Dissolved Organic Carbon (DOC) measurements from R/V Thomas G. Thompson cruise TN303 in the Eastern Tropical Pacific in 2013 (U.S. GEOTRACES EPZT project)

Website: https://www.bco-dmo.org/dataset/643592
Data Type: Cruise Results
Version: 2
Version Date: 2016-06-08

Project
» U.S. GEOTRACES East Pacific Zonal Transect (GP16) (U.S. GEOTRACES EPZT)
» GEOTRACES: Suspended particle geochemistry along the US GEOTRACES Eastern Pacific Zonal Transect, from high productivity ocean margin to deep sea hydrothermal plume (GEOTRACES EPZT Suspended Particles)

Program
» U.S. GEOTRACES (U.S. GEOTRACES)

Contributors	Affiliation	Role
Carlson, Craig A.	University of California-Santa Barbara (UCSB-MSI)	Principal Investigator
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Dissolved Organic Carbon (DOC) measurements from R/V Thomas G. Thompson cruise TN303 in the Eastern Tropical Pacific in 2013; a cruise of the US GEOTRACES Program.

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Coverage

Spatial Extent: **N**:-10.21911 **E**:-77.37617 **S**:-16.00067 **W**:-152.11975
Temporal Extent: 2013-10-29 - 2013-12-16

Dataset Description

Dissolved Organic Carbon (DOC) measurements for the 2013 East Pacific Zonal Transect (EPZT) cruise of the US GEOTRACES Program.

Methods & Sampling

All descriptions of sampling and analytical methodology, details of quality assurance and control procedures, and precision and accuracy of methods used are included in Carlson et al. (2010).

Briefly:
DOC samples were collected by a CTD rosette equipped with Niskin bottles. All samples were passed through an inline polycarbonate filter cartridge holding a combusted GF/F filter attached directly to the Niskin bottle via silicone tubing. Water was dripped directly into high-density polyethylene bottles that had been acid leached, flushed with Nanopure water and dried prior to each cruise. The samples were stored frozen at -20 degrees C until analysis at UCSB.

Data Processing Description

Carlson Lab Process:
Analytical runs were assessed daily based on internal standards, blanks and reference calibrations as described Carlson et al. 2010. Briefly, DOC samples were analyzed via high temperature combustion using a Shimadzu TOC-V or TOC-L in shore based laboratory at the University of California, Santa Barbara. The operating conditions of the Shimadzu TOC-V have been slightly modified from the manufacturer's model system. The condensation coil has been removed and the headspace of an internal water trap was reduced to minimize the system's dead space. The combustion tube contains 0.5 cm Pt pillows placed on top of Pt alumina beads to improve peak shape and to reduce alteration of combustion matrix throughout the run. CO2 free carrier gas is produced with a Whatman® gas generator (Carlson et al. 2004, 2010). Sample are drawn into 5 ml injection syringe and acidified with 2M HCL (1.5%) and sparged for 1.5 minutes with CO2 free gas. Three to five replicate 100 µl of sample are injected into combustion tube heated to 680 degrees C. The resulting gas stream is passed though several water and halide traps, including an added magnesium perchlorate trap. The CO2 in the carrier gas is analyzed with a non-dispersive infrared detector and the resulting peak area is integrated with Shimadzu chromatographic software. Injections continued until the at least three injection meet the specified range of a SD of 0.1 area counts, CV ≤2% or best 3 of 5 injections.

Extensive conditioning of the combustion tube with repeated injections of low carbon water (LCW) and deep seawater is essential to minimize the machine blanks. After conditioning, the system blank is assessed with UV oxidized low carbon water. The system response is standardized daily with a four-point calibration curve of potassium hydrogen phthalate or glucose solution in LCW. All samples are systematically referenced against low carbon water and low and high reference sea waters typically deep Sargasso Sea reference waters (2600 m) and surface Sargasso Sea water every 6 – 8 analyses (Carlson et al. 2010). The standard deviation of the deep and surface references analyzed throughout a run generally have a coefficient of variation ranging between 1-3% over the 3-7 independent analyses (number of references depends on size of the run).

