

POS515 CALVADOS
CALabrian arc mud VolcAnoes: Deep Origin and internal Structure

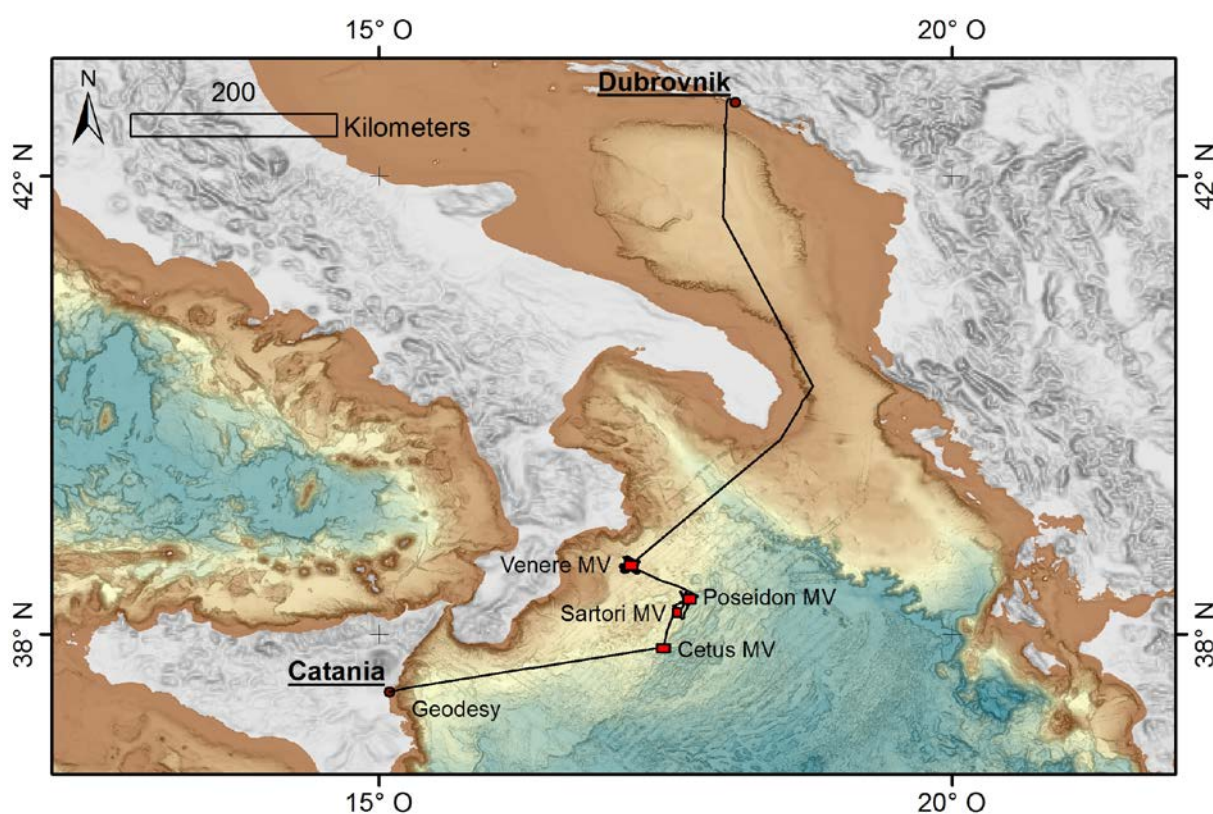
June 18 – July 13, 2017
Dubrovnik – Catania



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Objectives

The main objectives of our studies are on mud volcanoes and the interactions of geological, physical, and chemical processes shaping these structures. By observing ongoing changes and reconstructing past evolution we will improve estimates of gaseous and dissolved methane emissions over time, as well as better understand the role of mud volcanoes as geohazards. The investigations conducted during this project are based on high-resolution 3D seismic imaging of active mud volcanoes in different tectonic zones of the Calabrian accretionary prism, as well as Ocean Bottom Seismometers (OBS) imaging combined with velocity analyses, and regional 2D lines to tie the new data to the established stratigraphic framework spanning the past ~6 million years. From these data, we aim to identify changes in mud volcano activity since the late Miocene, as well as to image the deep-rooted feeder system of the mud volcanoes. Our new work builds on findings of R/V Meteor cruise M112 as well as new findings made during Poseidon cruise P499.



