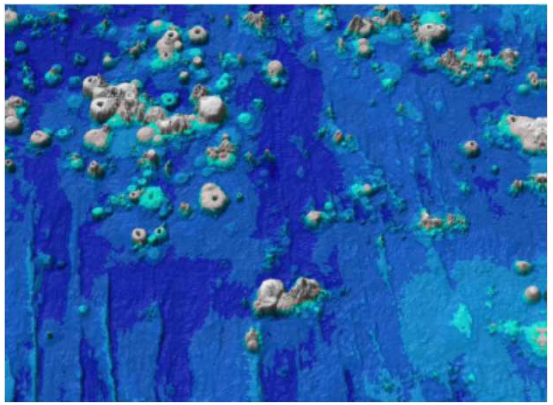
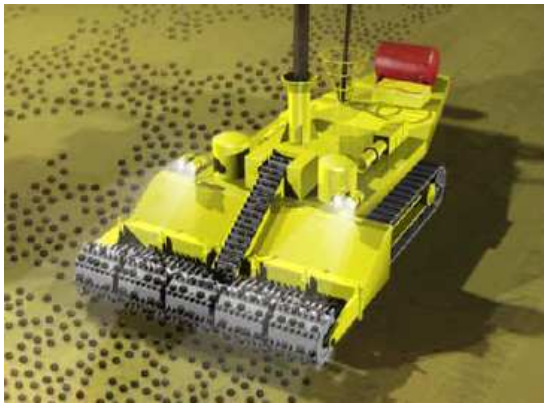
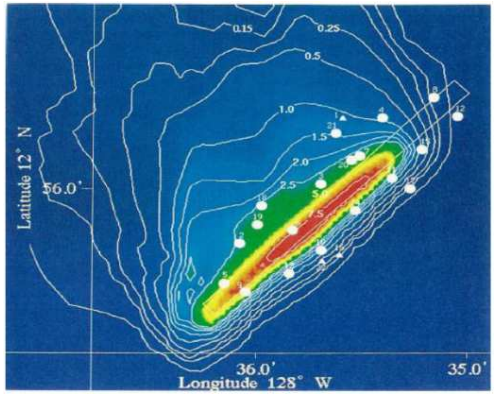
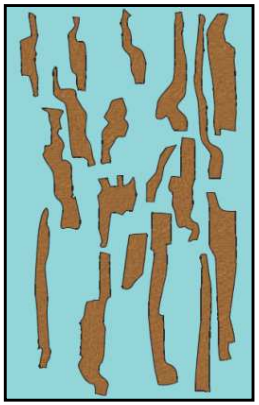



Delineation of IRZs and PRZs in the German license area (CCZ): Criteria and characteristics

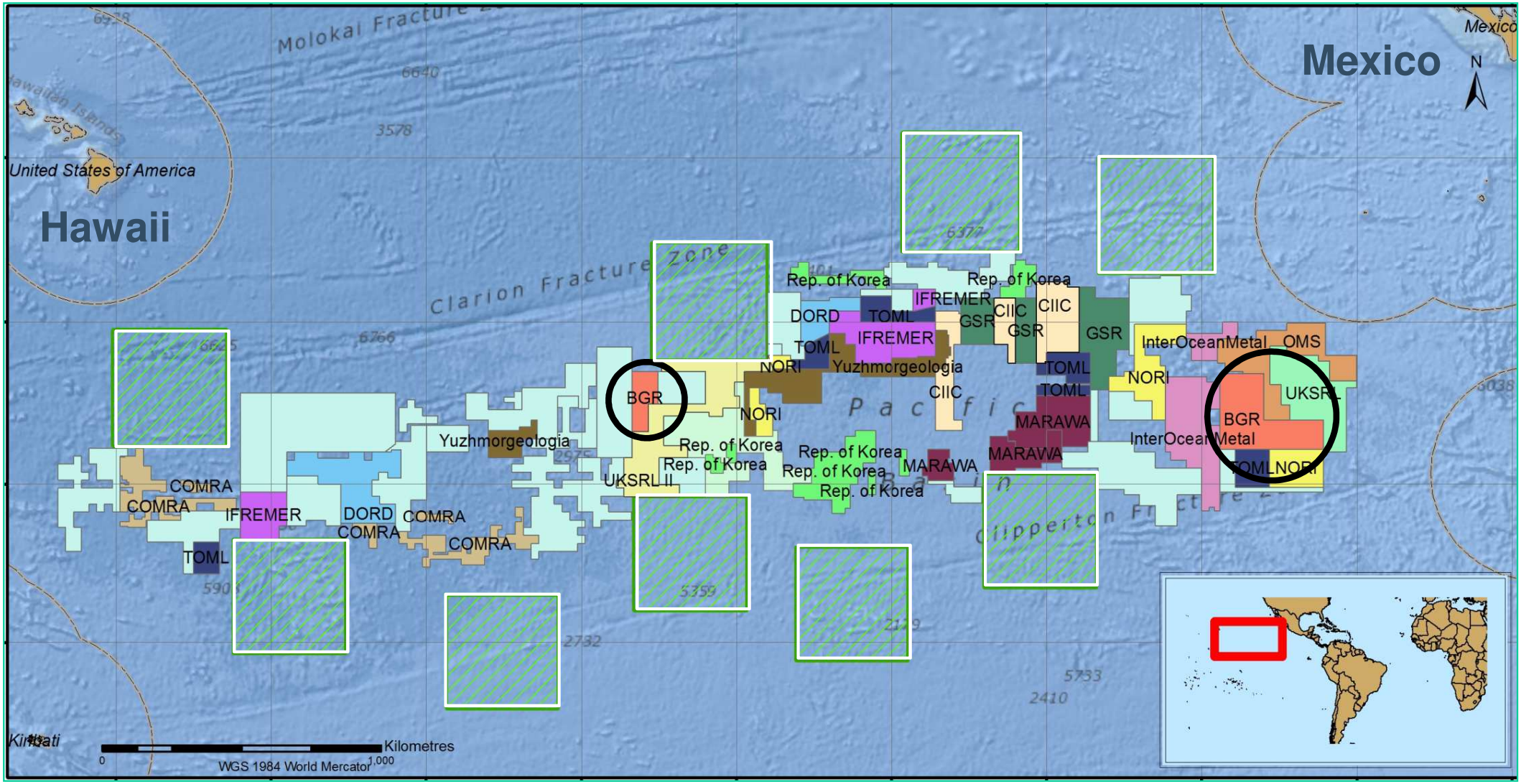
Annemiek Vink, Carsten Rühlemann, Thomas Kuhn – BGR Hannover, Germany
Annika Janssen, Katja Uhlenkott – DZMB Wilhelmshaven, Germany





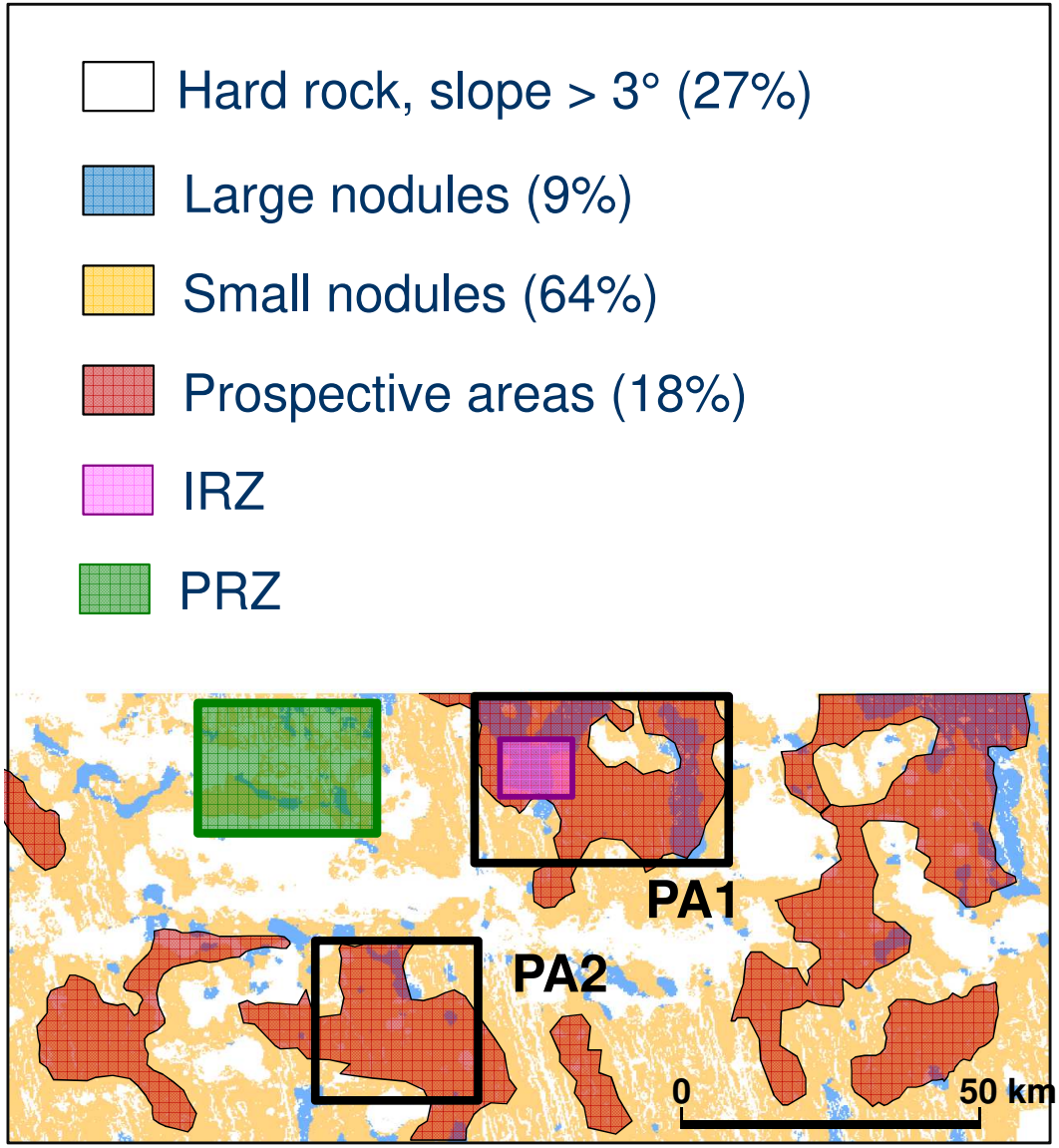
BGR Bundesanstalt für Geowissenschaften und Rohstoffe
GEOZENTRUM HANNOVER

