SR2411 Cruise Report

Marine IGUANA — Parte Dos

Marine Imaging of Galápagos Upwelling and Neighboring Archipelago

June 13th to July 3rd, 2024

San Cristobal to Puerto Ayora, Galápagos, Ecuador

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An Open Access Experiment to Image Galápagos Plume-Ridge Interaction

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Operations Summary

The operational objective of SR2411 was to recover 53 broadband ocean bottom seismometers that were deployed 15 months earlier during MGL2304. While transiting between sites, underway geophysical and physical oceanographic data were collected, including multibeam, magnetics, gravity, sub-bottom profiling, and acoustic doppler current profiling down to 400 m. We also deployed two floats for the GO-BGS global array of biogeochemistry sensors. We successfully recovered 49 of 53 ocean bottom seismometers. Four instruments remain on the seafloor; all were responsive to acoustic commands.

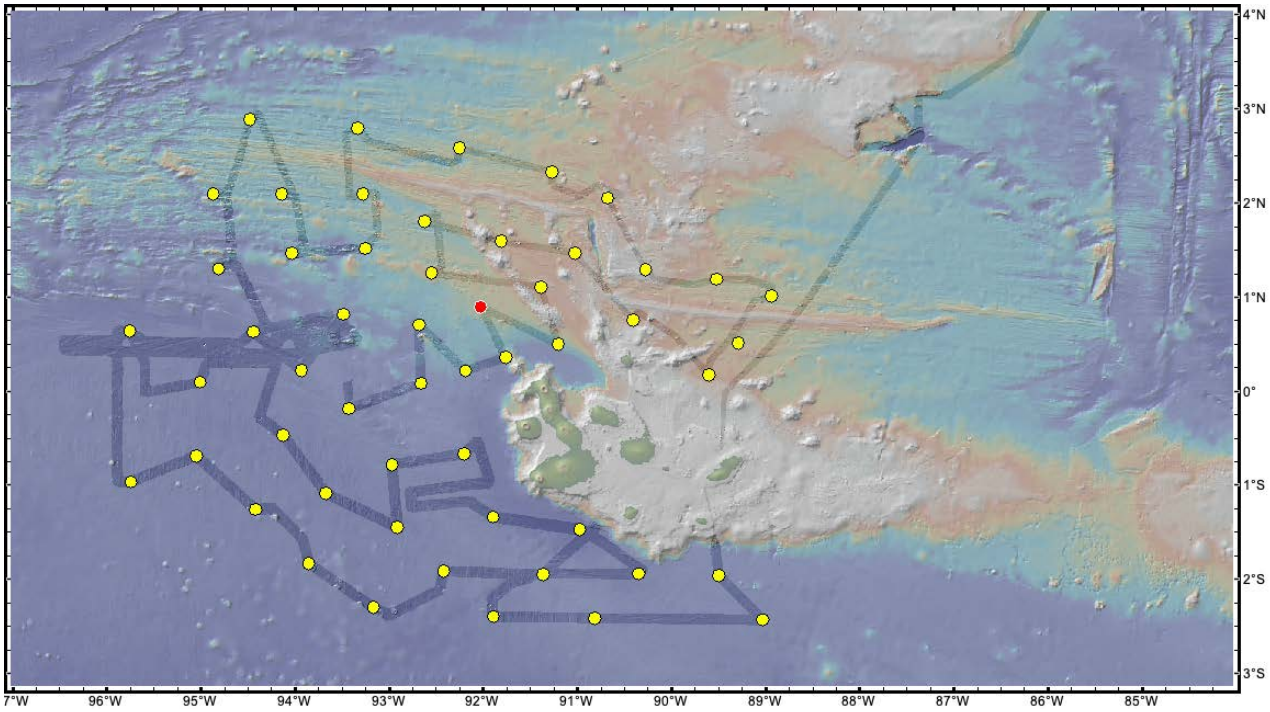


***Figure** 1. Map of ocean bottom seismometer locations (white dots) showing acquired multibeam bathymetry on top of existing global multi-resolution topography data (GMRT v4.2.1).*

Science Overview

The objective of this project is to seismically image the Galápagos mantle plume and the nearby Galápagos spreading center.

The ocean bottom seismometer (OBS) experiment has three main design goals to answer three main scientific questions (SQs):

(1) Determine the thickness of the plume reservoir material in the depth range of 50 to 300 km

(2) Map the lateral distribution of the plume reservoir over an area large enough to distinguish between channeled versus plume flow and detect possible ambient pressure-driven flows in the asthenosphere

(3) Verify the presence of small-scale convection and delineate its scale and nature and determine the spatial distribution of the molten material and the compositional heterogeneity of the associated mantle.

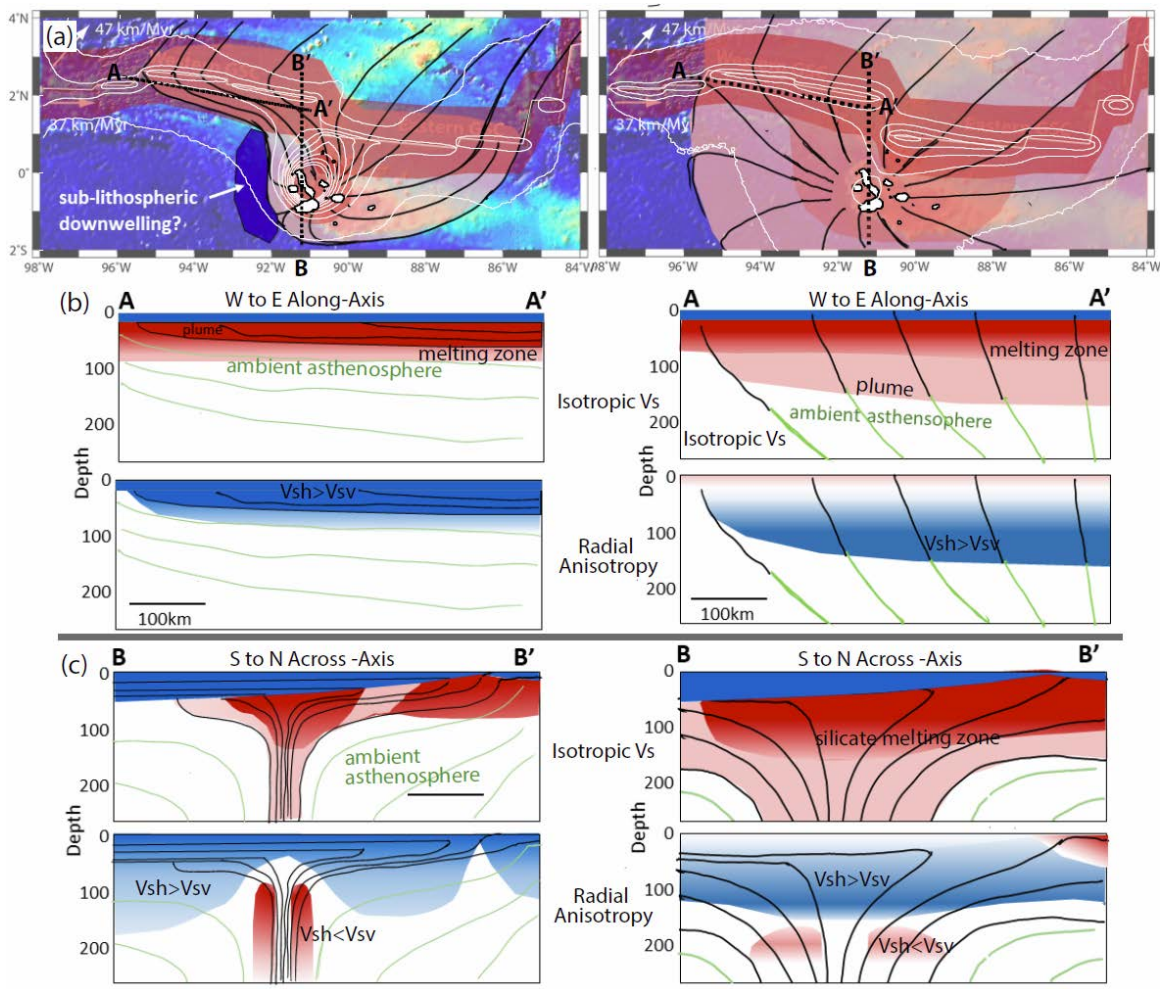


Figure 2. *Schematics of plume-ridge interaction regimes inspired by 3D geodynamic models by Ito and Bianco (2014) with seismic anisotropy calculated by Ito et al. (2014). The left column: low viscosity, thin plume with channel flow. Right column: High-viscosity surface layer dehydrated by melting silicates resulting in thick plume and radial flow. Black flux lines are from material flux from the plume, green flux lines are for asthenospheric flow. (Row a): Material maps of the plume (pink) and the melting zone (red). White contours are integrated melt volumes calculated with representative geodynamic models (model 1, left, and model 2, right). (Row b): West-East section along the GSC (A-A´). The upper panel shows schematics of the isotropic velocity structure of the lithosphere (blue), plume (pink), and molten zone (red). In the left panel, the molten zone is pink and the plume layer is red. Bottom panels show radial anisotropy patterns VSH > VSV (blue) and VSH < VSV (red) (c) Similar to (b) but for south-north sections, crossing the plume and Galápagos ridge (Galápagos spreading center, GSC). The plume material is pink and the melt zone is red.*

Experiment Design

To address the science questions, an open-access seismic experiment was planned, designed to produce the first visualization of the interaction between the Galápagos mantle plume and the Galápagos mid-ocean ridge. 53 broadband ocean bottom seismometers were deployed for 15 months in an array covering the area between the Galápagos Islands and the Western Galápagos Spreading Center (GSC). These ocean bottom seismometers are complemented by previous deployments of broadband seismometers on the Galápagos Islands.

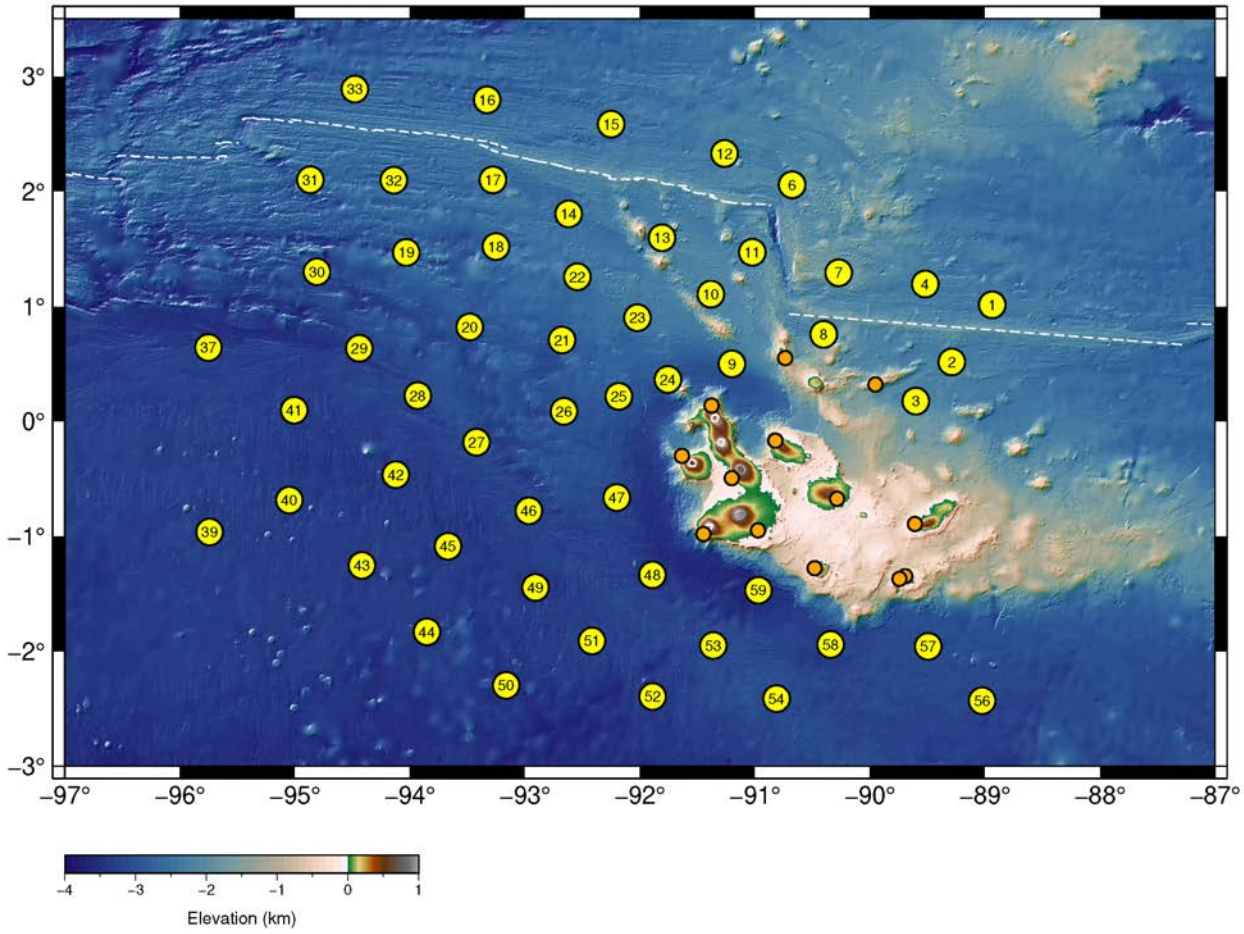


Figure 3. *Array Design. 53 ocean bottom seismometers were installed from the US research vessel Marcus Langseth in 2023. The objective of SR2411 was to recover these instruments. The ocean bottom array is complemented by data recorded from previous installations on the islands (IGUANA 1999-2003, orange circles) and the PAYG station of the Global Seismic Network in Santa Cruz.*

The experiment and subsequent analyses are designed to answer three main scientific questions:

* SQ1) At what depths, in what geographic pattern, and by what mechanisms, does the mantle plume material flow north to the Galápagos Spreading Center (GSC) and disperse along the ridge? What is the role of the ambient mantle circulation, including the return flow to the asthenosphere? What is the implication of the thickness of the plume layer below the GSC on the origin of geochemical gradients along the GSC?

* SQ2) Does the scale and nature of the heterogeneity indicate small-scale sub-lithospheric convection of the GSC? If so, how does this influence the flow of material from the plume along the base of the lithosphere?

* SQ3) What is the spatial distribution of the melting and release of volatiles, as well as the associated heterogeneities in composition and rheology due to plume-ridge interaction?

Beyond the interaction of the Galápagos plume and the ridge, the project will fundamentally advance the understanding of the chemical and physical processes of the mantle plumes, the asthenosphere, and their interactions with the oceanic lithosphere.

Research vessel

The *R/V Sally Ride* is a 238-foot, 3,043 gross ton US-flagged research vessel owned by the U.S. Navy and operated by Scripps Institution of Oceanography under a charter agreement with the Office of Naval Research. The *R/V Sally Ride* is classified by the US Bureau of Shipping and is inspected by the US Coast Guard; certified to transport a total of 44 people, of which ~20 are the ship's crew.

Figure 4. *Photo of the research vessel, R/V Sally Ride. Photo by Erik Jepsen, UC San Diego Publications.*

R/V *Sally Ride* is an Ocean Class Auxiliary General Oceanographic Research (AGOR) vessel designed to perform multidisciplinary oceanographic research worldwide, from littoral environments to the deepest ocean, from the tropics into first-year sea ice. Aboard *R/V Sally Ride*, systems permit improved over-the-side operations, station keeping, trackline maneuvering, and acoustic system performance to support demanding scientific tasks. Designed to be reliable, cost effective, and flexible, the Ocean Class AGOR capably supports the evolving needs of U.S. scientists.

The *R/V Sally Ride* is equipped with an onboard Acoustic Doppler Current Profiler, BGM-3 Gravimeter, a hull mounted Kongsberg Sub-Bottom Profiler 29, Knudsen 3260 3.5/12 kHz single beam echosounder sub-bottom profiler, a Kongsberg EM124 and EM712 Multibeam array transducers for 3D bathymetric surveying. *R/V Sally Ride* also tows a Geometrics G-882 Marine Magnetometer and performs Sippican Fast Deep XBT profiles daily.

For this project in the Galápagos, the *R/V Sally Ride* will be recovering 53 ocean bottom seismometers. The vessel will make use of the onboard and hull mounted systems listed above and the towed magnetometer.

Ocean bottom seismometers

The broadband underwater seismometers come from the US academic group, OBSIC, https://obsic.whoi.edu, and were recovered by a team of specialized technicians. The instruments are completely passive and non-invasive. During MGL2304 the instruments were dropped over the side of the ship and sank to the bottom of the sea by gravity. Once on the seabed, an OBS measures very small ground movements in three orthogonal spatial directions and changes in seawater pressure; this data are recorded on an internal media. After 15 months, the R/V Sally Ride returned to retrieve the instruments. This is accomplished by sending out a coded acoustic signal. An instrument constantly listens for a specific code, which causes the instrument to drop its anchor and float to the surface by its own buoyancy. Once on the

sea surface, the instrument is identified by ship's personnel by means of a top-mounted flag, radio direction finder, or a strobe light. It is then recovered with a stick and hook.

For this project we used three types of instruments 10 new Nanometrics T240 sensors, 18 Nanometrics Trillium Compact sensors, and 23 Nanometrics Trillium Compacts in a sphere. Details in Appendix A.

Permitting process

The following permits are provided in Appendix J:

1. Costa Rica	
Ministry of the Environment Permit	*SINAC-SE-DE-794-2024 firmado.pdf*
2. Ecuador Navy (INOCAR)	
Marine Directorate Permit	*AUTORIZACION_02342024O_SALLY_RIDEsigned_signed-signed.pdf*
3. Galápagos National Park (DPNG)	
3.1. Permit	*permiso_investigación_pc-10-24-signed (1).pdf*
3.2. Addendum	*Autorización de inclusión.pdf*
3.3. Approved Travel Advisory	*Aviso de viaje n019-jun-jul-Emilie H.pdf*
3.4. Approved Work Plan	*Cronogram PC-10-24-addicional-signed.pdf*
3.5. Transeúnte certificates	*40294415 FUNDACION CHARLES DARWIN-signed-signed.pdf*
4. Charles Darwin Foundation	
4.1. Cooperation agreement	*Convenio Emilie Hooft-signed.pdf*
4.2. Addendum	*Nuevo convenio Emilie Hooft-signed.pdf*
5. Instituto Geofísico	
Data use agreement	*Acuerdo_uso_datos_sísmicos_IG-EPN-2023-003-signed.pdf*
6. US Dept. of State	
Marine Scientific Research Application	*UOLetterofCommitment.pdf*
	Figures. Map of requested study area, EEZs and Marine Protected Areas

Overview of Results

Maps and Table of OBS

Several maps are provided that show the location of all ocean bottom seismometers, seismometers recovered, seismometers that remain on seafloor, seismometers by type. All plots also include the locations of island stations that are broadband.

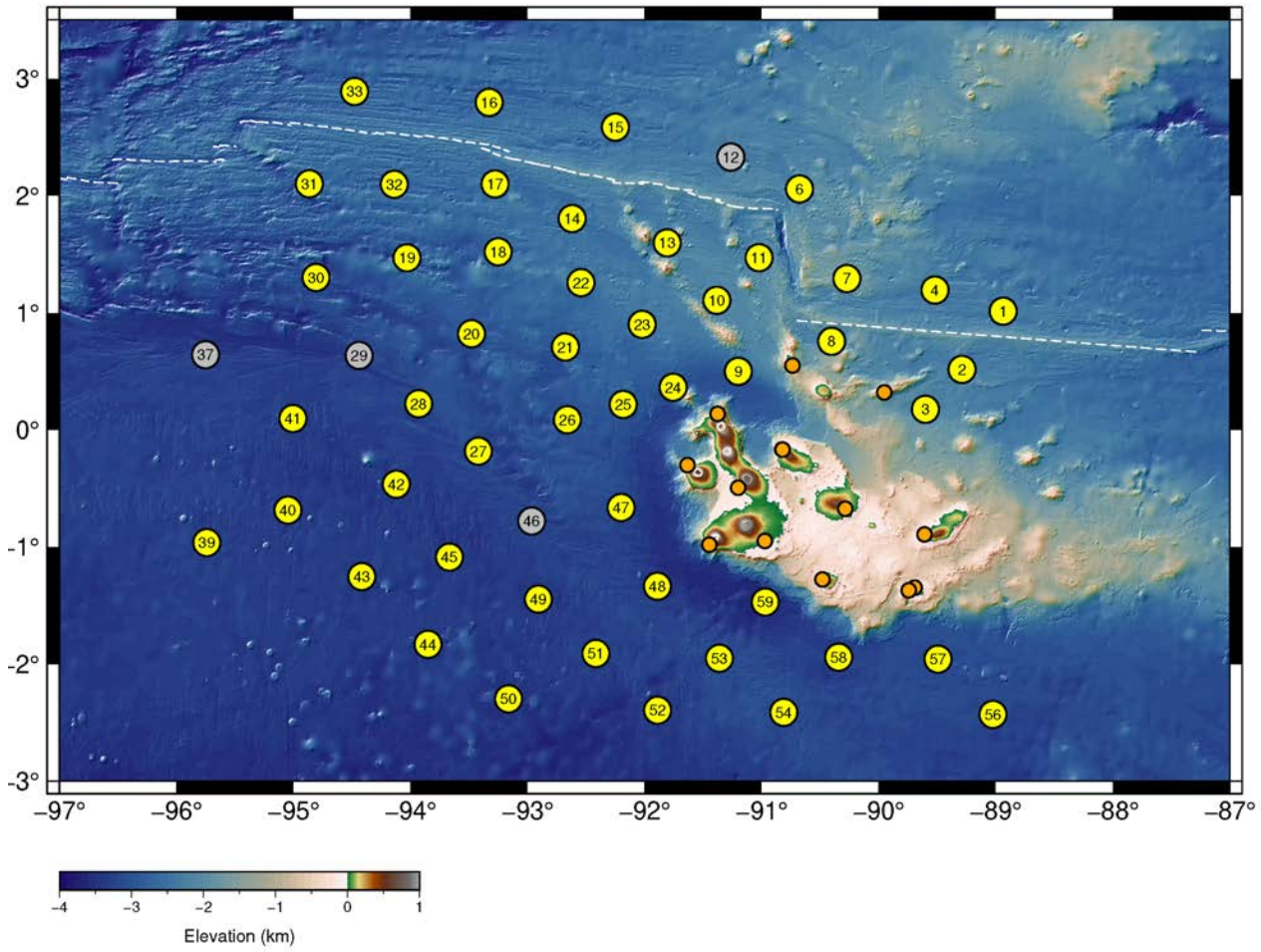


Figure 5. *Map of all sites, including recovered OBSs (yellow) and OBSs that remain on the seafloor (grey). Site numbers are not sequential. There are a total of 53 ocean bottom sites. Orange symbols are broadband island sites, including Network Code YH and GSN site PAYG.*

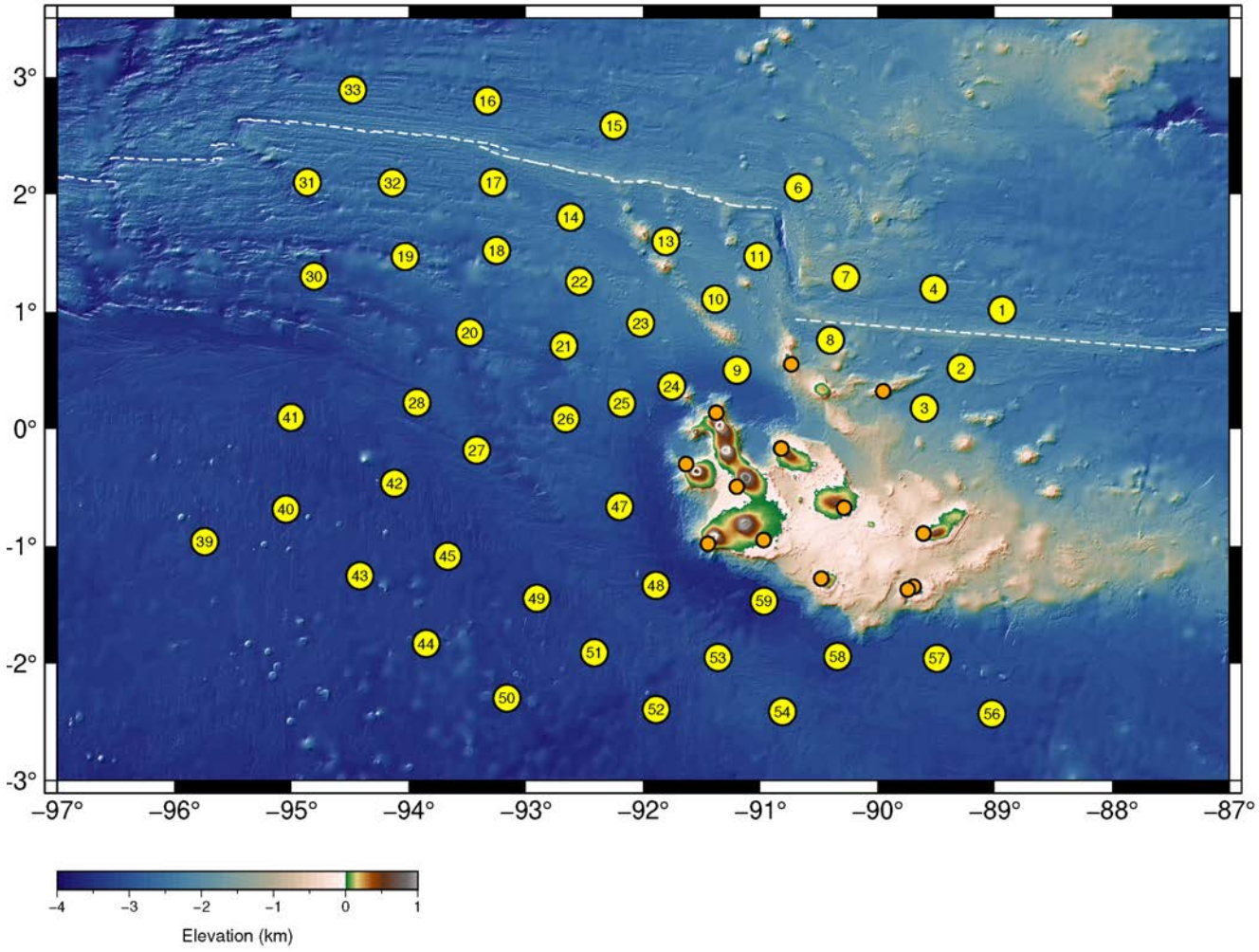


Figure 6. *Map of recovered OBSs and (yellow) broadband island sites from Network Code YH and GSN site PAYG (orange).*

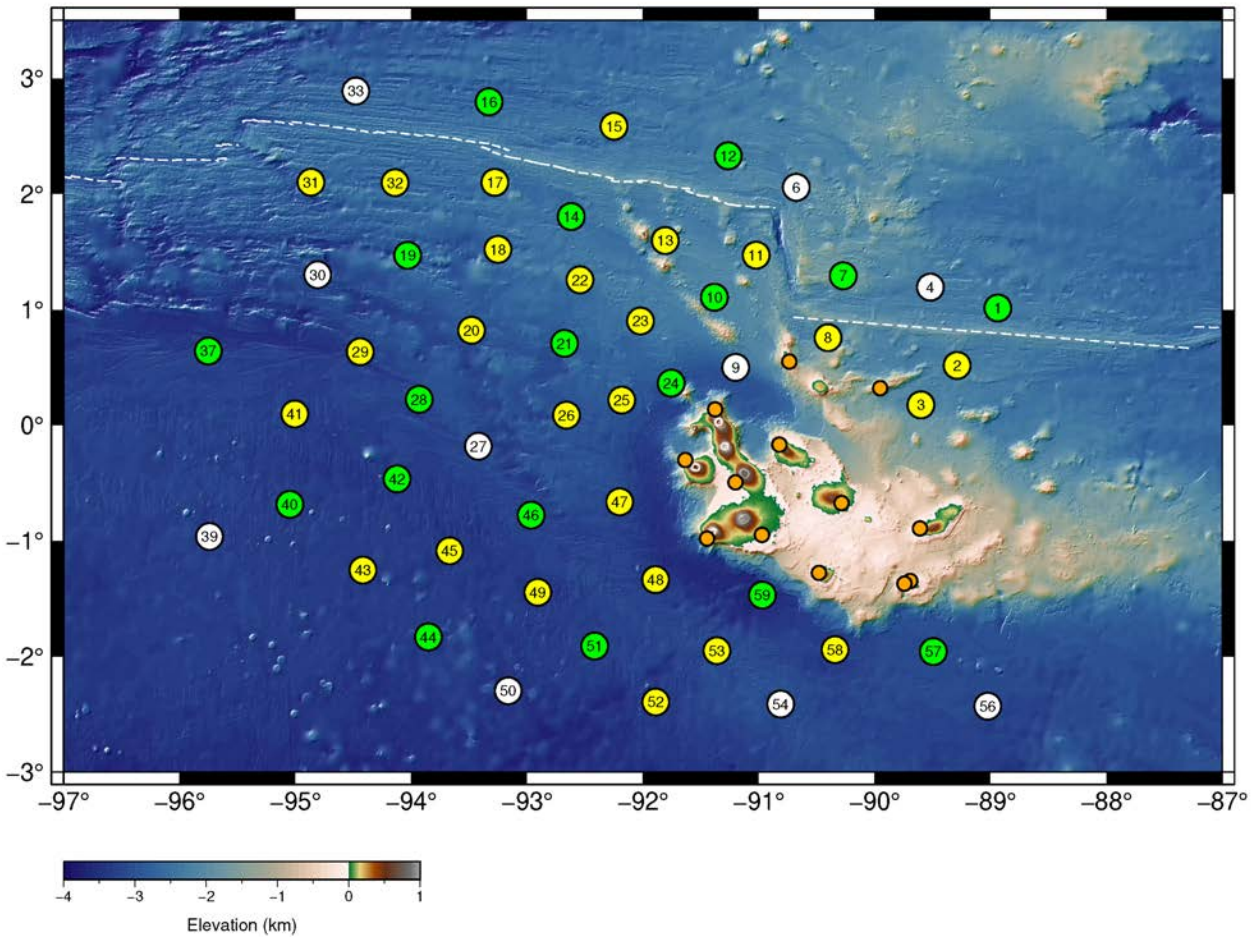


Figure 7. *Map of all OBSs by instrument type: compacts (green), spheres (yellow), T240 (white). Orange symbols are broadband island sites from Network Code YH and GSN site PAYG.*

** two OBS (S33 and S81) overheated in the sun on deck and were cooled and stabilized prior to deployment.*

Marine IGUANA OBS Table

OBS #	Type	OBS ID	Latitude (°)	Longitude (°)	Depth (m)	Date Deployed (UTC)	Time Deployed (UTC)	Date Recovered (UTC)	Time Recovered (UTC)
1	sphere	AN113	1.0132	-88.9369	2352	04/08/23	14:00:52	06/23/24	4:39:00
2	sphere	S68	0.5157	-89.2889	2369	04/08/23	7:50:22	06/22/24	23:31:37
3	compact	S30	0.1747	-89.6013	2205	04/08/23	2:46:07	06/22/24	18:52:06
4	T240	AN104	1.1931	-89.5193	2260	04/08/23	20:08:52	06/23/24	10:00:47
6	T240	AN105	2.0564	-90.6769	2330	04/09/23	9:39:37	06/23/24	20:40:46
7	compact	T114	1.2915	-90.2716	1642	04/09/23	2:39:37	06/23/24	15:17:44
8	sphere	S27	0.7564	-90.4024	2134	04/07/23	18:53:37	06/22/24	9:38:01
9	T240	AN111	0.4995	-91.2001	2716	04/07/23	11:32:37	06/20/24	16:18:00
10	compact	S87	1.1056	-91.383	2092	04/06/23	16:57:07	06/20/24	21:03:00
11	sphere	S73	1.4694	-91.0228	2137	04/06/23	11:10:37	06/22/24	1:30:11
12	compact	T121	2.3286	-91.2637	2384	04/09/23	15:37:37	NOT RECOVERED	
13	sphere	S05	1.596	-91.808	2313	04/06/23	4:15:07	06/21/24	18:36:45
14	compact	T111	1.8038	-92.6189	2489	04/04/23	13:35:52	06/21/24	10:26:05
15	sphere	S86	2.5843	-92.2501	2389	04/05/23	18:39:22	06/24/24	15:35:02
16	compact	S45	2.7949	-93.3285	2668	04/05/23	9:27:07	06/25/24	0:52:45
17	sphere	S85	2.0987	-93.2777	2586	04/05/23	2:50:52	06/25/24	7:56:50
18	sphere	S19	1.5202	-93.2519	2716	04/04/23	20:16:22	06/25/24	14:05:26
19	compact	S42	1.4682	-94.0306	3055	04/03/23	9:11:52	06/25/24	20:04:49
20	sphere	S01	0.8205	-93.4794	2939	04/03/23	17:29:07	06/18/24	19:48:50
21	compact	T105	0.7071	-92.6766	2980	04/04/23	2:30:07	06/19/24	16:02:30
22	sphere	S84	1.2568	-92.5439	2355	04/04/23	8:11:37	06/21/24	4:10:55
23	sphere	S82	0.9001	-92.0216	2414	04/06/23	23:26:37	06/20/24	8:10:00
24	compact	AN112	0.3636	-91.7568	2876	04/07/23	6:03:07	06/20/24	3:17:00
25	sphere	S81	0.2167	-92.1838	2845	03/27/23	21:09:07	06/19/24	22:47:50
26	sphere	S65	0.0857	-92.6597	2945	03/28/23	3:47:52	06/19/24	10:44:46
27	T240	AN109	-0.183	-93.4209	3114	03/28/23	19:52:37	06/19/24	3:34:10
28	compact	S48	0.2231	-93.9307	3199	03/30/23	13:43:22	06/18/24	13:00:26
29	sphere	S59	0.6349	-94.4401	3239	04/01/23	18:43:52	NOT RECOVERED	
30	T240	AN103	1.2999	-94.808	3250	04/02/23	2:18:22	06/27/24	1:02:24
31	sphere	S66	2.0998	-94.866	2746	04/02/23	10:18:52	06/26/24	17:35:25
32	sphere	S23	2.0958	-94.1394	2821	04/03/23	2:28:52	06/26/24	2:30:00
33	T240	AN110	2.8879	-94.4777	2628	04/02/23	18:07:52	06/26/24	10:29:39
37	compact	T113	0.6404	-95.7514	3312	04/01/23	7:37:37	NOT RECOVERED	

39	T240	AN102	-0.9632	-95.7405	3336	03/31/23	18:28:52	06/17/24	4:53:47
40	compact	S53	-0.6857	-95.0473	3381	03/31/23	9:02:07	06/16/24	23:13:29
41	sphere	S61	0.0968	-95.0055	3342	03/30/23	23:57:37	06/29/24	13:28:52
42	compact	T107	-0.4653	-94.1213	3390	03/30/23	6:21:07	06/30/24	3:00:37
43	sphere	S37	-1.2543	-94.4167	3351	03/29/23	21:39:07	06/16/24	16:20:59
44	compact	T104	-1.8313	-93.8518	3410	03/29/23	13:51:52	06/16/24	9:14:59
45	sphere	S88	-1.0878	-93.6678	3401	03/29/23	5:40:52	06/30/24	9:46:28
46	compact	T118	-0.7789	-92.9658	3271	03/28/23	12:28:07	NOT RECOVERED	
47	sphere	S67	-0.6645	-92.2008	3210	03/27/23	12:23:52	07/01/24	6:16:56
48	sphere	S33	-1.3364	-91.8914	3306	03/27/23	4:04:43	07/01/24	23:38:38
49	sphere	S71	-1.4457	-92.908	3413	03/26/23	18:30:13	06/30/24	16:53:28
50	T240	AN108	-2.2971	-93.1627	3500	03/26/23	9:29:42	06/16/24	3:04:59
51	compact	T120	-1.91	-92.417	3356	03/26/23	1:31:37	06/15/24	20:34:59
52	sphere	S70	-2.3945	-91.89	3431	03/25/23	18:05:51	06/15/24	6:24:19
53	sphere	S38	-1.95	-91.361	3137	03/25/23	11:02:06	06/15/24	13:17:09
54	T240	AN107	-2.4119	-90.812	3110	03/25/23	4:14:36	06/14/24	22:48:34
56	T240	AN106	-2.4299	-89.0249	3161	03/23/23	2:47:34	06/14/24	12:05:59
57	compact	T117	-1.9576	-89.4941	3129	03/24/23	3:17:36	06/14/24	6:20:14
58	sphere	S69	-1.9414	-90.3423	3147	03/24/23	11:20:36	07/02/24	14:51:00
59	compact	T116	-1.4702	-90.9698	3606	03/24/23	18:57:36	07/02/24	7:21:53

Seismic Data Inspection

The raw data was converted to miniseed format to check data quality and inspect teleseismic arrivals. This data was not yet corrected for timing drift nor were the horizontal channels oriented. More waveforms and quality inspection plots are provided in Appendix C.

Initial observations are: The vertical component has the cleanest arrivals (lowest noise levels). The horizontal components are noisy (caused by bottom currents and tilt). Rayleigh waves are usually the largest-amplitude arrivals, thus most likely observed above the noise. The signal-to-noise ratios (SNRs) are generally lower at longer periods (>30 s). Tidal signal was strong on the DPG channel (HDH).

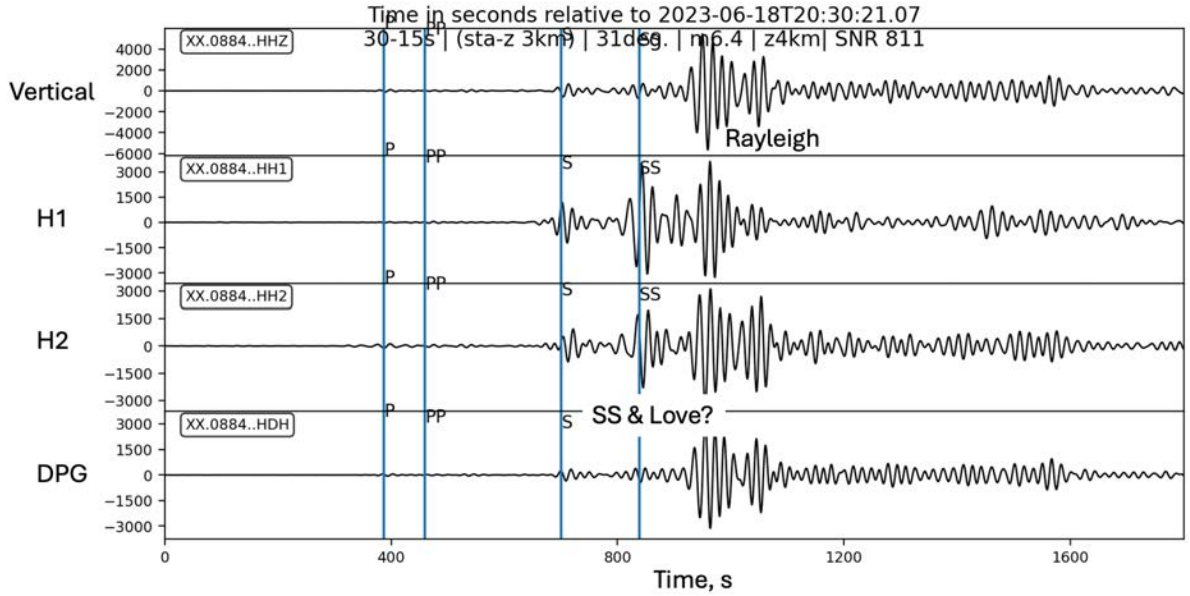


Figure 8. *Waveform showing the typical phase arrivals on OBS AN106-56 for a magnitude 6.4 event at distance of 31° and filtered from 30 to 15 seconds period.*

Seafloor maps

Seafloor bathymetric coverage of most of the region is sparse particularly to the south and west of the Galápagos archipelago. The OBS recovery track was designed to optimize for a short recovery time and increased bathymetric coverage. Throughout the cruise the survey plan was modified to improve coverage of bathymetric mapping, leaving adequate time for OBS recoveries and contingency, and also maximizing use of ship days. Details on multibeam bathymetry mapping and processing are provided in Appendix C.