Cruise narrative

The expedition set off on Monday, June 19, 2017, in Dubrovnik, Croatia. After a short transit of 1.5 days, we arrived Wednesday morning (June 21) at the first study site: the 'Venere' mud volcano. During transit, all gear and scientific equipment was prepared, so that we could start in time with the deployment of our twelve Ocean Bottom Seismometers (OBS). The instruments were deployed with a ~1 km grid-spacing, allowing for detailed seismic velocity analyses as well as 3D imaging. After we deployed the instruments, there was not enough time for finishing a 3D seismic (P-Cable) deployment, so we started off with a test of the airgun and recording systems by acquiring a set of 10 2D seismic lines over night across the main structural features of the mud volcano. Until Sunday (June 25) we attempted several deployments of the P-Cable system; however, continued system failures and electrical issues with lead-in cables forced us to finally switch to only 2D seismic profiling across the 'Venere' mud volcano. This way, we acquired 84 parallel lines (70 m spacing) across the mud volcano over the course of 5 ½ days until Saturday morning (July 1). The seismic source was a single generator-injector (GI) airgun, fired at an interval of 5 seconds for all of the parallel 2D survey lines. Reflection seismic data were acquired with a 96 channel streamer (1.5 m group offset). We then acquired additional lines for OBS refraction velocity analyses, which extend to further distances from the OBS than the 84 parallel 2D lines, and the airgun shot interval was set to ten seconds to prevent previous shot-noise problems on the refraction data. The 84 parallel 2D lines can be merged to form a pseudo-3D data set, with which all initial objectives of our study can still be addressed. After we accomplished all tasks at 'Venere' mud volcano, the OBS instruments were recovered on Sunday (July 2) and all but one OBS instrument had a complete data set. Since weather conditions had somewhat deteriorated, we could not acquire any additional seismic profiles connecting 'Venere' mud volcano to the next study site, the 'Poseidon' mud volcano chain. We therefore completed the transit and waited at the 2nd study site until the morning hours of Monday (July 3). In the meantime, all OBS instruments were prepared for re-deployment. With an early start at 06:00 am, we deployed the twelve OBS across the 'Poseidon' mud volcano chain within 3 hours. Here, we attempt only two crossing lines of OBS instruments for detailed 2D seismic refraction velocity analyses, as the water depth of ~2000m and required longer distances between individual airgun shots prevents us from applying the advanced 3D OBS mirror image processing, which uses the first sea-surface multiple for migration of the data.

The initial data acquired across the 'Poseidon' mud volcano chain (the first seismic data acquired ever across this feature) proved difficult for interpretation. In contrast to 'Venere', where deep stratigraphic horizons and the root of the mud volcano were imaged, 'Poseidon' and its neighboring structures appear seismically incoherent with low seismic impedance contrasts. During the initial survey, we had also crossed the 'Sartori' mud mound, a circular flat-topped structure, about 10km further south from 'Poseidon'. Here, the seismic data show a deep root of the mud volcano, stacks of mud flows perfectly to be imaged with 3D data, as well as deeper reflectivity beneath the root of the volcano. We therefore decided to switch our P-Cable data acquisition to the better imaging target of 'Sartori' mud volcano.

Since the two lines of OBS at the 'Poseidon' mud volcano chain will no longer be useful if we acquire data further south at 'Sartori', we decided to recover all instruments on Wednesday (July 5). Within 6 ½ hours all gear was back on deck and in the meantime, we prepared the P-Cable 3D system. In the afternoon we were finally able to completely deploy the P-Cable and GI airgun and started surveying of the 'Sartori' mud volcano at 22:00 in the evening. By Monday (July 10) morning, we had completed a total of 67 parallel lines of the 3D survey and started to prepare for the fill-in procedure. During the past few days, some lines were not optimally acquired leaving some gaps in the 3D fold coverage. We abbreviated the survey by skipping the western-most six lines and started a sequence of fill-in profiles.

On Tuesday afternoon (July 11) we stopped the P-cable survey at 'Sartori' at 16:00, recovering all gear. We then steamed ~20 nautical miles (3 hours) to the 'Cetus' mud volcano. We acquired a total of ten short 2D seismic profiles across the main structures, which yields some initial impression on the internal structural setting of this mud volcano. On Wednesday morning (July 12) at 06:00 we stopped all seismic work and recovered all gear, including the trawl-doors of the P-Cable system, which had been stored attached to the stern over night. We started the transit to the geodesy stations at ~7:30 am. By 20:00 we arrived at the geodesy stations with Mt. Etna in view. Downloading of the data using the transponder was accomplished within 2.5 hours. We arrived in Port of Catania at 10:0 on Thursday (July 13).

Cruise statistics on OBS locations and seismic lines acquired

The project CALVADOS accomplished all objectives initially set out for the expedition. In total we imaged four regions with mud volcanoes: 'Venere', the main target of the expedition, the 'Poseidon' mud volcano chain, 'Sartori' mud volcano (here we acquired a full 3D cube with the P-Cable system) and 'Cetus' mud volcano. Lists of all seismic profiles acquired and OBS positions occupied during the surveys are attached below.

A complete set of 84 2D (pseudo 3D) seismic lines spaced at 70 m were acquired at 'Venere' mud volcano, with an additional seven lines for refraction velocity analyses. All twelve OBS were recovered with complete data on all channels, allowing for the 3D mirror image processing. Here we used a 2D streamer with all 12 sections (150 m active length).

At the 'Poseidon' mud volcano chain we acquired two long seismic refraction profiles over twelve OBS instruments with complete data on all channels, as well as an additional twelve 2D lines for regional imaging of the mud volcanoes. Here we used a 2D streamer with all 12 sections (150 m active length).

At 'Sartori' mud volcano we acquired a 3D P-Cable dataset, containing 67 parallel lines at 60m spacing and a 3D bin size of 3.5 m. We additionally acquired 23 lines to fill the 3D cube and reduce data gaps.

At 'Cetus' mud volcano we acquired a total of 10 lines with a short streamer (4 sections, 50m active length).

