Conceptual and logical design of a Deep Sea Environmental Database for the Area: Geology, Oceanography and Ecology.

ISA's Workshop towards Taxonomic Standardization

Uljim-South Korea, November 23-30, 2014

International Seabed Authority

Introduction: background and why?

United Nations Convention on the law of the Sea (UNCLOS)

Part XI: The Area

Article 145

Protection of the Marine Environment

Necessary measures shall be taken in accordance with this Convention with respect to activities in the Area to ensure effective protection for the marine environment from harmful effects which may arise from such activities. To this end the Authority shall adopt appropriate rules, regulation and procedures for *inter alia*:

(a) the prevention and control of pollution and other hazards to the marine environment, including the coastline, and of interference with the ecological balance of the marine environment, particular attention being paid to the need for protection from harmful effects of such activities as drilling, dredging, excavation, disposal of waste, construction and operation or maintenance of installations, pipelines and other devices related to such activities;

(b) the protection and conservation of the natural resources of the Area and the prevention of damage to the flora and fauna of the marine environment

Introduction: background

1. *Environmental Data Management* for the CCFZ **is closely tight** to the *Environmental Management Plan* (EMP) implementation as proposed and recommended by LTC. This EMP was based on the available scientific data in 2011 (ISBA/17/LTC/7).

The EMP included the designation of nine Areas of Environmental Particular Interest (APEIs) disseminated on the geographical boundaries of the CCFZ

Report on the review of the Environmental Management Plan (EMP) for the Clarion Clipperton Zone implementation (ISBA/18/C/22; paragraph 4), and that such activity should be done every 2-3 years.

International Seabed Authority data realm

A total of 86 annual reports were screened. The methodology used was to identified and extract, when possible, from each report all the information (graphs, text, tables) dealing with environmental data using algorithms to obtain tabular data from a graph or figure assuming that clear referenced points were well resolved. The first outcome of this work is shown in Table 1.

Table 1. Summary of the number of stations that have been sampled at least once by contractors cruises. Not all of of them could be geographically placed (QGIS).

	Traceable Environmental Station for CCFZ		
Russia	101	Water-Sed-Fauna	need validation
Japan	50	Water-Sed-Fauna	need validation
Korea	377	Water-Sed-Fauna	need validation
IOM	120	Water-Sed-Fauna	need validation
IFREMER	30	Water-Sed-Fauna	need validation
COMRA	76	Water-Sed-Fauna	need validation
BGR	163	Water-Sed-Fauna	need validation
TOTAL	917		

International Seabed Authority data realm

Core Data On board

- water column
  - physical
    - CTD casts (PSU, Temp, Density) - profiles, water currents
  - chemical
    - Nutrients Profiles: N, P TOC, POC, Si, DO, Chla
  - biological
    - Phytoplankton - zooplakton-microbiota (abundances, biomass)
- Sediment column
  - physical
    - Texture, SS, porosity, density,
  - chemical
    - elemental constituents, nutrients profiles (porewater), 210Pb profiles,
  - biological
    - megafauna, macroinfauna, meiofauna, microfauna (abundances, biomass)

Ancillary Data: Meteorological,sea conditions

Database Purpose

CCFZ Environmental Management Plan

Evaluation of gap of knowledge: biotic and abiotic features

Support individual contributing Contractors of the Area

Sandor Mulsow
Head - OREM
ISA

DATABASE DESIGN

Conceptual design:	identification of entities[1] and relationships
Logical design:	assigning order, hierarchy and coherency to those relationships previously mapped and organises them
Physical design:	Reliability/availability, Performance Capacity or scalability, Manageability, Cost

[1] actual objects in the material world: species, habitat

Sandor Mulsow
Head - OREM
ISA

Conceptual design:

Template Presented to Contractors at ISA Meeting, 2012

GENERAL METADATA

Title of Cruise
Data generation institution
Ship Name
Cruise #
Leg #
Northern Boundary of sampling area
Southern Boundary of sampling area
Eastern Boundary of sampling area
Western Boundary of sampling area
Date (range) of sampling
Depth (range) of sampling

WATER COLUMN

Number of profiles: number
CTD model :
Sensor Range:
CTD Operator
Additional probes mounted on CTD frame
Accessibility
Contact Information
Latitude (WGS84)
Longitude (WGS84)
Detph (m)
Date: dd/mm/yyyy
Time: hh:mm

Compulsory Parameters
Temperature (Celsius)
Salinity (ppt)
pH
DO: ml/l
Turbidity: FTU

BOTTOM WATER

Methods of Water Sample collection and processing
Methods of nutrients analysis Laboratory
Location of water samples for reference check
Accessibility
Contact Information (email)

Compulsory Parameters
DO=mg/l
NO2-N=uM
NO3-N= uM
oPO4-P= uM
SIO2= uM
TOC = mg/kg or % dwt
Chlorophyll = ug/l

Pelagic Zone: nekton and plankton

Each one of the cast performed for **pelagic biota**, must have the following metadata information:

Method of collection: plankton net (mesh size), bongo net, surface trawl, column trawl, etc.,
Area/volume of sample: net area opening, time, flow meter, etc
Sample handling: splitter, sorting, etc
Sample fixation: formalin, buffered formalin, alcohol
Genomics sampling technique: identify individual sampled for DNA, RNA etc,
Sample storage location: Institution and conditions, fixed, deep freezer, etc
Identification key used and operator:
Accessibility
Contact Information (email)

Compulsory Parameters

Taxonomic Identification: lower level possible, genus and species level
Biomass = dry weight mg
Abundance = number of individuals per OUT (Operational Taxonomic Unit)
Density = number of individuals per unit of area/volume
Relative abundance = %
Dominance = %

NOTE: all the physical parameters as mentioned for water profile measurements should be associated to plankton and nekton samples.

Conceptual design:

Template Presented to Contractors at ISA Meeting, 2012

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Title of Cruise
Data generation institution
Ship Name
Cruise #
Leg #
Northern Boundary of sampling area
Southern Boundary of sampling area
Eastern Boundary of sampling area
Western Boundary of sampling area
Date (range) of sampling
Depth (range) of sampling

Sediment Pore Water Chemistry

Same general metadata heading plus the following specific information:
Method of sediment collection: box corer, multiple corer, gravity core, piston core, grab sampler, etc
Method of sediment processing (handling):
Pore water Analysis Description: Nutrient analyses, chemical analyses, etc
Lower limit of nutrient analysis:
Lower limit of metal analysis:
Accessibility:
Contact Information (email)

Compulsory Parameters

Sediment column : cm

DO: uM	NO_2-N=uM	NO_3-N= uM	Chla = ug/l
PO_4-P= uM	SIO_2= uM	TOC = mg/kg or % dwt	

Sediment Water Interface

Method of sediment collection: box corer, multicorer, grab sampler etc.
Area of the seafloor sampled: square meters, square cm
Method of sediment handling: sectioned and resolution (every 1,2 or 5 cm). Lower limit of detection for nutrients: uM Lower limit of detection for metals: ppm Grain size category: Folk 1974 reference.
Accessibility: Contact Information (email)

Compulsory Parameters

Sediment column: cm
Specific gravity: g cm^{-3}
Wet bulk density: g cm^{-3}
Dry bulk density: g cm^{-3}
Porosity
Shear Strength: pascal, kP
Grain size profile: % clay, silt, sand, gravel
Depth of RPD: cm

NO_2-N=uM	TOC = mg/kg or % dwt	
NO_3-N= uM	TIC = mg/kg or % dwt	
PO_4-P= uM	TC = mg/kg or % dwt	
SIO_2= uM	Carbonate (Alkalinity)	
Cu = ppm	Mn = ppt	Pb = ppm
Fe = ppt	Co = ppm	Hg = ppm
Cd = ppm	Zn = ppm	^{210}Pb = Bq g^{-1}

Benthos - EPIFAUNA

Same general metadata heading for sediment samples collected at the sediment water interface to sample infauna, plus the following specific information:
Photography-Video recording
Diving gear and camera system
Method for towing the camera: tethered, autonomous
Area covered by the swap: cm, m
Storage of original record:
Taxonomic Identification key used and operator:
Accessibility
Contact Information (email)

