**The 2019-2021 Gofar Transform Fault Earthquake
Prediction Experiment**
Leg 1: OBS Deployment and Rock Dredging

AT42-20 Cruise Report

R/V Atlantis
San Diego, USA to Manzanillo, Mexico
November 16th – December 13th, 2019

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Table of Contents

Cruise Synopsis	3
AT42-20 Science Party.....	4
AT42-20 Captain and Crew.....	4
Cruise Synopsis	5
OBS Deployments	6
Dredging Operations	11
Multibeam Mapping.....	19
MAPR Operations	21
Data Archiving.....	23
Outreach During the Cruise	24
Appendix I: AT42-20 Cruise Log.....	25
Appendix II: List of numbered samples and sub-samples	34
Appendix III: Dredge Location Maps and Profiles	42

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Cruise Synopsis

The goal of this cruise was to deploy 51 ocean bottom seismometers (OBS) and conduct rock dredges at the Quebrada/Discovery/Gofar (QDG) transform fault systems, with a focus on the Gofar system. QDG is located in the equatorial east Pacific on the East Pacific Rise (Figure 1). Sections of the Gofar and Discovery systems rupture with large ($M_w > 5.3$) earthquakes every 5-6 years, while only one event of this size has occurred on Quebrada in the last 35 years. Variations in along-strike earthquake behavior during these seismic cycles are further constrained by results from a 2008 OBS experiment on QDG. The 2008 experiment revealed the presence of 'rupture zones', which fail quasi-periodically in M6 earthquakes, and 'rupture barriers', which repeatedly stop large ruptures, yet undergo intense foreshock sequences. The current OBS deployment on Gofar is thus aimed at recording variations in stress build up, stress release, and fault strength within the context of a well-known seismic cycle.

During cruise AT42-20, OBS arrays were deployed on two segments of Gofar transform fault. On segment G1, 10 strong motion OBS and 7 broadband OBS were deployed, with the goal of capturing the end of two seismic cycles over the next two years of deployment. On segment G3, 4 broadband OBS and 3 mini-arrays of 10 OBS each were deployed. These deployments center on the G3B-C section of the fault, which served as a rupture barrier during the 2008 M6 earthquake. The arrays will be used to monitor the 4D evolution of the fault zone material.

Dredging was conducted to provide the first detailed characterization of rock types associated with the fault zone, in order to evaluate the rock properties giving rise to differences in seismic behavior. A total of 12 dredges were done on two Gofar segments, with dredges spaced at 10-20 km intervals on each segment. On Quebrada, 4 dredges and 4 gravity cores were done. A miniature autonomous plume recorder (MAPR) was deployed on the wire during dredging and OBS wire drops to look for hydrothermal vent signals. Multibeam data was collected along Gofar transform fault to provide a high-resolution map that was used to identify the fault zone and target locations for dredging.

Figure 1. Location Map. Location of the Quebrada, Discovery, and Gofar transform faults on the East Pacific Rise. White line indicates the plate boundary. Yellow boxes indicate focus areas.

AT42-20 Science Party

Last Name	First Name	Rank	Organization
Warren	Jessica	Chief scientist	U Delaware
Behn	Mark	Co-Chief scientist	Boston College
Fan	Wenyuan	Professor	Florida State U
Morrow	Thomas	Postdoc	Boston College
Prigent	Cécile	Postdoc	U Delaware
Schwartz	Darin	Postdoc	Boise State U
Andrys	Janine	Graduate student	U Rhode Island
Bahruth	Melinda	Graduate student	U Delaware
Gong	Jianhua	Graduate student	WHOI
Lin	Kuan-Yu	Graduate student	U Delaware
Gardner	Alan	OBSIC expedition leader	WHOI
Kot	Dan	OBSIC deck boss	WHOI
Rapa	Martin	OBSIC SIO lead	SIO
Kelly	Brian	OBSIC	WHOI
A'Hearn	Patrick	OBSIC	UNOLS

Watches

8am to 8pm: Mark Behn

8pm to 8am: Jessica Warren

OBS (daytime): Gardner, Kot, Rapa, Kelly, A'Hearn

8am to 4pm watch: Fan, Gong

4pm to 12am watch: Morrow, Andrys, Bahruth

12am to 8am watch: Prigent, Lin, Schwartz

AT42-20 Captain and Crew

Last Name	First Name	Rank	Last Name	First Name	Rank
Lunt	Allan	Master	Neumann	Patrick	AB
Leonard	Peter	Chief Mate	Nossiter	Mark	Cook
Biddle	Amy	2 nd Mate	Mlynarski	Janusz	Messman
Smith	Molly	3 rd Mate	Edwards	Tanzania	Steward
Shimada	Emily	Chief SSSG	Walsh	Jonathan	Chief Engineer
Smith	Justin	Dredge SSSG	Brennan	Philip	1 st Asst Engineer
D'Aoust	Anthony	SSSG	Robinson	William	2 nd Asst Engineer
Whims	Ronald	Chief Bosun	Castagno	Austin	3 rd Asst Engineer
Cacho	Clindor	2 nd Bosun/OS	Panter	James	CommEt
Capozzoli	Nicholas	OS	Costales	Anton	Oiler
Niziolek	Paul	OS	Gregory	Ryan	Oiler
Arthur	Robert	AB	Lawton	Cory	Oiler
McGill	James	AB	Spruill	Michael	Oiler

Cruise Synopsis

Cruise AT42-20 sailed on the R/V Atlantis from San Diego, CA on November 16th and returned to Manzanillo, Mexico on December 12th. The voyage consisted of eight outbound transit days, 13 science days and four inbound transit days, for a total length of 25 days. Science activities focused on OBS deployments and rock dredging.

Mobilization for cruise AT42-20 occurred at the Nimitz Marine Facility in San Diego, CA, with loading from 11/13 to 11/15. Equipment was also loaded for the two following cruises (AT42-21 and AT42-22). A rental Caterpillar generator in a 20' van cage was installed behind the winches on the 02 deck to provide contingency for two nonworking generators on the Atlantis.

On 11/16, the ship left MarFac at ~10:00 local time, fueled at 10th Ave, and departed at 16:30 (UTC time 00:30 on 11/17; all subsequent times are in UTC time unless noted). Transit took eight days, with arrival at the Gofar G1 segment at 06:30 on 11/25. The transit included a 3.5hr stop for a rosette calibration test of OBS, USBL, and MAPR equipment on 11/20.

Ten strong motion OBS were deployed on the Gofar G1 segment during the first day of operations on 11/25. The next eight days of OBS operations consisted of 30 wire drops on the Gofar G3 segment to deploy OBS in three arrays consisting of 10 instruments per array. Four to five OBS wire drops were done per day, with completion of these deployments on 12/2. Two days were spent deploying four OBS on G3 and seven on G1, including surveying 12 of the 21 OBS that were deployed by free fall, with the remainder to be surveyed on the next cruise. Wire drop OBS were not surveyed as their locations are taken from the USBL position at the time of release. OBS operations were completed on 12/5.

During OBS operations, dredges were conducted at night starting on 11/25 for a total of 12 dredges. Ten of these dredges were on the G3 segment and two on the G1 segment. Dredging on Gofar transform fault completed on 12/5.

The ship transited to Quebrada transform fault on 12/5, where round-the-clock dredging was planned for the final three days of science operations. After completion of dredges D13 through D16 on Quebrada, dredge operations ended early due to the failure of bolts in the sheave block when D17 reached the seafloor. After an emergency bolt replacement, the empty dredge was recovered but a second sheave also failed. With 25 hrs of science time remaining, dredge operations were terminated, as repairs required two days. Final science operations consisted of mapping around the Q1 segment and four gravity cores that returned a small amount of material.

The ship departed from the QDG study area at 05:00 UTC on 12/8 (23:00 local time on 12/7) and arrived in Manzanillo at 15:00 UTC on 12/12 (09:00 local time).

Appendix I contains the Cruise Log. The eLog is accessible online through the R2R program.

OBS Deployments

A total of 51 OBS from the NSF Ocean Bottom Seismometer Instrument Center (OBSIC) pool were deployed on the Gofar Transform Fault in the equatorial Pacific Ocean (Table 1, Figure 2). Twenty-one OBS were deployed by free-fall in two broadly spaced arrays on Gofar segments G1 (Figure 3) and G3 (Figure 4). Of these, 10 carried strong-motion accelerometers (SMOBS), and 11 were broadband seismometers (ARRA). Twelve of the free-fall instruments were surveyed to determine their final location. The remaining 9 instruments will be surveyed during the Leg 2 recovery cruise. The 10 SMOBS were modified to deploy the accelerometer external to the main package so that the accelerometer was mechanically decoupled from the OBS frame.

Thirty OBS were deployed in 3 mini-arrays (Figure 5) of 10 OBS each as part of a double-beam-forming experiment to measure earthquake-related changes in shear velocity. Two of these mini-arrays (A1 and A2) consisted of nine SIO short-period OBS (SPOBS) and one broadband OBS (ARRA). The third mini-array (A3) consisted of three SIO short-period OBS and seven SIO “Abalone” broadband OBS. Photos of typical deployments are shown in Figures 6 and 7. The 21 SPOBS were modified to deploy the geophone external to the main package so that the geophone was mechanically decoupled from the OBS frame and shielded from currents. All three mini-arrays were deployed at the western end of Gofar Transform Fault on Segment G3 (Figures 4). Each mini-array had an array dimension of ~1 km (Figure 5). All OBS in the mini-arrays were deployed using the CTD wire. A USBL beacon was attached to the acoustic release in order to achieve station placement to within ~20 m of the planned drop location (Figure 8). The MAPR was placed on the same bracket as the USBL beacon. Typical lowering rates were ~30 m/min for the SPOBS and 35 m/min for the Abalone and ARRA OBS. Retrieval rates were 60 m/min. The overall operation typically took ~3.5 hr, allowing 4–5 wire drop deployments per day.

Wire drop deployments faced several challenges. The first was layback of the wire due to ocean current at depth. At most sites, the layback on the wire was ≤ 50 m from the target drop location at a depth of 100–150 m off the seafloor. To achieve drop accuracies ≤ 20 m, the ship was moved ~3x the offset distance on a course 180° from the layback; the instrument was then released at its closest point to the planned drop location (Figure 7). To save time in positioning, the move was initiated when the wire was still 200–250 m above the seafloor. This did not seem to reduce our ability to accurately navigate the OBS into position. We experienced little bottom current at mini-arrays A2 & A3. Stronger currents were seen at depths > 2500 m at mini-array A1, likely due to the steep topographic gradients at this site and its location at the floor of the transform valley. For some instruments in mini-array A1, laybacks were 80–90 m and positioning accuracy deteriorated to 20–30 m. Positioning of the wire at this site also required accounting for current during the ship move. Further, on several deployments at A1, USBL communications were intermittent, making positioning of the OBS more challenging.

An additional challenge in the OBS deployments was snap-loads on the instrument package introduced through the wire by ship motion. Although no instruments lost an anchor, several experienced large snap-loads (in once case up to twice the dry weight of the instrument). This occurred even though we had low sea states ($< 4\text{--}5$ ft) throughout all deployments. In addition, pivoting of the acoustic release relative to the OBS lead to challenges during deployment. Heave-compensation on the winch could only be engaged in the all-stop position, which only

occurred during positioning at max wire out. Either technical difficulties or limitations to the system design prohibited heave-compensation from operating while the winch was paying out.

Leg 2 should contact the operators of the R/V Revelle prior to mobilization to determine whether heave-compensation can be enabled on their winch during pay out and whether it has recently been tested in this mode (the Revelle and the Atlantis have the same model/design winch). Instrument design changes could also be made to reduce the impact of snap loading (and unloading). For example, a syntactic floatation collar could be installed on the acoustic release to make it close to neutral, or at least significantly less negative than the instrument being deployed. This would mitigate any moment and pivot between the instrument and the release. Further, a buffer frame with a compliant member such as a rubber donut between the instrument and release could be designed to provide impact resistance, further mitigating the pivot point. These modifications are essential if deployments are required in rougher sea states. Finally, the USBL system on Revelle should also be evaluated. In particular, to reduce location dropouts, it would be optimal for the beacon used on the end of the wire to have an omnidirectional transducer.

Fig 2. Gofar OBS and dredge location map. Blue circles (surveyed OBS), black triangles (unsurveyed OBS), black squares (wire drop OBS), red triangles (dredges).

Fig 3: Gofar Segment G1 Location Map. Blue symbols are OBS surveyed during deployment, black triangles are OBS that will be surveyed on Leg 2, and red triangles are dredges.

Figure 4: Gofar Segment G3 Location Map. Blue symbols are OBS, which were all surveyed during deployment. Black squares are locations of OBS deployed in mini-arrays A1, A2, and A3. See Figure 5 for station locations within each mini-array. Red triangles denote dredge locations.

Figure 5: OBS locations within each of the mini-arrays shown in Figure 4. Grey, blue, and red triangles denote SPOBS, ARRA, and Abalone instruments.

Table 1: OBS Locations. For stations deployed by wire, final positions were determined based on USBL position and no error estimate is available for these positions. Free-fall OBS that were not surveyed are denoted in the RMS error column.