Acknowledgements

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Table 1 OBS deployment and recovery at ‘Venere’

Instrument	Deployment			Recovery
	Date / UTC Time	LAT (N)	LON (E)	Date / UTC Time
	(dd.mm.yy / hh:mm)	D:M	D:M	(dd.mm.yy / hh:mm)
OBS V01	21.06.17 / 08:31	38°37.29	17°12.49	02.07.17 / 09:23
OBS V02	21.06.17 / 08:49	38°36.841	17°12.837	02.07.17 / 08:58
OBS V03	21.06.17 / 09:05	38°36.414	17°13.132	02.07.17 / 05:45
OBS V04	21.06.17 / 09:20	38°36.133	17°12.493	02.07.17 / 06:25
OBS V05	21.06.17 / 09:32	38°36.581	17°12.211	02.07.17 / 08:33
OBS V06	21.06.17 / 09:45	38°37.046	17°11.892	02.07.17 / 09:42
OBS V07	21.06.17 / 10:04	38°36.773	17°11.364	02.07.17 / 10:15
OBS V08	21.06.17 / 10:24	38°36.321	17°11.664	02.07.17 / 08:08
OBS V09	21.06.17 / 10:43	38°35.878	17°11.972	02.07.17 / 06:48
OBS V10	21.06.17 / 10:56	38°35.590	17°11.370	02.07.17 / 07:15
OBS V11	21.06.17 / 11:08	38°36.006	17°11.037	02.07.17 / 07:38
OBS V12	21.06.17 / 11:19	38°36.46	17°10.72	02.07.17 / 10:31

Table 2 OBS deployment and recovery at ‘Poseidon’ mud volcano

Instrument	Deployment			Recovery
	Date / UTC Time	LAT (N)	LON (E)	Date / UTC Time
	(dd.mm.yy / hh:mm)	D:M	D:M	(dd.mm.yy / hh:mm)
OBS P01	03.07.17 / 03:58	38°19.375	17°44.075	05.07.17 / 11:10
OBS P02	03.07.17 / 04:13	38°19.107	17°43.406	05.07.17 / 10:40
OBS P03	03.07.17 / 04:27	38°18.886	17°42.823	05.07.17 / 10:05
OBS P04	03.07.17 / 04:39	38°18.640	17°42.293	05.07.17 / 06:15
OBS P05	03.07.17 / 04:51	38°18.385	17°41.729	05.07.17 / 09:31
OBS P06	03.07.17 / 05:05	38°18.118	17°41.128	05.07.17 / 08:56
OBS P07	03.07.17 / 05:20	38°17.837	17°40.495	05.07.17 / 08:23
OBS P08	03.07.17 / 05:51	38°17.694	17°43.004	05.07.17 / 05:02
OBS P09	03.07.17 / 06:08	38°18.180	17°42.668	05.07.17 / 05:45
OBS P10	03.07.17 / 06:27	38°19.046	17°42.061	05.07.17 / 06:44
OBS P11	03.07.17 / 06:41	38°19.504	17°41.736	05.07.17 / 07:18
OBS P12	03.07.17 / 06:54	38°19.977	17°41.385	05.07.17 / 07:48

Table 3

List of lines acquired at 'Venere' mud volcano

Profil-Nr. GeoEEL POS515	Date	Time Start UTC	Time End UTC	Latitude Start xx° xx.x'	Longitude Start xx° xx.x'	Latitude End xx° xx.x'	Longitude End xx° xx.x'	<u>Geometrics FFN Start</u>	<u>Geometrics FFN End</u>
2D seismic lines Survey P1000 - Test Survey									
1	21.06.2017	03:53	19:10	not recorded		38°38.463	17°13.764	140	1856
2	21.06.2017	19:33	20:37	38°36.404	17°14.164	38°35.270	17°09.34	2181	2958
3	21.06.2017	20:58	22:03	38°35.98	17°09.00	38°38.130	17°13.798	3204	3988
4	21.06.2017	22:29	23:35	38°37.19	17°14.35	38°35.015	17°09.39	4293	200
5	21.06.2017	23:54	00:57	38°35.79	17°09.28	38°37.98	17°14.03	not recorded	5500
6	22.06.2017	01:19	02:23	38°36.93	17°14.41	38°34.85	17°09.64	5786	6560
7	22.06.2017	02:45	03:45	38°35.55	17°09.23	38°37.73	17°14.10	6820	7590
8	22.06.2017	04:10	05:15	38°36.77	17°14.70	38°34.62	17°09.80	7900	8677
9	22.06.2017	05:36	06:40	38°35.48	17°09.29	38°37.66	17°14.21	8935	9686
10	22.06.2017	07:12	08:15	38°36.41	17°14.78	38°34.31	17°10.006	10060	10826
3D seismic lines									
1	25.06.2017	14:16	14:27	38°34.16	17°10.89	38°34.492	17°11.63	13335	13458
OBS shooting lines, no streamer									
1	25.06.2017	16:17	19:35	38°32.75	17°15.61	38°40.631	17°10.219	not applicable	
2	25.06.2017	20:05	22:31	38°40.562	17°09.454	38°32.66	17°14.91		
3	25.06.2017	23:20	03:44	38°32.58	17°14.29	38°40.59	17°08.77		
2D seismic lines Survey P1005									
1012	26.06.2017	10:15	11:20	38°33.99	17°10.49	38°36.147	17°15.306	18060	18830
1013	26.06.2017	11:54	13:12	38°37.40	17°15.04	38°35.31	17°09.34	19251	20186
1014	26.06.2017	13:44	14:48	38°34.03	17°10.48	38°36.24	17°15.20	20569	21551
1015	26.06.2017	15:24	16:47	38°37.50	17°14.15	38°35.36	17°09.35	21786	22774
1016	26.06.2017	17:17	18:21	38°34.03	17°10.35	38°36.183	17°15.171	22145	23890
1017	26.06.2017	18:57	20:09	38°37.503	17°14.108	38°35.387	17°09.313	24321	25185
1018	26.06.2017	20:39	21:41	38°34.077	17°10.386	38°36.216	17°15.214	25544	26269

