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## **Short Cruise Report**

R/V Sonne – SO263

Suva, Fiji – Suva, Fiji

## 1. June 2018 – 27. June 2018

# Chief Scientist: Karsten M. Haase

**Captain: Oliver Meyer** 





Figure 1: Shiptrack of RV Sonne during SO263 Tonga Rift. Map kindly provided by the WTD of RV Sonne.

## **Objectives**

The research program of SO263 Tonga Rift had the main objective of sampling fluids, rocks and biological specimen and mapping the northern Tonga arc and backarc volcanic edifices.

During and after the cruise we aim to test the following hypotheses with our working program:

- The isotopic signature of the subducted Louisville seamount occurs north of the islands of Tafahi and Niuatoputapu and is introduced gradually at ~4 Ma. We will use the trace element and isotope geochemistry of samples from Niua volcano, the island arc volcanoes to the south, and the arc stratigraphic profile to determine, whether the unique Pb-isotope signature of the subducting Louisville seamounts is present in the northern Tongan arc samples.
- The basement of the Tongan arc consists of a series of sheeted dykes with a depleted geochemical signature comparable to that of normal mid-ocean ridge basalt. We will use trace element and Sr-Nd-Pb isotope data of samples from the fore-arc profile to test whether the fore-arc had evolved from a normal, depleted oceanic crust to a more depleted mantle wedge composition with enriched signatures in the fluid-mobile elements with time.
- The island arc displays a systematic temporal evolution with an increasing depletion of the High Field Strength Elements and enrichment in fluid mobile elements. The geochemistry of samples from the arc profile combined with data from the Niua volcanic edifice will be used to develop a stratigraphic history of the evolution of the arc. Much of the compositional change between Niua, the seamounts south of Niua, and the arc profile may also be related to rollback of the subducting slab to the east. This will be correlated

with geochemical changes observed in the volcanoes situated at different distance to the active subduction.

- The Niua volcanic edifice displays a systematic temporal evolution from the more mafic samples exposed on the northern and eastern flanks and the silicic lavas exposed on the central edifice. Major element and trace element geochemistry of whole rocks, glasses and minerals will be used to determine the origin of the silicic melts and the timescales over which these changes occur.
- Silicic melts at Niua and Niuatahi form by fractional crystallisation and assimilation of material from deeper levels of the arc crust. Major element and trace element geochemistry of the whole rocks, glasses and minerals sampled will reveal whether the large volumes of dacites erupted at Niuatahi and the pumiceous silicic lavas at Niua form by similar processes and to what extent the eruption of the distinct lava types is controlled by their geodynamic setting, i.e. does the distance to the active subduction control lava composition? The assimilation of island arc crust will be evident from trace element, radiogenic and stable isotope geochemistry. The arc and fore-arc profiles will provide a unique dataset for potential assimilating endmembers.
- *The occurrence of As sulfides at Niua results from stronger degassing of magmatic fluids whereas less degassing leads to different sulfides and fluids at Niuatahi.* We will use the geochemical composition of the As-rich sulfides sampled at Niua and the fluid data of the co-existing fluids to determine the origin of these apparently extreme sulfides. By comparing the compositions of the Niuatahi and Niua sulfides and host rocks, we will be able to develop a model for the transport of As and other volatile elements by magmatic and hydrothermal fluids in the shallow island arc crust.
- Boninitic melts may not be representative for arc initiation but may also be present in the backarc and may thus provide constraints on the geodynamic interpretation of boninitic melts. Geochemical analyses of the samples from the stratigraphic profiles and the mafic Niua lavas will be used to determine whether these lavas are geochemically restricted to a certain geodynamic environment.
- Changes in melting regime along the North East Lau spreading center are correlated with distance to the propagating spreading axis in the south. We will use major element, trace element and U-series isotope geochemistry of glasses sampled along the NELSC and samples from diagonal ridge to determine whether changes in the regime of melting can be observed as a function of distance to the arc, i.e. can the impact from fluid-flux melting versus decompression melting of normal depleted mantle be quantified?
- *Hydrothermal plume signals can be used to constrain the hydrothermal element input and exchange between the oceanic crust and hydrosphere.* We will use the composition of fluids sampled *in-situ* using unique gas-tight fluid samplers (Seewald et al., 2002) and CTD to quantify the water-rock exchange ratios and contribute to the understanding of fluid chemistry in island arc environments.
- Disequilibria, which are critical for chemosynthetic life are strongly tied to mixing of chemical reduced hydrothermal vent fluids with ambient seawater, interaction of seawater with basement, volcanic degassing, or a combination of these processes. We

will use computational simulations of the fluid and water data to understand how metal solubilities are affected by volcanic and hydrologic processes in island arcs.

• *Hydrothermal vent communities, e.g. scale worms are unique to the Tonga systems as opposed to those commonly observed in the Mariana arc system.* Genetic investigations of scale worms sampled in the Niua volcanic field will reveal whether the Tonga and Mariana vent communities share a common ancestor or whether the two communities have evolved separately.

In general, the sampling strategy was based on the multibeam surveys of SO263 and previous cruises on a daily basis. The sampling was preferentially done by Remotely Operated Vehicle (ROV MARUM QUEST 4000) and TV grab to ensure consistent and accurate sampling as well as structural and geological control of the sampling. We also successfully performed volcanic wax corer (VSR) sampling in the vicinity of the NELSC. During the TV grab and CTD sampling we used Miniature Autonomous Plume Recorders (MAPR) devices provided by the Pacific Marine Environmental Laboratory of NOAA. These recorders of turbidity, E<sub>H</sub> and temperature were aimed at detecting potential hydrothermal plumes in the water column in the vicinity of northern Tonga.

#### **Cruise Narrative**

A delegation of scientists from the GeoZentrum Nordbayern of the Friedrich-Alexander-Universität Erlangen-Nürnberg and the entire Remotely Operated Vehicle (ROV) QUEST 4000 team arrived on the 29<sup>th</sup> of May and started installing the ROV and the TV grab onboard RV Sonne on the 30<sup>th</sup> of May. The majority of the scientific party joined on the 30<sup>th</sup> of May 2018 and the entire scientific party boarded the vessel on Friday, the 31<sup>st</sup> of May 2018. During port stay the installations for the ROV, the TV grab (TVG) and the volcanic wax corer (VSR) were done and the labs were prepared for operations at sea.