Benthos - INFAUNA

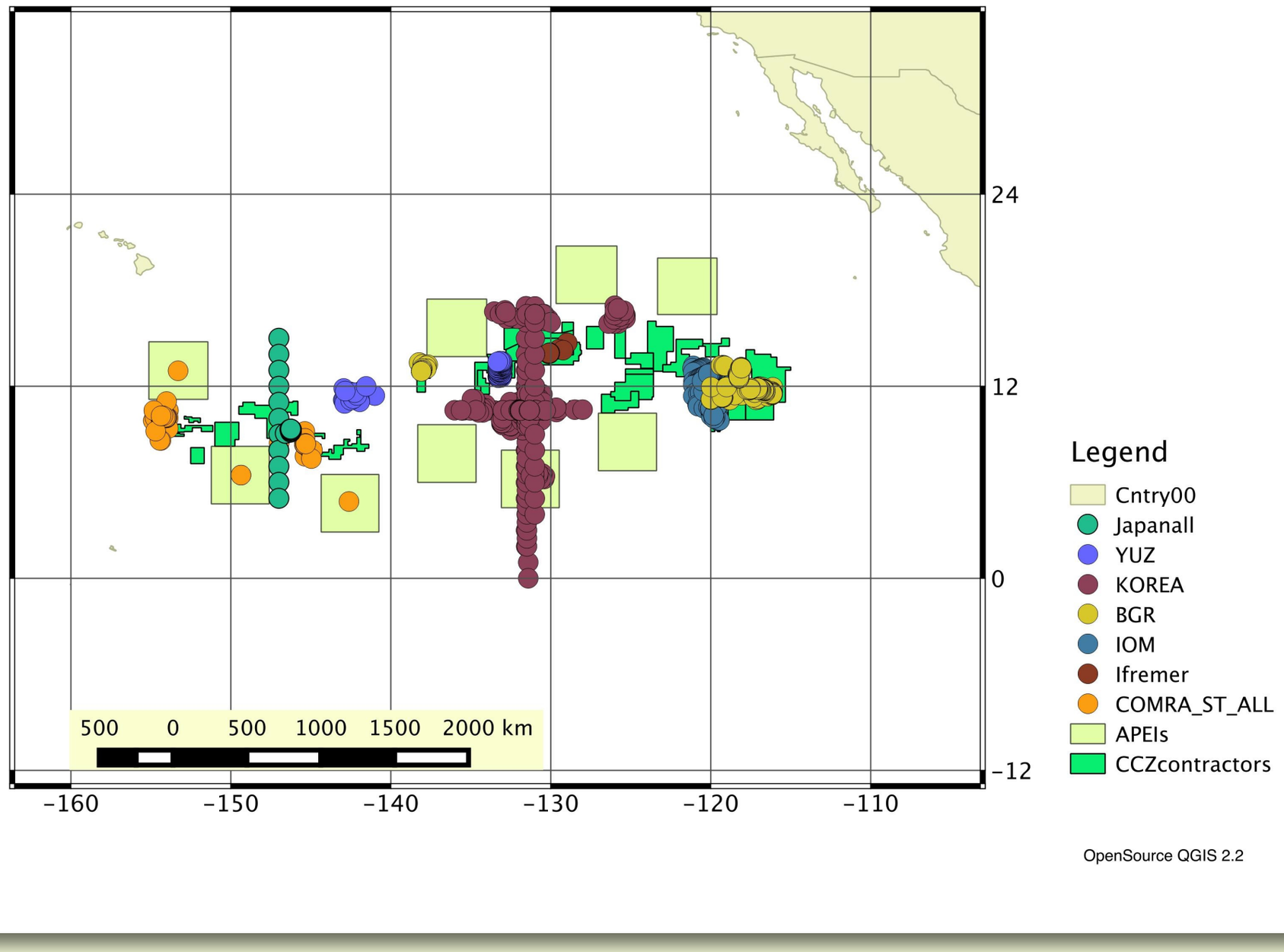
Same general metadata heading for sediment samples collected at the sediment water interface to sample **infauna**, plus the following specific information:

Method of sediment collection: box corer, multiple corer, gravity core, piston core, grab sampler, etc
Method of sediment processing (handling): sieving mesh size, fixation, sorting, preservation
Genomics sampling technique: identify individual sampled for DNA, RNA, extraction technique, preservation method, amplification method and sequence strategy, etc,
Sample storage location: Institution and conditions, fixed, deep freezer, etc
Taxonomic Identification key used and operator:
Accessibility
Contact Information (email)

Compulsory Parameters

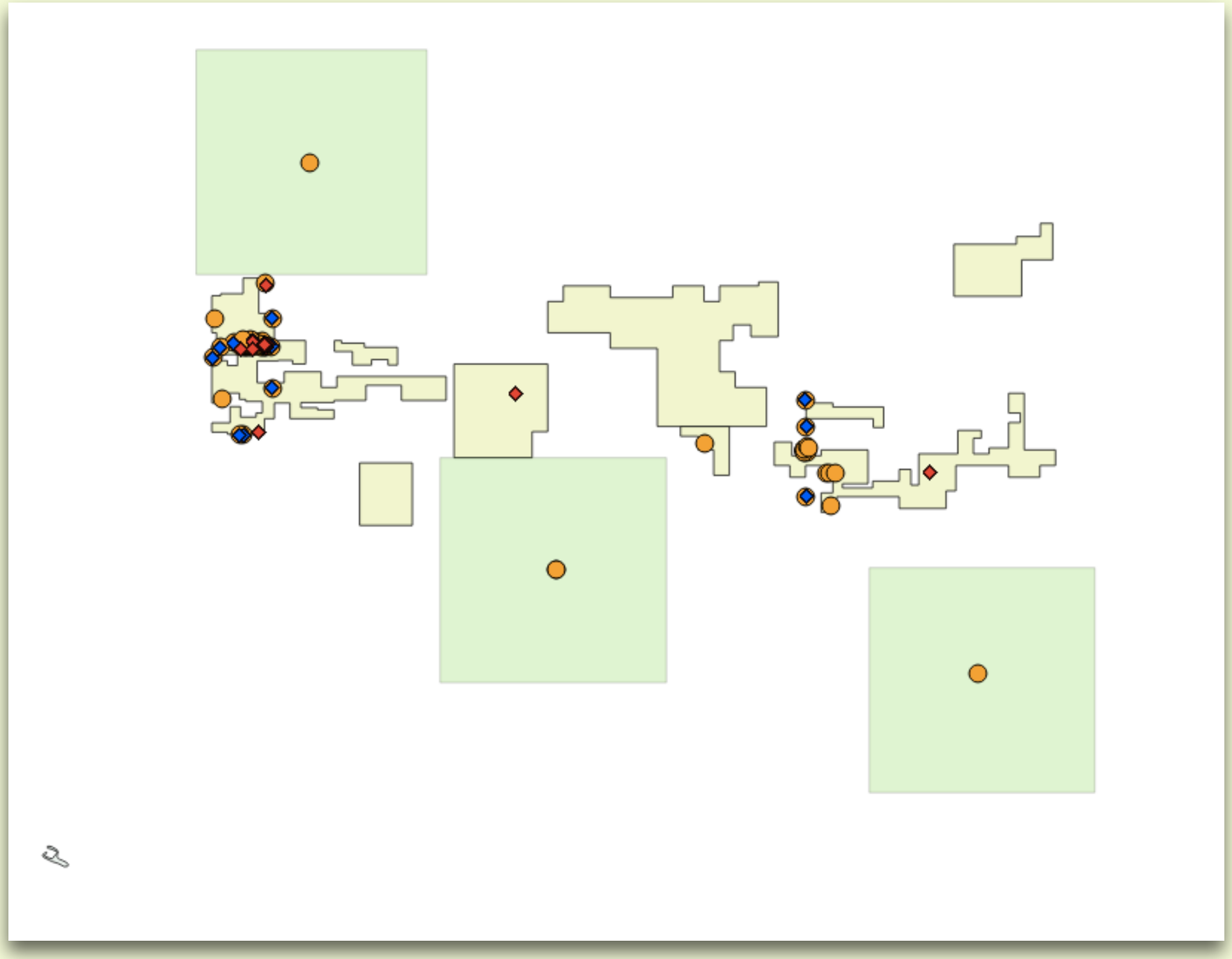
Taxonomic Identification: lower level possible, genus and species level
Biomass = dry weight mg
Abundance = number of individuals per OUT (Operational Taxonomic Unit)
Density = number of individuals per unit of area/volume
Relative abundance = %
Dominance = %
Genebank = sequence number
Taxonomist Reporting= traceability

International Seabed Authority



Geographically good coverage go the CCFZ.

