Dissolved Barium (Ba) from R/V Thomas G. Thompson cruise TN303 (GP16) in the Eastern Tropical Pacific in 2013 (U.S. GEOTRACES EPZT project)

Website: https://www.bco-dmo.org/dataset/648753
Data Type: Cruise Results
Version: 2
Version Date: 2016-11-10

Project
» U.S. GEOTRACES East Pacific Zonal Transect (GP16) (U.S. GEOTRACES EPZT)
» Geotraces Pacific Section: Gallium, vanadium, and associated elements indicative of dust input and redox cycling (EPZT_Ga_V_others)

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

Contributors	Affiliation	Role
Shiller, Alan M.	University of Southern Mississippi (USM)	Principal Investigator
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Dissolved Barium (Ba) from R/V Thomas G. Thompson cruise TN303 (GP16) in the Eastern Tropical Pacific in 2013 (U.S. GEOTRACES EPZT project).

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Coverage

Spatial Extent: **N**:-10.224 **E**:-77.3761 **S**:-16.0006 **W**:-152.079
Temporal Extent: 2013-10-28 - 2013-12-17

Dataset Description

A section of dissolved Ba concentrations comprised of 36 stations and additional surface water sampling across the Eastern Tropical Pacific from Ecuador to Tahiti.

Methods & Sampling

Water column samples were taken from the GEOTRACES carousel and filtered through pre-cleaned, 0.2 um Pall Acropak Supor filter capsules as described elsewhere (e.g., Cutter et al., 2012; Hatta et al., 2015). Near surface water samples were collected using an underway towed-fish pumped seawater system (Bruland et al., 2005) with samples filtered through sequential 0.45 um Osmonics and 0.2 µm Polycarbonate (PCTE) cartridge filters. Filtered water was collected in 125 mL HDPE bottles (Nalgene) that had been precleaned by soaking in hot 1.2 M HCl (reagent grade) for at least 8 h with subsequent thorough rinsing with ultrapure distilled deionized water (Barnstead E-pure). Samples were acidified in a laminar flow bench aboard ship using 0.5 mL of ultrapure HCl per 125 mL sample.

Barium was measured using a ThermoFisher Element 2 Inductively Coupled Plasma Mass Spectrometer (ICP-MS) and the isotope dilution method as described by Jacquet et al. (2005). Aliquots (50 uL) of each sample were spiked with 25 uL of a 135Ba-enriched solution (~170 nM) and then diluted 30-fold with 0.2 um ultrapure filtered water. A sample of ~93% enriched 135Ba was obtained from Oak Ridge National Laboratories for use as the enriched isotope spike. The ICP-MS was operated in low resolution and both 135Ba and 138Ba were determined. The samples were bracketed every 10 samples with a blank and the spike 135Ba solution. The volumes of the spikes, samples and dilution water were accurately assessed by calibrating each pipette by weight. The reproducibility error of this method was estimated by comparing samples collected at the same depths on different casts at the same station. For 42 pairs of these replicate samples, the average absolute deviation of 1.4 nmol/kg or typically 1.5%. Repeated runs of runs of US GEOTRACES intercalibration samples and in-house reference solutions suggest a precision of ±2.0%; the limit of detection for barium was 0.7 nmol/kg. Our precision is similar to that reported by other labs for Ba (e.g., Jacquet et al., 2005).

Data Processing Description

Data quality flags:
2 = Good data;
3 = Questionable data;
4 = Bad data.

Intercalibration:
See the Table 1 Supplement File (.PNG), which lists intercalibration data for reference waters, both our results and results we were able to find from collaborators. Results are reasonably comparable within the 2% precision generally given for Ba analysis. Note that European labs analyzing Ba tend to report values for one of the SLRS reference waters as well as an in house standard. We are hopeful that other data from the BATS crossover station will soon be available to make a better comparison.