On Saturday the 1<sup>st</sup> of June, RV SONNE left the port of Suva at 9:10 am and reached the open sea through a coral reef only a few minutes later with moderate seas and wind (Fig. 1). Heading SW from Suva into the open sea through the Fijian islands we steamed towards the NW for 44 hours into the working area at ~173°W and ~15°S. The scientific program started with hydroacoustic profiles after leaving Fijian territory in the night from the 1<sup>st</sup> to the 2<sup>nd</sup> of June. Steaming through increasing swell and winds we arrived in the working area on the 3<sup>rd</sup> of June and started untangling the ROVs winch cable from 8 am into the early evening hours prior to running a water column CTD station and three successful TV grabs in the vicinity of Niua South volcano during the early hours of the 5<sup>th</sup> of June (Fig. 1 and 2). The TV grabs contained several ten's of kg's of pumiceous, young lava. A fourth grab was unsuccessful as a result of technical problems. The morning of the 5<sup>th</sup> of July was used for additional ROV winch cable operations before the CTD was used for a Tow-Yo followed by four successful TV grabs in the morning containing both pumiceous felsic and basaltic lava. We started a short hydroacoustic survey and an additional vertical CTD and Tow-Yo in the morning of the 6<sup>th</sup> of June. At 2 pm on the 6<sup>th</sup> of June the ROV (dive #428) was lowered to the ocean floor, unfortunately experiencing hydraulic problems shortly after reaching the bottom which was covered by inactive and active black smoker chimneys. After the ROV was back on deck for additional maintenance we performed a vertical CTD profile and further Tow-Yos before deploying four TV grabs along the western and northern rim of Niua volcano. These TV grabs contained both pumiceous felsic lava as well as mafic pillow lavas and glass. From midnight on the 7th of June we continued our hydroacoustic survey across Niua volcano before starting ROV QUEST operations (dive #429) on the morning of the 7<sup>th</sup> of June at the hydrothermal field of Niua South. The sampling of sulfide and hard rock samples, biological specimen, and hydrothermal fluids commenced during the daylight hours of the 7<sup>th</sup> of June, but had to be abandoned as a result of a hydraulic ROV failure. Four successful TV grabs from south to north at Niua volcano recovered numerous mafic and felsic samples. A hydroacoustic survey south of Niua was conducted followed by two CTD Tow-Yos in the early morning hours of the 8<sup>th</sup> of June. During the afternoon two very successful TV grabs recovered two large black smoker pieces along with numerous biological specimen. Three TV grabs in the vicinity of Niua volcano yielded large amounts of mafic lava blocks. The early morning of the 9<sup>th</sup> of June was used to perform a hydroacoustic survey of the area east of Niua before reaching the ROV diving position at Niua South. After minor technical ROV difficulties the dive #430 started after lunchtime and successful fluid, biological and rock sampling was carried out. During the early evening of the 9<sup>th</sup> we sampled a seamount SW of Niua using the TV grab. This sampling brought on deck a massive carbonate sample. A second grab in the vicinity failed due to technical problems and a hydroacoustic survey was performed during the night hours until the morning of the 10<sup>th</sup>. During daytime of the 11<sup>th</sup> of June, we performed ROV dive #431 in the white smoker fields of Niua North with fluid, biology and rock sampling before testing the TV grab during the early evening hours. The TV grab was successful but further testing revealed that the issue of water impacting on the connecting box between the ship's cable and TV grab had not yet been solved. Thus, we had to terminate further TV grabbing and continued with a hydroacoustic survey during the night. On the 11<sup>th</sup> of June, we revisited the Niua South hydrothermal field during QUEST dive #432 and successfully recovered the biological traps, sampled fluids, rocks and performed a photo mosaic of an almost ten-meter-high sulfide chimney for biological investigations. Two vertical CTDs during the evening at the Hades and Prometheus hydrothermal fields at West Mata volcano only revealed a weak hydrothermal plume signal. A hydroacoustic survey was performed in the early morning hours of the 12<sup>th</sup> of June at Niua North before starting ROV dive #433 at Niua North. The dive aimed at investigating the white smoker areas and performing biological sampling in the Mussel Mania field. During the night, we performed 5 TV grabs on the seamounts south of Niua and recovered a number of pumiceous and mafic lava samples before continuing a short hydroacoustic survey. During the 13th of June ROV QUEST (dive #434) performed a stratigraphic sampling profile west of Niua aiming at the temporal evolution of the island arc. The 20, mostly mafic samples recovered from this section will provide unique insights into the evolution of the island arc crust. The night and early morning hours of the 14<sup>th</sup> of June we finalized sampling of the seamounts south of Niua performing five TV grabs recovering igneous rock samples and sediments before heading to the southern part of Niuatahi caldera volcano (formerly referred to as 'Volcano O') where ROV dive #435 targeted the hydrothermal field. Successful sampling of black smoker fluids, biological specimen and sulfide samples along with few lava samples from the active smoker field continued during daytime of the 14<sup>th</sup> prior to commencing TV grabs on the southern rim of Niuatahi. These TV grabs variably recovered lava blocks hosted in sediments, fresh, glassy block and dacitic pillow lavas and volcanic sulfides. During the early morning hours of the 15<sup>th</sup> of June we performed a CTD on the southern edge of Niuatahi before heading to the

North East Lau Spreading Centre (NELSC) where we successfully recovered volcanic glass samples from seven stations using the wax corer. ROV dive #436 was lowered during the early morning of the 16<sup>th</sup> of June and we continued our dive along the southern rim of Niuatahi in the hydrothermal field sampling fluids, biological specimen, sulfides and lava samples, interrupted by a short safety drill. The ROV dive had to be terminated during the early afternoon due to technical problems and we continued with four TV grabs on the western and northern flank of Niuatahi recovering numerous fresh, glassy dacitic lava samples. Three CTDs were conducted during the early night hours of the 17<sup>th</sup> of June prior to ROV dive #437 during the daylight hours targeting an additional hydrothermal smoker field on the southern caldera rim of Niuatahi. Following this RV Sonne headed to the northern caldera rim and volcanic ridge north of Niuatahi performing three successful TV grabs that yielded a number of fresh and glassy samples closer to Niuatahi and loose sedimentary material including pumiceous pieces some 10 km north of Niuatahi. During the night, we transited to the fore-arc North-East of Niua, where we performed dive #438 on the 18<sup>th</sup> of June and stratigraphically sampled 26 igneous rocks between 2295 m to 1530 m water depth before transiting back to Niuatahi. A TV grab was lowered during the night, but was aborted due to technical issues and we performed a CTD Tow-Yo at the northern part of Niuatahi volcano. On the 19<sup>th</sup> of June, we started ROV dive #439 at lunch time at the northern caldera rim of Niuatahi after technical difficulties with the ROV winch system. During the dive, several active smokers were sampled for fluids and sulfides. During the night, five wax corer stations were conducted along the southern section of the NELSC and ROV dive #440 of ROV QUEST on the 20<sup>th</sup> of June targeted the hydrothermal vent field in the northern part of the caldera. Fluids, sulfides and biological specimen were recovered. During the night, we targeted the central part of the NELSC using the volcanic wax corer sampling fresh volcanic glasses on the six stations sampled. Dive 110\_ROV (dive #441) on the 21st of June targeted the southern hydrothermal field of Niuatahi and the southern caldera wall of Niuatahi recovering fluid and geological sample material. During the night we performed four TV grabs along diagonal ridge a seamount east of the NELSC. A CTD was lowered during the early morning of the 22<sup>nd</sup> of June before the ROV (dive #442; 116 ROV) started diving close to Maka volcano along the NELSC. We sampled fluids, biological and geological samples prior to starting TV grabs along the NELSC and at two seamounts East and West of the spreading axis, respectively. During the early morning of the 23<sup>rd</sup> of June we performed an additional vertical CTD in the vicinity of the Maka hydrothermal field prior to commencing the final ROV dive (dive #443; 122\_ROV) of cruise SO263 approaching the Maka hydrothermal field from a southern direction sampling a number of lava flow fronts prior to sulfide, fluid and biological sampling. During the night, four TV grabs on three of the southern seamounts were performed recovering a number of mafic igneous samples before the final wax corer stations were conducted during the 24<sup>th</sup> of June. During the afternoon of the 24<sup>th</sup> of June until the 25<sup>th</sup> of June midnight we conducted a final hydroacoustic profile west of the NELSC before heading to Suva. RV Sonne arrived at Suva, Fiji on the 27<sup>th</sup> of June 8 am at docked on the berth at 8:55 am.

