

## Selenium volatilization and isotopic fractionation induced by micro-organisms during respiratory reduction of sulphate and fumarate

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In nature, biotic transformation of selenium (Se) oxyanions (e.g. selenite, selenate) by micro-organisms is an important process in the biogeochemical cycling of this trace element. Microbially mediated processes consist in the reduction and the methylation of water-soluble Se oxyanions. The successive reduction steps and transformations of Se when assimilated into amino acids (e.g. selenocystine and selenomethionine), or transformed in elemental Se or volatile organic Se species, tend toward an enrichment of lighter isotopes in the reaction products [1, 2].

Experimentally, the energy-generating metabolism of bacteria (*Desulfovibrio sp.*) exposed to selenite and growing either with sulfate/lactate or pyruvate/fumarate as electron acceptor/donor gave rise to different ratios of volatile Se species, mainly dimethyl selenide (DMSe), dimethyl diselenide (DMDS<sub>2</sub>) and dimethyl selenenyl sulfide (DMSeS). Numerous spheres of amorphous elemental Se at the nanometric scale (~10-600 nm) were found in the extracellular *medium* [3]. Selenium isotopic composition in *media*, cells and acid traps containing the produced volatile Se species [4] typically fit with the theoretical mass dependent fractionation line. Filtered *media* (<0.2 μm) and cells showed a similar isotopic composition in both growing conditions, while opposite values were measured for volatile Se depending of the strain metabolism (i.e. sulphate or fumarate reduction) and the main volatile Se specie produced.

Therefore, Se isotopes ratio measurements can provide relevant informations on the biochemical pathways involved in the volatilization of Se by micro-organisms.

[1] Herbel, Johnson, Oremland & Bullen (2000) *Geochim. Cosmochim. Acta* **64**, 3701–3709. [2] Schilling, Johnson & Wilcke (2011) *Environ. Sci. Technol.* **45**, 2670-2676. [3] Tomei, Barton, Lemanski, Zocco, Fink & Sillerud (1995) *J. Ind. Microbiol.* **14**, 329-336. [4] Winkel, Feldmann & Meharg (2010) *Environ. Sci. Technol.* **44**, 382-387.