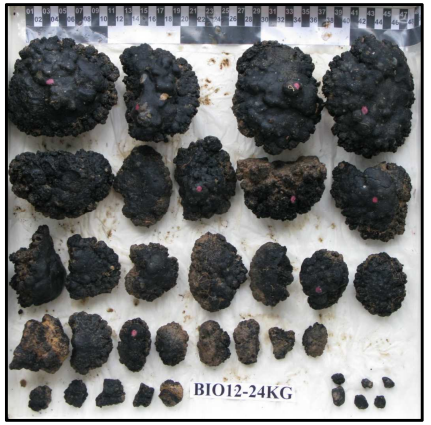
Nodule license areas in the CCZ



- Exploration contract July 2006 – July 2021
- 8 expeditions (2008 – 2016); next expedition spring 2018

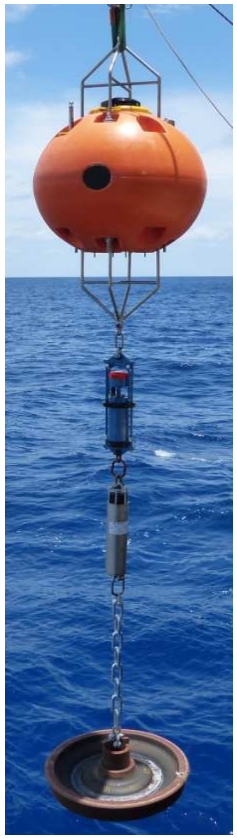
Prospective mining areas





BGR Bundesanstalt für Geowissenschaften und Rohstoffe
GEOZENTRUM HANNOVER

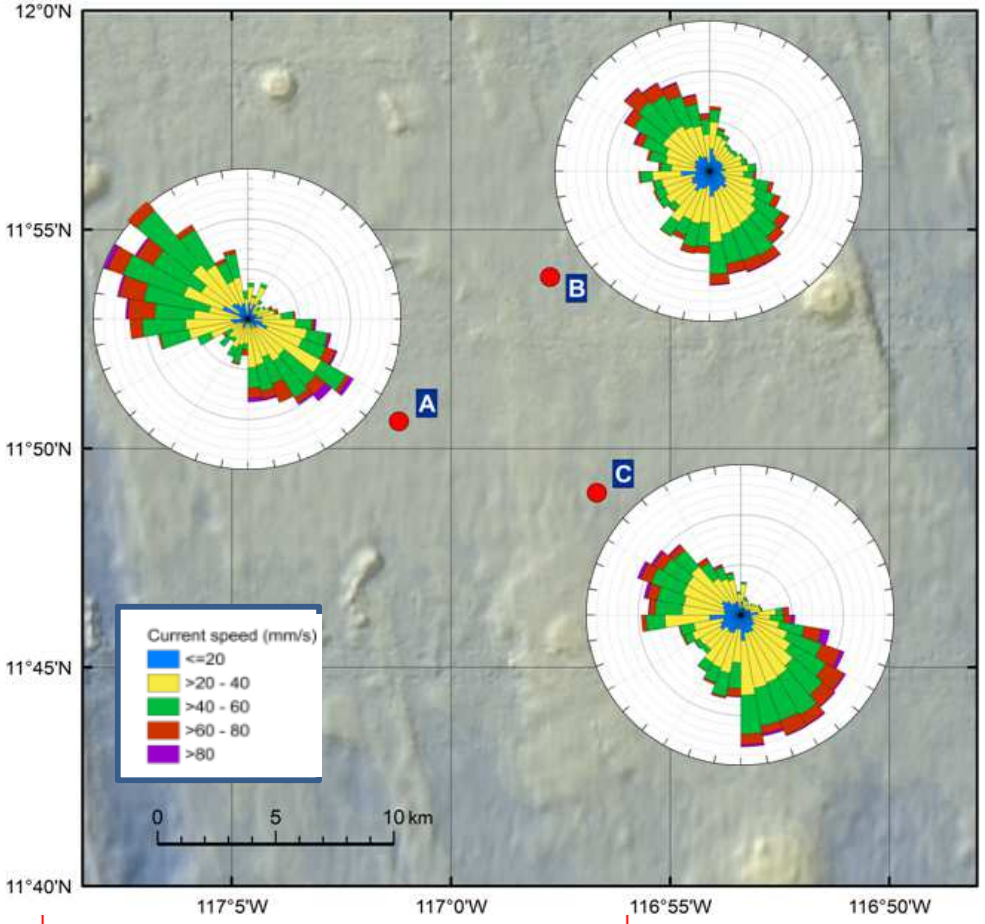
IRZ: Bottom current data

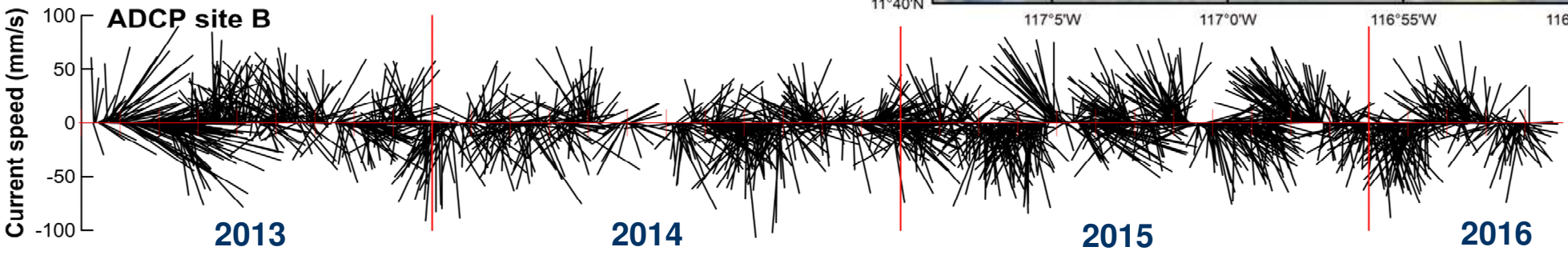


April 2013 – May 2014

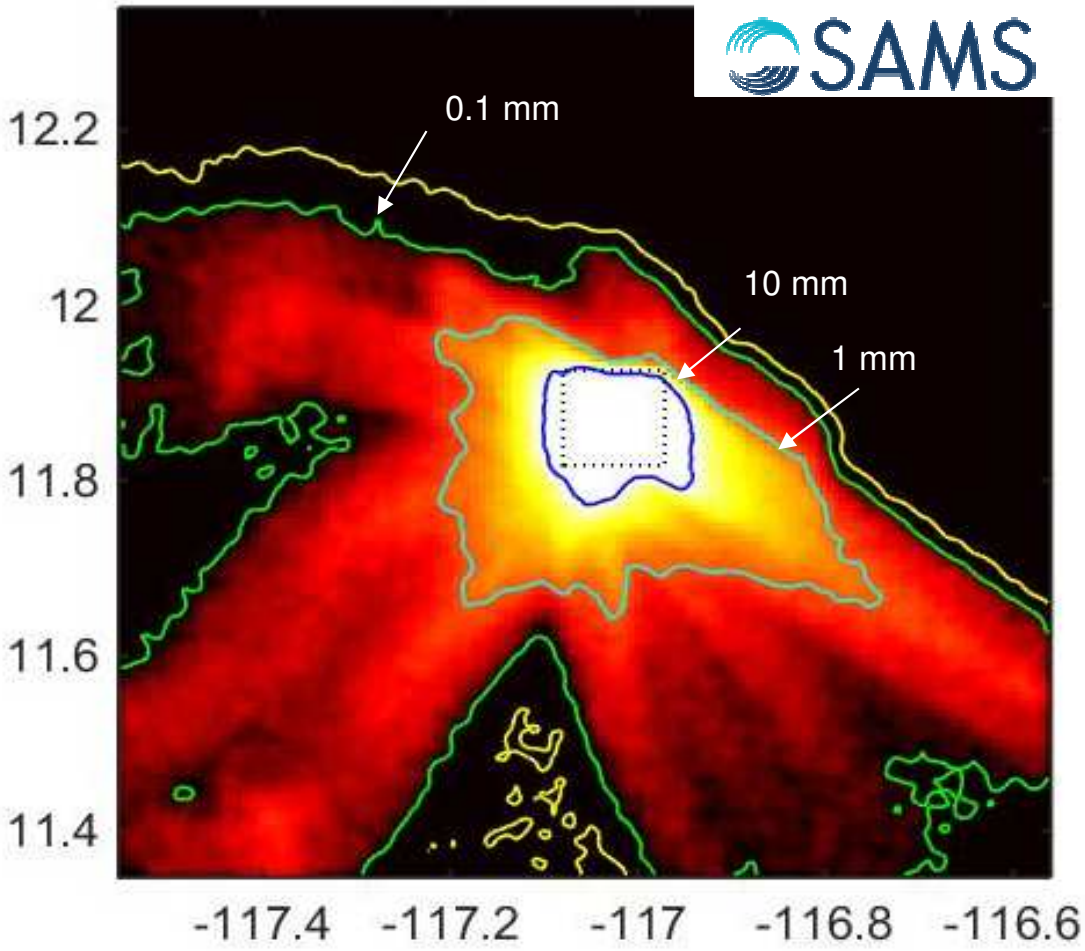
