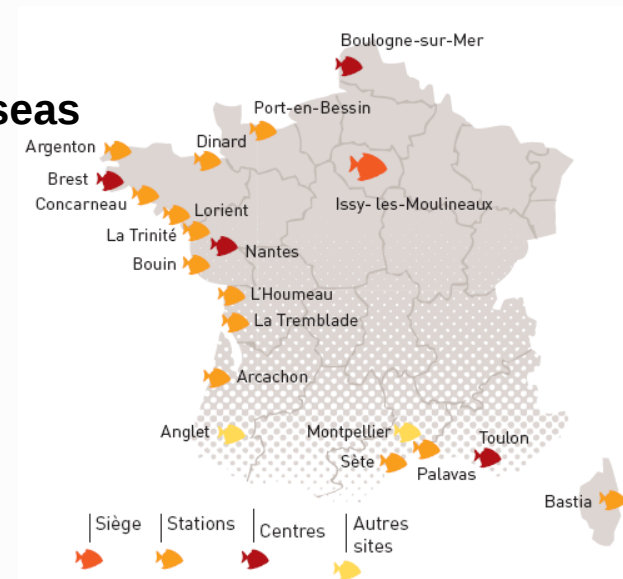


Using SBSE for the study of organic compounds in submarine hydrothermal vents: from the research vessel to the lab

Cécile Konn, Sophie Chataing
LGM, Ifremer, Brest

Ifremer: Institut français de recherche pour l'exploitation de la mer (1984)

- a budget of about 243 millions €
- 5 centers, 25 along the coastline of France and overseas
- over 1 600 people, 450 specialities
- 8 research vessels (4 highseas)
- 1 submersible and 1 ROV (- 6 000 m)
- 2 AUVs (autonomous vehicles)



DISCOVERING THE OCEANS WITH IFREMER

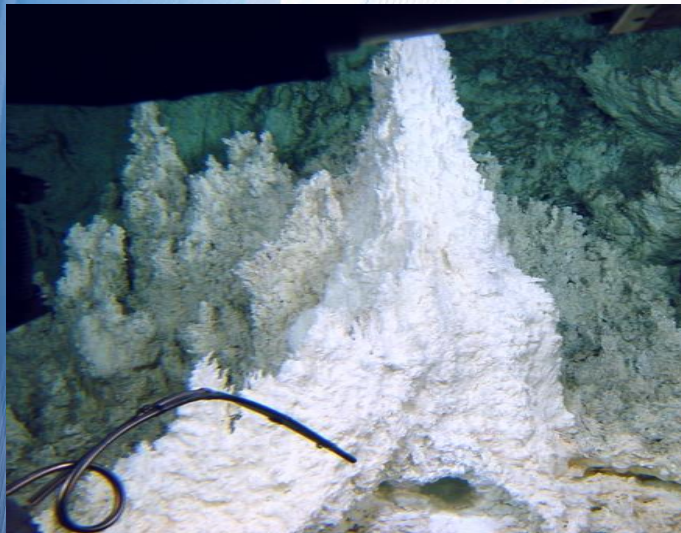
- RESEARCH
- MONITORING OF COASTAL AND OCEANIC WATERS
- DEVELOPMENT, MANAGEMENT AND OPEN ACCESS TO LARGE RESEARCH INFRASTRUCTURES

Laboratory of Geochemistry and Metallogeny?

- Research interests
 - ✓ Hydrothermal exploration
 - ✓ Geochemistry and metallogeny of rocks
 - ✓ Geochemistry of hydrothermal plumes and fluids
 - ✓ Gas hydrates
 - ✓ Cold seeps

- Study areas in all oceans and seas
 - ✓ Margins
 - ✓ Subduction zones
 - ✓ Mid-Ocean Ridges
 - ✓ Back arc basins

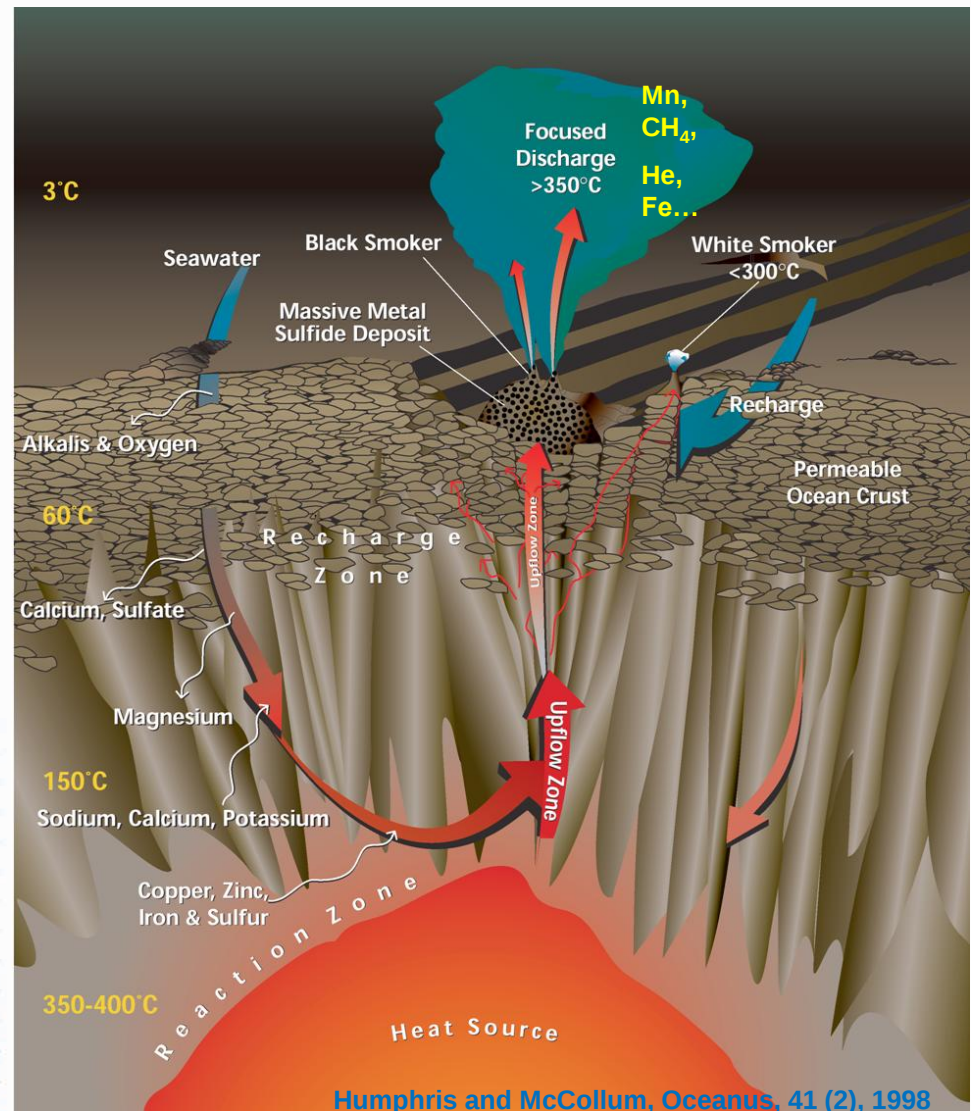
Hydrothermal system?