#### Acknowledgments

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We acknowledge the help and support of the captain and crew of SO236 also during the ROV, TV grab and VSR operations.

### **Participants**

Name	Discipline	Institution
Prof. Dr. Haase, Karsten	Chief Scientist	GZN, FAU
Prof. Dr. Bach, Wolfgang	Water-rock interactions	UB, MARUM
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Dr. Günther, Thomas	Petrology/Geochemistry	GZN, FAU
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UB	Fachbereich Geowissenschaften der Universität Bremen, Bremen, Germany
MARUM	Zentrum für Marine Umweltwissenschaften, Bremen, Germany
JU	Jacobs University, Bremen, Germany
UHawaii	School of Ocean and Earth Science and Technology, University of Hawai'i at Manoa, Hawai'I, USA
UBAY	Fakultät für Biologie, Chemie und Geowissenschaften, Universität Bayreuth, Germany
UVIC	University of Victoria, British Columbia, Canada
MPI	Max-Planck-Institut für Marine Mikrobiologie, Bremen, Germany
GEOMAR	Helmholtz-Zentrum für Ozeanforschung, Kiel, Germany
MLNR	Ministry of Land and Natural Resources, Kingdom of Tonga

Station	ROV- station (Marum)	Date (UTC)	Location	Start (UTC)	Start (	(Position)	Water depth [m]	Ende (UTC)	End	Position	Water depth [m]	Waterdepth of sample [m]	Sampl	e position	Sample time (UTC)	comments	Size/number of samples
					Latitude (°S)	Longitude (°W)			Latitude (°S)	Longitude (°W)			Latitude (°S)	Longitude (°W)			
Transit		31.05.18	Suva, Fiji	21:00	14050.51	170000.01	1000										
001 CTD		02.06.18	Ridge SW Mata	20:00	14 50.5 15°03 705'	173 29.0 173°38 987'	2760	10.10	15°03 571'	173°38 081'	2755	2760	15°03 718'	173°38 085'	00.10-10.18	Posidonia Background water sample	water samples: 8
001_01D		05.00.10	Ridge OW Mata	07.50	13 03.703	175 50.307	2700	10.13	13 03.371	175 50.501	2100	2700	13 03.710	175 30.305	03.10-10.10	Posidonia 50 m. debris fan, steep cliff.	water samples. o
002_TVG		03.06.18	Ridge SW Mata	10:48	15°00.816	173°39.732	1834	12:31	15°00.761	173°39.751'	1819	1831	15°00.448'	173°39.752	11:53	pumice	geology samples: 4
003_TVG		03.06.18	Ridge SW Mata	13:14	15°02.545	173°42.066	2111	14:57	15°02.588'	173°42.026'	2136	2138	15°02.585'	173°42.019'	14:15	grab full of mud, pumice and lava blocks, fine-grained pelagic sediment	geology samples: 3
004_TVG		03.06.18	Ridge SW Mata	15:38	15°06.105	173°40.597	1280	16:56	15°06.117'	173°40.539'	1342	1383	15°06.128	173°40.504'	16:20	Posidonia 50 m, blocky debris fan, pumiceaus?	geology samples: 1
005_TVG		03.06.18	Ridge SW Mata	17:14	15°06.113	173°40.624	1261	18:26	15°06.115'	173°40.621'	1268	1271	15°06.12'	173°40.62'	17:49	Posidonia 50 m, same as 004_TVG, 17:48 blackout, camera black, system; no sample	-
ROV Kabeltest		03.06.18	North of Mata	20:00			4000										
006_CTD		04.06.18	Niua south	03:32	15°09.846'	173°34.456'	1186	04:49	15°09.852'	173°34.445'	1178	1160	15°09.848'	173°34.452'	04:09-04:14	plume in water column (~1000 m water	water samples: 17
007 CTD		04.06.18	Niua south	05:46	15°10.341'	173°36.383'	1293	09:44	15°09.632'	173°33.574'	1218	1288	15°10.333'	173°36.381'	06:27-16:39	TOW-YO profile	water samples: 7
008_TVG		04.06.18	Niua south	10:50	15°09.2965'	173°35.257'	674	12:10	15°09.296'	173°35.256'	675	680	15°09.303'	173°35.260'	11:52	Posidonia 50 m, Niua South, field of lava block, intercalated	geology samples: 4
		04.00.40	Nius south	40:47	45840 470	470800 4041	4405	10:10	45840 470	470800.000	1400	1100	45840 400	470800 0071	40:40	pumice+lavas/pillows?, no sediments; sheet flows	
009_1VG		04.06.18	Niua south	12:47	15-10.476	173-36.101	1135	13:43	15-10.479	173-36.069	1162	1162	15-10.492	1/3-36.067	13:16	Posidonia 50 m, debris field pumice	geology samples: 4
010_TVG		04.06.18	Niua south	14:13	15°11.307'	173°36.423'	1584	15:32	15°11.331'	173°36.858'	1562	1561	15°11.342'	173°36.862'	14:59	flow units	geology samples: 2
011 TVG		04.06.18	Niua south	16:06	15°12.218'	173°35.335'	1755	17:25	15°12.255'	173°35.272'	1720	1719	15°12.270'	173°35.266'	16:46	Posidonia 50 m, blocky lava pumice	geology samples: 2
012 CTD		04.06.18	Niua south	18:07	15°08.491'	173°34.649'	907	22:37	15°11.664	173°34.155	1464	904	15°08.495'	173°34.653'	18:41	TOW-YO profile	water samples: 6