1019	26.06.2017	22:14	23:22	38°37.53	17°14.03	38°35.40	17°09.24	26682	27504
1020	26.06.2017	23:49	00:56	38°34.08	17°10.33	38°36.308	17°15.256	27835	28628
1021	27.06.2017	01:33	02:47	38°37.530	17°13.902	38°35.450	17°09.28	29065	29977
1022	27.06.2017	03:18	04:21	38°34.122	17°10.32	38°36.29	17°15.12	30337	31096
1023	27.06.2017	04:54	06:08	38°37.63	17°14.05	38°35.485	17°09.242	31500	32375
1024	27.06.2017	06:40	07:42	38°34.164	17°10.288	38°36.311	17°15.088	32763	33509
1025	27.06.2017	08:16	09:20	38°37.664	17°14.012	38°35.585	17°09.362	33911	34680
1026	27.06.2017	09:49	10:52	38°34.194	17°10.258	38°36.36	17°15.09	35027	35791
1027	27.06.2017	11:26	12:32	38°37.66	17°13.92	38°35.54	17°09.16	36190	36988
1028	27.06.2017	13:00	14:10	38°34.24	17°10.27	38°36.37	17°14.50	37328	38162
1029	27.06.2017	14:45	15:54	38°37.72	17°13.99	38°35.58	17°09.17	38589	39404
1030	27.06.2017	16:24	17:30	38°34.23	17°10.18	38°36.39	17°14.99	not recorded	40260
1031	27.06.2017	18:06	19:11	38°37.761	17°13.919	38°35.616	17°09.147	40988	41805
1032	27.06.2017	19:43	20:49	38°34.296	17°10.198	38°36.443	17°14.976	42160	42944
1033	27.06.2017	21:06	22:11	38°36.970	17°14.505	38°34.81	17°09.65	43149	43934
1034	27.06.2017	22:32	23:40	38°35.23	17°11.53	38°36.74	17°15.11	44175	44988
1035	28.06.2017	23:53	00:56	38°37.01	17°14.48	38°34.85	17°09.63	45175	45916
1036	28.06.2017	not recorded	02:23	not recorded		38°36.51	17°14.93	46145	46965
1037	28.06.2017	02:34	03:47	38°37.02	17°14.44	38°34.91	17°09.67	46213	47979
1038	28.06.2017	04:07	05:20	38°34.40	17°10.12	38°36.55	17°14.93	48207	49085
1039	28.06.2017	05:37	06:44	38°37.07	17°14.45	38°34.943	17°09.640	49300	50089
1040	28.06.2017	06:59	08:03	38°34.435	17°10.087	38°36.576	17°14.890	50275	51040
1041	28.06.2017	08:21	09:28	38°37.107	17°14.414	38°34.970	17°09.604	51254	52052
1042	28.06.2017	09:43	10:49	38°34.466	17°10.10	38°36.62	17°14.90	52238	53038
1043	28.06.2017	11:06	12:13	38°37.13	17°14.36	38°34.99	17°09.56	53232	54041
1044	28.06.2017	12:28	13:33	38°34.5	17°10.10	38°36.65	17°14.87	54216	55002
1045	28.06.2017	13:52	14:55	38°37.16	17°14.32	38°35.035	17°09.59	55230	55980
1046	28.06.2017	15:12	16:26	38°34.53	17°09.99	38°36.67	17°14.82	56197	57076
1047	28.06.2017	16:45	17:50	38°37.20	17°14.63	38°35.06	17°09.52	57304	58080

