

A study of degassing at mid-oceanic ridges by bubble-by-bubble analyses

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Using crushing to study relative He-Ar-CO₂ contents of MORB glass vesicles can give information on magma degassing processes and primary volatile composition as there are large variations in both solubility (He₂>>CO₂>>Ar) and diffusivity (CO₂<<Ar<He). But using bulk vesicle composition averages different stages of degassing. To improve knowledge of earliest stage of degassing, we ameliorate the method of [1], namely the analysis of individual vesicles by laser ablation. Previous results [1] show that there is a correlation between vesicle size (and so maybe bubble age) and vesicle composition, consistent with equilibrium-driven degassing processes, suggesting some early-nucleated bubbles are preserved in the glass and do not completely reequilibrate with the more evolved magma. But this study was limited to small vesicles due to difficulties imaging thick basaltic glass sections. In contrast, [2] investigated larger vesicles by randomly ablating large pieces of basalt but this method is tedious and doesn't provide knowledge on the size of the vesicle which has been analysed.

We present here analyses of individual vesicles in MORB glasses having a large size range (100µm to 800µm of diameter). The samples were imaged tomographically at the Mateis laboratory, Lyon and at the SLS synchrotron facility with 5 and 3.7µm resolution respectively. For opening bubbles, we used a 193nm laser to avoid noble gases diffusion by local heating. CO₂ contents were estimated by pressure measurement in the laser cell using a sensitive manometer. We analysed ⁴He, and Ar isotopes (36, 38, 40) in order to calculate ⁴⁰Ar* (⁴⁰Ar corrected from atmospheric contamination) on a VG 5400™ mass-spectrometer.

Some MORB glass samples from different ridges have been investigated in order to link degassing process to geodynamic context. We observe systematic variations in composition between bubbles consistent with equilibrium degassing, but surprisingly, it is not automatically the largest bubbles that preserve the least fractionated gases. Models of magma degassing including tomographic observations (vesicle volume and pressure inside the bubbles recalculated from CO₂ content) and volatile composition evolution (He-Ar-CO₂) will be presented.

[1] Burnard (1999) *EPSL* **174**, 199-211. [2] A. Raquin, PhD thesis, 2008.

Mineral studies on Earth and Mars: Chemical evolution approach

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Introduction

Life on Earth could have been originated by abiotic synthesis and accumulation of organic compounds, through physical and chemical processes known as chemical evolution [1]. Chemical evolution processes should not be privative of Earth, the process could have accomplished in other terrestrial planets, like Mars. On Earth and Mars, minerals should have participated actively in chemical evolution, acting as catalyst of reactions and as protective agents against degradation of molecules. In chemical evolution studies, the production of key molecules is as important as the decomposition of them. On these planets, UV and ionizing radiation were a very abundant source of energy. The purpose of this study is to test the role of minerals, like olivine, have on the decomposition induced by radiation (radiolysis) of hydrogen cyanide (HCN), a key compound on chemical evolution.

Results and Discussion

Samples with HCN (0.1 M) in aqueous solution and HCN-olivine were prepared according to [2], and then were irradiated at different doses in a gamma-ray source. The decomposition of the molecule was followed by gas-chromatography. Results show that the decomposition of HCN is modified in presence of olivine: this mineral enhance the decomposition. So, olivine is acting as a catalyst. HCN is not just a very reactive species, but also a parent molecule whose transformation can yield biological important molecules such as: amino acids, carboxylic acids and amines besides others [3]. So, the fact that olivine augments the breaking up of HCN leads to the possibility of the formation of new compounds. This is the first of a series of experiments, in which we are planning to evaluate the role of other minerals such as: silicates, ferrous oxides, etc.

[1] Negrón-Mendoza & Albarrán (1993) in *Chemical Evolution: Origin of Life*. Ponnampereuma & Chela-Flores. (eds), 235-237 [2] Draganić & Draganić (1988) *J. de Chim. Phys.* **85**. [3] Colín-García *et al.* (2009) *Astrobiology*, in press.