013_ROV	#aborted	05.06.18	Niua south	01:49	15°09.908'	173°34.457'	1163	02:22	15°09.897'	173°34.458'	1163	-	-	-	-	failed due to technical problems	geology samples: 0 fluid samples: 0
014_CTD		05.06.18	Niua south	02:42	15°09.849'	173°34.449'	1160	03:59	15°09.847'	173°34.447'	1170	1163	15°09.850'	173°34.448'	18:08-03:54	vertical sampling	no plume detected
015_CTD		05.06.18	Niua south	04:36	15-10.885	173-36.050	1198	06:47	15-09.759	173-35.749	939.5	1195	15-10.886	1/3-36.051	05:08	TOW-YO profile	fluid samples: 3
016 TVG		05.06.18	Niua south	07:05	15 10.235 15°08 711	173 35.926 173°34 656	820	08:17	15 10.213 15°08 674	173 35.874 173°34 742	806	804	15 10.227 15°08 682	173 872 173°34 747	00:25	Posidonia 50 m, blocky pumice	deology samples: 4
018 TVG		05.06.18	Niua south	10:25	15°10.6975	173°35.264	957	11:28	15°10.735	173°35,190	993	989	15°10.742	173°35.197	10:59	Posidonia 50 m, blocky pumice	geology samples: 3
019 TVG		05.06.18	Niua east	12:05	15°09.616'	173°32.431'	1222	13:25	15°09.598'	173°32.400'	1222	1223	15°09.610	173°32.407	12:50	Posidonia 50 m, blocky lava, pillows	geology samples: 1
020_multibeam		05.06.18	East of Niua	14:32	15°02.230'	173°33.710'	2070	19:39	15°09.346	173°34.113	1011	-	-	-	-	multibeam profile	-
021_ROV	#428	0506.06.2018	Niua south	19:56	15°09.909'	173°34.489'	1172	23:54	15°09.909'	173°34.486'	1142	1160	15°09.898'	173°34.465'	22:41	technical problems, chimney field with active black smoker	fluid samples: 2
022 CTD		06.06.18	Niua North	00:33	15°04.866'	173°33.336'	780	01:21	15°04.869	173°33.274	720	720	15°04.869	173°33.274	00:59 - 01:17	Posidonia 25 m, no plume found	-
023_CTD		06.06.18	Niua North	01:51	15°04.755	173°34.635	1729	04:16	15°04.7795	173°33.936	1216	1729	15°04.755	173°34.635	02:32 - 02:42	Posidonia 25 m, no plume found	-
024_TVG		06.06.18	Niua North	04:47	15°05.390'	173°35.426'	1590	06:10	15°05.419'	173°35.439'	1595	1598	15°05.417'	173°35.445'	05:27	debris, blocky pumice and loose material	geology samples: 5
025_TVG		06.06.18	Niua North	06:32	15°05.850	173°33.872	1313	08:01	15°05.838	173°33.901	1302	1300	15°05.840	173°33.898	07:12	Posidonia 50 m, pillow lava flows, massive grab of lava debris	geology samples: 3
026_TVG		06.06.18	Niua North	08:25	15°03.962	173°32.177	1531	10:00	15°03.994	173°32.180	1522	1515	15°03.995	173°32.193	09:14	Posidonia 50 m, sedimented top, few gravel, pumice?	geology samples: 5
027_TVG		06.06.18	Nothern cone Niua	10:26	15°03.886'	173°30.525'	1410	11:51	15°03.899'	173°30.516'	1414	1412	15°03.908'	173°30.524'	11:05	Posidonia 50 m, lava debris	geology samples: 4
028 multibeam		06.06.18	East of Niua	12:37	15°08.584'	173°30.517'	1024	18:50	15°19.140'	173°39.653'	1567	-	-	-	-	multibeam profile	
029_ROV	#429	0607.06.2018	Niua south	20:00	15°09.923'	173°34.482'	1159	05:40	15°09.845'	173°34.417'	1173		see dive log	see dive log		slightly and very active chimney fields, debris fields from old chimney structures, due to technical problems no further survey	geology samples: 8; biology samples: 2; fluid samples: 4
030_TVG		07.06.18	Niua South	06:06	15°12.385'	173°33.631'	1638	07:35	15°12.355'	173°33.626'	1631	1630	15°09.851'	173°34.484'	06:47		geology samples: 3
031_TVG		07.06.18	Niua South	08:07	15°12.975	173°35.325	2071	09:55	15°13.028	173°35.449	2040	2040	15°13.027	173°35.452	09:01	field of lava blocks, debris, sediment layer on to, huge blocks (grab not completely closed)	geology samples: 3
032_TVG		07.06.18	Niua North	10:44	15°06.946	173°33.937	1289	12:10	15°06.968	173°33.929	1280	1283	15°06.976	173°33.932	11:30	Posidonia 50 m, large blocks of lava and debris	geology samples: 1
033 TVG		07.06.18	Niua North	12:38	15°07.023	173°31.476	1353	13:57	15°07.018	173°31.404	1349	1346	15°07.029	173°31.404	13:19	steep slope with debris; on top: sediment with larger blocks of pumice	geology samples: 3
034_multibeam		07.06.18	East of Niua	14:56	15°14.917'	173°35.399'	1529	16:58	15°17.407'	173°40.620'	1352	-	-	-	-	multibeam profile	

# **Station list** of cruise SO263 Tonga-Rift. TVG = TV grab, ROV = Remotely Operated Vehicle Marum Quest 4000, multibeam = combined data from EM 122

