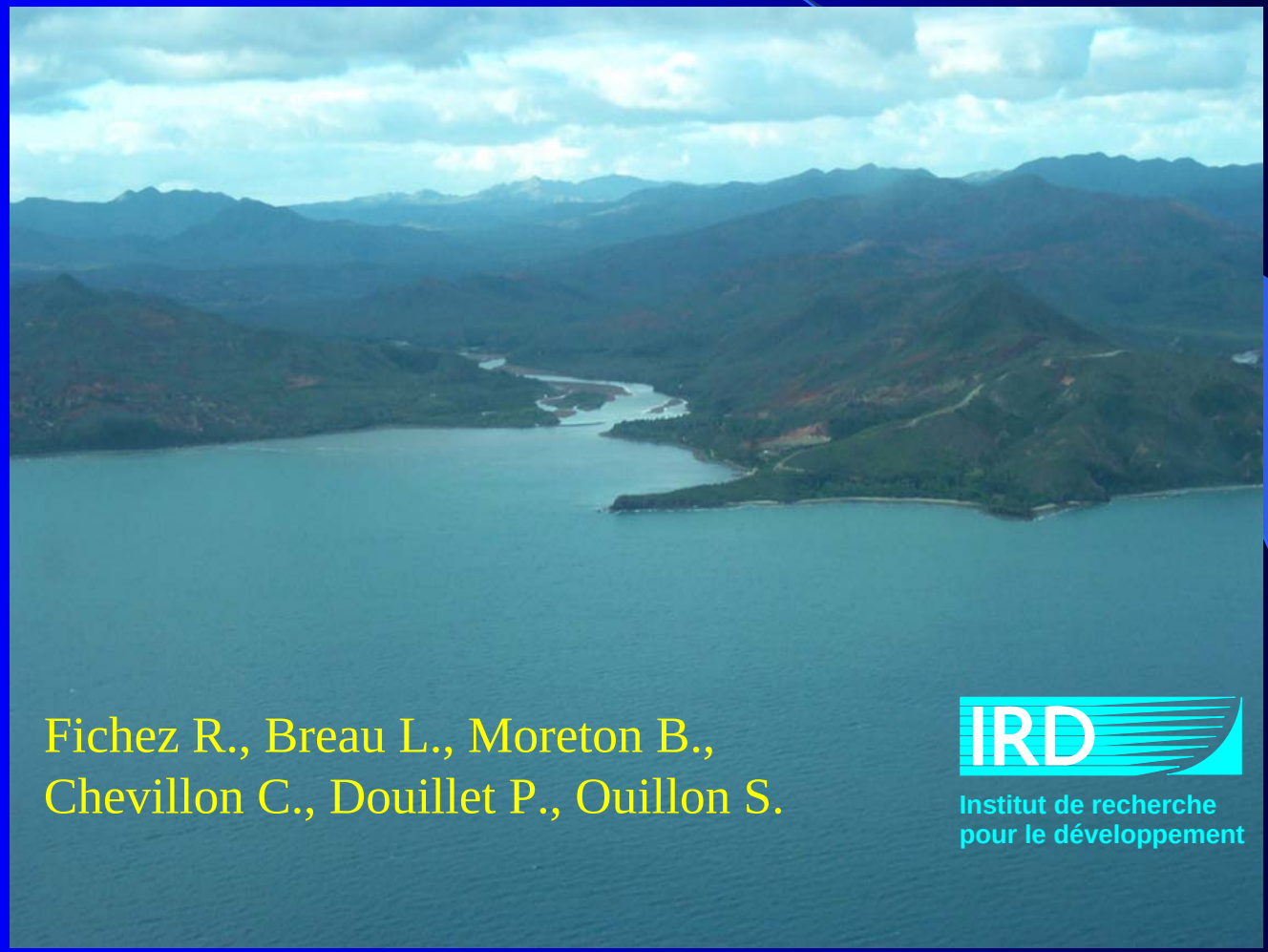
The fate of metals in the south-west lagoon of New Caledonia



Fichez R., Breau L., Moreton B.,
Chevillon C., Douillet P., Ouillon S.

IRD
Institut de recherche
pour le développement

Specificity of the site

Coral reef lagoon

Extremely poor environment (oligotrophic)

=> adaptation of ecosystem = biodiversity

Potential sources of alteration

Urbanisation

Mining activities

Sources of input

Terrigeneous inputs

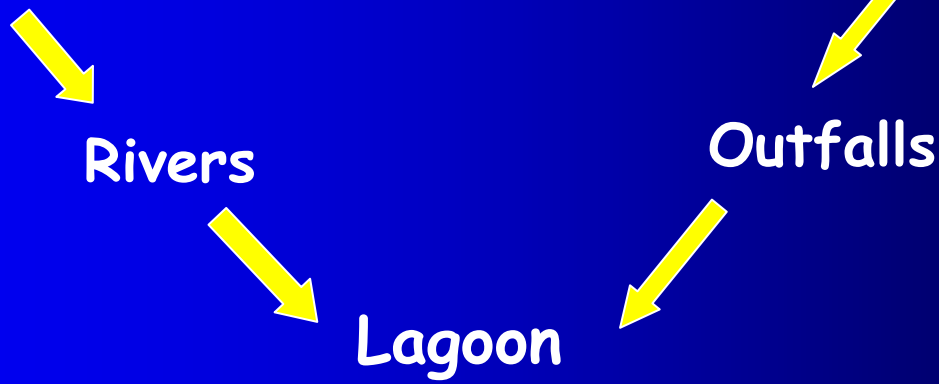
Natural Origin (soil erosion)

Human origin (mining, deforestation)

