DANMARKS OG GRØNLANDS GEOLOGISKE UNDERSØGELSE **RAPPORT 2022/9**

Geochemical Data Collection in LOOP2

MapField, 2019-2020

Hyojin Kim, Rasmus Jakobsen, Jens Aamand, Ingelise Møller
& Birgitte Hansen

GEOLOGICAL SURVEY OF DENMARK AND GREENLAND
DANISH MINISTRY OF CLIMATE, ENERGY AND UTILITIES

G E U S

DANMARKS OG GRØNLANDS GEOLOGISKE UNDERSØGELSE **RAPPORT 2022/9**

Geochemical Data Collection in LOOP2

MapField, 2019-2020

Results from The Innovation Fund Denmark project: MapField – Field-scale mapping for targeted Nregulation and management (8855-00025B)

Hyojin Kim, Rasmus Jakobsen, Jens Aamand, Ingelise Møller & Birgitte Hansen

Confidential report

Copy No.

Released 30.09.2024

GEOLOGICAL SURVEY OF DENMARK AND GREENLAND
DANISH MINISTRY OF CLIMATE, ENERGY AND UTILITIES

G E U S

Geochemical data collection in LOOP2 MapField, 2019-2020

Hyojin Kim, Rasmus Jakobsen, Jens Aamand, Ingelise Møller & Birgitte Hansen

G E U S

DE NATIONALE GEOLOGISKE UNDERSØGELSER FOR DANMARK OG GRØNLAND

KLIMA- OG ENERGIMINISTERIET

Data report 2019-2020 MapField

Authors: Hyojin Kim, Rasmus Jakobsen, Jens Aamand, Ingelise Møller & Birgitte Hansen

Table of content

1. Introduction

This report summarizes existing data and results of the field campaigns carried out in LOOP2 in May 2019 to collect geochemistry data for the MapField project. The geochemistry data includes groundwater chemistry, sediment chemistry, and nitrate reduction rates. We drilled boreholes to collect groundwater and sediment samples. The primary objectives of the geochemistry data collection are to capture transport and evolution of nitrate in the subsurface at the field scale and to quantify the rates of nitrate reduction. This geochemistry data will be input data for an integrated hydro-geochemistry modelling. Here, we describe the methods and results.

During the field work, Jens Aamand made a video about the field work for Geoviden which can be found: http://mapfield.dk/publikationer

2. Methods

2.1. Field campaign planning

To select the most important drilling sites of the study catchment, preliminary characterization of the subsurface structure and nitrate transport and fate was done using existing data. The existing data encompass 1) tTEM and geological interpretation of the tTEM model; 2) digital terrain model; 3) water chemistry (pore water, groundwater, and stream water chemistry) focusing on nitrate; 4) groundwater table; and 5) redox zones interpreted from sediment colors.

2.2. Identified hypotheses

Based on this preliminary analysis and the screening of the redox zones, hypotheses(is) for the evolution of nitrate in the subsurface were developed and sampling points for N reduction rates and detailed water chemistry profiling were selected as seen in Figure 1. These hypotheses both focused on optimization and iterative creative processes:

Optimization process:

1. Using 2 days for screening the redox conditions with the redox-geoprobe is optimal for planning the 3-days drilling campaign for sediment and water sampling.

Iterative creative process:

1. Investigation of the redox conditions on both sides of the boundary of the two landscape elements: Glacial hill and outwash plain are import for redox characterization of the subsurface in LOOP2.

   This might be due to transport and percolation of relative deep oxic nitrate containing groundwater from the glacial hill to deeper layers at the outwash plain. This might explain why oxic nitrate containing groundwater is found under surface-near reduced peat layers at the outwash plain.

   The boundary is probably an offset caused by glaciotectonic deformation caused by rebound of the subsurface due to the weight relief from the ice (https://eng.mapfield.dk/Media/637602161326369650/GEUS_report_2021_36_Geological%20mapping%20in%20MapField%20LOOP-areas%20and%20demo%20sites.pdf).

2. Exploring different laboratory methods for N reduction rate determination e.g. with and without the use of acetylene.

2.3. Borehole drilling and sample collection

In May 2019, to screen the redox interface of the selected sampling points, a redox probe survey was carried out. The groundwater table was measured as well. Two weeks after the redox probe survey, based on the screening results, a Geoprobe direct push method was used to collect core samples less than 1 meter from the redox probe points. The drilling was performed by Ejlskov. The core samples were cut and wrapped with aluminum tape in the field for pore-water chemistry (9cm-long), nitrate reduction rates (25cm-long), geochemistry sediment analysis (varying length), and lithological description (varying length). Except the lithology samples, all the core samples were stored in a cooling box in the field.

2.4. Water chemistry analysis

In the laboratory, the core samples for the pore water chemistry analysis were centrifuged to extract pore water. The water samples had been stored refrigerated until analysis. The centrifuged water yield varied and analyses were prioritized in the following order at GEUS: 1) Anions by an ion chromatography (IC); 2) ammonium by a Flow Injection Analysis (FIA); 3) Dissolved inorganic and organic carbon by an Infra-red (IR) detection on Shimadzu instrument; 4) Cations and trace elements by an Inductively Coupled Plasma - Mass Spectroscopy (ICP-MS); and 5) Water isotopes by a Cavity Ring Down Spectroscopy CRDS.

2.5. Sediment chemistry analysis

A number of sediment chemistry parameters were analyzed for at GEUS:

1) Sediment Reduction Capacity was determined by oxidation with Ce(IV)

2) Fe(III) from less stable Fe-oxides, and Fe(II) compounds soluble at pH 3 were determined by extraction in formic acid at pH 3

3) Sediment inorganic and organic carbon as well as total sulfur was analyzed using a LECO furnace.

2.6. Nitrate reduction rate measurements and experiments

Rates of nitrate reduction were measured in the laboratory at GEUS using the acetylene-block method, where the transformation of N_2O to N_2 is blocked by adding acetylene to a closed vial containing sediment, 20 mL of a 1 mmol nitrate solution and a headspace, and following the production of N_2O for up to 2 weeks. The production of N_2O was followed by measuring the concentration in the known headspace of the vial and calculating the concentration in the known water volume.

Many of the incubations from LOOP2 show two phases in the N_2O development. An initial phase where the development in the N_2O concentrations is very slow, followed by a second phase where the rate in the N_2O development has shifted to a much higher level.

Incubations in other experiments where the porewater was sampled over time strongly indicate that the initial phase, where a very slow rate in the N_2O development is seen, is a phase where the last traces of O_2 in the incubation flask are removed. This is supported by the observation that this initial phase is sometimes not seen in incubations where high rates are measured, presumably because in these the traces of oxygen are rapidly removed by a reactive electron donor.

In the cases where there is a second rapid phase and it is adequately well described by a highly linear increase over at least three measuring points this second rapid phase has been used. This implies that many samples have not been included in the calculation of the final rates because the rate determined from only two points has a high probability of being underestimated.

The values are transformed from the rates of development in the N_2O concentration determined pr. gram of incubated sediment into µmolN_2O/l/yr assuming that there are 5.4 kg of sediment pr. liter of groundwater/porewater. In the final calculation this has been multiplied by 2, as each mole of N_2O represents 2 moles of NO_3^-

In addition to the rate measurements, experiments to address different aspects of the nitrate reduction and clarify the interpretation of the acetylene block N_2O rate measurements a set of experiments common for LOOP3 and LOOP2 were carried out.

Experiment 1: A 1 mM nitrate solution was added to the nitrate rate incubations, but to clarify whether the rate was dependent on the nitrate concentration we set up 5 sets of 3 incubations with different nitrate concentration (0, 0.2, 0.5, 1 and 2 mM), using homogenized sediment from 1 core segment. Furthermore, to see if there was an effect of dissolved Fe(II), powdered $FeCO_3$ (siderite), was added to a 6th set of 3 vials with 1 mM of nitrate. In contrast to LOOP3 where an $FeCO_3$ suspension, prepared by adding $FeCl_2$ to a calcite suspension was used, the experiments with LOOP2 sediments used actual siderite powder prepared by powdering pure siderite crystals. The water in the vials was sampled for Fe^{2+} which was measured spectrophotometrically using Ferrozine.

Experiment 2: This was a parallel to Experiment 1 where the rates were measured by following the removal of nitrate from the water added to the incubations. In order to have enough water 400 g of sediment was added to 500 ml bottles. The same concentrations of nitrate were used and also set up in triplicates. Likewise, a set of 3 was amended with the powdered $FeCO_3$ (siderite).

Experiment 3: Earlier rate measurements had indicated that there was an accumulation of N_2O in the incubation flasks before the first sample, presumably before the addition of acetylene. To clarify the extent of this and to see if it was an artefact of preparing the incubations a couple of days in advance, before the acetylene was added, 4 sets of triplicates, with and without 1 mM of nitrate and with and without acetylene were set up and sampled for N_2O over time.

Experiment 4: To see if there was a significant removal of N_2O, which could affect the interpretation of the rate measurements we prepared 3 sets (in triplicates) of incubations with 1 mM nitrate and an initial concentration of N_2O of ~175 ppm in the gas phase. To one set we added 10% acetylene, like in the rate measurements, to another set we added siderite to have dissolved Fe(II) in the system and the last set just had the added nitrate.

2.7. Lithology description

Geological descriptions of the sediment samples were carried out at the laboratory at GEUS and shown in Appendix 1.

2.8. Re-evaluation of redox probe

In February-March 2020, Ejlskov concluded that the redox-probe has been unstable since the summer of 2018 (one year before the first round of measurement in LOOP 2) due to a hole in the insulation of the wire connecting the platinum electrode used for measurement of the signal. Ejlskov started troubleshooting the redox-probe and after a few rounds of amendments, the stability of the redox-probe was tested in four locations in LOOP2 in April 2020 (Sampling points P1, P2, P2A, P3 and P4). More test and adjustments were carried out and the final redox-probe measurements were carried out in September 2020 at sampling points P1, P2, P3 and P4. At the field campaigns in 2020 each sampling point were repeated two or three times.

2.9. Water table

Water table measurements were carried out in the field directly in the boreholes left after each redox-probe measurement. At a few locations the level of the water table was deeper than the bottom of the borehole. At other locations the borehole collapsed immediately after the drill stem was removed and it was not possible to measure the water table. The depth to the top of the collapse in the borehole was measured as it may be an indication of the water table. Water table measurements from the first round of redox probe measurements were used for the well panel plots. Water table measurements from the following field campaigns show similar levels.

To supplement and validate the information on the water table from field measurement an evaluation of the water table at each sampling point was carried out on existing data reported to the Jupiter database. The Jupiter borehole data including water level and a terrain grid were read into Geoscene 3D. Profiles crossing existing wells with water table levels and the MapField sampling points were drawn and at each sampling point the water table were interpreted taking the water level in adjacent well as well as the terrain level into account. At sampling points P6, P8 and P9 only interpreted water levels are available.

3. Results

3.1. Existing data

In total, water chemistry and groundwater table observations were available at 60 locations across the catchment (Figure1 and table1). Table 1 summarizes the availability of water chemistry and groundwater level data of LOOP2. Most LOOP monitoring stations have 1-5 filter depths for water sampling. Water chemistry was measured at 75 points and groundwater table is monitored at 64 points. The time-series of nitrate concentrations and groundwater table of each monitoring station are shown in Appendix 2 as an example.

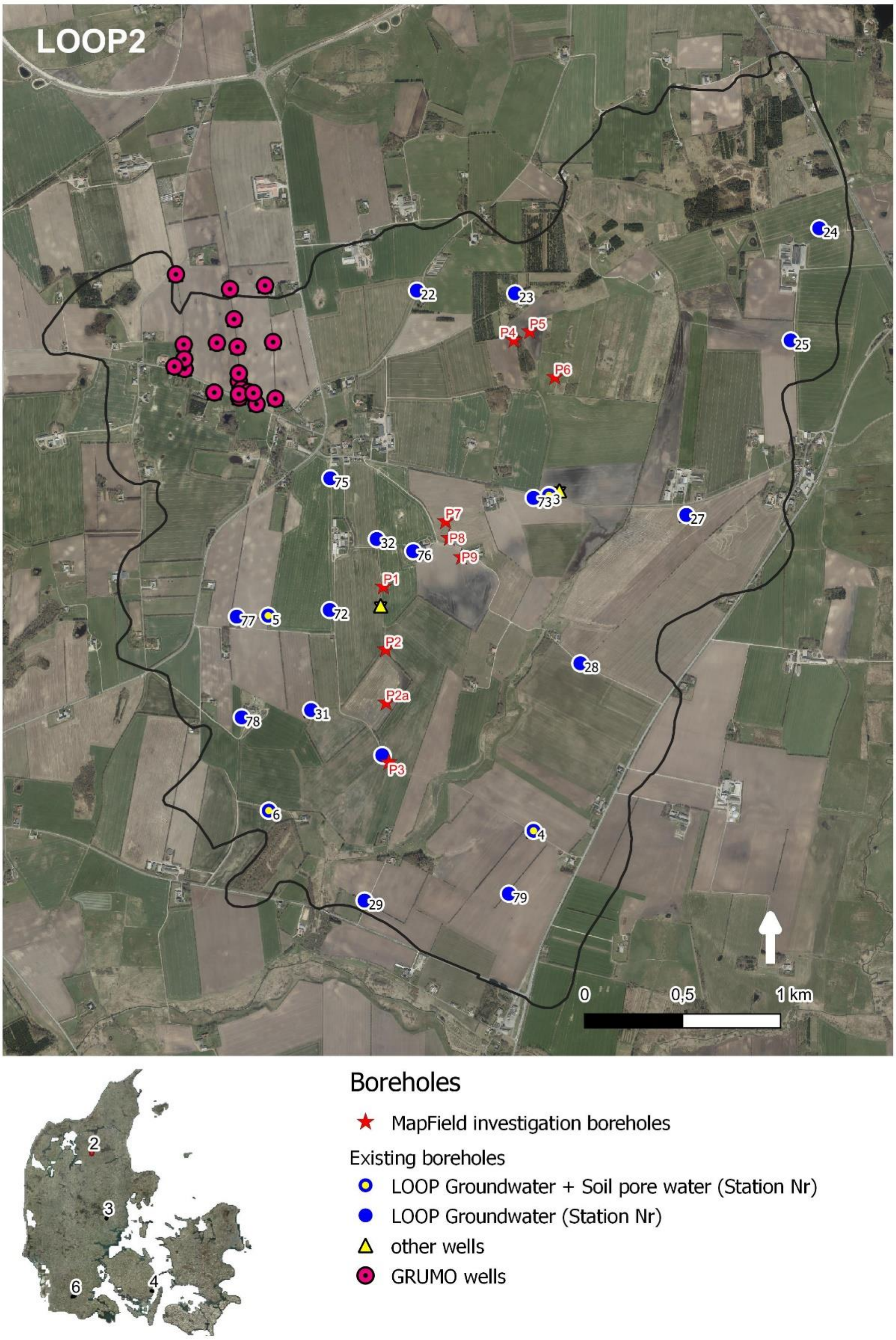


Figure 1. Overview of existing boreholes with geochemical information and MapField investigation wells

Table 1. Summary of Existing data in LOOP2 (No = number)

LOOP station Nr	Water chemistry							Groundwater table	
	DGU (X, Y)	Depth (m)	Data period	No. of DO samples	No. of NO3- samples	No. of Fe (II) samples	No. of SO42- samples	DGU (X, Y)	Data period (Nr. Of data)
1	40. 888 (531336, 6291836)	3.0-3.3	1989-1998	0	46	25	17	40. 889 (531336, 6291836)	2011-2011 (6)
	40. 889 (531336, 6291836)	5.0-5.3	1989-2018	43	184	155	60		
2								40. 963 (532402, 6291996)	1991-2017 (2344)
3	40. 899 (532946, 6291278)	1.2-1.5	1989-1998	0	28	15	6	40. 901 (532946, 6291278)	2011-2011 (4)
	40. 900 (532946, 6291278)	3.0-3.3	1989-1992	0	17	14	14	40. 904 (532945, 6291277)	2011-2011 (6)
	40. 901 (532946, 6291278)	5.0-5.3	1989-2017	19	134	111	55	40. 964 (532946, 6291278)	1991-2017 (1848)
	40. 902 (532945, 6291277)	1.2-1.5	1990-2017	3	23	15	2		
	40. 903 (532945, 6291277)	3.0-3.3	1989-1998	0	51	32	29		
	40. 904 (532945, 6291277)	5.0-5.3	1989-2017	23	155	136	59		
4	48. 956 (532866, 6289564)	3.0-3.3	1989-1998	0	28	14	11	48. 957 (532866, 6289564)	2017-2017 (6)
	48. 957 (532866, 6289564)	5.0-5.3	1989-2018	44	186	160	62	48. 999 (532866, 6289564)	1991-2017 (1879)
	48. 959 (532866, 6289564)	3.0-3.3	1990-1995	0	12	6	4		
	48. 960 (532866, 6289564)	5.0-5.3	1989-2018	44	185	156	63		
5	40. 905 (531512, 6290662)	1.2-1.5	1990-1995	0	16	10	1	40. 965 (531508, 6290655)	1991-2017 (698)
6	48. 962 (531515, 6289667)	3.0-3.3	1989-1998	0	43	22	13	48. 1000 (531515, 6289667)	1994-2017 (1398)
	48. 963 (531515, 6289667)	5.0-5.3	1989-2018	44	182	157	62		
	48. 965 (531515, 6289667)	3.0-3.3	1989-1998	0	57	33	27		
	48. 966 (531515, 6289667)	5.0-5.3	1989-2018	44	182	158	61		
21								40. 966 (530875, 6291924)	1991-2011 (18)
22	40. 882 (532271, 6292321)	3.0-3.3	1989-1995	0	19	14	7	40. 967 (532271, 6292321)	1991-1996 (12)
23	40. 886 (532772, 6292307)	5.0-5.3	1989-1996	0	31	19	14	40. 968 (532773, 6292307)	1991-1996 (12)
24	40. 865 (534324, 6292639)	5.0-5.3	1989-2012	8	88	79	35	40. 865 (534324, 6292639)	2011-2011 (6)
24				0	0	0	0	40. 969 (534324, 6292638)	1991-2012 (136)
25	40. 866 (534178, 6292066)	1.2-1.5	1989-1997	0	16	12	4	40. 867 (534178, 6292066)	2011-2011 (6)
	40. 867 (534178, 6292066)	3.0-3.3	1989-2018	42	137	123	45	40. 868 (534178, 6292067)	2011-2011 (6)
	40. 868 (534178, 6292067)	5.0-5.3	1989-2018	43	129	118	39	40. 970 (534178, 6292066)	1991-2017 (174)
26	40. 869 (533646, 6291176)	1.2-1.5	1990-1997	0	14	10	2	40. 971 (533645, 6291178)	1994-1996 (12)
	40. 870 (533646, 6291176)	3.0-3.3	1989-1998	0	36	24	17		
	40. 871 (533646, 6291176)	5.0-5.3	1989-1998	0	29	18	14		
27	40. 872 (533646, 6291176)	1.2-1.5	1989-1997	0	15	10	4		
	40. 873 (533646, 6291176)	3.0-3.3	1989-1997	0	32	22	18		
	40. 874 (533646, 6291176)	5.0-5.3	1989-1997	0	27	17	16		
28	40. 974 (533105, 6290419)	1.2-1.5	1989-1996	0	17	11	3	40. 973 (533106, 6290419)	1991-2017 (163)
	40. 975 (533105, 6290419)	3.0-3.3	1989-2017	31	120	110	47	40. 975 (533105, 6290419)	2011-2011 (5)
	40. 976 (533105, 6290419)	5.0-5.3	1989-2017	31	114	106	43	40. 976 (533105, 6290419)	2011-2011 (5)
29	48. 946 (532004, 6289208)	1.2-1.5	1989-1995	0	13	11	4	48. 1001 (532004, 6289205)	1994-2017 (166)
	48. 947 (532004, 6289208)	3.0-3.3	1989-2018	43	123	111	33		

	48. 948 (532004, 6289208)	5.0-5.3	1989-2018	44	127	118	41		
30	48. 952 (532097, 6289948)	1.2-1.5	1989-1994	0	16	10	1	48. 954 (532094, 6289950)	2011-2011 (6)
	48. 953 (532095, 6289950)	3.0-3.3	1989-1997	0	32	22	20	48. 1002 (532098, 6289950)	1994-2017 (162)
	48. 954 (532094, 6289950)	5.0-5.3	1989-2017	31	114	106	43		
31	48. 950 (531731, 6290180)	3.0-3.3	1989-1995	0	23	13	7	48. 1003 (531731, 6290180)	1994-2010 (14)
	48. 951 (531731, 6290180)	5.0-5.3	1989-1996	0	34	20	17		
32	40. 877 (532066, 6291053)	5.0-5.3	1989-2018	37	125	110	37	40. 877 (532066, 6291053)	2011-2011 (6)
								40. 972 (532064, 6291042)	1991-2016 (165)
71	40. 450 (532086, 6290713)	27.5-33.5	1989-1997	0	18	11	8	40. 450 (532086, 6290713)	1975-2006 (40)
72	40. 846 (531826, 6290691)	38.0-44.0	1989-1997	0	19	12	9		
73	40. 464 (532866, 6291263)	7.0-15.0	1989-1997	0	19	17	15	40. 464 (532866, 6291263)	1976-2006 (63)
75	40. 492 (531829, 6291363)	19.0-27.0	1989-1997	0	19	13	11	40. 492 (531829, 6291363)	1977-2000 (41)
76	40. 539 (532252, 6290991)	32.5-41.5	1986-1997	0	20	13	11	40. 539 (532252, 6290991)	1978-1988 (36)
77	40. 545 (531352, 6290657)	52.0-58.0	1989-1993	0	11	11	10	40. 545 (531352, 6290657)	1978-2006 (43)
78	48. 996 (531377, 6290143)	39.5-45.5	1989-1995	0	16	11	10	48. 996 (531377, 6290143)	1984-2016 (4287)
79	48. 689 (532740, 6289243)	10.2-16.5	1976-1997	0	20	13	10	48. 689 (532740, 6289243)	1976-2015 (54)
GRUMO	40. 511 (531388, 6291815)	19.0-29.0	1989-2015	15	33	26	20	40. 511 (531388, 6291815)	1976-2006 (8)
	40. 553 (531362, 6291859)	17.5-28.8	1989-2018	31	42	41	40	40. 553 (531362, 6291859)	1977-2017 (16)
								40. 962 (531336, 6291836)	1991-2017 (1988)
	40. 847 (531376, 6291817)	43.3-53.3	1989-2016	25	34	35	35	40. 847 (531376, 6291817)	1988-2001 (7)
	40. 911 (531362, 6291899)	9.0-15.0	1989-2018	34	43	42	43	40. 911 (531362, 6291899)	1988-2017 (52)
	40. 913 (531537, 6292058)	14.0-17.0	1989-2018	33	45	44	44	40. 913 (531537, 6292058)	1988-2017 (46)
	40. 914 (531356, 6292034)	11.0-17.0	1989-2018	32	44	43	42	40. 914 (531356, 6292034)	1988-2017 (53)
	40. 915 (531250, 6292055)	9.0-12.0	1989-2018	31	42	41	42	40. 915 (531250, 6292055)	1988-2017 (52)
	40. 916 (531081, 6292046)	15.0-18.0	1989-2018	32	42	41	42	40. 916 (531081, 6292046)	1988-2017 (50)
	40. 917 (531338, 6292175)	17.5-23.5	1989-2018	31	44	43	44	40. 917 (531338, 6292175)	1988-2017 (53)
	40. 918 (531362, 6291898)	104.0-109.0	1989-2017	28	36	39	39	40. 918 (531362, 6291898)	1988-2017 (52)
	40. 995 (531317, 6292329)	21.0-24.0	1993-2018	26	33	33	31	40. 995 (531317, 6292329)	1992-2017 (39)
	40. 1366 (531086, 6291921)	13.0-14.0	2005-2018	14	14	14	14	40. 1366 (531086, 6291921)	2005-2017 (14)
	40. 1367 (531084, 6291971)	15.0-16.0	2005-2018	15	15	15	15	40. 1367 (531084, 6291971)	2005-2017 (14)
	40. 1368 (531237, 6291801)	12.0-13.0	2005-2018	15	15	15	15	40. 1368 (531237, 6291801)	2005-2017 (16)
	40. 1371 (531452, 6291742)	15.7-16.7	2005-2018	16	16	16	16	40. 1371 (531452, 6291742)	2005-2017 (14)
	40. 1369 (531364, 6291775)	14.0-15.0	2005-2017	13	13	13	13	40. 1369 (531364, 6291775)	2005-2017 (12)
	40. 1370 (531411, 6291803)	14.6-15.6	2005-2018	14	14	14	14	40. 1370 (531411, 6291803)	2005-2017 (14)
	40. 1373 (531437, 6291798)	15.0-16.0	2005-2018	15	15	15	15	40. 1373 (531437, 6291798)	2005-2017 (14)
	40. 1374 (531034, 6291934)	13.0-14.0	2005-2018	15	15	15	15	40. 1374 (531034, 6291934)	2005-2017 (14)
	40. 1372 (531363, 6291793)	14.0-15.0	2005-2018	17	17	17	17		
	40. 1375 (531549, 6291769)	17.0-18.0	2005-2018	15	15	15	15	40. 1375 (531549, 6291769)	2005-2017 (14)
	40. 1376 (531041, 6292404)	20.0-21.0	2005-2017	13	14	14	14	40. 1376 (531041, 6292404)	2005-2017 (15)
	40. 1377 (531496, 6292346)	24.5-25.5	2005-2018	14	13	13	14	40. 1377 (531496, 6292346)	2005-2017 (14)
other	40. 1708 (532998, 6291300)		2014-2017	15	33	33	3		

	48. 927 (528652, 6289208)	33.0-39.0	1994-2018	4	4	4	4		
	40. 1022 (531367, 6291810)	105.0-114.0	1994-2017	11	14	14	14	40. 1022 (531367, 6291810)	1993-2006 (5)
								40. 827 (531374, 6291817)	1986-2001 (5)
								40. 1372 (531363, 6291793)	2005-2017 (15)
	40. 1708 (532998, 6291300)		2014-2017	15	33	33	3		

3.2. Results of the redox survey and sample collection

In May 2019, the redox survey was carried out at 9 points and core sampling was carried out at 10 points (Figure 1 and Table 2). P2a was added after the redox probe survey; therefore, the redox survey was not carried out at this point. In total 100 core samples for pore water extraction, 75 for the nitrate reduction rate measurements, 68 samples for the sediment geochemistry and 109 samples for the lithology description were collected. In addition, for methodological evaluation of the N reduction rate measurement, four additional cores were collected at P2. In April 2020, the redox survey was carried out again in five locations (P1, P2, P2a, P3, and P4) and again in September 2020 in four locations (P1, P2, P3, and P4). The data obtained in the redox probe survey of 2019 are unstable and should not be used in the interpretations and data analyses.

