Evaluation and monitoring of the impact of Marine Renewable Energies structures on *Haploops* settlements: What is the best tool?

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7, PDG -RBE - BE - LBMC Ifremer Nantes

SEM-REV test site
- 1 km² offshore Le Croisic
- Floating wind turbine technology development
- Electric cable buried in 2012
- Electricity production since spring 2018

=> **What is the impact of the buried electric cable on benthic environment?**
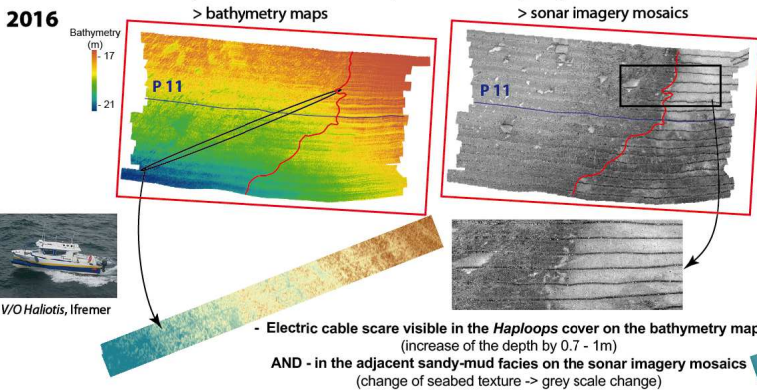(physical reworking)
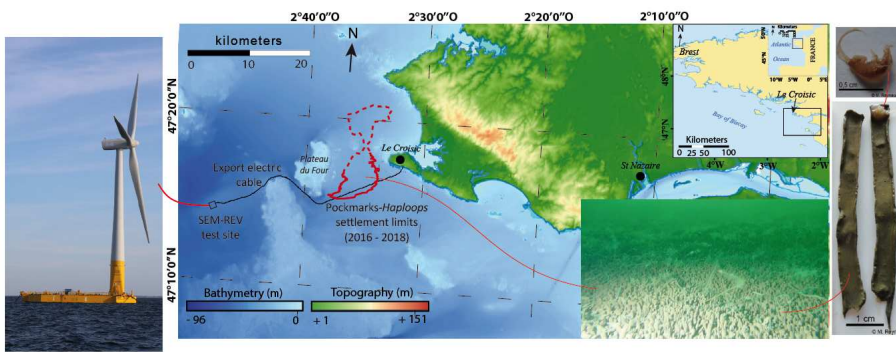
Haploops spp. settlement
- tube dwelling amphipode (crustaceans)
- dense colonies (up to 4,500 ind/m² at Le Croisic)
- linked to the presence of active pockmarks field (Champilou et al. 2019) (sedimentary feature of methane expulsion)
- ecosystem engineer specie
> modify environment structure and impact biodiversity

=> precise location of the pockmarks-Haploops cover

2016
> bathymetry maps
> sonar imagery mosaics

V/O Haliotis, Ifremer

=> spatio-temporal evolutio of the pockmarks-Haploops cover and cable scare

2017   **2018**

- Electric cable scare visible in the *Haploops* cover on the bathymetry map (increase of the depth by 0.7 - 1m)
AND - in the adjacent sandy-mud facies on the sonar imagery mosaics (change of seabed texture -> grey scale change)
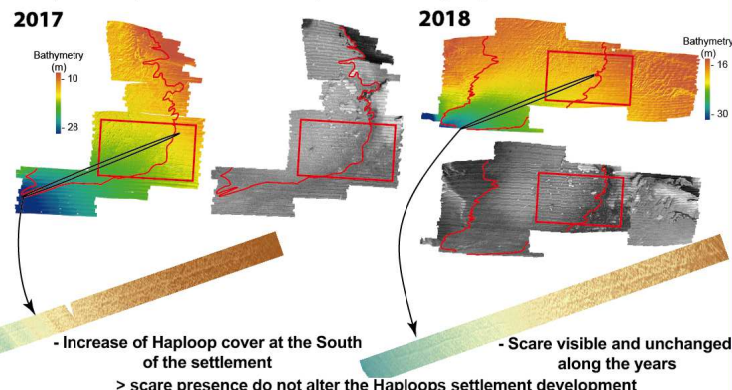
- Increase of Haploop cover at the South of the settlement
> scare presence do not alter the Haploops settlement development