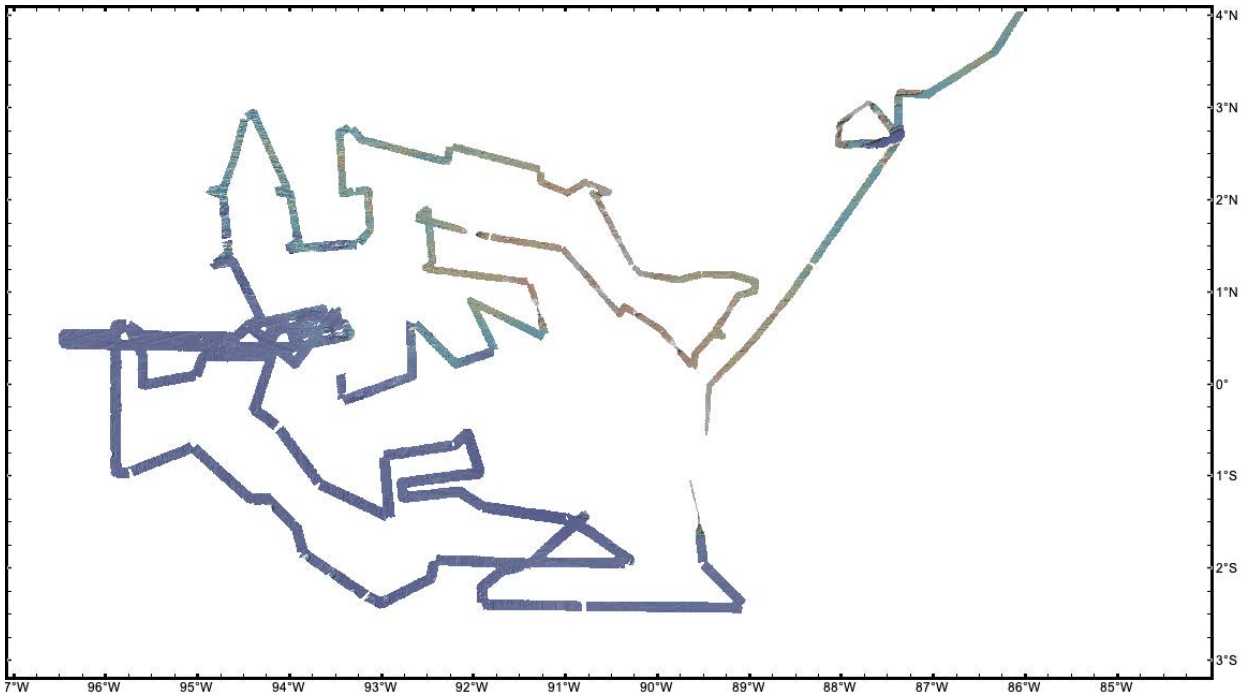


Figure 9. *Seafloor map from SR2411*

Cruise Log

Monday June 10: Most of the science team arrives in San Cristobal, lodging at Casa de Nelly.

Tuesday June 11: R/V Sally Ride arrives in Puerto Baquerizo Moreno. Science team prepares for cruise. Cruise related purchases made during the day. Planning for boarding ship on Wednesday.

Wednesday June 12: Science crew boards R/V Sally Ride at 10 am via motor launch. Berthing settled for Res Techs and OBSIC. Many return to shore for swimming, dinner, and last night out. All stay on board that evening.

Thursday June 13: Last day in port. Launch available for going ashore. All hands on board by 1400 LT. Sailing time is 1600 LT; ship departs at 1545 LT. We are UTC-6. Transit to first site is <7 hours. We arrive on site for the first recovery around 22:30 LT.

Friday June 14: Recoveries begin promptly after midnight. Seas calm on transit; science team settles into watches. All hands conduct fire and boat drill after lunch, muster and safety procedures discussed. Science crew donned their survival suits; orange gumbies everywhere. Tag line training following fire and boat drill. Watches begin. A total of 3 OBSs recovered on first day, **sites 57, 56, and 54**. A long transit between sites 56 and 54.

Saturday June 15: Seas remain calm. Transits are nominally 6 hours in this region of array. Emilie works to add waypoints for collecting additional bathymetry data. Successful recovery of 4 more OBS, **sites 52, 53, 51, 50.** A significant pod of whales spotted off of starboard quarter. Distant, but visible with binocs.

Sunday June 16: Another calm day at sea, some longer period swell traveling from lows in the south Pacific. Good sun. All on board settle into a routine. Successfully recover **sites 44, 43, 40, 39.**

Monday June 17: Approximately 90 Nm between sites 39 and 37, a 9 to 10 hour transit. Arrive at **site 37** just before 9 am LT. Instrument is enabled, burn command sent. All comms good and burn command sent and received. OBS does not lift off bottom. Over the next 1.5 hours nine separate burn commands are sent and received. Slant range remains constant. Each burn command is acknowledged by instrument, then it sends a one-minute ping while executing a 15 minute burn. At the end of 15 minutes, it sends 15 pings at a one second interval to indicate that it will stop burning, i.e., stop passing voltage to wire. We wait on site to accommodate for the predicted rise time. Given that time and some buffer we used RDF and visual to search. However, the OBS clearly remains on bottom. Instrument is disabled and ship continues on with recoveries at 1200 LT. We alter the recovery plan in anticipation of returning to this site later in the cruise.

Arrive at **site 29** (sphere/BBOBS) near the start of the 1600-2400 watch and enable. Burn commands sent and acknowledged. This instrument has two burn wires on separate systems. Both are activated multiple times, however, the instrument does not lift off. Around 2300 LT decision is made to disable instrument and move on to next site. It is concerning that an instrument with two releases (sphere/BBOBS) does not lift off bottom. The AARA instruments have a single release.

Tuesday June 18: Transit from site 29 to **site 28**. Arrive onsite at 0438 LT. Seas remain calm, bit more humid to the north of the archipelago. Long period well rocks ship gently. OBS enabled, burn command sent, confirmed release at 1118 UTC (0518LT). Relief all around and site 28 is recovered successfully. Day continues well, **sites 20 and 27** recovered successfully. A low pressure system in the Gulf of Mexico is creating steady winds from the south around the archipelago, creating light white caps and a long period southerly swell. Some sickness on board and the Captain provides attentive and thoughtful care.

Wednesday June 19: Transit to **site 26**, which is interrogated and released on the 0000-0400 watch. Site 26 successfully lifts off and reaches surface. The strobe light does not work (flooding) and ship finds the instrument using flood lights. Small fishing vessel seen nearby. OBS recovered without incident. Transiting northward to site 21 with following seas. Arrived at **site 21** at ~0820LT. Instrument enabled and released

without incident. During recovery of site 21 a Mahi Mahi is seen circling the instrument; Captain uses opportunity to fish off of port side. On board at 1000LT and underway for Site 25. Instrument successfully landed, Mahi Mahi not so much. On site for **site 25** at ~1515LT. Site enabled and released. Surfaces at ~1635LT, recovered without incident. Ship begins transit to site 24, which is located just NW of Roca Redonda. We discuss alternative routes for Wolf-Darwin lineament and also the status of personnel. **Site 24** released approximately 2017LT. Recovered without incident.

Thursday June 20: Working to the north of Isabella. Currents in this region flow NW, noticeably affects transit speeds. Nominal currents are 2kts, resulting in speeds varying from greater than 12kts when moving westwards to less than 9 kts when moving eastwards. Arrive **at site 23** at 0030LT. Burn command sent, received, and released. Recovered without incident. As we transit from site 23 to site 9, speeds are less due to currents and Vulcan Wolf and Punte Vincente Roca are visible broad off starboard. An opportunity for all to see the novel shape of Galápagos "soup bowl" volcanoes.

Vulcan Wolf on northern Isabella

Arrive at **Site 9** at ~0900LT. As we sail into the lee of Isabella the sea and winds decrease. All personnel onboard doing well. Captain and PIs discuss changes in cruise track that allow passage by Isla Darwin during daylight hours. Site 9 recovered without incident at ~1018LT. Ship transits north-northwest toward site at ~12 kts, a helpful current set. **Site 10** released at 1334LT and recovered at 1503LT. Ship turns west and sails towards site 22 at a good clip, ~12.5kts. **Site 22** released at 2044LT, recovered 2210LT without incident.

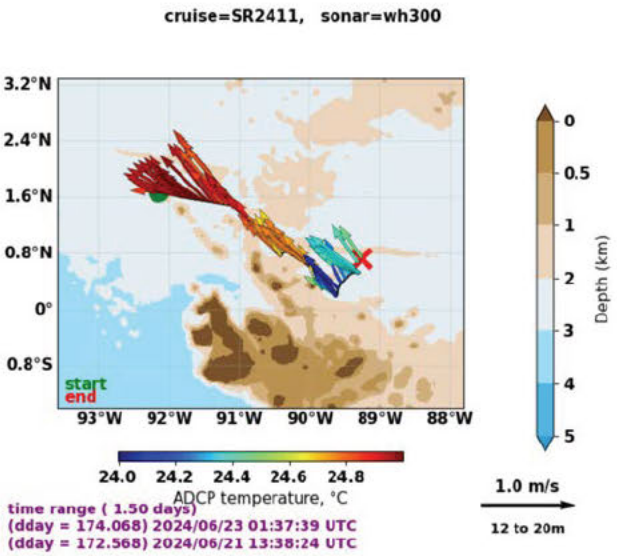
Friday June 21: The recovery order was revised so that additional mapping could be conducted between sites 22 and 14, thereby allowing an approach to **site 14** at approximately 0330 LT. With securing instruments and a successful release, the OBS would surface during the 0400-0800 watch, which the Captain mans. This would ensure an efficient recovery and an arrival at Isla Darwin shortly after breakfast. Site 14 on surface at 0414LT, on deck without incident at 0426. Efficient, indeed.

Good coordination between the science team and an amenable and enthusiastic Captain and crew positioned the R/V Sally Ride in an optimal location for a leisurely transit near an iconic feature, Isla Darwin and what remains of the Darwin Arch. Grey skies and a modest breeze present after breakfast, but skies cleared in time for a remarkable and well enjoyed transit. Everyone forward and on multiple levels, literally thousands of photos taken, great enthusiasm and a day to remember.

Today we sailed past Isla Darwin and Darwin's Arch, which collapsed in 2021. It is a remote part of the archipelago, and the first time many of us have seen it, even those that have had many visits to the region. The arch is now called the Pillars of Evolution. If one zooms in, one can see trees on the top of the two pillars. This is part of the Wolf-Darwin lineament, a feature that Jason Morgan proposed — over 50 years ago — is a conduit of mantle plume flow from the hotspot to the spreading center. Our experiment is testing how mantle plumes connect to mid-ocean ridges, a problem that has been outstanding since his seminal work on mantle plumes.

Following our sightseeing tour, we transit to site 13. **Site 13** released at 1103LT, on surface at 1216LT and on deck at 1236LT. Transit to **site 11,** leaving Isla Darwin to aft and Isla Pinta just visible on starboard quarter. **Site 11** released at 1814LT, on surface at 1915LT and on deck at 1930LT. All without incident. Transit is to SSE against current and toward Site 8.

Saturday June 22: **Site 8** released at 0216LT, sighted at 0321LT, and on deck without incident at 0938LT. Today's weather is grey, water temperature is 75˚C, air is 72˚C. Light breeze, diffuse light, slightly humid. Pleasant to be outside. Following recovery of Site 8, we continue our transit to SE. Surface currents steady to NW.



Site 3 released at 1129LT. This is a sphere with two releases. Interestingly, the first release did not work, the second did. Upon recovery, inspection showed that the ground wire had corroded away. Site 3 on deck at 1252LT, ship underway to site 2. **Site 2** is located just south of the GSC, OBS is released at 1619LT, sighted at 1724LT, on board without incident at 1731LT. At approximately 1950LT we cross over the Galápagos Spreading Center, shallowest depth approximately 1700m.

Crossing the Galápagos Spreading Center, rift evident on Knudsen 3260 and multibeam. Shallowest depth approximately 1700m, whereas many OBS depths are near 3000m

Site 1 is located north of the GSC, instrument is released at 2151LT, on surface at 2238LT, on board without incident at 2251LT.

Sunday June 23: Sea temperature generally warmer than air temperature, seas relatively calm, winds 10 to 15 kts. Morning begins with near glassy seas, overcast, wind builds modestly during the day. **Site 4** released at 0258LT, sighted at 0345LT, and on deck at 0447LT. We are well ahead of schedule, Hooft reviews gaps in seafloor mapping and continues making good adjustments to our recovery track so as to fill in gaps. **Site 7** released at 0818LT, sighted at 0903LT, on board without incident at 0917LT. Very efficient recoveries

continue. Ship transits to NE, Captain has the smoker going, which is welcomed by many. **Site 6** released at 1348LT, sighted at 1433LT, on deck at 1440. If the ELOG is right, if, that must be some sort of record…

Site 12, *not recovered:* Arrived on site at 2133LT. Instrument enabled and communications solid. Burn commands sent and received by OBS, instrument does not release. Over a period of more than 4 hours a total of 14 burn commands are sent to Site 12, a compact AARA instrument. All commands received, but instrument does not lift off of the seafloor. Ship waits for an additional hour in the event it is rising. No such luck. Site is disabled and remains on the seafloor. This is our third loss, all following a similar pattern.

Monday June 24: Quiet day on ship, grey skies, water temperatures approaching 82˚F. **Site 15** transit is longer than most, arrive on site and send release command at 0808LT. OBS lifts off, on surface and sighted at 0920LT, on board without incident at 0935LT. Transit to site 16 takes over 7 hours, a quiet day for many. We here nice talks from our Ecuadorean colleagues. **Site 16** burn command and release occurs at 1718LT, sighted at 1833LT, on board without incident at 1852. Moody sky, slightly more wind, seas build just a tad.

Happily awaiting arrival of OBS in a purple evening

During the 2000-2400 watch the Sally Ride transits southwards across the Galápagos Spreading Center. Decades earlier the GPRIME cruise measured crustal thickness, mapped the seafloor, dredged basalts, and conducted underway geophysics to understand how plume fed asthenosphere influenced ridge crest processes. That expedition involved scientists — John Sinton, Robert Detrick — well known to the current PIs. Our current expedition is, in part, motivated by the discoveries made during GPRIME.

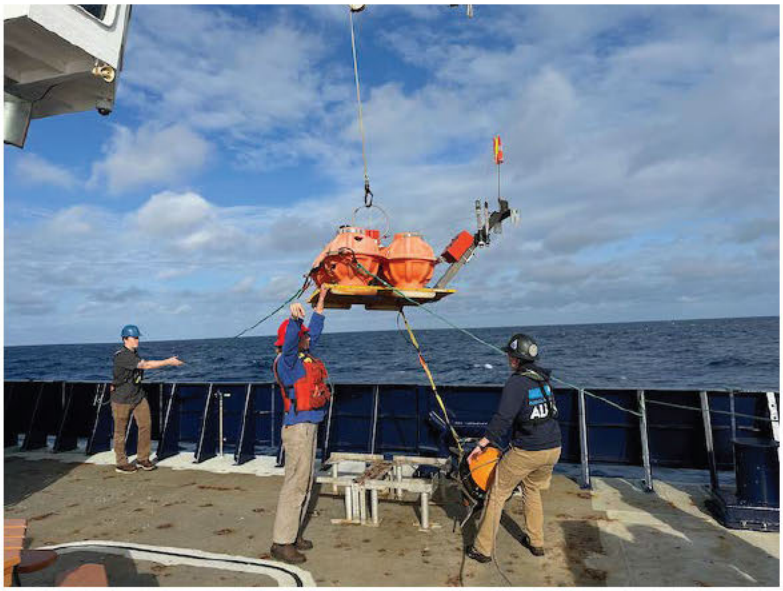
Garrett Ito and Emilie Hooft pointing out the GSC for John Sinton and Bob Detrick.

Tuesday June 25: Working north of the GSC, water temperatures warmer, skies typically cloudier and greyer in this region. Some modest winds, the occasional white cap and wave on fantail. Swell is from the south. Some relatively smaller low pressure systems near coast of central America, drawing winds up across the equator and Galápagos. **Site 17** released at 0023 LT, sighted at 0140LT, and onboard at 0156LT. Transit southwards to **Site 18**, against 3 to 5 foot swell. Site 18 released at 0633LT, sighted at 0750LT, onboard without incident at 0805LT.

Gavin McCarthy (OBSIC, WHOI) servicing O-ring on seismometer package.

Transit to west and **Site 19,** winds aft. Site 19 released at 1217LT, sighted at 1345LT and on deck at 1404LT. When things go well, the routine is just that, routine and efficient. Preparations underway for an equator

crossing ceremony. **Site 32** released at 1901LT, sighted at 2014LT and on deck at 1829LT. Sally Ride crosses the GSC moving northward toward site 33.



Site 18 coming on deck.

Wednesday June 26: **Site 33** released at 0315LT, on surface at 0407LT and on deck at 0429LT. Chief Scientist shows he can still tag an instrument. Ship transits SW towards site 31, passing over the GSC for the last time on this expedition. **Site 31** next, located south of the GSC. On site at 1117LT, recovered at 1135LT without incident. Warm surface waters increase evident in relative humidity and cloud cover. Transit southwards toward site 30.

Lobster with eggs, retrieved from Site 31.

Site 30 onsite at 1729LT, successful release, sighted at 1852LT and on board without incident at 1902LT. This is our last site in waters that are relatively warm; hopes of more clear sunsets in the near future.

Site 30 coming on board.

Thursday June 27: Following recovery of Site 30 ship transits to southeast to revisit site 29. Vessel arrives on site at 0150LT and proceeds to enable **Site 29.** Acoustics are strong, OBS enabled and a total of 10 burn commands are sent and received. Unfortunately, the instrument remains on the seafloor. After disabling acoustics at 0439LT, we begin a swath mapping survey to fill in gaps in seafloor coverage. This will last for approximately two days.

Friday June 28: Swath mapping continues, east-west transects primarily, gentle rocking of ship. We arrive at **Site 37** at 1741LT. Instrument is enabled and 10 burn commands are sent, received, but still no release. At 2029LT Site 37 is disabled and we begin a mapping transect to Site 41.

Saturday June 29: Morning begins with clear skies and glowing sunrise. **Site 41** is enabled at 0515LT, sighted at 0659LT and on deck without incident at 0728LT. More surveying and transiting between sites 41 and 42. The longer transit allows for some fun with the Equator Crossing skits. The Pollywogs redeem themselves with an inspired musical and dance routine that has all in stitches. Even King Neptune and Queen Aphrodite seem pleased.

Between sites 41 and 42 and swath mapping transit is planned to cross over a prominent feature that is present in GMRT data but has not been mapped by ship. The predicted depth to the top of the features is 1330 m. We ask the bridge to transit through the way point and are surprised by the absence of any significant relief on the seafloor. In this case, swath mapping has removed a significant artifact from GMRT. Sally Ride arrives at **Site 42** at 19:25LT, instrument released and sighted at 2046LT and on deck at 2100LT. Ship underway for mapping en route to site 45.

Sunday June 30: **Site 45** enabled and released at 0155LT, sighted at 0324LT, and on deck at 0346LT. Transit to site 49 is direct. **Site 49** enabled at 0849LT, released at 0848LT, sighted at 1044LT and on deck without incident at 1053LT. Ship underway to site 46. **Site 46** responds to burn commands at 1501LT but does not release from seafloor. A series of 10 burn commands are sent over a period of about 2 hours. At 1730LT the decision is made to disable Site 46 and continue on with other operations. This is our fourth instrument that has been successfully enabled, has received and acknowledged burn commands, but has unfortunately stayed on the seafloor. Clearly there is a recurring problem of unknown origin that makes it imperative that an ROV on a ship of opportunity visit an unrecovered OBS. The most likely candidate is one left on Axial volcano on the Juan de Fuca Ridge.

Monday July 1: **Site 47** released and sighted at 0001LT. On deck without incident at 0616LT. A mapping transit is completed between Site 47 and Site 48; total time is ~16 hours. **Site 48** released at 1555LT, on surface at 1727LT, and on deck at 1738LT. Transit to Site 59 is direct.

Site 48 coming on board

Tuesday July 2: **Site 59** released just before midnight local time. Site 59 sited at 0106LT and on deck at 0121LT without incident. Transit to site 58 is relatively short and parallels the Galápagos platform. **Site 58**, our last site to recover, is released at 0718LT and on deck without incident at 0851LT. Emilie tags her first instrument since EW9608. Nice to see and be part of. Following the recovery of Site 58 a mapping transit is planned so that a gravity line is collected that runs SW to NE over the transition from Nazca crust formed at the EPR to the Galápagos platform. Ship does this at a leisurely pace so that we arrive at anchorage early in the morning of July 3.

Wednesday July 3: R/V Sally Ride arrives in Puerto Ayora and the science team and technicians disembark. Post-cruise social event in the evening.

Thursday July 4: Post-cruise debriefings with the Science Director of the Charles Darwin research station, María José Barragán Paladines, the Executive Director and CEO, Rakan Zahawi, and the Visiting Scientists Program Manager, Marta Romoleroux. We also had a long meeting and science discussion with Stuart Banks, Principal Investigator - Deep-Ocean Exploration & Conservation, and Sarah Ryan Enright, Ocean Governance Researcher.

Friday July 5: The science team travels to Puerto Villamil, Isla Isabella.

Saturday July 6: Field trip to the caldera of Sierra Negra volcano and return travel to Puerto Ayora.

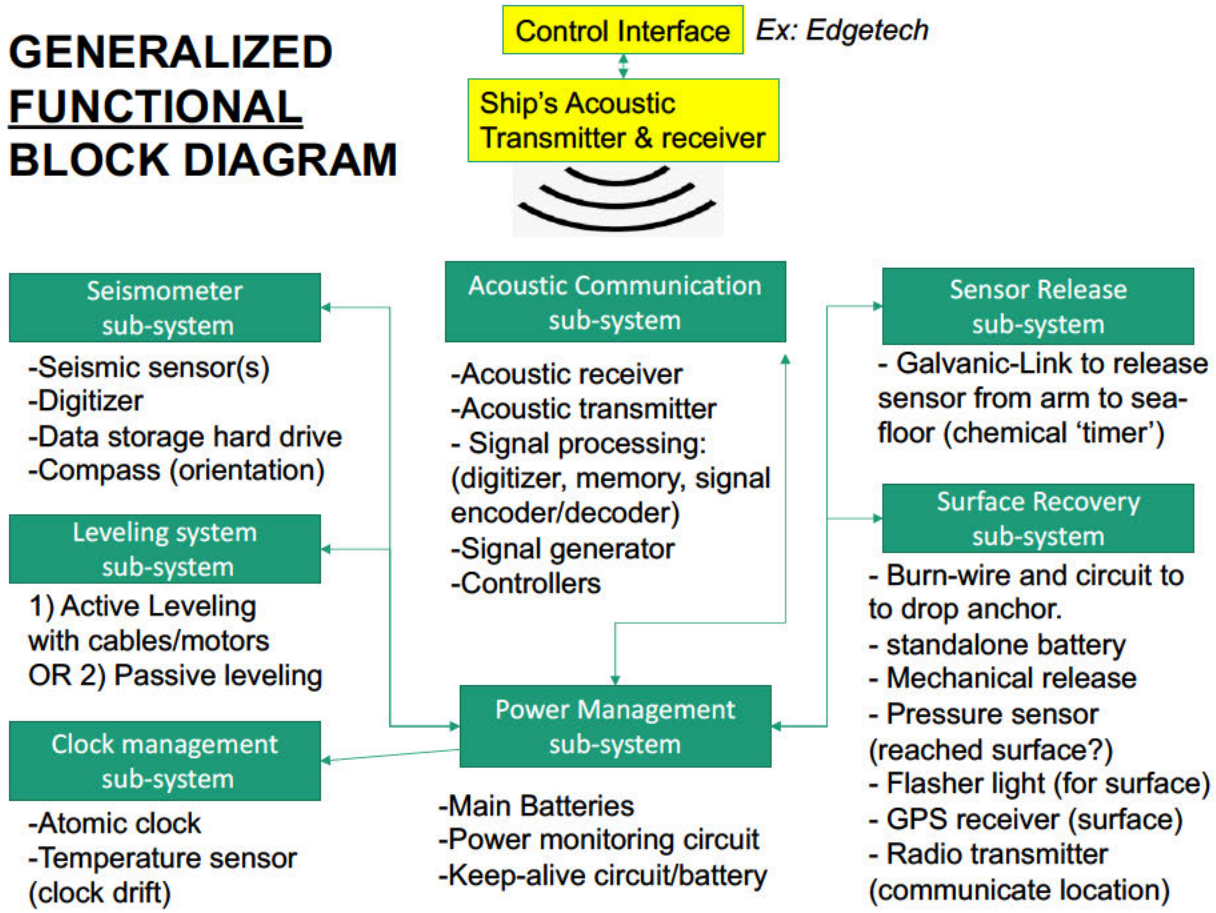
Sunday July 7: Departure from the Galapagos via the airport on Baltra island.

Appendices

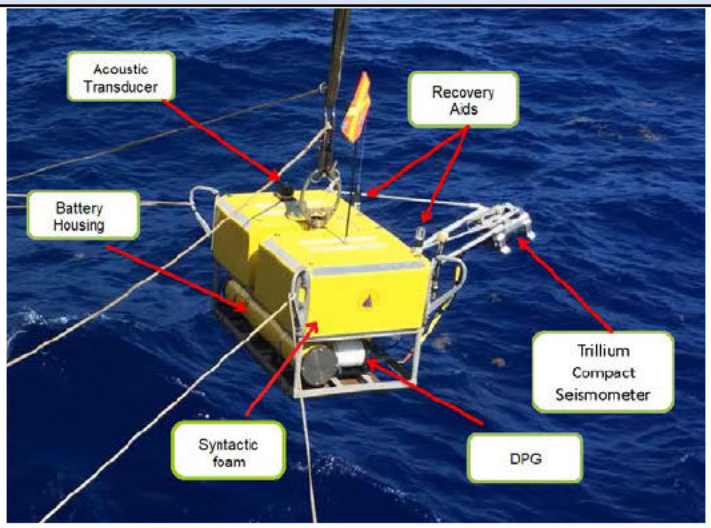
A: Ocean bottom seismometer stations

For this project we used three types of instruments 10 new Nanometrics T240 sensors, 18 Nanometrics Trillium Compact sensors, and 23 Nanometrics Trillium Compacts in a sphere.

A.1 Functional Block Diagram



A.2 ARRA Ocean-Bottom Seismometer



The ARRA OBS carries a Nanometrics Trillium Compact seismometer and a chip-scale atomic clock (CSAC), and is used for year-long monitoring of teleseismic and regional earthquakes.

Item	Specifications
Physical Attributes	Two 7075-T6 aluminum pressure housings holding: (i) 8.25" ID x 23.25" internal - data-logger, storage device, WHOI-designed controllers; (ii) 7" ID x 38.6" internal - acoustic-release board, and lithium batteries. Syntactic foam floatation: 52"x32"x15" / Finished Mass: 557 lbs nominal / Buoyancy 300 ± 27 lbs in seawater. A 257 mm long, 158 mm diameter titanium tube holds seismometer and leveling system. Leveling is via motorized gimbals. Air-weight (less 220 lb. anchor but with one-year battery pack) is 1,000 lbs. Water-weight on bottom (less sensor) is 93 lb. Buoyancy (less anchor) is 75 lb. Expected descent rate of ~55 m/min. Expected ascent rate of ~48 m/min.
Data Logger	Quanterra Q330 6-channel data engine with 24-bit A/Ds. Simultaneous sample rates of 200, 100, 50, 40, 20, 10, and 1 Hz. Quanterra Packet Baler 44 storage device with dual 16 GB flash disks (optional 64 GB capacity).
Clock	Symmetricom Chip-Scale Atomic Clock (CSAC). Drift : <~20 ms after 1 year.
Sensors	Nanometrics Trillium Compact OBS 3-axis seismometer with a velocity response that is flat from 120 s to 50 Hz. When deployed, the seismometer package is mechanically decoupled from motion of the OBS frame. Seismometer package has a water weight of 24.5 lb. Differential Pressure Gauge (DPG) long-period pressure sensor.
Recording Duration	Lithium battery pack for ~15 months recording at 40 Hz. Separate keep-alive battery for clock.
Operation	Operated in closed-housing mode i.e., programming of acquisition parameters, offloading of data, clock setting, etc., all done through penetrators. Pressure tubes carry an electronic vacuum gauge to check if the housings are sealed prior to deployment.

Information source: https://obsic.whoi.edu/instrumentation/arra-obs/

A.3 Angler Ocean-Bottom Seismometer

The ANGLER OBS carries a Nanometrics T240 seismometer and a chip-scale atomic clock (CSAC), and is used for year-long monitoring of teleseismic and regional earthquakes.

Item	Specifications
Physical Attributes	Two 7075-T6 aluminum pressure housings holding: (i) 8.25" ID x 23.25" internal - data-logger, storage device, WHOI-designed controllers; (ii) 7" ID x 38.6" internal - acoustic-release board, and lithium batteries. Syntactic foam floatation: 52"x32"x15" / Finished Mass: 557 lbs nominal / Buoyancy 300 ± 27 lbs in seawater. A 257 mm long, 158 mm diameter titanium tube holds seismometer and leveling system. Leveling is via motorized gimbals. Air-weight (less 220 lb. anchor but with one-year battery pack) is 1,000 lbs. Water-weight on bottom (less sensor) is 93 lb. Buoyancy (less anchor) is 75 lb. Expected descent rate of ~55 m/min. Expected ascent rate of ~48 m/min.
Data Logger	Quanterra Q8 6-channel data engine with 24-bit A/Ds. Simultaneous sample rates of 200, 100, 50, 40, 20, 10, and 1 Hz. Quanterra Packet Baler 44 storage device with dual 16 GB flash disks (optional 64 GB capacity).
Clock	Symmetricom Chip-Scale Atomic Clock (CSAC). Drift : <~20 ms after 1 year.
Sensors	Nanometrics T240 OBS 3-axis seismometer with a velocity response that is flat from 240 s to 35 Hz. When deployed, the seismometer package is mechanically decoupled from motion of the OBS frame. Seismometer package has a water weight of ~75 lb. Differential Pressure Gauge (DPG) long-period pressure sensor.
Recording Duration	Lithium battery pack for ~15 months recording at 40 Hz. Separate keep-alive battery for clock.
Operation	Operated in closed-housing mode i.e. programming of acquisition parameters, offloading of data, clock setting, etc, all done through penetrators. Pressure tubes carry an electronic vacuum gauge to check if the housings are sealed prior to deployment.

Information source: adaptation of https://obsic.whoi.edu/instrumentation/arra-obs/

Angler System Layout

Angler Instrument

- Angler Frame
- Acquisition Tube Assembly
- Battery Tube Assembly
- T240 Sensor
- Cable, Battery + RS232
- Cable, DPG, 5-Pin
- Cable, Sensor, 21-Pin
- Cable, Single Burnwire
- Cable, Single Burnwire
- Cable, Transducer, Low Profile
- Cable, Transducer, Low Profile
- DPG
  - Bulkhead, DPG, 5Pin
- Flasher
- Recovery Radio Transmitter
- Transducer, Solid
- Transducer, Solid

Angler Frame

- 9 in. Tube
- 9 in. Tube
- Half Float Pack

Assembly, Angler Acquisition Tube

- Angler Release End Cap
  - Battery, 19 Cell Release
  - Bulkhead, Burn, Low Profile
  - Bulkhead, Transducer, Low Profile
- Assembly, Angler Acquisition Chassis
  - Angler Release End Cap
    - Battery, 19 Cell Release
    - Bulkhead, Burn, Low Profile
    - Bulkhead, Transducer, Low Profile
    - PCB, Acoustic Release
  - Assembly, Angler Acquisition Tube Connector End Cap
    - Bulkhead, AT Battery
    - Bulkhead, AT DPG
    - Bulkhead, AT, Sensor
    - Bulkhead, Ser Uplink
    - Seal Vent Plug
  - Battery, Standard, Keep Alive
  - Cable, Clock Board
  - Cable, Internal Battery
  - Cable, POE Power
  - Cable, Power C-GRID
  - Cable, Q8, Network
  - Cable, Q8, Power
  - Cable, Q8, Timing
  - Cable, Q8, USB
  - Cable, Serial C-GRID
  - Cable, Serial C-GRID
  - Gigabit Ethernet Switch
  - PCB, POE Splitter
  - PCB, Power Cycled Clock Board
    - CSAC Element, Teledyne
    - PCB, Seascan with PLL
    - PCB, Q8, Main Controller
      - Serial to Ethernet Module
    - Q8
      - PCB, Q8 to Pressure Breakout
        - PCB, DPG Driver Card
      - PCB, Q8 to Seismometer Breakout
      - Thumb Drive
- Assembly, Angler AT Battery Chassis
  - Battery, 20 Cell Main, Electrochem or Battery, 20 Cell Main, Tadiran (number depends on experiment)
  - PCB, 9-Port Battery Monitor Board

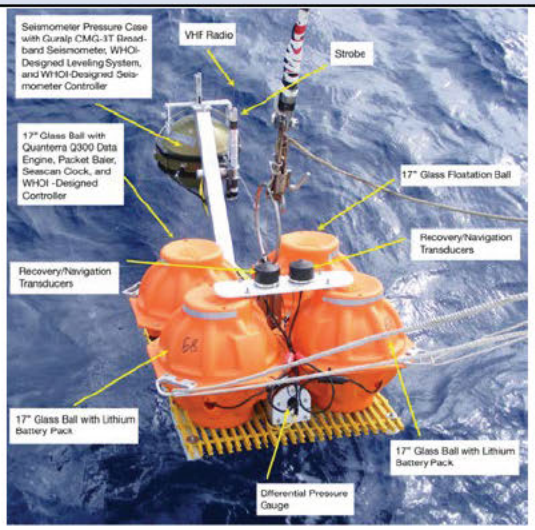
Assembly, Angler Battery Tube

- Angler Release End Cap
  - Battery, 19 Cell Release
  - Bulkhead, Burn, Low Profile
  - Bulkhead, Transducer, Low Profile
  - PCB, Acoustic Release
- Assembly, Angler BT Battery Chassis
  - Angler Battery Tube Connector End Cap
    - Bulkhead, Battery
    - Seal Vent Plug
  - Battery, 20 Cell Main, Electrochem or Battery, 20 Cell Main Tadiran (number depends on experiment)
  - PCB, 9-Port Battery Monitor Board

Assembly, T240 Sensor

- Sensor Housing Equatorial Ring Trillium
  - Bulkhead, Sensor Housing, Sensor
  - T240 Gimbal System
    - Cable, T240, Harness
    - PCB, Motor Controller for Leveler
  - T240 OBS
    - ALS, Fine Tilt Sensor
    - Cable, T240, Analog
    - Cable, T240, Digital
    - PCB, T240, Breakout
    - PCB, T240, Leveler
  - Sensor Housing Hemisphere Trillium
  - Sensor Housing Hemisphere Trillium

A.4 Broad Band Ocean-Bottom Seismometer (BBOBS)



These instruments are equipped with a Nanometrics Compact broadband seismometer.

Item	Specifications
Physical Attributes	Three 17" Nautilus glass ball pressure housings holding: (i) data-logger, storage device, controllers; (ii) acoustic-release board, WHOI recovery board, and lithium batteries; (iii) lithium batteries. One 17" Benthos ball for floatation. A 14" I.D. Al sphere holds seismometer and leveling system. Leveling is via a gravity-driven, 2-axis gimbal system that can be locked in place by motor-driven disk brakes mounted on each gimbal axis in order to record ground motion with high fidelity. A WHOI-designed controller is capable of locking/unlocking the seismometer masses, centering the masses, and activating/de-activating the disk brakes. The controller also carries a compass, temperature, and tilt sensor. The controller is capable of automatically monitoring seismometer tilt and initiating a leveling procedure if necessary. Air-weight (less 175 lb. anchor but with one-year battery pack) is 530 lbs. Water-weight on bottom (less sensor) is 65 lb. Buoyancy (less anchor) is 66 lbs. Descent rate: ~55 m/min. Ascent rate: ~ 48 m/min.
Data Logger	Quanterra Q330 6-channel data engine with 24-bit A/Ds. Simultaneous sample rates of 200, 100, 50, 40, 20, 10 and 1 Hz. Quanterra Packet Baler storage device with 20 GByte rotary disk drive.
Clock	Seascan low-power, digitally-temperature-compensated (DTCXO), clock with drift rate, before end-point correction, of <5 ms/day.
Sensors	Nanometrics Compact broadband seismometer with a velocity response that is flat from 120 s to 50 Hz. When deployed, the seismometer package is mechanically decoupled from motion of the Differential Pressure Gauge (DPG) long-period pressure sensor.
Recording	Lithium battery pack for ~15 months recording at 40 Hz. Keep-alive battery for clock.
Operation	Operated in closed-ball mode i.e. programming of acquisition parameters, offloading of data, clock setting, etc., all done through penetrators. Glass spheres carry an electronic vacuum gauge to that can be monitored to check if the spheres are sealed prior to deployment.

Information source: https://obsic.whoi.edu/instrumentation/broadbandobs/

BBOBS System

BBOBS Instrument

- Assembly, Battery Ball 1, 17 in.
- Assembly, Battery Ball 2, 17 in.
- Assembly, Broadband Acquisition Ball
- Passive OR Active Leveling System
- Frame
  - Buoyancy Ball
- Cable, DPG 50 in. OR Cable, DPG 60 in.
- Cable, Guralp Sensor
- Differential Pressure Gauge
  - Connector, DPG Sensor
- Flasher (strobe)
- JBox
- Recovery Radio Transmitter
- Transducer, Solid
- Transducer, Solid

Assembly, Battery Ball 1, 17 in.

- Battery Ball 17 in.
  - Penetrator, BB, OBS Battery
  - Penetrator, BB, OBS Transducer
- Battery, Main Tadiran Quad (Number determined by experiment)
- Battery, Release, Alkaline Quad
- Cable, BB, JP3 Auxiliary
- Cable, BB JP4 Sense
- PCB, Acoustic Release
- PCB, Commoning Board
  - Cable, Commoning Board Fuse
- PCB, Recovery

Assembly, Battery Ball 2, 17 in.

- Battery Ball 17 in.
  - Penetrator, BB, OBS Battery
  - Penetrator, BB, OBS Transducer
- Battery, Main Tadiran Quad (Number determined by experiment)
- Battery, Release, Alkaline Quad
- PCB, Acoustic Release
- PCB, Commoning Board
  - Cable, Commoning Board Fuse
- PCB, Recovery

Assembly, Broadband, Acquisition Ball

- Assembly, AB, Core System
  - Baler 14
    - Hard Drive
  - Battery, Standard, Keep Alive
  - Cable, AC Board to Lander Board
  - Cable, Hydrahead (2way and 4way, or 5way)
  - PCB, Auxiliary Controller Board
    - Timebase
  - PCB, Glass, Lander Board
  - Q330
- GPS Antenna
- Acquisition Ball (Broadband or Keck)
  - Penetrator, AB, Broadband Battery
  - Penetrator, AB, OBS, Sensor 1
  - Penetrator, AB, OBS, Sensor 2
  - Penetrator, AB, Shore
- Ethernet Cable (Not recorded in Roundabout)

Assembly, Passive Leveling System Guralp CMG-3T

- Sensor Housing Hemisphere 14.5 in.
- Sensor Housing Hemisphere 14.5 in.
- Sensor Housing Equatorial Ring 14.5 in.
  - Bulkhead, PSL, Sensor Sphere
  - Guralp Sensor
    - PCB, Guralp PSL, Control Board
      - PCB, PSL, Compass
      - PCB, PSL, Persistor
        - Compact Flashcard
      - PCB, PLS, Tilt Sensor
  - PSL, Gimbal System
    - Cable, PSL Harness
  - PCB, PLS, Vacuum Board

Assembly, Active Leveling System Guralp CMG-3T

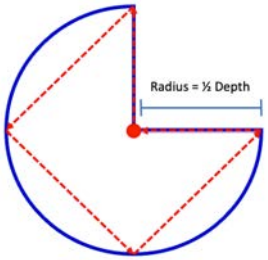
- Sensor Housing Equatorial Ring 14.5 in.
  - ALS Gimbal System
    - Cable, ALS, Harness
  - Bulkhead, ASL, Sensor Sphere
  - Guralp Sensor
    - ALS, Fine Tilt Sensor
    - Battery, ALS, EGL
    - PCB, ALS, Guralp Motherboard
      - MicroSD Card
  - PCB, ALS, Motor Controller
- Sensor Housing Hemisphere 14.5 in.
- Sensor Housing Hemisphere 14.5 in.

