

## Cruise Summary

# Escanaba Trough: Exploring the Seafloor and Oceanic Footprints

TN-403

R/V Thomas G. Thompson, ROV Jason II, AUV Sentry



May 26 – June 13, 2022  
Newport OR to Newport OR

(USGS Field Activity 2022-621-FA)

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## Acknowledgements

We are grateful to Captain Eric Haroldson and the crew of the Thomas G. Thompson for the successful expedition. We are grateful to Jason expedition Lead Mario Fernandez and Sentry expedition lead Justin Fujii for their efforts making this cruise a success. This expedition was made possible by funding from the Bureau of Ocean and Energy Management (BOEM) through Interagency Agreements M19PG00021 and M20PG00028; the National Atmospheric and Oceanic Administration (NOAA) and National Oceanographic Partnership Program (NOPP); and US Geological Survey (USGS) through the Coastal and Marine Hazards and Resources Program. We are grateful for Dave Clague and collaborators for sharing access to his AUV based maps of Escanaba Trough prior to their publication.

## List of Participants

### Ship's crew:

|                     |         |
|---------------------|---------|
| Barnaby, Bruce      | Ch Mate |
| Castner, Bernadette | 3 Mate  |
| Clampitt, Brian     | AB      |
| Eldred, Brian       | Oiler   |
| Fellingham, Sue     | 2 Cook  |
| Hansen, Michael     | AB      |
| Haroldson, Eric     | Master  |
| Hassler, Nicholas   | Oiler   |
| Huffman, Niki       | Oiler   |
| Hunger, Maya        | Steward |
| Johnson, Mark       | Ch Engr |
| MacLeod, Brady      | 2 Engr  |
| McGregor, Gary      | AB      |
| Mickle, Andrew John | AB      |
| Minshall, Andrew    | 3 Engr  |
| Myers, Scott        | 1 Engr  |
| Johnson, Omiles     | AB      |
| Parra, Hannah       | AB-LTD  |
| Rian, Alex Ta       | Mess    |
| Varberg, Kate       | AB      |
| Wilson, Andrew      | 2 Mate  |
| Yordan, Mario       | Oiler   |

### Jason:

|                  |                 |
|------------------|-----------------|
| Bachant, Megan   | Mech            |
| Conroy, Gianna   | Mech            |
| Fernandez, Mario | Expedition lead |

|                    |        |
|--------------------|--------|
| Hall, Peter        | E.T.   |
| Inglis, Gabby      | E.T.   |
| Judge, Chris       | E.T.   |
| McCue, Scott       | Data   |
| Pelowski, James    |        |
| Sergent, Sarah     | Intern |
| Sutherland, Amanda | Mech   |
| Tradd, Ben         | Mech   |

Sentry:

|                  |                 |
|------------------|-----------------|
| Catanzaro, Nick  |                 |
| Fujii, Justin    | Expedition lead |
| Garcia, Joe      |                 |
| McCarthy, Mike   |                 |
| Skowronski, Mike |                 |

Science:

|                     |                            |
|---------------------|----------------------------|
| Adamczyk, Katlin    | USGS                       |
| Dal Ferro, Peter    | USGS                       |
| Demopoulos, Amanda  | USGS; co-PI                |
| Favela, Jaycee      | USGS                       |
| Gartman, Amy        | USGS; Chief Scientist      |
| Hoffman, Colleen    | University of Washington   |
| Ianiri, Hope        | USGS                       |
| Jamieson, John      | Memorial University; co-PI |
| Knorr, Paul         | BOEM                       |
| Lorenson, Tom       | USGS                       |
| Mizell, Kira        | USGS                       |
| Moore, Laura        | University of Washington   |
| Pearsall, Peter     | USGS                       |
| Scheffler, Johannes | Memorial University        |
| Tidwell, Jacob      | USGS                       |
| Weitemeyer, Karen   | Ocean Floor Geophysics     |
| Yeo, Isobel         | NOC; co-PI                 |
| Zierenberg, Robert  | UC Davis; co-PI            |

## Background and major objectives

Escanaba Trough, off Northern California is the only mid-ocean ridge style spreading center in the US Exclusive Economic Zone (EEZ). Many critical as well as potentially toxic elements (Sb, As, Ba, Co, Ga, Ge, Te) are contained in Escanaba sulfide minerals, and prior work found these minerals to be more concentrated at Escanaba than in typical seafloor sulfide minerals.

The compelling objectives motivating this expedition were to increase knowledge of the Escanaba Trough hydrothermal system through ocean exploration and to better understand the minerals, fluids, and organisms that live near active and inactive hydrothermal settings in the Trough. Through these samples we aim investigate the continuity of this system through time; to characterize the ecosystem, including microbes and megafauna inhabiting the trough; and to explore interactions between marine life, the metal sulfide deposits, and the hydrothermal and oceanic environment enveloping both. The five major objectives motivating this expedition were:

1. Acquire baseline data regarding the location, size and composition of sulfide mineralization within the Escanaba Trough
2. Explore the mineralogy and element composition, including critical and potentially toxic elements and their release and redistribution within the environment as the deposit ages
3. Characterize the organisms inhabiting hydrothermally active and inactive regions of the hydrothermal deposits, including deep-sea corals
4. Characterize the water column including oxygen, particles, metals, and redox chemistry
5. Explore the extent to which AUV-based surveys can be used to detect sulfide deposits buried under sediments

## Cruise summary

The R/V Thompson was equipped with the ROV Jason, AUV Sentry, a 4.5 m gravity core from PCMSC, and its own CTD. Our work plan was to maximize time in the water for the submergence assets, while collecting CTD casts at locations complementary to the seafloor work, and collecting gravity cores in areas of interest determined from the AUV based maps and seafloor footage. To complement AUV based maps, an integrated self potential (iSP) sensor by Ocean Floor Geophysics was integrated onto Sentry. During transits and during poor weather, we mapped using the Thompson's Kongsberg Simrad EM 302 multibeam echosounder. During mapping, 3.5 kHz subbottom profiling was also conducted simultaneously.

On May 26<sup>th</sup> we left port and went to 44.5533, -124.9467, a location offshore chosen to test Sentry and the iSP integration. That dive was aborted due to communication issues. At the same location we tested and conditioned the CTD in a deployment to 500 m (V22A-01). During this test all bottles were fired successfully.

On May 28<sup>th</sup> we returned to just offshore Newport and picked up two additional participants from the J dock. After pickup we began transit to Escanaba Trough. Upon arrival at station both Jason and Sentry called no dive due to sea state and wind. In lieu of submergence operations we collected a gravity coring (GC-01 and GC-02) and CTD ops (V22A-02).

On May 29<sup>th</sup> we successfully launched Sentry (sentry638). We remained in place waiting for Sentry to hit bottom and begin moving prior to repositioning to launch Jason (J2-1417). J2-1417 was aborted due to oil leaking. A CTD cast (V22A-03) was conducted. When Sentry reached the surface we conducted an active source test for the iSP sensor prior to recovering Sentry. GC-03 was conducted. On May 30<sup>th</sup> J2-1418 was attempted but recovered within a half hour due to a critical ground fault. GC04 and V22A-04 were conducted followed by a mapping line. On May 31<sup>st</sup> sentry639 was launched, followed by the second attempt at J2-1418. This time the dive was successful with a 20.4 hour deck to deck duration. Sentry was subsequently recovered. We then conducted V22A-05, V22A-06, and GC05.

On June 1 we launched sentry640 followed by J2-1419. After recovery of both assets on June 2<sup>nd</sup> we conducted GC06 and V22A-07. Paired dives sentry641 and Jason J2-1420 were cut slightly short (less than an hour) due to incoming weather. After recovery of both assets we transited to Eureka for a medical transfer of a non life or limb threatening injury. This transfer took 27 hours and was timed to be coincident with bad weather which was expected to curtail science operations. After arrival back on station on June 5<sup>th</sup> we undertook joint sentry642 and J2-1421. J2-1421 was aborted 2.5 hours early due to loss of thrusters. Recovery of both assets was followed by CTD casts V22A-08 and V22A-09, and gravity core GC07. The launch of Sentry dive sentry643 was delayed several hours due to servo issues. Once in the water sentry643 was paired with J2-1422; J2-1422 was recovered early due to efficient use of bottom time. Due to the early recovery Jason volunteered to do a short turn around dive; J2-1423 was a planned 12 hours deck to deck dive that launched seven hours after the recovery of J2-1422 while Sentry charged. After recovery of J2-1423, sentry644 was launched, but was aborted due to servo issues. J2-1424 was launched subsequently while Sentry team worked to resolve their servo issues. On the evening of June 9<sup>th</sup> sentry645 was launched, retrying the same box as sentry644. The same issue caused the dive to be aborted again, with launch to recovery taking four hours. Jason was still working so we then conducted V22A-10. We then transited for planned dive J2-

1425, which was initially delayed then finally called off due to weather. June 10<sup>th</sup> was a foggy morning, sentry646 was a new attempt at the location of sentry644 and 645, at MESCA. This time the repair was successful so we conducted joint Jason dive J2-1425 at Central Hill. This was our largest separation of the assets and due to that and concern over Sentry after the reoccurring issue the Jason dive was on the shorter side (13.5 hours deck to deck). Finding Sentry on the surface was difficult and took about two hours on this occasion. We then dove Jason J2-1426 on the new Sentry map, which was very rapid with the lapse of only one hour between Sentry on deck and Jason in the water- we did not have the new Sentry map in hand as Jason was launched and we planned the dive as Jason descended. This was a short dive and was recovered early on June 12<sup>th</sup>. We then transited to the junction of the Escanaba segment with the Phoenix segment and dove sentry647 on the southern section of the Phoenix segment. We conducted V22A-11 at Central Hill while Sentry mapped. We returned to check on Sentry, which was working fine but slowly. There was not a large enough window of time to dive Jason before required Sentry recovery so we conducted GC-08 and V22A-12 before recovering Sentry early on June 13<sup>th</sup>. We dove Jason J2-1427 on the new Sentry map one hour after Sentry was recovered. We recovered Jason on the afternoon of June 13<sup>th</sup> and were able to take one final gravity core GC-09 before beginning transit back to Newport.

Of our Jason and Sentry dives, we conducted seven simultaneously (sentry638-J2-1417; sentry639-J2-1418; sentry640-J2-1419; sentry641-J2-1420; sentry642-J2-1421; sentry 643-J2-1422; and sentry646-J2-1425). For all of the joint operations, our sequence was to launch Sentry, ensure Sentry was behaving properly, then launch and recover Jason, and finally recover Sentry. For the joint dives, between one and three hours elapsed between the Sentry and subsequent Jason launch. Dives where we successfully completed joint operations averaged ~ 18 hours for Jason and 23 hours for Sentry, which was not substantially different than our ideal dive time for each asset operated on its own.

Over our 18 days at sea eleven Jason dives and ten Sentry dives were completed, as well as 9 gravity cores and 11 CTD casts. The total area covered ship based multibeam, including transit was 7074 km<sup>2</sup>. The cruise DOI is doi:10.7284/909744

#### Jason Dives

| Dive #  | Location                         | Status    | Length (h) |
|---------|----------------------------------|-----------|------------|
| J2-1417 | N4 to N3                         | Aborted   | 9.5        |
| J2-1418 | Central Hill                     | Completed | 20.4       |
| J2-1419 | Edifice Rex West                 | Completed | 20.9       |
| J2-1420 | Edifice Rex East                 | Completed | 18.0       |
| J2-1421 | SESCA Hill S3A                   | Aborted   | 18.2       |
| J2-1422 | SESCA Hill S2A                   | Completed | 16.4       |
| J2-1423 | SESCA Hill S3                    | Completed | 13.0       |
| J2-1424 | SESCA, unnamed hill & North Hill | Completed | 20.2       |
| J2-1425 | Central Hill                     | Completed | 13.5       |
| J2-1426 | MESCA                            | Completed | 12.5       |

|         |               |           |      |
|---------|---------------|-----------|------|
| J2-1427 | South Phoenix | Completed | 12.4 |
|---------|---------------|-----------|------|

#### Sentry Dives

| Dive #    | Location                               | Status    | Length (h) | Area (km <sup>2</sup> ) |
|-----------|----------------------------------------|-----------|------------|-------------------------|
| sentry638 | Western Edifice Rex                    | Completed | 22.5       | 7.5                     |
| sentry639 | Central Hill                           | Completed | 23.8       | 7.2                     |
| sentry640 | Eastern Edifice Rex                    | Completed | 24.4       | 7.2                     |
| sentry641 | North Edifice Rex                      | Completed | 21.8       | 5.6                     |
| sentry642 | SESCA Hill S3                          | Completed | 22.6       | 6.2                     |
| sentry643 | SESCA North Hill, East Hill, 3170 Hill | Completed | 23.1       | 6.3                     |
| sentry644 | MESCA                                  | Aborted   | 3.4        | 0.1                     |
| sentry645 | MESCA                                  | Aborted   | 4.1        | 0.1                     |
| sentry646 | MESCA                                  | Completed | 24.3       | 4.8                     |
| sentry647 | South Phoenix                          | Half      | 20.7       | 3.9                     |

## Jason sampling summary

### Rocks

#### **J2-1417-R01**

Date: 2022/05/29

Time (UTC): 22:07

Latitude: 41.04132

Longitude: -127.50099

Depth: 3284 m

Dive Location: North end of NESCA, exploring N4 and N3 mounds.

Sampling location:

Sample was collected at the base of a series of 3-5 m inactive chimneys on the western flank of N4. The substrate between chimneys is hydrothermal (appears to be massive sulfide) and lightly covered by sediment.

Sample was lying on the seafloor with a light dusting of sediment. Sample was collected near a patch of white microbial mats (no T anomaly) and abundant clams (alive and dead) and anemones.

Dimensions: 8 x 5 x 3 cm



**J2-1417-R02**

Date: 2022/05/29

Time (UTC): 23:02

Latitude: 41.04141

Longitude: -127.50088

Depth: 3277 m

Dive Location:

North end of NESCA, exploring N4 and N3 mounds.

Sampling location:

Sample was collected at the top of a ~4 m inactive chimney that forms part of the chimney cluster on the western flank of N4. The substrate between chimneys is hydrothermal (appears to be massive sulfide) and lightly covered in sediment.

Sample was broken off of the top of a chimney edifice that hosted several short spires at the summit.

Dimensions: 9 x 6 x 5 inches



**J2-1418-R01**

Date: 2022/05/31

Time (UTC): 13:44

Latitude: 41.00031

Longitude: -127.49447

Depth: 3219 m

Dive Location: NESCA – Central Hill

Sampling location:

Sample was collected in an area of active ~diffuse/clear venting (207°C) and abundant tube worms and other animals near the top of the 1083A mound.

Dimensions: 12x10x6 cm



**J2-1418-R02**

Date: 2022/05/31

Time (UTC): 16:05

Latitude: 41.00021

Longitude: -127.49448

Depth: 3272 m

Dive Location: NESCA – Central Hill

Sampling location:

Sample was collected from sulfide talus at base of 1083A mound.

Dimensions: 12 x 8 x 6 cm



**J2-1418-R03**

Date: 2022/05/31

Time (UTC): 17:24

Latitude: 41.00006

Longitude: --127.49482

Depth: 3235 m

Dive Location:

NESCA – Central Hill

Sampling location: Sulfide from small sedimented inactive mound SW of the active site.

Dimensions: 6 x 5 x 5 cm



**J2-1418-R04**

Date: 2022/05/31

Time (UTC): 22:44

Latitude: 40.99409

Longitude: -127.50634

Depth: 3284

Dive Location: NESCA – Central Hill

Sampling location: Sulfide from wall of pockmark

Dimensions: 10 x 5 x 3 cm



**J2-1418-R05**

Date: 2022/05/31

Time (UTC): 23:12

Latitude: 40.99431

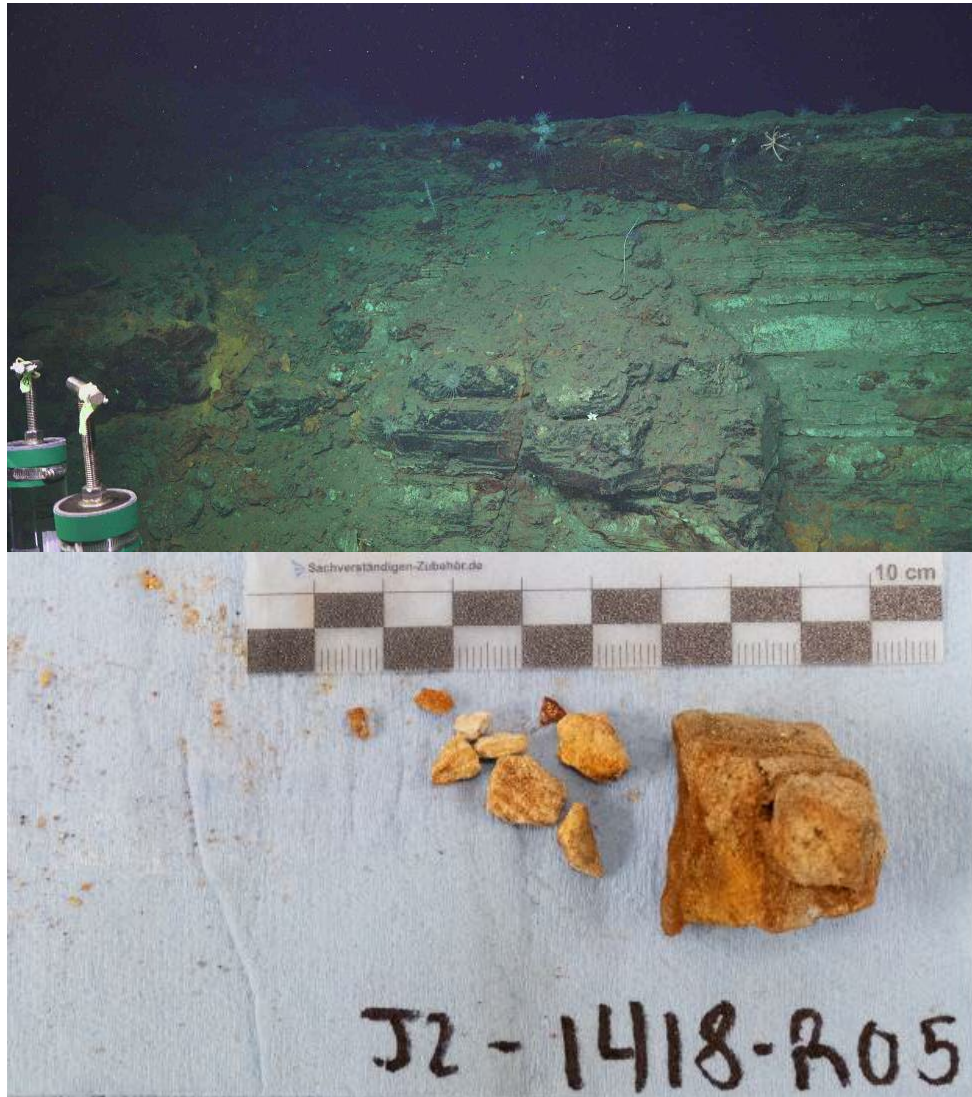
Longitude: -127.50634

Depth: 3270 m

Dive Location: NESCA – Central Hill

Sampling location: Indurated sediment from wall of pockmark

Dimensions: 3 x 2 x 2 cm



**J2-1418-R06**

Date: 2022/05/31

Time (UTC): 23:38

Latitude: 40.99431

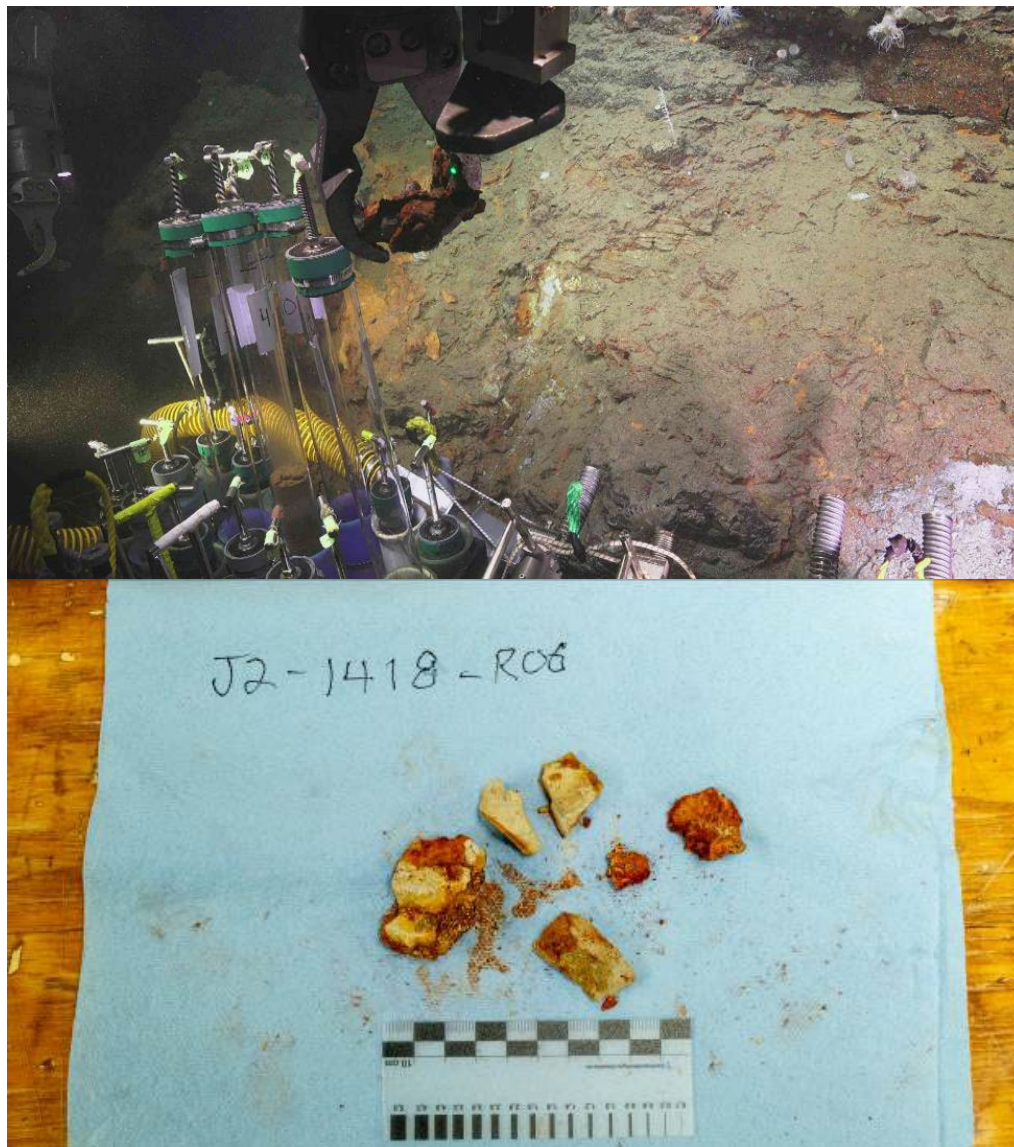
Longitude: -127.50633

Depth: 3268

Dive Location: NESCA – Central Hill

Sampling location: Indurated sediment from wall of pockmark

Dimensions: 2-6 cm fragments



**J2-1419-R01**

Date: 2022/06/01

Time (UTC): 0:57

Latitude: 41.06359

Longitude: -127.49913

Depth: 3314 m

Dive Location: Edifice Rex

Sampling location: Sulfide sample from central mound in pockmark

Dimensions: 6 x 3 x 3 cm



**J2-1419-R02**

Date: 2022/06/02

Time (UTC): 04:35

Latitude: 41.07085

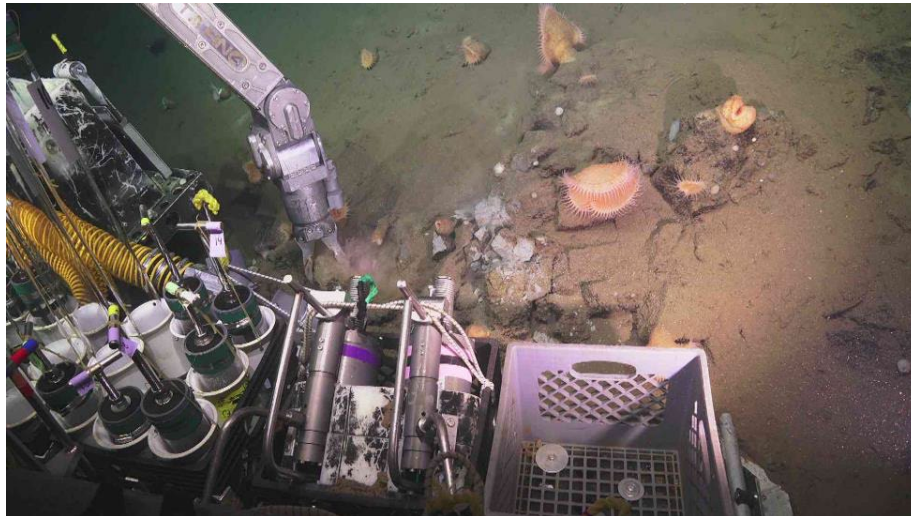
Longitude: -127.49906

Depth: 3305 m

Dive Location: Edifice Rex

Sampling location: Sediment from pockmark in sedimented valley west of Edifice Rex

Dimensions: 5 x 4 x 4 cm



**J2-1419-R03**

Date: 2022/06/02

Time (UTC): 07:04

Latitude: 41.06536

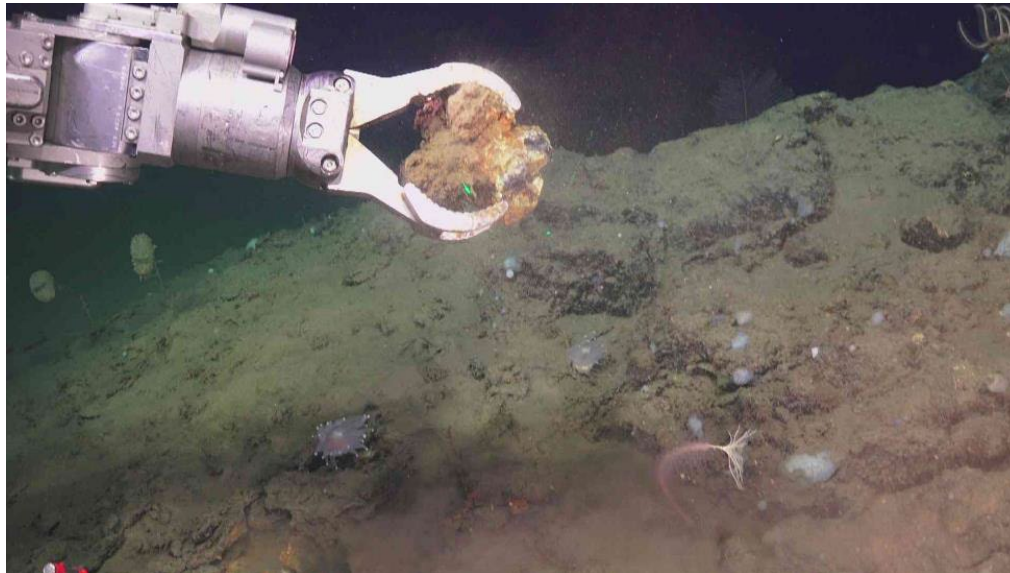
Longitude: -127.49517

Depth: 3284 m

Dive Location: Edifice Rex

Sampling location: Hydrothermally altered uplifted mound on sedimented plain

Dimensions: 14 x 7 cm



**J2-1419-R04**

Date: 2022/06/02

Time (UTC): 08:08

Latitude: 41.06209

Longitude: -127.49373

Depth: 3309 m

Dive Location: Edifice Rex

Sampling location: Sedimentary rock on inner slope of pockmark.

