Cruise Report:
Geoforce DTS
C.C.G.S. Vector
PGC2021-004

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GEOFORCE
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1.0 - Introduction

This report is a review of the Geoforce Deep Tow System (DTS) operations on board the Canadian Coast Guard Ship Vector during the Geological Survey of Canada-Pacific Region (GSCP) mission PGC2021-004. The scientific objectives of this mission were to conduct seabed acoustic surveys to: determine location, length, and activity of potential fault systems; map landslide features; and to investigate some structures in Burrard Inlet that would assist in completing a geomorphology map and quantify the venting source seen near pockmarks in English Bay. In support of the scientific objectives the Geoforce DTS was used to collect high resolution sub bottom seismic data. The mission took place from August 11 to August 18, 2021 under the direction of Chief Scientist Karen Douglas, and Co-Chief Scientist Vaughn Barrie.

Geoforce Group Limited provided senior technician Tom Fralic under the standing offer contract #7000002753 to supervise the installation, operation and maintenance of the DTS system during the field program.

This survey was completed entirely with the newly acquired Geoforce DTS. Geoforce was granted a Built in Canada Innovation Program (BCIP) contract (UT849-208463/001/SC) in 2019 to cover the costs of development of an upgraded DTS, previously known as the Huntec system. The most notable improvements from the legacy system are: hydrophone digitizer housed inside the DTS; long range ethernet network communications from topside to DTS; the ability to swap between Boomer or Sparker “on-the-fly” by use of topside software; a newly designed tow-cable Junction Box which utilizes subsea connectors, and a software based waterfall data visualizer/recorder.

2.0 – Equipment

2.1 – Digital Deep Tow System

The DTS system is a deep towed, high resolution, sub-bottom profiling system complete with two acoustic sources (Boomer/Sparker), high-voltage Energy Storage Unit (ESU), Digital Acquisition Unit (DAU), and two receiving hydrophones housed in an underwater tow fish. This system is complimented with a custom data acquisition software known as Geoforce Cerebella and a purpose-built Topside Control Unit (TCU) for both receiving DTS telemetry and providing low voltage and high voltage to the DTS.

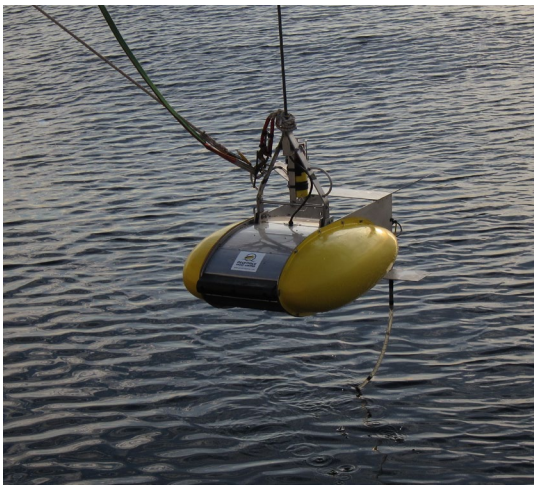

Figure 1: Geoforce DTS

DTS SN3004 system was primarily used on this mission. The maximum transmit power output of this system is 1000 Joules with an ED10F/C Boomer and a twenty-tip mini Sparker source. For this mission, the internal single element GF16 hydrophone was recorded as “Internal Channel”. The externally towed Geoforce GF15/10P streamer hydrophone was recorded as “External Channel” (overall streamer length 15 feet, single channel with a combined 10-foot active section, total of 10 AQ-16 elements with an effective spacing of 12 inches).

The ED10/FC Boomer source is depth compensated and outputs a highly repeatable broadband pulse, capable of resolving 10 centimeters. Peak output intensity at 480 Joules is 212 dB/1µPa @ 1m, SPL(RMS) at 189.2 dB/µPa @ 1 m, with a pulse duration of 160µs, the output frequency is centered at roughly 3.5 kHz with a frequency band of 500 Hz - 10kHz.