BCO-DMO Processing:
- modified parameter names to conform to BCO-DMO and GEOTRACES IDP parameter naming conventions;
- separated Barium columns in _BOTTLE and _FISH, in accordance with the GEOTRACES IDP conventions;
- replaced blanks (missing data) with "nd" ("no data");
- correction made on 10 November 2016: removed duplicate data for sample number 9981;
- 04 March 2019: removed embargo on dataset.

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
Ba_Dissolved_joined.csv (Comma Separated Values (.csv), 172.66 KB) MD5:03d7eefe2475483f2566380d98992c0 Primary data file for dataset ID 648753

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Supplemental Files

File
Table 1 Barium Intercalibration EPZT filename: Barium_table1.PNG (Portable Network Graphics (.png), 13.10 KB) MD5:1b2fbc3da4cf2f6d0f117a9216b27148 Table 1. Barium intercalibration data for reference waters; associated with the GEOTRACES EPZT (GP16) dissolved Ba dataset from PI Alan Shiller.

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Related Publications

Bruland, K. W., Rue, E. L., Smith, G. J., & DiTullio, G. R. (2005). Iron, macronutrients and diatom blooms in the Peru upwelling regime: brown and blue waters of Peru. Marine Chemistry, 93(2-4), 81–103. doi:10.1016/j.marchem.2004.06.011
Methods

Cutter, G. A., & Bruland, K. W. (2012). Rapid and noncontaminating sampling system for trace elements in global ocean surveys. Limnology and Oceanography: Methods, 10(6), 425–436. doi:10.4319/lom.2012.10.425
Methods

Hatta, M., Measures, C. I., Wu, J., Roshan, S., Fitzsimmons, J. N., Sedwick, P., & Morton, P. (2015). An overview of dissolved Fe and Mn distributions during the 2010–2011 U.S. GEOTRACES north Atlantic cruises: GEOTRACES GA03. Deep Sea Research Part II: Topical Studies in Oceanography, 116, 117–129. doi:10.1016/j.dsr2.2014.07.005
Methods

Jacquet, S. H. M., Dehairs, F., Cardinal, D., Navez, J., & Delille, B. (2005). Barium distribution across the Southern Ocean frontal system in the Crozet–Kerguelen Basin. Marine Chemistry, 95(3-4), 149–162. doi:10.1016/j.marchem.2004.09.002
Methods

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Parameters

Parameter	Description	Units
cruise_id	Cruise identification	unitless
cruise_name	Cruise name	unitless
STNNBR	Station number	unitless
GEOTRC_EVENTNO	GEOTRACES event number	unitless
LATITUDE_PI	Latitude, as reported by the PI.	decimal degrees
LONGITUDE_PI	Longitude, as reported by the PI.	decimal degrees
EVENT_LAT	Latitude at the start of the event (north is positive), from the event log.	decimal degrees
EVENT_LON	Longitude at the start of the event (east is positive), from the event log.	decimal degrees
ISO_DATETIME_UTC_START_EVENT	Date and time, formatted to the ISO 8601 standard, at the start of the sampling event, from the event log.	YYYY-MM-DDTHH:MM:SS[.xx]Z
CASTNO	Cast number	unitless
GEOTRC_SAMPNO	Unique GEOTRACES sample number	unitless
SMDEPTH	Saunders-Mantyla depth (integrated; uses dynamic height); as reported in the bottle file.	meters
Ba_D_CONC_BOTTLE	Dissolved Barium (Ba) concentration of samples collected by Go-Flo bottles.	nanomoles per kilogram (nmol/kg)
Ba_D_CONC_BOTTLE_FLAG	Quality flag for Ba_D_CONC_BOTTLE. 2 = Good data; 3 = Questionable data; 4 = Bad data.	unitless
Ba_D_CONC_FISH	Dissolved Barium (Ba) concentration of samples collected by GeoFish.	nanomoles per kilogram (nmol/kg)
Ba_D_CONC_FISH_FLAG	Quality flag for Ba_D_CONC_FISH. 2 = Good data; 3 = Questionable data; 4 = Bad data.	unitless
GEOTRC_INSTR	Sampling instrument, from the event log.	unitless
SAMPNO	Sequential sample number within the cast (usually corresponds to bottle number); from the bottle file.	unitless
GFISH_NO	GeoFish tow number; from the event log.	unitless
BTLNBR	Bottle number; typically 1-24, from the bottle file.	unitless
BTLNBR_FLAG_W	Bottle number quality flag reported in the bottle file; follows WOCE conventions. 2 = good; 3 = questionable; 4 = bad; 9 = missing data.	unitless
BTL_ISO_DATETIME_UTC	Date and time, formatted to the ISO 8601 standard, at the time of bottle firing, from the bottle file.	YYYY-MM-DDTHH:MM:SS[.xx]Z
BTL_LAT	Latitude of bottle firing (north is positive), from the bottle file.	decimal degrees
BTL_LON	Lonitude of bottle firing (east is positive), from the bottle file.	decimal degrees
ODF_CTDPRS	The ODF software acquisition measurement of pressure, from the bottle file.	decibars
FMDEPTH	Fofonoff-Millard depth (non-integrated; also used by SBE), from the bottle file.	meters
BTMDEPTH	Bottom depth, from the bottle file.	meters
CTDPRS	CTD pressure, from the bottle file.	decibars
CTDDEPTH	CTD bottle firing depth, from the bottle file.	meters