International Seabed Authority



brown dots = Stations reported (except APEIs)

blue dots = Nutrient data (water & sed. column)

red dots = CTD data

Environmental Data Assimilation Exercise - June 2014

International Seabed Authority

Global Deep Sea Environmental Database

Universality of Database Integration:

Any platform: Unix, MacOS, Windows##, Linux

spreadsheet any format: no size limit

SDN Format

Seabird CNV format

ARGO format

Medatlas Format (Ifremer

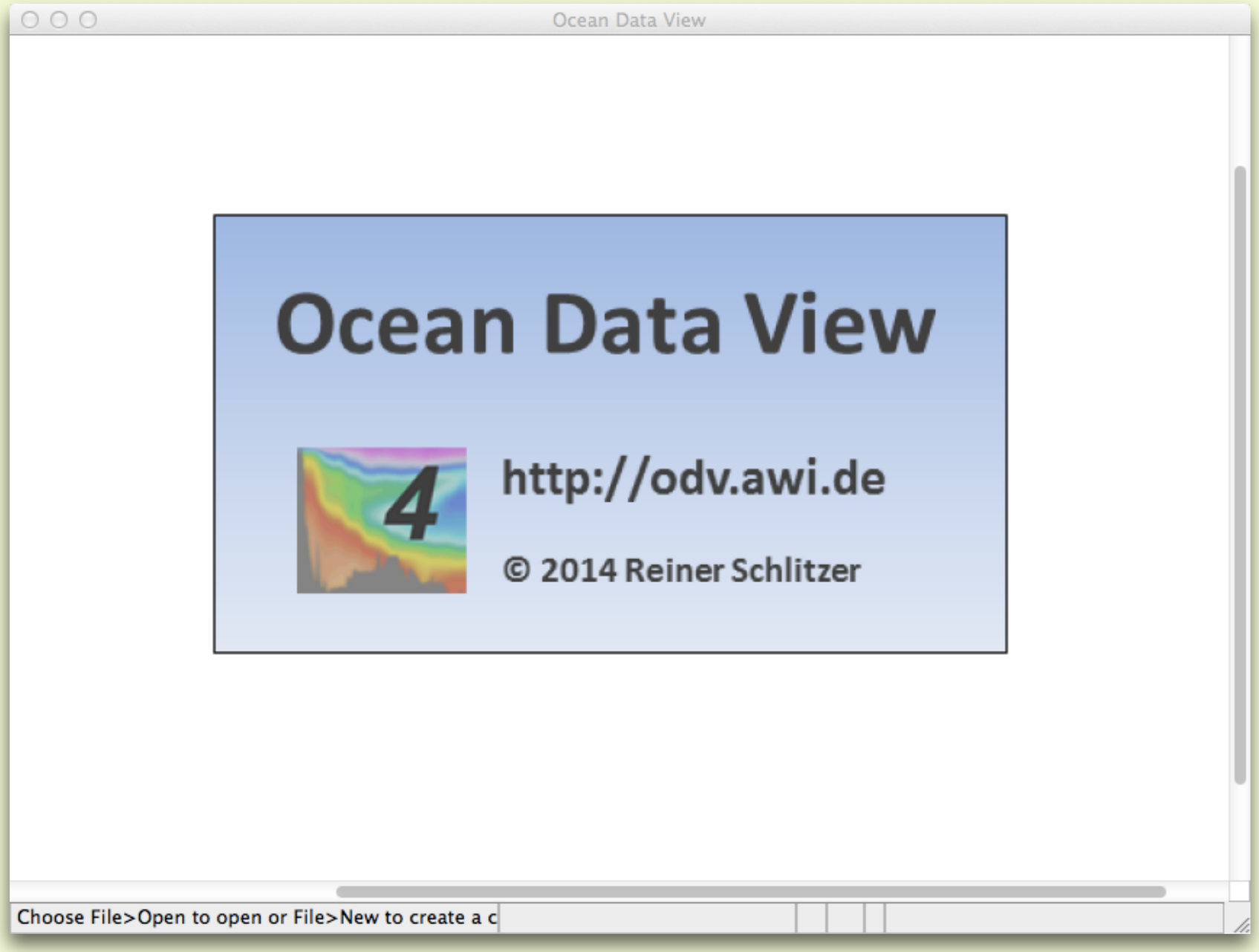
GTSPP format

World Ocean Database

WOCE data format

Open Source software only: OpenOffice and Ocean Data View

Temporary Database Used: Open Source, platform independent - Ocean Data View



Global Deep Sea Database [only 3 contractors included]

	A	B	C	D	E	F	G	H
1	Cruise	station	year	type	Lon	Lat	depth[m]	Bott.depth][m]
81214	DY115	DY115-20 WS0804-CTD	2008.07.14 / 06:30	B	**-154.00465**	**10.00475**	5109.00	4878.00
81215	DY115	DY115-20 WS0804-CTD	2008.07.14 / 06:30	B	**-154.00465**	**10.00475**	5109.00	4879.00
81216	DY115	DY115-20 WS0804-CTD	2008.07.14 / 06:30	B	**-154.00465**	**10.00475**	5109.00	4880.00
81217	DY115	DY115-20 WS0804-CTD	2008.07.14 / 06:30	B	**-154.00465**	**10.00475**	5109.00	4881.00

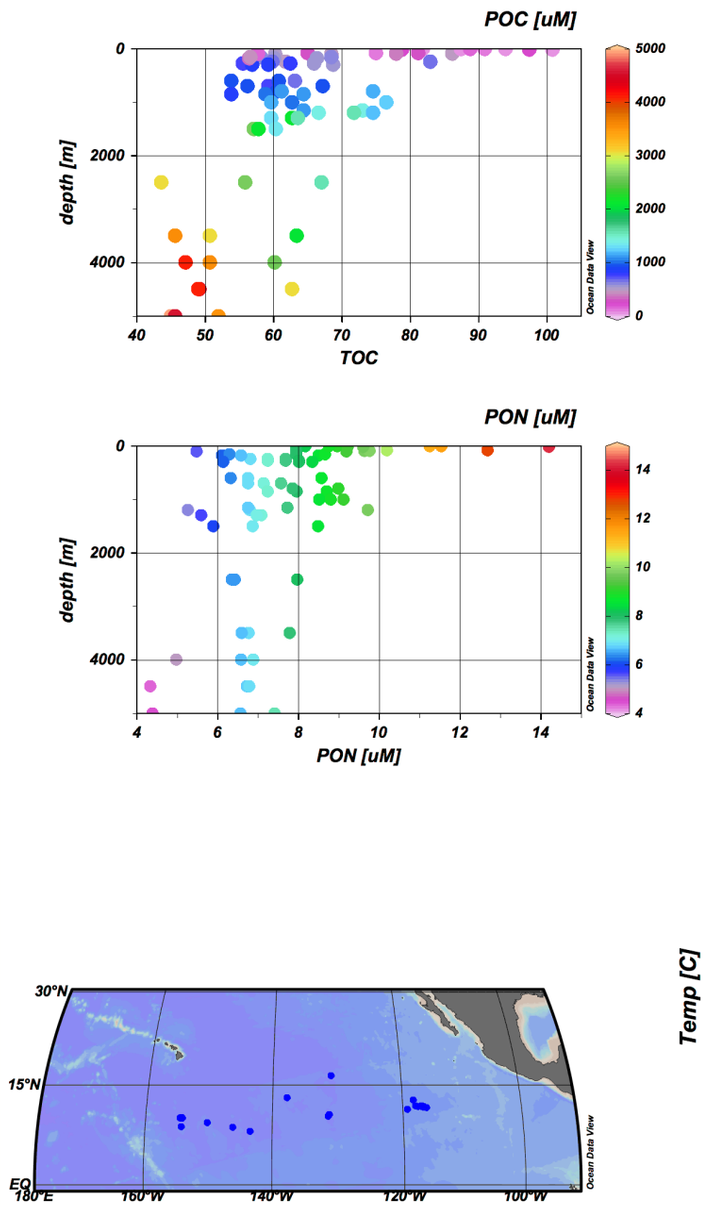
	I	J	K	L	M	N	O	P	Q
1	Temp[C]	PSU	Density[kg m3	SV[m s-1]	Conductivity[sm-1]	DO [mg l-1]	TOC [uM]	PON[uM]	POC[uM]
81214	1.40	34.76	50.11	1539.30	3.20				
81215	1.40	34.76	50.11	1539.31	3.20				
81216	1.40	34.76	50.12	1539.33	3.20				