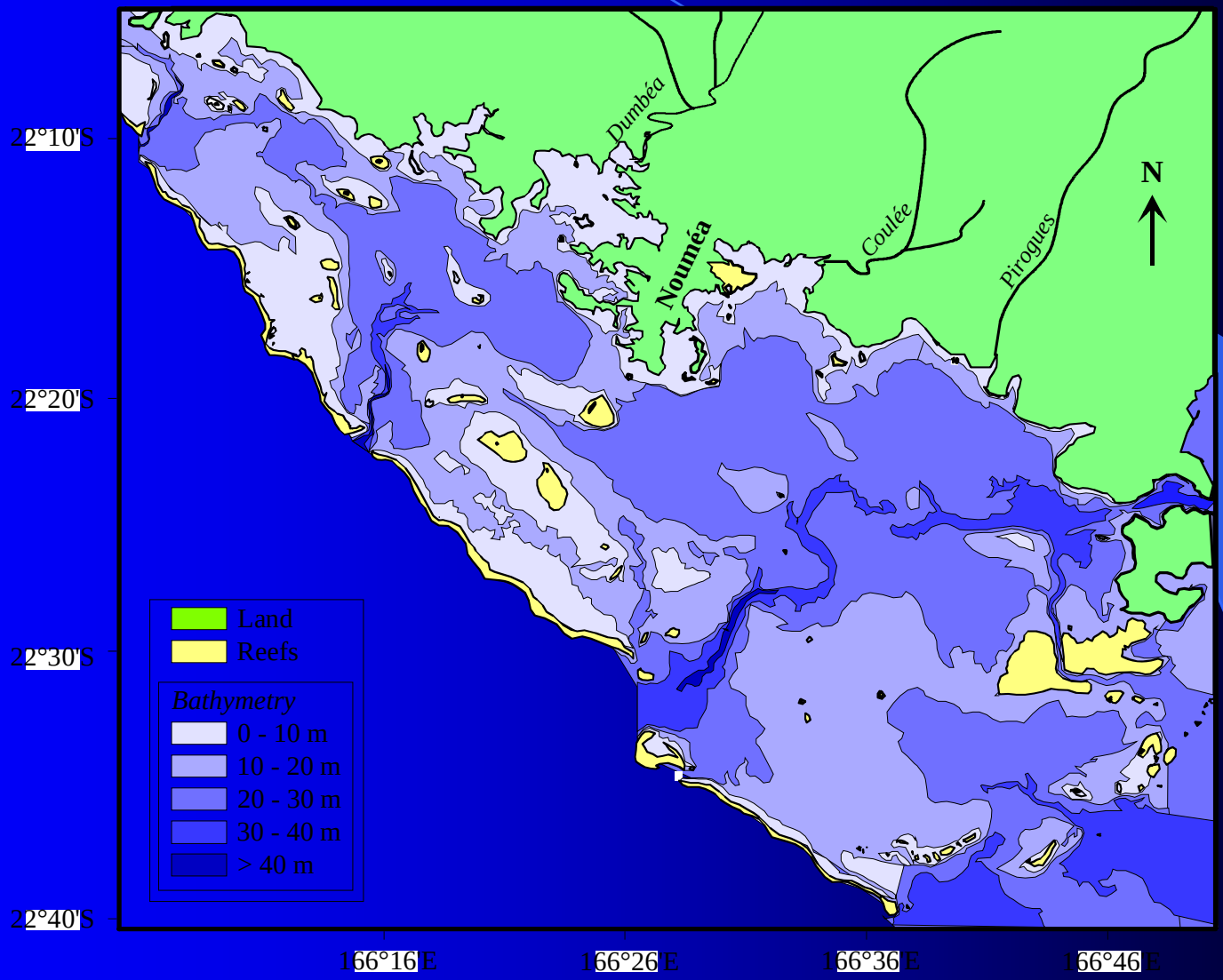
Anthropogenic inputs

Urban

Industrial



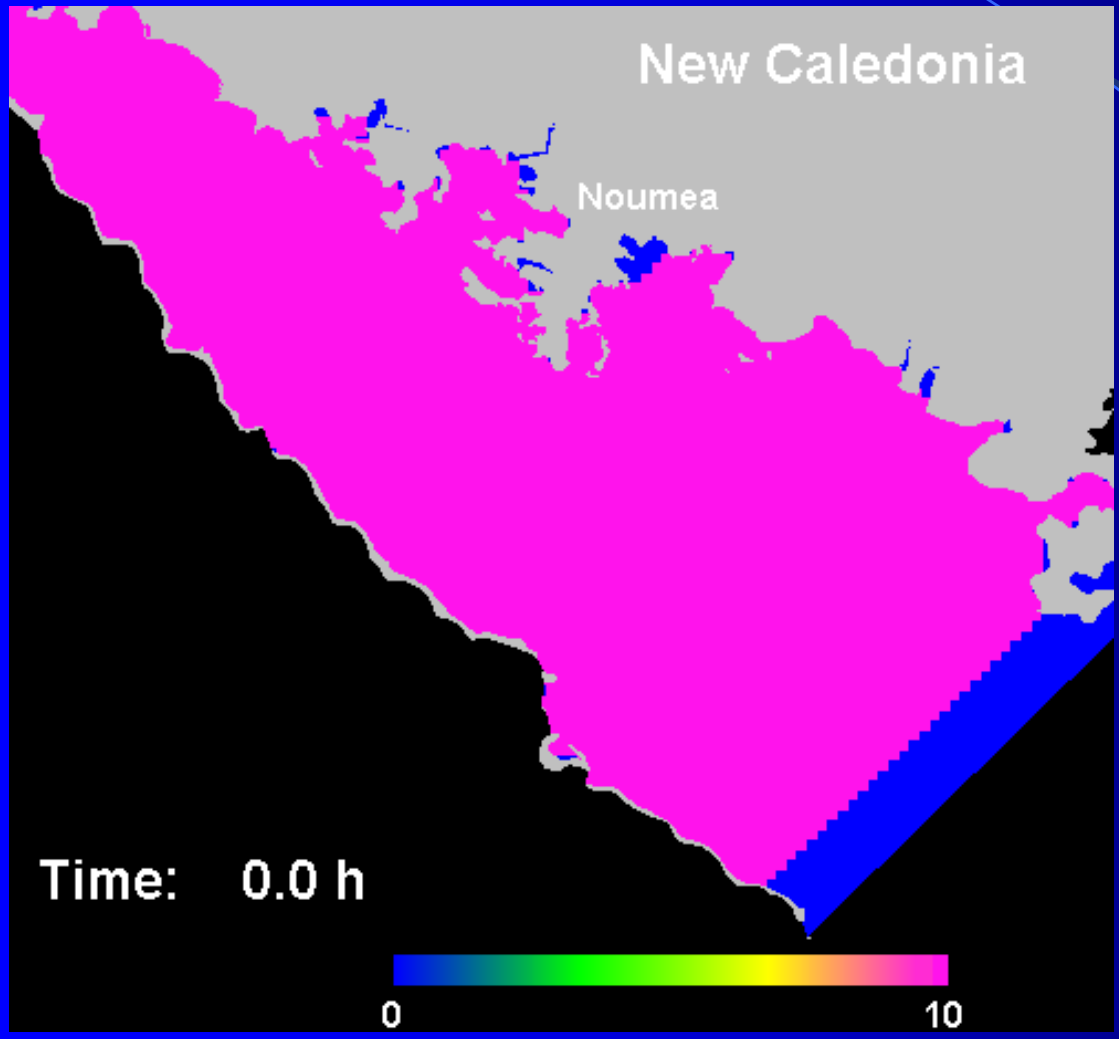
South west lagoon



Environmental setting

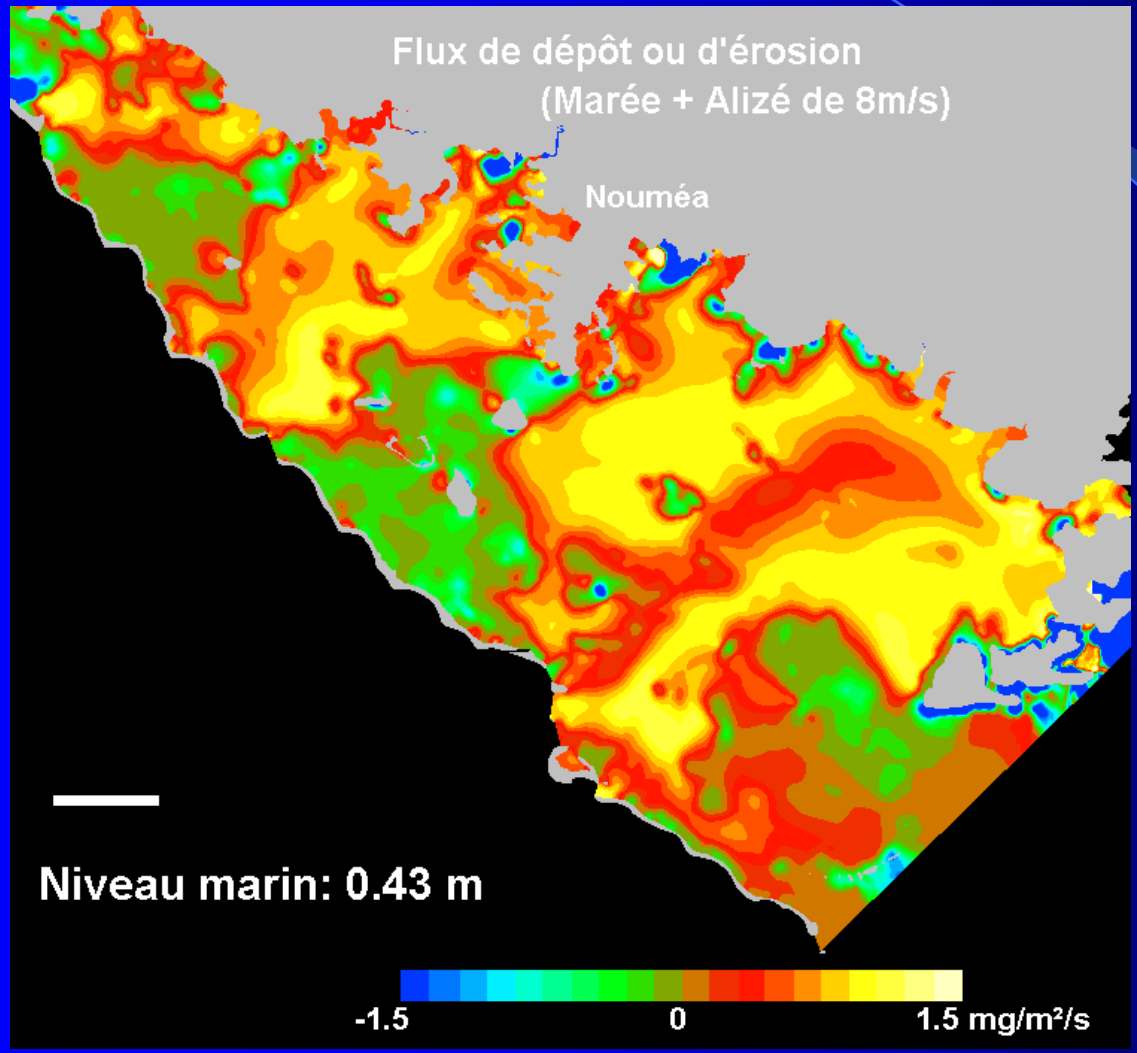
Environmental conditions

Hydrodynamics



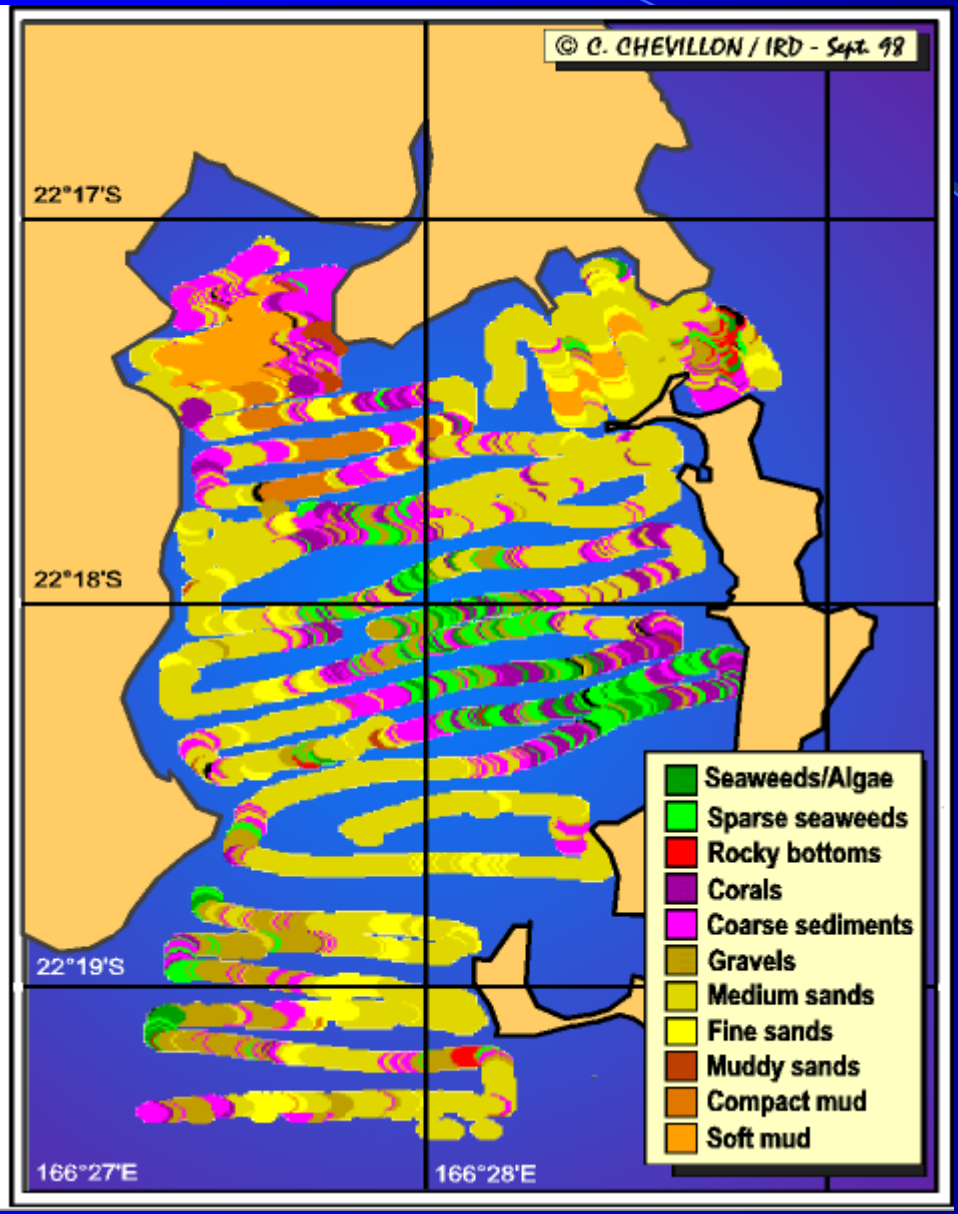
Environmental conditions

Transport



Environmental conditions

Sediments



Metal distribution

Metal Forms

