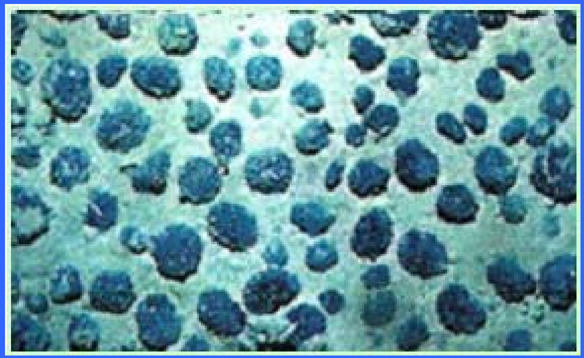
The International Seabed Authority

Data and information to administer the mineral resources of the Area: The International Seabed Authority's Geological Model of Polymetallic Nodule Deposits in the Clarion Clipperton Zone and its CDR

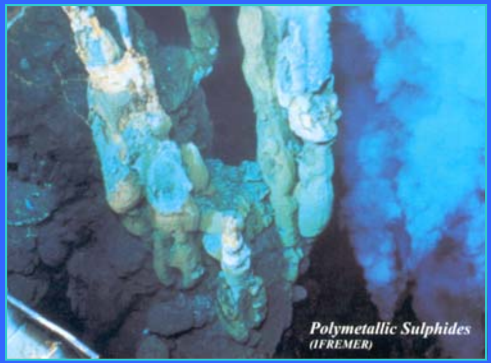
SENSITIZATION SEMINAR ISA KINGSTON
28-30 MARCH 2011

Main Mineral Resources Central Data Repository

Cobalt rich Crusts



Polymetallic Nodules



Polymetallic Sulphides

Objectives Of The CDR

- Prior Situation : Large quantity of data collected and known to exist, but dispersed widely among various organizations and companies worldwide :
  – in different formats, standards and supports
  – not readily accessible to potential users.
- The CDR aims to collect and centralize all public and private data and information on marine mineral resources.
  – Should be accessible to all member states.
  – Should display the acquired data and information.
  – Display data in various forms : listing, graphs, maps…
  – develop an integrated database system for use as a management and research tool

Central Data Repository

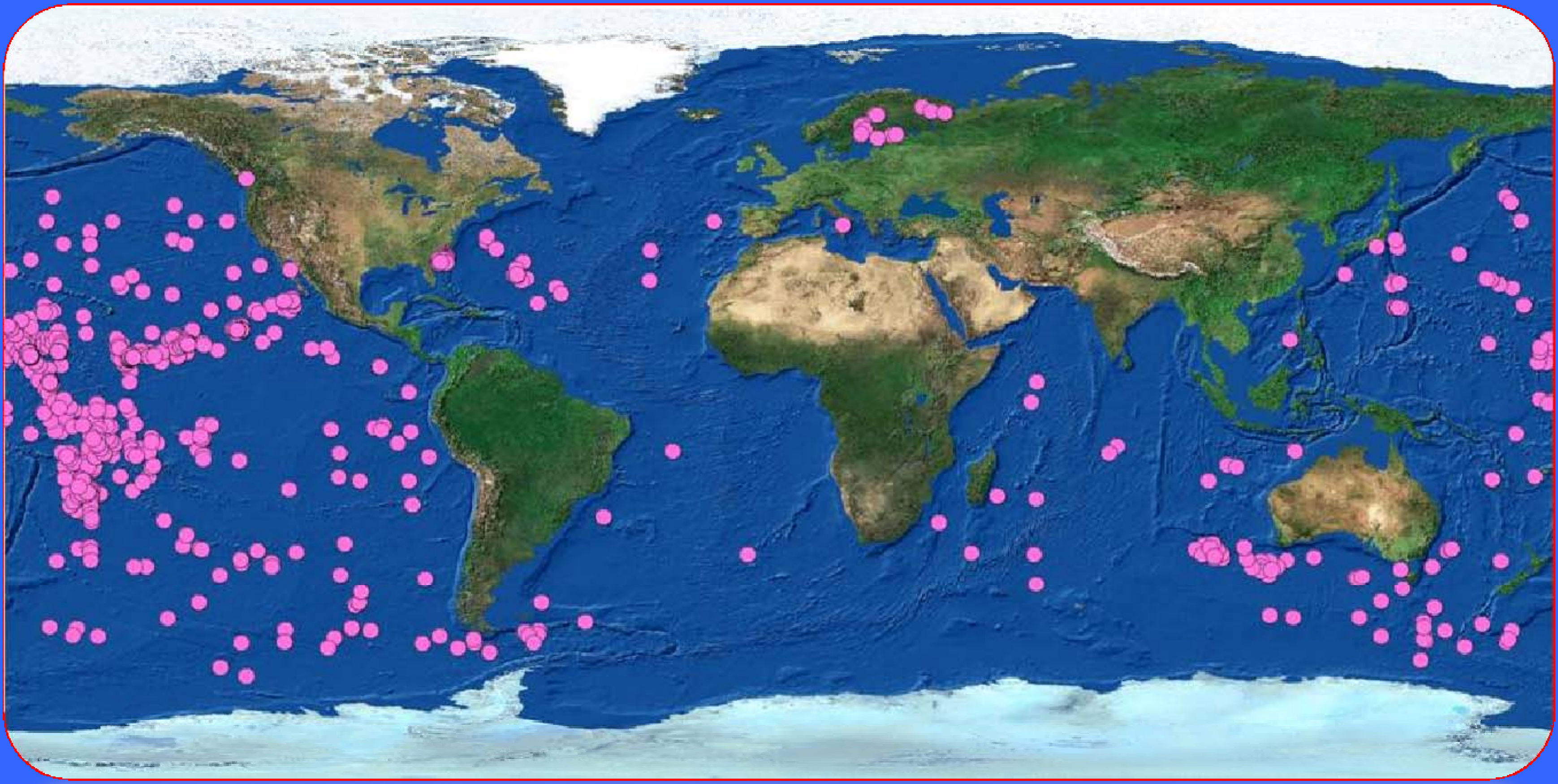
(a) NOAA – National Data Center, NGDC – (United States of America).
(b) U.S. Geological Survey (USGS) – (United States of America).
(c) Ministry of Natural Resources – (Russian Federation).
(d) COMRA – (China).
(e) Institute of Marine and Coastal Sciences, Rutgers University – (USA).
(f) Geological Survey of Finland – (Finland).
(g) Federal Institute of Geosciences and Natural Resources – (Germany).
(h) Bureau of Resource Sciences – (Australia).
(i) University of Toronto – (Canada).
(j) Geological Survey of Norway – (Norway).
(k) National Institute of Oceanography – (India).
(l) InterOceanMetal Joint Organization (IOM) – (Poland).
(m) IFREMER – (France).
(n) SOPAC – (Fiji).
(o) KORDI – (Republic of Korea).
(p) SCRIPPS Institution of Oceanography – (United States of America).
(q) DOALOS/United Nations.

Data Inventory

<u>Polymetallic Nodules</u> :

- **Sample Data Set** : Ancillary data describing samples and related information, such as cruise references etc… 2,753 samples
- **Geochemical Data Set** : data related to Location, Depth and results of geochemical analysis for over 60 elements including the method of analysis.
- **Major Elements Data Set** : Similar to the "Geochemical Data Set" set , but for the 9 elements that constitute 90% of the material on deep sea Polymetallic nodules (Al, Co, Cu, Fe, Mn, Ni, Pb, Si, Zn)

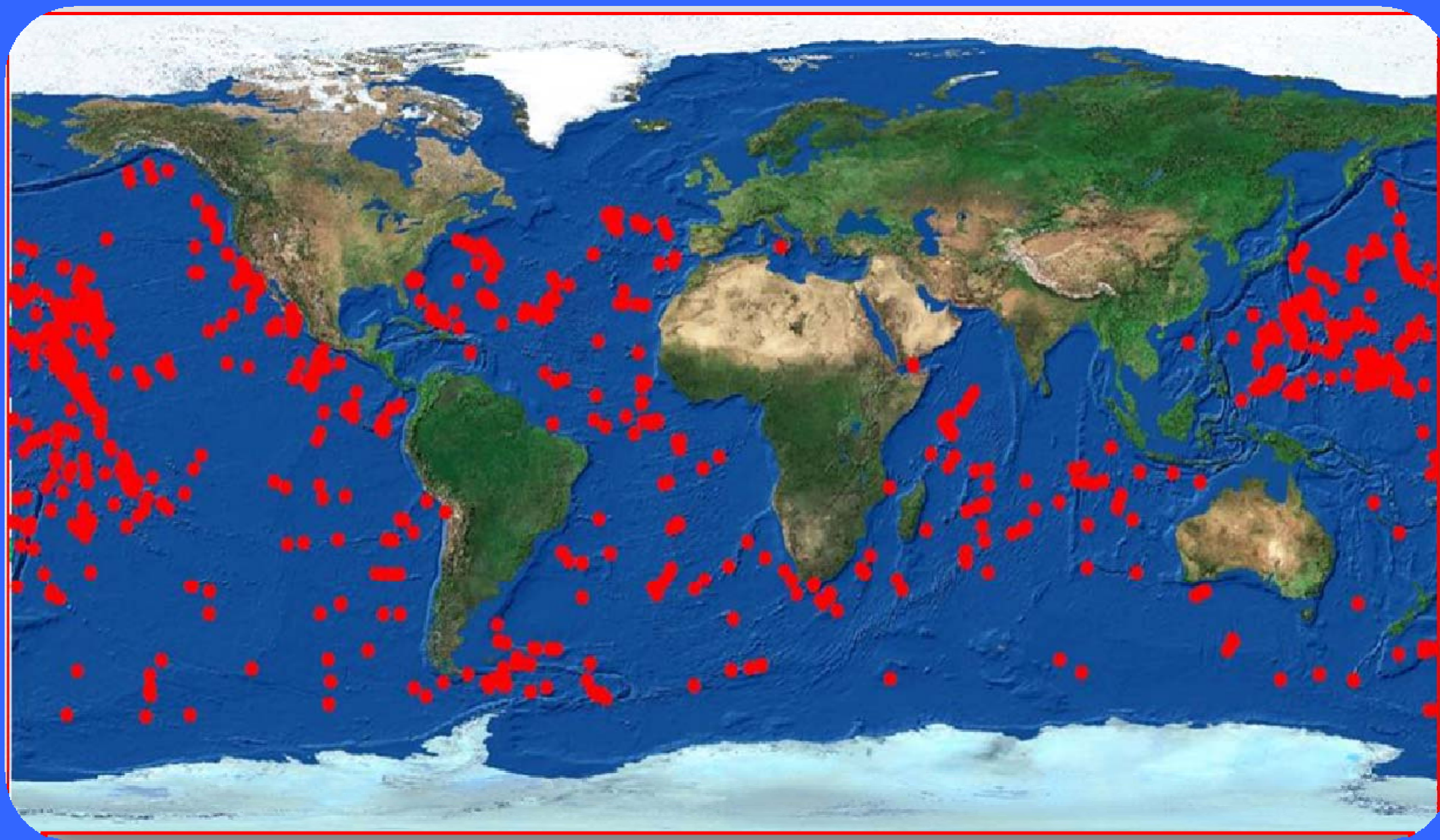
Polymetallic nodule locations in the CDR



Data Inventory -Cobalt rich ferromanganese crusts.

- **Sample Data Set** : Ancillary data describing samples and related information, etc… 3,533 samples
- **Geochemical Data Set** : data related to Location, Depth , thickness of crusts and results of geochemical analysis for over 60 elements including their analysis methods. – 3533 records
- **Major Elements Data Set** : Similar to the “Major Elements Set” of the Nodule Data – 3,533 records

Cobalt rich ferromanganese crust locations in the CDR



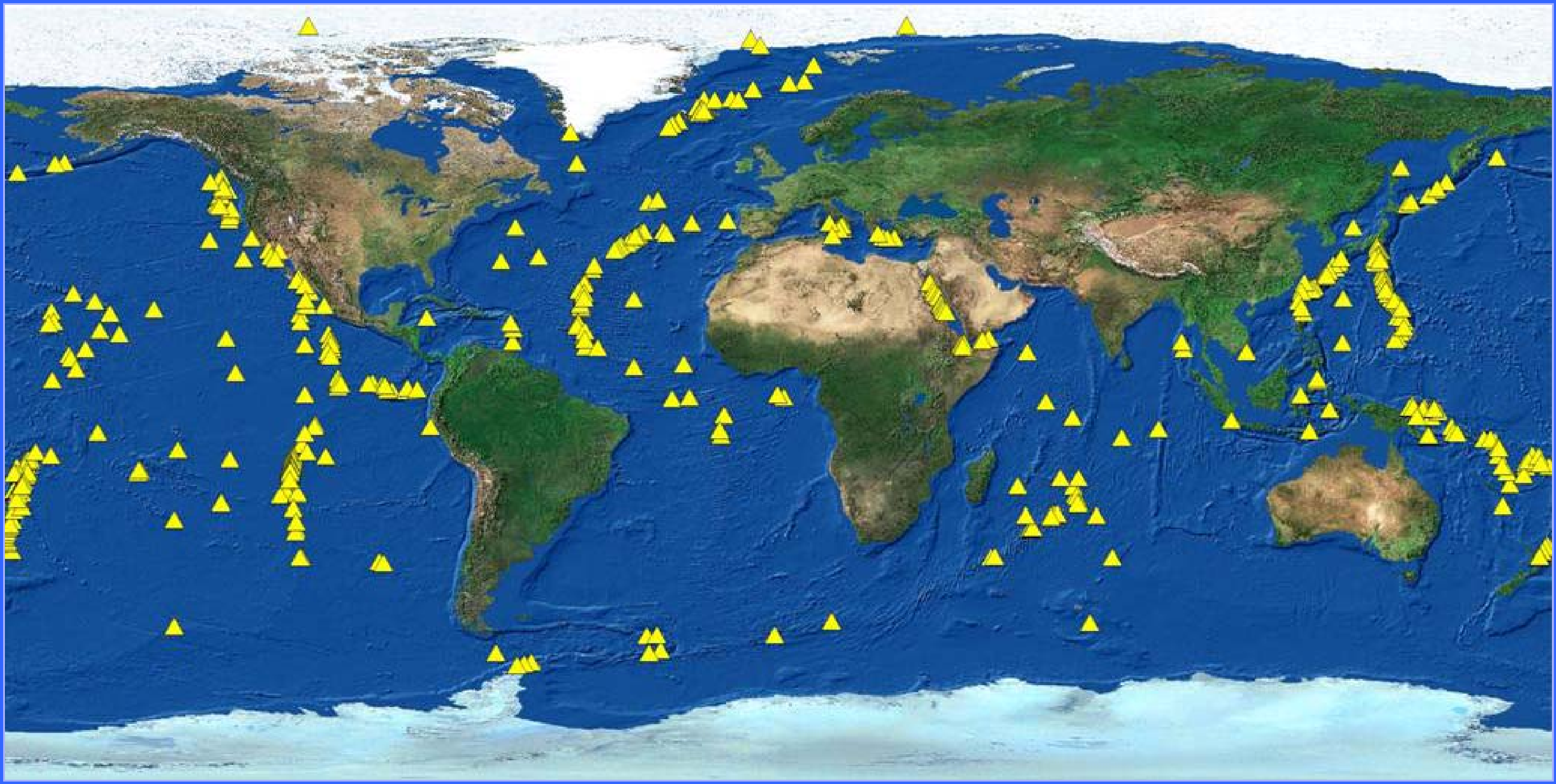
Data Inventory

- **Seafloor Hydrothermal Vent Systems and Seafloor Polymetallic Sulphides**
- In 2001-2002, the Secretariat acquired a validated set of data on the worldwide distribution of seafloor polymetallic sulphides from the Geological Survey of Canada (GSC). During the first quarter of 2003, the Secretariat integrated that data set into the CDR. The related data is grouped into four functional sets:

Deposit Information : Location data, geological information and description of 327 sites of seafloor hydrothermal activity and mineral deposits.