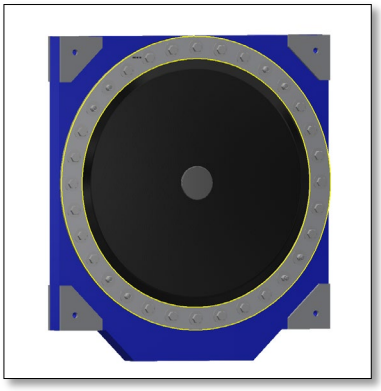

Figure 2 - ED10/FC Boomer

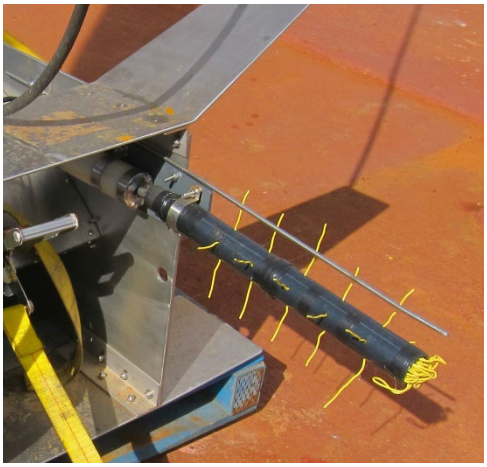

Figure 3 - 20 tip mini-sparker

The Sparker source consists of twenty exposed #18 AWG solid core tips. The peak output intensity at 125m depth, 480 Joules is 210 dB/1µPa @ 1m, SPL(RMS) at 177.9 dB/µPa @ 1 m. Acoustic output is centered at approximately 2000 Hz, with a bandwidth of 600 Hz – 6 kHz. Unlike the Boomer, the Sparker output characteristics are directly affected by atmospheric water pressure, the acoustical values are depth dependent, and because the system was towed at a variety of depths, these are not static values.

Figure 4 - Roller Block

Figure 5 - DTS on deck

The deck equipment consists of an oceanographic winch, which includes a Focal multi-way slip ring and a 400-meter, fourteen-conductor, armored tow cable. The tow cable is handled by a 36-inch diameter roller cluster rigged on the center position of the aft A frame.

Figure 6 - DTS Topside equipment in operation

The lab instrumentation consists of a Windows 10 PC running Geoforce Cerebella logging software, a Geoforce TCU, a Huntec Mk III PCU, and a Huntec low pass filter unit.

2.2 - Recording Systems

A Geoforce Cerebella acquisition system was used as the digital recording device. This software is designed specifically to communicate with the Geoforce DTS and was a large portion of the BCIP contract. This software incorporates a waterfall view which can be viewed on a separate screen with a primary purpose of providing data quality assurance to the operator, but in certain scenarios can also be used to interpret on the fly. The software also includes displays showing the DTS depth, attitude (pitch and roll), ambient water temperature, leak sensor indicators, trigger options, and TCU status.

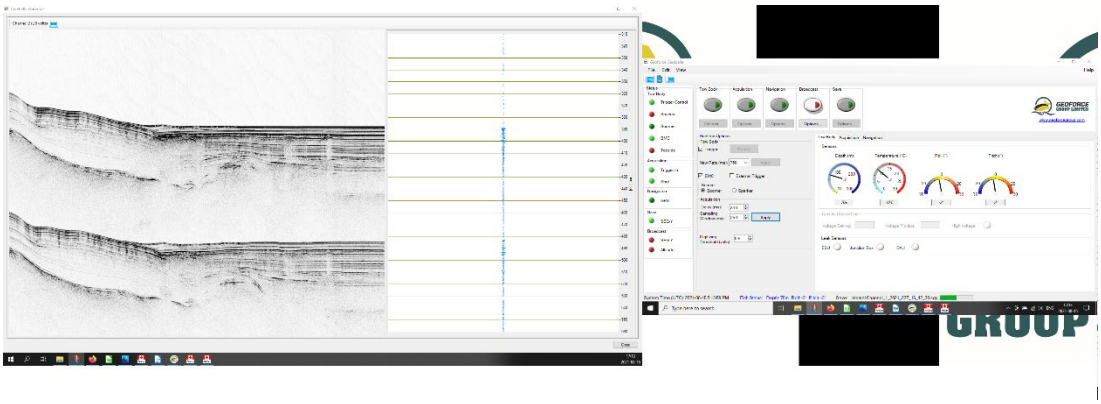

Figure 7 - Geoforce Cerebella software in operation

2.2 - Spares

A spares kit was assembled which included some compatible parts from legacy GSCA Huntec systems AGC#2 and AGC#3. An official spares kit for the Geoforce DTS in its current form has not been acquired by GSCA. No components were used.