Table 2. Summary of core samples collected in the MapField project

Point	DGU (X, Y)	Depth (m)		No. of samples					Total
		Rx*	Core*	L[1)]	S[2)]	R[3)]	W[4)]	E[5)]	
P1	40. 2054 (523100, 6290810)	14	13.13	19	10	10	13		**52**
P2	40. 2055 (532123, 6290598)	8	7.31	11	10	10	10	**4**	**45**
P2a	48. 2126 (532114, 6290217)	16	14.83	12	7	12	14		**45**
P3	48. 2127 (532166, 6289890)	7	6.1	6	5	5	7		**23**
P4	40. 2056 (532766, 6292068)	18	18.3	16	9	7	15		**47**
P5	40. 2057 (532847, 6292112)		6.37	7	5	8	9		**29**
P6	40. 2058 (532975, 6291879)		9.76	11	6	9	10		**36**
P7	40. 2059 (532417, 6291143)		6.03	6	4	3	5		**18**
P8	40. 2060 (532436, 6291057)		5.9	5	4	3	5		**17**
P9	40. 2061 (532499, 6290960)		11.25	16	8	8	12		**44**
Total				**109**	**68**	**75**	**100**		**352**

***Redox, investigation depths of the second survey; **Core; [1)] Lithology; [2)] Sediment chemistry; [3)] N reduction rate; [4)] Pore water chemistry; and [5)] N rate experiment;**

3.3. Interpretation of redox zones

The interpreted redox zones are shown in the chemistry tables in Appendix 2 where:

- Redox zone A is the oxic zone
- Redox zone B the anoxic nitrate reducing zone
- Redox zone C is the reduced zone

The evaluation of the redox zones is mainly based on the following indicators:

- The nitrate and sulfate, being redox sensitive water chemical compounds:
    - Stable high nitrate concentrations and low sulfate concentrations indicate oxic conditions
    - Low and/or deceasing nitrate concentrations over depth on agricultural fields indicate nitrate reducing conditions sometimes supported by increasing sulfate concentrations
    - Stable nitrate concentrations below 1-3 mg/l indicate reduced conditions as low concentrations of nitrate could be from ammonium oxidation during sampling
- The sediment content of Fe^{2+}/Fe_{total}, where even small amounts of extractable Fe(II) indicate lack of oxygen implying nitrate reducing or reduced conditions
- Color descriptions of the sediment, where reddish, orange, brown colors indicate oxic conditions, and olive, greyish colors indicate nitrate reducing or reduced conditions

The redox probe measurements seem to be able to detect the redox interfaces to some degree.

3.4. Overview on the MapField chemical analyses

The results from the analysis performed in 2019 on pore water and sediment samples are summarized in Appendix 3. Nitrate reduction rate, sediment chemistry and selected water chemistry data are displayed in diagrams in Appendix 4 together with redox-probe measurements despite of its uncertainty.

3.5. Results from the extra nitrate reduction rate experiments

The set of experiments that were the same for LOOP3 and LOOP2 are reported here.

Usage/production of N_2O

Rate measurements made in rOpen indicated that there could be a production of N_2O without the addition of acetylene as well as a consumption of N_2O. To clarify the magnitude of these effect and if possible whether the disappearance of N_2O was related to the presence of dissolved Fe^{2+} acting as electron donor, a set of experiments with sediment from LOOP3 and LOOP2 were carried out. The results from the N_2O production experiments are shown in Figure 2. In the experiment with the LOOP3 sediments there was a delay of at least 70 hours before any significant changes were seen, but sometime during the period until the next sampling at close to 400 hours, the concentration had increased in all flasks. It is however clear that the increase in the flasks with acetylene was about two orders of magnitude higher, implying that any release of N_2O not related to the acetylene blocking is negligible. The second experiment with LOOP2 sediment was sampled more frequently and for a longer time. The sediment is much more reactive with rapid increases in most systems where acetylene was added (“1-(A-B)+Ace”). The plateau around 3000 ppm corresponds to where all the nitrate added is reduce. In the systems with added nitrate (“1-(A-C)”) without acetylene there is an increase in N_2O to a peak value, ranging from 22-85 ppm, followed by a decrease to very low values. The peak values presumably reflect that the last step in the denitrification where N_2O is reduced to N_2 takes longer to reach the maximum rate than the N_2O production, leading to a peak before the rates are balanced. The systems (“0-(A-C)”) that only have the nitrate naturally present in the porewater of the sample reach much lower levels of N_2O, the systems without acetylene have a peak as seen for the systems with added nitrate, though this is much lower, presumably due to the much lower nitrate concentration, which based on the maximum N_2O development in the systems with acetylene should be around 40µM or ~2.5 mg/L.

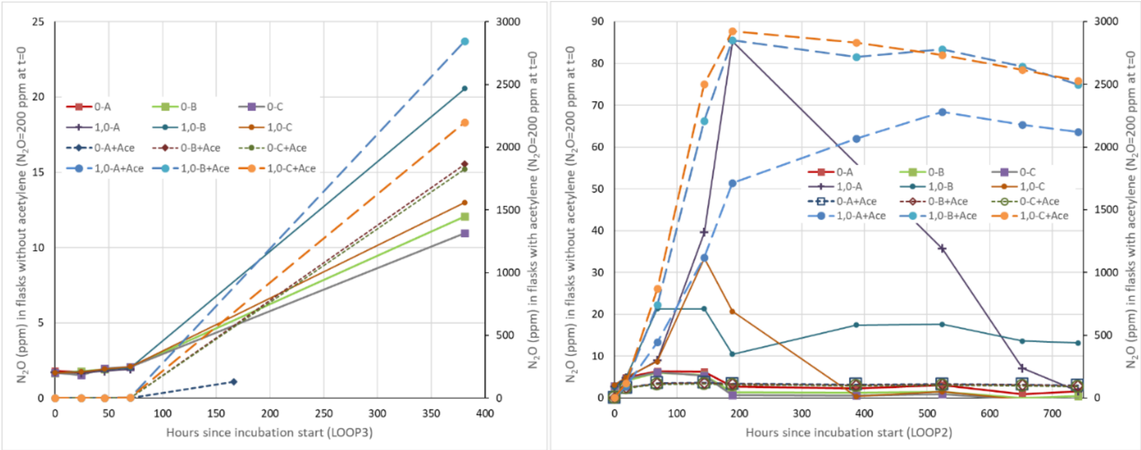


Figure 2: The development of N_2O in sediments from LOOP3(left) and LOOP2(right). The "+Ace" are systems where N_2O consumption was blocked by acetylene, the "0-" systems had no nitrate added, the "1,0" experiments had a conc. of 1 mM nitrate presence. A, B, C are the three triplicates.

To look into the consumption of N_2O, and to see if this was affected by the presence of Fe^{2+} a set of experiments where N_2O was added initially was setup for both LOOP3 and LOOP2 sediments, 1 mM of nitrate was added to all of these systems, the Fe^{2+} concentration is shown in figure 4.

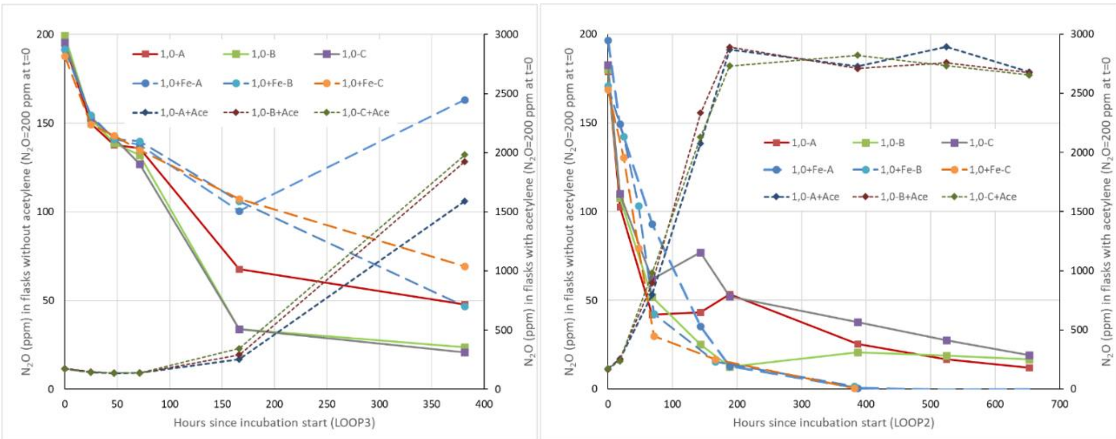


Figure 3: The development of N_2O in LOOP3(left) and LOOP2(right) incubations with an initial N_2O concentration of ~200 ppm, with and without Fe^{2+} and with acetylene (secondary Y-axis)

The results are similar for LOOP3 and LOOP 2, but again the sediment in the LOOP2 systems is more reactive, so everything goes faster. In both LOOP3 and LOOP2 in the systems without acetylene and without added Fe^{2+} the N_2O is used, more rapidly in the LOOP2 systems. The effect of the presence of Fe^{2+} is not clear, in both the LOOP3 and LOOP2 sediments the use of N_2O is faster without Fe^{2+} compared to when Fe^{2+} has been added, but later the rate is generally higher in the presence of Fe^{2+} and in the LOOP2 systems the N_2O is completely removed after 400 hours in the presence of

Fe^{2+}. This could be an effect of the Fe^{2+} concentration which stayed at a higher concentration in the LOOP2 systems (Figure 4).

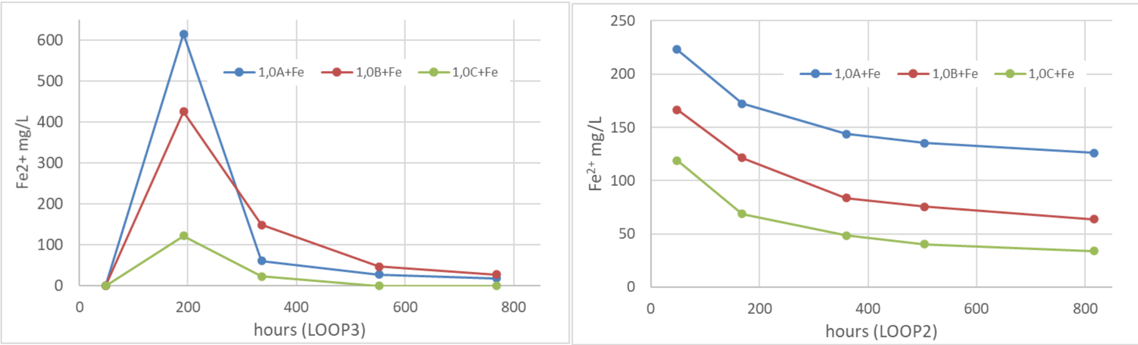


Figure 4: The Fe^{2+} in the (1,0Fe-(A-C) experiments in Figure 3 for LOOP3(left) and LOOP2(right). The difference in the initial Fe^{2+} concentration could be due to the different preparations. In the LOOP 3 experiment a slurry of CaCO3 which had been stirred in a $FeCl_2$ solution was used, while for LOOP2 siderite $FeCO_3$ was used.

In the systems where acetylene was added, there is an increase from the initial ~200 ppm N_2O added in all the systems. In the less reactive LOOP3 system there is a lag phase during which N_2O is slowly being used before the production starts after ~75 hours, this lag-time is similar to what is seen in figure 3. In the LOOP2 systems the rate is so fast that all of the nitrate is used after ~200 hours, very similar to the behavior seen for LOOP2 in figure 3.

Comparison of rates determined by N_2O and nitrate removal

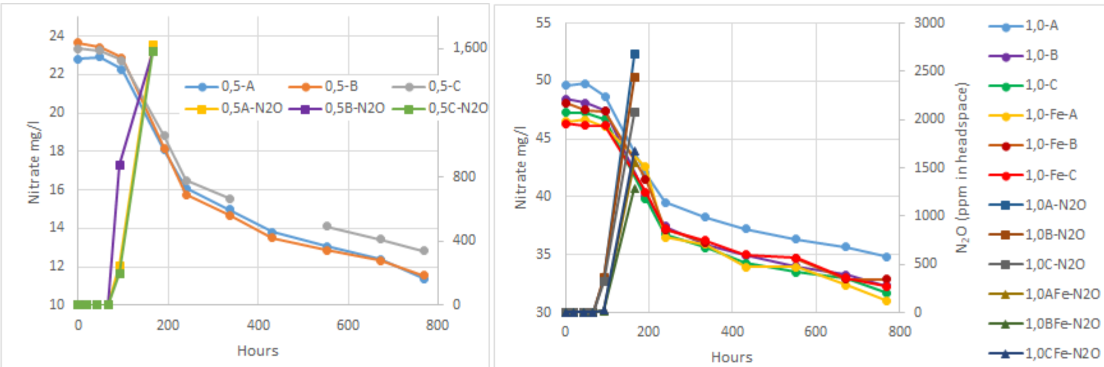


Figure 5: The development of nitrate and N_2O (acetylene blocked) (separate flasks) in sediments from LOOP3 at an initial nitrate concentration of ~0.5 mM and ~1.0 mM (with and without Fe^{2+} for 1mM. The Fe^{2+} concentration was ~60 mg/L in the N_2O systems and ~1 in the nitrate removal flask – except for "1,0-A which had~3 mg/l of Fe^{2+})

As the title reads, the first aim of these sets of experiments was to compare rates determined by the acetylene block method – leading to N_2O accumulation with rates determined more directly by the removal of nitrate from the water in the system. The second aim of the experiments was to see if there was an effect of the nitrate concentration on the nitrate reduction rate – an effect that could be important for how the removal of nitrate in the aquifer is modeled. These two aims were pursued in experiments set up with sediment from LOOP3 and LOOP2. Additional more detailed experiments looking into the effect of the nitrate concentration on the rates were later made with sediment from LOOP6 and LOOP4 using the acetylene block method, these will be described in a separate section.

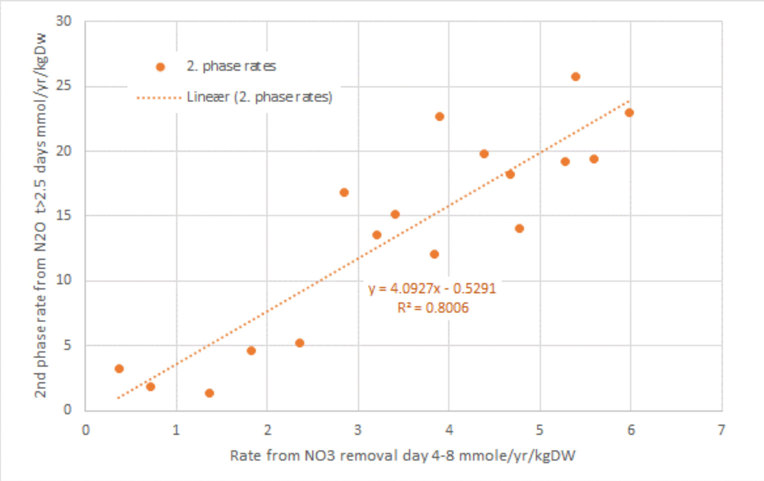


Figure 6:Crossplot of the rates determined by nitrate removal and N_2O accumulation after acetylene blocking for LOOP3 sediments

The development in the nitrate concentration and the N_2O is shown for concentrations ~0.5 mM and 1.0 mM in Figure 5. For both types of systems, the measured parameters display an initial lag phase before much happens. Our interpretation is that due to the relatively low reactivity of the sediments it takes time before the last traces of oxygen, present in the systems after these have been set up, is completely gone. There appears to be an effect of the presence of Fe^{2+} on the development of N_2O in the acetylene blocked systems with Fe^{2+} where the Fe^{2+} concentration is ~60 mg/l, as these show a slightly lower rate of N_2O development. The effect is not necessarily an effect of the Fe^{2+} but could be other parameters e.g. the pH, which was not measured. Based on the delay seen in both experiments, both the ones displayed in Figure 5 and the experiments with 0.2 mM and 2.0 mM of nitrate it was decided to use the late stages (if it is seen) of the N_2O data for calculating the rates both for these experiments and in general – and in order to make the nitrate removal rates as comparable as possible the period from 96-192 hours was used to calculate the rates. The derived rates from the two sets of experiments are cross-plotted in Fig. 6 after being recalculated into a common unit of mmol NO3/yr/kg_{dw}.

The values obtained from the two different methods for rate measurements correlate reasonably well, however the slope is quite far from 1:1, a simple linear correlations indicates that rates measured by the acetylene block method are 4 times higher than the rate derived from nitrate removal. The reason for this is not known, but it could be related to the difficulties in removing the last traces of oxygen, which may have affected the two systems differently or it could be a scale problem, as the nitrate removal took place in larger bottles with more sediment.

In the corresponding LOOP2 experiment there was no lag phase which is assumed to be due to a much higher rate. The results for four of the tested concentrations are shown in Fig. 7. Based on the results from LOOP3 samples for N_2O were taken for a longer time – however it turned out that because the reactivity of the sediment was much higher, implying that the nitrate was quickly gone, the increase in N_2O ceased in many of the systems after ~200 hours. It should be kept in mind that the nitrate removal and the N_2O development is observed in different flasks, and in spite of being set up with the same sediment they obviously do not behave identically and can be out of sync (e.g. in the “1,0” Fe flasks). For this set of experiments, data for sulfate from the nitrate removal systems are also available, they are shown in Figure 8. The Fe^{2+} concentrations from the systems to which Fe^{2} was added (in the form of siderite) are shown in Figure 9.

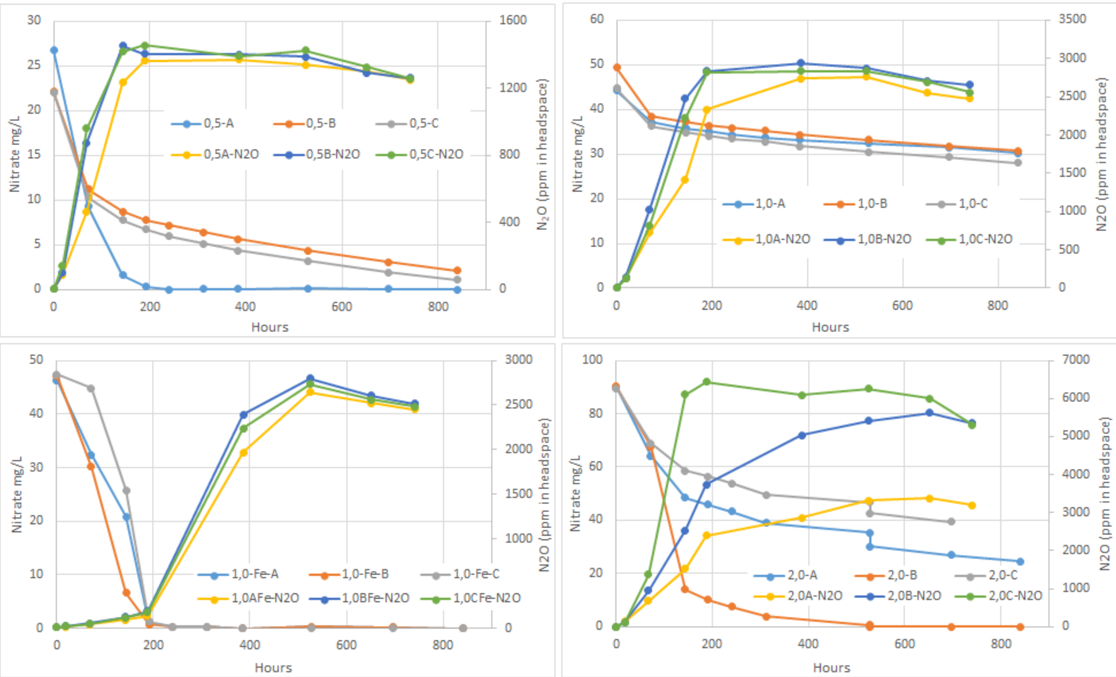


Figure 7: The development of nitrate and N_2O (acetylene blocked) (NB! In separate flasks) in sediments from LOOP2 at different initial nitrate concentrations (with and without Fe^{2+} for 1mM). The Fe^{2+} concentration was ~60 mg/L in the N_2O system.

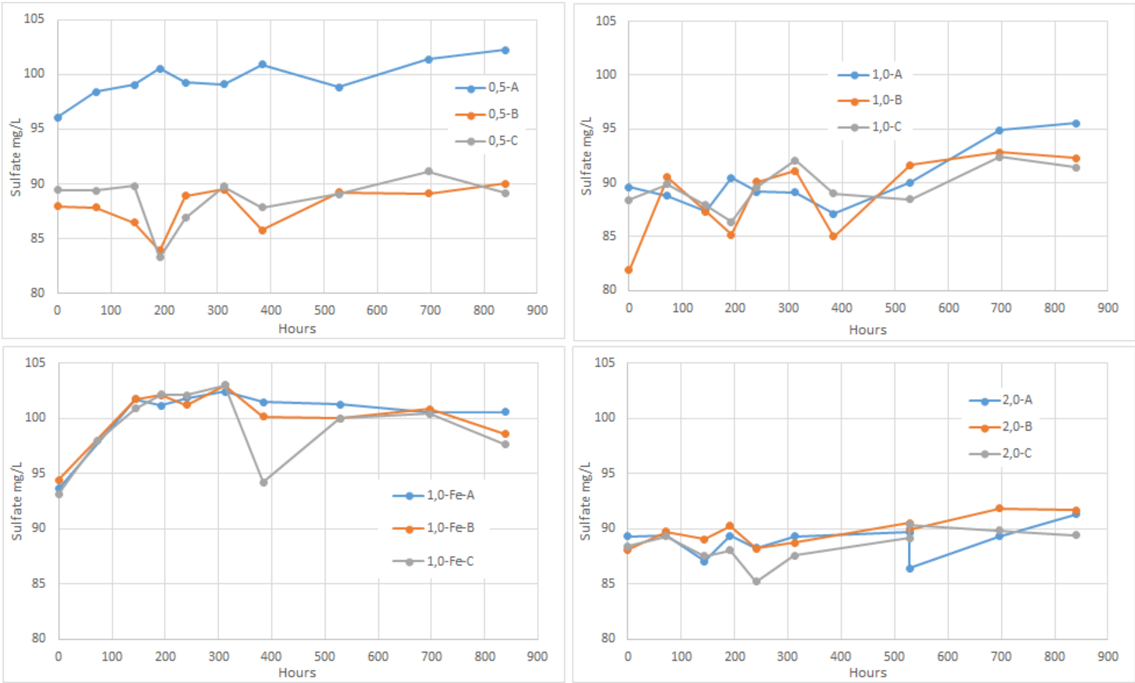


Figure 8. Sulfate development in LOOP2 nitrate removal systems for 0.5, 1.0, 1.0 with Fe2+, and 2.0 mmol/L of nitrate

The sulfate data show a rapid increase of about 7 mg/l in ~150 hours in sulfate in all of the flasks to which Fe^{2+} was added, while in the other flasks the changes in sulfate look different. In the systems with 0.5 mmol/L of nitrate flasks B+C show little change, while flask A has a higher initial sulfate concentration and shows an increase, also ~7 mg/L, this is also the flask that shows a notably faster removal of nitrate (Fig. 7 top-left) indicating that the faster rate is due to pyrite oxidation. The flasks with 1.0 mmol/L nitrate without Fe shows an erratic sulfate concentration with a slightly increasing trend, while the flasks with 2.0 mmol/L of nitrate show very little change.