1048	28.06.2017	18:05	19:10	38°34.559	17°10.028	38°36.705	17°14.792	58260	59043
1049	28.06.2017	19:27	20:24	38°37.236	17°14.316	38°35.098	17°09.512	59239	59931
1050	28.06.2017	20:39	21:42	38°34.602	17°10.008	38°36.733	17°14.778	60104	60865
1051	28.06.2017	21:59	22:58	38°37.252	17°14.288	38°35.10	17°09.40	61047	61784
1052	28.06.2017	23:09	00:11	38°34.84	17°10.45	38°36.78	17°14.78	61920	62670
1053	29.06.2017	00:28	01:30	38°37.28	17°14.29	38°34.708	17°09.357	62858	63500
1054	29.06.2017	01:40	02:45	38°34.65	17°09.86	38°36.81	17°14.74	63730	64511
1055	29.06.2017	03:04	04:04	38°37.31	17°14.24	38°35.22	17°09.48	64737	65454
1056	29.06.2017	04:20	05:25	38°34.69	17°09.89	38°36.38	17°14.69	65646	66436
1057	29.06.2017	05:43	06:42	38°37.39	17°14.27	38°35.229	17°09.241	66641	67339
1058	29.06.2017	06:56	07:59	38°34.724	17°09.885	38°36.871	17°14.667	67508	68273
1059	29.06.2017	08:17	09:16	38°37.407	17°14.170	38°35.261	17°09.381	68484	69189
1060	29.06.2017	09:31	10:33	38°34.772	17°09.888	38°36.93	17°14.73	69369	70122
1061	29.06.2017	10:58	11:51	38°37.181	17°13.677	38°35.268	17°09.312	70361	71064
1062	29.06.2017	12:03	13:13	38°34.83	17°09.88	38°36.966	17°14.688	71198	71932
1063	29.06.2017	13:22	14:23	38°37.58	17°13.98	38°35.45	17°09.26	72146	72882
1064	29.06.2017	14:38	15:24	38°34.83	17°09.79	38°37.04	17°14.76	73071	73830
1065	29.06.2017	16:17	17:18	38°38.23	17°13.47	38°36.13	17°08.75	74250	74984
1066	29.06.2017	17:31	18:33	38°35.66	17°09.20	38°37.814	17°14.001	75135	75878
1067	29.06.2017	18:51	19:51	38°38.309	17°13.537	38°36.181	17°08.743	76086	76812
1068	29.06.2017	20:04	21:04	38°35.702	17°09.173	38°37.843	17°13.962	76970	77685
1069	29.06.2017	21:20	22:24	38°38.329	17°13.477	38°36.16	17°08.61	77886	78653
1070	29.06.2017	22:38	23:35	38°35.77	17°09.22	38°37.89	17°13.97	78815	79502
1071	29.06.2017	23:56	00:56	38°38.239	17°13.247	38°36.193	17°08.596	79736	80488
1072	30.06.2017	01:09	02:07	38°35.815	17°09.239	38°37.91	17°13.92	80612	81326
1073	30.06.2017	02:24	03:26	38°38.43	17°13.47	38°36.28	07°08.57	81538	82280
1074	30.06.2017	03:42	04:46	38°35.81	17°09.13	38°37.95	07°13.90	82470	83246
1075	30.06.2017	05:04	06:05	38°38.46	17°13.43	38°36.307	17°08.647	83457	84179
1076	30.06.2017	06:19	07:20	38°35.842	17°09.089	38°37.980	17°13.882	84344	85074

1077	30.06.2017	07:36	08:37	38°38.468	17°13.406	38°36.336	17°08.619	85269	85999
1078	30.06.2017	08:51	09:58	38°35.874	17°09.063	38°38.197	17°14.068	86174	86955
1079	30.06.2017	10:10	11:14	38°38.49	17°13.40	38°36.36	17°08.57	87126	87888
1080	30.06.2017	11:30	12:24	38°35.956	17°09.138	38°38.40	17°13.84	87888	88746
1081	30.06.2017	12:41	13:42	38°38.50	17°13.29	38°36.403	17°08.551	88936	89670
1082	30.06.2017	13:54	14:51	38°35.96	17°09.03	38°38.08	17°13.80	89815	90503
1083	30.06.2017	15:09	16:18	38°38.60	17°13.34	38°36.44	17°08.53	90720	91550
1084	30.06.2017	16:31	17:30	38°35.96	17°08.97	38°38.11	17°13.77	91703	92409
1085	30.06.2017	17:49	18:57	38°38.611	17°13.333	38°36.473	17°08.520	92634	93446
1086	30.06.2017	19:11	20:12	38°35.966	17°08.990	38°38.144	17°13.742	93614	94341
1087	30.06.2017	20:29	21:39	38°38.363	17°13.927	38°36.510	17°08.501	94541	95390
1088	30.06.2017	21:53	22:53	38°36.0250	17°08.975	38°38.175	17°13.726	95555	96280
1089	01.07.2017	23:14	00:14	38°38.588	17°13.200	38°36.53	17°08.44	96489	97244
1090	01.07.2017	00:27	01:28	38°36.12	17°09.109	38°38.278	17°13.812	97410	981160
1091	01.07.2017	01:44	02:50	38°38.69	17°13.22	38°36.57	17°08.449	98327	99125
1092	01.07.2017	03:06	04:05	38°36.08	17°08.90	38°38.28	17°13.82	99305	100032
1093	01.07.2017	04:23	05:26	38°38.73	17°13.22	38°36.59	17°08.40	100238	101007
1094	01.07.2017	05:42	06:49	38°36.118	17°08.85	38°38.276	17°13.650	101187	101986
1095	01.07.2017	07:08	08:08	38°38.768	17°13.176	38°36.630	17°08.379	102212	102934
1095t	01.07.2017	8:08	08:37	38°36.630	17°08.379	38°38.157	17°06.919	102934	103274
2D seismiclines P1006									
1096	01.07.2017	08:51	10:54	38°34.743	17°08.896	38°38.77	17°15.72	103362	104090
1097	01.07.2017	11:06	12:54	38°38.24	17°15.94	38°34.208	17°06.958	104176	104829
1098	01.07.2017	13:10	15:04	38°33.63	17°06.85	38°37.67	17°16.12	104912	105607
1098t	01.07.2017	15:04	16:43	38°37.67	17°16.12	38°40.61	17°10.24	105607	106198
1099	01.07.2017	16:43	18:48	38°40.61	17°10.24	38°32.680	17°15.642	106198	106942
1100	01.07.2017	19:05	21:59	38°32.713	17°14.875	38°40.671	17°09.390	107048	108083
1101	01.07.2017	22:17	not recorded	38°40.460	17°08.844	38°32.510	17°14.312	108192	108830
1102	02.07.2017	00:35	03:58	38°32.483	17°13.547	38°40.39	17°07.97	108855	110239