Dimensions: 14 x 10 x 8 cm



**J2-1419-R05**

Date: 2022/06/02

Time (UTC): 09:01

Latitude: 41.06248

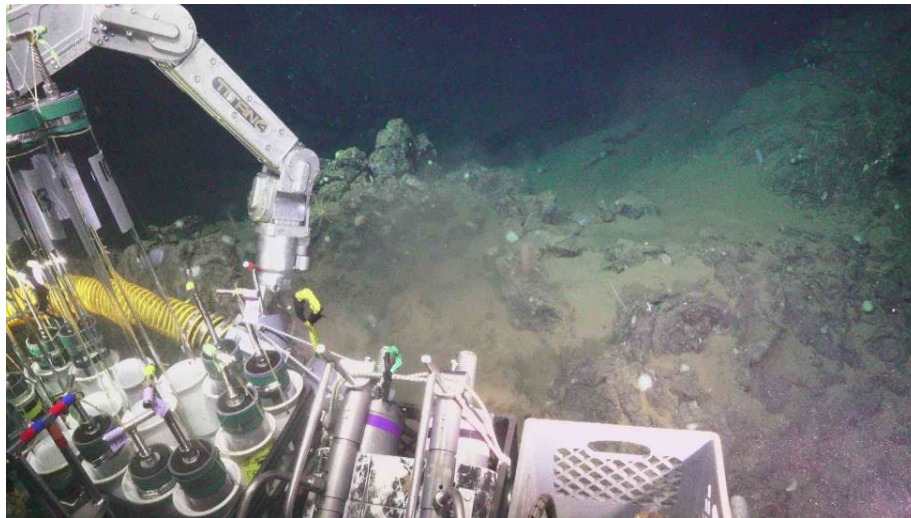
Longitude: -127.49159

Depth: 3309 m

Dive Location: Edifice Rex

Sampling location: Basalt from sheetflow

Dimensions: a) 30 x 10 x 10 cm; b) 10 x 4 cm



**J2-1419-R06**

Date: 2022/06/02

Time (UTC): 09:57

Latitude: 41.06269

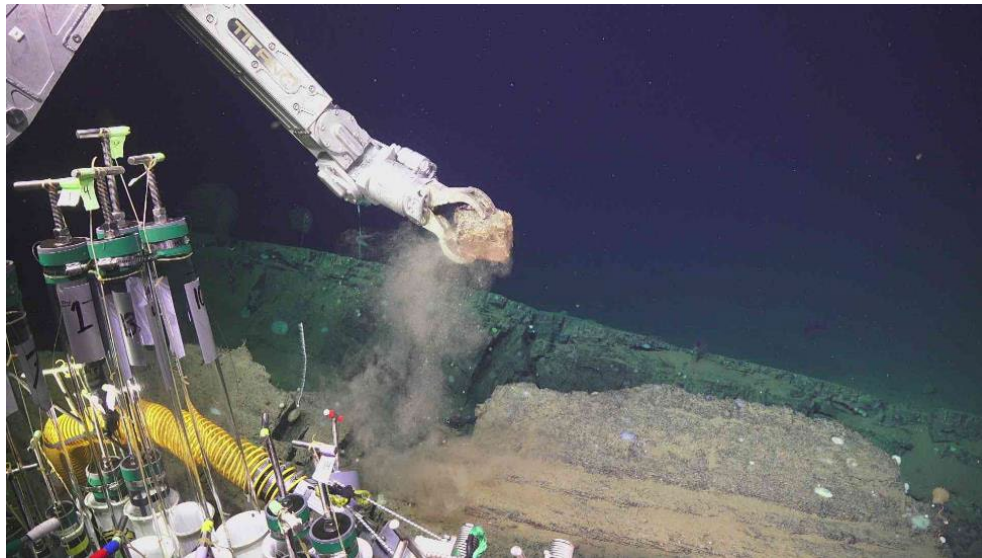
Longitude: -127.49068

Depth: 3305 m

Dive Location: Edifice Rex

Sampling location: Basalt fissure

Dimensions: a) 13 x 10 cm; b) 10 x 8 x 3 cm



**J2-1419-R07**

Date: 2022/06/02

Time (UTC): 10:33

Latitude: 41.06373

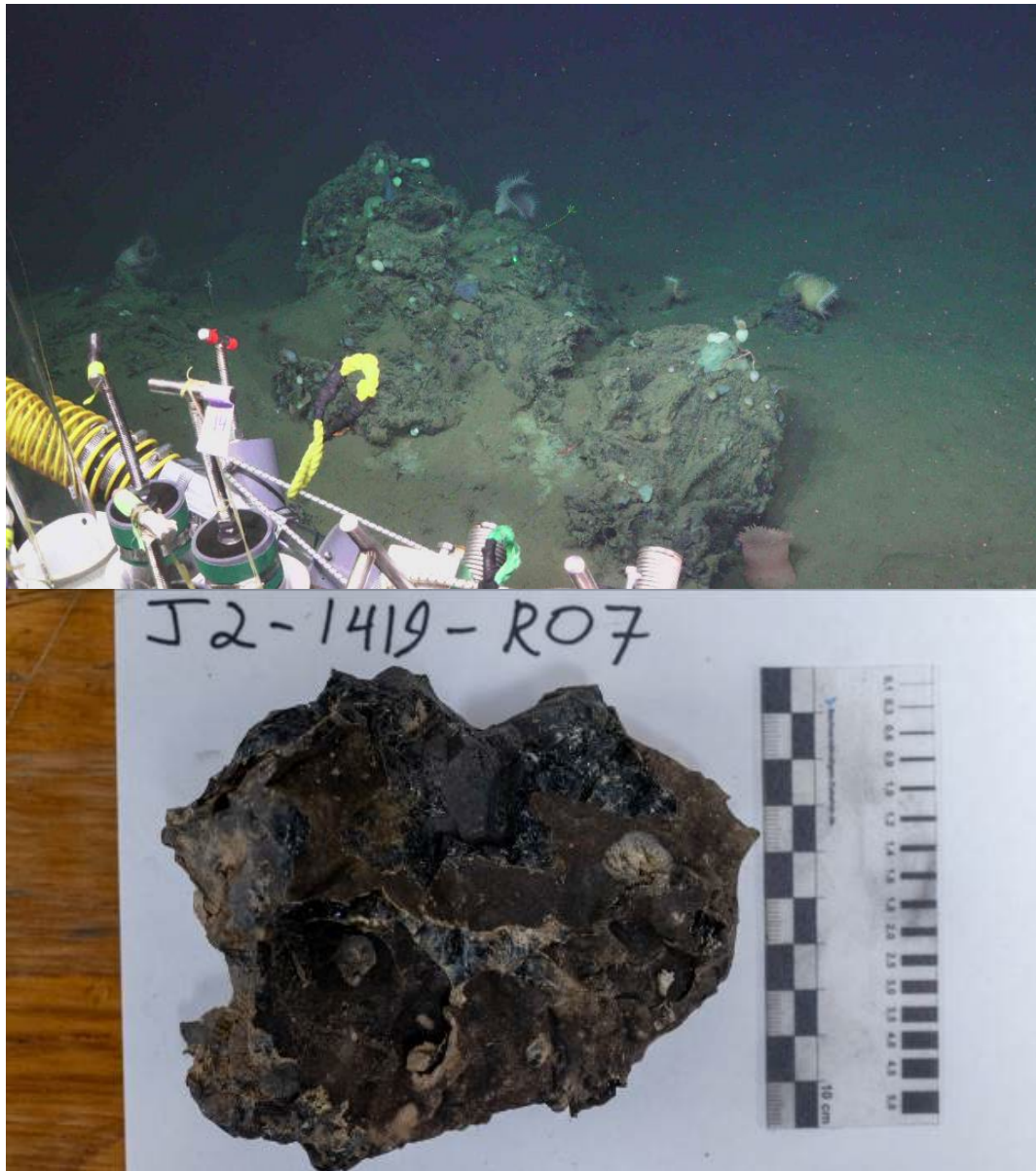
Longitude: -127.48944

Depth: 3300 m

Dive Location: Edifice Rex

Sampling location: Small basalt outcrop in sediment plain

Dimensions: a) 8 x 5 x 4 cm; b) 10 x 8 x 4



**J2-1419-R08**

Date: 2022/06/02

Time (UTC): 10:45

Latitude: 41.06381

Longitude: -127.48886

Depth: 3300 m

Dive Location: Edifice Rex

Sampling location: Inflated, fractured sheet flow

Dimensions: Variable, up to 12 x 7 cm



**J2-1419-R09**

Date: 2022/06/02

Time (UTC): 12:18

Latitude: 41.06877

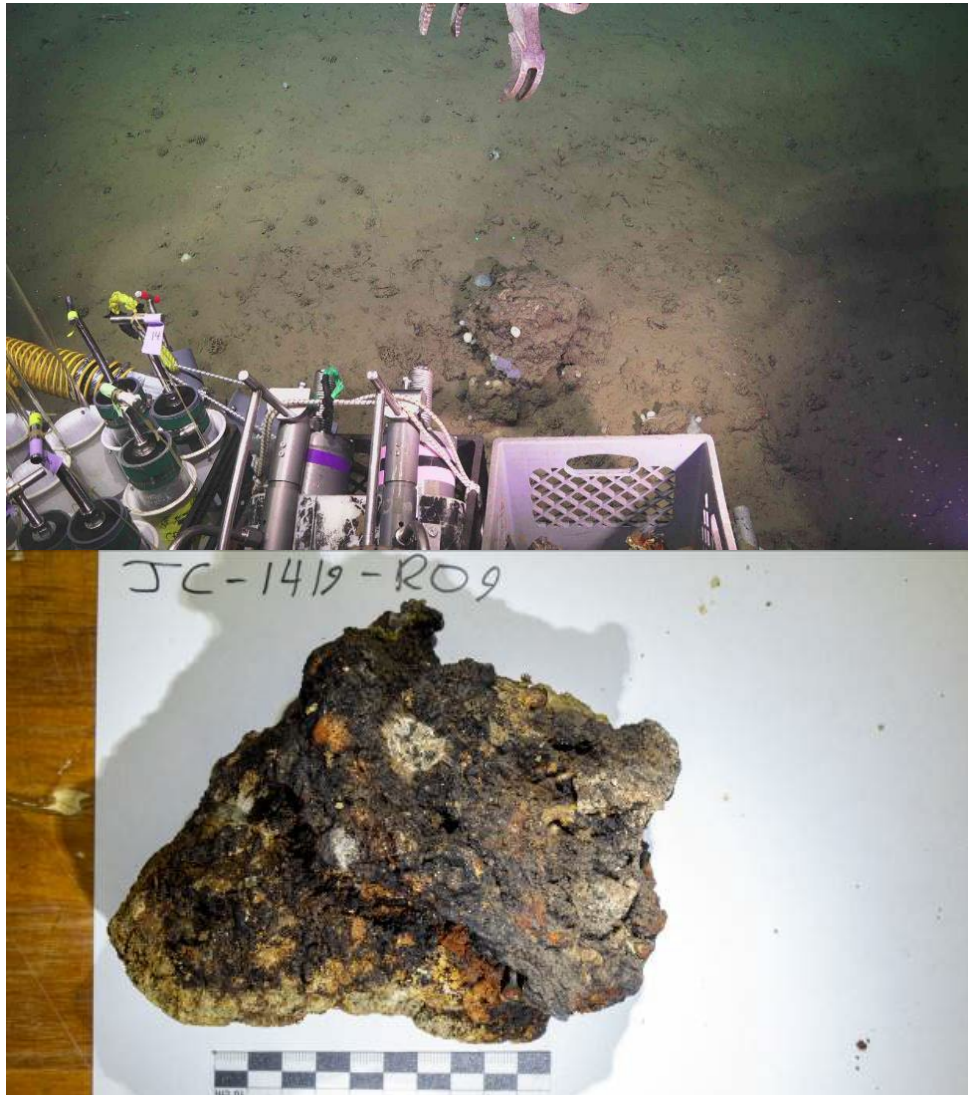
Longitude: -127.48762

Depth: 3282 m

Dive Location: Edifice Rex

Sampling location: Indurated sediment outcrop within sedimented plain

Dimensions: 15 x 9 x 7 cm



**J2-1420-R01**

Date: 2022/06/03

Time (UTC): 12:08

Latitude: 41.08008

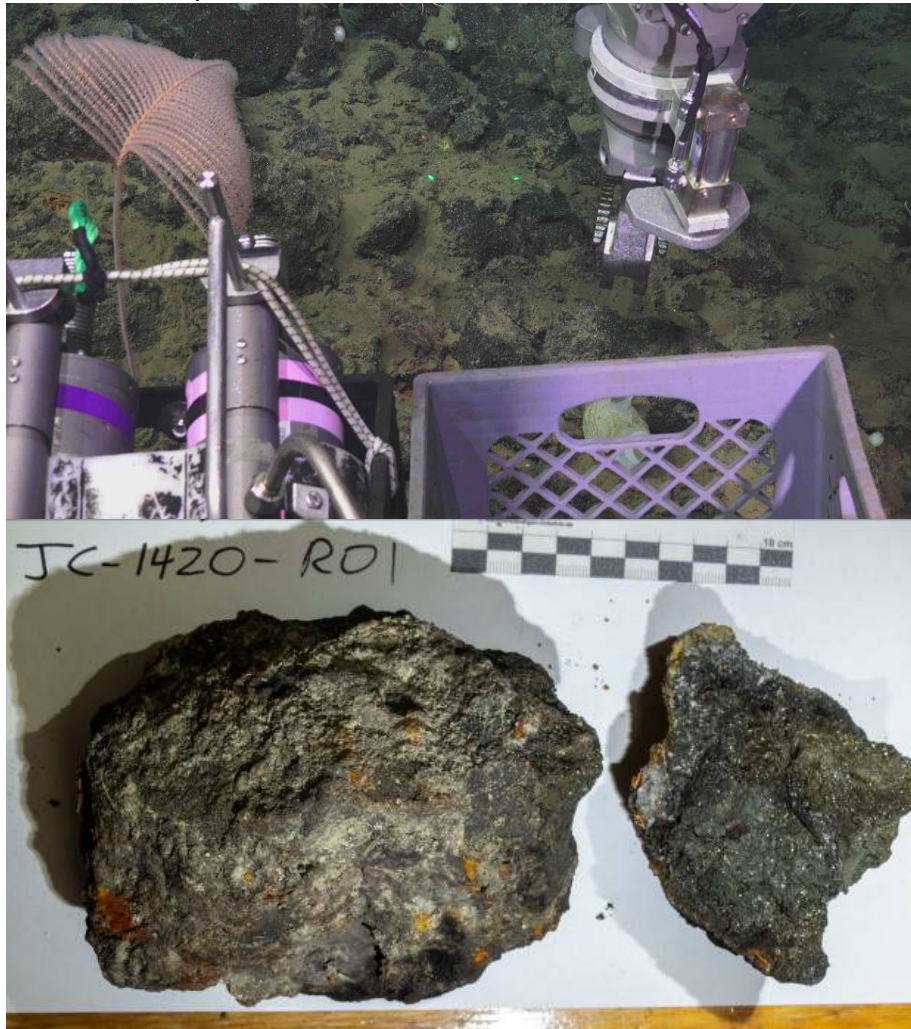
Longitude: -127.45182

Depth: 3198 m

Dive Location: Edifice Rex East

Sampling location: Base of inactive chimney on side of pockmark

Dimensions: Up to 12 cm in diameter



**J2-1420-R02**

Date: 2022/06/03

Time (UTC): 13:38

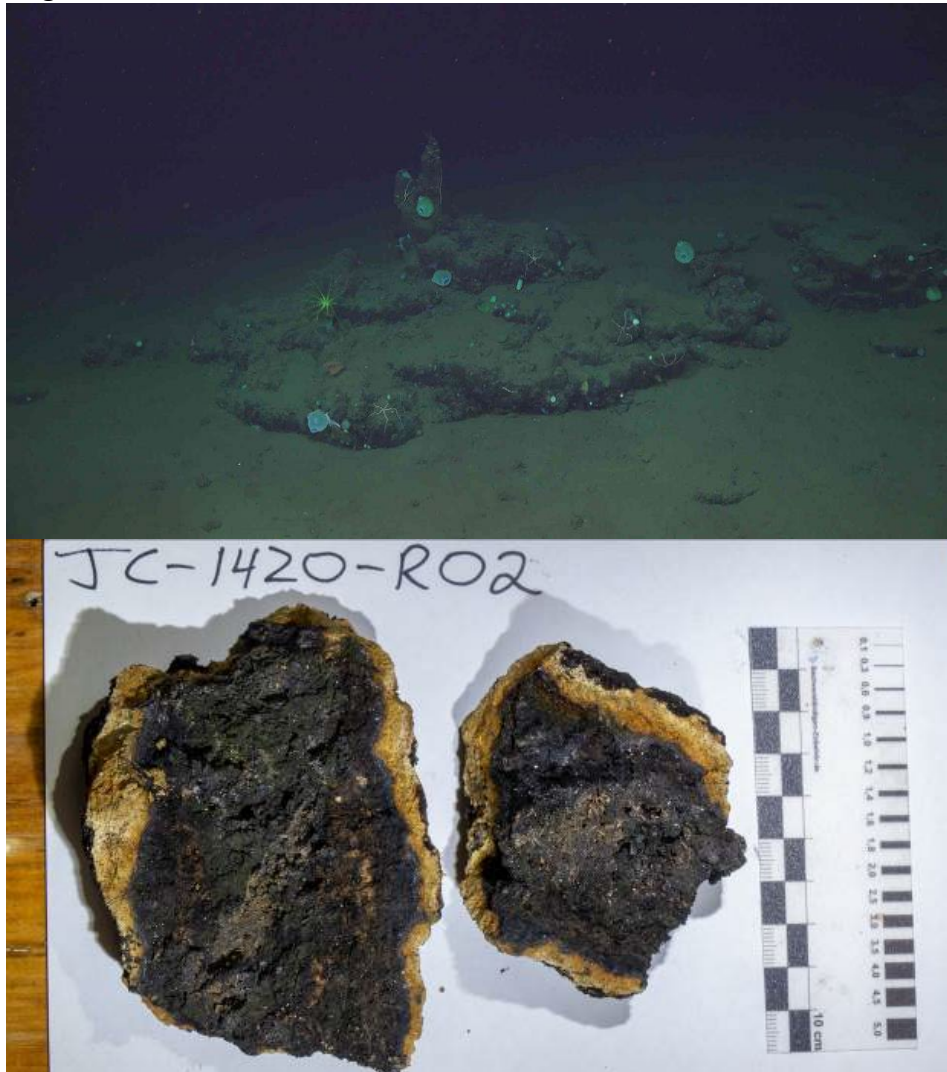
Latitude: 41.08054

Longitude: -127.45222

Depth: 3203 m

Dive Location: Edifice Rex East

Sampling location: Hydrothermal outcrop on sedimented base of pockmark.  
original diameter of 6-8 cm



**J2-1420-R03**

Date: 2022/06/03

Time (UTC): 16:08

Latitude: 41.08115

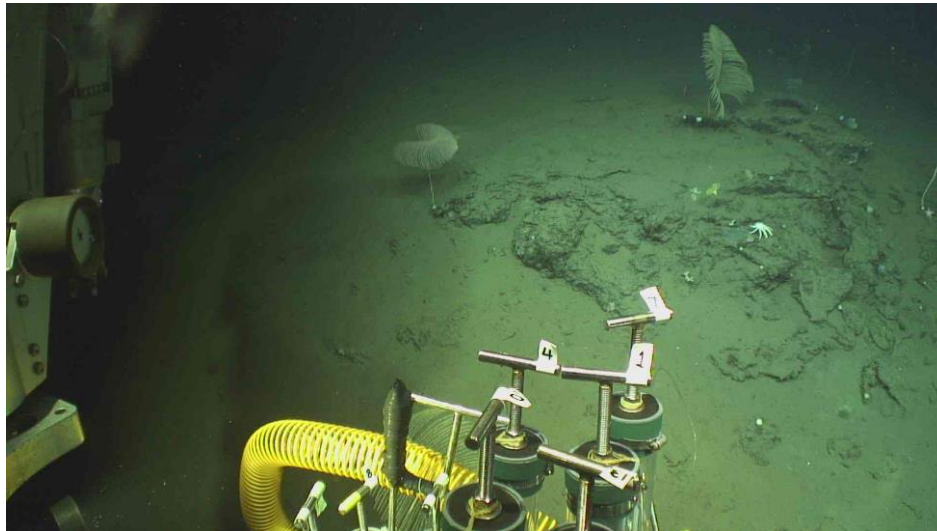
Longitude: -127.45128

Depth: 3202 m

Dive Location: Edifice Rex East

Sampling location: Crusty hydrothermal outcrop within sediment.

Dimensions: 9 x 4 x 2 cm



J2-1420-R04

Date: 2022/06/

Time (UTC): 16:46

Latitude: 41.08157

Longitude: -127.45048

Depth: 3209 m

Dive Location: Edifice Rex East

Sampling location: Small inactive chimney at base of pockmark.

Dimensions: 10 x 8 x 6 cm, and 7 x 7 x 3 cm



**J2-1420-R05**

Date: 2022/06/03

Time (UTC): 18:22

Latitude: 41.08226

Longitude: -127.44718

Depth: 3222 m

Dive Location: Edifice Rex East

Sampling location: Indurated sediment with crust from a crusty sediment mound.