May 2014 – June 2015

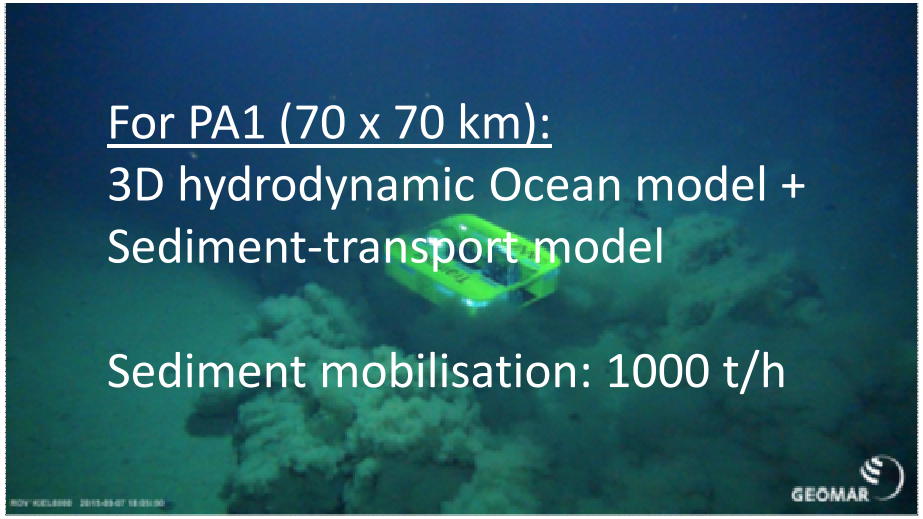
June 2015 – May 2016

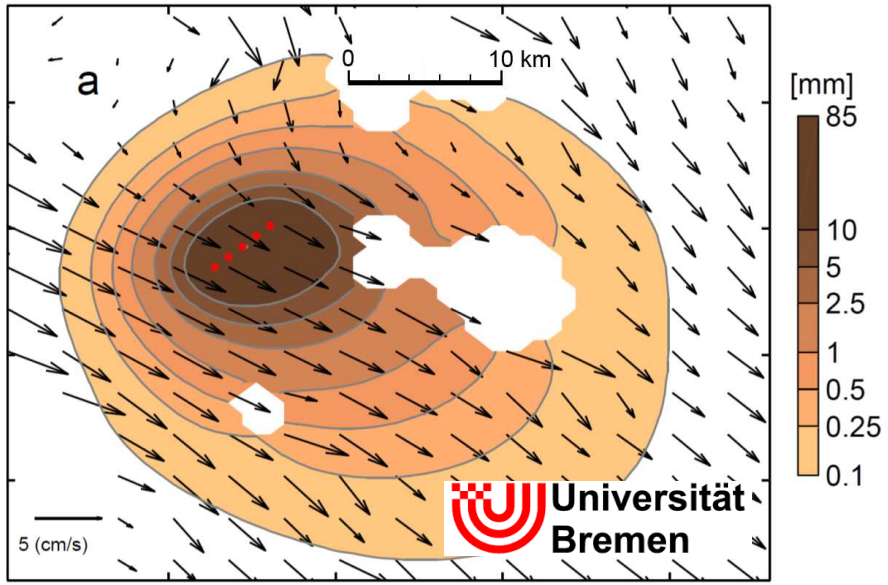




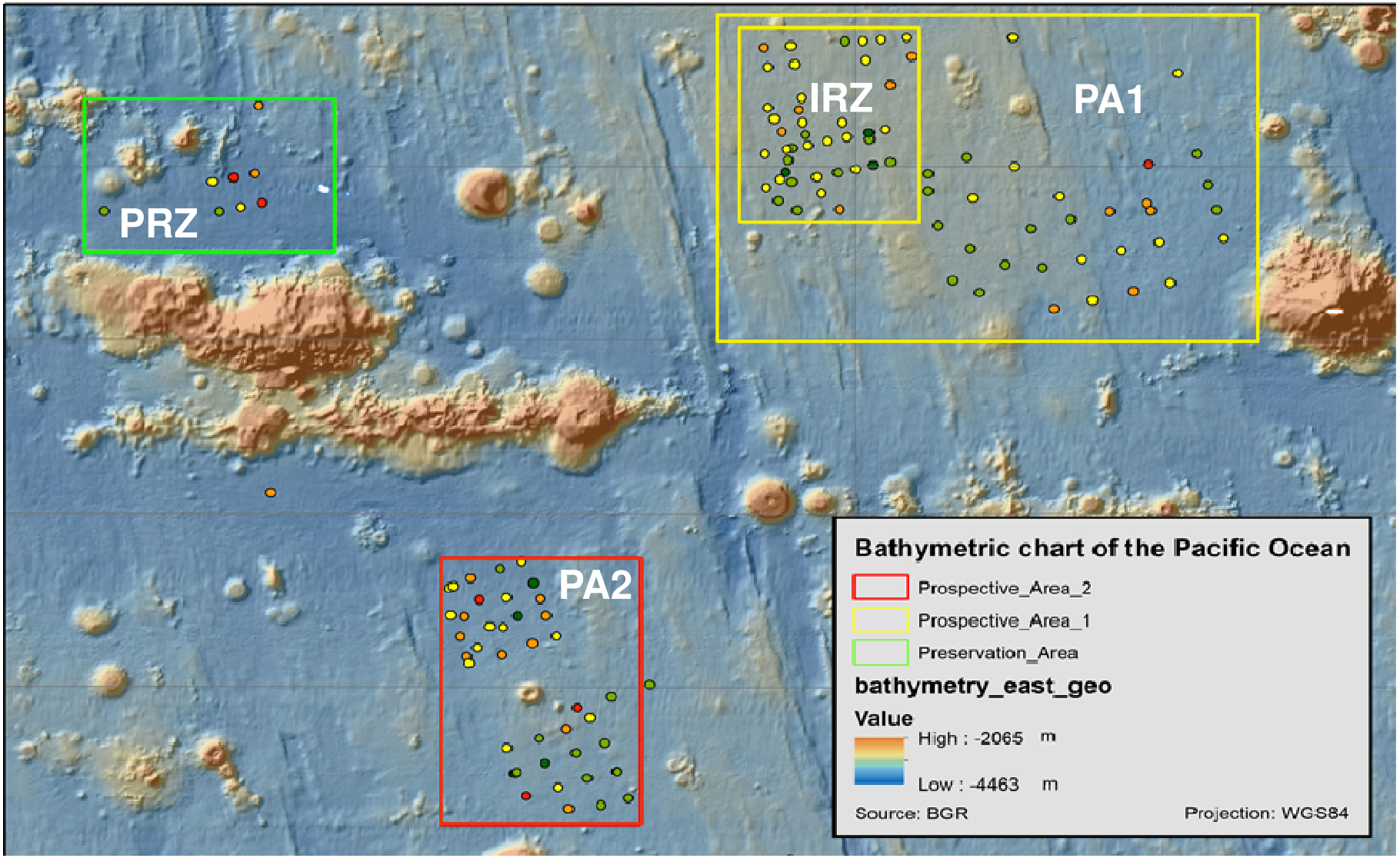
IRZ: Plume modelling





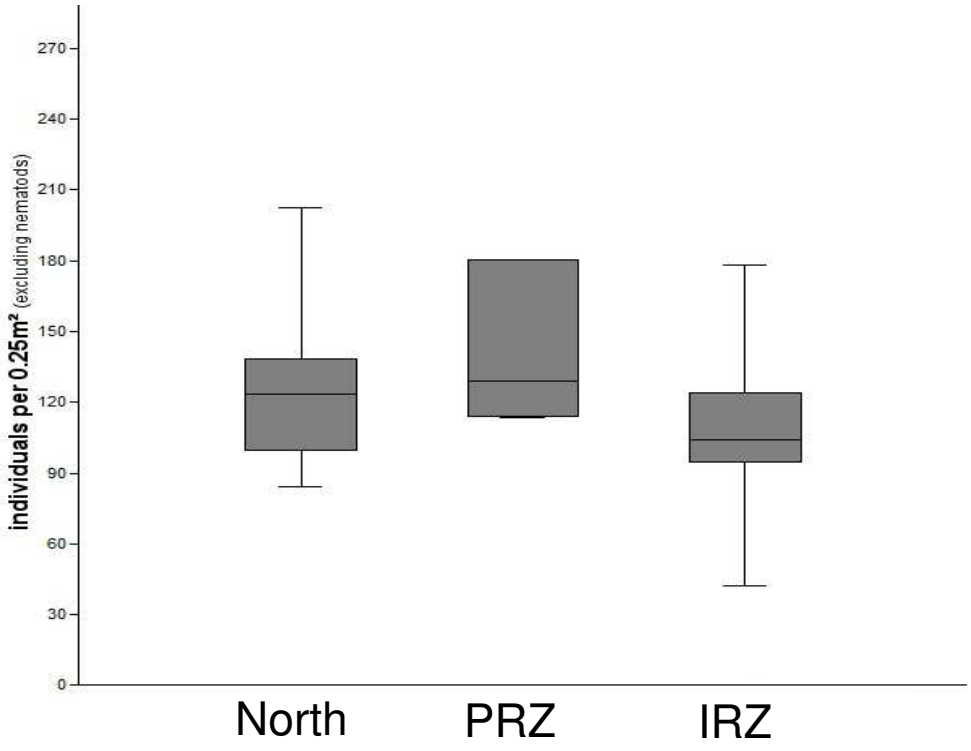


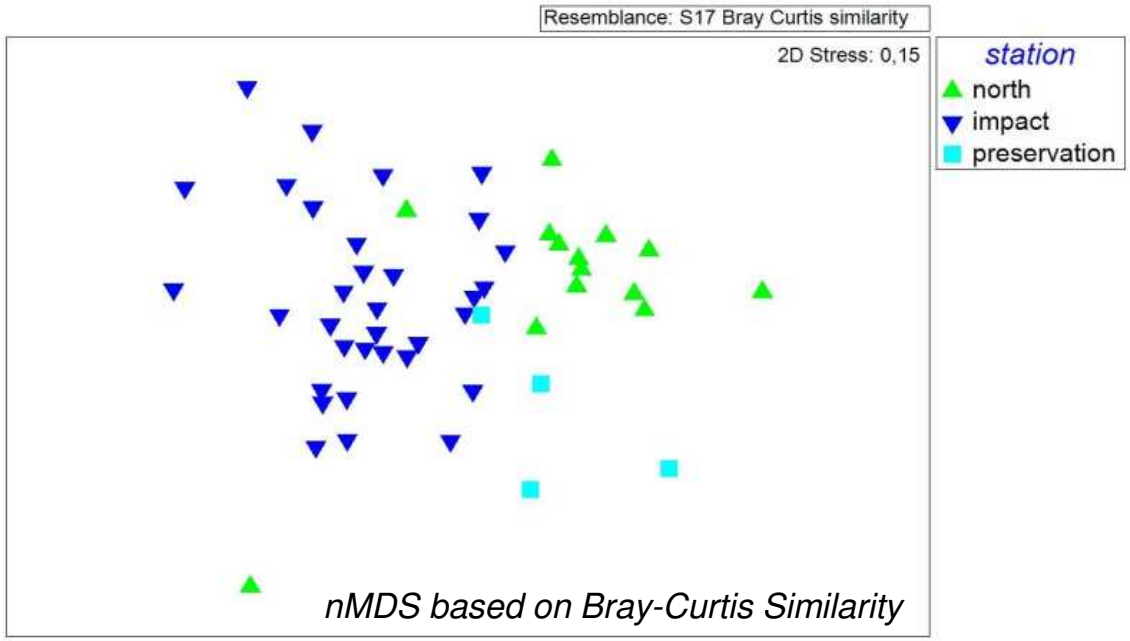
Box core samples



BGR Bundesanstalt für Geowissenschaften und Rohstoffe
GEOZENTRUM HANNOVER

Macrofauna IRZ vs. PRZ





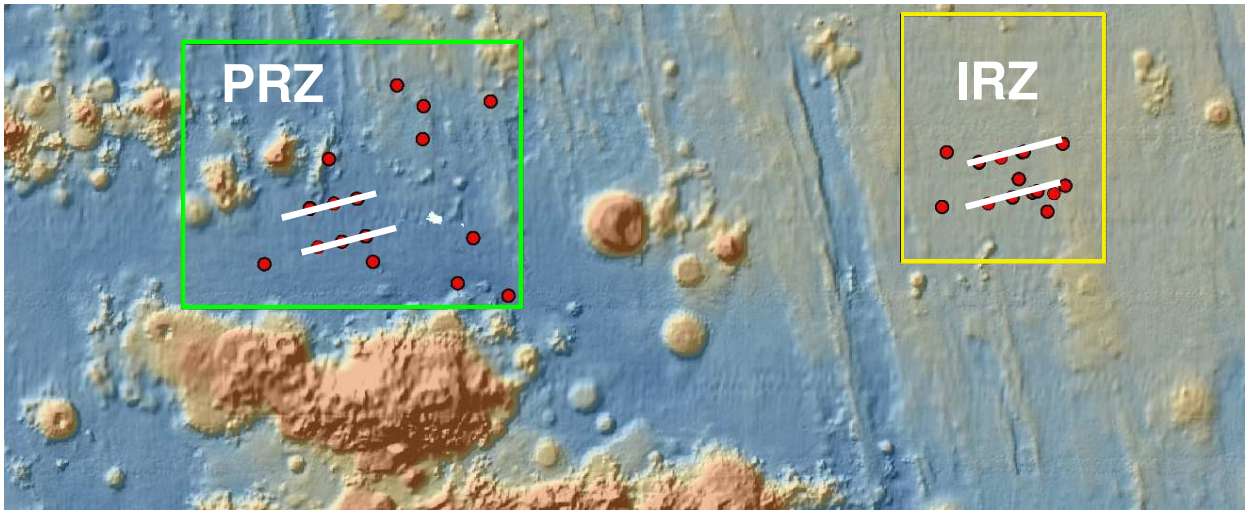
total densities in eastern German license area: 37 - 202 ind./ 0.25 m²

