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CRUISE REPORT

CAGE-ARCLIM cruise: Culturing (sub)Arctic planktic foraminifera
Neogloboquadrina pachyderma and *Globigerina bulloides*: Implications for
ocean acidification and paleoceanography reconstructions

on R/V Helmer Hanssen, June 23rd – June 30th 2022

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Acknowledgements:

Truls Holm contributed with of various acoustic equipment connected with this cruise. All cruise participants contributed to the collection of the data. They are all warmly thanked for their great contribution to make this cruise a great success.

This report was finalized on June 30th 2022 by M. M. Ezat.

Summary

From the morning of June 23rd to the morning of June 30th 2022, the Department of Geosciences at UiT the Arctic University of Norway, arranged a scientific cruise on R/V “Helmer Hanssen aimed at sampling living planktic foraminifera (*Neogloboquadrina pachyderma* and *Globigerina bulloides*) for culturing experiments both onboard and continued at the culturing laboratory at the Department. The purpose is to investigate the physiological and calcification responses of these species to a wide range of temperature, salinity and carbonate chemistry as well as to establish proxy calibration for paleoceanographic reconstructions.

The sampling is planned to take place in the Norwegian Sea and the Greenland Sea (for locations see Fig. 1). Seawater for the culturing experiments were also collected. The scientific sampling was done within the framework of the ongoing TFS-financed project “ARCLIM, The Arctic Ocean under warm climates” at the Department of Geosciences, UiT the Arctic University of Norway. A total of 50 plankton net casts, 16 CTD (conductivity-temperature-depth) casts, and 2 multicorers were performed to collect living specimens of the planktic foraminiferal species and surface sediments.