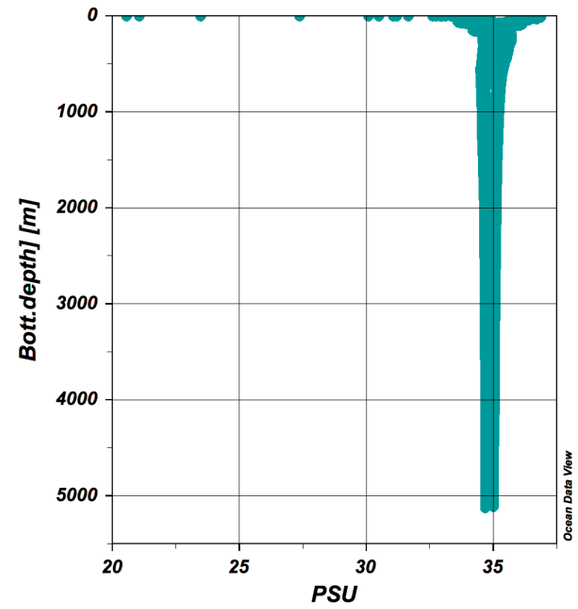
	N	O	P	Q	R	S	T	U
1	DO [mg l-1]	TOC [uM]	PON[uM]	POC[uM]	Sidepth[m]	Si[uM]	Pdepth[m]	PO4-P[uM]
81214								
81215								
81216								

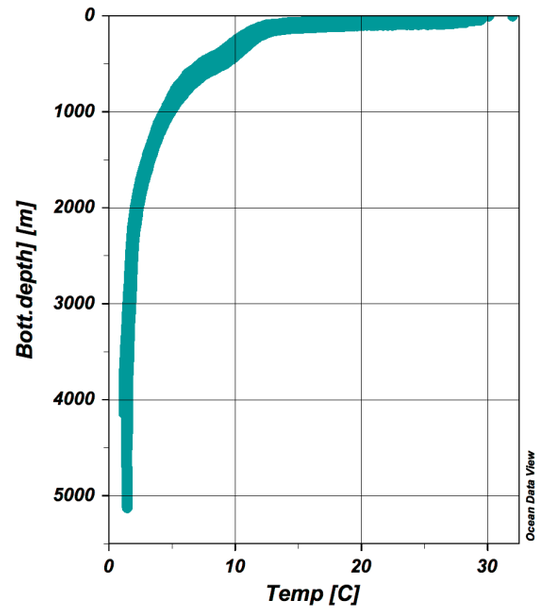
CTD and Nutrients

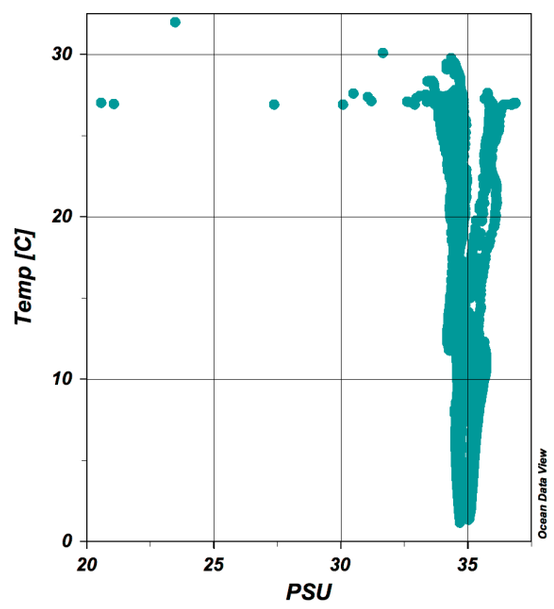
Global Deepsea Environmental Database (GDED-ISA)

