

Studying trace element speciation allows to better understand geochemical controls on their distributions and isotopic signatures in sediments

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Examining trace element geochemistry in sediments, notably their distributions and isotopic fractionations can inform us of the paleo-environmental conditions prevailing at the time of deposition. However, diagenetic processes often alter the original signal in sediment and remain poorly understood. To better characterize these reactions, we need to determine trace element speciation. The use of spectroscopic methods might contribute to filling this knowledge gap. Among them, X-ray absorption fine structure (XAFS) is a powerful method allowing us to identify trace element species present in sediment at natural level. In this presentation, I will briefly show the advantages of XAFS and related methods and their applications to better understand connections between the abundance, the isotopic composition, and the speciation of trace elements. The topics covered will include:

(i) Speciation of cerium (Ce) and other rare earth elements (REE) to evaluate the importance of REE pattern as a proxy of redox condition. The effect of early diagenesis on the REE pattern will be discussed [1,2]. In addition, the potential of Ce stable isotope coupled with Ce anomaly will be shown to estimate more quantitatively redox condition of the environment [3,4].

(ii) Molybdenum (Mo) isotopes have been widely used as a paleo-redox tracer. Speciation of Mo at the solid-water interface can help us better interpret Mo isotope data [5].

(iii) By combining the measurements of abundance, isotopic composition and speciation, we can predict what could be the potential trace element signature before actual isotopic measurements of natural samples. Some examples of this approach will be given for tungsten (W) isotope [6], abundance ratios of Mo and W [7], and rubidium isotope.

[1] Takahashi et al., *Geochim. Cosmochim. Acta* 71 (2007) 984. [2] Takahashi et al., *Geochem. J.* 49 (2015) 653. [3] Nakada et al. *Geochim. Cosmochim. Acta* 103 (2013) 49. [4] Nakada et al. *Geochim. Cosmochim. Acta* 181 (2016) 89. [5] Kashiwabara et al. *Geochim. Cosmochim. Acta* 75 (2011) 5762. [6] Kashiwabara et al. *Geochim. Cosmochim. Acta* 204 (2017) 52. [7] Watanabe et al. *Chem. Geol.* 471 (2017) 38.