EUROPEAN SYNCHROTRON RADIATION FACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

Experiment Report Form

	Experiment title: Analysing the possible effects of deep sea mining on the nematodes of the abyssal plains using SR nano-XRF and ptychography	**Experiment number**: EV 287
Beamline:	**Date of experiment**: from: 9/11/2017 to: 13/11/2017	**Date of report**:
Shifts:	**Local contact(s)**: Andreas walter Johannes	*Received at ESRF:*

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Report:

The abyssal deep sea (> 4000 m), one of the last pristine environments on Earth, is currently facing exploitation of its rich, economically valuable mineral deposits. Mining of these geological features may pose, among others, risks of releasing increased, potentially toxic, amounts of heavy metals at the seafloor with unknown consequences to the benthic fauna. In a combined effort with the Department of Marine Biology at Ghent University, led by Prof. Ann Vanreusel, we investigated the impacts of increased amounts of copper on nematodes from abyssal plains. Environmental factors such as pressure, temperature and oxygen saturation significantly influence copper toxicity in marine invertebrates. Therefore, we conducted *in-situ* copper enrichment experiments at 4200 m depth in a ferromanganese nodule region in the South- East Pacific. The experiments on these unique samples yielded otherwise unattainable insights to some of the more remote parts of our planet and its ecosystem. Bulk copper content of nematodes exposed to different copper concentrations measured by lab-scale μXRF provided a first indication of the potential for copper to accumulate in deep-sea nematode tissue.[1] The study of nematodes with SR-XRF coupled to ptychography at the nano-beamline of ID13 aimed at imaging a detailed map of the internal distribution of copper and other elements in the nematode body, significantly adding to the understanding of

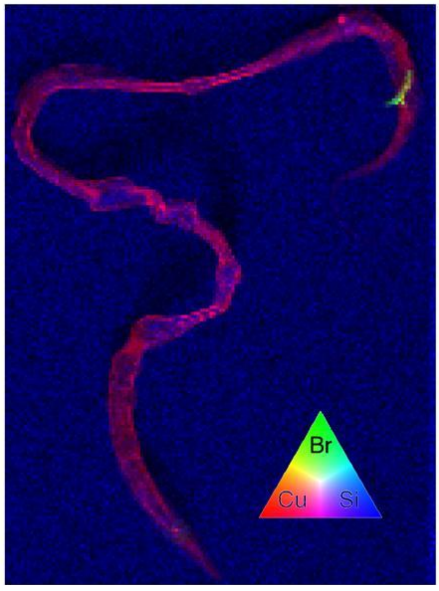

Fig. 1 overview image of nematode, showing Cu to be present throughpout the

the elemental accumulation mechanisms behind copper toxicity and detoxification.

The XRF experiments yielded high resolution images of the elemental composition of these unique organism for the first time. The copper proved to be present throughout the nematodes, not solely concentrated in specific organs (Fig. 1). Furthermore, the elemental maps for other elements yielded new infomation on the elemental composition of certain body structures of the nematodes, such bromine being present in elevated concentration around the head (Fig. 2) and the reproductive organs (Fig. 3).

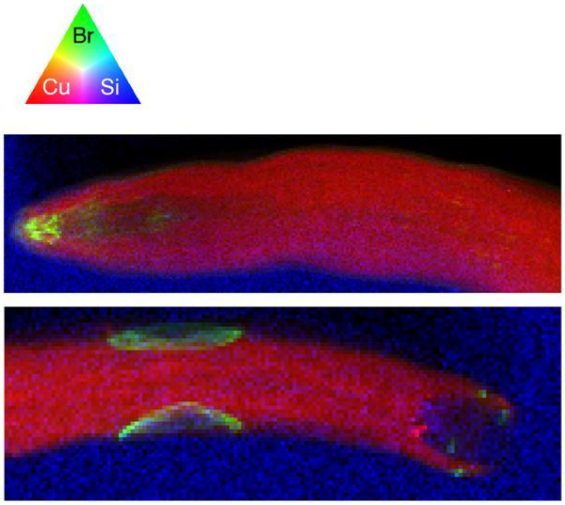

Fig. 2 Images of the head of two different nematodes, several organs are enriched in Br

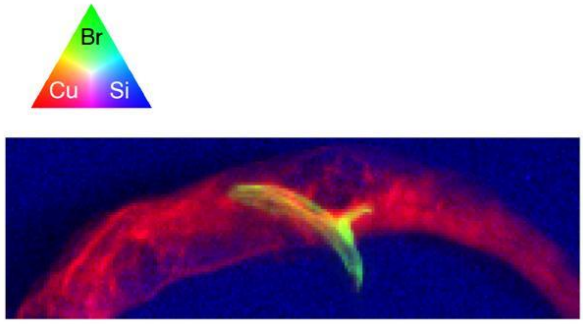

Fig. 3 The drill-like reprocudtive organ of this male nematode is also enriched in Br.

The ptychography study of these samples yielded sub-optimal images. After 2 shifts of beamtime trying to optimize the parameters for these measurements, it was decided to focus on the XRF side of the experiment, which had by then proven to yield good results. This way, a larger amount of nematodes could be processed during the available time, albeit with only one of the two envisaged techniques.

References

1. Mevenkamp, L., Guilini, K., Boetius, A., De Grave, J., Laforce, B., Vandenberghe, D., … Vanreusel, A. (2019). Responses of an abyssal meiobenthic community to short-term burial with crushed nodule particles in the south-east Pacific. *Biogeosciences*, 2329–2341.