



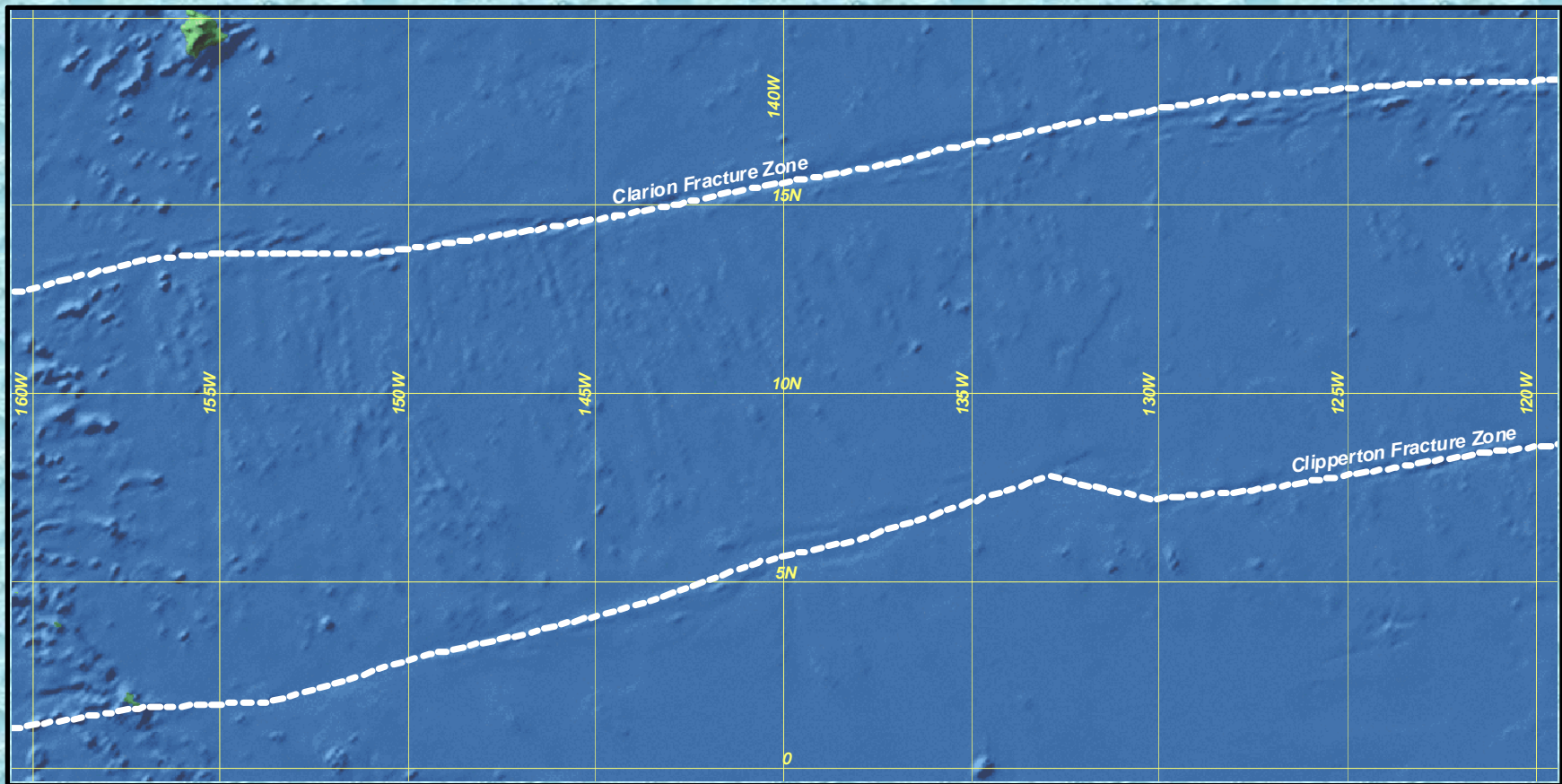
# Review of Data used for the Geological Model

**Vijay Kodagali**

**International Seabed Authority**

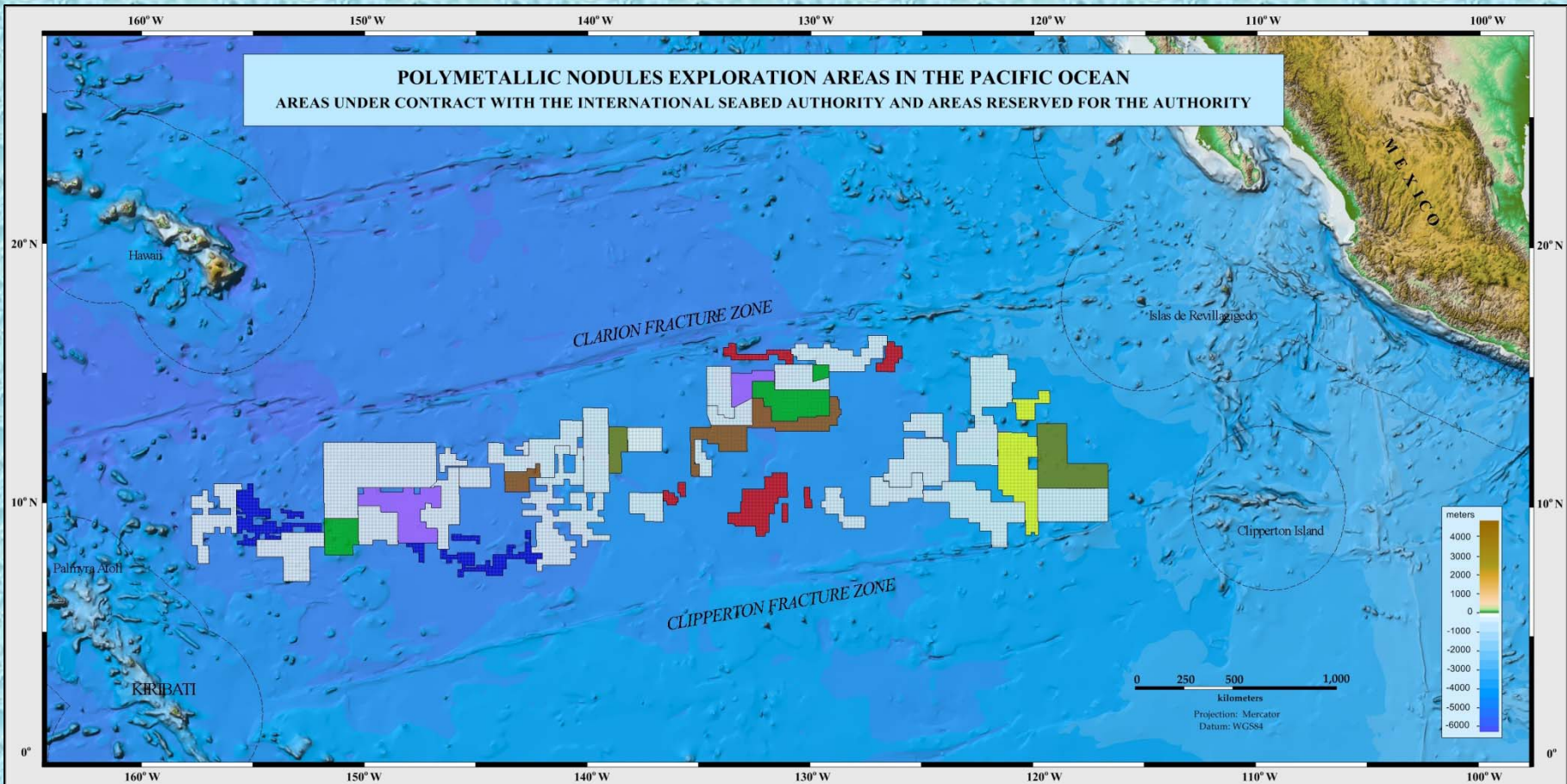
**Workshop on the Results of a Project to Develop a Geological model of Polymetallic Nodule  
Deposits in the Clarion-Clipperton Zone  
Kingston, Jamaica 14-17 December, 2009**

# AREA OF INTEREST: 110° – 160° W; 0° – 20° N





**POLYMETALLIC NODULES EXPLORATION AREAS IN THE PACIFIC OCEAN**  
**AREAS UNDER CONTRACT WITH THE INTERNATIONAL SEABED AUTHORITY AND AREAS RESERVED FOR THE AUTHORITY**



**Legend**

<b>Contractor Areas</b>	Reserved Areas
COMRA (China)	Limits of Exclusive Economic Zones (indicative only; Source: VLIZ)
DORD (Japan)	
Government of Korea	
IFREMER (France)	
Interoceanmetal	
Yuzhmorgeologia (Russian Federation)	
BGR (Germany)	



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# ISA

- *Coordinated the efforts of contractors and consultants.*
- *Setting up secured FTP and VPN sites for the Model Program*
- *Periodic Review of the program*
- *Presenting mid-term results/progress to Authority's bodies -LTC and Council.*
- *Peer review of the draft documents.*
- *Final Workshop and publishing the results.*





## Consultants and Contractors

- *Contractors- Provided Additional Data, provided services of experts. Permitted use of confidential data.*
- *Independent experts identified as consultants- Some consultants provided additional data.*
- *Dr C Morgan acted as chief consultant- in addition to his contribution in Biogeochemical model, resource evaluation and Sediment data analysis, helped in assimilation of results from other consultants and drafted the final products.*



# ISA's secured FTP/VPN site

- Bathymetry data from the public domain.
- Additional data acquired from contractors for GeoModel Program.
- Data/reports submitted by consultants
- Digitization and geo-referencing of bathymetric maps provided by Pioneer Investors.