– **Geochemical Data :** Geochemical analyses for 2,640 samples of seafloor polymetallic sulphides and hydrothermal precipitates from 69 different sites worldwide: Contains for each sample , geochemical analyses for up to 70 elements, together with their analyses method, sample type, mineralogical information, deposit location and references

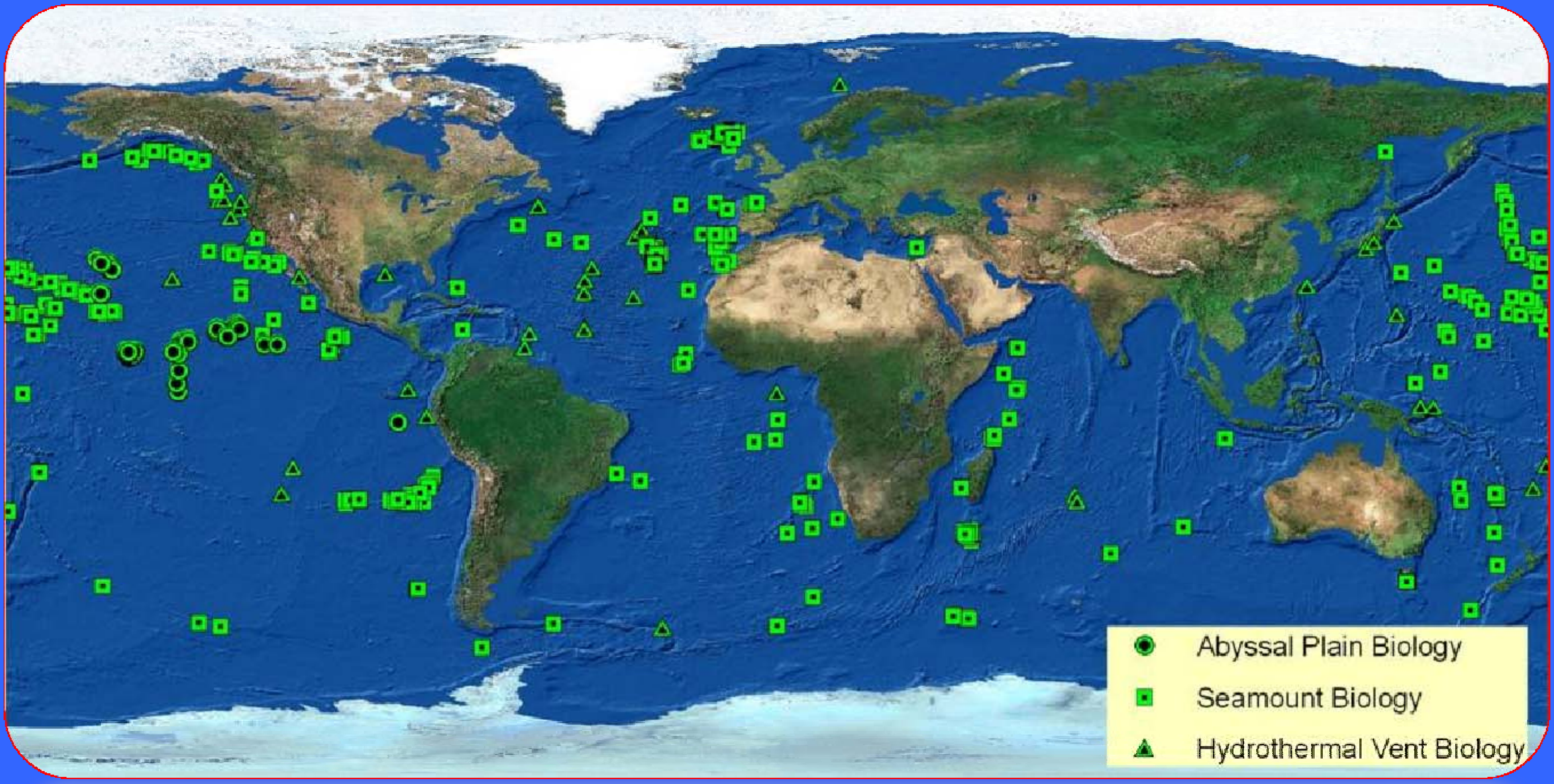
: Locations of polymetallic sulphides occurrences in the CDR



Biological data

- Over the past couple of years, the Authority has been successful in assembling a biological data set which is now part of the CDR. Three types of biological data: abyssal plain biology; seamount biology; and vent biology, are available. The data streams contain information including the taxonomy of the species in given locations, collection and sampler details and depth information. The total amount of biological data available is listed in the consolidated Table 1, which also indicates the sources of the data. Each occurrence of a biological sample is noted as a separate record, and hence, a single location is listed several times. The number of records, therefore, exceeds the number of locations from which data was available.

Biological data locations represented in the CDR



Summary of Data Inventory

Data Type	Polymetallic Nodules	Cobalt-rich Ferromanganese Crusts	Polymetallic Sulphides/ Hydrothermal Vent Systems
Geochemical elements	2,753 records	3,533 records	6,000 records
Sample data	2,753 records	3,533 records	
Reduced data Set		1,225 records	
Major elements	2,753 records	3,533 records	
Actual data within the 'Area'	1,944 records	627 records	232 sites
Deposits			690 sites
Analysis methods			137 protocols
Main source of data	US-NGDC	US-USGS	Canada – GSC, M/s Ambrose Associates
Marine minerals bibliography	~2,500 records		2,500 references
Biological data			
Abyssal Plain Biology	666 (662)* records From CCZ area only		
Vent biology			395 (196)*
Seamount biology		7,318 (2,915)* records	
Main source of data	Kaplan Project, Publications, Contractors	Seamounts Online	ChEss (Chemosynthetic Ecosystem Science)

* Numbers within brackets show records falling within the Area.

Dynamic On-line database queries

- More Flexibility

- Selection of subsets based on various parameters
  - Location (lat/Long. Or geographic zones)
  - Elements abundance
  - Cruise ID and Date

- Selection based on any user defined criteria
  - With the available forms, the end user may develop his own queries based on any field or combination of fields

WEBGIS

As an integral part of an online Atlas, a Web Geographical Information System (WebGIS) accommodates the Secretariat's geographic information on the Area and regions of potential outer continental shelf. The map interface allows for interactive mapping by external users, and aims to enable the dissemination of available data on resource potentials as well as other physical, political and environmental information.

Objectives:

1 Map mineral resource distributions in the Area.
2. Integrate additional information from various sources and compile a holistic, multidisciplinary 'Seabed GIS' (including bathymetry, maritime boundaries, geological structures, biogeography, sediments and areas of particular interest).
3. Make the spatial information accessible through an interactive WWW interface.
4. Contribute data and maps to the United Nations Atlas of the Oceans.
5. Create visualization and analysis capabilities to support research and decision-making.

Presently, the following information can readily be mapped using the interactive WebGis tool:

- Deposit/occurrence locations from the CDR.
- Ocean floor features (such as seamounts, ridges, trenches and basins).
- EEZ limits.
- Biological data.
- World seas.
- Surficial sediments and sediment thickness.
- Bathymetric contours.
- Thematic maps, movies, 3D animations, etc.

Patents Database

- **A survey of international Patents to identify trends in the development of deep seabed mining technology (1960-1998)**
  - Related to Polymetallic nodule exploitation
  - Survey Resulted in the identification of 352 patents in 12 patents systems
  - Started in 1960, peak in 1983 with 34 patents for that year. Much reduced pace subsequently.
  - 85% of the patents from USA, JAPAN, USSR
  - 2 searchable CDROMS produced, containing patents grouped in 10 volumes and many sub-volumes according to Design Concepts
  - Database fully implemented in the CDR, can be viewed with ADOBE READER

POLYMETALLIC NODULES DATA IN THE RESERVED AREAS

POLYDAT - data repository of the reserved areas submitted by contractors.

Framework

- **Available Data**
  - Co-Ordinates
    - Sampling Station

Topography

2335 station data

Water depth, abundance, Mn, Ni, Cu, Co

Acknowledgement

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. The Secretariat has so far received data from the following institutions

- NOAA
- USGS
- InterOceanMetal Joint Organization (IOM)
- GSC – Geological Survey of Canada
- COMRA, China
- IFREMER France
- The Republic of Korea
- DORD Japan
- Inter Ridge
- other public domains

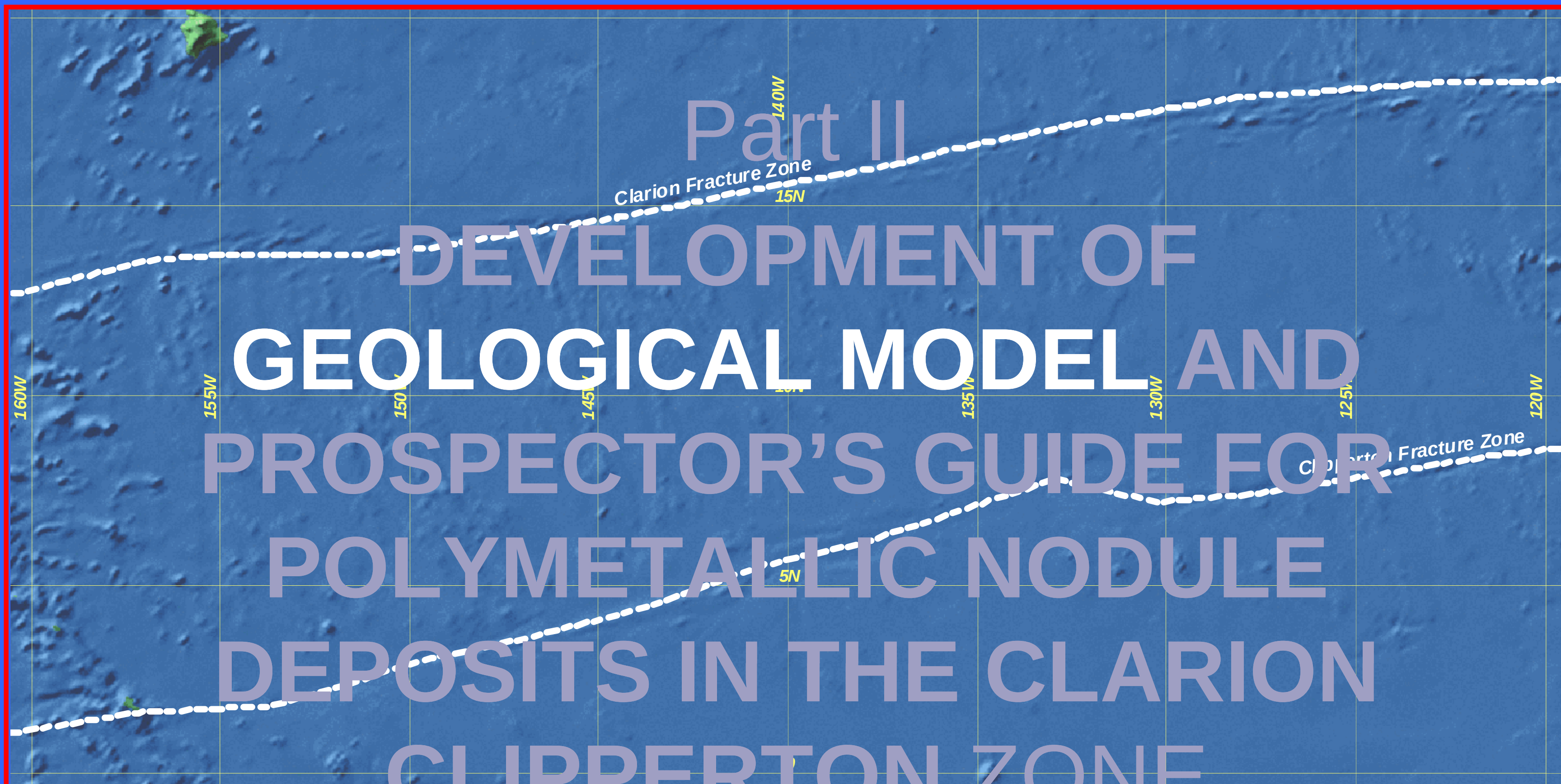
We wish to express our gratitude to these institutions/sites.

We will strive to excel

- Continuously update the CDR database with new data sourced from the public domain, institutions, contractors and published literature. Try to integrate gravity data, seafloor age and other data in to the CDR-WebGIS by 2011.
- Request the Contractors and other member States to provide any non-proprietary data for addition to the CDR.
- More biological data to be collected from different sources and through collaboration with marine scientific institutions and organizations. Also, increase the database with all environmental, physical meteorological data.
- Continue to develop a more robust CDR with better graphic interfaces, a searchable database (for example, SQL-based query forms) and more user-friendly options.
- Link CDR to Google Earth.
- Continuously update the bibliographic database
- Refine the patent searchable database and update the patent database to include all recent patents.
- Extend the CDR to include map, photograph and video galleries.
- Update the CDR with the data and results of the Geological Model of Polymetallic Nodule Deposits in the Clarion-Clipperton Fracture Zone project.
- Strive to establish a museum of marine mineral resources.

Part II

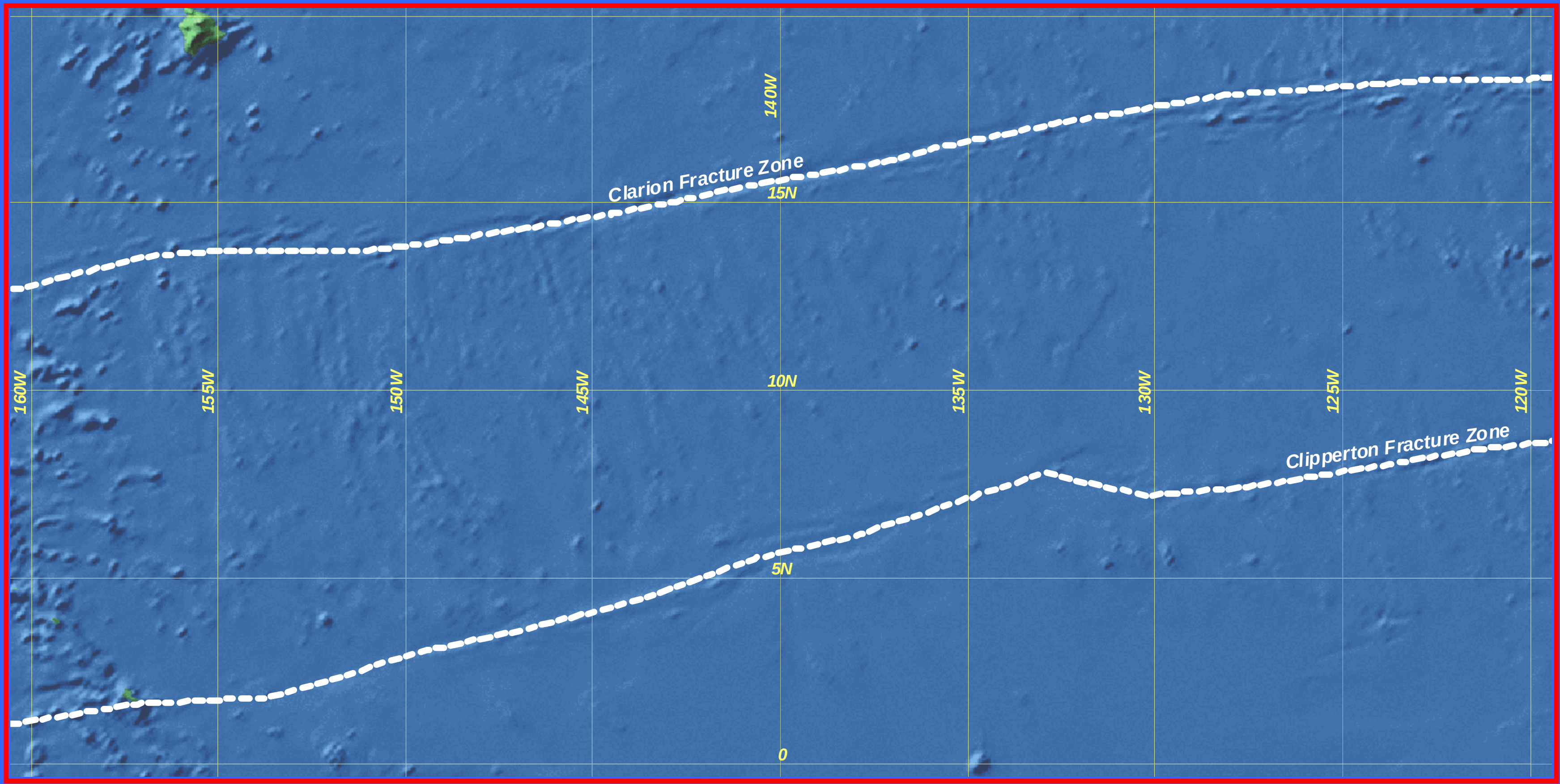
DEVELOPMENT OF GEOLOGICAL MODEL AND PROSPECTOR'S GUIDE FOR POLYMETALLIC NODULE DEPOSITS IN THE CLARION CLIPPERTON ZONE