Daily reference waters were calibrated with DOC CRM provided by D. Hansell (University of Miami; Hansell 2005).

DOC calculation:
µMC = (average sample area – average machine blank area) / (slope of std curve)

Data from each DOC run were then streamed and summarized into a master file (excel based spreadsheet) which was merged with sample collection metadata (bottle & CTD data from ODF and GT-C bottle files). Data were visualized using Ocean Data View (Schlitzer, R., Ocean Data View, http://odv.awi.de, 2016), assessed by individual station and profile, and WOCE quality flags added to identify outliers. Any questionable samples or profiles are first re-analyzed. If reruns were repeatable within limits of instrument precision (1-2 uM C), an average of the two runs is reported. For samples that remain outliers (i.e. a sudden shift of 3 uM C or greater within an oceanic profile), WOCE flags are left in place to designate "bad" or "questionable".

Data output from the TOC-V instrument is in micromoles carbon per liter. Analytical temperature was also reported for each run and used for accurate conversion to micromoles carbon per kg using supporting sample salinity data from the ODF-bottle file.

A final review of the data was then conducted by both the PI and data manager before data submission.

Additional GEOTRACES Processing by BCO-DMO:
As was done for the GEOTRACES-NAT data, BCO-DMO added standard US GEOTRACES information, such as the US GEOTRACES event number, to each submitted dataset lacking this information. To accomplish this, BCO-DMO compiled a 'master' dataset composed of the following parameters:
cruise_id, EXPOCODE,SECT_ID, STNNBR, CASTNO, GEOTRC_EVENTNO, GEOTRC_SAMPNO, GEOTRC_INSTR, SAMPNO, GF_NO, BTLNBR, BTLNBR_FLAG_W, DATE_START_EVENT, TIME_START_EVENT, ISO_DATETIME_UTC_START_EVENT, EVENT_LAT, EVENT_LON, DEPTH_MIN, DEPTH_MAX, BTL_DATE, BTL_TIME, BTL_ISO_DATETIME_UTC, BTL_LAT, BTL_LON, ODF_CTDPRS, SMDEPTH, FMDEPTH, BTMDEPTH, CTDPRS, CTDDEPTH.

This added information will facilitate subsequent analysis and inter-comparison of the datasets.

Bottle parameters in the master file were taken from the GT-C_Bottle and ODF_Bottle datasets. Non-bottle parameters, including those from GeoFish tows, Aerosol sampling, and McLane Pumps, were taken from the TN303 Event Log (version 30 Oct 2014). Where applicable, pump information was taken from the PUMP_Nuts_Sals dataset.

A standardized BCO-DMO method (called "join") was then used to merge the missing parameters to each US GEOTRACES dataset, most often by matching on sample_GEOTRC or on some unique combination of other parameters.

If the master parameters were included in the original data file and the values did not differ from the master file, the original data columns were retained and the names of the parameters were changed from the PI-submitted names to the standardized master names. If there were differences between the PI-supplied parameter values and those in the master file, both columns were retained. If the original data submission included all of the master parameters, no additional columns were added, but parameter names were modified to match the naming conventions of the master file.

See the dataset parameters documentation for a description of which parameters were supplied by the PI and which were added via the join method.

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Data Files

File
DOC_joined.csv (Comma Separated Values (.csv), 296.05 KB) MD5:9cbbba640ce445fd4a76d9c21e9f2293 Primary data file for dataset ID 643592

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Related Publications

Carlson, C. A., Giovannoni, S. J., Hansell, D. A., Goldberg, S. J., Parsons, R., & Vergin, K. (2004). Interactions among dissolved organic carbon, microbial processes, and community structure in the mesopelagic zone of the northwestern Sargasso Sea. Limnology and Oceanography, 49(4), 1073–1083. doi:10.4319/lo.2004.49.4.1073
Methods