Under what main forms are metals present in the marine environment ?

- Dissolved – metal ions (M^+), potentially most toxic, also dissolved organic metals.
- Suspended/Particulate – deposited in estuarine systems (flocculation), transported further
- Sediment (ultimate end member or sink for metals, or a source in itself)

Dissolved metals

Paucity of data in New Caledonia

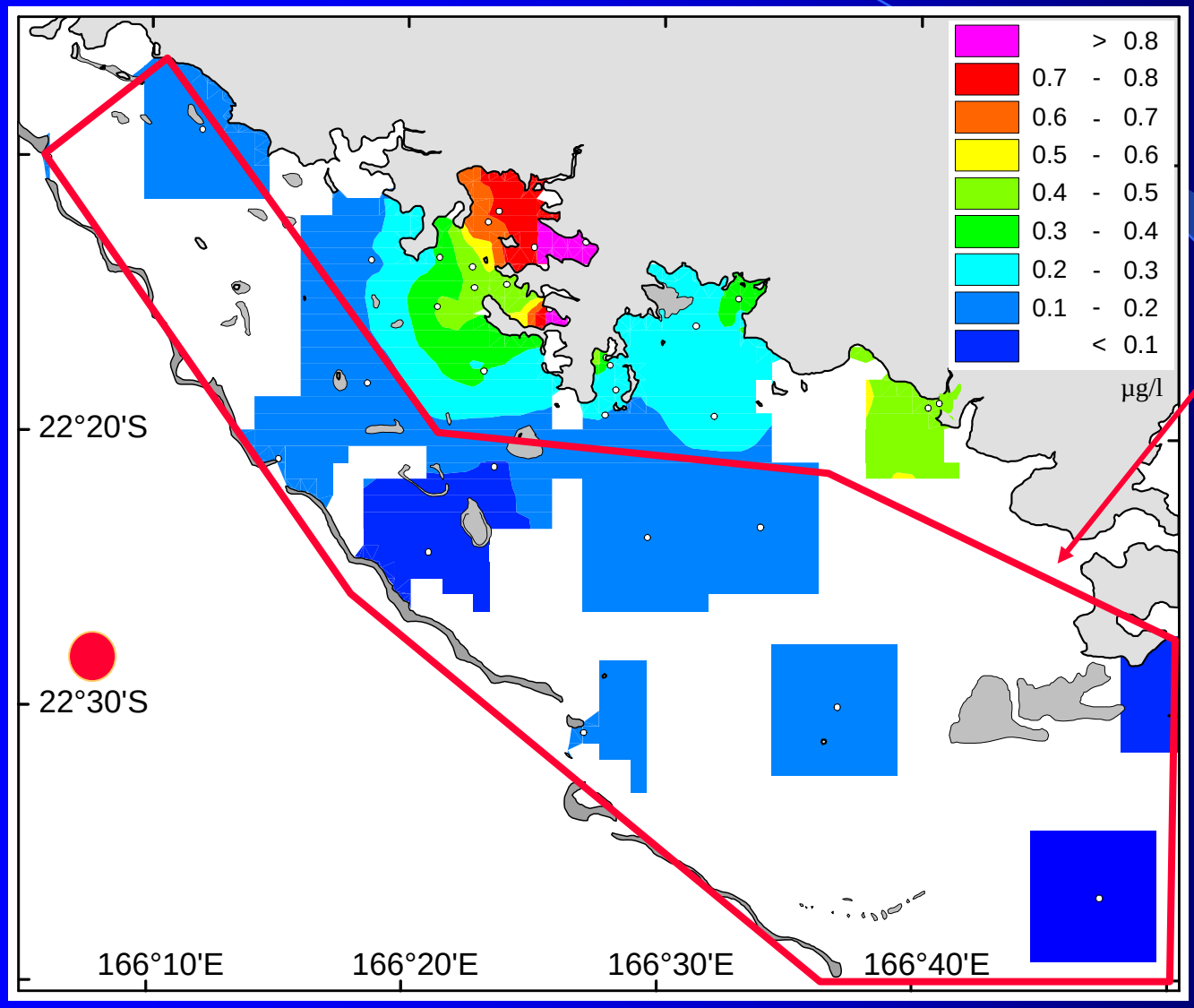
Sources:

- Several values from 1989 ($\mu g l^{-1}$)

Site	Ni	Co	Cr	Mn
Baie de la Ouenghi	11	<1	5	<1
Baie de Kuara	11	<1	4	<1
Baie de Prony	<1	<1	2	1

- Mining projects (Goro-Nickel, SMSP-Falconbridge)
- Research (IRD)

Results dissolved Ni



Gulf of Papua New Guinea (Oceanic) =

0.05µg/l - 0.15µg/l

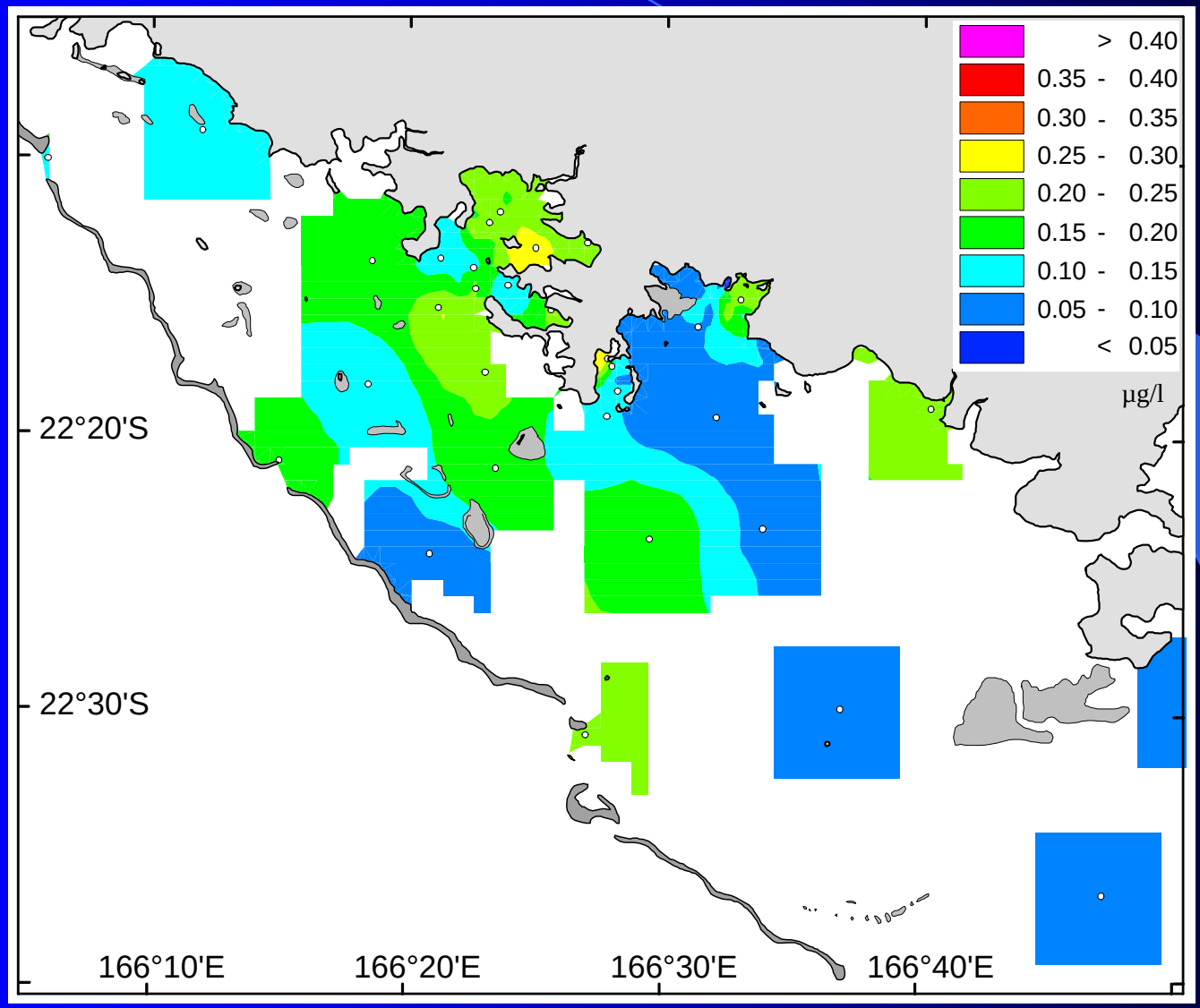
(Szymczak, 1992)

New Caledonia – Offshore (Oceanic) sample =

0.06µg/l

(Szymczak, 2002)

Results dissolved Cu



Metals in Sediment Sequential Extraction

Study sediment components - 4 phases sequential extraction:

- Organic
- Carbonates
- Oxides - Terrigenous
- Refractory - Terrigenous

Method

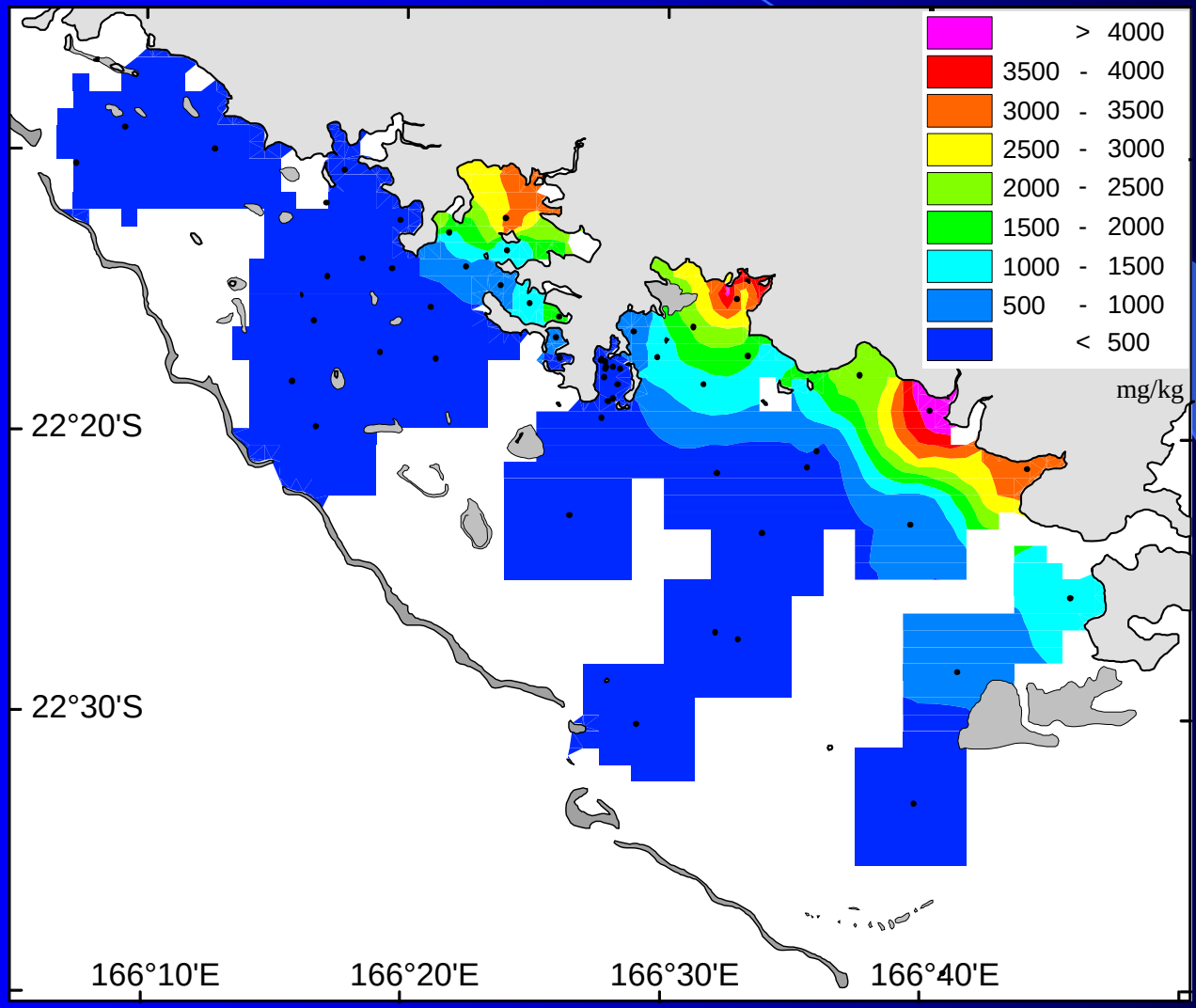
- Microwave digestion, ultrasonic = reduces time, uses less reagent, lower risk of contamination

