-14 isotope standard.

- Not determined.