Station	ROV- station (Marum)	Date (UTC)	Location	Start (UTC)	Start (	Position)	Water depth [m]	Ende (UTC)	End	Position	Water depth [m]	Waterdepth of sample [m]	Sample	position	Sample time (UTC)	comments	Size/number of samples
					Latitude (°S)	Longitude (°W)			Latitude (°S)	Longitude (°W)			Latitude (°S)	Longitude (°W)			
035_CTD		07.06.18	Niua North	19:11	15°04.678'	173°34.570'	1629	22:33	15°04.945'	173°32.690'	1140	1696-1111	15°04.698'	173°34.625'	20:17-22:11	TOW-YO profile	water samples: 16
036_CTD		0708.06.2018	Niua North	22:53	15°04.177'	173°32.699'	1344	01:47	15°05.204	173°33.529	1080	1375-1091	15°04.091'	173°32.689'	00:03-01:29	TOW-YO profile	water samples: 18
037_TVG		08.06.18	Niua South	02:39	15°09.857	173°34.526	1177	04:19	15°09.865	173°34.458	1175	1173	15°09.889	173°34.465	03:31	Posidonia 50 m, active vents (plume in water column) and old chimney talus; chimney sampled	geology samples: 10 biology samples Sedimentary samples: 1
038_TVG		08.06.18	Niua North	04:26	15°09.862	173°34.454	1174	05:48	15°09.865	173°34.465	1171	1169	15°09.854	173°34.458	05:01	Posidonia 50 m, see 037_TVG	geology samples: 2
039_TVG		08.06.18	Niua North	06:26	15°05.508'	173°31.797'	1282	07:37	15°05.491'	173°31.900'	1240	1248	15°05.476'	173°31.897'	06:58	little cone with blocks of lava, next to field of little pumice (?), little sediment	geology samples: 1
040_TVG		08.06.18	Niua North	07:54	15°05.649	173°31.170	1034	09:06	15°05.661	173°31.236	1029	1035	15°05.650	173°31.237	08:31	Posidonia 50 m, prob. Lava flow, dense mafic material	geology samples: 1
041_TVG		08.06.18	Niua North	09:28	15°04.823	173°30.965	1189	10:39	15°04.790	173°31.007	1156	1152	15°04.784	173°31.012	10:00	lava field, huge block	geology samples: 5
042_multibeam 043_ROV	#430	09.06.18	Niua South	02:06	15 05.695 15°09.918'	173 29.562 173°34.455'	1154	08:05	15 06.092 15°09.786'	173 29.547 173°34.400'	1119	1164	15 05.716 15°09.895'	173 29.529 173°34.438'	03:10-07:04	continuation of dive#428 & #429, further north; avtive vent fields sampled, old/ little active chimneys sampled	fluid samples: 5 geology samples: 6
044_TVG		09.06.18	South of Niua	09:12	15°18.059'	173°41.495'	690	10:26	15°17.996	173°41.488	669	679	15°18.008	173°41.485	09:53	Posidonia 50 m, MAPR 75 m, lava flows and pillows	geology samples: 1
045_TVG		09.06.18	Königs-Mount	11:20	15°19.015	173°43.039	1048	12:56	15°18.993	173°43.000	1043	-	-	-	-	Posidonia 50 m, technical blackout	-
046 multibeam		09.06.18	E and SE of Niua	14:36	15°09.436'	173°28.748'	2665	18:39	15°00.854'	173°31.323'	2251	-	-	-	-	multibeam profile	-
047_ROV	#431	09.06.18	Niua North	20:50	15°04.857'	173°33.457'	862	07:47	15°04.833'	173°33.182'	727					sampling native sulfur blocks, sulfur vents and mussel mainia	geology samples: 10 fluid samples: 6 biology samples: 3
048_TVG		10.06.18	Niua North	08:11	15°03.482'	173°33.441'	1352	09:32	15°03.470'	173°33.451"	1323	1328	15°03.468'	173°33.452'	08:52	andesitic debris field, technical problems	geology samples: 8
049_multibeam		10.06.18	East of Niua	10:19	15°00.086'	173°29.889'	1025	16:26	15°01.695'	173°12.987'	3024	-	-	-	-	multibeam profile	-
050_ROV	#432	1011.06.2018	Niua south	20:08	15°09.919'	173°34.453'	1158	08:09	15°09.869'	173°34.297'	1082	see dive log	see dive log	see dive log	see dive log	diving again in Niua South to take more fluid samples and survey of the east side of the crater	fluid samples: 6 biology samples: 1 geology samples: 14
051_CTD		11.06.18	West Mata	09:21	15°05.731'	173°44.930'	1252	10:26	15°05.658'	173°44.904'	1219	1189	15°05.681'	173°44.950'	9:57-10:25	CTD vertical sampling, no plume signal	water samples
052 CTD		11.06.18	West Mata	10:26	15°05.658'	173°44.903'	1208	11:51	15°05.655'	173°44.899'	1219	1209	15°05.655'	173°44.898'	11:24-11:50	CTD vertical sampling	water samples
053_multibeam	#433	11.06.18	East of Niua Niua North	13:38 20:53	14°57.880' 15°04.836'	173°28.359' 173°33.459'	905 1065	19:19 06:52	15°10.824' 15°04.890'	173°31.278' 173°33.261'	715	- see dive log	- see dive log	- see dive log	- see dive log	multibeam profile dive in Niua North to sample hyolithe outcrops, sulfur lake and vents, which were sampled, further mussel sampling	fluid samples: 6 biology samples: 3 geology samples: 11
055_TVG		12.06.18	southern island arc seamount	08:18	15°15.445'	173°35.496'	1025									Posidonia 50 m	geology samples: 3
056_TVG		12.06.18	South of Niua	09:47	15°16.651'	173°35.606'	1359	11:48	15°16.679'	173°35.617'	1352	1352	15°16.684'	173°35.619'	10:57	Posidonia 50 m, MAPR 75 m, mainly sediment, some pumice blocks	geology samples: 4
057_TVG		12.06.18	South of Niua	12:11	15°17.363'	173°35.946'	1108	13:21	15°17.369'	173°35.918'	1108	1285	15°17.375'	173°35.925'	12:46	Posidonia 50 m, MAPR 75 m, pumice field, sediment layer; lava flows (with sulfur?)	geology samples: 4
058_TVG		12.06.18	South of Niua	13:45	15°18.326'	173°35.570'	1400	15:05	15°18.309'	173°35.459'	1352	1347	15°18.323'	173°35.467'	14:26	Posidonia 50 m, MAPR 75 m, platy, black crusts, less blocky material	geology samples: 1
059_TVG		12.06.18	South of Niua	15:40	15°20.512'	173°35.824	790	16:45	15°20.529'	173°35.737'	763	760	15°20.538'	173°35.743	16:13	Posidonia 50 m, MAPR 75 m, flows with sediment cover	geology samples: 1
060 multibeam		12.06.18	East of Niua	17:03	15°18.354'	173°34.289'	1425	18:15	15°20.575'	173°24.676'	1809	-	-	-	-	multibeam profile	
061_ROV	#434	1213.06.2018	S Rift wall	21:46	15°19.341'	173°27.777	1920	07:55	15°19.648'	173°28.119'	1433	see dive log	see dive log	see dive log	see dive log	straugraphic sampling of rift wall, south of Niua, lava flow outcrops and dykes, samples with large phenocrysts (Cpx, Plag, Ol)	geology samples: 20
062_TVG		13.06.18	Smt south of Niua	08:50	15°20.663'	173°35.713'	771	10:01	15°20.523'	173°35.718'	770	766	15°20.530'	173°35.720'	09:33	Posidonia 50 m, MAPR 75 m, boggl hadd, hard lava surface, some biological growth	geology samples: 1
063_TVG		13.06.18	Smt south of Niua	10:20	15°20.752'	173°34.976'	995	11:32	15°20.755'	173°34.950'	1001	1003	15°20.761'	173°34.955'	10:59	Posidonia 50 m, MAPR 75 m, sand, Mn-crust?	geology samples: 6