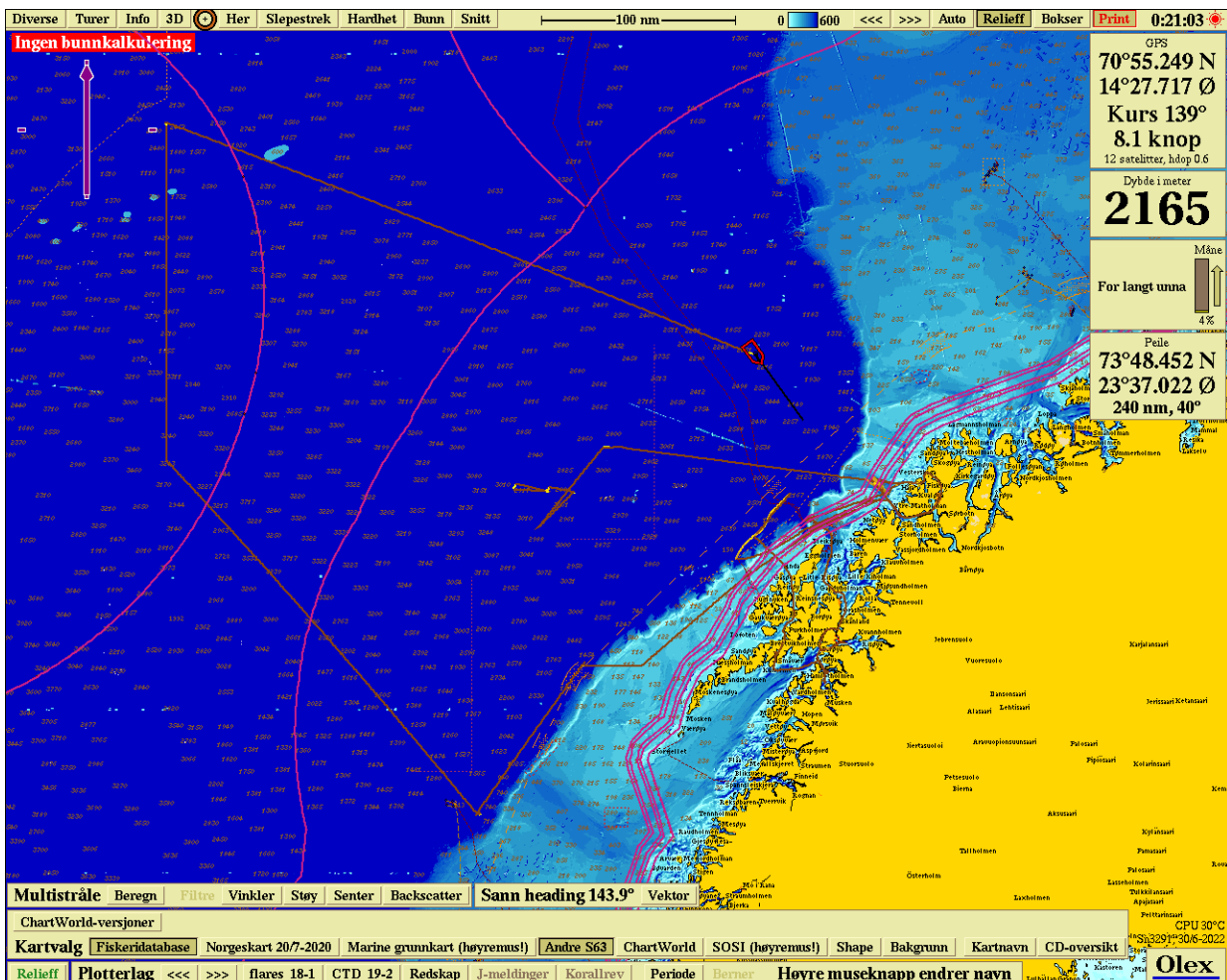


Figure 1: Overview map based on map from OLEX, the route from Troms  to the working area and to Troms  with last sampling station on the way.

Participants

Scientific crew:

Participants

Affiliation

Mohamed M. Ezat (Researcher, chief scientist)	UiT
Julie Meilland (Researcher, co-chief scientist)	MARUM, Bremen University
Adele Westgård (PhD student, co-chief scientist)	UiT
Tom Chalk (Researcher, CNRS, co-chief scientist)	CNRS, France
Freya Sykes (PhD student, co-chief scientist)	UiT
Naima El bani Altuna (Researcher)	UiT
Pushpak Nadar (Master Student)	MARUM, Bremen University
Franziska Tell (PhD student)	MARUM, Bremen University
Elwyn de la Vega (postdoc)	Galway University, Ireland

Equipment/Methods

Plankton/water sampling

Plankton nets (WP-2 net from HydroBios) were cast together with CTD-stations for capture of live planktic foraminifera for culturing experiments. The tows were done at 50 m, 60 m and 100 m. The water properties – temperature, salinity – were measured using a *Seabird 911 Plus* CTD. Data collection was performed during downcasts at a speed of approx. 1.0 m/s. The data of selected CTD stations were used for records of modern water mass properties for the experimental studies of living planktic foraminifera. Multicorer to collect surface sediments.

Journal (*times in UTC*)

Thursday, June 23rd 2022

~06:30: Embarkation of the vessel and departure 06:30 (UTC) towards the Vøring plateau.

08:00: set up of microscopes, the water filtration system and digital meters for pH, salinity.

Friday, June 24th 2022

Weather: winds 3.5 m/s, air temperature 8.4C, sea surface temperature 9.2C.

Protocol

12:15: CTD station HH22-CTD1057 start, 68,14N 01012E, 1139 m water depth, water collected from 150 m water depth

13:09: CTD station HH22-CTD1057 end

13:12: PN station HH22-PN1058, 50-0m, for exploratory purpose (nothing stored)
13:41: CTD station HH22-CTD1059, only upper 200 meters, water collected from 150 m water depth
14:20: CTD station HH22-CTD1060, only upper 200 meters, water collected from 150 m water depth
14:57: CTD station HH22-CTD1061, only upper 200 meters, water collected from 150 m water depth
15:19: CTD station HH22-CTD1062, only upper 200 meters, water collected from 150 m water depth

Summary

We collected about 300L water that had been filtered for the culturing experiments.