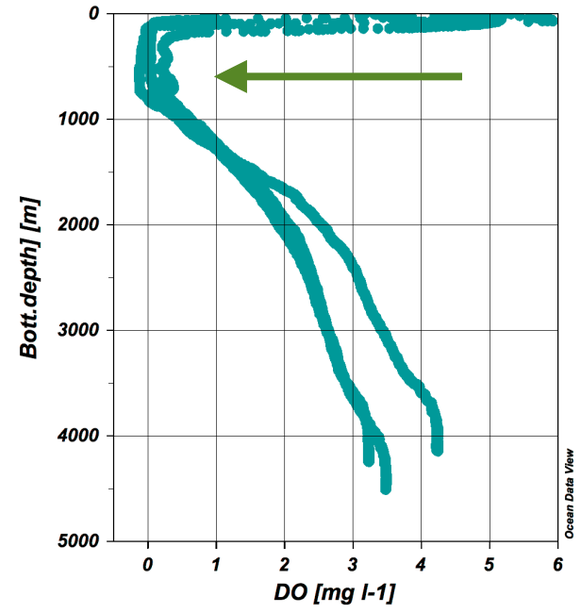
WATER COLUMN
CTD and Nutrients



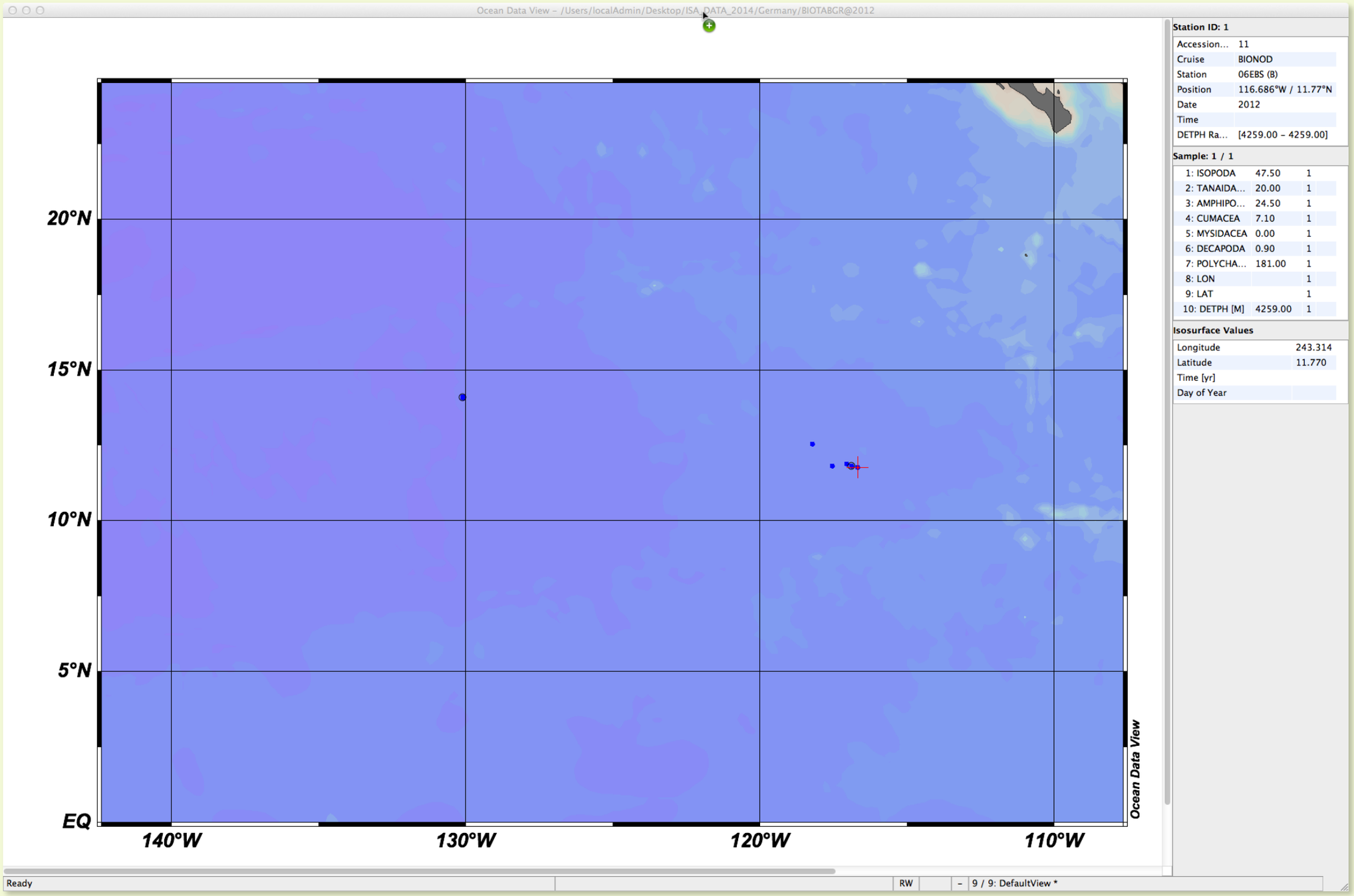






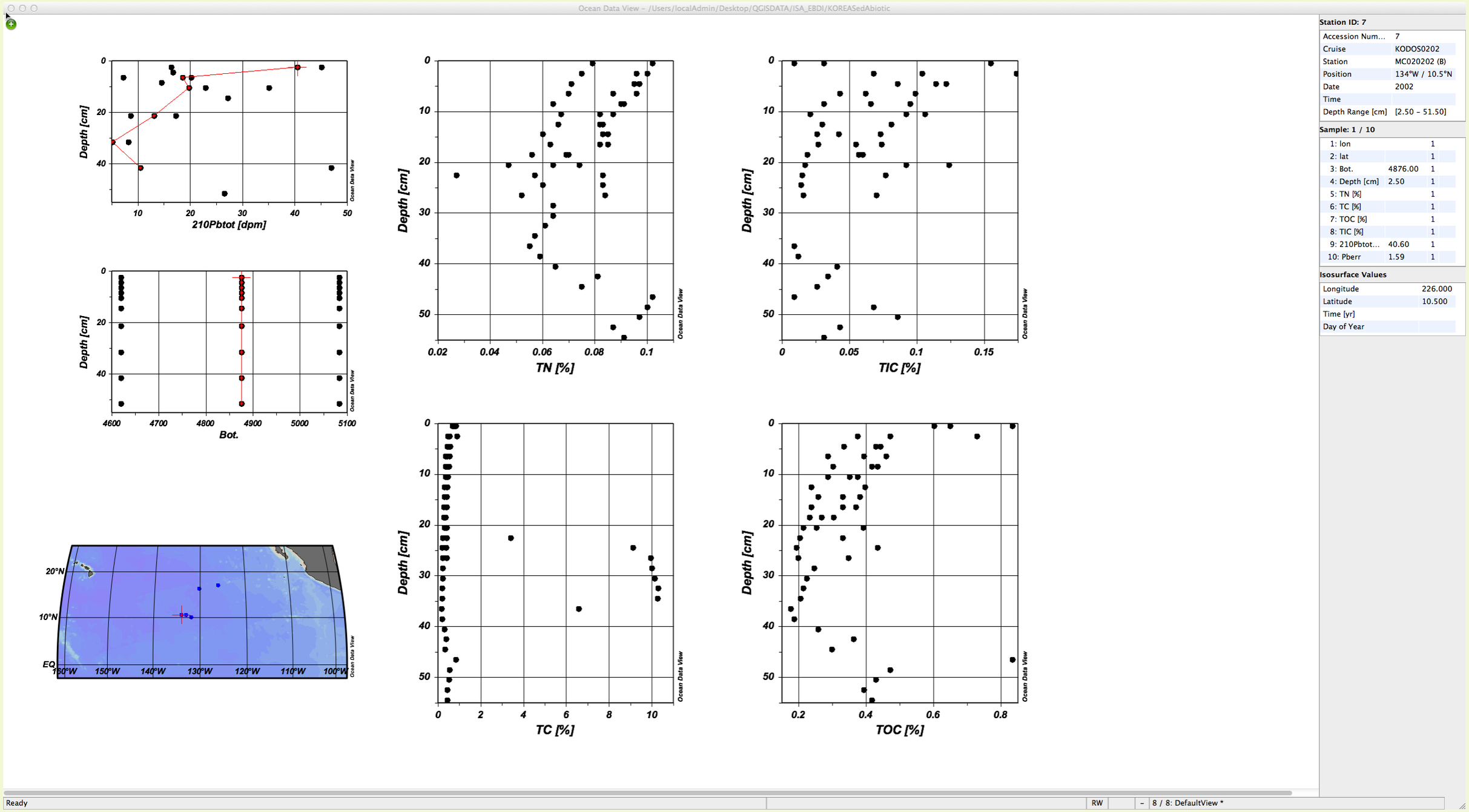


Global Deepsea Environmental Database (GDED-ISA)