Station	ROV- station (Marum)	Date (UTC)	Location	Start (UTC)	Start (	Position)	Water depth [m]	Ende (UTC)	End	Position	Water depth [m]	Waterdepth of sample [m]	Sample	position	Sample time (UTC)	comments	Size/number of samples
	( <i></i>				Latitude (°S)	Longitude (°W)			Latitude (°S)	Longitude (°W)			Latitude (°S)	Longitude (°W)			
064_TVG		13.06.18	Smt south of Niua	12:00	15°20.828'	173°35.640'	852	13:23	15°20.879'	173°35.719'	812	-	-	-	-	Posidonia 50 m, MAPR 75 m, MnOOH encoated flat banked ground with light sediment filled cracks "hardground", no sampling possible (similar to previous station)	-
065_TVG		13.06.18	Smt south of Niua	13:47	15°21.740'	173°35.774'	920	14:50	15°21.760'	173°35.709'	907	900	15°21.766'	173°35.718'	14:07	Posidonia 50 m, MAPR 75 m, Mn- crust, small lava blocks	geology samples: 5
066_TVG		13.06.18	Smt south of Niua	15:18	15°22.735'	173°36.953'	448	16:25	15°22.710'	173°36.908'	451	-	-	-	-	Posidonia 50 m, MAPR 75 m, massive flows, crust of Mn, sampling not possible due to hard ground, small sample on top of the TVG	geology samples: 1
067_multibeam		13.06.18	East of seamounts South of Niua	17:00	15°28.778'	173°35.509'	1133	19:51	15°23.484'	174°00.017'	1683	-	-	-	-	multibeam profile	-
068_ROV	#435	1314.06.2018	Niuatahi	20:00	15°23.281'	173°59.894'	1615	07:59	15°23.031'	173°59.778'	1548	see dive log	see dive log	see dive log	see dive log	first dive at Niuatahi-starting in a very active vent field, diving through caldera fault	geology samples: 10 fluid samples: 4 biology samples: 4
069_TVG		14.06.18	Niuatahi	08:16	15°22.469'	174.00.044'	1417	09:41	15°22.460'	174.00.051'	1419	1420	15°22.477'	174.00.059'	08:59	Posidonia 50 m, MAPR 75 m, Pile of lava debris, pumice and lava pieces	geology samples: 5
070_TVG		14.06.18	Niuatahi	10:19	15°23.874'	174°00.612'	1604	12:00	15°23.824'	174°00.602'	1578	1566	15°23.832'	174°00.615'	11:02	Posidonia 50 m, MAPR 75 m, massive sulfide, maybe native sulfur on seafloor	geology samples: 1
071_TVG		14.06.18	Niuatahi	12:24	15°24.137'	174°02.030	1552	13:49	15°24.170'	174°01.989	1538	1537	15°24.175'	174°01.999'	13:03	Posidonia 50 m, MAPR 75 m, field of lava with sediment in between	geology samples: 4
072_TVG		14.06.18	Niuatahi	14:15	15°24.701'	174°01.502	1932	16:15	15°24.729'	174°01.454	1930	1926	15°24.736'	174°01.466'	15:18	Posidonia 50 m, MAPR 75 m, massive flows and pillows	geology samples: 1
073_CTD		14.06.18	Niuatahi	19:20	15°24.026'	174°00.379'	1787	22:03	15°22.153'	173°59.141'	1813				18:40-21:18	MAPR #64, 0m; Posidonia 25 m; TOW- YO profile	water samples: 11
074 VSR		1415.06.2018	NELSC	23:42	15°21.267'	174°13.755'	1858	01:12	15°21.239'	174°13.799'	1804	1801	15°21.245'	174°13.802'	00:26	MAPR 75m; fresh glass	geology sample: 2
075_VSR		15.06.18	NELSC	01:26	15°21.509'	174°13.973'	1693	02:46	15°21.516'	174°13.945'	1702	1700	15°21.521'	174°13.949'	02:06	MAPR 75 m, fresh glass	geology sample: 2
076_VSR		15.06.18	NELSC	03:20	15°22.456'	174°14.656	1650	04:38	15°22.463'	174°14.634'	1674	1670	15°22.461'	174°14.629'	04:00	MAPR 75m; fresh glass	geology sample: 2
077_VSR		15.06.18	NELSC	04:52	15°22.324'	174°14.011'	1674	06:10	15°22.325'	174°14.007'	1676	1681	15°22.334'	174°14.010'	05:29	MAPR 75 m, fresh glass	geology sample: 2
078 VSR		15.06.18	NELSC	06:24	15°22.837'	174°14.445'	1618	07:37	15°22.783'	174°14.391'	1780	1636	15°22.784'	174°14.385'	07:00	MAPR 75m; fresh glass	geology sample: 2
079 VSR		15.06.18	NELSC	08:00	15°23.260'	174°14.857'	1593	09:12	15°23.227'	174°14.827'	1613	1615	15°23.222"	174°14.826'	08:35	MAPR 75 m, fresh glass	geology sample: 2
080 VSR		15.06.18	NELSC	09:41	15°24.237'	174°15.923'	1826	11:07	15°24.236'	174°15.893'	1822	1826	15°24.237'	174°15.907'	10:23	MAPR 75m; fresh glass	geology sample: 2
081_multibeam 082_ROV	#436	15.05.18 1516.06.2018	NELSC Niuatahi	11:10 19:58	15°24.229 15°23.293'	174°15.895' 173°59.856'	1715	18:04 04:17	15°21.000' 15°23.274'	174°14.850' 173°59.842'	2066 1588	- see dive log	- see dive log	- see dive log	- see dive log	multibeam profile second dive at Niuatahi active vent field and caldera rim fault	- geology samples: 5 fluid samples: 3
083_TVG		16.06.18	Niuatahi (western caldera rim)	05:36	15°21.484'	174°03.762'	1309	06:40	15°21.458'	174°03.718'	1302	1306	15°21.476'	174°03.743'	05:36	MAPR 75m, Posidonia 50 m, dacitic pillow lavas, little sediment	geology sample: 2
084_TVG		16.06.18	Niuatahi (western caldera rim)	06:57	15°21.207'	174°03.985'	1348	08:25	15°21.200'	174°02.946'	1366	1357	15°21.220'	174°02.961'	07:40	MAPR 75m, Posidonia 50 m, glassy volcanic sediment	geology sample: 3
085_TVG		16.06.18	Cone west of Niuatahi	08:54	15°19.912'	174°04.983'	1610	10:25	15°19.858'	174°04.937'	1519	1593	15°19.863'	174°04.945'	09:37	MAPR 75m, Posidonia 50 m, blocks of lava, pillows	geology samples: 2
086_TVG		16.06.18	Cone north of Niuatahi	11:04	15°18.758'	174°00.715'	1588	12:40	15°18.759'	174°00.695'	1589	1591	15°18.757'	174°00.704'	11:50	MAPR 75m, Posidonia 50 m, blocks of lava	geology samples: 1
087_CTD		16.06.18	Niuatahi (northern caldera rim)	13:08	15°19.597'	173°59.759'	1564	14:49	15°19.625'	173°59.751'	1564	1560	15°19.621'	173°59.746'	13:56-14:43	CTD vertical sampling	water samples
088_CTD		16.06.18	Niuatahi (southern caldera rim)	15:38	15°23.273'	173°59.842'	1580	17:20	15°23.272'	173°59.831'	1580	1579	15°23.263'	173°59.838'	16:24-17:18	plume in water column	water samples: 7
089_CTD		16.06.18	Niuatahi (southern caldera rim)	17:42	15°23.852'	174°00.634'	1579	19:25	15°23.832'	174°00.615'	1573	1570	15°23.834'	174°00.612'	18:44-19:24	plume in water column	water samples: 7
090_ROV	#437	1617.06.2018	SW Niuatahi	20:06	15°23.990'	174°00.640'	1666	06:32	15°23.868'	174°00.568'	1554	see dive log	see dive log	see dive log	see dive log	ROV dive on cone south Niuatahi, see 070_TVG position, active at minimum depth, fresh lava flow outcrops	geology samples: 14 fluid samples: 3 biology samples: 3
091_TVG		17.06.18	Caldera ridge North of Niuatahi	08:35	15°18.436'	173°59.051'	1521	10:05	15°18.398'	173°59.041'	1509	1508	15°18.409'	173°59.050'	09:19	Posidonia 50 m, sediment covered lava flow	geology samples: 1