- **Consultants**
- **Directories for each consultants they can place their reports data etc. directly here.**
- **Reports-data submitted by consultants**
- **Contractors**
- **IOM-COMRA-KORDI-DORD data**
- **Reformatted data for use of consultants**



- Bathymetry – additional data from COMRA-KORDI and IOM
- GEBCO DATA in excel format
- GEBCO DATA from CCZ in ASCII-XYZ format (zipped files)
- Bathymetry – (From Dr L Parson)
- Report, fly through, GMT grids etc.





# ***GEOLOGICAL MODEL: DATA COLLECTION***

## **PROXY DATA**

- *BATHYMETRY*
- *TECTONIC/VOLCANIC DATA*
- *SEDIMENT DATA*
- *NODULE MORPHOLOGY*
- *WATER COLUMN DATA*
- *BIOLOGICAL DATA*

## **RESOURCE DATA**

- *ABUNDANCE*
- *MANGANESE*
- *NICKEL*
- *COPPER*
- *COBALT*



# Central Data Repository

- **Sources of Data :**
  - **Scientific and technical bodies, including, Geological Survey of Canada, National Geophysical Data Center (USA), National Oceanic and Atmospheric Administration (USA), Scripps Institution of Oceanography (USA), United States Geological Survey Inter-Ridge and others.**





# Summary of Data Inventory

Data Type	Nodules
Geochemical elements	2,753 records
Sample data	2,753 rec.
Reduced Data Set	
Major Elements	2,753 rec.
Deposits	
Analysis Methods	
Bibliography	
Main Source of Data	US-NGDC
Marine minerals bibliography	~2500 records



# Data from the contractors

- COMRA, China
- KORDI Republic of Korea
- InterOcean Metal Joint Organization
- DORD, Japan
- IFREMER

Data/reports are in a closed FTP site/VPN of the authority with access to all consultants.





