

Are noble gases subducted in the deep mantle?

M. MOREIRA AND A. RAQUIN

Institut de Physique du Globe de Paris, 4 place Jussieu, 75005 Paris, France (moreira@ipgp.jussieu.fr)

Staudacher and Allegre [1] proposed that noble gases are not subducted in the mantle. However, new Ar and Xe results challenge this concept of “noble gas subduction barrier”. The $^{38}\text{Ar}/^{36}\text{Ar}$ ratio is atmospheric in mantle-derived rocks (MORB & OIB), whereas a solar-like value is expected based on Ne. Furthermore, $^{124-128}\text{Xe}/^{130}\text{Xe}$ in CO_2 well gases appear to be different from air, showing a mixture air-solar [2]. These two observations may suggest a recycling of air-like noble gases in MORB and OIB sources. We developed a model of degassing-subduction for noble gases in order to constrain the subduction fluxes and to discuss the consequences of such a subduction. Our model assumes that mantle was initially solar, Atmosphere was different from mantle due to gas loss or late veneer and subduction started 4.4Ga ago. Both radiogenic and primordial isotopic ratios are used to constrain the subduction fluxes. In order to obtain atmospheric $^{38}\text{Ar}/^{36}\text{Ar}$ and $^{124-128}\text{Xe}/^{130}\text{Xe}$ and present-day MORB radiogenic isotopic ratios, 3 observations have to be made. A. The mantle was fully degassed at the end of accretion (>99.999%). B. The subduction of xenon is massive (>80%). C. The radiogenic isotopic ratios were much higher in the Archean mantle, which is not observed in the few available archean samples. Finally, this noble gas subduction has to occur in all mantle, including the OIB reservoir. Therefore, it appears difficult to consider that the mantle had initial solar isotopic compositions. Another explanation has to be found for the air-like compositions of heavy noble gases in the mantle, for example the SW irradiation of the parent bodies and solar nebula processes.

[1] Staudacher & Allègre (1988) *EPSL* **89**, 173-183.

[2] Holland & Ballentine (2006) *Nature* **441**, 186-191.

Ionization and speciation of water in silicate melts

R. MORETTI^{1*} AND J. ROUX²

¹INGV-Osservatorio Vesuviano, Napoli, Italy

(*correspondence: moretti@ov.ingv.it)

²IPG, 4 Place Jussieu 4, Paris, France (roux@ipgp.jussieu.fr)

Water in silicate melts is commonly assumed to take the form of molecular water (H_2O_m) and hydroxyl groups (OH), the latter bounded to network formers (T) as T-OH groups. Although free hydroxyls (OH⁻) were only recently ascertained in depolymerized melts [1], the amphoteric behavior of water, was already suggested long ago [2] and preliminarily modelled considering redox data [3]. However, autoprotolysis of water has not been assessed in silicate melts hitherto, because of the rather complex nature of such a solvent. Here, a simple theoretical frame is developed based on the extended two-sublattice hypothesis of Temkin. The theory accounts for acid-base properties of the melt phase, and reconciles differing notations. An independent proof of our appraisal is given by an algorithmic approach to chemical equilibria between O and H in polymeric silicate melts. The assessment of the ionization constant of water in melts can explain the conditions at which precipitation of hydrous minerals can occur. Because of the amphoteric behavior, melt polymerization can be affected less than that normally perceived and assumed, depending on bulk composition. This has implications for the redox behavior, which is strictly connected to melt acid-base properties, hence polymerization. These connections must be accounted for when modelling magmatic equilibria.

[1] Xue & Kanzaki (2004) *Geochim. Cosmochim. Acta* **68**, 5027-5057. [2] Fraser (1977) In *Thermodynamics in Geology* (D.G. Fraser, ed.) D. Reidel Pub. Co. [3] Moretti (2005) *Ann. Geophysics* **48**, 503-608.