- Scare visible and unchanged along the years

=> explore the link between methane resevoir, pockmarks and *Haploops*

Long cores
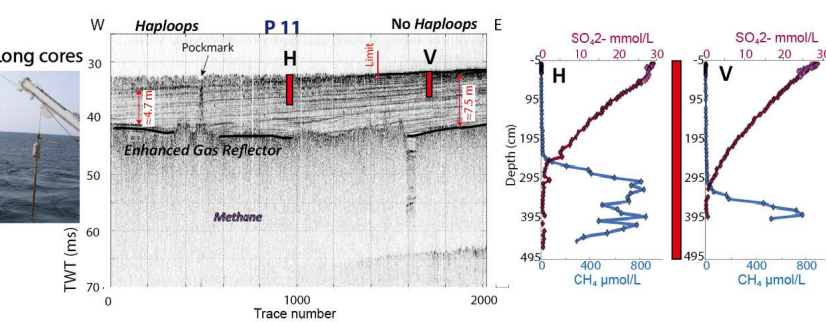
- Methane-sulfate transition zone higher in the sedimentary column in the *Haploops* facies
- Remobilisation of nutrients higher in *Haploops* facies
> direct or indirect source of food for **Haploops**

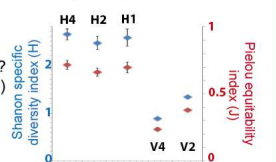## => 2D porewater description > are chemical microenvironments microhabitats?

Interface cores
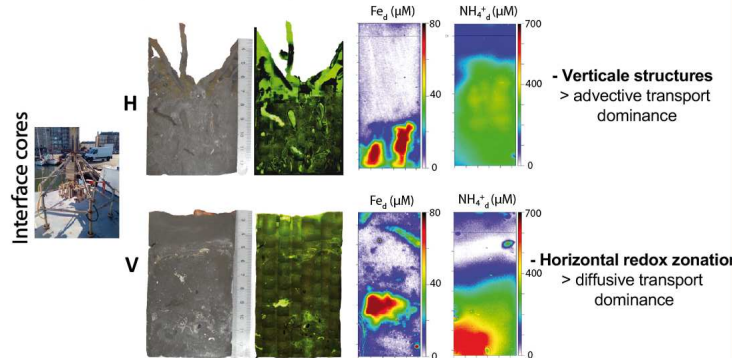
- Verticale structures > advective transport dominance

- Horizontal redox zonation > diffusive transport dominance

Interface cores by divers
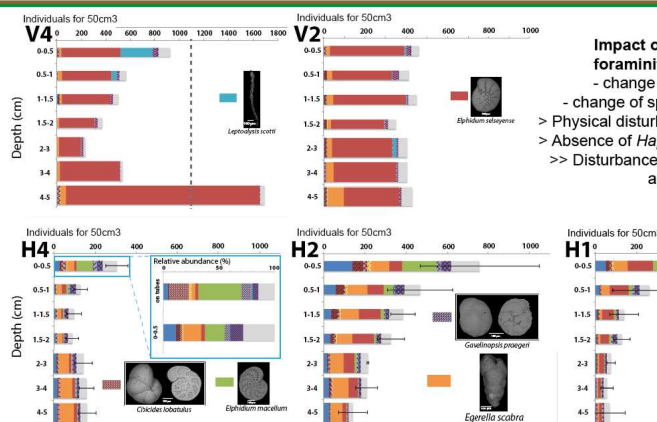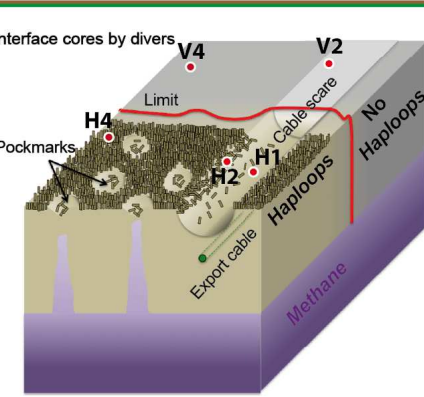
Impact of the cable scare on foraminiferal assemblages :
- change of vertical distribution
- change of specific relative abundance
> Physical disturbance (sediments reworking)?
> Absence of *Haploops*? (long resilience time)
>> Disturbance of th link between methane and *Haploops*?

Ecological parameters

Shanon specific diversity index (H)
Pielou equitability index (J)

Low abundance with high specific richness in the Haploops facies vs high abundance and unbalanced community in No *Haploops* facies
> No Haploops is a stressed environment?
> Geochimical microhabitats and/or physical perturbation ?

The multidisciplinary approach:
- Geophysics allows frequents monitoring at a kilometer scale of habitats evolution and physical anthropic disturbance
- Geochemistry allow better understanding of biogeochemical link between gas reservoir, *Haploops* settlements and foraminifera ecology (from metric to submillimetric scale)
- Foraminiferal assemblages indicate that *Haploops* covers are riches in biodiversity and ecologically equilibrated suggesting that *Haploops* dynamics monitoring is very important

No tool is better to another, it depends of the asked question
Muldidisciplinary approach vital:
- to understand complex interactions between physics, chemistry and biology
- to determine the importance of anthropic disturbance
The development of a bioindicator index from foraminifera will help environmental agencies to easily qualify the ecological status of such complex systems