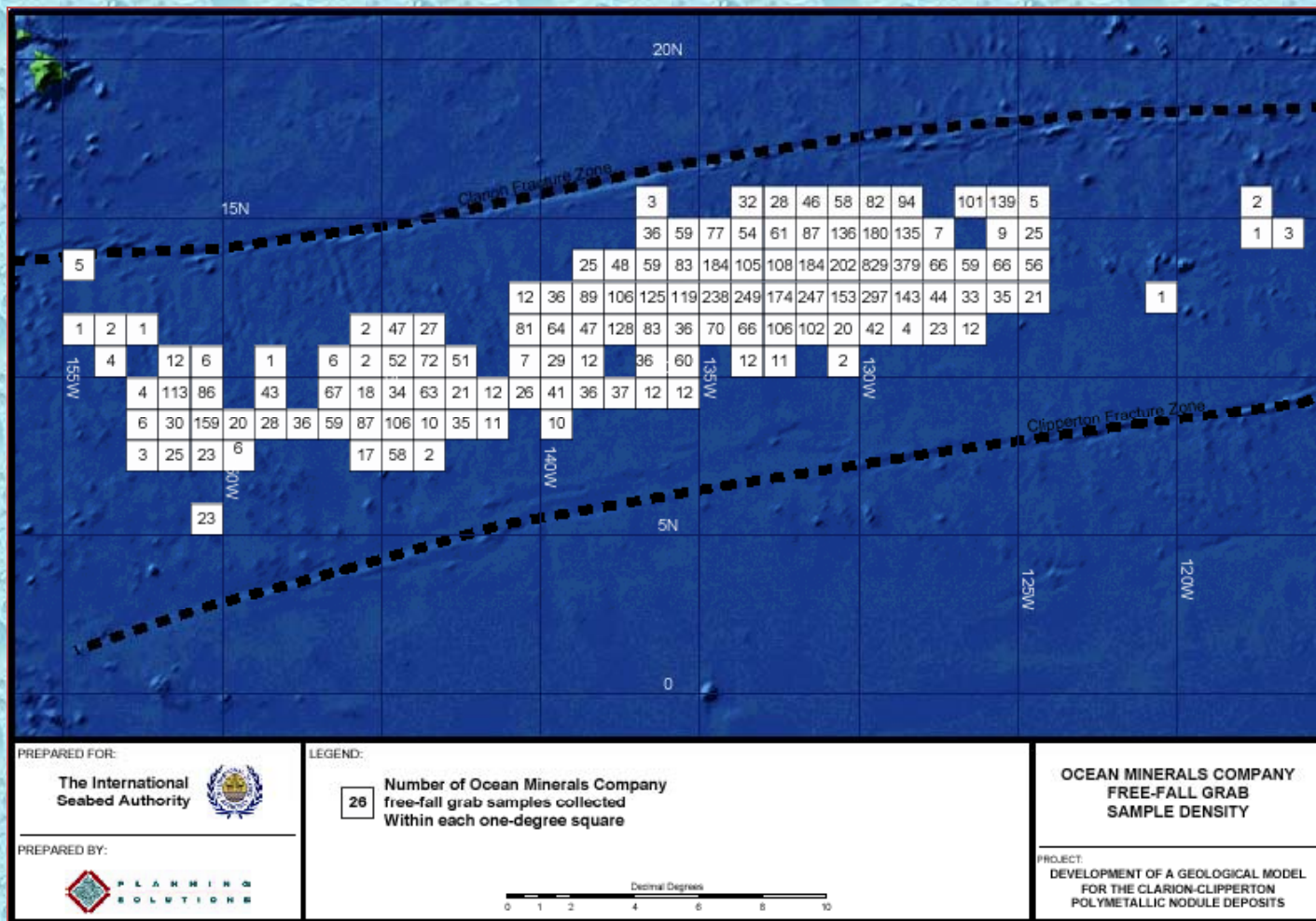
# Geological Model Additional Data

- Contractors
- Consortia
- Scientific Organizations
- Others



# Geological Model

## Sources of data





## KORDI Republic of Korea

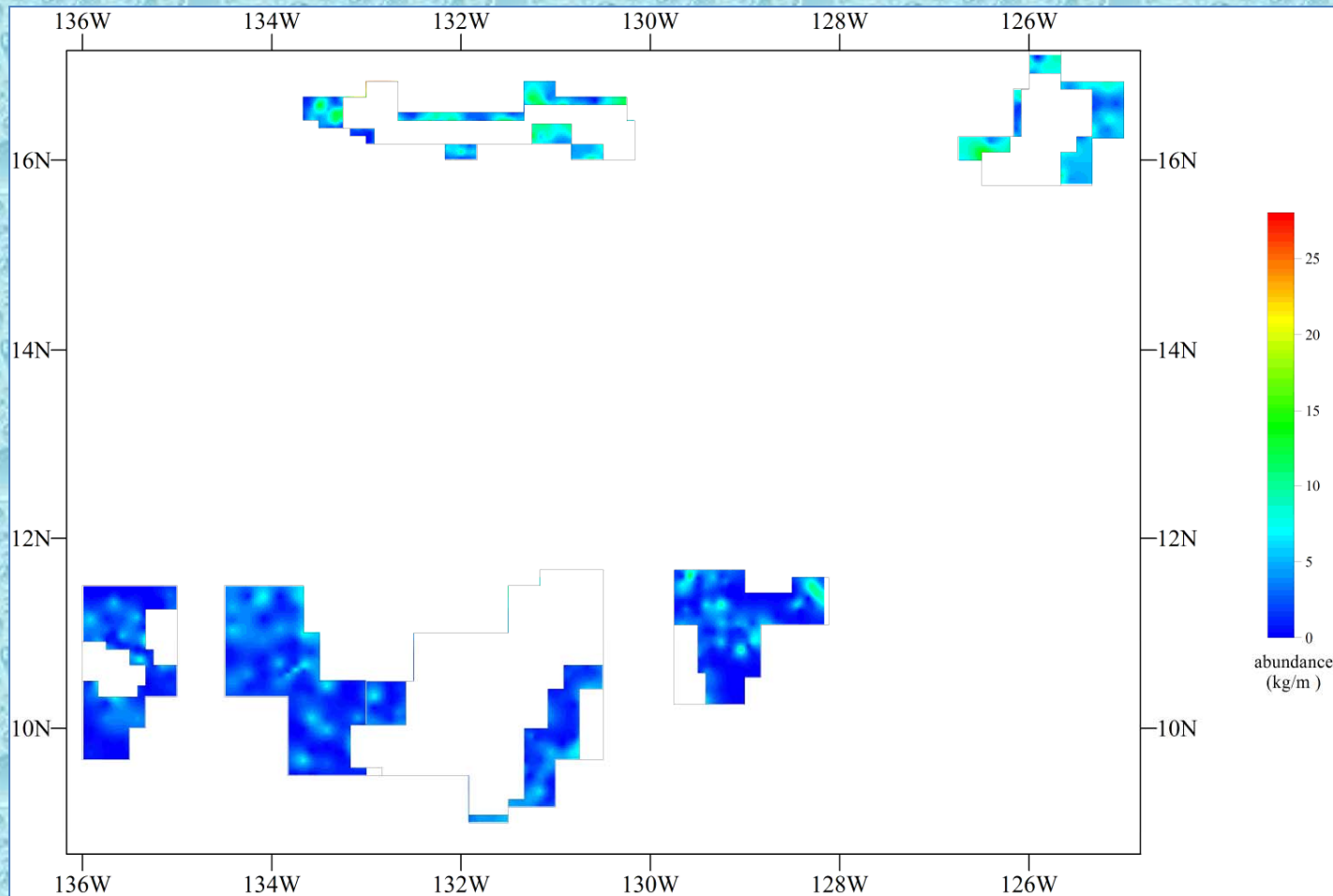
<b>Nodule Morphology and size</b>	<b>1339 data points in the contract area</b>
<b>Accumulation rate/age of nodules</b>	<b>Data from published papers provided</b>
<b>Sediment Distribution (facies) and thickness</b>	<b>Thickness of 4 lithologic units- 266 stations</b>
<b>Relation between abundance and sediment distribution</b>	<b>81 stations outside the pioneer area.</b>
<b>Transparent layer</b>	<b>326 stations</b>
<b>Biology Primary Productivity</b>	<b>Data on present and paleo-Biological productivity of the water column in reserved relinquished and contractor areas.</b>

Content	COMRA	KORDI
Polymetallic nodules data MFES abundance	241+536 station 50000 data points	232 stations outside the area
Gravity and Magnetic data	6610 points	Figures for free-air anomaly and magnetic intensity and magnetic anomaly provided
Meteorology	3396 points	
CTD	7 Profiles	
Bathymetric data	xyz and grd data around 250000 xyz points additional around 8300 xyz points single beam echosounding	Have provided multibeam data in 12 sectors in xyz format
Sialite data	440 points	
Sediment type	Around 1500	
Particle size of sediment	Around 200	
Deep tow photography	4 profiles data	

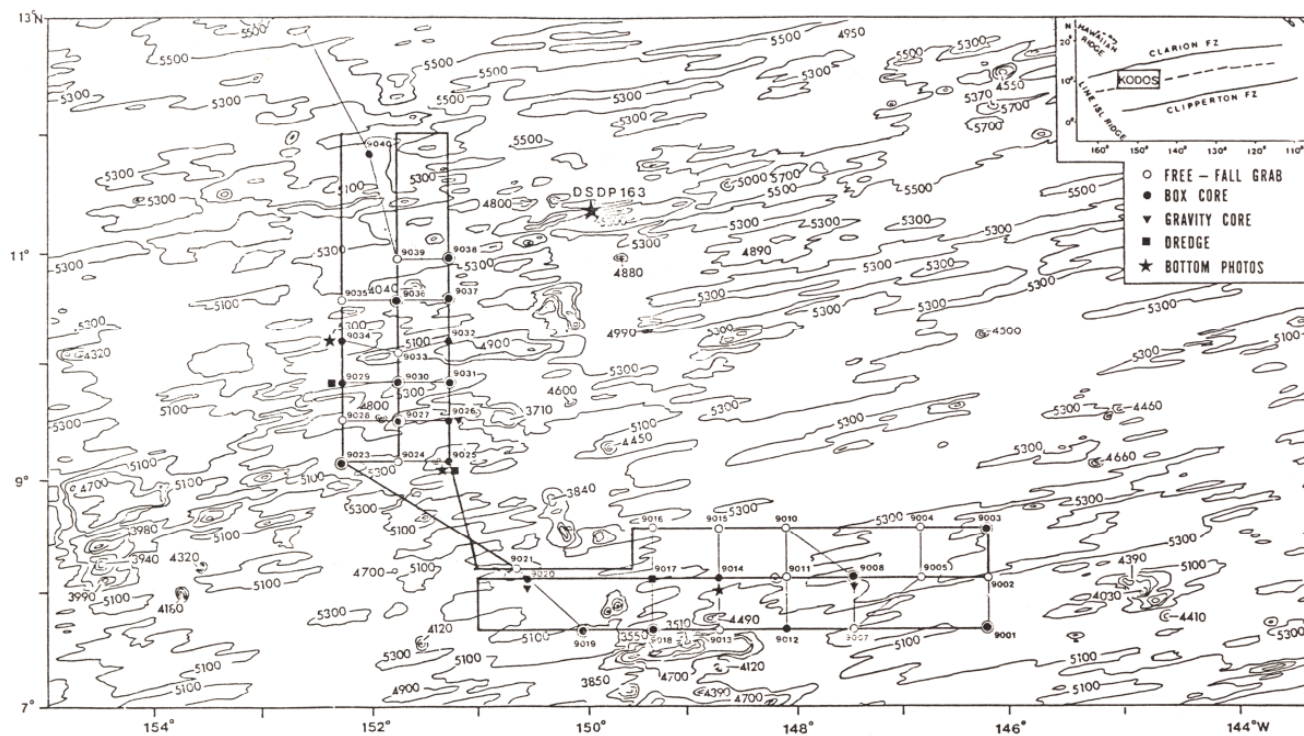
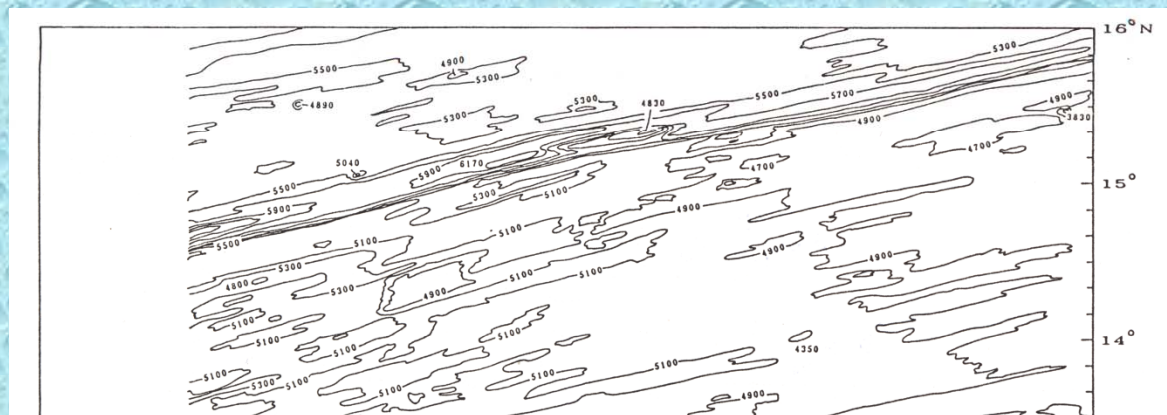