Aim

- Identify various sources of inputs

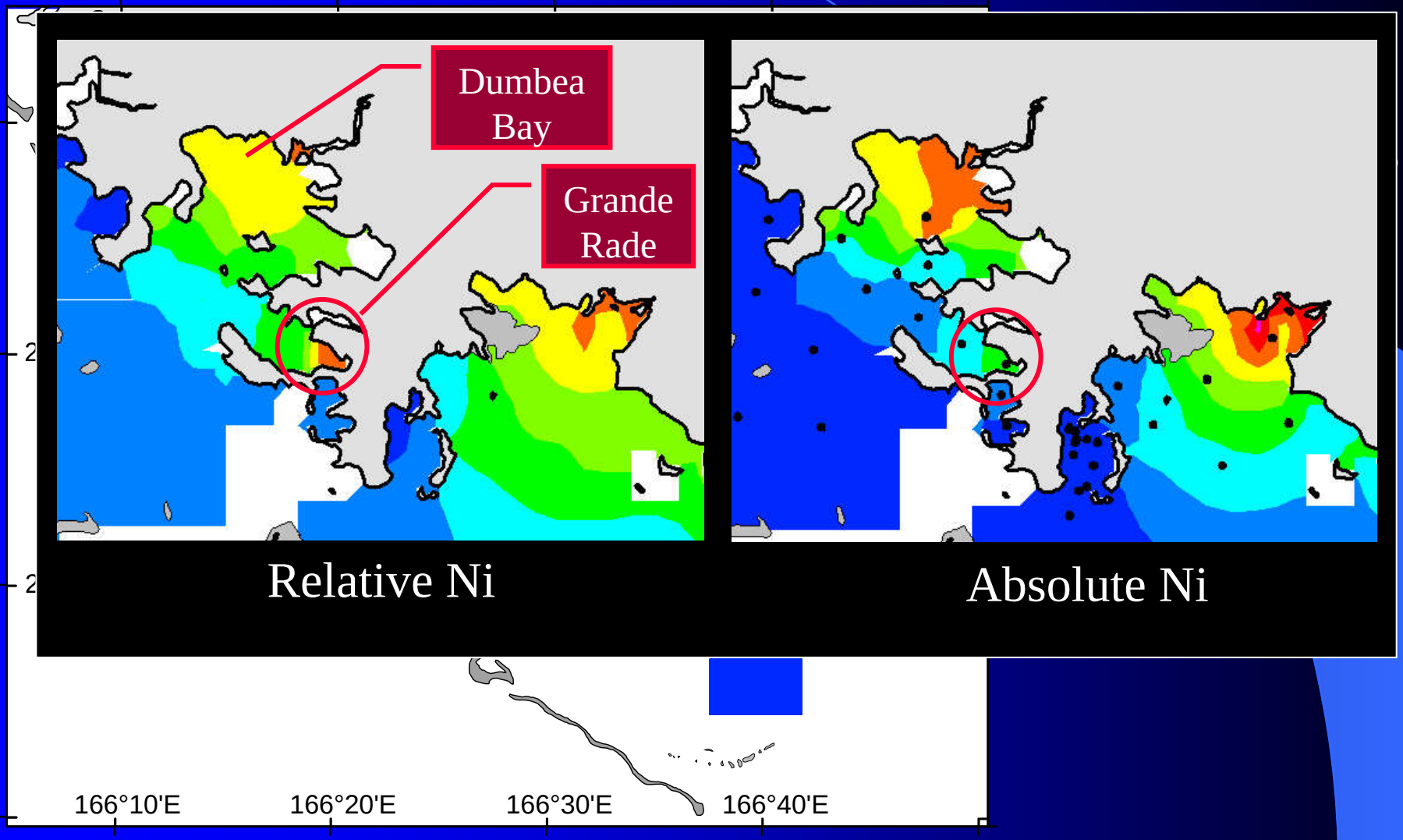
Metal in sediments

Spatial distribution of Nickel in the refractory phase (Absolute)



Metal in sediments

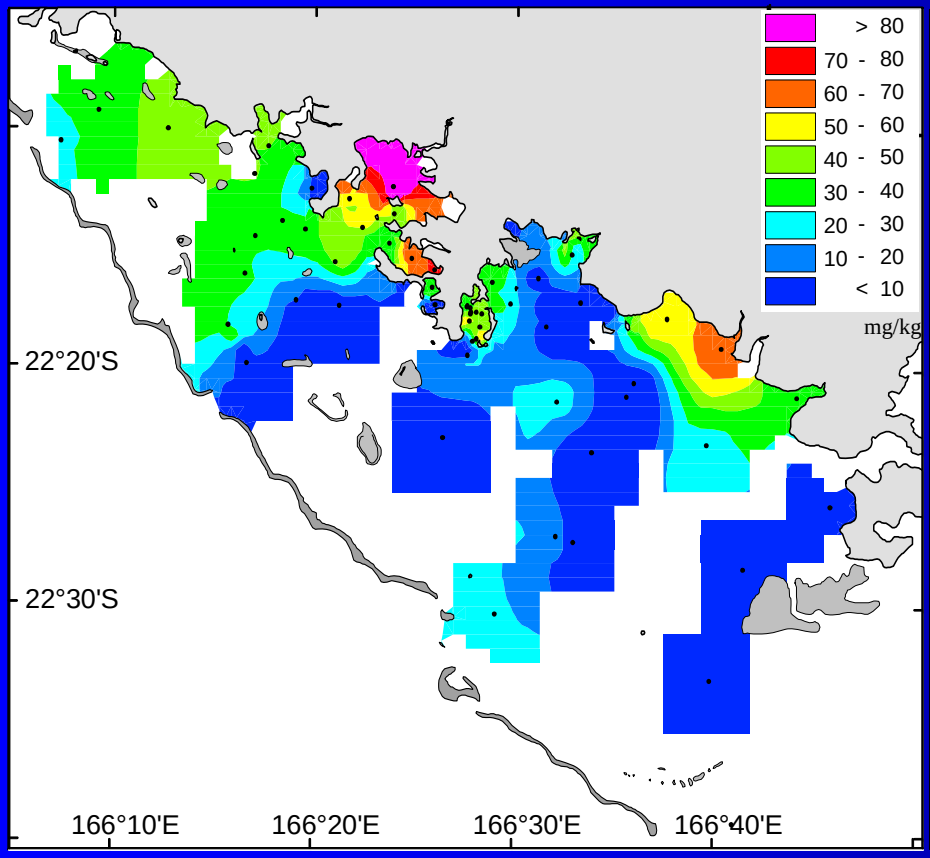
Spatial distribution of Nickel in the refractory phase (Relative)