B: Station location & acoustic survey

The deployment cruise — MGL2304— used acoustic ranging to relocate all OBS packages on the seafloor. The appendix below is identical to that of MGL2304 and included here for completeness.

Acoustic Survey design: The travel time data used for the OBS relocation is two-way water wave travel times from an Edgetech transponder box. The Edgetech box was connected to the sonar pod on the hull of the ship. It is programmed to emits signals at a frequency - always 11 kHz for the OBSIC stations – and listens to a response from the OBS at a defined frequency – between 11.5 and 13 kHz for the OBSIC stations.

The instruments were deployed "enabled" to respond. The ship holds station over the OBS as it sinks to the seafloor. The OBS reaches the seafloor when the two-way travel time for the response no longer increases.



After the OBS is on the seafloor, the acoustic survey is started and the two-way travel time is recorded every 15 seconds together with GPS navigation strings. The pattern for the acoustic survey that was sailed by the ship is shown by the red dashed line in the diagram. This pattern includes variations in range to measure OBS depth and variations in azimuth to locate the OBS in map view. Any bad lines or errors in headers were removed.

After the survey was completed the code to "disable" the OBS was sent. Following a successful response to this command at least 3 ranging commands were sent to ensure that it was in fact "disabled".

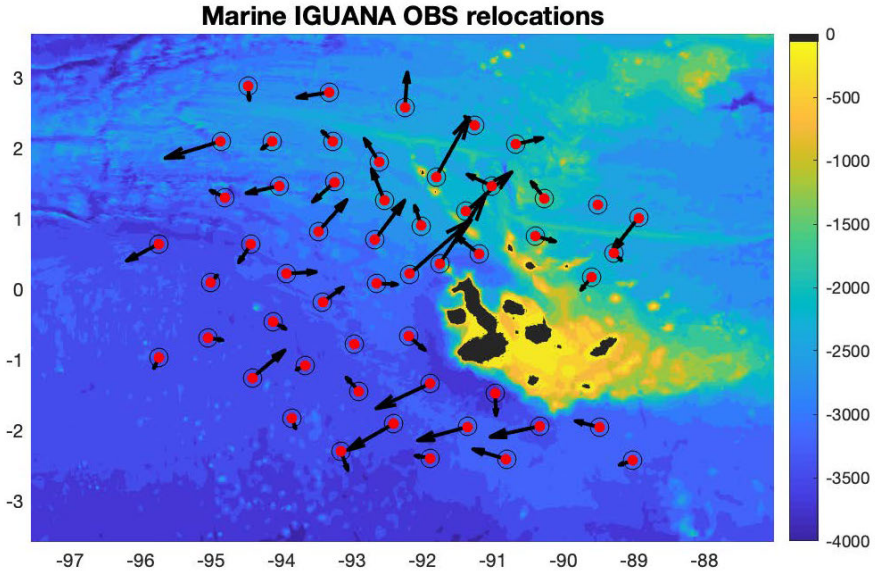


Figure B1. *Plots of OBS relocation result. The initial and final positions of the OBS (open and red circles, respectively) and an arrow representing the motion of the OBS are shown*

Relocation: is done by least squares inversion or grid search.

The code used is: *MGL2304/Public/OBSLocations_AUTO/m-files/run_obs_relocation.m*.

Parameters used were:

Horizontal offset of transducer from GPS location (m)	Azimuth of transducer relative to GPS location (degrees clockwise from ship's bow)	Transducer Depth (m)	OBS transducer Height above seafloor (m)
20.2	0	7	0.7

Table of OBS relocations (from MGL2304 — Marine IGNUANA deployment cruise)

Hooft Galapagos Broadband Deployment Cruise

Station Name	OBS Type	OBS I.D.	Deployment Date (UTC)	Deployment Time (UTC)	Deployment Latitude (decimal degrees)	Deployment Longitude (decimal degrees)	Deployment Depth (m)	Sounding Speed from Levitus Database (m/s)	InvertedStation Lat	InvertedStationLon	Inverted Depth (m)	Inverted Distance Shift (m)	Inverted Direction Shift (deg. East of	Initial Misfit (ms)	Final Misfit (ms)	95% Confidence Half-Width in E/W (m)	95% Confidence Half-Width in N/S (m)	95% Confidence Half-Width in Depth (m)
56	T240	AN106	2023-03-23	2:47:34	-2.429672	-89.024328	3181	1494.7	-2.4299	-89.0249	3154	62	251	15	1	1.2	1.3	0.4
57	compact	T117	2023-03-24	3:17:36	-1.957820	-89.493092	3141	1494.6	-1.9576	-89.4941	3121	113	285	19	1	1.0	1.1	0.3
58	sphere	S69	2023-03-24	11:20:36	-1.907598	-90.340268	3155	1494.4	-1.9414	-90.3423	3139	232	257	30	2	1.4	1.3	0.4
59	compact	T116	2023-03-24	18:57:36	-1.469313	-90.969650	3616	1497.1	-1.4702	-90.9698	3599	104	178	16	2	1.3	1.3	0.3
54	T240	A107	2023-03-25	4:14:36	-2.412370	-90.810570	3110	1494.3	-2.4119	-90.8120	3102	160	287	22	1	1.4	1.4	0.4
53	sphere	S38	2023-03-25	11:02:06	-1.949110	-91.358628	3151	1493.9	-1.9500	-91.3610	3129	239	255	34	1	1.4	1.5	0.4
52	sphere	S70	2023-03-25	18:05:51	-2.394610	-91.889355	3449	1495.6	-2.3945	-91.8900	3424	71	279	17	1	1.3	1.3	0.3
51	compact	T120	2023-03-26	1:31:37	-1.908943	-92.415143	3369	1495.4	-1.9100	-92.4170	3348	242	240	38	2	1.4	1.4	0.4
50	T240	AN108	2023-03-26	9:29:42	-2.296338	-93.162998	3503	1496.1	-2.2971	-93.1627	3493	93	160	13	2	1.3	1.3	0.3
49	sphere	71	2023-03-26	18:30:13	-1.446222	-92.907443	3420	1495.5	-1.4457	-92.9080	3405	86	318	13	2	1.3	1.3	0.3
48	sphere	S33	2023-03-27	4:04:43	-1.335397	-91.889202	3319	1495.3	-1.3364	-91.8914	3298	274	245	41	1	1.3	1.1	0.3
47	sphere	S67	2023-03-27	12:23:52	-0.663887	-92.201450	3218	1494.8	-0.6645	-92.2008	3202	100	131	17	1	1.4	1.3	0.4
25	sphere	S81	2023-03-27	21:09:07	0.214493	-92.186367	2853	1493.5	0.2167	-92.1838	2837	378	49	52	1	1.4	1.4	0.4
26	sphere	S65	2023-03-28	3:47:52	0.085757	-92.660577	2955	1493.6	0.0857	-92.6597	2937	97	93	17	2	1.3	1.3	0.4
46	compact	T118	2023-03-28	12:28:07	-0.779025	-92.965850	3278	1494.6	-0.7789	-92.9658	3263	12	4	9	1	1.4	1.3	0.4
27	T240	AN109	2023-03-28	19:52:37	-0.183657	-93.421785	3122	1494.2	-0.1830	-93.4209	3107	117	54	16	1	1.2	1.0	0.3
45	sphere	S88	2023-03-29	5:40:52	-1.087675	-93.667430	3405	1495.6	-1.0878	-93.6678	3394	44	247	8	2	1.5	1.4	0.4
44	compact	T104	2023-03-29	13:51:52	-1.830885	-93.851897	3425	1492.5	-1.8313	-93.8518	3402	49	163	15	2	1.9	1.7	0.4
43	sphere	S37	2023-03-29	21:39:07	-1.255440	-94.418035	3349	1495.3	-1.2543	-94.4167	3343	195	50	27	1	1.3	1.3	0.4
42	compact	T107	2023-03-30	6:21:07	-0.465040	-94.121783	3392	1495.1	-0.4653	-94.1213	3383	65	119	9	2	1.4	1.4	0.4
28	compact	S48	2023-03-30	13:43:22	0.223047	-93.931917	3209	1494.4	0.2231	-93.9307	3191	136	87	18	2	1.4	0.9	0.3
41	sphere	S61	2023-03-30	23:57:37	0.096458	-95.005775	3342	1494.9	0.0968	-95.0055	3334	43	41	8	1	1.3	1.4	0.4
40	compact	S53	2023-03-31	9:02:07	-0.703963	-95.047925	3384	1495.6	-0.6857	-95.0473	3374	68	100	11	1	1.2	1.3	0.3
39	T240	AN102	2023-03-31	18:28:52	-0.962755	-95.740237	3338	1495.1	-0.9632	-95.7405	3328	57	206	9	1	1.5	1.3	0.3
37	compact	T113	2023-04-01	7:37:37	0.641120	-95.750072	3310	1495.3	0.6404	-95.7514	3305	167	242	22	1	1.4	1.4	0.4
29	sphere	S59	2023-04-01	18:43:52	0.635638	-94.439558	3246	1495.0	0.6349	-94.4401	3231	100	214	16	2	1.4	1.4	0.4
30	T240	AN103	2023-04-02	2:18:22	1.299613	-94.807383	3254	1494.9	1.2999	-94.8080	3243	75	296	11	2	1.3	1.3	0.3
31	sphere	S66	2023-04-02	10:18:52	2.100475	-94.863693	2747	1492.4	2.0998	-94.8660	2738	268	253	41	1	1.5	1.8	0.4
33	T240	AN110	2023-04-02	18:07:52	2.888530	-94.477707	2635	1492.4	2.8879	-94.4777	2620	67	176	11	1	1.6	1.6	0.4
32	sphere	S23	2023-04-03	2:28:52	2.096063	-94.138965	2826	1492.6	2.0958	-94.1394	2813	58	234	10	1	1.5	1.4	0.4
19	compact	S42	2023-04-03	9:11:52	1.468547	-94.029178	3059	1493.5	1.4682	-94.0306	3047	158	257	22	1	1.4	1.4	0.4
20	sphere	S01	2023-04-03	17:29:07	0.819208	-93.480620	2940	1493.5	0.8205	-93.4794	2931	195	42	26	1	1.5	1.5	0.4
21	compact	T105	2023-04-04	2:30:07	0.705497	-92.677837	2986	1493.4	0.7071	-92.6766	2972	225	37	28	2	1.5	1.5	0.4
22	sphere	S84	2023-04-04	8:11:37	1.255495	-92.543385	2365	1491.4	1.2568	-92.5439	2348	158	338	20	2	1.8	1.9	0.5
14	compact	T111	2023-04-04	13:35:52	1.802778	-92.618277	2490	1492.1	1.8038	-92.6189	2481	128	328	20	1	1.5	1.4	0.4
18	sphere	S19	2023-04-04	20:16:22	1.520982	-93.250967	2721	1493.2	1.5202	-93.2519	2708	136	228	20	2	1.3	1.2	0.4
17	sphere	S85	2023-04-05	2:50:52	2.098267	-93.277247	2588	1492.2	2.0987	-93.2777	2579	68	314	12	1	1.4	1.7	0.4
16	compact	S45	2023-04-05	9:27:07	2.795160	-93.327188	2673	1492.8	2.7949	-93.3285	2661	149	261	22	1	1.4	1.4	0.4
15	sphere	S86	2023-04-05	18:39:22	2.582903	-92.250187	2400	1491.8	2.5843	-92.2501	2381	160	4	24	2	2.0	1.7	0.5
13	sphere	S05	2023-04-06	4:15:07	1.593523	-91.809348	2318	1491.5	1.5960	-91.8080	2305	312	29	40	2	1.5	1.7	0.5
11	sphere	S73	2023-04-06	11:10:37	1.468952	-91.021745	2139	1491.4	1.4694	-91.0228	2129	123	295	21	2	3.3	4.2	1.6
10	compact	S87	2023-04-06	16:57:07	1.103928	-91.384888	2091	1491.4	1.1056	-91.3830	2084	277	49	43	1	1.7	1.8	0.5
23	sphere	S82	2023-04-06	23:26:37	0.899308	-92.021358	2416	1491.9	0.9001	-92.0216	2406	98	342	14	1	1.5	1.6	0.4
24	compact	AN112	2023-04-07	6:03:07	0.360765	-91.758733	2888	1492.5	0.3636	-91.7568	2869	384	33	57	1	1.7	1.6	0.4
9	T240	AN111	2023-04-07	11:32:37	0.498747	-91.199172	2727	1492.8	0.4995	-91.2001	2709	134	309	23	1	1.5	1.4	0.4
8	sphere	S27	2023-04-07	18:53:37	0.756673	-90.403243	2140	1491.4	0.7564	-90.4024	2126	97	106	14	1	2.0	1.9	0.5
3	compact	S30	2023-04-08	2:46:07	0.175228	-89.600835	2213	1491.4	0.1747	-89.6013	2197	78	219	13	1	1.8	1.8	0.4
2	sphere	S68	2023-04-08	7:50:22	0.516055	-89.289193	2373	1492.1	0.5157	-89.2889	2361	50	134	8	2	1.7	1.7	0.4
1	sphere	AN113	2023-04-08	14:00:52	1.014617	-88.935752	2346	1491.9	1.0132	-88.9369	2344	198	218	28	2	1.4	1.5	0.4
4	T240	AN104	2023-04-08	20:08:52	1.193102	-89.519342	2267	1491.7	1.1931	-89.5193	2253	8	52	9	2	1.7	1.6	0.4
7	compact	T114	2023-04-09	2:39:37	1.290783	-90.271058	1648	1491.7	1.2915	-90.2716	1635	98	321	16	1	1.7	1.7	0.5
6	T240	AN105	2023-04-09	9:39:37	2.056183	-90.677993	2333	1491.6	2.0564	-90.6769	2322	126	77	18	1	1.5	1.5	0.4
12	compact	T121	2023-04-09	15:37:37	2.328233	-91.263345	2392	1491.8	2.3286	-91.2637	2376	60	312	11	2	1.6	1.6	0.4

** two OBS (S33 and S81) overheated in the sun on deck and were cooled and stabilized prior to deployment.*

C: Seismic Data Inspection

C.1 File Conversion

On board the ship, the seismic data from the recovered instruments was processed into miniseed files. This was done to check the quality of the data, as well as look for arrivals from teleseismic and regional earthquake events. Files exist for each day of deployment for horizontal channels (HH1 and HH2), vertical channel (HHZ), and differential pressure gauge (DPG) channel (HDH). All the miniseed data are located in SR2411_scienceparty_share/SeismicData/mseed and are organized by instrument (ID_deployment#), year, and day of year. The data was not time corrected nor were the horizontal channels oriented, as this will be done thoroughly at a later date (by OBSIC team and researchers). After the data is properly processed, it will be sent to IRIS.

Because we are using three different instrument frame types (Angler, ARRA, BBOBS), there are three separate scripts for converting the raw multiplexed data to miniseed. The instrument ID, 'AN' corresponds to Angler, 'T' corresponds to ARRA, and 'S' corresponds to BBOB. You can run the scripts for a specific list of stations. These python scripts are located in SR2411_scienceparty_share/Seismic_data_samples_and_codes/multiplex2miniseed and titled run_<INSTRUMENT-TYPE>_miniseed2days_for_eeeh.py. They were written by J.A. Collins from WHOI.

Be aware that the files contain data for dates from BEFORE instrument deployment, as well as some AFTER or during instrument recovery. These files do not have meaningful data. The scripts also unpack a lot of additional channels that we did not need, so we only saved HH1, HH2, HHZ, HDH to the drive.

C.2 Seismograms

After the data was in miniseed format, we plotted and filtered the seismograms to check data quality and look for earthquake arrivals. The vertical component has the cleanest arrivals (lowest noise levels). The horizontal components are noisy (caused by bottom currents and tilt). Rayleigh waves are usually the largest-amplitude arrivals, thus most likely observed above the noise. The signal-to-noise ratios (SNRs) are generally lower at longer periods (>30 s). Tidal signal was strong on the DPG channel (HDH).

C.2.1 Waveforms for Telesiesmic Arrivals

We were able to find multiple arrival phases beyond P for events ranging in magnitude from 7 to 5.5.

Plots were made by Kaisa Autumn and Yang Shen. Yang Shen used SAC. Kaisa used *SR2411_scienceparty_share/Seismic_data_samples_and_codes/matlab/plt_event_KA.m* and are located in *SR2411_scienceparty_share/SeismicData/EarthquakePlots*. A 2nd-order zero-phase bandpass filter of [0.005 0.05] Hz was found to work well for most of the data, but on some instruments [0.01 to 0.1] worked better for horizontal channels.

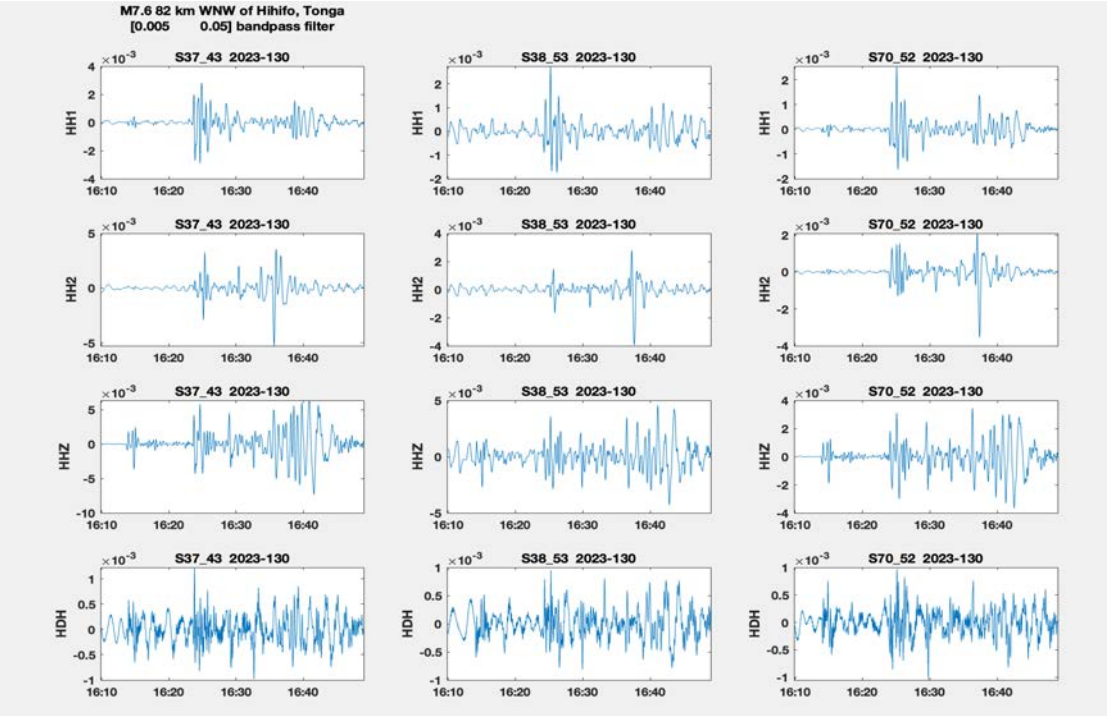


Figure C1. *Data from S37, S38, and S70 on 4 channels showing the arrival of the M7.6 May 10 2023 Hihifo, Tonga earthquake.*

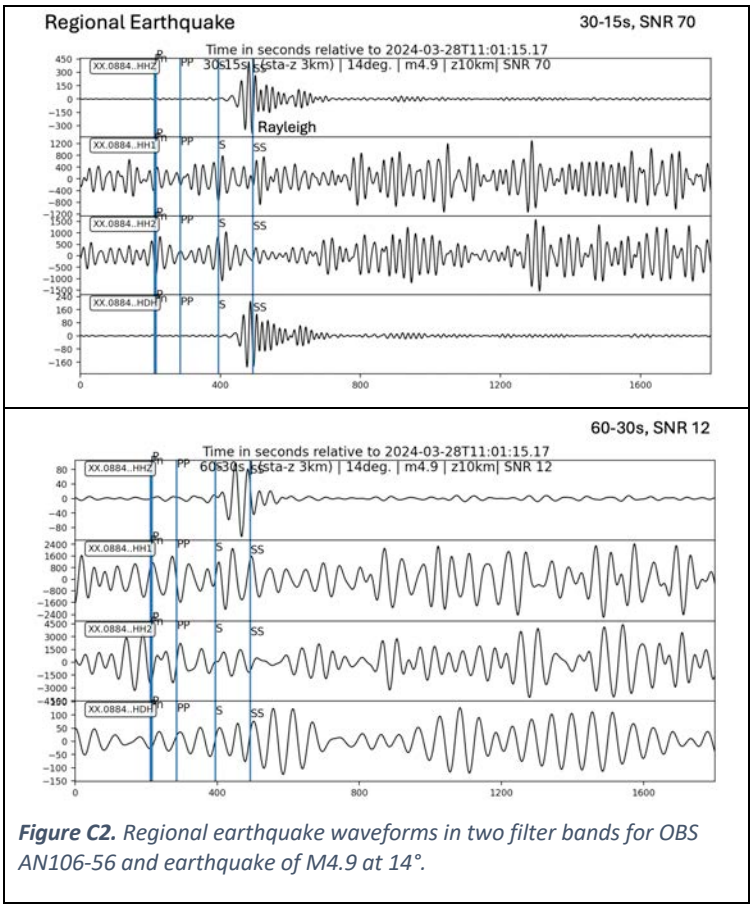


Figure C2. *Regional earthquake waveforms in two filter bands for OBS AN106-56 and earthquake of M4.9 at 14°.*

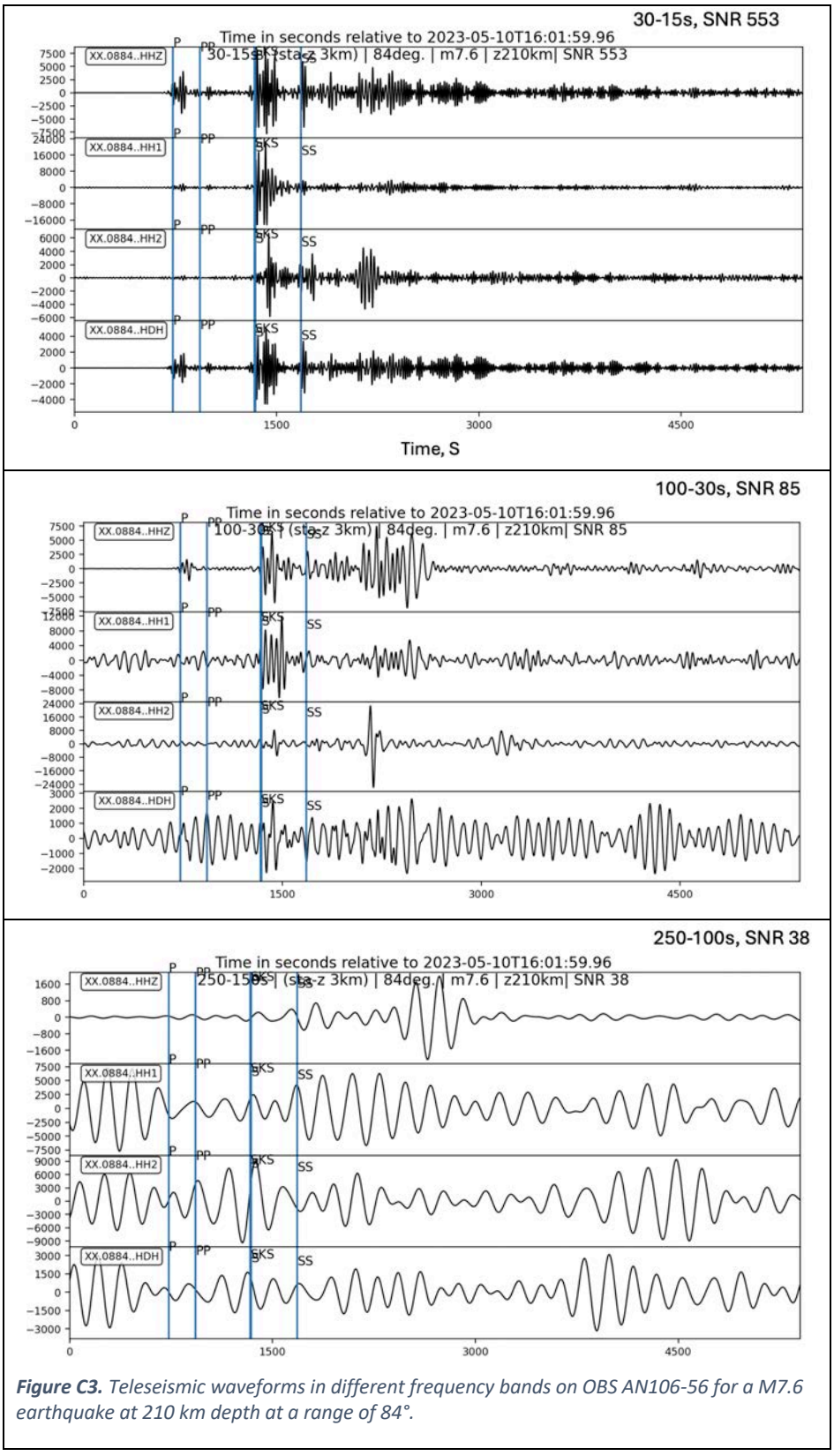


Figure C3. *Teleseismic waveforms in different frequency bands on OBS AN106-56 for a M7.6 earthquake at 210 km depth at a range of 84°.*

C.3 Evaluation of Signal and Noise Characteristics

Charles Hoots made power spectral density plots of noise and 491 earthquake arrivals on AN106-56. Noise at periods shorter than 10s is near the New High Noise Model (NHNM). Noise at longer periods lies below this level. Arrivals of large (M5.5+) earthquakes typically have energy above the noise for periods longer than about 10 seconds.

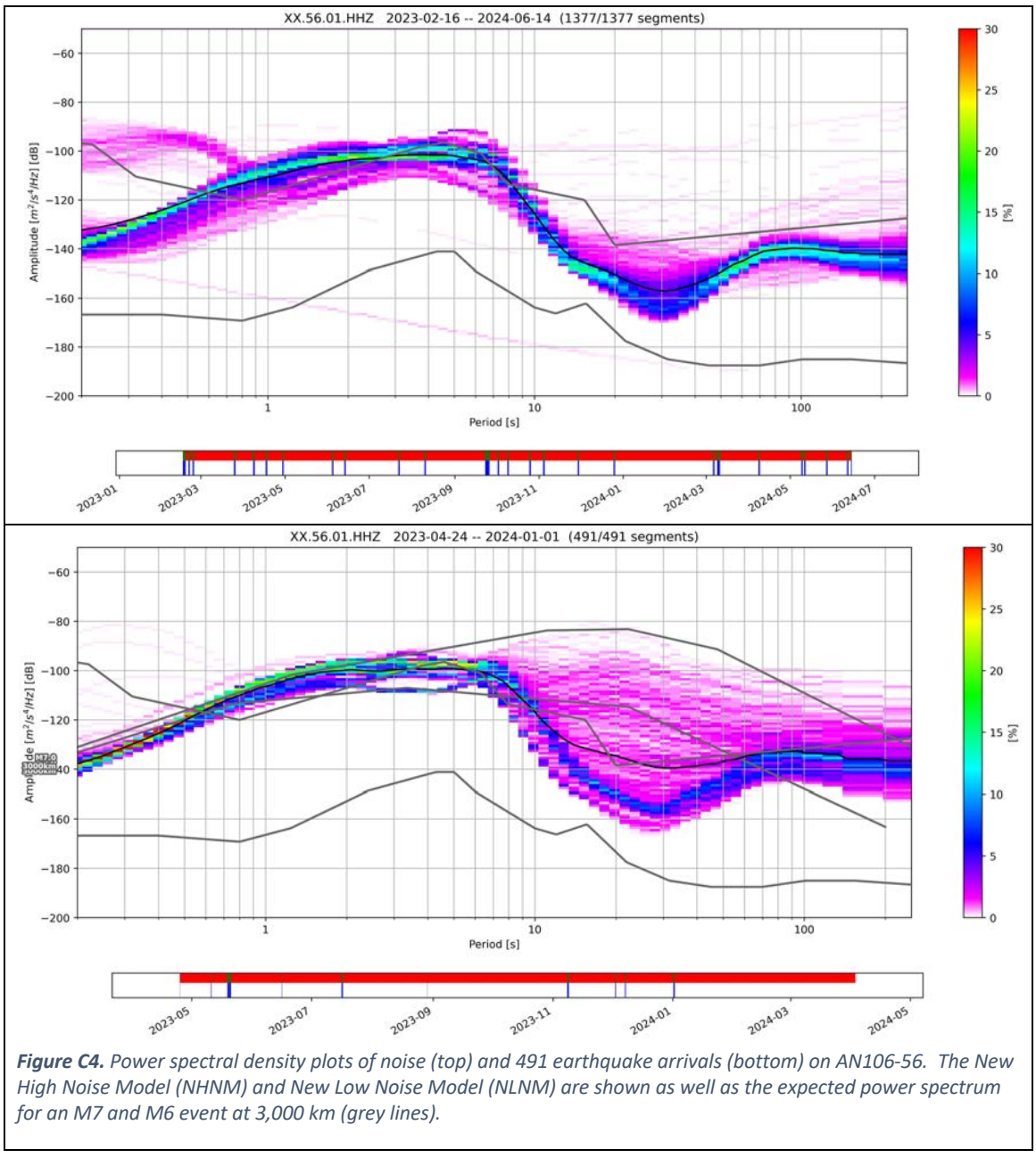


Figure C4. *Power spectral density plots of noise (top) and 491 earthquake arrivals (bottom) on AN106-56. The New High Noise Model (NHNM) and New Low Noise Model (NLNM) are shown as well as the expected power spectrum for an M7 and M6 event at 3,000 km (grey lines).*

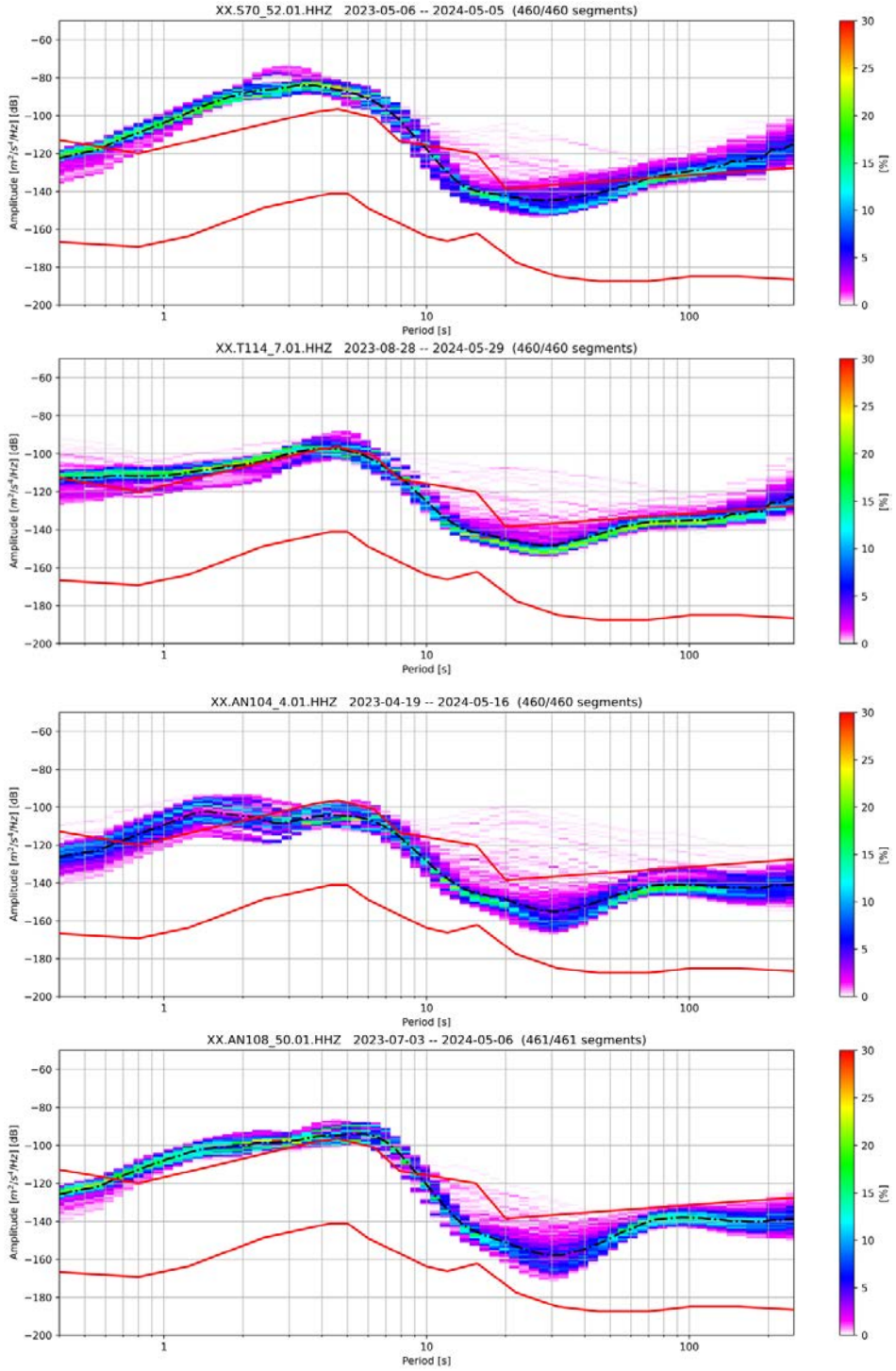


Figure C5. *Vertical channel probabilistic power spectral density at four stations. Stations S70 and T114 are both Trillium Compact T120s at 3.43 km and 1.64km below sea level, respectively. Stations AN104 and AN108 are both Trillium Compact T240s at 2.26 km and 3.5 km below sea level, respectively. These four stations represent the shallowest and deepest points in the array for either a T120 or T240.*

Charles Hoots also tested the noise removal method of Zali, Zahra, Theresa Rein, Frank Krüger, Matthias Ohrnberger, and Frank Scherbaum. “Ocean Bottom Seismometer (OBS) Noise Reduction from Horizontal and Vertical Components Using Harmonic–Percussive Separation Algorithms.” Solid Earth 14, no. 2 (March

1, 2023): 181–95. https://doi.org/10.5194/se-14-181-2023. The following show original and cleaned waveforms.