# KORDI Abundance from relinquished areas.

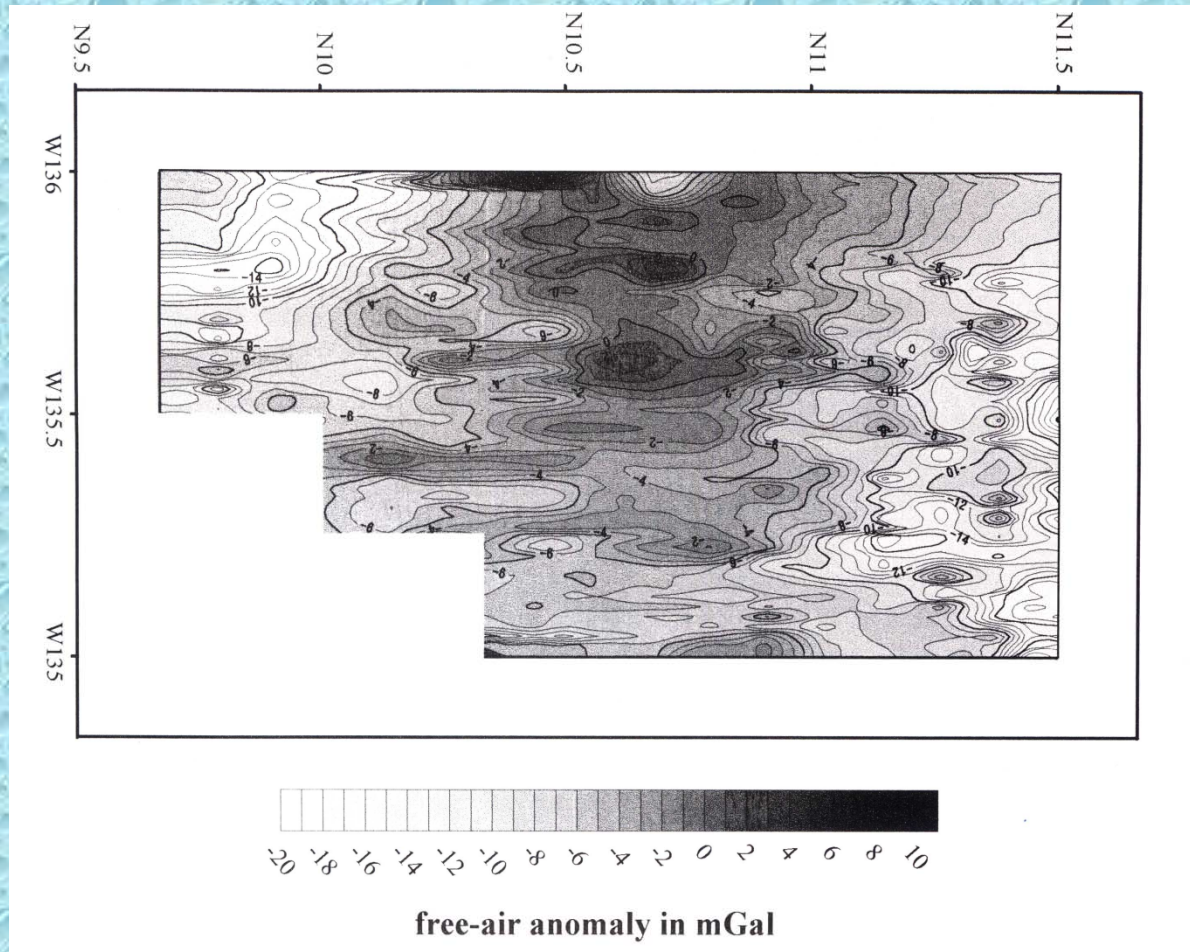


# KORDI BATHYMETRY





# KORDI FREE AIR ANOMALY



# DORD-JAPAN DATA

- 1450 data points- Mn/Fe ratio only

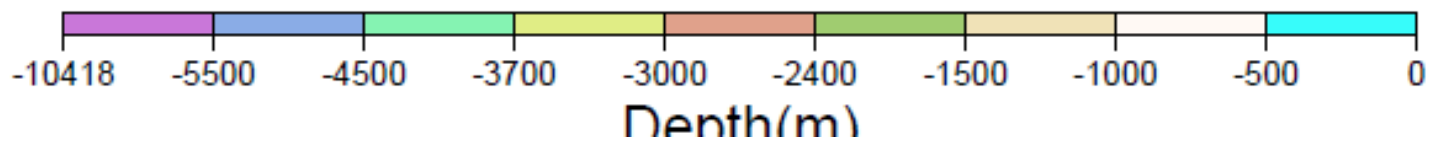
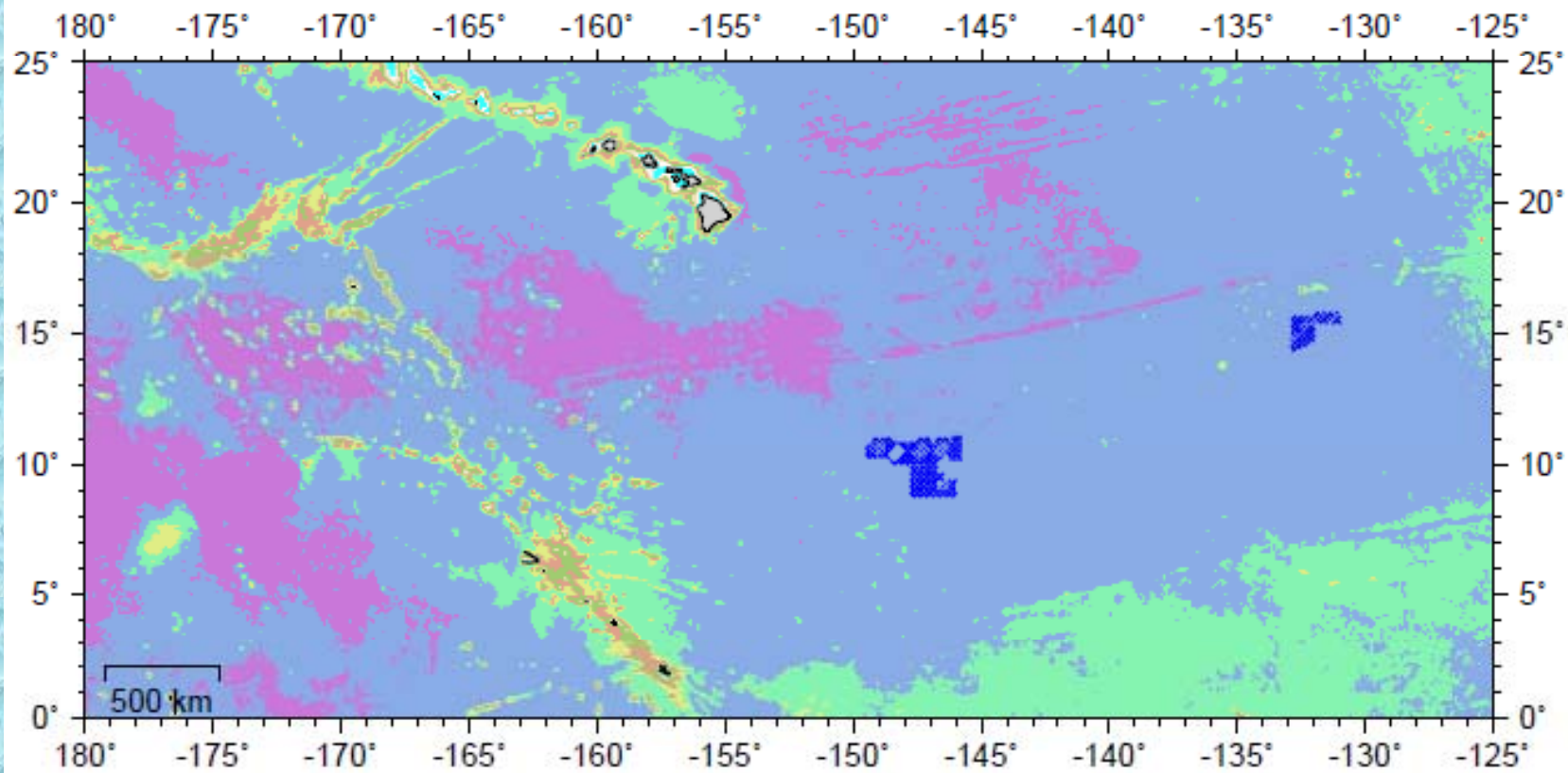
# IFREMER-France DATA

- Around 500 stations nodule abundance-grade data for data validation
- Sediment data





# DORD DATA (Depth & Mn/Fe)



<i>Data Source</i>	<i>CDR</i>	<i>KOREA</i>	<i>OMCO</i>	<i>COMRA</i>	<i>IOM</i>	<i>Totals After Screening</i>
<i># Stations: Abundance</i>	<b>253</b>	<b>329</b>	<b>7,738</b>	<b>52,473</b>	<b>790</b>	<b>61,583</b>
<i># Stations: Manganese</i>	<b>879</b>	<b>258</b>	<b>5,875</b>	<b>716</b>	<b>664</b>	<b>8,392</b>
<i>#Stations: Cobalt</i>	<b>711</b>	<b>258</b>	<b>5,900</b>	<b>716</b>	<b>664</b>	<b>8,249</b>
<i>#Stations: Nickel</i>	<b>799</b>	<b>258</b>	<b>5,923</b>	<b>716</b>	<b>664</b>	<b>8,360</b>
<i># Stations: Copper</i>	<b>882</b>	<b>258</b>	<b>5,924</b>	<b>714</b>	<b>664</b>	<b>8,442</b>