Carbonate chimneys (*Lost City*)

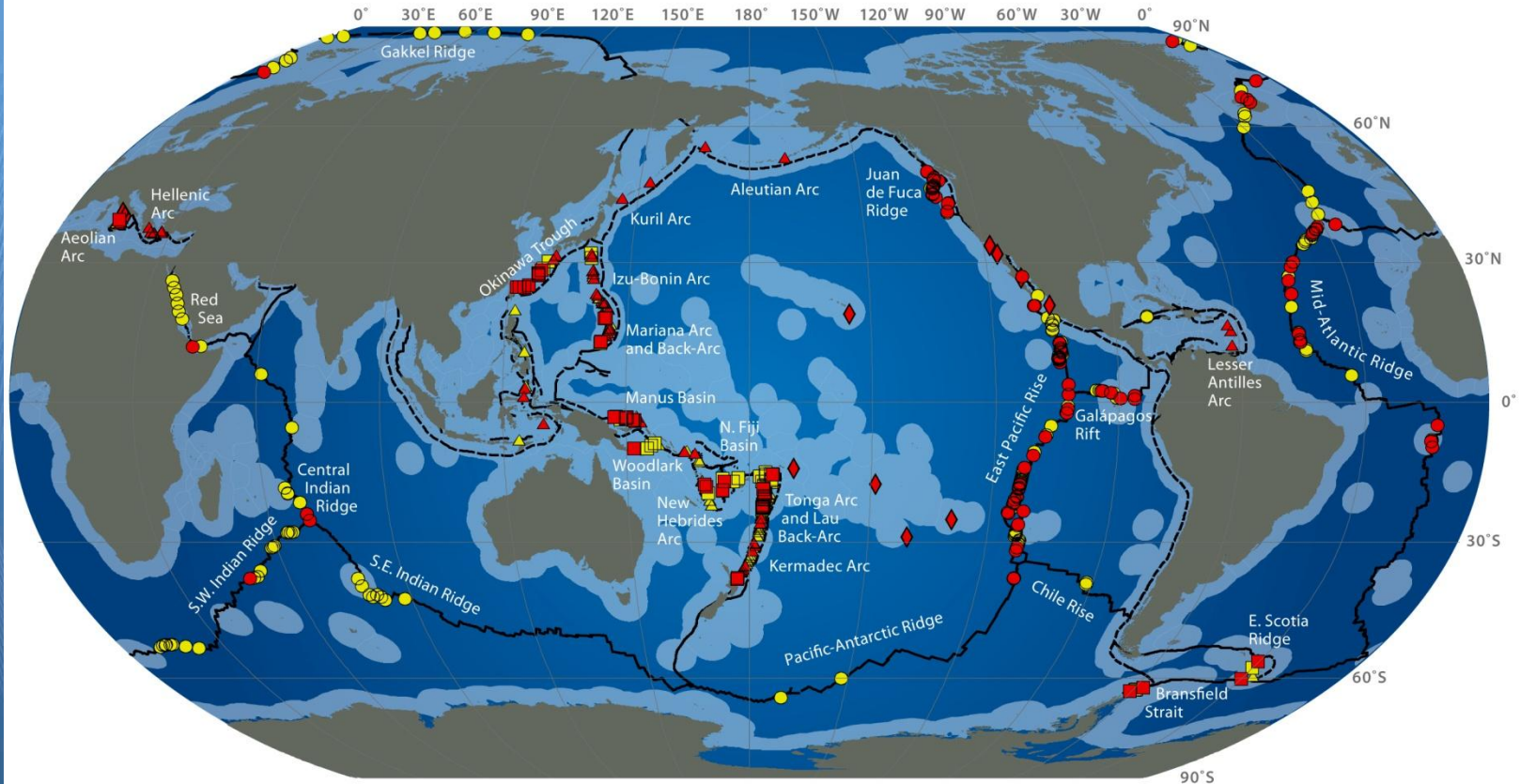


Black smoker (*Rainbow*)



Where are hydrothermal vents located?