Table 4 List of lines acquired at 'Poseidon' mud volcano chain

Profil-Nr. GeoEEL POS515	Date	Time Start UTC	Time End UTC	Latitude Start xx° xx.X'	Longitude Start xx° xx.X'	Latitude End xx° xx.X'	Longitude End xx° xx.X'	<u>Geometrics FFN Start</u>	<u>Geometrics FFN End</u>
2D seismic lines Survey P4000									
5001	03.07.2017	08:22	09:57	38°21.579	17°40.117	38°17.041	17°34.00	110444	111015
5002	03.07.2017	10:20	11:24	38°18.00	17°45.501	38°19.16	17°45.09	111270	111520
5003	03.07.2017	11:30	14:18	38°19.81	17°45.60	not recorded		111559	112575
5004	03.07.2017	14:21	15:03	38°14.665	17°34.02	38°11.94	17°35.34	112590	112862
5005	03.07.2017	15:21	16:13	38°11.42	17°36.14	38°13.43	17°38.09	112996	113435
5006	03.07.2017	16:13	17:23	38°13.43	17°38.09	38°16.332	17°39.880	113435	114039
2D seismic lines P6000									
6001	04.07.2017	14:54	15:48	38°17.86	17°40.47	38°20.69	17°41.63	115124	115581
6002	04.07.2017	18:00	17:12	not recorded		38°17.08	17°44.92	115600	116300
6003	04.07.2017	17:30	18:36	38°17.41	17°45.51	38°21.203	17°42.750	116444	117018
6004	04.07.2017	18:46	20:01	38°21.209	17°42.137	38°16.467	17°40.909	117105	117744
6005	04.07.2017	21:18	21:25	38°16.535	17°41.425	38°20.487	17°38.532	117890	118465
6006	04.07.2017	21:42	22:50	38°20.934	17°39.121	38°16.73	17°42.15	118610	119199
6007	04.07.2017	23:02	23:15	38°16.89	17°42.81	38°20.83	17°39.963	119308	119921
6008	05.07.2017	00:34	01:20	38°21.308	17°41.022	38°18.288	17°43.244	120085	120502
6009	05.07.2017	01:28	02:24	38°17.955	17°43.072	38°17.21	17°38.495	120547	121035
6010	05.07.2017	02:53	03:58	38°17.03	17°38.67	38°18.96	17°43.12	121282	121838

Table 5 List of lines acquired at 'Sartori' mud volcano

Profil-Nr. GeoEEL	Date	Time Start	Time End	Latitude Start	Longitude Start	Latitude End	Longitude End	Geometrics FFN Start	Geometrics FFN End
POS515		UTC	UTC	xx° xx.X'	xx° xx.X'	xx° xx.X'	xx° xx.X'		
3D P-Cable Survey P7000									
7001	05.07.2017	20:00	20:58:00	38°10.147	17°37.385	38°13.287	17°37.940	124037	124543
7002	05.07.2017	21:39	22:31	38°13.278	17°36.260	38°10.11	17°36.15	124893	124543
7003	06.07.2017	23:07	00:17	38°10.10	17°37.79	38°13.399	17°37.895	125654	126251
7004	06.07.2017	00:55	01:47	38°12.842	17°36.188	38°10.12	17°36.09	126400	127023
7005	06.07.2017	02:29	03:35	38°10.13	17°37.73	38°13.27	17°37.86	127373	127950
7006	06.07.2017	04:15	05:11	38°13.29	17°36.14	38°10.13	17°36.06	128182	128770
7007	06.07.2017	05:54	06:49	38°10.147	17°37.674	38°13.293	17°37.820	129136	129603
7008	06.07.2017	07:24	08:29	38°13.280	17°36.124	38°10.150	17°36.023	129908	130460
7009	06.07.2017	09:10	10:00	38°10.167	17°37.656	38°13.171	17°37.778	130979	131241
7010	06.07.2017	10:38	11:42	38°13.200	17°36.087	38°10.15	17°35.98	131577	132128
7011	06.07.2017	12:19	13:13	38°10.2	17°37.63	38°13.308	17°37.741	132454	132901
7012	06.07.2017	13:50	14:49	38°13.34	17°36.05	38°10.15	17°35.94	133220	133720
7013	06.07.2017	15:25	16:28	38°10.14	17°37.58	38°13.28	17°37.68	134034	134573
7014	06.07.2017	17:05	17:56	38°13.29	17°36.00	38°15.148	17°35.892	134892	135322
7015	06.07.2017	18:34	19:42	38°10.147	17°37.525	38°13.296	17°37.657	135652	136229
7016	06.07.2017	20:21	21:12	38°13.273	17°35.959	38°10.147	17°35.847	136562	137001
7017	06.07.2017	21:53	22:57	38°10.170	17°37.483	38°13.36	17°37.60	137356	137911
7018	06.07.2017	23:33	00:25	38°13.3	17°35.89	38°09.911	17°35.855	138217	137600
7019	07.07.2017	01:05	02:00	38°10.15	17°37.44	38°13.29	17°37.56	139013	139473
7020	07.07.2017	02:36	03:35	38°13.29	17°35.87	38°10.15	17°35.77	139780	140288
7021	07.07.2017	04:12	05:05	38°10.15	17°37.42	38°13.29	17°37.53	140608	141064
7022	07.07.2017	05:44	06:24	38°13.266	17°35.841	38°10.154	17°35.731	141384	141889
7023	07.07.2017	07:20	08:19	38°10.174	17°37.381	38°13.301	17°37.485	142214	142720