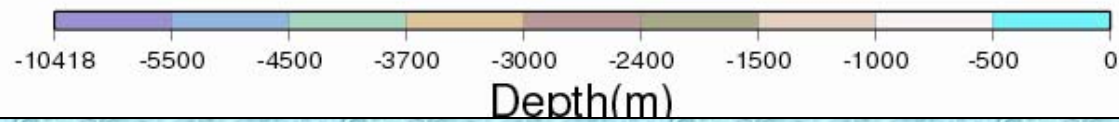
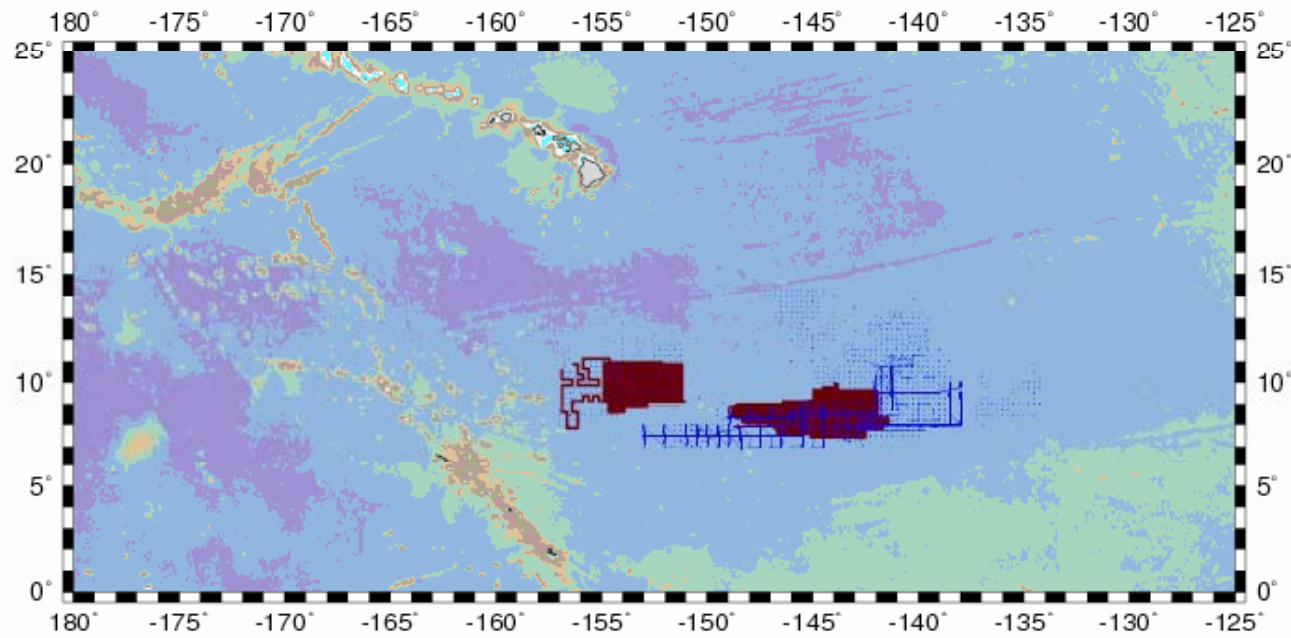


# Elementary statistics

	<i>Abundance (kg/m<sup>2</sup>)</i>	<i>Mn (%)</i>	<i>Co (%)</i>	<i>Ni (%)</i>	<i>Cu (%)</i>
<i>N of cases</i>	<b>61,583</b>	<b>8,392</b>	<b>8,249</b>	<b>8,360</b>	<b>8,442</b>
<i>Minimum</i>	<b>0.0</b>	<b>10.0</b>	<b>0.02</b>	<b>0.37</b>	<b>0.23</b>
<i>Maximum</i>	<b>44.1</b>	<b>41.1</b>	<b>0.5</b>	<b>1.78</b>	<b>1.99</b>
<i>Median</i>	<b>5.8</b>	<b>30.01</b>	<b>0.23</b>	<b>1.39</b>	<b>1.19</b>
<i>Mean</i>	<b>7.2</b>	<b>29.0</b>	<b>0.23</b>	<b>1.34</b>	<b>1.14</b>
<i>Standard Dev.</i>	<b>6.1</b>	<b>3.8</b>	<b>0.05</b>	<b>0.20</b>	<b>0.24</b>