Global Distribution of Hydrothermal Vent Fields



Credits: S. Beaulieu, K. Joyce, and S.A. Soule (WHOI), 2010



Mid-ocean ridge

● Active

● Unconfirmed

Arc volcano

▲ Active

▲ Unconfirmed

Back-arc spreading center

■ Active

■ Unconfirmed

Intra-plate volcano
& Other

◆ Active

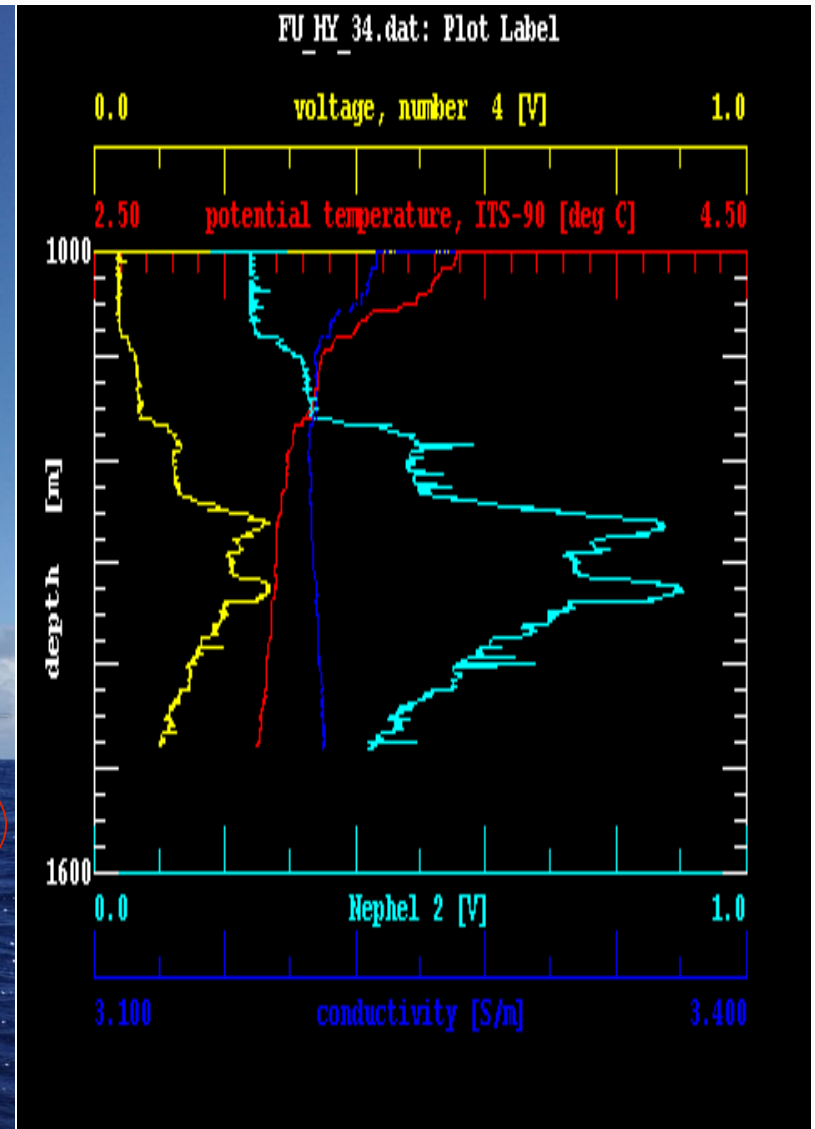
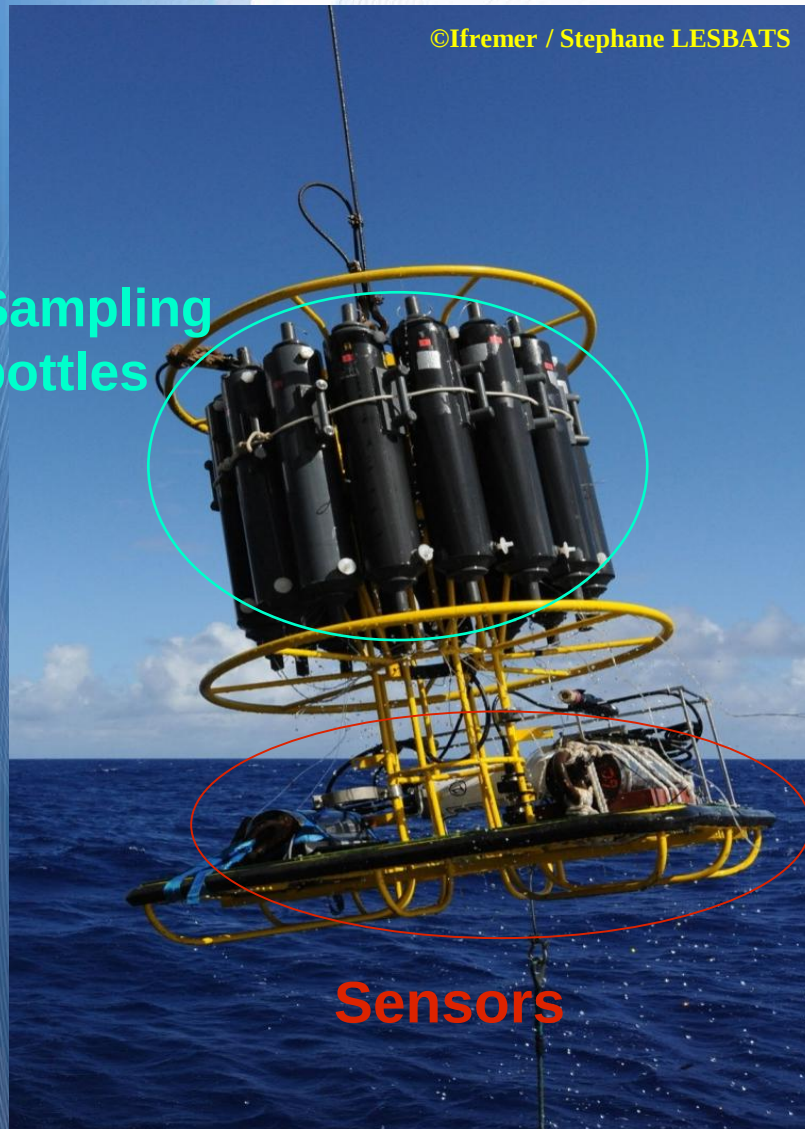
— Ridge & Transform