Station	ROV- station (Marum)	Date (UTC)	Location	Start (UTC)	Start (	Position)	Water depth [m]	Ende (UTC)	End	Position	Water depth [m]	Waterdepth of sample [m]	Sample	e position	Sample time (UTC)	comments	Size/number of samples
					Latitude (°S)	Longitude (°W)			Latitude (°S)	Longitude (°W)			Latitude (°S)	Longitude (°W)			
092_TVG		17.06.18	northern ridge of Niuatahi	10:36	15°16.848'	173°58.936'	2113	12:15	15°16.818'	173°58.903'	2108	2105	15°16.818'	173°58.905'	11:22	Posidonia 50 m, sediment layer above pillows	geology samples: 1
093_TVG		17.06.18	northern ridge of Niuatahi	12:58	15°13.839'	173°58.535'	2326	14:51	15°13.941'	173°58.492'	2331	2331	15°13.921'	173°58.512'	13:52	Posidonia 50 m, sediment with single blocks of pumice	geology samples: 2
094_ROV	#438	1718.06.2018	fore arc rift wall	19:55	14°56.226'	173°22.865'	2337	07:45	14°57.122'	173°23.122'	1586	see dive log	see dive log	see dive log	see dive log		geology samples: 26
095_TVG			northern ridge of Niuatahi	11:02	15°17.889'	173°55.331'	2396	12:50	15°17.895'	173°55.309'	2397	-	-	-	-	technical defect	-
096_CTD		18:06.2018	Central cone Niuatahi	13:57	15°22.701'	174°01.318'	1824	18:33	15°24.605'	173°58.036'	1660	1818	15°22.821'	174°01.215'	14:28-18:02	TOW-YO Profil, MAPR, Posidonia 25 m	water samples
097_ROV	#439	1819.06.2018	Niuatahi North	20:00	15°19.791'	174°00.175'	1849	08:04	15°19.817'	173°59.779'	1850	see dive log	see dive log	see dive log	see dive log	delayed dive due to winch problems in northern Niuatahi, sampling active vent field	geology samples: 4 fluid samples: 5 biology samples: 1
098_VSR		19.06.18	NELSC	09:50	15°24.828'	174°16.493'	1801	11:12	15°24.855'	174°16.473'	1813	1812	15°24.852'	174°16.471'	10:33	fresh glass	geology samples: 1
099_VSR		19.06.18	NELSC	11:32	15°25.515'	174°17.286'	1710	12:45	15°25.615'	174°17.268'	1702	1669	15°25.569'	174°17.280'	12:09	fresh glass	geology samples: 1
100_VSR		19.06.18	NELSC	13:00	15°25.776'	174°17.232'	1743	14:15	15°25.988'	174°17.370'	1733	1745	15°25.988'	174°17.220'	13:39	fresh glass	geology samples: 1
101 VSR		19.06.18	NELSC	14:37	15°26.456'	174°17.946'	1823	15:50	15°26.491'	174°17.859'	1783	1780	15°26.496'	174°17.859'	15:12	fresh glass	geology samples: 1
102_VSR		19.06.18	NELSC	16:13	15°27.300'	174°18.709'	1910	17:26	15°27.233'	174°18.715'	1870	1873	15°27.238'	174°18.715'	16:50	fresh glass	geology samples: 1
103_ROV	#440	1920.06.2018	Niuatahi North	20:03	15°19.830'	173°59.745'	1686	08:45	15°19.616'	173°59.716'	1687	see dive log	see dive log	see dive log	see dive log		geology samples: 10 fluid samples: 5 biology samples: 2
104 VSR		20.06.18	NELSC	19:07	15°16.439'	174°12.357'	2032	11:30	15°16.456'	174°12.263'	2033	2033	15°16.457'	174°12.362'	10:48		geology samples: 1
105_VSR		20.06.18	NELSC	11:58	15°17.852'	174°13.256'	1977	13:18	15°17.877'	174°13.251'	1982	1981	15°17.883'	174°13.250'	12:38		geology samples: 1
106 VSR		20.06.18	NELSC	13:50	15°18.568'	174°14.452'	1681	14:58	15°18.589'	174°14.392'	1715	1717	15°18.588'	174°14.392'	14:22		geology samples: 1
107_VSR		20.06.18	NELSC	15:18	15°19.779'	174°14.540'	1805	16:32	15°19.738'	174°14.456'	1815	1818	15°19.739'	174°14.459'	15:55		geology samples: 1
108_VSR		20.06.18	NELSC	16:54	15°20.646'	174°15.133'	1955	18:16	15°20.635'	174°15.135'	1942	1934	15°20.630'	174°15.134'	17:35	glass up to 1 cm	geology samples: 1
109_VSR		20.06.18	northern NELSC, 'off-axis'	18:32	15°20.553'	174°14.442'	1835	19:49	15°20.551'	174°14.056'	1825	1820	15°20.551'	174°14.060'	19:10	few glass to 1 mm, sediment dark basaltic and light pumiceous glass	geology samples: 1
110_ROV	#441	2021.06.2018	Niuatahi South	21:26	15°23.289'	173°59.837'	1885	08:05	15°23.618'	173°59.394'	1568	see dive log	see dive log	see dive log	see dive log		geology samples: 10 fluid samples: 6
111_TVG		21.06.18	Diagonal ridge	08:56	15°22.528'	174°06.103'	1384	10:33	15°22.420'	174°06.100'	1365	1360	15°22.432'	174°06.112'	09:51	MAPR 75m, Posidonia 50 m, sediment?	geology samples: 10
112_TVG		21.06.18	Diagonal ridge	11:10	15°24.252'	174°08.484'	1457	12:35	15°24.275'	174°08.489'	1461	1477	15°24.281'	174°08.500'	11:52	MAPR 75m, Posidonia 50 m, single blocks of pumice? Sediment covered	geology samples: 4
113_TVG		21.06.18	Diagonal ridge	13:16	15°24.125'	174°12.404'	2248	15:06	15°24.228'	174°12.265'	2132	2129	15°24.236'	174°12.279'	14:15	MAPR 75m, Posidonia 50 m, field of blocky, angular talus, little sediment, lava flows/pillow fragments?	geology samples: 1
114_TVG		21.06.18	Diagonal ridge	15:40	15°26.562'	174°12.440'	2080	17:25	15°26.601'	174°12.389'	2134	2133	15°26.603'	174°12.410	16:30	MAPR 75m, Posidonia 50 m, single blocks of pumice or carbonate?	geology samples: 1
115_CTD		21.06.18	Maka hydrothermal field	18:07	15°23.34'	174°15.19'	1803	19:36	15°23.34'	174°15.19'	1803	1803	15°23.34'	174°15.19'	19:01	MAPR 64m, vertical CTD, no plume	water samples
116_ROV	#442	2122.06.2018	Maka hydrothermal field	20:21	15°25.050'	174°16.791'	1780	08:05	15°25.357'	174°16.999'	1820	see dive log	see dive log	see dive log	see dive log	following fresh pillow flow terraces SW to active vent field with hydrothermal activity, mussels and bacterial mats	geology samples: 12 fluid samples: biology samples:
117_TVG		22.06.18	NELSC	08:40	15°22.090'	174°14.264'	1425	10:10	15°22.088'	174°14.278'	1410	1412	15°22.092'	174°14.287'	09:19	MAPR 75m, Posidonia 50 m talus mount with Lava, Pillow mount	geology sample: 1
118_TVG		22.06.18	NELSC off-axis	10:44	15°22.790'	174°18.448'	2050	12:50	15°22.766'	174°18.492'	2011	2015	15°22.774'	174°18.499'	11:53	MAPR 75m, Posidonia 50 m sediment with little blocks (pumice?)	geology sample: 1
119_TVG		22.06.18	NELSC off-axis	13:24	15°24.546'	174°14.672'	1986	15:15	15°24.618'	174°14.608'	2026	2028	15°24.619'	174°14.619'	14:16	MAPR 75m, Posidonia 50 m sediment with glass splices	geology sample: 1
120_TVG		22.06.18	NELSC	15:47	15°27.931'	174°15.950'	2138	17:35	15°28.071'	174°15.881'	2057	2031	15°28.064'	174°15.892'	16:29	MAPR 75m, Posidonia 50 m, debris, angular with sediment	geology sample: 4
121_CTD		22.06.18	Maka hydrothermal field	18:00	15°25.358'	174°16.97'	1598	19:33	15°25.358'	174°16.97'	1598	1598	15°25.358'	174°16.97'	18:44	MAPR 64m, vertical CTD, Maka Plume sampled	Water samples
122_ROV	#443	2223.06.2018	Maka hydrothermal field	08:00	15°25.562'	174°17.214'	1729	19:35	15°25.355'	174°17.013'	1556	see dive log	see dive log	see dive log	see dive log	Dive in south Maka with pillow/ lobate flows, corals and active vent field on top of the seamount	geology samples: 18 fluid samples: 4 biology samples: 3
123_TVG		23.06.18	seamount southern NELSC	10:28	15°40.964'	174°30.811'	1869	12:05	15°40.969'	174°30.845'	1859	1867	15°40.973'	174°30.827'	11:12	MAPR 75m, Posidonia 50 m, round blocks, sediment	geology samples: 2