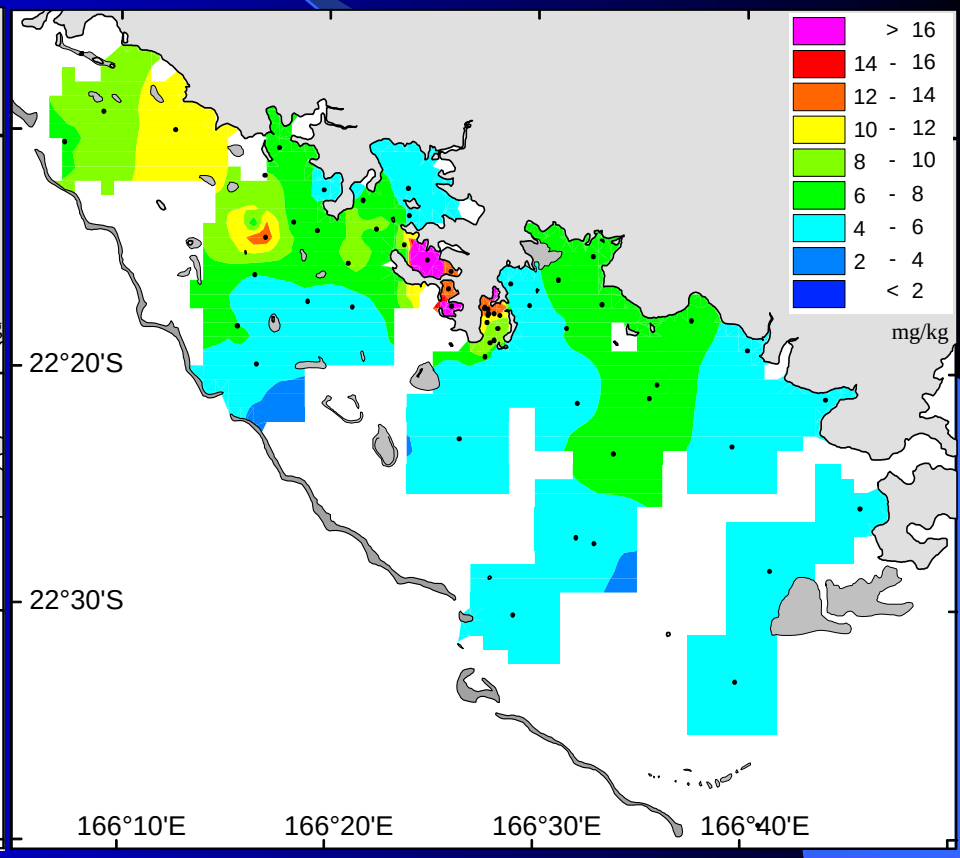
Metal in sediments

Spatial distribution of Ni and Zn in the organic phase

Ni

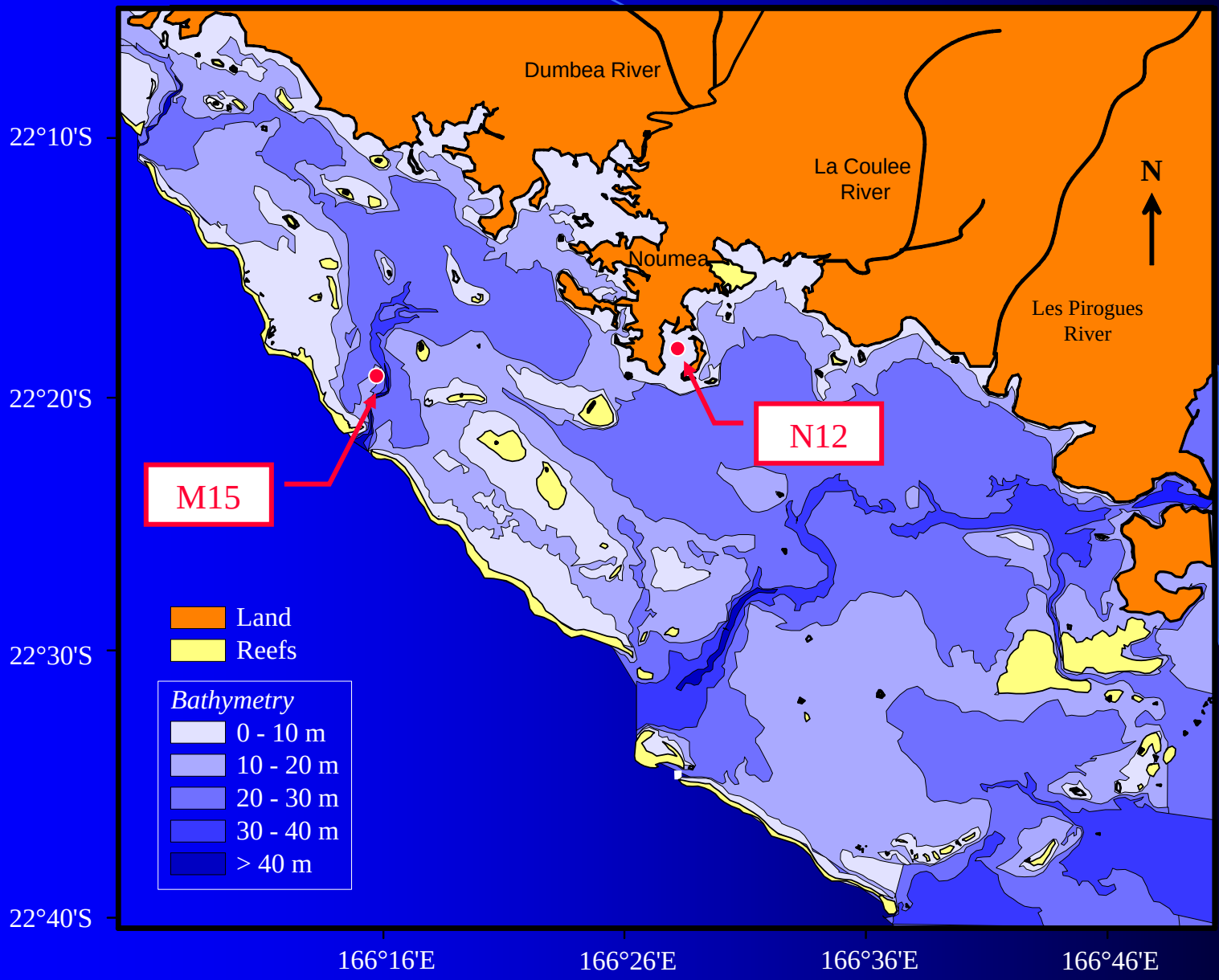


Zn

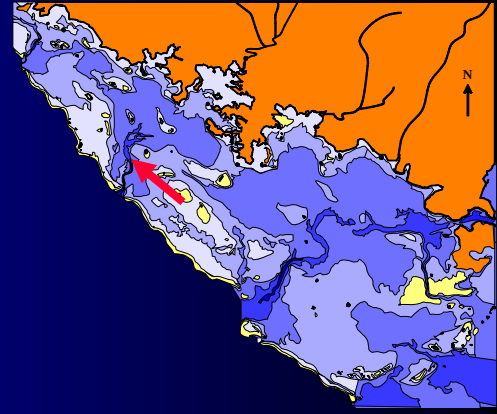


Sediment records of past environmental changes

Sediment records



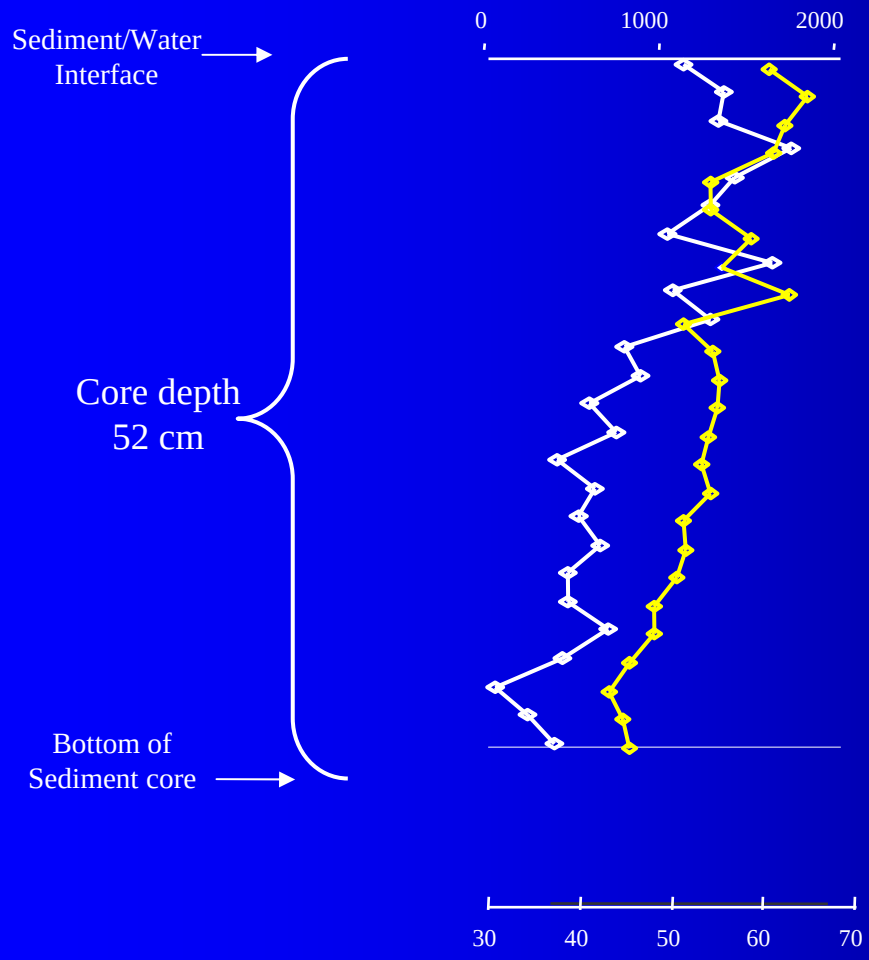
Sediment Records – Core M15



Residual Phase

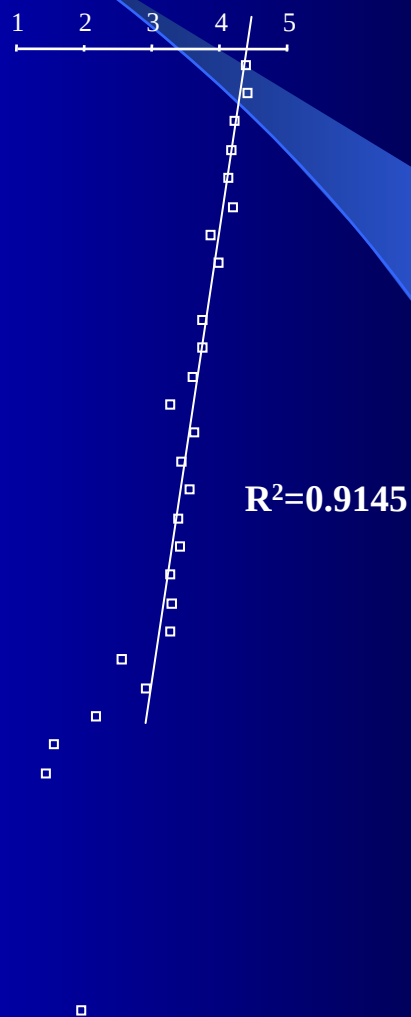
Ni in the <40µm fraction

Conc. (µg/g relative)



Pb-210

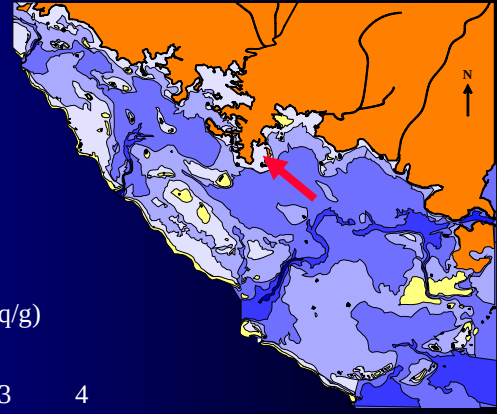
Ln (Po-210)(mBq/g)



R^2=0.9145

Sediment Records – Core N12

Refractory Phase



Ni in the <40µm fraction