Carlson, C. A., Hansell, D. A., Nelson, N. B., Siegel, D. A., Smethie, W. M., Khatiwala, S., Meyers, M. M., Halewood, E. (2010). Dissolved organic carbon export and subsequent remineralization in the mesopelagic and bathypelagic realms of the North Atlantic basin. Deep Sea Research Part II: Topical Studies in Oceanography, 57(16), 1433–1445. doi:10.1016/j.dsr2.2010.02.013
Methods

Hansell, D. A. (2005). Dissolved Organic Carbon Reference Material Program. Eos, Transactions American Geophysical Union, 86(35), 318. doi:10.1029/2005eo350003
Methods

Hansell, D. A., & Carlson, C. A. (1998). Deep-ocean gradients in the concentration of dissolved organic carbon. Nature, 395(6699), 263–266. doi:10.1038/26200
Methods

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Parameters

Parameter	Description	Units
cruise_id	Cruise identifier. TN = R/V Thomas G. Thompson.	dimensionless
cruise_name	Cruise name.	dimensionless
STNNBR	Station number, provided by the PI.	dimensionless
GEOTRC_EVENTNO	GEOTRACES event number.	dimensionless
BTMDEPTH	Bottom depth.	meters
CASTNO	Cast number.	dimensionless
ISO_DATETIME_UTC_START_EVENT	Date and time (UTC) at start of the event, formatted to ISO 8601 standard, according to the event log.	YYYY-mm-ddTHH:MM:SS.xxZ
Date_Start_PI	Date at the start of the event, provided by PI.	YYYYmmdd
Time_Start_PI	Time at the start of the event, provided by PI.	HH:MM:SS
EVENT_LAT	Latitude at the start of the event, according to the event log.	decimal degrees
EVENT_LON	Longitude at the start of the event, according to the event log.	decimal degrees
GEOTRC_SAMPNO	GEOTRACES sample number.	dimensionless
DOC	Dissolved organic carbon (DOC).	micromoles per kilogram (umol/kg)

DOC_FLAG_W	WOCE quality flag for DOC.	dimensionless
analytical_temp_DOC	Analytical temperature.	degrees Celsius
analytical_temp_DOC_FLAG_W	WOCE quality flag for analytical temperature.	dimensionless
SAMPNO	Bottle sample number, according to PI.	dimensionless
BTLNBR	Bottle number, according to PI.	dimensionless
BTLNBR_FLAG_W	WOCE bottle quality flag, according to PI.	dimensionless
BTL_LAT	Latitude when the bottle was fired, according to PI.	decimal degrees
BTL_LON	Longitude when the bottle was fired, according to PI.	decimal degrees
BTL_ISO_DATETIME_UTC	Date and time (UTC) when the bottle was fired, formatted to ISO 8601 standard, according to the bottle file.	YYYY-mm-ddTHH:MM:SS.xxZ
SALNTY	Salinity, provided by the PI.	PSU?
SALNTY_FLAG_W	WOCE quality flag for salinity.	dimensionless
GEOTRC_INSTR	Sampling instrument.	dimensionless
GFISH_NO	GeoFish tow number, according to the event log.	dimensionless
CTDPRS	CTD pressure, provided by the PI.	decibars
CTDDEPTH	CTD depth, provided by the PI.	meters
ODF_CTDPRS	Pressure, determined by ODF group.	decibars
SMDEPTH	SMDEPTH is Saunders-Mantyla depth (integrated; uses dynamic height)	meters
FMDEPTH	FMDEPTH is Fofonoff-Millard depth (non-integrated; also used by SBE)	meters

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Instruments

Dataset-specific Instrument Name	Niskin bottle
Generic Instrument Name	Niskin bottle
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

Dataset-specific Instrument Name	Shimadzu TOC-V Analyzer
Generic Instrument Name	Shimadzu TOC-V Analyzer
Generic Instrument Description	A Shimadzu TOC-V Analyzer measures DOC by high temperature combustion method.

