Water column analytical data from the Chile Triple Junction collected on two cruises aboard the R/V Melville during February-March 2010 and April 2012

Website: https://www.bco-dmo.org/dataset/871203
Data Type: Cruise Results
Version: 1
Version Date: 2022-03-28

Project
» Hydrothermal Exploration of the Chile Triple Junction (Chile Triple Junction)

Contributors	Affiliation	Role
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Abstract
The hydrothermal plume samples reported here were acquired aboard R/V Melville during two short cruises of opportunity conducted in 2010 (MV1003) and 2012 (MV1205). Surveys along the axis of the ridge-crest were conducted using the ship's Seabird 911+ CTD rosette. A combination of tow-yo, vertical casts, and "pogo" stations were employed. An ultra-short baseline (USBL) navigation beacon was attached to the CTD-rosette for all deployments to ensure that we could navigate precisely where all samples and ancillary data were collected, as well as their sample depths.

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Coverage

Spatial Extent: **N**:-45.6917 **E**:-75.7852 **S**:-46.2832 **W**:-76.8658
Temporal Extent: 2010-02-25 - 2012-04-26

Methods & Sampling

The hydrothermal plume samples reported here were acquired aboard R/V Melville during two short cruises of opportunity conducted in 2010 (MV 1003) and 2012 (MV 1205). Surveys along the axis of the ridge-crest were conducted using the ship's Seabird 911+ CTD rosette. A combination of tow-yo, vertical casts, and "pogo" stations were employed. An ultra-short baseline (USBL) navigation beacon was attached to the CTD-rosette for all deployments to ensure that we could navigate precisely where all samples and ancillary data were collected, as well as their sample depths.

Samples collected for Helium analyses were processed at the NOAA/PMEL Helium Isotope Laboratory in Newport, OR. The gas and liquid phases of the cold-welded samples were separated using a high-vacuum extraction line. The content of each sealed Cu tube was dropped into an evacuated flask and continuously stirred with a magnetic stirrer during the extraction process. A combined charcoal-LN_2 trap was then used to pump the gas phase into aluminosilicate ampoules during the 15 minute-long gas extraction process. The ampoules were subsequently sealed with a hot flame and stored dry until analysis. Isotope ratios and concentrations of helium were determined using a dual collector, 21 cm radius, sector-type mass spectrometer specially designed for helium isotope analyses. The precision for the helium isotope ratios in seawater samples averaged 0.2% in δ^3He, where δ^3He is the percentage deviation of the isotopic ratio $R=^3He/^4He$ in the water sample from the atmospheric $^3He/^4He$ ratio $R_a = 1.39 \times 10^{-6}$: $\delta^3He = ((R/Ra)-1)*100$ [%].

Methane concentrations were determined at sea. After equilibration, the headspace gas was injected into a SRI 8610C gas chromatograph. Separation of CH_4 was done using a 15 m long Molecular Sieve 5A column and CH_4 concentrations were measured with a flame ionization detector. The measured background seawater CH_4 concentration was 0.4 nM. Sampling and analytical precision, determined through replicate draws, was <2.5% of the measured concentrations or ±0.1 nM, whichever is greater.

Analyses for total dissolvable iron (TDFe) and manganese (TDMn) were conducted on samples selected from Cruise MV1003 (2010) based on shipboard dissolved CH_4 data. Those analyses were conducted using Mg-precipitation, isotope dilution, and inductively coupled plasma mass spectrometry (ICP-MS) following standard methods described elsewhere [Saito and Schneider, 2006; Noble et al., 2008]. Briefly, unfiltered seawater samples were acidified to pH 1.7 using high purity HCl (SeaStar Inc) and then left for 4 months to allow the dissolution of labile metals in weak acid. For each analysis 13.0mL of processed sample was decanted into a centrifuge tube, spiked with ^{57}Fe stable isotope and precipitated using a small amount of high-purity ammonia (SeaStar Inc.) then centrifuged for 3 min at 3000 rpm (1460 x g) and decanted. The sample was resuspended in 5% high-purity nitric acid with 1ppm indium (In) and analysis was conducted on an Element 2 ICP-MS using an Aridus desolvator and platinum X-cones. Fe and Mn concentrations were calculated using the ^{57}Fe for isotope dilution and In as a recovery tracer [Saito and Schneider, 2006]. Precisions in the measurements were typically better than ±1.0nM for Fe and ±0.2nM for Mn.

All relevant metadata (precision, accuracy, etc.) are published in German et al., 2022 (doi: 10.1029/2021GC010317).

Data Processing Description

BCO-DMO Processing:
- converted dates to YYYY-MM-DD format;
- created date/time field in ISO8601 format;
- renamed fields to comply with BCO-DMO naming conventions;
- converted latitude and longitude values from degrees and decimal minutes to decimal degrees.