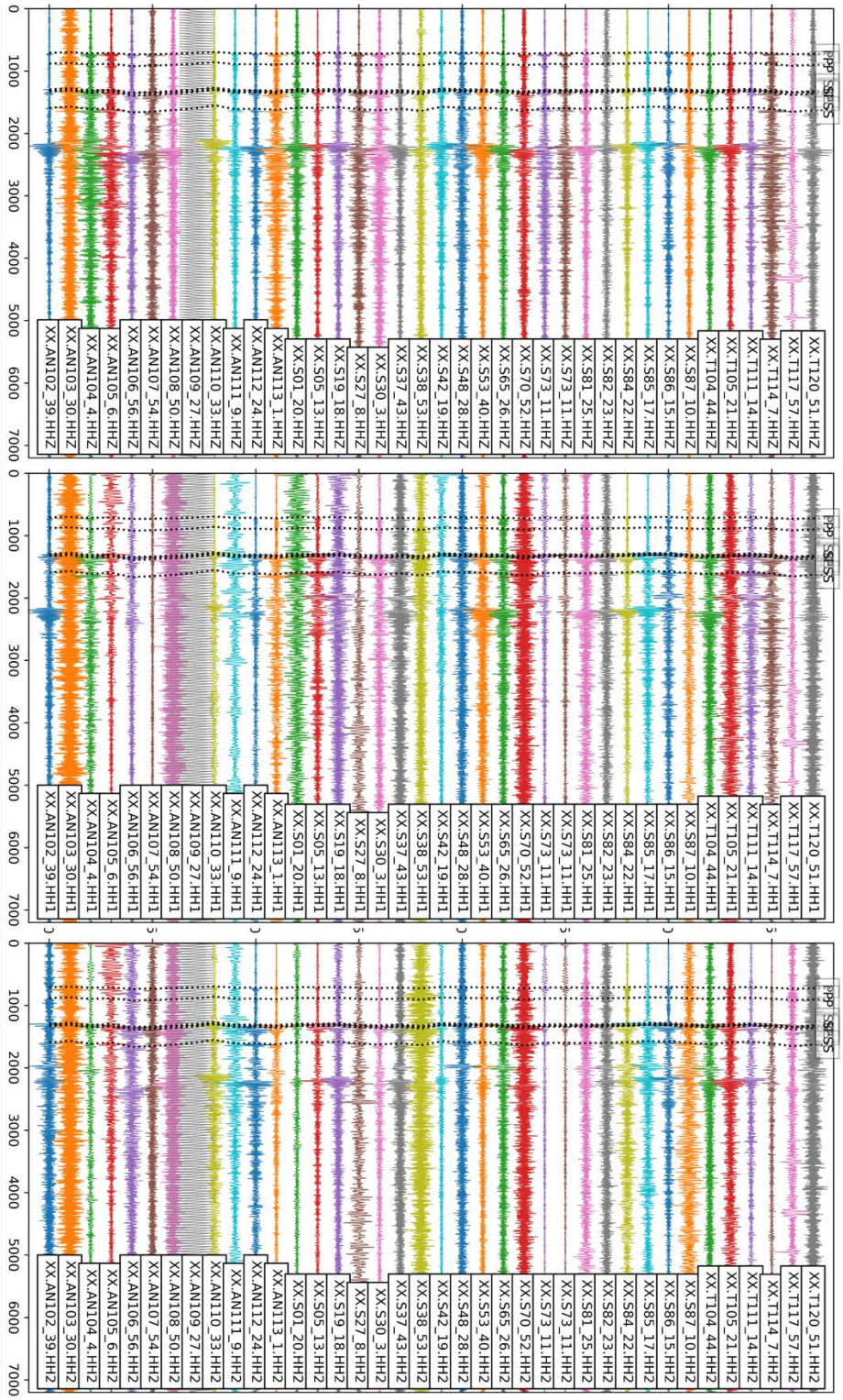


Figure C6. *Vertical and horizontal record sections for 38 Iguana stations bandpassed at 1-50s. The event is a shallow (43km) M7.2 in the Aleutian Islands, Alaska. The dead traces observed on AN109 shown here are prevalent in the first three months of deployment and cease around April, 2023.*

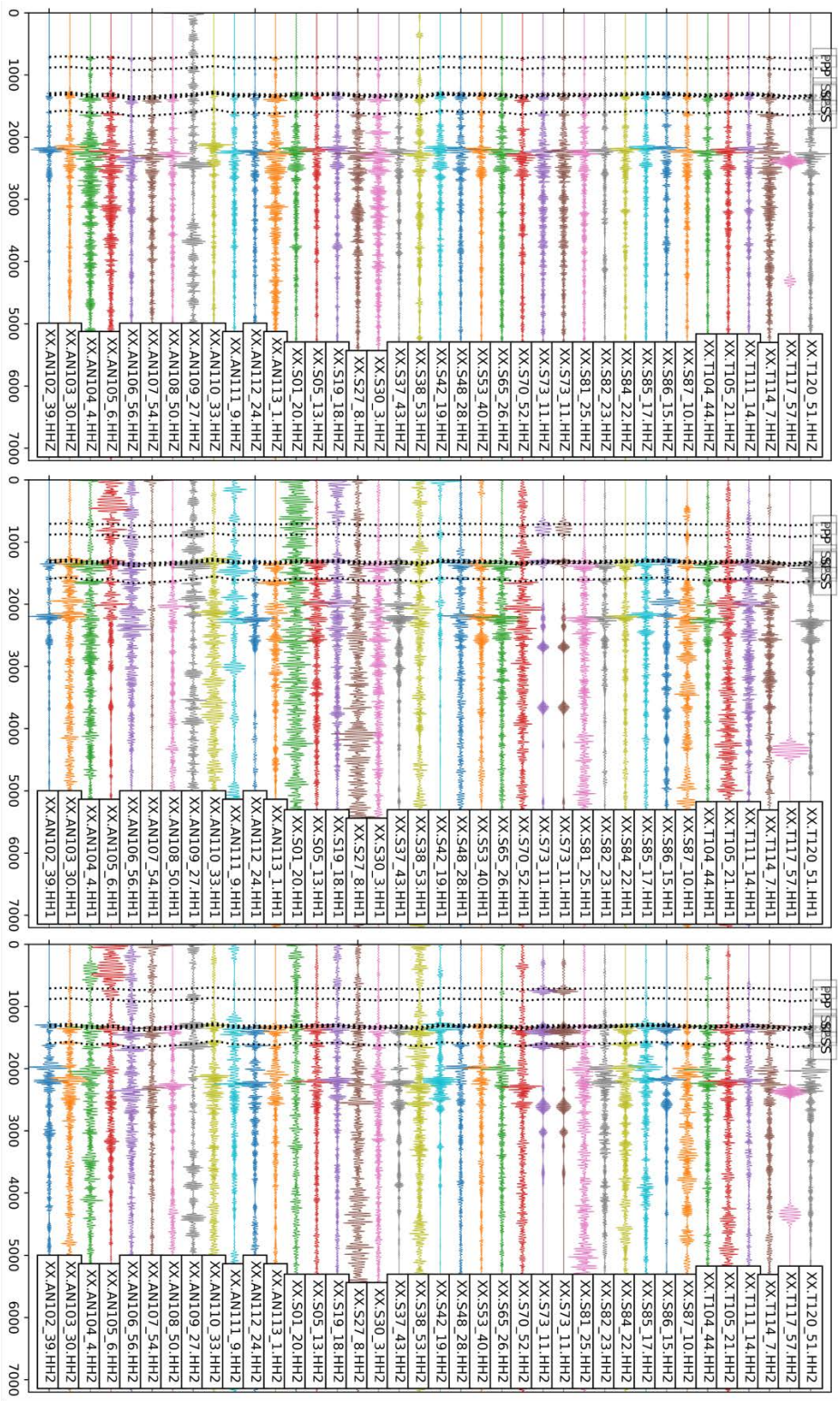


Figure C7. *Vertical and horizontal record sections for 38 Iguana stations with Harmonic-Percussive Separation applied to each channel (Zali et al, 2023) and bandpassed at 1-50s. The event is a shallow M7.2 in the Aleutian Islands, Alaska.*

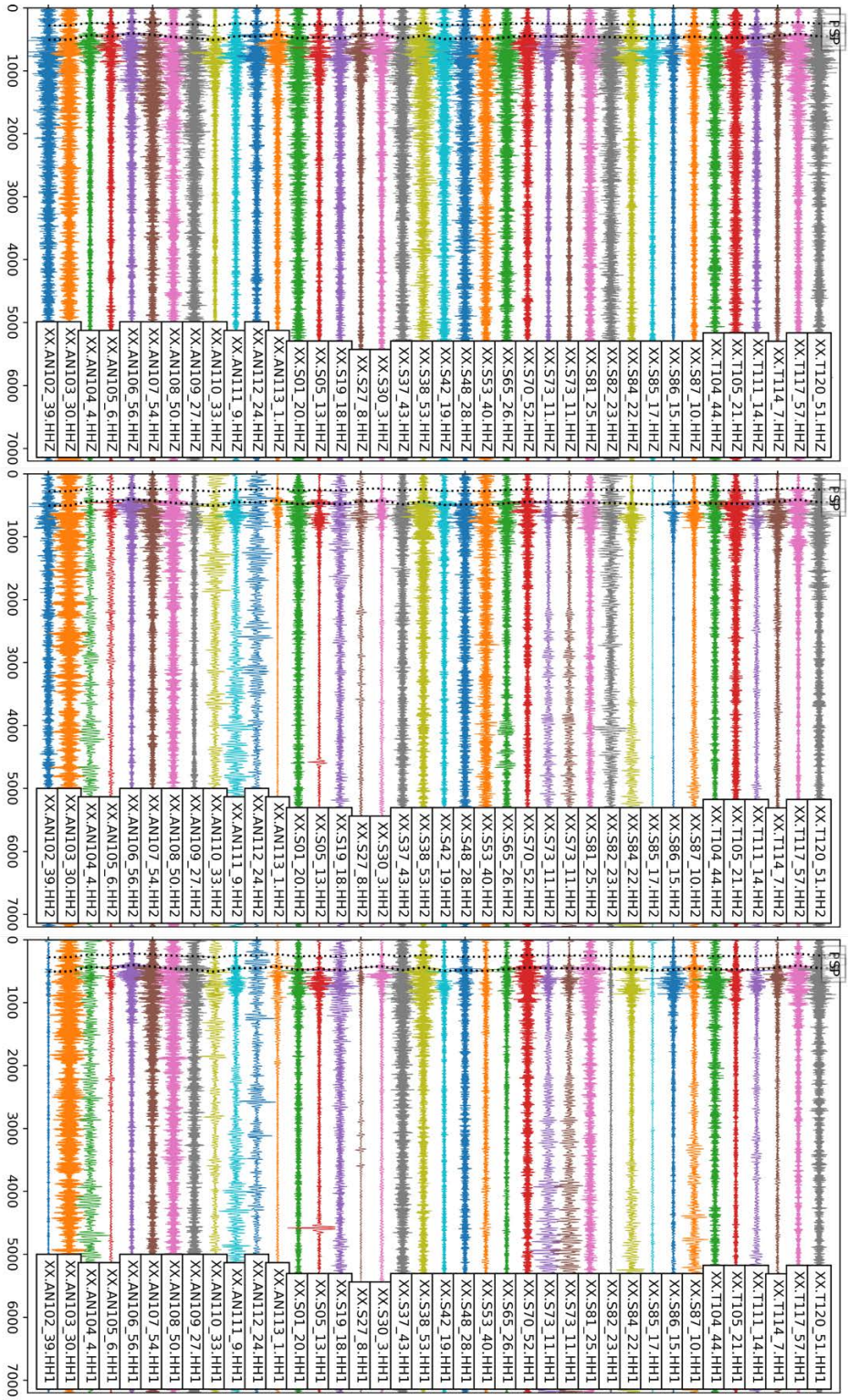


Figure C8. *Vertical and horizontal record sections for 38 Iguana stations bandpassed at 1-50s. The event is a deep (621km) M6.5 beneath western South America. Note the traces for AN109 are no longer dead.*

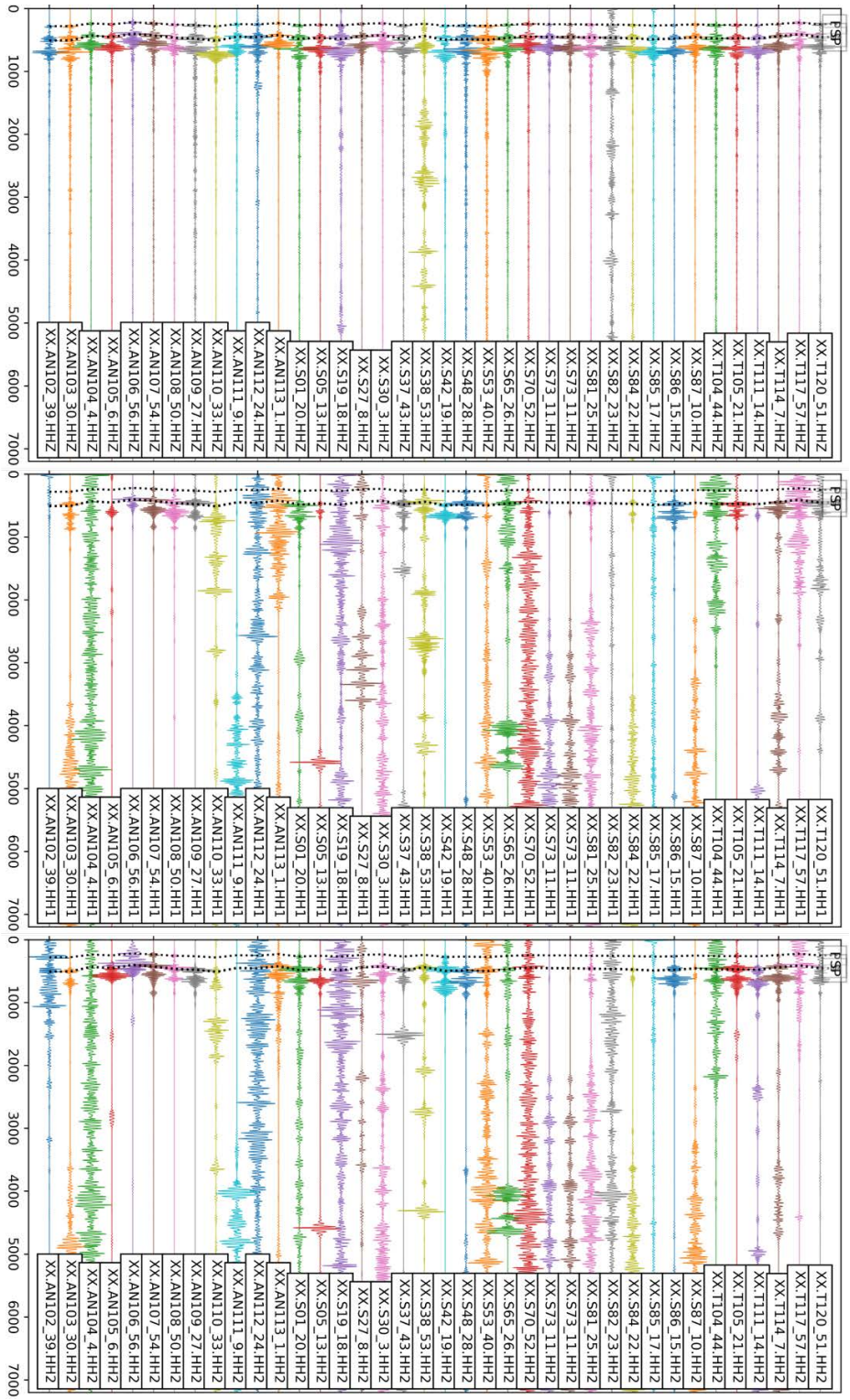
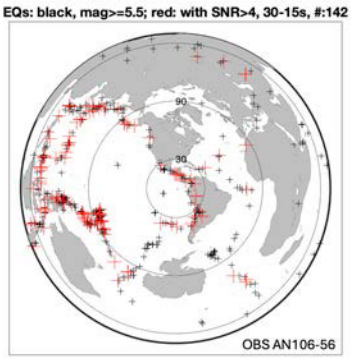


Figure C9*. Vertical and horizontal record sections for 38 Iguana stations with Harmonic-Percussive Separation applied to each channel (Zali et al, 2023) and bandpassed at 1-50s.*

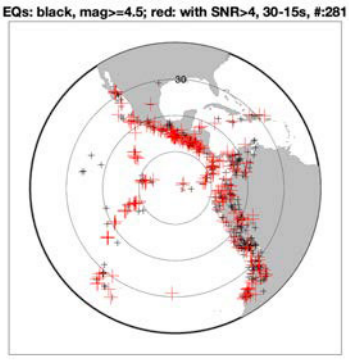
Yang Shen evaluated noise in 20-minute windows prior to the earthquake origin time and determined signal to noise ratios (SNR) for teleseismic and regional Rayleigh waves and P waves to estimate the number of useable events. He also compared the SNR of the 3 different instrument types with a very limited sampling of 2 instruments per sensor type.



Rayleigh waves on the vertical

30-15 s period

# of earthquakes with SNR>4: 142

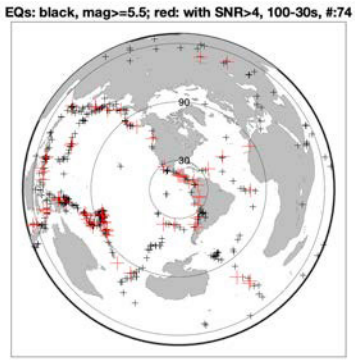


Rayleigh waves on the vertical

30-15 s period

# of earthquakes with SNR>4: 281

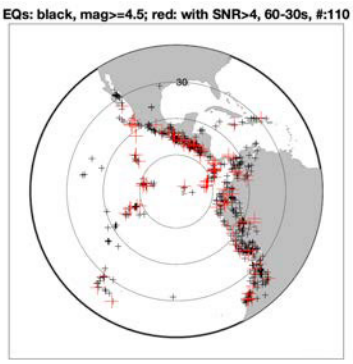
(There are some overlaps with the global m5.5 and larger earthquakes in this distance range)



Rayleigh waves on the vertical

100-30 s period

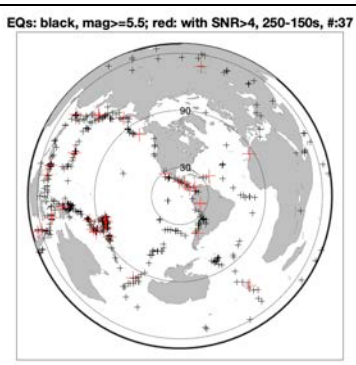
# of earthquakes with SNR>4: 74



Rayleigh waves on the vertical

60-30 s period

# of earthquakes with SNR>4: 110

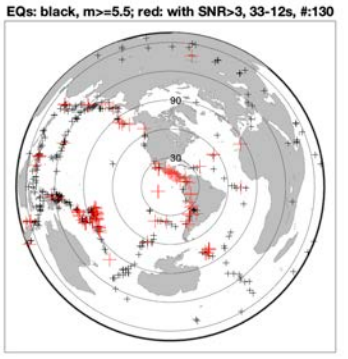


Rayleigh waves on the vertical

250-150 s period

# of earthquakes with SNR>4: 37

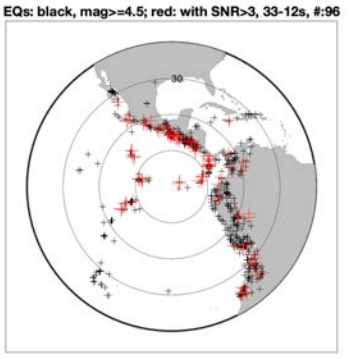
Figure C10. *Estimate of the number of usable events based on the SNR of Rayleigh waves on the vertical channel for teleseismic and regional events.*



P wave on the vertical

33-12 s period

# of earthquakes with SNR >=3: 130



P wave on the vertical

33-12 s period

# of earthquakes with SNR >=3: 96

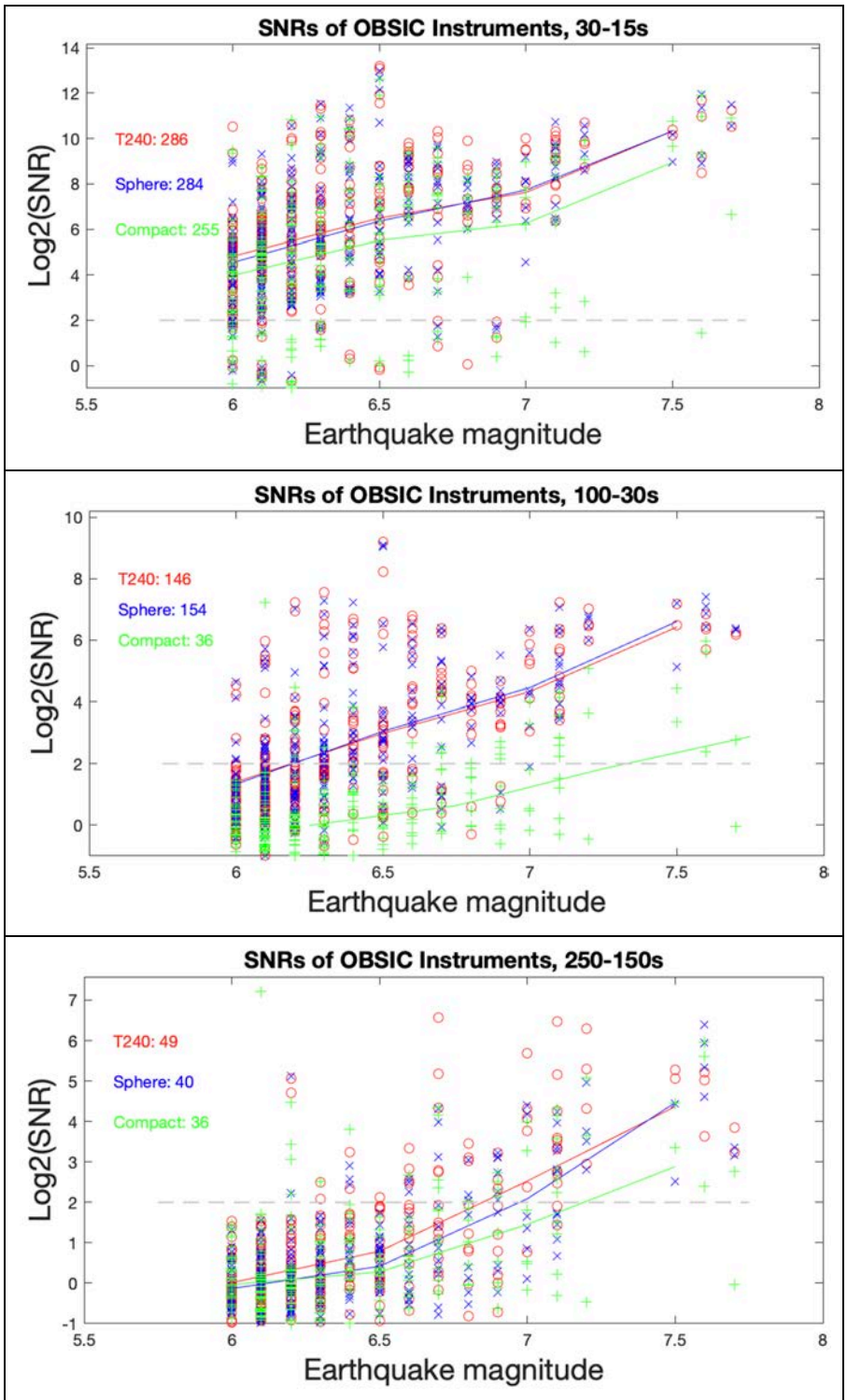


Figure C11. *Evaluation of the performance of different instrument types in a range of frequency bands by comparison of 6 individual sensors: T240: AN106_56, AN107_54; Sphere: S37_43, S70_52; Compact: T117_57, T120_51*

From screening of earthquakes with magnitude 5.5 and above in the USGS global earthquake catalog, we found over 400 earthquakes having useful Rayleigh wave arrivals with SNR>4 at periods of 30 – 15 seconds on station AN106-56. The numbers of earthquakes with SNR>4 at 100-30 s and 250-150 s periods are 137, and 43, respectively. At regional distances (<30 degrees), many additional earthquakes with magnitude less than 5.5 yielded useful arrivals.

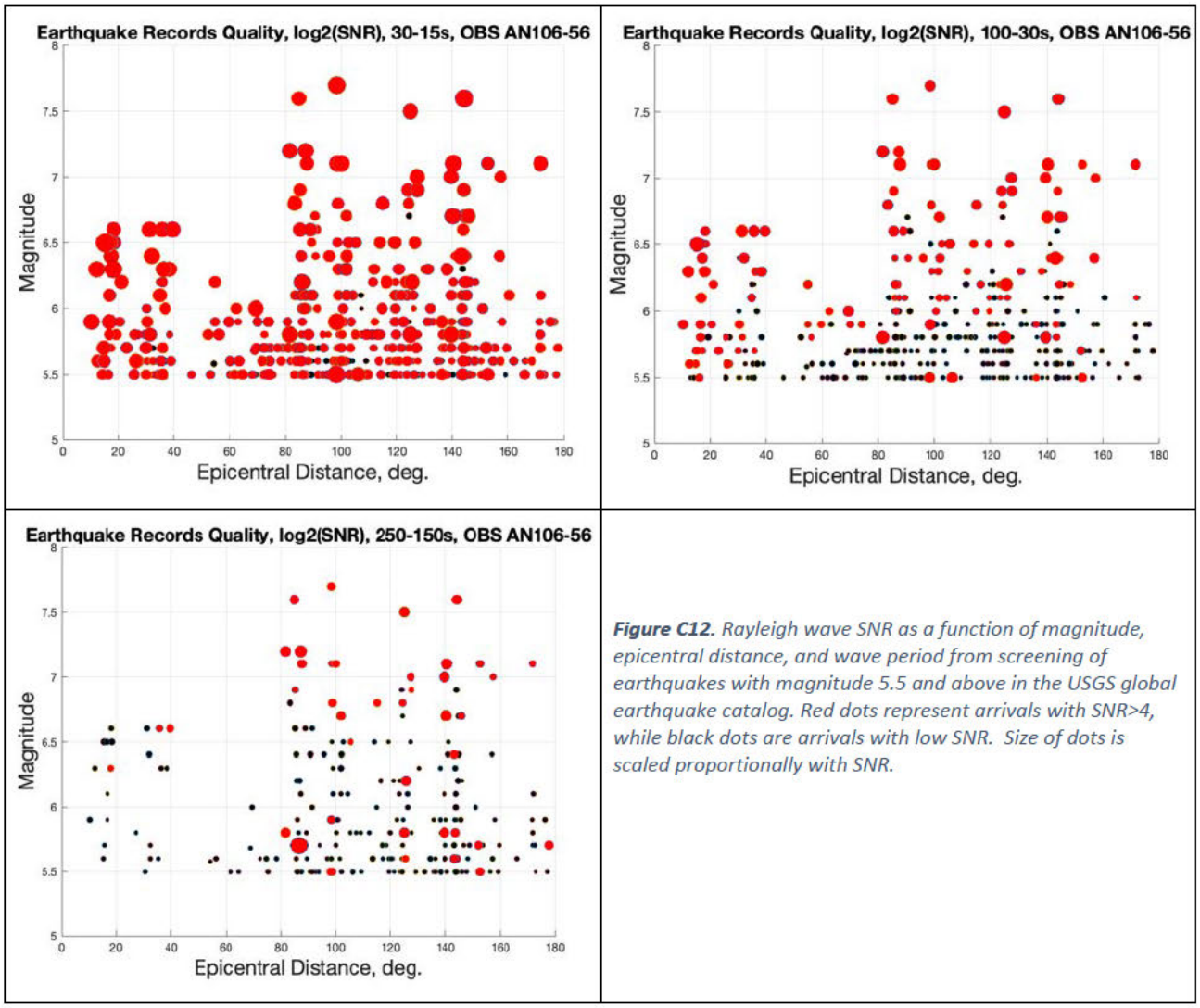


Figure C12. *Rayleigh wave SNR as a function of magnitude, epicentral distance, and wave period from screening of earthquakes with magnitude 5.5 and above in the USGS global earthquake catalog. Red dots represent arrivals with SNR>4, while black dots are arrivals with low SNR. Size of dots is scaled proportionally with SNR.*

Yang Shen and Kaisa Autumn plotted the pressure signal from the Differential Pressure Gages for each day over a one-month period to illustrate the tidal pressure signal. Yang Shen noted that noise on the horizontal channel appears to correlate with the tides.

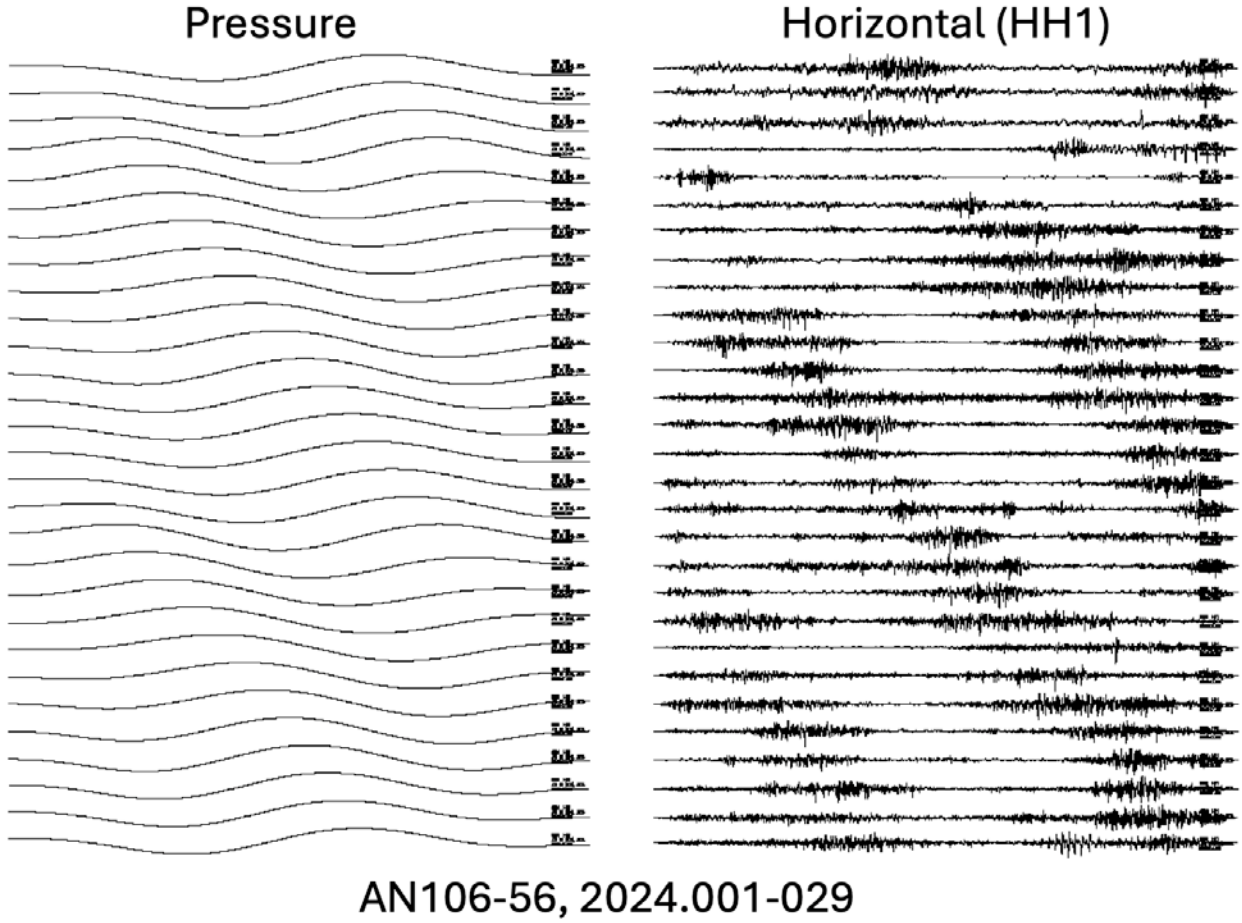


Figure C13. *Horizontal noise appears to vary coincident with the pressure signal.*

C.3 Relative teleseismic arrival times from cross-correlation

Kaisa Autumn also did some cross-correlations of the data to look at relative traveltime delays for first P arrivals. Using data from many stations, waveforms for an earthquake event are aligned using cross-correlation to get traveltime differences. Arrival times for certain P phases are predicted using TauP and are shown by the colored triangles. Cross-correlation code (ProcSeis) is not on the cruise drive, but was written by Brandon P. VanderBeek (University of Padua) and modified by Rebeckah Hufstetler (University of Oregon).

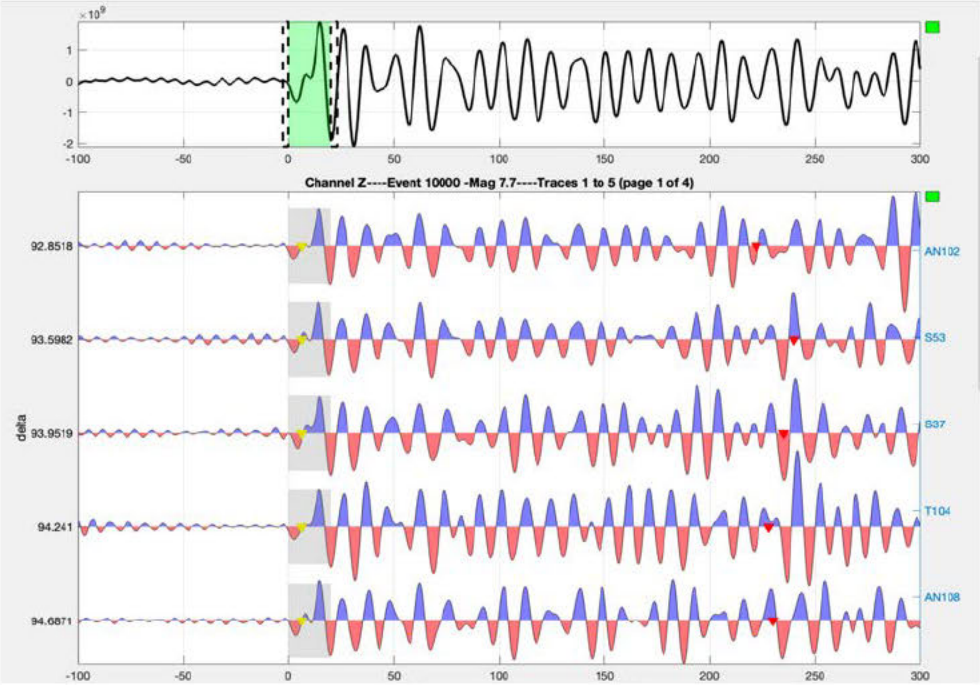


Figure C14. *Data from instruments on vertical channel showing the arrival of the M7.7 May 19 2023 SE of Loyalty Islands earthquake. Waveforms have been cross-correlated using ProcSeis (BPV). Averaged waveform is shown on top. Yellow triangle shows predicted first P arrival (TauP).*

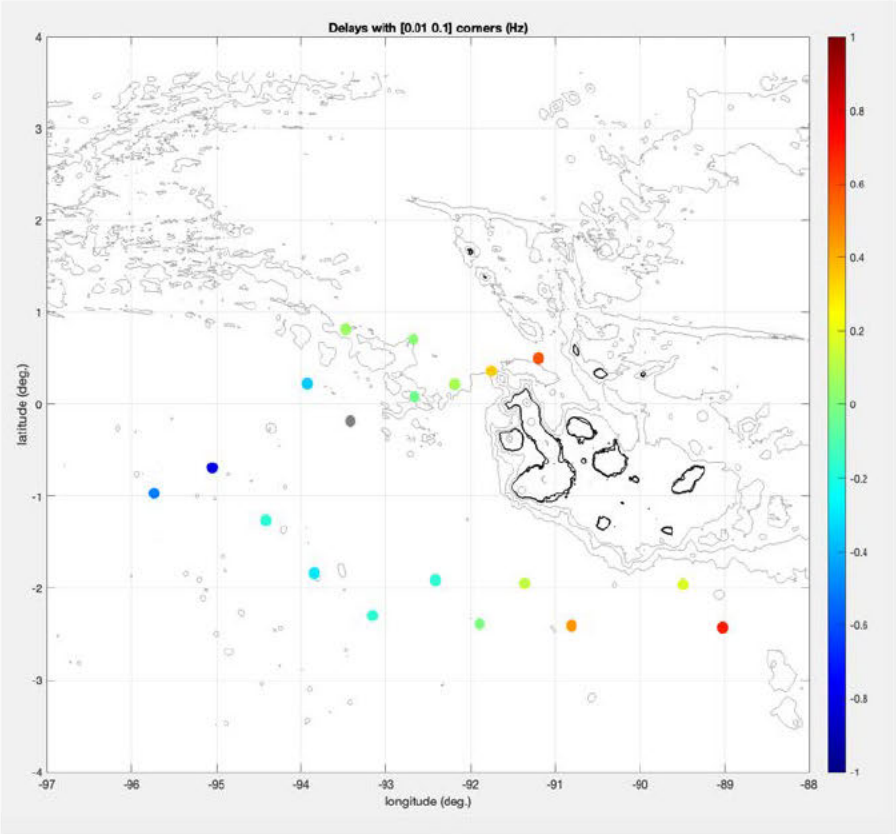


Figure C15. *Relative delay times from 19 instruments (one with bad data in gray) of first P arrival from the M7.7 earthquake on May 19 2023 SE of Loyalty Islands. Color scale shows delay times in seconds.*

D: Multibeam bathymetry mapping

The OBS recovery track was designed to optimize for a short recovery time and increased bathymetric and gravity coverage of the region.

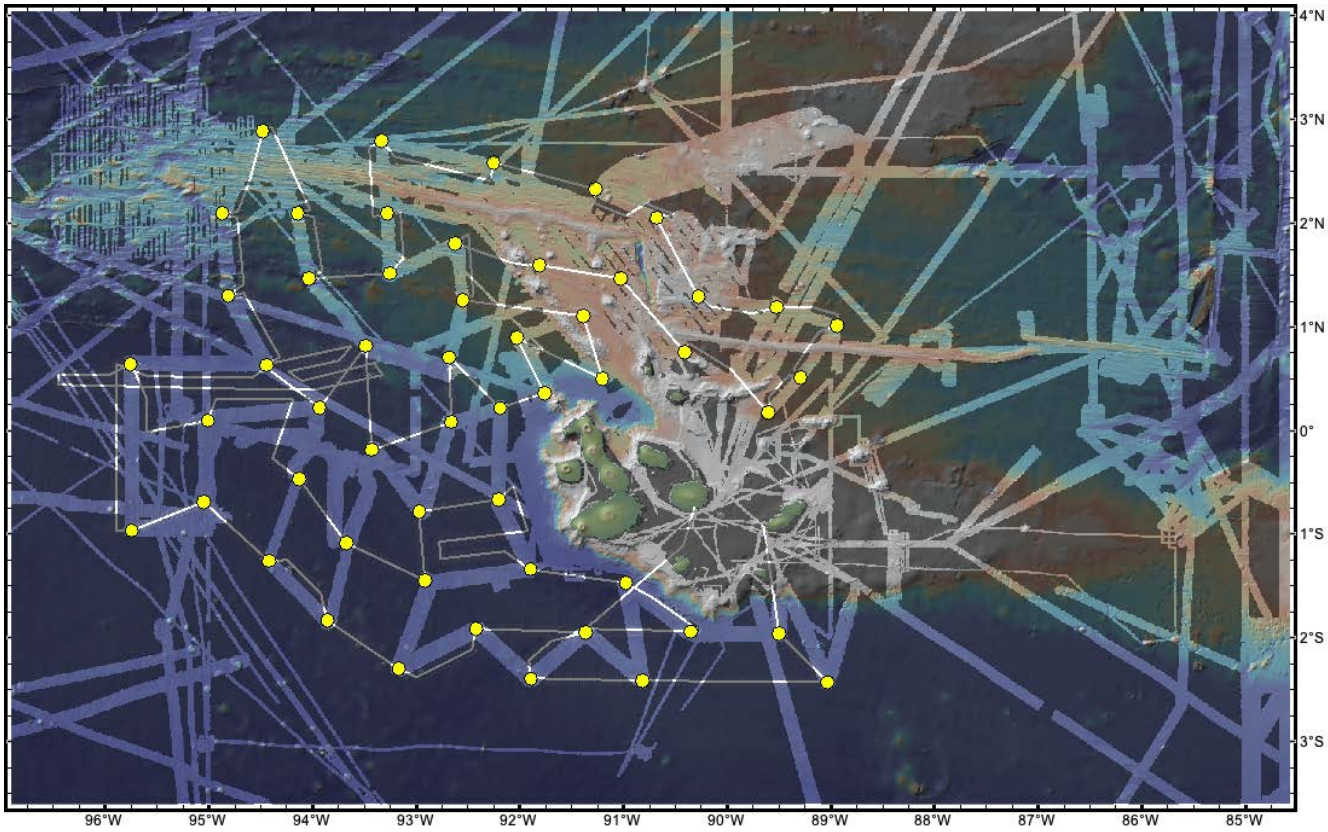


Figure D1. *OBS recovery track on masked GMRT v4.2.1 bathymetric data*

Data Collection

The bathymetric data was collected using R/V Sally Ride's Kongsberg EM124 12kHz multibeam echo sounder. The EM122 has a maximum swath width up to 6 times the water depth depending on the sea state. Data was acquired by the EM124 system into one hour ".kmall" files with the filenames ####_YYYYMMDD_HHMMSS_SallyRide, where "####" is a sequential file starting with "0000" on 06/13/2024 and ending with "0501".

The water column velocity structure was determined by XBT throughout the study area and input into the EM124 processing software. The EM124 system converted the XBT EDF file formats into ASVP format by applying smoothing to the XBT profiles and extended them from the last sampled depth down to 12 km.

Multibeam Data Editing

The following chart and list of steps outline the workflow established by Dave Caress (MBARI), the lead developer of MBSystem. This is summarized with additional details in "Galapagos 2024 Workflows and Notes.xlsx".

Quick Workflow Summary	All previous steps are done for you by typing the following into terminal:
UPDATES THE DATASET:	Two options for getting the latest data:
	Option 1: (standard option) Get data the latest data downloaded correctly for the current time and open a terminal into that exact folder to start editing quickly:
	~/Documents/GalapagosRecovery/update_datasets.py
	Option 2: You have an older folder you want to check on getting older data for:
	First, cd to that folder: cd <directory-path-name eg, ~/Documents/GalapagosRecovery/SeismoArray_20240620>
	Last, run the **local** update function:
	~/Documents/GalapagosRecovery/local_update_datasets.py
	~/Documents/GalapagosRecovery/update_datasets.py
	If you want to update files in a SPECIFIC directory use: cd <directory-path-name eg, ~/Documents/GalapagosRecovery/SeismoArray_20240620>
	Now that you are in that folder run the local update function: ~/Documents/GalapagosRecovery/local_update_datasets.py
PREPARES THE DATASET:	./preprocess.cmd
EDITS THE DATASET:	mbeditviz -I datalist.mb-1 &
COMPILES THE DATASET:	./fast_postprocess.cmd
VIEW THE RESULTS:	open *.jpg
0	If the ship's file system is not mounted, be in a finder window, type "windows" + k (to Go --> Connect to the server) and return
	SAVE ALL CURRENT WORK ON SCREEN
1	-Hit dismiss>dismiss on all MB windows, DO NOT hit the close window button (red X).
	cd ~/Documents/Cocos_Ridge_{date}
2	#If you are the 4pm-8pm shift: 1. cd ~/Documents 2. mkdir SeismoArray_<CURRENTDAY> 3. cd to new folder and continue to rsync step.
4	rsync -arv /Volumes/cruise/SR2411/multibeam-em124/rawdata/*20240621* . %entery correct Julian Day
5	cp ~/Documents/Scripts/*.cmd .
Note:	Run the following three once a day? ::
i	./fast_postprocess.cmd
ii	rsync -arv /Users/user1/Documents/GalapagosRecovery/* /Volumes/scienceparty_share/SR2411_scienceparty_share/MBSystem_Swath_Editing/.
iii	rsync -arv /Users/user1/Documents/GalapagosRecovery /Volumes/LaCie/.
	To make an edited bathymetry grid *mbgrid -I datalistp.mb-1 -A2 -F5 -N -C4 -E50/50 -O ZTopo -V* *mbgrdviz -I ZTopo.grd &*
	*to delete *.lck files type "rm *.lck" in the folder with the data you are editing*
Shift Responsibilities	
1	Answer the phone
2	Check the screens to make sure gravity, multibeam, and magnetics are still running
3	Stay up to date on MB Edits
4	Keep the bottom on the 3.5 khz screen

Workflow Steps:

Copy (rsync -av) the *.kmall files (output files of the EM124 and EM712 systems) from sr-sci-filesvr.ucsd.edu/cruise/SR2411/multibeam-em124 (or multibeam-em712) to the local folder, which was created and named according to year and day (e.g., /Documents/GalapagosRecovery/SeismoArray_20240620). From within the local SeismoArray_2024{*month*}{*day*} folder run ../update_datasets.py achieves the above.