Dimensions: 10 x 7 x 0.4 cm



**J2-1420-R06**

Date: 2022/06/03

Time (UTC): 20:59

Latitude: 41.07949

Longitude: -127.44634

Depth: 3230

Dive Location: Edifice Rex East

Sampling location: Small hydrothermal sulfide outcrop

Dimensions: 14 x 7 x 4 cm



**J2-1421-R01**

Date: 2022/06/05

Time (UTC): 16:02

Latitude: 40.69876

Longitude: -127.52797

Depth: 3232 m

Dive Location: Southern SESCA

Sampling location: Inactive hydrothermal outcrop

Dimensions: 7 x 5 x 2.5 cm



**J2-1421-R02**

Date: 2022/06/05

Time (UTC): 16:30

Latitude: 40.69874

Longitude: -127.52788

Depth: 3232 m

Dive Location: Southern SESCA

Sampling location: Inactive hydrothermal outcrop in vent cluster

Multiple fragments sulfide up to 6 cm across



**J2-1421-R03**

Date: 2022/06/05

Time (UTC): 17:13

Latitude: 40.69831

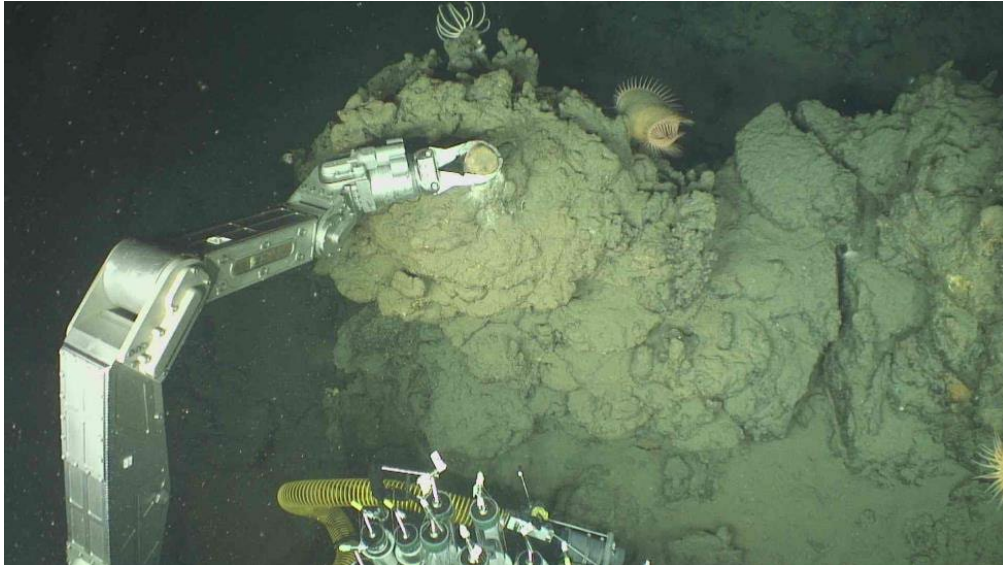
Longitude: -127.52864

Depth: 3232 m

Dive Location: SESCA

Sampling location: Inactive hydrothermal outcrop in vent cluster

Dimensions: 5 x 4 x 3 cm (largest fragment)



**J2-1421-R04**

Date: 2022/06/05

Time (UTC): 20:10

Latitude: 40.69615

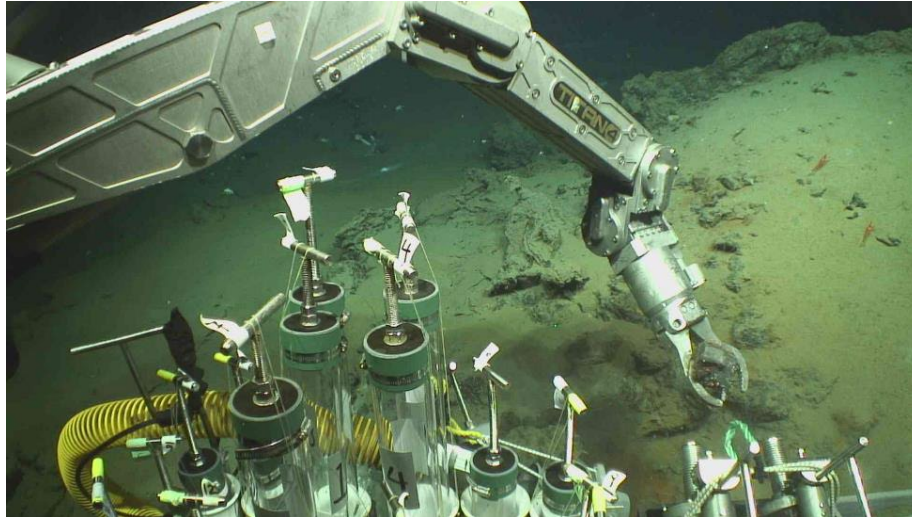
Longitude: -127.52742

Depth: 3222 m

Dive Location: South SESCA (S4a)

Sampling location: Inactive hydrothermal outcrop in vent cluster

Dimensions: 12 x 8 x 5 cm (largest)



**J2-1421-R05**

Date: 2022/06/05

Time (UTC): 21:35

Latitude: 40.69624

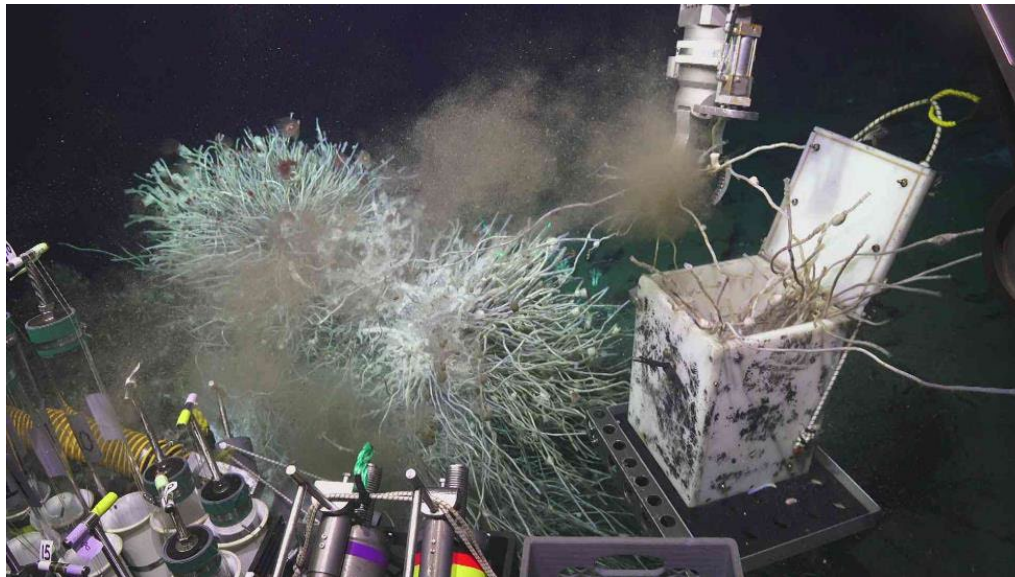
Longitude: -127.52759

Depth: 3221 m

Dive Location: South SESCA (S4a)

Sampling location: Active hydrothermal outcrop in vent cluster

Dimensions: 16 x 6 x 5 cm



**J2-1421-R06**

Date: 2022/06/06

Time (UTC): 02:56

Latitude: 40.69571

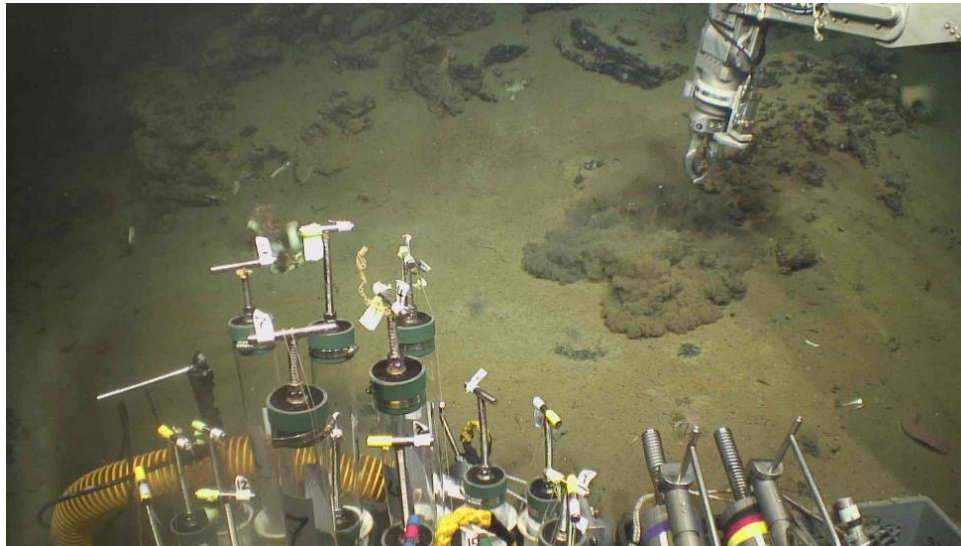
Longitude: -127.52819

Depth: 3223 m

Dive Location: South SESCA (S4a)

Sampling location: Inactive hydrothermal outcrop in vent cluster

8x5 cm 3 cm thick and 9x7x5 cm



**J2-1422-R01**

Date: 2022/06/07

Time (UTC): 05:30

Latitude: 40.77458

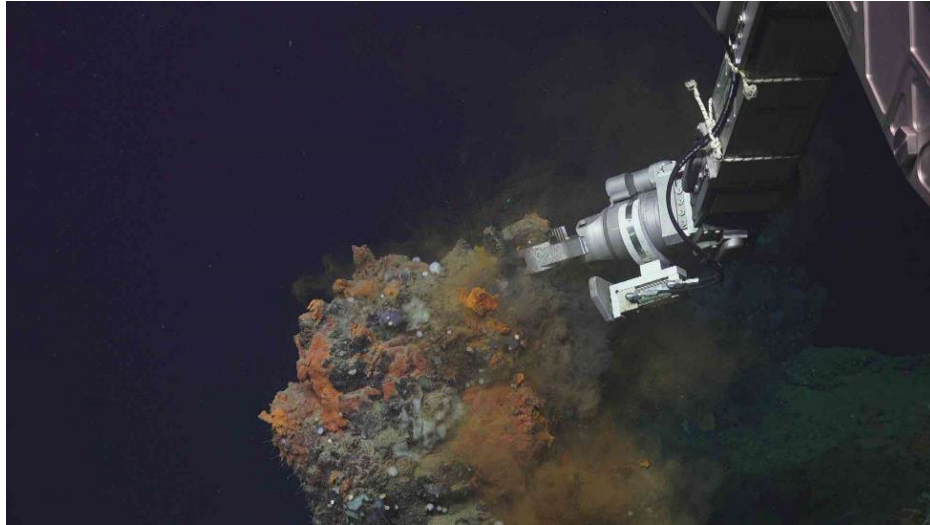
Longitude: -127.53578

Depth: 3223 m

Dive Location: South SESCA (S2)

Sampling location: Inactive chimney

Dimensions: 8 x 5 x 4 cm



**J2-1422-R02**

Date: 2022/06/07

Time (UTC): 06:23

Latitude: 40.77450

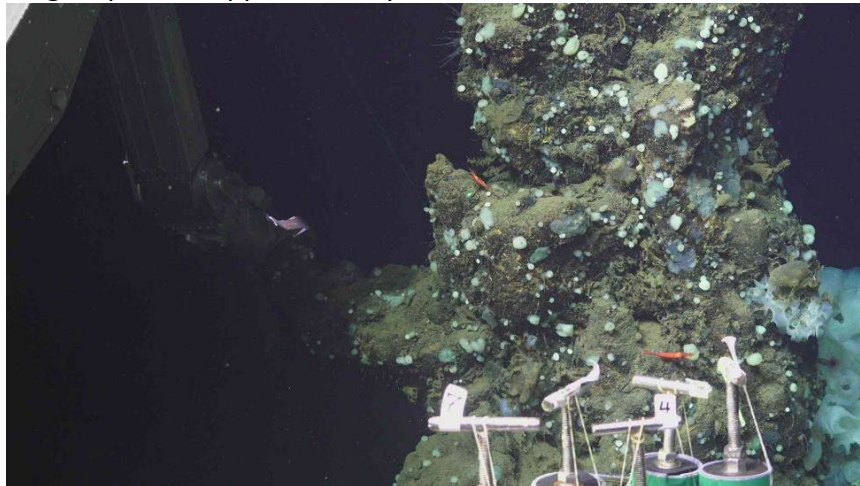
Longitude: -127.53562

Depth: 3225 m

Dive Location: South SESCA (S2)

Sampling location: Inactive chimney

Largest piece is approximately 8x11



**J2-1422-R03**

Date: 2022/06/07

Time (UTC): 08:27

Latitude: 40.77378

Longitude: -127.53665

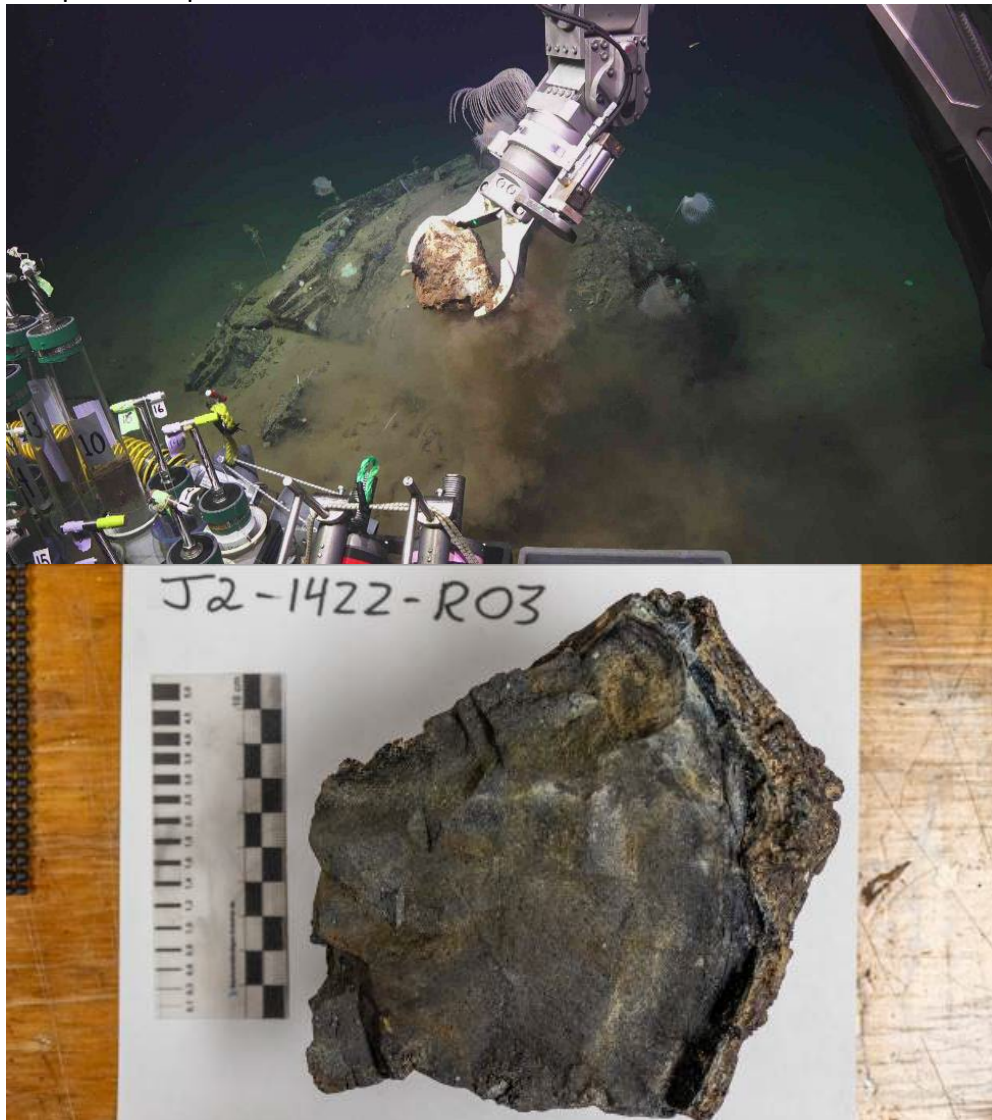
Depth: 3231 m

Dive Location:

South SESCA (S2)

Sampling location: Basalt outcrop in sediment

Sample description: Dimensions: 12 x 10 x 9 cm



**J2-1422-R04**

Date: 2022/06/07

Time (UTC): 09:38

Latitude: 40.77198

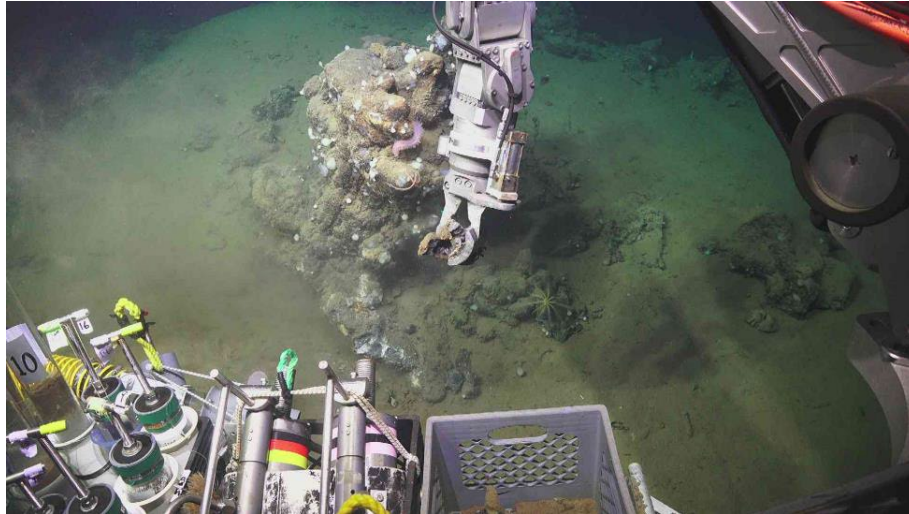
Longitude: -127.53910

Depth: 3228 m

Dive Location: South SESCA (S2)

Sampling location: Inactive chimney

3-4 cm pieces



**J2-1422-R05**

Date: 2022/06/07

Time (UTC): 10:16

Latitude: 40.77190

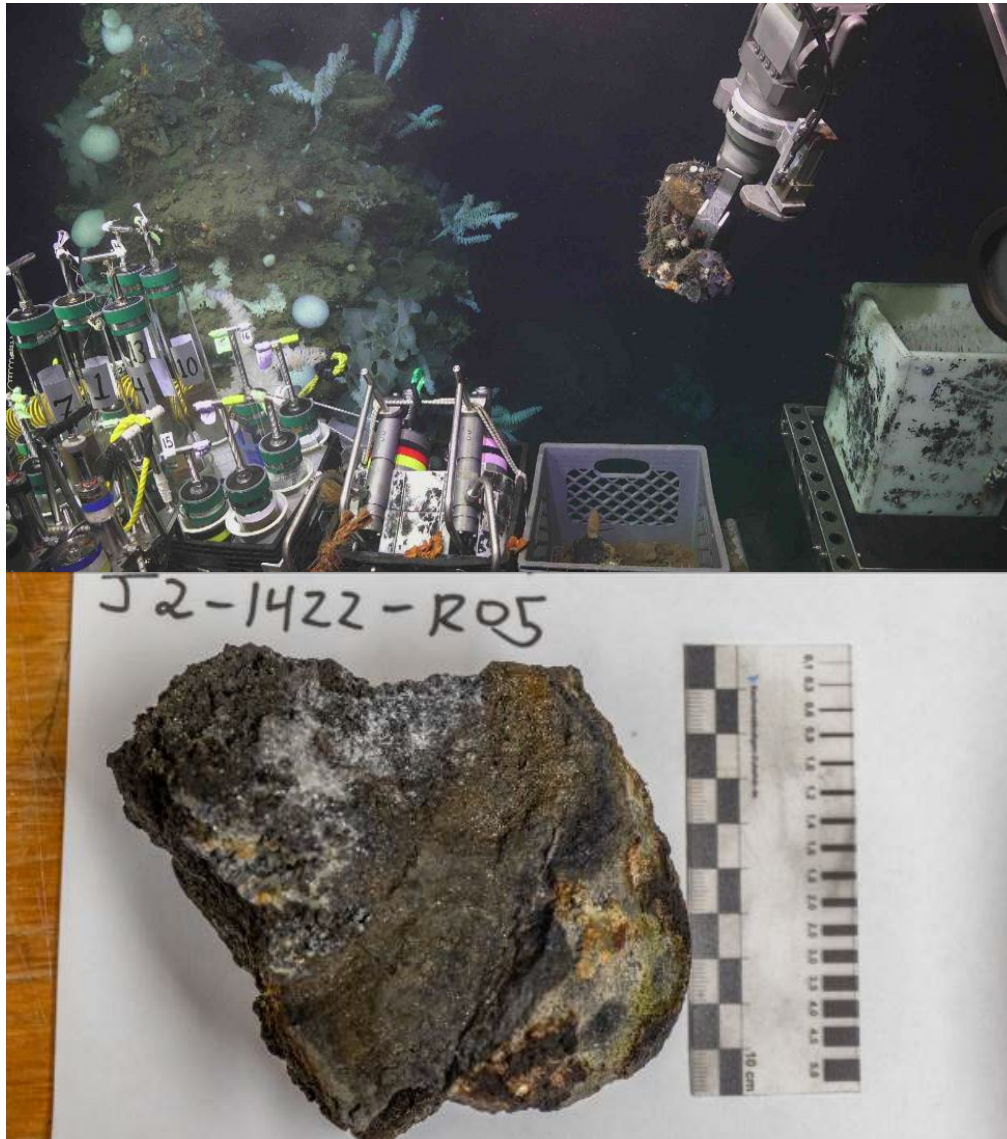
Longitude: -127.53919

Depth: 3228 m

Dive Location: South SESCA (S2)

Sampling location: Inactive chimney

Dimensions: 10 x 8 x 5 cm



**J2-1422-R06**

Date: 2022/06/07

Time (UTC): 12:18

Latitude: 40.77192

Longitude: -127.54551

Depth: 3228 m

Dive Location: South SESCA (S2)

Sampling location: Inactive chimney

Four fragments, largest 8x2x3



J2-1422-R07

Date: 2022/06/07

Time (UTC): 13:53

Latitude: 40.77426

Longitude: -127.54769

Depth: 3231 m

Dive Location: South SESCA (S2)

Sampling location: Inactive chimney



**J2-1423-R01**

Date: 2022/06/08

Time (UTC): 06:34

Latitude: 40.71337

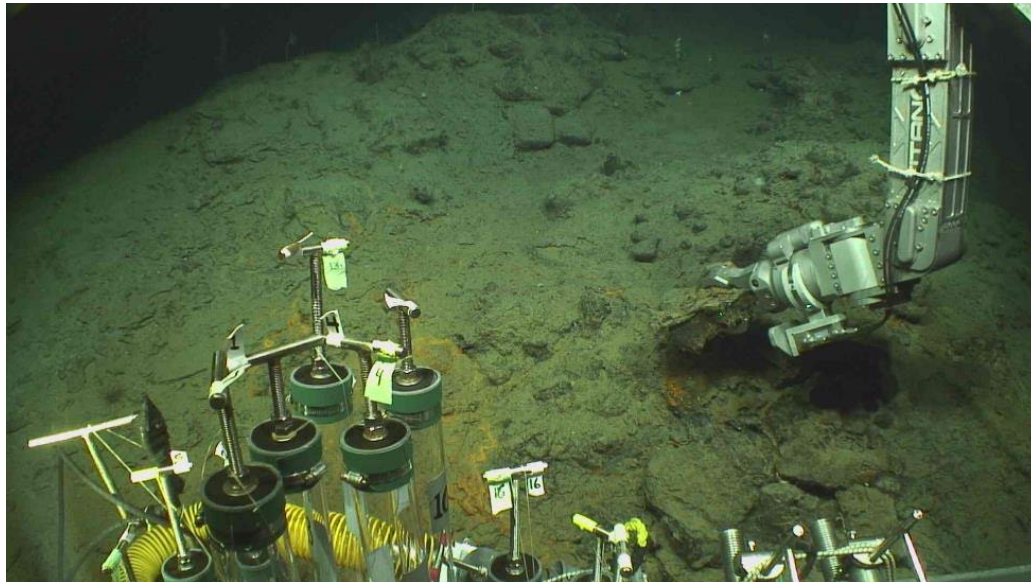
Longitude: -127.51845

Depth: 3212 m

Dive Location: South SESCA (S3a)