Station Name	OBS I.D.	OBS Type	Deployment Method	Station Latitude (deg)	Station Latitude (min)	Station Latitude (hemi)	Station Longitude (deg)	Station Longitude (min)	Station Longitude (hemi)	Station Depth (m)	RMS error (m)
G01	S83	SMOBS	Free-Fall	4	29.7360	S	104	48.4330	W	3152.0	No survey
G02	S43	SMOBS	Free-Fall	4	34.4525	S	104	48.813	W	3346	1.2
G03	S81	SMOBS	Free-Fall	4	40.3480	S	104	50.4850	W	3110.0	No survey
G04	S89	SMOBS	Free-Fall	4	33.0658	S	104	51.5193	W	3299.5	1.9
G05	S33	SMOBS	Free-Fall	4	33.1351	S	104	54.2183	W	3364.4	2.2
G06	S82	SMOBS	Free-Fall	4	27.5900	S	104	54.8250	W	3265.0	No survey
G07	S74	SMOBS	Free-Fall	4	38.4140	S	104	56.8840	W	3034.0	No survey
G08	S20	SMOBS	Free-Fall	4	31.9509	S	104	56.9663	W	3059.9	1.8
G09	S28	SMOBS	Free-Fall	4	32.4685	S	104	59.6425	W	3679.8	2.1
G10	S14	SMOBS	Free-Fall	4	26.6690	S	105	01.1920	W	2798.0	No survey
A2_01	93	SPOBS	Wire-drop	4	32.7056	S	105	58.8087	W	3287.0	USBL position
A2_02	126	SPOBS	Wire-drop	4	32.4058	S	105	58.5914	W	3271.0	USBL position
A2_03	213	SPOBS	Wire-drop	4	32.0756	S	105	58.3258	W	3207.0	USBL position
A2_04	233	SPOBS	Wire-drop	4	32.7847	S	105	58.4361	W	3282.0	USBL position
A2_05	218	SPOBS	Wire-drop	4	32.6752	S	105	58.1404	W	3262.0	USBL position
A2_06	124	SPOBS	Wire-drop	4	32.6563	S	105	57.9702	W	3267.0	USBL position
A2_07	86	SPOBS	Wire-drop	4	32.5589	S	105	57.7315	W	3406.0	USBL position
A2_08	63	SPOBS	Wire-drop	4	32.6676	S	105	57.7832	W	3384.0	USBL position
A2_09	217	SPOBS	Wire-drop	4	32.9083	S	105	57.9541	W	3401.0	USBL position
A2_10	T105	ARRA	Wire-drop	4	32.9671	S	105	58.2157	W	3445.0	USBL position
A3_01	210	SPOBS	Wire-drop	4	35.8229	S	105	56.2534	W	3278.0	USBL position
A3_02	85	SPOBS	Wire-drop	4	36.0767	S	105	56.5337	W	3319.0	USBL position
A3_03	209	SPOBS	Wire-drop	4	36.3462	S	105	56.8417	W	3257.0	USBL position
A3_04	14	Abalone	Wire-drop	4	35.6644	S	105	56.6338	W	3357.0	USBL position
A3_05	02	Abalone	Wire-drop	4	35.7400	S	105	56.9069	W	3379.0	USBL position
A3_06	10	Abalone	Wire-drop	4	35.7126	S	105	57.0877	W	3371.0	USBL position
A3_07	12	Abalone	Wire-drop	4	35.7730	S	105	57.3518	W	3318.0	USBL position
A3_08	13	Abalone	Wire-drop	4	35.6718	S	105	57.2962	W	3323.0	USBL position
A3_09	6	Abalone	Wire-drop	4	35.4465	S	105	57.0793	W	3327.0	USBL position
A3_10	05	Abalone	Wire-drop	4	35.4516	S	105	56.8009	W	3289.0	USBL position
A1_01	200	SPOBS	Wire-drop	4	35.1291	S	105	53.4633	W	3461.0	USBL position
A1_02	227	SPOBS	Wire-drop	4	35.4832	S	105	53.5466	W	3117.0	USBL position
A1_03	13	SPOBS	Wire-drop	4	35.8647	S	105	53.6651	W	3132.0	USBL position
A1_04	92	SPOBS	Wire-drop	4	35.1729	S	105	53.8371	W	3446.0	USBL position
A1_05	202	SPOBS	Wire-drop	4	35.3827	S	105	54.0493	W	3438.0	USBL position
A1_06	234	SPOBS	Wire-drop	4	35.4597	S	105	54.2239	W	3387.0	USBL position
A1_07	17	SPOBS	Wire-drop	4	35.6234	S	105	54.4007	W	3237.0	USBL position
A1_08	219	SPOBS	Wire-drop	4	35.5119	S	105	54.4093	W	3355.0	USBL position
A1_09	220	SPOBS	Wire-drop	4	35.2226	S	105	54.3270	W	3457.0	USBL position
A1_10	T103	ARRA	Wire-drop	4	35.0991	S	105	54.1011	W	3445.0	USBL position
G13	T111	ARRA	Free-Fall	4	33.5684	S	106	01.0171	W	3562.7	2.3
G14	T107	ARRA	Free-Fall	4	37.1446	S	106	00.6616	W	3006.4	2.1
G15	T110	ARRA	Free-Fall	4	34.1596	S	105	56.9274	W	3694.9	2.4
G16	T112	ARRA	Free-Fall	4	31.7676	S	105	52.3331	W	3069.9	2.1
G17	T108	ARRA	Free-Fall	4	28.4269	S	105	04.9780	W	2696.0	No survey
G18	T113	ARRA	Free-Fall	4	37.2510	S	105	03.2540	W	2905.0	No survey
G19	T104	ARRA	Free-Fall	4	33.2248	S	105	01.7935	W	3131.5	2.5
G20	T101	ARRA	Free-Fall	4	34.5925	S	104	46.2870	W	3267.3	1.6
G21	T109	ARRA	Free-Fall	4	40.4240	S	104	44.1340	W	3294.0	No survey
G22	T102	ARRA	Free-Fall	4	35.3276	S	104	43.6522	W	3030.8	2.1
G23	T106	ARRA	Free-Fall	4	29.8420	S	104	42.0620	W	3327.0	No survey

Figure 6. Segment G1 free-fall deployments: (left) SMOBS; (right) Kot deploys an ARRA OBS.

Figure 7. Wire deployments (left) SPOBS deployment by wire; (middle) Prepping Abalone OBS for wire deployment; (right) ARRA deployment by wire. Note yellow USBL beacon and silver MAPR on bracket attached to the acoustic release.

Figure 8. Example of USBL monitoring setup in the computer lab. Left monitor was used for wire navigation. In this example, the ship was moved to the southeast (blue dots on right monitor) to reposition the wire over the target drop point.

Dredging Operations

Summary: A total of 17 dredges were conducted on the Gofar and Quebrada transform faults (Table 2). On Gofar, 2 dredges were on segment G1 (46 km length) and 10 on Gofar G3 (95 km length). On Quebrada, 2 dredges were on segments Q2 (27 km length) and 2 dredges on Q3 (22 km length). In addition, 4 gravity cores were done on Q1 (42 km length) when problems with the winch blocks resulted in cancelation of the last day of dredging.

Rocks were recovered in 14 dredges, two dredges recovered no rocks, and the 17th dredge was aborted due to failure of the sheave blocks. All 12 Gofar dredges recovered abundant rock samples, while only one Quebrada dredge recovered a significant volume of rock. During the final day of operations, four gravity cores were collected, with basalt chips recovered in three cores and marine sediments in the fourth core. A sample list is provided in Appendix II.

Major objectives: The major objective of the dredging campaign was to recover rocks from the active fault zone of Gofar transform fault. Dredges were conducted within the transform fault valley on relatively small ridges that outcrop discontinuously within the fault zone (Figure 2).

Dredging locations: Each dredge track was selected based on features that had a high potential for recovery (i.e., small regions of positive relief that are likely fault scarps or pushups). When choosing dredge targets, the higher resolution bathymetry datasets collected during cruise TN214 (Quebrada) and the current cruise (Gofar) were used to identify dredge targets, as these maps revealed the presence of small ridges (<~500 m relief) within the transform zones. Sections of the fault where the transform valley has a flat bottom were avoided when selecting dredge targets as these seemed unlikely to yield fault rocks. Fault segment ends were also avoided as their bathymetric appearance suggests that basalt lava flows from adjacent ridges cover the fault.

Dredging tracts often followed relatively shallow slopes that corresponded to elevation gains of 100-200 m over 300-400 m horizontal distances. Several dredges were run at diagonal angles to extend the track length to 600-1000 m. For dredges on steeper, longer slopes, the track length was in the range of 1.0-1.2 km. Appendix III contains maps of each individual dredge track.

Gofar transform fault was the primary target for the dredging campaign, with dredge locations planned around the OBS deployment schedule. Thus, dredges D1 and D12 were conducted on segment G1 (Figure 3), while D2 through D11 were on segment G3 (Figure 4), which minimized transit times between sites.

Segment G3 on Gofar transform fault was the primary target for dredging (Figure 4). At 95 km long, this segment is the longest of all the QDG fault segments (Figure 1). The previous OBS experiment provides the most information on this fault segment and the majority of seismometers were deployed here for the current experiment. Sections of G3 have large ($M_w > 5.3$) earthquakes every 5-6 years and are separated by barrier zones that have deep seismicity but no large events. A total of 10 dredges were collected along segment G3 at a spacing of <10 km apart (Figure 4). Dredge locations were selected for roughly even spacing along the fault, with higher-density sampling around 105.9°W. This section of the fault marks the transition from G3B (an asperity zone) to G3C (a barrier zone) and was a particular focus for both dredging and OBS array deployment.

Table 2. Dredge Locations

Cruise AT42-20: Dredge Locations		START DREDGE			ON BOTTOM			OFF BOTTOM			ON DECK										
		DATE	GMT	Depth mbsl	Pinger Wire Out	MAPR Wire Out	DATE	GMT	Depth mbsl	Wire Out m	Latitude	Longitude	DATE	GMT	Depth mbsl						
AT42-20-D01	G1: Traverse up northern wall of the transform valley, near OBS G08	11/25/2019	6:31:20	3582	350	370	11/25/2019	8:36:05	3543	3551	-4.543 S	-104.955 W	11/25/2019	11:32:48	3156	3100	-4.536 S	-104.957 W	11/25/2019	13:15:29	3055
	G3: Traverse up SW slope of transforme ridge that spans seismic to aseismic zone	11/26/2019	6:19:32	3808	250	270	11/26/2019	8:27:01	3779	3825	-4.572 S	-105.981 W	11/26/2019	10:51:43	3605	3576	-4.564 S	-105.976 W	11/26/2019	12:47:06	3605
AT42-20-D03	G3: Traverse up SW slope of transforme ridge that spans seismic to aseismic zone	11/27/2019	3:13:00	3787	250	270	11/27/2019	5:20:00	3787	3898	-4.579 S	-105.953 W	11/27/2019	6:55:00	3635	3635	-4.569 S	-105.949 W	11/27/2019	8:52:36	3665
	G3: Traverse up NW slope of shallow ridge in transform valley, west of OBS A1	11/28/2019	4:10:25	3526	250	270	11/28/2019	6:05:31	3520	3552	-4.578 S	-105.922 W	11/28/2019	7:49:17	3467	3412	-4.582 S	-105.914 W	11/28/2019	9:38:33	3462
AT42-20-D05	G3: Traverse up SW slope of transforme ridge that spans seismic to aseismic zone	11/29/2019	3:17:13	3242	250	270	11/29/2019	5:17:51	3720	3838	-4.568 S	-106.008 W	11/29/2019	6:52:06	3590	3498	-4.563 S	-105.007 W	11/29/2019	8:43:31	3543
AT42-20-D06	G3: Traverse up NE slope of small transforme ridge in western seismic zone	11/30/2019	4:17:12	3652	250	270	11/30/2019	6:11:46	3581	3632	-4.557 S	-106.037 W	11/30/2019	7:30:54	3534	3484	-4.563 S	-106.033 W	11/30/2019	9:18:00	3650
	G3: Traverse up NE slope of shallow ridge in transform valley, east of D8	12/1/2019	2:41:59	3683	250	270	12/1/2019	4:42:43	3794	3822	-4.592 S	-105.816 W	12/1/2019	6:47:12	3514	3640	-4.602 S	-105.821 W	12/1/2019	8:36:41	3711
AT42-20-D08	G3: Transect up NE slope of shallow ridge in transform valley, east of OBS A1 array	12/2/2019	4:15:34	3556	250	270	12/2/2019	6:13:02	3591	3636	-4.581 S	-105.866 W	12/2/2019	8:08:20	3372	3385	-4.591 S	-105.862 W	12/2/2019	9:54:56	3342
	G3: Transect up NE slope of shallow ridge, east of dredge D7	12/2/2019	22:18:51	3726	230	250	12/3/2019	0:24:48	3641	3733	-4.603 S	-105.761 W	12/3/2019	2:22:00	3397	3404	-4.613 S	-105.765 W	12/3/2019	4:09:51	3392
AT42-20-D10	G3: Transect up NE slope of shallow ridge, east of dredge D9	12/3/2019	4:57:05	3972	250	270	12/3/2019	7:05:30	4100	4111	-4.619 S	-105.681 W	12/3/2019	9:42:16	3547	3568	-4.638 S	-105.685 W	12/3/2019	11:36:37	3153
AT42-20-D11	G3: Traverse up SW slope of shallow ridge, east of D10	12/4/2019	0:18:51	3459	250	270	12/4/2019	2:08:43	3348	3572	-4.654 S	-105.581 W	12/4/2019	4:03:47	3408	3337	-4.648 S	-105.590 W	12/4/2019	5:49:45	3380
AT42-20-D12	G1: Traverse up SW facing slope, midway between OBS G04 and G05	12/5/2019	5:49:15	3467	250	270	12/5/2019	7:37:15	3331	3401	-4.559 S	-104.888 W	12/5/2019	9:52:04	3170	3103	-4.553 S	-104.877 W	12/5/2019	11:31:26	3153
AT42-20-D13	G3: Traverse up NE slope of shallow ridge in transform valley	12/5/2019	19:58:54	4115	250	270	12/5/2019	22:12:23	4257	4320	-3.735 S	-103.408 W	12/5/2019	23:31:20	4197	4192	-3.740 S	-103.404 W	12/6/2019	1:42:11	4161
AT42-20-D14	G3: Traverse up NW slope of shallow ridge, at intersection with transform valley wall	12/6/2019	2:14:28	4372	250	270	12/6/2019	4:35:32	4390	4490	-3.750 S	-103.358 W	12/6/2019	6:12:16	4315	4520	-3.746 S	-103.365 W	12/6/2019	8:30:29	4029
AT42-20-D15	Q2: Traverse up SW slope of shallow ridge in transform valley	12/6/2019	9:39:01	4311	250	270	12/6/2019	11:53:40	4325	4336	-3.703 S	-103.199 W	12/6/2019	13:14:37	4290	4144	-3.693 S	-103.202 W	12/6/2019	15:25:03	4287
AT42-20-D16	Q2: Traverse up NE slope of shallow ridge in transform valley	12/6/2019	16:11:10	4062	250	270	12/6/2019	18:19:26	4023	4111	-3.716 S	-103.129 W	12/6/2019	20:09:36	3911	3925	-3.721 S	-103.122 W	12/6/2019	22:13:26	3911
AT42-20-D17	Q2: Aborted	12/6/2019	23:14:24	4119	250	270	12/7/2019	1:31:19	4103	4159	-3.717 S	-102.991 W	12/7/2019	2:56:09	4103	4159	-3.717 S	-102.991 W	12/7/2019	5:13:57	4103
AT42-20-GC1	Q1: Transform valley	12/7/2019	15:07:37	3853			12/7/2019	16:25:31	3854	3950	-3.747 S	-102.810 W	12/7/2019	17:45:16					12/7/2019	17:45:16	3870
AT42-20-GC2	Q1: Transform valley	12/7/2019	18:23:47	3813			12/7/2019	19:40:07	3813	3914	-3.740 S	-102.847 W	12/7/2019	21:04:40					12/8/2019	21:04:40	3813
AT42-20-GC3	Q1: Transform valley	12/7/2019	21:28:02	3813			12/7/2019	22:42:24	3800	3854	-3.735 S	-102.871 W	12/7/2019	0:00:31					12/7/2019	0:00:31	3800
AT42-20-GC4	Q1: Transform valley	12/8/2019	0:25:04	3800			12/8/2019	1:40:16	3835	3865	-3.726 S	-102.928 W	12/8/2019	2:58:41					12/8/2019	2:58:41	3835

Information in this table transcribed from handwritten station log sheets, not from eLog system.