3.0 – Operations

3.1 - Recording Parameters

Cerebella Digital Recorder
Software: Geoforce Cerebella v1.3.8.0
Format: SEG-Y
Storage Medium: Internal Hard Disk Drive
Sample Rate: 25.6 kHz
Record Length: 350 ms & 250 ms
Trigger I/P: DTS Internally Generated Trigger (BMC on)
Analog I/P 1: DTS Internal Raw
Analog I/P 2: DTS External Raw
File Break: 1 Hour
Navigation: Ship’s position embedded on SEG-Y files

3.2 – Pre-cruise Preparation

T. Fralic arrived on site at Institute of Ocean Science (IOS) in Sidney, BC to prepare the DTS and kit on August 7,2021. The first known task was to install the new style Junction Box on the PGC winch, which is compatible with the same tow cable and termination as the legacy Huntec systems. After an assessment of the existing mechanical termination, it was decided to perform a mechanical re-termination for two reasons: the age and use that had been on the previous termination, and because there was not enough electrical cable exiting the mechanical termination to perform a suitable electrical termination to the new Junction Box. The winch also required rewiring on the stationary input connector to accommodate for the changes in wiring from analog Huntec equipment.

After the mechanical and electrical terminations were completed, a “pull-test” was completed by Greg Middleton at the DFO Winch Shop. The 2670lb test weight was attached to the end of a steel wire, through an A-frame, and attached to the Mechanical Termination of the DTS Tow Cable, the purpose of this test was to prove the winch, cable, and termination could handle the load, and not so much to pick up the load.

A series of low voltage electrical tests were then completed in the IOS hanger to test the communications and hydrophone noise levels. During testing it was noticed that the DSL communication “LINK” was intermittently dropping, but communications were continuing. This meant one of the two DSL lines was dropping, while the other redundant line took over, the cause of this proved to be dirty contacts on the new stationary winch connector, which was remedied.

3.3 - Equipment Performance

3.3.1 – DTS

The DTS was used in a variety of power levels, depths, and timing and did not have any faults to report, there were no unplanned recoveries due to DTS performance.
On the final day of survey T. Fralic increased the modem speed from 6 mbps to 11 mbps, this worked for the whole day of surveying. This increase in speed is beneficial in multiple ways: because the modem uses a “bonded-pair” to transmit ethernet over DSL, the 5.5 mbps per line now offers a fully redundant line if one pair were to fail during transmit, and will cause no lagging; this will also allow for a 3rd optional channel to be used if desired; and this could also mean the analog data could be sampled at the maximum sample rate of the Analog Digital Converter (ADC) at 51.2 kHz, rather than the current sample rate of 25.6 kHz.
Sampling at 51.2 kHz was briefly tested and no lagging/buffering was observed.

3.3.2 – Winch and Power Pack

- During the on-shore pull test, the winch payed out with a choppy/jerky movement but behaved better on pay-in/pay-out with a test load attached.
- When the winch was on board and in operation the winch was challenging to find an ideal pay-out speed, too fast and the receiving streamer loses tension and data is affected, too slow and the winch would uncomfortably shake.
- On DTS recovery, the winch pulls the DTS in until it surfaces above the water, then stalls, then recovery can be completed. The best guess to this is the rapid change in load, from pulling a semi-heavy unit through water, to pulling a very heavy item through air. At the moment of the DTS surfacing it is also filled with water, which adds to the in-air weight.
- During operation, the 440V hydraulic power pack would often cut out, losing power, and requiring a reset on the thermal cutout switch. This became more and more frequent to the point that it was questionable whether to launch again and risk losing power while the DTS is deployed. At this time the Chief Engineer was asked to help, when he began troubleshooting it was clear there was arcing on the thermal cutout switch, due to dirty contacts. The arcing eventually built up enough heat to trip the thermal cutout. The Chief Engineer took the whole thermal cutout mechanism apart and rebuilt on deck, cleaning dirty contacts. Once this was completed the power pack did not fail unexpectedly.