Sampling location: Sulfide crust from inactive mound

Dimensions: 14 x 6 x 6 cm



**J2-1423-R02**

Date: 2022/06/08

Time (UTC): 07:13

Latitude: 40.71328

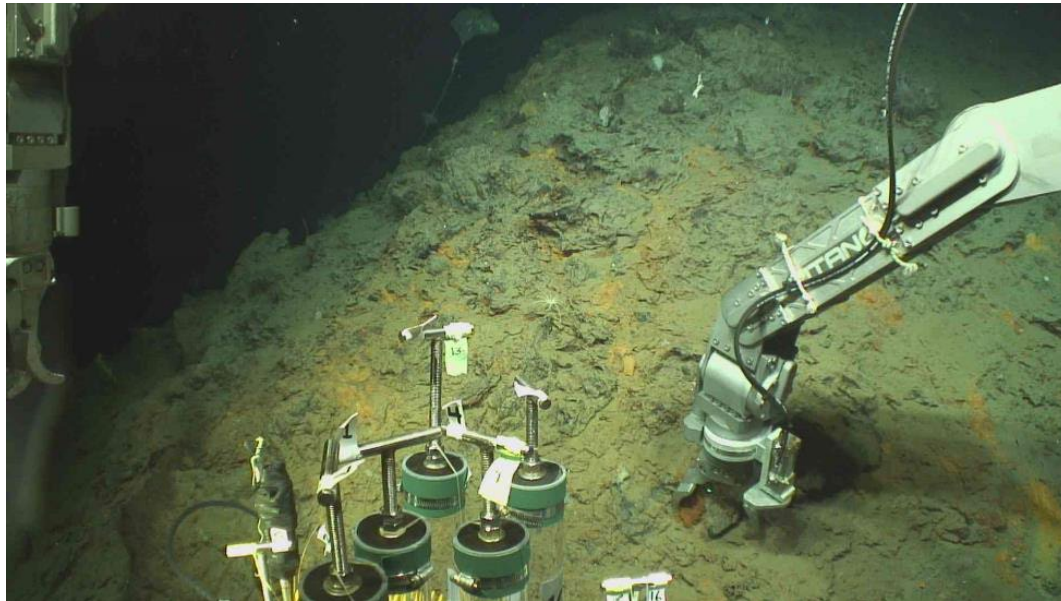
Longitude: -127.51841

Depth: 3216 m

Dive Location: South SESCA (S3a)

Sampling location: Sulfide crust from inactive mound

Dimensions: 7 x 5 x 2 cm



**J2-1423-R03**

Date: 2022/06/08

Time (UTC): 08:44

Latitude: 40.71329

Longitude: -127.52041

Depth: 3224 m

Dive Location: South SESCA (S3a)

Sampling location: Hydrothermal material from pockmark

Two fragments, largest is 6x5x4



**J2-1423-R04**

Date: 2022/06/08

Time (UTC): 08:55

Latitude: 40.71326

Longitude: -127.52038

Depth: 3224 m

Dive Location: South SESCA (S3a)

Sampling location: Hydrothermal material from pockmark

Dimensions: 10 x 7 x 6 cm



**J2-1423-R05**

Date: 2022/06/08

Time (UTC): 10:23

Latitude: 40.71430

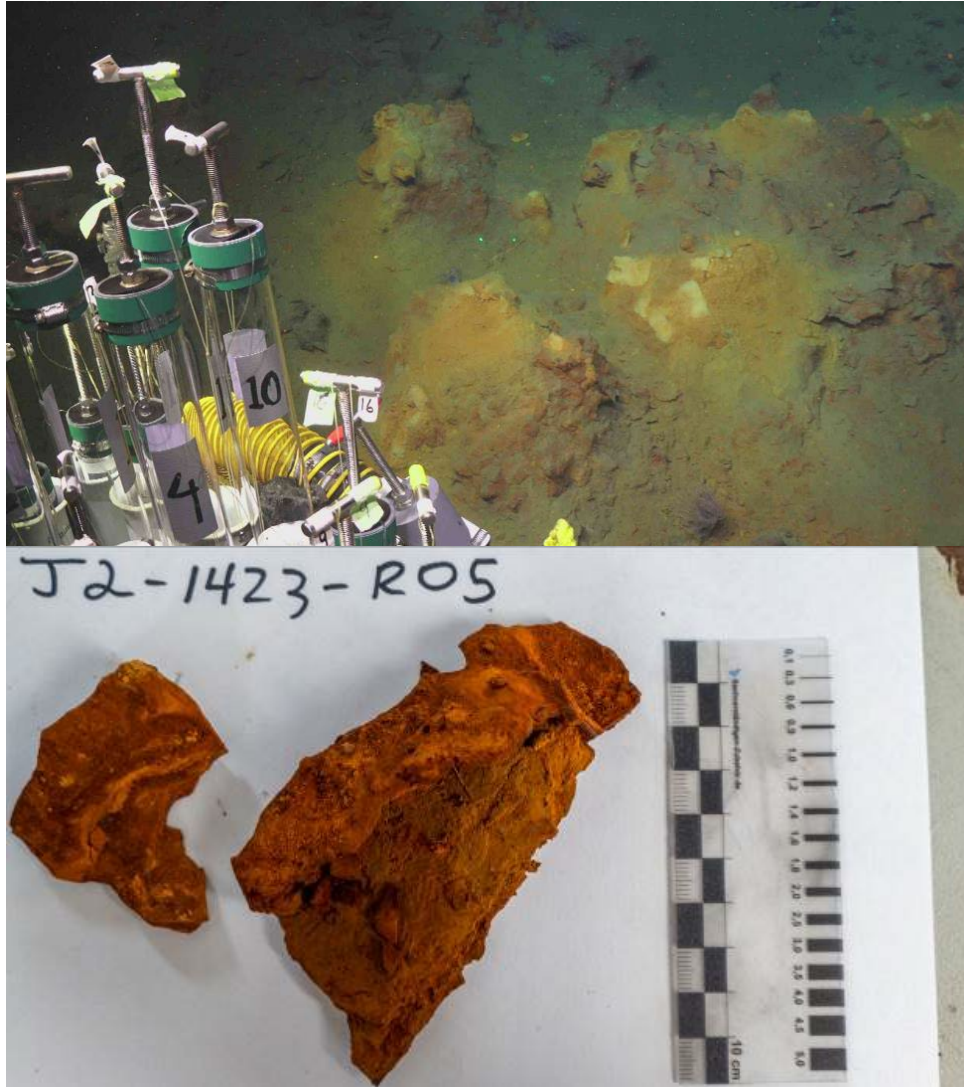
Longitude: -127.52115

Depth: 3230 m

Dive Location: South SESCA (S3a)

Sampling location: Hydrothermal material from pockmark

Multiple fragments up to 9x5 cm, 2 cm thick



**J2-1423-R06**

Date: 2022/06/08

Time (UTC): 11:17

Latitude: 40.71366

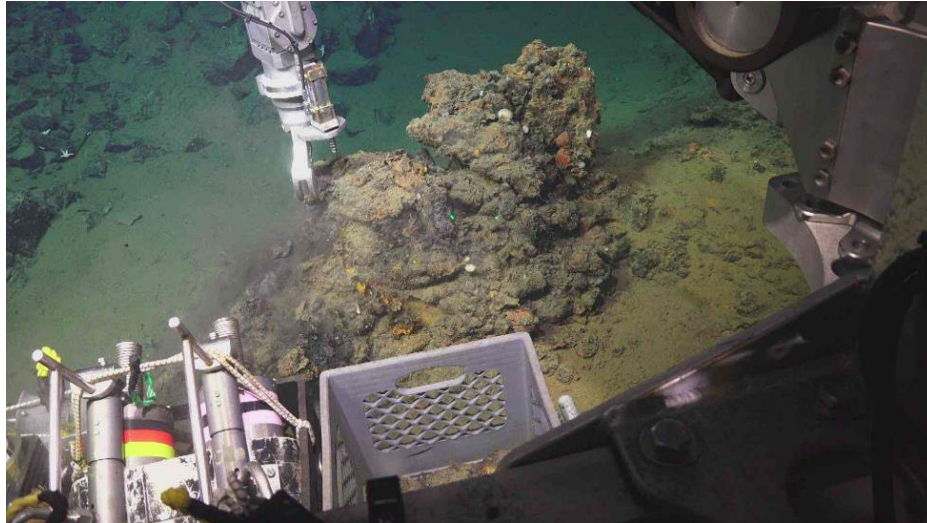
Longitude: -127.52300

Depth: 3221 m

Dive Location: South SESCA (S3a)

Sampling location: Hydrothermal material from pockmark

Several pieces, largest is 8x4x4 cm



**J2-1423-R07**

Date: 2022/06/08

Time (UTC): 11:24

Latitude: 40.71365

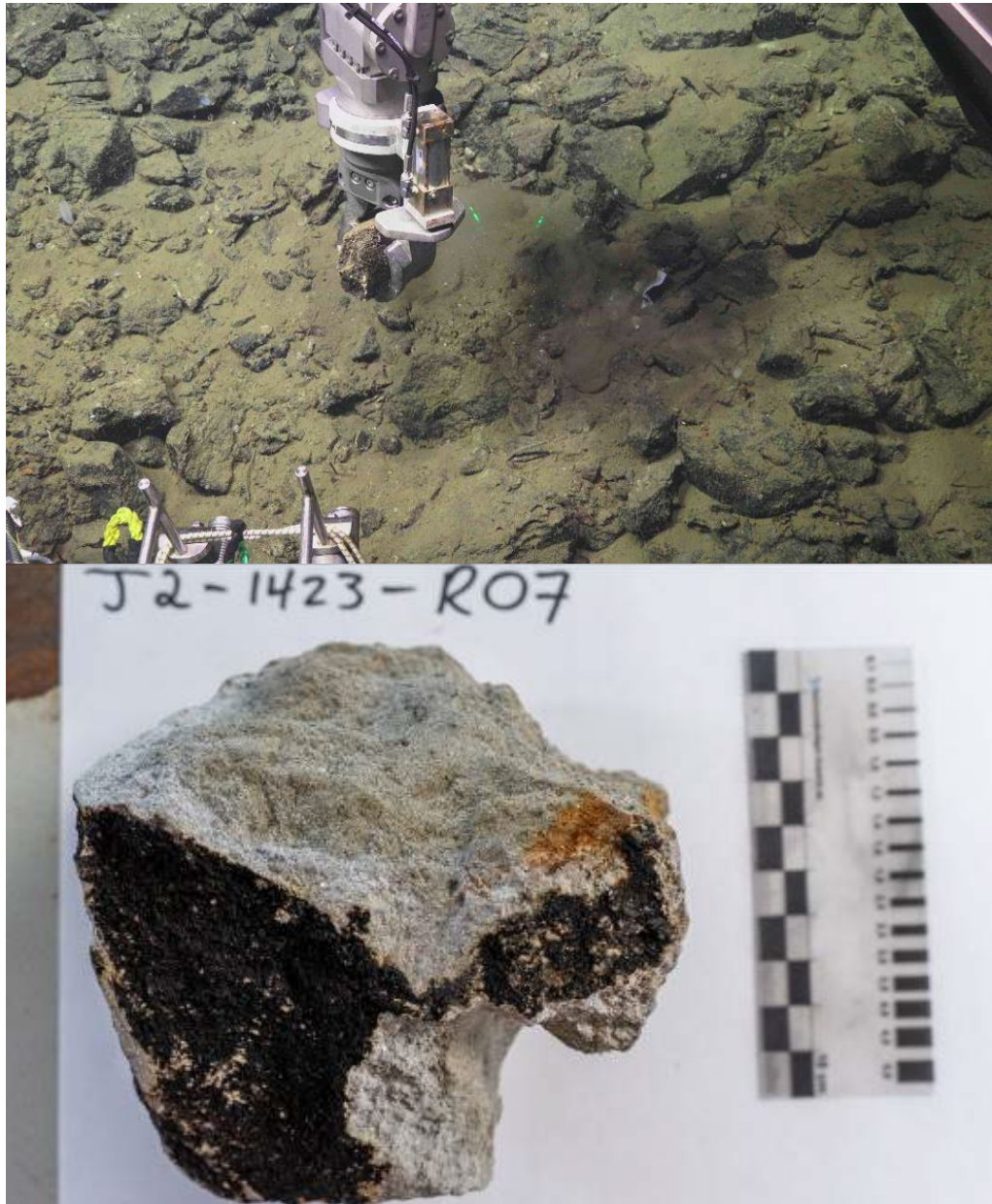
Longitude: -127.52306

Depth: 3220 m

Dive Location: South SESCA (S3a)

Sampling location: Indurated sediment from uplifted mound

Dimensions: 6 x 8 x 9 cm



**J2-1424-R01**

Date: 2022/06/08

Time (UTC): 23:35

Latitude: 40.77138

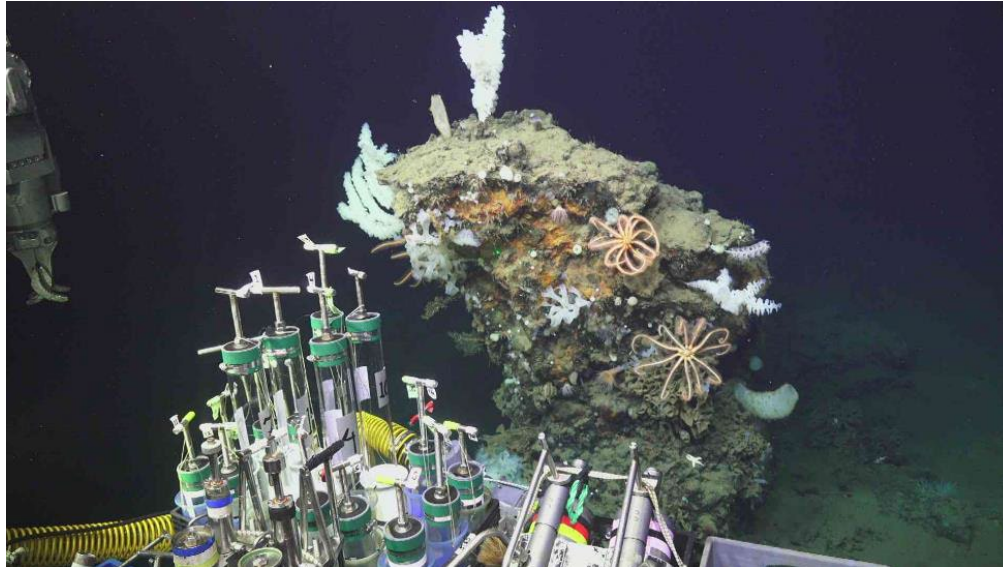
Longitude: -127.49887

Depth: 3232 m

Dive Location: North SESCA (S1)

Sampling location: Inactive chimney

Dimensions: 14 x 12 x 8 cm (largest)



**J2-1424-R02**

Date: 2022/06/09

Time (UTC): 00:55

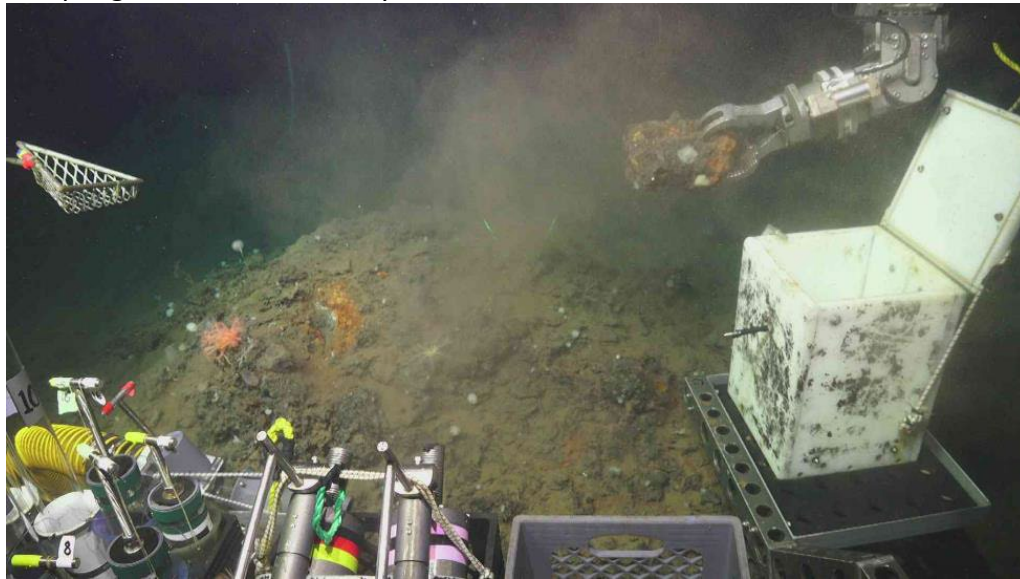
Latitude: 40.77205

Longitude: -127.49738

Depth: 3239 m

Dive Location: North SESCA (S1)

Sampling location: Inactive hydrothermal mound



**J2-1424-R03**

Date: 2022/06/09

Time (UTC): 05:18

Latitude: 40.79019

Longitude: -127.50534

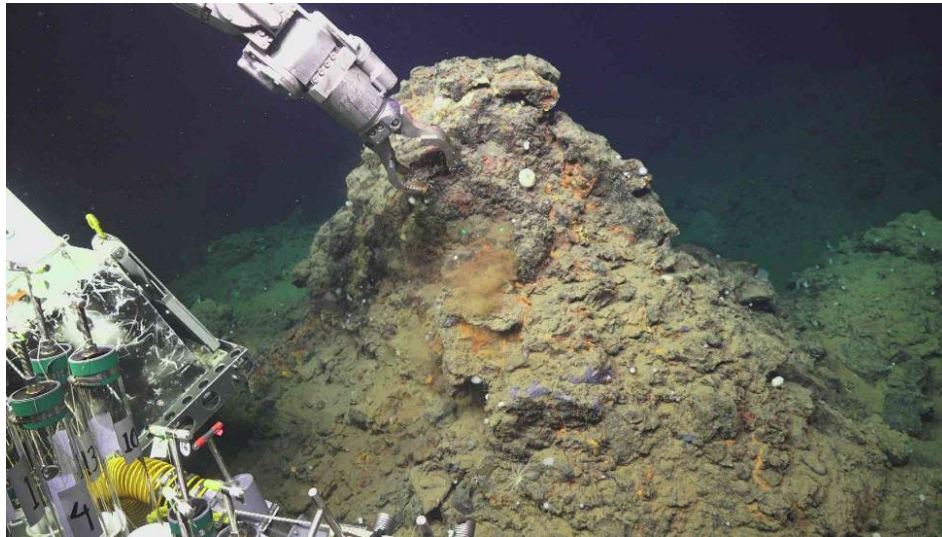
Depth: 3229 m

Dive Location: North SESCA (S1)

Sampling location: Inactive chimney

Sample description:

Dimensions: 12 x 10 x 8 cm



**J2-1424-R04**

Date: 2022/06/09

Time (UTC): 08:29

Latitude: 40.79089

Longitude: -127.50242

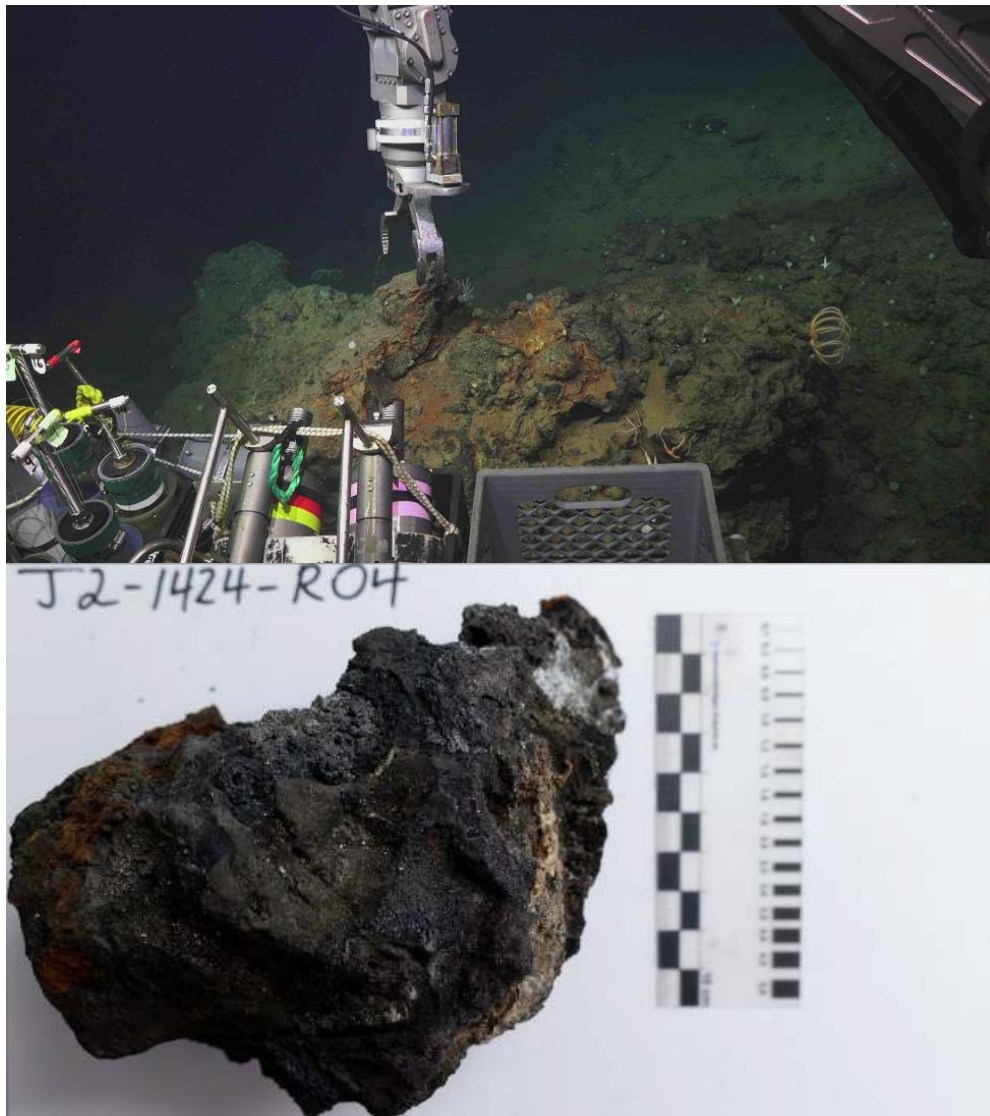
Depth: 3229 m

Dive Location: North SESCA (S1)

Sampling location: Side of inactive mound

Sample description:

Dimensions: 13 x 7 x 7 cm



**J2-1424-R05**

Date: 2022/06/09

Time (UTC): 08:43

Latitude: 40.79089

Longitude: -127.50222

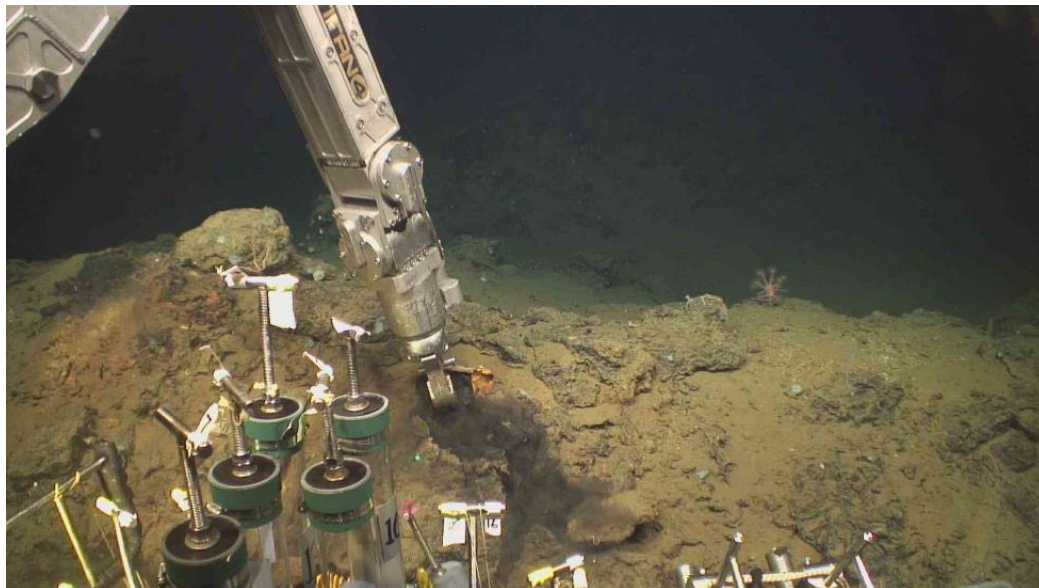
Depth: 3233 m

Dive Location: North SESCA (S1)