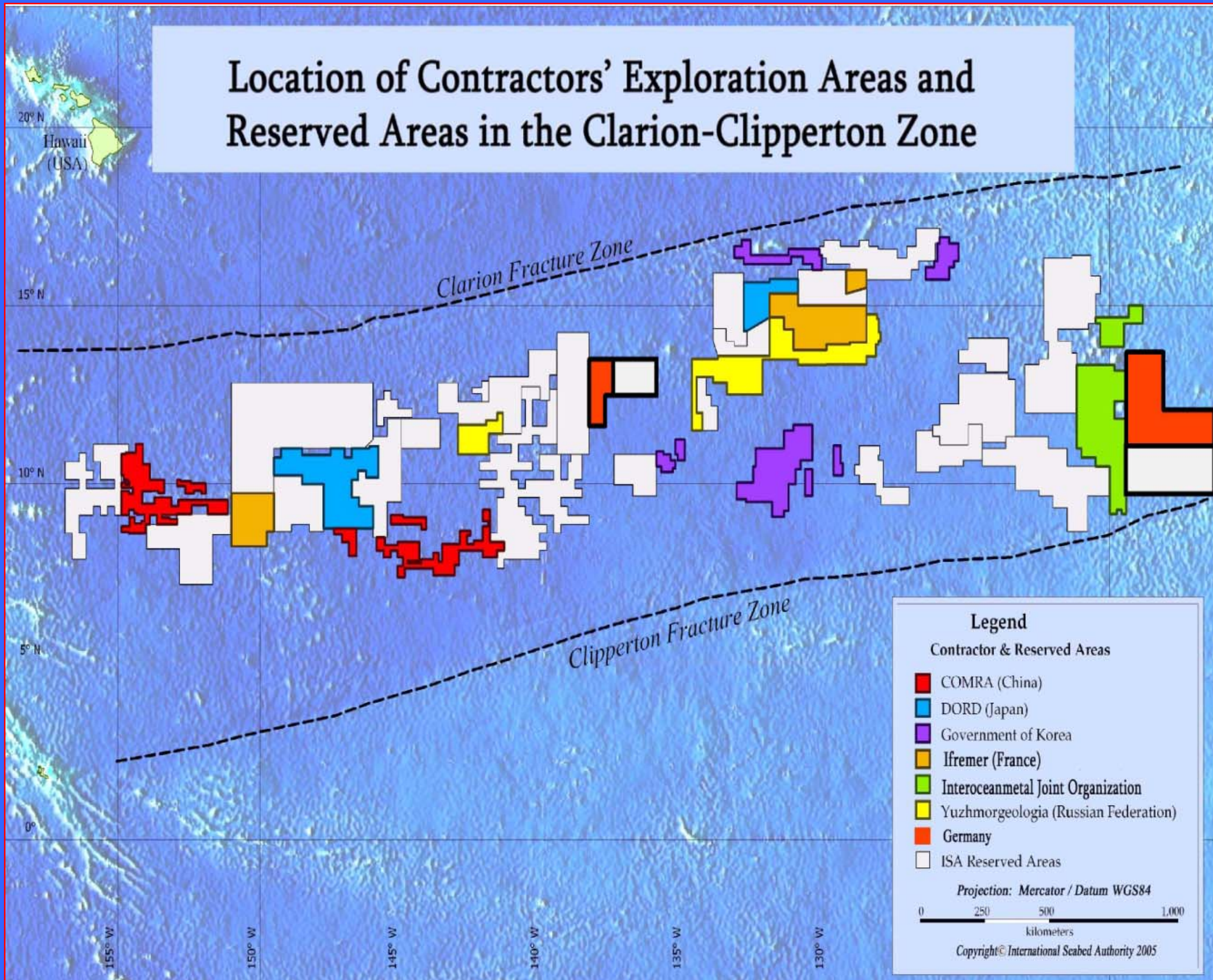


PROGRAMME OBJECTIVES

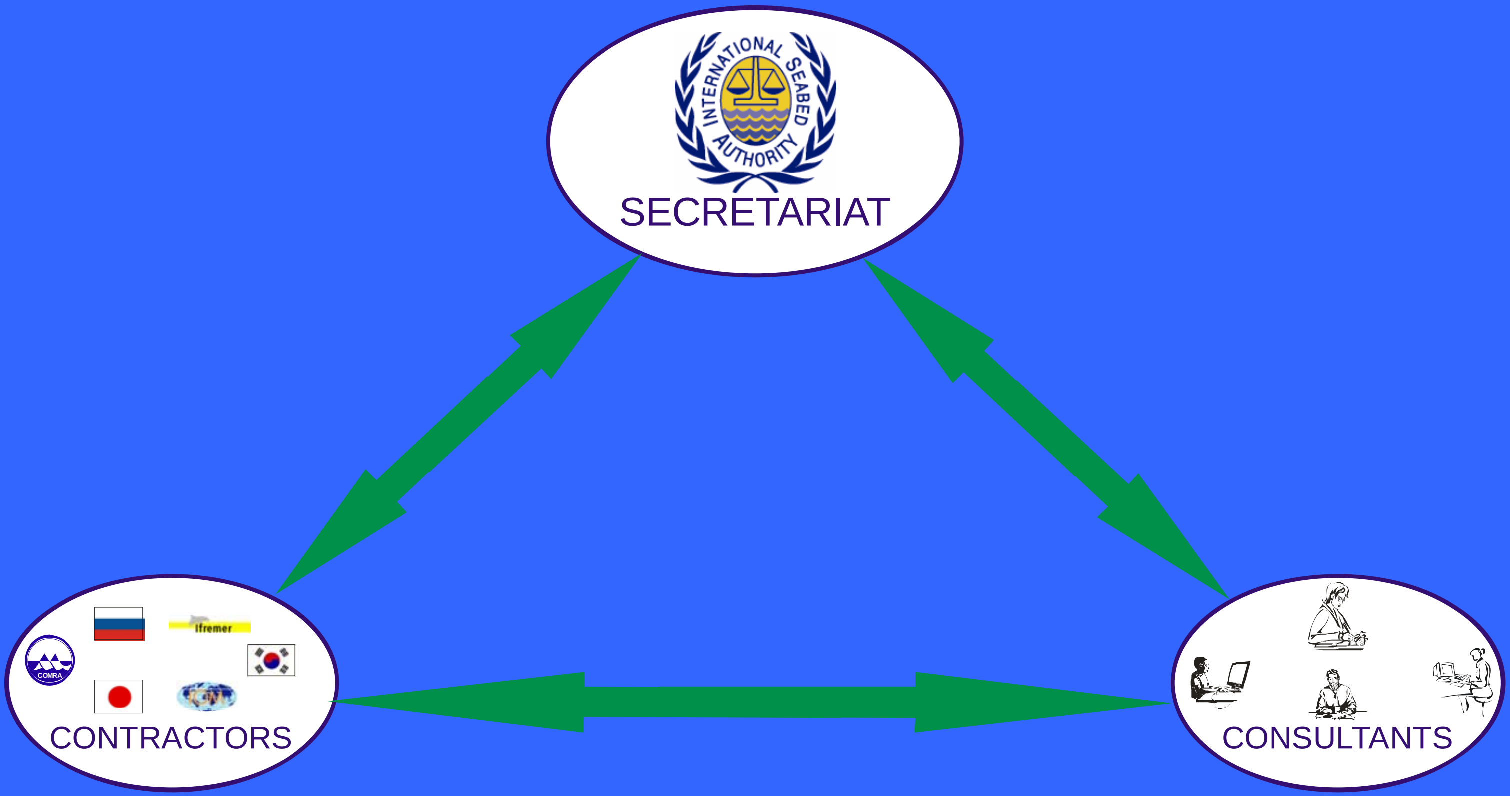
1. IMPROVE CLARION-CLIPPERTON RESOURCE ASSESSMENT
2. INTEGRATE AVAILABLE RESOURCE AND RELATED ENVIRONMENTAL DATA
3. PROVIDE USEFUL GUIDELINES FOR PROSPECTING AND EXPLORATION

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




Location of Contractors' Exploration Areas and Reserved Areas in the Clarion-Clipperton Zone
20° N
Hawaii (USA)
15° N
10° N
5° N
0°
Clarion Fracture Zone
Clipperton Fracture Zone
155° W
150° W
145° W
140° W
135° W
130° W
Legend
Contractor & Reserved Areas
COMRA (China)
DORD (Japan)
Government of Korea
Ifremer (France)
Interoceanmetal Joint Organization
Yuzhmorgeologia (Russian Federation)
Germany
ISA Reserved Areas
Projection: Mercator / Datum WGS84
0 250 500 1,000
kilometers
Copyright© International Seabed Authority 2005

PROGRAMME TEAM

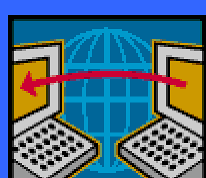


MAJOR SCHEDULE MILESTONES

MILESTONE	COMPLETION DATE
1. DRAFT REPORTS	JULY 2006
2. MID-COURSE MTG.	SEPTEMBER 2006
3. Interim REPORTS	2007-2008
4. Final reports	Early 2009
5. External Review of documents	June 2009
6. FINAL WORKSHOP	December 2009
7. Publication of results	2010-2011

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.



DATA COLLECTION

PROXY DATA

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

RESOURCE DATA

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

Geological model Programme- additional data provided by contractors

Content	COMRA	KORDI	IOM
Polymetallic nodules data MFES abundance	241+536 station 50000 data points	232 stations outside the area	230 +69 +561 (abundance and chemistry)
Gravity and Magnetic data	6610 points	Figures for free-air anomaly and magnetic intensity and magnetic anomaly provided	
Meteorology	3396 points		
CTD	7 Profiles		15 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	2 blocks Block-1 22 ascii files Block-2 55 ascii files
Sediment type	Around 1500		4 sediment cores
Particle size of sediment	Around 200		
Deep tow photography	4 profiles data		

Other contractor data

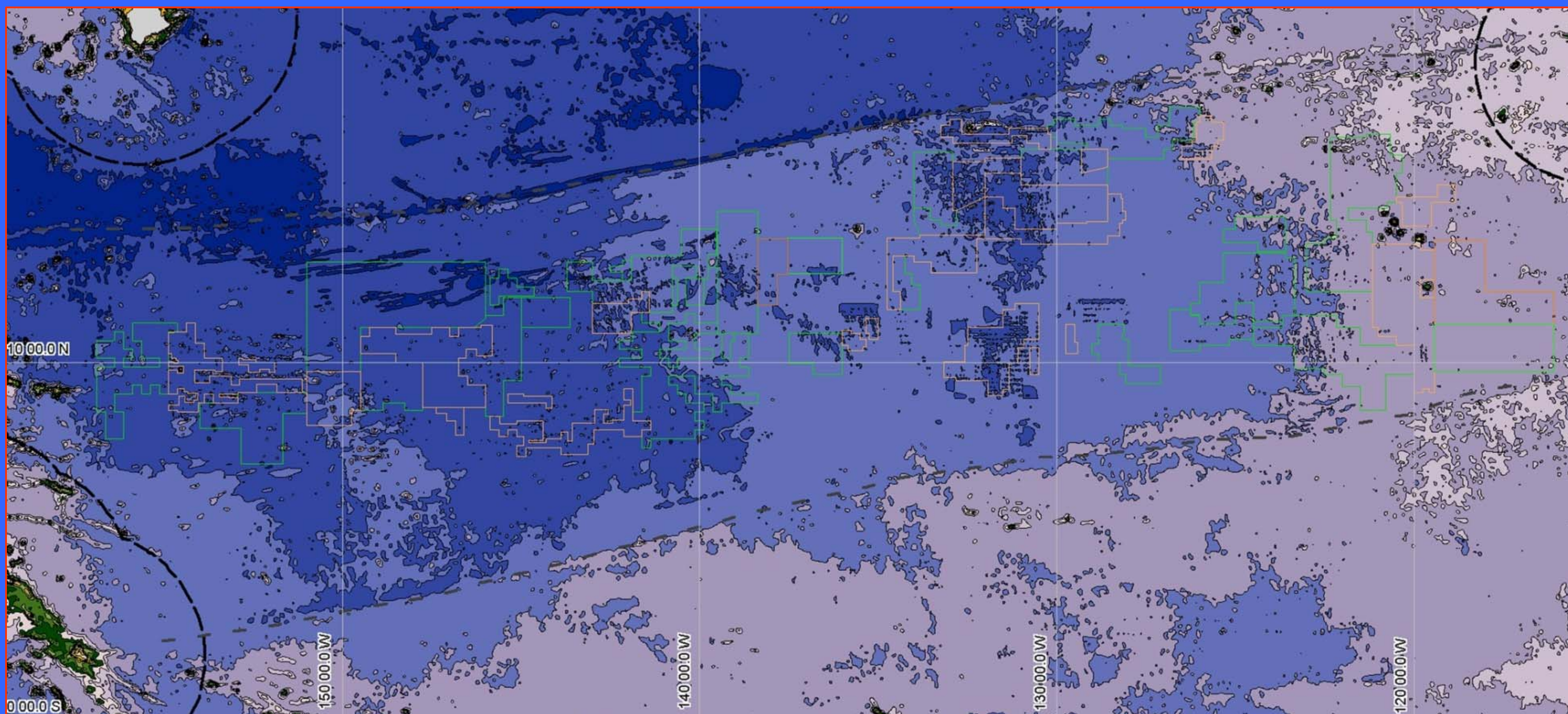
DORD JAPAN 1450 data points Mn/Fe ratios only

IFREMER- 500 stations nodule abundance, grade data for validation and sediment data

Prospector's Guide Proxies

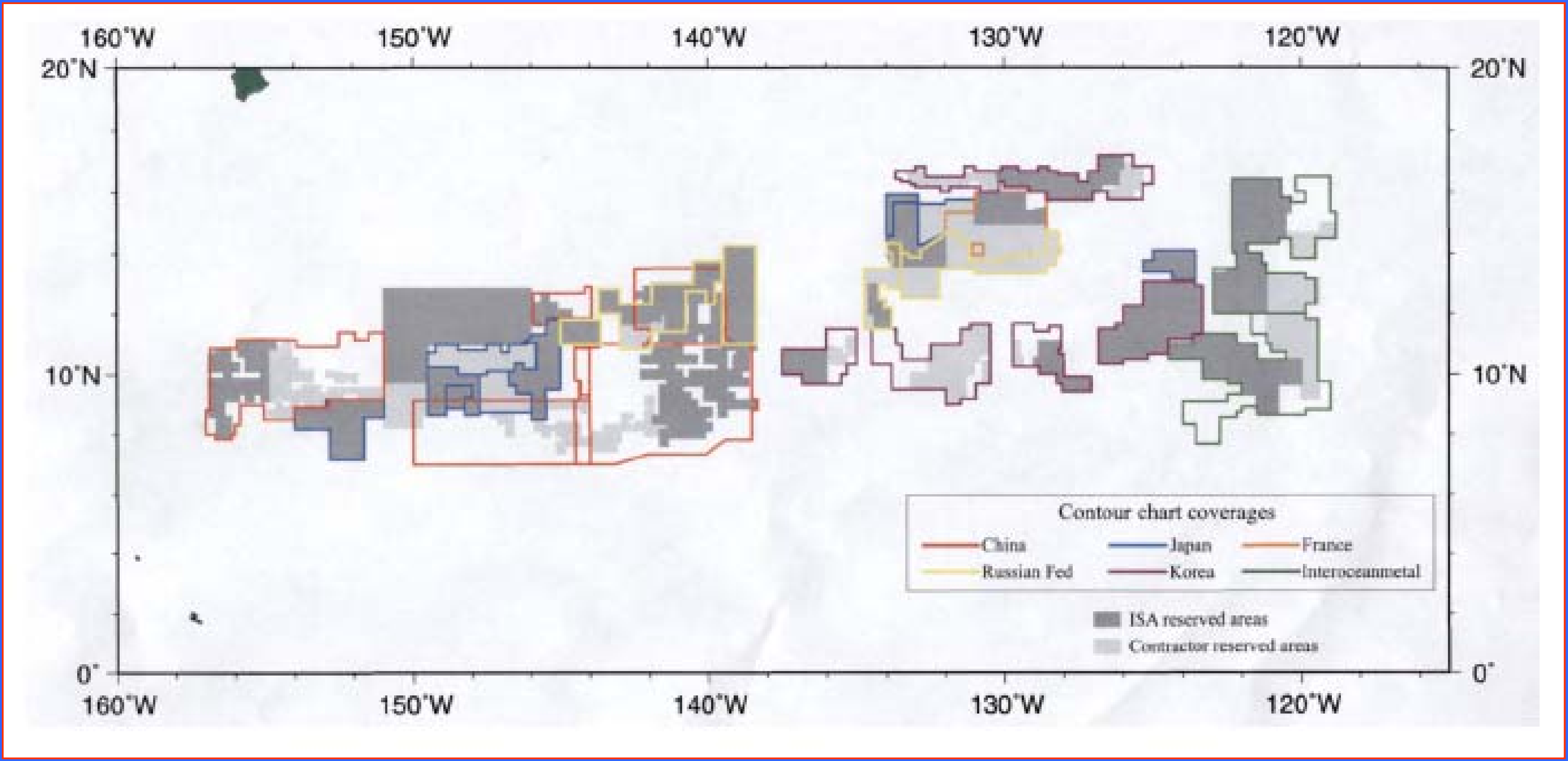
- *Gridded Bathymetry*
- *Volcanic, tectonic and sediment factors*
- *Growth model for Polymetallic nodules*
- *Nodule coverage, Morphology and distribution in eastern CCZ*
- *Sediments in eastern CCZ*
- *Nodule genesis and sediment distribution in Korean Allocated area*
- *Bathymetry and sediments in COMRA area*
- *Regional examination of sediments*
- *Benthic Biological data from CCZ*

Bathymetric map of CCZ
(from etopo- 1' depth data)



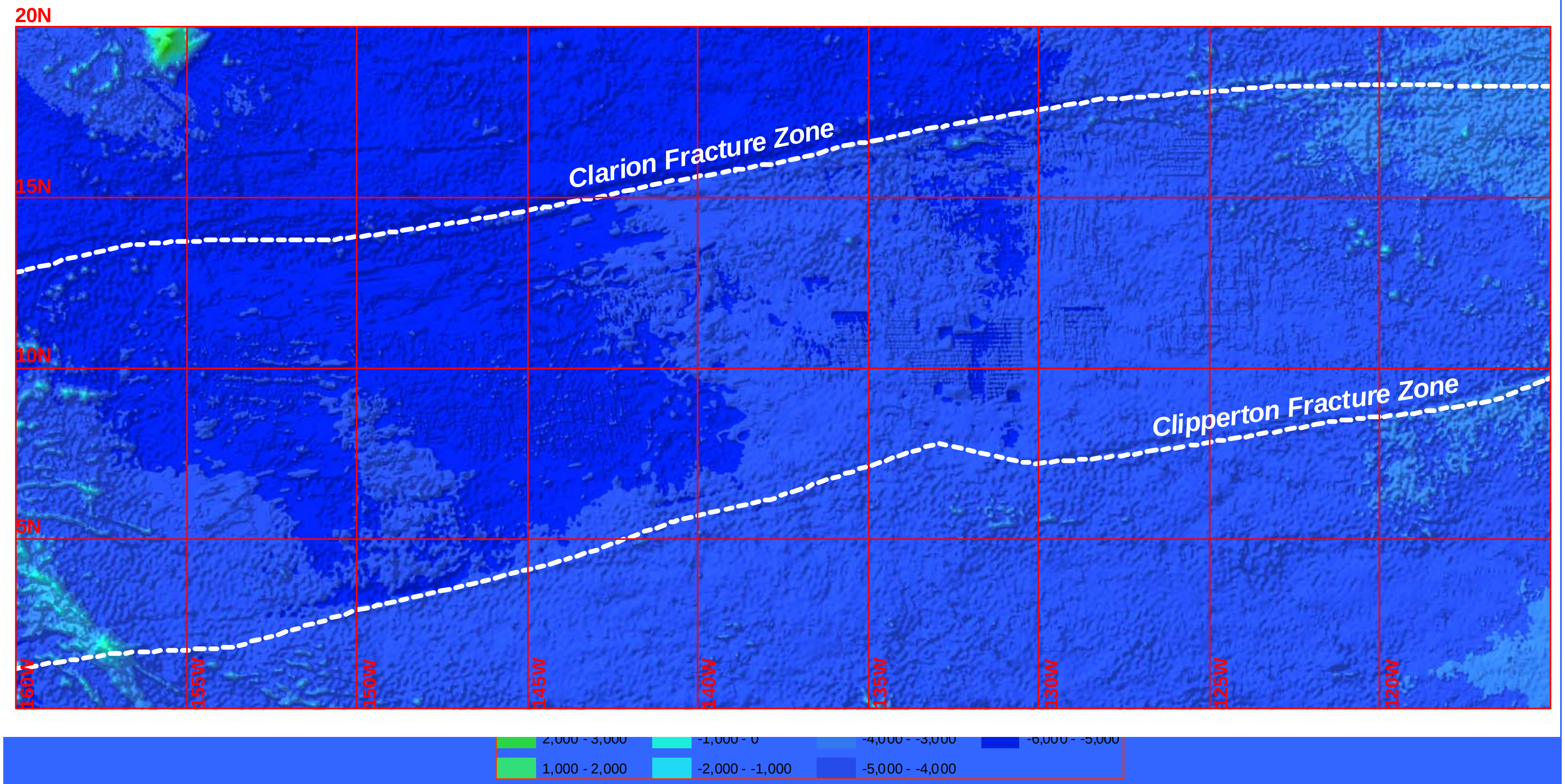
-6500.0000..-6000.0000	-3000.0000..-2500.0000
-6000.0000..-5500.0000	-2500.0000..-2000.0000
-5500.0000..-5000.0000	-2000.0000..-1500.0000
-5000.0000..-4500.0000	-1500.0000..-1000.0000
-4500.0000..-4000.0000	-1000.0000..-500.0000
-4000.0000..-3500.0000	-500.0000..0.0000
-3500.0000..-3000.0000	0.0000..500.0000