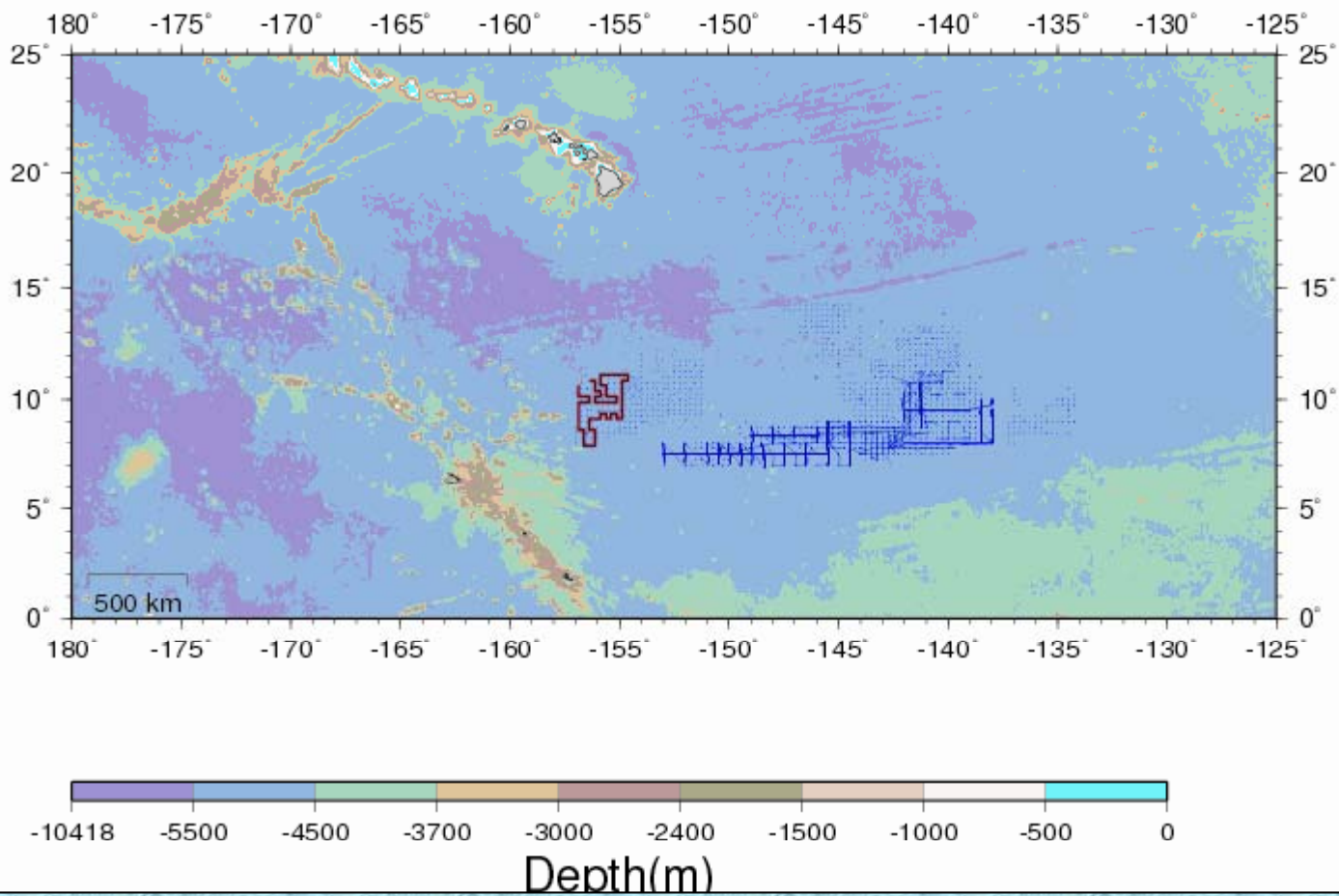


# COMRA DEPTH DATA IN THE CCZ

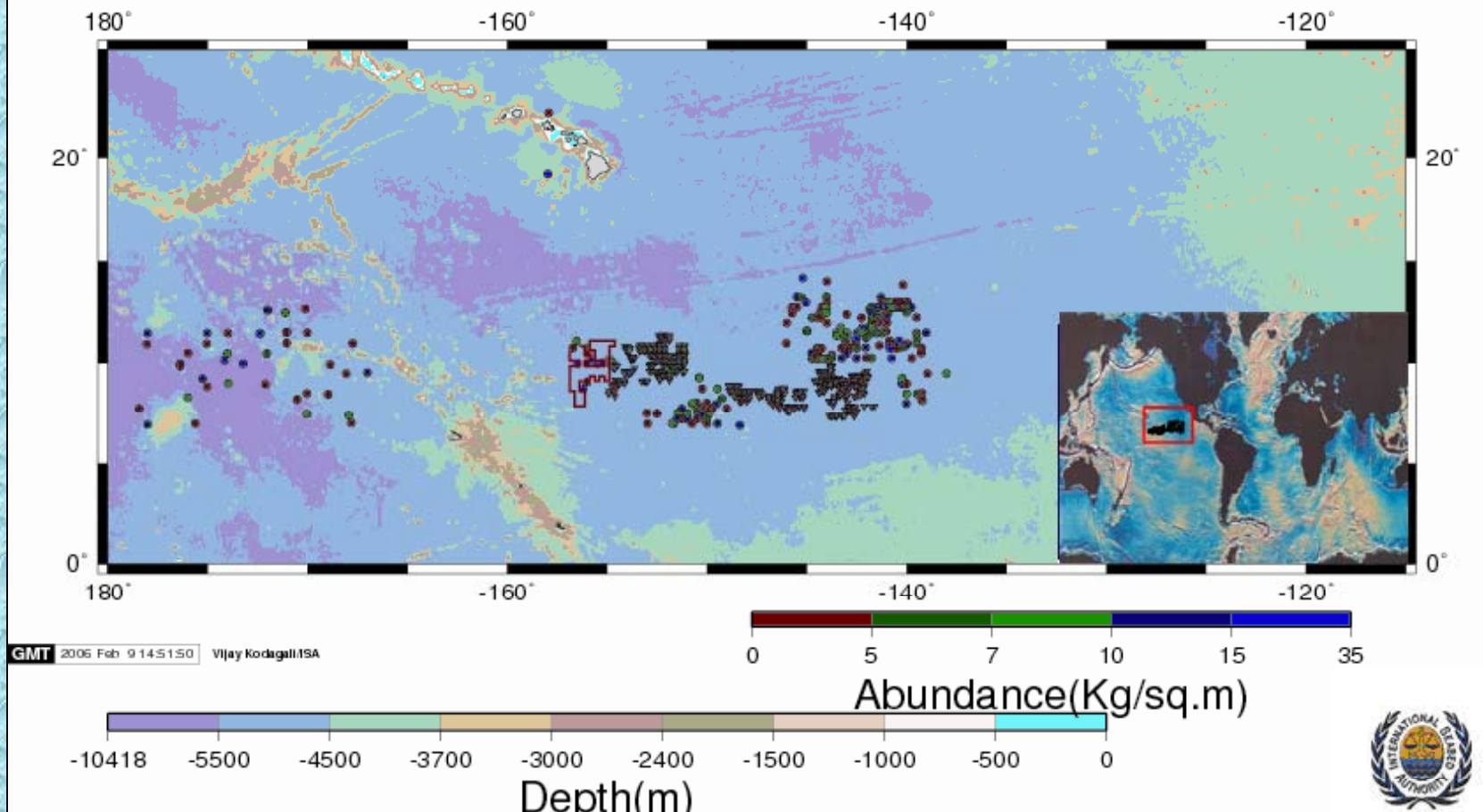




# COMRA DEPTH DATA (Single Beam)

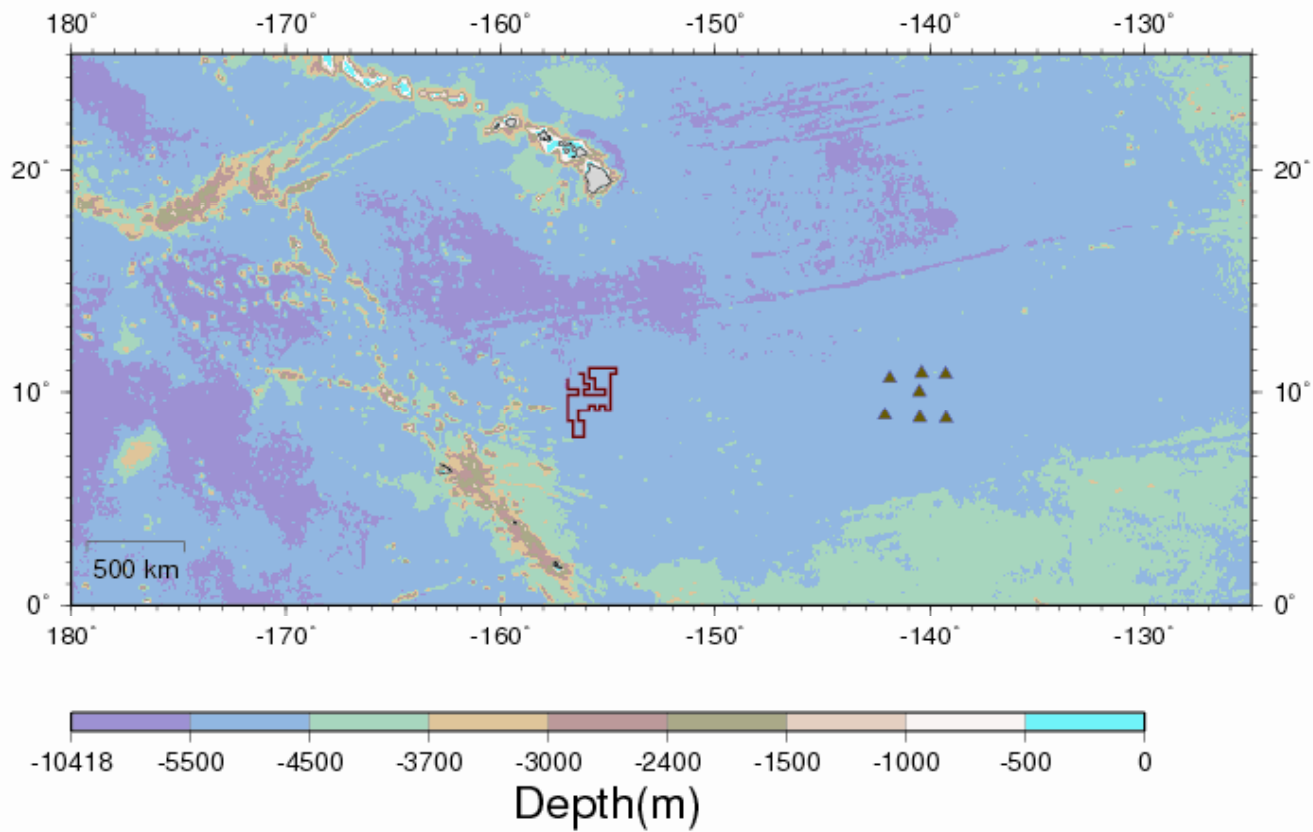


# COMRA ABUNDANCE (NEW) DATA IN THE CCZ

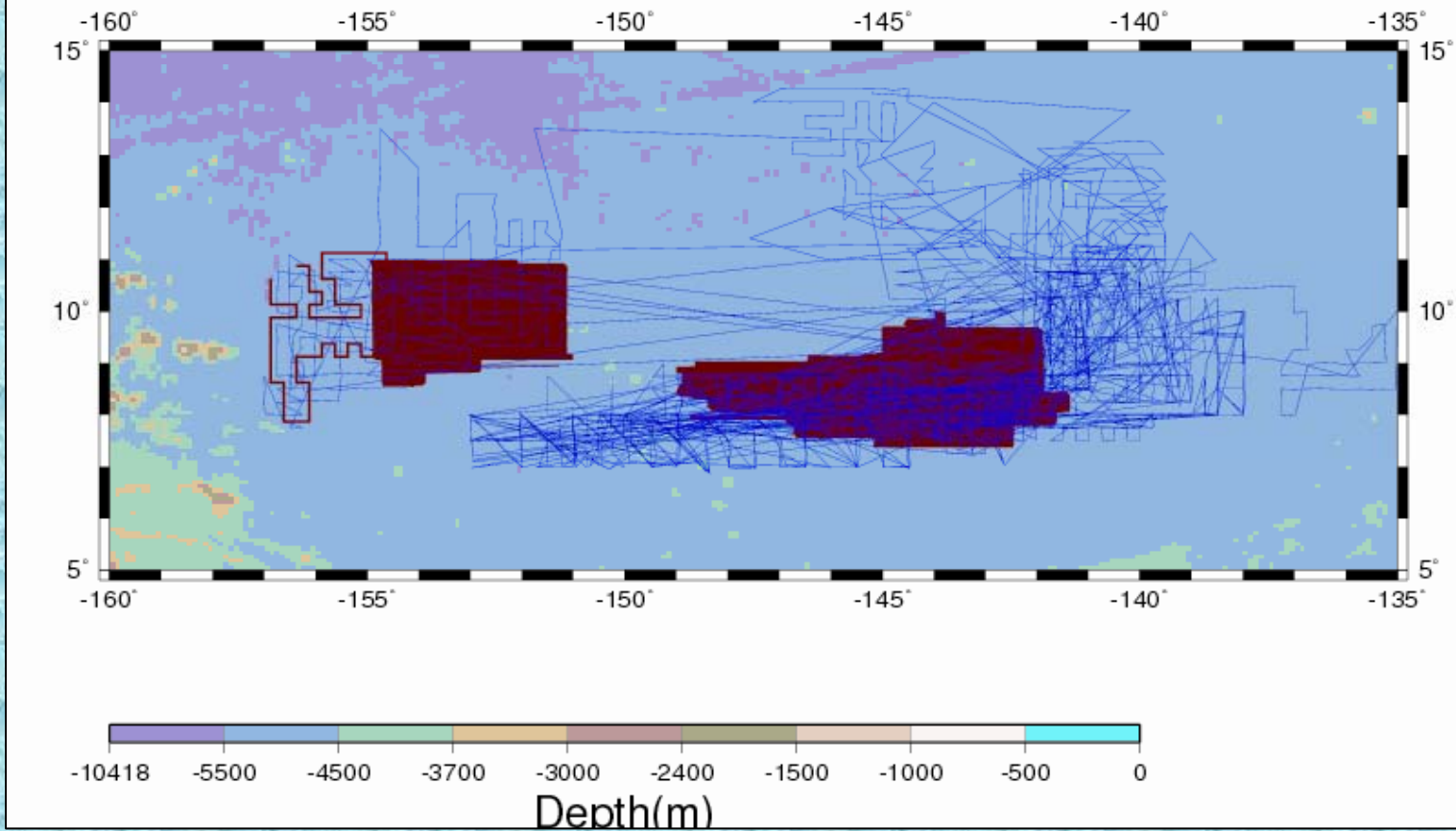