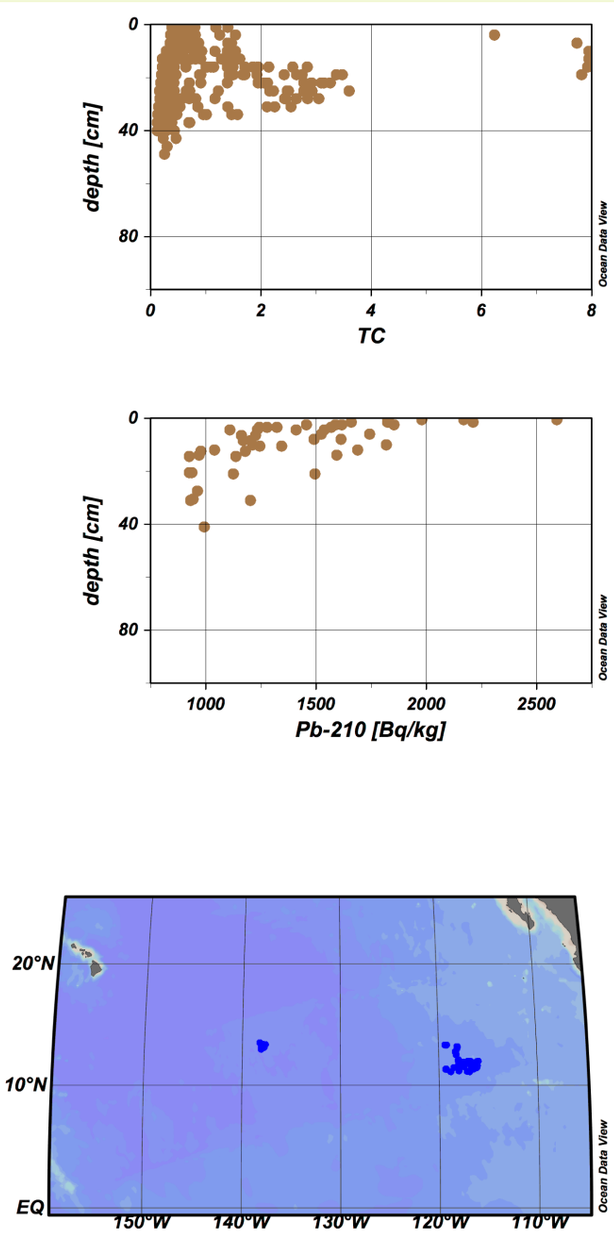


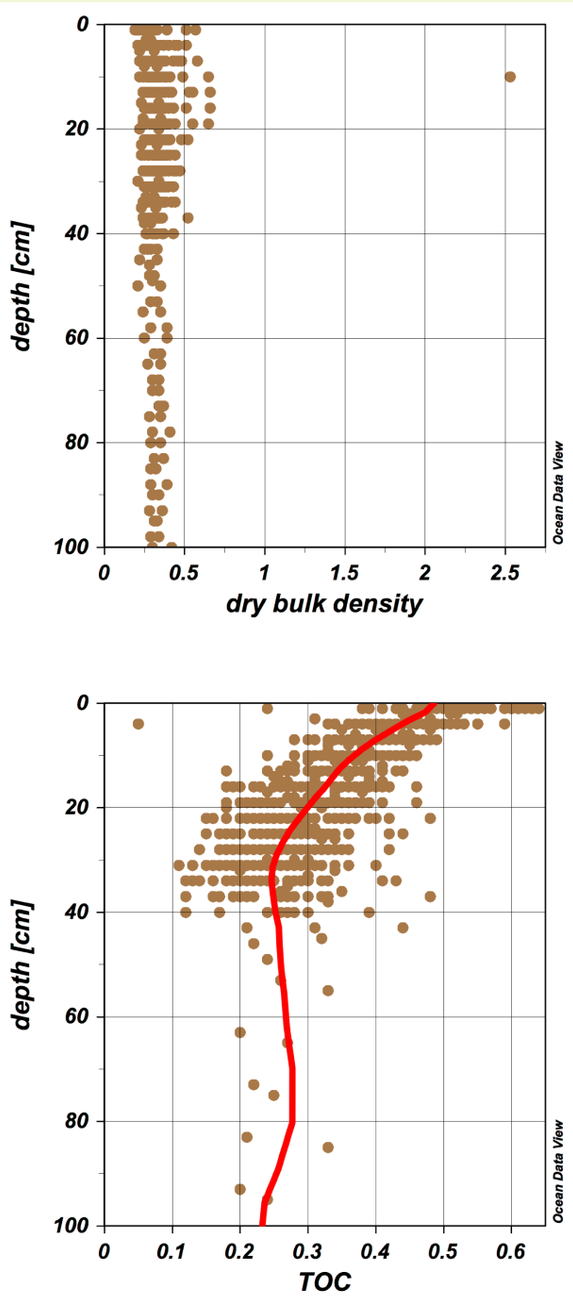
BIOTA: Crustacea Data

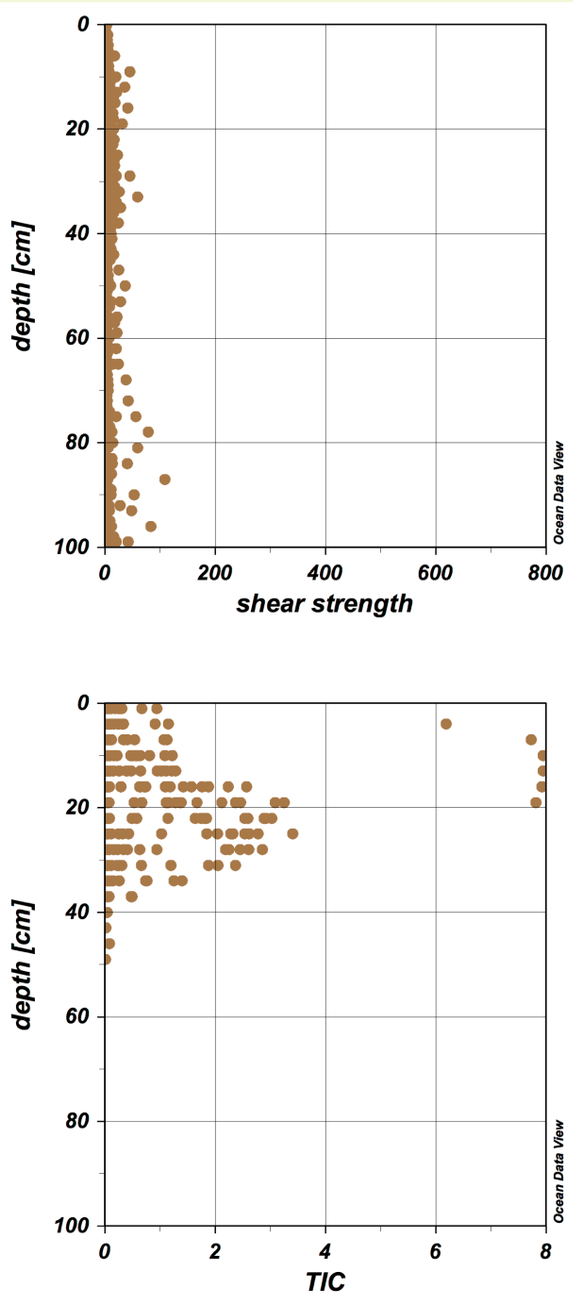
Global Deepsea Environmental Database (GDED-ISA)



Global Deepsea Environmental Database (GDED-ISA)





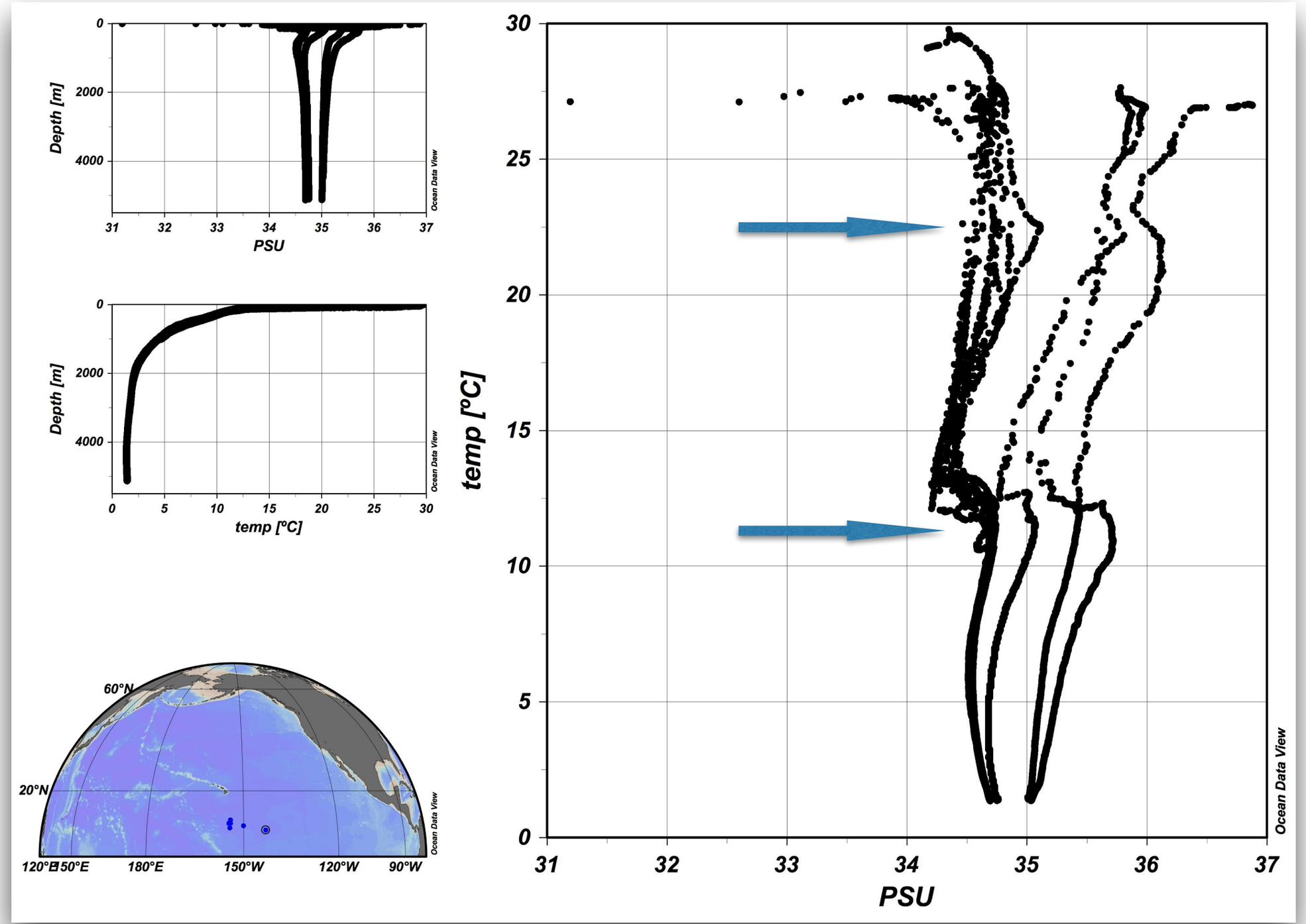


151 Sediment Column Data: Texture, Tracers, Nutrients profiles

Tracers data allows derived integrative variables - sedimentation rates, biological mixing rates, constituents inventories