Coverage of ISA Datasets



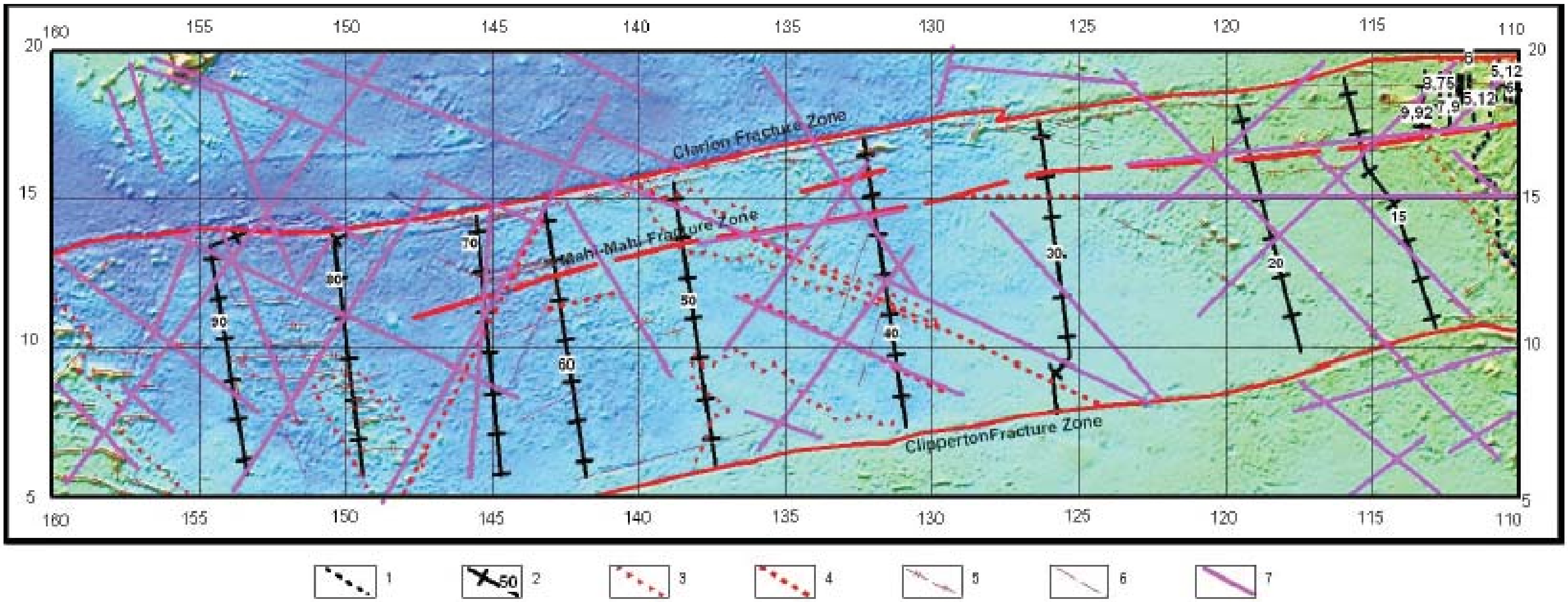
ONE MINUTE BATHYMETRY

ONE-MINUTE BATHYMETRY



Depths & Elevations in Meters

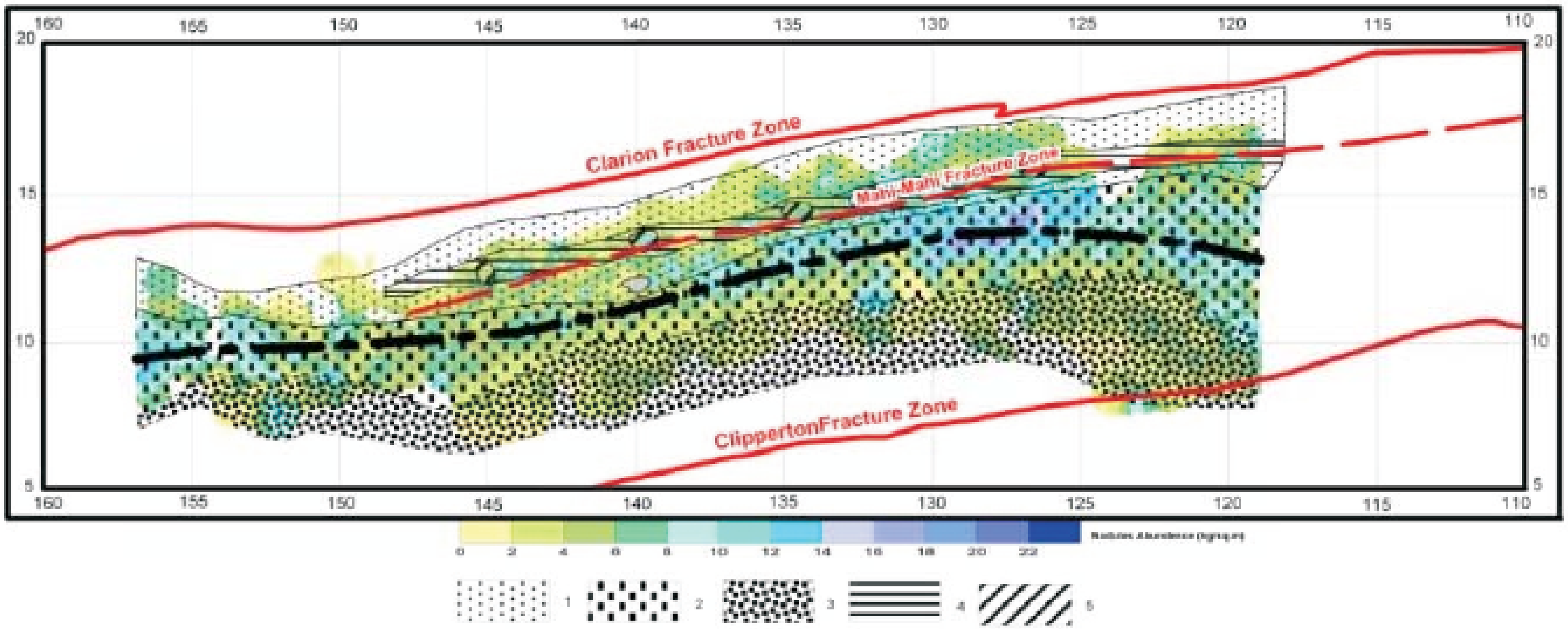
PROXY DATA: TECTONICS & VOLCANISM



1 - Extinct Rift of the Mathematicians Ridge; 2 - Basement Age (Isochrons in million years); 3 - Secondary level rise boundaries; 4 - Structural Lineations; 5 - Volcanic ridges and chains; 6 - Trenches or faults; 7 - Linear features indicated by seismic activity

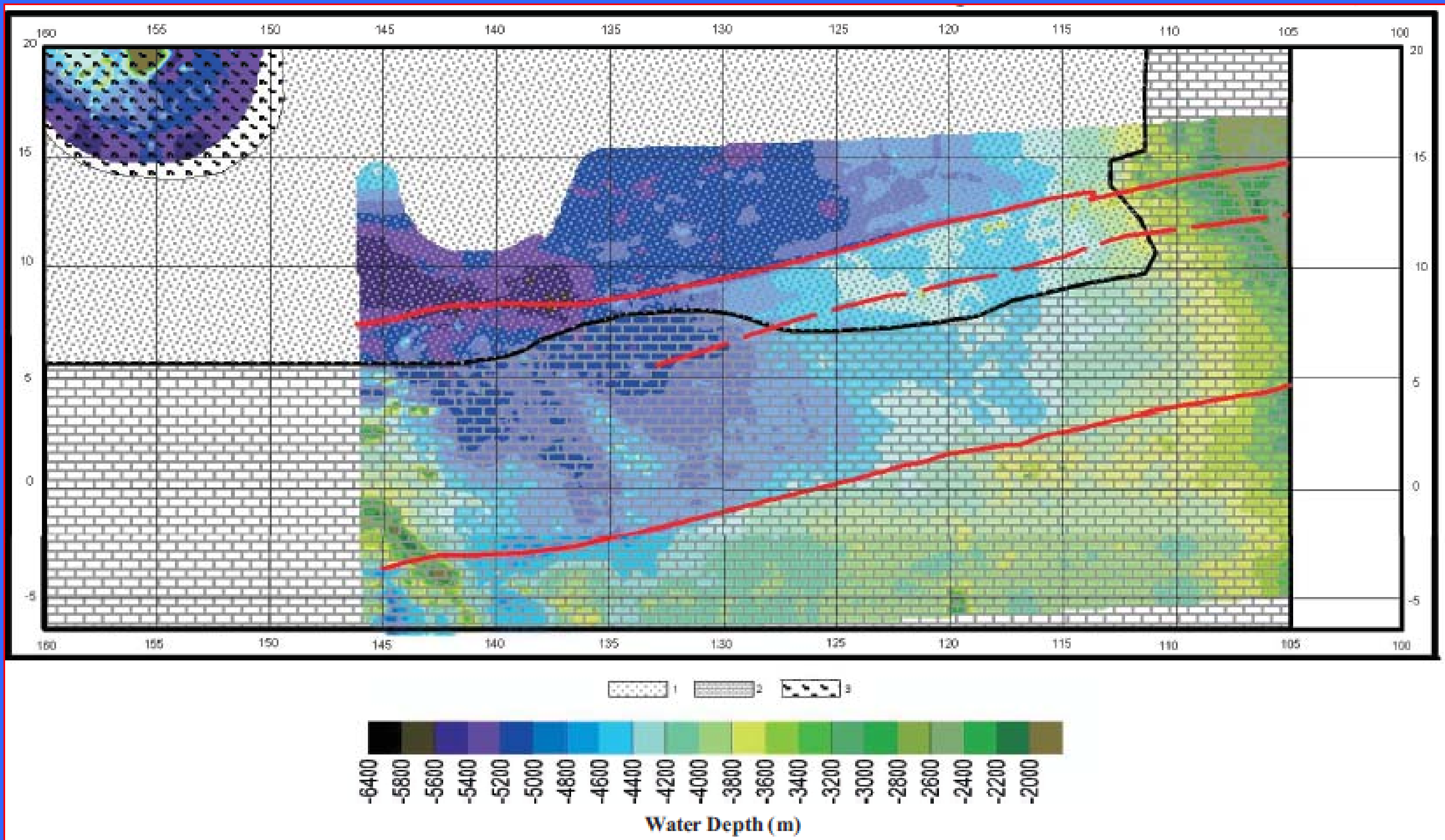
Tectonic sketch of the CCZ

Sediment facies and nodule abundance



1 - Northern facies; 2 - Central facies; 3 - Southern facies; 4 - Mahi-Mahi Fracture Zone; 5 - Hydrothermal deposits;
Thick black dashed line - Axial line of maximum nodule abundance

Paleo-reconstruction of CCZ-20 MYA



1. Siliceous-Argillaceous Sediments; 2. Calcareous Sediments; 3. Hawaiian Ash Fall

PROXY DATA: nodule morphology

IOM- report on nodule coverage, Morphology, and distribution in eastern Part of the CCZ.

-Based on 926 station data

-Discoid type nodules dominate

-Distribution of nodule types shows zonality

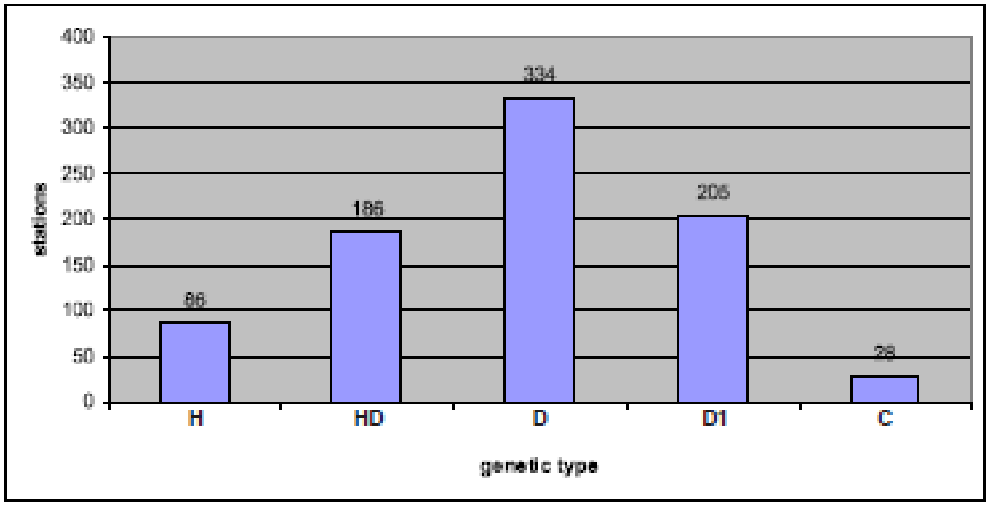
Classification	Surface shape	Morphology	Mineralogy	Chemical Make-up	Occurrence	Genesis
S-type	Smooth	Spherical, aggregate with poly-nucleus, irregular	Vernadite	Rich in Fe, Co, poor in Mn, Cu, Ni, ratio of Mn/Fe is less than 2	Exposure on surface layer	Hydro-genous; Source of ore-forming materials is sea water
R-type	Rough, grainy, papillate shape	Spherical, waxberry, kidney	Todorokite and vernadite	Rich in Mn, Cu, Ni, ratio of Mn/Fe is larger than 5	Buried or mostly buried in surface layer	Diagenetic, ore-forming materials are from pore water in surface sediments
S-R type	Smooth on the top side surface, rough on the lower side surface	Generally asymmetric elliptical, some tabular or irregular	Difference between top side and lower side, the top is similar to S-type and the lower side similar to R-type	Difference between top side and lower side, the top is similar to S-type but the lower side is similar to R-type	Semi- buried in surface layer	Mixed Genesis; hydrogenous for the top side and diagenetic for the lower side

Classification and characteristics of CCZ nodules

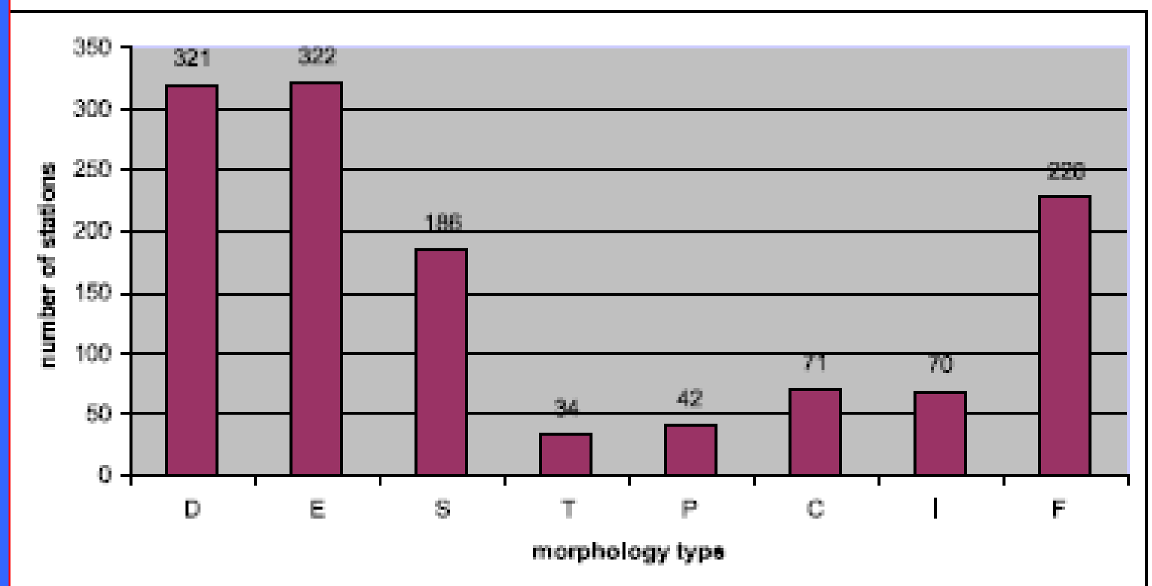
Six factors necessary for nodule growth

- Supply of metals
- Presence of Nuclei
- Antarctic Bottom Water (AABW)
- Semi-liquid surface layer
- Bioturbation
- Internal Stratigraphy

