The marine Mercury cycle: Speciation and stable isotopes

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Determine the distributions of Hg, including its concentration, chemical speciation, and physical form, and to evaluate the sources, sinks, and internal cycling of these species to characterize more completely the physical, chemical and biological processes regulating their distributions (modified).
Hg speciation and isotopes

Isotopic signature

δ: Isotopic variation

Speciation of chemical forms

δ’

δ’: Isotopic variation

Interface

Isotopic fractionation (δ″)

Physical, chemical and biological processes

Modification of chemical forms

Sources

Transformations

Biogeochemical cycles

Coupling

Concentrations

Isotopes (δ)

Chemical species
Go-Ship Mediterranean cruise
April 6th-28th 2011

Key parameters:
- S, T, alkalinity, nutrients
- $^3$He, DIC, $^{14}$C, $^{15}$N, $O_2$+iso, Ba, Hg, Nd, Ra
- CFC, PFOS
- Cocos, microbio, DNA

RV Meteor
Chief scientist: Toste Tanhua
Methods for determination of inorganic and methylated Hg

GET
- Teflon 0.1% HCl
- Propylation
- Isotopic dilution
- GC-HR-ICP-MS

Eleni
- Glass 0.4% HCl
- Ethylation
- CV-AFS

Daniel
- Teflon 0.4% HCl
- Hydration
- Purge and Cryo-trapping GC-CV-AFS

Monperrus et al. 2005
Monperrus et al. 2007

Horvat et al. 2003
Horvat et al. 1993
Bloom 1989
Bloom and Fitzgerald 1988

Cossa et al. 2009
Heimbürger et al. 2010
TRANSCAR - ARKXXII/3 Arctic cruise
August 5th - October 7th 2011

- ~250 CTD casts (24 bottles)
- Sea-water, Sea-ice, snow cover, brine
- On board: Hg_T, Hg_R, DGM (CV-AFS)
- Home lab: Hg_i + MeHg (3 methods)
- TGM (Tekran 2537A)
- Atmospheric particulate Hg (Tisch 5170-VBL)

Key parameters:
- $^{234}$Th, $^{228}$Th
- Radium isotopes
- O$_2$/Ar
- Radon
- $^{7}$Be
- Hg
- carbonate system

Chief scientist: Ursula Schauer
Head of Geochemistry group: Michiel Rutgers van der Loeff
Mediterranean process study

*Project CLION (submitted) 2012-2016*

About the release of elements from coastal sediments and their fate in the marine environment

**Submarine Groundwater Discharge (SGD)**
- SGD Hg flux ~ Atmospheric Hg flux (Bone et al., 2007; Laurier et al., 2007; Black et al., 2009)
- Speciation needed
- **Not** accounted for in the MED Hg budget

- Hg speciation in SGDs, benthic flux chambers, rivers, sediments, sea water
- 5 transects sampled in every season
- Hg sensors

*Project leader: Catherine Jeandel*
Marine Hg isotopes

MIF
- Induced through photo-reduction/-degradation of Hg species in the surface ocean
- Atmosphere $- \Delta^{199}\text{Hg}$
- Ocean $+ \Delta^{199}\text{Hg}$
- But mostly indirect evidence
- Aquatic organisms accumulate essentially MeHg
- MeHg minor fraction in the surface Ocean
- Marine Hg isotopic signature remains unknown

Sonke, GCA accepted
GEOTRACES Mediterranean cruise (2013)

- $\text{Hg}_T \sim 1\text{pM} = 0.2\text{ng/L}$
- 100L sea water @ 0.2ng/L = 20ng for isotopic analysis
- 2 profiles of 5 depths

You are still here.

Chief scientist: Micha Rijkenberg
Thank you and see you in

10th INTERNATIONAL CONFERENCE ON MERCURY AS A GLOBAL POLLUTANT
July 24-29, 2011, Halifax, N.S., Canada

WWW.MERCURY2011.ORG