Run “preprocess.cmd”. This runs:

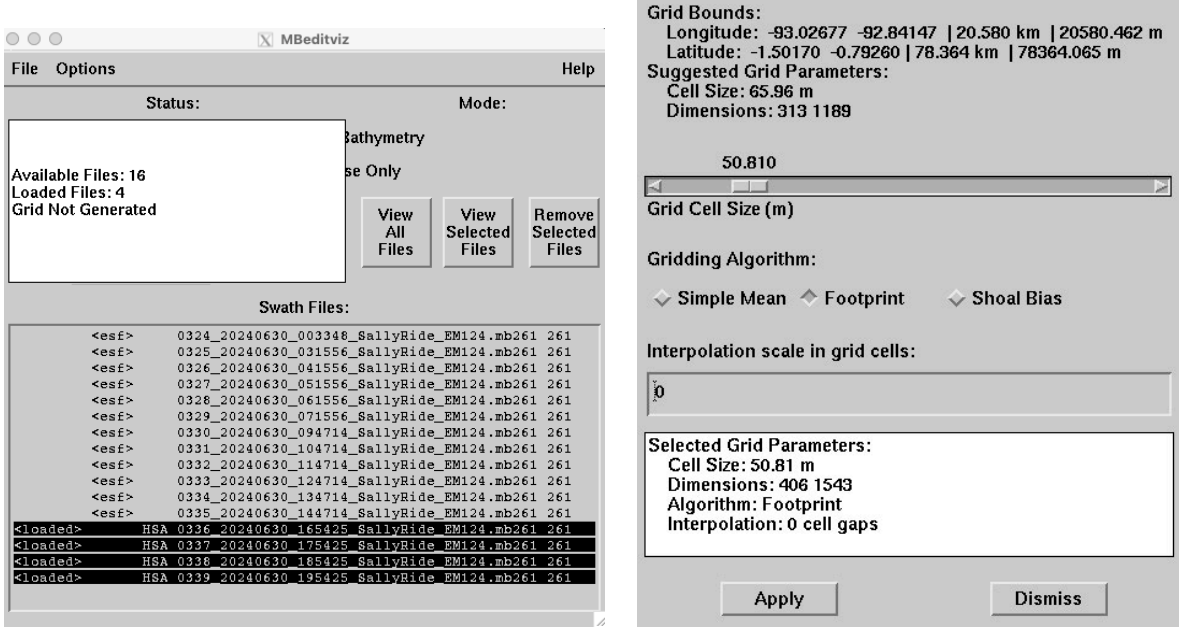
mbpreprocess: creates files for use by MBSystem (“.fbt”, “.inf”, *.fnv” and *.mb261*). The new *.mb261 files contain the bulk of the data used by MBsystem.

mbm_makedatalist: creates “datalistl.mb-1”, which lists the available *.kmall files, and “datalist.mb-1”, which lists the *.mb261 files, which are read by subsequent mbsystem tools

mbotps: grabs tidal models

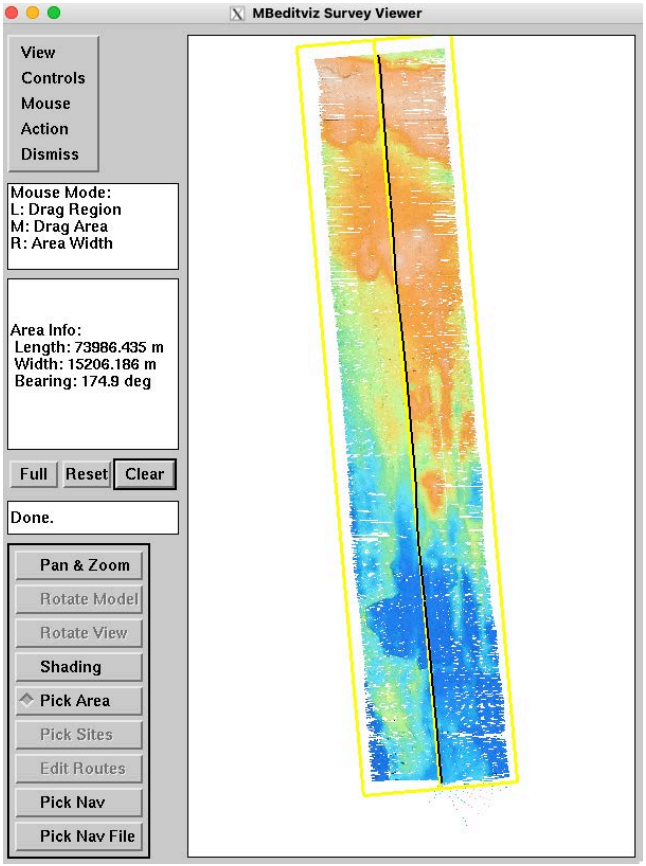
mbprocess: Apply the settings in the parameter file and the other ancillary files (navigation, flagged bathymetry, etc.)

Run “mbeditviz -I datalist.mb-1 &”

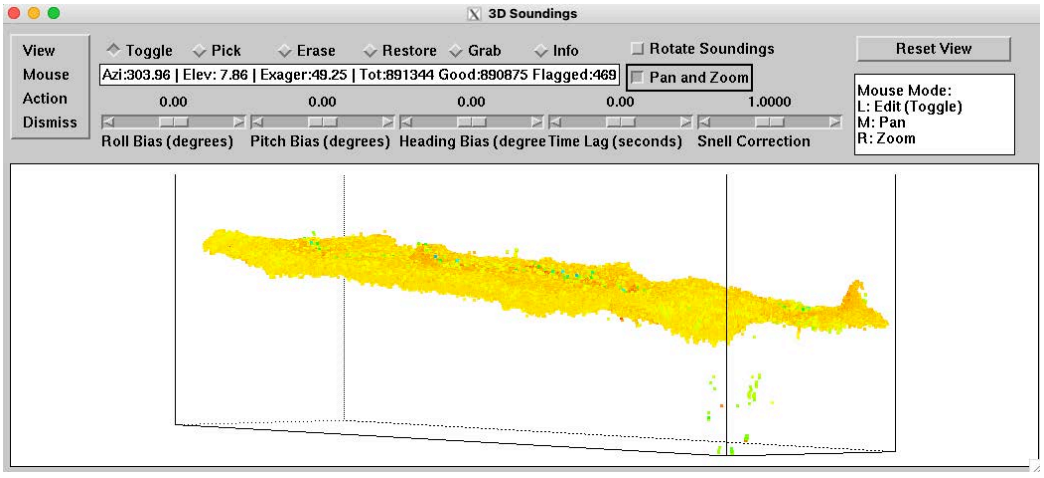


Select the files you wish to edit (the *esf files have been edited), and then the grid size you wish to view the data. We used 50 m. D. Caress recommends the rule of thumb that the Sally Ride system's lateral resolution is about 20 m per 1000m of depth.

In the “Mbeditviz Survey Viewer”, you see the bathymetry at the grid resolution specified in the previous step. The objective of editing is to produce a geologically reasonable map. And this display updates after depth soundings are edited (although sometimes not so to be sure select Action->Reset display). Note the different buttons shown by the tool; they each have separate functions for the 3 mouse buttons (MBSystem only works with a 3-button mouse). To edit the data click on “Pick Area” and select the area you wish to pick.



The “3D Soundings Window” (shown below) is the tool we used for removing seafloor soundings that appeared as outliers from the rest of the soundings (e.g., the green dots in the right the above image). “Pick” removes (or more precisely “flags”) individual points, “Erase” allows you to drag the cursor over whole groups of points for flagging for removal. “Restore” restores points. By panning, zooming, and rotating, we could view outlier points and then remove them. For all MBSystem tool windows close them using the buttons provided (“Dismiss” or “Quit”); do NOT click the red button in the upper left. If the red button is accidentally clicked the program is halted and numerous temporary *lck files remain and will prevent anyone from editing those files. Remove those temporary files and things will work normally.



After editing, run “../post_process.cmd” or “../fast_post_process.cmd”. These scripts create various NetCDF grid files of the bathymetry as well as for computing and viewing the “psuedo sidescan”. “ZTopo.grd” is a NetCDF file of the edited bathymetry.

E: Expendable bathythermograph - XBT

An XBT is an expendable bathythermograph and is used to measure temperature throughout the water column. It's a small probe that is dropped over the side of the ship and collects temperature data as it falls through the water. A small copper wire is attached to the probe to transmit the temperature data back to the ship. We can calculate the depth at which the probe is recording because the speed of the probe is known, and the time the probe is launched is recorded.

Using this temperature profile and the salinity of the water, the speed of sound through the water column is calculated. This is an important value to know for multibeam mapping of the seafloor, because the speed that the sonar wave travels through the water needs to be precise for accurate seafloor measurements.

The *R/V Sally Ride* uses the Turo Devil Bathythermograph Data Acquisition System and uses Sippican Fast Deep expendable probes that are performed daily.

To launch a probe from a vessel, the ship must slow down to around 6 knots and the canister containing the probe is inserted into the Sippican Hand-Held Launcher. Contacts on the canister provide the electrical connections to the launcher which is connected by cable to the Turo computer software program. When the probe is ready to be launched, the operator pulls a release pin out of the canister, and the probe slides out of the canister into the water. The probe's hydrodynamic shape allows it to descend through the water at a stable and known rate, enabling continuous calculation of its depth throughout the entire descent. As the probe descends, its sensors continuously measure the water temperature. Soon after the probe reaches its maximum depth around 1,000 meters, temperatures stop recording and the wire is broken to complete the profile.

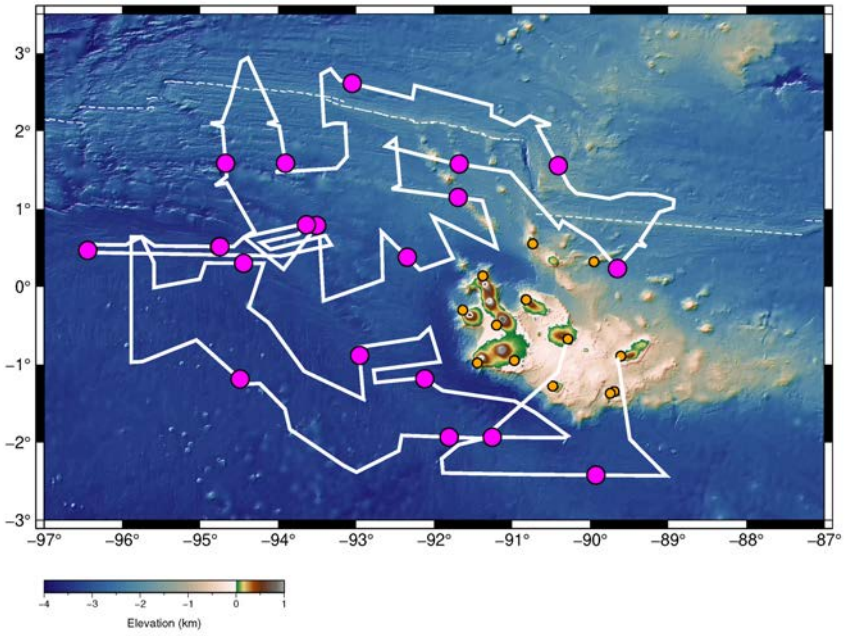


Figure E1. *Map of good XBTs in this study (magenta) with track lines (white).*

Table of XBT locations

XBT #	Longitude	Latitude
1	-89.927	-2.4211
2	-91.809	-1.9331
4	-94.489	-1.1880
5	-94.754	0.5135
6	-94.746	0.5135
7	-93.506	0.7860
8	-92.345	0.3781
10	-91.694	1.1466
11	-91.680	1.5759
12	-89.651	0.2317
13	-90.410	1.5530
14	-93.051	2.6111
15	-93.906	1.5855
17	-94.674	1.5839
18	-93.638	0.7946
19	-96.441	0.4650
20	-94.443	0.2997
21	-92.956	0.8845
22	-92.122	-1.1835
23	-91.257	-1.9349

F: Gravity data

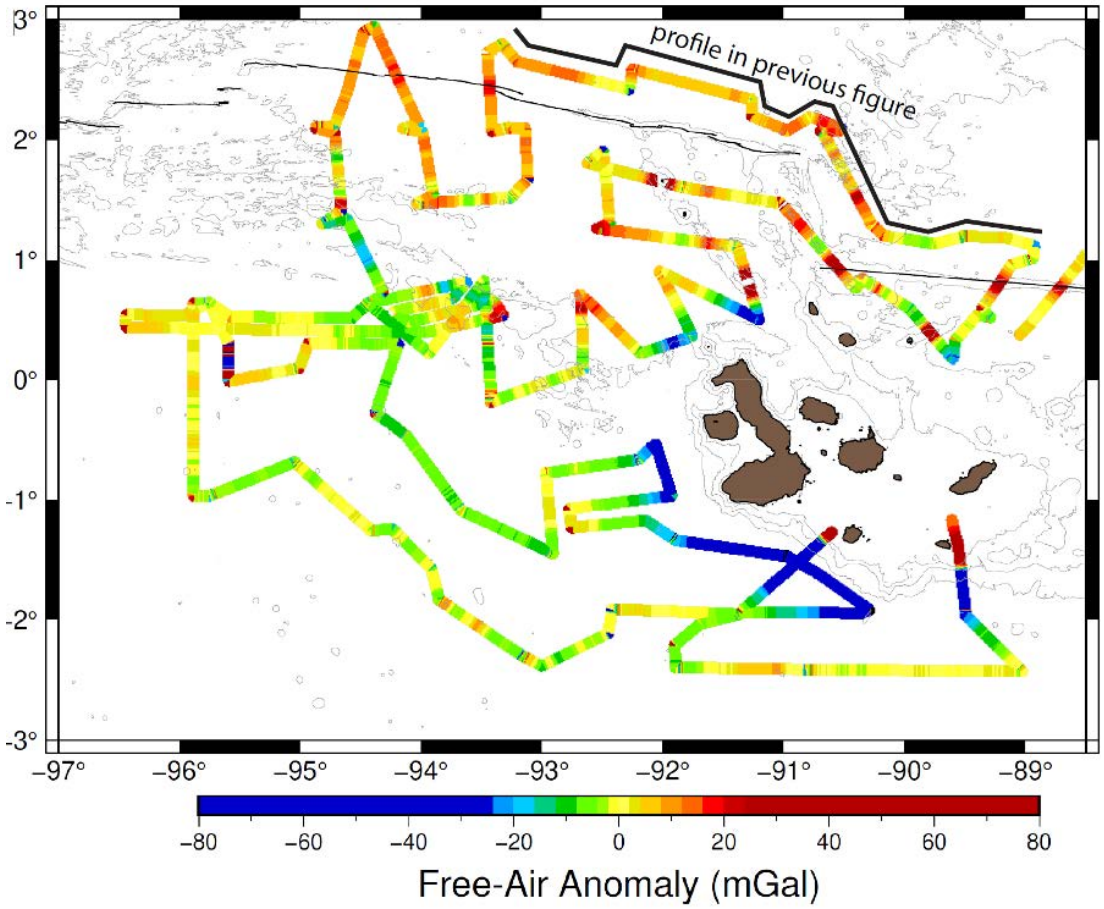


Figure F1. *Map displaying the FAA gravity as colors along the SR2411 ship tracks. Black line marks the profile show in the figure above. Gray contours are bathymetry every 1000 meters.*

The gravity field was recorded using a Dynamic gravity Systems AT1M-25 marine gravimeter. Gravity measurements were displayed in real-time on a monitor in the main lab throughout the duration of the experiment with measurements recorded every 1-second. The gravimeter appeared to be functioning properly and producing quality data. Preliminary data processing was performed throughout the cruise to ensure data quality.

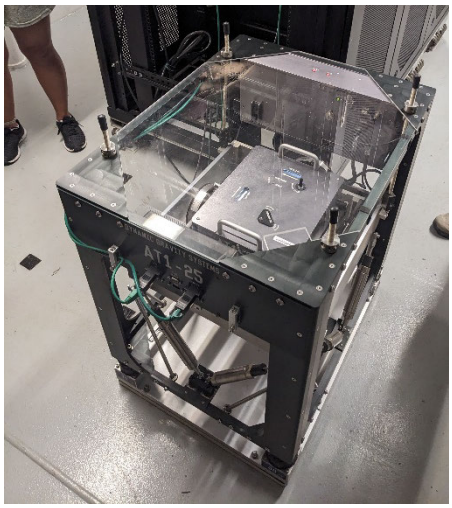
The raw data provided by Scripps are in the folder "cruise/SR2411/gravimeter-dgs/ascii_data", in files written daily with the format AT1M-25_2024{*MM*}{*DD*}_{*JD*}.dat, where {*MM*}, {*DD*}, and {*JD*} are 2, 2, and 3 digit integers respectively. Copies of these data are in "SR2411_scienceparty_share/Grav_Mag/DATA/" within individual folders with the name format of GravMag_2024{*MM*}{*DD*}. Also contained in those folders are *.MET files, which were used to extract depth (column 44) for data processing.

Instrument Detail

The Sally Ride's Dynamic gravity Systems (DgS) Advanced Technology Marine (AT1M-25) gravimeter resides on the "First Platform", one deck below the main deck Software at approximately **sea level.** The location of the gravimeter relative to the navigation reference point (NRP) of the *R/V Sally Ride* is detailed in Appendix I.3 on Sensor Offsets. (note that "Z" in Sensor Offsets is positive down and relative to the reference plate on the lower-most deck. Z = -3.411m places the meter on the First Platform, one deck above).

The data were output at 1-second intervals and logged by the Dgs Marine Logger Software. The raw data are recorded at 1 Hz without additional filtering (except for Qc) and are output to mGals using conversion calibrations kept by DgS. The expected accuracy at sea is 0.7 mGals or better. The raw data for each day are stored as a .dat file in an ASCII comma-delimited format. These files have the following layout:

[1] Qc_Gravity (Cross-coupling corrected gravity in mGal)
[2] Gravity (Uncorrected gravity)
[7] Status (Monitors state of the sensor)
[15] Latitude
[16] Longitude
[17] Speed (Knots)←Apparently ~ half of the true speed
[18] Course
[20] Year
[21] Month
[22] Day
[23] Hours
[24] Minutes
[25] Seconds



The location of the gravimeter relative to the navigation reference point (NRP) of the *R/V Sally Ride* is detailed in Appendix I.3 on Sensor Offsets.

Gravity Ties

CG-5 ship-to-shore gravity tie report
Vessel: R/V Sally Ride
Release Date: 2024/06/05 12:14:00
Software version:
Port/Pier/Berth: Marina Bahia Golfito, Costa Rica

Location	**Time (UTC)**	**CG5 Gravity Readings (mGal)**		
First Pier Measurement	11:02:00	3561.691	3561.682	3561.672
Gravity Station Measurement	11:41:00	3623.52	3625.405	3625.048
Second Pier Measurement	12:14:00	3619.904	3642.755	3639.964

Gravity station number	UCRG (?)
Elevation of station (meters)	10.121
Gravity at station (mGal)	9782.26043
Mean ship gravity at pier (mGal)	9347.597
Elevation of the pier (meters)	2

We did not use gravity tie data measured by the CG-5 gravimeter because the readings appear erroneous (measurements at each location should differ by < 0.01 mGal and the two pier measurements should differ by < 0.1 mGal given the tidal change recorded by the ship's meter). Instead, we assumed the absolute gravity at the ship equals that at the benchmark, corrected down to sea level, which is the level of the meter on the ship (by adding 0.3086 mGal/m x 10.121m). As shown below, the tidal effect on gravity is very small (~0.1 mGal) so the main error in the above approximation is due to the difference in true absolute gravity between the benchmark location and the ship.

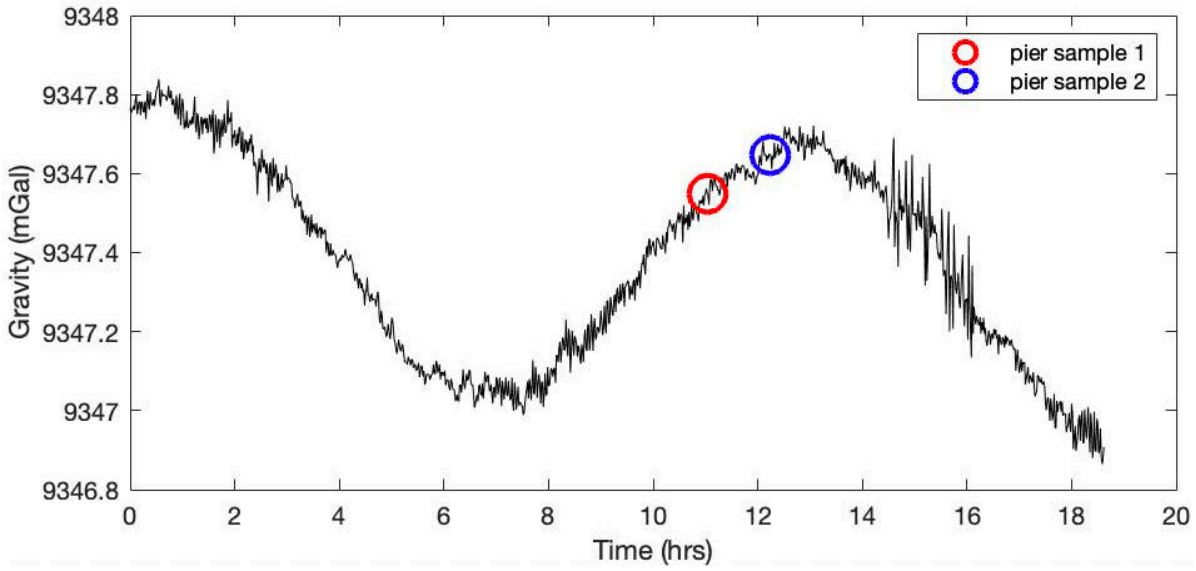


Figure F2. *The ship's gravity measured on the day the gravity tie was done, shows a clear tidal signal. Small circles indicate when the two pier measurements were taken.*

Processing Methodology

The gravity and navigation data are merged with depth measurements ("*.MET" files) via timestamps. To beat down noise due to ship motion still present in the "Qc" gravity output (column 1), we applied a 180-second Gaussian filter, and down-sampled the data at the same interval. The ship speed (column [17] of the raw dgs files) was erroneous: the given values were approximately half of the true speed. We therefore computed the ship speed using the navigation at 30-second time intervals. The computed speed (VT) and ship course (azimuth) (column 18) were then smoothed with the same 180-second Gaussian filter and then used to compute and apply the Eötvös correction (Eq. 1 below). Navigation (latitude and longitude) associated with each (filtered and resampled) gravity point was smoothed with a 10-s Gaussian filter to mitigate errors in GPS measurements. The Free-air anomaly (FAA) was then calculated by subtracting the computed value using the 1984 International Gravity (IGF) formula (Eq. 2). The MATLAB script for the above is called "SR_Raw2FAA.m" (specify the month and day of data and then run). The output is written in "SR2411_scienceparty_share/Grav_MAG/DATA/Processed_Daily_Grav", in files named *grvJD{JD}.txt*.

To verify the consistency of the computed FAA, the MATLAB script "SR_FAA_Satellite_Check.m"(specify the Julian Day to run) extracts and compares the FAA values from Sandwell & Smith's latest satellite-derived grid at the navigation points for each shipboard measurement. The output is written in "SR2411_scienceparty_share/ Grav_MAG/DATA/Processed_Daily_Grav", in files named *grvJD{JD}sat.txt.*

Eötvös Correction: The Eötvös correction is the change in the Earth's gravity due to centrifugal acceleration when the gravity measurement platform is moving. In mGal, the Eötvös correction is:

$$\text{Eötvös} = [7.5038 * VE * \cos(\phi)] + [0.004154 * VT] \quad (1)$$

where *VE* is the eastward component of the ship's velocity, ϕ is the latitude in degrees, and *VT* is the ship's speed in knots.

Free-air Anomaly: The Free-air Anomaly (FAA) is computed by subtracting the gravitational effects of the reference ellipsoid from the observed gravity values. For this, we used the 1984 International Gravity Formula (IGF):

$$g_{IGRF}(\phi) = 978032.67714[1 + 0.00193185138639 * \sin^2(\phi)]/\mathrm{sqrt}[1 - 0.00669437999013 * \sin(\phi)^2] \quad (2)$$

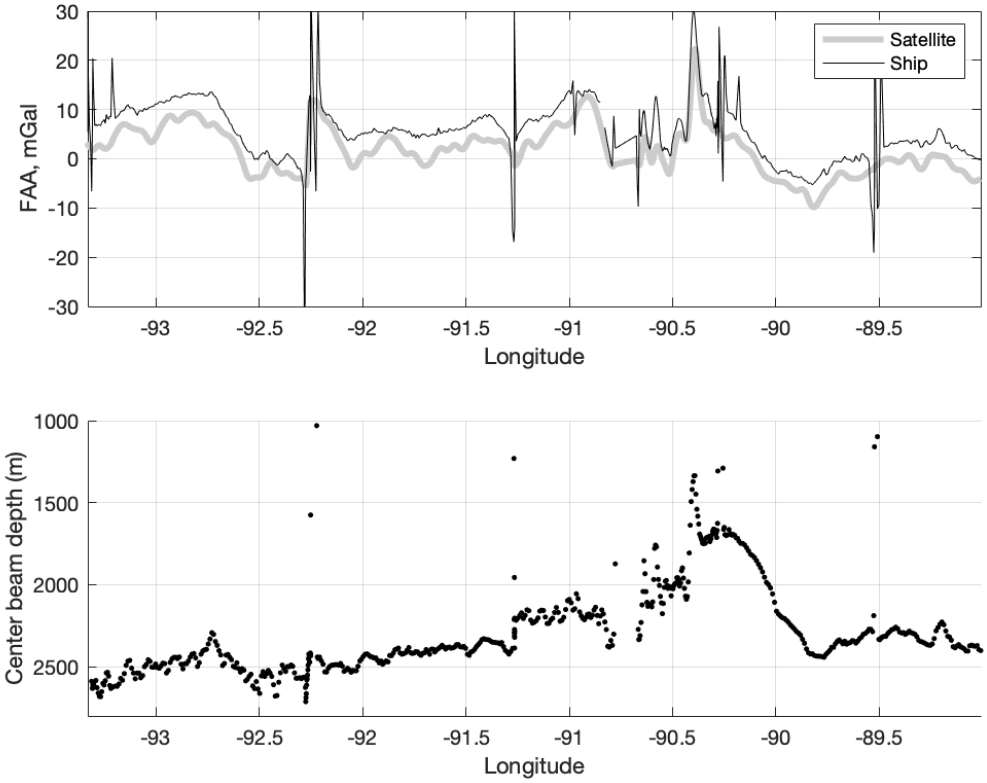


Figure F3. *(top) Comparison of computed shipboard FAA (black) with Sandwell and Smith's satellite-derived FAA (gray), along the ship track between OBSs 1, 4, 7, 6, 2, 15 and 16, which is generally east-to-west, roughly paralleling and north of the Galapagos Spreading Center plate boundary, and going over the southernmost end of the Cocos Ridge (labeled in the map below). The shift between the shipboard and satellite date is due to the erroneous gravity tie in Golfito. The smooth trending data are reliable, but interrupted by spikes, which reflect errors or other noise during changes in the ship's speed and/or heading, especially while approaching, during, or leaving OBS recoveries. During geophysical interpretation or analysis, it is common to remove the data where these large errors occur. (bottom) The EM124 center-beam seafloor depth is shown for comparison. The miscellaneous points above the seafloor are presumably artifacts recorded while on station as the EM124 was turned on or off.*

Measurement Offset and DGS Instrument Drift:

The measurement offset due to the lack of a gravity tie as well as instrument drift can be measured by comparing the shipboard FAA with the satellite-derived field (Figure 4). We subtract the satellite-derived FAA from the ship's (light orange), apply a median filter with a 2-day window (gray), and resample every hour. The median filter addresses the high-amplitude errors associated with changes in ship velocity and true deviations between the more-accurate DGS readings at shorter wavelengths compared to the satellite FAA. Fitting a line to the median-filtered differences yields,

$$\Delta g = 2.86 + 0.0137\, t$$

where *t* is time in hours starting from the beginning of the record (Grav_Mag/ DATA/Processed_Daily_Grav/grv_all_sat.txt). The MATLAB script for doing this is called "Offset_Drift_Correction.m".

Measurement offset correction: subtract 2.86 mGal to all measurements to achieve a more accurate measurements of absolute gravity and FAA:

Drift correction: subtract 0.0137(mGal/hr) × *t* from all measurements to correct for linear instrument drift.

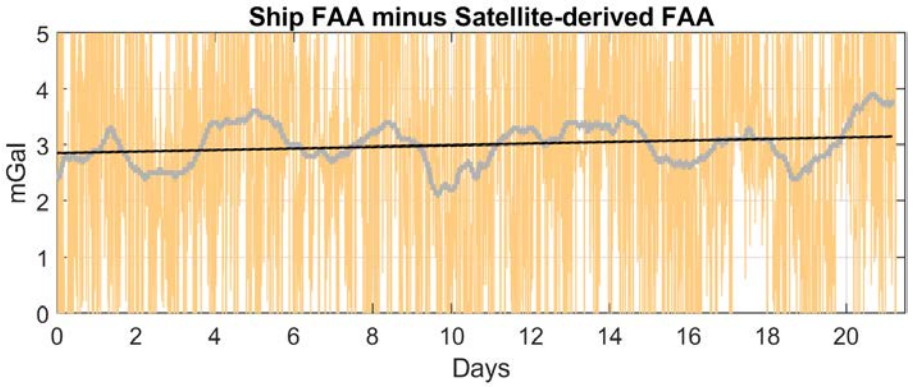


Figure F4. *The DGS shipboard free-air anomaly (FAA) minus the satellite-derived FAA are plotted versus time in hours since the beginning of SR2411 and ~12 hours before the end (light orange). A 2-day median filter is applied and resampled every hour (gray). A line is fit to the filtered differences (black) to estimate the measurement offset due to the lack of a gravity*

G: Magnetic data

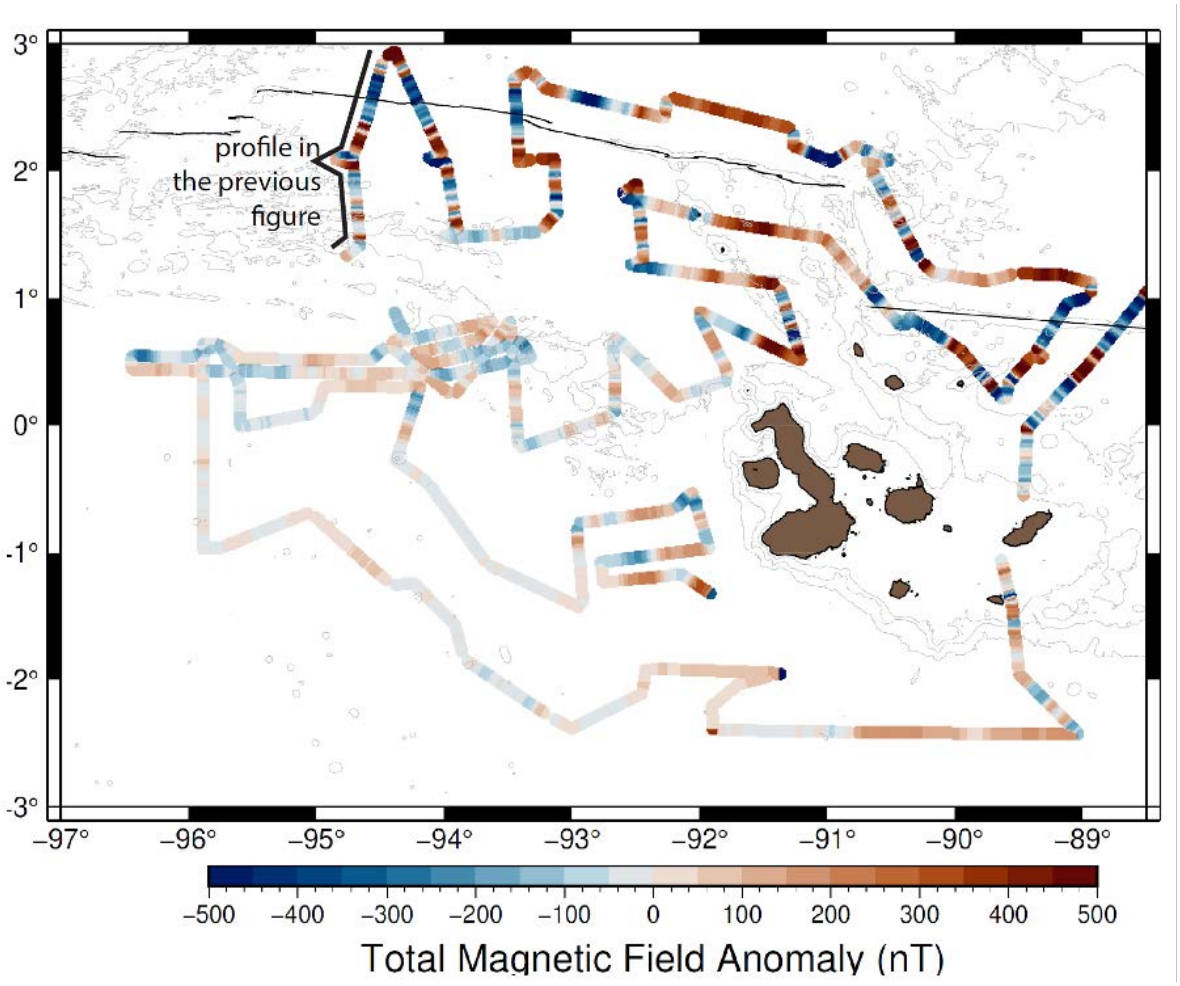


Figure G1. *Map displaying the total magnetic field anomaly as colors along the ship tracks. Gray contours are bathymetry every 1000 meters. Bold line locates the profile shown in the previous figure.*

Data Collection:

The magnetic field was recorded using a Marine Magnetics SeaSpy magnetometer towed 300 meters astern of the vessel on the port side. Data was logged by the BOB data logging system. The system performed well during the survey.

The magnetic data were collected during transit between each OBS recovery. The magnetometer was brought on board ~15 minutes before reaching an OBS station and deployed again after finishing the OBS recovery.

Instrument details:

Name: Marine Magnetics SeaSPY Towed Magnetometer(SS1+ALT)

Operating Principle: Overhauser magnetometer sensor?

Operating range: 18,000 to 120,000 nT

Operating Zones: No restrictions. SeaSPY will perform exactly according to spec throughout the entire range.

SS1+ALT Counter Sensitivity: Maximum sensitivity of 15pT RMS at rates up to 1Hz. Up to 4 samples per second.

Heading Error: NONE

Absolute Accuracy: 0.1nT

Output: RS-232, 9600bps

Mechanical: Sensor Fish: Body 12.7 cm dia., 124 cm long with fin assembly, 16 kg. Includes Sensor and Electronics.

Tow Cable: Kevlar Reinforced twisted pair conductor tow cable. Breaking strength 2,500 kg, 1cm in OD, 7,000 m maximum. Weighs 125 g/m with terminations.

Operating Temperature: -45°C to +60°C

Storage Temperature: -45°C to +60°C. Moderate temperatures are recommended

Water Tight: O-Ring sealed for up to 6000 m depth operation

Data file:

The files are "cruise/SR2411/magnetometer-bob/data/ SR2411_Galapagos_Recovery{*DD*}{*MM*}*2024*.csv", where {*DD*} is two-digit day and {*MM*} is the two-digit month. The columns are as follows:

[1] Reading_Date (day-month abbreviation- yr)

[2] Reading_Time (UTC)

[3] Total Magnetic_Field

[4] Signal_Quality

[5] Depth (from sea level)

[16] Mag_Latitude

[17] Mag_Longitude

Data processing

The raw 1-second total magnetic field measurements were filtered with a 60-second Gaussian filter and resampled every 180 seconds. As with the gravity processing, the navigation was smoothed using a 10-second Gaussian filter. We then subtracted the International Geomagnetic Reference Field (IGRF) to produce the "total magnetic field anomaly", which reflects local variations largely due to magnetized oceanic crust. This is done using the MATLAB script "SR_mag.m" (set the Julian Day in the script and run) to generate a file called: {*DD*}{*MM*}tot_mag.txt.

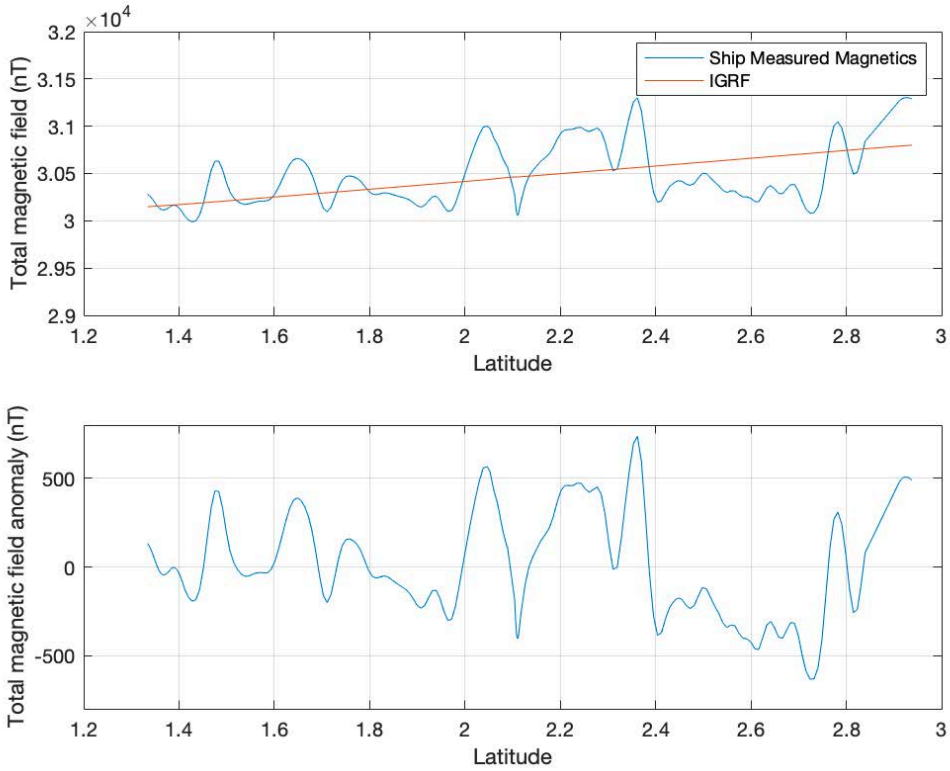


Figure G2*. (top) The total magnetic field after Gaussian smoothing and down sampling (black) compared with the IGRF field (gray). (Bottom) The total magnetic field anomaly is computed by subtracting the IGRF field from the total magnetic field measurements from the ship. The data are along the ship tracks between OBS's 30, 31, and 33, which includes SR2411's furthest west crossing of the Galapagos Spreading Center (marked on the map in the next figure). Here the Galapagos Spreading Center is located at ~ 2.6°N. The ridge axis "central magnetic high" is relatively high amplitude, but is negative given that we are near the Equator.*

H: Oceanography: Sea-surface temperature, salinity, currents

H.1 Salinity and temperature

The Shipboard Meteorological Acquisition System (MetAcq) onboard the R/V Sally Ride acquires, filters, displays and distributes meteorological sensor data from a wide variety of sensor types and data input devices. Atmospheric meteorological sensors are generally located on either the forward part of the ship on the MET mast and/or above the ship's upper bridge deck. Sensors that measure seawater properties are generally located near the uncontaminated seawater in-take area or in one of the ship's laboratories that has a connection to the uncontaminated seawater line.

For fun and curiosity, and because oceanographic currents in the vicinity of the Galápagos interact in several ways, sea surface temperature and salinity values were extracted from MetAcq and plotted below.