Histogram of Genetic Nodule Types in the Eastern CCZ



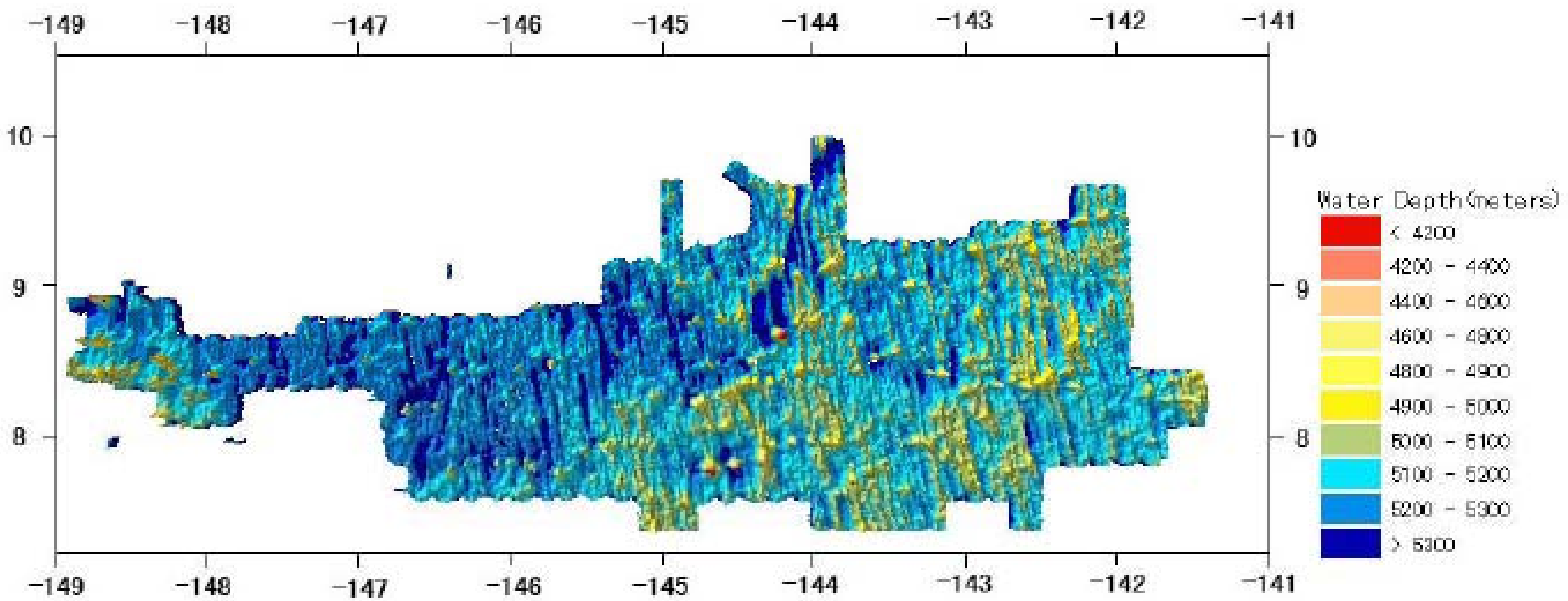
Histogram of Nodule Morphological Types



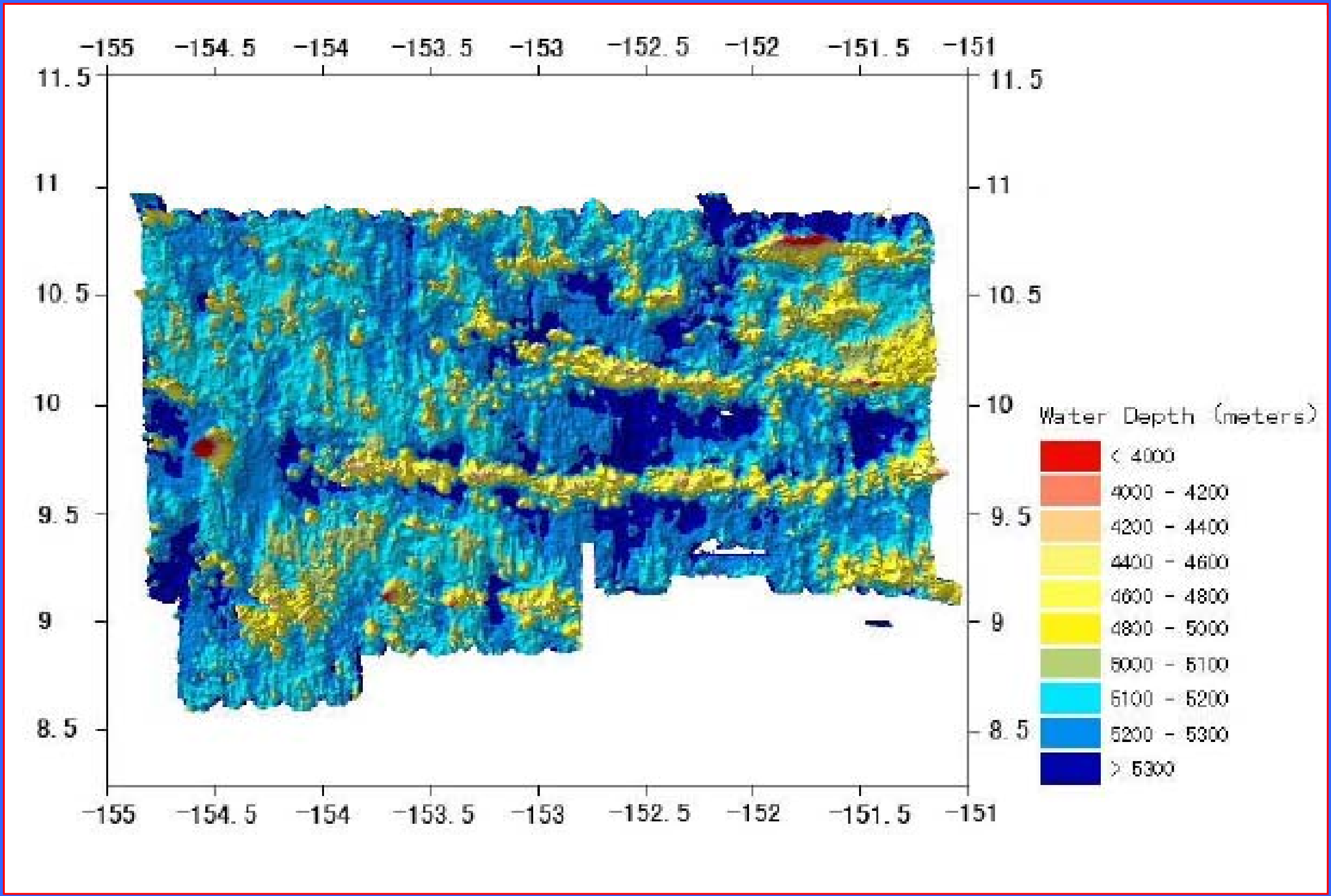
Depth Range (m)	No. Stations	Nodule Coverage, %			Nodule Abundance, kg/m^2		
		Mean	Min.	Max.	Mean	Min.	Max.
3,470 - 4,100	51	31.7	3	80	7.05	0.00	22.50
4,101 - 4,200	63	33.0	0	85	7.61	0.08	18.00
4,201 - 4,300	154	29.9	0	75	8.05	0.00	22.50
4,301 - 4,400	348	29.6	0	99	8.62	0.00	30.00
4,401 - 4,500	196	30.0	0	77	8.80	0.00	43.60
> 4,500	112	23.8	0	61	5.38	0.00	22.90

Abundance and Coverage Vs. Water depth

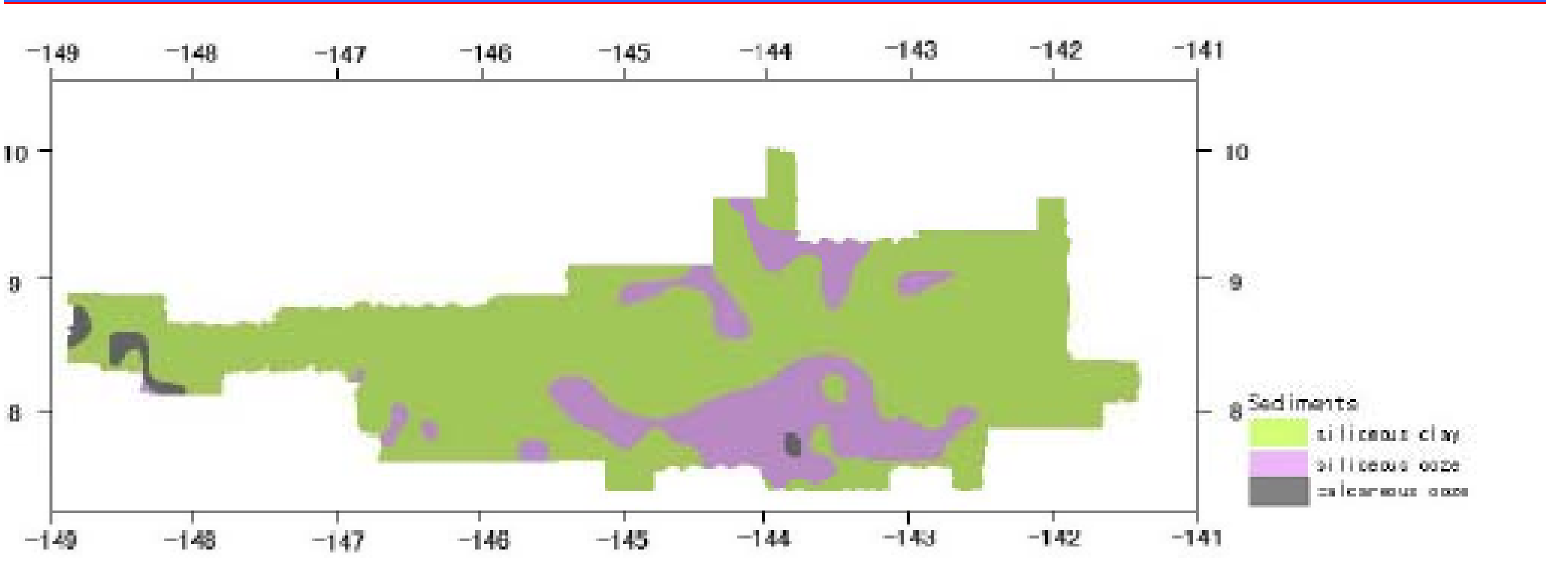
Bathymetry and sediments- COMRA east area