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Deployments

TN303

Website	https://www.bco-dmo.org/deployment/499719
Platform	R/V Thomas G. Thompson
Report	http://dmoserv3.whoi.edu/data_docs/GEOTRACES/EPZT/GT13_EPZT_ODFReport_All.pdf
Start Date	2013-10-25
End Date	2013-12-20
Description	A zonal transect in the eastern tropical South Pacific (ETSP) from Peru to Tahiti as the second cruise of the U.S.GEOTRACES Program. This Pacific section includes a large area characterized by high rates of primary production and particle export in the eastern boundary associated with the Peru Upwelling, a large oxygen minimum zone that is a major global sink for fixed nitrogen, and a large hydrothermal plume arising from the East Pacific Rise. This particular section was selected as a result of open planning workshops in 2007 and 2008, with a final recommendation made by the U.S.GEOTRACES Steering Committee in 2009. It is the first part of a two-stage plan that will include a meridional section of the Pacific from Tahiti to Alaska as a subsequent expedition. Figure 1. The 2013 GEOTRACES EPZT Cruise Track. [click on the image to view a larger version] Additional cruise information is available from the Rolling Deck to Repository (R2R): http://www.rvdata.us/catalog/TN303

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Project Information

U.S. GEOTRACES East Pacific Zonal Transect (GP16) (U.S. GEOTRACES EPZT)

Website: http://www.geotraces.org/

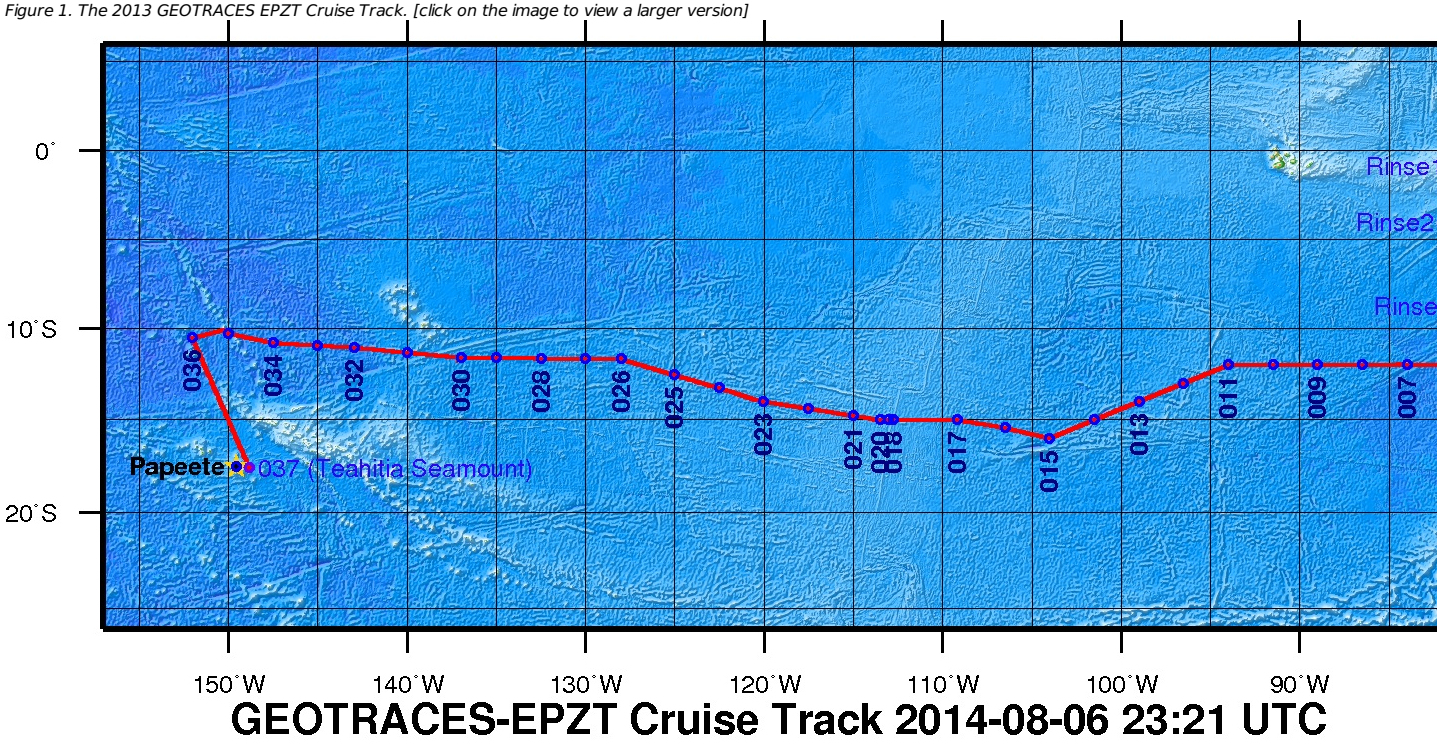
Coverage: Eastern Tropical Pacific - Transect from Peru to Tahiti (GP16)