7024	07.07.2017	09:03	10:00	38°13.281	17°35.803	38°10.06	17°35.69	143093	143594
7025	07.07.2017	10:40	11:49	38°10.15	17°37.33	38°13.28	17°37.45	143936	144529
7026	07.07.2017	12:32	13:22	38°12.982	17°35.741	38°10.009	17°35.641	144910	145312
7027	07.07.2017	14:06	15:09	38°10.21	17°37.28	38°13.29	17°37.41	145697	146241
7028	07.07.2017	15:46	16:40	38°13.29	17°35.70	38°10.14	17°35.60	146545	147015
7029	07.07.2017	17::21	18:16	38°10.51	17°37.21	38°13.307	17°37.361	147368	147838
7030	07.07.2017	18:52	19:53	38°13.284	17°35.666	38°10.155	17°35.565	148148	148665
7031	07.07.2017	20:31	21:22	38°10.169	17°37.206	38°13.303	17°37.324	148997	149430
7032	07.07.2017	21:58	23:01	38°13.87	17°37.56	38°10.15	17°36.52	149787	150290
7033	07.07.2017	23:38	00:35	38°10.15	17°37.16	38°13.622	17°37.185	150603	151110
7034	08.07.2017	01:14	02:07	38°13.144	17°35.609	38°10.13	17°35.48	151400	151877
7035	08.07.2017	02:43	03:44	38°10.15	17°37.13	38°13.30	17°37.24	152186	152707
7036	08.07.2017	04:24	05:19	38°13.31	17°35.55	38°10.15	17°35.44	153049	153528
7037	08.07.2017	05:59	07:06	38°10.165	17°37.095	38°13.311	17°37.200	153864	154434
7038	08.07.2017	7:49	08:40	38°13.285	17°35.512	38°10.164	17°35.397	154780	155242
7039	08.07.2017	09:22	10:40	38°10.177	17°37.038	38°10.077	17°35.361	155608	156250
7040	08.07.2017	11:00	11:54	38°13.013	17°35.432	38°10.077	17°35.361	156450	156899
7041	08.07.2017	12,34	13:37	38°10.23	17°36.99	38°13.885	17°36.877	157260	157770
7042	08.07.2017	14:00	15:05	38°13.31	17°35.41	38°10.17	17°35.32	157992	158547
7043	08.07.2017	15:45	16:36	38°10.198	17°36.995	38°13.29	17°37.07	158884	159342
7044	08.07.2017	17:18	18:23	38°13.31	17°35.39	38°10.172	17°35.282	159689	160243
7045	08.07.2017	19:10	19:52	38°10.174	17°36.928	38°13.27	17°37.04	160560	161010
7046	08.07.2017	20:33	21:30	38°13.297	17°35.365	38°10.093	17°35.251	161363	161842
7047	08.07.2017	22:08	23:06	38°10.25	17°36.91	38°13.33	17°36.99	162180	162687
7048	08.07.2017	23:46	00:39	38°13.31	17°35.30	38°10.15	17°35.2	163013	163476
7049	09.07.2017	01:14	02:23	38°10.06	17°36.82	38°13.30	17°36.95	163779	164366
7050	09.07.2017	03:04	04:07	38°13.30	17°35.27	38°09.73	17°35.31	164720	165255
7051	09.07.2017	04:42	05:50	38°10.15	17°36.80	38°13.29	17°36.91	165557	166136
7052	09.07.2017	06:26	07:22	38°13.294	17°35.213	38°10.156	17°35.113	166444	166921