Figure 9: Quebrada Location Map. Red triangles indicate dredge locations on segments Q3 and Q2. Red diamonds indicate gravity core locations on segment Q1.

Figure 10: Quebrada Sample Locations. Red triangles indicate dredges on segments Q3 and Q2. Red diamonds indicate gravity cores on segment Q1.

Two dredges were conducted on Gofar segment G1 (Figure 3), which is 46 km long. Both dredges were in the central zone of the fault, where the bathymetry was the most promising for recovering fault rocks.

The ship transited to Quebrada transform fault for the final three days of science time, which were dedicated to dredging. A total of eight dredges were planned for Quebrada, of which four were successfully completed (Figure 9) before failure of the sheave blocks (see technical description below). Quebrada has no large repeating earthquake events, unlike both Gofar and Discovery. The aim of the Quebrada dredging was to achieve similar spacing to the sampling on Gofar, so that this fault system could be directly compared. Quebrada consists of four fault segments (Figure 9), but no suitable fault targets were identified on Q4 (27 km length). Two dredges were done on Q3 (22 km length), but D13 recovered only one rock and D14 recovered mud, apart from small basalt glass fragments in the burlap sack (Figure 10). On segment Q2 (27

km length), D15 was empty and D16 recovered rocks. Four dredges were planned for segment Q1 (42 km length), but the sheave block failure terminated dredging operations. Four gravity cores (GC1-4) were conducted on Q1, recovering a few basalt fragments.

No dredges were conducted on Discovery transform fault (Figure 1), which has the most complex bathymetry of the QDG system. After evaluation of the bathymetry, we decided that collecting one or two dredges on Discovery would not provide enough insight into the fault system and that the time was better spent on a comprehensive dredging program for Quebrada.

Rock types: The two main types of rocks recovered by dredging the transform faults are basalt and basaltic breccia (Table 3). Each dredge recovered basalts with multiple textural (phenocrysts and vesicle content) and morphological (rounded versus angular vs pillow vs sheet flow) characteristics, indicating that multiple eruptions were sampled. Pillow basalts were recovered in nine dredges and represent 14% of samples overall. This may under-estimate their volume as this includes only samples that could be positively identified as pillows. The most common phenocryst phase was plagioclase, followed by olivine, while clinopyroxene-bearing samples were rare. Samples had a range of alteration from fresh to highly altered. Weathering ranged from light to heavy. Trace manganese crusts were present on many samples, but only one sample had a crust of 1 mm thickness.

Breccias were recovered in 10 dredges, representing 21% of samples overall, though some dredges contained up to 95% breccia. The breccias have varying levels of maturity, including incipient brecciation of basalt, angular clasts with low matrix volume, and matrix supported rounded clasts. Based on color, the matrix composition is variable between and within dredges and ranges from unconsolidated to consolidated. The matrix of a small number of breccias has a ductile overprint. Pillow basalt was rare in dredges that contained breccia, though glass fragments were found in the matrix of some breccias.

Archiving of Samples: Dredges were numbered with the ship, leg, and dredge number (e.g., AT42-20-1 for the first dredge). Samples from each dredge were designated with an additional number (e.g., AT42-20-1-1 designates sample 1 from dredge 1). Sub-samples for thin sections, bulk rock, and glass chips were designated with an additional number (e.g., AT42-20-1-1-1 designates sub-sample 1). This system for sub-sampling follows IGSN protocol for creating “child” samples from “parent” samples, with each child of a parent having a different sub-sample number designation. The sample name was marked on each rock by painting a white square with acrylic paint and labeling with a sharpie marker.

Samples will be archived at the WHOI Seafloor Samples Laboratory. Prior to setting sail, we obtained International Geo Sample Number (IGSN) numbers from the WHOI repository for 100 samples per dredge and 4 children per sample. Based on an estimate of 20 dredges, this meant that 2,000 IGSNs were provided for samples and 8,000 IGSNs for sub-samples, with unused numbers to be removed from the system after the cruise. The first five characters for the WHOI-generated IGSNs are “IESFS”. Pre-generated labels, containing a QR code, sample name, and IGSN number, were also created by WHOI in the SESAR system. These labels were used on the bag for every sample and sub-sample. Appendix II contains a summary of the parent and child samples, including sample names and parent IGSN numbers.

Table 3. Summary of Dredge and Gravity Core Samples

Atlantis Cruise 42 Leg 20 Rock Sample Summary															
Dredge	Contents	Weight kg	Described samples kg	Pillow Basalt kg	Basalt kg	Diabase kg	Breccia kg	Mylonite kg	Mud/ Clay kg	% Pillow	% Basalt	% Diabase	% Breccia	% Mylon	% Mud/Clay
1	104 kg pillow basalt, 162 kg basalt	265	67	104	162					39%	61%	0%	0%	0%	0%
2	89 kg basalt, 157 kg basalt breccias, 55 kg unsorted pebbles	301	66		89		157			0%	36%	0%	64%	0%	0%
3	113 kg basalt, 7 kg basalt breccia, 0.4 kg mud	116	29		113		7		0.4	0%	94%	0%	6%	0%	0.3%
4	4 kg basalt, 3 diabase, 148 kg basalt breccia, 0.4 kg mud	155	31		4	3	148		0.4	0%	2%	2%	95%	0%	0.3%
5	150 kg basalt, 28 kg pillow basalt, 1 kg basalt breccia	179	19	28	150		1			15%	84%	0%	0%	0%	0%
6	53 kg basalt, 28 kg pillow basalt	81	30	28	53					35%	65%	0%	0%	0%	0%
7	37 kg Basalt, 7 kg diabase, 39 kg basalt breccia, 4 kg mylonites, 0.05 kg mud, 13 kg unsorted pebbles	100	29		37	7	39	4	0.05	0%	43%	8%	45%	5%	0.1%
8	111 kg basalt, 16 kg breccia	127	31		111		16			0%	87%	0%	13%	0%	0%
9	57 kg pillow basalt, 64 kg basalt, 0.4 kg basalt breccia	121	45	57	64		0.4			47%	53%	0%	0%	0%	0%
10	1 kg pillow basalt, 33 kg basalt, 9 kg diabase, 22 kg diatomite	65	44	1	33	9			22	1%	51%	14%	0%	0%	34%
11	37 kg pillow basalt, 129 kg basalt, 53 kg basalt breccia	219	52	37	129		53			17%	59%	0%	24%	0%	0%
12	20 kg pillow basalt, 333 kg basalt, 1 kg diabase, 1 kg basalt breccia	356	31	20	333	1	1			6%	94%	0%	0%	0%	0%
13	2 kg Pillow basalt	2	2	2						100%	0%	0%	0%	0%	0%
14	Empty (burlap sack glass)	0.01	0.01												
15	2 kg mud	2	2						2	0%	0%	0%	0%	0%	100%
16	3 kg pillow basalt, 10 kg basalt, 4 kg breccias	17	9	3	10		4			18%	59%	0%	24%	0%	0%
17	Dredge aborted (burlap sack glass)	0.01	0.01												
GC1	Basalt pebbles, sand	0.1	0.1												
GC2	Pebbles, sand of weathered basalt	0.1	0.1												
GC3	Basalt pebbles, sand	0.1	0.1												
GC4	Mud	2	2												
All Samples*		2106	487	279	1287	21	426	4	25	14%	63%	1%	21%	0.2%	1%

*Weights of individual lithologies may not sum to the full weight of a dredge as the lithology was not identified for all samples.

Dredge Technical Description: Dredges were conducted using the 9/16” trawl wire, traction winch and starboard crane on the Atlantis, with a dredge and weak link system provided by Scripps Institution of Oceanography (SIO).

The dredge chain bag was lined with an inner net bag that was attached with zip ties, which were replaced as necessary. The dredge was weighted with an iron pig weight (~20 kg) wrapped in a burlap sack, which was dropped in and zip tied to the chain bag after lifting the dredge off the deck during deployment. The burlap sack catches small fragments of rock and glass that would otherwise fall through the chain link. A new sack was used for each dredge and the old sack was soaked in a bucket to recover glass and chips, before being thrown out.

At 250-350 m of wire out, a 12 KHz Benthos Pinger was attached to the wire. The pinger batteries were changed once after dredge 3 and the remaining 14 dredges were conducted with the same set of pinger batteries with excellent trace resolution. A MAPR was attached 20 m above the pinger and set to collect data every 5 seconds (maximum resolution possible). Initial descent of the dredge was at 20 m/min, with an increase in speed at 500 meters to 35 m/min, the maximum for the Atlantis 9/16” wire. This process was reversed for dredge ascent and recovery.

SIO provided four of their dredges for the cruise and WHOI provided three of their dredges. The same SIO dredge was used for all dredging. Scripps provided a set of weak links on the dredge basket and a spare set of weak links for use with either dredge system. Each set consisted of 1 link with a main link bolt hole (3/8”) and 2 links with two bolt holes each, for either a main link (3/8”) or a side link (7/16”) bolt.

Scripps provided the following bolts:

Bolt Size	Breaking Strength	Quantity
3/8”	19,000 lbs	12
3/8”	17,100 lbs	25
3/8”	13,700 lbs	25
3/8”	11,800 lbs	25
7/16”	8,000 lbs	50
7/16”	5,000 lbs	50

For dredging during AT42-20, the main weak link had a 3/8” bolt with 13,700 lbs breaking strength and the two side links had 7/16” bolts with 5,000 lbs breaking strength. The same set of bolts was used throughout the dredging, as high tensions were never reached. Bolts showed no signs of damage when inspected after each dredge. All dredges were in a similar depth range (3500-4500 m), so bolts did not need to be exchanged to accommodate different dredging depths.

An increase in the factor of safety (FoS) from 2 to 1.5 was approved ahead of the cruise, which allowed for maximum trawl wire tensions of 21,666 lbs instead of 16,250 lbs (where the yield strength of the wire is 32,500 lbs). The tension at the head block equals the wet weight of the cable plus dynamic tension. Heave resulting from sea conditions adds dynamic tension that is typically calculated as a factor of 1.7 on the wet weight of the cable. Additional dynamic tension occurs if the dredge catches on an outcrop. The weak link was thus chosen based on the depth of a dredge, which was used to calculate the wet weight of the cable and the allowable dynamic

tension range. If a head block tension of 21,666 lbs was reached, the weak link should have parted and the dredge would have been lost.

Wire tensions when the dredge reached bottom were ~5000-7000 lbs, while tensions when the dredge left bottom were ~6000-8000 lbs. Maximum tensions for each dredge, in lbs:

Dredge 1	No data
Dredge 2	10,378 lbs
Dredge 3	9,028
Dredge 4	7,766
Dredge 5	No data
Dredge 6	8,252
Dredge 7	8,796
Dredge 8	9,064
Dredge 9	8,380
Dredge 10	11,692
Dredge 11	8,080
Dredge 12	~8,000
Dredge 13	8,750
Dredge 14	9,826
Dredge 15	No data
Dredge 16	8,918
Dredge 17	Aborted

Maximum tensions throughout dredging operations only exceeded 10,000 lbs twice. The wire tension only climbed rapidly once, reaching 11,692 lbs during dredge 10 before dropping. This reflects calm sea conditions and dredging profiles that targeted relatively flat seafloor topography. Rocks recovered from the fault looked like talus and loosely consolidated fault rocks, both of which suggest that solid outcrops were not present in the fault zone. The more typical type of dredging up outcrop walls was not done on cruise AT42-20.

Once the dredge reached the seafloor, either active or passive dredging was conducted, depending on the depth, terrain, sea conditions, dredging direction, and recommendation of the dredge technician. The first dredge was deployed in passive mode, with 300 m of wire paid out at ~10 m/min while the ship moved at 0.2-0.4 kn. The ship then stopped and wire was brought in at 10-15 m/min until the pinger was 300 m from the bottom. This was repeated four times to reach the top of the slope. For the last two wire layouts, only 150 m of wire was laid out as the most variation in tension occurred when winding in wire for a pinger distance of 100-150 m off-bottom. The last two layouts were also done at faster ship speed (0.4 kn) and wire rate (15 m/min). The dredge took 7.75 hr to complete.

The remainder of the dredges was conducted in active mode, with the pinger placed at 250 m above the dredge. For active dredging, the dredge was lowered until the dredge touched bottom, then the ship moved in the line direction at ~0.4 kn while paying out wire at a speed to match the ship speed (~12m/m). When the pinger was 125-150 m off-bottom, the winch payout was stopped and the dredge was dragged along the seafloor with the ship going at 0.2-0.4 kn. Wire was not paid out during active dredging unless the wire tension rose above 10,000 lbs without

rapid release. This only happened once during 16 dredges and required minimal wire payout to resolve. Dredging in active mode took 5.5-6 hr, depending on depth and track length.

The dredging program ended during deployment of D17 (located in the vicinity of GC1 on Figure 10), which was the first of four planned dredges on the Quebrada Q1 segment. After D17 reached the seafloor, the sheave block at the base of the crane was found to be making an unusual noise. Five bolts on the sheave had sheared off and an emergency replacement with steel bolts was done before recovering the empty dredge. Upon recovery, the head block in the winch room was also showing signs of stress. This sheave had been fixed after a cruise that routinely reached tensions of ~15,000 lbs and metal shims that had been used for the previous repair had fallen onto the floor of the winch room. With 25 hrs of science time remaining, dredge operations were terminated as repairing the two sheaves required two days. Final science operations consisted of mapping around the Quebrada Q1 segment and four gravity cores that returned a small amount of material.

The initial problem with the sheave in the base of the crane was only identified because an AB happened to be on deck to turn on lights and noticed a noise. None of the sheaves have cameras that can be used to monitor them during dredging. Hence, the sheave problem could easily have escalated before being noticed. Another issue was that the IP camera that monitors the bull wheels has an inadequate refresh rate, such that often times it would appear to be turning in the opposite direction than it actually was. As this did not happen with the analog camera pointed at the storage drum, a system of analog cameras for monitoring the winch and sheave system would have provided safer operating conditions. Finally, the Atlantis does not have a backup option for dredging. For example, the 0.681 fiber optic termination that normally sits on the portside crane cannot easily be replaced with the 0.680 wire, which could have been used for dredging.