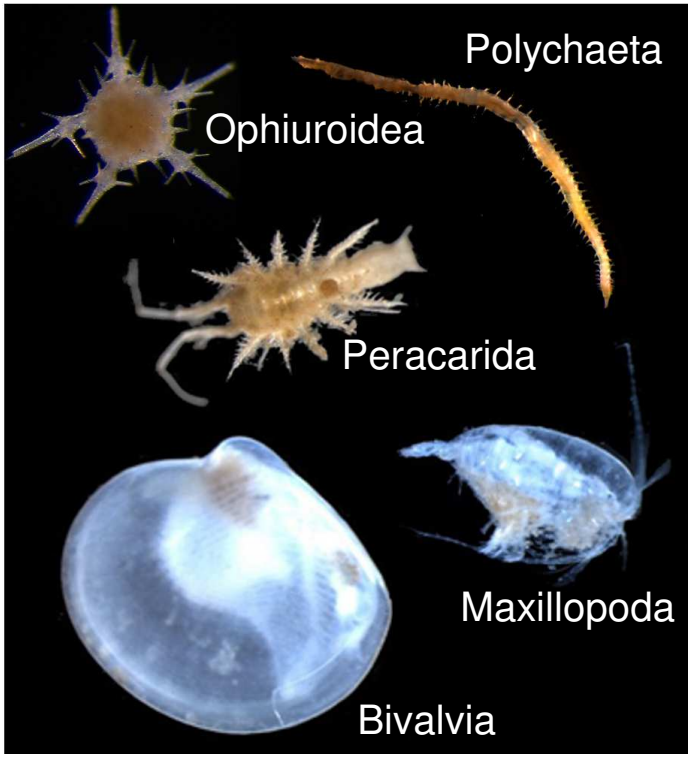
- Significantly higher densities in the PRZ
- Small but siginificant differences in macrobenthic community composition

DZMB

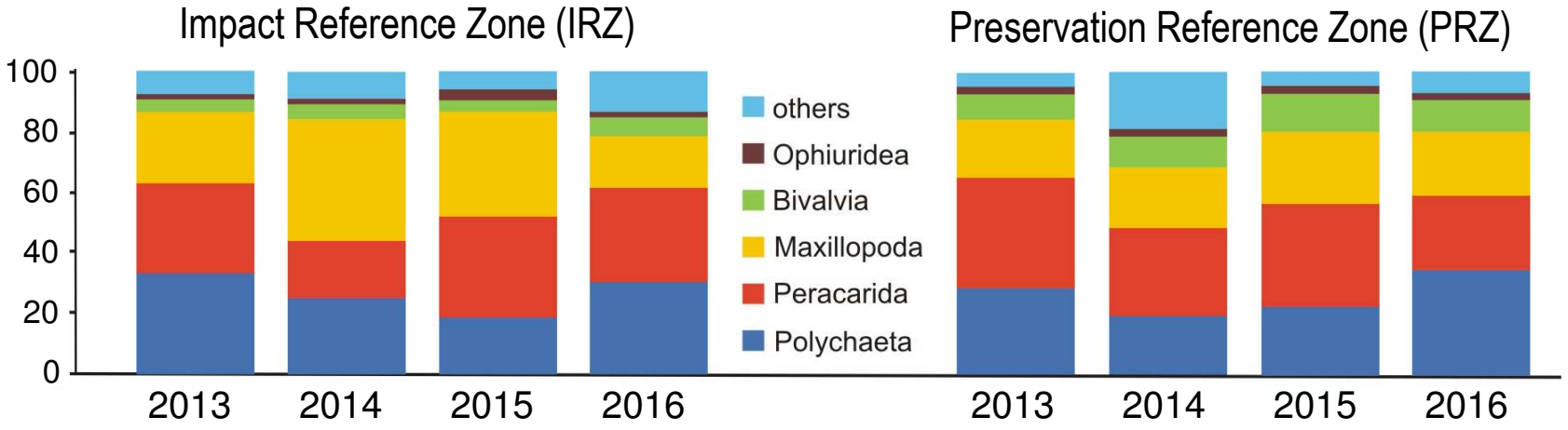
BGR Bundesanstalt für Geowissenschaften und Rohstoffe
GEOZENTRUM HANNOVER

Macrofauna IRZ vs. PRZ

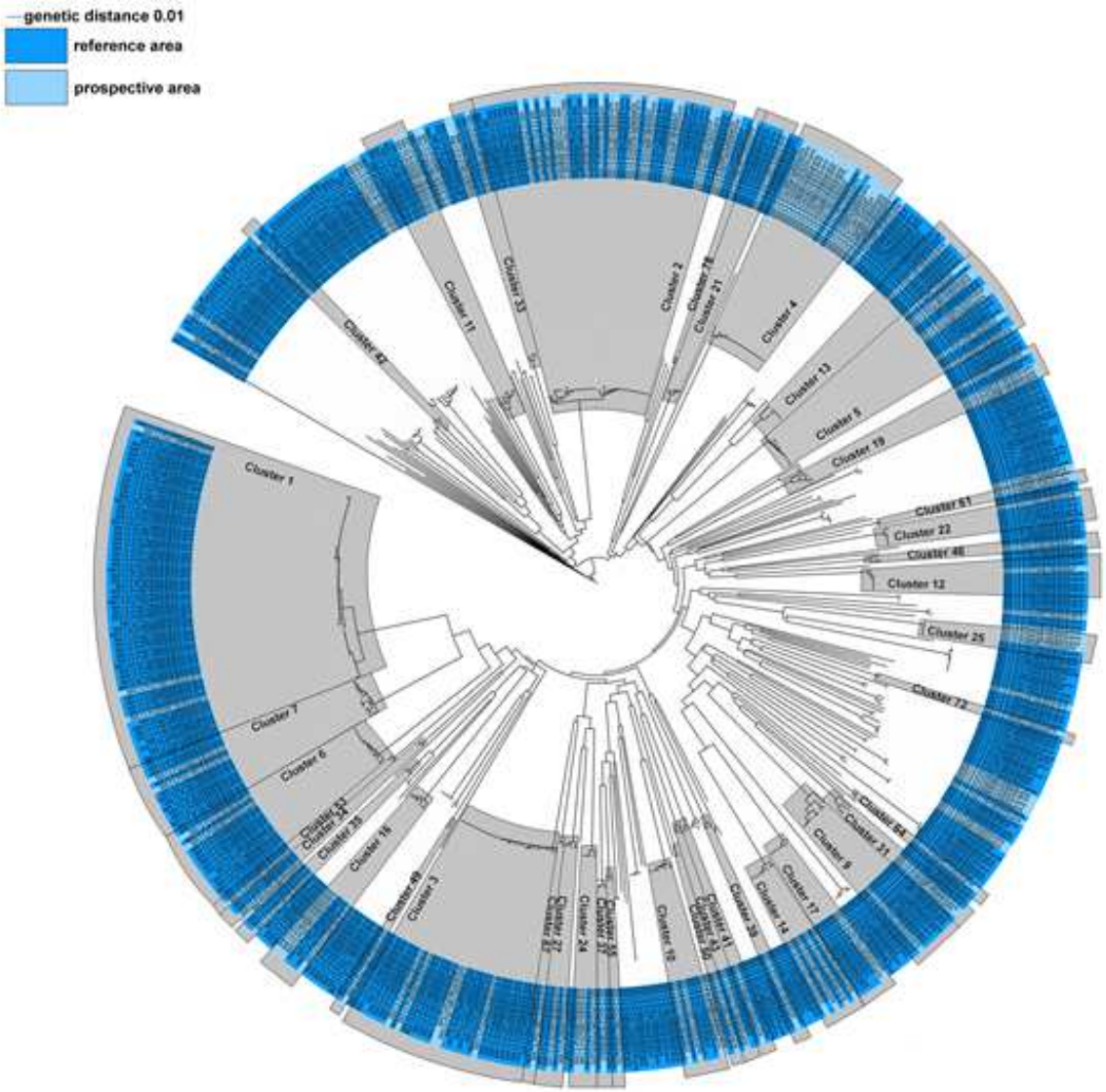




- No significant differences in community structure between IRZ and PRZ at higher taxonomic level



