VTRCC Cruise Data: Vitoria Trindade Ridge and Columbia Channel Cruise
Survey Vessel: NHo Cruzeiro do Sul;
Acquisition Date: October 14 to November 6, 2021;
Vessel Velocity: 4 to 7 knots;

Contact: gabrieltagliaro@usp.br
University of São Paulo - CORE Lab

Authors:
Gabriel Tagliaro, Mateus A. C. Gama, Adolfo N. Britzke, Vinicius H. A. Louro, Pedro Bauli, Gabriela C. Patines, Gabrielle D. Bonifatto, Ana C. B. Vieira, Beatriz B. S. Silva, Geandré C. Boni, Luan K. P. Silva, Paula P. Sergipe, Raylla S. Silva, Sarah A. Dos Santos, Tainá N. Caram, Tayná L. F. Pereira, Luigi Jovane

---

High-Resolution Multichannel Seismic

Multichannel seismic data was acquired using a sparker seismic source with 800 tips model Geo-Source 800, a up to 7 kJ energy power supply (GeoSpark 2000X) and a 48-channel streamer, all from the Geo Marine Survey Systems. Seismic acquisition and SEG-Y conversion was performed with the software GeoRecorder, also from Geo Marine Survey Systems. The Geo-Source 800 uses a negative discharge for seismic pulse generation which results in a more stable seismic signature with a frequency range between 200 – 3000 Hz, centered at ~1 kHz. The streamer is composed by three hydrophones per channel, with a total active length of 150 m and 2 x 25 m cable stretches, to a total of 200 m of streamer deployment. Channel distance in the streamer is 3.125 m and channel sampling occurred at 10 kHz. Geographic geometry was supplied by a DGPS antenna placed atop the seismic source configured with the WGS-84 ellipsoid and UTM projection zone 23S. Geometry distance averaged 5 m between source and streamer (dx) and ~20 m between source and first channel (dy; Table 1). The source was placed at 1.5 m water depth while the streamer at 0.5 m water depth. Energy levels and trigger interval for pulse generation varied across the survey depending on the bathymetric profile (Table 1). Vessel velocity during seismic acquisition averaged 4 knots (Table 1).

Seismic processing was performed with the software RadExPro v2022.1. Basic brutestack seismic processing was made for all seismic lines, following the steps: quality control (data

filtering), preprocessing (noise filtering), geometry evaluation, normal moveout correction and stacking. For Lines L01 and L17 was performed an improve seismic processing, including the following additional processing steps: static correction, deconvolution, multiple suppression and migration. Bandpass filtering was performed between 200 – 1500 Hz. For stacking, common mid points (CMD) gathers were established according to Table 1.

Subbottom Profiler

High resolution subbottom profiler data were acquired employing an SBP-120 from Kongsberg installed in the hull of the ship. Survey geometry came from a SeaPath 330 positioning system with two GNSS antennas without differential positioning. Acquisition occurred in the Kongsberg SIS software with the ellipsoid WGS-84 and a UTM projection and zone 23S. The equipment was operated with one main channel, in a frequency of 2.5-6.5 kHz, with chirp up linear pulse, which results in a maximum vertical resolution ~0.3 ms. The data was logged in Topas raw format and converted to SEG-Y format. The power of the SBP pulse and trigger interval varied along the survey depending on ocean conditions and seafloor depth. Seismic data was then converted from time to depth assuming a sound speed of 1500 m/s. Survey velocities ranged from 4-7 knots.

Multibeam Bathymetry and Sound Velocity Profiling

Multibeam bathymetry was performed with the deep echosounder Kongsberg EM-122 with 12 kHz of operating frequency. The system was coupled with the SeaPath 330 positioning system with two GNSS antennas. Acquisition occurred in the Kongsberg SIS software with the ellipsoid WGS-84 and UTM projection. Swath width was to set to automatic up to 55° with a ping frequency of 40 Hz. Due to the deep characteristics of the EM-122 equipment, multibeam bathymetry was not performed in water depths shallow than 200 m.

To estimate sound velocity profiles for bathymetric processing, temperature profiles were first obtained for the water column throughout the survey every 50 nautical miles, to a total of 31

profiles. For that we used Expendable Bathythermograph (XBT) Lockheed Martin model T5 to the deeper portion of the survey (down to 1860 m water depth) and the model T7 over the shallower regions (down to 760 m; Fig. 6). A salinity profile is then calculated by linearly interpolating the measured temperature profile to the nearest WOA/RTOFS salinity profile. Sound speed values are then calculated from the salinity updated profile using the UNESCO equation. Sound velocities were then incorporated during the multibeam bathymetry acquisition directly into the SIS software.

Multibeam bathymetry preprocessing was performed on the software CARIS HIPS from Teledyne during the expedition. A Patch Test calibration of the echosounder was done atop the Columbia Seamount on October 26th on where roll, pitch, yaw, heading and the time delay were calibrated. The corrected values from the Patch Test were then inserted on the processing procedure. Survey velocity range between 4-7 knots. Finally, spike removal and surface equalization processing were performed with the software EIVA NaviModel Producer after the expedition.