--- Trench

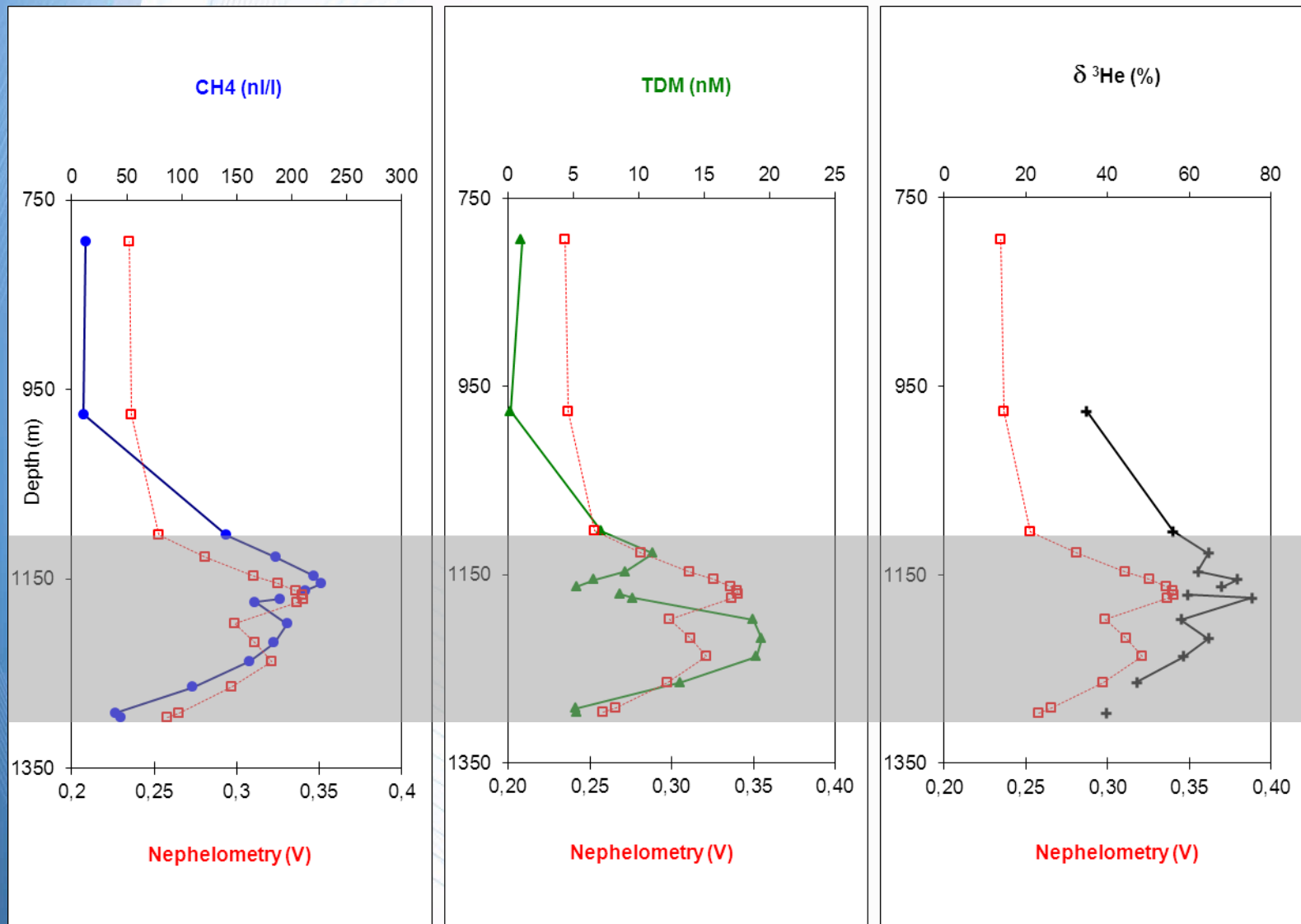
● Exclusive Economic Zones



Hydrothermal plumes / vents search



Hydrothermal plumes / vents search



Sampling



Ultramafic-hosted?

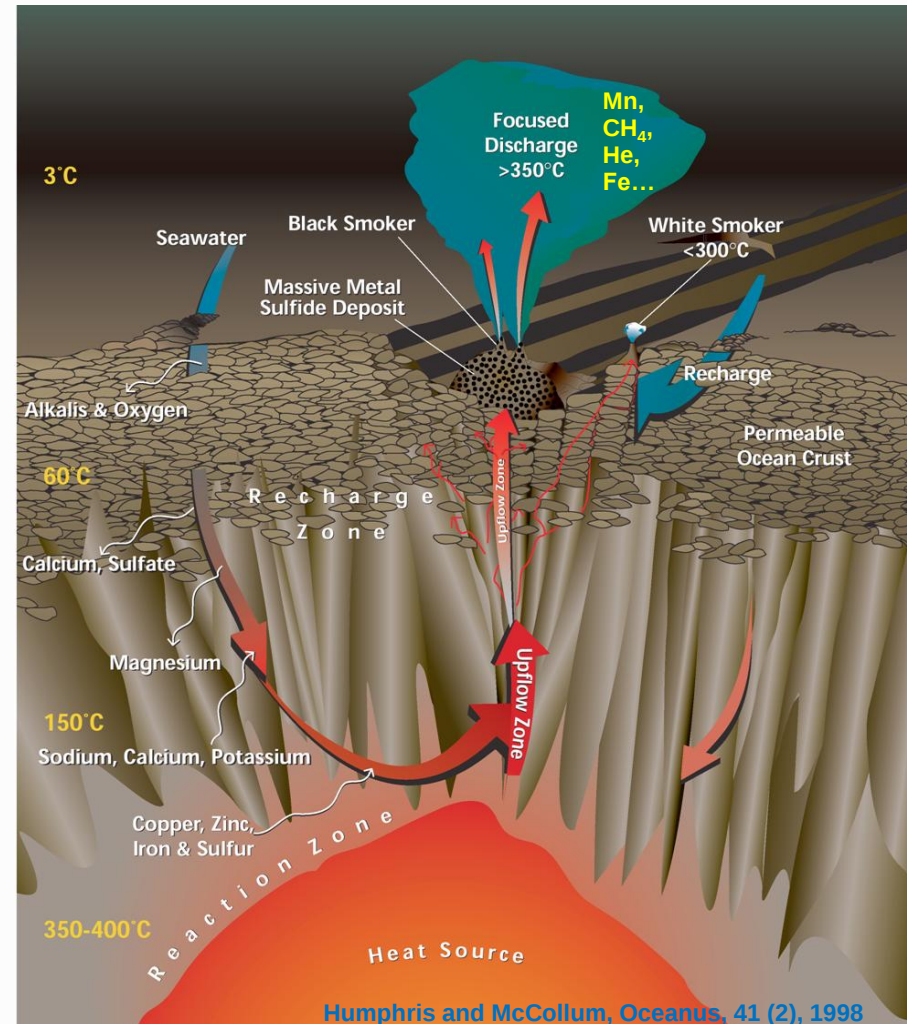
- ➔ Underlying rocks
= Mantle rocks
= peridotites (olivine rich)
- ➔ Seawater / Mantle interaction
= alteration of olivine
→ serpentine

SERPENTINISATION

- ➔ H_2 production
- ➔ reducing conditions

Thermodynamically
favorable for

$CO_2 \rightarrow CH_4 \rightarrow$ Organics



Origin of organic compounds in hydrothermal fluids



Rocks, minerals, metals,
almost all gases, water...

Inorganic world



Living world = **organic** world

**Abiotic
synthesis**



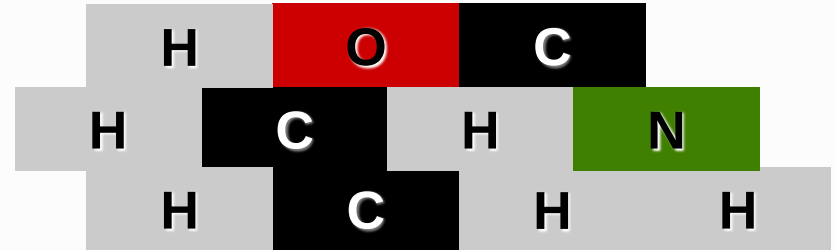
?