Sampling location: Inactive mound

Sample description:

Dimensions: 11 x 7 x 2 cm



**J2-1424-R06**

Date: 2022/06/09

Time (UTC): 09:33

Latitude: 40.79200

Longitude: -127.50046

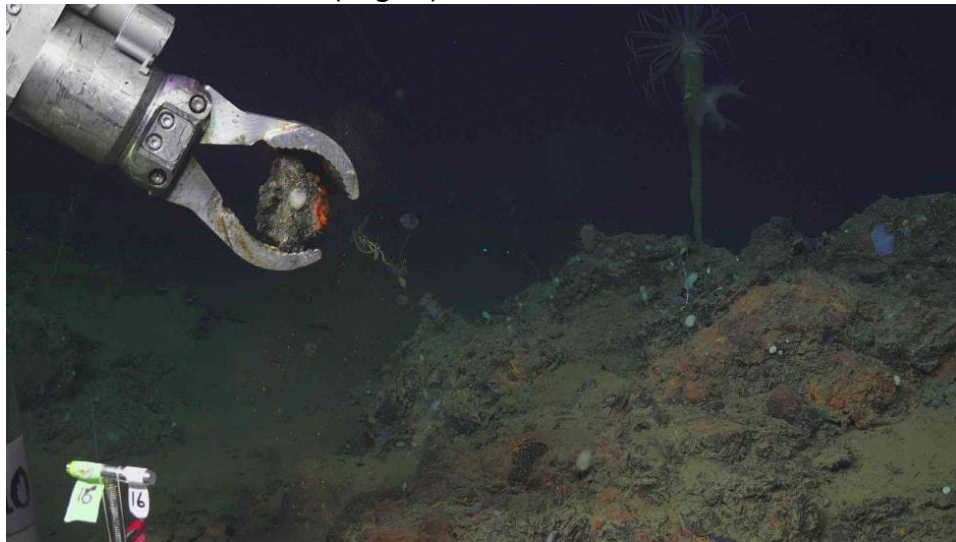
Depth: 3237 m

Dive Location: North SESCA (S1)

Sampling location: Inactive mound

Sample description:

Dimensions: 5 x 3 x 2 cm (largest)



**J2-1424-R07**

Date: 2022/06/09

Time (UTC): 10:32

Latitude: 40.79449

Longitude: -127.50017

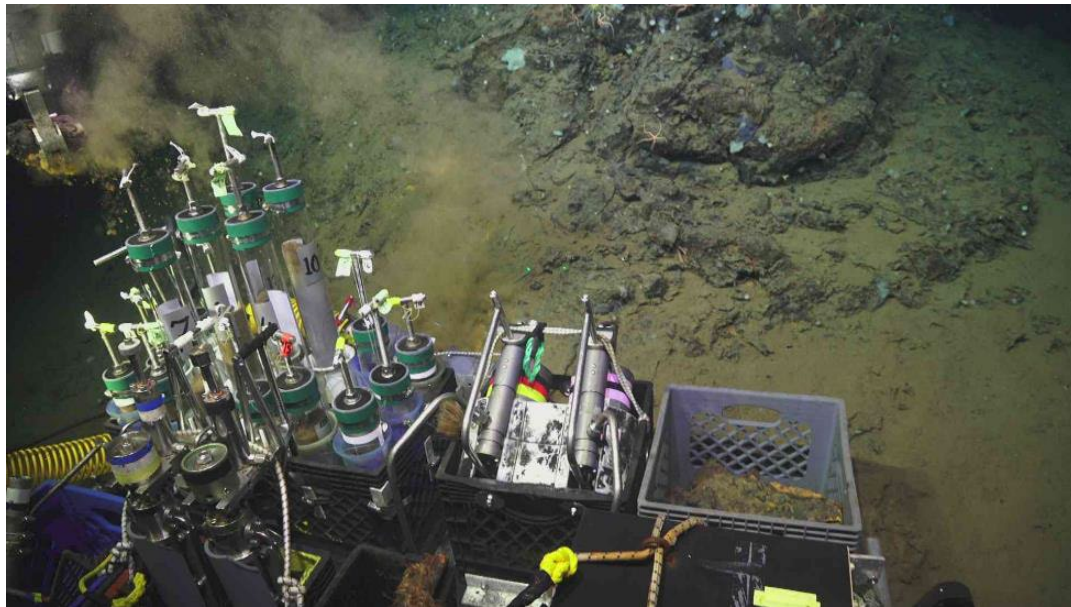
Depth: 3232 m

Dive Location: North SESCA (S1)

Sampling location: Inactive mound

Sample description:

Dimensions: 6 x 4 x 3 cm



**J2-1424-R08**

Date: 2022/06/09

Time (UTC): 11:53

Latitude: 40.79667

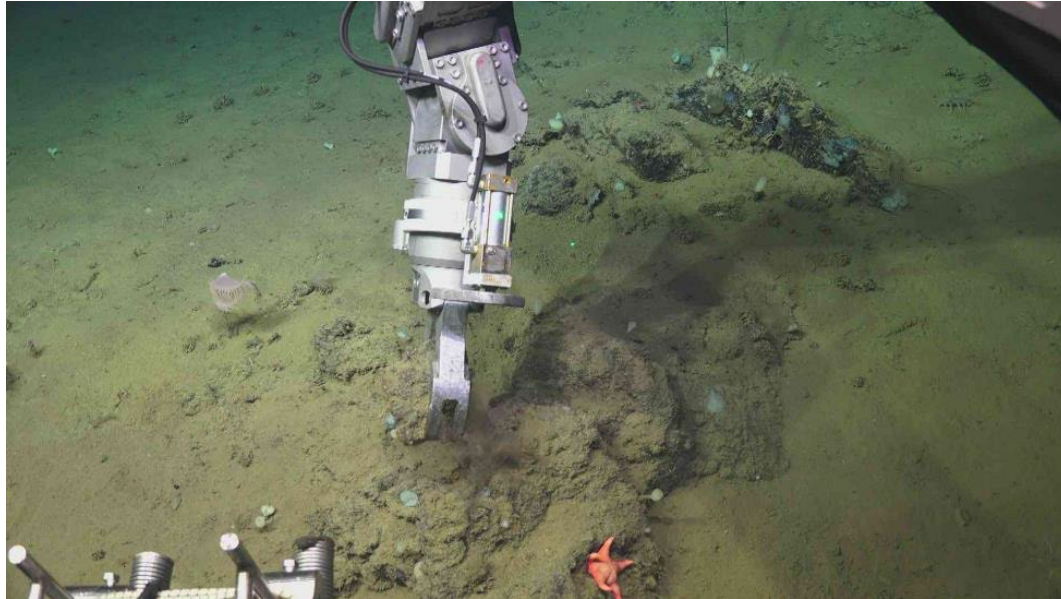
Longitude: -127.50564

Depth: 3211 m

Dive Location: North SESCA (S1)

Sampling location: Inactive hydrothermal outcrop in sediment

Sample description: Dimensions: 8 x 6 x 4 cm



**J2-1424-R09**

Date: 2022/06/09

Time (UTC): 13:44

Latitude: 40.79138

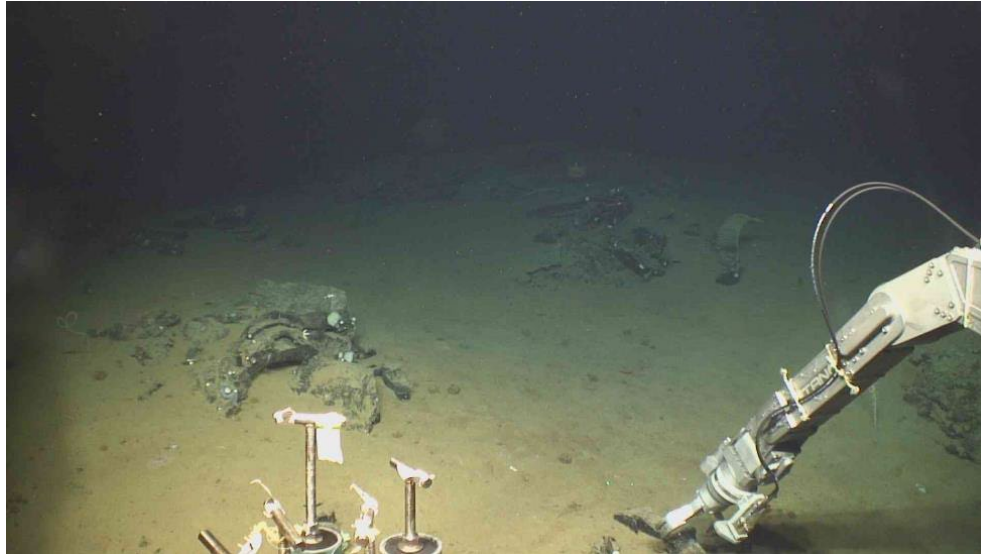
Longitude: -127.51099

Depth: 3245 m

Dive Location: North SESCA (S1)

Sampling location: Basalt outcrop in sediment

Dimensions: 14 x 11 x 8 cm



J2-1425-R01

Date: 2022/06/10

Time (UTC): 21:56

Latitude: 40.99165

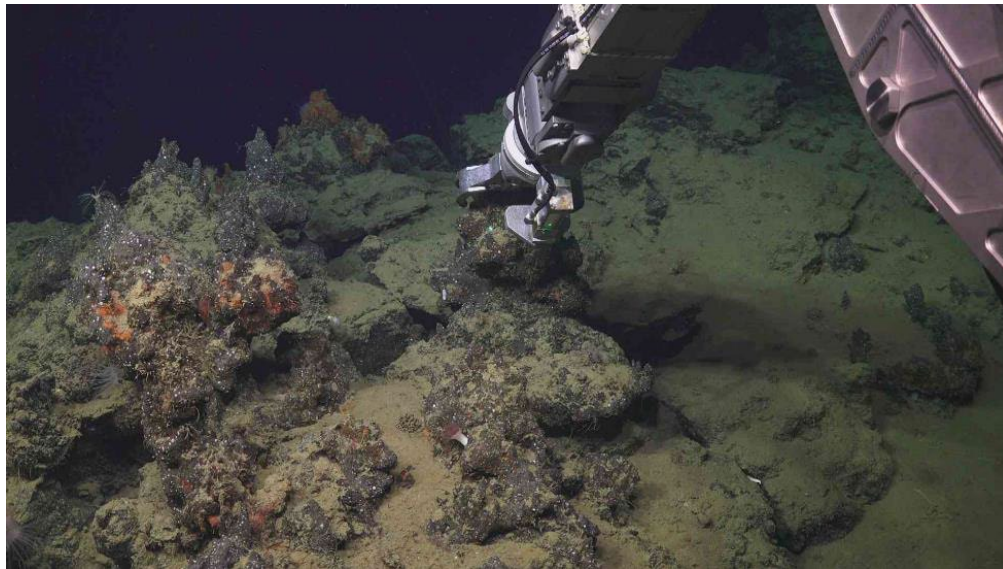
Longitude: -127.49363

Depth: 3250 m

Dive Location: NESCA – Central Hill

Sampling location: Inactive sulfide mound

Dimensions: 12 x 9 x 6 cm



**J2-1425-R02**

Date: 2022/06/10

Time (UTC): 22:02

Latitude: 40.99167

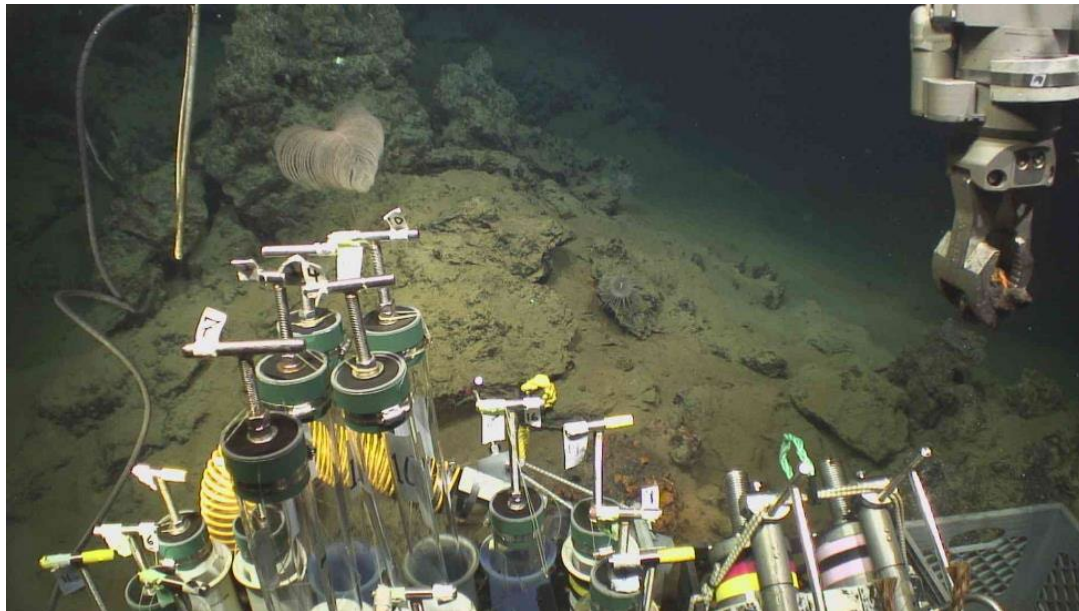
Longitude: -127.49360

Depth: 3249 m

Dive Location: NESCA – Central Hill

Sampling location: Inactive hydrothermal mound

Dimensions: 6 x 4 x 2 cm



**J2-1425-R03**

Date: 2022/06/11

Time (UTC): 02:47

Latitude: 40.99143

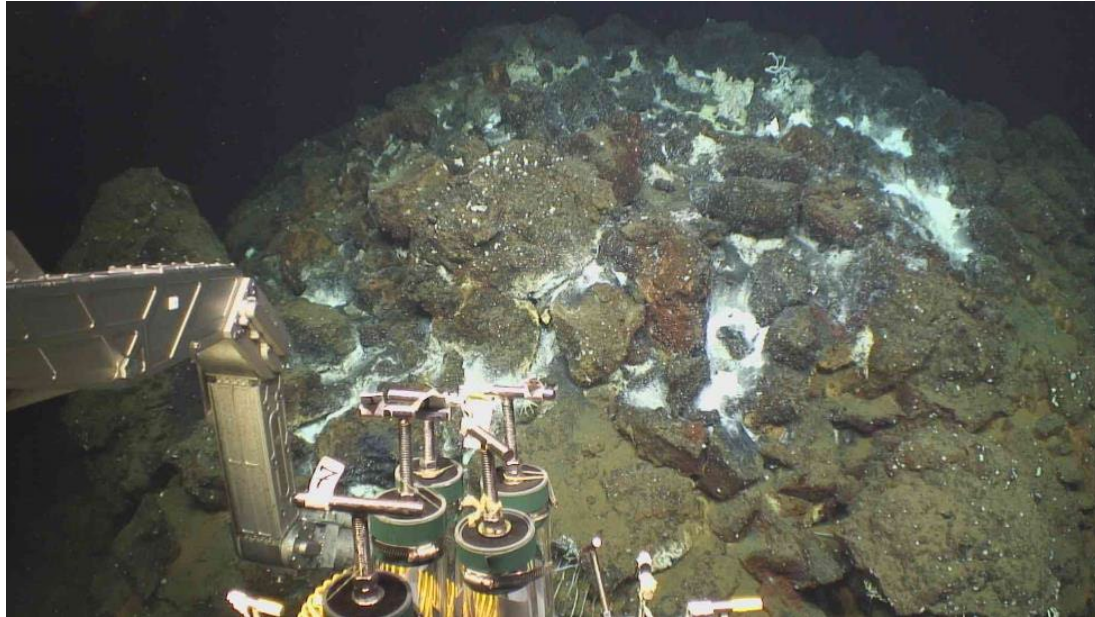
Longitude: -127.49277

Depth: 3239 m

Dive Location: NESCA – Central Hill

Sampling location: Diffusely venting mound (64°C)

Dimensions: 9 x 5 x 3 cm



**J2-1425-R04**

Date: 2022/06/11

Time (UTC): 02:47

Latitude: 40.99516

Longitude: -127.48924

Depth: 3232 m

Dive Location: NESCA – Central Hill

Sampling location: Inactive chimney

Dimensions: 6 x 6 x 6 cm (dark) and 10 x 8 x 5 cm (weathered crust)



**J2-1425-R05**

Date: 2022/06/11

Time (UTC): 03:07

Latitude: 40.99576

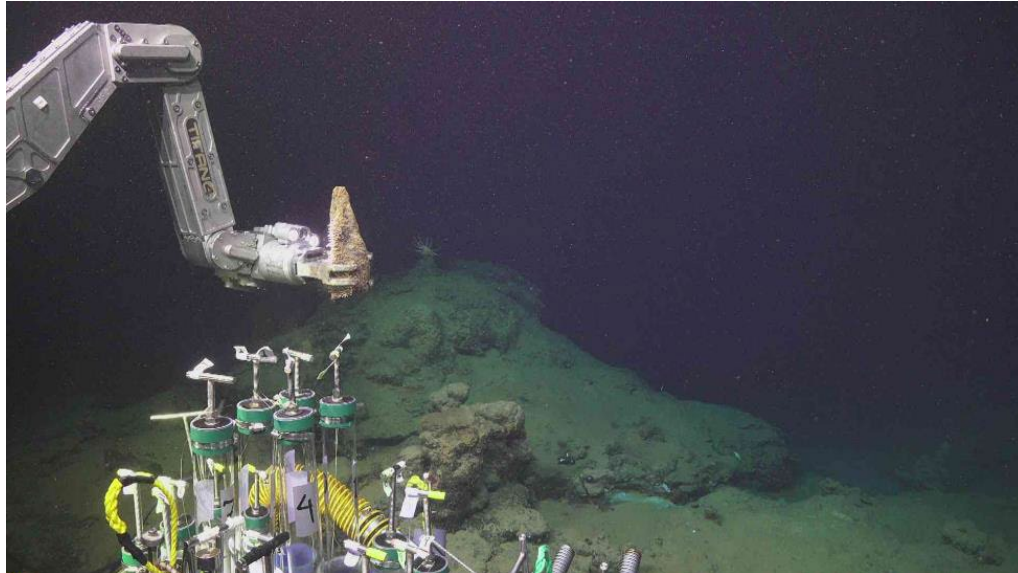
Longitude: -127.48962

Depth: 3227 m

Dive Location: NESCA – Central Hill

Sampling location: Inactive chimney spire

Dimensions: 9 x 7 x 5 cm



J2-1425-R05



**J2-1425-R06**

Date: 2022/06/11

Time (UTC): 04:47

Latitude: 41.00306

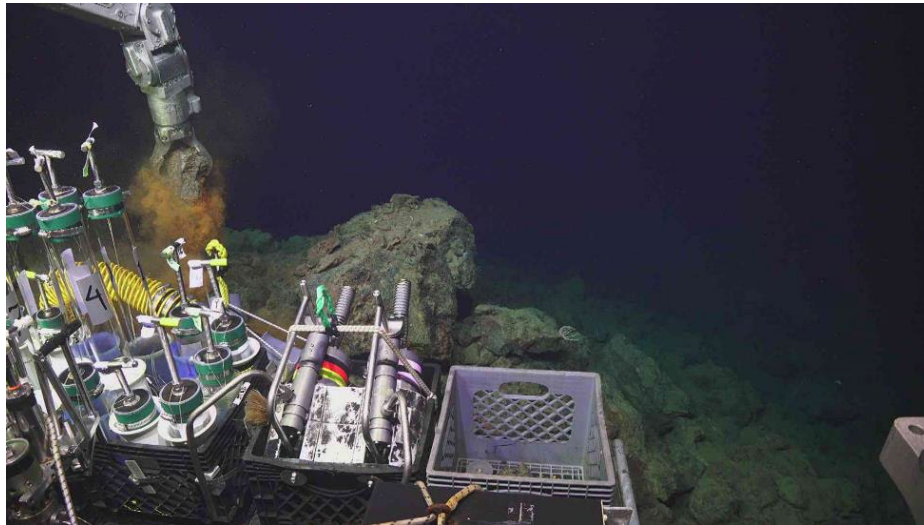
Longitude: -127.49322

Depth: 3225 m

Dive Location: NESCA – Central Hill

Sampling location: Inactive hydrothermal mound

Dimensions: 13 x 8 x 8 cm



**J2-1426-R01**

Date: 2022/06/11

Time (UTC): 20:12

Latitude: 40.88913

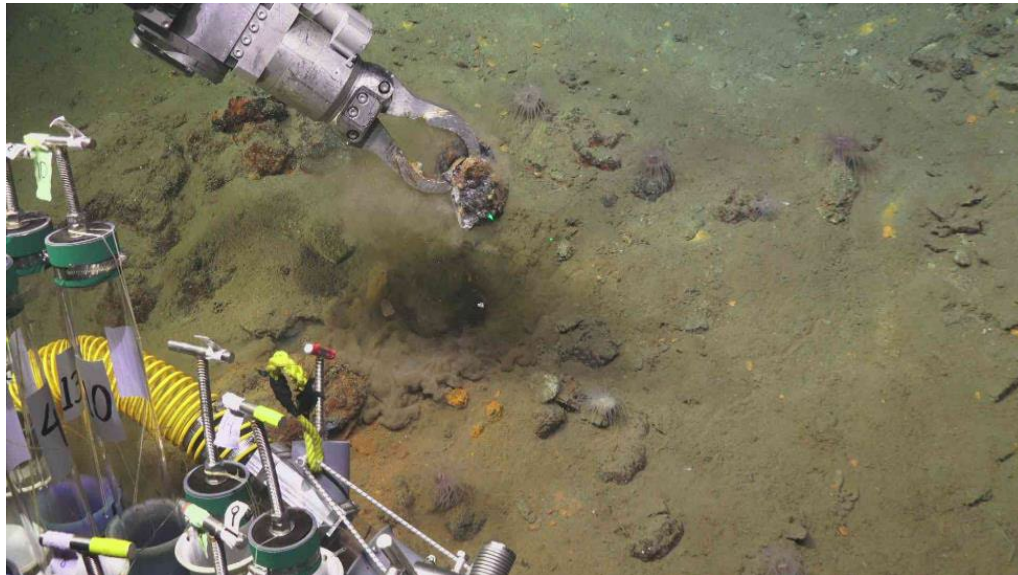
Longitude: -127.51703

Depth: 3319 m

Dive Location: MESCA - Pockmark

Sampling location: Sulfide talus on wall of pockmark

Dimensions: 15 x 8 x 6 cm



J2-1426-R01



**J2-1426-R02**

Date: 2022/06/11

Time (UTC): 20:59

Latitude: 40.88937

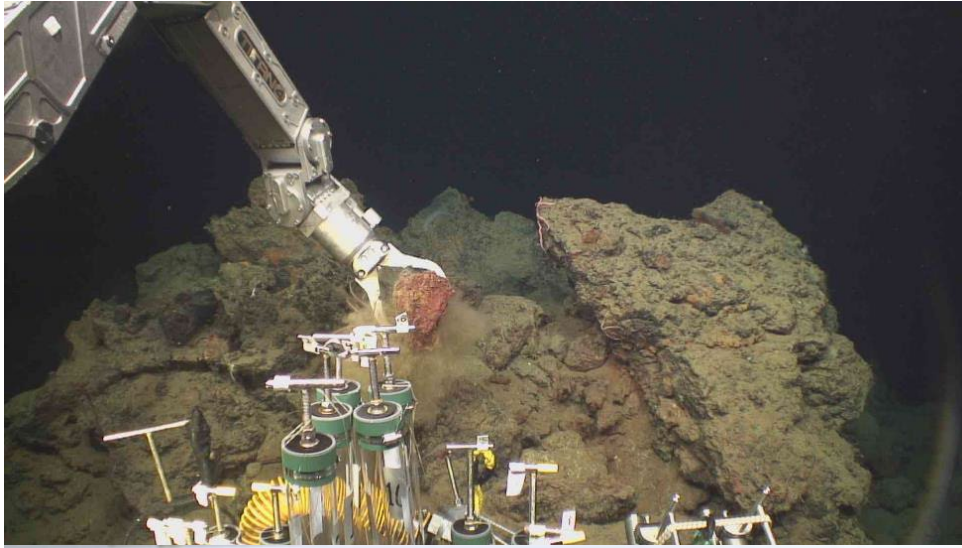
Longitude: -127.51761

Depth: 3282 m

Dive Location: MESCA - Pockmark

Sampling location: Inactive mound on lip of pockmark

Dimensions: 17 x 12 x 10 cm



**J2-1426-R03**

Date: 2022/06/11

Time (UTC): 21:19

Latitude: 40.88952

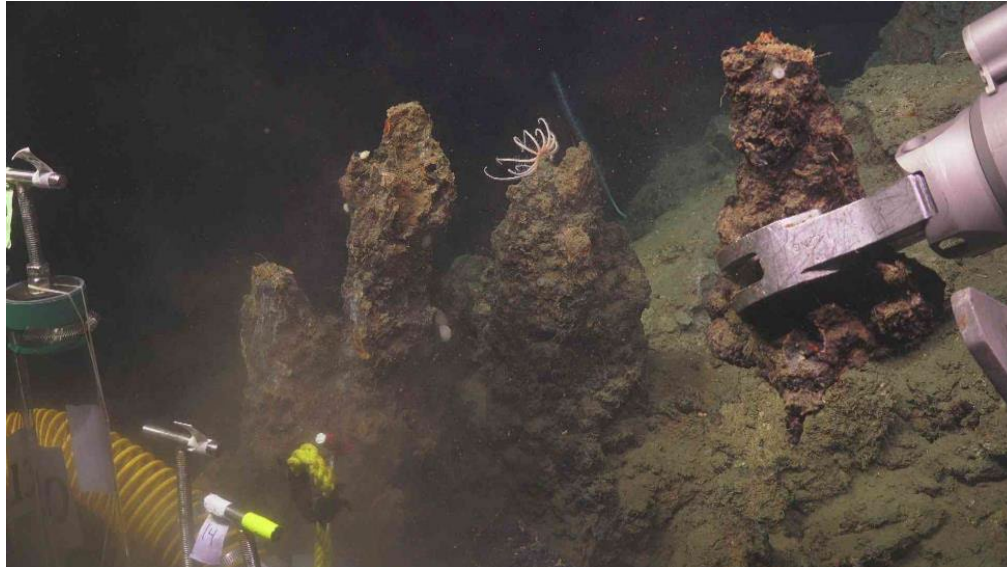
Longitude: -127.51774

Depth: 3283

Dive Location: MESCA - Pockmark

Sampling location: Inactive spire on inactive mound on lip of pockmark

Dimensions: 10 x 5 x 4 cm



**J2-1427-R01**

Date: 2022/06/13

Time (UTC): 08:09

Latitude:

Longitude:

Depth: 3201 m

Dive Location: South Phoenix

Sampling location: Pillow basalt outcrop on side of large mound

Dimensions: 10 x 8 x 5 cm



**J2-1427-R02**

Date: 2022/06/13

Time (UTC): 11:51

Latitude:

Longitude:

Depth: 3236 m

Dive Location:

South Phoenix

Sampling location: Pillow basalt from basalt mound

Dimensions: 5 x 4 x 4 cm



**J2-1427-R03**

Date: 2022/06/13

Time (UTC): 12:31

Latitude:

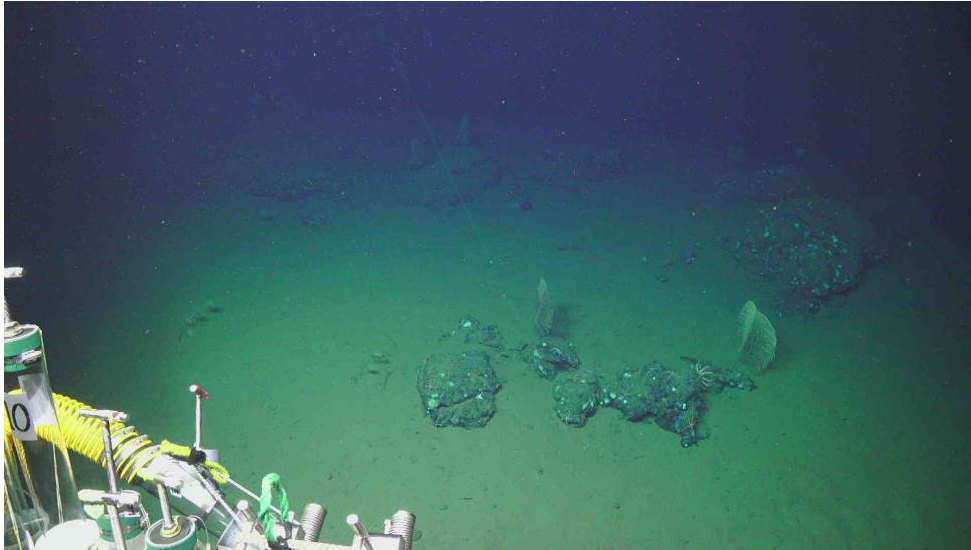
Longitude:

Depth: 3243 m

Dive Location: South Phoenix

Sampling location: Exposed pillow basalt in sediment

Dimensions: 15 x 12 x 10 cm



**J2-1427-R04**

Date: 2022/06/13

Time (UTC): 13:44

Latitude:

Longitude:

Depth: 3284 m

Dive Location: South Phoenix

Sampling location: Small sedimented basalt outcrop

Sample description: Dimensions: 7 x 5 x 4 cm



**Points of contact:**

Hydrothermal minerals: Dr. Amy Gartman, [agartman@usgs.gov](mailto:agartman@usgs.gov); Dr. John Jamieson, [jjamieson@mun.ca](mailto:jjamieson@mun.ca); Dr. Johannes Scheffler, [jmscheffler@mun.ca](mailto:jmscheffler@mun.ca)

Basalt: Dr. Isobel Yeo, [i.yeo@noc.ac.uk](mailto:i.yeo@noc.ac.uk)

## Biology

Previously published studies of the biological communities at Escanaba Trough from the 1980s revealed areas of active vents, surrounded by inactive sulfide areas, and extensive sedimented seafloor. More recent studies conducted by MBARI and collaborators revealed distinct changes in these environments, and associated megafaunal communities, following declined venting activity. For the current Escanaba expedition, we sought to address the following research questions: Are inactive sites characterized by mostly active vent species, background species, or species unique to inactive sulfides, or some combination? What are the community patterns along an inactive sulfide gradient? What geochemical drivers might be responsible for these patterns?

In order to address these questions, we investigated several locations within the Escanaba Trough that included previously sampled active sites (e.g., Central Hill) and recently mapped locations, including sites within the northern, central, and southern extent of the region. By both revisiting historic sites and investigating new ones, we sought to understand community changes over space and time, and tie those patterns to the underlying environment, including sediment biogeochemistry and microbial ecology. Throughout the dives, we conducted high-resolution image transects, collected representative fauna that were dominant within each of the locations, and sampled sediments and water for a variety of analyses. By co-locating samples collected and analyzed for sediment biogeochemical characteristics with biological analysis, our goal was to identify important drivers of these biological communities, from microbes to megafauna.

During the Escanaba expedition, we encountered characteristic vent fauna near active venting, including chemosynthetic tubeworms and clams, along with limpets and various crustaceans. In areas with declined vent activity, these vent-associated megafauna were largely absent and replaced by fauna typically found in background hardbottom and soft sediment environments, including deep-sea corals, anemones, and holothurians. Thus, throughout the expedition, we observed a gradient in the community composition, spanning from symbiont-rich megafauna (e.g., tubeworms) to their subsequent decline and replacement, likely due to lack of sufficient fluid flow. In total, we collected dozens of hours of video imagery, as well as > 100 biological samples (e.g., deep-sea corals, sponges, tubeworms, clams), dozens of sediment cores, as well as water samples analyzed for nutrients, microbes, and particulate organic matter analyses. Biological samples will be processed to confirm species identification and for stable isotope analysis for food-web analysis. Sediment cores were collected along transects that encompassed active venting sites (where present), inactive sulfide areas, and background, soft-sediment environments. These cores will be processed and analyzed for microbial and macrofaunal community composition and structure, biomarker composition, as well as a suite of biogeochemical and sediment characteristics analyses.

Together, analyses of these samples and imagery will help shed light on how these environments function across active, inactive, and background deep-sea environments, including their overall community structure, composition, and trophic connections throughout, and important drivers influencing their functional ecology.

A list of collected biological samples via ROV-based slurp and grab sampling is included below. Additional biological samples were removed from rock samples and push cores.

Point of contact: Dr. Amanda Demopoulos ademopoulos@usgs.gov

| Sample ID   | Time     | Lat         | Long          | Depth | Notes                                                                                           |
|-------------|----------|-------------|---------------|-------|-------------------------------------------------------------------------------------------------|
| J2-1417-B01 | 22:23:04 | 41.04127973 | -127.50096259 | 3285  | Scoop from bacterial mat, clams, anenome, black fine grain sediment.                            |
| J2-1418-B01 | 13:58:14 | 41.00028194 | -127.49443777 | 3219  | Mass of tubeworms frm venting area                                                              |
| J2-1418-B02 | 14:20:59 | 41.00031679 | -127.49443233 | 3219  | Slurp. Slurp over diffuse active venting area, maybe should be S01, but calling B02 this dive   |
| J2-1418-B03 | 17:46:03 | 40.99989677 | -127.49481755 | 3231  | Black coral growing on sulfide.                                                                 |
| J2-1418-B04 | 23:48:48 | 40.99434635 | -127.50637574 | 3073  | Black coral from top of chimney mound.                                                          |
| J2-1419-S01 | 06:57:27 | 41.06537796 | -127.49518678 | 3284  | Slurped sediment and worms. Red small mesh.                                                     |
| J2-1419-B01 | 09:44:22 | 41.06256430 | -127.49103830 | 3306  | Black coral.                                                                                    |
| J2-1419-S02 | 15:27:16 | 41.06891641 | -127.48947037 | 3279  | White slurp. Seapen coral with brittle star.                                                    |
| J2-1419-S03 | 15:48:07 | 41.06884535 | -127.48898789 | 3280  | Blue slurp.                                                                                     |
| J2-1420-S01 | 12:31:35 | 41.08008836 | -127.45180137 | 3197  | Tunicate, spnge, soft coral? A rock                                                             |
| J2-1420-S02 | 14:06:59 | 41.08054635 | -127.45226412 | 3202  | Pink/red flower like invertabrate on top of chimney-possible tunicate.                          |
| J2-1420-B01 | 15:07:24 | 41.08108864 | -127.45273877 | 3208  | Red/pink urchin.                                                                                |
| J2-1420-B02 | 15:51:33 | 41.08128174 | -127.45159508 | 3192  | Section of bamboo coral.                                                                        |
| J2-1420-B03 | 18:32:03 | 41.08223618 | -127.44726903 | 3221  | Black coral.                                                                                    |
| J2-1420-B04 | 18:35:06 | 41.08230469 | -127.44729078 | 3221  | Bamboo coral.                                                                                   |
| J2-1421-B01 | 16:14:27 | 40.69873761 | -127.52799720 | 3232  | Bamboo coral.                                                                                   |
| J2-1421-B02 | 17:24:37 | 40.69834030 | -127.52866368 | 3232  | Black coral.                                                                                    |
| J2-1421-S01 | 20:03:59 | 40.69615472 | -127.52747168 | 3222  | White/blue microbial mat 2.7C. Also got squat lobster and limpets. Red slurp?                   |
| J2-1421-B03 | 21:29:33 | 40.69625805 | -127.52760141 | 3221  | Tubeworms, some snails.                                                                         |
| J2-1421-B04 | 00:36:36 | 40.69611489 | -127.52823039 | 3223  | Clams. Several form similar area.                                                               |
| J2-1422-B01 | 06:06:02 | 40.77457691 | -127.53573832 | 3224  | Black coral.                                                                                    |
| J2-1422-B02 | 06:31:25 | 40.77444043 | -127.53557518 | 3223  | Bamboo coral growing on chimney.                                                                |
| J2-1422-B03 | 08:39:07 | 40.77365570 | -127.53698676 | 3229  | Large, full coral surrounded by other coral species on basalt.                                  |
| J2-1422-B04 | 10:01:13 | 40.77187830 | -127.53923244 | 3227  | 3 sponge species. Large cup shaped sponge, large leaf shaped sponge, and flower looking sponge. |
| J2-1422-B05 | 13:27:28 | 40.77401734 | -127.54758078 | 3231  | ALSO 13:35 Two black corals, white and yellow.                                                  |
| J2-1422-B06 | 14:44:08 | 40.77151033 | -127.54881034 | 3233  | White pyramid urchin.                                                                           |
| J2-1422-B07 | 15:06:52 | 40.77058610 | -127.54977307 | 3231  | Slurp red, small coral on basalt talus.                                                         |
| J2-1422-B08 | 15:16:48 | 40.77059891 | -127.54978291 | 3231  | Slurp red, small coral on basalt talus.                                                         |
| J2-1423-B01 | 05:13:45 | 40.71358588 | -127.51480423 | 3233  | Whip coral.                                                                                     |
| J2-1423-B02 | 06:43:03 | 40.71338370 | -127.51847937 | 3210  | Black coral.                                                                                    |
| J2-1424-B01 | 01:12:14 | 40.77200670 | -127.49737492 | 3239  | Octocoral pink with polyps retracted.                                                           |
| J2-1424-B02 | 05:29:46 | 40.79018753 | -127.50536006 | 3229  | Small pyramid coral.                                                                            |

|             |          |             |               |      |                                             |
|-------------|----------|-------------|---------------|------|---------------------------------------------|
| J2-1424-B03 | 05:35:35 | 40.79020370 | -127.50535969 | 3229 | Black coral, top only.                      |
| J2-1424-B04 | 05:52:53 | 40.79022041 | -127.50525667 | 3231 | Bamboo coral sample from internodal branch. |
| J2-1425-B01 | 00:06:46 | 40.99140317 | -127.49302003 | 3240 | Tubeworms by fluid flow.                    |
| J2-1426-B01 | 22:42:28 | 40.88906209 | -127.51806071 | 3289 | Whip coral with anenome.                    |
| J2-1426-B02 | 22:58:12 | 40.88918441 | -127.51804925 | 3288 | Whip coral.                                 |
| J2-1426-B03 | 23:15:17 | 40.88917075 | -127.51945605 | 3285 | Octocoral bathyalcyon in bio box at 23:23.  |
| J2-1427-B01 | 07:24:46 | 41.16608611 | -127.40937366 | 3203 | Black coral.                                |
| J2-1427-B02 | 08:16:00 | 41.16511476 | -127.40786907 | 3202 | Pink octocoral.                             |
| J2-1427-B03 | 12:03:38 | 41.16079296 | -127.41638346 | 3236 | White coral? On basalt outcrop near R02.    |

## Microbiology

Subsamples of all rocks, as well as sediment from push cores and water from ROV-Niskins and CTD casts were preserved for microbiology. All microbial samples were stored in an ultralow - 80°C freezer. Almost 600 subsamples of rock, fluids, and sediment were frozen for 16S and whole genome sequencing. A complete list of subsamples frozen for microbial work are listed in the Appendix.

Points of contact: Dr. Kiana Frank, [klfrank@hawaii.edu](mailto:klfrank@hawaii.edu); Michaela Setzer, [msetzer2@hawaii.edu](mailto:msetzer2@hawaii.edu)

## Push Cores

Push cores were collected in triplicate, on a transect from “most hydrothermal” (station 1) to “least hydrothermal” (station 5). One 60 or 80 cm core (Archive core) was collected and returned whole to PCMSC for geochemical and mineralogical analysis and archival. One 30 cm core (Biology core) was processed shipboard for infauna and microbiological subsamples. One 30 cm core (OC core) was processed shipboard for electrode micro profiling, pore water collection and organic carbon. “Extra” cores were not collected in triplicate and will only have geochemical and mineralogical information. On dive J2-1421 the dive was aborted before the transect was completed.

The core naming convention is Dive#+PC##. An aggregated list of all collected push core is below.

### Points of contact:

Infauna: ademopoulos@usgs.gov

Microbiology: klfrank@hawaii.edu

Inorganic geochemistry: agartman@usgs.gov

Organic geochemistry: hianiri@usgs.gov

| Dive #  | Archive core | Biology core | OC   | Transect station | depth | Latitude (dd) | Longitude (dd) | Date    | Time collected (UTC) | Location name    |
|---------|--------------|--------------|------|------------------|-------|---------------|----------------|---------|----------------------|------------------|
| J2-1418 | PC15         | PC14         | PC16 | 5                | 3235  | 40.9991013    | -127.494772    | 5/31/22 | 19:03                | Central Hill     |
| J2-1418 | PC12         | PC11         | PC13 | 4                | 3233  | 40.9995693    | -127.494824    | 5/31/22 | 18:31                | Central Hill     |
| J2-1418 | PC08         | PC09         | PC10 | 3                | 3232  | 40.9997423    | -127.494854    | 5/31/22 | 18:07                | Central Hill     |
| J2-1418 | PC06         | PC05         | PC07 | 2                | 3238  | 41.0000579    | -127.49488     | 5/31/22 | 17:14                | Central Hill     |
| J2-1418 | PC03         | PC01         | PC02 | 1                | 3232  | 41.0001349    | -127.494681    | 5/31/22 | 16:38                | Central Hill     |
| J2-1418 | PC04         |              |      | extra            | 3232  | 41.0001424    | -127.494669    | 5/31/22 | 16:43                | Central Hill     |
| J2-1419 | PC14         | PC15         | PC16 | 5                | 3280  | 41.0689159    | -127.489471    | 6/2/22  | 15:04                | Edifice Rex West |
| J2-1419 | PC11         | PC13         | PC12 | 4                | 3281  | 41.0689131    | -127.488873    | 6/2/22  | 14:41                | Edifice Rex West |
| J2-1419 | PC08         | PC10         | PC09 | 3                | 3282  | 41.0688613    | -127.488448    | 6/2/22  | 14:18                | Edifice Rex West |
| J2-1419 | PC05         | PC07         | PC06 | 2                | 3283  | 41.0688968    | -127.488059    | 6/2/22  | 13:59                | Edifice Rex West |
| J2-1419 | PC02         | PC04         | PC03 | 1                | 3280  | 41.0689364    | -127.487815    | 6/2/22  | 13:37                | Edifice Rex West |
| J2-1419 | PC01         |              |      | extra            | 3301  | 41.0639459    | -127.499108    | 6/2/22  | 3:55                 | Edifice Rex West |
| J2-1420 | PC14         | PC16         | PC15 | 5                | 3225  | 41.0821284    | -127.447741    | 6/3/22  | 19:36                | Edifice Rex East |
| J2-1420 | PC11         | PC13         | PC12 | 4                | 3225  | 41.0820619    | -127.447643    | 6/3/22  | 19:24                | Edifice Rex East |
| J2-1420 | PC08         | PC10         | PC09 | 3                | 3225  | 41.0822137    | -127.447522    | 6/3/22  | 19:06                | Edifice Rex East |
| J2-1420 | PC05         | PC07         | PC06 | 2                | 3224  | 41.0822654    | -127.44739     | 6/3/22  | 18:44                | Edifice Rex East |

|         |      |       |      |       |      |            |             |         |       |                            |
|---------|------|-------|------|-------|------|------------|-------------|---------|-------|----------------------------|
| J2-1420 | PC02 | PC04  | PC03 | 1     | 3223 | 41.08224   | -127.447097 | 6/3/22  | 18:00 | Edifice Rex East           |
| J2-1420 | PC01 |       |      | extra | 3201 | 41.079984  | -127.451598 | 6/3/22  | 13:05 | Edifice Rex East           |
| J2-1421 | PC02 | PC04  | PC03 | 2     | 3224 | 40.6957314 | -127.528223 | 6/6/22  | 1:39  | SESCA Hill S3A             |
| J2-1421 | PC05 | PC007 | PC06 | 1     | 3224 | 40.6957282 | -127.528174 | 6/6/22  | 2:48  | SESCA Hill S3A             |
| J2-1421 | PC01 |       |      | extra | 3233 | 40.6987255 | -127.527985 | 6/5/22  | 16:09 | SESCA Hill S3A             |
| J2-1422 | PC13 | PC15  | PC14 | 5     | 3230 | 40.7740633 | -127.536194 | 6/7/22  | 7:59  | SESCA Hill S2A             |
| J2-1422 | PC10 | PC12  | PC11 | 4     | 3230 | 40.7742732 | -127.535717 | 6/7/22  | 7:44  | SESCA Hill S2A             |
| J2-1422 | PC07 | PC09  | PC08 | 3     | 3229 | 40.774283  | -127.535733 | 6/7/22  | 7:32  | SESCA Hill S2A             |
| J2-1422 | PC04 | PC06  | PC05 | 2     | 3229 | 40.7743228 | -127.535714 | 6/7/22  | 7:18  | SESCA Hill S2A             |
| J2-1422 | PC01 | PC03  | PC02 | 1     | 3226 | 40.7743683 | -127.535593 | 6/7/22  | 7:01  | SESCA Hill S2A             |
| J2-1424 | PC13 | PC15  | PC14 | 5     | 3235 | 40.7903111 | -127.504819 | 6/9/22  | 7:48  | SESCA unnamed & North Hill |
| J2-1424 | PC10 | PC12  | PC11 | 4     | 3234 | 40.7903514 | -127.504936 | 6/9/22  | 7:35  | SESCA unnamed & North Hill |
| J2-1424 | PC07 | PC09  | PC08 | 3     | 3234 | 40.7903006 | -127.505046 | 6/9/22  | 7:17  | SESCA unnamed & North Hill |
| J2-1424 | PC01 |       |      | 2     | 3234 | 40.7903038 | -127.505151 | 6/9/22  | 6:16  | SESCA unnamed & North Hill |
| J2-1424 | PC04 | PC06  | PC05 | 1     | 3232 | 40.7902985 | -127.505202 | 6/9/22  | 6:36  | SESCA unnamed & North Hill |
| J2-1425 | PC01 |       |      | extra | 3250 | 40.9916163 | -127.493486 | 6/10/22 | 22:12 | Central Hill               |
| J2-1426 | PC13 | PC15  | PC14 | 5     | 3289 | 40.8890661 | -127.517985 | 6/11/22 | 22:30 | MESCA                      |
| J2-1426 | PC10 | PC12  | PC11 | 4     | 3289 | 40.8891425 | -127.517944 | 6/11/22 | 22:16 | MESCA                      |
| J2-1426 | PC07 | PC09  | PC08 | 3     | 3291 | 40.8891832 | -127.517807 | 6/11/22 | 22:04 | MESCA                      |
| J2-1426 | PC04 | PC06  | PC05 | 2     | 3287 | 40.8892495 | -127.517694 | 6/11/22 | 21:48 | MESCA                      |
| J2-1426 | PC01 | PC03  | PC02 | 1     | 3286 | 40.8892778 | -127.51761  | 6/11/22 | 21:35 | MESCA                      |

### High temperature fluids

High and low temperature focused vent fluids were sampled utilizing two distinct sampler types. Altogether, thirteen fluid samples were collected at three locations; six by means of the Gas Tight type sampler; and seven by means of the Major type sampler. Two samples of each sampler type were collected at the three locations. Additionally, one Majors sampling process was aborted (J2-1418-M02) leaving one unpaired Majors type sample, J2-1418-M01. Analyses of fluid samples from Major samplers will be led by Dr. Eoghan Reeves, University of Bergen, Norway.

### Major sampler processing

Samples collected using the Majors samplers were split into subsample aliquots in a variety of vials and bottles (glass/HDPE), and were also analyzed at sea for some parameters (pH(25°C), total alkalinity). The subsamples follow the scheme: 15mL for major and minor elements (anions, cations, purged of H<sub>2</sub>S with N<sub>2</sub>), 20mL for volatile organics (trace amounts of organic compounds and alcohols, frozen at -80°C), 15mL for dissolved nitrogen species (ammonium etc., frozen at -80°C), 15mL for dissolved organic acids (formate etc., frozen at -80°C), 30mL for metals (acidified with HNO<sub>3</sub>, subsampled and diluted at sea for SiO<sub>2</sub>). The remaining fluid and particles in the sampler were filtered to collect any metal precipitates for reconstitution of the fluid metals content.

The total alkalinity of the samples was determined shipboard by means of volumetric acid-base-titration (classical gran titration) and evaluation of the pH logged versus the volume of added acid. At least two titrations were performed on each sample.

Remaining amounts of each sample were passed on for Radon and Radium analyses.

Majors samplers were used multiple times and cleaned between successful sample recoveries and recurring deployment.