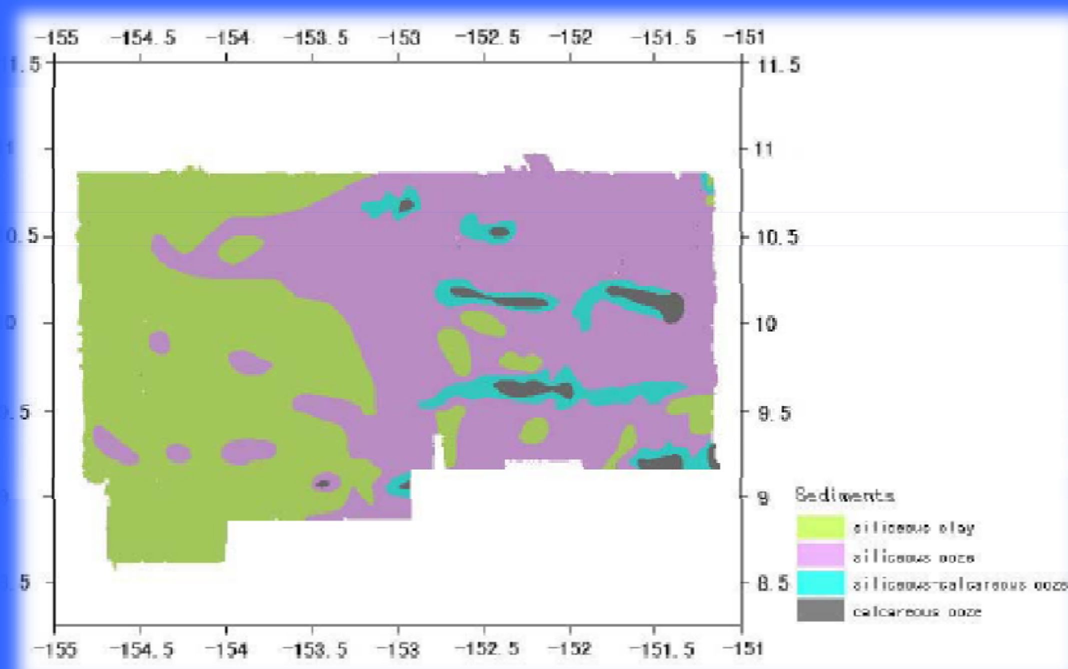
COMRA West area



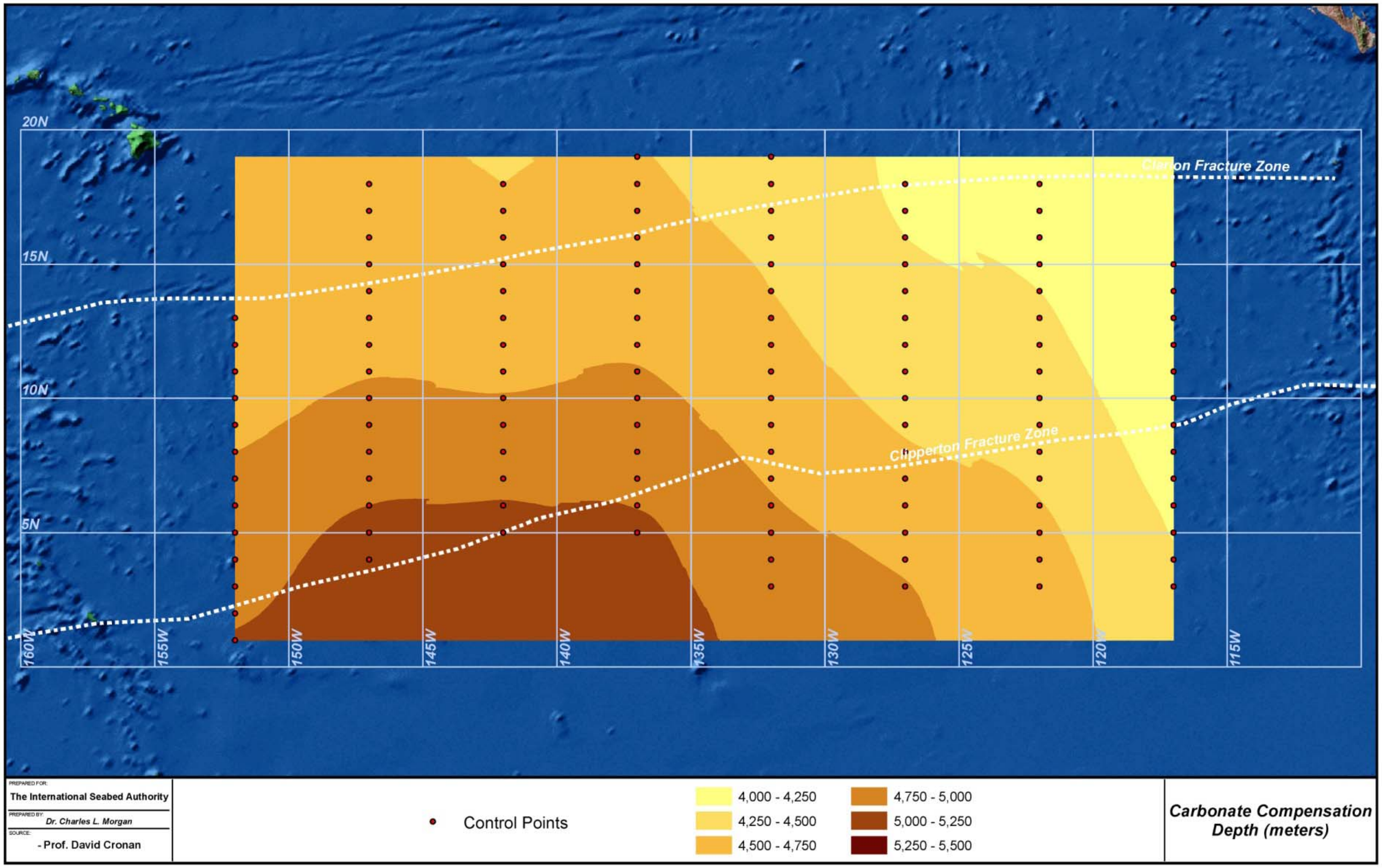
Sediment distribution- COMRA east



COMRA-West

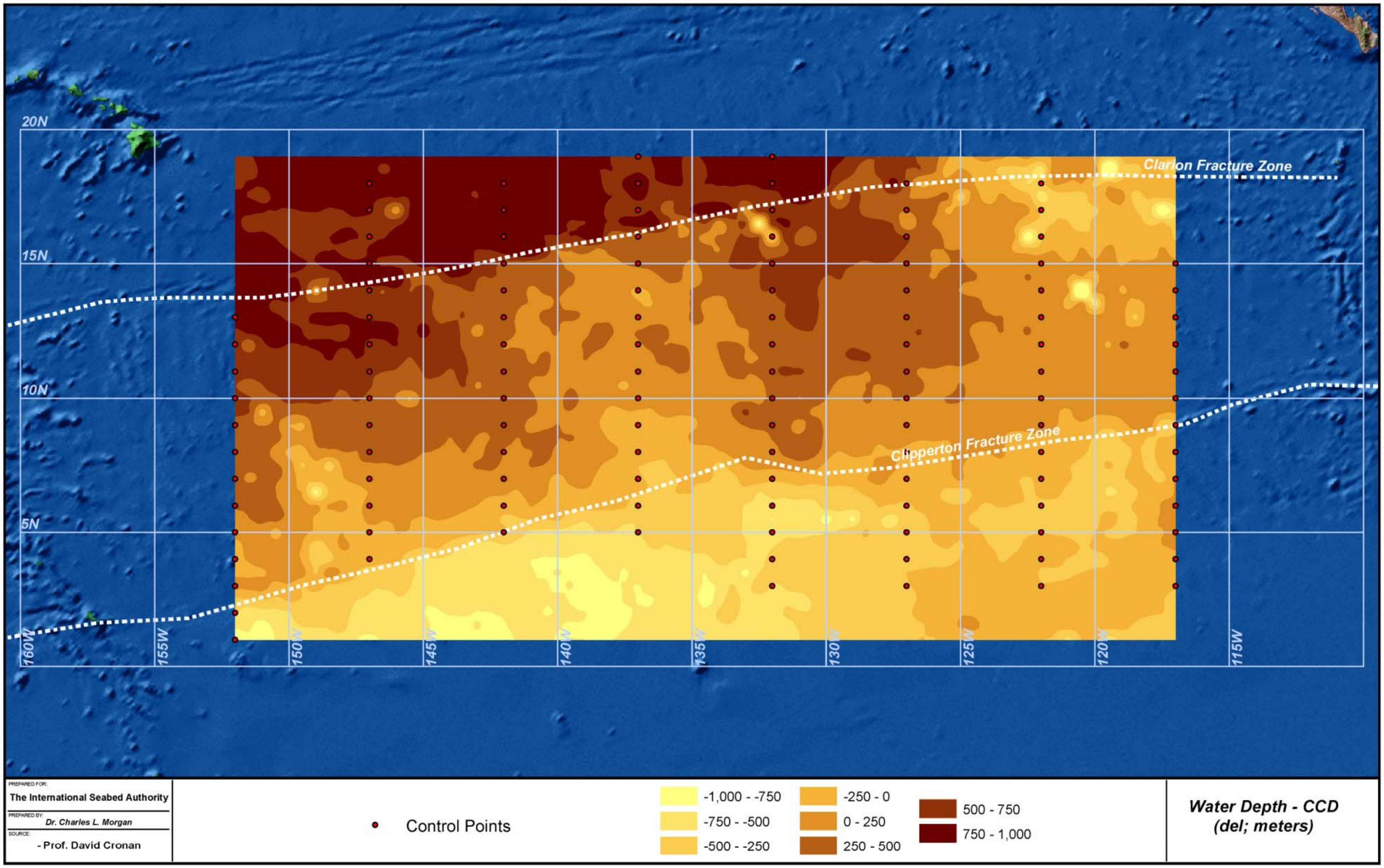


PROXY DATA: WATER COLUMN

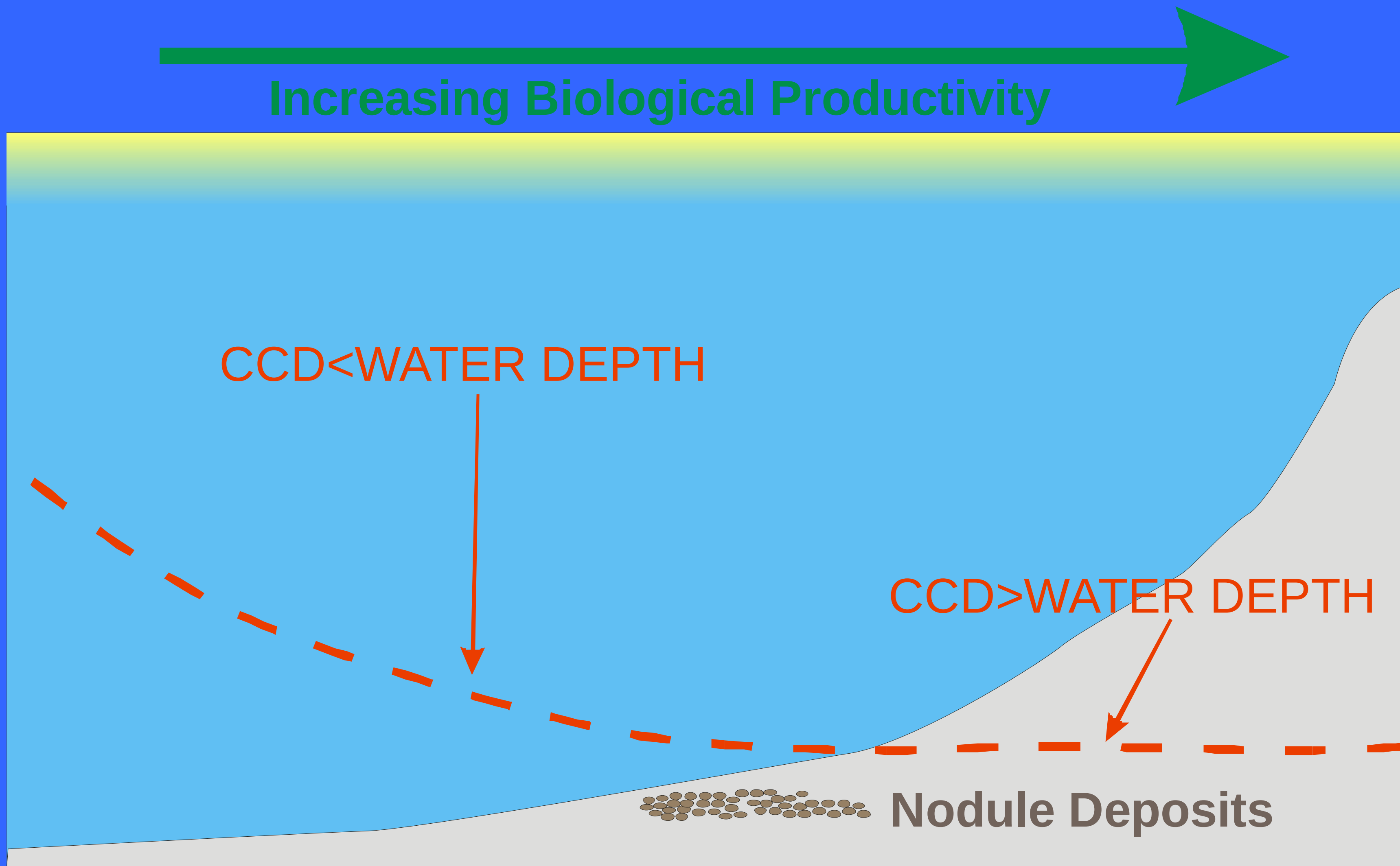


WATER COLUMN DATA: CCD

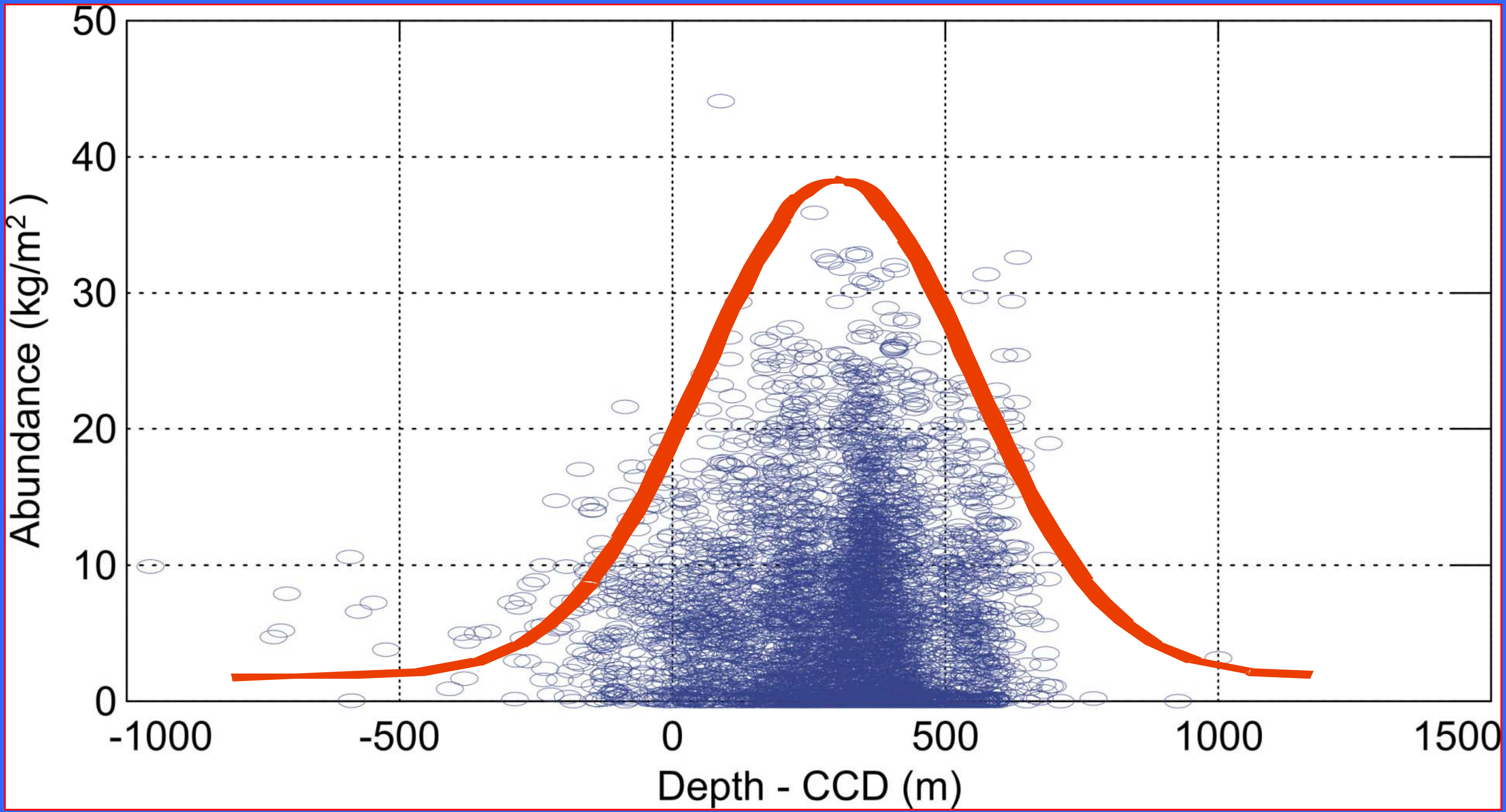
WATER COLUMN DATA: DEPTH - CCD



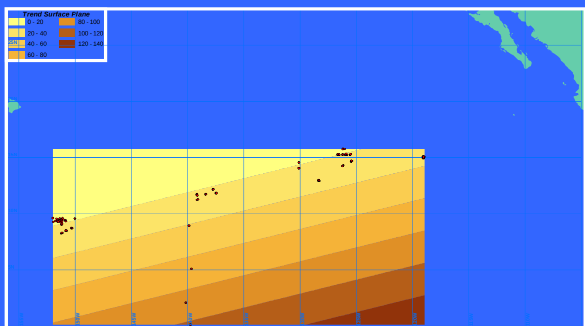
CCD vs WATER DEPTH



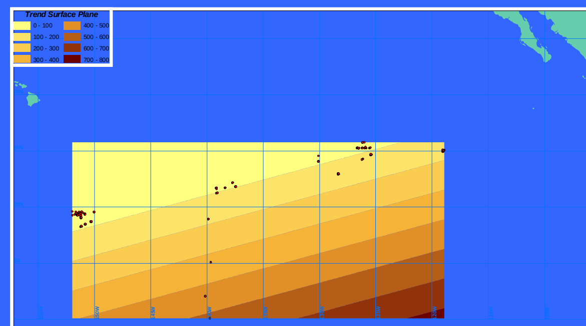
(DEPTH – CCD) vs Abundance



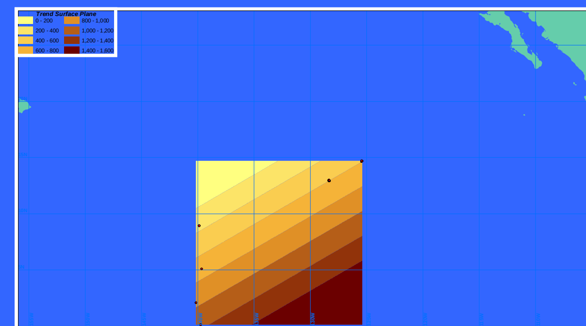
BIOLOGICAL DATA:
BENTHIC FAUNAL ABUNDANCE
TREND SURFACE PLANES



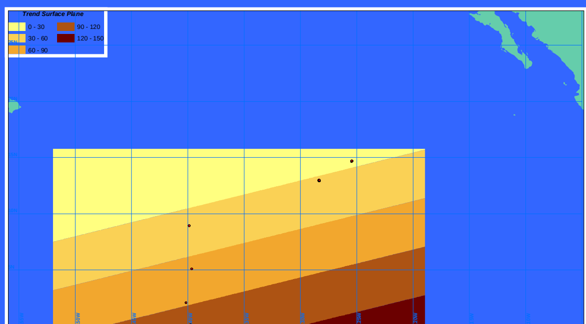
Isopods (#/m^2)



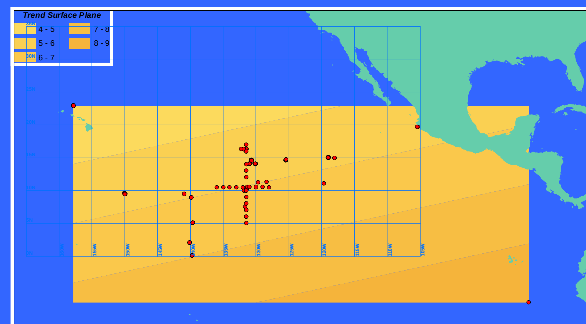
Polychaetes (#/m^2)



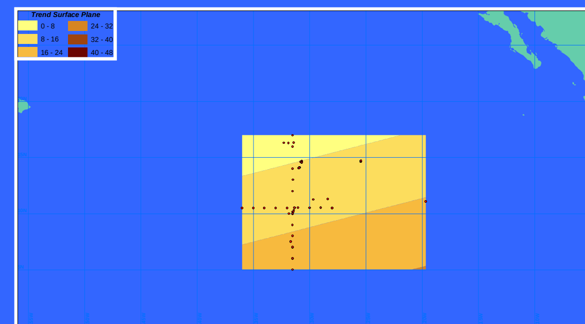
Macrofauna (#/m^2)



Tanaids (#/m^2)

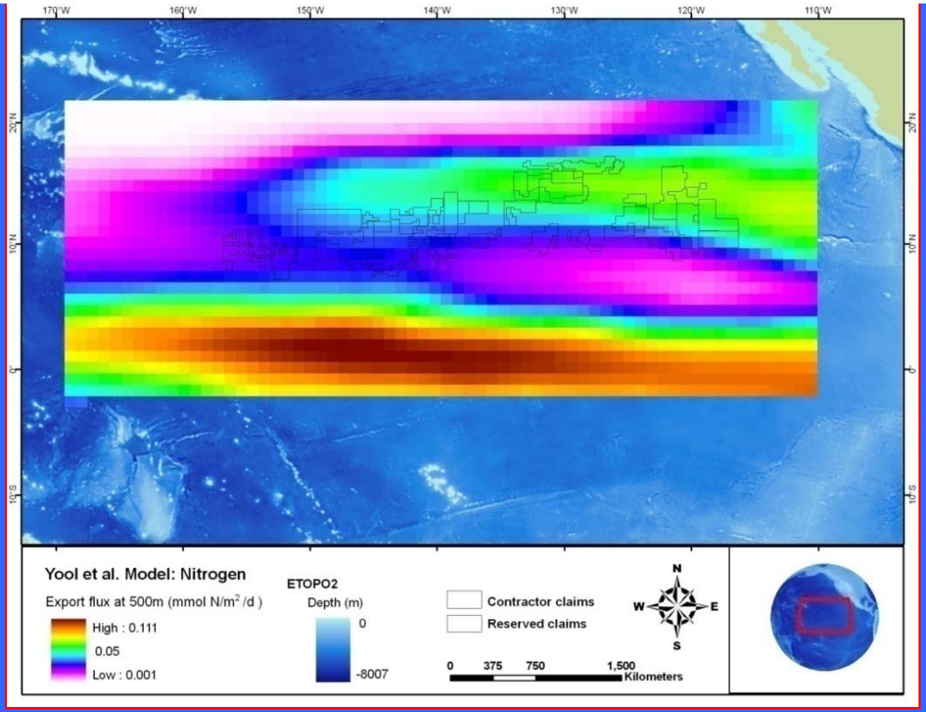


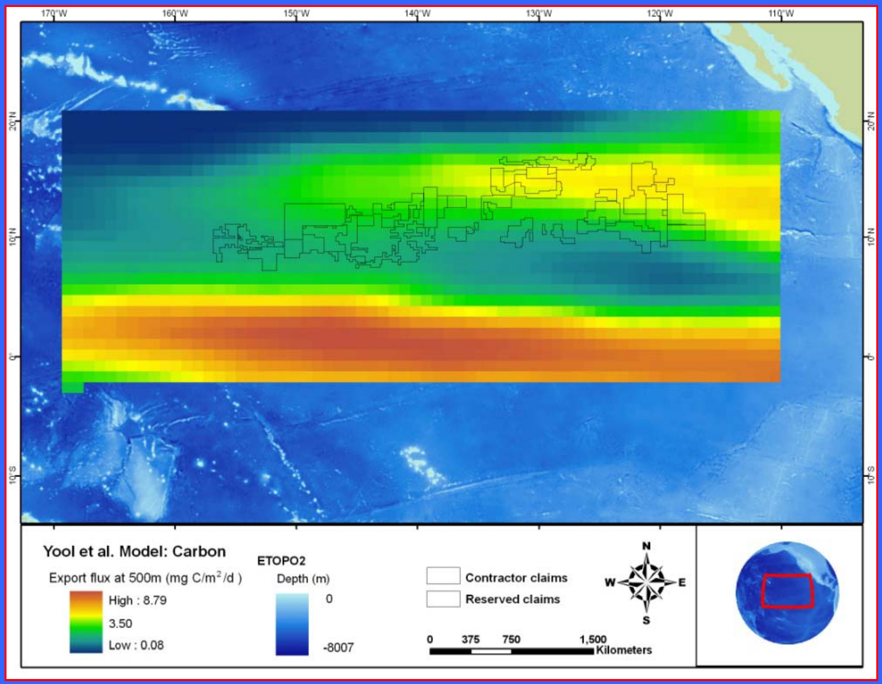
Nematodes (#/cm^2)