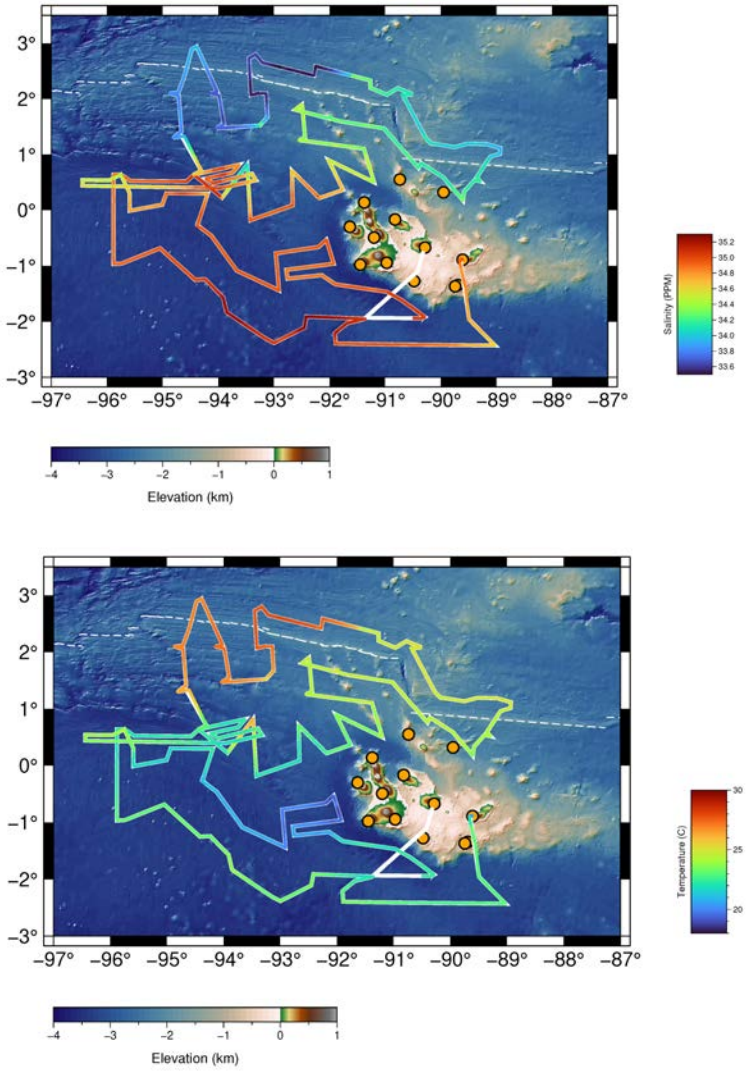
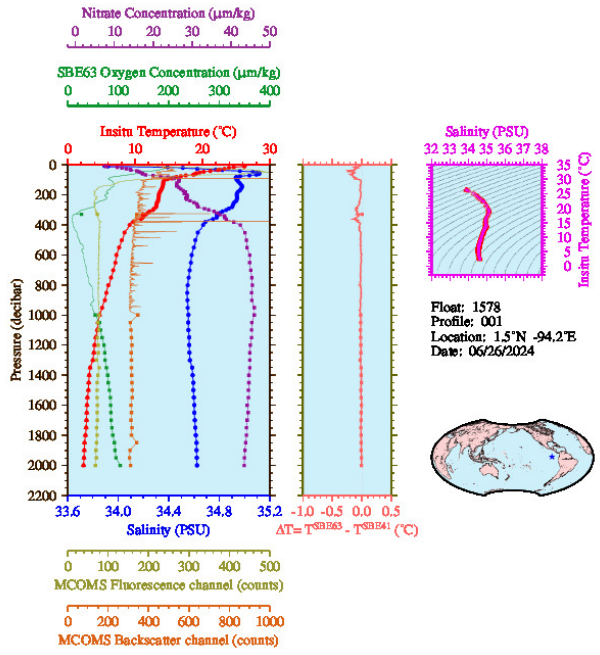
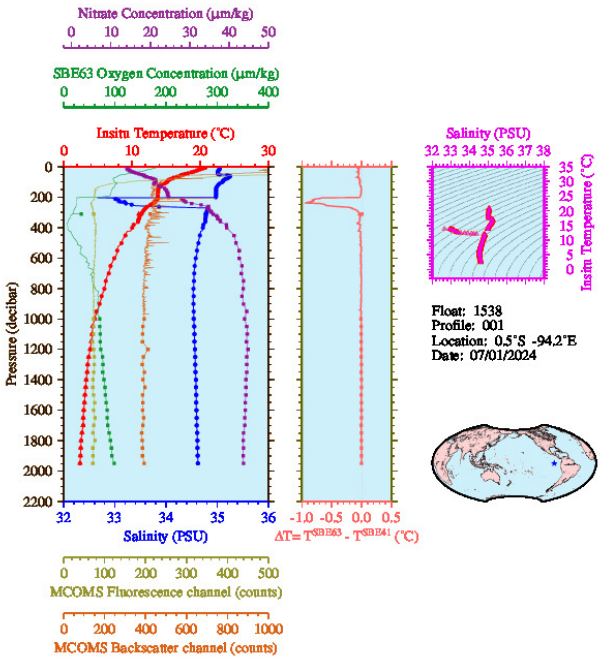


Figure H1. *Salinity and sea surface water temperature along the track*

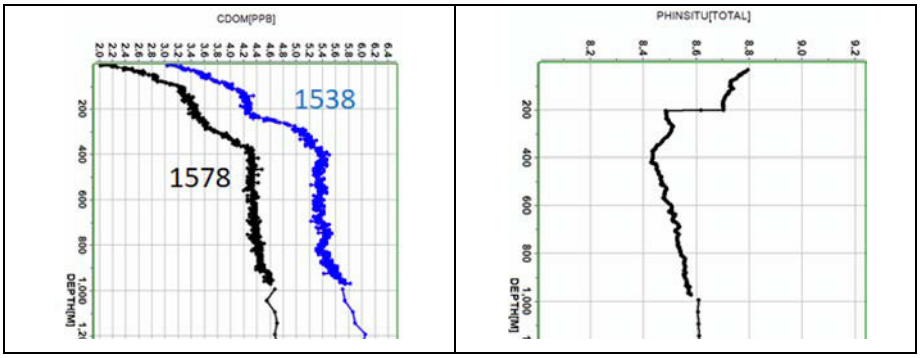
H.2 GO-BGC Floats

We deployed two floats (1578 and 1538) for the Global BioGeochemistry Array progam. The Global Ocean Biogeochemistry Array is a global robotic network of profiling floats carrying chemical and biological sensors that will revolutionize our understanding of ocean biogeochemical cycles, carbon uptake, acidification, deoxygenation, and ecosystem health.

GO-BGC utilizes autonomous robotic floats to measure temperature, salinity, pH, nitrate, chlorophyll, suspended particles, light, and derived parameters DIC, pCO2 and total alkalinity in the ocean from the surface to 2000m. These floats can operate continuously for years in all weather conditions, providing near real-time observations of ocean biogeochemistry and ecosystems throughout the world's oceans. GO-BGC will deploy 500 autonomous floats in the world's oceans between 2021 and 2026 as part of the OneArgo array. GO-BGC data are made freely available through the Data page and the Argo data system.

	
http://runt.ocean.washington.edu/argo/homographs/TP/1578.shtml	http://runt.ocean.washington.edu/argo/homographs/TP/1538.shtml
Also available: Trajectories for float 1578	Also available: Trajectory for float 1538

The first profile from 1538 (right) looks good but the pH is shifted way to high, shows a bit of a pump offset (unusual for NAVIS) and also a big step shift at 200m. The salinity sensor looks to have gotten fouled from 300 to 200 dbar and then recovered. There is also a big offset in CDOM between 1538 and 1578.



I: Ship

I.1 Track

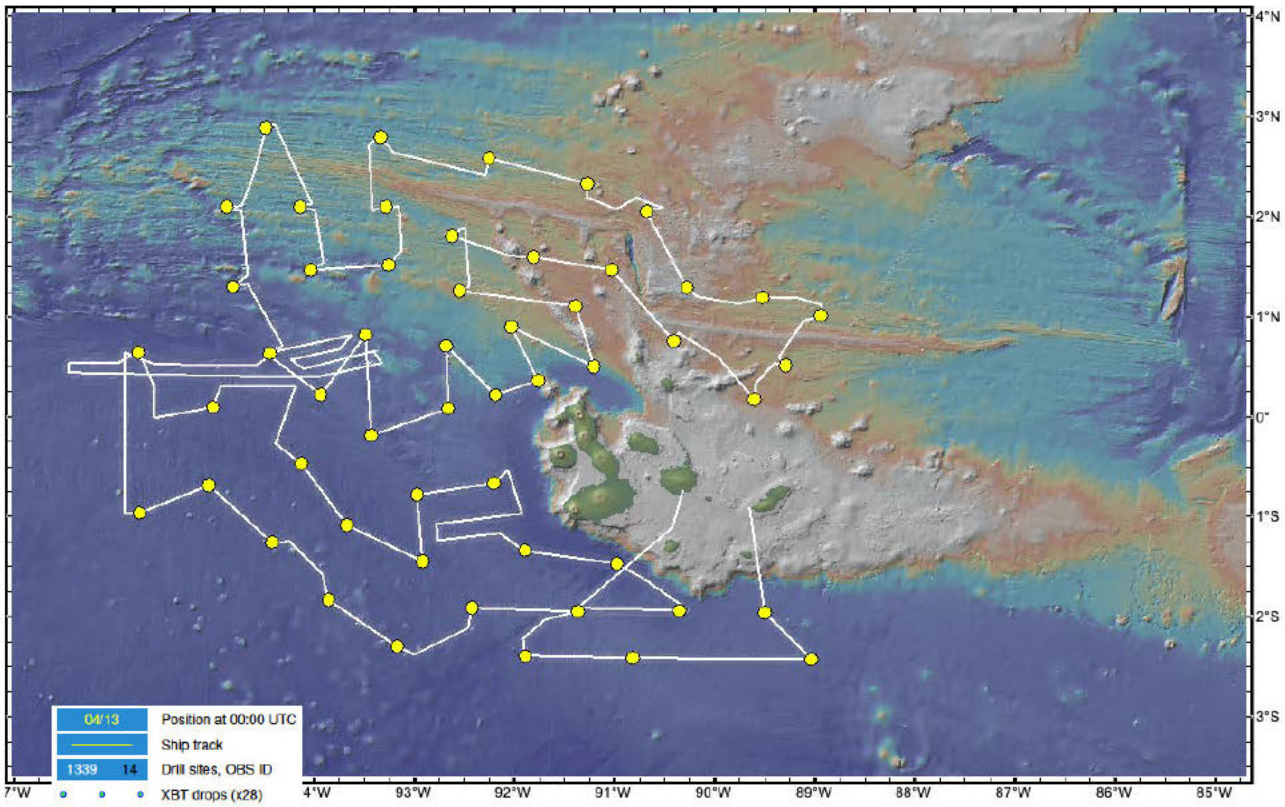


Figure I1. *MGL2304 ship track showing OBS locations (green numbers), XBT drop points (dark outlined circles) and the position at the start of each GMT day (yellow label).*

I.2 OBS Recovery Routine

We used the ELogger system for Watch standing records.

Complete Recovery Workflow for the Science Team

[A] Shift Summary Responsibilities

1. Designate who on shift will do mag recovery/deployment.
2. Designate who on shift maintains systems and e-log.
3. Keep up with the EM124/712 bathymetry processing.
4. Disable/enable all systems for approach/leaving the OBS sites.
5. Maintain the E-Log
6. Answer the phone

[B] Systems

On APPROACH to OBS Site:		On LEAVING OBS Site:	
1	Bridge will radio when we are 15-minutes out from OBS	1	Bridge will notify on departure
2	1-2 on shift should help pull in the magnetometer	2	1-2 on shift should help deploy the magnetometer
3	Disable the following four systems from the lab:	3	Enable the same four systems from the lab:
	MAG/BOB Software		**MAG/BOB Software**
	1 Turn off mag sampling (mag will be left on deck)		1 Open BOB Program. Confirm it is set to SR2411
	2 Turn off MAG/BOB Software		2 Go through Tabs 1-4, Connect on tab 2&3 --> Next
	3 Close BOB Program		3 Tab 4: Click Zero Depth Sensor and Set Mag Clock
	4 Radio to Deck that Mag is off		4 Turn sampling on
	Knudson 3.5khz Single Beam Echo Profiler		**Multibeam 124/712**
	1 Click Recording -> End Line		1 Start pinging
	2 Click depth to turn off		2 Start recording
	ADCP		**SBP 29**
	1 Stop Recording		1 Click Play Button
	2 Click "Yes"		2 Click Green Button
	SBP 29		3 Double Click SR2411 Folder, SGY_Processed Directory, OK
	1 Click Green Button		4 Click Red Button
	2 Click Red Button		5 Double Click SR2411 Folder, TOPAS-RAW Directory, OK
	3 Click Play Button (right directed arrow)		**Knudson 3.5khz Single Beam Bottom Profiler**
			1 Start Transmit
	Multibeam 124/712 (do this when the Magy is confirmed on deck)		2 Click Recording -> Start Line
	1 Stop Recording		**ADCP**
	2 Stop Pinging		1 Start Recording

[C] Logging E-LOGGER: http://sr-elogger.ucsd.edu:8090/sr2411-SE/page

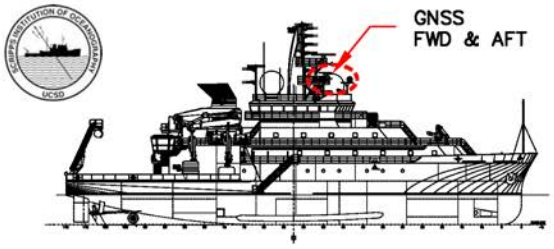
On approach and during recovery, record the following events in the e-logger

1	When mag is on deck
3	When the FIRST BURN command is sent down to site
4	When the BURN IS ACKNOWLEDGED by OBS
5	When OBS breaches surface and how this is confirmed (e.g. by sight or radio)
6	When OBS is on deck
7	When mag is re-deployed

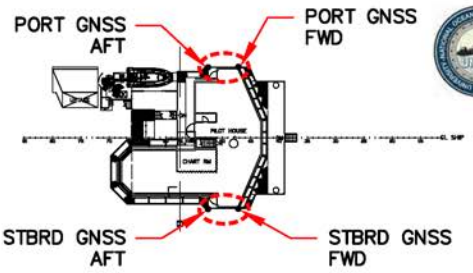
[D] Non-Recovery Specific Shift/Daily Logging

1	Log any time ANY system is turned on or off
2	Log time and successful reading for XBT deployment/calibration

I.3 Sensor offsets

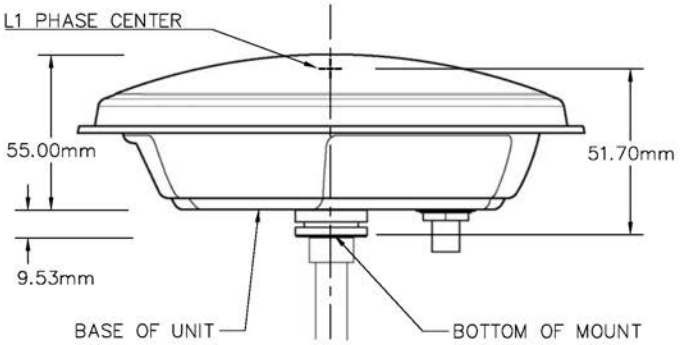


POINT LOCATION ON VESSEL



BRIDGE DECK

WCI REF #	LONGITUDINAL OFFSET (X) POSITIVE FORWARD	TRANSVERSE OFFSET (Y) POSITIVE TO STARBOARD	BASELINE OFFSET (Z) POSITIVE DOWN	SENSOR DESCRIPTION AND NOTES
1015	-7.5786	-7.0582	-21.2910	CENTER OF PORT AFT SEAPATH NOVATEL 850 GNSS ANTENNA @ BASE OF MOUNT
1015	-7.5786	-7.0582	-21.3427	CENTER OF PORT AFT SEAPATH NOVATEL 850 GNSS ANTENNA @ L1 PHASE CENTER
1015	-7.5786	-7.0582	-21.3430	CENTER OF PORT AFT SEAPATH NOVATEL 850 GNSS ANTENNA @ L2 PHASE CENTER
1007	-3.5782	-7.0447	-21.2746	CENTER OF PORT FWD SEAPATH NOVATEL 850 GNSS ANTENNA @ BASE OF MOUNT
1007	-3.5782	-7.0447	-21.3263	CENTER OF PORT FWD SEAPATH NOVATEL 850 GNSS ANTENNA @ L1 PHASE CENTER
1007	-3.5782	-7.0447	-21.3266	CENTER OF PORT FWD SEAPATH NOVATEL 850 GNSS ANTENNA @ L2 PHASE CENTER
8127	-7.7113	6.6391	-21.2974	CENTER OF STBD AFT SEAPATH NOVATEL 850 GNSS ANTENNA @ BASE OF MOUNT
8127	-7.7113	6.6391	-21.2974	CENTER OF STBD AFT SEAPATH NOVATEL 850 GNSS ANTENNA @ L1 PHASE CENTER
8127	-7.7113	6.6391	-21.3491	CENTER OF STBD AFT SEAPATH NOVATEL 850 GNSS ANTENNA @ L2 PHASE CENTER
8117	-3.7061	6.6183	-21.2691	CENTER OF STBD FWD SEAPATH NOVATEL 850 GNSS ANTENNA @ BASE OF MOUNT
8117	-3.7061	6.6183	-21.3208	CENTER OF STBD FWD SEAPATH NOVATEL 850 GNSS ANTENNA @ L1 PHASE CENTER
8117	-3.7061	6.6183	-21.3211	CENTER OF STBD FWD SEAPATH NOVATEL 850 GNSS ANTENNA @ L2 PHASE CENTER



NOVATEL GNSS-850 ANTENNA
L1 PHASE CENTER OFFSET
PER KONGSBERG SEAPATH 380 MANUAL

RV SALLY RIDE

SCI. EQUIP. SURVEY, MARCH 2024
COMPLETED AT NIMITZ MARINE FACILITY
SAN DIEGO, CALIFORNIA

DWG3033-001.DWG

DATE:	2024-04-01
DWG BY:	JWD
CHK BY:	CRB2
SCALE:	NTS
REV #:	
JOB NO:	3033-001

WESTLAKE CONSULTANTS INC.
ENGINEERING ◆ SURVEYING ◆ PLANNING
PACIFIC CORPORATE CENTER
15115 S.W. SEQUOIA PARKWAY, SUITE 150
TIGARD, OREGON 97224
(503) 684-0652
FAX (503) 624-0157

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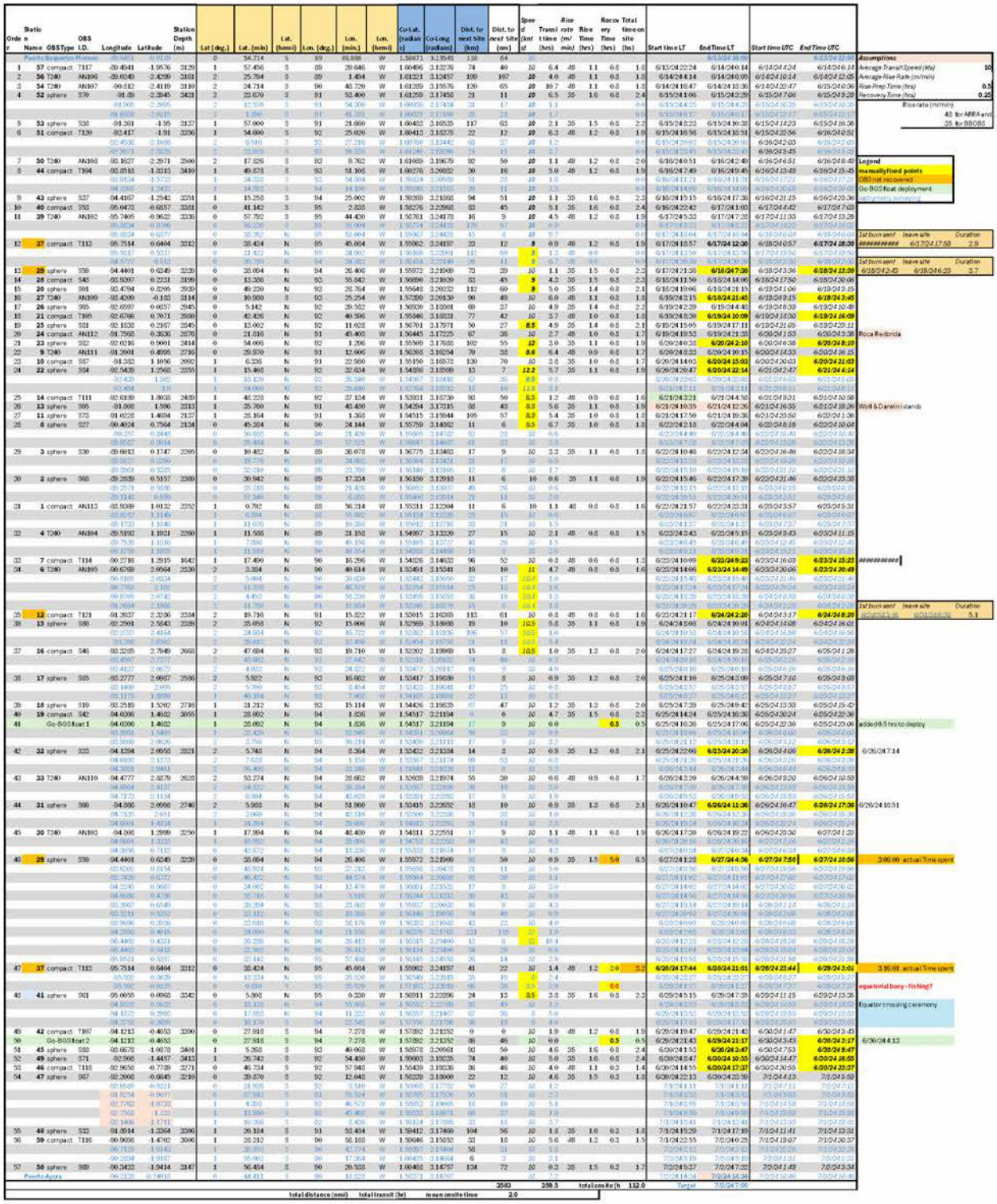
TABLE 1 R/V SALLY RIDE ELEMENT COORDINATE SUMMARY MAY 2021			
ELEMENT	COORDINATE (METERS)		
	X+ Fwd	Y+ Stbd	Z+ Down
GRANITE BLOCK	3.490	-0.233	-0.054
REF BLOCK STBD AFT	0.000	0.000	0.000
REF BLOCK PORT AFT	0.000	-0.458	0.001
REF BLOCK PORT FWD	0.610	-0.459	0.001
REF BLOCK STBD FWD	0.610	0.001	0.001
REF BLOCK CENTER	0.304	-0.229	0.000
IMU	NOT INSTALLED		
SBP29 @ Array	2.100	-2.293	1.011
124TX @ Array	2.059	-0.762	1.009
124RX @ Array	-2.346	-0.212	1.005
712TX @ Array	0.331	0.067	1.007
712RX @ Array	-1.090	0.413	1.004
HIPAP 501 retracted position HiPAP 501 deployed position	-3.808	0.401	1.007
Echo 12 KHZ	-3.808	-2.647	1.006
PORT I/B SEACHEST (Spare)	-3.809	-1.428	1.008
PORT SEACHEST	-21.270	-6.592	-1.022
STBD SEACHEST	-20.853	6.312	-0.948
STBD O/B SEACHEST	21.330	1.464	0.058
Bowthruster	19.339	-0.225	0.992
INCUBATOR PUMP	17.774	1.164	-3.136
O/B UNCONT SEAWATER PUMP 1	16.625	1.987	-3.145
I/B UNCONT SEAWATER PUMP 2	16.631	1.568	-3.145
Ship ops echosounder	Hull, covered by keel block		
Ship ops speed log	7.460	0.390	1.010
ADCP EC150	-3.806	2.226	1.005
EK80 18 KHZ	-1.367	2.225	1.007
EK80 70 KHZ	0.156	2.304	1.009
EK80 200 KHZ	0.762	1.997	1.010
EK80 120 KHZ	0.765	2.685	1.009
EK80 38 KHZ	1.672	2.229	1.009
Knudsen SBP	3.170	0.836	0.991
300 KHZ ADCP	6.246	0.393	1.008
38 KHZ ADCP	6.915	-1.435	1.004
150 KHZ ADCP	6.549	-2.654	1.002
BRIDGE FATHOMETER	3.195	-3.367	1.008
PORT CAMERA	-2.281	-2.479	1.065
STBD CAMERA	-2.280	2.051	1.063
Valeport Thru-hull SVS retracted position	-2.921	-0.517	1.008
Valeport Thru-hull SVS deployed position	At Hull penetration Could not operate		
Rev-1 MRU - Hydrins (@ Phase Center)	0.490	-0.328	-0.087
Rev-1 MRU - SEATEX 5+ (@ Phase Ctr)	0.511	-0.111	-0.017
MRU MARKEY WINCH	-22.460	3.471	-9.127
Sea-Bird hull temperature sensor	-2.973	-0.112	0.909
BGM-3 sensor	0.821	1.944	-3.411
MOONPOOL	-28.777	-2.051	-0.077
MOONPOOL ON AFT DECK	-28.762	-2.047	-5.768

I.4 Timeline



J: Permits

J.1 Costa Rica

Ministry of the Environment Permit: SINAC-SE-DE-794-2024 firmado.pdf

MINISTERIO DE AMBIENTE Y ENERGÍA | GOBIERNO DE COSTA RICA

SISTEMA NACIONAL DE AREAS DE CONSERVACIÓN

SECRETARÍA EJECUTIVA
DIRECCIÓN EJECUTIVA

June 4, 2024
SINAC-SE-DE-794-2024

Dr. Emilie Hooft
Scientific Expedition / RV Sally Ride
Department of Earth Sciences
University of Oregon, USA

Dear Dr. Hooft:

Upon request from Dr. Stuart Banks, Principal Marine Scientist of the Charles Darwin Foundation, in Galapagos, Ecuador, I am writing to you to communicate the consent of the Government of Costa Rica for the scientific vessel RV Sally Ride to take bathymetric, gravitational and magnetic data during its innocent passage from the port of Golfito, in Costa Rica, to the Galapagos Islands, from June 7 to June 11 of this year.

According to Costa Rican regulations, gathering this kind of scientific records during the innocent passage of a vessel through the waters of our Exclusive Economic Zone does not require the prior obtaining of any formal permit. However, I would like to remark our institutional interest in having access to such data coming from this and similar future scientific marine expeditions, which certainly shall be of great value to universities and other marine research entities in our country.

Sincerely,

(Firmado digitalmente con GAUDI)
David Chavarría Morales
DIRECTOR EJECUTIVO a.i

DCHM/GIA /correspondencia enviada Dirección Ejecutiva 2024

Dirección: Santa Rosa de Santo Domingo de Heredia,
Cementerio 300 Norte y 300 Oeste, Parque Ecológico.
Central telefónica: (506) 2522-6500 / 2522-6666
Apdo: 11384-1000, San José Costa Rica
www.sinac.go.cr

J.2 Ecuador Navy (INOCAR)

Marine Directorate Permit: *AUTORIZACION_02342024O_SALLY_RIDEsigned_signed-signed.pdf*

AUTORIZACIÓN NRO. DIRNEA-SNA -NRO. 0234-2024

Para el ingreso con fines científicos de la embarcación "SALLY RIDE"

RICARDO UNDA SERRANO
CONTRALMIRANTE

DIRECTOR NACIONAL DE LOS ESPACIOS ACUÁTICOS.

C O N S I D E R A N D O:

Que, conforme al Art. 158 de la Constitución de la República del Ecuador vigente, las Fuerzas Armadas tienen como misión fundamental la defensa de la soberanía y la integridad territorial.

Que, la Convención de las Naciones Unidas sobre el Derecho del Mar - CONVEMAR, fue adoptada en 1982 y establece un exhaustivo régimen de ley y orden en los océanos y mares del mundo, emanando reglas que rigen todos los usos posibles de los océanos y sus recursos.

Que, el 22 de mayo de 2012, el Ecuador se adhirió a la Convención de las Naciones Unidas sobre el Derecho del Mar CONVEMAR, adhesión que fue aprobada por la Asamblea Nacional y publicada en el Registro Oficial Suplemento 715 del 1 de junio de 2012. Posteriormente se ratificó bajo aprobación de la Asamblea Nacional, mediante Decreto Ejecutivo No. 1238, publicado en Registro Oficial 759 del 2 de agosto de 2012.

Que, el Estado ecuatoriano, según lo establecido en el Art. 56 de la CONVEMAR, goza de derechos de soberanía en su Zona Económica Exclusiva para los fines de exploración y explotación, conservación y administración de los recursos naturales, tanto vivos como no vivos, de las aguas suprayacentes al lecho y del lecho y el subsuelo del mar. Así mismo, tiene jurisdicción con respecto a la investigación científica marina, la protección y preservación del medio marino, entre otros.

Que, conforme a lo establecido en el Art. 58 de la CONVEMAR, en la Zona Económica Exclusiva todos los estados, sean ribereños o sin litoral, gozan de las libertades de navegación y de otros usos del mar internacionalmente legítimos relacionados con dichas libertades, tales como los vinculados a la operación de buques, entre otros. Paralelamente, en el ejercicio de sus derechos y en el cumplimiento de sus deberes en la Zona Económica Exclusiva, los estados tendrán debidamente en cuenta los derechos y deberes del Estado ribereño y cumplirán las leyes y reglamentos dictados por el mismo de conformidad con las disposiciones de la Convención y otras normas de derecho internacional.

Av. General Elizalde 101 y Malecón Simón Bolívar
Teléfono: 04-2-320400 Ext: 37124.- correo electrónico: dirnea@armada.mil.ec
Guayaquil– Ecuador

Que, con relación a la ejecución de leyes y reglamentos del estado ribereño, conforme lo establecido en el Art. 73 de la CONVEMAR, se faculta al Estado ecuatoriano, en el ejercicio de sus derechos de soberanía para la exploración, explotación, conservación y administración de los recursos vivos de la Zona Económica Exclusiva, a tomar las medidas que sean necesarias para garantizar el cumplimiento de las leyes y reglamentos dictados de conformidad con esta Convención.

Que, el Ecuador es Estado miembro de la Organización Marítima Internacional, OMI, desde 1956 y como tal es parte de los principales convenios e instrumentos de la OMI, relacionados con la seguridad marítima y protección del medio marino, como son: el Convenio Internacional para la Seguridad de la Vida Humana en el Mar (SOLAS 74), el Convenio Internacional para prevenir la contaminación por los buques (MARPOL 73/78); el Convenio Internacional de Líneas de Carga, LL/66, el Convenio Internacional sobre Arqueo de buques, Arqueo 1969; instrumentos donde el Estado de abanderamiento puede autorizar a una organización a actuar en su nombre para los reconocimientos y certificaciones necesarios para garantizar que las naves cumplen con las condiciones mínimas relacionadas con la seguridad marítima y la prevención de la contaminación marítima.

Que, mediante el cuarto suplemento del Registro Oficial Nro. 472 de 14 de junio de 2021, se promulgó la Ley Orgánica de Navegación, Gestión de la Seguridad y Protección Marítima y Fluvial en los Espacios Acuáticos, derogando **el Código de Policía Marítima.**

Que, de conformidad con lo establecido en el Art. 9 de la Ley Orgánica de Navegación, Gestión de la Seguridad y Protección Marítima y Fluvial en los Espacios Acuáticos, la Fuerza Naval del Ecuador es la Autoridad Marítima Nacional (**representada por el señor Director Nacional de los Espacios Acuáticos**), que ejerce sus competencias institucionales en los espacios acuáticos nacionales, dentro del Sistema de Organización Marítima Nacional; ejercer atribuciones como Estado ribereño, Estado rector del puerto y Estado de abanderamiento con el fin de garantizar la soberanía nacional y precautelar la integridad de sus espacios acuáticos nacionales así como velar por la seguridad de las actividades marítimas, en el ámbito de sus competencias.

Que, de conformidad con lo establecido en el Art. 144, numeral 2) del Reglamento General a la Ley Orgánica de Navegación, Gestión de la Seguridad y Protección Marítima y Fluvial en los Espacios Acuáticos, publicado en el Registro Oficial Segundo Suplemento Nro. 343 de 30 de junio de 2023, textualmente dice: "Toda nave extranjera que pretenda ingresar en los espacios acuáticos nacionales con fines culturales, turísticos, recreativos, deportivos para navegar y realizar actividades en los espacios acuáticos nacionales deberá presentar su solicitud

ante la Autoridad Marítima Nacional, por medio de una agencia naviera autorizada en nuestro país.

Que, con Orden General Nro. 135, de 15 de agosto de 2023, el señor Ministro de Defensa Nacional, emitió la Resolución No. **ARE-DIRNEA-SNA-008-2023**, mediante la cual RESUELVE: Art. 1.- Establecer la "NORMA TÉCNICA QUE REGULA EL PROCEDIMIENTO Y REQUISITOS PARA EL INGRESO DE NAVES DE BANDERA EXTRANJERA EN LOS ESPACIOS ACUÁTICOS NACIONALES CON FINES CIENTÍFICOS, CULTURALES, TURÍSTICOS, RECREATIVOS Y DEPORTIVOS."

Que, mediante acuerdo ministerial Nro. 439 del 06 de diciembre del 2023 y orden general Nro. 051 del 07 de diciembre del 2023. ACUERDOS MINISTERIALES, LIT.B "TRASBORDOS DE SEÑORES OFICIALES ALMIRANTES POR NECESIDADES DEL SERVICIO"; ACUERDA: Artículo 1. - Dar el pase por necesidades del servicio, al siguiente personal de señores oficiales almirantes pertenecientes a la Fuerza Naval: 0910736263 CALM RICARDO MANUEL UNDA SERRANO de la Dirección General de Intereses Marítimos, a la Dirección Nacional de los Espacios Acuáticos, como Director Nacional.

Que, el señor Lawrence Ian Jeffers, con pasaporte Nro. 674122005, de nacionalidad ESTADOUNIDENSE, representado por el señor Antonio Moreano Silva, con cédula de ciudadanía Nro. 1712197381, de la Agencia Naviera GALAYACHTS S.A., presentó el 17 de mayo del 2024 una solicitud encaminada a obtener autorización para visitar las Islas Galápagos, con fines científicos, a bordo de la embarcación denominada "SALLY RIDE", con matrícula / IMO: 1246681 / 9695171, de bandera de ESTADOS UNIDOS, con 72,6 m -238 ft de eslora, 15,2 m - 50 ft de manga, 5,2 m - 17 ft de calado y 2641 toneladas de registro bruto, del 10 de junio al 05 de julio del 2024.

Que, el Sr. Mayr. Lenin Enrique Torres Mejía, Jefe de la Unidad Nacional de INTERPOL, mediante oficio Nro. PN-INTERPOL-QX-2024-1088-O, del 21 de mayo del 2024, remite el parte policial Nro. 2024052111341669807 fecha 21 de mayo del 2024 elaborado por el señor Cabo Primero de Policía Jimmy Ortiz George, documento mediante el cual informa que se ha verificado los manifiestos de la tripulación y pasajeros de la embarcación "SALLY RIDE", sin existir novedades de importancia.

En uso de la facultad delegada y de conformidad con lo señalado anteriormente, esta Dirección Nacional.

AUTORIZACIÓN NRO. DIRNEA-SNA -NRO. 0234-2024

Para el ingreso con fines científicos de la embarcación "SALLY RIDE"

A C U E R D A:

Art. 1.- Autorizar el ingreso a los espacios marítimos jurisdiccionales de la embarcación denominada SALLY RIDE, con MATRICULA/IMO: 1246681 / 9695171, de bandera de ESTADOS UNIDOS, comandada por el señor Lawrence Ian Jeffers, con pasaporte Nro. 674122005, a las Islas Galápagos, del 10 de junio al 05 de julio del 2024, con Christian Randal con pasaporte nro. 573149347, Jackson John con pasaporte nro.569407475, Haddon Derek con pasaporte nro. 674443100, Monocandilos Anthony con pasaporte nro. 527581442, Connelly Davidcon pasaporte nro. 551911258, Morfitt Samuel con pasaporte nro. A07275810, Anastasi Ellenora con pasaporte nro. 595778300, Manuel Wilson con pasaporte nro. 538560416, Sheffield Ryan con pasaporte nro. 663633688, Copeland Andre con pasaporte nro. 559090091, Buccigross Joseph con pasaporte nro. 648902205, Joaquin Angelica con pasaporte nro. 561476908, Look Ashley con pasaporte nro. 667098429 y Hooft Emilie con pasaporte nro. HB689898, Toomey Douglas con pasaporte nro. 562165745, Apuzen-Ito Garrett con pasaporte nro. 641173388, Shen Yang con pasaporte nro. 669075097, Quisanga Andrea con pasaporte nro. 0550254353, Castillo Whashington con pasaporte nro. 1727401240, Marcayata Esther con pasaporte nro. A4470595, Autum Kaisa con pasaporte nro. 554083597, Kongpet Panupong con pasaporte nro. AD1005395, Hoots Charles con pasaporte nro. 525246469, Sassard Vincent con pasaporte nro. 18CI69083, Young Madeline con pasaporte nro. 650695930, Islam Apu Saiful con pasaporte nro. EL0692942, Nathan Michelle con pasaporte nro. 571699709, Rai Buddhi con pasaporte nro. 656408802, Brewer Hannah con pasaporte nro. A25988717, Kot Daniel con pasaporte nro. 550504414, Gardner Alan con pasaporte nro. 526176032, McCarthy Gavin con pasaporte nro. 539072547, Manger Joshua con pasaporte nro. A35311998, Boettiger Amber con pasaporte nro. 543081977, Thompson Maya con pasaporte nro. A36324749, a bordo de la mencionada embarcación con el siguiente itinerario:

FECHA	ACTIVIDAD
10 de junio del 2024	Arribo a Pto. Baquerizo Moreno
13 de junio del 2024 al 03 de julio del 2024	Zarpe a viaje científico
03 de julio del 2024	Arribo a Pto. Ayora
05 de julio del 2024	Salida de Pto. Ayora

Art. 2.- Las naves y artefactos navales, sea cual fuere su bandera, para arribar a puertos ecuatorianos, cumplirán los procedimientos de recepción de naves en la Capitanía de Puerto correspondiente, conforme a la normativa, según lo establece el artículo 43 de la Ley de Navegación, Seguridad y Gestión de la Seguridad Marítima y Fluvial en los Espacios Acuáticos y su Reglamento.

Art. 3.- Durante su permanencia en los espacios acuáticos nacionales ecuatorianos, la tripulación y los pasajeros deben cumplir estrictamente con todas

las normas legales y reglamentarias vigentes; así como, las disposiciones relacionadas con la conservación y preservación de las Reservas Naturales, Marinas y de Parques Nacionales, emitidas por las autoridades competentes.

Art. 4.- El responsable ante las autoridades ecuatorianas, por los pagos de tributos o por cualquier acontecimiento o imprevistos que produzca la nave o su tripulación y pasajeros, será la Agencia Naviera GALAYACHTS S.A..

Art. 5.- Es también responsabilidad de la Agencia Naviera GALAYACHTS S.A., dar estricto cumplimiento de lo dispuesto en los "Lineamientos para el Desarrollo de Actividades Relacionadas al Arribo, Estadía y Zarpe de Embarcaciones de Visitantes y Tripulantes", del 30 de noviembre del 2021.

Art. 6.- En el caso de que la Agencia Naviera GALAYACHTS S.A., incumpliere la normativa establecida, será motivo de suspensión de la presente autorización y se procederá a la respectiva denuncia en la Fiscalía amparado en el Art. 282, inciso primero del Código Orgánico Integral Penal; sin perjuicio de las sanciones administrativas, conforme lo establecido en el numeral 22 del artículo 15, de la Ley Orgánica de Navegación, Gestión de la Seguridad y Protección Marítima y Fluvial en los Espacios Acuáticos y su Reglamento.

COMUNÍQUESE Y PUBLÍQUESE. –

Dado en la Dirección Nacional de los Espacios Acuáticos, en Guayaquil, a los 21 días del mes de mayo del 2024.

EL DIRECTOR NACIONAL DE LOS ESPACIOS ACUÁTICOS

Firmado electrónicamente por:
RICARDO MANUEL UNDA SERRANO

Ricardo Unda Serrano
CONTRALMIRANTE

ACCIÓN	NOMBRES Y APELLIDOS	CARGO	FIRMA
Elaborado por	Sr. CBOS-GC Canchingre González Cristhian	Elaborador de Autorizaciones de ingreso de naves	Firmado electrónicamente por: CRISTHIAN LEONARDO CANCHINGRE GONZALEZ
Revisado por:	Sr. CPCB-SU Perugachi Salamea Carlos	Subdirector de Seguridad a la Navegación.	Firmado electrónicamente por: CARLOS FERNANDO PERUGACHI SALAMEA

J.3 Galápagos National Park

J.3.1 DPNG Permit - permiso_investigación_pc-10-24-signed (1).pdf

REPÚBLICA DEL ECUADOR

Ministerio del Ambiente, Agua y Transición Ecológica

Parque Nacional GALÁPAGOS Ecuador

DIRECCIÓN DEL PARQUE NACIONAL GALÁPAGOS (DPNG)
DIRECCIÓN DE GESTIÓN AMBIENTAL
PERMISO DE INVESTIGACIÓN CIENTÍFICA: **N° PC-10-24**

Título del Proyecto: Un experimento de datos abiertos para visualizar la interacción entre la pluma y la Cordillera Subamarina de Galápagos.	
Nombre del Investigador principal: Emilie Hooft. *e-mail: emilie@uoregon.edu*	**Contraparte DPNG:** Jenifer Suarez.
Participantes: *Douglas Toomey, Garrett Ito, Yang Shen, Mario Ruiz, Rebeckah Hufstetle, Zhangbao Cheng, Hannah Brewer, Daniel Kot, Timothy Kane, Kevin Nikolaus, Alan Gardner.*	
Institución: *Fundación Charles Darwin.*	
Se requiere colectar muestras: NO.	
Vigencia del Permiso de Investigación: 22 de febrero de 2024 al 22 de febrero de 2025.	