Small-scale connectivity



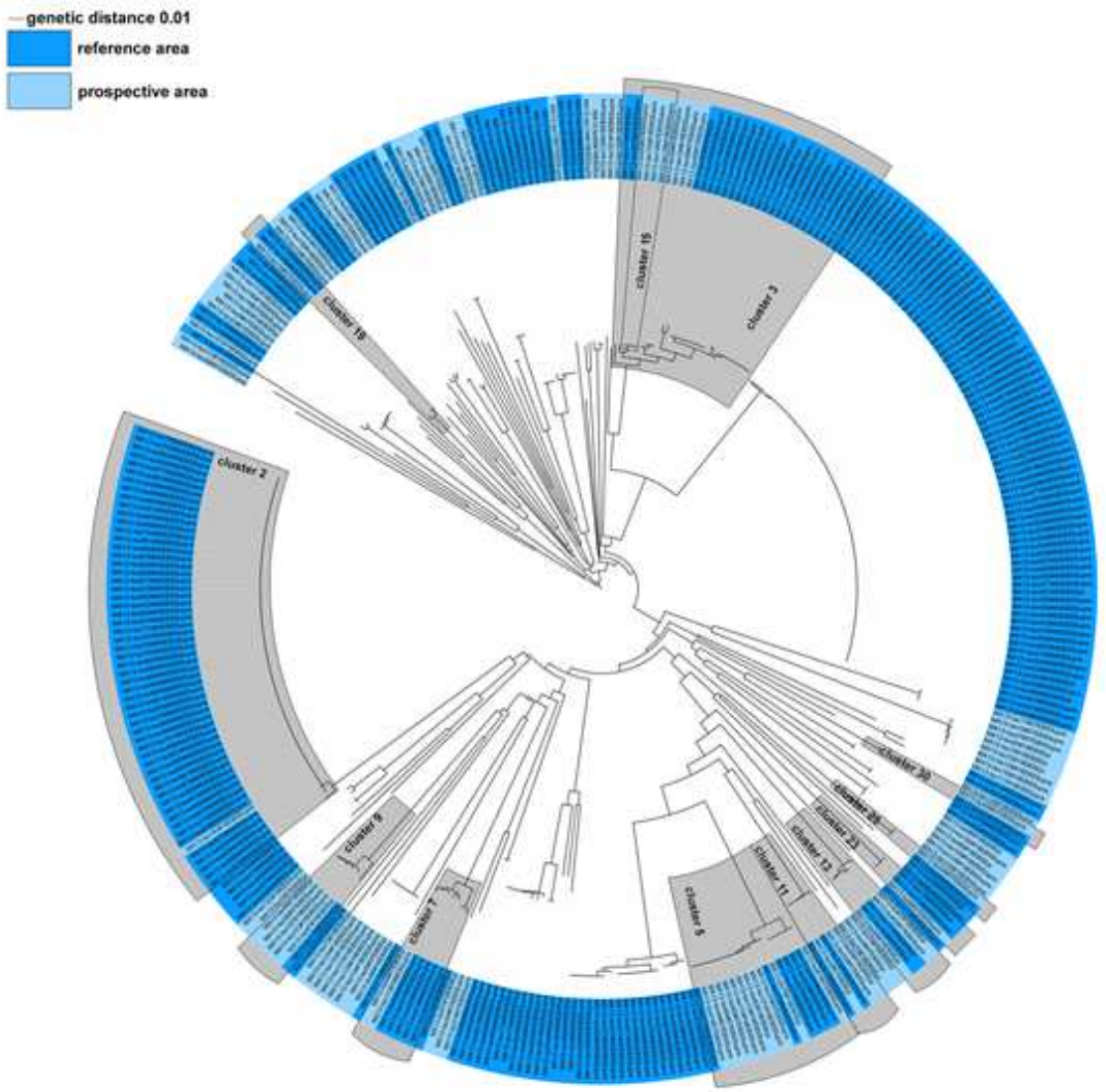
Polychaeta*:

- 550 sequences – 147 MOTUs
- 67 MOTUs singletons (46%)
- 40 MOTUs shared (27%)
- 35 MOTUs in PRZ
- 5 MOTUs in IRZ

** Mitochondrial Cytochromoxidase Subunit 1 (COI) gene*

Raschka (2014), Master thesis

Small-scale connectivity



Raschka (2014), Master thesis

Isopods:

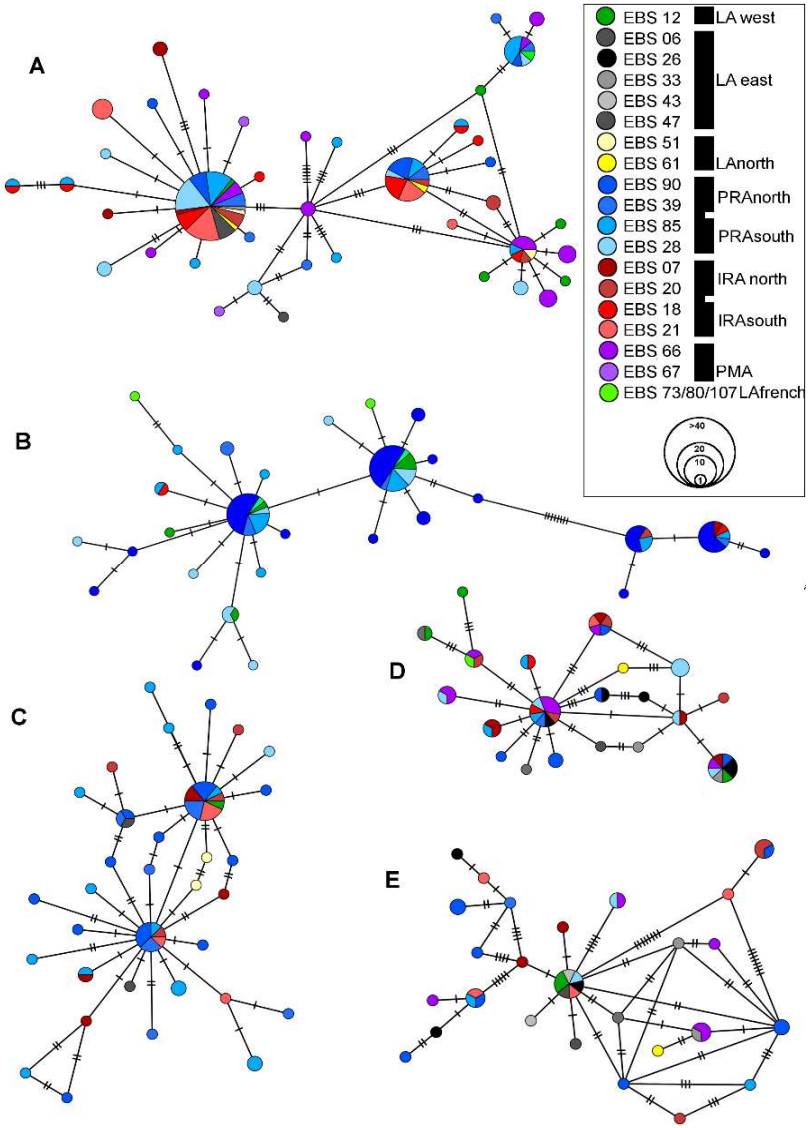
- 349 sequences – 83 MOTUs
- 45 MOTUs singletons (54%)
- 11 MOTUs shared (13%)
- 15 MOTUs PRZ
- 12 MOTUs IRZ

- Max. one-third of the putative species live in both areas
- phylogenetic differences within one area are almost as high as between areas

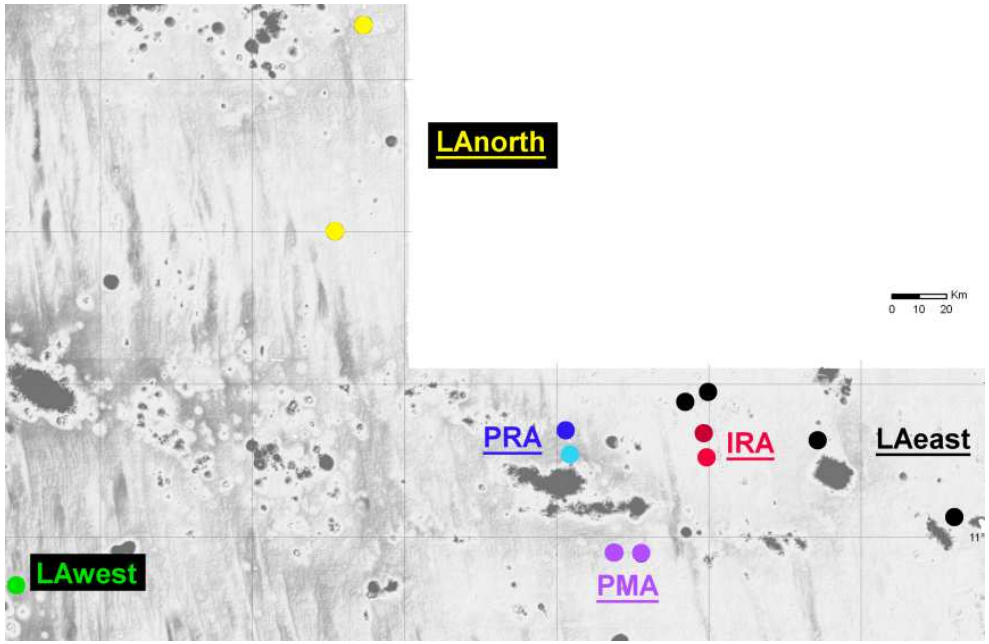
DZMB

BGR Bundesanstalt für Geowissenschaften und Rohstoffe
GEOZENTRUM HANNOVER

Genetic structure between populations



Janssen et al. (submitted)