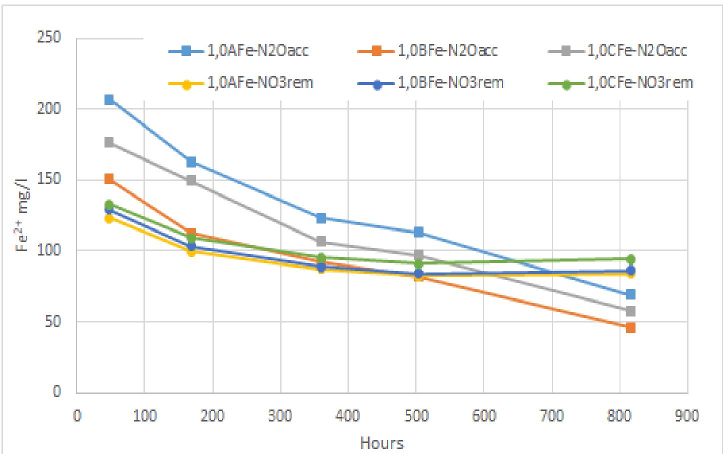


Figure 9: Development of Fe^{2+} in the 1 mmol/L nitrate systems with Fe^{2+} added as siderite "...N2Oacc" are from the acetylene blocked systems, while "...NO3rem" are from the nitrate removal systems

The course of the Fe^{2+} concentrations do not reflect the variations seen in the nitrate, N_2O and sulfate shown in Figure 7 and 8, presumably because the Fe^{2+} concentration is controlled by equilibrium with the siderite added to the flasks, the decrease over time may reflect that the equilibrium concentration is being controlled by increasingly larger crystals and is most probably related to the increase in dissolved carbonate due to the oxidation of organic matter in the systems.

The rates measured by the N_2O accumulation and the nitrate removal are compared in the crossplot in Figure 10. There is considerable scatter in the plot, but the correlation between the rate obtained by the two methods show a slope close to 1 indicating that the two methods give comparable results.

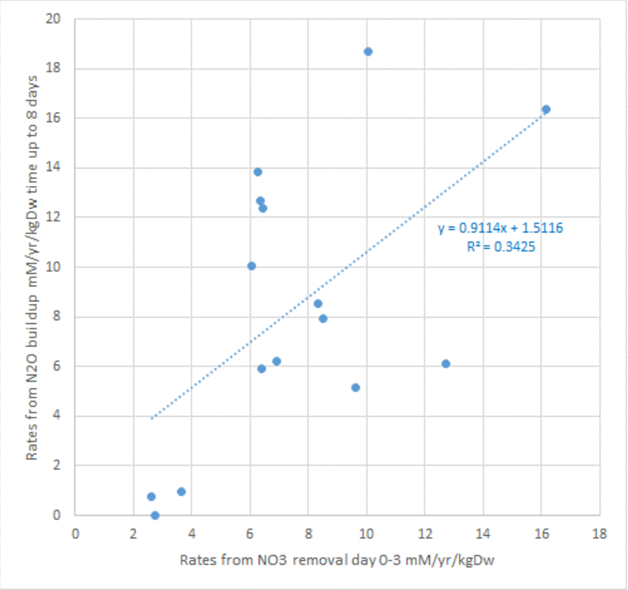


Figure 10. Crossplot of the rates determined by nitrate removal and N2O accumulation after acetylene blocking for LOOP2 sediments

The discrepancy between the comparison for LOOP3 compared to LOOP2 sediment could be an effect of the long initial lag phase which could have affected the reactivity of the organic matter in the LOOP3 sediments, resulting in a lower rate.

<u>The effect of the nitrate concentration on the rate of nitrate reduction.</u>

The experiments described above also aimed at determining if there was an effect of the nitrate concentration on the determined rate. The results for the acetylene block and nitrate removal experiments for LOOP3 are shown in Figure 11.

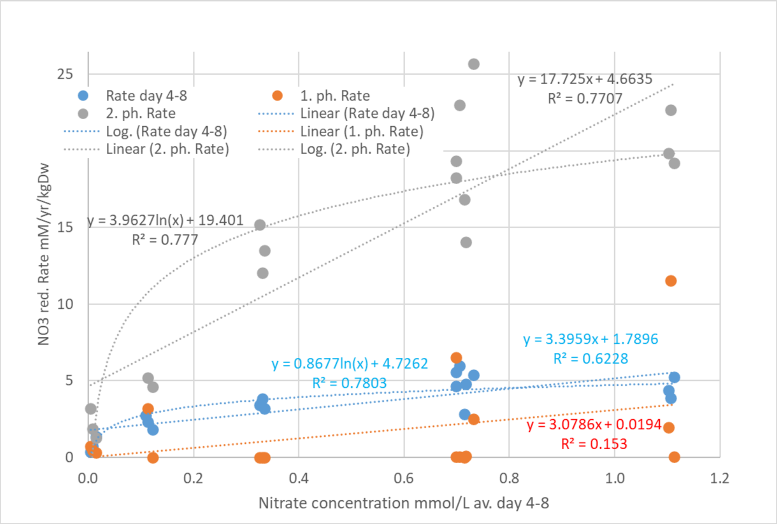


Figure 11. The rate as a function of the nitrate concentration for the early and late N2O rates and the rates determined from the nitrate removal for the LOOP3 sediments. The concentrations are in both cases from the nitrate removal experiments interpolated for 114 hours since nitrate was not measured in the acetylene block experiments.

Rates determined from the initial development in the N_2O show close to no correlation, further indicating that the early rates do probably not reflect actual rates. The late (2nd phase) N_2O rates show significant correlation, with no difference in the R^2 between a linear and a log correlation. The rates determined from the nitrate removal show significant linear as well as log correlation, with the R^2 value for the log correlation being slightly higher.

For LOOP2 the rates there was no initial lag phase as seen from Figure 7. The plot corresponding to Figure 11 for LOOP2 is shown in Figure 12. Due to the lack of initial lag phase the rates from the nitrate removal experiment are the rates derived from day 0-3 also used in Figure 10. The reactivity of the sediment is so high that the acetylene block rates are all 1. phase rates. Only a few bottles show a different (but lower) rate at late times.

Figure 12 indicates that there is an effect of the nitrate concentration when the concentration is below ~0.1 mmol/L and this appears to be the case for both the rates determined from nitrate removal and from N_2O accumulation. The correlation (R^2) is not notably different for a log correlation compared to a linear correlation, on the other hand for the linear correlation the rate is not zero when the nitrate concentration is zero.

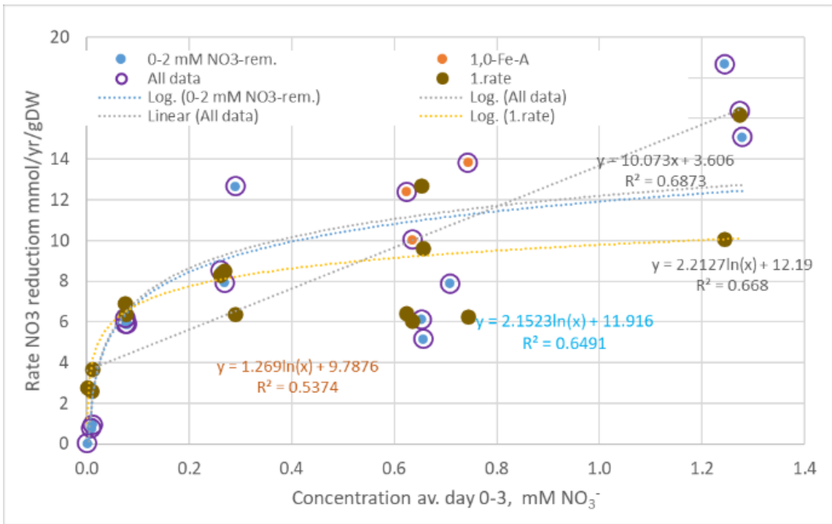


Figure 12: The Concentration - rate relationship seen for LOOP 2 experiments. For all data sets the average concentration for the 0-3 day interval was used.

To look a little further into this the development of the concentration of nitrate over time was replotted as the ratio between the concentration at time t and the initial concentration at t=0 (C_t/C_0) for LOOP3 in Figure 13. The figure shows that it is only for the lowest initial concentration (0.2 mmol/L NO_3^-) that an exponential development is seen, but at this low concentration it does seem that the development is well approximated by a first order dependency on the nitrate concentration.

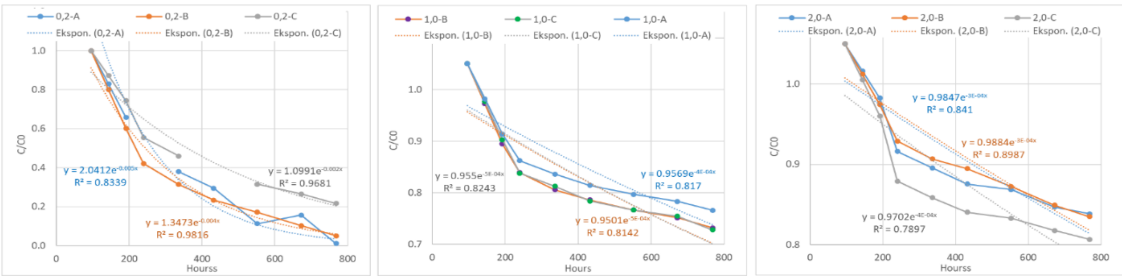


Figure 13:Development in the nitrate concentration over time for LOOP3 sediment incubations plotted as C_t/C_0 as a function of time for initial concentrations of 0.2, 1.0 and 2.0 mmol/L of nitrate with exponential curve fits.

For LOOP2 sediments only one out of the many nitrate removal curves indicate first order behavior (Fig. 14 – “0,5-C”), and this is only when disregarding the first interval, focusing on the data where the concentration is below 0.16 mmol/L. The “0,5-A” curve is from the flask with indication of pyrite oxidation, which could explain the notably different behavior. In summary the data indicate that the rate of nitrate reduction depends on the nitrate concentrations at concentrations below 0.1-0.2 mmol/L. Additional experiments were made for LOOP6 and LOOP4 described in the LOOP4 data report.

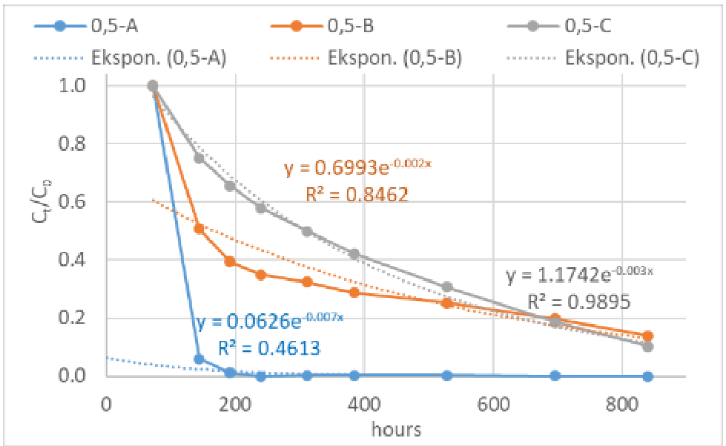


Figure 14: Development in the nitrate concentration over time for LOOP2 sediment incubations plotted as C_t/C_0 as a function of time for initial concentrations <0.16 mmol/L of nitrate with exponential curve fits.

Appendices

Appendix 1: Lithological descriptions of the MapField samples

Appendix 2: Water chemistry of existing data (LOOP, GRUMO and others)

Excel file available

Appendix 3: Water (Appendix3-1 and 3-2), sediment chemistry (Appendix 3-3), denitrification rates (Appendix 3-4) collected in the MapField project

Appendix 4: Well panels illustrating all the collected parameters

The well panels display from left towards right:

Panel 1: Lithology (from Jupiter, Appendix 1)

Panel 2: Sediment color (from Jupiter, Appendix 1)

Panel 3: Redox probe measurement (unstable 2019 data, not to be used in the interpretations, and 2020 data use with caution)

Panel 4: Redox capacity (analysis pending) and N-rate (blue curve)

Panel 5: Sediment chemistry; formic acid extracted Fe(II) and total Fe as well as the Fe(II)/Fe(total).

Panel 6: Water isotopes; δO_{18} and δD.

Panel 7: Concentrations of ammonium.

Panel 8: Concentrations of Cl^-, NO_3^- and SO_4^{2-} and DOC

Panel 9: Concentrations of Ca^{2+}, Mg^{2+}, K^+ and Na^+

Appendix 1: Lithological descriptions of the MapField samples

BORERAPPORT

DGU arkivnr: 40. 2054

Borested : Lindholmvej 4
9600 Års

Kommune : Vesthimmerland
Region : Nordjylland

Boringsdato : 14/5 2019
Boringsdybde : 13,13 meter
Terrænkote : 29 meter o. DNN

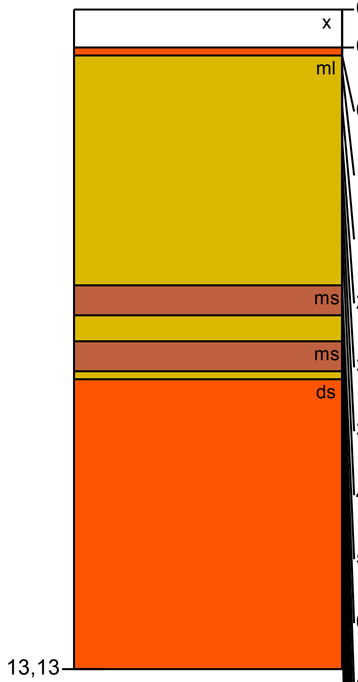
Brøndborer : Palle Ejlskov
MOB-nr :
BB-journr :
BB-bornr : LOOP2 - P1

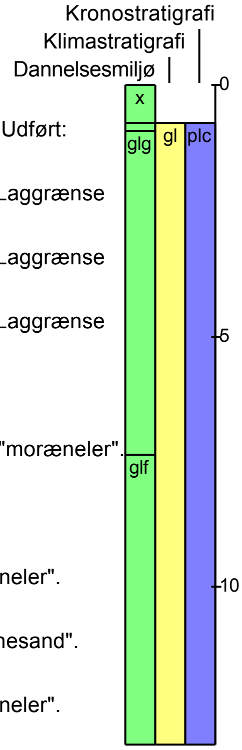
Prøver
- modtaget : 15/5 2019 **antal** : 20
- beskrevet : 25/2 2020 **af** : HJG
- antal gemt : 0

Formål : Undersøg./videnskab
Anvendelse :
Boremetode :

Kortblad : 1216 IINV
UTM-zone : 32
UTM-koord. : 532100, 6290810

Datum : EUREF89
Koordinatkilde : Brøndborer
Koordinatmetode : Landinspektør





meter u.t.

0 **INGEN PRØVE**, (ukendt lag, oplysninger mangler).

0,77 **SAND**, fint og mellem, svagt gruset, brun 10YR 5/3, kalkfri, "smeltevandssand", Udført: sigteanalyse. Laggrænse skønnet. Prøve udtaget ved .77 m.

0,9 **LER**, siltet, stærkt sandet, svagt gruset, gulbrun 10YR 5/4, kalkfri, "moræneler". Laggrænse skønnet. Prøve udtaget ved .97 m.

1,2 **LER**, siltet, stærkt sandet, svagt gruset, gulbrun 10YR 5/4, kalkfri, "moræneler". Laggrænse skønnet. Prøve udtaget ved 1.47 m.

1,9 **LER**, siltet, stærkt sandet, svagt gruset, gulbrun 10YR 5/4, kalkfri, "moræneler". Laggrænse skønnet. Prøve udtaget ved 2.44 m.

2,6 **LER**, siltet, stærkt sandet, svagt gruset, slirer af sand, gulbrun 10YR 5/4, kalkfri, "moræneler". Laggrænse skønnet. Prøve udtaget ved 2.69 m.

3,1 **LER**, siltet, stærkt sandet, svagt gruset, få slirer af sand, brun 10YR 5/3, kalkfri, "moræneler". Laggrænse skønnet. Prøve udtaget ved 3.66 m.

3,7 **LER**, siltet, stærkt sandet, svagt gruset, lys gråbrun 10YR 6/3, stærkt kalkholdig, "moræneler". Laggrænse skønnet. Prøve udtaget ved 3.71 m.

4,4 **LER**, siltet, sandet, svagt gruset, lys gråbrun 10YR 6/3, stærkt kalkholdig, "moræneler". Laggrænse skønnet. Prøve udtaget ved 5.13 m.

5,5 **SAND**, leret, siltet, svagt gruset, lys gråbrun 10YR 6/3, stærkt kalkholdig, "morænesand". Laggrænse skønnet. Prøve udtaget ved 5.87 m.

6,1 **LER**, siltet, sandet, svagt gruset, lys gråbrun 10YR 6/3, stærkt kalkholdig, "moræneler". Laggrænse skønnet. Prøve udtaget ved 6.35 m.

6,6 **SAND**, svagt siltet, svagt gruset, lys gråbrun 10YR 6/3, stærkt kalkholdig, "morænesand". Laggrænse skønnet. Prøve udtaget ved 6.98 m.

7,2 **LER**, siltet, stærkt sandet, svagt gruset, lys gråbrun 10YR 6/3, stærkt kalkholdig, "moræneler". Laggrænse skønnet. Prøve udtaget ved 7.32 m.

7,35 **SAND**, mest fint, svagt siltet, lys brungrå 10YR 6/2, stærkt kalkholdig, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 7.37 m.

7,5 **SAND**, mest mellem, lys brungrå 10YR 6/2, få bryozoer, kalkholdig, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 7.57 m.

8,1 **SAND**, mest mellem, lys brungrå 10YR 6/2, få bryozoer, kalkholdig, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 8.89 m.

9,4 **SAND**, mest mellem, lys brungrå 10YR 6/2, få bryozoer, kalkholdig, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 9.93 m.

10,2 **SAND**, mest mellem, lys brungrå 10YR 6/2, få bryozoer, kalkholdig, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 10.46 m.

10,6 **SAND**, fint og mellem, lys gråbrun 10YR 6/3, kalkholdig, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 10.71 m.

10,8 **SAND**, mest mellem, lys brungrå 10YR 6/2, få bryozoer, kalkholdig, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 10.98 m.

11,8 **SAND**, mest mellem, lys brungrå 10YR 6/2, stærkt kalkholdig, "smeltevandssand". Prøve udtaget ved 12.59 m.

fortsættes..

Aflejringsmiljø - Alder (klima-, krono-, litho-, biostratigrafi)

meter u.t.		
0 -	0,77	mangler
0,77 -	0,9	glaciofluvial - glacial - pleistocæn
0,9 -	7,35	glacigen - glacial - pleistocæn
7,35 -	13,13	glaciofluvial - glacial - pleistocæn

De Nationale Geologiske Undersøgelser for Danmark og Grønland

BORERAPPORT

DGU arkivnr: 40. 2055

Borested : Lindholmvej 8
9600 Års

Kommune : Vesthimmerland
Region : Nordjylland

Boringsdato : 14/5 2019
Boringsdybde : 7,55 meter
Terrænkote : 21,9 meter o. DNN

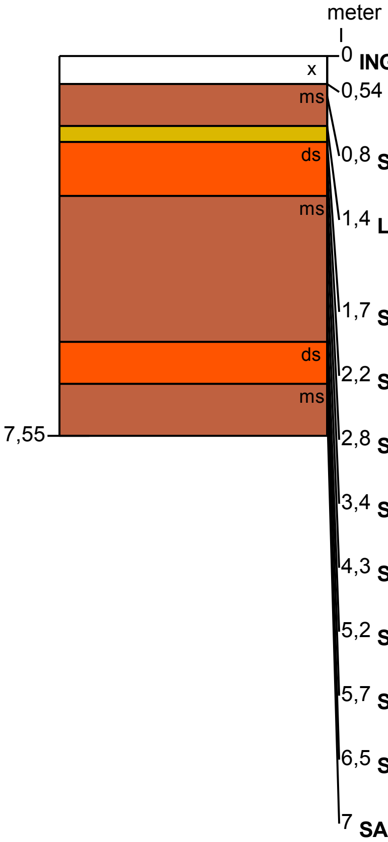
Brøndborer : Palle Ejlskov
MOB-nr :
BB-journr :
BB-bornr : LOOP2 - P2

Prøver
- modtaget : 15/5 2019 **antal** : 12
- beskrevet : 24/2 2020 **af** : HJG
- antal gemt : 0

Formål : Undersøg./videnskab
Anvendelse :
Boremetode :

Kortblad : 1216 IINV
UTM-zone : 32
UTM-koord. : 532123, 6290598

Datum : EUREF89
Koordinatkilde : Brøndborer
Koordinatmetode : Landinspektør



0 **INGEN PRØVE**, (ukendt lag, oplysninger mangler).

0,54 **SAND**, svagt leret, svagt siltet, stærkt gruset, gråbrun 2.5Y 5/2, kalkfri, "morænesand". Laggrænse skønnet. Prøve udtaget ved .54 m.

0,8 **SAND**, svagt leret, svagt siltet, svagt gruset, mørk gulbrun 10YR 4/4, kalkfri, "morænesand". Laggrænse skønnet. Prøve udtaget ved 1.27 m. Note: Bw E-horisont.

1,4 **LER**, siltet, sandet, svagt gruset, få slirer af sand, lys olivenbrun 2.5Y 5/3, kalkfri, "moræneler". Laggrænse skønnet. Prøve udtaget ved 1.47 m. Note: Røde jernudfældningspletter. Bt(g)-horisont.

1,7 **SAND**, mest mellem, brun 10YR 5/3, kalkfri, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 1.98 m.

2,2 **SAND**, mest mellem, grå 10YR 6/1, kalkfri, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 2.49 m.

2,8 **SAND**, svagt leret, svagt siltet, svagt gruset, grå 10YR 5/1, kalkfri, "morænesand". Laggrænse skønnet. Prøve udtaget ved 3.23 m.

3,4 **SAND**, svagt leret, svagt siltet, svagt gruset, grå 10YR 5/1, svagt kalkholdig, "morænesand". Laggrænse skønnet. Prøve udtaget ved 3.71 m.

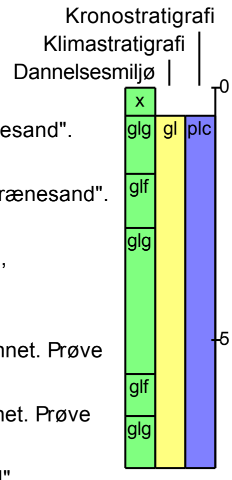
4,3 **SAND**, stærkt leret, siltet, svagt gruset, mørk grå 10YR 4/1, stærkt kalkholdig, "morænesand". Laggrænse skønnet. Prøve udtaget ved 4.99 m.

5,2 **SAND**, svagt leret, svagt siltet, svagt gruset, grå 10YR 5/1, stærkt kalkholdig, "morænesand". Laggrænse skønnet. Prøve udtaget ved 5.47 m.

5,7 **SAND**, mest mellem, lys brungrå 10YR 6/2, kalkholdig, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 6.21 m.

6,5 **SAND**, leret, siltet, svagt gruset, grå 10YR 5/1, stærkt kalkholdig, "morænesand". Laggrænse skønnet. Prøve udtaget ved 6.69 m.

7 **SAND**, stærkt leret, siltet, svagt gruset, grå 10YR 5/1, stærkt kalkholdig, "morænesand". Prøve udtaget ved 7.31 m. Note: Rødbrune udfældninger med okker.