Gravity Core Technical Description: Four gravity cores were deployed during the final day of science operations (Figure 10). The gravity cores used the ¼” hydrowire and the starboard-side hydro boom. Gravity cores took ~3 hours to complete and were done along Quebrada segment Q1. The first three cores recovered small rock fragments and the final core recovered marine sediment.

Gravity cores were lowered at the maximum wire out rate for the hydrowire of 60 m/min. Maximum wire tensions were no higher than 2500 lbs at the maximum depth, while a FOS of 2 for this wire is 3,375 lbs. When the gravity core was estimated to be ~100 m off the seafloor, the core was allowed to free-fall, reaching a descent rate of ~85 m/min.

Multibeam Mapping

We utilized the EM122 multibeam system on the R/V Atlantis to make high-resolution bathymetry maps of Gofar transform fault. Multibeam mapping of the QDG system during the 2006 KN182-13 cruise created the first 200-m resolution map of the region. Mapping during the 2007 TN214 cruise produced 75-m resolution maps of Quebrada and Discovery transform faults, but not Gofar. Figure 11 shows the area that was mapped during AT42-20, which includes a higher resolution map of Gofar transform fault and complementary mapping around existing high-resolution data for Quebrada transform fault.

Figure 11. New area mapped by multibeam (color) over previous survey data (grey).

Mapping occurred after nightly dredges were on deck and before OBS deployments began each morning. Mapping routes aimed to maximize coverage along Gofar while minimizing transit times and fitting within allocated time between other operations, typically ~2 hrs. Primary objectives for mapping operations were (1) providing detailed coverage of dredge targets prior to dredging, (2) providing detailed coverage along Gofar segment G3, and (3) providing coverage of the intra-transform seafloor between G3 and the western fracture zone of G2. Following early termination of dredging operations when equipment problems arose, 10 hrs of survey covered the intra-transform and fracture zone regions east of Quebrada Transform Fault, expanding the 2007 mapping done by cruise TN214. Final science operations completed with surveying of a seamount at ~3° 35' S, 103° 5' W, immediately north of Quebrada. Multibeam data were also collected during transits when the ship was in international waters.

Mapping soundings were collected with the R/V *Atlantis*' Kongsberg EM122 12 kHz Multibeam Echosounder system. The EM122 transducer arrays are mounted in the bottom level transducer room. The EM122 system has an effective depth range of 20-12,000 m. Each ping can record up to 864 soundings over a 150-degree arc swath. Swath width at the seafloor is dependent on ocean depth. The R/V *Atlantis* EM122 compensates for up to 15 degrees of variation in roll, pitch, yaw,

and heave. Beam and sounding collection parameters were controlled using the Seafloor Information System software (v4.3.1).

Sound velocity profiles were locally calibrated using XBT casts on 2019/11/20 19:32:01, 2019/11/26 02:50:10, and 2019/12/05 20:20:21 UTC. Soundings were collected at ~8 knots with a symmetric beam angle of 40-45 degrees, yielding a swath width of ~5-6 km. Beam angle, ship velocity, and ocean depth yielded soundings at ~40-60 m horizontal resolution or less. When survey time permitted, outside loop turns and overlapping swaths improved coverage area and quality.

MAPR Operations

Miniature Autonomous Plume Recorders (MAPRs) were used to search for hydrothermal anomalies during dredging and wire OBS deployments. MAPRs are self-contained, internally recording instruments that can be attached to the wire during deployment of other equipment. They measure pressure, temperature, light backscattering (for suspended particle concentrations), and oxidation-reduction potential (ORP, for detecting the presence of reduced chemical species such as H_2S and Fe^{2+}). Hydrothermal plumes are primarily detected as layers of increased light scattering (increased concentration of suspended particulate material), although small temperature anomalies can sometimes be observed too. The ORP sensor is most useful near the seafloor where sediment suspension can make light-scattering anomalies unreliable.

Two MAPRs, S/N 53 and S/N 58, were made available for the cruise by Sharon Walker (NOAA-PMEL) and used interchangeably during operations. For dredge operations, the MAPR was attached to the 9/16" wire at a distance of 20 meters above the pinger, placing it 270 meters above the dredge basket. For OBS wire deployments, the MAPR was bolted to a bracket attached to the acoustic release immediately above the OBS (Figure 7). The MAPR was deployed continuously for the four to five OBS deployed per day, resulting in one data file covering multiple events. For many of the OBS deployments, short duration anomalies were recorded in the light backscattering sensor during descent. As these anomalies were not present during ascent, this suggests that a component of the OBS, possibly the flag, was interfering with the sensor.

The Windows7 MAPR Terminal application (provided by Baker and Walker, NOAA-PMEL) was used to communicate with the MAPR to configure it for deployment and to download data. Data were collected with a 5-second sampling interval, which is the maximum resolution possible. Data were downloaded and analyzed following deployment using the Transfer Data function in the terminal application. This generated a csv file that was read into Excel using the macro provided by Baker and Walker. The pressure sensor has a built-in arbitrary, but deliberate, offset from atmospheric pressure, which was corrected for using the average pre-deployment pressure. The conversion of pressure to depth was calculated in the Excel spreadsheet as a function of latitude.

Wenyuan Fan created plots of each MAPR dataset in Matlab, with descent and ascent datasets plotted separately. Five plots as a function of depth were created per site: Temp (C), Neph (V), OPR (counts), δNeph (V), and $\delta\text{ORP}/\delta t$ (mV/s).

The MAPR was deployed a total of 44 times (Table 4). MAPR data are being archived through the R2R program. Submitted files consist of 21 raw log files, 20 processed Excel spreadsheets, and the metadata table (Table 4).

Table 4. MAPR Metadata for Cruise AT42-20

MAPR Metadata for Cruise AT42-20					MAPR Run Time			
Event	Station	Event Type	Lat	Long	S/N	(min)	Records	Data File
1	Rosette	Rosette Test	14.983	-110.813	53	220	19	M58-TestData-112119
2	D1	Dredge	-4.543	-104.955	53	403	34	M53-D1-112519
3	D2	Dredge	-4.572	-105.981	53	360	30	M53-D12-112619
4	A2-01	OBS Wire	-4.545	-105.980	53	550	66	M53-A2_1to4_112719
5	A2-02	OBS Wire	-4.540	-105.977	53	550	66	M53-A2_1to4_112719
6	A2-03	OBS Wire	-4.535	-105.972	53	550	66	M53-A2_1to4_112719
7	A2-04	OBS Wire	-4.546	-105.974	53	550	66	M53-A2_1to4_112719
8	D3	Dredge	-4.579	-105.953	53	0	0	MAPR timer reset to 1/1/2003
9	A2-05	OBS Wire	-4.545	-105.969	58	993	83	M58-A2-5to9-112819
10	A2-06	OBS Wire	-4.544	-105.966	58	993	83	M58-A2-5to9-112819
11	A2-07	OBS Wire	-4.543	-105.962	58	993	83	M58-A2-5to9-112819
12	A2-08	OBS Wire	-4.544	-105.963	58	993	83	M58-A2-5to9-112819
13	A2-09	OBS Wire	-4.548	-105.966	58	993	83	M58-A2-5to9-112819
14	D4	Dredge	-4.578	-105.922	53	0	0	MAPR timer reset to 1/1/2003
15	A2-10	OBS Wire	-4.549	-105.970	53	0	0	Date/time correct but no data
16	A3-01	OBS Wire	-4.597	-105.938	53	0	0	Date/time correct but no data
17	A3-02	OBS Wire	-4.601	-105.942	53	0	0	Date/time correct but no data
18	A3-03	OBS Wire	-4.606	-105.947	53	0	0	Date/time correct but no data
19	D5	Dredge	-4.568	-106.008	58	300	25	M58-D5-112919
20	A3-04	OBS Wire	-4.594	-105.944	53	316	18	M53-A3-04-112919
21	D6	Dredge	-4.557	-106.037	58	320	27	M58-D6-113019
22	A3-09	OBS Wire	-4.591	-105.951	53	825	69	M53-A1-02-120119
23	A3-10	OBS Wire	-4.591	-105.947	53	825	69	M53-A1-02-120119
24	A1-01	OBS Wire	-4.585	-105.891	53	825	69	M53-A1-02-120119
25	A1-02	OBS Wire	-4.591	-105.892	53	825	69	M53-A1-02-120119
26	D7	Dredge	-4.592	-105.816	58	300	32	M58-D7-120119
27	A1-03	OBS Wire	-4.598	-105.894	53	972	81	M53-A1-03-10-120219
28	A1-04	OBS Wire	-4.586	-105.897	53	972	81	M53-A1-03-10-120219
29	A1-05	OBS Wire	-4.590	-105.901	53	972	81	M53-A1-03-10-120219
30	A1-06	OBS Wire	-4.591	-105.904	53	972	81	M53-A1-03-10-120219
31	A1-10	OBS Wire	-4.585	-105.902	53	972	81	M53-A1-03-10-120219
32	D8	Dredge	-4.581	-105.866	58	320	27	M58-D8-120219
33	A1-07	OBS Wire	-4.594	-105.907	53	0	0	MAPR timer reset to 1/1/2003
34	A1-08	OBS Wire	-4.592	-105.907	53	0	0	MAPR timer reset to 1/1/2003
35	A1-09	OBS Wire	-4.587	-105.905	53	0	0	MAPR timer reset to 1/1/2003
36	D9	Dredge	-4.603	-105.761	58	335	28	M58-D9-120219
37	D10	Dredge	-4.619	-105.681	58	399	34	M58-A1-02-120219
38	D11	Dredge	-4.654	-105.581	58	327	26	M58-D11-120419
39	D12	Dredge	-4.559	-104.888	58	363	31	M58-D12-120519
40	D13	Dredge	-3.735	-103.408	58	333	28	M58-D13-120619
41	D14	Dredge	-3.750	-103.358	58	416	35	M58-D14-120619
42	D15	Dredge	-3.703	-103.199	53	357	30	M53-D15-120619
43	D16	Dredge	-3.716	-103.129	53	305	26	M53-D16-12062019
44	D17	Dredge	-3.717	-102.991	58	840	71	M58-D17-120719

Lat/Long for dredges are from log sheet "on bottom" location.

Lat/Long for OBS are from USBL position when OBS dropped.

Data Archiving

Underway data collected during the cruise was transferred to the Rolling Deck to Repository Program (R2R) at the end of the cruise. Data submitted to R2R include:

- Event Log
- ADCP
- CTD
- MAPR
- Multibeam
- Shiptrack
- XBT

Seafloor samples are being archived at the WHOI Seafloor Sample Repository. Sample IGSNs will be searchable through the SESUR database after the moratorium period.

As OBS were deployed during this cruise, OBS data is not available from AT42-20.

Outreach During the Cruise

We created a twitter feed (<https://twitter.com/4castgofar>) for this project that can be used by all three cruises. The twitter handle @4castgofar comes from the project acronym 4D Characterization of Aseismic and Seismic Transients at Gofar, created by co-PI Emily Roland.

Posts at sea focused on daily life, science activities, and cruise personnel. Weekly features included “Methods Monday”, “Faculty Fridays”, and “Student Saturdays”. Each feature presented either a public-oriented explanation of ship instrumentation and methodologies or a highlight of members of the science party. The goal of these highlights was to inform the public about cruise objectives and, by showcasing members of the science party, promote diversity and inclusion in sea-going scientific expeditions.

During AT42-20, the @4castGofar Twitter blog recorded >22,000 impressions (contacts with users), 374 unique profile visits, and accumulated 47 followers. Each individual Tweet post averaged 5,000 impressions and 2% engagement rate (i.e., 2% of the impressions resulted in a user clicking on or otherwise interacting with the Tweet post). For reference, average the engagement rate across the Twitter platform in 2019 was 0.06% and the 99th percentile engagement rate was 2.7%. The @4castgofar account averaged two clicks per day, one “retweet” (post share) per day, and 7 “likes” per day.

AT42-20 Science Party. Row 1: Jessica, Jianhua; Row 2: Kuan-Yu, Janine, Melinda, Tony, Wenyan, Mark, Thomas; Row 3: Martin, Cécile, Dan, Alan, Darin, Brian; Row 4: Patrick.

Appendix I: AT42-20 Cruise Log

4CAST Gofar Leg 1: Passive Seismic Deployment & Dredging

All dates/times in UTC

11/17/2019

00:30 Depart 10th Ave Fuel Pier San Diego, CA

11/18/2019

Transit South

11/19/2019

Transit South

11/20/2019

Transit South

19:32 XBT

20:28 Begin rosette test for SIO releases, USBL beacon, & MAPR (wire out ~50 m/min)

21:41 Wire at 3500 m for tests. SIO tests all successful; took ~20 minutes to relocate USBL beacon to within 8m of target 100 m off original ship position.

23:59 Rosette secured on deck.