Global Deep Sea Environmental Data

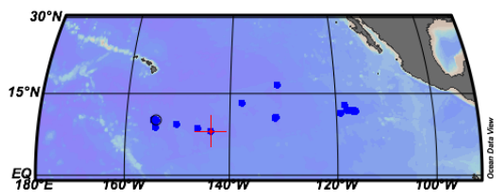
Physical Properties of Water Column

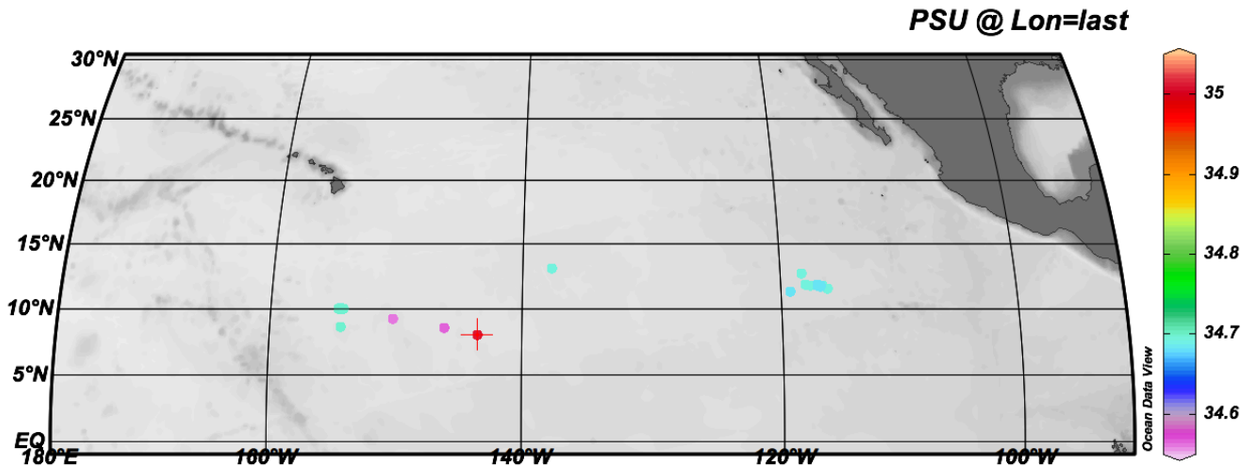


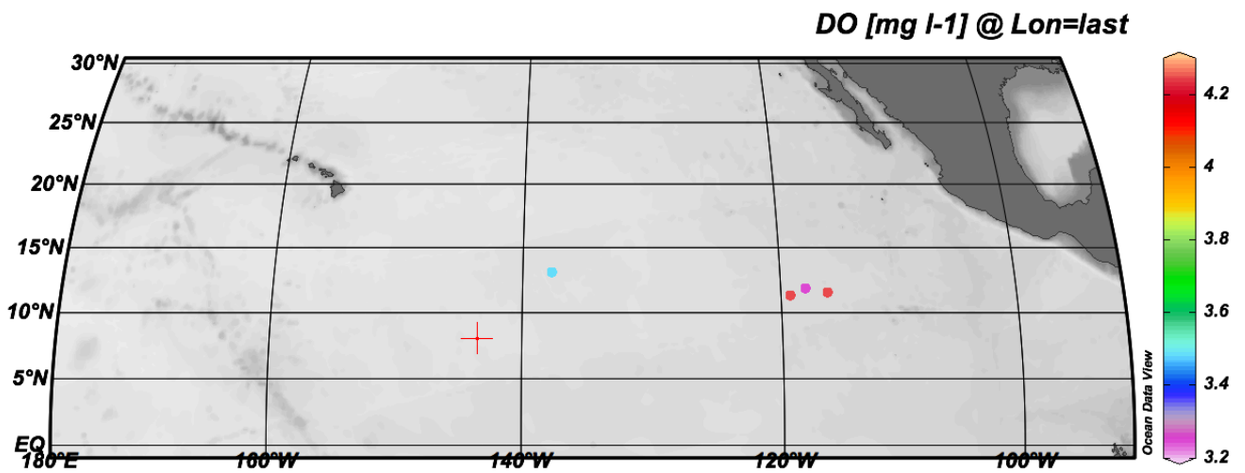
Open Source software only: OpenOffice and Ocean Data View

Global Deep Sea Environmental Database Data Universe

Ocean Data View – /Users/localAdmin/Desktop/QGISDATA/DatabaseGEDB/GDDB







Station ID: 15

Accession…	15
Cruise	DY115-20
Station	E0801-CTD (B)
Position	143.391°W / 8.024°N
Date	
Time	
Bott.dept…	[5.00 – 5119.00]

Sample: 1 / 5115

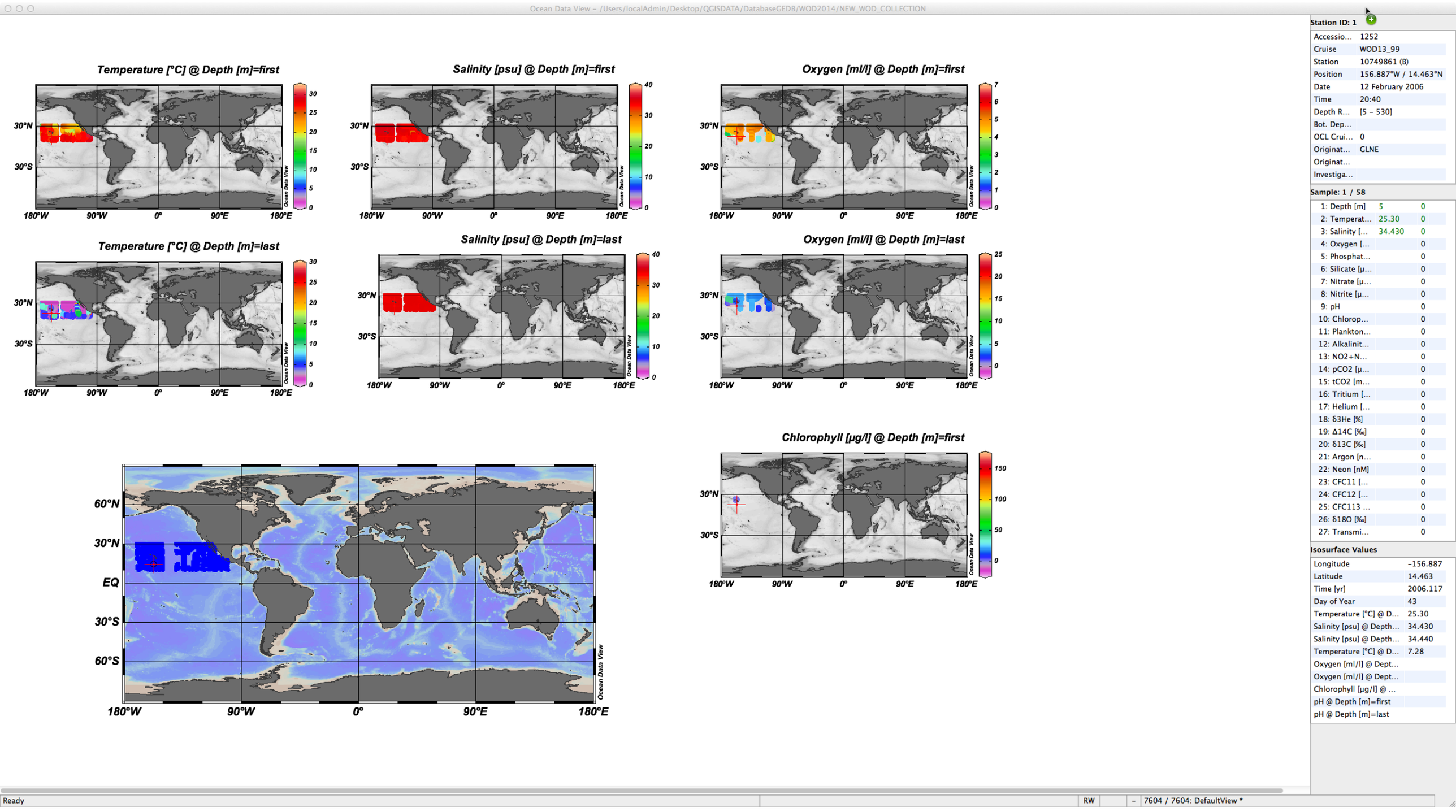
1: Lon		1
2: lat		1
3: depth [m]	5119.00	1
4: Bott.dept…	5.00	1
5: Temp [C]	27.63	1
6: PSU	35.78	1
7: DO [mg l…		1
8: DENS [KG…		1
9: SV [M/S]		1
10: COND [S…		1
11: TOC		1
12: [uM]		1
13: PON [uM]		1
14: POC [uM]		1
15: Sidepth […		1
16: Si [uM]		1
17: Pdepth [m]		1
18: PO4-P [u…		1
19: Tndepth …		1