Aflejringsmiljø - Alder (klima-, krono-, litho-, biostratigrafi)

meter u.t.			
0	-	0,54	mangler
0,54	-	1,7	glacigen - glacial - pleistocæn
1,7	-	2,8	glaciofluvial - glacial - pleistocæn
2,8	-	5,7	glacigen - glacial - pleistocæn
5,7	-	6,5	glaciofluvial - glacial - pleistocæn
6,5	-	7,55	glacigen - glacial - pleistocæn

BORERAPPORT

DGU arkivnr: 48. 2126

Borested : Lindholmvej 8
9600 Års

Kommune : Vesthimmerland
Region : Nordjylland

Boringsdato : 14/5 2019
Boringsdybde : 14,83 meter
Terrænkote : 18,77 meter o. DNN

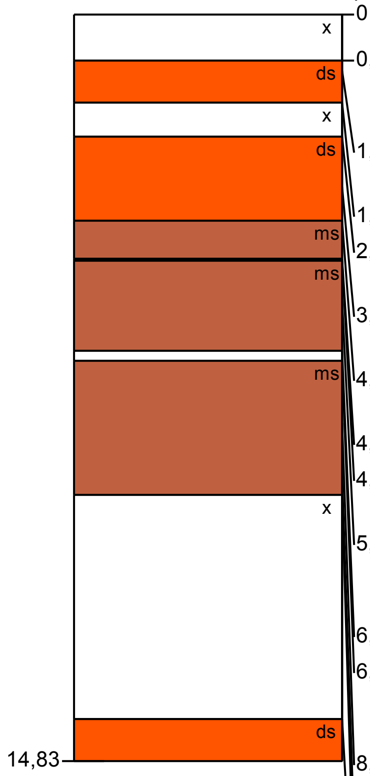
Brøndborer : Palle Ejlskov
MOB-nr :
BB-journr :
BB-bornr : LOOP2 - P2a

Prøver
- modtaget : 15/5 2019 **antal** : 11
- beskrevet : 25/2 2020 **af** : HJG
- antal gemt : 0

Formål : Undersøg./videnskab
Anvendelse :
Boremetode :

Kortblad : 1216 IINV
UTM-zone : 32
UTM-koord. : 532114, 6290217

Datum : EUREF89
Koordinatkilde : Brøndborer
Koordinatmetode : Landinspektør



meter u.t.

0 **INGEN PRØVE**, (ukendt lag, oplysninger mangler).

0,9 **SAND**, mest mellem, svagt gruset, gulbrun 10YR 5/4, kalkfri, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved .9 m. Note: Bw -horisont. Kernestykke 0,54-1,22 optræder ikke i excel-ark med prøvenumre og -dybder.

1,1 **SAND**, fint og mellem, svagt gruset, gråbrun 10YR 5/2, kalkfri, "smeltevandssand", Udført: sigteanalyse. Prøve udtaget ved 1.22 m.

1,76 **INGEN PRØVE**, (ukendt lag, oplysninger mangler). Note: Kernestykke 1,76-2,44 mangler.

2,44 **SAND**, mest fint, lys brungrå 10YR 6/2, kalkfri, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 3.33 m.

3,4 **SAND**, mest fint, grå 10YR 6/1, kalkfri, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 3.66 m.

4,1 **SAND**, svagt leret, svagt siltet, svagt gruset, grå 10YR 5/1, kalkholdig, "morænesand". Prøve udtaget ved 4.35 m. Note: Vandmættet.

4,84 **INGEN PRØVE**, (ukendt lag, oplysninger mangler). Note: Kernestykke 4,84-4,88 mangler.

4,88 **SAND**, svagt leret, svagt siltet, svagt gruset, grå 10YR 5/1, kalkholdig, "morænesand". Laggrænse skønnet. Prøve udtaget ved 5.47 m. Note: Vandmættet.

5,7 **SAND**, svagt leret, svagt siltet, svagt gruset, grå 10YR 5/1, svagt indh.af kalkklaster, stærkt kalkholdig, "morænesand". Prøve udtaget ved 5.8 m. Note: Vandmættet. 2 kernestykker med samme påskrift: "5,96-". Indholdet er dog det samme..

6,69 **INGEN PRØVE**, (ukendt lag, oplysninger mangler). Note: Kernestykke 6,69-6,89 mangler.

6,89 **SAND**, svagt leret, svagt siltet, svagt gruset, grå 10YR 5/1, svagt indh.af kalkklaster, stærkt kalkholdig, "morænesand". Laggrænse skønnet. Prøve udtaget ved 7.27 m. Note: Vandmættet.

8,1 **SAND**, svagt leret, svagt siltet, svagt gruset, gråbrun 10YR 5/2, stærkt kalkholdig, "morænesand". Laggrænse skønnet. Prøve udtaget ved 8.84 m. Note: Tør.

9,2 **SAND**, svagt leret, svagt siltet, svagt gruset, gråbrun 10YR 5/2, stærkt kalkholdig, "morænesand". Prøve udtaget ved 9.53 m. Note: Tør.

9,53 **INGEN PRØVE**, (ukendt lag, oplysninger mangler).

14 **SAND**, mest fint, lys brungrå 10YR 6/2, kalkholdig, "smeltevandssand". Prøve udtaget ved 14.2 m.

fortsættes..

BORERAPPORT

DGU arkivnr: 48. 2126

Aflejringsmiljø - Alder (klima-, krono-, litho-, biostratigrafi)

meter u.t.		
0	0,9	mangler
0,9	1,76	glaciofluvial - glacial - pleistocæn
1,76	2,44	mangler - glacial - pleistocæn
2,44	4,1	glaciofluvial - glacial - pleistocæn
4,1	4,84	glacigen - glacial - pleistocæn
4,84	4,88	mangler - glacial - pleistocæn
4,88	6,69	glacigen - glacial - pleistocæn
6,69	6,89	mangler - glacial - pleistocæn
6,89	9,53	glacigen - glacial - pleistocæn
9,53	14	mangler - glacial - pleistocæn
14	14,83	glaciofluvial - glacial - pleistocæn

BORERAPPORT

DGU arkivnr: 48. 2127

Borested : Lindholmvej 8
9600 Års

Kommune : Vesthimmerland
Region : Nordjylland

Boringsdato : 14/5 2019 **Boringsdybde** : 6,1 meter **Terrænkote** : 18,34 meter o. DNN

Brøndborer : Palle Ejlskov
MOB-nr :
BB-journr :
BB-bornr : LOOP2 - P3

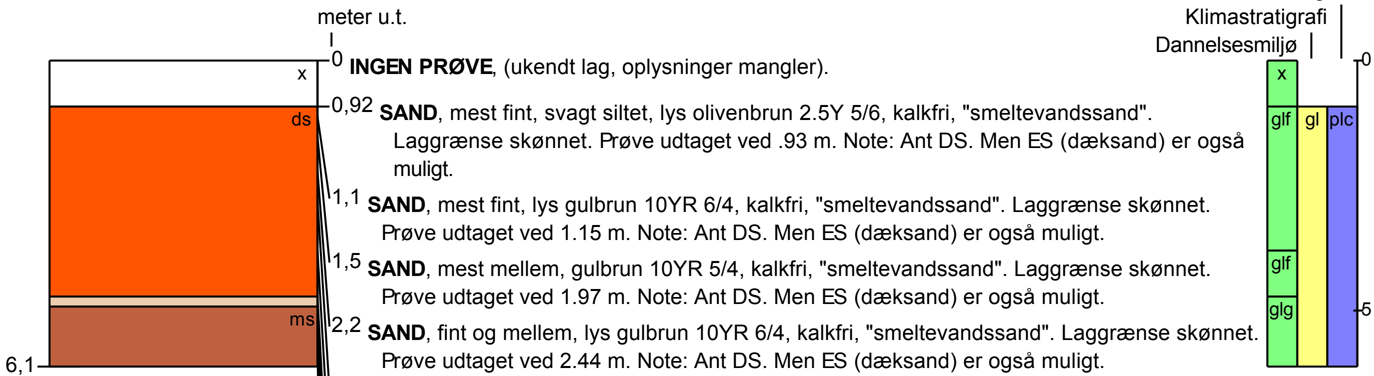
Prøver
- modtaget : 15/5 2019 **antal** : 11
- beskrevet : 20/2 2020 **af** : HJG
- antal gemt : 0

Formål : Undersøg./videnskab
Anvendelse :
Boremetode :

Kortblad : 1216 IINV
UTM-zone : 32
UTM-koord. : 532166, 6289890

Datum : EUREF89
Koordinatkilde : Brøndborer
Koordinatmetode : Landinspektør

Notater : Boringen består af kernestykker, hvor en del intervaller mangler. Sedimentet er ofte komprimeret (sjældnere ekspanderet) under prøvetagning. Begge dele giver usikkerhed om prøvedybder.



0 **INGEN PRØVE**, (ukendt lag, oplysninger mangler).

0,92 **SAND**, mest fint, svagt siltet, lys olivenbrun 2.5Y 5/6, kalkfri, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved .93 m. Note: Ant DS. Men ES (dæksand) er også muligt.

1,1 **SAND**, mest fint, lys gulbrun 10YR 6/4, kalkfri, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 1.15 m. Note: Ant DS. Men ES (dæksand) er også muligt.

1,5 **SAND**, mest mellem, gulbrun 10YR 5/4, kalkfri, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 1.97 m. Note: Ant DS. Men ES (dæksand) er også muligt.

2,2 **SAND**, fint og mellem, lys gulbrun 10YR 6/4, kalkfri, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 2.44 m. Note: Ant DS. Men ES (dæksand) er også muligt.

2,8 **SAND**, mest fint, lys grå 10YR 7/1, kalkfri, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 3.22 m. Note: Ant DS. Men ES (dæksand) er også muligt.

3,8 **SAND**, mest mellem, gruset, lys brungrå 10YR 6/2, kalkholdig, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 4.55 m.

4,7 **SILT**, gruset, stenet, grå 2.5Y 6/1, stærkt indh.af kalkklaster, stærkt kalkholdig, "morænesilt". Laggrænse skønnet. Prøve udtaget ved 4.8 m. Note: Et sediment bestående af silt med kalkklaster fra 0,5 ril 3 cm.

4,9 **SAND**, stærkt leret, siltet, svagt gruset, grå 2.5Y 6/1, indh.af kalkklaster, stærkt kalkholdig, "morænesand". Laggrænse skønnet. Prøve udtaget ved 5.08 m.

5,2 **SAND**, leret, siltet, svagt gruset, grå 2.5Y 6/1, svagt indh.af kalkklaster, stærkt kalkholdig, "morænesand". Laggrænse skønnet. Prøve udtaget ved 5.43 m.

5,6 **SAND**, svagt leret, svagt siltet, svagt gruset, grå 2.5Y 5/1, svagt indh.af kalkklaster, stærkt kalkholdig, "morænesand". Laggrænse skønnet. Prøve udtaget ved 5.7 m.

5,9 **SAND**, svagt leret, svagt siltet, svagt gruset, grå 2.5Y 5/1, svagt indh.af kalkklaster, stærkt kalkholdig, "morænesand". Prøve udtaget ved 6.1 m.

Aflejringsmiljø - Alder (klima-, krono-, litho-, biostratigrafi)

meter u.t.		
0	- 0,92	mangler
0,92	- 3,8	ant. glaciofluvial **-** glacial **-** pleistocæn
3,8	- 4,7	glaciofluvial **-** glacial **-** pleistocæn
4,7	- 6,1	glacigen **-** glacial **-** pleistocæn

BORERAPPORT

DGU arkivnr: 40. 2056

Borested : Sjøstrupvej 40
9600 Års

Kommune : Vesthimmerland
Region : Nordjylland

Boringsdato : 14/5 2019
Boringsdybde : 18,3 meter
Terrænkote : 32,46 meter o. DNN

Brøndborer : Palle Ejlskov
MOB-nr :
BB-journr :
BB-bornr : LOOP2 - P4

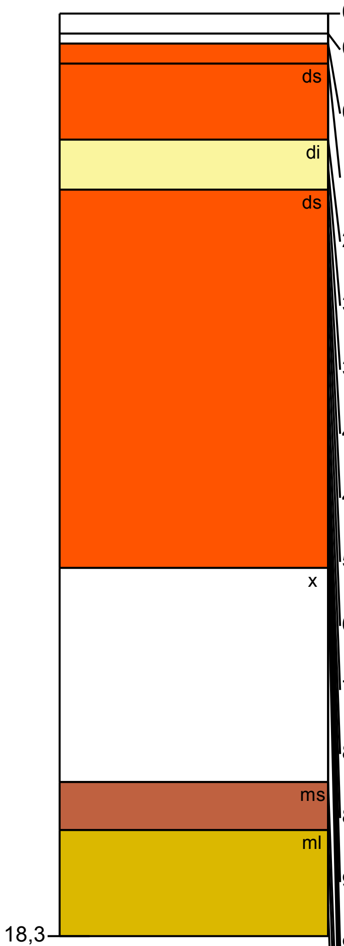
Prøver
- modtaget : 15/5 2019 **antal** : 20
- beskrevet : 22/2 2020 **af** : HJG
- antal gemt : 0

Formål : Undersøg./videnskab
Anvendelse :
Boremetode :

Kortblad : 1216 IINV
UTM-zone : 32
UTM-koord. : 532766, 6292068

Datum : EUREF89
Koordinatkilde : Brøndborer
Koordinatmetode : Landinspektør

Notater : Boringen består af kernestykker, hvor en del intervaller mangler. Sedimentet er ofte komprimeret (sjældnere ekspanderet) under prøvetagning. Begge dele giver usikkerhed om prøvedybder. Boring sat på skråning med mod tørvebassin.



0 **INGEN PRØVE**, (ukendt lag, oplysninger mangler).

0,39 **MULD**, stærkt sandet, indh. af planterester, sort 10YR 2/1, kalkfri. (muld). Laggrænse skønnet. Prøve udtaget ved .39 m.

0,6 **SAND**, mest mellem, svagt gruset, mørk brun 7.5YR 3/4, kalkfri, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved .82 m. Note: Bs-horisont.

1 **SAND**, mest fint, gulbrun 10YR 5/4, kalkfri, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 2.17 m.

2,5 **SILT**, leret, svagt sandet, gulbrun 10YR 5/4, kalkfri, "smeltevandssilt". Laggrænse skønnet. Prøve udtaget ved 2.74 m.

3 **SILT**, svagt leret, sandet, brun 10YR 5/3, kalkholdig, "smeltevandssilt". Laggrænse skønnet. Prøve udtaget ved 3.35 m.

3,5 **SAND**, mellem og groft, gruset, lys brungrå 10YR 6/2, få bryozoer, stærkt kalkholdig, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 3.66 m.

4,1 **SAND**, mest mellem, lys brungrå 10YR 6/2, få bryozoer, kalkholdig, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 4.55 m.

4,7 **SAND**, mest mellem, lys gråbrun 10YR 6/3, svagt kalkholdig, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 4.88 m.

5,3 **SAND**, mellem og groft, gruset, lys gråbrun 10YR 6/3, kalkfri, "smeltevandssand", Udført: sigteanalyse. Laggrænse skønnet. Prøve udtaget ved 5.81 m.

6,2 **SAND**, mellem og groft, svagt gruset, lys gråbrun 10YR 6/3, kalkfri, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 6.49 m.

7,2 **SAND**, mellem og groft, gruset, brun 10YR 5/3, kalkfri, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 7.91 m.

8,1 **SAND**, mest mellem, svagt gruset, brun 10YR 5/3, kalkfri, "smeltevandssand", Udført: sigteanalyse. Laggrænse skønnet. Prøve udtaget ved 8.2 m.

8,5 **SAND**, mest mellem, brun 10YR 5/3, kalkfri, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 8.93 m.

9,2 **SAND**, mest mellem, brun 10YR 5/3, kalkfri, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 9.52 m. Note: En enk flintsten 4x3x3 cm.

9,9 **SAND**, mest mellem, brun 10YR 5/3, kalkfri, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 10.35 m.

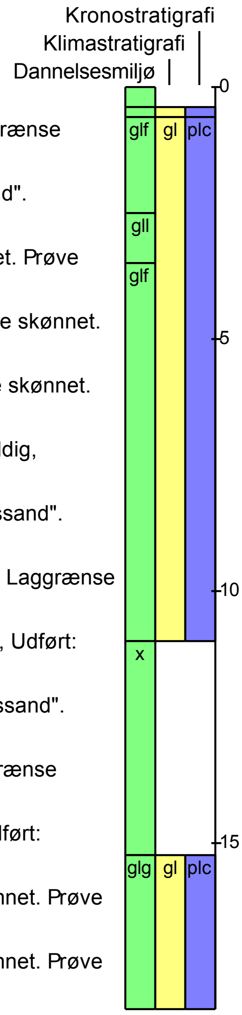
10,6 **SAND**, mest mellem, lys gråbrun 10YR 6/3, få bryozoer, kalkholdig, "smeltevandssand". Prøve udtaget ved 10.74 m.

10,98 **INGEN PRØVE**, (ukendt lag, oplysninger mangler).

15,23 **SAND**, leret, siltet, svagt gruset, brun 10YR 5/3, stærkt kalkholdig, "morænesand". Laggrænse skønnet. Prøve udtaget ved 15.35 m.

16,2 **LER**, siltet, sandet, svagt gruset, gråbrun 10YR 5/2, stærkt kalkholdig, "moræneler". Laggrænse skønnet. Prøve udtaget ved 17.18 m.

17,7 **LER**, siltet, sandet, svagt gruset, grå 10YR 5/1, stærkt kalkholdig, "moræneler". Prøve udtaget ved 18.15 m.



fortsættes..

Aflejringsmiljø - Alder (klima-, krono-, litho-, biostratigrafi)

meter u.t.	
0 - 0,39	mangler
0,39 - 0,6	terrigen - postglacial - holocæn
0,6 - 2,5	glaciofluvial - glacial - pleistocæn
2,5 - 3,5	glaciolakustrin - glacial - pleistocæn
3,5 - 10,98	glaciofluvial - glacial - pleistocæn
10,98 - 15,23	mangler
15,23 - 18,3	glacigen - glacial - pleistocæn

BORERAPPORT

DGU arkivnr: 40. 2057

Borested : Sjøstrupvej 40
9600 Års

Kommune : Vesthimmerland
Region : Nordjylland

Boringsdato : 15/5 2019
Boringsdybde : 6,37 meter
Terrænkote : 23,94 meter o. DNN

Brøndborer : Palle Ejlskov
MOB-nr :
BB-journr :
BB-bornr : LOOP2 - P5

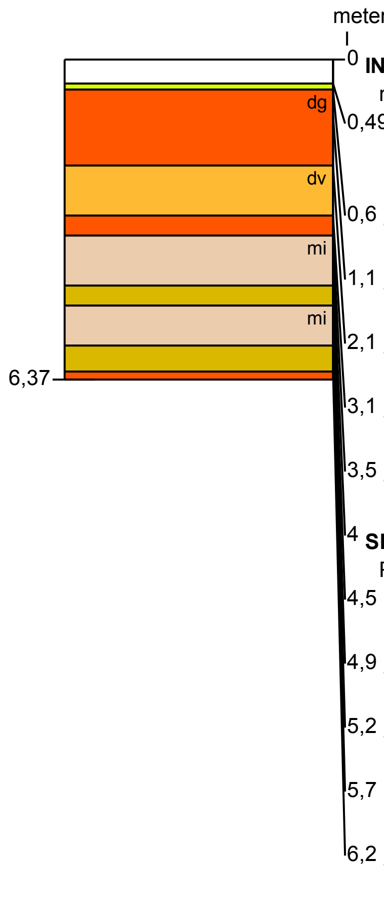
Prøver
- modtaget : 15/5 2019 **antal** : 12
- beskrevet : 22/2 2020 **af** : HJG
- antal gemt : 0

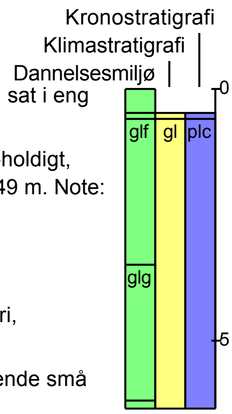
Formål : Undersøg./videnskab
Anvendelse :
Boremetode :

Kortblad : 1216 IINV
UTM-zone : 32
UTM-koord. : 532847, 6292112

Datum : EUREF89
Koordinatkilde : Brøndborer
Koordinatmetode : Landinspektør

Notater : Boringen består af kernestykker, hvor en del intervaller mangler. Sedimentet er ofte komprimeret (sjældnere ekspanderet) under prøvetagning. Begge dele giver usikkerhed om prøvedybder.





0 **INGEN PRØVE**, (ukendt lag, oplysninger mangler). Note: Sandsynligvis tørv. Boring sat i eng med tidligere tørveskær..

0,49 **TØRV**, siltet, sandet, gruset, indh. af planterester, mørk gråbrun 10YR 3/2, flint-holdigt, kalkfri. (postglacial ferskvandstørv). Laggrænse skønnet. Prøve udtaget ved .49 m. Note: Lugt af svovl. Gennemvåd.

0,6 **SAND OG GRUS**, usorteret, svagt stenet, gråbrun 10YR 5/2, flint-holdigt, kalkfri, "smeltevandsgrus". Laggrænse skønnet. Prøve udtaget ved .79 m.

1,1 **SAND OG GRUS**, mellem og groft, svagt stenet, brun 10YR 5/3, flint-holdigt, kalkfri, "smeltevandsgrus". Laggrænse skønnet. Prøve udtaget ved 1.44 m.

2,1 **SILT**, leret, slirer af sand, lys brungrå 10YR 6/2, stærkt kalkholdig. (glacial vekslende små smeltevandslag). Laggrænse skønnet. Prøve udtaget ved 3.03 m.

3,1 **SAND**, mest mellem, svagt siltet, gruset, gulbrun 10YR 5/4, få bryozoer, stærkt kalkholdig, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 3.23 m.

3,5 **SILT**, leret, sandet, få slirer af sand, lys brungrå 10YR 6/2, stærkt kalkholdig, "morænesilt". Laggrænse skønnet. Prøve udtaget ved 3.76 m. Note: Våd.

4 **SILT**, leret, sandet, lys brungrå 10YR 6/2, stærkt kalkholdig, "morænesilt". Laggrænse skønnet. Prøve udtaget ved 4.26 m. Note: Våd. Enk gruskorn.

4,5 **LER**, stærkt siltet, sandet, lys brungrå 10YR 6/2, stærkt kalkholdig, "moræneler". Laggrænse skønnet. Prøve udtaget ved 4.75 m.

4,9 **SILT**, leret, sandet, lys brungrå 10YR 6/2, stærkt kalkholdig, "morænesilt". Laggrænse skønnet. Prøve udtaget ved 4.98 m. Note: Enk gruskorn.

5,2 **SILT**, leret, sandet, lys brungrå 10YR 6/2, stærkt kalkholdig, "morænesilt". Laggrænse skønnet. Prøve udtaget ved 5.48 m. Note: Enk gruskorn.

5,7 **LER**, stærkt siltet, sandet, slirer af sand, lys brungrå 10YR 6/2, stærkt kalkholdig, "moræneler". Laggrænse skønnet. Prøve udtaget ved 5.97 m.

6,2 **SAND**, mest fint, svagt siltet, brun 10YR 5/3, stærkt kalkholdig, "smeltevandssand". Prøve udtaget ved 6.37 m.

Aflejringsmiljø - Alder (klima-, krono-, litho-, biostratigrafi)

meter u.t.

0	- 0,49	mangler
0,49	- 0,6	lakustrin - postglacial - holocæn
0,6	- 3,5	glaciofluvial - glacial - pleistocæn
3,5	- 6,2	ant. glacigen - glacial - pleistocæn
6,2	- 6,37	glaciofluvial - glacial - pleistocæn

BORERAPPORT

DGU arkivnr: 40. 2058

Borested : Sjøstrupvej 40
9600 Års

Kommune : Vesthimmerland
Region : Nordjylland

Boringsdato : 15/5 2019
Boringsdybde : 9,76 meter
Terrænkote : 22,42 meter o. DNN

Brøndborer : Palle Ejlskov
MOB-nr :
BB-journr :
BB-bornr : LOOP2 - P6

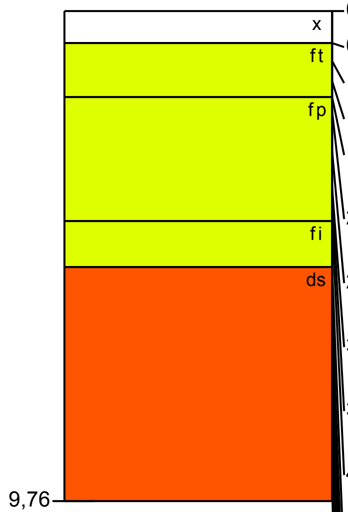
Prøver
- modtaget : 15/5 2019 **antal** : 17
- beskrevet : 22/2 2020 **af** : HJG
- antal gemt : 0

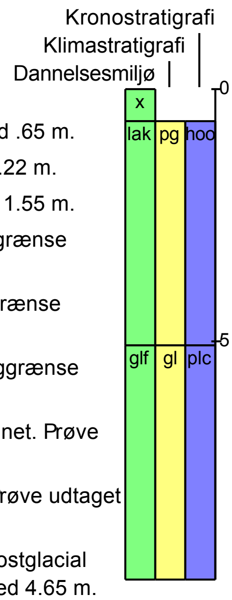
Formål : Undersøg./videnskab
Anvendelse :
Boremetode :

Kortblad : 1216 IINV
UTM-zone : 32
UTM-koord. : 532975, 6291879

Datum : EUREF89
Koordinatkilde : Brøndborer
Koordinatmetode : Landinspektør

Notater : Boringen består af kernestykker, hvor en del intervaller mangler. Sedimentet er ofte komprimeret (sjældnere ekspanderet) under prøvetagning. Begge dele giver usikkerhed om prøvedybder.





meter u.t.