11/21/2019

Transit South

16:22 Begin underway data (e.g., ADCP, multibeam) acquisition after leaving French EEZ (around Clipperton Island)

11/22/2019

Transit South

11/23/2019

Transit South

11/24/2019

Transit South

11/25/2019

06:17 On Station for Dredge Site DT1 4.543S, 104.955W, 3582 m

06:31 Deploy dredge

06:50 pinger & MAPR deployed

08:36 dredge on bottom
 09:10 dredging (pulling in first wire pullout/4 wire payouts in total)
 11:32 dredge off bottom
 13:15 dredge recovered
 13:39 Underway to SMOBS G01
 14:43 On station for SMOBS G01 4.496S, 104.947W
 14:55 SMOBS G01 deployed (free-fall, disabled, no survey)
 15:33 On station for SMOBS G02 4.574S, 104.815W
 15:55 SMOBS G02 deployed (free-fall, disabled, no survey)
 16:32 On station for SMOBS G03 4.671S, 104.841W
 16:52 SMOBS G03 deployed (free-fall, disabled, no survey)
 17:37 On station for SMOBS G04 4.550S, 104.860W
 18:10 SMOBS G04 deployed (free-fall, disabled, no survey)
 18:38 On station for SMOBS G05 4.552S, 104.905W
 18:54 SMOBS G05 deployed (free-fall, disabled, no survey)
 19:33 On station for SMOBS G06 4.460S, 104.913W
 19:51 SMOBS G06 deployed (free-fall, disabled, no survey)
 20:57 On station for SMOBS G07 4.640S, 104.948W
 21:01 SMOBS G07 deployed (free-fall, disabled, no survey)
 21:40 On station for SMOBS G08 4.533S, 104.948W
 21:52 SMOBS G08 deployed (free-fall, disabled, no survey)
 22:20 On station for SMOBS G09 4.542S, 104.993W
 22:22 SMOBS G09 deployed (free-fall, disabled, no survey)
 23:02 On station for SMOBS G10 4.445S, 105.020W
 23:06 SMOBS G10 deployed (free-fall, disabled, no survey)
 23:16 Underway to Gofar G3 segment

11/26/2019

02:50 Start shorting mapping transit at G3 segment / XBT
 06:07 On Station for Dredge Site DT04 (dredge D2) 4.572S, 105.982W
 06:19 deploy dredge
 06:34 pinger & MAPR deployed
 08:27 dredge on bottom 3779m
 08:33 dredging (pulling in first wire pullout/2 wire payouts in total)
 09:19 start active dredging
 10:51 dredge off bottom
 12:47 dredge recovered
 13:46 deploy wire/MAPR/USBL for SPOBS A2_01 4.545S, 105.976W
 15:34 max wire out, 3100 m (wire out at 30 m/min)
 15:46 SPOBS A2_01 released from wire (~16 m from target)
 16:54 wire/MAPR/USBL recovered (wire in at 60 m/min)
 17:02 deploy wire/MAPR/USBL for SPOBS A2_02 4.540S, 105.977W
 18:48 max wire out, 3100m (wire out at 30 m/min)
 19:02 SPOBS A2_02, release from wire (~20m from target)
 20:08 wire/MAPR/USBL recovered (wire in at 60 m/min)
 20:24 deploy wire/MAPR/USBL for SPOBS A2_03 4.534S, 105.972W

22:13 max wire out, 3000m (wire out at 30 m/min; brief pause for USBL software issue)
 22:15 SPOBS A2_03, release from wire (~6 m from target)
 23:15 wire/MAPR/USBL recovered (wire in at 60 m/min)
 23:40 deploy wire/MAPR/USBL for SPOBS A2_04 4.546S, 105.974W 3300m

11/27/2019

01:25 max wire out, 3150m (wire out at 30 m/min)
 01:38 SPOBS A2_04, release from wire (~18 m from target)
 02:42 wire/MAPR/USBL recovered (wire in at 60 m/min)
 03:10 On Station for Dredge Site DT05 (dredge D3) 4.578S, 105.953W
 05:20 dredge on bottom (wire out 3898m)
 05:21 start active dredging (0.4 knots, payout 100 m wire)
 06:28 ship stopped pulling in wire
 06:56 dredge off bottom (wire out 3607m)
 08:52 dredge recovered
 09:00 begin short bathymetry survey
 11:45 deploy wire/MAPR/USBL for SPOBS A2_05 4.544S, 105.969W
 13:30 max wire out, 3100m (wire out at 30 m/min)
 13:33 SPOBS A2_05, release from wire (~15m from target)
 14:34 wire/MAPR/USBL recovered (wire in at 60 m/min)
 14:37 deploy wire/MAPR/USBL for SPOBS A2_06 4.544S, 105.966W
 16:24 max wire out, 3100m (wire out at 30 m/min)
 16:46 SPOBS A2_06, release from wire (~15m from target)
 17:50 wire/MAPR/USBL recovered (wire in at 60 m/min)
 17:55 deploy wire/MAPR/USBL for SPOBS A2_07 4.543S, 105.962W
 19:43 max wire out, 3150m (wire out at 30 m/min)
 19:59 SPOBS A2_07, release from wire (~10m from target)
 21:20 wire/MAPR/USBL recovered (wire in at 60 m/min)
 21:33 deploy wire/MAPR/USBL for SPOBS A2_08 4.545S, 105.963W
 23:22 max wire out, 3150m (wire out at 30 m/min)
 23:24 SPOBS A2_08, release from wire (~8m from target)

11/28/2019

00:27 wire/MAPR/USBL recovered (wire in at 60 m/min); USBL beacon damaged during operation. Swapped Alvin beacon out for old Sentry beacon
 00:50 deploy wire/MAPR/USBL for SPOBS A2_09 4.549S, 105.966W
 02:36 max wire out, 3150m (wire out at 30 m/min)
 02:38 SPOBS A2_09, release from wire
 03:39 wire/MAPR/USBL recovered (wire in at 60 m/min)
 04:10 On Station for Dredge D4 4.577S, 105.923W
 06:05 dredge on bottom (wire out 3552)
 06:07 start active dredging (0.4 knots, payout 100 m wire)
 06:18 ship stopped pulling in wire
 07:49 dredge off bottom (wire out 3607m)
 09:38 dredge recovered
 09:45 begin short bathymetry survey

12:25 deploy wire/MAPR/USBL for ARRA A2_10 4.550S, 105.970W
 14:38 max wire out, 3250m (wire out at 30 m/min)
 14:47 SPOBS A2_10, release from wire
 16:11 wire/MAPR/USBL recovered (wire in at 60 m/min)
 16:40 deploy wire/MAPR/USBL for SPOBS A3_01 4.597S, 105.938W
 18:26 max wire out, 3100m (wire out at 30 m/min)
 18:46 SPOBS A3_1, release from wire
 20:28 wire/MAPR/USBL recovered (wire in at 60 m/min)
 20:41 deploy wire/MAPR/USBL for SPOBS A3_02 4.601S, 105.942W
 22:30 max wire out, 3150m (wire out at 30 m/min)
 22:31 SPOBS A3_2, release from wire
 23:35 wire/MAPR/USBL recovered (wire in at 60 m/min)
 23:47 deploy wire/MAPR/USBL for SPOBS A3_03 4.605S, 105.947W

11/29/2019

01:36 max wire out, 3100m (wire out at 30 m/min)
 01:42 SPOBS A3_3, release from wire
 02:41 wire/MAPR/USBL recovered (wire in at 60 m/min)
 03:17 On Station for Dredge D5 (site DT3) 4.568S, 106.009W
 05:22 dredge on bottom
 05:30 start active dredging (0.4 knots, 3918m wire out)
 06:52 dredge off bottom
 08:43 dredge recovered
 09:00 begin short bathymetry survey
 12:13 deploy wire/MAPR/USBL for Abalone A3_04 4.594S, 105.944W
 14:03 max wire out, 3150m (wire out at 30 m/min)
 14:12 SPOBS A3_4, release from wire
 15:16 wire/MAPR/USBL recovered (wire in at 60 m/min)
 15:26 deploy wire/USBL for Abalone A3_05 4.596S, 105.946W
 17:17 max wire out, 3150m (wire out at 30 m/min)
 17:23 SPOBS A3_05, release from wire
 18:27 wire/USBL recovered (wire in at 60 m/min)
 18:28 deploy wire/USBL for Abalone A3_06 4.595S, 105.952W
 20:23 max wire out, 3200m (wire out at 30 m/min)
 20:39 SPOBS A3_06, release from wire
 21:43 wire/USBL recovered (wire in at 60 m/min)
 21:44 deploy wire/USBL for Abalone A3_07 4.596S, 105.956W
 23:34 max wire out, 3150m (wire out at 30 m/min)
 23:34 SPOBS A3_07, release from wire

11/30/2019

00:36 wire/USBL recovered (wire in at 60 m/min)
 00:41 deploy wire/USBL for Abalone A3_08 4.594S, 105.955W
 02:32 max wire out, 3200m (wire out at 30 m/min)
 02:32 SPOBS A3_08, release from wire
 03:36 wire/USBL recovered (wire in at 60 m/min)

04:17 On Station for Dredge Site DT33 (dredge D6) 4.557S, 106.037W
 06:12 dredge on bottom (3652m wire start paying out wire for active dredging)
 06:25 start active dredging (3740m wire out)
 07:30 dredge off bottom
 09:18 dredge recovered
 09:25 begin short bathymetry survey
 12:52 deploy wire/MAPR/USBL for Abalone A3_09 4.591S, 105.951W
 14:40 max wire out, 3150m (wire out at 30 m/min)
 14:49 SPOBS A3_09, release from wire
 15:52 wire/MAPR/USBL recovered (wire in at 60 m/min)
 15:54 deploy wire/MAPR/USBL for Abalone A3_10 4.591S, 105.947W
 17:43 max wire out, 3150m (wire out at 30 m/min)
 17:53 SPOBS A3_10, release from wire
 18:53 wire/MAPR/USBL recovered (wire in at 60 m/min)
 19:18 deploy wire/MAPR/USBL for SIO SPOBS A1_01 4.586S, 105.891W
 21:08 max wire out, 3200m (wire out at 30 m/min)
 21:58 SIO SPOBS A1_01, release from wire
 23:00 wire/MAPR/USBL recovered (wire in at 60 m/min)
 23:08 deploy wire/MAPR/USBL for SIO SPOBS A1_02 4.592S, 105.893W

12/1/2019

01:01 max wire out, 3150m (wire out at 30 m/min)
 01:05 SIO SPOBS A1_02, release from wire
 02:05 wire/MAPR/USBL recovered (wire in at 60 m/min)
 02:41 On Station for Dredge Site DT34 (dredge D7) 4.592S, 105.817W
 04:42 dredge/MAPR on bottom (3822m wire start paying out wire for active dredging)
 04:55 start active dredging (3919m wire out)
 06:47 dredge off bottom
 08:36 dredge/MAPR recovered
 08:40 start short bathymetry survey
 12:06 deploy wire/MAPR/USBL for SIO SPOBS A1_03 4.598S, 105.895W
 13:47 max wire out, 3000m (wire out at 30 m/min)
 14:11 SPOBS A1_03, release from wire
 15:08 wire/MAPR/USBL recovered (wire in at 60 m/min)
 15:23 deploy wire/MAPR/USBL for SIO SPOBS A1_04 4.587S, 105.897W
 17:08 max wire out, 3150m (wire out at 30 m/min)
 17:18 SPOBS A1_04, release from wire
 18:15 wire/MAPR/USBL recovered (wire in at 60 m/min)
 18:16 deploy wire/MAPR/USBL for SIO SPOBS A1_05 4.589S, 105.900W
 20:13 max wire out, 3200m (wire out at 30 m/min)
 20:31 SPOBS A1_05, release from wire
 21:34 wire/MAPR/USBL recovered (wire in at 60 m/min)
 21:36 deploy wire/MAPR/USBL for SIO SPOBS A1_06 4.591S, 105.904W
 23:25 max wire out, 3150m (wire out at 30 m/min)
 23:42 SPOBS A1_06, release from wire

12/2/2019

00:46 wire/MAPR/USBL recovered (wire in at 60 m/min)
00:48 deploy wire/MAPR/USBL for WHOI ARRA A1_10 4.585S, 105.902W
02:36 max wire out, 3100m (wire out at 30 m/min)
02:55 SPOBS A1_10, release from wire (27 m from target)
03:53 wire/MAPR/USBL recovered (wire in at 60 m/min)
04:15 On Station for dredge D8 4.581S, 105.866W
06:13 dredge/MAPR on bottom (3636m wire start paying out wire for active dredging)
06:26 start active dredging (3731m wire out)
08:08 dredge off bottom
09:54 dredge/MAPR recovered
10:00 start short bathymetry survey
12:22 deploy wire/MAPR/USBL for SIO SPOBS A1_07 4.594S, 105.907W
14:28 max wire out, 3000m (wire out at 30 m/min)
14:29 SPOBS A1_07, release from wire
15:30 wire/MAPR/USBL recovered (wire in at 60 m/min)
15:31 deploy wire/MAPR/USBL for SIO SPOBS A1_08 4.592S, 105.907W
17:15 max wire out, 3100m (wire out at 30 m/min)
17:23 SPOBS A1_08, release from wire
18:30 wire/MAPR/USBL recovered (wire in at 60 m/min)
18:31 deploy wire/MAPR/USBL for SIO SPOBS A1_09 4.587S, 105.905W
20:19 max wire out, 3200m (wire out at 30 m/min)
20:20 SPOBS A1_09, release from wire
21:25 wire/MAPR/USBL recovered (wire in at 60 m/min)
22:18 On Station for dredge D9 4.603S, 105.761W

12/3/2019

00:24 dredge/MAPR on bottom
02:22 dredge off bottom
04:10 dredge/MAPR recovered
04:57 On Station for dredge D10 4.618S, 105.681W
07:05 dredge/MAPR on bottom (4112 wire start paying out wire for active dredging)
07:19 start active dredging (4172m wire out)
09:42 dredge off bottom
11:36 dredge/MAPR recovered
11:40 start short bathymetry survey
13:39 ARRA G14 deployed 4° 37.189 S, 106°00.627 W (free-fall, disabled, no survey)
14:20 ARRA G15 deployed 4° 34.213 S, 105° 56.894 W (free-fall, disabled, no survey)
14:58 ARRA G16 deployed 4° 31.814 S, 105° 52.237 W (free-fall, disabled, no survey)
15:49 ARRA G13 deployed 4° 33.572 S, 106° 00.925 W (free-fall, disabled, no survey)
17:32 G15 start survey
18:22 G15 end survey
18:50 G16 start survey
19:39 G16 end survey
20:23 G13 start survey

21:11 G13 end survey
21:15 Start short bathymetry survey

12/4/2019

00:18 On Station for dredge D11 4.562S, 106.004W
02:08 dredge/MAPR on bottom (3572m wire start paying out wire for active dredging)
02:26 start active dredging (3674m wire out)
03:57 dredge off bottom
05:49 dredge/MAPR recovered
05:55 Transit to Segment G1, bathymetry survey
12:05 ARRA G17 deployed 4.474 S, 105.083 W (free-fall, disabled, no survey)
13:03 ARRA G18 deployed 4.621 S, 105.054 W (free-fall, disabled, no survey)
13:37 ARRA G19 deployed 4.554 S, 105.030 W (free-fall, disabled, no survey)
15:10 ARRA G20 deployed 4.576 S, 104.771W (free-fall, disabled, no survey)
15:51 ARRA G21 deployed 4.674 S, 104.736 W (free-fall, disabled, no survey)
16:28 ARRA G22 deployed 4.588 S, 105.727 W (free-fall, disabled, no survey)
17:04 ARRA G23 deployed 4.497 S, 104.701 W (free-fall, disabled, no survey)
17:45 G02 start survey
18:50 G02 end survey
19:03 G20 start survey
19:50 G20 end survey
20:10 G22 start survey
21:02 G22 end survey
21:05 Start bathymetric survey along G1 fault segment