Marine Magnetometry

The SeaSPY magnetometer from Marine Magnetics was used to acquire the magnetic field data. The sensor (torpedo) was towed 250 meters from the vessel and 300 meters from the vessel's GPS. The SeaSPY magnetometer is a Proton Precession (Overhauser) sensor of absolute accuracy, and the resolution of the system is 0.1 nT and 0.001 nT, respectively. The data was acquired in a 10 Hz frequency, from the continental slope to the furthest point from the continent, nearby the Trindade Island. The frequency resulted in measurements for every meter traveled, in average, considering the variable speed between four and seven nautical knots, with the sensor about 30 to 35 meters below the sea level. The survey also occurred in parallel to the seismic survey, without any perceptible interference.

Seafloor Sediment Sampling

During the expedition nine seafloor sediment samples were collected within the Vitória-Trindade Ridge with a Van-Veen grab sampler (3600 cm^2) on the top of the volcanic seamounts (Fig. 2; Table 2). Sample V7 collected only rhodoliths, without additional sediments. Grain sizes larger than 40 mm diameter (pebble size) were separated for rhodolith' measurements. Sediment samples were washed to dissolve the salt concentration for 48 hours, then oven-dried at 45 °C for 72 hours. For rhodolith samples, we dried samples at 35 °C for 48 hours. The morphometry of the rhodoliths was classified in spheirodal, discoidal and ellipsoidal based on the measurement of the long (L), intermediate (I) and short (S) axis with a Vernier Caliper.

Subsequently, samples had their weight measured and carried out the sieving in phi fractions (-1.5, -1.0, -0.5, 0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0 and > 4.0) for 10 minutes. Samples sieved were descripted in phi fractions, they were grouped in the following orders: granules (-2 to -1), very coarse sand (-1 to 0), coarse sand (0 to 1), medium sand (1 to 2), fine sand (2 to 3), very fine sand (3 to 4) and silt (> 4). The mean grain size and sorting were analyzed on Gradistat v9.1 software[17]. Sediment samples were also placed on a Petri dish for microscope analysis and photography using the Fiji software[18]. Grains were then classified (Carbonate debris, foraminifers, bryozoans, sponge's spicules, bivalves, gastropods, crustaceans, echinoderms, and annelida) and its abundance was quantified based on 300 random point counts per sample.

Table 1. Main parameters used during the acquisition and processing of multichannel seismic data.

Seismic Line	Vessel Velocity (knots)	Record Length (ms)	Trigger Length (ms)	Source Energy (J)	CMP gather (m)	Distance between source and streamer – dx (m)	Distance between source and streamer – dy (m)
L01	4.8	5000	5000	7000	6.25	5	13
L02_1	4.5	5000	5000	7000	6.25	5	15
L02_2	4.5	5000	5000	7000	6.25	5	15
L03	4.3	5000	5000	7000	6.25	5	25
L07	4.2	7000	7000	7000	6.25	5	25
L08_1	4.3	6000	6000	6300	6.25	5	25
L08_2	4.3	4000	4500	6300	6.25	5	25
L08_3	4.3	4000	4500	6300	6.25	5	25
L08_4	4.3	4000	4500	6300	6.25	5	25
L08_5	4.3	4000	4500	6300	6.25	5	25
L09	4.3	4000	4500	6300	1.562	5	30
L10	3.5	6000	6500	6300	1.562	5	30
L11_1	3.5	4000	4500	6300	6.25	5	13
L11_2	3.5	4000	4500	6300	6.25	0	35
L12	4	4000	4500	6300	6.25	0	21
L13	4	4000	4500	6300	6.25	5	25
L14	4.2	4000	4500	6300	6.25	5	25
L15	4.2	4000	4500	4950	6.25	5	25
L16_1	4.2	4000	4500	7000	6.25	5	30
L16_2	4.2	4000	4500	7000	6.25	5	30
L17	4	4000	4500	7000	6.25	5	30

Table 2. Location of Van Veen grabber seafloor sediment samples.

Sediment Sample	Seamount	Seafloor Depth (m)	Latitude (°)	Longitude (°)
V1	Columbia Seamount	69	-20.7311	-31.8347
V2	Columbia Seamount	220	-20.7018	-31.8010
V3	Dogaressa Bank	80	-20.8992	-33.5974
V4	Dogaressa Bank	114	-20.9178	-33.9887
V5	Davis Bank	84	-20.8098	-34.7022
V6	Davis Bank	94	-20.5321	-35.8778
V7	Jaseur Seamount	57.8	-20.5934	-35.8778
V8	Jaseur Seamount	110.4	-20.5934	-35.8997
V9	Jaseur Seamount	99.1	-20.5927	-35.9153