OXIDIZED



REDUCED



Scientific stakes

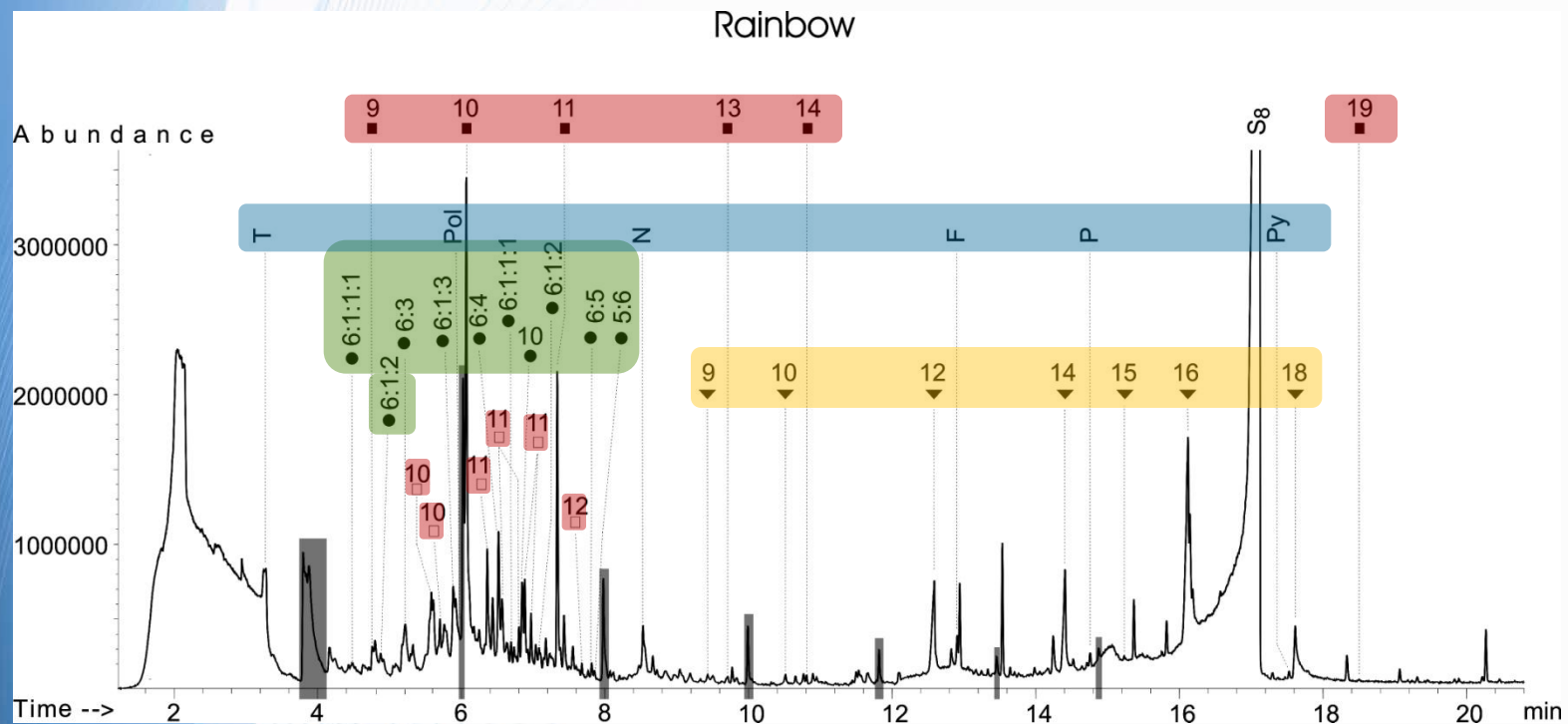
How did life start?

Could part of the oil be renewable?

Is abiotic synthesis of organic compounds occurring in submarine hydrothermal systems?

- Are there organic compounds in hydrothermal fluids?
- Where do they come from?

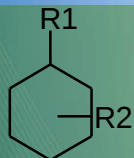
Are there organic compounds in hydrothermal fluids?



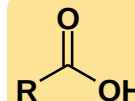
C. Konn et al., 2009, Chemical Geology



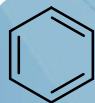
Linear, methyl and branched hydrocarbons C9 – C19



Cyclohexanes C9 – C11

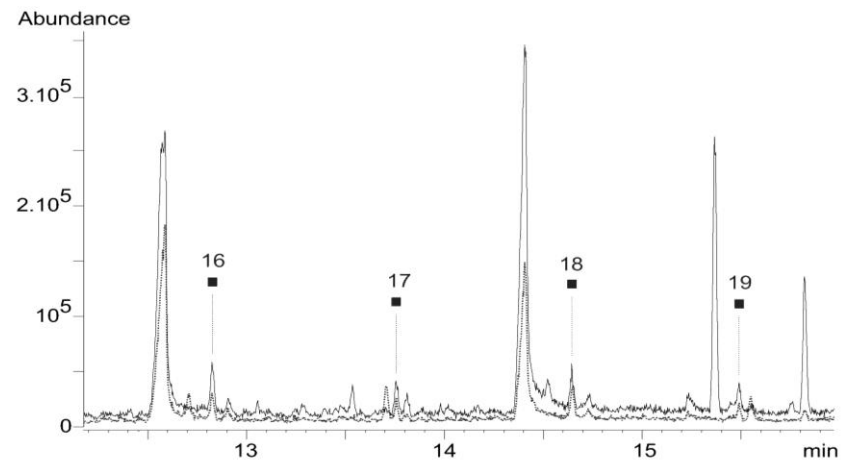
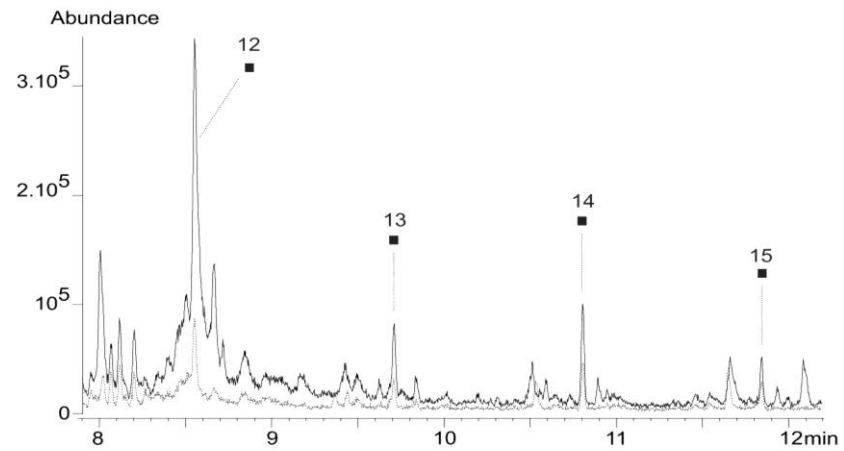
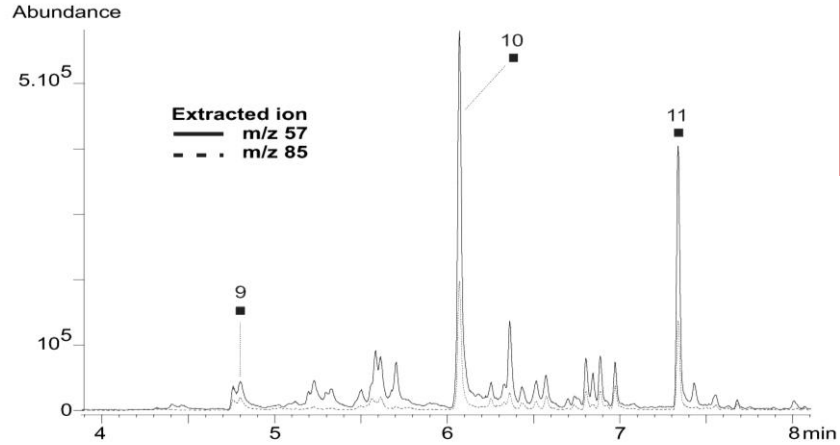


