ROPOS CANADIAN SCIENTIFIC SUBMERSIBLE FACILITY

Winter 2020 Report

Introduction

Like many organizations in 2020, the COVID-19 pandemic has adversely affected the Canadian Scientific Submersible Facility (CSSF). All 2020 missions were cancelled outright or, for some, delayed until 2021/2022. Nine months on from the outbreak and the CSSF office is still up and running with adjustments as per provincial guidelines to ensure staff are kept safe.

The team is presently focused on maintaining and upgrading our existing systems, preparing for a mission based out of New Zealand in March, and returning ROPOS to its science configuration following the new coring drill's testing and removal of all its components. In addition to the drill system, we have taken on the design and construction of some new innovative ocean science research tools which are described below.

With 2021 just around the corner, we look forward to re-engaging with the research community, with the hope that 2021 will be an exceptionally exciting and productive year.

2020 – Quiet, but not Crickets

A positive side-effect of the COVID-19 "lockdown" was the time it afforded colleagues to catch their breath, to spend more time with family, and to contemplate new approaches to achieve their scientific objectives.

Thanks to these perpetually forward-looking established long-term scientists and their Institutes, we were awarded a couple of projects that have kept us busy for the second half of this year. We greatly appreciate our clients and the trust bestowed through these projects.

Project #1 – Deep-sea multi-core drilling system

CSSF completed the integration of a ROV mounted rock coring drill for our client the Federal Institute for Geosciences and Natural Resources (BGR). (https://www.bgr.bund.de/EN/Home/homepage_node_en.html). After design and assembly, the system was tank trialled and then shipped to Germany in mid-November 2020. The coring drill was a mechanically intensive project, that required substantial alterations to ROPOS's bumper bar and center camera brackets. It also spurred the need for a new deep foam pack (4,000 m) and the creation of a large bottom mounted frame for mounting the drill.

We also incorporated a new smart valve pack and counterweight at the back of the vehicle to "balance" the system in-air and in-water.

A new foam pack was required due to the increase of the overall weight of ROPOS in air with the drill mounted. The increased in-air weight of the integrated system would affect our ability to conduct drill operations off many of the vessels of opportunity we work off. The new 4,000 m rated foam-pack is of a lower density, which means the pack can provide the required floatation for drill operations but weighs less in air.

Some highlights of the new multi-core drill system include:

- a system capable of producing vertical core samples in depths of up to 4,000 m
- standardized core dimensions of 75 mm diameter and length up to 1,000 mm
- a two-speed motor that provides operator flexibility in more difficult drilling conditions
- a multi-core magazine that supports additional core tubes in line with the drill, enabling the recovery of up to 4 cores per dive
- a selection of different core barrel accessories for drilling different substrates, including Shelby push cores, which can be pressed into the seabed by the drill head (no rotation) for softer sediments
- a lifting apparatus for moving the drill onboard a ship, with a built-in capability to raise it into place for mounting to the front of ROPOS

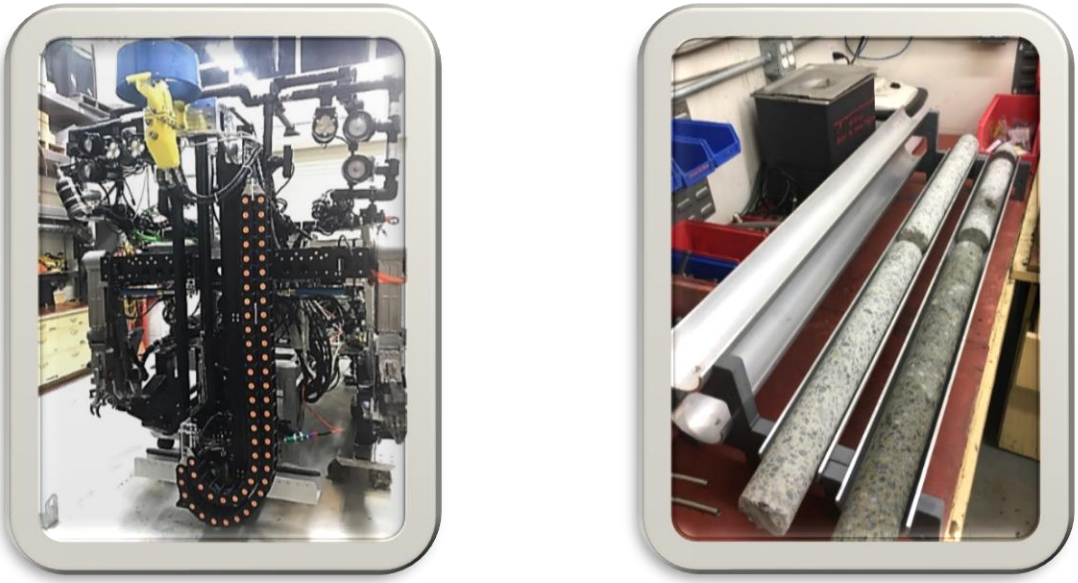

Figure 1: (Left) The multi-core drill system mounted to the front of ROPOS (minus the foam pack), and (Right) the selection of cores drilled in the test tank November 3-5, 2020 .