Meiofauna (#/cm^2)

Nitrogen export flux



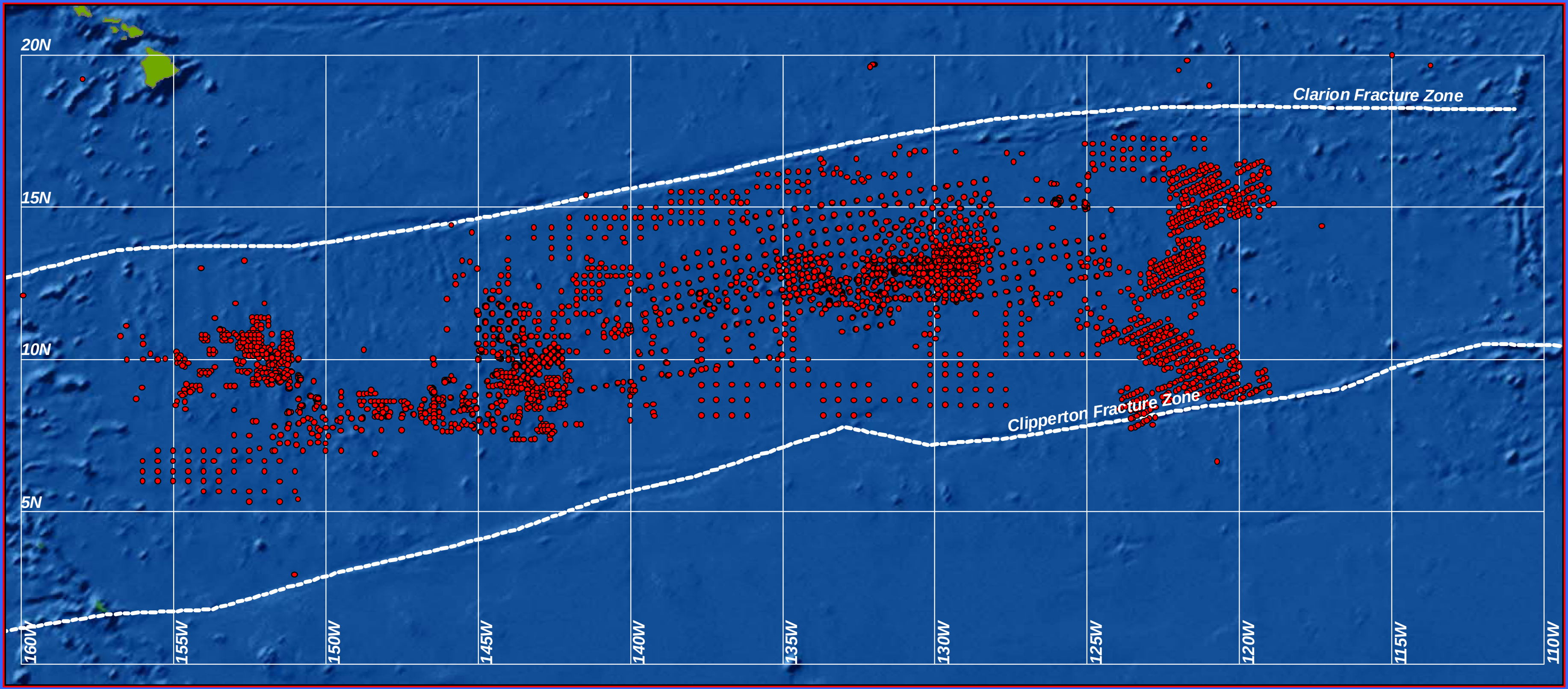


Carbon export flux

- Geological Model
  - Primary data source
  - Inferred resources
  - SDSS (Spatial decision support system) Modeling

- Data Sets-
- KORDI models using Geostatistical and GIS techniques.
- Biogeochemical approach to modeling examines the use of specific proxy variables to predict deposit characteristics where data are lacking.
- Spatial Decision Support System (SDSS) approach to the modeling, which employs Weights of Evidence Modeling, Fuzzy Logic, Logistic Regression and Artificial Neural Network (ANN) techniques based on the some of proxy variables

SAMPLE STATIONS IN RESOURCE ASSESSMENT



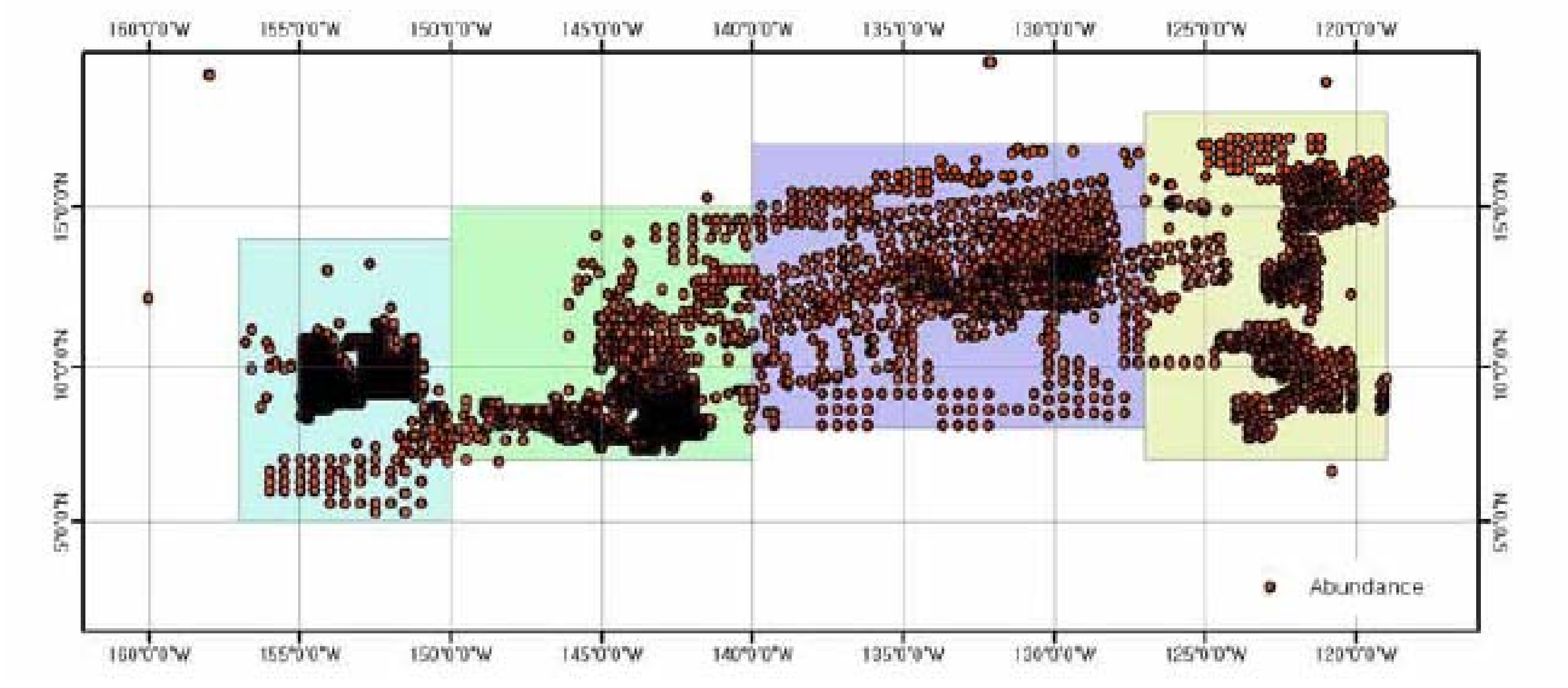
Data Source	CDR	KOREA	OMCO	COMRA	IOM	Totals After Screening
# Stations: Abundance	253	329	7,738	52,473	790	61,583
# Stations: Manganese	879	258	5,875	716	664	8,392
#Stations: Cobalt	711	258	5,900	716	664	8,249
#Stations: Nickel	799	258	5,923	716	664	8,360
# Stations: Copper	882	258	5,924	714	664	8,442

Summary resources

	Abundance	*Manganese*	*Cobalt*	*Nickel*	*Copper*
Mean (kg/m^2)	5.58	1.51	0.012	0.07	0.06
Median (kg/m^2)	5.06	1.33	0.011	0.06	0.05
Maximum (kg/m^2)	24.22	7.71	0.059	0.36	0.33
Minimum (kg/m^2)	0.01	0.00	0.000	0.00	0.00
Mean Std. (kg/m^2) Error	5.38	2.61	0.036	0.15	0.15
Tonnage (10^6-metric)	27,063	7,300	58	340	290

Source	Included Area ($km^2 \times 10^6$)	Estimated Tons (metric tons X 10^6)				
		Nodules	Mn	Co	Ni	Cu
Reduced area	3.83	21,100	5,950*	46.4*	270*	234*
Total study area	4.19	30,700	8,657*	67.5*	393*	341*
Biogeochemical model	4.85	27,100	7,300	58.0	340	290
Potential resources of nodules	12.57	62,000	17,500	134.0	761	669
*Estimated using mean metal content values						

Inferred resources



Station map and blocks used in the study

Block	Area (km^2)	ArcGIS OK (10^6 ton)	GSILB OK	SIS Realizations (10^6 ton)		
				R1	R2	R3
ISA-1	1,056,593.908	6,850.134	6,658.146	8,869.857	7,906.983	8,271.747
ISA-2	1,405,484.041	7,568.250	7,625.559	9,442.066	9,160.971	9,324.734
ISA-3	966,323.969	5,304.177	5,097.307	7,397.636	4,811.399	6,045.043
ISA-4	764,320.813	3,660.990	3,690.781	4,969.960	4,731.932	5,309.745
Total	4,192,722.731	23,383.551	23,071.793	30,679.520	26,611.285	28,951.269

OK- Ordinary Kriging
SIS-Sequential Indicator simulation

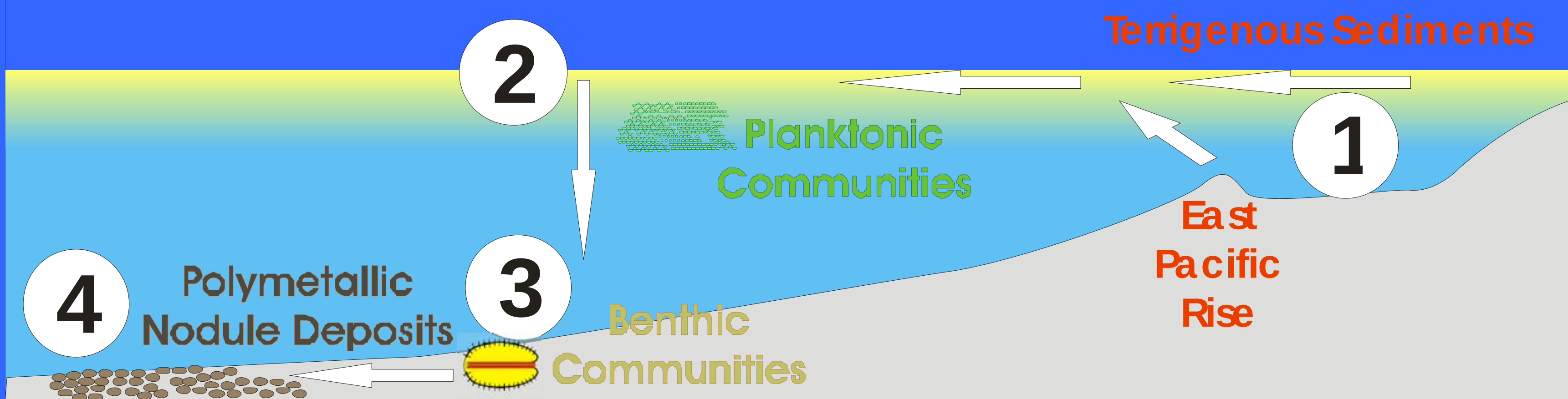
- Biogeochemical modeling
- The model presented here predicts the geographical distributions of nodule metal content (Mn, Co,Ni, Cu, and Ni concentrations) and abundance (kilograms of ore deposits per square meter of seafloor) using as model components the values of other, known variables, including chlorophyll concentrations in surface waters, distance from the East Pacific Rise, and Carbonate Compensation Depth (CCD).

	Abundance	*Manganese*	*Cobalt*	*Nickel*	*Copper*
Mean (kg/m^2)	5.58	1.51	0.012	0.07	0.06
Median (kg/m^2)	5.06	1.33	0.011	0.06	0.05
Maximum (kg/m^2)	24.22	7.71	0.059	0.36	0.33
Minimum (kg/m^2)	0.01	0.00	0.000	0.00	0.00
Mean Std. (kg/m^2) Error	5.38	2.61	0.036	0.15	0.15
Tonnage (10^6-metric)	27,063	7,300	58	340	290

Summary of resource estimation-
Estimation from biogeochemical modeling

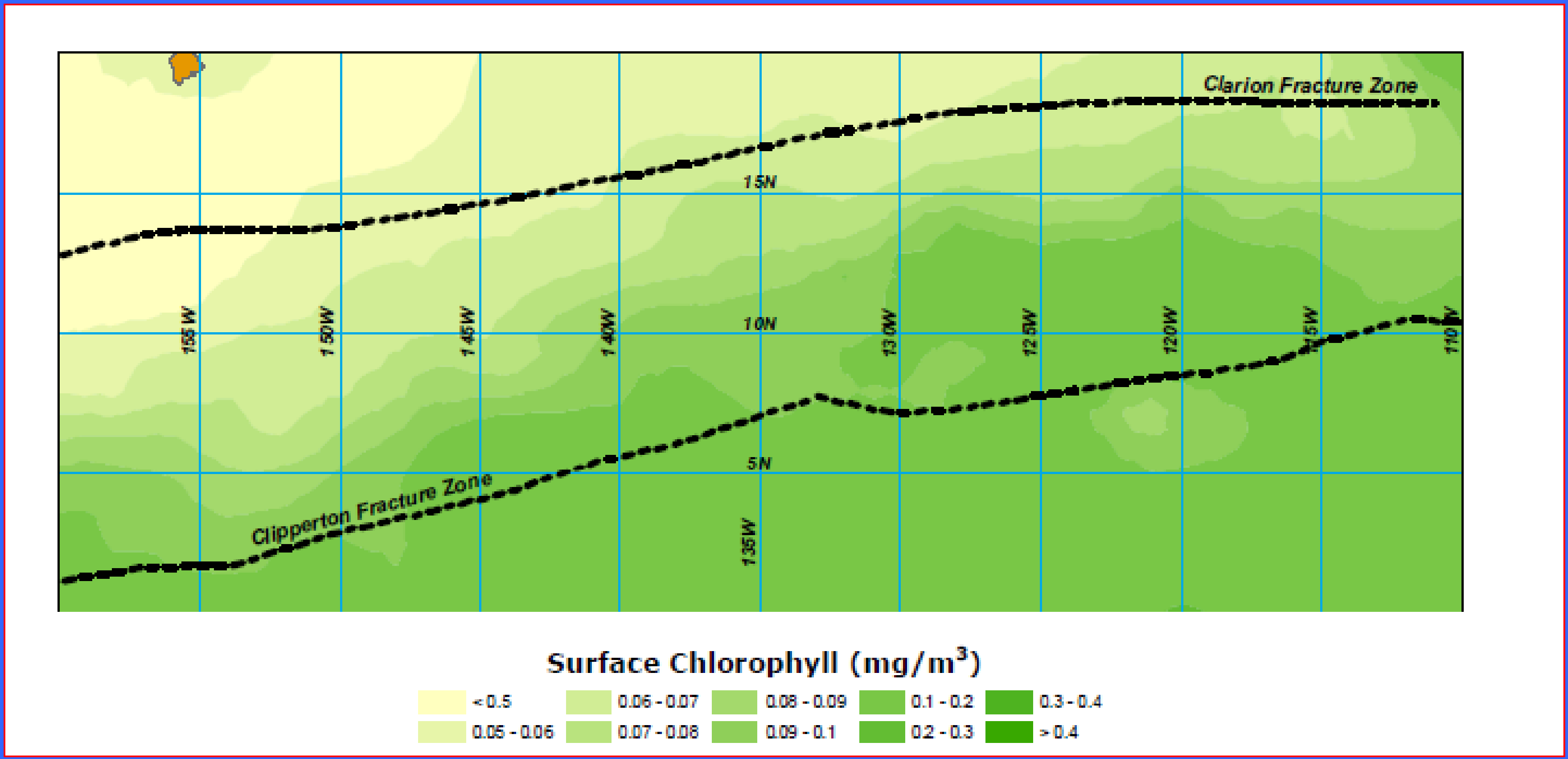
MODEL DEFINITION:
GENERAL HYPOTHESIS

1. Sources of metals: Land and East Pacific Rise, carried in suspended sediments
2. Sediments consumed by zooplankton & converted to larger pellets that sink
3. Fecal pellets metabolized by benthic fauna, releasing reduced metals
4. Reduced metals scavanged by Mn oxide surfaces