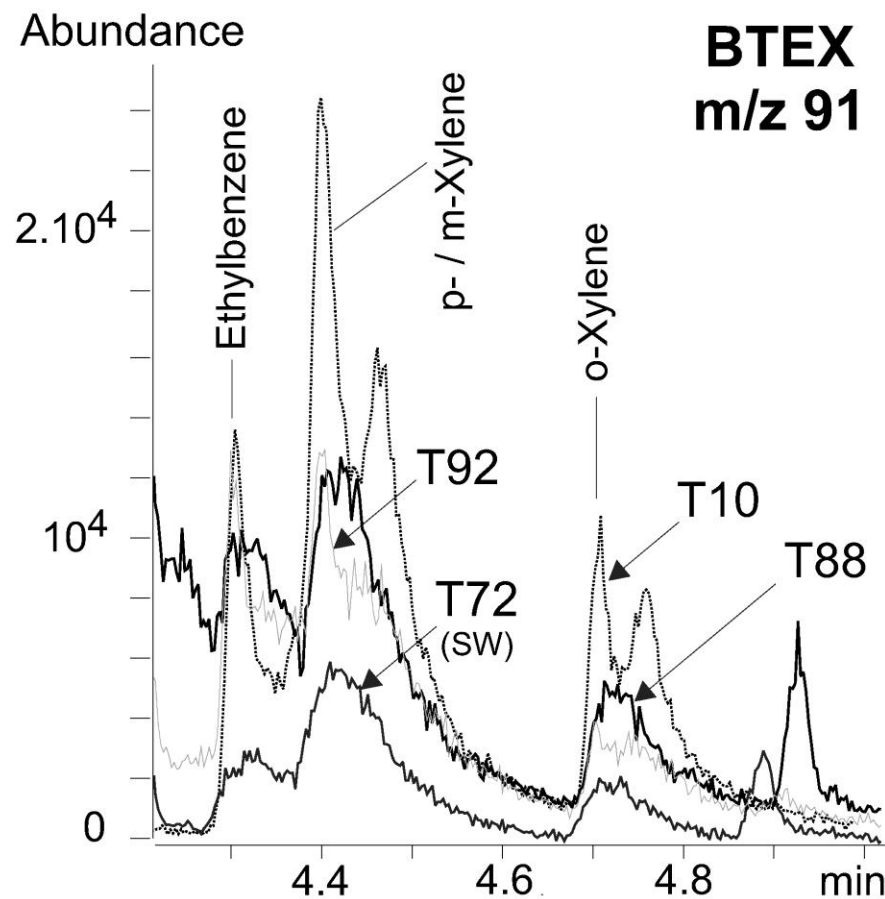
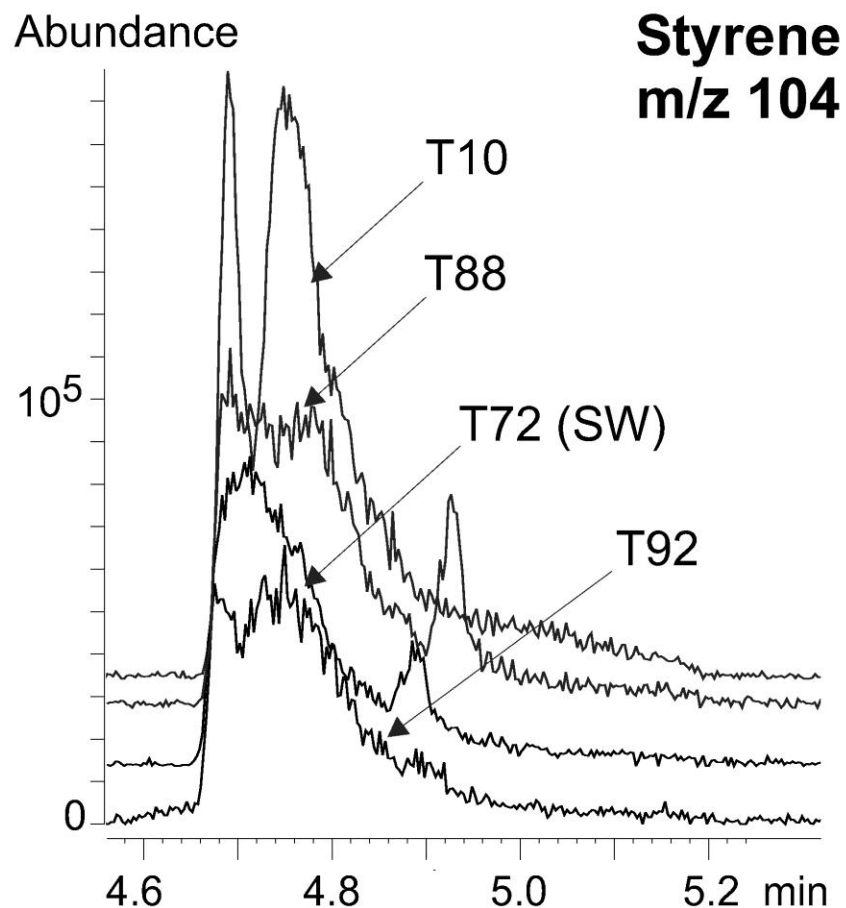
Fatty acids C9 – C18