Condiciones de cumplimiento obligatorio:

1. Galápagos es un Archipiélago frágil, su endemismo y diversidad constituyen elementos sustanciales para regular todas las acciones de investigación científica que se requieran ejecutar en las áreas protegidas del Parque Nacional Galápagos. En consecuencia, los investigadores interesados en desarrollar proyectos de investigación científica en las áreas protegidas de Galápagos, deberán aplicar metodologías de mínimo impacto (no invasiva) sobre las especies objeto de estudio o ecosistemas. La Autoridad Ambiental se reserva el derecho de ejecutar las acciones de prevención respectiva, según sea el caso.
2. La participación y coordinación de la contraparte institucional es obligatoria y vinculante en el desarrollo de proyectos de investigación científica, y estará presente durante la fase de regulación y control de los permisos de investigación aprobados, concomitante con el mantenimiento de la integridad ecológica y la biodiversidad de los ecosistemas insulares y marinos de Galápagos.
3. El investigador principal y los participantes autorizados deberán cumplir estrictamente con todas las regulaciones establecidas en el Manual de Procedimientos para Científicos Visitantes y Protocolos para viajes de Campo y Campamentos en las Islas Galápagos.
4. Únicamente el equipo de investigación autorizado, se encuentra habilitado a participar en cada una de las fases que comprende el desarrollo del proyecto de investigación aprobado.
5. Los investigadores principales o participantes que registren incumplimientos a las obligaciones contenidas en los permisos de investigación, no podrán participar en ninguna de las fases de investigación aprobada por esta Dirección.
6. Los datos, muestras o elementos constitutivos en el marco de un permiso de investigación son propiedad del Estado ecuatoriano. En consecuencia, el análisis de datos y avances de la investigación deberán estar disponibles permanentemente para la Autoridad Ambiental o contraparte institucional asignada, existiendo el compromiso de usarlos únicamente para acciones de manejo.
7. La inclusión de nueva metodología, sitios de estudio, muestras, etc., deberá contar con el respectivo pronunciamiento de viabilidad por parte de la contraparte asignada, siendo el investigador principal responsable de informar oportunamente a la Autoridad Ambiental lo antes señalado, a través del formato para inclusiones correspondiente.
8. El permiso de investigación no faculta la ejecución de actividades de interpretación o educación ambiental en las áreas de estudios autorizadas. Para ello, es necesario gestionar oportunamente con la Dirección de Educación y Participación Social de la DPNG la autorización respectiva.
9. El material audiovisual que se genere al amparo del permiso de investigación, tiene como finalidad únicamente alcanzar los objetivos científicos del proyecto propuesto. En el caso de requerir material audiovisual para comercializar, difundir por redes u otros medios, es necesario gestionar oportunamente con la Dirección de Educación Ambiental y Participación Social de la DPNG la autorización correspondiente.
10. Previo a la salida de campo, el investigador principal deberá presentar el AVISO DE VIAJE DE CAMPO de acuerdo con el formato establecido, con mínimo 72 horas de anticipación. De igual manera, deberá coordinar todas sus actividades con los responsables del Proceso de Conservación y Restauración de Ecosistemas Insulares e Investigación Aplicada de la DPNG o Unidades Técnicas, según sea el caso.
11. Una vez emitido el Permiso de Investigación, en un tiempo perentorio no superior a 5 días, deberá presentar un Plan o Cronograma de Trabajo de Salidas de Campo Semestral a su contraparte institucional asignada, a fin de acordar la presencia o no de un guardaparque (dependiendo la disponibilidad o sensibilidad ecológica del sitio).
12. Durante las salidas de campo, el investigador principal deberá portar una copia legible del Permiso de Investigación aprobado y Aviso de Viaje de Campo, y brindar todas las facilidades a efectos de ejecutar las acciones de control por parte del personal técnico Guardaparque asignado.
13. Posterior a la salida de campo, el investigador principal deberá remitir un INFORME TÉCNICO DE CAMPO por cada aviso de viaje autorizado, en un máximo de 5 días laborables.
14. Durante el trabajo de campo en sitios con acceso de turistas, deberá evitarse el contacto con estos, y no manipular fauna y flora mientras haya visitantes en el sitio. De no ser posible, el investigador principal deberá brindar una breve explicación de las actividades de investigación a los visitantes y posteriormente retomar el desarrollo de sus actividades.
15. *Los sitios autorizados son: Reserva Marina Galápagos y Hermandad.*

DIRECCIÓN DEL PARQUE NACIONAL GALÁPAGOS (DPNG)
DIRECCIÓN DE GESTIÓN AMBIENTAL
PERMISO DE INVESTIGACIÓN CIENTÍFICA: **N° PC-10-24**

16. *Se autoriza el uso de gravímetro BGM3, perfilador de subfondo de 3,5 khz, transductores de 12 KHZ, matriz multihaz Kongsberg EM 122 para topografía batimétrica 3D, y un magnetómetro geometrics G-882 (equipos de embarcación), mismos que permitirán recuperar los 53 sismómetros submarinos instalados en el 2023, para visualizar sísmicamente la pluma mantélica de Galápagos y su interacción con el centro de expansión de occidente de Galápagos.*

17. *Se autoriza, con fines estrictamente científicos, el uso de la embarcación R/V Sally Ride / bandera de Estados Unidos de América. Previo a su operación en las áreas protegidas de Galápagos, el investigador principal del presente proyecto deberá cumplir u obtener todos los documentos habilitantes, emitidos por el Consejo de Gobierno de Galápagos, Armada del Ecuador y otras instituciones competentes.*

18. *No se autoriza colectar, ni movilizar muestras.*

19. El investigador principal debe remitir el documento final ya aceptado para la publicación científica (informar también la existencia de otras publicaciones indirectas producto del presente estudio), la DPNG no realizará ninguna difusión científica en este marco, hasta contar con la publicación científica oficial.

20. Previo a la renovación del permiso de investigación, el investigador principal o su contraparte institucional deberá remitir lo siguiente:
    - Una copia digital (Tabla de Excel 97-2003) de los datos obtenidos durante la ejecución del proyecto.
    - Informe de difusión de resultados del proyecto (en el formato establecido por el Proceso de Investigación Aplicada) a un grupo meta (estudiante, guías, etc.), a fin de favorecer los procesos de formación continua.
    - Informe de criterio técnico emitido por la contraparte institucional asignada inherente a la propuesta de investigación presentada.
    - RESUMEN EJECUTIVO del proyecto (en el formato establecido por el Proceso el Proceso de Investigación Aplicada), con todos los detalles de la investigación y sus recomendaciones técnicas aplicables al manejo de las Áreas Protegidas.
    - Artículos y publicaciones resultantes del proyecto de investigación (en el caso de publicaciones únicamente en formato digital; si son libros o tesis, una copia impresa y una digital, en el caso de la versión digital deberán remitirse en dispositivos magnéticos adecuadamente identificados).

21. Los datos que se desprendan de esta investigación no podrán ser utilizados para estudios posteriores sin la previa autorización del Ministerio del Ambiente a través de la DPNG.

22. Para el fiel cumplimiento de las obligaciones dispuestas anteriormente se responsabiliza a Emilie Hooft. En consecuencia, la inobservancia de cualquiera de estas condiciones, así como la ejecución de actividades no autorizadas o el uso indebido de este documento, motivarán la suspensión inmediata del permiso de investigación.

Referencia legal: Mediante Resolución N° 71 del 14 de diciembre de 2012, se delega al Director de Gestión Ambiental suscribir permisos de investigación científica en las áreas protegidas de Galápagos.

Fecha de emisión: 21 de febrero de 2024.	EDWIN RODRIGO ROBALINO GARCES **Director de Gestión Ambiental** **DIRECCIÓN DEL PARQUE NACIONAL GALÁPAGOS**	Parque Nacional GALÁPAGOS Ecuador **Sello PNG**

J.3.2 Addendum - Autorización de inclusión.pdf

REPÚBLICA DEL ECUADOR

Parque Nacional GALÁPAGOS Ecuador

Oficio Nro. MAATE-DPNG/DGA-2024-0816-O

Puerto Ayora, 16 de mayo de 2024

Asunto: AUTORIZACIÓN DE INCLUSIÓN PARA PERMISO DE INVESTIGACIÓN PC-10-24.

Señora
Martha Leonor Romoleroux Paredes
Programa de Científicos Visitantes
FUNDACION CHARLES DARWIN
En su Despacho

De mi consideración:

En atención a su oficio No. FCD-CV-125-24 recibido el 13 de mayo de 2024, inherente al permiso de investigación No. PC-10-24 del proyecto denominado "***Un experimento de datos abiertos para visualizar la interacción entre la pluma y la Cordillera Subamarina de Galápagos***"; y con base en el Informe Técnico No. 23/IA-CONTROL-2024, se autoriza incluir lo siguiente:

1. **Colaborador:**

Andrea Quisanga / [redacted]
Ancdres Castillo / [redacted]
Esther Marcayata / [redacted]
Kaisa Autum / [redacted]
Panupong Kongpet / [redacted]
Charles Hoots / [redacted]
Vincent Sasard / [redacted]
Madeline Young / [redacted]
Saiful Apu / [redacted]
Michelle Nathan [redacted]
Buddhi Rai / [redacted]
Daniel Kot / [redacted]
Gavin McCarthy / [redacted]
Josh Manger / [redacted]
Amber Boettuger / [redacted]
Maya Thompson / [redacted]
Brent De Vries / [redacted]

1. **Equipo:**

Go-BGC FLOAT 1 / LAT. 1.4686 LONG. -94.0306. Flotador de recolección de datos.
Go-BGC FLOAT 2 / LAT. -0.4653 LONG. -94.1213. Flotador de recolección de datos.

Adicionalmente, se recomienda revisar cuidadosamente las obligaciones contenidas en su permiso de investigación, toda vez que su inobservancia puede conllevar a la anulación o impedir la renovación de su proyecto de investigación, particularmente la contenida en el numeral 20.

Finalmente, y en caso de tener cualquier inquietud, no dude en comunicarse con el Ingeniero Steve Bayas, Responsable del Proceso de Investigación Aplicada al teléfono 053706260 ext. 1140, quien le podrá proveer la información necesaria para solventar sus preguntas.

Sin otro particular, me suscribo.

Atentamente,

REPÚBLICA DEL ECUADOR

Parque Nacional GALÁPAGOS Ecuador

Oficio Nro. MAATE-DPNG/DGA-2024-0816-O

Puerto Ayora, 16 de mayo de 2024

Documento firmado electrónicamente

Blgo. Edwin Rodrigo Robalino Garcés
DIRECTOR DE GESTIÓN AMBIENTAL PNG

Referencias:
- MAATE-DPNG/DAF/GA/DA-2024-2928-E

Copia:
Señor Ingeniero
Steve Darwin Bayas López
Responsable (E) de los Procesos Investigación Aplicada y Cambio Climático

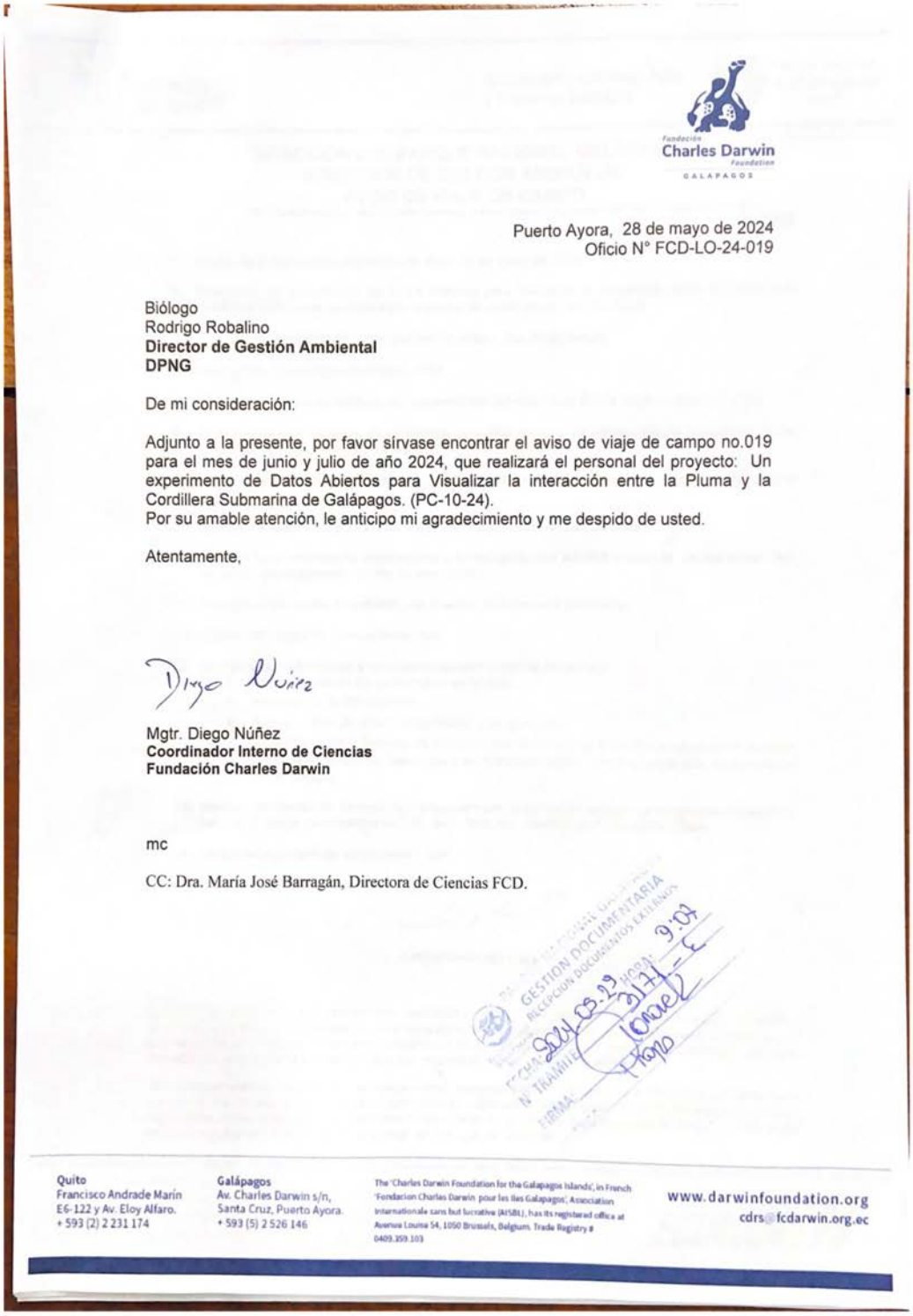
Señora Licenciada
Rosa Elizabeth Moreira Pillajo
Secretaria 1

em/sb

Firmado electrónicamente por: EDWIN RODRIGO ROBALINO GARCES

** Documento firmado electrónicamente por Quipux*

J.3.3 Approved Travel Advisory: Aviso de viaje n019-jun-jul-Emilie H.pdf



Fundación Charles Darwin Foundation
GALAPAGOS

Puerto Ayora, 28 de mayo de 2024
Oficio N° FCD-LO-24-019

Biólogo
Rodrigo Robalino
Director de Gestión Ambiental
DPNG

De mi consideración:

Adjunto a la presente, por favor sírvase encontrar el aviso de viaje de campo no.019 para el mes de junio y julio de año 2024, que realizará el personal del proyecto: Un experimento de Datos Abiertos para Visualizar la interacción entre la Pluma y la Cordillera Submarina de Galápagos. (PC-10-24).
Por su amable atención, le anticipo mi agradecimiento y me despido de usted.

Atentamente,

Diego Núñez

Mgtr. Diego Núñez
Coordinador Interno de Ciencias
Fundación Charles Darwin

mc

CC: Dra. María José Barragán, Directora de Ciencias FCD.

GESTIÓN DOCUMENTARIA
RECEPCIÓN DOCUMENTOS EXTERNOS
FECHA: 2024-05-29 HORA: 9:04
N° TRÁMITE: 2314-E
FIRMA:

Quito
Francisco Andrade Marín
E6-122 y Av. Eloy Alfaro.
+ 593 (2) 2 231 174

Galápagos
Av. Charles Darwin s/n,
Santa Cruz, Puerto Ayora.
+ 593 (5) 2 526 146

The 'Charles Darwin Foundation for the Galapagos Islands', in French 'Fondation Charles Darwin pour les Iles Galapagos', Association Internationale sans but lucrative (AISBL), has its registered office at Avenue Louise 54, 1050 Brussels, Belgium. Trade Registry # 0409.359.103

www.darwinfoundation.org
cdrs@fcdarwin.org.ec

REPÚBLICA DEL ECUADOR

Ministerio del Ambiente, Agua y Transición Ecológica

Parque Nacional GALÁPAGOS Ecuador

DIRECCIÓN DEL PARQUE NACIONAL GALÁPAGOS
DIRECCIÓN DE GESTIÓN AMBIENTAL
AVISO DE VIAJE DE CAMPO

"Este documento es un instrumento de control y seguimiento a los Procesos de Regulación de Permisos de Investigación Científica"

Nro. 019

1. **Fecha de presentación del aviso de viaje**: 28 de mayo de 2024.
2. **Proyecto**: Un experimento de Datos Abiertos para Visualizar la interacción entre la Pluma y la Cordillera Submarina de Galápagos. Permiso de investigación no. PC-10-24.
3. **Nombre del investigador principal del Proyecto:** Dra. Emilie Hooft.
4. **Institución**: Universidad de Oregon, FCD.
5. **Nombre y número de teléfono del responsable del viaje**: Dra. Emilie Hooft +1-542-632-2523.
6. **Fecha y nombre del lugar de embarque de salida de viaje de campo (Fecha de salida):** 12 de junio, 2024 de Puerto Baquerizo Moreno.
7. **Fecha y nombre del lugar de desembarque de retorno de viaje de campo (Fecha de retorno):** 3 de julio, 2024 en Puerto Ayora.
8. **Nombre de los Participantes del viaje:** Ver Anexo I: Lista de participantes.
9. **Nombre de la contraparte institucional o su delegado que asistirá al viaje de campo en calidad de autoridad ambiental**: Jenifer Suarez, DPNG
10. **Nombre de los sitios de estudio**: Ver Anexo II: coordenadas geográficas
11. **Nombre del lugar de campamento**: N/A
12. **Enumere las actividades a ejecutarse durante la salida de campo**:
    - Recuperación de 53 sismómetros en la RMG
    - Mapeo del fondo marino
    - Recopilación de datos magnéticos y de gravedad
    - Despliegue de 2 flotadores bioquímicos Go-BGS con el fin de visualizar sísmicamente la pluma mantélica de Galápagos y su interacción con el centro de expansión del Occidente de Galápagos.
13. **Nombre del medio de transporte a emplear para la salida de campo:** La expedición se llevará a cabo en el buque de investigación R/V Sally Ride, con bandera de los Estados Unidos.
14. **Incluir fecha y hora de cuarentena:** N/A

- Emilie Hooft

Responsable del viaje

Nota:

**Los medios de transporte que no se encuentren registrados en el permiso de investigación, deberán presentar una solicitud de inclusión a la Dirección del Parque Nacional Galápagos para su regulación. Se deja expresamente señalado que lo descrito en líneas anteriores, no exime el cumplimiento de los demás requisitos o documentos habilitantes que otras dependencias o instituciones soliciten para autorizar la operación en esta jurisdicción territorial.*

**El investigador principal del proyecto o su delegado serán responsables por la veracidad de la información que consta en la presente misiva. En caso de determinarse no conformidades relativas a la inobservancia de las obligaciones del permiso de investigación aprobado, ejecución de actividades no autorizadas o uso indebido de este documento, la Autoridad Ambiental procederá a suspender inmediatamente el permiso de investigación pertinente.*

Anexo I

Fundación Charles Darwin Foundation GALAPAGOS

LISTA DE PARTICIPANTES - EXPEDICIÓN R/V SALLY RIDE

Investigadora principal: Dra. Emilie Hooft - Universidad de Oregon

Nombre	Institución	Nacionalidad	Pasaporte/C.I.	Cargo, rol o función
Emilie Hooft	University of Oregon	Canada	[redacted]	IP: Professor
Douglas Toomey	University of Oregon	USA		Co-IP: Professor
Garrett Ito	University of Hawaii	USA		Co-IP: Professor
Yang Shen	University of Rhode Island	USA		Co-IP: Professor
Por decidir	INOCAR	Ecuador		INOCAR participante
Por decidir	GNP	Ecuador		GNP/CDF participante
Andrea Quisanga	IG-EPN #1	Ecuador		IG-EPN cientifica
Andres Castillo	IG-EPN #2	Ecuador		IG-EPN estudiante
Esther Marcayata Vaca	CDF	Ecuador		CDF
Madeline Young	University of Idaho	USA		Estudiante doctorado
Kaisa Autum	University of Oregon	USA		Estudiante doctorado
Panupong Kongpet	University of Hawaii	Thailand		Estudiante doctorado
Charles Hoots	University of Hawaii	USA		Estudiante doctorado
Vincent Sasard	Purdue University	France		Estudiante doctorado
Saiful Apu	University of Kansas	Bangladesh		Estudiante doctorado
Michelle Nathan	Honolulu Community College	USA		Participante/instructor
Buddhi Rai	University of Hawaii Maui College	USA		Participante/instructor
Hannah Brewer	WHOI	USA		Técnica marina
Daniel Kot	WHOI	USA		Técnico marino
Alan Gardner	WHOI	USA		Técnico marino
Gavin McCarthy	WHOI	USA		Técnico marino
Josh Manger	Scripps Institution of Oceanography	USA		Técnico marino
Amber Boettiger	Scripps Institution of Oceanography	USA		Técnico marino
Maya Thompson	Scripps Institution of Oceanography	USA		Técnico marino
Brent De Vries	Scripps Institution of Oceanography	USA		Técnico marino

Fundación Charles Darwin Foundation GALAPAGOS

Anexoll

Lista de sismógrafos y coordenadas

Station#	*Longitude*	*Latitude*	*Water Depth(m)*
1	-88.9357	1.0148	2458
2	-89.2894	0.5163	2352
3	-89.5723	0.0801	2017
4	-89.5193	1.1929	2280
5	-89.8553	1.6291	1947
6	-90.6777	2.0564	2317
7	-90.2709	1.2908	1698
8	-90.4035	0.7567	2058
9	-91.1994	0.4985	2727
10	-91.385	1.1039	2116
11	-91.0225	1.4688	2134
12	-91.2701	2.3145	2387
13	-91.8095	1.5935	2249
14	-92.6053	1.8071	2542
15	-92.2516	2.5638	2413
16	-93.3304	2.7864	2736
17	-93.2773	2.1009	2581
18	-93.2508	1.5045	2851
19	-94.0289	1.4688	2943
20	-93.4807	0.819	2942
21	-92.676	0.6944	2911
22	-92.5434	1.2552	2198
23	-92.0217	0.8991	2443
24	-91.7211	0.3561	2656
25	-92.1809	0.2226	2958
26	-92.676	0.0623	2976
27	-93.4011	-0.178	3121
28	-93.9317	0.2226	3158
29	-94.4445	0.6499	3281
30	-94.8071	1.2997	3259
31	-94.8601	2.1098	2663
32	-94.1527	2.092	2711

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Santa Cruz, Puerto Ayora.
+ 593 (5) 2 526 146

www.darwinfoundation.org
cdrs@fcdarwin.org.ec

Fundación
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33	-94.4799	2.8843	2633
34	-95.7444	2.6439	2936
35	-95.7355	1.9496	2888
36	-95.4968	1.1573	3378
37	-96.213	0.6499	3361
38	-95.9566	-0.0178	3162
39	-95.7355	-0.9436	3325
40	-95.0016	-0.7211	3406
41	-95.037	0.1157	3274
42	-94.1262	-0.4451	3313
43	-94.418	-1.2552	3346
44	-93.8344	-1.8516	2721
45	-93.6487	-1.0861	3404
46	-92.9325	-0.7923	3215
47	-92.2074	-0.6766	3253
48	-91.8891	-1.3353	3325
49	-92.8617	-1.4688	3383
50	-93.1624	-2.2967	3500
51	-92.4108	-1.9139	3348
52	-91.8891	-2.3947	3391
53	-91.3585	-1.9496	3011
54	-90.8103	-2.4125	3098
55	-89.4928	-1.9585	3121
56	-89.0241	-2.4303	3181
57	-89.8641	-2.4837	3165
58	-90.3328	-1.9674	3120
59	-90.9695	-1.4688	3643

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J.3.4 Approved Work Plan: Cronograma de actividades-signed.pdf

Fundación Charles Darwin Foundation
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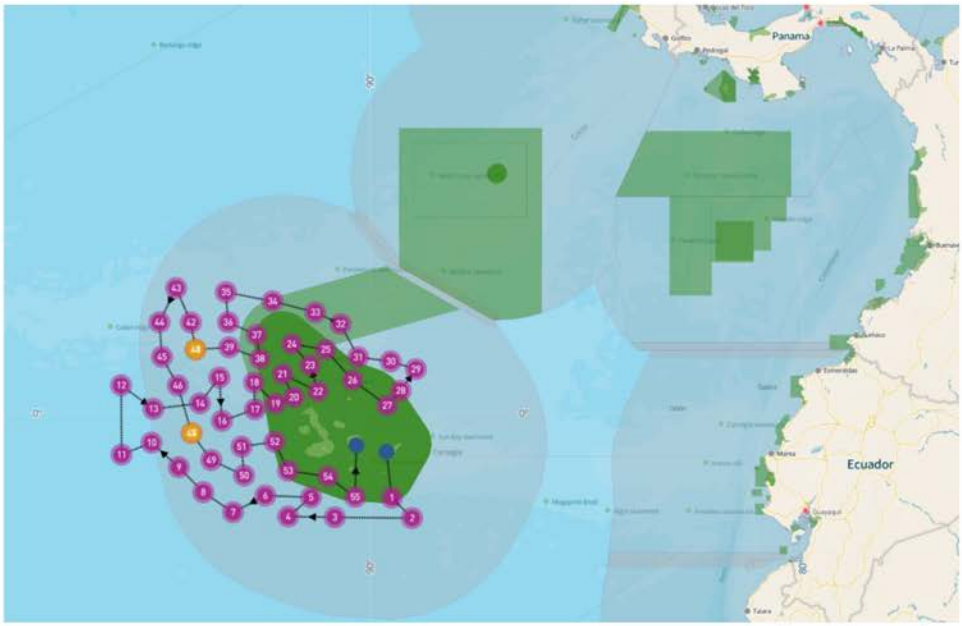
Cronograma de actividades

1. **Título del Proyecto**: Un Experimento de Datos Abiertos para Visualizar la Interacción entre la Pluma y la Cordillera Submarina de Galápagos.
2. **No. Permiso de Investigación:** PC-10-24
3. **Nombre del investigador principal del Proyecto:** Dra. Emilie Hooft
4. **Institución**: Univesrity of Oregon, Estados Unidos
5. **Fecha**: 27 de mayo de 2024

Programa:
10 de junio: Los científicos llegan a Galápagos.
11 de junio: El buque de investigación Sally Ride llega a Puerto Baquerizo Moreno
12 de junio: inspección del casco y carga científica.
13 de junio: el buque de investigación Sally Ride zarpa de Puerto Baquerizo Moreno
14 de junio al 2 de julio: recuperación de 53 sismómetros, mapeo del fondo marino, recopilación de datos magnéticos y de gravedad y despliegue de 2 flotadores bioquímicos Go-BGS. El orden preliminar de recuperación del instrumento se muestra en este mapa. Trabajaremos las 24 horas los siete días de la semana.



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3 de julio: el barco de investigación regresa a Puerto Ayora y desembarcan los científicos y técnicos del barco.
Del 4 al 6 de julio: el barco de investigación sale. Científicos en la estación de investigación Charles Darwin para reuniones posteriores al crucero, incluso con el personal de la FCD y una excursión.
7 de julio: la expedición está completa, los científicos parten de Galápagos o se quedan para tiempo personal

Firman en aceptación de este documento:

Emilie Hooft Digitally signed by Emilie Hooft Date: 2024.05.27 16:47:14 -07'00'

Dra. Emilie Hooft
Investigadora Principal
Universidad de Oregon

Dr. Rakan Zahawi
Director Ejecutivo
Fundación Charles Darwin

J.3.5 Transeúnte certificate: 40294415 FUNDACION CHARLES DARWIN-signed-signed.pdf

CONSEJO DE GOBIERNO REGIMEN ESPECIAL GALÁPAGOS

CERTIFICADO DE TRANSEUNTE No. 40294415

PUERTO AYORA martes, 04 junio 2024

En cumplimiento a lo dispuesto en los artículos 14 numeral 10 y artículo 39 de la Ley Orgánica de Régimen Especial de la provincia de Galápagos, y vista la solicitud presentada por: FUNDACION CHARLES DARWIN para realizar actividades de VOLUNTARIO/A, mediante la cual solicita el ingreso en calidad de transeúnte.

Una vez autorizado por la Dirección de Migración, Transporte y Movilidad de Vehículos y Maquinarias del Consejo de Gobierno del Régimen Especial de Galápagos por cuanto reúne los requisitos exigidos en el Art. 42 de la Ley Orgánica de Régimen Especial de la provincia de Galápagos, se extiende el presente certificado de **TRANSEÚNTE**, a la(s) siguiente(s) persona(s):

NOMBRES	IDENTIFICACIÓN	NACIONALIDAD	DESDE	HASTA
MR. PANUPONG KONGPET	[redacted]	Tailandia	10/06/2024	10/07/2024
EMILIE ERNESTINE EBBA HOOFT TOOMEY	[redacted]	Canadá	10/06/2024	10/07/2024
ALAN THOMPSON GARDNER	[redacted]	Estados Unidos	10/06/2024	10/07/2024
GAVIN PATRICK MC CARTHY	[redacted]	Estados Unidos	10/06/2024	10/07/2024
MICHELLE HOKULANI AKIE NATHAN	[redacted]	Estados Unidos	10/06/2024	10/07/2024
YANG SHEN	[redacted]	Estados Unidos	10/06/2024	10/07/2024
MADELINE KAELEIGH YOUNG	[redacted]	Estados Unidos	10/06/2024	10/07/2024
MAYA BARRETT THOMPSON	[redacted]		10/06/2024	10/07/2024
WASHINGTON ANDRES CASTILLO TOAPANTA	[redacted]	Ecuador	10/06/2024	10/07/2024
HANNAH MARIE BREWER	[redacted]	Estados Unidos	10/06/2024	10/07/2024
CHARLES ROBERT HOOTS	[redacted]	Estados Unidos	10/06/2024	10/07/2024
VINCENT LOUIS SASSARD	[redacted]	Francia	10/06/2024	10/07/2024
JOSHUA PHILLIP MANGER	[redacted]	Estados Unidos	10/06/2024	10/07/2024
DANIEL STEPHEN KOT	[redacted]	Estados Unidos	10/06/2024	10/07/2024

Nota: El presente certificado le permite permanecer en la Provincia como transeúnte durante las fechas indicadas previamente. Tome en cuenta que podrá ingresar a partir de 10 junio 2024, y su fecha máxima de salida es 10 julio 2024

Atentamente,

ERIKA ALEXANDRA GARCES MENDIETA

DIRECCIÓN DE MIGRACIÓN, TRANSPORTE Y MOVILIDAD DE VEHÍCULOS Y MAQUINARIAS
CONSEJO DE GOBIERNO DEL RÉGIMEN ESPECIAL DE GALÁPAGOS

40294415

CERTIFICADO DE TRANSEUNTE No. 40294415

PUERTO AYORA martes, 04 junio 2024

En cumplimiento a lo dispuesto en los artículos 14 numeral 10 y artículo 39 de la Ley Orgánica de Régimen Especial de la provincia de Galápagos, y vista la solicitud presentada por: FUNDACION CHARLES DARWIN para realizar actividades de VOLUNTARIO/A, mediante la cual solicita el ingreso en calidad de transeúnte.

Una vez autorizado por la Dirección de Migración, Transporte y Movilidad de Vehículos y Maquinarias del Consejo de Gobierno del Régimen Especial de Galápagos por cuanto reúne los requisitos exigidos en el Art. 42 de la Ley Orgánica de Régimen Especial de la provincia de Galápagos, se extiende el presente certificado de **TRANSEÚNTE**, a la(s) siguiente(s) persona(s):

NOMBRES	IDENTIFICACIÓN	NACIONALIDAD	DESDE	HASTA
SAIFUL ISLAM	[redacted]	Bangladesh	10/06/2024	10/07/2024
BUDDHI MAN RAI	[redacted]	Estados Unidos	10/06/2024	10/07/2024
ANDREA ELIZABETH QUISANGA TINILLO	[redacted]	Ecuador	10/06/2024	10/07/2024
KAISA RAQUEL AUTUMN	[redacted]	Estados Unidos	10/06/2024	10/07/2024
THOMAS BRENT DE VRIES	[redacted]	Estados Unidos	10/06/2024	10/07/2024
AMBER KAY BOETTIGER	[redacted]	Estados Unidos	10/06/2024	10/07/2024
GARRETT TETSUO APUZEN-ITO	[redacted]	Estados Unidos	10/06/2024	10/07/2024
DOUGLAS RAY TOOMEY	[redacted]	Estados Unidos	10/06/2024	10/07/2024

Nota: El presente certificado le permite permanecer en la Provincia como transeúnte durante las fechas indicadas previamente. Tome en cuenta que podrá ingresar a partir de 10 junio 2024, y su fecha máxima de salida es 10 julio 2024

Atentamente,

ERIKA ALEXANDRA GARCES MENDIETA

DIRECCIÓN DE MIGRACIÓN, TRANSPORTE Y MOVILIDAD DE VEHÍCULOS Y MAQUINARIAS
CONSEJO DE GOBIERNO DEL RÉGIMEN ESPECIAL DE GALÁPAGOS

40294415

J.4 Charles Darwin Foundation

J.4.1 Cooperation agreement: Convenio Emilie Hooft-signed.pdf

Fundación Charles Darwin Foundation GALAPAGOS

CONVENIO DE COOPERACIÓN

En Puerto Ayora, cantón Santa Cruz, Provincia de Galápagos, el **22 de mayo 2024**, intervienen por una parte el **Dr. Rakan Zahawi**, en calidad de Representante Legal de la Fundación Charles Darwin (FCD) quien en adelante se llamará la "Fundación", y por otra la **Dra. Emilie Hooft,** ciudadana de Canadá, con pasaporte no. **HB689898,** a quien en lo sucesivo denominaremos la "Voluntaria", para celebrar el siguiente Convenio de Cooperación.

PRIMERA. - DENOMINACIÓN DEL PROGRAMA: Un Experimento de Datos Abiertos para Visualizar la Interacción entre la Pluma y la Cordillera Submarina de Galápagos, permiso de investigación no. PC-10-24, liderado por la Dra. Emilie Hooft de la Universidad de Oregaon.

SEGUNDA. – DURACIÓN Y LUGAR: El período de cooperación será del 10 de junio hasta el 10 de julio del 2024. La Voluntaria desarrollará las actividades del proyecto en la Reserva Marina de Galápagos a bordo del buque de investigación R/V Sally Ride, con bandera de los Estados Unidos.

TERCERA. - OBJETIVOS: El objetivo de este proyecto es visualizar sísmicamente la pluma mantélica de Galápagos y su interacción con el centro de expansión del Occidente de Galápagos. En marzo/abril de 2023 se instalaron 53 sismómetros submarinos de banda ancha y estos se recuperarán en junio de 2024.

CUARTA. – PERFIL REQUERIDO:

- Doctorado en Geofísica, Oceanografía, Geología Marina u otro campo relacionado.
- Experiencia previa en el despliegue y recuperación de instrumentación submarina, como sismógrafos y/o instrumentos oceanográficos.
- Conocimiento profundo de la tectónica de placas, procesos volcánicos y geológicos submarinos.
- Familiaridad con técnicas de análisis de datos sísmicos y oceanográficos.
- Experiencia en trabajo de campo en entornos marinos remotos y exigentes.

QUINTA. - NÚMERO DE VOLUNTARIOS/AS: Para la ejecución de este programa, la expedición está compuesta por 23 participantes entre científicos, estudiantes y técnicos marinos.

SEXTA. - DETALLE DE LAS ACTIVIDADES: La Voluntaria realizará las siguientes actividades autorizadas en el permiso de investigación:

- Ubicar los instrumentos que fueron instalados en el fondo del mar en junio del 2023 a través de una señal acústica codificada.
- Recuperar los instrumentos cuando flotan hacia la superficie por su propia boyancia.
- Una vez en la superficie del mar, el personal del barco identifica el instrumento mediante una bandera o una luz estroboscópica montada en la parte superior.
- Subir el instrumento al barco con un palo y un gancho.
- Procesar los datos obtenidos.
- Mantener reuniones con la DPNG, INOCAR y el Instituto Geofísico-EPN

SEPTIMA. - MEDIOS Y RECURSOS PRECISOS PARA LLEVARLO A CABO. – El proyecto se lleva a cabo en el R/V Sally Ride que es un buque de investigación de 238 pies y 3043 toneladas brutas con bandera de EE. UU., de propiedad y operado por el Scripps Institution of Oceanography, University of California San Diego. El barco está clasificado por la Oficina Estadounidense de Transporte Marítimo y está inspeccionado por la Guardia Costera de los EE. UU.; está certificado para transportar un total de 55 personas de las cuales aproximadamente 20 son la tripulación del barco. El buque cuenta con los equipos y recursos necesarios para llevar a cabo el trabajo de la expedición.

OCTAVA. - FUENTES DE FINANCIAMIENTO PARA CUBRIR EL VIAJE, MANUTENCIÓN Y ALOJAMIENTO DURANTE LA ESTANCIA DE LOS VOLUNTARIOS. – El proyecto está financiado por la Fundación Nacional de Ciencias de Estados Unidos OCE-1928197

NOVENA. - MECANISMOS DE CONTROL, SEGUIMIENTO Y EVALUACIÓN PARA VERIFICAR EL CUMPLIMIENTO DE LOS FINES Y OBJETO DEL PROGRAMA POR PARTE DEL RESPONSABLE. La Voluntaria entregará el Informe de Campo requerido por la DPNG al haber finalizado la expedición

DECIMA. - ACEPTACIÓN POR PARTE DE LA ENTIDAD AUSPICIANTE DE SER RESPONSABLE POR LAS EVENTUALIDADES QUE PUEDAN DERIVARSE DEL CONVENIO. La entidad auspiciante asume la responsabilidad por cualquier eventualidad derivada del convenio entre la Voluntaria y la Fundación. La Voluntaria cuenta con seguro médico privado, asimismo, el buque cuenta con todos los instrumentos y equipos que garantizan la seguridad y bienestar de la Voluntaria y demás tripulantes. La Fundación responderá adecuadamente a cualquier situación imprevista durante el programa.

DECIMA PRIMERA. - HORARIO DE TRABAJO. – El horario de trabajo se ajustará a las necesidades del proyecto y a sus propias responsabilidades, sin embargo, el horario de la Fundación es de lunes a viernes de 07:45hrs. a 12:30hrs. y de 14:00hrs. a 17:15hrs.

DECIMA SEGUNDA. - CUMPLIMIENTO DE NORMAS Y PROCEDIMIENTOS. -La Voluntaria cumplirá con los reglamentos establecidos por la Dirección del Parque Nacional Galápagos en su Protocolo de Campo y con el Código de Ética y Conducta de la Fundación. Así mismo, la Voluntaria se compromete a cumplir con todas las leyes, reglamentos y normas establecidas por las autoridades nacionales y locales.

DECIMA TERCERA. - TERMINACION POR LAS PARTES: Se espera que tanto la Voluntaria como la Fundación mantengan una colaboración fructífera y mutuamente beneficiosa. No obstante, el presente Convenio podrá ser terminado anticipadamente por cualquiera de las partes. Esta justificación puede abarcar diversos motivos, como el incumplimiento de las obligaciones contractuales por parte de la otra parte, cambios en las circunstancias que dificulten o imposibiliten la continuación del Convenio, o eventos de fuerza mayor, entre otros.