12/5/2019

00:15 G19 start survey
01:02 G19 end survey
01:17 G09 start survey
02:08 G09 end survey
02:18 G08 start survey
03:14 G08 end survey
03:33 G05 start survey
04:20 G05 end survey
04:35 G04 start survey
05:23 G04 end survey
05:49 On Station for dredge D12 4.559S, 104.888W
07:37 dredge/MAPR on bottom (3401m wire start paying out wire for active dredging)
07:55 start active dredging
09:52 dredge off bottom
11:31 dredge/MAPR recovered
11:35 Start transit to Quebrada Transform
19:59 On Station for dredge D13 3.735S, 103.408W
20:20 XBT 3.735S, 103.408W
22:12 dredge/MAPR on bottom
23:31 dredge off bottom

12/6/2019

01:42 dredge/MAPR recovered (one rock)
02:14 On Station for dredge D14 3.749S, 103.358W
04:35 dredge/MAPR on bottom
06:12 dredge off bottom
08:30 dredge/MAPR recovered
09:39 On Station for dredge D15 3.703S, 103.199W
11:53 dredge/MAPR on bottom (4336m wire start paying out wire for active dredging)
12:10 start active dredging (4477m wire out)
12:58 stop active dredging and start hauling in at 4495m
13:14 dredge off bottom (4144m wire out)
15:25 dredge/MAPR recovered
16:08 On Station for dredge D16 3.716S, 103.128W
18:19 dredge/MAPR on bottom
20:09 dredge off bottom
22:13 dredge/MAPR recovered
23:14 On Station for dredge D17 3.717S, 102.991W

12/7/2019

01:31 dredge/MAPR on bottom
02:56 winch block sheared, recovering dredge w/o dredging
04:45 dredge/MAPR recovered / pins sheared / dredging suspended
05:00 begin mapping survey
15:07 deploy gravity core GC1 3.747S 102.811W
16:25 gravity core on bottom
17:45 recover gravity core
18:23 deploy gravity core GC2 3.734S 102.848W
19:40 gravity core on bottom
21:04 recover gravity core
21:28 deploy gravity core GC3 3.735S 102.871W
22:42 gravity core on bottom

12/7/2019

00:00 recover gravity core
00:25 deploy gravity core GC4 3.726S 102.929W
01:40 gravity core on bottom
02:58 recover gravity core
03:00 begin short bathymetry survey
05:00 end bathymetry survey; begin transit to Manzanillo

12/8/2019

Transit to Manzanillo

12/9/2019

Transit to Manzanillo

12/10/2019

Transit to Manzanillo

12/11/2019

Transit to Manzanillo

12/12/2019

Arrive Manzanillo

The full Event Log is accessible online through the R2R program.

Appendix II: List of numbered samples and sub-samples

AT42-20 Dredge Samples				PARENT	BASALT	TECTONIC	WHOLE ROCK		THIN SECTION
#	Sample Name	IGSN	Lithology	WHOI	SLAB	SLAB	GLASS	SPECIMEN	BILLET
1	AT42-20-01-01	IESFS0016	Pillow Basalt	X	1		2		
2	AT42-20-01-02	IESFS0017	Pillow Basalt	X	1		2		
3	AT42-20-01-03	IESFS0018	Pillow Basalt	X	1		2		
4	AT42-20-01-04	IESFS0019	Pillow Basalt	X	1		2		
5	AT42-20-01-05	IESFS001A	Pillow Basalt	X	1		2		
6	AT42-20-01-06	IESFS001B	Pillow Basalt	X	1		2		
7	AT42-20-01-07	IESFS001C	Pillow Basalt	X	1		2		
8	AT42-20-01-08	IESFS001D	Pillow Basalt	X	1		2		
9	AT42-20-01-09	IESFS001E	Pillow Basalt	X	1		2		
10	AT42-20-01-10	IESFS001F	Pillow Basalt	X	1		2		
11	AT42-20-01-11	IESFS001G	Pillow Basalt	X	1		2		
12	AT42-20-01-12	IESFS001H	Pillow Basalt	X					
13	AT42-20-01-13	IESFS001I	Pillow Basalt	X					
14	AT42-20-01-14	IESFS001J	Pillow Basalt	X					
15	AT42-20-01-15	IESFS001K	Pillow Basalt	X					
16	AT42-20-01-16	IESFS001L	Pillow Basalt	X					
17	AT42-20-01-17	IESFS001M	Pillow Basalt	X					
18	AT42-20-01-18	IESFS001N	Pillow Basalt	X					
19	AT42-20-01-19	IESFS001O	Pillow Basalt	X					
20	AT42-20-01-20	IESFS001P	Pillow Basalt	X					
21	AT42-20-01-21	IESFS001Q	Pillow Basalt	X					
22	AT42-20-01-22	IESFS001R	Pillow Basalt	X					
23	AT42-20-01-23	IESFS001S	Pillow Basalt	X					
24	AT42-20-01-24	IESFS001T	Pillow Basalt	X					
25	AT42-20-01-25	IESFS001U	Pillow Basalt	X					
26	AT42-20-01-26	IESFS001V	Pillow Basalt	X					
27	AT42-20-01-27	IESFS001W	Pillow Basalt	X					
28	AT42-20-01-28	IESFS001X	Pillow Basalt	X					
29	AT42-20-01-29	IESFS001Y	Pillow Basalt	X					
30	AT42-20-01-30	IESFS001Z	Pillow Basalt	X					
31	AT42-20-01-31	IESFS0020	Pillow Basalt	X					
32	AT42-20-01-32	IESFS0021	Pillow Basalt	X					
33	AT42-20-01-33	IESFS0022	Basalt	X					
34	AT42-20-01-34	IESFS0023	Basalt	X					
35	AT42-20-01-35	IESFS0024	Basalt	X					
36	AT42-20-01-36	IESFS0025	Basalt	X					
37	AT42-20-01-37	IESFS0026	Basalt	X	1				
38	AT42-20-01-38	IESFS0027	Basalt	X	1				
39	AT42-20-01-39	IESFS0028	Basalt	X	1				
40	AT42-20-01-40	IESFS0029	Basalt	X	1				
41	AT42-20-01-41	IESFS002A	Burlap sack fragments	At URI/BSU			1		
42	AT42-20-02-01	IESFS003Y	Basalt	X	1			2	
43	AT42-20-02-02	IESFS003Z	Basalt	X	1			2	
44	AT42-20-02-03	IESFS0040	Basalt	X	1			2	
45	AT42-20-02-04	IESFS0041	Basalt	X					
46	AT42-20-02-05	IESFS0042	Basalt	X					
47	AT42-20-02-06	IESFS0043	Basalt	X					
48	AT42-20-02-07	IESFS0044	Basalt	X	1			2	
49	AT42-20-02-08	IESFS0045	Basalt	X	1			2	
50	AT42-20-02-09	IESFS0046	Basalt	X					
51	AT42-20-02-10	IESFS0047	Basalt	X					
52	AT42-20-02-11	IESFS0048	Basalt	X					
53	AT42-20-02-12	IESFS0049	Basalt	X					
54	AT42-20-02-13	IESFS004A	Basalt	X					
55	AT42-20-02-14	IESFS004B	Basalt	X					
56	AT42-20-02-15	IESFS004C	Basalt	X					
57	AT42-20-02-16	IESFS004D	Basalt	X					
58	AT42-20-02-17	IESFS004E	Basalt	X					
59	AT42-20-02-18	IESFS004F	Basalt	X	1			2	
60	AT42-20-02-19	IESFS004G	Basalt	X	1			2	
61	AT42-20-02-20	IESFS004H	Basalt	X					
62	AT42-20-02-21	IESFS004I	Basalt	X					
63	AT42-20-02-22	IESFS004J	Basalt	X	1			2	
64	AT42-20-02-23	IESFS004K	Basalt	X	1			2	
65	AT42-20-02-24	IESFS004L	Basalt	X	1			2	
66	AT42-20-02-25	IESFS004M	Basalt	X	1			2	
67	AT42-20-02-26	IESFS004N	Basalt	X					
68	AT42-20-02-27	IESFS004O	Basalt	X					
69	AT42-20-02-28	IESFS004P	Basalt	X					
70	AT42-20-02-29	IESFS004Q	Basalt	X					
71	AT42-20-02-30	IESFS004R	Basalt	X					

AT42-20 Dredge Samples				PARENT	BASALT	TECTONIC	WHOLE ROCK		THIN SECTION
#	Sample Name	IGSN	Lithology	WHOI	SLAB	SLAB	GLASS	SPECIMEN	BILLET
72	AT42-20-02-31	IESFS004S	Basalt	X					
73	AT42-20-02-32	IESFS004T	Basalt	X					
74	AT42-20-02-33	IESFS004U	Basalt	X		1			2
75	AT42-20-02-34	IESFS004V	Basalt breccia	X		1			
76	AT42-20-02-35	IESFS004W	Basalt breccia	X		1			
77	AT42-20-02-36	IESFS004X	Basalt breccia	X		1			2
78	AT42-20-02-37	IESFS004Y	Basalt breccia	X		1			
79	AT42-20-02-38	IESFS004Z	Basalt breccia	X		1			
80	AT42-20-02-39	IESFS0050	Basalt breccia	X		1			
81	AT42-20-02-40	IESFS0051	Basalt breccia	X		1			
82	AT42-20-02-41	IESFS0052	Basalt breccia	X		1			
83	AT42-20-02-42	IESFS0053	Basalt breccia	X		1			
84	AT42-20-02-43	IESFS0054	Basalt breccia	X		1			
85	AT42-20-02-44	IESFS0055	Basalt breccia	X		1			
86	AT42-20-02-45	IESFS0056	Basalt breccia	X		1			2
87	AT42-20-02-46	IESFS0057	Basalt breccia	X		1			2
88	AT42-20-02-47	IESFS0058	Basalt breccia	X		1			
89	AT42-20-02-48	IESFS0059	Basalt breccia	X		1			2
90	AT42-20-02-49	IESFS005A	Basalt breccia	X		1			
91	AT42-20-02-50	IESFS005B	Basalt breccia	X		1			2
92	AT42-20-02-51	IESFS005C	Basalt breccia	X		1			2
93	AT42-20-02-52	IESFS005D	Basalt	X		1			
94	AT42-20-02-53	IESFS005E	Basalt	X		1			
95	AT42-20-02-54	IESFS005F	Basalt breccia	X		1			2
96	AT42-20-02-55	IESFS005G	Basalt breccia	X		1			2
97	AT42-20-02-56	IESFS005H	Basalt breccia	X		1			
98	AT42-20-02-57	IESFS005I	Basalt breccia	X		1			2
99	AT42-20-02-58	IESFS005J	Basalt breccia	X		1			2
100	AT42-20-02-59	IESFS005K	Basalt breccia	X		1			
101	AT42-20-02-60	IESFS005L	Basalt breccia	X		1			2
102	AT42-20-02-61	IESFS005M	Basalt breccia	X		1			
103	AT42-20-02-62	IESFS005N	Basalt breccia	X		1			2
104	AT42-20-02-63	IESFS005O	Basalt breccia	X		1			
105	AT42-20-02-64	IESFS005P	Basalt breccia	X		1			
106	AT42-20-02-65	IESFS005Q	Basalt breccia	X		1			
107	AT42-20-02-66	IESFS005R	Basalt breccia	X		1			2
108	AT42-20-02-67	IESFS005S	Basalt breccia	X		1			
109	AT42-20-02-68	IESFS005T	Basalt breccia	X		1			
110	AT42-20-02-69	IESFS005U	Basalt breccia	X		1			
111	AT42-20-02-70	IESFS005V	Basalt breccia	X		1			
112	AT42-20-03-01	IESFS006Q	Basalt	X	1			2	
113	AT42-20-03-02	IESFS006R	Basalt	X					
114	AT42-20-03-03	IESFS006S	Basalt	X					
115	AT42-20-03-04	IESFS006T	Basalt	X	1			2	3
116	AT42-20-03-05	IESFS006U	Basalt	X					
117	AT42-20-03-06	IESFS006V	Basalt	X					
118	AT42-20-03-07	IESFS006W	Basalt	X	1			2	
119	AT42-20-03-08	IESFS006X	Basalt	X					
120	AT42-20-03-09	IESFS006Y	Basalt	X					
121	AT42-20-03-10	IESFS006Z	Basalt	X	1			2	
122	AT42-20-03-11	IESFS0070	Basalt	X					
123	AT42-20-03-12	IESFS0071	Basalt	X					
124	AT42-20-03-13	IESFS0072	Basalt	X					
125	AT42-20-03-14	IESFS0073	Basalt	X					
126	AT42-20-03-15	IESFS0074	Basalt	X					
127	AT42-20-03-16	IESFS0075	Basalt	X					
128	AT42-20-03-17	IESFS0076	Basalt	X					
129	AT42-20-03-18	IESFS0077	Basalt	X					
130	AT42-20-03-19	IESFS0078	Basalt	X					
131	AT42-20-03-20	IESFS0079	Basalt	X					
132	AT42-20-03-21	IESFS007A	Basalt	X					
133	AT42-20-03-22	IESFS007B	Basalt	X					
134	AT42-20-03-23	IESFS007C	Basalt	X					
135	AT42-20-03-24	IESFS007D	Basalt	X					
136	AT42-20-03-25	IESFS007E	Basalt	X					
137	AT42-20-03-26	IESFS007F	Basalt	X					
138	AT42-20-03-27	IESFS007G	Basalt	X					
139	AT42-20-03-28	IESFS007H	Basalt	X					
140	AT42-20-03-29	IESFS007I	Basalt	X					
141	AT42-20-03-30	IESFS007J	Basalt	X					
142	AT42-20-03-31	IESFS007K	Basalt	X					