From the NSF Award Abstract
The mission of the International GEOTRACES Program (https://www.geotraces.org/), of which the U.S. chemical oceanography research community is a founding member, is "to identify processes and quantify fluxes that control the distributions of key trace elements and isotopes in the ocean, and to establish the sensitivity of these distributions to changing environmental conditions" (GEOTRACES Science Plan, 2006). In the United States, ocean chemists are currently in the process of organizing a zonal transect in the eastern tropical South Pacific (ETSP) from Peru to Tahiti as the second cruise of the U.S.GEOTRACES Program. This Pacific section includes a large area characterized by high rates of primary production and particle export in the eastern boundary associated with the Peru Upwelling, a large oxygen minimum zone that is a major global sink for fixed nitrogen, and a large hydrothermal plume arising from the East Pacific Rise. This particular section was selected as a result of open planning workshops in 2007 and 2008, with a final recommendation made by the U.S.GEOTRACES Steering Committee in 2009. It is the first part of a two-stage plan that will include a meridional section of the Pacific from Tahiti to Alaska as a subsequent expedition.

This award provides funding for management of the U.S.GEOTRACES Pacific campaign to a team of scientists from the University of Southern California, Old Dominion University, and the Woods Hole Oceanographic Institution. The three co-leaders will provide mission leadership, essential support services, and management structure for acquiring the trace elements and isotopes samples listed as core parameters in the International GEOTRACES Science Plan, plus hydrographic and nutrient data needed by participating investigators. With this support from NSF, the management team will (1) plan and coordinate the 52-day Pacific research cruise described above; (2) obtain representative samples for a wide variety of trace metals of interest using conventional CTD/rosette and GEOTRACES Sampling Systems; (3) acquire conventional JGOFS/WOCE-quality hydrographic data (CTD, transmissometer, fluorometer, oxygen sensor, etc) along with discrete samples for salinity, dissolved oxygen (to 1 uM detection limits), plant pigments, redox tracers such as ammonium and nitrite, and dissolved nutrients at micro- and nanomolar levels; (4) ensure that proper QA/QC protocols are followed and reported, as well as fulfilling all GEOTRACES Intercalibration protocols; (5) prepare and deliver all hydrographic-type data to the GEOTRACES Data Center (and US data centers); and (6) coordinate cruise communications between all participating investigators, including preparation of a hydrographic report/publication.

Broader Impacts: The project is part of an international collaborative program that has forged strong partnerships in the intercalibration and implementation phases that are unprecedented in chemical oceanography. The science product of these collective missions will enhance our ability to understand how to interpret the chemical composition of the ocean, and interpret how climate change will affect ocean chemistry. Partnerships include contributions to the infrastructure of developing nations with overlapping interests in the study area, in this case Peru. There is a strong educational component to the program, with many Ph.D. students carrying out thesis research within the program.