### Gas Tight samplers

Gas tight samplers were deployed at the same locations as Major samplers. The provided Gas Tight samplers were used only once each. As of the end of the cruise they hold the respective samples and are to be returned for on-shore analyses. Analysis of gas-tight samplers will be led by Dr. Tamara Baumberger, Oregon State University and NOAA PMEL.

| Dive #  | Latitude    | Longitude     | T in °C | Depth | Samples collected                                                         |
|---------|-------------|---------------|---------|-------|---------------------------------------------------------------------------|
| J2-1418 | 41.00001765 | -127.49442745 | 210     | 3219  | J2-1418-M01<br>J2-1418-M03<br>J2-1418-M04<br>J2-1418-GT01<br>J2-1418-GT02 |

|         |             |                |    |      |                                                            |
|---------|-------------|----------------|----|------|------------------------------------------------------------|
| J2-1421 | 40.69594644 | -127.52811118  | 22 | 3220 | J2-1421-M01<br>J2-1421-M02<br>J2-1421-GT01<br>J2-1421-GT02 |
| J2-1425 | 40.99140538 | -127.492872443 | 64 | 3240 | J2-1425-M01<br>J2-1425-M02<br>J2-1425-GT01<br>J2-1425-GT02 |

## Notes on fluid sampling

### J2-1418

There was difficulty sampling M01, which was attempted multiple times and the snorkel contacted the rock, sediment and microbial matter covering the orifice and which appears to have been entrained in the recovered sample. M02 was aborted. M03 and M04 were sampled successfully, had a distinct smell of H<sub>2</sub>S and was visibly effervescent.

### J2- 1421

These samples were taken from a diffuse venting site from under a dense cluster of tube worms. No distinct orifice was evident nor could be excavated with a piece of crimped titanium tubing. The samples contained noticeable amounts of tube worm debris reminiscent of white "lint" and red "feathers" which would have been caught on the filtrate subsample. The fluids were not noticeably effervescent and had only minor H<sub>2</sub>S smell.

### J2-1425

There was difficulty sampling M01, several attempts were made

Points of contact:

Dr. Eoghan Reeves, eoghan.reeves@uib.no

Dr. Tamara Baumberger, tamara.baumberger@noaa.gov

## Gravity Cores

Nine gravity cores were attempted, eight recovered material. All gravity cores took place during daylight hours at the request of the ship as this was the first time the ship had gravity cored using the A-frame. We used a 4.5 m barrel length.

| Core # | Date (UTC) | Core Length (cm) | # sections | Latitude | Longitude | Ship's Water Depth(m) | Wire Out(m) | Sensor Depth (m) | Pull-out Tension | Time Deployed (UTC) | Time on Bottom (UTC) | Time Recovered (UTC) |
|--------|------------|------------------|------------|----------|-----------|-----------------------|-------------|------------------|------------------|---------------------|----------------------|----------------------|
| GC-01  | 2022-05-28 | 359              | 3          | 41.055   | -127.5063 | 3270                  | 3260        | 3295.1           | 7795             | 17:14               | 18:13                | 19:38                |
| GC-02  | 2022-05-29 | 20               | 1          | 40.9944  | -127.5066 | 3290                  | 3273        | 3314.3           | 7285             | 1:04                | 2:01                 | 4:04                 |
| GC-03  | 2022-05-30 | 342              | 3          | 41.0556  | -127.5078 | 3267                  | 3249        | 3285.9           | 7484             | 15:08               | 16:10                | 17:58                |
| GC-04  | 2022-05-30 | 417              | 3          | 41.0555  | -127.507  | 3271                  | 3249        | 3287.7           | 6946             | 20:14               | 21:25                | 22:43                |
| GC-05  | 2022-06-01 | 94               | 1          | 41.0004  | -127.4948 | 3242                  | 3212        | 3257.4           | 7226             | 15:07               | 16:04                | 17:20                |
| GC-06  | 2022-06-02 | 371              | 3          | 41.0551  | -127.5156 | 3290                  | 3190        | 3228.8           | 7451             | 20:35               | 21:39                | 22:57                |
| GC-07  | 2022-06-06 | 0                | 0          | 40.698   | -127.5222 | 3233                  | 3202        | 3249.4           | 6100             | 16:39               | 17:34                | 18:37                |
| GC-08  | 2022-06-12 | 392              | 3          | 40.8887  | -127.5144 | 3304                  | 3265        | 3320             | 8015             | 17:25               | 18:22                | 19:33                |
| GC-09  | 2022-06-13 | 233              | 2          | 41.1632  | -127.4076 | 3209                  | 3180        | 3217.2           | 8361             | 16:42               | 17:38                | 18:42                |

### Notes on recovery

GC01- penetration above the coupler, grey pelagic mud with reddish brown top 7cm.

GC02- sulphide rocks, round pebbles to cobbles of pyrrhotite size range 1-8 cm, no mud residue

GC03- mud to the hilt, grey hemipelagic top cms oxidized pale brown

GC04- penetration above coupler, petroleum/ asphalt smell

GC05- no comments

GC06- no comments

GC07- penetration to the nose cone joint- mud on nose and head, not pipe. Pressure sensor shows core fell over after minimum penetration

GC08- penetration to 40 cm below head

GC09- penetration mid barrel, hit and dented cutter nose on rock

### Point of contact:

Dr. Amy Gartman, [agartman@usgs.gov](mailto:agartman@usgs.gov)

## Low temperature fluids

Includes ROV based Niskins and CTD casts

### CTD cast

There were a total of 12 CTD casts done during the duration of the TN-403: Escanaba. There were regions of interest along Escanaba Trough: (1) Northern Escanaba (NESCA), (2) Southern Escanaba, and (3) Middle Escanaba (MESCA). The CTD program was to supplement the ROV Jason and AUV Sentry dives and better capture hydrothermal plume geochemistry over active site and understand overlying water column at inactive sites. Locations were chosen based on interesting features and sensor information from Miniature Autonomous Plume Recorders attached to ROV Jason and AUV Sentry. Based on these observations, 7 casts were completed at NESCA, 3 at SESCA, and 1 at MESCA. Cast V22A-01 was a soak cast and no samples were taken.

### General Observations

In addition to two oxygen sensors, transmissometer, altimeter, and fluorometer sensors on the ship's CTD, we added two LSS sensors to measure turbidity as well as an oxidation-reduction potential (ORP) sensor to detect any anomalies in the hydrothermal plumes. The three additional sensors were provided by the National Oceanographic and Atmospheric Administration – Pacific Marine Environmental Laboratory Vents group. General observations include a bottom nepheloid layer at all stations characterized by a steadily increasing turbidity signal from just below 2000 m to the bottom. This layer often had 1-2 small local maxima that varied by station. These maxima will be explored further to assess the likelihood of them corresponding to a hydrothermal plume signal. Casts taken at NESCA had small local maxima at around 1000 m, which was not observed at either MESCA or SESCA. ORP anomalies were not observed. All stations had an oxygen minimum ( $< 30 \mu\text{mol/kg}$ ) layer between 500 m and 1000 m depth.

### Subsamples Taken

A variety of trace metal, biological, and xxx samples were taken to understand the geochemistry of hydrothermal plumes and over layer water column along Escanaba Trough. Below is the table with the total number of samples taken for each measurement.

Table 1. Subsample totals from the CTD casts on TN-403

| Type of Measurement | # of samples | Filter used                     |
|---------------------|--------------|---------------------------------|
| Helium              | 33           | NA                              |
| Methane             | 40           | NA                              |
| TdTMs               | 43           | NA                              |
| dTMs*               | 43           | 0.2 $\mu\text{m}$ AcroPack      |
| pTMs                | 38           | 0.2 $\mu\text{m}$ polycarbonate |
| Fe Speciation*      | 43           | 0.2 $\mu\text{m}$ AcroPack      |
| Siderophores*       | 36           | 0.2 $\mu\text{m}$ AcroPack      |

|                            |    |                      |
|----------------------------|----|----------------------|
| unacidified dTMs*          | 7  | 0.2 µm polycarbonate |
| Radium                     | 11 |                      |
| Radon                      | 17 |                      |
| Barium*                    | 18 | 0.2 µm polycarbonate |
| DNA                        | 36 |                      |
| Particulate Organic Matter | 15 |                      |
| eDNA                       | 8  |                      |

\*Filtrate was collected

Particulate organic matter and eDNA was processed by Dr. Amanda Demopoulos at the US Geological Survey ([ademopoulos@usgs.gov](mailto:ademopoulos@usgs.gov)), microbial samples were collected for Dr. Kiana Frank at the University of Hawaii ([klfrank@hawaii.edu](mailto:klfrank@hawaii.edu)), and radium, radon and barium were processed and analyzed by Dr. Tom Lorenson at the US Geological Survey ([tdlorenson@gmail.com](mailto:tdlorenson@gmail.com)). Trace metal samples were processed on board in a HEPA bubble and will analyzed at the University of Washington. For more information contact Dr. Colleen Hoffman ([clhoffma@uw.edu](mailto:clhoffma@uw.edu)). Helium samples will be analyzed at the NOAA PMEL Helium Isotope Laboratory in Newport, OR. For more information contact Dr. Tamara Baumberger ([tamara.baumberger@noaa.gov](mailto:tamara.baumberger@noaa.gov)).

#### Subsampling of the ROV Jason Niskins

Trace metal subsampling of the ROV Jason niskins were prioritized over active hydrothermal venting sites where high temperature fluids were taken. Barium samples were also sampled on these dives. On dives where no active venting took place, subsamples for eDNA, particulate organic matter, and microbial community analysis were prioritized. These samples were also collected on the trace metal specific dives, just with lower volumes. Radon was sub sampled on all but one ROV Jason dive where niskins were fired. Below is a table of the total number subsamples collected from the ROV Jason niskins.

Table 2. Subsample totals from the ROV Jason niskins on TN-403

| Type of Measurement | # of samples | Filter used          |
|---------------------|--------------|----------------------|
| Helium              | 2            | NA                   |
| Methane             | 2            | NA                   |
| TdTMs               | 4            | NA                   |
| dTMs*               | 4            | 0.2 µm AcroPack      |
| pTMs                | 4            | 0.2 µm polycarbonate |
| Fe Speciation*      | 4            | 0.2 µm AcroPack      |
| Siderophores*       | 4            | 0.2 µm AcroPack      |
| Radon               | 6            |                      |
| Barium*             | 3            | 0.2 µm polycarbonate |
| DNA                 | 8            |                      |

|                            |    |  |
|----------------------------|----|--|
| Particulate Organic Matter | 10 |  |
| eDNA                       | 9  |  |

\*Filtrate was collected

Particulate organic matter and eDNA was processed by Dr. Amanda Demopoulos at the US Geological Survey ([ademopoulos@usgs.gov](mailto:ademopoulos@usgs.gov)), microbial samples were collected for Dr. Kiana Frank at the University of Hawaii ([klfrank@hawaii.edu](mailto:klfrank@hawaii.edu)), and radium, radon and barium were processed and analyzed by Dr. Tom Lorenson at the US Geological Survey ([tdlorenson@gmail.com](mailto:tdlorenson@gmail.com)). Trace metal samples were processed on board in a HEPA bubble and will analyzed at the University of Washington. For more information contact Dr. Colleen Hoffman ([clhoffma@uw.edu](mailto:clhoffma@uw.edu)). Helium samples will be analyzed at the NOAA PMEL Helium Isotope Laboratory in Newport, OR. For more information contact Dr. Tamara Baumberger ([tamara.baumberger@noaa.gov](mailto:tamara.baumberger@noaa.gov)).

#### Synchrotron Analyses and Imaging

Samples for Scanning Transmission X-ray Microscopy (STXM) and Extended X-ray Absorptive Fine Structure (EXAFS) were collected to investigate mineralogy and organic-mineral interactions in both hydrothermal plume particles and microbial mats along Escanaba Trough. Additionally, Scanning Electron Microscopy (SEM) may also be done to investigate the morphology and distribution of different types of particles observed.

Table 3. Synchrotron and SEM sample collection on TN-403: Escanaba

| Cast/Dive # | Sample #        | Depth (m) | Vol. Filtered (L) | Filter used | Planned Analyses |     |       |
|-------------|-----------------|-----------|-------------------|-------------|------------------|-----|-------|
|             |                 |           |                   |             | STXM             | SEM | EXAFS |
| V22A-03     | 042<br>PC01     | 3200      | 10                | 0.2 um PC   | x                | x   | x     |
| J2-1421     | Surface<br>R-05 | 3224      | NA                | NA          | x                | x   | x     |
| J2-1423     | Surface         | 3230      | NA                | NA          | x                | x   | x     |

Samples were filtered or scooped from rock/sediment samples, opened in a nitrogen (99.999%) filled glove bag, stored on an acid cleaned petri slide/2 mL tube, sealed in mylar, and frozen at -20°C. They will be transported to the University of Washington and eventually to University of Minnesota-Twin Cities for analysis at the Advance Light Source (Lawrence Livermore National Laboratory). Once on shore samples will be rinsed with nitrogen spared MilliQ to remove sea salts. For further information about these samples and data, please contact Dr. Brandy Toner ([toner@umn.edu](mailto:toner@umn.edu)).

#### Miniature Autonomous Plume Recorders

We deployed Miniature Autonomous Plume Recorders (MAPR) from the National Oceanographic and Atmospheric Administration-Pacific Marine Environmental Laboratory vent group on AUV Sentry and ROV Jason to detect particle, temperature, and oxidation/reduction

potential (ORP) anomalies. ORP anomalies are excellent indicators of hydrothermal activity and fluid flow. In particular, ORP anomalies in the absence of particle anomalies are an indicator of diffuse (low temperature, particle-poor fluid), which is the anticipated flow in this region. ORP anomalies ( $> 0.5$  mV signal drops) were detected in 3 out of 9 Sentry dives and on all Jason dives.

ORP anomalies on Jason tended to be much larger and more frequent than those on Sentry, which is expected given Jason's closer proximity to the seafloor (2-7 m, 65 m respectively). ORP anomalies on Jason dives coincide with all locations in which visible diffuse fluid was observed. In addition, initial overview of ORP signals taken from Jason indicate that anomalies can often be matched to observed microbial mats, despite the absence of visible fluid flow or temperature anomaly. This suggests that low-temperature fluid flow may be present in these locations and sustaining elevated microbial activity. ORP anomalies were smaller and less frequently observed on Sentry but still instructive. We were able to confirm visible low-temperature venting at two sites, Central Hill, Dive 1418 and Central Hill, Dive 1425, that had strong ORP signal drops as observed 65 m above the seafloor by the MAPR on Sentry. Future work will involve further matching ORP anomalies from Jason dives to events in the sealog to characterize the relationship between putative hydrothermal fluid flow and the observed environment. In addition, ORP anomalies will be matched between Jason and Sentry where possible to estimate the extent of the hydrothermal plume. ORP data from the CTD casts will also be included into this comparison.

Temperature and particle anomalies were infrequent. On Jason dives, particle anomalies are not reliable because they could be related to sediment stirred up from ROV operations. Sentry displayed few particle anomalies. Small temperature anomalies (maximum of  $0.7^{\circ}\text{C}$  above background; dive 1418) were found in a select few dives (1417, 1418, 1421, 1425).

A full list of fluid subsamples is included as an appendix

Points of contact:

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## Sentry

The starboard crane on the Thompson was used for Sentry operations.

Technical issues encountered by the Sentry operations group during the cruise. Issues which primarily affected individual dives are listed in the respective dive reports where applicable.

1. T.1: Freewave comms issues prior to pulling cables on Sentry638. Could not run mission and cancelled dive and surface EP calibration 5/25. Comms were tested and repaired, but bandwidth is still limited and traffic over the network is still a concern, but can complete a full pre-dive. Surface driving still needs to be tested.
2. T.2: Edgetech works correctly, but didn't collect data during the dive. Suspect that the vehicle didn't correctly power the Edgetech on
3. T.3: Aft servo did not communicate prior to deck test before Sentry641 causing a delay in dive by 1 hour 11
4. T.4: Fwd servo worked correctly through deck test up until launch. Servo would be 90 degrees off of correct position when mission ran prior to launch. Replaced, but delayed dive by 3 hours.
5. T.5: Aft servo lost its centering during Sentry643 and Sentry could not maintain horizontal speed. After abort, the wing was not perfectly vertical and caused Sentry to ascend slow. The vehicle drove slow during recovery, but recovery went fine
6. T.6: Replaced aft servo after Sentry643, but Sentry unable to drive correctly during Sentry644 and aborted dive immediately. Out of the water for 24 hours.

### Sentry dive summaries

#### Sentry638

Weather: Deployment: winds 15-22kt, seas 7-10ft Recovery: winds 12-15kt, seas 7-10ft

Reason for end of dive: Battery

Important Positions

Dive Origin: 41 4 -127 -35

Launch Position: Sentry638 launch position: 41 4.135'N 127 31.431'W

#### Narrative

Sentry638 is the first dive of TN-403

Sentry638 was originally supposed to be a test dive off the coast of Newport in between setting sail and picking up the final cruise participants, but was cancelled due to wireless communication issues with Sentry prior to launch. The mission was later changed to be a day dive at Edifice Rex driving a large multibeam pattern to extend the coverage of the existing multibeam map. This dive was limited to 11 hours due to weather picking up on the 29th and constraining the recovery to be during the day due to unknown performance of the wireless communications on Sentry and to maximize the success of a safe recovery of Sentry on the first dive. Due to weather, the mission was changed again, but adjusted to be a full length dive based on improved weather. The bottom of the survey was kept the same and extended to the north to expand on the coverage

## Dive Statistics

### 0.1 sentry638 Summary

#### sentry638 Summary

Origin: 41.066667 -127.583333

Origin: 41 4.000'N 127 35.000'W

Launch: 2022/05/29 15:37:60

Survey start: 2022/05/29 17:13:09

Survey start: Lat:41.069270 Lon:-127.524192

Survey start: Lat:41 4.156'N Lon:127 31.452'W

Survey end: 2022/05/30 12:01:08

Survey end: Lat:41.069868 Lon:-127.508747

Survey end: Lat:41 4.192'N Lon:127 30.525'W

Ascent begins: 2022/05/30 12:01:08

On the surface: 2022/05/30 13:14:38

On deck: 2022/05/30 14:05:27

descent rate: 33.3 m/min

ascent rate: 43.9 m/min

survey time: 18.8 hours

deck-to-deck time 22.5 hours

Min survey depth: 3123m

Max survey depth: 3250m

Mean survey depth: 3202m

Mean survey height: 68m

distance travelled: 51.20km

average speed: 0.75m/s

average speed during photo runs: NaN m/s over 0.00 km average speed during multibeam runs:  
0.75 m/s over 51.20 km total vertical during survey: 3768m

Battery energy at launch: 18.1 kwhr

Battery energy at survey start: 17.5 kwhr

Battery energy at survey end: 2.6 kwhr

Battery energy on surface: 2.3 kwhr

Battery energy on deck: 1.9 kwhr

## Sensor Information

### Table 1: Sentry Sensor Configuration Sensor

Qty(3) APS 1540 Magnetometers (center, port, stbd) Edgetech 4-24kHz Sub-Bottom Profiler (SBP) Edgetech 2205 with 120kHz/540kHz enabled Kongsberg EM2040 Multibeam Sonar Seabird SBE49 Conductivity-Temperature-Depth (CTD) Seapoint optical backscatter sensor (OBS)

Anderaa Optode model 4330

300kHz RDI DVL

Blue View P900-90 Forward Looking Sonar IXEA PHINS

Reson Sound Velocity Probe

NOAA PMEL MAPR

NOAA PMEL ORP Sensor

OFG Sensor

### **Sentry 639**

Weather: Deployment: winds 15-22kt, seas 7-10ft Recovery: winds 12-15kt, seas 10-12ft

Reason for end of dive: End of mission

Important Positions

Dive Origin: 40 58 -127 -32

Launch Position: sentry639 launch position: 41 0.431'N 127 28.793'W

Narrative

Sentry639 is the second dive of TN-403

Sentry639 is a dual Jason/Sentry dive at Central Hill with a primary goal of collecting EP data and remapping the area.

Dive Statistics

0.3 sentry639 Summary

sentry639 Summary

Origin: 40.966667 -127.533333

Origin: 40 58.000'N 127 32.000'W

Launch: 2022/05/31 05:39:26

Survey start: 2022/05/31 07:11:22

Survey start: Lat:41.007855 Lon:-127.479023

Survey start: Lat:41 0.471'N Lon:127 28.741'W

Survey end: 2022/06/01 03:41:35

Survey end: Lat:41.001043 Lon:-127.506519

Survey end: Lat:41 0.063'N Lon:127 30.391'W

Ascent begins: 2022/06/01 03:41:35

On the surface: 2022/06/01 05:01:05

On deck: 2022/06/01 05:18:24

descent rate: 35.1 m/min

ascent rate: 40.7 m/min

survey time: 20.5 hours

deck-to-deck time 23.6 hours

Min survey depth: 3132m

Max survey depth: 3273m

Mean survey depth: 3206m

Mean survey height: 68m

distance travelled: 51.53km

average speed: 0.70m/s

average speed during photo runs: NaN m/s over 0.00 km average speed during multibeam runs: 0.70 m/s over 51.53 km total vertical during survey: 6917m

Battery energy at launch: 18.4 kwhr

Battery energy at survey start: 17.8 kwhr

Battery energy at survey end: 2.7 kwhr

Battery energy on surface: 2.4 kwhr

Battery energy on deck: 2.3 kwhr

## Sensor Information

### Table 2: Sentry Sensor Configuration Sensor

Qty(3) APS 1540 Magnetometers (center, port, stbd) Edgetech 4-24kHz SBP  
Edgetech 2205 with 120kHz/540kHz enabled Kongsberg EM2040 Multibeam Sonar  
Seabird SBE49 CTD Seapoint OBS  
Anderaa Optode model 4330 300kHz RDI DVL  
Blue View P900-90 Forward Looking Sonar IXEA PHINS  
Reson Sound Velocity Probe  
NOAA PMEL MAPR  
NOAA PMEL ORP Sensor  
OFG Sensor

## Sentry 640

### Summary

Weather: Deployment: winds 4-8kt, seas 1-3ft Recovery: winds 15-20kt, seas 5-7ft

Reason for end of dive: End of mission

### Important Positions

Dive Origin: 41 4 -127 -35

Launch Position: sentry640 launch position: 41 4.299'N 127 29.232'W

### Narrative

Sentry640 is the third dive of TN-403

Sentry640 is a dual Jason/Sentry dive at Edifice Rex where Jason dove on the map of Sentry638 and Sentry extending the map to the East of Edifice Rex.

### Dive Statistics

#### 0.5 sentry640 Summary

#### sentry640 Summary

Origin: 41.066667 -127.583333

Origin: 41 4.000'N 127 35.000'W

Launch: 2022/06/01 19:10:18

Survey start: 2022/06/01 20:40:40

Survey start: Lat:41.072438 Lon:-127.486592

Survey start: Lat:41 4.346'N Lon:127 29.196'W

Survey end: 2022/06/02 18:11:54

Survey end: Lat:41.064016 Lon:-127.489541

Survey end: Lat:41 3.841'N Lon:127 29.372'W

Ascent begins: 2022/06/02 18:11:54

On the surface: 2022/06/02 19:26:08

On deck: 2022/06/02 20:00:05

descent rate: 35.5 m/min

ascent rate: 43.7 m/min

survey time: 21.5 hours

deck-to-deck time 24.8 hours

Min survey depth: 3115m

Max survey depth: 3248m

Mean survey depth: 3190m  
 Mean survey height: 67m  
 distance travelled: 50.42km  
 average speed: 0.65m/s  
 average speed during photo runs: NaN m/s over 0.00 km average speed during multibeam runs:  
 0.65 m/s over 50.42 km total vertical during survey: 3917m  
 Battery energy at launch: 18.4 kwhr  
 Battery energy at survey start: 17.8 kwhr  
 Battery energy at survey end: 3.8 kwhr  
 Battery energy on surface: 3.4 kwhr  
 Battery energy on deck: 3.2 kwhr  
 Sensor Information  
 Table 3: Sentry Sensor Configuration Sensor  
 Qty(3) APS 1540 Magnetometers (center, port, stbd) Edgetech 4-24kHz SBP  
 Edgetech 2205 with 120kHz/540kHz enabled Kongsberg EM2040 Multibeam Sonar  
 Seabird SBE49 CTD Seapoint OBS  
 Anderaa Optode model 4330 300kHz RDI DVL  
 Blue View P900-90 Forward Looking Sonar IXEA PHINS  
 Reson Sound Velocity Probe  
 NOAA PMEL MAPR  
 NOAA PMEL ORP Sensor  
 OFG Sensor

## **Sentry 641**

### **Summary**

Weather: Deployment: winds 10-15kt, seas 3-7ft Recovery: winds 25-30kt, seas 10-12ft  
 Reason for end of dive: End of mission/Medical Transfer

### **Important Positions**

Dive Origin: 41 4 -127 -35

Launch Position: sentry641 launch position: 41 4.783'N 127 27.505'W

### **Narrative**

Sentry641 is the fourth dive of TN-403

Sentry641 is a dual Jason/Sentry dive at Edifice Rex with Jason diving on the map of Sentry640 and Sentry extending the map to the north to map 2x interesting features.