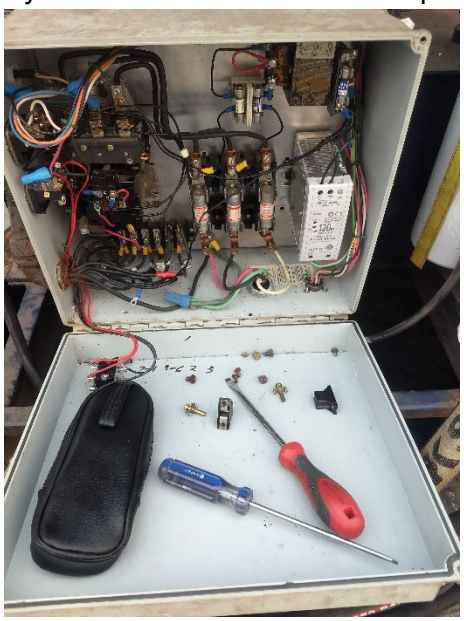

Figure 8 - Power Pack Thermal Cutout Removed

Figure 9 - Thermal Cutout result of arcing

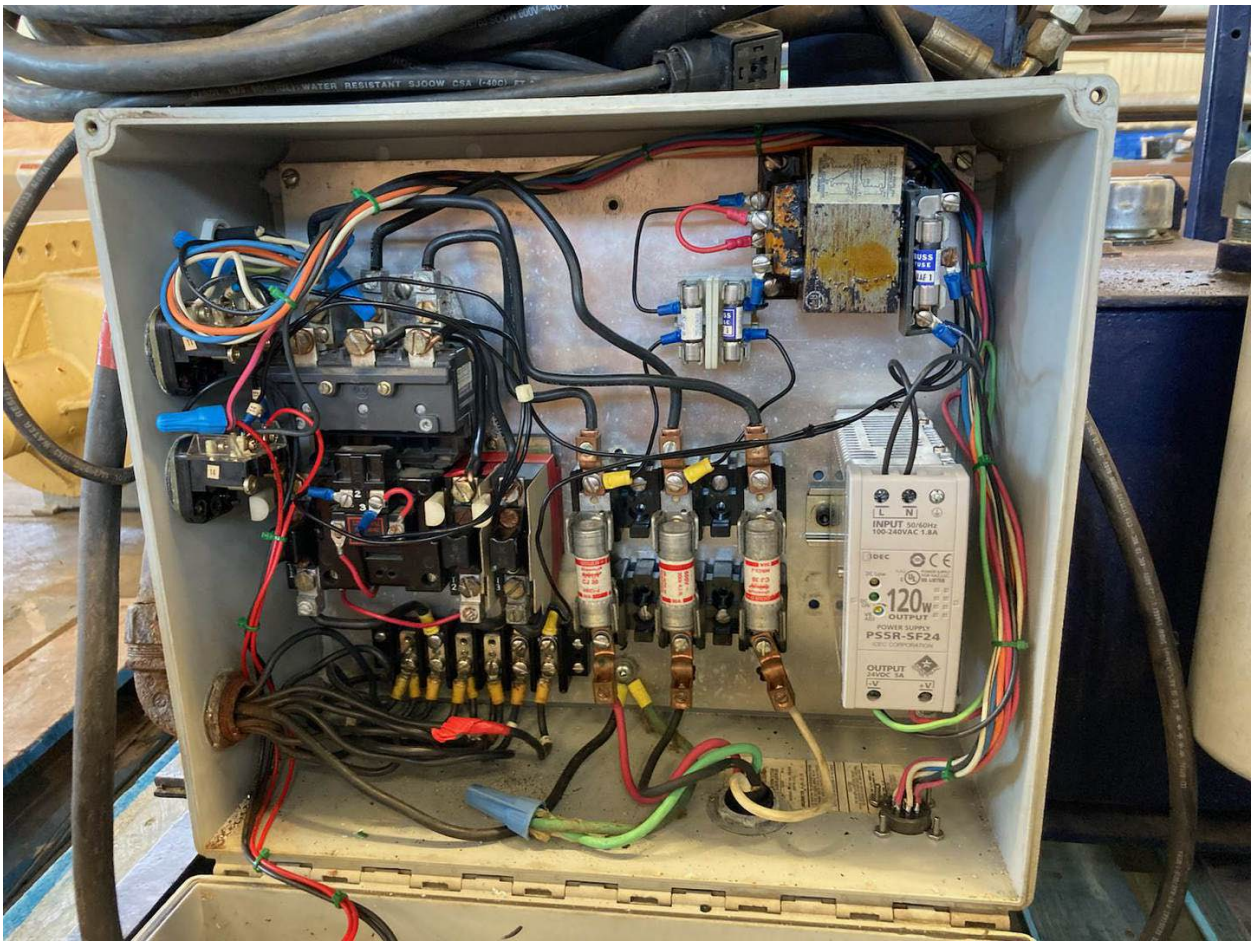

Figure 8 – Powerpack electrical after rebuild

- During operation in the Sansum Narrows, the winch could not pay-in the DTS, due to the high currents. This caused the surface ghost to temporarily enter the band of data.

3.3.3 – Roller Block

- The Roller block suffered damage on one of the vertical rollers due to cable bouncing during cable payout

Figure 9 - Roller Block in operation

Figure 10 - Roller Block after survey

3.4 - Consumables

No consumables were used during this trip.