Figure 2: The temporary test tank, and the drill system mounted to the front of ROPOS.

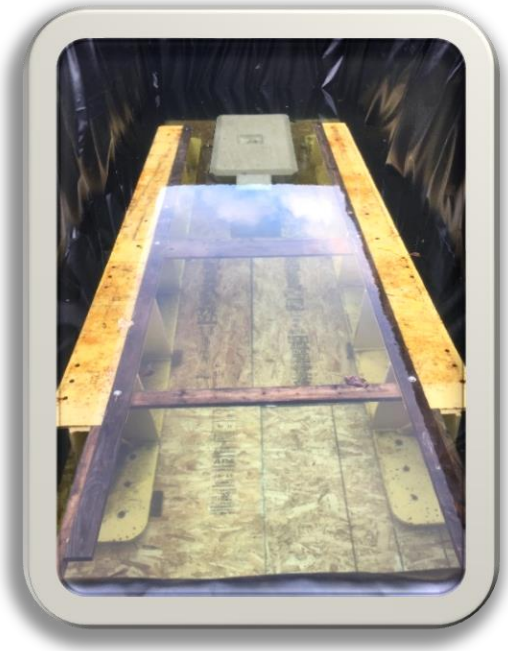

Figure 3: A view inside the test tank. The two concrete blocks (centre, top) were used for the drill testing. . The smaller block had several seafloor rocks interspersed in the concrete.

Project #2 – Autonomous Temperature Acquisition Probe (ATAP)

The ATAP is designed for insertion into soft seafloor sediments. The probe itself hosts six high temperature, high-resolution thermistors for measuring temperature gradients over the length of the 60cm probe. The primary purpose of this new tool is to detect the presence of warmer water up to 60 cm below the seabed, thereby providing a means to establish the extent of hydrothermal venting beneath the seafloor.

An additional feature of the ATAP is an optical (blue light) wireless communications link so the ROV can insert the probe into the seafloor and then leave it there for some period during the dive. The ATAP records temperature data continuously during this time, which can then be uploaded wirelessly the next time the ROV returns to the sensor. With the data in hand, the principle investigator can then interpret the results and determine if the probe needs to be re-located to further investigate the margins.

Some highlights of the ATAP include:

- a one-atmosphere Titanium housing coupled to a rigid 60 cm long multi-node (6) temperature probe; all 5,000 m rated
- 4-wire RTD thermistors suitable for measuring water temperature up to 200 °C
- Inclusion of a logger to record time-stamped temperature data, with time synchronization to the ROV logging system
- Real-time data transmission via an optical link between the ATAP and the ROV
- GUI application for the control and monitoring of the ATAP if the system includes the optical link, which is integrated into the ROV logging system

Project #3 - Smart Gas Tights (SmGT's)

There has been significant interest in having the CSSF team develop a “smart” module for the traditional Gas Tight Sampler.

Highlights include:

- 4,000 m rated system
- two-part optical wireless system for communications between the ROV and the sampler
- 400 °C temperature sensor at the inlet tip of the sampler
- one-atmosphere Titanium housing for all the interface components
- software Graphic User Interface (GUI) that the operator can use to monitor and log the temperature at the Sampler inlet and then use it to capture a sample.

Project #4 - Operations Container Modifications

The operations container has undergone a make-over. We have made the following changes:

1. To reduce the disruption of the comings and goings of personnel during a dive, we have installed a second door on the container, located close to “the back of the room”.
2. To make space for additional personnel in the container, we have consolidated all the servers and rack mounted equipment into one rack.
3. To reduce the number of elbow clashes during a dive we have extended the length of the table by a few feet, which should give the 3 people seated at the table plenty of room for their personnel effects.
4. To reduce the number of neck injuries (due to craning) we have mounted a larger HD monitor above the science/navigation table so that science personnel situated in the middle of container can easily see the video footage from the ZEUS Plus HD camera.