Figure 1. The 2013 GEOTRACES EPZT Cruise Track. [click on the image to view a larger version]



GEOTRACES: Suspended particle geochemistry along the US GEOTRACES Eastern Pacific Zonal Transect, from high productivity ocean margin to deep sea hydrothermal plume (GEOTRACES EPZT Suspended Particles)

Coverage: Subtropical Southeastern Pacific Ocean

During the 2013 GEOTRACES Eastern Pacific cruise a diverse range of oceanic environments will be encountered from the high productivity/high particle flux waters off Peru to the Peru-Chile oxygen minimum zone, the hydrothermal plume of the East Pacific Rise, and finally to some of the most oligotrophic waters around Tahiti. Scientists from Rutgers University and Woods Hole Oceanographic Institution will sample suspended particulates from the same GO-Flo bottles that will be used to sample dissolved trace metals and their isotopes (TEIs) across this entire transect. The suspended matter samples will be analyzed for 42 elements, including the particle-reactive rare earth elements. In addition, core-top sediments will be collected at every water-column sampling station and analyzed for both bulk composition (i.e., relative % content of organic carbon, opal, biogenic carbonate and lithogenic components) and the same 42 elements to be analyzed in the suspended particulates. Results from this study will be used to assess the role of suspended particulates in the biogeochemical cycling of TEIs across the Eastern Pacific by addressing three key sets of questions: (1) How does uptake of TEIs into phytoplankton and non-living particles in the upper ocean drive the suspended particulate composition through the deeper water column, along the substantial gradient from the high productivity Peru margin to the oligotrophic ocean interior?; (2) How faithfully is the along-transect variability in the upper ocean transmitted to the sediment (paleo) record?; (3) What are the relative influences of vertical recycling versus lateral advection in generating the distributions of dissolved and particulate TEIs observed in the Peru-Chile OMZ?; (4) Is there a characteristic signature of OMZ activity that is preserved in core-top sediments?; (5) What dominates TEI uptake onto/into authigenic particles in hydrothermal plumes and to what extent are these processes augmented by continuing uptake in core-top sediments?; and (6) What is the net effect from submarine venting on global TEI budgets?

As regards broader impacts, the scientist from Rutgers University is collaborating with the Education Director of the Centers for Ocean Science Education Excellence Networked Ocean World (COSEE-NOW) to contribute to the MARE (Marine Activities, Resources, and Education) program by inviting teachers and high school students to workshops and presentations on climate and ocean sciences. With the help of COSEE-NOW, he also plans to create educational video clips during the Pacific cruise and the subsequent laboratory based analytical work to educate them on the use of geochemistry to understand how the ocean works. Both scientists also plan to develop a teaching module entitled "Particles, Metals, and Carbon" for an Introduction to Oceanography class taught by the Rutgers scientist. One postdoc from Rutgers University would be supported and trained as part of this project.

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Program Information

U.S. GEOTRACES (U.S. GEOTRACES)

Website: http://www.geotraces.org/

Coverage: Global

GEOTRACES is a SCOR sponsored program; and funding for program infrastructure development is provided by the U.S. National Science Foundation.

GEOTRACES gained momentum following a special symposium, S02: Biogeochemical cycling of trace elements and isotopes in the ocean and applications to constrain contemporary marine processes (GEOSECS II), at a 2003 Goldschmidt meeting convened in Japan. The GEOSECS II acronym referred to the Geochemical Ocean Section Studies To determine full water column distributions of selected trace elements and isotopes, including their concentration, chemical speciation, and physical form, along a sufficient number of sections in each ocean basin to establish the principal relationships between these distributions and with more traditional hydrographic parameters;

* To evaluate the sources, sinks, and internal cycling of these species and thereby characterize more completely the physical, chemical and biological processes regulating their distributions, and the sensitivity of these processes to global change; and

* To understand the processes that control the concentrations of geochemical species used for proxies of the past environment, both in the water column and in the substrates that reflect the water column.

GEOTRACES will be global in scope, consisting of ocean sections complemented by regional process studies. Sections and process studies will combine fieldwork, laboratory experiments and modelling. Beyond realizing the scientific objectives identified above, a natural outcome of this work will be to build a community of marine scientists who understand the processes regulating trace element cycles sufficiently well to exploit this knowledge reliably in future interdisciplinary studies.

Expand "Projects" below for information about and data resulting from individual US GEOTRACES research projects.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1235248
NSF Division of Ocean Sciences (NSF OCE)	OCE-1130870

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