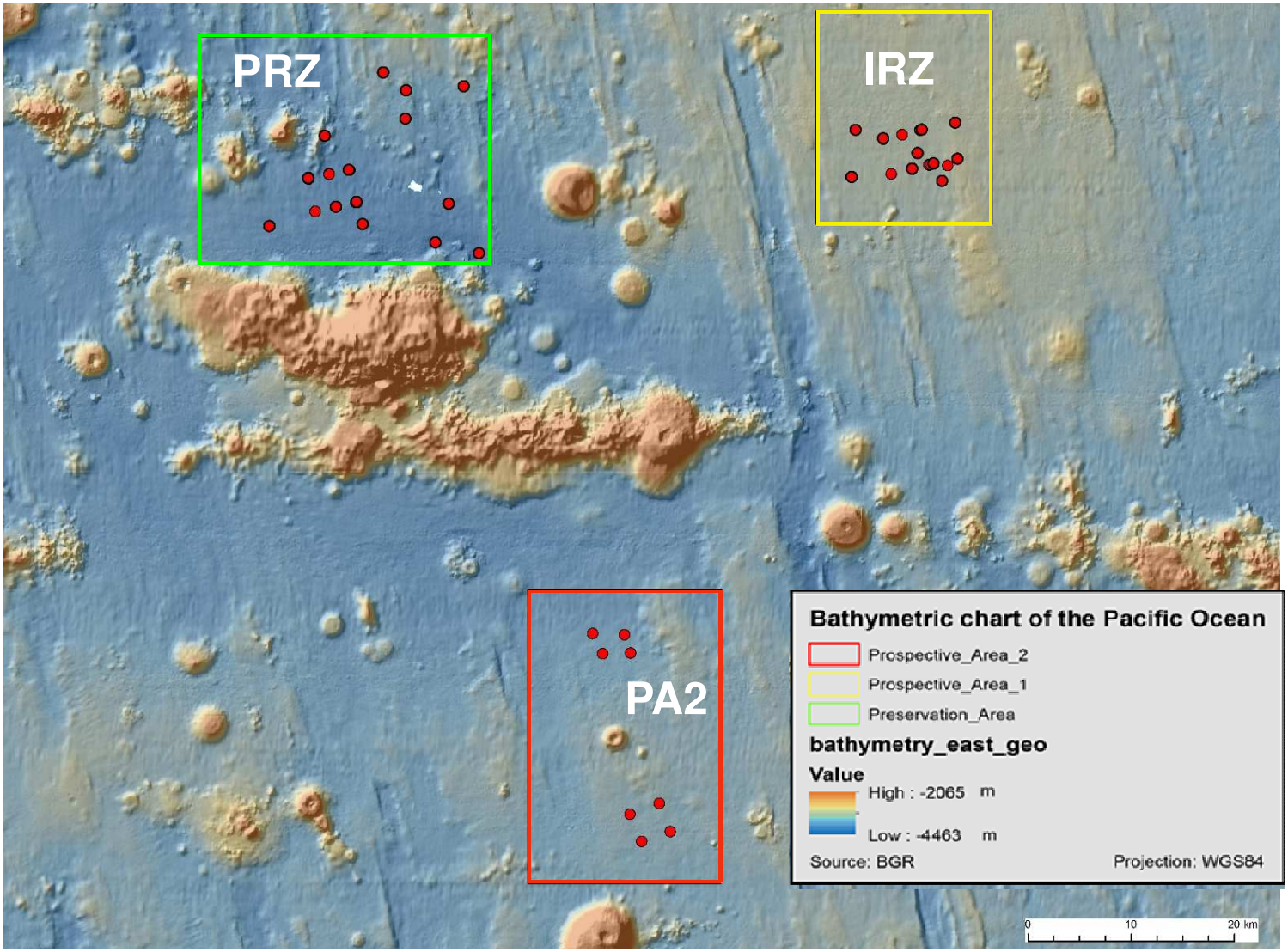


- No geographic population structure:
  - hardly divergence
  - sufficient gene flow

DZMB

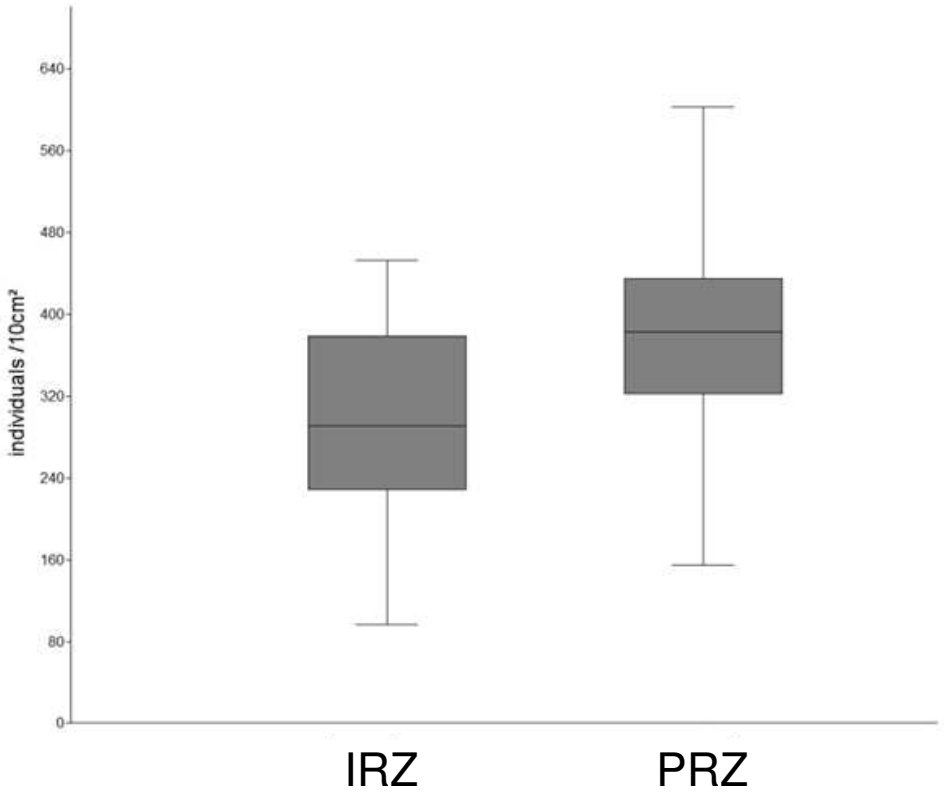
BGR Bundesanstalt für Geowissenschaften und Rohstoffe
GEOZENTRUM HANNOVER

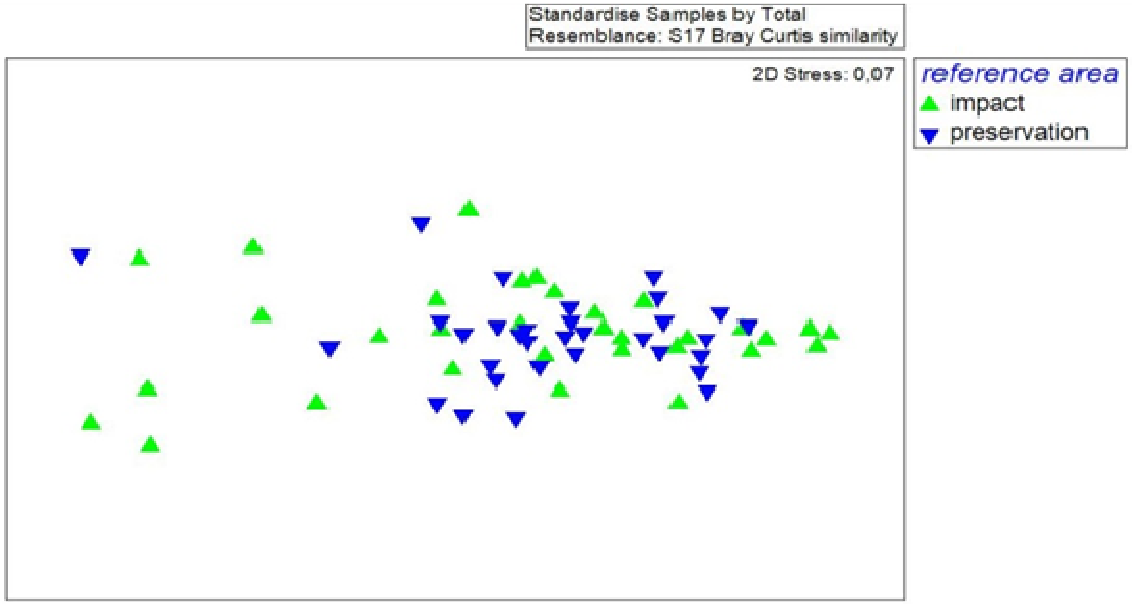
Multicorer samples



BGR Bundesanstalt für Geowissenschaften und Rohstoffe
GEOZENTRUM HANNOVER

Meiofauna IRZ vs. PRZ



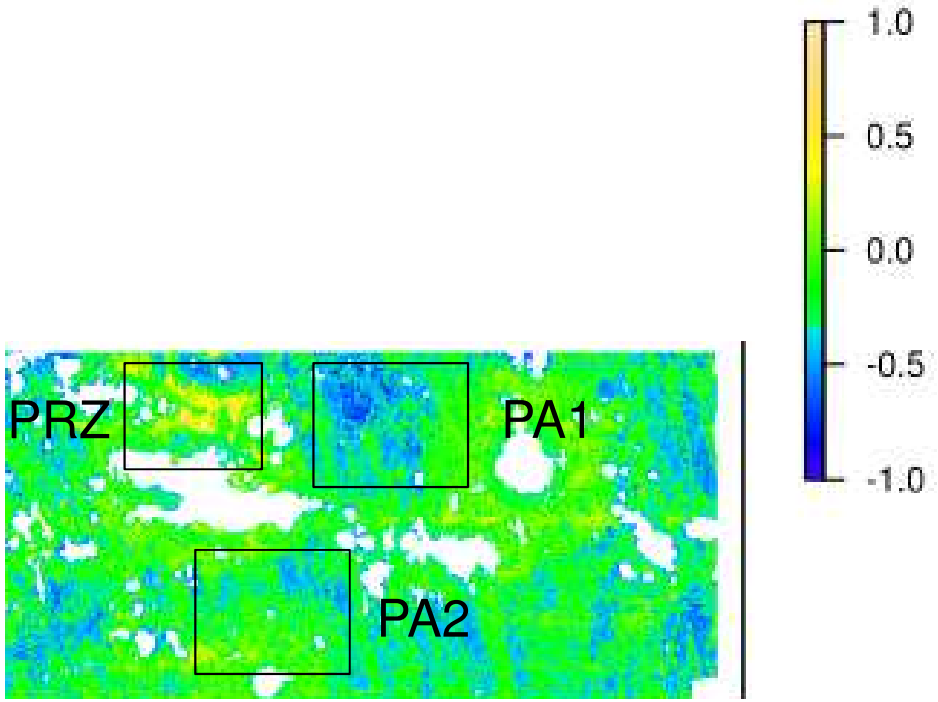


- Significantly higher densities in the PRZ
- No siginificant differences in meiobenthic community structure at higher taxonomic level

DZMB

BGR Bundesanstalt für Geowissenschaften und Rohstoffe
GEOZENTRUM HANNOVER

Meiofauna total abundance



…from point sampling to spatial mapping…

R-Package Random-Forest (machine-learning algorithm)

Mapping based on:

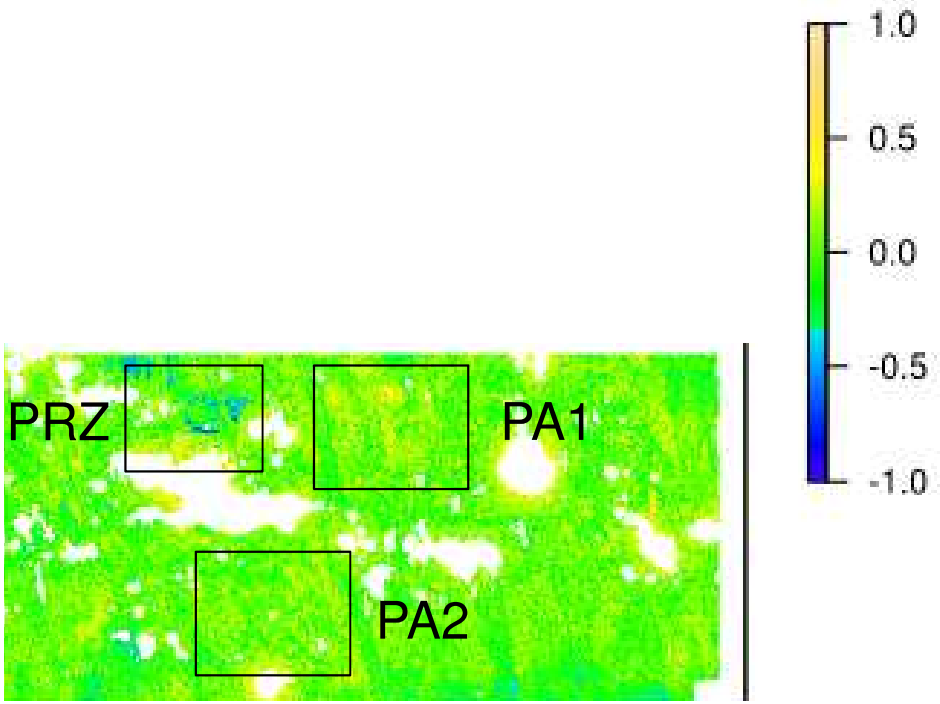
- Bathymetry
- Backscatter
- Mn-nodule coverage