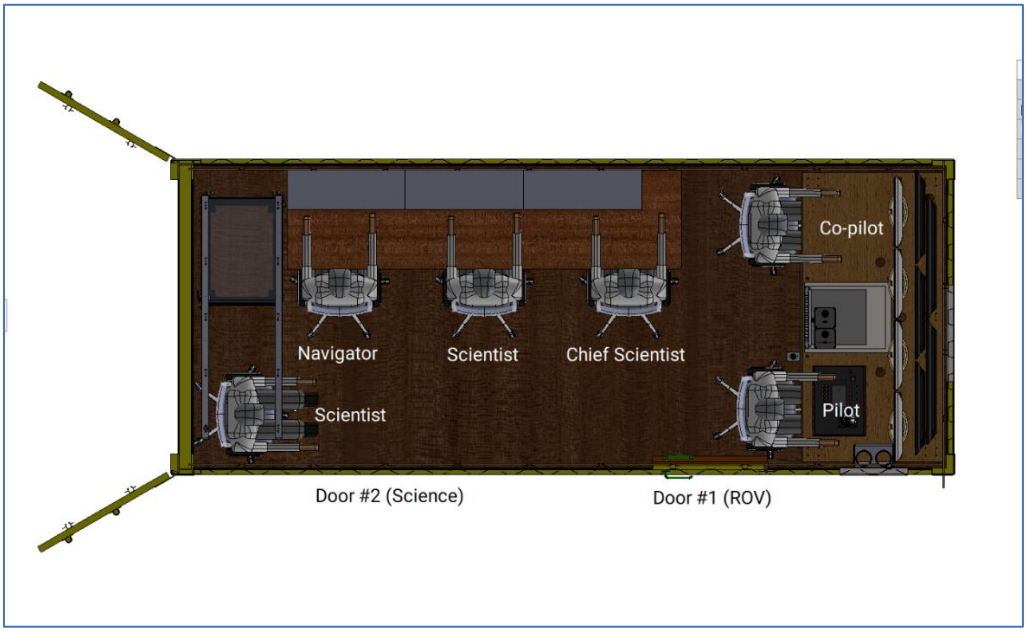

Figure 4: A rendering of the operations container in its new configuration

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2021 Offshore

National Science Foundation / Instrument (Data!) Recoveries on Tangaroa

With funding from NSF, the ROPOS system will be assisting Dr. Laura Wallace from the University of Texas and Dr. Evan Solomon from the University of Washington to recover numerous instruments deployed in the waters East of the North Island, New Zealand.

The system will be departing the Marine Technology Centre in early January, arriving in Wellington, New Zealand during the first week of February. The ROPOS team will be individually quarantined for two weeks in New Zealand before being allowed to mobilize the system onto the New Zealand National Institute of Water and National Institute of Water and Atmospheric (NIWA) RV Tangaroa.

We have had excellent support from Greg Foothead, GM Vessel Operations, and his team at NIWA. Pre-mobilization work includes the design and fabrication of winch foundation mounts and adaptors for their side-mounted A-frame.

ROV Operations will be based in our Operations container (20 ft). The primary objectives are recovering environmental monitoring free-standing instrumentation deployed previously, uploading pore pressure data from two Cork observatories, sediment sampling (push cores) and video surveys of active seep and non-seep sites.

We appreciate all the hard work and support from the funding agency, the mission leads and NIWA staff. We are looking forward to working with this new user group and are very excited to get back out on the water!

Other Potential Operations

After the RV Tangaroa mission, we have several other opportunities that we are currently pursuing.

There are potentially some domestic opportunities (within Canada) to work in both the Pacific and Atlantic Oceans.

We also have a few International potential international opportunities with longstanding clients in the Indian Ocean.

With the ever-present unpredictability of COVID, and its impact on funding levels in most countries, it is proving more difficult for prospective clients to commit to any project six months to a year out.

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Did You Know…

- In "Shallow Mode", ROPOS can operate with as few as 3 crew for 12-hour operations, or with up to 8 for sustained 24/7 diving. We can work from vessels with or without navigation services down to a 1,000 metres depth. You may be surprised by just how small a vessel we can squeeze onto. And yes, we can operate without bringing containers onboard. If your science questions are leading you to shallow water, and availability is limiting you to smaller ships, please do not hesitate to contact us to discuss the options.

- A client has asked CSSF to develop a plan to return to 5,000 m operations, but with a single body. If this interests you, please get in touch.

Contacts

For more information on the contents of this newsletter, or on any other related matter please feel free to contact us.

Keith Tamburri
Assistant Manager
E. tamburri@ropos.com
T. 250-655-5096 Ext 102

Paul Macoun
Manager, Science & user Support
E. macoun@ropos.com
T. 250-655-5096 Ext 103

Laurie Tiesmaki
Administration
E. operations@ropos.com
T. 250-655-5096 Ext 100