DYCOMED – Dynamics of chemical contaminants in the Mediterranean Sea: An integrated investigation from the atmosphere to the sea bed

**Lars-Eric Heimbürger**

Scientific supervisors: Daniel Cossa and Christophe Migon

Jean-Francois Chiffoleau, Ioanna Bouloubassi, Jean-Claude Marty, Jacek Tronczynski, Laurent Coppola, Vincenzo Vellucci, Aurélie Dufour, Bernard Averty, Dominique Auger, Emmanuelle Rozouel, Grigor Obolenski, Francis Louis, Celine Bachelier, Anne Lorre, Marie-Helene Taphanel, Frederic Vaultier, Floriane Desprez de Gésincourt, Emilie Diamond, Roger Kerouel and the teams of the RV Tethys II.

1[IFREMER - Centre de la Méditerranée]
2[Laboratoire d’Océanographie de Villefranche-sur-Mer]
3[IFREMER - Centre de Nantes]
4[LOCEAN – Univ. Pierre et Marie Curie Paris VI]
5[IFREMER – Centre de Brest]
DYCOMED – Dynamics of chemical contaminants in the Mediterranean Sea: An integrated investigation from the atmosphere to the sea bed

Sampling site

- Cap Ferrat atmospheric sampling site
- DYFAMED site sheltered from lateral coastal inputs by the Ligurian current (→)
DYCOMED – Dynamics of chemical contaminants in the Mediterranean Sea: An integrated investigation from the atmosphere to the sea bed

Sampling plan

• TM s (Li, Al, V, Mn, Co, Ni, Fe, Cu, Zn, Ag, Cd, Hg, Pb)

• POPs (PCBs, PAHs, PBDEs)

• Organo-metals (MeHg, TBT)

• Biomarkers (alkenones, fatty acids, sterols)

• Black carbon

• DIC, DOC

• Nutrients
Summary of sampling strategy

- **Atmosphere**: dry and wet deposition: TM + Hg + Aerosol: TM + POP + BC
  - Jan 2006 – Mai 2009
  - + archive since 1986

- **Water column**: TM + Hg (nf + f)
  - Jul 2007 – Mai 2009
  - 0 – 2200m (12 depths)

- **Suspended particulate matter**: TM + Hg + POP
  - Jul 2007 – Nov 2008
  - 100 + 200 + 1000m

- **Sediment traps**: TM + Hg + POP
  - 200 + 1000m

- **Sediment core**: TM + Hg + POP
  - available
  - 45cm-core
Quantification of trace metal enrichments of Ligurian surface waters by atmospheric deposition

Lars-Eric HEIMBÜRGER\(^1,2\), Christophe MIGON\(^2\) and Daniel COSSA\(^1\)

- LC with flow of \(37.8 \times 10^{12} \text{ m}^3 \text{ year}^{-1}\)
- \(V\) of the LC \(10.6 \times 10^{12} \text{ m}^3\)
- \(t_R = V/LC\) -> equals 102 days
- \(\Delta c = [F_{TM} \times t_R] / ML\)

- \(\Delta c/c\) ratio between total seawater labile atmospheric deposition during 102 days (\(\Delta c\)) and dissolved concentrations in Ligurian surface waters (\(c\)) illustrates the impact of atmospheric deposition on surface seawater
Trace metal concentrations in the North-western Mediterranean atmospheric aerosol between 1986 and 2008: Seasonal patterns and decadal trends

Lars-Eric HEIMBÜRGER1,2, Christophe MIGON2, Aurélie DUFOUR2, Jean-François CHIFFOLEAU3 and Daniel COSSA1

Saharan dust input

Autumn/winter

Crustal Intermediate anthropogenic
Seasonal variations of trace elements in the water column of the Ligurian Sea, North-western Mediterranean

- Highly stratified water column over sampling time with only little winter mixing

Scavenged-like, but shifting towards nutrient-like
Seasonal variations of trace elements in the water column of the Ligurian Sea, North-western Mediterranean

Impact of exceptional wet TM deposition inputs in winter 2009?

- Elevated concentrations for Co, Cu and Zn
- Lower concentrations for nutrients and Ni

2007: very dry year
2008: very high precipitation rates in winter
Seasonality of methyl mercury distributions in relation with biological activity in an oceanic water column of the North-western Mediterranean

Lars-Eric Heimbürger1,2, Daniel Cossa1, Christophe Migon2, Jean-Claude Marty2, Bernard Averty3 and Aurélie Dufour2

Methyl mercury (MeHg)
- Toxic Hg species
- Formed in situ in the water column
- Accumulating in the marine food web
- Top predators (tuna) highly contaminated
- Very low picomolar level in sea water (0.3 ± 0.17 pmol L⁻¹, n = 214)
Perspectives

Acquired data with ongoing exploitation

- Wet and dry deposition of TM on Cap Ferrat 2006-08
- POPs (PCBs, PBDEs and PAH) in aerosols (project EXTREMA)
- Hg in atmosphere (project EXTREMA)
- POPs (PCBs, PBDEs and PAHs) in sediment traps
- POPs (PCBs, PBDEs and PAH) in SPM (in situ pumps)
- TMs and Hg in SPM (in situ pumps)
- Hg in SPM (in situ pumps)
- TMs and Hg in sediment core

**Forecasted outcome in terms of publications:**

- Persistent organic contaminants (PCBs, PAHs, PBDEs) in sediment traps, on suspended particulate matter and sediment
- Extreme input events such as (heavy rain, Saharan dust): marine response (atmosphere vs. surface seawater)
- POPs, TMs and black carbon (BC) in aerosols at Cap Ferrat: a 3 month survey
- Anthropogenic part of atmospherically-transported iron in the Ligurian region
DYCOMED – Dynamics of chemical contaminants in the Mediterranean Sea: An integrated investigation from the atmosphere to the sea bed

Globicephala macrorhynchus - Short-finned pilot whale

Merci!