PolyAromatic Hydrocarbons (PAH)

Alkanes

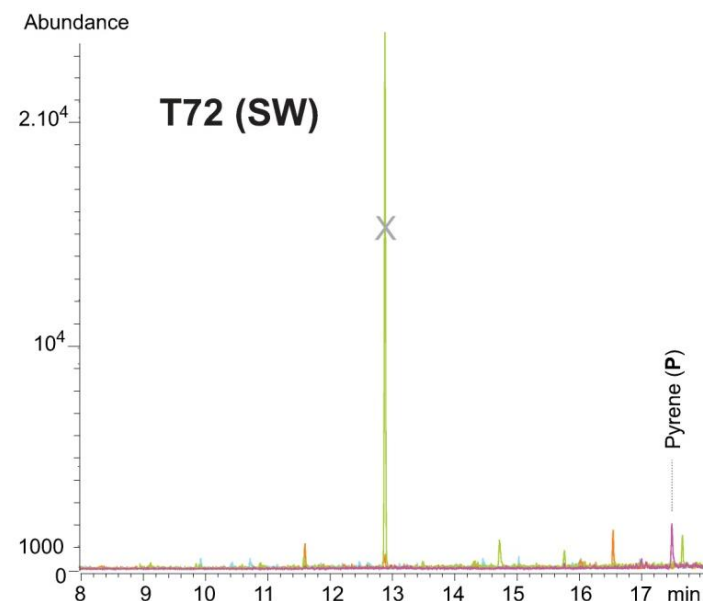
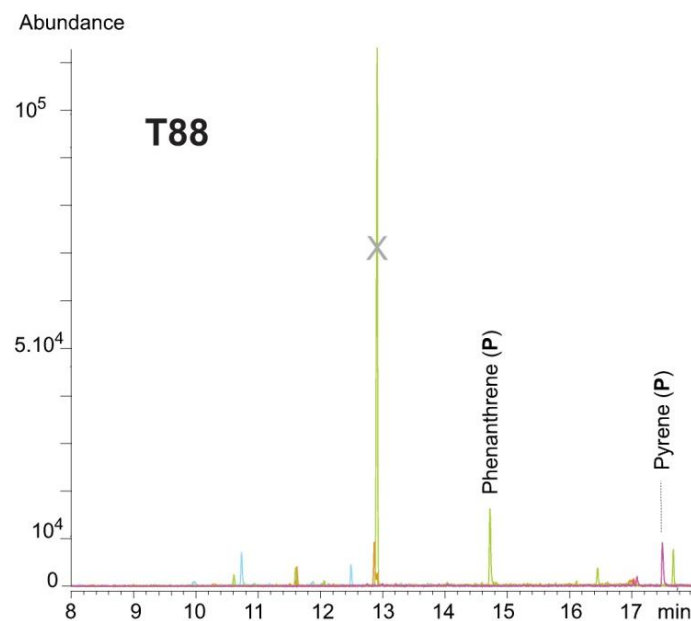
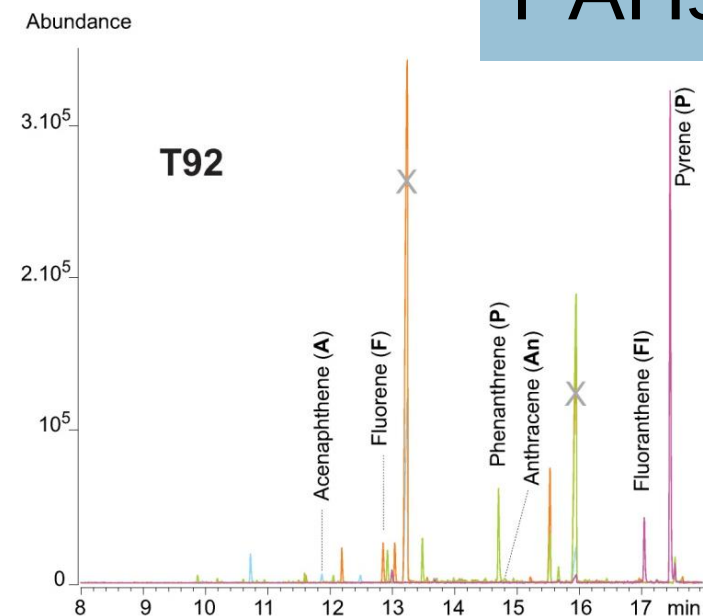
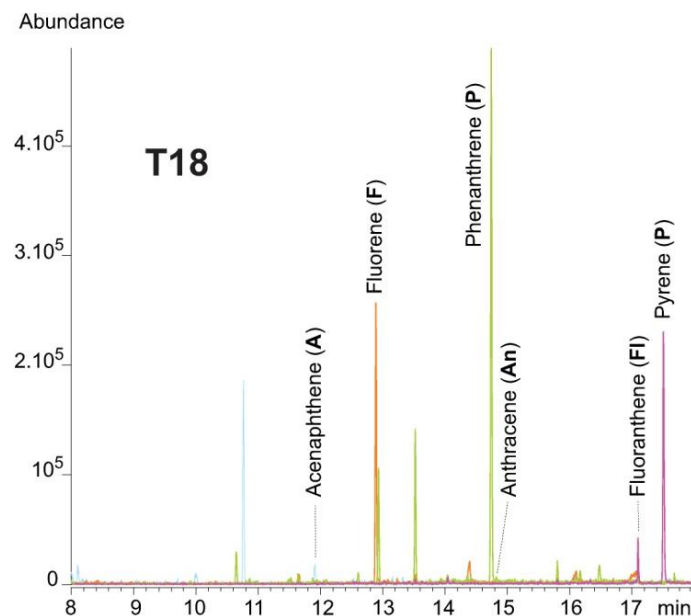