Saturday, June 25th 2022

Weather: Sunny, air temperature 8.9°C; winds 7.1 m/s..

We reached our first working station at 03:00 (UTC time) ~66.5N, 7E, water depth 1031m.

Protocol of June 25th (times in UTC)

03:02, CTD station HH22-1063, only upper 200m
03:18, PN station HH22- PN1064, 50-25m
03:27, PN station HH22-PN1065, 25-0m
04:36, PN station HH22-PN1066, 75-50m
05:08, PN station HH22-PN1067, 50-0m (due to a technical issue, this is the same net as station number 1068 in the cruise track)
05:33, PN station HH22-PN1069, 50-0m
06:19, PN station HH22-PN1070, 50-0m
07:12, PN station HH22-PN1071, 50-0m
07:55, PN station HH22-PN1072, 50-0m
08:45, PN station HH22-PN1073, 50-0m
09:18, PN station HH22-PN1074, 50-0m
10:14, PN station HH22-PN1075, 50-0m
10:56, PN station HH22-PN1076, 50-0m
12:17, PN station HH22-PN1077, 50-0m
13:09, PN station HH22-PN1078, 50-0m
13:46, PN station HH22-PN1079, 50-0m
14:39, PN station HH22-PN1080, 50-0m
15:28, PN station HH22-PN1081, 50-0m
16:22, PN station HH22-PN1082, 50-0m
16:29, CTD station HH22-CTD1083 (only the upper 250m), water collected from 150 m, and then 100, 75, 50, 25m.
17:00, PN station HH22-PN1084, 50-0m
18:38, CTD station HH22-CTD1085 (all the way), water collected from 200, 150, 100, 76, 50, 25, 10m water depth.
22:12, multicorer station HH22-1086-MC, 6 core lines (5 recovered, and one lost). All sampled on board.

Sunday, June 26th 2022

Weather: sunny, winds 6 m/s, air temperature 11°C.

Protocol

03:13, PN station HH22-PN1087, 50-0m
03:30, PN station HH22-PN1088, 100-75

04:14, PN station HH22-PN1089, 50-0m
04:30, PN station HH22-PN1090, 200-100
05:09, PN station HH22-PN1091, 50-0m
06:26, PN station HH22-PN1092, 50-0m
07:19, PN station HH22-PN1093, 50-0m
09:03, CTD station HH22-CTD1094, upper 200m. Water collected at 150, 50, 25 water depth.
09:49, PN station HH22-PN1095, twisted (didn't work).
10:08, PN station HH22-PN1096, 200-150
10:40, PN station HH22-PN1097, 100-80m
11:04, PN station HH22-PN1098, 80-50m
12:09, PN station HH22-PN1099, 50-25m
12:21, CTD HH22-PN1100, upper 200m, water collected from 150m
12:40, PN station HH12-PN1101, 25-0m

Monday, June 27th 2022

Weather: winds (5 m/s), air temperature 7.9°C, We reached 70N, 0E at 12:50 (UTC). Water depth ~3000m. was hunt for pachyderma, but only found a few and with parasites.

Protocol

12:57, CTD station HH22-PN1102, upper 250m
13:10, PN station HH12-PN1103, 75-25m

Tuesday, June 28th 2022

Weather: sunny, winds 4-7 m/s, air temperature ~4.5°C.