0 **INGEN PRØVE**, (ukendt lag, oplysninger mangler).

0,65 **TØRV**, sort 10YR 2/1, kalkfri, "kærtørv". Laggrænse skønnet. Prøve udtaget ved .65 m.

1 **TØRV**, sort 10YR 2/1, kalkfri, "kærtørv". Laggrænse skønnet. Prøve udtaget ved 1.22 m.

1,4 **TØRV**, sort 10YR 2/1, kalkfri, "kærtørv". Laggrænse skønnet. Prøve udtaget ved 1.55 m.

1,7 **GYTJE** (DYND), sandet, grå 2.5Y 5/1, kalkfri. (postglacial ferskvandsgytje). Laggrænse skønnet. Prøve udtaget ved 1.84 m.

2 **GYTJE** (DYND), mørk olivengrå 5Y 3/2, kalkfri. (postglacial ferskvandsgytje). Laggrænse skønnet. Prøve udtaget ved 2.34 m.

2,8 **GYTJE** (DYND), mørk olivengrå 5Y 3/2, kalkfri. (postglacial ferskvandsgytje). Laggrænse skønnet. Prøve udtaget ved 3.31 m.

3,5 **GYTJE** (DYND), olivengrå 5Y 5/2, stærkt kalkholdig, "kalkgytje". Laggrænse skønnet. Prøve udtaget ved 3.66 m.

3,7 **GYTJE** (DYND), grå 5Y 5/1, stærkt kalkholdig, "kalkgytje". Laggrænse skønnet. Prøve udtaget ved 3.76 m.

4,2 **SILT**, svagt leret, svagt sandet, grå 5Y 6/1, få planterester, stærkt kalkholdig. (postglacial ferskvandssilt), Udført: analyseslemning. Laggrænse skønnet. Prøve udtaget ved 4.65 m. Note: Planterester brune.

5,1 **SAND**, mest mellem, svagt gruset, grå 2.5Y 6/1, kalkholdig, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 5.77 m.

5,9 **SAND**, fint og mellem, grå 2.5Y 6/1, stærkt kalkholdig, "smeltevandssand", Udført: sigteanalyse. Laggrænse skønnet. Prøve udtaget ved 6.06 m. Note: Enk gruskorn.

6,4 **SAND**, mest mellem, grå 2.5Y 6/1, kalkholdig, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 6.79 m.

6,9 **SAND**, mest mellem, grå 2.5Y 6/1, kalkholdig, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 6.99 m.

7,5 **SAND**, mest mellem, svagt gruset, grå 2.5Y 6/1, svagt indh.af kalkklaster, kalkholdig, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 7.95 m.

8,2 **SAND**, mest mellem, svagt gruset, grå 2.5Y 6/1, svagt indh.af kalkklaster, kalkholdig, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 8.54 m.

8,8 **SAND**, fint og mellem, svagt gruset, grå 2.5Y 6/1, svagt indh.af kalkklaster, stærkt kalkholdig, "smeltevandssand", Udført: sigteanalyse. Laggrænse skønnet. Prøve udtaget ved 9.1 m.

9,4 **SAND**, fint og mellem, svagt gruset, grå 2.5Y 6/1, svagt indh.af kalkklaster, stærkt kalkholdig, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 9.65 m.

fortsættes..

Aflejringsmiljø - Alder (klima-, krono-, litho-, biostratigrafi)

meter u.t.		
0	- 0,65	mangler
0,65	- 5,1	lakustrin - postglacial - holocæn
5,1	- 9,76	glaciofluvial - glacial - pleistocæn

BORERAPPORT

DGU arkivnr: 40. 2059

Borested : Lindholmvej 5
9600 Års

Kommune : Vesthimmerland
Region : Nordjylland

Boringsdato : 15/5 2019
Boringsdybde : 5,48 meter
Terrænkote : 37,02 meter o. DNN

Brøndborer : Palle Ejlskov
MOB-nr :
BB-journr :
BB-bornr : LOOP2 - P7

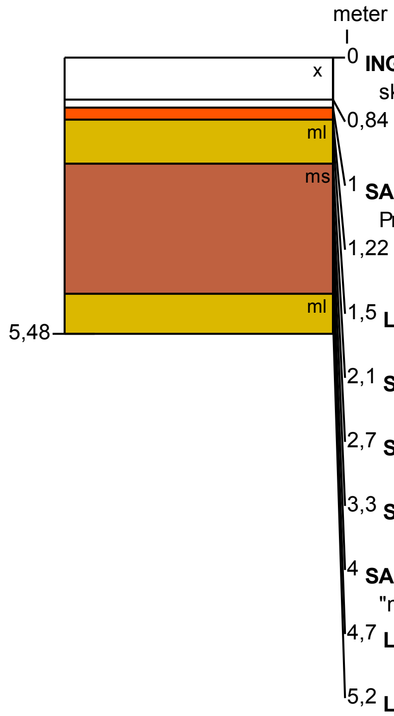
Prøver
- modtaget : 15/5 2019 **antal** : 10
- beskrevet : 19/2 2020 **af** : HJG
- antal gemt : 0

Formål : Undersøg./videnskab
Anvendelse :
Boremetode :

Kortblad : 1216 IINV
UTM-zone : 32
UTM-koord. : 532417, 6291143

Datum : EUREF89
Koordinatkilde : Brøndborer
Koordinatmetode : Landinspektør

Notater : Boringen består af kernestykker, hvor en del intervaller mangler. Sedimentet er ofte komprimeret (sjældnere ekspanderet) under prøvetagning. Begge dele giver usikkerhed om prøvedybder. Ligger på skrånende terræn, så muldlag på en m er ikke usandsynligt



0 **INGEN PRØVE**, (ukendt lag, oplysninger mangler). Laggrænse skønnet. Note: Ligger på skrånende terræn, så muldlag på en meter er ikke usandsynligt.

0,84 **MULD**, mest mellem, sandet, indh. af planterester, mørk gråbrun 10YR 3/2, kalkfri. (muld). Laggrænse skønnet. Prøve udtaget ved .84 m. Note: Enk gruskorn.

1 **SAND**, mest mellem, mørk gulbrun 10YR 4/4, kalkfri, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 1.22 m.

1,22 **LER**, siltet, stærkt sandet, svagt gruset, slirer af sand, brun 10YR 5/3, kalkfri, "moræneler". Laggrænse skønnet. Prøve udtaget ved 1.22 m.

1,5 **LER**, siltet, stærkt sandet, svagt gruset, mange slirer af sand, brun 10YR 5/3, kalkfri, "moræneler". Laggrænse skønnet. Prøve udtaget ved 1.72 m.

2,1 **SAND**, leret, siltet, svagt gruset, brun 10YR 5/3, kalkfri, "morænesand". Laggrænse skønnet. Prøve udtaget ved 2.44 m.

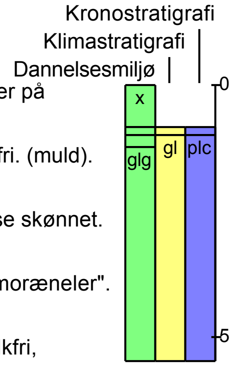
2,7 **SAND**, stærkt leret, siltet, svagt gruset, brun 10YR 5/3, kalkfri, "morænesand". Laggrænse skønnet. Prøve udtaget ved 2.94 m.

3,3 **SAND**, stærkt leret, siltet, svagt gruset, slirer af sand, lys gråbrun 10YR 6/3, stærkt kalkholdig, "morænesand". Laggrænse skønnet. Prøve udtaget ved 3.66 m.

4 **SAND**, stærkt leret, siltet, svagt gruset, lys gråbrun 10YR 6/3, stærkt kalkholdig, "morænesand". Laggrænse skønnet. Prøve udtaget ved 4.36 m.

4,7 **LER**, siltet, stærkt sandet, svagt gruset, slirer af sand, lys gråbrun 10YR 6/3, stærkt kalkholdig, "moræneler". Laggrænse skønnet. Prøve udtaget ved 4.88 m.

5,2 **LER**, siltet, stærkt sandet, svagt gruset, få slirer af sand, lys gråbrun 10YR 6/3, stærkt kalkholdig, "moræneler". Laggrænse skønnet. Prøve udtaget ved 5.48 m.



Aflejringsmiljø - Alder (klima-, krono-, litho-, biostratigrafi)

meter u.t.	
0 - 0,84	mangler
0,84 - 1	terrigen - postglacial - holocæn
1 - 1,22	glaciofluvial - glacial - pleistocæn
1,22 - 5,48	glacigen - glacial - pleistocæn

BORERAPPORT

DGU arkivnr: 40. 2060

Borested : Lindholmvej 5
9600 Års

Kommune : Vesthimmerland
Region : Nordjylland

Boringsdato : 15/5 2019
Boringsdybde : 5,38 meter
Terrænkote : 31,58 meter o. DNN

Brøndborer : Palle Ejlskov
MOB-nr :
BB-journr :
BB-bornr : LOOP2 - P8

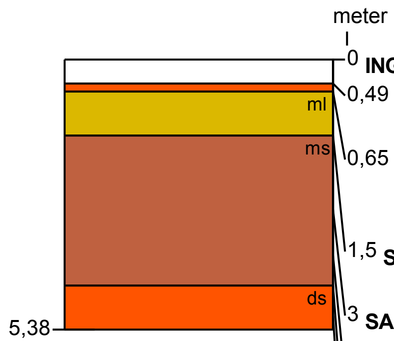
Prøver
- modtaget : 15/5 2019 **antal** : 7
- beskrevet : 17/2 2020 **af** : HJG
- antal gemt : 0

Formål : Undersøg./videnskab
Anvendelse :
Boremetode :

Kortblad : 1216 IINV
UTM-zone : 32
UTM-koord. : 532436, 6291057

Datum : EUREF89
Koordinatkilde : Brøndborer
Koordinatmetode : Landinspektør

Notater : Boringen består af kernestykker, hvor en del intervaller mangler. Sedimentet er ofte komprimeret (sjældnere ekspanderet) under prøvetagning. Begge dele giver usikkerhed om prøvedybder.



0 **INGEN PRØVE**, (ukendt lag, oplysninger mangler).

0,49 **SAND**, fint og mellem, svagt siltet, brun 10YR 5/3, kalkfri, "smeltevandssand", Udført: sigteanalyse. Laggrænse skønnet. Prøve udtaget ved .49 m. Note: Enk gruskorn.

0,65 **LER**, siltet, sandet, svagt gruset, lys gråbrun 10YR 6/3, kalkfri, "moræneler". Laggrænse skønnet. Prøve udtaget ved .8 m. Note: Med udfælningspletter i mørk gullig brun (10YR 4/6).

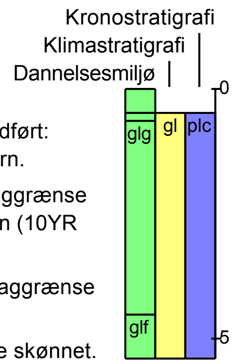
1,5 **SAND**, stærkt leret, siltet, svagt gruset, brun 10YR 5/3, kalkfri, "morænesand". Laggrænse skønnet. Prøve udtaget ved 2.3 m.

3 **SAND**, leret, siltet, svagt gruset, brun 10YR 5/3, kalkfri, "morænesand". Laggrænse skønnet. Prøve udtaget ved 3.6 m.

3,9 **SAND**, leret, siltet, svagt gruset, slirer af sand, lys gråbrun 10YR 6/3, stærkt kalkholdig, "morænesand". Laggrænse skønnet. Prøve udtaget ved 4.16 m.

4,5 **SAND**, fint og mellem, svagt gruset, få klumper af ler, lys gråbrun 10YR 6/3, stærkt kalkholdig, "smeltevandssand", Udført: sigteanalyse. Laggrænse skønnet. Prøve udtaget ved 4.88 m.

5,1 **SAND**, mest fint, lys brungrå 10YR 6/2, stærkt kalkholdig, "smeltevandssand", Udført: sigteanalyse. Laggrænse skønnet. Prøve udtaget ved 5.38 m. Note: 1/3 mellemsand.



Aflejringsmiljø - Alder (klima-, krono-, litho-, biostratigrafi)

meter u.t.

0	- 0,49	mangler
0,49	- 0,65	glaciofluvial - glacial - pleistocæn
0,65	- 4,5	glacigen - glacial - pleistocæn
4,5	- 5,38	glaciofluvial - glacial - pleistocæn

GEUS

BORERAPPORT

DGU arkivnr: 40. 2061

Borested : Lindholmvej 4
9600 Års

Kommune : Vesthimmerland
Region : Nordjylland

Boringsdato : 15/5 2019
Boringsdybde : 11,25 meter
Terrænkote : 24,6 meter o. DNN

Brøndborer : Palle Ejlskov
MOB-nr :
BB-journr :
BB-bornr : LOOP2 - P9

Prøver
- modtaget : 15/5 2019 **antal** : 19
- beskrevet : 28/2 2020 **af** : HJG
- antal gemt : 0

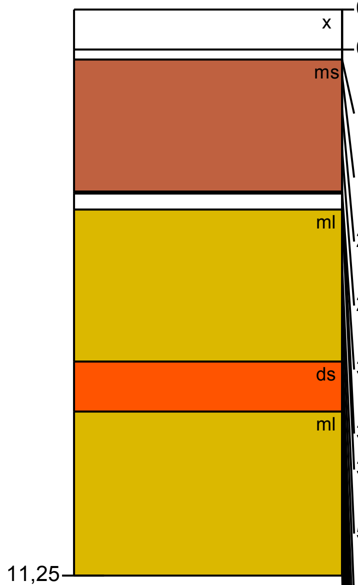
Formål : Undersøg./videnskab
Anvendelse :
Boremetode :

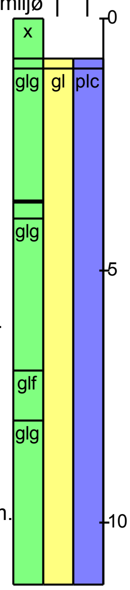
Kortblad : 1216 IINV
UTM-zone : 32
UTM-koord. : 532499, 6290960

Datum : EUREF89
Koordinatkilde : Brøndborer
Koordinatmetode : Landinspektør

meter u.t.

Kronostratigrafi
Klimastratigrafi
Dannelsesmiljø





0 **INGEN PRØVE**, (ukendt lag, oplysninger mangler).

0,8 **MULD**, siltet, sandet, svagt gruset, indh. af planterester, mørk gråbrun 10YR 3/3, kalkfri. (muld). Laggrænse skønnet. Prøve udtaget ved .8 m.

1 **SAND**, svagt leret, svagt siltet, svagt gruset, lys olivenbrun 2.5Y 5/4, kalkfri, "morænesand". Laggrænse skønnet. Prøve udtaget ved 1.1 m.

1,3 **SAND**, svagt leret, svagt siltet, svagt gruset, lys olivenbrun 2.5Y 5/4, kalkfri, "morænesand". Laggrænse skønnet. Prøve udtaget ved 1.62 m.

2 **SAND**, leret, siltet, svagt gruset, lys brunsort 2.5Y 6/2, kalkfri, "morænesand". Laggrænse skønnet. Prøve udtaget ved 2.44 m. Note: Med slirer af gullig brun (10YR 5/4).

2,8 **SAND**, leret, siltet, svagt gruset, brun 10YR 5/3, kalkfri, "morænesand". Laggrænse skønnet. Prøve udtaget ved 3.14 m.

3,6 **SILT**, leret, svagt sandet, slirer af sand, utydelig horisontal lagdeling, lys gråbrun 10YR 6/3, kalkfri, "smeltevandssilt". Prøve udtaget ved 3.27 m.

3,66 **INGEN PRØVE**, (ukendt lag, oplysninger mangler).

3,97 **LER**, siltet, stærkt sandet, svagt gruset, slirer af sand, grå 10YR 6/1, svagt indh.af kalkklaster, stærkt kalkholdig, "moræneler". Laggrænse skønnet. Prøve udtaget ved 4.88 m.

5,1 **LER**, siltet, stærkt sandet, svagt gruset, få slirer af sand, grå 10YR 6/1, stærkt kalkholdig, "moræneler". Laggrænse skønnet. Prøve udtaget ved 5.38 m.

5,7 **LER**, siltet, stærkt sandet, svagt gruset, grå 10YR 5/1, stærkt kalkholdig, "moræneler". Laggrænse skønnet. Prøve udtaget ved 6.1 m.

6,5 **LER**, siltet, stærkt sandet, svagt gruset, grå 10YR 5/1, stærkt kalkholdig, "moræneler". Laggrænse skønnet. Prøve udtaget ved 6.8 m.

7 **SAND**, mest mellem, svagt gruset, brun 10YR 5/3, få bryozoer, kalkholdig, "smeltevandssand". Laggrænse skønnet. Prøve udtaget ved 7.29 m.

7,6 **SAND**, mest mellem, gruset, lys brungrå 10YR 6/2, få bryozoer, stærkt kalkholdig, "smeltevandssand", Udført: sigteanalyse. Laggrænse skønnet. Prøve udtaget ved 7.91 m.

8 **LER**, siltet, sandet, svagt gruset, grå 10YR 5/1, stærkt kalkholdig, "moræneler". Laggrænse skønnet. Prøve udtaget ved 8.21 m.

8,5 **LER**, siltet, sandet, svagt gruset, grå 10YR 5/1, svagt indh.af kalkklaster, stærkt kalkholdig, "moræneler". Laggrænse skønnet. Prøve udtaget ved 8.8 m.

9,2 **LER**, siltet, stærkt sandet, svagt gruset, grå 10YR 5/1, stærkt kalkholdig, "moræneler". Laggrænse skønnet. Prøve udtaget ved 9.63 m.

9,8 **LER**, siltet, stærkt sandet, svagt gruset, grå 10YR 5/1, svagt indh.af kalkklaster, stærkt kalkholdig, "moræneler". Laggrænse skønnet. Prøve udtaget ved 10 m.

10,2 **LER**, siltet, sandet, svagt gruset, grå 10YR 5/1, svagt indh.af kalkklaster, stærkt kalkholdig, "moræneler". Laggrænse skønnet. Prøve udtaget ved 10.46 m.

10,7 **LER**, siltet, stærkt sandet, svagt gruset, grå 10YR 5/1, svagt indh.af kalkklaster, stærkt kalkholdig, "moræneler". Laggrænse skønnet. Prøve udtaget ved 10.95 m.

11,1 **LER**, siltet, stærkt sandet, svagt gruset, lys brungrå 10YR 6/2, stærkt kalkholdig, "moræneler". Prøve udtaget ved 11.2 m.

fortsættes..

Aflejringsmiljø - Alder (klima-, krono-, litho-, biostratigrafi)

meter u.t.			
0	-	0,8	mangler
0,8	-	1	terrigen - postglacial - holocæn
1	-	3,6	glacigen - glacial - pleistocæn
3,6	-	3,66	glaciolakustrin - glacial - pleistocæn
3,66	-	3,97	mangler - glacial - pleistocæn
3,97	-	7	glacigen - glacial - pleistocæn
7	-	8	glaciofluvial - glacial - pleistocæn
8	-	11,25	glacigen - glacial - pleistocæn

Appendix 3: Water (Appendix3-1 and 3-2), sediment chemistry (Appendix 3-3), denitrification rates (Appendix 3-4) collected in the MapField project

Appendix3-1. Results of anions, dissolved organic carbon (DOC), dissolved inorganic carbon (DIC), stable isotope of water of LOOP2

LOOPNr	ID	method	DGUnr	Depth (m)	mg/L						µg/L	mg/L		‰	
					F^-	Cl^-	Br^-	NO_3^-	PO_4^-	SO_4^{2-}	NH_4^+	DOC	TIC	δO18	δD
LOOP2	P1	GeoProbe	40. 2054	1.78	0.97	832.49	-0.05	84.51	-0.05	39.56	6573.65	70.54	9.86	-7.06	-47.98
LOOP2	P1	GeoProbe	40. 2054	2.94	0.40	141.45	0.33	78.38	-0.05	44.91	1362.46	61.68			
LOOP2	P1	GeoProbe	40. 2054	4.16	3.03	55.15	0.27	37.43	-0.05	68.07					
LOOP2	P1	GeoProbe	40. 2054	5.38	1.05	35.71	0.12	45.67	-0.05	45.64	192.85				
LOOP2	P1	GeoProbe	40. 2054	5.92	1.05	36.63	0.42	54.99	-0.05	42.70	208.06		66.64		
LOOP2	P1	GeoProbe	40. 2054	6.60	1.43	39.07	0.57	73.82	-0.05	65.14	636.69		76.71		
LOOP2	P1	GeoProbe	40. 2054	7.82	0.69	41.56	0.02	56.76	-0.05	43.54	1042.26	66.45	103.40	-7.21	-49.42
LOOP2	P1	GeoProbe	40. 2054	9.14	0.30	28.50	0.18	65.90	-0.05	41.71	262.07	39.67	93.07	-7.42	-51.18
LOOP2	P1	GeoProbe	40. 2054	10.17	0.09	27.60	0.09	90.87	-0.05	46.16	133.70	35.67	56.87	-7.50	-52.56
LOOP2	P1	GeoProbe	40. 2054	10.76	0.18	26.93	0.11	91.74	-0.05	46.14	182.15	35.30	70.97	-7.60	-51.95
LOOP2	P1	GeoProbe	40. 2054	12.10	0.37	30.97	0.13	117.36	-0.05	38.43	100.36	68.13	57.52	-7.99	-55.73
LOOP2	P1	GeoProbe	40. 2054	12.84	0.12	29.75	0.16	142.07	-0.05	38.68	18.62	57.58	52.36	-7.97	-55.55
LOOP2	P2	GeoProbe	40. 2055	0.30	0.46	10.32	-0.05	79.59	-0.05	36.70	77.13				
LOOP2	P2	GeoProbe	40. 2055	1.94	0.16	26.02	0.11	124.71	-0.05	56.26	241.96	68.54	11.75	-7.00	-48.59
LOOP2	P2	GeoProbe	40. 2055	3.19	0.25	48.08	0.01	82.31	-0.05	76.86	195.29	67.56	23.04	-7.11	-48.86
LOOP2	P2	GeoProbe	40. 2055	3.88	1.38	29.40	-0.05	51.86	-0.05	89.12	419.95	103.80	55.23	-6.92	-48.90
LOOP2	P2	GeoProbe	40. 2055	4.16	1.55	41.89	0.43	0.69	-0.05	160.56	1996.75	124.45	58.77	-7.49	-50.51
LOOP2	P2	GeoProbe	40. 2055	4.70	0.99	33.88	0.23	0.46	-0.05	161.90	458.72	94.56	55.09	-7.87	-51.81
LOOP2	P2	GeoProbe	40. 2055	5.03	0.43	242.66	0.48	0.18	-0.05	104.57	827.24	100.55	84.52	-7.72	-51.92
LOOP2	P2	GeoProbe	40. 2055	5.92	0.21	27.05	0.19	0.06	-0.05	114.35	7.30	98.26	53.16	-7.62	-52.82
LOOP2	P2	GeoProbe	40. 2055	5.93	2.66	38.12	-0.05	0.52	0.19	164.36					
LOOP2	P2	GeoProbe	40. 2055	6.40	0.22	48.25	0.25	0.07	-0.05	107.17	241.21	66.16	63.67	-7.79	-53.02
LOOP2	P2	GeoProbe	40. 2055	7.02	0.41	65.47	0.29	2.31	-0.05	118.30	508.07	112.25	69.54	-7.49	-53.02
LOOP2	P2a	GeoProbe	48. 2126	1.32	0.27	15.13	-0.05	0.06	-0.05	54.34	376.04	103.90		-6.63	-47.70
LOOP2	P2a	GeoProbe	48. 2126	2.69	0.21	26.95	0.39	0.12	-0.05	144.48	2119.82	82.36	76.71	-7.56	-52.57
LOOP2	P2a	GeoProbe	48. 2126	3.58	0.29	26.66	0.15	0.05	-0.05	136.12	240.00	57.21	53.80	-8.09	-55.34
LOOP2	P2a	GeoProbe	48. 2126	3.91	0.23	25.31	0.18	0.07	-0.05	122.92	191.84	57.29	36.76	-7.76	-53.99
LOOP2	P2a	GeoProbe	48. 2126	4.60	0.67	27.82	0.28	0.19	0.11	121.82	795.49	84.48	62.57	-7.50	-54.72
LOOP2	P2a	GeoProbe	48. 2126	5.03	0.37	25.37	0.21	0.10	-0.05	117.39	67.25	70.83	34.65	-7.34	-53.74
LOOP2	P2a	GeoProbe	48. 2126	5.72	0.30	13.02	0.10	0.07	-0.05	96.40	193.32	46.33	75.22	-7.75	-54.11