7053	09.07.2017	08:45	09:00	38°10.178	17°36.752	38°13.322	17°36.874	167290	167773
7054	09.07.2017	09:40	10:41	38°13.296	17°35.175	38°10.16	17°35.07	168107	168635
7055	09.07.2017	11:19	12:09	38°10.18	17°36.71	38°13.42	17°36.82	168962	169387
7056	09.07.2017	12:48	13:49	38°13.209	17°35.138	38°10.16	17°35.03	169706	170241
7057	09.07.2017	14:25	15:22	38°10.12	17°36.67	38°13.30	17°36.78	170556	171046
7058	09.07.2017	16:10	17:14	38°13.29	17°35.14	38°10.17	17°34.99	171300	171711
7059	09.07.2017	17:45	18:47	38°10.16	17°36.66	38°13.414	17°36.755	172014	172515
7060	09.07.2017	18:29	20:21	38°13.288	17°35.075	38°10.169	17°34.949	172873	173308
7061	09.07.2017	20:59	22:05	38°10.230	17°36.604	38°13.315	17°36.699	173630	174208
7062	09.07.2017	22:45	23:30	38°13.211	17°35.011	38°10.15	17°34.902	174540	174949
7063	10.07.2017	0:09	1:16	38°10.157	17°36.552	38°13.398	17°36.661	175272	175820
7064	10.07.2017	01:52	02:43	38°13.19	17°34.94	38°10.18	17°34.86	176156	176594
7065	10.07.2017	03:24	04:24	38°10.18	17°36.50	38°13.61	17°36.34	176945	177458
7066	10.07.2017	05:01	06:01	38°13.32	17°34.89	38°10.166	17°34.382	177772	178292
7067	10.07.2017	06:40	07:30	38°10.198	17°36.471	38°13.334	17°36.580	178616	179050
7068	10.07.2017	08:07	09:12	38°13.325	17°34.902	38°10.184	17°34.785	179374	179922
7069	10.07.2017	9:46	10:38	38°10.217	17°36.198	38°13.414	17°36.305	180213	180645
7070	10.07.2017	11:04	11:57	38°12.787	17°37.387	38°10.123	17°37.311	180910	181341
7071	10.07.2017	12:24	13:20	38°10.181	17°36.229	38°13.328	17°36.334	181573	182051
7072	10.07.2017	13:44	14:38	38°13.223	17°37.453	38°10.31	17°37.36	182263	182725
7073	10.07.2017	15:06	16:05	38°19.82	17°36.29	38°13.30	17°36.38	182959	183469
7074	10.07.2017	16:37	17:30	38°13.29	17°35.08	38°10.17	17°34.93	183731	184229
7075	10.07.2017	18:02	19:02	38°10.195	17°36.317	38°13.321	17°36.415	184505	185016
7076	10.07.2017	19:30	20:20	38°13.291	17°35.270	38°10.072	17°35.156	185259	185657
7077	10.07.2017	20:49	21:47	38°10.190	17°36.35	38°13.331	17°36.451	185993	186478
7078	10.07.2017	22:20	23:10	38°12.743	17°35.279	38°10.287	17°35.186	186761	187171
7079	10.07.2017	23:48	0:34	38°11.357	17°36.44	38°13.307	17°36.503	187365	187883
7080	11.07.2017	1:02	1:57	38°13.315	17°35.55	38°10.16	17°35.42	188113	188557
7081	11.07.2017	2:29	3:24	38°10.16	17°36.82	38°13.31	17°36.93	188842	189311

7082	11.07.2017	04:05	4:37	38°13.34	17°35.00	38°11.53	17°34.93	189665	189934
7083	11.07.2017	5:00	5:30	38°11.55	17°35.88	38°13.32	17°35.92	190125	190380
7084	11.07.2017	05:56	6,52	38°13.28	17°37.18	38°10.134	17°37.066	190607	191088
7085	11.07.2017	07:21	08:19	38°10.209	17°35.882	38°13.328	17°35.987	191331	191821
7086	11.07.2017	09:10	10:03	38°13.260	17°36.339	38°10.131	17°36.433	192239	192692
7087	11.07.2017	10:29	not recorded	38°10.245	17°37.567	not recorded		192913	not recorded
7088	11.07.2017	not recorded	11:22	not recorded		38°13.325	17°37.563	not recorded	193381
7089	11.07.2017	11:44	12:34	38°13.266	17°36.54	38°10.146	17°36.429	193560	193992
7090	11.07.2017	13:16	13:54	38°11.042	17°36.15	38°13.369	17°36.252	194350	194666

Table 6 List of lines acquired at 'Cetus' mud volcano

Profil-Nr. GeoEEL POS515	Date	Time Start UTC	Time End UTC	Latitude Start xx° xx.x'	Longitude Start xx° xx.x'	Latitude End xx° xx.x'	Longitude End xx° xx.x'	<u>Geometrics FFN Start</u>	<u>Geometrics FFN End</u>
2D Survey P8000									
8001	11.07.2017	18:41	19:11	37°53.525	17°27.707	37°51.577	17°27.708	195142	195363
8002	11.07.2017	19:25	19:54	37°51.657	17°27.225	37°53.583	17°27.166	195468	195685
8003	11.07.2017	20:12	20:40	37°53.493	17°27.981	37°51.565	17°27.948	195826	196033
8004	11.07.2017	20:57	21:16	37°51.660	17°27.482	37°53.064	17°27.488	196157	196307
8005	11.07.2017	22:14	22:41	37°53.507	17°28.217	37°51.594	17°28.2	196499	196701
8006	11.07.2017	23:26	00:18	37°52.715	17°26.371	37°52.769	17°30.91	197026	197426
8007	11.07.2017	00:29	not recorded	37°52.383	17°30.816	37°52.263	17°26.457	197513	197877
8008	11.07.2017	not recorded	02:19	not recorded		37°52.89	17°30.89	197948	198331
8009	11.07.2017	02:44	03:43	37°52.64	17°30.80	37°52.58	17°26.51	198515	199085
8010	11.07.2017	3:46	4:00	37°53.07	17°26.56	37°53.06	17°27.75	198979	199085