Protocol

06:05, CTD station HH22-CTD1104, 250 m
06:18, PN station HH22-PN1105, 50-0m
06:53, PN station HH22-PN1106, 50-0m
07:36, PN station HH22-PN1107, 50-0m
07:44, CTD station HH22-CTD1108
08:46, PN station HH22-PN1109, 50-0m
09:39, PN station HH22-PN1110, 50-0m
10:34, PN station HH22-PN1111, 50-0m
10:53, PN station HH22-PN1112, 50-0m
11:32, CTD station HH22-CTD1113, 3000m
13:22, PN station HH22-PN1114, 50-0m
13:44, PN station HH22-PN1115, 50-0m
14:08, PN station HH22-PN1116, 50-0m
14:30, PN station HH22-PN1117, 50-0m

Wednesday, June 29th 2022

Weather, wind 10-12 m/S, air temperatures 7.5-10.5C

Protocol

18:03, PN station HH22-PN1118, 200-100m

18:25, PN station HH22-PN1119, 100-75m

18:37, PN station HH22-PN1120, 75-50m

18:48, PN station HH22-PN1121, 50-25m

18:56, PN station HH22-PN1122, 25-0m

19:04, CTD station HH22-CTD 1123, upper 200m

20:24, HH22-1124MC, two core were sampled A & B.

20:54, CTD, all the way, the salinity was different between up and down...

Thursday, June 29th 2022

1400: Arrival Tromsø and embarkation

Outcome of the cruise

We succeeded in getting all wanted CTD's and plankton net tows for the experiments and cultivation projects. A total of 50 plankton net casts, 16 CTD (conductivity-temperature-depth) casts, and 2 multicorers were performed. About 400L of seawater that were collected and filtered on board. The filtered seawater had been manipulated to achieve variable target salinity and carbonate chemistry. About 450 specimens of *G. bulloides* and ~500 specimens *N. pachyderma* have been placed at different temperature, salinity and/or carbonate chemistry treatments on board. After the cruise, the cultivation experiments have been continued at the UiT culturing Lab for planktic foraminifera until September 2022.

Tables of performed activities

Date (UTC)	Time (UTC)	Activity	Station number	Latitude (N)	Longitude (E)	Depth (m)
24.06.2022	12:15:13	CTD with water START	1057	6814.400809	01012.665266	1139
24.06.2022	13:09:06	CTD with water STOP	1057	6815.100857	01014.458984	1152
24.06.2022	13:12:56	Net WP2 START	1058	6815.159917	01014.575958	1153
24.06.2022	13:17:28	Net WP2 STOP	1058	6815.228265	01014.715654	1155
24.06.2022	13:41:40	CTD with water START	1059	6815.582013	01015.456381	1163
24.06.2022	13:54:14	CTD with water STOP	1059	6815.759332	01015.855764	1167
24.06.2022	14:20:26	CTD with water START	1060	6816.145475	01016.609596	1184
24.06.2022	14:31:24	CTD with water STOP	1060	6816.304615	01016.898088	1187
24.06.2022	14:57:46	CTD with water START	1061	6816.721575	01017.576683	1203
24.06.2022	15:08:34	CTD with	1061	6816.892335	01017.860294	1210