LOOP2	P2a	GeoProbe	48. 2126	6.25	0.34	26.02	0.20	0.13	-0.05	127.30	209.02	82.63	35.81	-7.41	-53.50
LOOP2	P2a	GeoProbe	48. 2126	6.94	0.23	22.49	0.21	0.07	0.07	105.76	36.95	79.13	31.26	-7.74	-53.67
LOOP2	P2a	GeoProbe	48. 2126	7.23	1.34	30.78	0.29	0.25	-0.05	107.62	409.28	87.31	47.91	-7.62	-52.54
LOOP2	P2A	GeoProbe	48. 2126	7.93	0.21	30.91	0.22	38.68	-0.05	66.21	1089.33	125.96	53.41	-7.34	-51.27
LOOP2	P2a	GeoProbe	48. 2126	8.89	0.30	29.76	0.19	0.12	-0.05	109.43	78.33	73.70	50.82	-8.10	-53.01
LOOP2	P2a	GeoProbe	48. 2126	9.58	0.24	32.40	0.29	0.15	0.06	118.55	101.29	85.97	49.50	-7.87	-52.47
LOOP2	P2A	GeoProbe	48. 2126	10.00	0.89	33.11	0.37	-0.05	-0.05	165.57	2.56	46.49	66.28	-7.66	-53.47
LOOP2	P2a	GeoProbe	48. 2126	14.45	0.13	27.40	0.16	50.03	-0.05	45.40	118.27				
LOOP2	P2a	GeoProbe	48. 2126	14.79	0.26	26.54	0.32	20.21	-0.05	47.49	70.67	44.65	66.79	-8.03	-53.61
LOOP2	P3	GeoProbe	48. 2127	1.57	0.06	32.61	-0.05	210.82	-0.05	46.87	113.26	39.50	20.94	-7.33	-48.36
LOOP2	P3	GeoProbe	48. 2127	2.59	0.34	28.87	0.16	0.12	0.09	66.22	147.19	66.36	44.58	-7.75	-53.12
LOOP2	P3	GeoProbe	48. 2127	2.98	0.28	32.25	0.15	0.09	-0.05	91.27	89.90	52.48	34.54	-8.09	-54.83
LOOP2	P3	GeoProbe	48. 2127	4.11	0.16	33.59	0.12	0.10	0.09	97.61	183.79	50.58	25.99	-8.24	-56.44
LOOP2	P3	GeoProbe	48. 2127	4.40	0.13	33.81	0.13	0.07	0.11	89.43	35.36	52.64	31.18	-8.15	-56.95
LOOP2	P3	GeoProbe	48. 2127	5.68	1.62	42.54	-0.05	0.40	0.05	97.16	447.55	117.90	25.50	-8.39	-57.72
LOOP2	P4	GeoProbe	40. 2056	0.35	3.63	389.37	3.31	202.76	0.36	101.11	38109.18				
LOOP2	P4	GeoProbe	40. 2056	1.57	3.88	40.11	0.27	11.73	-0.05	79.38	357.55				
LOOP2	P4	GeoProbe	40. 2056	2.99	0.60	22.17	0.31	153.03	-0.05	46.45	532.93	46.72	51.97	-7.48	-50.37
LOOP2	P4	GeoProbe	40. 2056	5.86	0.80	48.96	0.17	82.12	-0.05	30.67	26.62	42.84	8.32	-8.16	-52.85
LOOP2	P4	GeoProbe	40. 2056	6.25	0.28	52.36	0.20	7.59	-0.05	77.22	229.08	58.12	65.56	-8.26	-52.07
LOOP2	P4	GeoProbe	40. 2056	7.47	0.28	87.63	0.24	6.55	-0.05	26.41	796.33	44.55	61.98	-8.07	-52.21
LOOP2	P4	GeoProbe	40. 2056	8.16	0.14	58.55	0.31	33.14	0.16	27.53	118.61	69.86	19.82	-7.91	-53.61
LOOP2	P4	GeoProbe	40. 2056	8.69	0.39	186.38	0.36		-0.05	33.40	459.76	66.59	61.21	-7.95	-52.53
LOOP2	P4	GeoProbe	40. 2056	9.48	0.21	62.45	0.29	30.85	0.07	32.31	102.16	53.01	19.77	-7.95	-52.99
LOOP2	P4	GeoProbe	40. 2056	10.11	0.29	52.37	0.14	0.50	0.12	25.40	110.49	61.79	60.34	-7.93	-53.24
LOOP2	P4	GeoProbe	40. 2056	10.70	0.32	82.39	0.27	0.06	-0.05	31.62	524.44	71.13	60.60	-7.73	-52.46
LOOP2	P4	GeoProbe	40. 2056	11.05	0.08	29.06	0.18	0.01	0.17	101.75	103.10	58.78	51.82	-7.87	-53.24
LOOP2	P4	GeoProbe	40. 2056	14.99	1.24	37.02	0.21	51.19	0.36	53.98	138.87				
LOOP2	P4	GeoProbe	40. 2056	17.73	1.98	57.65	0.62	5.19	0.23	100.25	361.86				
LOOP2	P5	GeoProbe	40. 2057	1.37	0.89	184.52	0.70	0.21	-0.05	77.99	651.13	128.41	51.32	-8.16	-55.36
LOOP2	P5	GeoProbe	40. 2057	1.90	3.02	75.44	1.57	3.41	0.36	166.62	1255.93				
LOOP2	P5	GeoProbe	40. 2057	2.19	1.60	84.36	-0.05	0.48	0.19	142.04	199.15				
LOOP2	P5	GeoProbe	40. 2057	2.59	0.92	40.25	0.25	0.16	-0.05	155.81	113.30	98.31	36.48	-8.26	-57.09
LOOP2	P5	GeoProbe	40. 2057	3.28	0.34	47.08	0.37	0.19	-0.05	69.93	169.87	90.40	51.87	-8.34	-57.73

LOOP2	P5	GeoProbe	40. 2057	3.57	0.38	44.80	0.27	4.89	0.05	71.40	172.94	66.11	48.18	-8.20	-57.10
LOOP2	P5	GeoProbe	40. 2057	4.51	0.63	41.88	0.15	2.12	-0.05	94.20	96.10	103.96	38.23	-8.07	-56.53
LOOP2	P5	GeoProbe	40. 2057	5.73	0.31	29.64	0.26	0.09	-0.05	96.95	79.71	122.89	35.69	-8.35	-56.87
LOOP2	P6	GeoProbe	40. 2058	0.40	0.50	28.04	0.04	11.59	0.10	100.44	80.53	71.34	6.45	-7.54	-51.08
LOOP2	P6	GeoProbe	40. 2058	2.28	0.34	28.68	-0.05	0.05	0.11	151.36	3680.95	39.19	33.12	-8.57	-58.41
LOOP2	P6	GeoProbe	40. 2058	3.36	0.23	29.02	0.07	0.04	0.07	22.84	3846.51	42.06	45.52	-8.48	-58.10
LOOP2	P6	GeoProbe	40. 2058	3.81	0.25	28.31	0.11	0.09	0.06	106.42	2499.81	47.68	46.48	-8.19	-57.50
LOOP2	P6	GeoProbe	40. 2058	5.82	0.17	29.01	0.15	0.16	-0.05	118.48	1707.20	59.58	55.68	-8.02	-55.14
LOOP2	P6	GeoProbe	40. 2058	6.35	0.31	30.06	0.24	0.25	-0.05	115.74	383.68	49.26	51.28	-8.44	-56.99
LOOP2	P6	GeoProbe	40. 2058	7.04	0.27	29.82	0.16	0.20	0.11	123.92	1906.58	35.46	43.36	-8.30	-56.89
LOOP2	P6	GeoProbe	40. 2058	7.67	0.23	33.61	0.28	0.14	0.08	117.93	203.47	39.47	46.08	-8.30	-56.81
LOOP2	P6	GeoProbe	40. 2058	8.83	0.50	27.80	0.28	0.07	0.09	108.28	653.19	42.69	41.93	-8.02	-57.20
LOOP2	P6	GeoProbe	40. 2058	9.76	0.16	53.95	0.31	0.20	-0.05	59.28	3.29	51.17	45.93	-8.41	-57.12
LOOP2	P7	GeoProbe	40. 2059	0.35	0.61	5.65	0.10	12.05	0.09	17.49	82.37	64.91	10.01	-7.75	-54.18
LOOP2	P7	GeoProbe	40. 2059	1.77	0.49	28.04	-0.05	205.89	-0.05	35.36	46.16		11.65		
LOOP2	P7	GeoProbe	40. 2059	2.99	0.19	24.69	-0.05	152.01	-0.05	32.22	59.38	46.74	9.24	-7.52	-50.39
LOOP2	P7	GeoProbe	40. 2059	4.61	0.95	24.65	-0.05	68.03	-0.05	45.16	213.33		47.00		
LOOP2	P7	GeoProbe	40. 2059	5.73	0.48	22.94	-0.05	60.42	0.07	35.54	119.35		59.12	-6.88	-46.97
LOOP2	P8	GeoProbe	40. 2060	0.35	1.66	12.14	0.33	41.43	0.26	13.30	204.65	60.89	13.96	-8.44	-60.22
LOOP2	P8	GeoProbe	40. 2060	1.47	2.15	29.82	-0.05	93.84	-0.05	55.65	251.46	77.14			
LOOP2	P8	GeoProbe	40. 2060	2.79	0.99	24.09	-0.05	76.59	-0.05	49.81	189.43	46.55	11.00	-7.16	-47.82
LOOP2	P8	GeoProbe	40. 2060	4.21	1.05	47.55	-0.05	77.41	0.27	81.05					
LOOP2	P8	GeoProbe	40. 2060	5.13	0.27	45.71	0.31	0.20	-0.05	28.35	3237.75	68.83	49.88		
LOOP2	P8	GeoProbe	40. 2060	5.43	0.49	32.64	0.23	122.05	0.06	22.22	28.59	73.71	34.66	-7.60	-50.74
LOOP2	P9	GeoProbe	40. 2061	1.67	1.28	43.41	0.25	206.56	-0.05	9.47	481.81	50.68	7.77	-7.75	-52.97
LOOP2	P9	GeoProbe	40. 2061	3.19	0.71	18.57	0.20	6.31	-0.05	12.80	302.27	47.81	9.11		
LOOP2	P9	GeoProbe	40. 2061	4.02	0.72	22.57	0.36	0.22	0.06	27.98	541.97	47.46	58.34	-7.78	-51.74
LOOP2	P9	GeoProbe	40. 2061	4.31	1.02	72.50	0.39	9.24	0.10	39.42	623.18	49.66	35.76	-7.73	-52.29
LOOP2	P9	GeoProbe	40. 2061	5.43	1.56	26.12	0.38	31.06	0.11	43.80	525.87	75.57	32.30	-7.88	-53.16
LOOP2	P9	GeoProbe	40. 2061	6.85	1.17	29.07	0.60	0.28	-0.05	181.29	145.00	95.72	30.53	-7.85	-52.97
LOOP2	P9	GeoProbe	40. 2061	7.47							248.10	37.00	53.87	-7.76	-53.10
LOOP2	P9	GeoProbe	40. 2061	8.46	0.19	32.29	0.16	49.59	-0.05	49.68	395.38	36.91	48.65	-7.98	-53.57
LOOP2	P9	GeoProbe	40. 2061	8.69	0.31	26.94	0.27	11.59	-0.05	83.11	383.22	24.57	38.84	-8.01	-53.54
LOOP2	P9	GeoProbe	40. 2061	9.68	0.90	32.06	0.38	29.06	-0.05	221.44	86.53		37.77		

LOOP2	P9	GeoProbe	40. 2061	10.51	1.36	28.10	0.16	0.31	-0.05	191.55	121.77		23.31		

Appendix3-2. Results of cations of LOOP2

LOOPNr	ID	method	DGUnr	Depth (m)	mg/L									
					Al	Ba	Ca	Fe	K	Mg	Mn	Na	Ni	Sr
LOOP2	P1	GeoProbe	40. 2054	1.78	0.52	0.32	96.50		4.37	39.35	0.52	429.93	0.05	0.78
LOOP2	P1	GeoProbe	40. 2054	2.94	0.30	0.04	52.27		1.74	15.55	0.03	70.30	0.03	0.38
LOOP2	P1	GeoProbe	40. 2054	5.38	0.33	0.11	104.57		2.20	9.94	0.02	41.52	0.01	0.68
LOOP2	P1	GeoProbe	40. 2054	5.92	0.34	0.18	99.01		4.82	9.23	0.02	44.83	0.01	0.62
LOOP2	P1	GeoProbe	40. 2054	6.60	0.30	0.13	117.57		9.18	9.10	0.02	41.06	0.01	0.56
LOOP2	P1	GeoProbe	40. 2054	7.82	0.33	0.05	144.66		3.99	8.71	0.06	32.30	0.01	0.47
LOOP2	P1	GeoProbe	40. 2054	9.14	0.28	0.03	118.67		3.11	7.88	0.36	22.41	0.01	0.33
LOOP2	P1	GeoProbe	40. 2054	10.17	0.27	0.03	98.49		1.89	8.71	0.17	22.24	0.01	0.30
LOOP2	P1	GeoProbe	40. 2054	10.76	0.32	0.03	103.51		1.84	8.19	0.05	22.49	0.01	0.30
LOOP2	P1	GeoProbe	40. 2054	12.10	0.27	0.07	102.99		3.41	9.63	0.26	27.72	0.01	0.32
LOOP2	P1	GeoProbe	40. 2054	12.84	0.27	0.04	94.96		2.51	8.67	0.03	25.30	0.01	0.29
LOOP2	P2	GeoProbe	40. 2055	0.30	3.96	0.12	29.27	2.87	7.42	3.14	0.02	29.21	0.01	0.16
LOOP2	P2	GeoProbe	40. 2055	1.94	0.28	0.14	50.40		21.75	7.96	0.13	21.03	0.02	0.23
LOOP2	P2	GeoProbe	40. 2055	3.19	0.28	0.10	67.57		5.81	7.40	0.11	34.64	0.03	0.31
LOOP2	P2	GeoProbe	40. 2055	3.88	0.28	0.11	113.82		6.91	10.26	0.12	31.28	0.03	0.46
LOOP2	P2	GeoProbe	40. 2055	4.16	0.27	0.07	123.29		3.12	8.14	0.21	41.10	0.02	0.44
LOOP2	P2	GeoProbe	40. 2055	4.70	0.27	0.08	119.00		2.56	7.27	0.17	36.51	0.01	0.45
LOOP2	P2	GeoProbe	40. 2055	5.03	0.49	0.09	147.07		5.40	12.71	0.37	134.83	0.01	0.53
LOOP2	P2	GeoProbe	40. 2055	5.92	2.16	0.08	102.23	1.03	3.02	9.98	0.82	28.64	0.24	0.33
LOOP2	P2	GeoProbe	40. 2055	6.40	0.27	0.05	109.39		3.05	10.10	1.20	34.33	0.01	0.38
LOOP2	P2	GeoProbe	40. 2055	7.02	0.33	0.12	115.12	0.02	2.89	9.89	0.05	48.05	0.26	0.45
LOOP2	P2a	GeoProbe	48. 2126	1.32	0.30	0.09	102.67	0.04	7.79	7.50	0.45	34.87	0.05	0.36
LOOP2	P2a	GeoProbe	48. 2126	2.69	0.32	0.09	106.41		5.18	9.34	0.10	29.32	0.04	0.36
LOOP2	P2a	GeoProbe	48. 2126	3.58	0.35	0.08	82.29	0.14	2.92	7.89	0.06	25.13	0.02	0.28

LOOP2	P2a	GeoProbe	48. 2126	3.91	0.29	0.07	78.42		2.50	8.32	0.10	26.89	0.01	0.26
LOOP2	P2a	GeoProbe	48. 2126	4.60	0.31	0.06	69.45		3.46	7.89	0.09	31.08	0.01	0.31
LOOP2	P2a	GeoProbe	48. 2126	5.03	0.34	0.05	69.34		2.73	7.57	0.10	26.00	0.01	0.24
LOOP2	P2a	GeoProbe	48. 2126	5.72	0.27	0.05	68.21		2.87	7.35	0.09	26.50	0.01	0.24
LOOP2	P2a	GeoProbe	48. 2126	6.25	0.27	0.05	68.30		2.77	7.38	0.10	26.37	0.02	0.24
LOOP2	P2a	GeoProbe	48. 2126	6.94	0.26	0.05	62.25	1.25	2.32	6.90	0.07	25.54	0.01	0.23
LOOP2	P2a	GeoProbe	48. 2126	7.23	0.38	0.05	66.75		3.52	7.42	0.08	28.67	0.01	0.23
LOOP2	P2a	GeoProbe	48. 2126	8.89	0.27	0.06	65.85		3.35	7.14	0.07	26.74	0.01	0.20
LOOP2	P2a	GeoProbe	48. 2126	9.58	0.26	0.06	71.22		3.94	7.93	0.09	30.12	0.01	0.24
LOOP2	P2a	GeoProbe	48. 2126	14.45	0.27	0.04	99.01		2.32	9.31	0.08	26.49	0.01	0.31
LOOP2	P2a	GeoProbe	48. 2126	14.79	0.26	0.08	105.13		2.77	10.01	0.11	27.66	0.01	0.38
LOOP2	P3	GeoProbe	48. 2127	1.57	0.38	0.12	76.12	0.05	39.59	8.85	0.03	24.82	0.01	0.27
LOOP2	P3	GeoProbe	48. 2127	2.59	0.32	0.06	76.48	0.00	3.47	8.00	0.53	26.87	0.01	0.27
LOOP2	P3	GeoProbe	48. 2127	2.98	0.27	0.10	79.98	0.03	5.90	4.78	0.11	24.16	0.01	0.27
LOOP2	P3	GeoProbe	48. 2127	4.11	0.27	0.05	68.95		2.91	5.86	0.04	24.90	0.02	0.25
LOOP2	P3	GeoProbe	48. 2127	4.40	0.26	0.06	67.45		2.88	5.71	0.04	24.15	0.01	0.26
LOOP2	P3	GeoProbe	48. 2127	5.68	0.34	0.08	78.96		4.45	7.31	0.09	35.24	0.02	0.34
LOOP2	P4	GeoProbe	40. 2056	0.35	3.98	0.17	93.55	0.32	22.11	14.12	0.06	284.50	0.02	0.66
LOOP2	P4	GeoProbe	40. 2056	1.57	0.81	0.06	38.83	0.53	11.63	5.78	0.03	62.54	0.02	0.38
LOOP2	P4	GeoProbe	40. 2056	2.99	0.34	0.28	112.61	0.00	25.26	11.19	0.09	33.81	0.02	0.53
LOOP2	P4	GeoProbe	40. 2056	5.86	0.36	0.04	44.29	0.03	15.06	6.88	0.06	24.80	0.01	0.28
LOOP2	P4	GeoProbe	40. 2056	6.25	0.34	0.07	109.40		16.10	13.13	0.39	33.97	0.01	0.64
LOOP2	P4	GeoProbe	40. 2056	7.47	0.47	0.08	96.76		18.24	8.54	0.17	61.07	0.01	0.46
LOOP2	P4	GeoProbe	40. 2056	8.16	0.33	0.05	39.31	0.00	14.21	3.91	0.21	47.46	0.01	0.24
LOOP2	P4	GeoProbe	40. 2056	8.69	0.34	0.08	86.89		17.76	9.73	0.33	120.27	0.01	0.47
LOOP2	P4	GeoProbe	40. 2056	9.48	0.42	0.08	39.90	0.04	13.89	5.84	0.18	44.78	0.01	0.29
LOOP2	P4	GeoProbe	40. 2056	10.11	0.53	0.06	76.32	0.06	22.65	9.16	0.61	46.13	0.05	0.48
LOOP2	P4	GeoProbe	40. 2056	10.70	0.44	0.07	84.51	0.21	22.67	11.83	2.12	53.74	0.02	0.53
LOOP2	P4	GeoProbe	40. 2056	11.05	0.06	0.06	105.74	0.04	3.51	10.31	2.16	37.23	0.02	0.29
LOOP2	P4	GeoProbe	40. 2056	14.99	0.35	0.12	79.58	0.02	16.98	10.81	0.04	51.19	0.01	0.75
LOOP2	P4	GeoProbe	40. 2056	17.73	0.35	0.11	95.48	0.03	4.52	17.28	0.03	71.07	0.01	0.78
LOOP2	P5	GeoProbe	40. 2057	1.37	0.39	0.05	138.74	0.04	3.70	11.84	0.60	78.73	0.02	0.42
LOOP2	P5	GeoProbe	40. 2057	1.90	0.42	0.10	120.57	0.06	4.78	17.44	0.06	72.19	0.02	0.81
LOOP2	P5	GeoProbe	40. 2057	2.19	0.39	0.08	91.05	0.20	4.15	12.18	0.10	64.38	0.01	0.65

LOOP2	P5	GeoProbe	40. 2057	2.59	0.36	0.09	98.72	0.02	2.61	11.93	0.06	38.35	0.01	0.42
LOOP2	P5	GeoProbe	40. 2057	3.28	0.34	0.09	100.27	0.01	2.00	10.88	0.05	29.36	0.01	0.33
LOOP2	P5	GeoProbe	40. 2057	3.57	0.34	0.09	95.98		1.79	11.31	0.20	30.66	0.01	0.37
LOOP2	P5	GeoProbe	40. 2057	4.51	0.33	0.07	85.38		1.70	8.86	0.02	32.55	0.01	0.32
LOOP2	P5	GeoProbe	40. 2057	5.73	0.37	0.07	77.24		1.52	8.13	0.02	26.21	0.00	0.31
LOOP2	P6	GeoProbe	40. 2058	0.40	0.57	0.06	71.71	0.03	1.03	3.75	0.01	16.15	0.00	0.25
LOOP2	P6	GeoProbe	40. 2058	2.28	0.40	0.13	106.37		1.92	6.70	0.05	28.29	0.01	0.36
LOOP2	P6	GeoProbe	40. 2058	3.36	0.36	0.06	76.83		1.18	4.49	0.04	21.51	0.00	0.20
LOOP2	P6	GeoProbe	40. 2058	3.81	0.36	0.13	100.37		1.66	6.10	0.02	23.80	0.01	0.32
LOOP2	P6	GeoProbe	40. 2058	5.82	0.35	0.07	119.86	0.02	2.47	12.89	0.13	22.13	0.01	0.36
LOOP2	P6	GeoProbe	40. 2058	6.35	0.50	0.04	113.81	0.03	2.89	11.19	0.07	28.32	0.01	0.37
LOOP2	P6	GeoProbe	40. 2058	7.04	0.35	0.05	102.26		2.62	10.19	0.03	27.48	0.01	0.33
LOOP2	P6	GeoProbe	40. 2058	7.67	0.35	0.05	105.73	0.13	3.36	10.82	0.04	31.05	0.01	0.36
LOOP2	P6	GeoProbe	40. 2058	8.83	0.42	0.06	92.90		3.62	9.18	0.04	29.78	0.01	0.33
LOOP2	P7	GeoProbe	40. 2059	0.35	0.89	0.07	15.64	0.94	4.33	2.12	0.29	20.06	0.01	0.13
LOOP2	P7	GeoProbe	40. 2059	1.77	0.10	0.17	73.64	0.01	16.41	10.15	0.04	30.41	0.01	0.39
LOOP2	P7	GeoProbe	40. 2059	2.99	0.11	0.04	57.74	0.01	3.05	12.40	0.29	20.44	0.02	0.33
LOOP2	P7	GeoProbe	40. 2059	4.61	0.34	0.06	105.27	0.05	1.58	12.36	0.05	38.16	0.01	0.62
LOOP2	P7	GeoProbe	40. 2059	5.73	0.16	0.09	111.88		1.41	14.05	0.06	30.21	0.01	0.55
LOOP2	P8	GeoProbe	40. 2060	0.35	0.42	0.08	34.55	0.40	12.05	3.82	0.05	22.18	0.01	0.21
LOOP2	P8	GeoProbe	40. 2060	1.47	0.13	0.07	51.71	0.28	3.58	8.43	0.05	40.88	0.01	0.34
LOOP2	P8	GeoProbe	40. 2060	2.79	0.08	0.10	44.05	0.02	2.02	12.23	0.08	33.07	0.01	0.39
LOOP2	P9	GeoProbe	40. 2061	3.19	0.07	0.06	103.71	0.00	1.25	6.62	0.03	20.85	0.01	0.37
LOOP2	P9	GeoProbe	40. 2061	4.02	0.14	0.26	76.26	0.08	4.72	6.63	0.05	27.21	0.01	0.43
LOOP2	P9	GeoProbe	40. 2061	4.31	0.09	0.03	20.70	0.01	1.36	1.66	0.06	11.95	0.00	0.11
LOOP2	P9	GeoProbe	40. 2061	5.43	0.10	0.06	87.09	3.34	1.66	16.84	0.28	17.68	0.03	0.46
LOOP2	P9	GeoProbe	40. 2061	6.85	0.10	0.10	81.46		2.32	15.00	0.02	36.75	0.01	0.45
LOOP2	P9	GeoProbe	40. 2061	7.47	0.14	0.06	75.53	0.01	2.24	10.53	0.02	28.79	0.01	0.39
LOOP2	P9	GeoProbe	40. 2061	8.46	0.10	0.10	107.64	0.12	2.83	13.58	0.11	31.68	0.02	0.53
LOOP2	P9	GeoProbe	40. 2061	8.69	0.07	0.04	100.93		2.25	12.82	0.68	25.90	0.01	0.34
LOOP2	P9	GeoProbe	40. 2061	9.68	0.09	0.04	103.17	0.01	1.79	11.04	0.21	26.88	0.01	0.35
LOOP2	P9	GeoProbe	40. 2061	10.51	0.07	0.05	84.31	0.00	2.38	10.44	0.29	25.96	0.01	0.32