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	GeoFish Towed near-Surface Sampler
Generic Instrument Description	The GeoFish towed sampler is a custom designed near surface (2 meters or less) sampling system for the collection of trace metal clean seawater. It consists of a PVC encapsulated lead weighted torpedo and separate PVC depressor vane supporting the intake utilizing all PFA Teflon tubing connected to a deck mounted, air-driven, PFA Teflon dual-diaphragm pump which provides trace-metal clean seawater at up to 3.7L/min. The GeoFish is towed at up to 13kts off to the side of the vessel outside of the ship's wake to avoid possible contamination from the ship's hull. It was developed by Geoffrey Smith and Ken Bruland (University of California, Santa Cruz).

Dataset-specific Instrument Name	
Generic Instrument Name	GO-FLO Teflon Trace Metal Bottle
Generic Instrument Description	GO-FLO Teflon-lined Trace Metal free sampling bottles are used for collecting water samples for trace metal, nutrient and pigment analysis. The GO-FLO sampling bottle is designed specifically to avoid sample contamination at the surface, internal spring contamination, loss of sample on deck (internal seals), and exchange of water from different depths.

Dataset-specific Instrument Name	
Generic Instrument Name	Sea-Bird SBE 911plus CTD
Generic Instrument Description	[tethered, real-time] 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

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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)