		water STOP				
24.06.2022	15:19:02	CTD with water START	1062	6817.054016	01018.082519	1218
24.06.2022	15:29:45	CTD with water STOP	1062	6817.243297	01018.309878	1226
25.06.2022	03:02:24	CTD with water START	1063	6657.952797	00738.004828	1032
25.06.2022	03:13:01	CTD with water STOP	1063	6657.942870	00737.966964	1032
25.06.2022	03:18:12	Net WP2 START	1064	6657.929151	00737.932430	1033
25.06.2022	03:22:39	Net WP2 STOP	1064	6657.923548	00737.890277	1032
25.06.2022	03:27:01	Net WP2 START	1065	6657.914347	00737.855078	1032
25.06.2022	03:29:20	Net WP2 STOP	1065	6657.909082	00737.835658	1032
25.06.2022	04:36:22	Net WP2 START	1066	6657.634484	00737.437369	1029
25.06.2022	04:41:37	Net WP2 STOP	1066	6657.609724	00737.418984	1029
25.06.2022	05:08:00	Net WP2 START	1067	6657.445598	00737.322249	1026
25.06.2022	05:14:01	Net WP2 START	1068	6657.398792	00737.299778	1025
25.06.2022	05:14:17	Net WP2 STOP	1068	6657.396279	00737.298591	1025
25.06.2022	05:33:00	Net WP2 START	1069	6657.245688	00737.221399	1022
25.06.2022	05:36:16	Net WP2 STOP	1069	6657.218714	00737.211816	1022
25.06.2022	06:19:22	Net WP2 START	1070	6656.867034	00736.938720	1016
25.06.2022	06:24:43	Net WP2 STOP	1070	6656.832127	00736.897424	1015
25.06.2022	07:12:57	Net WP2 START	1071	6657.951736	00737.481996	1037
25.06.2022	07:17:32	Net WP2 STOP	1071	6657.910846	00737.459752	1036
25.06.2022	07:55:18	Net WP2 START	1072	6657.619081	00736.905761	1034
25.06.2022	08:00:29	Net WP2 STOP	1072	6657.558630	00736.832195	1033
25.06.2022	08:45:19	Net WP2 START	1073	6657.713618	00736.732851	1037
25.06.2022	08:50:45	Net WP2 STOP	1073	6657.770766	00736.795257	1038
25.06.2022	09:18:00	Net WP2 START	1074	6657.897431	00737.809232	1033
25.06.2022	09:22:51	Net WP2 STOP	1074	6657.928833	00737.915622	1032

25.06.2022	10:14:45	Net WP2 START	1075	6658.168308	00738.539468	1032
25.06.2022	10:20:22	Net WP2 STOP	1075	6658.198676	00738.523045	1033
25.06.2022	10:56:51	Net WP2 START	1076	6658.539635	00739.063096	1033
25.06.2022	11:03:17	Net WP2 STOP	1076	6658.600097	00739.156453	1033
25.06.2022	12:17:52	Net WP2 START	1077	6657.521694	00736.474192	1034
25.06.2022	12:23:16	Net WP2 STOP	1077	6657.537968	00736.419951	1035
25.06.2022	13:09:49	Net WP2 START	1078	6657.773369	00736.636591	1038
25.06.2022	13:15:14	Net WP2 STOP	1078	6657.786350	00736.638960	1039
25.06.2022	13:46:32	Net WP2 START	1079	6657.767058	00737.207396	1033
25.06.2022	13:51:52	Net WP2 STOP	1079	6657.756475	00737.110289	1034
25.06.2022	14:39:40	Net WP2 START	1080	6657.705502	00737.615859	1029
25.06.2022	14:44:51	Net WP2 STOP	1080	6657.727633	00737.610507	1030
25.06.2022	15:28:00	Net WP2 START	1081	6657.918047	00738.387900	1028
25.06.2022	15:32:50	Net WP2 STOP	1081	6657.900607	00738.354498	1027
25.06.2022	16:21:29	Net WP2 START	1082	6657.846977	00738.078516	1028
25.06.2022	16:26:30	Net WP2 STOP	1082	6657.864495	00738.059709	1029
25.06.2022	16:29:20	CTD with water START	1083	6657.864085	00738.058066	1028
25.06.2022	16:42:36	CTD with water STOP	1083	6657.890421	00738.072610	1030
25.06.2022	17:00:13	Net WP2 START	1084	6657.927351	00738.194759	1030
25.06.2022	17:05:29	Net WP2 STOP	1084	6657.921349	00738.254231	1029
25.06.2022	18:38:29	CTD with water START	1085	6658.603003	00738.985550	1034
25.06.2022	19:21:46	CTD with water STOP	1085	6658.665248	00740.099283	1023
25.06.2022	22:12:45	Multicorer START	1086	6658.010275	00740.998065	1008
25.06.2022	22:12:58	Multicorer STOP	1086	6658.010316	00741.000769	1008
26.06.2022	03:11:33	Net WP2 START	1087	6657.962770	00737.805067	1032
26.06.2022	03:17:18	Net WP2	1087	6658.027142	00737.825623	1034