Appendix3-3. Formic acid extractable Fe(II), Fe(total), and Fe(II)/Fe(total) of LOOP2

LOOPNr	DGUnr	borehole	Depth (m)	mg/Kg		Fe(II)/Fe(total)
				Fe(II)	Fe(total)	
LOOP2	40. 2054	P1	1.07	0.2	28.4	0.01
LOOP2	40. 2054	P1	1.6	1.1	162.5	0.01
LOOP2	40. 2054	P1	2.79	10.5	207.1	0.05
LOOP2	40. 2054	P1	4.01	18.2	205.9	0.09
LOOP2	40. 2054	P1	4.325	11.7	150.8	0.08
LOOP2	40. 2054	P1	5.23	9.8	282.8	0.03
LOOP2	40. 2054	P1	6.45	4.0	206.4	0.02
LOOP2	40. 2054	P1	7.67	0.9	66.1	0.01
LOOP2	40. 2054	P1	8.99	238.5	441.4	0.54
LOOP2	40. 2054	P1	10.025	1.4	111.4	0.01
LOOP2	40. 2054	P1	12.49	3.7	135.7	0.03
LOOP2	40. 2055	P2	0.44	20.7	80.0	0.26
LOOP2	40. 2055	P2	1.555	96.5	253.0	0.38
LOOP2	40. 2055	P2	2.79	5.0	97.0	0.05
LOOP2	40. 2055	P2	3.53	163.5	261.0	0.63
LOOP2	40. 2055	P2	4.01	483.1	517.1	0.93
LOOP2	40. 2055	P2	4.55	517.6	565.6	0.92
LOOP2	40. 2055	P2	5.37	331.4	757.9	0.44
LOOP2	40. 2055	P2	5.77	680.7	755.3	0.90
LOOP2	40. 2055	P2	6.25	36.7	295.8	0.12
LOOP2	40. 2055	P2	6.87	168.7	264.7	0.64
LOOP2	48. 2126	P2a	1.66	512.5	752.1	0.68
LOOP2	48. 2126	P2a	3.065	411.8	623.2	0.66
LOOP2	48. 2126	P2a	4.25	671.3	710.7	0.94
LOOP2	48. 2126	P2a	5.37	635.9	663.8	0.96
LOOP2	48. 2126	P2a	6.59	1061.9	1128.3	0.94
LOOP2	48. 2126	P2a	9.23	520.4	559.8	0.93
LOOP2	48. 2126	P2a	14.3	42.9	223.3	0.19
LOOP2	48. 2127	P3	0.49	8.2	256.7	0.03
LOOP2	48. 2127	P3	1.42	3.8	43.2	0.09
LOOP2	48. 2127	P3	2.88	33.2	172.1	0.19
LOOP2	48. 2127	P3	4.25	326.8	491.2	0.67
LOOP2	48. 2127	P3	5.53	552.3	581.1	0.95
LOOP2	40. 2056	P4	1.71	0.2	18.9	0.01
LOOP2	40. 2056	P4	2.64	0.3	22.0	0.02
LOOP2	40. 2056	P4	3.95	4.5	57.9	0.08
LOOP2	40. 2056	P4	6.39	4.0	99.4	0.04
LOOP2	40. 2056	P4	7.81	874.3	1295.6	0.67
LOOP2	40. 2056	P4	8.83	617.0	1035.2	0.60

LOOP2	40. 2056	P4	10.25	526.6	859.3	0.61
LOOP2	40. 2056	P4	14.84	128.9	474.1	0.27
LOOP2	40. 2056	P4	15.13	158.1	463.0	0.34
LOOP2	40. 2056	P4	17.58	159.9	344.9	0.46
LOOP2	40. 2057	P5	0.44	62.0	113.5	0.55
LOOP2	40. 2057	P5	1.59	3.4	124.0	0.03
LOOP2	40. 2057	P5	2.93	182.2	426.1	0.43
LOOP2	40. 2057	P5	4.36	34.3	217.1	0.16
LOOP2	40. 2057	P5	5.58	5.6	178.1	0.03
LOOP2	40. 2058	P6	3.36	18.4	18.1	1.02
LOOP2	40. 2058	P6	4.15	478.3	502.1	0.95
LOOP2	40. 2058	P6	5.47	632.2	662.0	0.95
LOOP2	40. 2058	P6	6.69	123.1	243.7	0.51
LOOP2	40. 2058	P6	8.01	341.0	480.8	0.71
LOOP2	40. 2058	P6	9.17	752.8	770.5	0.98
LOOP2	40. 2059	P7	1.91	0.7	140.4	0.01
LOOP2	40. 2059	P7	3.195	0.4	110.5	0.00
LOOP2	40. 2059	P7	4.46	70.6	568.7	0.12
LOOP2	40. 2059	P7	5.58	318.6	692.9	0.46
LOOP2	40. 2060	P8	1.37	0.4	72.0	0.01
LOOP2	40. 2060	P8	2.64	0.2	52.6	0.00
LOOP2	40. 2060	P8	4.565	5.3	208.2	0.03
LOOP2	40. 2060	P8	5.785	0.3	50.6	0.01
LOOP2	40. 2061	P9	5.57	42.7	151.5	0.28
LOOP2	40. 2061	P9	7.19	609.9	628.5	0.97
LOOP2	40. 2061	P9	8.83	256.0	542.1	0.47
LOOP2	40. 2061	P9	10.85	438.0	459.1	0.95

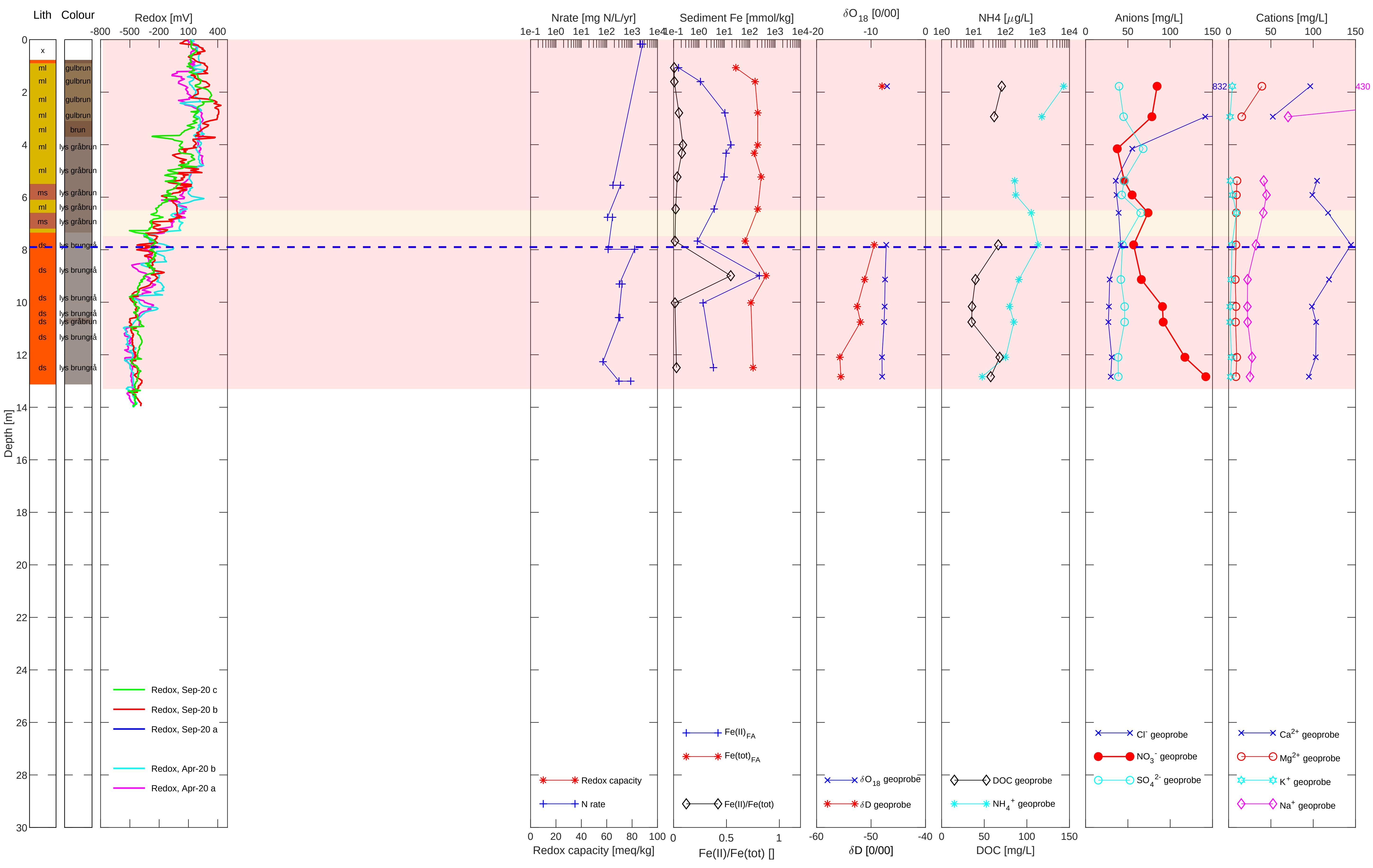
Appendix3-4. Denitrification rate of LOOP2

LOOP Nr	DGU Nr	Borehole	Depth (m)	mg N /yr	
				Repeat1	Repeat2
LOOP2	40. 2054	P1	5.5	176.6	350.1
LOOP2	40. 2054	P1	6.8	107.5	168.6
LOOP2	40. 2054	P1	8.0	113.7	1256.1
LOOP2	40. 2054	P1	9.3	315.6	400.1
LOOP2	40. 2054	P1	10.6	295.0	329.8
LOOP2	40. 2054	P1	12.3	71.1	
LOOP2	40. 2054	P1	13.0	303.7	880.3
LOOP2	40. 2055	P2	1.8	136.8	262.6
LOOP2	40. 2055	P2	3.0	96.9	97.6
LOOP2	40. 2055	P2	4.3	601.0	1301.2
LOOP2	40. 2055	P2	5.2	276.3	894.3

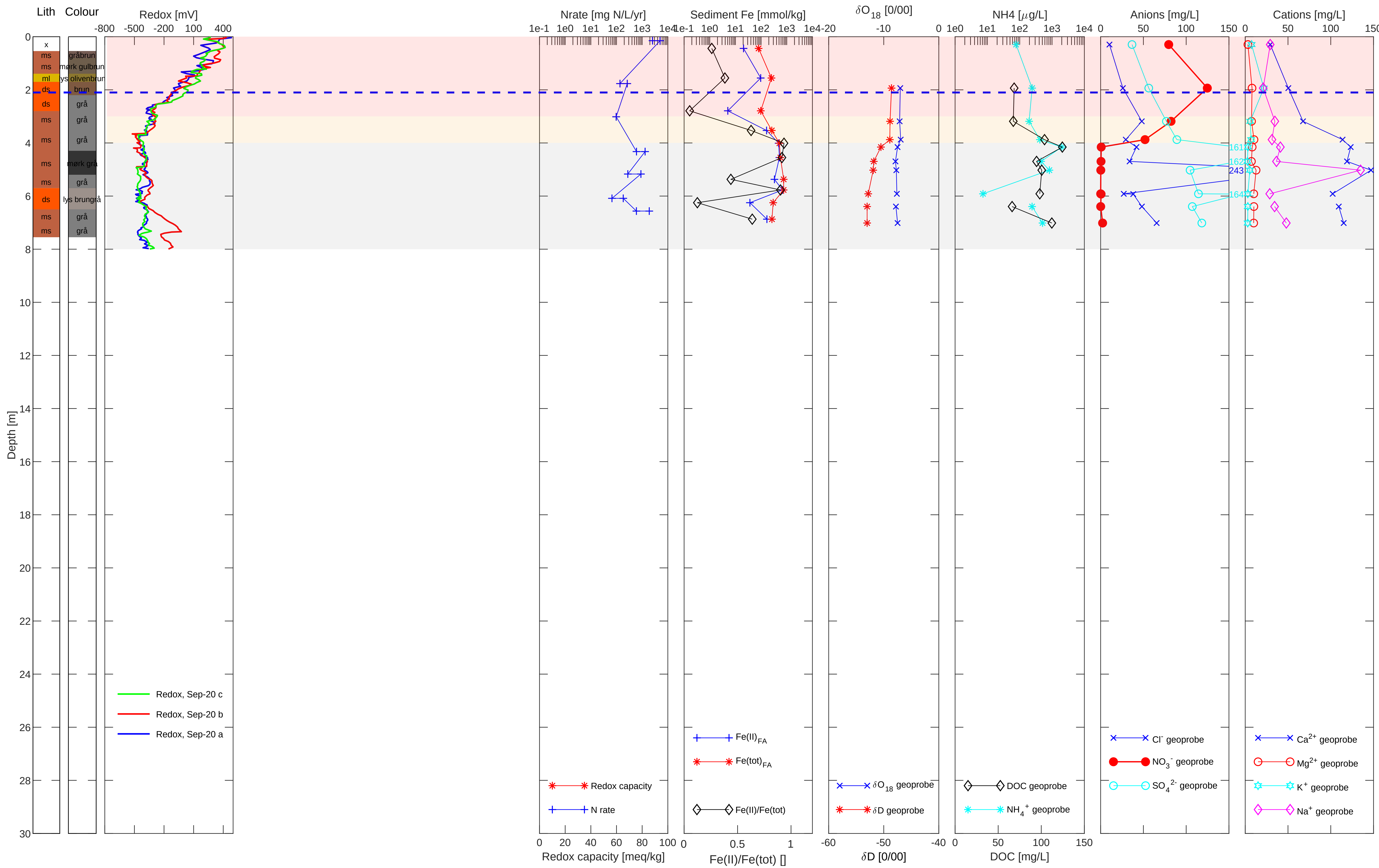
LOOP2	40. 2055	P2	6.1	66.6	183.1
LOOP2	40. 2055	P2	6.6	596.5	
LOOP2	48. 2126	P2a	1.5	1713.0	1761.5
LOOP2	48. 2126	P2a	2.9	961.5	1162.7
LOOP2	48. 2126	P2a	4.1	1044.8	
LOOP2	48. 2126	P2a	6.4	300.3	542.9
LOOP2	48. 2126	P2a	9.0	815.4	929.4
LOOP2	48. 2126	P2a	9.7	581.9	1163.1
LOOP2	48. 2126	P2a	14.6	1143.5	
LOOP2	48. 2127	P3	0.2	3962.7	
LOOP2	48. 2127	P3	2.7	2000.8	2661.4
LOOP2	48. 2127	P3	3.1	1533.0	1817.7
LOOP2	48. 2127	P3	4.0	1220.3	1369.6
LOOP2	48. 2127	P3	5.8	653.1	683.3
LOOP2	20. 2056	P4	1.4	14.7	57.9
LOOP2	20. 2056	P4	6.0	51.2	120.1
LOOP2	20. 2056	P4	7.6	367.2	368.5
LOOP2	20. 2056	P4	10.0	340.8	410.0
LOOP2	20. 2056	P4	17.9	151.1	229.8
LOOP2	40. 2057	P5	1.8	380.4	471.1
LOOP2	40. 2057	P5	2.7	694.8	882.9
LOOP2	40. 2057	P5	3.4	693.5	1131.1
LOOP2	40. 2057	P5	3.7	67.6	284.5
LOOP2	40. 2057	P5	5.9	4.7	
LOOP2	40. 2058	P6	0.2	6153.1	
LOOP2	40. 2058	P6	4.0	599.8	657.6
LOOP2	40. 2058	P6	6.0	22.3	22.5
LOOP2	40. 2058	P6	6.5	997.6	1025.8
LOOP2	40. 2058	P6	7.2	670.4	1035.2
LOOP2	40. 2058	P6	7.8	1108.8	1137.8
LOOP2	40. 2058	P6	9.0	631.3	1110.7
LOOP2	40. 2059	P7	4.8	514.1	
LOOP2	40. 2059	P7	5.9	57.4	
LOOP2	40. 2061	P9	1.8	5.4	53.0
LOOP2	40. 2061	P9	7.0	4.8	22.7
LOOP2	40. 2061	P9	7.6	88.4	235.3
LOOP2	40. 2061	P9	8.3	66.0	
LOOP2	40. 2061	P9	10.7	2.9	

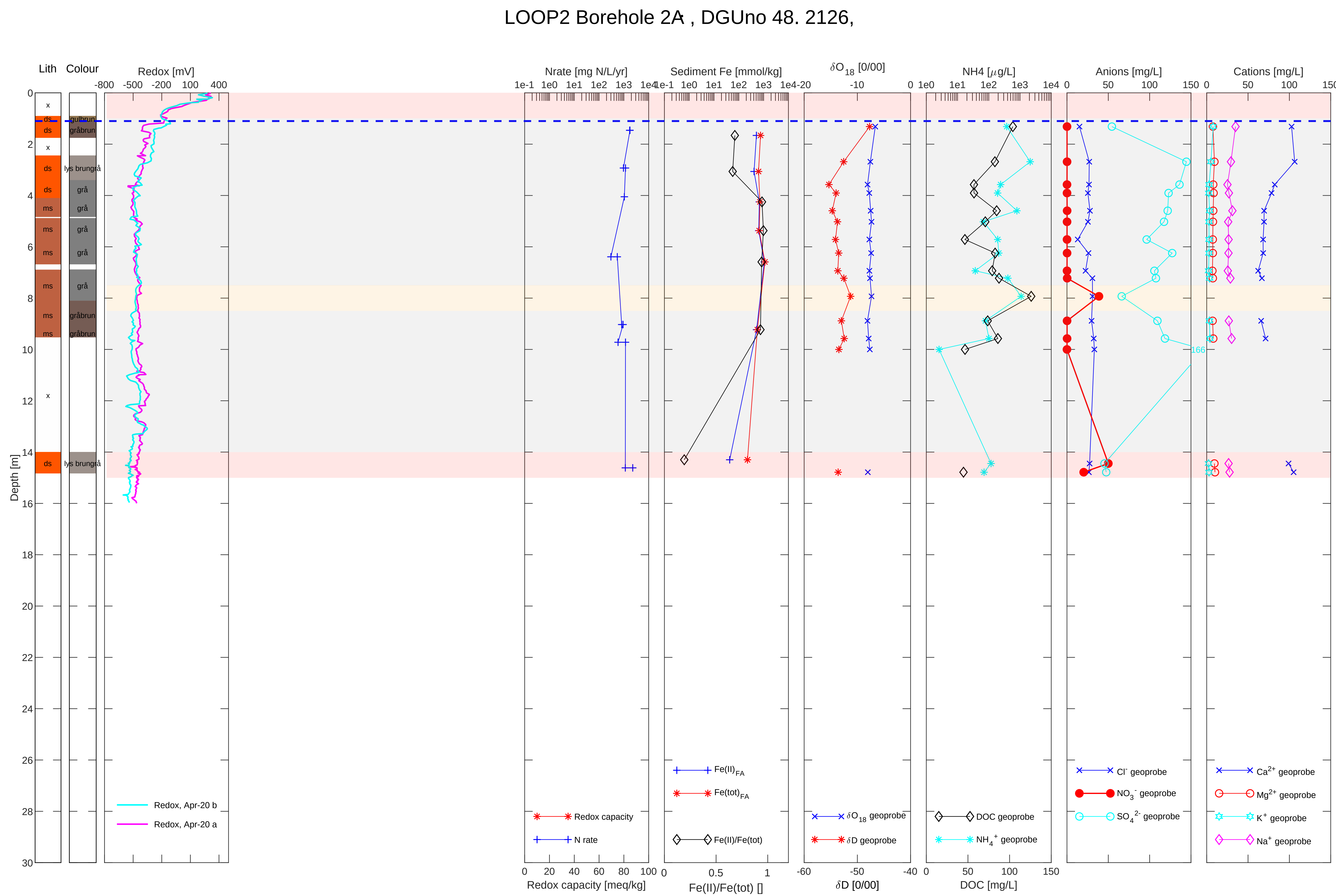
Appendix 4: Well panels illustrating all the collected parameters