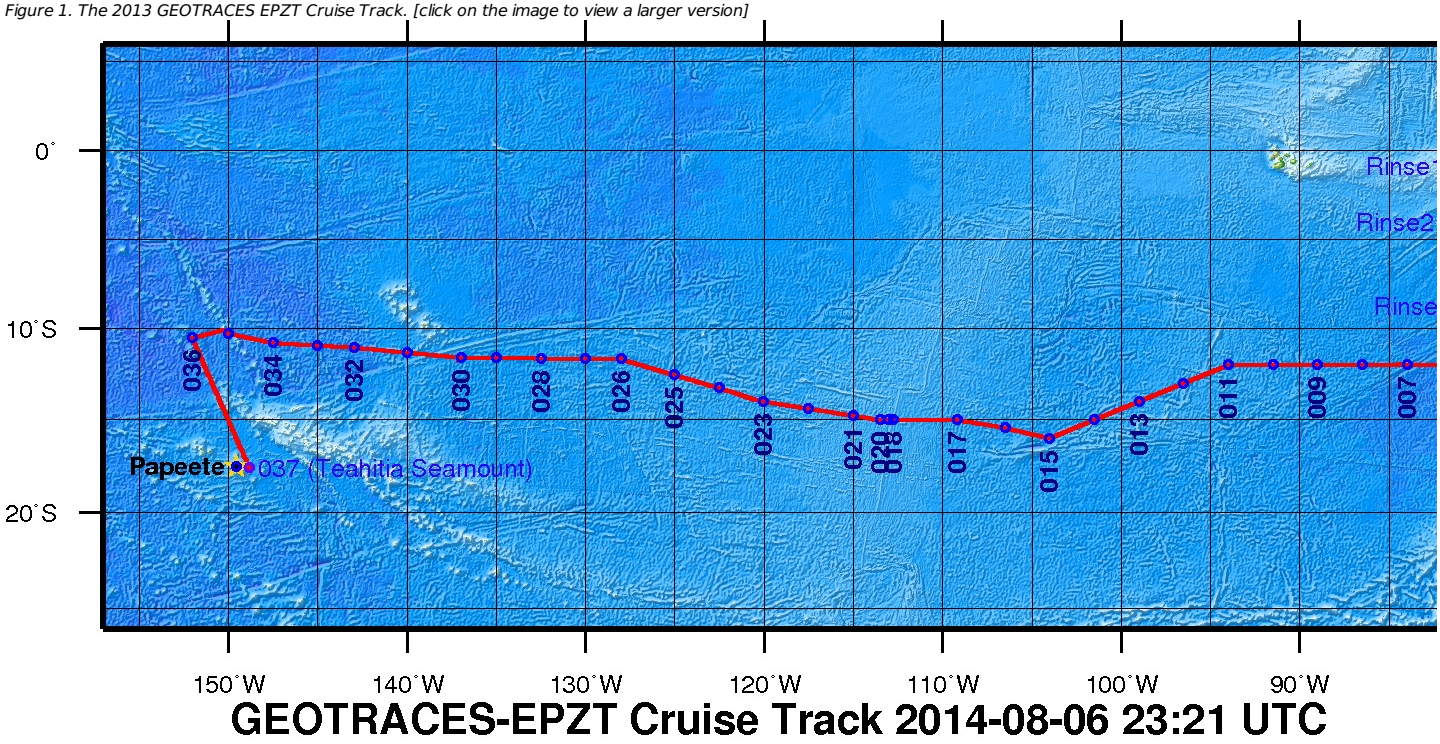
From the NSF Award Abstract
The mission of the International GEOTRACES Program (https://www.geotraces.org/), of which the U.S. chemical oceanography research community is a founding member, is "to identify processes and quantify fluxes that control the distributions of key trace elements and isotopes 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 Pacific Section: Gallium, vanadium, and associated elements indicative of dust input and redox cycling (EPZT_Ga_V_others)

Coverage: Eastern Pacific

Extracted from the NSF award abstract:

During the 2013 GEOTRACES Eastern Pacific Zonal Section cruise, a scientist from the University of Southern Mississippi will determine the distributions of gallium (Ga) and vanadium (V), as well as V redox speciation. The planned cruise track is ideal for this effort because it will traverse various oceanic environments that influence the biogeochemistry of these elements namely, the Peru margin/upwelling zone and the associated oxygen minimum zone, gradients in atmospheric inputs and biological productivity from the Peru margin to Tahiti, and hydrothermal vents along the East Pacific Rise. Specific goals of the project include: (1) examine the discrepancy between surface water Ga and aluminum (Al) distributions and estimate dust inputs; (2) confirm the relationship observed in the North Pacific between the surface ocean Ga/Al ratio and the chlorophyll distribution; (3) compare the surface ocean manganese distribution with that of Ga, Al, and lead to differentiate between shelf and aerosol inputs; (4) determine if there is evidence of shelf V removal which contributes to the surface ocean V depletion; (5) test for hydrothermal influences on the V distribution downstream from the East Pacific Rise; and (6) compare V redox speciation with that of other elements including selenium, arsenic, and iodine as a means of examining the importance of water column reduction versus advective interactions with reducing coastal sediments. As such, the elements selected as the focus of this study, will provide information on dust input and redox cycling, especially when compared with other elements being determined by other cruise participants.

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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-1261214

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