		STOP				
26.06.2022	03:30:13	Net WP2 START	1088	6658.156919	00737.901066	1035
26.06.2022	03:39:26	Net WP2 STOP	1088	6658.236431	00737.930190	1037
26.06.2022	04:14:05	Net WP2 START	1089	6658.601200	00737.853591	1043
26.06.2022	04:19:53	Net WP2 STOP	1089	6658.664943	00737.880687	1044
26.06.2022	04:30:22	Net WP2 START	1090	6658.759983 N	00738.069688 E	1043
26.06.2022	04:50:25	Net WP2 STOP	1090	6658.820334	00738.758870	1036
26.06.2022	05:09:18	Net WP2 START	1091	6658.815201	00739.457200	1028
26.06.2022	05:14:57	Net WP2 STOP	1091	6658.818714	00739.575002	1028
26.06.2022	06:26:14	Net WP2 START	1092	6657.885202	00739.127699	1019
26.06.2022	06:32:59	Net WP2 STOP	1092	6657.910208	00739.287067	1019
26.06.2022	07:19:28	Net WP2 START	1093	6658.057634	00741.183810	1005
26.06.2022	07:26:37	Net WP2 STOP	1093	6658.089778	00741.483947	1002
26.06.2022	09:03:44	CTD with water START	1094	6657.844093	00739.051953	1020
26.06.2022	09:15:59	CTD with water STOP	1094	6657.850663	00739.172588	1019
26.06.2022	09:49:28	Net WP2 START	1095	6657.989156	00738.797621	1025
26.06.2022	10:01:49	Net WP2 STOP	1095	6658.015436	00738.825753	1026
26.06.2022	10:08:20	Net WP2 START	1096	6658.027229	00738.810765	1026
26.06.2022	10:32:36	Net WP2 STOP	1096	6658.071872	00738.716071	1028
26.06.2022	10:40:36	Net WP2 START	1097	6658.084704	00738.684301	1028
26.06.2022	10:53:18	Net WP2 STOP	1097	6658.101652	00738.640213	1029
26.06.2022	11:04:24	Net WP2 START	1098	6658.114601	00738.585170	1030
26.06.2022	11:10:33	Net WP2 STOP	1098	6658.123312	00738.552138	1030
26.06.2022	12:09:52	Net WP2 START	1099	6658.217044	00738.104007	1035
26.06.2022	12:15:02	Net WP2 STOP	1099	6658.226460	00738.063931	1037
26.06.2022	12:21:43	CTD with water START	1100	6658.238693	00738.004924	1037