LOOP2 Borehole 1·, DGUno 40. 2054,



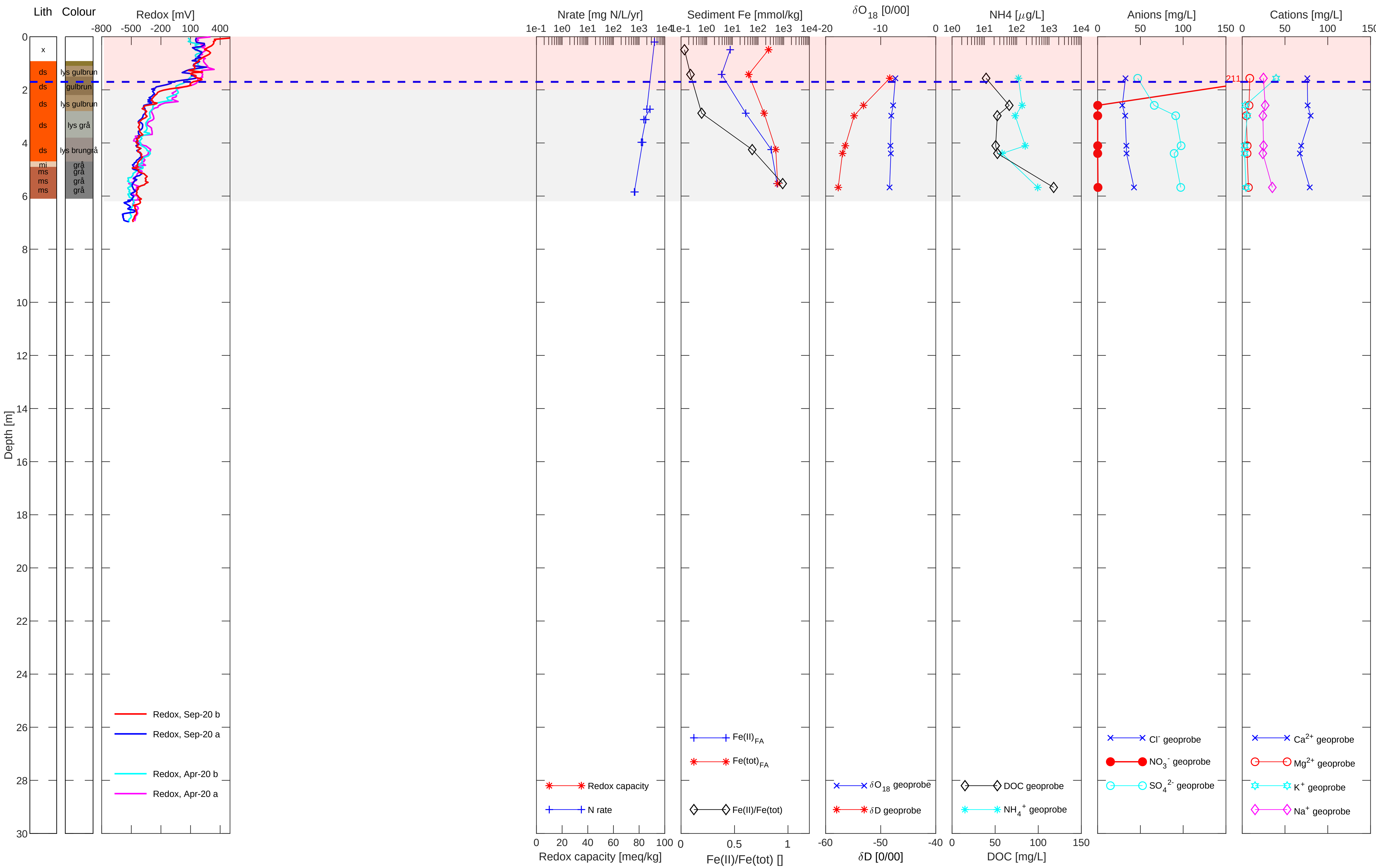
LOOP2 Borehole 2·, DGUno 40. 2055,



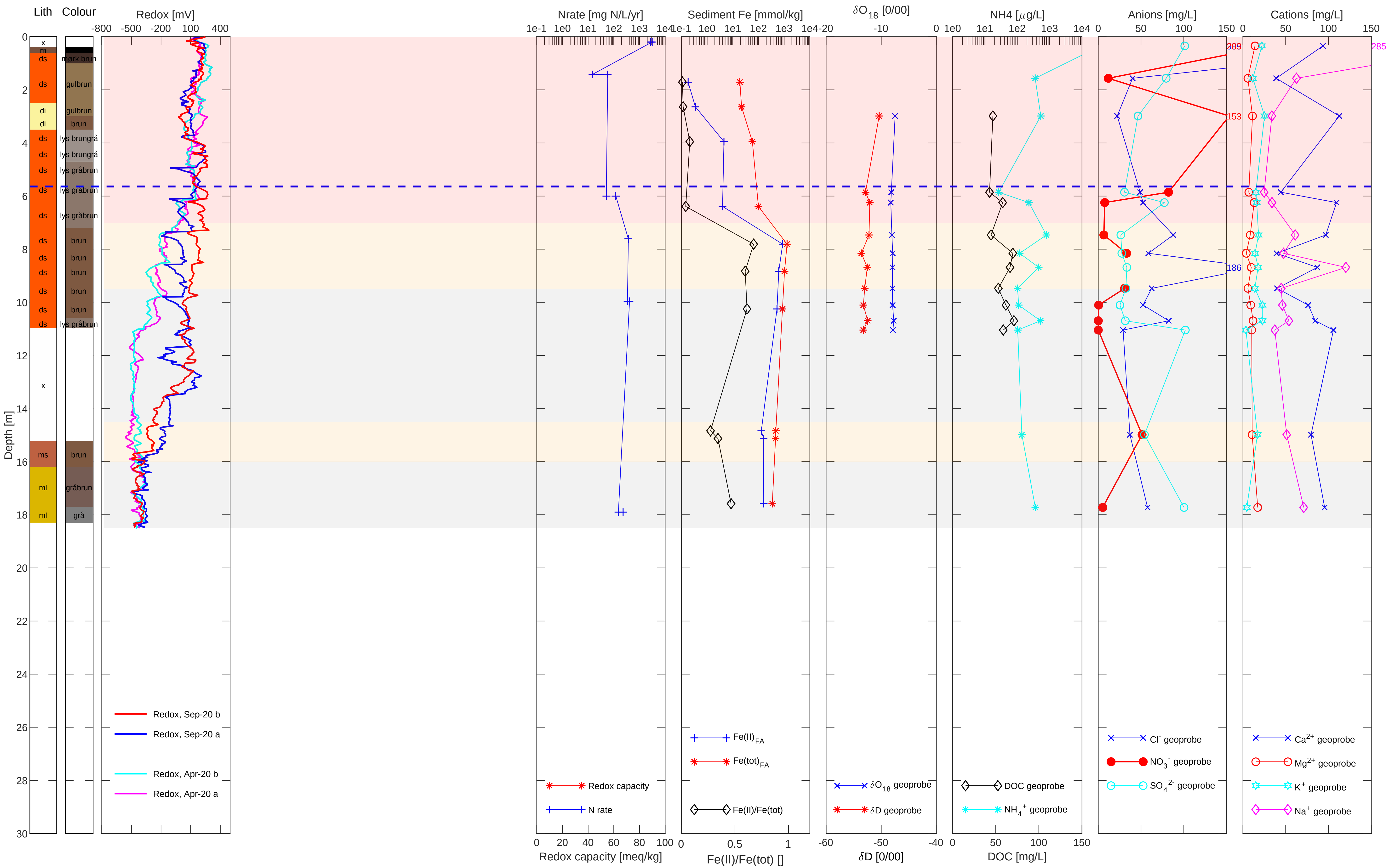


LOOP2 Borehole 2A , DGUno 48. 2126,
Lith
Colour
Redox [mV]
Nrate [mg N/L/yr]
Sediment Fe [mmol/kg]
δO18 [0/00]
NH4 [μg/L]
Anions [mg/L]
Cations [mg/L]
Depth [m]
Redox, Apr-20 b
Redox, Apr-20 a
Redox capacity
N rate
Fe(II)FA
Fe(tot)FA
Fe(II)/Fe(tot)
δO18 geoprobe
δD geoprobe
DOC geoprobe
NH4+ geoprobe
Cl- geoprobe
NO3- geoprobe
SO42- geoprobe
Ca2+ geoprobe
Mg2+ geoprobe
K+ geoprobe
Na+ geoprobe
Redox capacity [meq/kg]
Fe(II)/Fe(tot) []
δD [0/00]
DOC [mg/L]
ds
ms
x
gulbrun
gråbrun
lys brungrå
grå
166

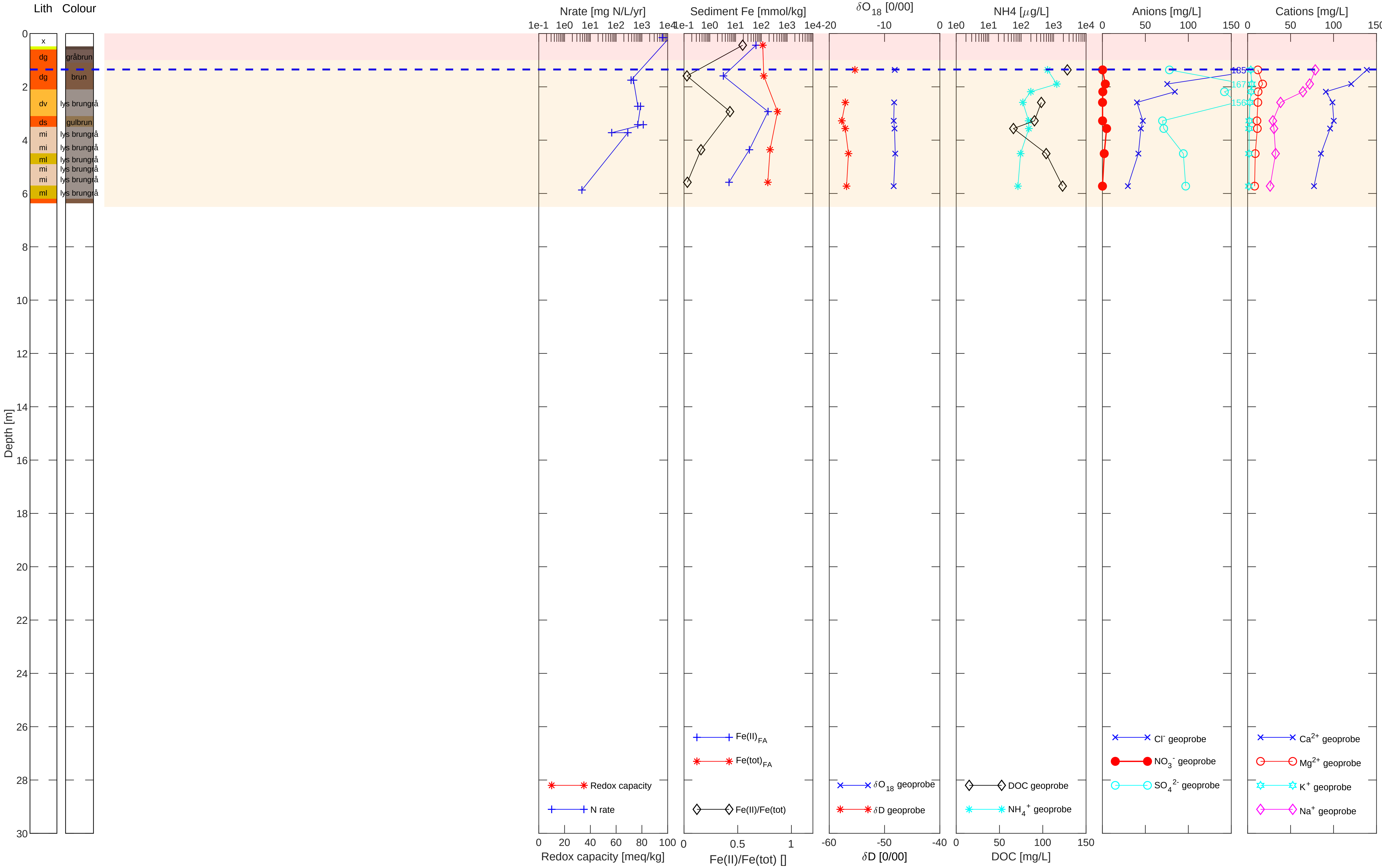
LOOP2 Borehole 3·, DGUno 48. 2127,



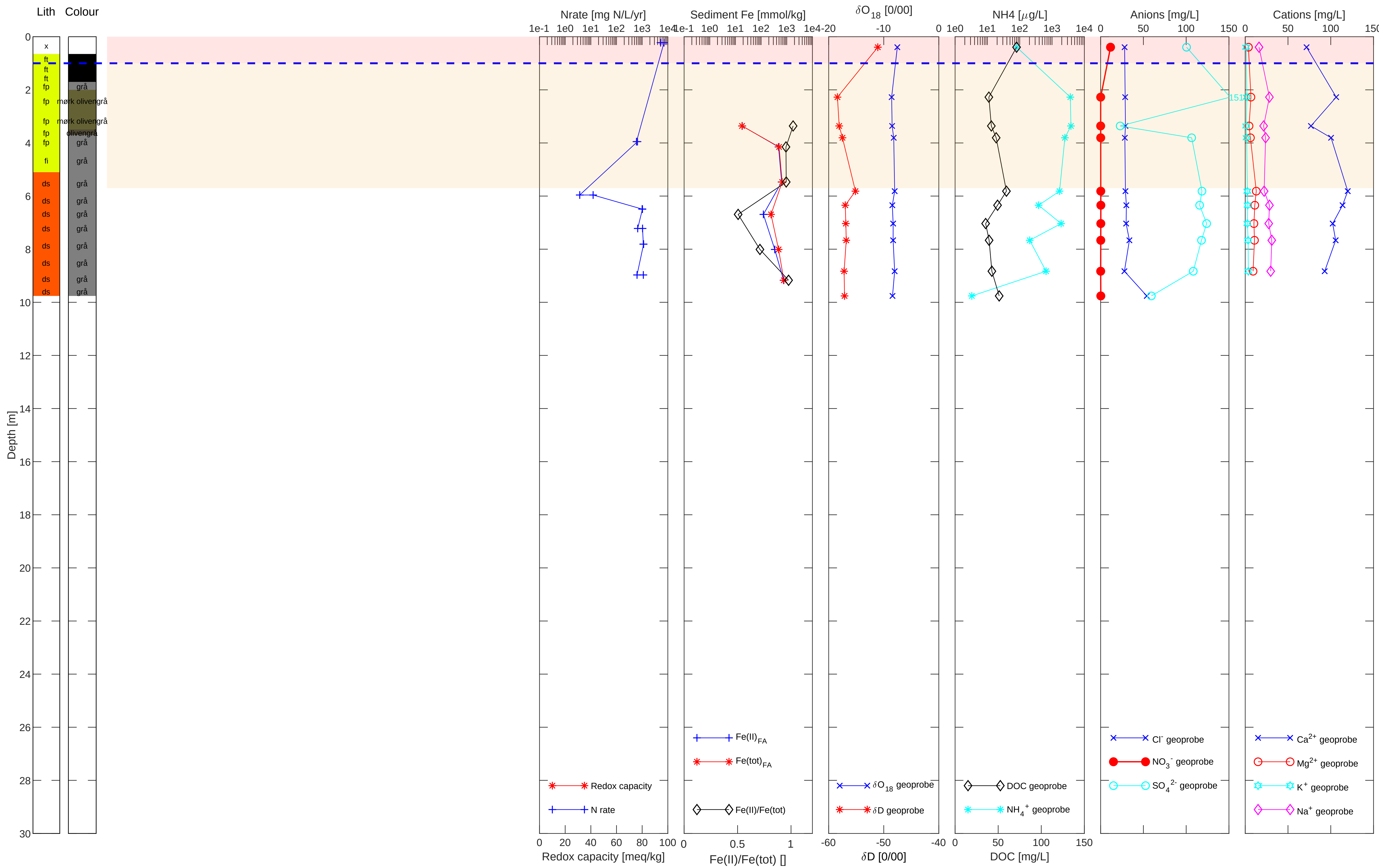
LOOP2 Borehole 4·, DGUno 40. 2056,



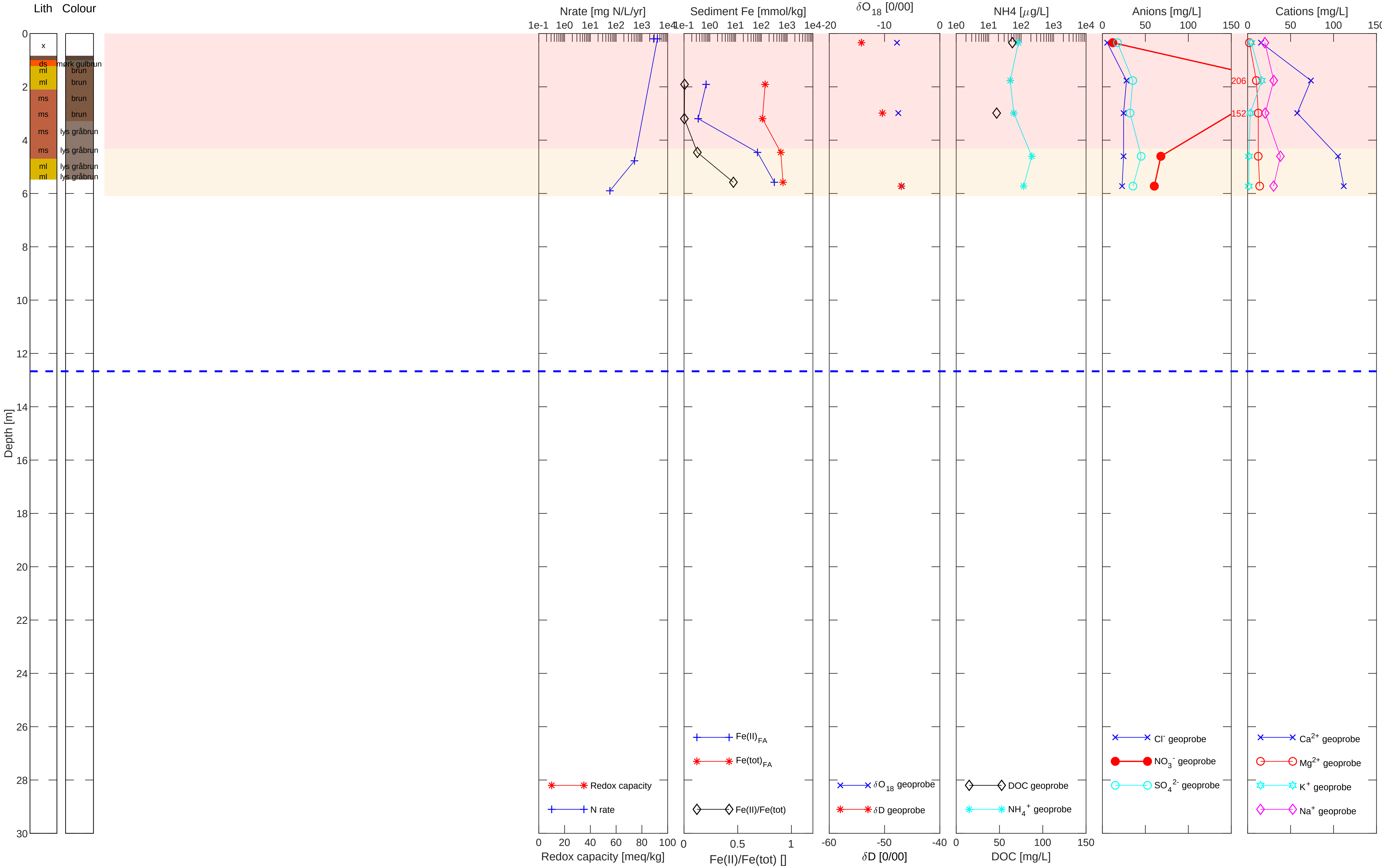
LOOP2 Borehole 5·, DGUno 40. 2057,



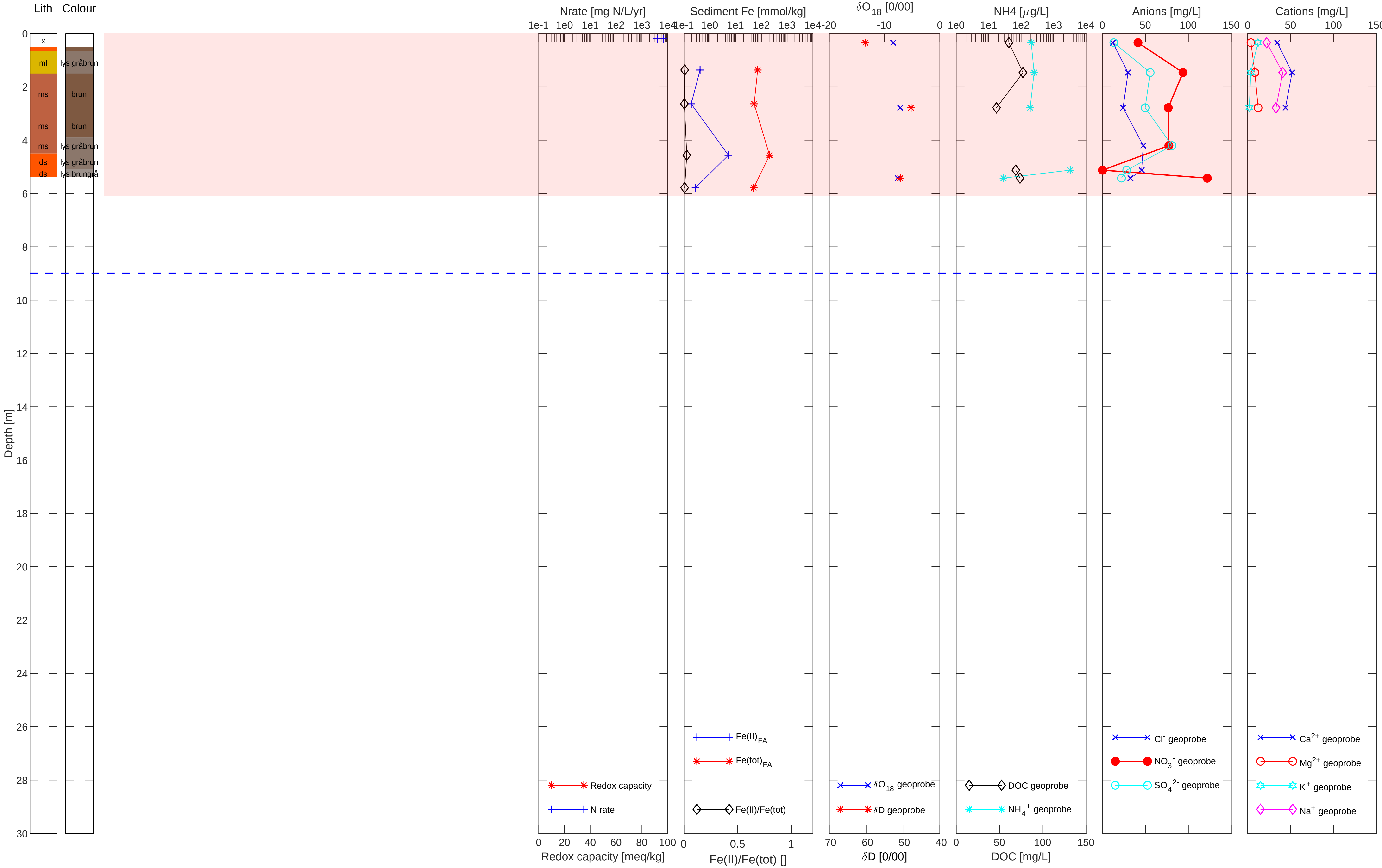
LOOP2 Borehole 6·, DGUno 40. 2058,

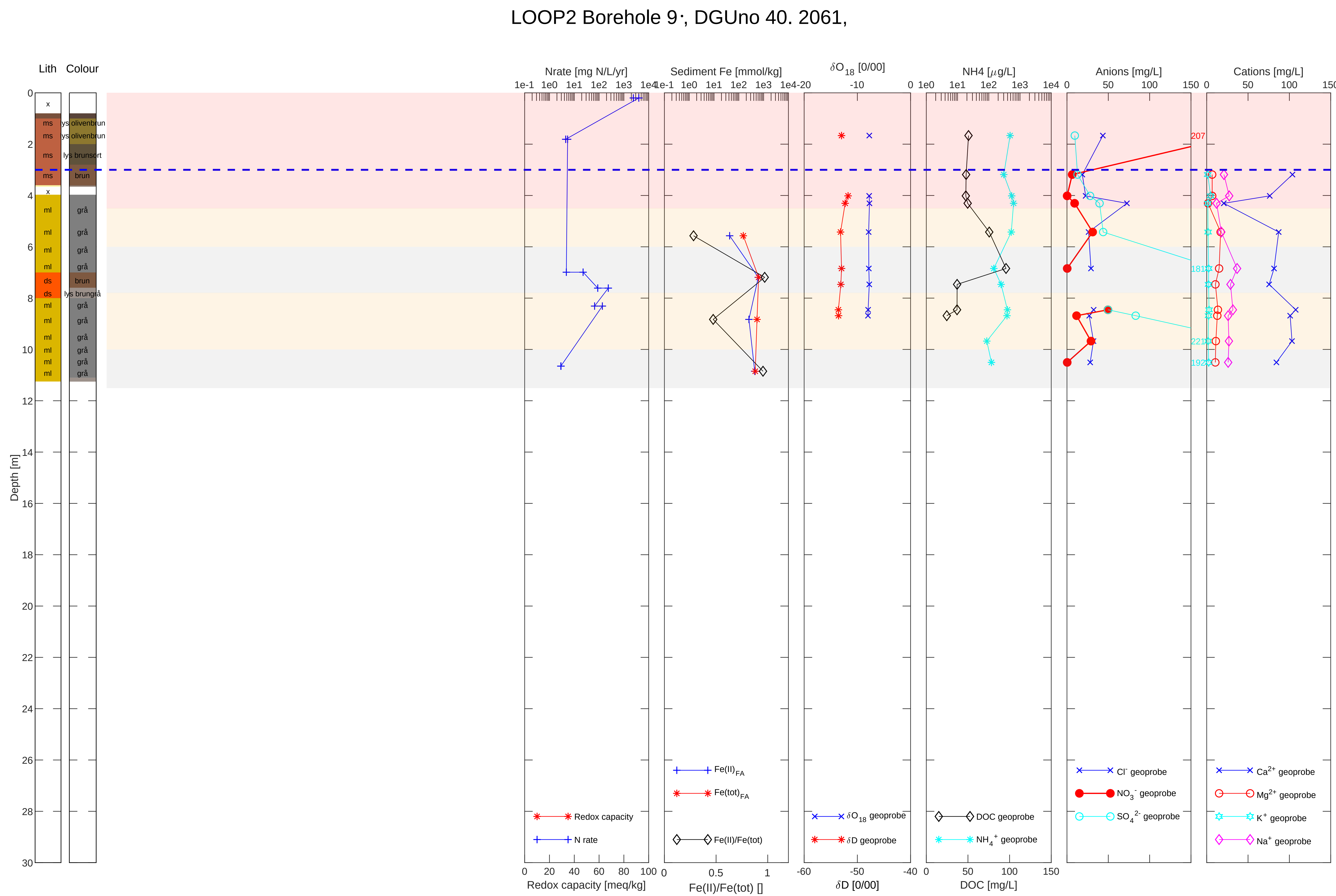


LOOP2 Borehole 7·, DGUno 40. 2059,



LOOP2 Borehole 8·, DGUno 40. 2060,





LOOP2 Borehole 9·, DGUno 40. 2061,
Lith
Colour
Depth [m]
Nrate [mg N/L/yr]
Redox capacity [meq/kg]
Redox capacity
N rate
Sediment Fe [mmol/kg]
Fe(II)/Fe(tot) []
Fe(II)FA
Fe(tot)FA
Fe(II)/Fe(tot)
δO18 [0/00]
δD [0/00]
δO18 geoprobe
δD geoprobe
NH4 [µg/L]
DOC [mg/L]
DOC geoprobe
NH4+ geoprobe
Anions [mg/L]
Cl- geoprobe
NO3- geoprobe
SO4 2- geoprobe
Cations [mg/L]
Ca2+ geoprobe
Mg2+ geoprobe
K+ geoprobe
Na+ geoprobe
ms
ml
ds
lys olivenbrun
lys brunsort
brun
grå
lys brungrå
207
181
221
192