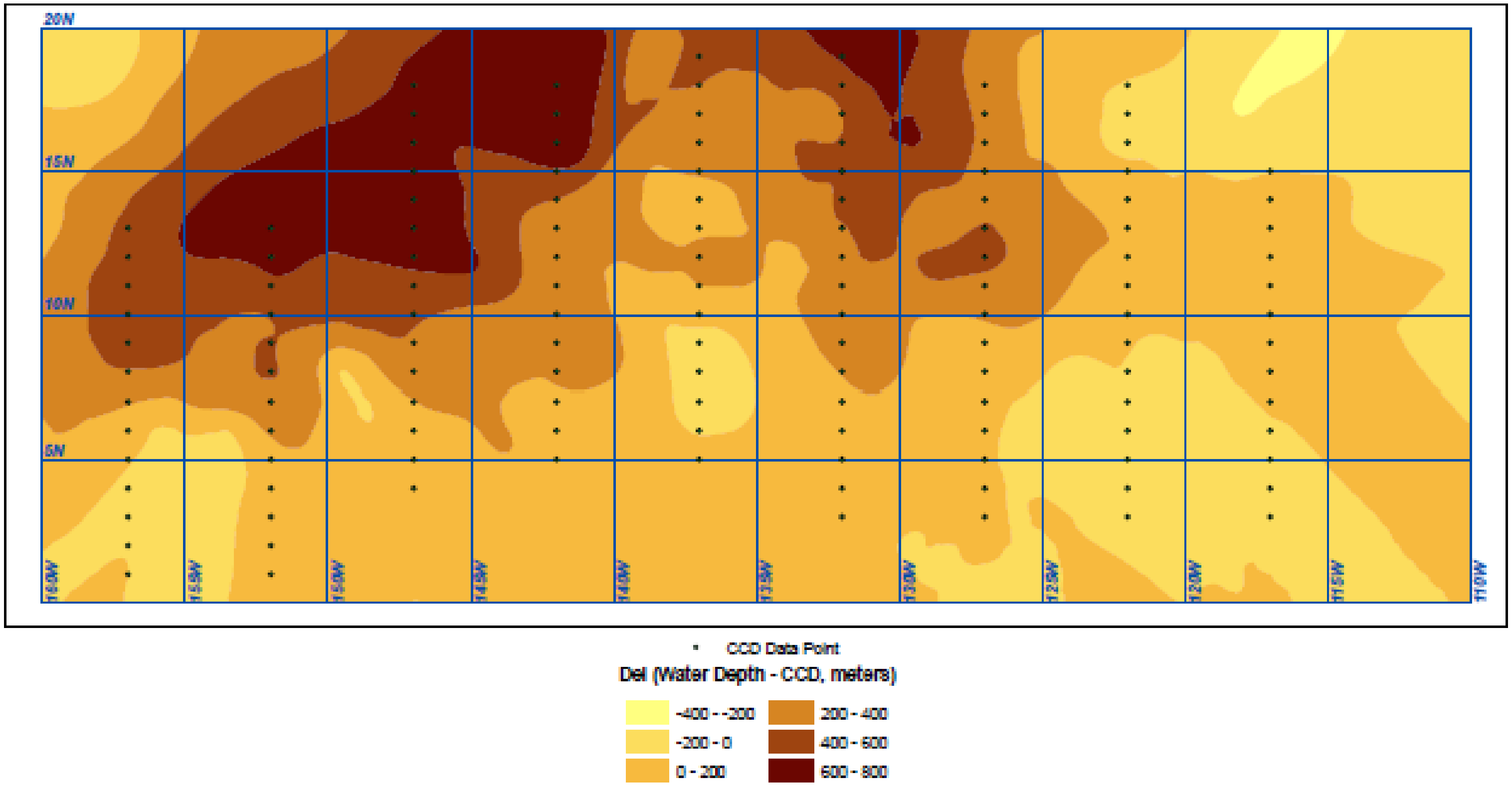
Proxy variables used

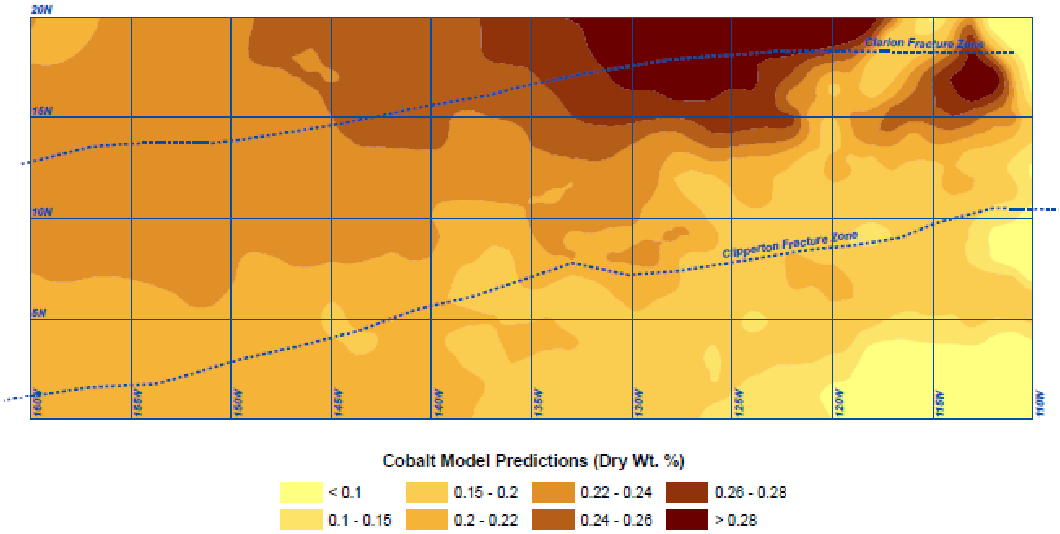
- Distance from EPR
- Chlorophyll content in surface waters The chlorophyll content in surface waters is closely related to the level of biological activity taking place and also to the export productivity at the site, (i.e. the flux rate of biogenic material out of surface waters). In this study we use the estimates of chlorophyll content that were determined by blending historical archives of in situ (National Oceanographic Data Center) and satellite (Coastal Zone Color Scanner) chlorophyll data, which were combined using the blended analysis method of Reynolds (1988) in an attempt to construct an improved climatological seasonal representation of global chlorophyll distributions (Gregg, W.W. and M.E. Conkright, 2000). These data are available as seasonal and annual averages.
- Distance from CCD

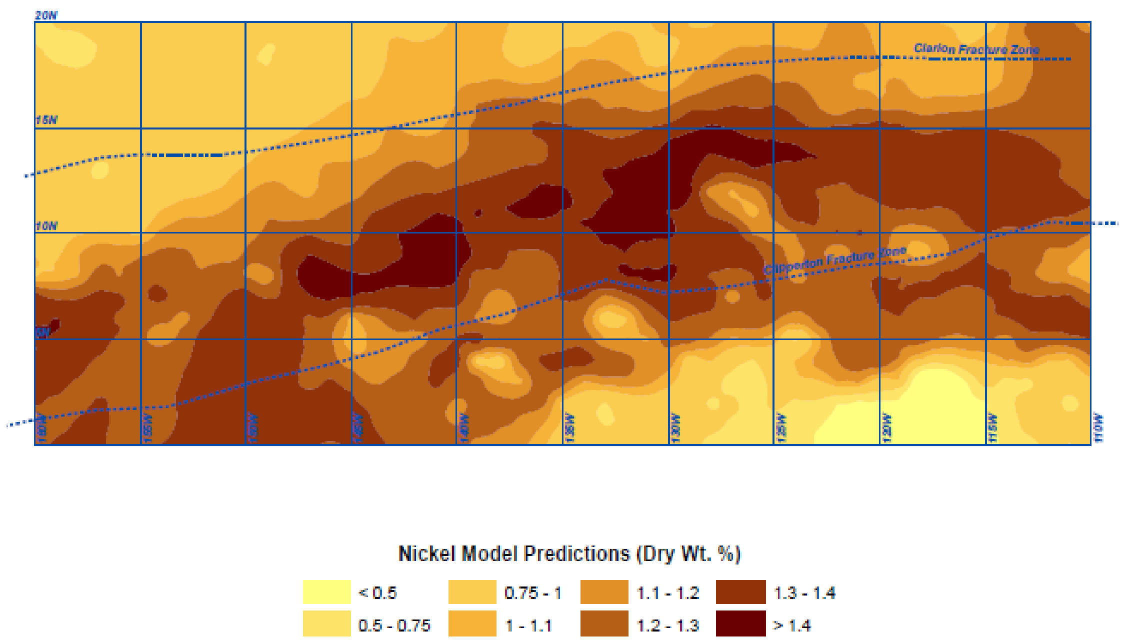


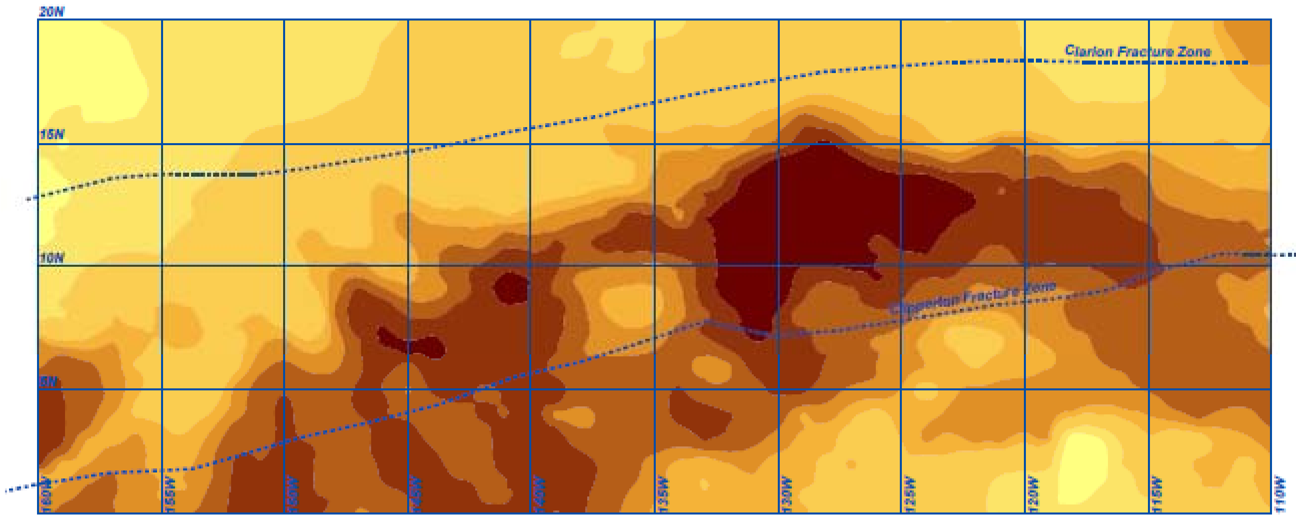
Chlorophyll in surface waters

Figure 5.5 Water Depth minus CCD (del) in the Clarion-Clipperton Zone



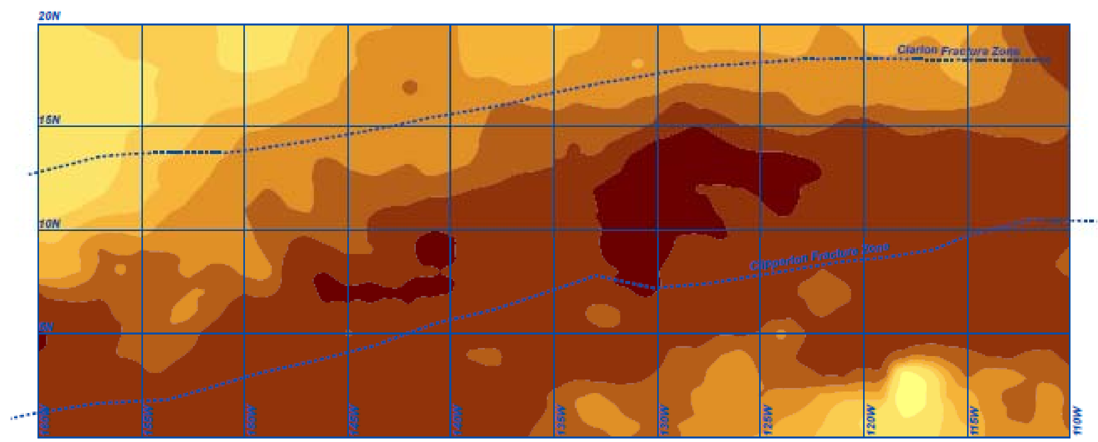

20N
15N
10N
5N
Clarion Fracture Zone
Clipperton Fracture Zone
160W
155W
150W
145W
140W
135W
130W
125W
120W
115W
110W
Cobalt Model Predictions (Dry Wt. %)
< 0.1
0.1 - 0.15
0.15 - 0.2
0.2 - 0.22
0.22 - 0.24
0.24 - 0.26
0.26 - 0.28
> 0.28


20N
15N
10N
Clarion Fracture Zone
Clipperton Fracture Zone
110W
Nickel Model Predictions (Dry Wt. %)
< 0.5
0.5 - 0.75
0.75 - 1
1 - 1.1
1.1 - 1.2
1.2 - 1.3
1.3 - 1.4
> 1.4



Copper Model Predictions (Dry Wt. %)

< 0.6 | 0.6 - 0.8 | 0.8 - 1 | 1 - 1.05 | 1.05 - 1.1 | 1.1 - 1.15 | 1.15 - 1.2 | > 1.2



Manganese Model Predictions (Dry Wt. %)

< 15 | 15 - 20 | 20 - 22 | 22 - 24 | 24 - 26 | 26 - 28 | 28 - 30 | > 30

- **SPATIAL DECISION SUPPORT SYSTEM MODELING (SDSS)**
- The study is based on data sets compiled by other experts that include bathymetry, topography, sediment type, CCD, and surface chlorophyll. Specific techniques employed in the study include Weights of Evidence Modeling, Fuzzy Logic, Logistic Regression and Artificial Neural Network (ANN) techniques

Figure 6.9 Logistic Regression Results, Posterior Probabilities in the CCZ

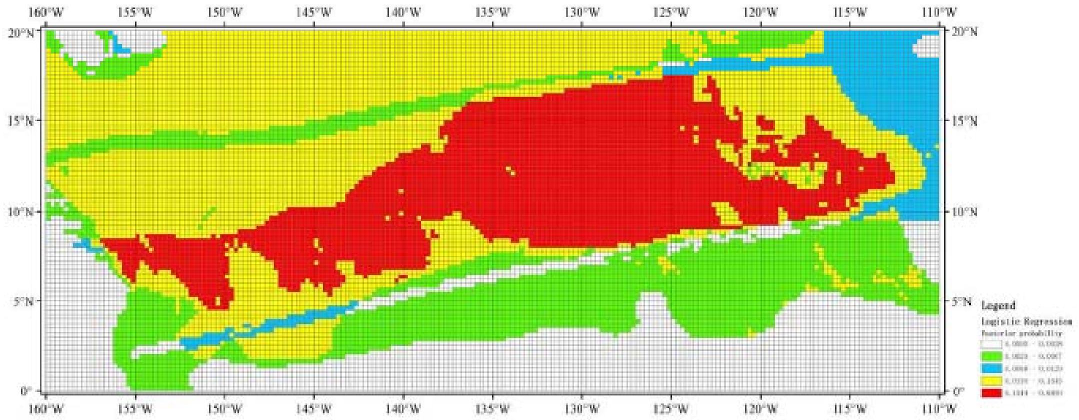


Figure 6.10 Fuzzy Logic Results, Combined Membership Function Values in the CCZ

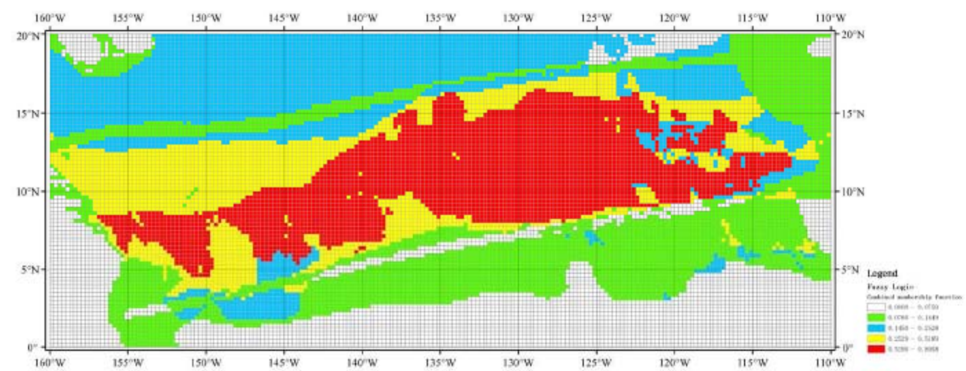
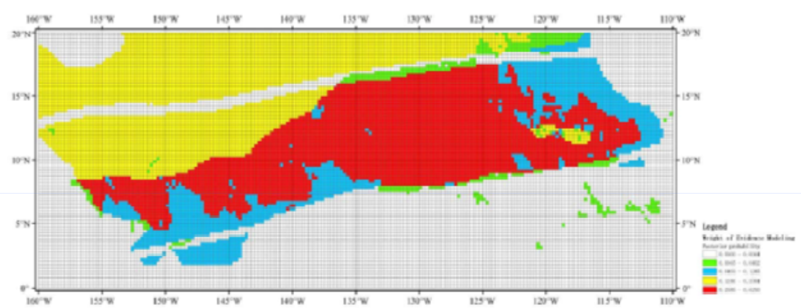


Figure 6.8 Weights of Evidence Results, Posterior Probabilities in the CCZ



Workshop on the results of a project to develop a geological model of polymetallic nodules in the Clarion Clipperton Zone

- **ISA 14-17 December 2009**
- The workshop was attended by a total of 24 participants, including some members of the Legal and Technical Commission of the Authority, representatives of contractors, representatives of member States, industry representatives and the experts who contributed to the development of the Model

Thank You