Station	ROV- station	Date (UTC)	Location	Start (UTC)	Start (	(Position)	Water depth	Ende (UTC)	End Position		Water depth	Waterdepth of sample	Sample position		Sample time (UTC)	comments	Size/number of samples
	(Marulli)				Latitude (°S)	Longitude (°W)	Lini		Latitude (°S)	Longitude (°W)		լոյ	Latitude (°S)	Longitude (°W)			
124_TVG		23.06.18	seamount southern NELSC	12:20	15°40.989'	174°31.121'	2030	14:10	15°40. 989'	174°31.120'	2029	2031	15°40.991'	174°31.134'	13:07	MAPR 75m, Posidonia 50 m, pumice debris, sediment	geology samples: 3
125_TVG		23.06.18	seamount southern NELSC	14:33	15°42.318'	174°28.836'	1260	15:40	15°42.381'	174°28.726'	1262	1259	15°42.384'	174°28.790'	15:02	MAPR 75m, Posidonia 50 m, sediment cover with blocks of lava	geology samples: 5
126_TVG		23.06.18	seamount southern NELSC	16:06	15°42.467'	174°27.196'	1193	17:25	15°42.466'	174°27.100'	1204	1210	15°42.473'	174°27.108'	16:41	MAPR 75m, Posidonia 50 m, talus with sediment	geology samples: 4
127_VSR		23.06.18	NELSC	19:08	15°31.669'	174°24.793'	2787	21:00	15°31.069'	174°23.864'	2773	2772	15°31.675'	174°23.85'	20:01	only sediment, no sample taken	-
128_VSR		23.06.18	NELSC	21:17	15°30.877'	174°23.030'	2774	23:06	15°30.825'	174°23.035'	2774	2773	15°30.829'	174°23.035'	22:12	sediment with tiny pumice pieces	geology sample: 1
129_VSR		2324.06.2018	NELSC	23:40	15°29.78'	174°21.08'	2190	01:10	15°29.42'	174°20.61	2173	2180	15°29.77'	174°21.05'	00:28	glass pieces, rock fragment 3 cm in diameter	geology sample: 1
130_VSR		24.06.18	NELSC	01:21	15°29.34'	174°20.50'	2267	02:55	15°29.331'	174°20.496'	2261	2291	15°29.332'	174°20.499'	02:06	glass pieces up to 1 cm in diameter	geology sample: 1
131 multibeam		2425.06.2018	East of NELSC	06:45	15°04.140	174°33.814	2465	01:46	15°23.109	175°11.594	1932	-	-	-	-	multibeam profile	-