26.06.2022	12:33:06	CTD with water STOP	1100	6658.264521	00737.871468	1038
26.06.2022	12:40:52	Net WP2 START	1101	6658.281384	00737.773189	1039
26.06.2022	12:48:38	Net WP2 STOP	1101	6658.305718	00737.658829	1041
27.06.2022	12:57:00	CTD with water START	1102	7000.090505	00000.112028	3250
27.06.2022	13:08:18	CTD with water STOP	1102	7000.204678	00000.376052	3251
27.06.2022	13:10:59	Net WP2 START	1103	7000.228653	00000.439501	3250
27.06.2022	13:17:41	Net WP2 STOP	1103	7000.295068	00000.585837	3250
28.06.2022	06:05:31	CTD with water START	1104	7253.405811	00000.275774	2960
28.06.2022	06:18:50	CTD with water STOP	1104	7253.342454	00000.298663	2966
28.06.2022	06:18:59	Net WP2 START	1105	7253.341587	00000.298081	2966
28.06.2022	06:28:19	Net WP2 STOP	1105	7253.287552	00000.242144	2968
28.06.2022	06:53:34	Net WP2 START	1106	7253.133927	00000.028584	2970
28.06.2022	07:00:37	Net WP2 STOP	1106	7253.112603	00000.008713	2971
28.06.2022	07:36:20	Net WP2 START	1107	7253.021076	00000.108694	2969
28.06.2022	07:44:08	Net WP2 STOP	1107	7253.065269	00000.088192	2970
28.06.2022	07:44:28	CTD with water START	1108	7253.067320	00000.085955	2970
28.06.2022	07:57:59	CTD with water STOP	1108	7253.149144	00000.053378	2970
28.06.2022	08:46:29	Net WP2 START	1109	7253.220439	00000.574618	2975
28.06.2022	08:54:21	Net WP2 STOP	1109	7253.201770	00000.608663	2975
28.06.2022	09:39:44	Net WP2 START	1110	7253.087691	00001.054071	2976
28.06.2022	09:47:54	Net WP2 STOP	1110	7253.063041	00001.128532	2976
28.06.2022	10:34:34	Net WP2 START	1111	7253.368972	00000.141969	2960
28.06.2022	10:53:21	Net WP2 STOP	1111	7253.504690	00000.303597	2934
28.06.2022	10:53:27	Net WP2 START	1112	7253.505503	00000.305217	2935
28.06.2022	11:10:00	Net WP2 STOP	1112	7253.620413	00000.654873	2912
28.06.2022	11:32:36	CTD with	1113	7253.759196	00001.224742	2870

		water START				
28.06.2022	13:20:02	CTD with water STOP	1113	7254.467189	00003.183477	2998
28.06.2022	13:22:18	Net WP2 START	1114	7254.475272	00003.243487	2998
28.06.2022	13:31:39	Net WP2 STOP	1114	7254.517185	00003.412920	3000
28.06.2022	13:44:21	Net WP2 START	1115	7254.579953	00003.646071	3003
28.06.2022	13:51:11	Net WP2 STOP	1115	7254.616209	00003.731347	3003
28.06.2022	14:08:33	Net WP2 START	1116	7254.653575	00004.043923	3005
28.06.2022	14:14:13	Net WP2 STOP	1116	7254.667736	00004.123435	3006
28.06.2022	14:30:57	Net WP2 START	1117	7254.711193	00004.400104	3007
28.06.2022	14:34:15	Net WP2 STOP	1117	7254.721403	00004.463772	3007
29.06.2022	18:03:53	Net WP2 START	1118	7055.378473	01420.954013	2182
29.06.2022	18:23:32	Net WP2 STOP	1118	7055.494504	01421.463615	2179
29.06.2022	18:25:57	Net WP2 START	1119	7055.491322	01421.515335	2180
29.06.2022	18:34:38	Net WP2 STOP	1119	7055.518889	01421.711393	2179
29.06.2022	18:37:46	Net WP2 START	1120	7055.530852	01421.778815	2178
29.06.2022	18:45:13	Net WP2 STOP	1120	7055.536191	01421.933722	2178
29.06.2022	18:48:27	Net WP2 START	1121	7055.540761	01422.022701	2178
29.06.2022	18:53:46	Net WP2 STOP	1121	7055.541642	01422.159771	2177
29.06.2022	18:56:42	Net WP2 START	1122	7055.550633	01422.249250	2177
29.06.2022	19:00:36	Net WP2 STOP	1122	7055.547196	01422.375288	2177
29.06.2022	19:04:20	CTD with water START	1123	7055.532691	01422.472501	2177
29.06.2022	19:17:58	CTD with water STOP	1123	7055.504871	01422.855936	2175
29.06.2022	20:24:02	Multicorer START	1124	7055.355470	01425.041918	2173
29.06.2022	20:50:18	Multicorer STOP	1124	7054.910343	01425.507410	2176
29.06.2022	20:54:27	CTD with water START	1125	7054.754115	01425.492385	2179
29.06.2022	22:17:34	CTD with water STOP	1125	7055.375086	01427.361123	2165