Conc. (µg/g relative)

0 500 1000

Pb-210

Ln (Po-210)(mBq/g)

0 1 2 3 4

Sediment/Water Interface

Core depth 54 cm

Bottom of Sediment core

0 100 200 300 400

Conc. (µg/g absolute)

Metal incorporation in benthic organisms

Bioaccumulation - target species

Mollusks bivalves

Gafrarium tumidum

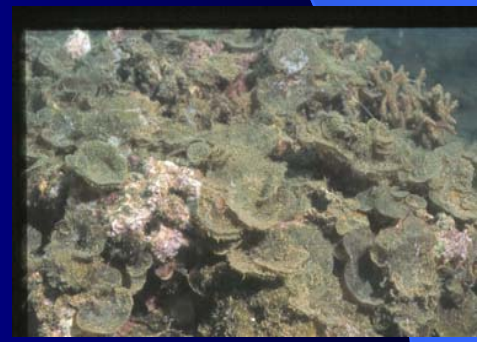
Isognomon isognomon

Hyotissa hyotis

Macroalgae

Caulerpa (2 sp.)

Halimeda (2 sp.)



Lobophora variegata

Bioaccumulation – target species

Holothurians

Holothuria edulis

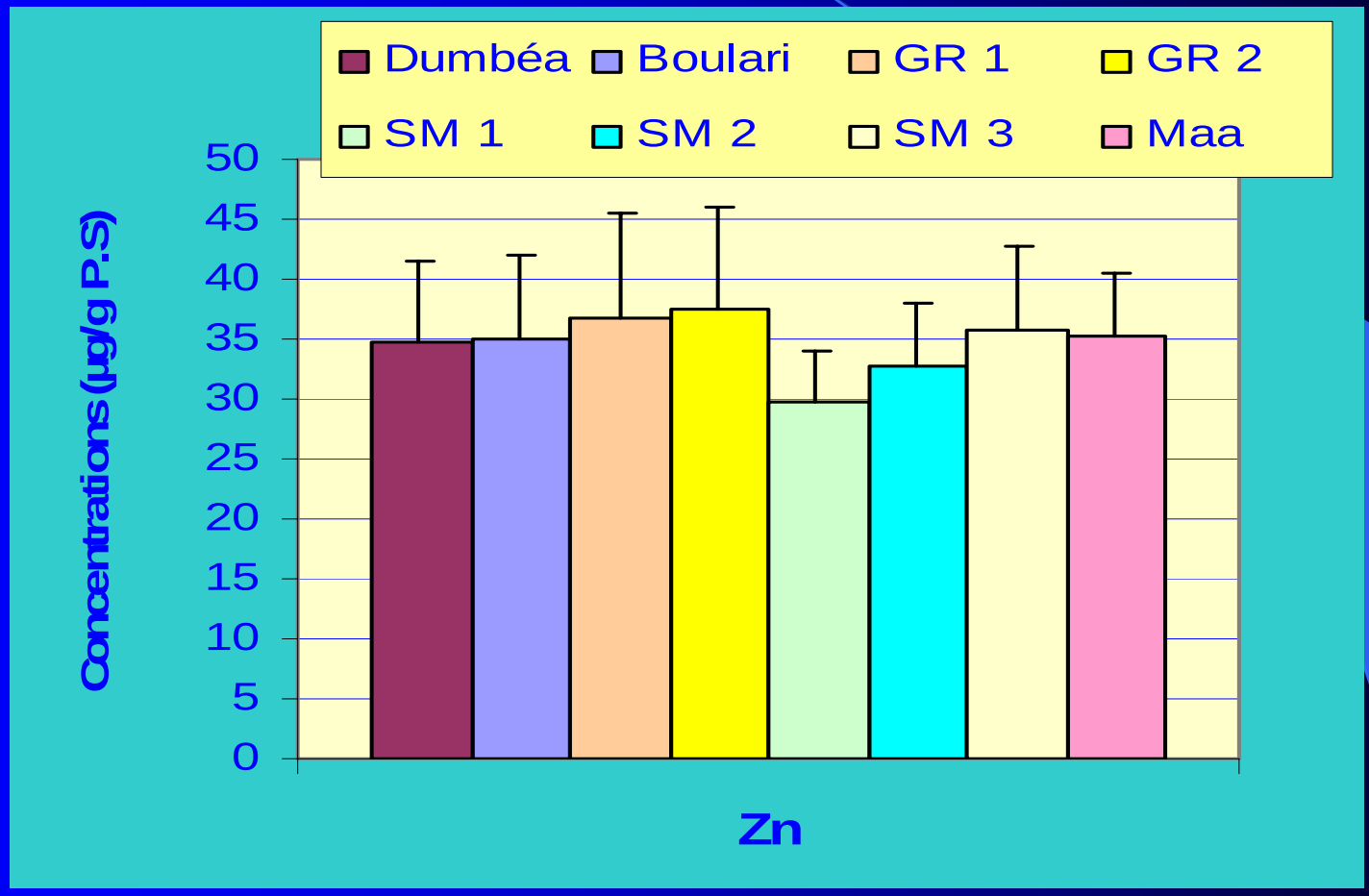
Soft corals

(2 species)

Sarcophyton sp.

