Chronic toxicity of metals/metalloids in mammals is mediated by their effect on Se-metabolism

JŰRGEN GAILER[1], GRAHAM N. GEORGE[2], AND INGRID J. PICKERING[2]

[1]University of Calgary, Calgary, Canada, jgailer@ucalgary.ca
(* presenting author)
[2]University of Saskatchewan, Saskatoon, Canada,
g.george@usask.ca; ingrid.pickering@usask.ca

The etiology of numerous human diseases, including autism and type 2 diabetes, the incidences of which are rising globally, is not well understood. Conversely, the concentration of toxic metals and metalloids, such as As, Cd, Hg and Pb in human blood of the average population is well established, but strikingly little is known about the role that these inorganic pollutants might play in the etiology of human disease processes [1]. Hence, the establishment of functional connections between the chronic exposure to inorganic pollutants and the etiology of certain diseases remains one of the great challenges in the post-genomic era. This requires us to uncover hitherto unknown biomolecular mechanisms which must explain how exceedingly small doses of a toxic metal/metalloid compound (low µg per day) – or mixtures thereof – may eventually result in a particular human disease. The biological complexity that is associated with mammalian organisms, however, makes the discovery of relevant mechanisms a monumental challenge. Recent findings suggest that a better understanding of the bioinorganic chemistry of inorganic pollutants in the bloodstream represents one fruitful strategy to unravel pertinent biomolecular mechanisms [1, 2]. In particular, the adverse effect(s) that toxic metals/metalloid compounds exert on the transport of the essential ultratrace element selenium to organs has emerged as highly relevant [3, 4]. An overview of the effect that As^{III} and Hg^{2+} exert on the mammalian metabolism of selenite will be presented and the health relevance of these findings will be discussed.

[1] Gailer (2012) *J. Inorg. Biochem.* in press. [2] Gailer (2009) *Biochimie* **91**, 1268-1272. [3] Jahromi *et al*. (2010) *Dalton Trans*. **39**, 329-336. [4] Gómez-Ariza, *et al.* (2011) *Metallomics*, **3**, 566-577.

The igneous contribution to atmosphere chemistry

FABRICE GAILLARD[1]*, BRUNO SCAILLET[1]

[1] CNRS-INSU, Université d'Orléans, ISTO, UMR 7327, 45071, Orléans, France, gaillard@cnrs-orleans.fr; bscaille@cnrs-orleans.fr (* presenting author).

We intend here to discuss the relationships between volcanic degassing and atmosphere chemistry in a (comparative) planetary perspective, with a particular emphasis on the atmospheric oxygenation that occurred on Earth, at the Archean-Proterozoic transition [1].

Igneous rocks and volcanic exhalations are moderately reduced [1]. For several reasons, secular variations in their redox state have been proposed [2] but so far no evidence of this has been found [3]. The only clear large scale modification of mantle redox state occurred at the end of the core formation at about 4.45 Ga. But it is only two billions years later that Earth's atmosphere became oxidized. This timelag between the mantle and the atmosphere great oxidation events [4] may possibly reflect changes in the conditions of volcanic degassing [5,6] that, in turn, may have been conditioned by large scale geodynamic modifications [7]. We will pursue here this analysis by evaluating alternative scenarii leading to changes in volcanic gas compositions. This includes changes in the intrusive/extrusive ratios and variations of the depth of melting. We will also discuss wether the great oxidation event (GOE) is unique to Earth or a common planetary process. The fact that Mars atmosphere is oxidized with an oxygen content comparable to that of the Earth's atmosphere after the GEO must be considered in the light of a possible GOE on Mars. The observation that Martian basalts show redox conditions much more reducing than that on Earth should also be incorporated in our contemplation on the role of igneous input to atmosphere chemistry. The fact that Venus atmosphere is reduced and may be comparable to that of Earth before the great oxidation event is also intriguing.

Because sulfur is an important component in volcanic processes and because of the diversity of its possible redox states, sulfur plays a dominant role in redox processes impacting oxygen abundance in planetary atmospheres [5,8]. We suggest that the efficiency of sulfur transfer from planetary interiors to their atmospheres is playing a major role in atmospheric oxygenation on Earth, and elsewhere.

[1] Holland (2002) *Cosmochimica Acta* **66,** 3811-3826. [2] Kasting, Eggler & Raeburn (1993) *Journal of Geology* **101**, 245–257. [3] Canil (2002) *Earth and Planetary Science Letters* **195**, 75-90. [4] Scaillet & Gaillard (2011), *Nature* **480**, 48-49. [5] Gaillard, Scaillet & Arndt (2011) *Nature* **478**, 229-232. [6] Kump, & Barley (2007) *Nature* **448**, 1033-1036. [7] Sleep & Windley (1982) *Journal of Geology* **90**, 363-379. [8] Lyons, Gill, (2010) *Elements* **6**, 93-99.