# COMRA-STATIONS-CTD PROFILES

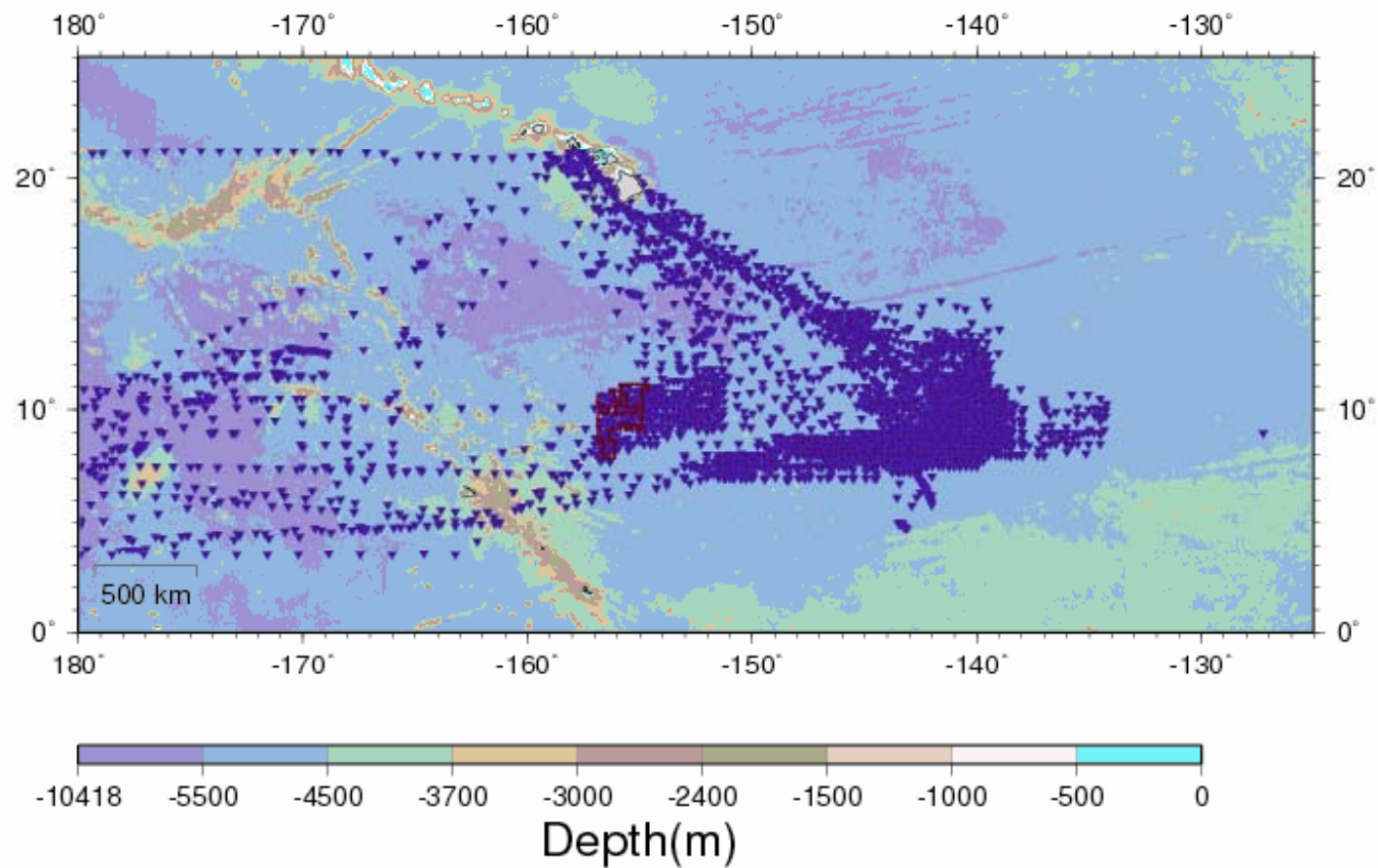


# COMRA MFES(OLD) DATA IN THE CCZ

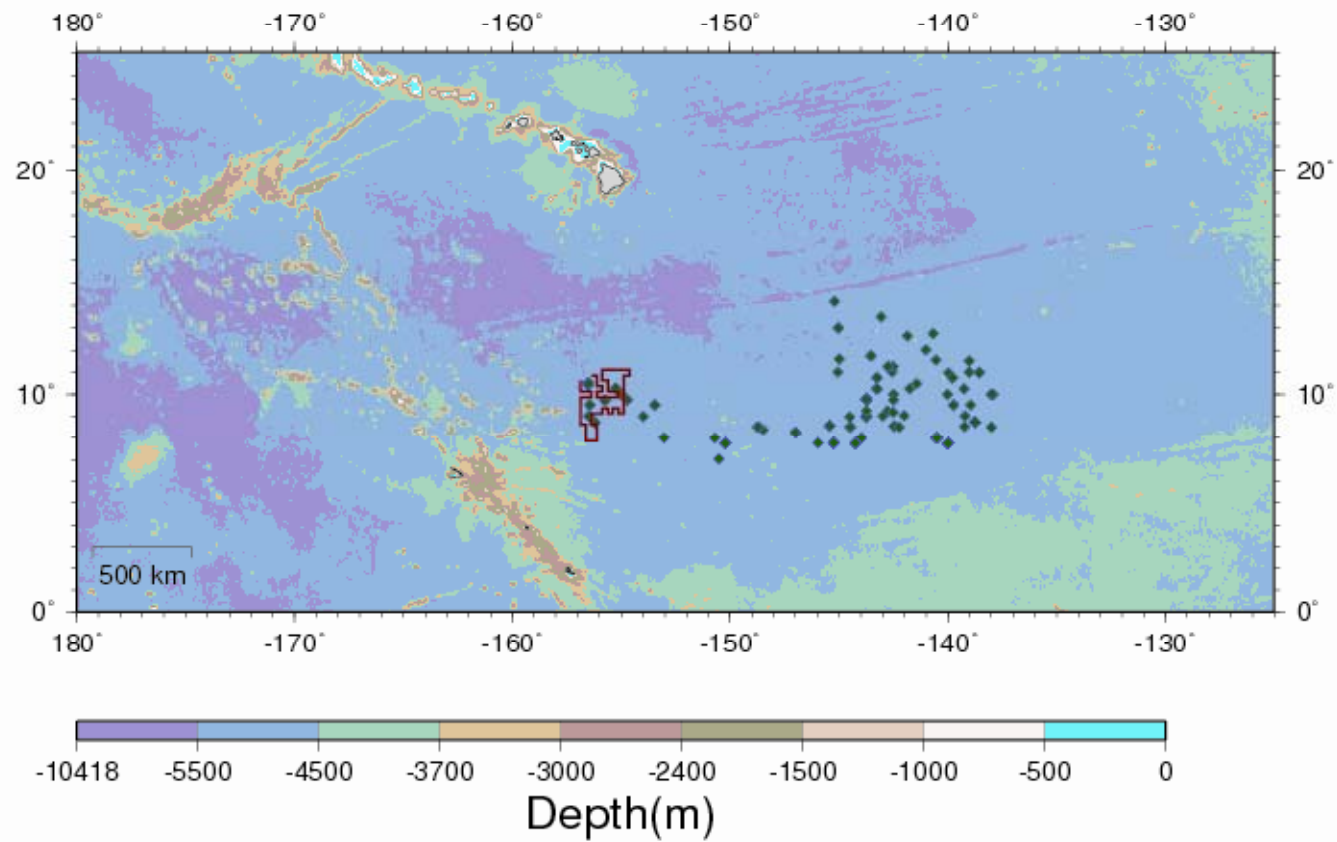




# COMRA-STATIONS-METEROLOGY DATA

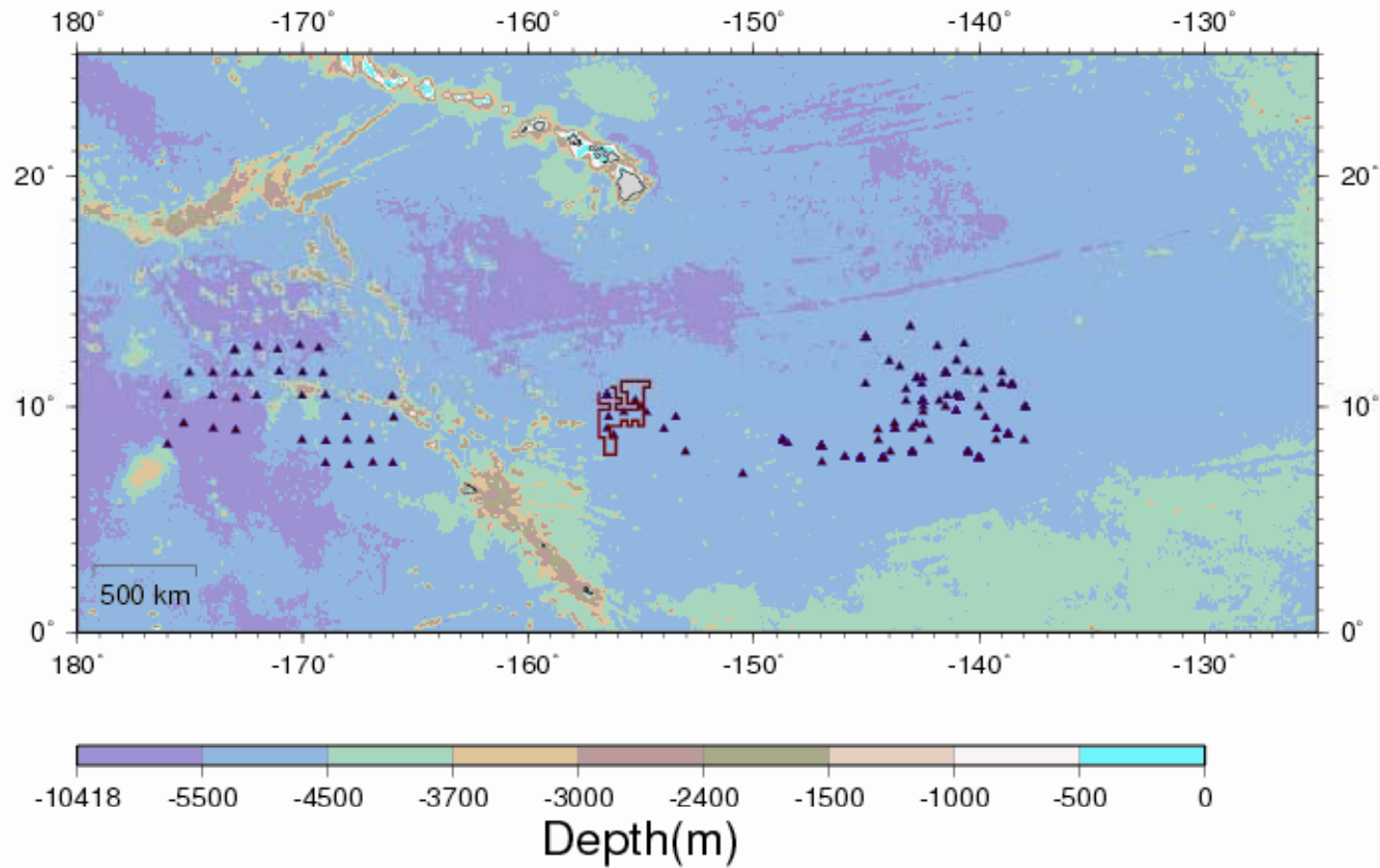


# COMRA-STATIONS-SEDIMENT SIZE

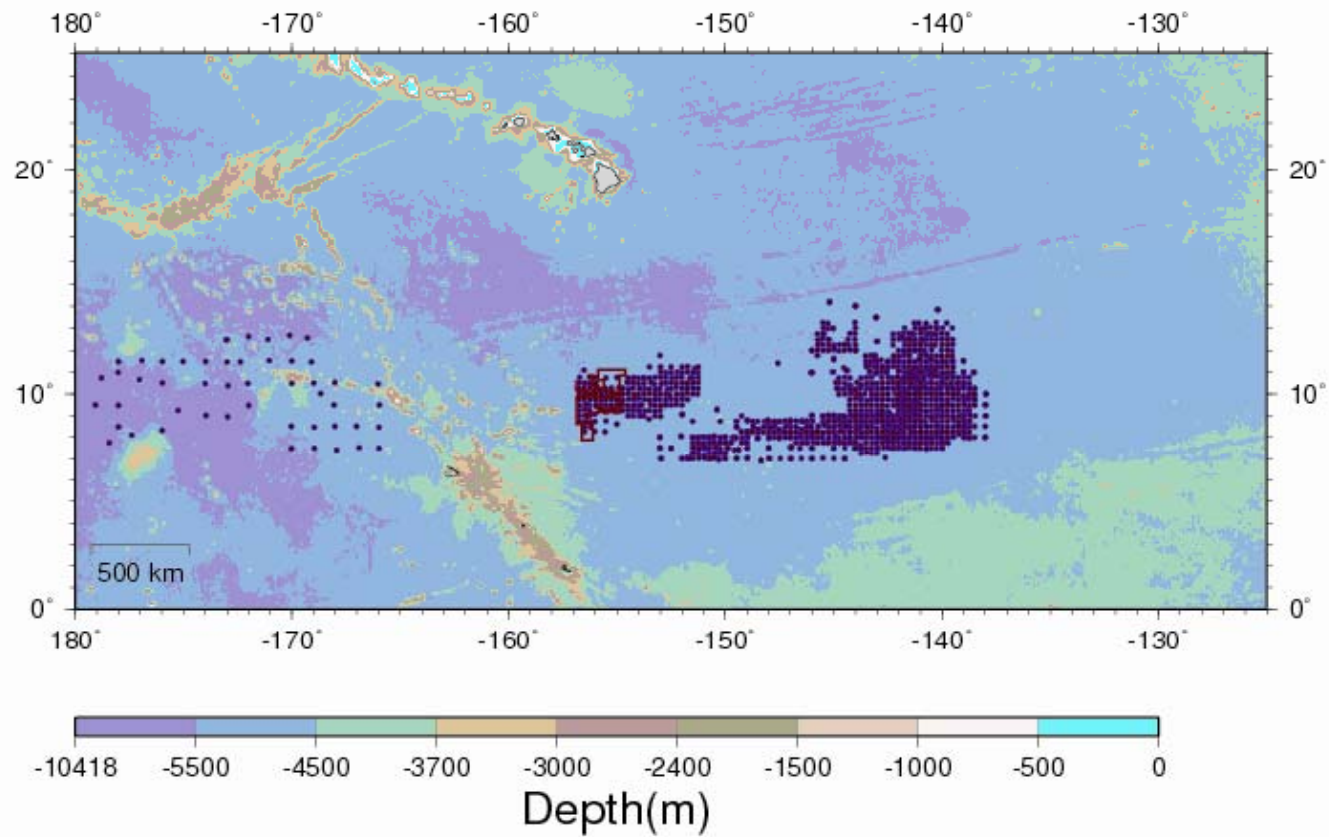




# COMRA-Stations-Clay Minerals



# COMRA-Stations-Sediment Type





# Old bathymetric maps from Contractors- conversion to digital form

- scanning of the maps
- Geo-referencing, re-sampling and rectifying the scanned maps
- Digitizing, editing and labeling
- Generation of X-Y values for each vortex of each contour line of the maps.



**THANK YOU**