0.44 of variation explained

DZMB

BGR Bundesanstalt für Geowissenschaften und Rohstoffe
GEOZENTRUM HANNOVER

Meiofauna diversity (Simpson Index)



Mapping based on:

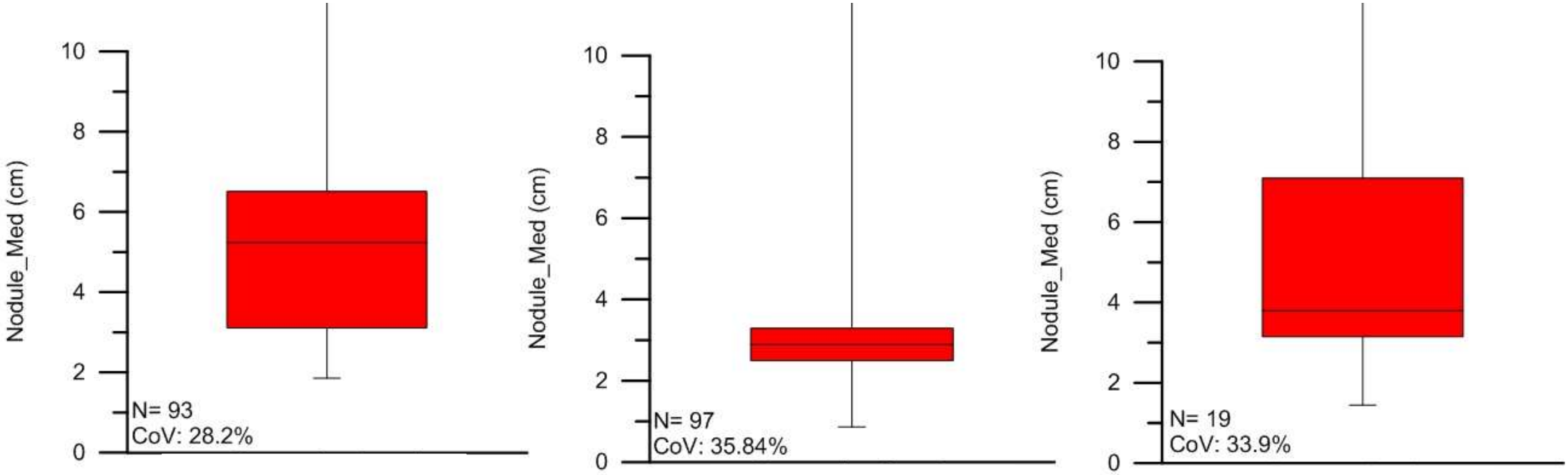
- Bathymetry
- Backscatter
- Mn-nodule coverage

0.32 of variation explained

DZMB

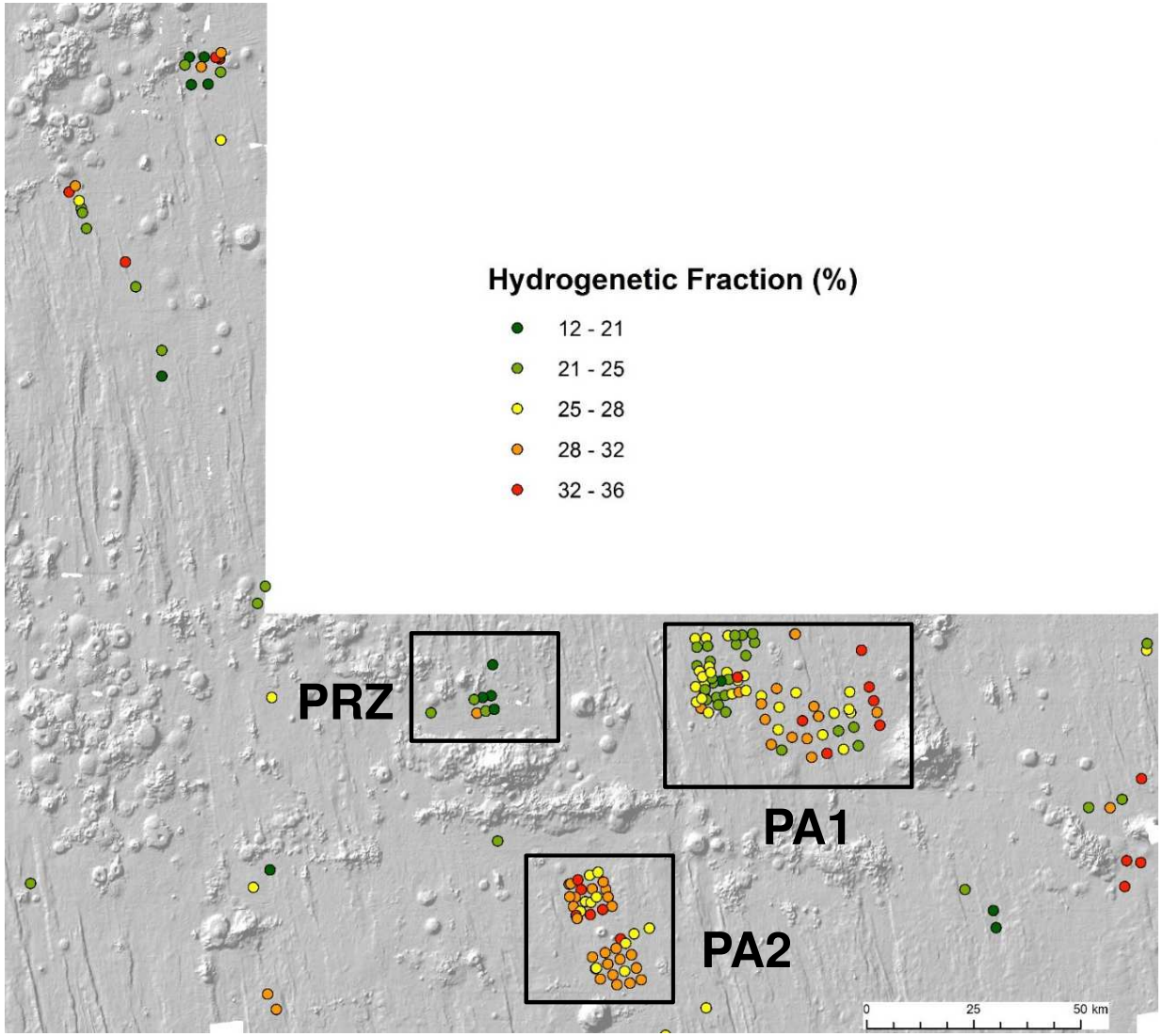
BGR Bundesanstalt für Geowissenschaften und Rohstoffe
GEOZENTRUM HANNOVER

Nodule size variability



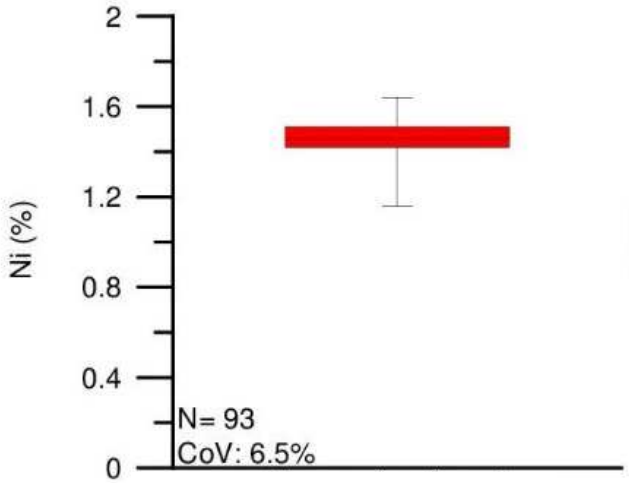
BGR Bundesanstalt für Geowissenschaften und Rohstoffe
GEOZENTRUM HANNOVER