Isosurface Values

Longitude	216.609
Latitude	8.024
Time [yr]	
Day of Year	
PSU @ Lon=first	35.78
DO [mg l-1] @ Lon=first	
TOC @ Lon=first	
Temp [C] @ Lon=first	27.63
Temp [C] @ Lon=last	1.47
PSU @ Lon=last	35.01
DO [mg l-1] @ Lon=last	

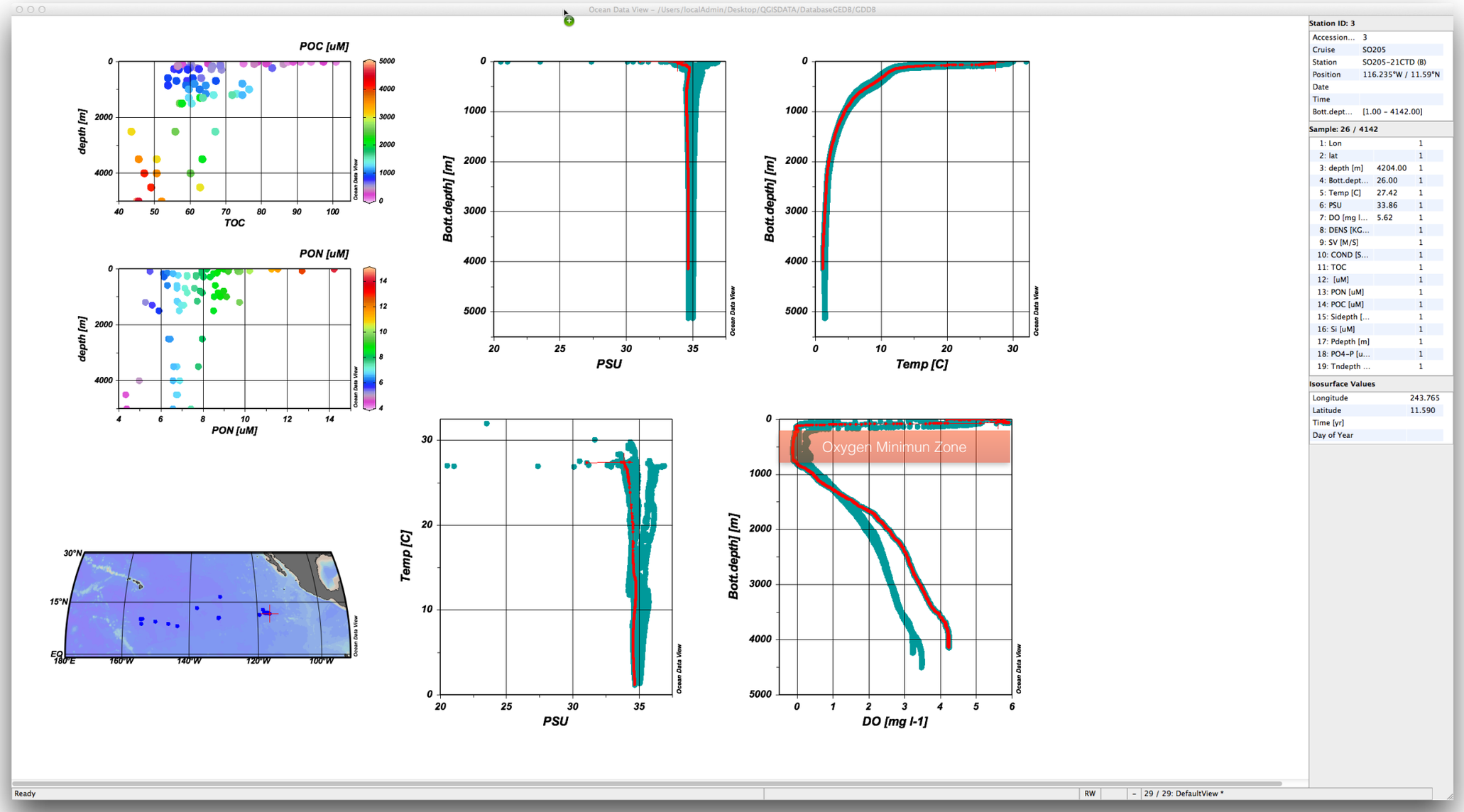
Ready | RW | – | 29 / 29: DefaultView *

Global Deep Sea Environmental Database + World Ocean Database



Global Deep Sea Environmental Data

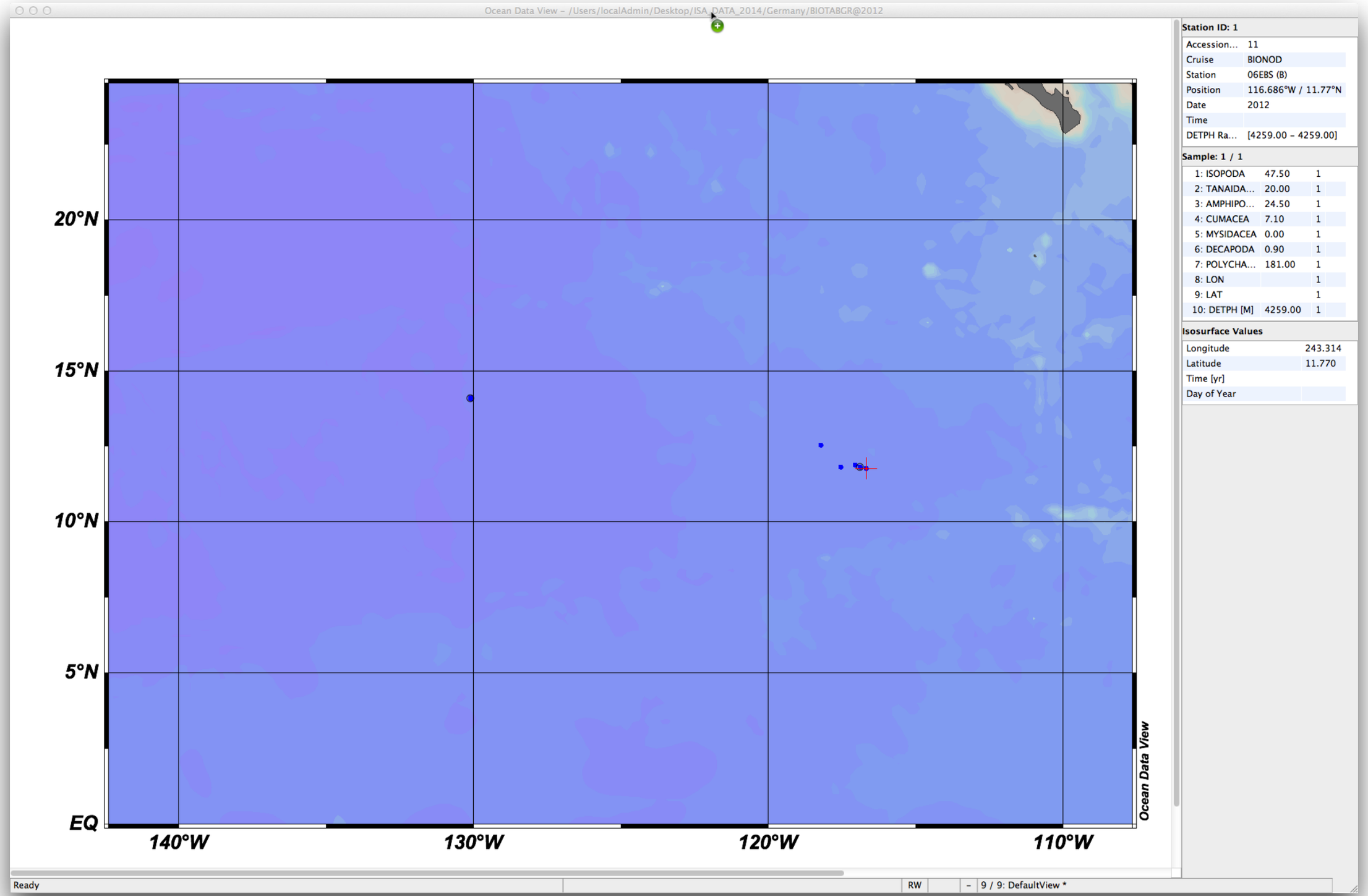
Physical- Chemical Properties of Water Column for the CCFZ



Open Source software only: OpenOffice and Ocean Data View

Global Deep Sea Environmental Data

Biota example: Crustacean abundances



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Database Design

DATABASE DESIGN

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