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Data Files

File
water_column.csv (Comma Separated Values (.csv), 13.00 KB) MD5:51754e31f88541722982f2720ca0e485 Primary data file for dataset ID 871203

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Related Publications

German, C. R., Baumberger, T., Lilley, M. D., Lupton, J. E., Noble, A. E., Saito, M., Thurber, A. R., & Blackman, D. K. (2022). Hydrothermal Exploration of the Southern Chile Rise: Sediment-Hosted Venting at the Chile Triple

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Parameters

Parameter	Description	Units
Cruise_ID	Cruise identifier	unitless
Date	Sampling date in format YYYY-MM-DD	unitless
Time_UTC	Sampling time (UTC) in format hh:mm	unitless
ISO_DateTime_UTC	Sampling date and time (UTC) in format YYYY-MM-DDThh:mmZ	unitless
Cast	Cast number	unitless
Bottle	Rosette position	unitless
Latitude	Latitude of sample (negative values = South)	decimal degrees North
Longitude	Longitude of sample (negative values = West)	decimal degrees East
Depth	Sample depth	meters (m)
delta_3He	He 3/4 anomaly	percent (%)
CH4	Dissolved methane (CH4)	nanomolar (nM)
TDFe	Total dissolvable iron (Fe)	nanomolar (nM)
TDMn	Total dissolvable manganese (Mn)	nanomolar (nM)

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Instruments

Dataset-specific Instrument Name	centrifuge
Generic Instrument Name	Centrifuge
Generic Instrument Description	A machine with a rapidly rotating container that applies centrifugal force to its contents, typically to separate fluids of different densities (e.g., cream from milk) or liquids from solids.

Dataset-specific Instrument Name	Seabird 911+ CTD
Generic Instrument Name	CTD Sea-Bird SBE 911plus
Generic Instrument Description	The Sea-Bird SBE 911 plus is a type of CTD instrument package for continuous measurement of conductivity, temperature and pressure. The SBE 911 plus includes the SBE 9plus Underwater Unit and the SBE 11plus Deck Unit (for real-time readout using conductive wire) for deployment from a vessel. The combination of the SBE 9 plus and SBE 11 plus is called a SBE 911 plus. The SBE 9 plus uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3 plus and SBE 4). The SBE 9 plus CTD can be configured with up to eight auxiliary sensors to measure other parameters including dissolved oxygen, pH, turbidity, fluorescence, light (PAR), light transmission, etc.). more information from Sea-Bird Electronics

Dataset-specific Instrument Name	SRI 8610C gas chromatograph
Generic Instrument Name	Gas Chromatograph
Generic Instrument Description	Instrument separating gases, volatile substances, or substances dissolved in a volatile solvent by transporting an inert gas through a column packed with a sorbent to a detector for assay. (from SeaDataNet, BODC)

Dataset-specific Instrument Name	Element 2 ICP-MS
Generic Instrument Name	Inductively Coupled Plasma Mass Spectrometer
Generic Instrument Description	An ICP Mass Spec is an instrument that passes nebulized samples into an inductively-coupled gas plasma (8-10000 K) where they are atomized and ionized. Ions of specific mass-to-charge ratios are quantified in a quadrupole mass spectrometer.

Dataset-specific Instrument Name	
Generic Instrument Name	Mass Spectrometer
Dataset-specific Description	A dual collector, 21 cm radius, sector-type mass spectrometer specially designed for helium isotope analyses
Generic Instrument Description	General term for instruments used to measure the mass-to-charge ratio of ions; generally used to find the composition of a sample by generating a mass spectrum representing the masses of sample components.

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Deployments

MV1205

Website	https://www.bco-dmo.org/deployment/871219
Platform	R/V Melville
Start Date	2012-04-20
End Date	2012-04-30
Description	See more information from the Rolling Deck to Repository (R2R) at https://www.rvdata.us/search/cruise/MV1205 and from NOAA at https://oceanexplorer.noaa.gov/explorations/12chile/background/backgroun...

MV1003

Website	https://www.bco-dmo.org/deployment/871300
Platform	R/V Melville
Start Date	2010-02-24
End Date	2010-03-17
Description	See additional information from the Rolling Deck to Repository (R2R) at https://www.rvdata.us/search/cruise/MV1003 and from NOAA at https://oceanexplorer.noaa.gov/explorations/10chile/

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Project Information

Hydrothermal Exploration of the Chile Triple Junction (Chile Triple Junction)

The first INSPIRE (INternational Southeast Pacific Investigation of Reducing Environments) expedition took place from February 24 to March 17, 2010. During 22 days aboard the research vessel (R/V) Melville, members of the INSPIRE: Chile 2010 expedition set out to explore four largely unknown regions of our planet, in search of missing links in our understanding of biology, geology, and chemistry within the deep ocean. Through hours of conductivity, temperature, depth (CTD) work - comprising 33 separate deployments, 26 bouts of multicoring, and 10 trawls - we sampled at depths between 350 and 6100 meters (up to 18,000 feet).

The 2012 INSPIRE expedition took place from April 20-30, 2012. During the 10-day cruise on the R/V Melville, we probed for strange new biological life forms, communities, and ecosystems dependent on as-yet-unknown conditions. Members of the INSPIRE team used an autonomous underwater vehicle (outfitted with cameras and chemical sensors) called Sentry - in combination with instrumentation to measure conductivity, temperature, depth (CTD), a multicorer, and a towed camera system - to locate and characterize heretofore unknown and some barely known ecosystems.

Read more about both expeditions:
https://oceanexplorer.noaa.gov/explorations/10chile/
https://oceanexplorer.noaa.gov/explorations/12chile/welcome.html

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Funding

Funding Source	Award
NOAA Ocean Exploration	NOAA-OER NA08OAR4600757

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