DECIMA CUARTA. - PROPIEDAD Y CONFIDENCIALIDAD DE DOCUMENTOS: Toda información obtenida por la Voluntaria producto de su participación en el programa, será compartida con la DPNG, EPN, INOCAR y FCD de acuerdo a los requisitos de la DPNG que constan en el permiso de investigación.

DECIMA QUINTA. - NATURALEZA Y CARACTERÍSTICAS DEL CONVENIO.: Este convenio, por su naturaleza, es de orden estrictamente civil. Por lo tanto, no existe relación de carácter laboral durante la vigencia del presente Convenio.

DECIMA SEXTA. - JURISDICCIÓN EN CASO DE DISPUTAS En caso de controversia, las partes fijan su domicilio en Puerto Ayora y se someten a la jurisdicción de los jueces competentes.

Para constancia de aceptación de lo indicado, las partes firman en el lugar y fecha arriba indicados.

Firma electrónica de las partes.

Emilie Hooft

Digitally signed by Emilie Hooft
Date: 2024.05.27 16:49:00 -07'00'

Dr. Rakan Zahawi
LA FUNDACIÓN

Dra. Emilie Hooft
LA VOLUNTARIA

J.4.2 Addendum: Nuevo convenio Emilie Hooft-signed.pdf

Fundación Charles Darwin Foundation
GALAPAGOS

CONVENIO DE COOPERACIÓN

En Puerto Ayora, cantón Santa Cruz, Provincia de Galápagos, el **20 de junio de 2024**, intervienen por una parte el **Dr. Rakan Zahawi**, en calidad de Representante Legal de la Fundación Charles Darwin (FCD) quien en adelante se llamará la "Fundación", y por otra la **Dra. Emilie Hooft,** ciudadana de Canadá, con pasaporte no. **HB689898,** a quien en lo sucesivo denominaremos la "Voluntaria", para celebrar el siguiente Convenio de Cooperación.

PRIMERA. - DENOMINACIÓN DEL PROGRAMA: Un Experimento de Datos Abiertos para Visualizar la Interacción entre la Pluma y la Cordillera Submarina de Galápagos, permiso de investigación no. PC-10-24, liderado por la Dra. Emilie Hooft de la Universidad de Oregon. La expedición culminará el 10 de julio de 024, sin embargo, dos de los participantes, Maya Thompson con pasaporte no. A36324749 y Joshua Manger, pasaporte no. A35311998, deben permanecer en Galápagos por tiempo adicional para completar el procesamiento de los datos.

SEGUNDA. – DURACIÓN Y LUGAR: El período de cooperación será del 11 al 14 de julio del 2024.

TERCERA. - OBJETIVOS: El objetivo de este proyecto es visualizar sísmicamente la pluma mantélica de Galápagos y su interacción con el centro de expansión del Occidente de Galápagos. En marzo/abril de 2023 se instalaron 53 sismómetros submarinos de banda ancha y estos se recuperarán en junio de 2024.

CUARTA. – PERFIL REQUERIDO:

- Doctorado en Geofísica, Oceanografía, Geología Marina u otro campo relacionado.
- Experiencia previa en el despliegue y recuperación de instrumentación submarina, como sismógrafos y/o instrumentos oceanográficos.
- Conocimiento profundo de la tectónica de placas, procesos volcánicos y geológicos submarinos.
- Familiaridad con técnicas de análisis de datos sísmicos y oceanográficos.
- Experiencia en trabajo de campo en entornos marinos remotos y exigentes.

QUINTA. - NÚMERO DE VOLUNTARIOS/AS: Para la ejecución de este programa, la expedición está compuesta por 23 participantes entre científicos, estudiantes y técnicos marinos.

SEXTA. - DETALLE DE LAS ACTIVIDADES: La Voluntaria realizará las siguientes actividades autorizadas en el permiso de investigación:

- Ubicar los instrumentos que fueron instalados en el fondo del mar en junio del 2023 a través de una señal acústica codificada.
- Recuperar los instrumentos cuando flotan hacia la superficie por su propia boyancia.
- Una vez en la superficie del mar, el personal del barco identifica el instrumento mediante una bandera o una luz estroboscópica montada en la parte superior.
- Subir el instrumento al barco con un palo y un gancho.

- Procesar los datos obtenidos.
- Mantener reuniones con la DPNG, INOCAR y el Instituto Geofísico-EPN

SEPTIMA. - MEDIOS Y RECURSOS PRECISOS PARA LLEVARLO A CABO. – El proyecto se lleva a cabo en el R/V Sally Ride que es un buque de investigación de 238 pies y 3043 toneladas brutas con bandera de EE. UU., de propiedad y operado por el Scripps Institution of Oceanography, University of California San Diego. El barco está clasificado por la Oficina Estadounidense de Transporte Marítimo y está inspeccionado por la Guardia Costera de los EE. UU.; está certificado para transportar un total de 55 personas de las cuales aproximadamente 20 son la tripulación del barco. El buque cuenta con los equipos y recursos necesarios para llevar a cabo el trabajo de la expedición.

OCTAVA. - FUENTES DE FINANCIAMIENTO PARA CUBRIR EL VIAJE, MANUTENCIÓN Y ALOJAMIENTO DURANTE LA ESTANCIA DE LOS VOLUNTARIOS. – El proyecto está financiado por la Fundación Nacional de Ciencias de Estados Unidos OCE-1928197

NOVENA. - MECANISMOS DE CONTROL, SEGUIMIENTO Y EVALUACIÓN PARA VERIFICAR EL CUMPLIMIENTO DE LOS FINES Y OBJETO DEL PROGRAMA POR PARTE DEL RESPONSABLE. La Voluntaria entregará el Informe de Campo requerido por la DPNG al haber finalizado la expedición

DECIMA. - ACEPTACIÓN POR PARTE DE LA ENTIDAD AUSPICIANTE DE SER RESPONSABLE POR LAS EVENTUALIDADES QUE PUEDAN DERIVARSE DEL CONVENIO. La entidad auspiciante asume la responsabilidad por cualquier eventualidad derivada del convenio entre la Voluntaria y la Fundación. La Voluntaria cuenta con seguro médico privado, asimismo, el buque cuenta con todos los instrumentos y equipos que garantizan la seguridad y bienestar de la Voluntaria y demás tripulantes. La Fundación responderá adecuadamente a cualquier situación imprevista durante el programa.

DECIMA PRIMERA. - HORARIO DE TRABAJO. – El horario de trabajo se ajustará a las necesidades del proyecto y a sus propias responsabilidades, sin embargo, el horario de la Fundación es de lunes a viernes de 07:45hrs. a 12:30hrs. y de 14:00hrs. a 17:15hrs.

DECIMA SEGUNDA. - CUMPLIMIENTO DE NORMAS Y PROCEDIMIENTOS. -La Voluntaria cumplirá con los reglamentos establecidos por la Dirección del Parque Nacional Galápagos en su Protocolo de Campo y con el Código de Ética y Conducta de la Fundación. Así mismo, la Voluntaria se compromete a cumplir con todas las leyes, reglamentos y normas establecidas por las autoridades nacionales y locales.

DECIMA TERCERA. - TERMINACION POR LAS PARTES: Se espera que tanto la Voluntaria como la Fundación mantengan una colaboración fructífera y mutuamente beneficiosa. No obstante, el presente Convenio podrá ser terminado anticipadamente por cualquiera de las partes. Esta justificación puede abarcar diversos motivos, como el incumplimiento de las obligaciones contractuales por parte de la otra parte, cambios en las circunstancias que dificulten o imposibiliten la continuación del Convenio, o eventos de fuerza mayor, entre otros.

DECIMA CUARTA. - **PROPIEDAD Y CONFIDENCIALIDAD DE DOCUMENTOS:** Toda información obtenida por la Voluntaria producto de su participación en el programa, será compartida con la DPNG, EPN, INOCAR y FCD de acuerdo a los requisitos de la DPNG que constan en el permiso de investigación.

DECIMA QUINTA. - NATURALEZA Y CARACTERÍSTICAS DEL CONVENIO.: Este convenio, por su naturaleza, es de orden estrictamente civil. Por lo tanto, no existe relación de carácter laboral durante la vigencia del presente Convenio.

DECIMA SEXTA. - JURISDICCIÓN EN CASO DE DISPUTAS En caso de controversia, las partes fijan su domicilio en Puerto Ayora y se someten a la jurisdicción de los jueces competentes.

Para constancia de aceptación de lo indicado, las partes firman en el lugar y fecha arriba indicados.

Firma electrónica de las partes.

Emilie Hooft

Digitally signed by Emilie Hooft
Date: 2024.06.20 20:10:06 -06'00'

Dr. Rakan Zahawi
LA FUNDACIÓN

Dra. Emilie Hooft
LA VOLUNTARIA

J.4 Instituto Geofísico Data use agreement: *Acuerdo_uso_datos_sísmicos_IG-EPN-2023-003-signed.pdf*

INSTITUTO GEOFÍSICO
ESCUELA POLITÉCNICA NACIONAL
Campus Ing. José Rubén Orellana

Instituto Geofísico

Apartado 2759 Telf.: 2225-655; Fax: (593)-2-2567847 - www.igepn.edu.ec. Quito - Ecuador

Acuerdo de Transferencia y Uso de los Datos

Proveedor: Instituto Geofísico, Ecuador	**Receptor:**
Representante de institución proveedora de los datos: **Nombre**: Mario Ruiz **Email**: mruiz@igepn.edu.ec	**Investigador solicitante /receptor de datos:** **Nombre:** Emilie Hooft **Email:** emilie@uoregon.edu
Duración de Acuerdo: **Fecha de Inicio**: NA **Fecha de Terminación de Compromisos**: NA	**Título del Proyecto: NA**
No. acuerdo: IG-EPN-2023-003	**Anexos:**

TERMINOS DEL ACUERDO

1) El Proveedor proporcionará el conjunto de datos descrito en el Anexo 1 (los "Datos") al Receptor para el propósito de investigación establecido en el Anexo 1 (el "Proyecto"). El Proveedor conservará la propiedad de los derechos que pueda tener sobre los Datos, y el Receptor no obtendrá ningún derecho sobre los Datos que no sean los establecidos en este documento.

2) En los casos que corresponda, el reembolso de cualquier costo asociado con la preparación, compilación y transferencia de los Datos al Receptor se detallará en el Anexo 1.

3) El Destinatario no utilizará los Datos excepto según lo autorizado en virtud de este Acuerdo. Los Datos se utilizarán únicamente para llevar a cabo el Proyecto mencionado en este documento y únicamente por el Investigador Receptor, su facultad o departamento, los empleados, los becarios y los estudiantes asociados al Receptor ("Personal del Receptor") y el Personal Colaborador (como se define en el Anexo 3) que tienen la necesidad de usar, o proporcionar un servicio con respecto a los Datos en relación con el Proyecto y cuyas obligaciones de uso sean consistentes con los términos de este Acuerdo (colectivamente, "Personas autorizadas").

Teléfonos: (2) 2225-655; (2) 222-5627; Fax: (593-2) 256-7847
Página Web: www.igepn.edu.ec; Correo Electrónico: geofisico@igepn.edu.ec
Dirección: Campus Ing. José Rubén Orellana - Calle Ladrón de Guevara E11-253
Apartado Postal 2759 - Quito – Ecuador

4) Excepto según lo autorizado en este Acuerdo o lo que exija la ley, el Receptor acepta mantener el control sobre los Datos y no divulgará, liberará, venderá, alquilará, arrendará, prestará ni otorgará acceso a los Datos a ningún tercero, excepto a las Personas Autorizadas, sin el consentimiento previo por escrito del Proveedor. El Receptor acepta establecer medidas de seguridad administrativas, técnicas y físicas apropiadas para evitar el uso no autorizado o el acceso a los Datos y cumplir con cualquier otro requisito especial relacionado con la protección de los Datos tal como se establece en el Anexo 2.

5) El Receptor acepta utilizar los Datos de conformidad con todas las leyes, normas y reglamentaciones aplicables, así como con todas las normas profesionales aplicables a dicha investigación.

6) Se promoverá que el Receptor de los datos ponga a disposición del público los resultados del Proyecto. Antes de que el Receptor envíe un artículo o resumen para su publicación o tenga la intención de divulgar públicamente información sobre los resultados del Proyecto, el Proveedor tendrá treinta (30) días a partir de la recepción para revisar los manuscritos propuestos y diez (10) días a partir de la recepción para revisar los resúmenes propuestos. para garantizar que los Datos estén debidamente protegidos. El proveedor puede solicitar por escrito que la publicación propuesta u otra divulgación se retrase hasta treinta (30) días adicionales según sea necesario para proteger la información de propiedad exclusiva.

7) El Receptor acepta reconocer la contribución del Proveedor como fuente de los Datos en todas las divulgaciones públicas escritas, visuales u orales relacionadas con la investigación del Destinatario utilizando los Datos, según corresponda de acuerdo con los estándares académicos y cualquier formato específico que se haya indicado en el Anexo 1.

8) A menos que se rescinda este acuerdo antes de la fecha prevista o se extienda a través de una modificación de acuerdo con la Sección 13, este Acuerdo vencerá en la Fecha de finalización establecida anteriormente. Cualquiera de las partes puede rescindir este Acuerdo con treinta (30) días de notificación por escrito al Funcionario autorizado de la otra parte, como se establece a continuación. Al vencimiento o terminación anticipada de este Acuerdo, el Destinatario deberá seguir las instrucciones de disposición provistas en el Anexo 1, siempre que, sin embargo, el Destinatario pueda retener una (1) copia de los Datos en la medida necesaria para cumplir con los requisitos de retención de registros bajo cualquier ley, y para fines de integridad y verificación de la investigación.

9) A excepción de lo dispuesto a continuación o lo que prohíba la ley, se entiende que los Datos entregados de conformidad con este Acuerdo se proporcionan "TAL

COMO ESTAN". El proveedor no declara ni extiende garantías de ningún tipo, ya sea expresa o implícitamente. No existen garantías expresas ni implícitas de comercialización o idoneidad para un fin en particular o que el uso de los datos no infringirá ningún derecho de patente, derecho de autor, marca registrada u otros derechos de propiedad medida en que lo prohíba la ley. El Receptor asume toda la responsabilidad por los daños que puedan surgir de su uso, almacenamiento, divulgación o disposición de los Datos. El Proveedor no será responsable ante el Receptor por ninguna pérdida, reclamo o demanda hecha por el Receptor, o hecha contra el Receptor por cualquier otra parte, debido o que surja del uso de los Datos por parte del Destinatario, excepto en la medida en que permitidos por la ley cuando sean causados por negligencia grave o dolo del Prestador. Ninguna indemnización por cualquier pérdida, reclamo, daño o responsabilidad está prevista ni proporcionada por ninguna de las partes en virtud de este Acuerdo.

10) Ninguna de las partes utilizará el nombre, las marcas registradas u otros logotipos de la otra parte en publicidad, anuncios o comunicados de prensa sin la aprobación previa por escrito de un representante autorizado de esa parte. Las partes acuerdan que cada una de ellas puede divulgar información fáctica sobre la existencia y el propósito de la relación que es objeto de este Acuerdo para otros fines sin el permiso por escrito de la otra parte, siempre que dicha declaración describa de manera precisa y adecuada la relación de las partes. y no implicará de ninguna manera el respaldo de la otra parte cuyo nombre se está utilizando.

11) A menos que se especifique lo contrario, este Acuerdo y los Anexos enumerados a continuación representan el acuerdo completo entre el Proveedor y el Receptor con respecto a la transferencia de los Datos al Receptor para el Proyecto.:

    Anexo 1: Información Específica de los datos

    Anexo 2: Términos y Condiciones específicas de los Datos

    Anexo 3: Identificación de Colaboradores Permitidos

12) Ninguna modificación o renuncia de este Acuerdo será válida a menos que sea por escrito y ejecutada por representantes debidamente autorizados de ambas partes.

13) Los Funcionarios Autorizados del Proveedor y el Receptor que suscriben declaran y afirman expresamente que el contenido de cualquier declaración hecha en este documento es veraz y precisa y que están debidamente autorizados para firmar este Acuerdo en nombre de su institución.

Representante oficial del Proveedor	Representante oficial de Institución Receptora
	Emilie Hooft Digitally signed by Emilie Hooft Date: 2024.06.21 20:48:40 -06'00'
Nombre: Mario Ruiz **Cargo**: Director **Email**: mruiz@igepn.edu.ec	**Nombre:** Emilie Hooft **Cargo:** Professora **Email:** emilie@uoregon.edu
Información de contacto para Notificaciones Oficiales: **Nombre**: Lilian Tipán **Dirección**: Ladrón de Guevara E11-253 y Andalucía, CP. 170525, Quito-Ecuador **Teléfono**: (593-2)2225627	**Información de contacto para Notificaciones Oficiales:** **Nombre:** Emilie Hooft **Dirección:** 1272 University of Oregon, Eugene, OR 97403, USA **Teléfono:** +1 541-632-2523

ANEXO 1: Información específica de los datos

1. Descripción de los datos:

Estación	Período

ANEXO 2: Términos y condiciones específicas de los datos

No se requieren términos y condiciones adicionales.

ANEXO 3: Identificación de colaboradores permitidos

Nombre	Identificación	Cargo	Email

J.5 US Dept. of State

Marine Scientific Research Application: UOLetterofCommitment.pdf

UNIVERSITY OF OREGON

College of Arts and Sciences

November 29, 2023

Letter of commitment for a scientific investigation

To whom it may concern,

This letter is in regard to the project, "An Open Access Experiment to Image Galápagos Plume-Ridge Interaction", supported by National Science Foundation grant OCE-1928197 to the University of Oregon.

- The name and address of our representative in Ecuador is:

  Dr. Mario Ruiz, Director of the Instituto Geofísico, ESCUELA POLITÉCNICA NACIONAL

  mruiz@igepn.edu.ec, +593 2 2428 723

  Av. Ladrón de Guevara E11-253 - Fac. Ing. Civil y Ambiental

  Apartado Postal 2759 – Quito, Ecuador

- The name and address of the shipping agent in the Galapagos is:

  Mr. Antonio Moreano, Sea Masters Group

  +593 99-911-6066

  https://www.seamastersgalapagos.com

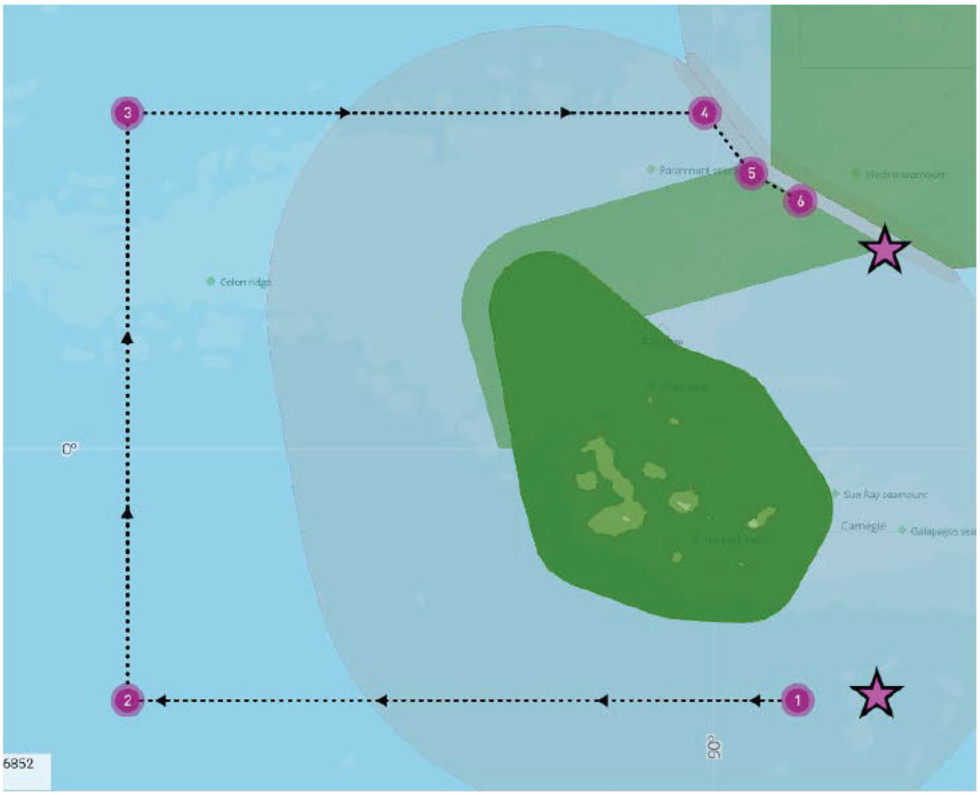
- We commit that we will deliver to the Ecuadorian Government, with no cost, the complete results and conclusions of the developed research.
- We also commit to observe the regulations of marine environment preservation and compensation.

Sincerely,

Emilie Hooft

Emilie Hooft, Professor
Dept. Earth Sciences
emilie@uoregon.edu

Department of Earth Sciences
100 Cascade Hall
1272 University of Oregon, Eugene OR 97403-1272
541-346-4573 | FAX 541-346-4692 earthsciences.uoregon.edu



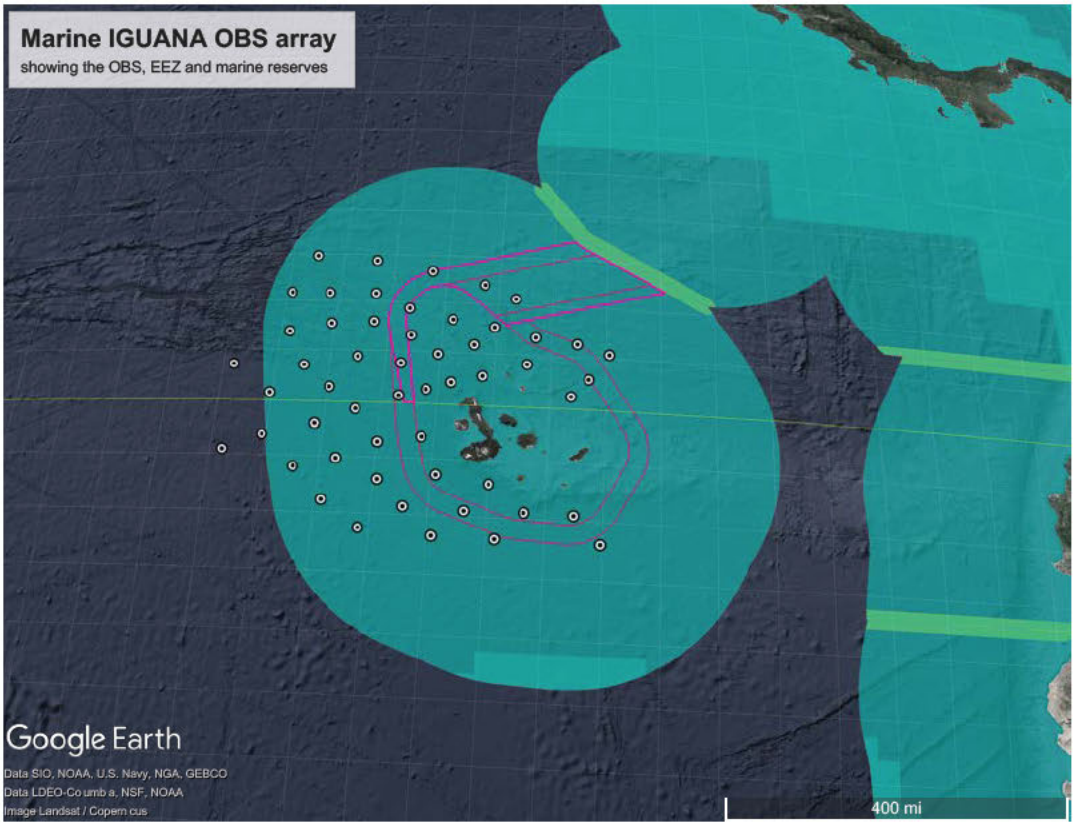


***Figure J1**. Map of Marine IGUANA OBS array, requested study area (pink circles and stars), EEZs and Marine Protected Areas*

K: List of Contacts

K.1 Ecuador and Galápagos

K.1.1 Charles Darwin Research Foundation (CDRF)

Dr. Maria-José Barragán

Directora de Ciencias / Science Director
Fundación Charles Darwin/Charles Darwin Foundation
Puerto Ayora, Islas Galápagos, Ecuador
Tel. +593 5 2 526 146 Ext. 225

Email: mariajose.barragan@fcdarwin.org.ec

www.facebook.com/darwinfoundation
www.twitter.com/darwinfound
www.darwinfoundation.org

Ms. Marta Romoleroux

Visiting Scientists Program/Programa de Científicos Visitantes
Fundación Charles Darwin/Charles Darwin Foundation
Puerto Ayora, Islas Galápagos, Ecuador
Tel. +593 5 2 526 146 Ext. 105

Email: cientificos@fcdarwin.org.ec

Dr. Stuart Banks

Senior Marine Scientist - Investigatora Marina Profunda
Charles Darwin Foundation - Fundación Charles Darwin
Puerto Ayora, Santa Cruz Island, Galápagos - Ecuador
Email: stuart.banks@fcdarwin.org.ec

Office Phone: (+593)-5-2526-146/147

K.1.2 Galápagos Ship Agent

Mr. Antonio Moreano
Sea Masters Group - Yacht Support
for Galápagos
Cell. +(593) 999 11 6066
WhatsApp 593 9 99116066

Agency. www.seamastersGalápagos.com
Provisions. www.Galápagosprovisions.com
Villa Rental. www.blueheronGalápagos.com
AYSS Member: www.ayss.org

K.1.3 Instituto Geofísico – Escuela Politécnica Naciona

Dr. Mario Ruiz
Director, Instituto Geofísico de la Escuela Politécnica Nacional
*mruiz@igepn.edu.ec; cell: +593-0*984 524695

K.1.4 Galápagos National Park

Jennifer Suarez
Email: jmsuarez@Galápagos.gob.ec

*K.*1.5 *INOCAR – Ecuadorian Navy*

Capt. Edwin Pazmino
Capitán Edwin Pazmino
Director de Oceanografía y Meteorología Marina
Instituto Oceanográfico y Antártico de la Armada
Guayaquil-Ecuador
npazmino@armada.mil.ec**;** +593 93 984 4938

Dr. Pritha Tutasi, Ph.D.
Investigador Oceanográfico 3
Responsable de la División de Oceanografía Operacional
Dirección de Oceanografía y meteorología Marina
Av. 25 de Julio vía Pto. Marítimo. Base Naval Sur
Email: pritha.tutasi@inocar.mil.ec
Tel.: + (593-4) 3813440 Fax: (593-4) 2485166
Código Postal: 8940 - Guayaquil-Ecuador; www.inocar.mil.ec

*K.*1.6 *US Embassy in Ecuador Contacts*

*** (added for future use on May 23, 2023)*

Alex "Sash" Lewis
handles RATS State Department requests for permits
US Embassy in Quito
Email: LewisAG@state.gov

Stater, Timothy M (Guayaquil)
Consul General
U.S. Consulate General in Guayaquil, Ecuador
Email: StaterTM@state.gov

Genevieve "Genny" Vidlak-Masura
Political Economic Officer
U.S. Consulate General in Guayaquil, Ecuador
Email: MasuraGM@state.gov; +593 098 531 5130

K.2 NSF and Research Vessel

K.2.1 NSF Program Manager

Gail Christeson
Program Director for Marine Geology and Geoophysics, Directorate for Geosciences
Division of Ocean Sciences, National Science Foundation, USA
gchriste@nsf.gov; +1-703-292-2952

K.2.2 Ship Managers – R/V Sally Ride

Ms. Hannah Delapp
Research Vessel Expeditionary Coordinator
858.900.1728 hdelapp@ucsd.edu

Mr. Joost van der Zwaag
Marine Superintendent
858.534.1643 jvanderzwaag@ucsd.edu

K.2.3 Resident Technicians for SR2411 R/V Sally Ride

Deck Technicians

Josh Manger
jmanger@ucsd.edu

Amber Boettiger
aboettiger@ucsd.edu

Instrument Technician

Maya Thompson
m6thompson@ucsd.edu

L: Participants

L.1 Participant List

Nombre	Last name	Email	Role	Organization
Emilie	Hooft	emilie@uoregon.edu	PI	University of Oregon
Douglas	Toomey	drt@uoregon.edu	Chief Scientist	University of Oregon
Garrett	Apuzen-Ito	gito@hawaii.edu	Scientist	University of Hawaii
Yang	Shen	yshen@uri.edu	Scientist	University of Rhode Island
Andrea	Quisanga Tinillo	andrea.quisanga@epn.edu.ec	IG-EPN	Undergrad student
Andres	Castillo Toapanta	washington.castillo@epn.edu.ec	IG-EPN	Undergrad student
Esther	Marcayata Vaca	esther.marcayata21@gmail.com	CDF and GNP	CDF volunteer & DPNG observer
Madeline	Young	youn1613@vandals.uidaho.edu	PhD student	University of Idaho
Kaisa	Autumn	kautumn@uoregon.edu	PhD student	University of Oregon
Panupong	Kongpet	panupong.k.nik@gmail.com	MSc student	University of Hawaii
Charles	Hoots	choots@hawaii.edu	PhD student	University of Hawaii
Vincent	Sassard	vsassard@purdue.edu	Apply to Sail PhD student	Purdue University
Saiful	Apu	saifulapu@ku.edu	Apply to Sail PhD student	University of Kansa
Michelle	Nathan	mhw@hawaii.edu	Community College Instructor	Honolulu Community College
Buddhi	Rai	buddhi.rai@hawaii.edu	Community College Instructor	University of Hawaii Maui College
Hannah	Brewer	hbrewer@whoi.edu	Marine Technical lead	OBSIC - WHOI
Daniel	Kot	dkot@whoi.edu	Marine Technician	OBSIC - WHOI
Alan	Gardner	agardner@whoi.edu	Marine Technician	OBSIC - WHOI
Gavin	McCarthy	gavin.mccarthy@whoi.edu	Marine Technician	OBSIC - WHOI
Josh	Manger	jmanger@ucsd.edu	Sally Ride Technician	SIO
Amber	Boettiger	aboettiger@ucsd.edu	Sally Ride Technician	SIO
Maya	Thompson	m6thompson@ucsd.edu	Sally Ride Technician	SIO
Brent De Vries		tbdevries@ucsd.edu	Sally Ride Technician	SIO

L.2 Watch Schedule

	Science Watch Schedule	
12:00-4:00	*4:00-8:00*	*8:00-12:00*
Garrett Apuzen-Ito	**Doug Toomey**	**Emilie Hooft**
Nik (Panupong) Kongpet	Yang Shen	Kaisa Autumn
Saiful Apu	Vincent Sassard	Charles Hoots
Maddie Young	Michelle Nathan	Budhi Rai
Andrea Quisanga	Esther Marcayata	Andres (Washington) Castillo

Technical Watch Schedule	**OBSIC**	**OBSIC**	**Science Officer**
Noon to Midnight	Alan Gardner	Dan Kot	Amber Boettiger
Midnight to Noon	Hannah Brewer	Gavin McCarthy	Josh Manger

L.3 Pre-cruise preparation

- Sally Ride Handbook: https://scripps.ucsd.edu/ships/sally-ride/handbook
- Ship's Layout & Berthing: https://scripps.ucsd.edu/ships/sally-ride/rv-sally-ride-layout-and-configuration
- *Cruise_Info&Preparation.docx:*

R/V Sally Ride

Cruise # SR2410: Muelle de Golfito June 5 to San Cristobal June 11 2024

- **June 4 (Tuesday):** Arrive San Jose and 1 night in DoubleTree by Hilton Cariari, Itinerary #7279184654269
- **June 5 (Wednesday):** Fly from San Jose to Golfito: 1 night in Hotel Casa Rolando Golfito Resort, Itinerary # 72832794879640
- **June 6 (Thursday):** Embark from Muelle de Golfito
- **June 7 (Friday):** Sail
- **June 11 (Wednesday):** Ship arrives for inspection in San Cristobal, Puerto Baquerizo Moreno

Cruise # SR2411 Puerto Baquerizo Moreno, San Cristobal June 13 to Puerto Ayora, Santa Cruz July 3

Mobilization: Puerto Baquerizo Moreno, San Cristobal,Galapagos June 13 via small boat

Demobilization: Puerto Ayora, Santa Cruz, Galapagos, July 3 by via small boat

At sea: June 13 – July 3, 2024

- **June 9 (Sunday):** Night in hotel in Quito, *{Hotel name itinerary #}*
- **June 10 (Monday):** Fly from Quito to San Cristobal, Galapagos, Ecuador. 2 nights in hotel *{Hotel name itinerary #}*
- **June 11 (Tuesday):** Ship arrives for inspection in San Cristobal, Puerto Baquerizo Moreno
- **June 12 (Wednesday):** Embark Puerto Baquerizo Moreno via small boat. Time TBD
- **July 3 (Wednesday):** Disembark Puerto Ayora, Santa Cruz Island, Ecuador

Departure from San Cristobal:

All cruise participants must be onboard Wed July 12. Embarkment will be by motor launch. Dr. Hooft

Ecuadorian participants will embark in San Cristobal on March 21st and should arrive there on March 19th. Participants should book their own accommodations.

Disembarking in Puerto Ayora, Santa Cruz island, Galapagos, Ecuador:

All cruise participants will disembark in Puerto Ayora by motor launch on July 3th. We will stay in rooms at the Charles Darwin research station and depart the Galapagos on July 7th unless you have arranged for an earlier departure.

1. Science

The overarching goal of this expedition is to collect data that will allow for seismic imaging of Galapagos plume-ride interaction. To this end, we will recover up to 53 ocean-bottom seismometers primarily to the east of the Galapagos archipelago and along the southern flank of the Galapagos spreading center. These data will be used to address key science questions regarding the dynamics of plume-ridge interaction and of hotspot systems more broadly. These questions include:

i. At what depths, in what geographic pattern, and by what mechanism does mantle plume material flow northward to the Galapagos Spreading Center (GSC) and disperse along the ridge? What is the role of ambient mantle circulation, including asthenospheric return flow? What does the thickness of the plume layer beneath the GSC imply about the origin of geochemical gradients long the GSC?

ii. Do the scale and nature of heterogeneity indicate small-scale, sub-lithospheric convection (SSC)? If so, how does that influence the flow of plume material along the base of the lithosphere?

iii. What is the spatial distribution of melting and volatile release, as well as the associated heterogeneity in composition and rheology due to plume-ridge interaction? Beyond Galapagos plume-ridge interaction, the project will substantially advance a broad understanding of the chemical and physical processes of mantle plumes, the asthenosphere, and their interactions with the oceanic lithosphere.

2. Life at Sea

We will work 24 hours a day while at sea. Each person will be assigned a shift of 4 hours on duty, 8 hours of off-shift for personal time, followed by another 4-hour shift and 8 hours off-shift. When you are on shift, your primary responsibility is to assist in the cruise science activities which will include keeping shift notes, monitoring and logging data from the instrument panels in the science lab, processing of bathymetric, magnetic and/or gravimetric data, deploying XBT (Expendable Bathythermograph) probes, and assisting in the recovering of the OBSs (Ocean Bottom Seismometers).

When you are off shift, enjoy your free time! The ship has several common spaces including a small library, movie room, and a small gym. Please remember that the ship's common areas are used by both science party and crew and are often near a crew's berth, so we need to respect them as shared spaces.

Keep in mind that internet access is limited.

You will be assigned a berth with a bunk mate and a shared bathroom between a couple of berths. The berths have two bunks (an upper and lower) with a curtain and bed light, a small sink, and a shared cabinet for your belongings. Bedding and towels are provided. There is also a life vest, and survival ("gumby") suit in the berths for each occupant that you will need for the fire drill, and in the case of an emergency. Generally, bunk mates are on different shifts in which case it is important to not disturb your roommate during their rest hours.

There are 3 scheduled meals a day (breakfast, lunch, and dinner) at set times – these never change, unless we're in port. The crew who are about to go on shift have priority at the start of meal times. There are leftovers, snacks, coffee, and tea available in the fridge and galley at any time.

Overall, keep in mind that we are visitors to the ship, and we want to be as clean and respectful as possible to the crew. If you have any questions or concerns, at any time, let the Chief (Doug Toomey) or co-Chief (Emilie Hooft) Scientist, or the Captain know! We will do all we can to be sure you feel comfortable aboard.

3. Medical

Bring your personal medicines. However, not everything should, or can, be anticipated. If something comes up, however small, physical or mental, please let the Chief (Doug Toomey) or co-Chief (Emilie Hooft) Scientist know or talk to the Captain or First Mate. They should be able to find medicines and can access medical services for any questions you have. Below are details on seasickness, medical emergencies, and importantly the COVID protocol for the cruise.

Seasickness: Seasickness is normal and not necessarily predictable. The most common seasickness medication is Dramamine. Another option is Bonine and if you know you are prone to motion sickness you could ask your doctor about getting a Scopolamine patch prior to boarding. Usually, one does not require sickness medication for the entire cruise but please bring enough in case you find yourself in that unlucky situation. Some prefer to take medication 24 hours before and a few days into the cruise before going without while others simply take it on an as-needed basis (e.g. take Dramine if you start feeling sick and take a nap). Generally, not eating too heavily before departure is helpful (dry crackers and ginger ale can help settle the stomach).

Medical Emergencies: The Captain and or First Mate are fully trained in emergency medicine, the ship has a sick bay with medicines and medical tools, the ship subscribes to an onshore medical service, and the vessel has a helicopter deck for extreme emergencies.

COVID Protocol:

If fully vaccinated: no pre-travel testing or self-quarantine, 7 day symptom tracking prior to boarding, embark testing based on pre-boarding symptom screening.

If not fully vaccinated: PCR test is needed prior to travel, 7 days of self quarantine followed by a PCR test, 7 day pre-boarding tracking

See https://www.unols.org/document/document/unols-updated-covid-19-guidance-21june2023

Recommendations while traveling

- Avoid contact with anyone who is sick or shows symptoms
- Wear mask in indoor public spaces or outdoors in crowds
- Clean your hands often and avoid touching eyes, nose, and mouth

4. Packing List

Clothing

Plan to bring enough for 5-6 days. There are laundry facilities and detergent on the vessel. Think in layers – for any given day, you'll want short sleeve shirts, long sleeve shirts, and fleece/puffy jackets/sweatshirts. The lab of the ship can feel chilly, and the deck can get windy. Bring clothing that you don't mind getting dirty or, possibly, damaged.

- Masks
- Close-toed work shoes are a must-have! Required while moving about the ship. Ideally, a waterproof hiking-type boot. Consider bringing an extra pair of more comfortable close-toed shoes for use while off-shift.
- Work pants (e.g., jeans)
- Shirts
- Underwear
- Jacket
- Waterproof windbreaker (ideally one that can get a bit dirty/that you don't care much about)
- For abandon ship practice/scenarios you need:
    - hat with a brim
    - sunglasses
    - long-sleeved shirt and pants
    - a flashlight
- Sleeping clothes
- Flip-flops (convenient for showers)
- Gym cloths if you would like to use the exercise room during your free time

Toiletries

- The ship will have towels.
- Otherwise bring all toiletries needed for the trip – the ship does not have soap, shampoo, etc.
- Any personal medications required.
- Seasickness medication
- Earplugs if you are a light sleeper
- Sunscreen – the sun is very strong at the equator because it travels straight down through the atmosphere and not along a longer angled path.

Other

- Your computer, backup disks, and everything necessary to work without internet
- Books/reading material
- Comfort snacks – sometimes the best way to ward off minor seasickness is to snack on salty or sweet things, and having your favorite snack helps. Ginger candies are always nice for the stomach.
- Laptop and charger
- Phone and charger
- Headphones
- Camera
- Notebooks and writing utensils
- Pre-download any movies/music/podcasts/shows you might want to enjoy (do not expect to download/stream such material via the ship's internet)

- Any other items that you find improve your quality of life and are portable!

6. Useful Contacts and Resources

Chief Scientist: Doug Toomey: drt@uoregon.edu

Co-Chief Scientist, Project Principal Investigator: Emilie Hooft: emilie@uoregon.edu

Project co-Investigator: Garrett Apuzen-Ito, gito@hawaii.edu

Project co-Investigator: Yang Shen yshen@uri.edu

https://scripps.ucsd.edu/ships/sally-ride

https://rvsallyride.ucsd.edu/about-the-ship/

M: Cruise T-shirt