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Behavior and fate of tungsten-based nanoparticles and their biological impacts within freshwater ecosystems

AMAZIGH OUAKSEL[1], ANDREA CARBONI[1], DANIELLE SLOMBERG[2], VLADIMIR VIDAL[3], OLIVIER PROUX[4], LENKA BROUSSET[5], BERNARD ANGELETTI[6], ALAIN THIÉRY[5], JEROME ROSE[2] AND MÉLANIE AUFFAN[7]

[1]CEREGE, CNRS, Aix Marseille Univ, IRD, INRAE, Aix-en-Provence, France

[2]Aix Marseille Univ, CNRS, IRD, INRAE, Coll France, CEREGE UMR 7330

[3]CEREGE, Aix Marseille Univ, CNRS, IRD, INRA

[4]OSUG, CNRS-Univ. Grenoble Alpes, Saint Martin d'Hères

[5]CNRS, Aix-Marseille Université, CNRS, IMBE, UMR 7263, Marseille

[6]CEREGE, Aix Marseille Univ, CNRS, IRD, INRAE, Coll France, CEREGE UMR 7330

[7]CEREGE

Presenting Author: ouaksel@cerege.fr

The world has to face a major energetic transition in the next years. Solutions to secure future energy supplies, optimize waste treatment and limit our impacts on natural resources are being developed. Tungsten-based (nano)materials are being increasingly used in various fields of emerging technologies such as heat generation, photocatalysis, energy-related and gas-sensor applications [1]. The uses of tungsten have been expanding for numerous reasons, including the general assumption that tungsten is neither toxic nor particularly mobile in the environment. However, considerable questions persist regarding tungsten biogeochemistry in natural environments (soil, freshwater, biota) including the speciation-dependent biological effects of W-based nanoparticles [2], and trophic transfers under a realistic exposure scenario.

Thanks to their robustness, mesocosms have been widely used in the framework of nano-safety studies during the last decade. Mesocosms allow for the study of the behavior, fate and impacts of pollutants under environmentally relevant exposure conditions by combining the relevance of a field trial (exposure in complex media, low dose tested, and mid- to long-term duration) with the capacity of monitoring [3].

In this study, we used freshwater mesocosm facilities to evaluate (i) the exposure and hazards of aquatic environments contaminated with relevant W-based particles, and (ii) the bio-physico-chemical driving their behavior and fate in the critical zone. We used (High Energy Resolution Fluorescence Detected X-ray Absorption Spectroscopy) HERFD-XAS to characterize the evolution of W speciation in freshwater ecosystems, and to characterize the (bio)transformation of W particles with regard to their ecotoxicity and bioavailability. These results will be discussed in term of speciation-dependent biological effects of W-oxide-based nanoparticles, and trophic transfers under a realistic exposure scenario.

References

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