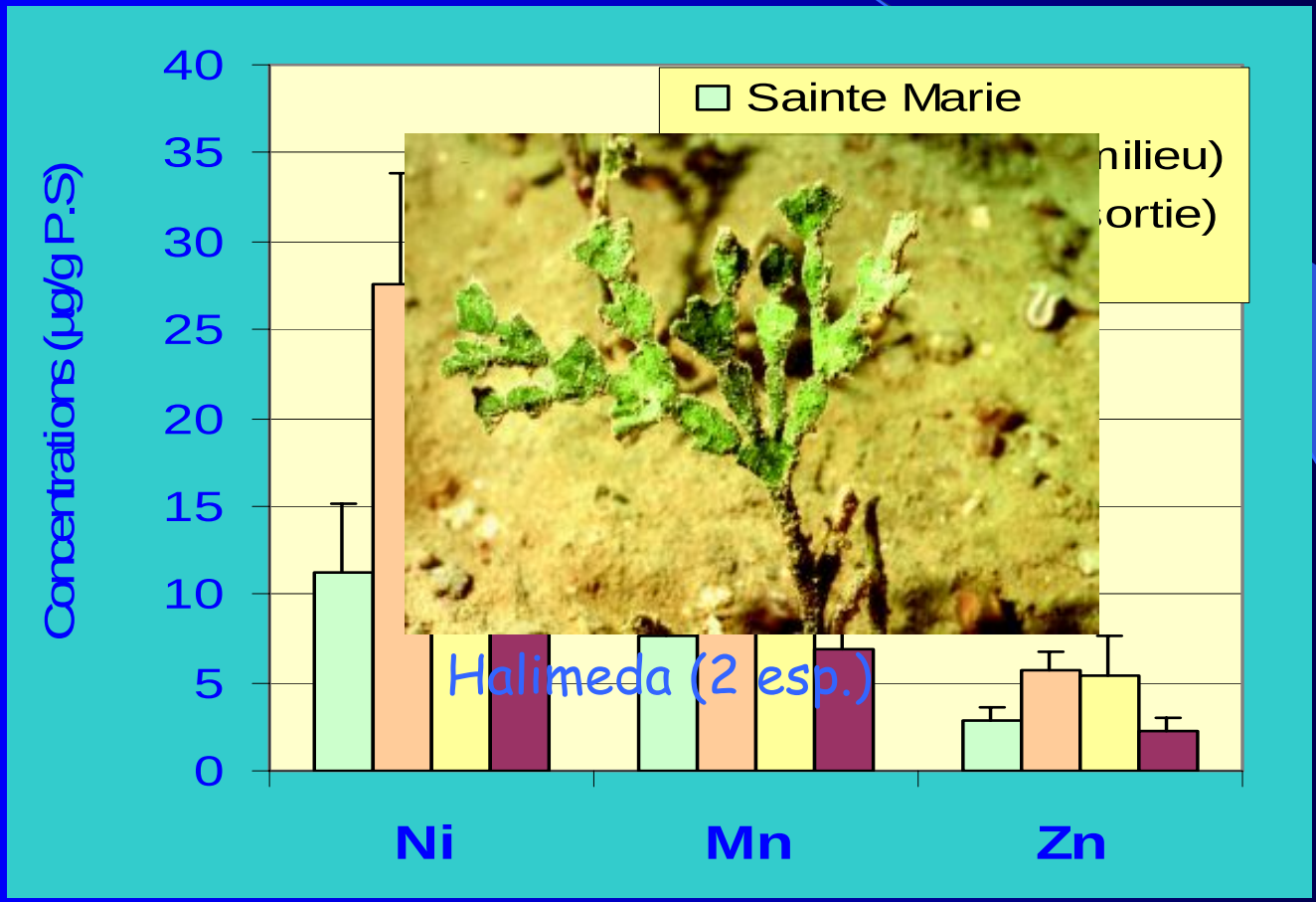
Sinularia leptoclados

Bioaccumulation - Holothurians



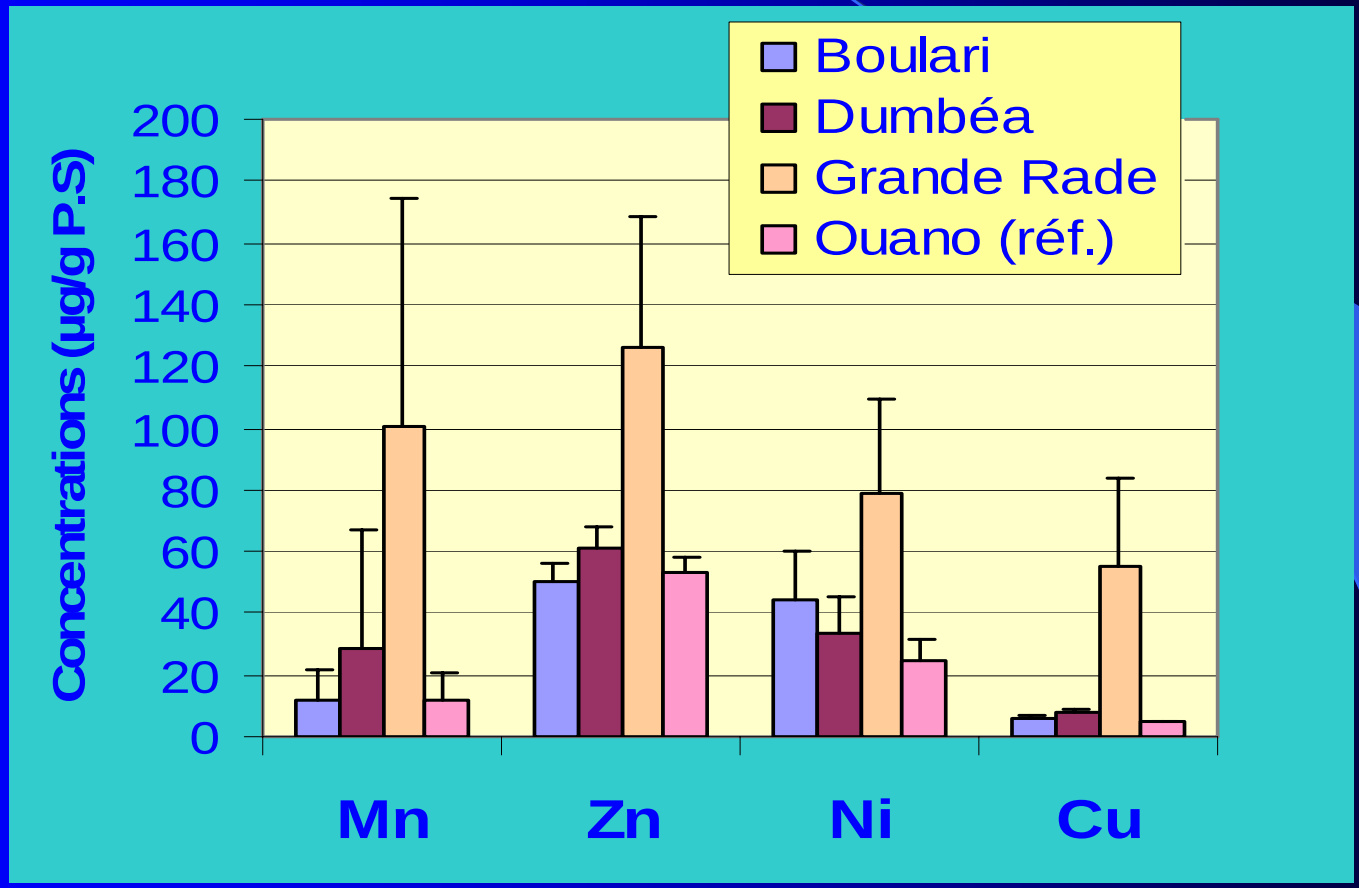
Holothuria edulis

Bioaccumulation - Algae



Halimeda incrassata

Bioaccumulation - Bivalves



Gafrarium tumidum

Bioaccumulation => Bio-indicators

Applied research

Tools for environmental bio-monitoring

- Bio-accumulation
- Integration in time
- Various sources
  - Dissolved
  - Particles
  - Sédiments

Conclusion

- Need for scientific background information on the environment
- Need for additional scientific work to establish adapted tools for environmental survey
- Need for capacity building of local expertise on technical issues