AT42-20 Dredge Samples				PARENT	BASALT	TECTONIC	WHOLE ROCK		THIN SECTION
#	Sample Name	IGSN	Lithology	WHOI	SLAB	SLAB	GLASS	SPECIMEN	BILLET
143	AT42-20-03-32	IESFS007L	Basalt	X					
144	AT42-20-03-33	IESFS007M	Basalt	X					
145	AT42-20-03-34	IESFS007N	Basalt	X					
146	AT42-20-03-35	IESFS007O	Basalt	X					
147	AT42-20-03-36	IESFS007P	Basalt	X					
148	AT42-20-03-37	IESFS007Q	Basalt	X					
149	AT42-20-03-38	IESFS007R	Basalt	X					
150	AT42-20-03-39	IESFS007S	Basalt	X					
151	AT42-20-03-40	IESFS007T	Basalt	X					
152	AT42-20-03-41	IESFS007U	Basalt	X					
153	AT42-20-03-42	IESFS007V	Basalt	X					
154	AT42-20-03-43	IESFS007W	Basalt	X					
155	AT42-20-03-44	IESFS007X	Basalt	X					
156	AT42-20-03-45	IESFS007Y	Basalt	X					
157	AT42-20-03-46	IESFS007Z	Basalt	X					
158	AT42-20-03-47	IESFS0080	Basalt	X					
159	AT42-20-03-48	IESFS0081	Basalt	X					
160	AT42-20-03-49	IESFS0082	Basalt	At UD					
161	AT42-20-03-50	IESFS0083	Basalt	At UD					
162	AT42-20-03-51	IESFS0084	Basalt	X		1			
163	AT42-20-03-52	IESFS0085	Basalt	X		1			
164	AT42-20-03-53	IESFS0086	Basalt	X		1			
165	AT42-20-03-54	IESFS0087	Basalt breccia	X		1			
166	AT42-20-03-55	IESFS0088	Basalt breccia	X		1			2
167	AT42-20-03-56	IESFS0089	Basalt breccia	X		1			
168	AT42-20-03-57	IESFS008A	Basalt breccia	X		1			2
169	AT42-20-03-58	IESFS008B	Basalt breccia	X		1			
170	AT42-20-03-59	IESFS008C	Basalt breccia	X		1			
171	AT42-20-03-60	IESFS008D	Basalt	X		1			2
172	AT42-20-03-61	IESFS008E	Basalt	X		1			2
173	AT42-20-03-62	IESFS008F	Basalt	X		1			2
174	AT42-20-03-63	IESFS008G	Basalt breccia	X		1			2
175	AT42-20-03-64	IESFS008H	Basalt breccia	X		1			2
176	AT42-20-03-65	IESFS008I	Basalt breccia	X		1			2
177	AT42-20-03-66	IESFS008J	Basalt breccia	X		1			
178	AT42-20-03-67	IESFS008K	Diabase breccia	X		1			2
179	AT42-20-03-68	IESFS008L	Basalt, unconsolidated mud	At UD					
180	AT42-20-03-69	IESFS008M	Basalt, unconsolidated mud	At UD					
181	AT42-20-03-70	IESFS008N	Consolidated mud	X					
182	AT42-20-03-71	IESFS008O	Unconsolidated mud	At UD					
183	AT42-20-03-72	IESFS008P	Basalt breccia pebbles	X					
184	AT42-20-03-73	IESFS008Q	Basalt breccia pebbles	X					
185	AT42-20-03-74	IESFS008R	Basalt breccia pebbles	X					
186	AT42-20-04-01	IESFS009I	Basalt	X	1			2	
187	AT42-20-04-02	IESFS009J	Diabase	X	1				
188	AT42-20-04-03	IESFS009K	Basalt	X	1				2
189	AT42-20-04-04	IESFS009L	Basalt	X	1				
190	AT42-20-04-05	IESFS009M	Diabase	X	1			2	
191	AT42-20-04-06	IESFS009N	Basalt	X	1				
192	AT42-20-04-07	IESFS009O	Diabase	X	1			2	
193	AT42-20-04-08	IESFS009P	Diabase	X	1				
194	AT42-20-04-09	IESFS009Q	Basalt breccia	X		1			2
195	AT42-20-04-10	IESFS009R	Basalt breccia	X		1			2
196	AT42-20-04-11	IESFS009S	Basalt breccia	X		1			
197	AT42-20-04-12	IESFS009T	Basalt breccia	X		1			2
198	AT42-20-04-13	IESFS009U	Basalt breccia	X		1			2
199	AT42-20-04-14	IESFS009V	Basalt breccia	X		1			
200	AT42-20-04-15	IESFS009W	Basalt breccia	X		1			
201	AT42-20-04-16	IESFS009X	Basalt breccia	X		1			
202	AT42-20-04-17	IESFS009Y	Basalt breccia	X		1			
203	AT42-20-04-18	IESFS009Z	Basalt breccia	X		1			2
204	AT42-20-04-19	IESFS00A0	Basalt breccia	X					
205	AT42-20-04-20	IESFS00A1	Basalt breccia	X					
206	AT42-20-04-21	IESFS00A2	Basalt breccia	X					
207	AT42-20-04-22	IESFS00A3	Basalt breccia	X					
208	AT42-20-04-23	IESFS00A4	Basalt breccia	X					
209	AT42-20-04-24	IESFS00A5	Basalt breccia	X					
210	AT42-20-04-25	IESFS00A6	Basalt breccia	X					
211	AT42-20-04-26	IESFS00A7	Basalt breccia	X					
212	AT42-20-04-27	IESFS00A8	Basalt breccia	X					
213	AT42-20-04-28	IESFS00A9	Basalt breccia	X					

AT42-20 Dredge Samples				PARENT	BASALT	TECTONIC	WHOLE ROCK		THIN SECTION
#	Sample Name	IGSN	Lithology	WHOI	SLAB	SLAB	GLASS	SPECIMEN	BILLET
214	AT42-20-04-29	IESFS00AA	White unconsolidated mud	At UD					
215	AT42-20-05-01	IESFS00CA	Basalt	X	1				
216	AT42-20-05-02	IESFS00CB	Pillow basalt	X	1				
217	AT42-20-05-03	IESFS00CC	Pillow basalt	X	1				
218	AT42-20-05-04	IESFS00CD	Pillow basalt	X	1			2	
219	AT42-20-05-05	IESFS00CE	Pillow basalt	X	1			2	
220	AT42-20-05-06	IESFS00CF	Pillow basalt	X	1			2	
221	AT42-20-05-07	IESFS00CG	Pillow basalt	X	1				
222	AT42-20-05-08	IESFS00CH	Pillow basalt	X	1			2	
223	AT42-20-05-09	IESFS00CI	Pillow basalt	X	1			2	
224	AT42-20-05-10	IESFS00CJ	Basalt	X	1				
225	AT42-20-05-11	IESFS00CK	Pillow basalt	X	1			2	
226	AT42-20-05-12	IESFS00CL	Pillow basalt	X	1			2	
227	AT42-20-05-13	IESFS00CM	Pillow basalt	X	1				
228	AT42-20-05-14	IESFS00CN	Pillow basalt	X					
229	AT42-20-05-15	IESFS00CO	Pillow basalt	X					
230	AT42-20-05-16	IESFS00CP	Basalt	X					
231	AT42-20-05-17	IESFS00CQ	Basalt	X					
232	AT42-20-05-18	IESFS00CR	Pillow basalt	X					
233	AT42-20-05-19	IESFS00CS	Pillow basalt	X					
234	AT42-20-05-20	IESFS00CT	Basalt	X					
235	AT42-20-05-21	IESFS00CU	Pillow basalt	X					
236	AT42-20-05-22	IESFS00CV	Pillow basalt	X					
237	AT42-20-05-23	IESFS00CW	Pillow basalt	X					
238	AT42-20-05-24	IESFS00CX	Basalt	X					
239	AT42-20-05-25	IESFS00CY	Basalt	X					
240	AT42-20-05-26	IESFS00CZ	Basalt	X					
241	AT42-20-05-27	IESFS00D0	Pillow basalt	X					
242	AT42-20-05-28	IESFS00D1	Basalt	X					
243	AT42-20-05-29	IESFS00D2	Basalt	X					
244	AT42-20-05-30	IESFS00D3	Basalt	X					
245	AT42-20-05-31	IESFS00D4	Pillow basalt	X					
246	AT42-20-05-32	IESFS00D5	Pillow basalt	X					
247	AT42-20-05-33	IESFS00D6	Basalt	X					
248	AT42-20-05-34	IESFS00D7	Pillow basalt	X					
249	AT42-20-05-35	IESFS00D8	Basalt breccia	X			1		2
250	AT42-20-05-36	IESFS00D9	Basalt breccia	X			1		2
251	AT42-20-05-37	IESFS00DA	Basalt breccia	X			1		
252	AT42-20-05-38	IESFS00DB	Basalt	X					
253	AT42-20-05-39	IESFS00DC	Burlap sack fragments	X			1		
254	AT42-20-06-01	IESFS00F2	Basalt	X	1			2	
255	AT42-20-06-02	IESFS00F3	Basalt	X	1				
256	AT42-20-06-03	IESFS00F4	Pillow basalt	X	1				
257	AT42-20-06-04	IESFS00F5	Pillow basalt	X	1			2	
258	AT42-20-06-05	IESFS00F6	Pillow basalt	X	1			2	
259	AT42-20-06-06	IESFS00F7	Pillow basalt	X	1			2	
260	AT42-20-06-07	IESFS00F8	Pillow basalt	X	1				
261	AT42-20-06-08	IESFS00F9	Pillow basalt	X	1				
262	AT42-20-06-09	IESFS00FA	Pillow basalt	X	1			2	
263	AT42-20-06-10	IESFS00FB	Pillow basalt	X	1				
264	AT42-20-07-01	IESFS00HU	Basalt	X	1			2	
265	AT42-20-07-02	IESFS00HV	Basalt	X	1			2	
266	AT42-20-07-03	IESFS00HW	Basalt	X	1				
267	AT42-20-07-04	IESFS00HX	Basalt	X	1				
268	AT42-20-07-05	IESFS00HY	Diabase	X	1			2	
269	AT42-20-07-06	IESFS00HZ	Diabase	X	1				
270	AT42-20-07-07	IESFS00I0	Diabase	X	1			2	
271	AT42-20-07-08	IESFS00I1	Diabase	X	1			2	
272	AT42-20-07-09	IESFS00I2	Diabase	X	1				
273	AT42-20-07-10	IESFS00I3	Diabase	X	1				
274	AT42-20-07-11	IESFS00I4	Basalt breccia	X			1		
275	AT42-20-07-12	IESFS00I5	Basalt	X	1				
276	AT42-20-07-13	IESFS00I6	Diabase	X	1				
277	AT42-20-07-14	IESFS00I7	Basalt	X	1				
278	AT42-20-07-15	IESFS00I8	Basalt	X	1				
279	AT42-20-07-16	IESFS00I9	Diabase	X	1			2	
280	AT42-20-07-17	IESFS00IA	Diabase	X	1			2	
281	AT42-20-07-18	IESFS00IB	Basalt	X			1		
282	AT42-20-07-19	IESFS00IC	Basalt	X			1		
283	AT42-20-07-20	IESFS00ID	Basalt	X			1		
284	AT42-20-07-21	IESFS00IE	Basalt	X			1		

AT42-20 Dredge Samples				PARENT	BASALT	TECTONIC	WHOLE ROCK		THIN SECTION
#	Sample Name	IGSN	Lithology	WHOI	SLAB	SLAB	GLASS	SPECIMEN	BILLET
285	AT42-20-07-22	IESFS00IF	Basalt breccia	X		1			
286	AT42-20-07-23	IESFS00IG	Basalt breccia	X		1			2
287	AT42-20-07-24	IESFS00IH	Basalt	X		1			
288	AT42-20-07-25	IESFS00II	Basalt breccia	X		1			
289	AT42-20-07-26	IESFS00IJ	Basalt	X		1			
290	AT42-20-07-27	IESFS00IK	Basalt breccia	X		1			2
291	AT42-20-07-28	IESFS00IL	Basalt breccia	X		1			
292	AT42-20-07-29	IESFS00IM	Basalt breccia	X		1			
293	AT42-20-07-30	IESFS00IN	Basalt breccia	X		1			2
294	AT42-20-07-31	IESFS00IO	Basalt breccia	X		1			2
295	AT42-20-07-32	IESFS00IP	Basalt breccia	X		1			
296	AT42-20-07-33	IESFS00IQ	Basalt breccia	X		1			
297	AT42-20-07-34	IESFS00IR	Basalt breccia	X		1			
298	AT42-20-07-35	IESFS00IS	Protomylonite	X		1			2
299	AT42-20-07-36	IESFS00IT	Protomylonite	X		1			2
300	AT42-20-07-37	IESFS00IU	Mylonite	X		1			2 & 3
301	AT42-20-07-38	IESFS00IV	Basalt breccia	X		1			
302	AT42-20-07-39	IESFS00IW	Basalt breccia	X		1			
303	AT42-20-07-40	IESFS00IX	Basalt breccia	X		1			2
304	AT42-20-07-41	IESFS00IY	Basalt breccia	X		1			2
305	AT42-20-07-42	IESFS00IZ	Fault gouge	At UD		1			
306	AT42-20-08-01	IESFS00KM	Basalt	X	1				
307	AT42-20-08-02	IESFS00KN	Basalt	X	1		2		
308	AT42-20-08-03	IESFS00KO	Basalt	X	1		2		
309	AT42-20-08-04	IESFS00KP	Basalt	X	1		2		
310	AT42-20-08-05	IESFS00KQ	Basalt	X	1				
311	AT42-20-08-06	IESFS00KR	Basalt	X	1				
312	AT42-20-08-07	IESFS00KS	Basalt	X	1		2		
313	AT42-20-08-08	IESFS00KT	Basalt	X	1		2		
314	AT42-20-08-09	IESFS00KU	Basalt	X	1				
315	AT42-20-08-10	IESFS00KV	Basalt	X	1				
316	AT42-20-08-11	IESFS00KW	Basalt	X	1				
317	AT42-20-08-12	IESFS00KX	Basalt	X	1				
318	AT42-20-08-13	IESFS00KY	Basalt	X	1				
319	AT42-20-08-14	IESFS00KZ	Basalt	X	1				
320	AT42-20-08-15	IESFS00L0	Basalt	X	1				
321	AT42-20-08-16	IESFS00L1	Basalt	X	1		2		
322	AT42-20-08-17	IESFS00L2	Breccia	X		1			
323	AT42-20-08-18	IESFS00L3	Breccia	X		1			
324	AT42-20-08-19	IESFS00L4	Breccia	X		1			
325	AT42-20-08-20	IESFS00L5	Breccia	X		1			2
326	AT42-20-08-21	IESFS00L6	Basalt	X		1			2
327	AT42-20-08-22	IESFS00L7	Breccia	X		1			2
328	AT42-20-08-23	IESFS00L8	Breccia	X		1			2
329	AT42-20-08-24	IESFS00L9	Breccia	X					
330	AT42-20-08-25	IESFS00LA	Breccia	X					
331	AT42-20-08-26	IESFS00LB	Breccia	X					
332	AT42-20-08-27	IESFS00LC	Breccia	X					
333	AT42-20-08-28	IESFS00LD	Breccia	X					
334	AT42-20-08-29	IESFS00LE	Burlap sack fragments	X			1		
335	AT42-20-09-01	IESFS00NE	Pillow basalt	X	1		2		
336	AT42-20-09-02	IESFS00NF	Pillow basalt	X	1		2		
337	AT42-20-09-03	IESFS00NG	Pillow basalt	X	1		2		
338	AT42-20-09-04	IESFS00NH	Pillow basalt	X	1		2		
339	AT42-20-09-05	IESFS00NI	Pillow basalt	X	1		2		
340	AT42-20-09-06	IESFS00NJ	Pillow basalt	X	1		2		
341	AT42-20-09-07	IESFS00NK	Basalt	X	1				
342	AT42-20-09-08	IESFS00NL	Basalt	X	1				
343	AT42-20-09-09	IESFS00NM	Basalt	X	1				
344	AT42-20-09-10	IESFS00NN	Basalt	X	1				
345	AT42-20-09-11	IESFS00NO	Basalt	X	1				
346	AT42-20-09-12	IESFS00NP	Basalt	X	1				
347	AT42-20-09-13	IESFS00NQ	Basalt	X	1				
348	AT42-20-09-14	IESFS00NR	Basalt breccia	X		1			2
349	AT42-20-09-15	IESFS00NS	Burlap sack fragments	At URI/BSU			1		
350	AT42-20-10-01	IESFS00Q6	Pillow basalt	X	1		2		
351	AT42-20-10-02	IESFS00Q7	Basalt	X	1				
352	AT42-20-10-03	IESFS00Q8	Basalt	X	1				
353	AT42-20-10-04	IESFS00Q9	Basalt	X	1				
354	AT42-20-10-05	IESFS00QA	Basalt	X	1				
355	AT42-20-10-06	IESFS00QB	Basalt	X	1		2		