### **Dive Statistics**

0.7 sentry641 Summary

sentry641 Summary

Origin: 41.066667 -127.583333

Origin: 41 4.000'N 127 35.000'W

Launch: 2022/06/03 05:50:16

Survey start: 2022/06/03 07:19:50

Survey start: Lat:41.080170 Lon:-127.457382

Survey start: Lat:41 4.810'N Lon:127 27.443'W

Survey end: 2022/06/04 01:56:09

Survey end: Lat:41.080590 Lon:-127.454592  
 Survey end: Lat:41 4.835'N Lon:127 27.276'W  
 Ascent begins: 2022/06/04 01:56:09  
 On the surface: 2022/06/04 03:09:59  
 On deck: 2022/06/04 03:22:23  
 descent rate: 35.2 m/min  
 ascent rate: 42.7 m/min  
 survey time: 18.6 hours  
 deck-to-deck time 21.5 hours  
 Min survey depth: 3109m  
 Max survey depth: 3245m  
 Mean survey depth: 3184m  
 Mean survey height: 68m  
 distance travelled: 43.82km  
 average speed: 0.65m/s  
 average speed during photo runs: NaN m/s over 0.00 km average speed during multibeam runs:  
 0.65 m/s over 43.82 km total vertical during survey: 4371m  
 Battery energy at launch: 17.0 kwhr  
 Battery energy at survey start: 16.3 kwhr  
 Battery energy at survey end: 3.9 kwhr  
 Battery energy on surface: 3.6 kwhr  
 Battery energy on deck: 3.5 kwhr  
 Sensor Information  
 Table 4: Sentry Sensor Configuration Sensor  
 Qty(3) APS 1540 Magnetometers (center, port, stbd) Edgetech 4-24kHz SBP  
 Edgetech 2205 with 120kHz/540kHz enabled Kongsberg EM2040 Multibeam Sonar  
 Seabird SBE49 CTD Seapoint OBS  
 Anderaa Optode model 4330 300kHz RDI DVL  
 Blue View P900-90 Forward Looking Sonar IXEA PHINS  
 Reson Sound Velocity Probe  
 NOAA PMEL MAPR  
 NOAA PMEL ORP Sensor  
 OFG Sensor

## **Sentry 642**

### **Summary**

Weather: Deployment: winds 10-15kt, seas 3-7ft Recovery: winds 12-15kt, seas 10-12ft

Reason for end of dive: End of mission

### **Important Positions**

Dive Origin: 40 42 -127 -33

Launch Position: sentry642 launch position: 40 42.216'N 127 31.580'W

### **Narrative**

Sentry641 is the fifth dive of TN-403

Sentry641 is a dual Jason/Sentry dive at SESCO with Jason diving on the pock marks on the map generated from a previous cruise while Sentry extends the coverage on the north and eastern sides of the existing map.

#### Dive Statistics

##### 0.9 sentry642 Summary

##### sentry642 Summary

Origin: 40.700000 -127.550000

Origin: 40 42.000'N 127 33.000'W

Launch: 2022/06/05 09:10:31

Survey start: 2022/06/05 10:39:26

Survey start: Lat:40.704189 Lon:-127.524708

Survey start: Lat:40 42.251'N Lon:127 31.483'W

Survey end: 2022/06/06 06:11:13

Survey end: Lat:40.694835 Lon:-127.505095

Survey end: Lat:40 41.690'N Lon:127 30.306'W

Ascent begins: 2022/06/06 06:11:13

On the surface: 2022/06/06 07:25:57

On deck: 2022/06/06 07:42:49

descent rate: 35.6 m/min

ascent rate: 42.9 m/min

survey time: 19.5 hours

deck-to-deck time 22.5 hours

Min survey depth: 3134m

Max survey depth: 3214m

Mean survey depth: 3179m

Mean survey height: 67m

distance travelled: 45.96km

average speed: 0.65m/s

average speed during photo runs: NaN m/s over 0.00 km average speed during multibeam runs:

0.65 m/s over 45.96 km total vertical during survey: 3307m

Battery energy at launch: 18.3 kwhr

Battery energy at survey start: 17.7 kwhr

Battery energy at survey end: 5.2 kwhr

Battery energy on surface: 4.8 kwhr

Battery energy on deck: 4.7 kwhr

#### Sensor Information

Table 5: Sentry Sensor Configuration Sensor

Qty(3) APS 1540 Magnetometers (center, port, stbd) Edgetech 4-24kHz SBP

Edgetech 2205 with 120kHz/540kHz enabled Kongsberg EM2040 Multibeam Sonar

Seabird SBE49 CTD Seapoint OBS

Anderaa Optode model 4330 300kHz RDI DVL

Blue View P900-90 Forward Looking Sonar IXEA PHINS

Reson Sound Velocity Probe

NOAA PMEL MAPR

NOAA PMEL ORP Sensor  
OFG Sensor

### **Sentry 643**

#### Summary

Weather: Deployment: winds 10-15kt, seas 3-7ft Recovery: winds 16-24kt, seas 5-7ft

Reason for end of dive: End of mission

#### Important Positions

Dive Origin: 40 42 -127 -33

Launch Position: sentry643 launch position: 40 47.187'N 127 30.799'W

#### Narrative

Sentry643 is the sixth dive of TN-403

Sentry643 is a dual Jason/Sentry dive at SESCA with Jason diving on the pock marks on the map generated from a previous cruise while Sentry extends the coverage on the north and eastern sides of the existing map.

#### Dive Statistics

0.11 sentry643 Summary

sentry643 Summary

Origin: 40.700000 -127.550000

Origin: 40 42.000'N 127 33.000'W

Launch: 2022/06/06 22:49:12

Survey start: 2022/06/07 00:20:08

Survey start: Lat:40.787848 Lon:-127.513296

Survey start: Lat:40 47.271'N Lon:127 30.798'W

Survey end: 2022/06/07 20:15:47

Survey end: Lat:40.768628 Lon:-127.504183

Survey end: Lat:40 46.118'N Lon:127 30.251'W

Ascent begins: 2022/06/07 20:15:47

On the surface: 2022/06/07 21:37:03

On deck: 2022/06/07 21:54:24

descent rate: 34.8 m/min

ascent rate: 39.3 m/min

survey time: 19.9 hours

deck-to-deck time 23.1 hours

Min survey depth: 3087m

Max survey depth: 3200m

Mean survey depth: 3164m

Mean survey height: 70m

distance travelled: 44.51km

average speed: 0.62m/s

average speed during photo runs: NaN m/s over 0.00 km average speed during multibeam runs:  
0.62 m/s over 44.51 km total vertical during survey: 4356m

Battery energy at launch: 18.0 kwhr

Battery energy at survey start: 17.4 kwhr

Battery energy at survey end: 4.1 kwhr

Battery energy on surface: 3.7 kwhr

Battery energy on deck: 3.6 kwhr

Sensor Information

Table 6: Sentry Sensor Configuration Sensor

Qty(3) APS 1540 Magnetometers (center, port, stbd) Edgetech 4-24kHz SBP

Edgetech 2205 with 120kHz/540kHz enabled Kongsberg EM2040 Multibeam Sonar

Seabird SBE49 CTD Seapoint OBS

Anderaa Optode model 4330 300kHz RDI DVL

Blue View P900-90 Forward Looking Sonar IXEA PHINS

Reson Sound Velocity Probe

NOAA PMEL MAPR

NOAA PMEL ORP Sensor

OFG Sensor

## **Sentry 644**

Summary

Weather: Deployment: winds 5-10kt, seas 3-7ft Recovery: winds 5-10kt, seas 5-7ft

Reason for end of dive: Servo Failure - Aborted Early

Important Positions

Dive Origin: 40 51.5 -127 -36

Launch Position: sentry644 launch position: 40 53.823'N 127 32.869'W

Narrative

Sentry644 is the seventh dive of TN-403

Sentry644 is a dual Jason/Sentry dive where Jason is diving at SESCO and Sentry explores and maps MESCA. Unfortunately, Sentry had servo issues when it reached the bottom and was unable to complete to drive. Acoustic commands were sent to try and fix the behavior, but did not work and the dive was aborted almost as soon as Sentry reached the bottom.

Dive Statistics

0.13 sentry644 Summary

sentry644 Summary

Origin: 40.858333 -127.600000

Origin: 40 51.500'N 127 36.000'W

Launch: 2022/06/08 15:32:39

Survey start: 2022/06/08 17:04:05

Survey start: Lat:40.895215 Lon:-127.547369

Survey start: Lat:40 53.713'N Lon:127 32.842'W

Survey end: 2022/06/08 17:22:18

Survey end: Lat:40.894881 Lon:-127.544133

Survey end: Lat:40 53.693'N Lon:127 32.648'W

Ascent begins: 2022/06/08 17:22:18

On the surface: 2022/06/08 18:35:30

On deck: 2022/06/08 18:52:25

descent rate: 35.1 m/min

ascent rate: 44.0 m/min  
 survey time: 0.3 hours  
 deck-to-deck time 3.3 hours  
 Min survey depth: 3212m  
 Max survey depth: 3227m  
 Mean survey depth: 3223m  
 Mean survey height: 69m  
 distance travelled: 0.28km  
 average speed: 0.26m/s  
 average speed during photo runs: NaN m/s over 0.00 km average speed during multibeam runs:  
 0.26 m/s over 0.28 km total vertical during survey: 54m  
 Battery energy at launch: 18.4 kwhr  
 Battery energy at survey start: 17.7 kwhr  
 Battery energy at survey end: 17.4 kwhr  
 Battery energy on surface: 17.1 kwhr  
 Battery energy on deck: 17.0 kwhr  
 Sensor Information  
 Table 7: Sentry Sensor Configuration Sensor  
 Qty(3) APS 1540 Magnetometers (center, port, stbd) Edgetech 4-24kHz SBP  
 Edgetech 2205 with 120kHz/540kHz enabled Kongsberg EM2040 Multibeam Sonar  
 Seabird SBE49 CTD Seapoint OBS  
 Anderaa Optode model 4330 300kHz RDI DVL  
 Blue View P900-90 Forward Looking Sonar IXEA PHINS  
 Reson Sound Velocity Probe  
 NOAA PMEL MAPR  
 NOAA PMEL ORP Sensor  
 OFG Sensor  
**Sentry 645**  
 Summary  
 Weather: Deployment: winds 5-10kt, seas 3-7ft Recovery: winds 5-10kt, seas 5-7ft  
 Reason for end of dive: Servo Failure - Aborted Early  
 Important Positions  
 Dive Origin: 40 51.5 -127 -36  
 Launch Position: sentry645 launch position: 40 53.823'N 127 32.869'W  
 Narrative  
 Sentry645 is the eighth dive of TN-403  
 Sentry645 is a dual Jason/Sentry dive where Jason is diving at SESCA and Sentry explores and maps MESCA. This is the same mission as Sentry644. Sentry was unable to drive at a constant speed and never made it to the end of tracklines, but was able to hold heading. The vehicle was monitored for a little longer to collect some behavior data, then aborted.  
 Dive Statistics  
 0.15 sentry645 Summary  
 sentry645 Summary  
 Origin: 40.858333 -127.600000

Origin: 40 51.500'N 127 36.000'W  
 Launch: 2022/06/09 17:40:52  
 Survey start: 2022/06/09 19:13:26  
 Survey start: Lat:40.893617 Lon:-127.545870  
 Survey start: Lat:40 53.617'N Lon:127 32.752'W  
 Survey end: 2022/06/09 19:56:26  
 Survey end: Lat:40.896476 Lon:-127.547888  
 Survey end: Lat:40 53.789'N Lon:127 32.873'W  
 Ascent begins: 2022/06/09 19:56:26  
 On the surface: 2022/06/09 21:08:17  
 On deck: 2022/06/09 21:48:26  
 descent rate: 34.6 m/min  
 ascent rate: 44.3 m/min  
 survey time: 0.7 hours  
 deck-to-deck time 4.1 hours  
 Min survey depth: 3169m  
 Max survey depth: 3231m  
 Mean survey depth: 3218m  
 Mean survey height: 74m  
 distance travelled: 0.68km  
 average speed: 0.26m/s  
 average speed during photo runs: NaN m/s over 0.00 km average speed during multibeam runs:  
 0.26 m/s over 0.68 km total vertical during survey: 155m  
 Battery energy at launch: 18.3 kwhr  
 Battery energy at survey start: 17.6 kwhr  
 Battery energy at survey end: 16.9 kwhr  
 Battery energy on surface: 16.7 kwhr  
 Battery energy on deck: 16.2 kwhr  
 Sensor Information  
 Table 8: Sentry Sensor Configuration Sensor  
 Qty(3) APS 1540 Magnetometers (center, port, stbd) Edgetech 4-24kHz SBP  
 Edgetech 2205 with 120kHz/540kHz enabled Kongsberg EM2040 Multibeam Sonar  
 Seabird SBE49 CTD Seapoint OBS  
 Anderaa Optode model 4330 300kHz RDI DVL  
 Blue View P900-90 Forward Looking Sonar IXEA PHINS  
 Reson Sound Velocity Probe  
 NOAA PMEL MAPR  
 NOAA PMEL ORP Sensor  
 OFG Sensor

## **Sentry 646**

### **Summary**

Weather: Deployment: winds 5-10kt, seas 3-7ft

Recovery: winds 5-10kt, seas 5-7ft, FOG (Very Limited Visibility)

Reason for end of dive: Servo Failure

Important Positions

Dive Origin: 40 51.5 -127 -36

Launch Position: sentry646 launch position: 40 53.985'N 127 32.157'W

Narrative

Sentry646 is the ninth dive of TN-403

Sentry646 is a dual Jason/Sentry dive where Jason is diving at Central Hill and Sentry explores and maps MESCA. This is the third attempt at mapping MESCA, but the tracklines were slightly adjusted. Sentry was unable to drive at a constant speed, but was able to hold heading, altitude, and reach the end of tracklines. The decision was then made to release the ship to do a Jason dive while Sentry continued to map the site. LBL was the primary source of navigation and the best way to monitor the vehicle remotely without SMS or USBL. The vehicle performed well and Sentry was still able to achieve 50 percent of the survey. The fog became worse throughout the day while Sentry was driving and the visibility was so poor that it took about an hour and a half to find it while it was on the surface. Luckily a pocket in the fog formed, allowing for enough time to make the approach and recover Sentry.

Dive Statistics

0.17 sentry646 Summary

sentry646 Summary

Origin: 40.858333 -127.600000

Origin: 40 51.500'N 127 36.000'W

Launch: 2022/06/10 14:20:23

Survey start: 2022/06/10 15:52:27

Survey start: Lat:40.899845 Lon:-127.535046

Survey start: Lat:40 53.991'N Lon:127 32.103'W

Survey end: 2022/06/11 11:33:26

Survey end: Lat:40.896663 Lon:-127.517294

Survey end: Lat:40 53.800'N Lon:127 31.038'W

Ascent begins: 2022/06/11 11:33:26

On the surface: 2022/06/11 12:49:07

On deck: 2022/06/11 14:33:51

descent rate: 35.1 m/min

ascent rate: 42.7 m/min

survey time: 19.7 hours

deck-to-deck time 24.2 hours

Min survey depth: 3140m

Max survey depth: 3271m

Mean survey depth: 3213m

Mean survey height: 70m

distance travelled: 31.77km

average speed: 0.44m/s

average speed during photo runs: NaN m/s over 0.00 km average speed during multibeam runs: 0.44 m/s over 31.77 km total vertical during survey: 2635m

Battery energy at launch: 18.4 kwhr

Battery energy at survey start: 17.7 kwhr

Battery energy at survey end: 4.2 kwhr

Battery energy on surface: 3.9 kwhr

Battery energy on deck: 3.4 kwhr

Sensor Information

Table 9: Sentry Sensor Configuration Sensor

Qty(3) APS 1540 Magnetometers (center, port, stbd) Edgetech 4-24kHz SBP

Edgetech 2205 with 120kHz/540kHz enabled Kongsberg EM2040 Multibeam Sonar

Seabird SBE49 CTD Seapoint OBS

Anderaa Optode model 4330 300kHz RDI DVL

Blue View P900-90 Forward Looking Sonar IXEA PHINS

Reson Sound Velocity Probe

NOAA PMEL MAPR

NOAA PMEL ORP Sensor

OFG Sensor

## **Sentry 647**

Summary

Weather: Deployment: winds 5-10kt, seas 3-7ft Recovery: winds 18-25kt, seas 6-8ft

Reason for end of dive: Battery

Important Positions

Dive Origin: 41 4 -127 -35

Launch Position: sentry647 launch position: 41 9.673'N 127 25.470'W

Narrative

Sentry647 is the tenth dive of TN-403

Sentry647 is an exploratory mission to NESCA to map two points of interest. The vehicle was unable to maintain speed, but appears to be unrelated to the servos. The vehicle was monitored for a while before releasing the ship to do a CTD. The ship then returned to check the status of Sentry. Once found good, the ship was then released to do a gravity core 30Km away while Sentry finished the first survey block of the planned mission.

Dive Statistics

0.19 sentry647 Summary

sentry647 Summary

Origin: 41.066667 -127.583333

Origin: 41 4.000'N 127 35.000'W

Launch: 2022/06/12 06:04:22

Survey start: 2022/06/12 07:33:35

Survey start: Lat:41.158862 Lon:-127.425777

Survey start: Lat:41 9.532'N Lon:127 25.547'W

Survey end: 2022/06/13 00:58:22

Survey end: Lat:41.154145 Lon:-127.445802

Survey end: Lat:41 9.249'N Lon:127 26.748'W

Ascent begins: 2022/06/13 00:58:22

On the surface: 2022/06/13 02:19:04

On deck: 2022/06/13 02:40:47

descent rate: 35.9 m/min

ascent rate: 39.4 m/min

survey time: 17.4 hours

deck-to-deck time 20.6 hours

Min survey depth: 3117m

Max survey depth: 3229m

Mean survey depth: 3163m

Mean survey height: 73m

distance travelled: 26.22km

average speed: 0.41m/s

average speed during photo runs: NaN m/s over 0.00 km average speed during multibeam runs:

0.41 m/s over 26.22 km total vertical during survey: 2328m

Battery energy at launch: 18.5 kwhr

Battery energy at survey start: 18.0 kwhr

Battery energy at survey end: 4.0 kwhr

Battery energy on surface: 3.7 kwhr

Battery energy on deck: 3.5 kwhr

Sensor Information

Table 10: Sentry Sensor Configuration Sensor

Qty(3) APS 1540 Magnetometers (center, port, stbd) Edgetech 4-24kHz SBP

Edgetech 2205 with 120kHz/540kHz enabled Kongsberg EM2040 Multibeam Sonar

Seabird SBE49 CTD Seapoint OBS

Anderaa Optode model 4330 300kHz RDI DVL

Blue View P900-90 Forward Looking Sonar IXEA PHINS

Reson Sound Velocity Probe

NOAA PMEL MAPR

NOAA PMEL ORP Sensor

OFG Sensor

Point of contact, ship and AUV based mapping: Dr. Isobel Yeo, i.yeo@noc.ac.uk

## Self Potential

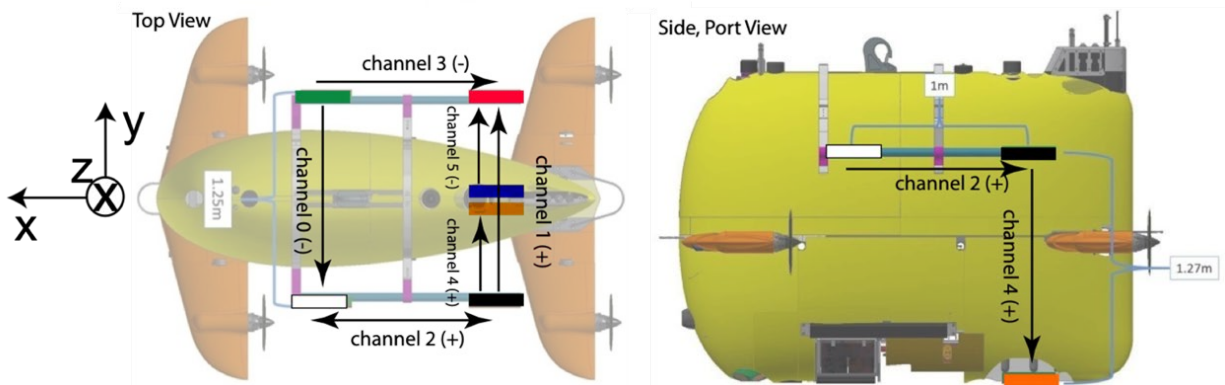


Figure 1 Schematic of the electrode configuration on the Sentry AUV, channel (ch) 0, 1 are crossline and ch 2 and 3 are inline, while ch 4 and 5 are the quasi vertical channels.



OFG was contracted to provide Self Potential (SP) measurements using the WHOI Sentry Autonomous Underwater Vehicle (AUV) on an expedition to the Escanaba Trough. Several locations with active and inactive seafloor massive sulfide deposits, submarine hydrothermal vents, and sedimented areas were surveyed with AUV-SP. Eight dives collected SP data. Some technical issues were encountered with the Sentry AUV. Stray electrical currents were identified with the servos but could not be resolved. Adjustments were made to minimize these effects. Accurate, quantitative data was acquired.

There were no incidents in the deployment or recovery of the AUV and no damage to electrodes. This is due to the careful skill of the deck crew as recoveries sometimes occurred under very difficult sea states.

SP equipment was installed during 10 dives, but survey data was only collected for 8 of the 10 dives due to technical problems with the AUV. Therefore, 2/10 dives the AUV was recovered and no survey data was collected. A summary of the dive number, location and number of line kilometers is provided in Table 1. As part of OFG's QC process the time series is reviewed along with spectra and spectrograms of each channel. In this section we present the raw time series for each survey in millivolts per meter.

The general steps for processing the data is selecting which channels will be used to represent the x, y and z components of the electric field. The measured voltage across a dipole is divided

by the dipole length (separation between the two pairs of electrodes) to get an electric field measurement in  $\mu\text{V}/\text{cm}$ . The electric field data is then merged with the position and attitude of the AUV (north, east, depth, altitude, heading, pitch, roll). The compensated magnetic field in the body frame of reference of the AUV and the velocity from the DVL (also in the body frame of reference of the AUV) is used to compute a correction for the motion induced electromotive force (iemf). The computed iemf is removed from the electric field data (again in the AUV body frame of reference) for each component. A time offset of -1 second is applied to the magnetometer data to synchronize it's position relative to the electric field data. A unique scaling is applied to each component to account for the fact the magnetic field is measured at a point, while the electric field is measured across a dipole of 105 to 167 cm depending on the components dipole length. The dives that used the first set of electrodes (sentry638 to 641) only had electrode drift on some channels and so channels with no electrode drift were selected for the x, y, z electric field components. The dives with the second set of electrodes (sentry642 to 647) all drifted and so picking one set over another based on drift did not necessarily solve the issue. Therefore, a polynomial was fit to the electrode drift curve and this was removed from the data, after the iemf was removed. All electric field data was then band pass filtered (with a high corner frequency of 0.006153 Hz and a low corner frequency of  $1.6\text{e-}4$  Hz). The high corner frequency was selected based on the nominal speed of the AUV (0.8m/s) and the nominal altitude of the survey (65m), while the lower corner frequency was selected based on the nominal line length (5 km) and the speed of the AUV (0.8m/s). This is to allow for any regional SP fields to be detected across lines. All survey lines were 150 m apart for all AUV dives, this is a little larger than the recommended  $65 \times 2 = 130$  m line spacing and was a compromise to also gather a larger area of multibeam data. In some instances the filtering did not remove bands of high amplitude electric field data that are noise. Therefore, these time segments were replaced with the electric field data neighbouring the noise occurrence. This is referred to in the table as "reset spikes".

Once these processing steps have been carried out the data is stacked using a 1 second window (data is sampled at 100 Hz) and is then rotated into an inertial and geodetic frame of reference and output to two ascii files: an inertial (NED) with other data produces, and geodetic (ENU).

Table 1

| Dive      | Location                                | Line kilometers (approximate) |
|-----------|-----------------------------------------|-------------------------------|
| sentry638 | Edifice Rex                             | 48                            |
| sentry639 | Central Hill                            | 48                            |
| sentry640 | Edifice Rex East                        | 45                            |
| sentry641 | Edifice Rex North                       | 36                            |
| sentry642 | SESCA-S3                                | 43                            |
| sentry643 | SESCA, North Hill, East Hill, 3170 Hill | 42                            |
| sentry644 | No survey data collected                |                               |
| sentry645 | No survey data collected                |                               |
| sentry646 | MESCA                                   | 31                            |
| sentry647 | north-north                             | 25                            |