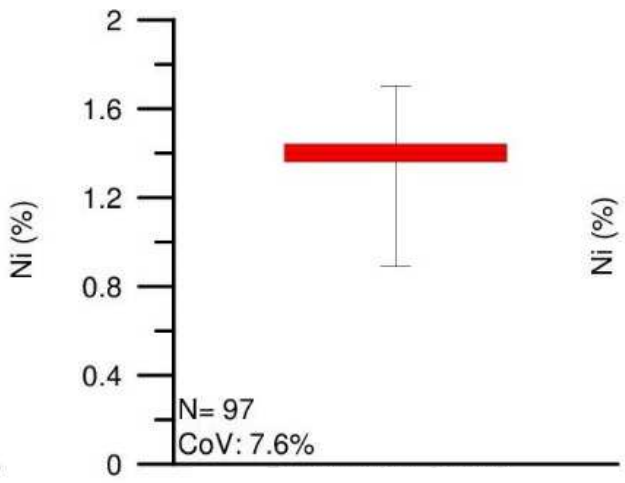
Geochemical variability of nodules

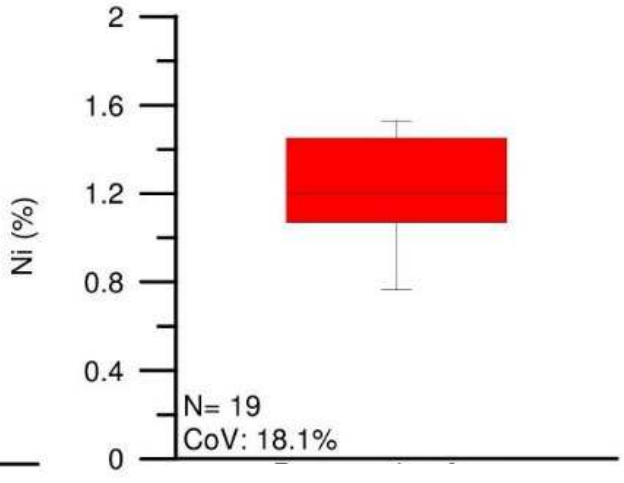


BGR Bundesanstalt für Geowissenschaften und Rohstoffe
GEOZENTRUM HANNOVER

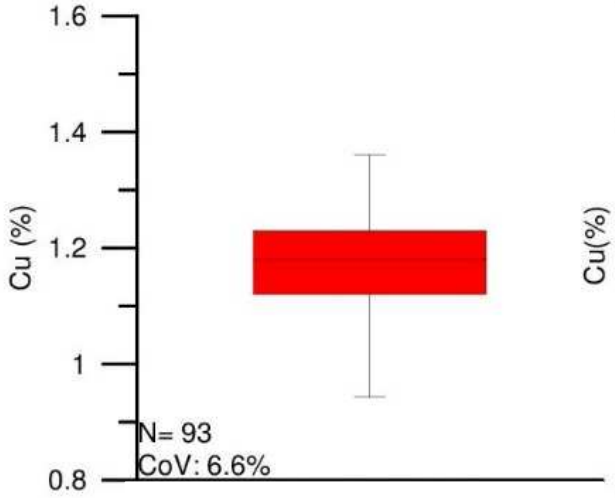
Geochemical variability of nodules

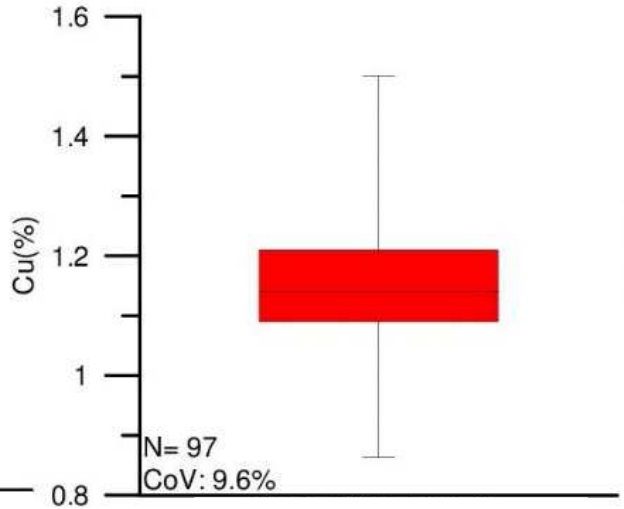


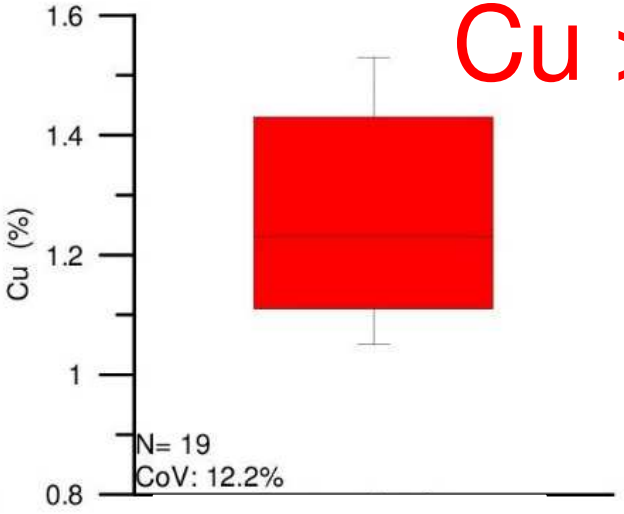




PA1 **PA2** **PRZ**



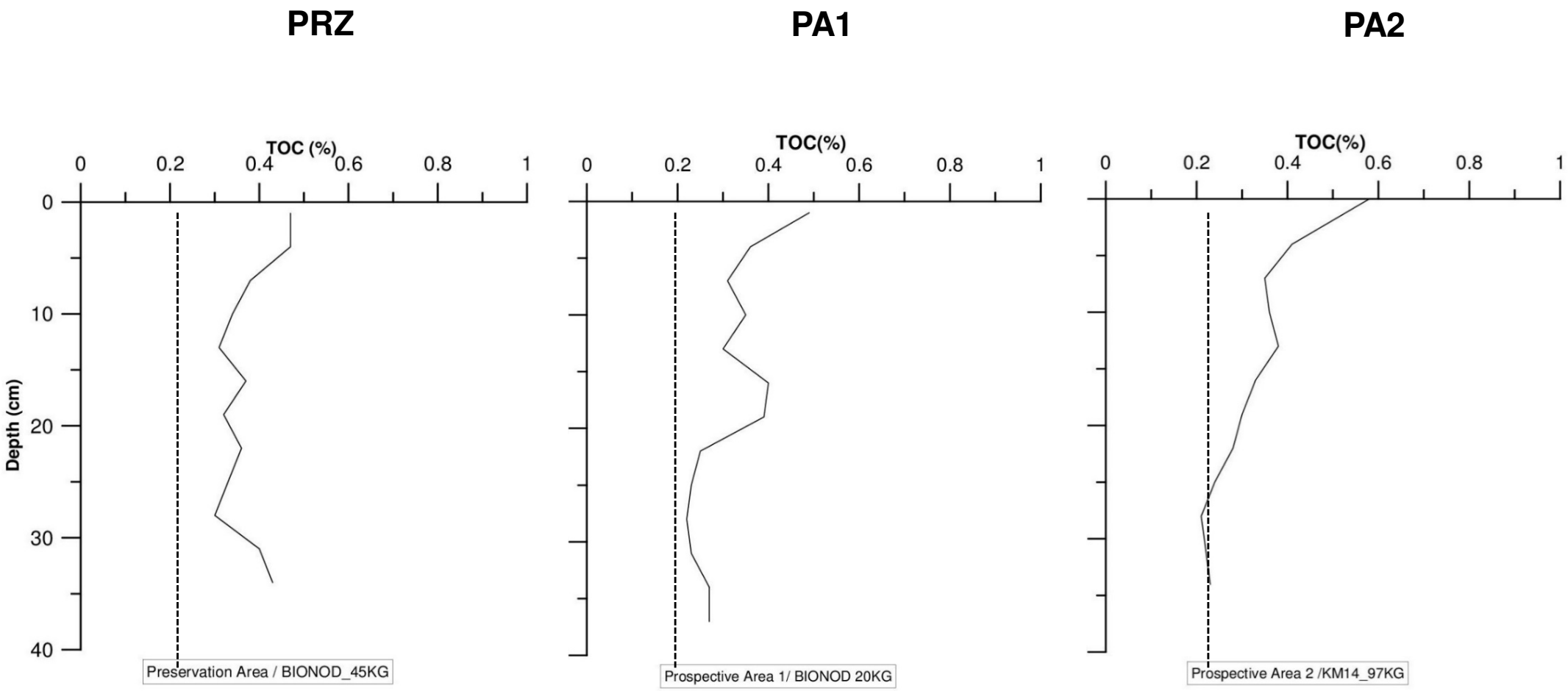




Cu > Ni

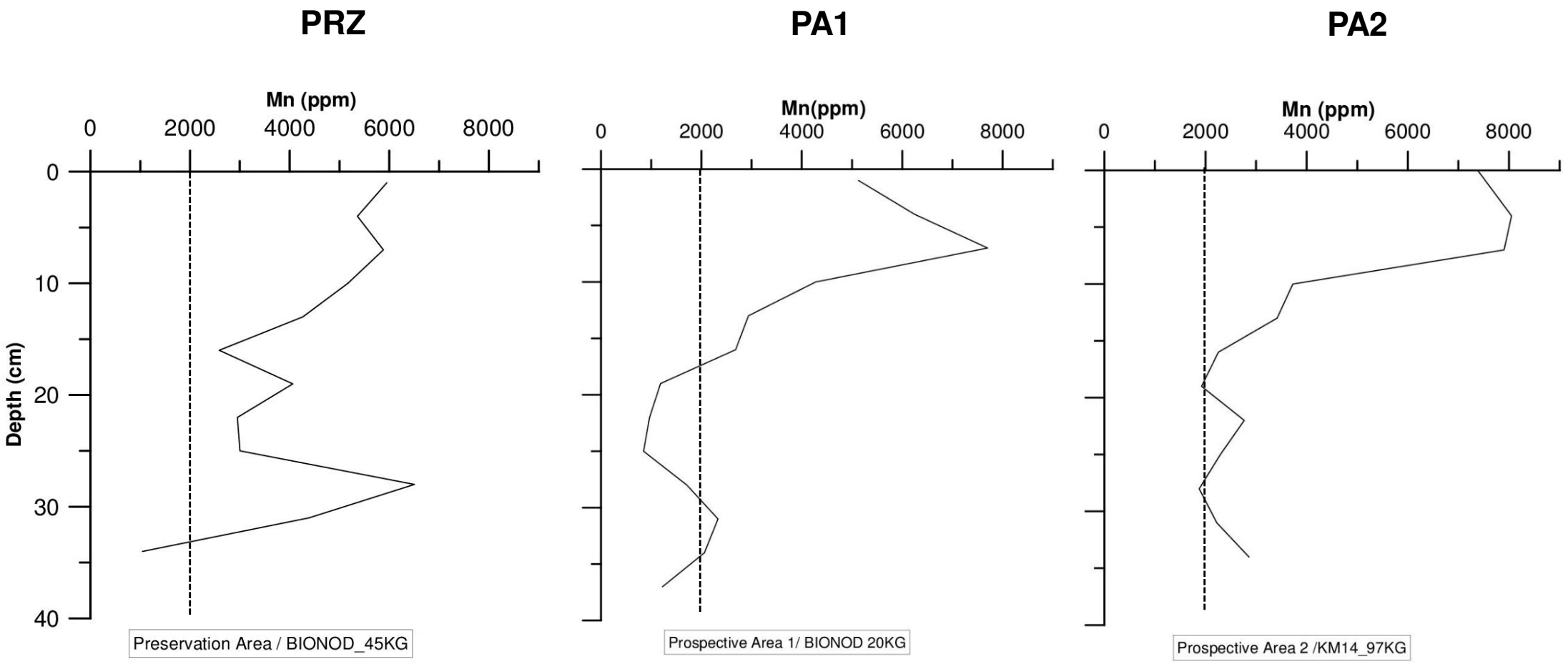
BGR Bundesanstalt für Geowissenschaften und Rohstoffe
GEOZENTRUM HANNOVER

TOC concentrations



BGR Bundesanstalt für Geowissenschaften und Rohstoffe
GEOZENTRUM HANNOVER

MnO_2 content



BGR Bundesanstalt für Geowissenschaften und Rohstoffe
GEOZENTRUM HANNOVER

What have we learnt?

PRZ *is* a functional area for:

- ensuring representative and stable biota of the seabed
- as a protected area with a wide range of nodule facies and habitats

But:

⇒ high degree of spatial variability in geological, geochemical and ecological conditions (topography, nodule composition, size, coverage, biodiversity)

⇓

between and within reference areas at small scales

So at the size scales of IRZs and PRZs (> 50 km apart), the definition of a PRZ as being "…as ecologically similar as possible to the impact zone, and …removed from potential mining impacts…" (CCZ EMP) may be a difficult goal to reach!