AT42-20 Dredge Samples				PARENT	BASALT	TECTONIC	WHOLE ROCK		THIN SECTION
#	Sample Name	IGSN	Lithology	WHOI	SLAB	SLAB	GLASS	SPECIMEN	BILLET
356	AT42-20-10-07	IESFS00QC	Basalt	X	1			2	
357	AT42-20-10-08	IESFS00QD	Diabase	X	1				
358	AT42-20-10-09	IESFS00QE	Diabase	X	1				
359	AT42-20-10-10	IESFS00QF	Basalt	X	1			2	
360	AT42-20-10-11	IESFS00QG	Diabase	X	1				
361	AT42-20-10-12	IESFS00QH	Diabase	X	1				
362	AT42-20-10-13	IESFS00QI	Basalt	X	1			2	
363	AT42-20-10-14	IESFS00QJ	Diabase	X	1			2	
364	AT42-20-10-15	IESFS00QK	Diatomite	At UD					
365	AT42-20-10-16	IESFS00QL	Diatomite	X					
366	AT42-20-10-17	IESFS00QM	Diatomite	X					
367	AT42-20-10-18	IESFS00QN	Diatomite	X					
368	AT42-20-10-19	IESFS00QO	Diatomite	X					
369	AT42-20-10-20	IESFS00QP	Diatomite	X					
370	AT42-20-10-21	IESFS00QQ	Diatomite	X					
371	AT42-20-10-22	IESFS00QR	Diatomite	X					
372	AT42-20-11-01	IESFS00SY	Basalt	X	1				
373	AT42-20-11-02	IESFS00SZ	Basalt	X	1				
374	AT42-20-11-03	IESFS00T0	Basalt	X	1				
375	AT42-20-11-04	IESFS00T1	Basalt	X	1				
376	AT42-20-11-05	IESFS00T2	Pillow basalt	X	1				
377	AT42-20-11-06	IESFS00T3	Basalt	X	1				
378	AT42-20-11-07	IESFS00T4	Basalt	X	1				
379	AT42-20-11-08	IESFS00T5	Basalt	X	1				
380	AT42-20-11-09	IESFS00T6	Basalt	X	1				
381	AT42-20-11-10	IESFS00T7	Basalt	X	1				
382	AT42-20-11-11	IESFS00T8	Pillow basalt	X	1		2		
383	AT42-20-11-12	IESFS00T9	Pillow basalt	X	1		2		
384	AT42-20-11-13	IESFS00TA	Pillow basalt	X	1		2		
385	AT42-20-11-14	IESFS00TB	Pillow basalt	X	1		2		
386	AT42-20-11-15	IESFS00TC	Pillow basalt	X	1		2		
387	AT42-20-11-16	IESFS00TD	Pillow basalt	X	1		2		
388	AT42-20-11-17	IESFS00TE	Pillow basalt	X	1		2		
389	AT42-20-11-18	IESFS00TF	Pillow basalt	X	1		2		
390	AT42-20-11-19	IESFS00TG	Basalt	X	1				
391	AT42-20-11-20	IESFS00TH	Basalt breccia	X		1			
392	AT42-20-11-21	IESFS00TI	Basalt breccia	X		1			
393	AT42-20-11-22	IESFS00TJ	Basalt breccia	X		1			
394	AT42-20-11-23	IESFS00TK	Basalt breccia	X		1			2
395	AT42-20-11-24	IESFS00TL	Basalt breccia	X		1			2
396	AT42-20-11-25	IESFS00TM	Basalt breccia	X		1			
397	AT42-20-11-26	IESFS00TN	Basalt breccia	X		1			
398	AT42-20-11-27	IESFS00TO	Basalt breccia	X		1			2
399	AT42-20-11-28	IESFS00TP	Basalt breccia	X		1			2
400	AT42-20-11-29	IESFS00TQ	Basalt breccia	X		1			
401	AT42-20-11-30	IESFS00TR	Basalt breccia	X		1			2
402	AT42-20-11-31	IESFS00TS	Basalt breccia	X		1			
403	AT42-20-11-32	IESFS00TT	Basalt breccia	X		1			2
404	AT42-20-11-33	IESFS00TU	Basalt breccia	X		1			2
405	AT42-20-11-34	IESFS00TV	Burlap sack fragments	X			1		
406	AT42-20-12-01	IESFS00VQ	Basalt	X	1				
407	AT42-20-12-02	IESFS00VR	Basalt	X	1		2		
408	AT42-20-12-03	IESFS00VS	Pillow basalt	X	1		2		
409	AT42-20-12-04	IESFS00VT	Pillow basalt	X	1				
410	AT42-20-12-05	IESFS00VU	Pillow basalt	X	1		2		
411	AT42-20-12-06	IESFS00VV	Pillow basalt	X	1		2		
412	AT42-20-12-07	IESFS00VW	Basalt	X	1		2		
413	AT42-20-12-08	IESFS00VX	Basalt	X	1		2		
414	AT42-20-12-09	IESFS00VY	Pillow basalt	X	1				
415	AT42-20-12-10	IESFS00VZ	Pillow basalt	X	1		2		
416	AT42-20-12-11	IESFS00W0	Basalt	X	1				
417	AT42-20-12-12	IESFS00W1	Pillow basalt	X	1		2		
418	AT42-20-12-13	IESFS00W2	Pillow basalt	X	1		2		
419	AT42-20-12-14	IESFS00W3	Pillow basalt	X	1				
420	AT42-20-12-15	IESFS00W4	Pillow basalt	X	1		2		
421	AT42-20-12-16	IESFS00W5	Pillow basalt	X	1				
422	AT42-20-12-17	IESFS00W6	Pillow basalt	X	1				
423	AT42-20-12-18	IESFS00W7	Pillow basalt	X	1				
424	AT42-20-12-19	IESFS00W8	Basalt	X	1				
425	AT42-20-12-20	IESFS00W9	Diabase	X	1				
426	AT42-20-12-21	IESFS00WA	Diabase	X	1				

AT42-20 Dredge Samples				PARENT	BASALT	TECTONIC	WHOLE ROCK		THIN SECTION
#	Sample Name	IGSN	Lithology	WHOI	SLAB	SLAB	GLASS	SPECIMEN	BILLET
427	AT42-20-12-22	IESFS00WB	Basalt	X	1				
428	AT42-20-12-23	IESFS00WC	Basalt breccia	X		1			
429	AT42-20-12-24	IESFS00WD	Basalt breccia	X		1			
430	AT42-20-12-25	IESFS00WE	Basalt breccia	X		1			
431	AT42-20-12-26	IESFS00WF	Basalt breccia	X		1			2
432	AT42-20-12-27	IESFS00WG	Basalt breccia	X		1			2
433	AT42-20-12-28	IESFS00WH	Basalt	X		1			
434	AT42-20-12-29	IESFS00WI	Basalt	X					
435	AT42-20-12-30	IESFS00WJ	Basalt	X					
436	AT42-20-12-31	IESFS00WK	Basalt	X					
437	AT42-20-12-32	IESFS00WL	Basalt	X					
438	AT42-20-12-33	IESFS00WM	Basalt	X					
439	AT42-20-12-34	IESFS00WN	Basalt	X					
440	AT42-20-12-35	IESFS00WO	Basalt	X					
441	AT42-20-12-36	IESFS00WP	Basalt	X					
442	AT42-20-12-37	IESFS00WQ	Burlap sack fragments	X			1		
443	AT42-20-13-01	IESFS00YI	Pillow basalt	X	1		2		
444	AT42-20-13-02	IESFS00YJ	Burlap sack fragments	X			1		
445	AT42-20-14-01	IESFS011A	Burlap sack fragments	X			1		
446	AT42-20-15-01	IESFS0142	Mud	X					
447	AT42-20-15-02	IESFS0143	Mud	X					
448	AT42-20-15-03	IESFS0144	Mud	X					
449	AT42-20-15-04	IESFS0145	Mud	X					
450	AT42-20-15-05	IESFS0146	Mud	X					
451	AT42-20-15-06	IESFS0147	Mud	X					
452	AT42-20-15-07	IESFS0148	Mud	X					
453	AT42-20-15-08	IESFS0149	Mud	X					
454	AT42-20-15-09	IESFS014A	Mud	X					
455	AT42-20-15-10	IESFS014B	Mud	X					
456	AT42-20-15-11	IESFS014C	Mud	X					
457	AT42-20-15-12	IESFS014D	Mud	X					
458	AT42-20-15-13	IESFS014E	Burlap sack fragments	X			1		
459	AT42-20-16-01	IESFS016U	Basalt	X	1				
460	AT42-20-16-02	IESFS016V	Basalt	X	1				
461	AT42-20-16-03	IESFS016W	Basalt	X	1				
462	AT42-20-16-04	IESFS016X	Pillow basalt	X	1		2		
463	AT42-20-16-05	IESFS016Y	Pillow basalt	X	1		2		
464	AT42-20-16-06	IESFS016Z	Pillow basalt	X	1		2		
465	AT42-20-16-07	IESFS0170	Basalt	X	1				
466	AT42-20-16-08	IESFS0171	Basalt	X	1				
467	AT42-20-16-09	IESFS0172	Basalt	X	1				
468	AT42-20-16-10	IESFS0173	Basalt	X	1				
469	AT42-20-16-11	IESFS0174	Pillow basalt	X	1		2		
470	AT42-20-16-12	IESFS0175	Pillow basalt	X	1				
471	AT42-20-16-13	IESFS0176	Pillow basalt	X	1		2		
472	AT42-20-16-14	IESFS0177	Pillow basalt	X	1		2		
473	AT42-20-16-15	IESFS0178	Pillow basalt	X	1		2		
474	AT42-20-16-16	IESFS0179	Pillow basalt	X	1		2		
475	AT42-20-16-17	IESFS017A	Basalt	X	1				
476	AT42-20-16-18	IESFS017B	Basalt breccia	X		1			
477	AT42-20-16-19	IESFS017C	Basalt breccia	X		1			
478	AT42-20-16-20	IESFS017D	Basalt breccia	X		1			
479	AT42-20-16-21	IESFS017E	Basalt breccia	X		1			
480	AT42-20-16-22	IESFS017F	Basalt breccia	X		1			
481	AT42-20-16-23	IESFS017G	Basalt breccia	X		1			
482	AT42-20-16-24	IESFS017H	Basalt breccia	X		1			
483	AT42-20-16-25	IESFS017I	Unconsolidated breccia	X		1			
484	AT42-20-16-26	IESFS017J	Unconsolidated breccia	X		1			
485	AT42-20-16-27	IESFS017K	Unconsolidated breccia	X		1			
486	AT42-20-16-28	IESFS017L	Unconsolidated breccia	X		1			
487	AT42-20-16-29	IESFS017M	Unconsolidated breccia	X		1			
488	AT42-20-16-30	IESFS017N	Unconsolidated breccia	X		1			
489	AT42-20-16-31	IESFS017O	Unconsolidated breccia	X		1			
490	AT42-20-16-32	IESFS017P	Unconsolidated breccia	X		1			
491	AT42-20-16-33	IESFS017Q	Unconsolidated breccia	X		1			
492	AT42-20-16-34	IESFS017R	Unconsolidated breccia	X		1			
493	AT42-20-16-35	IESFS017S	Unconsolidated breccia	X		1			
494	AT42-20-16-36	IESFS017T	Unconsolidated breccia	X		1			
495	AT42-20-16-37	IESFS017U	Unconsolidated breccia	X		1			
496	AT42-20-16-38	IESFS017V	Unconsolidated breccia	X		1			
497	AT42-20-16-39	IESFS017W	Unconsolidated breccia	X		1			

AT42-20 Dredge Samples				PARENT	BASALT	TECTONIC	WHOLE ROCK	THIN SECTION	
#	Sample Name	IGSN	Lithology	WHOI	SLAB	SLAB	GLASS	SPECIMEN	BILLET
498	AT42-20-16-40	IESFS017X	Unconsolidated breccia	X		1			
499	AT42-20-16-41	IESFS017Y	Burlap sack fragments	X			1		
500	AT42-20-16-42	IESFS017Z	Basalt	X	1				
501	AT42-20-16-43	IESFS0180	Basalt	X	1				
502	AT42-20-16-44	IESFS0181	Basalt	X	1				
503	AT42-20-16-45	IESFS0182	Basalt	At UD	2				
504	AT42-20-17-01	IESFS019M	Burlap sack fragments	X			1		
505	AT42-20-GC1	IESFS01CE	Gravity core sediments	X			1		
506	AT42-20-GC2	IESFS01CF	Gravity core sediments	X			1		
507	AT42-20-GC3	IESFS01CG	Gravity core sediments	X			1		
508	AT42-20-GC4	IESFS01CH	Gravity core sediments	X					

Notes

- Numbers indicate the sub-sample number, not the number of sub-samples!
- Parent samples are being sent to the WHOI Seafloor Sample Repository, except as noted.
- Subsamples for analysis:
 - Slabs and billets are at UD
 - Whole rock specimens are at BSU
 - Two splits of picked glasses, one at URI and other at BSU.
 - Glass splits at URI will be accessioned to the GSO Marine Geological Samples Laboratory at end of the project.

Appendix III: Dredge Location Maps and Profiles

Gravity Core Location Maps