C. Konn et al., 2012, Geochemical Transactions

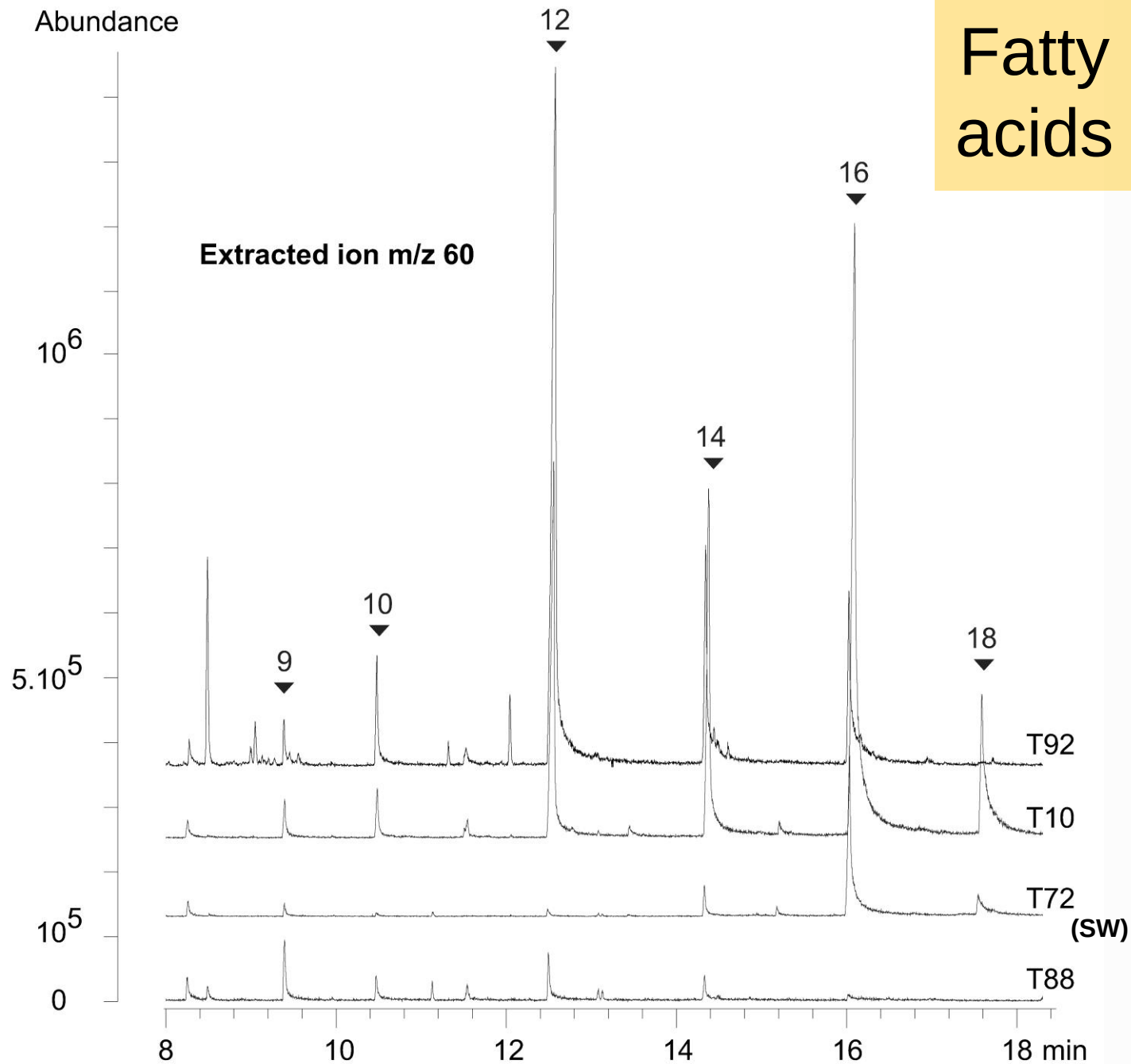
extracted ions: m/z 154, m/z 166, m/z 178, m/z 202

C. Konn et al., 2012, Geochemical Transactions

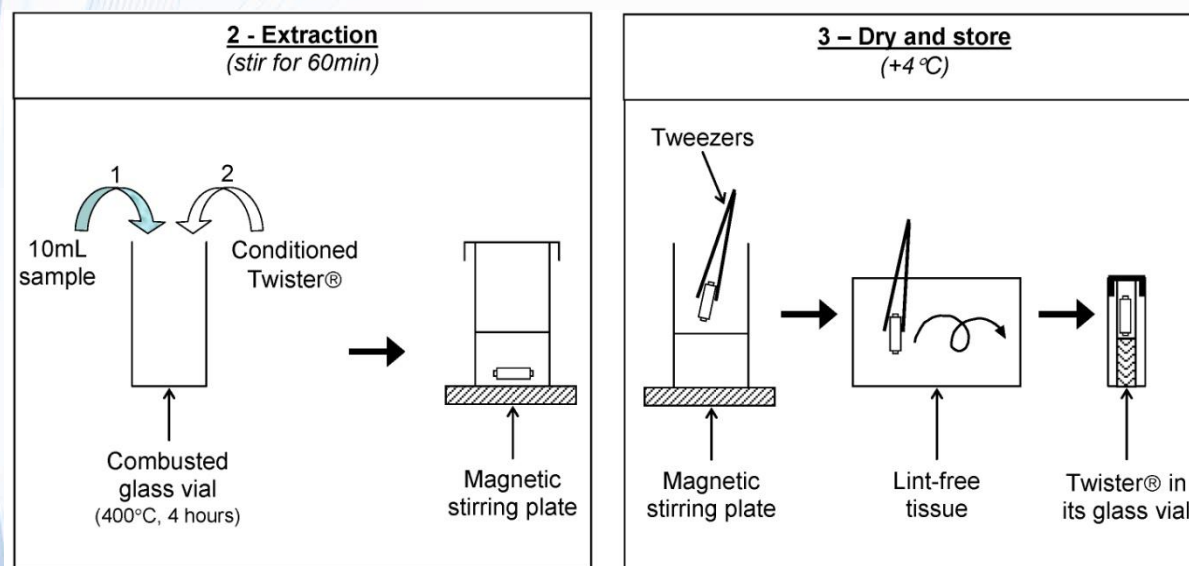


Fatty acids

C. Konn et al., 2012, Geochemical Transactions



Original protocol: qualitative study



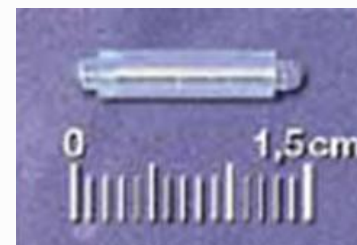
24 μ L PDMS

300 rpm

60 min

Light

10 mL sample



~~Internal Standards~~
~~Organic modifier~~
~~Gas tight vials~~

Conclusions and perspectives

Use of SBSE

- Preparation technique to be used on board a research vessel
- Detection of a wide range of dissolved organic compounds in seafloor hydrothermal fluids
- Understanding of the geochemical processes controlling the formation and distribution of the compounds

Work to continue

- Quantification
- Determination of their origin
- *In situ* measurements
- Exploration!!!

Thank you for your attention



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