Vers un modèle de dégazage du magma océan définissant la composition de l'atmosphère à l'Hadéen

Fabrice Gaillard*[1], Fabien Bernadou[1], Mathieu Roskosz[2], Mohamed Ali Bouhifd[3], Yves Marrocchi[4], Giada Iacono-Marziano[1], Manuel Moreira[1], Bruno Scaillet[1], Gregory Rogerie[1].

[1] : Institut des Sciences de la Terre d'Orléans, CNRS/Université d'Orléans/BRGM, France

[2] : IMPMC, CNRS, UMR 7590, Sorbonne Universités, Université Pierre et Marie Curie, Muséum National d'Histoire Naturelle, France.

[3] : Laboratoire Magmas et Volcans, Université Clermont Auvergne, CNRS, IRD, OPGC, France.

[4] : CRPG, CNRS, Université de Lorraine, UMR 7358, France

Texte :

Nitrogen, carbon, hydrogen and sulfur are essential elements for life constituting less than ca. 1 % of terrestrial planet masses. While they are abundant in the atmosphere due to their volatile nature, the Earth's interior represents the major C-H-N-S reservoirs. Capturing the origin of such distribution between surficial and deep reservoirs require deciphering 4.5 Giga-years of planetary activities, with many unknowns.
Here, we show that the mass of carbon, nitrogen and presumably hydrogen outgassed by the last magma ocean episode, 4.5 Giga-years ago, is similar to the mass of these elements in Earth's present-day exosphere (atmosphere+ocean+crust). By modelling the equilibrium partitioning of C-H-O-N-S elements between the magma ocean and its atmosphere, we show that the oxidation state is critical, yielding H_2-CO dominated atmospheres under strongly reduced conditions and CO_2-N_2-SO_2-rich ones under oxidizing conditions. On Earth, magma ocean degassing at reducing conditions must have produced a C-N-H rich atmosphere. Venus's dry, SO_2-poor, CO_2-N_2 atmosphere perfectly corresponds to an equilibration under slightly more oxidized conditions, possibly linked to enhanced hydrogen loss to space due to a long-lasting magma ocean stage[9]. The C-H-N contents of the mantle and the atmosphere must have marginally changed since these reservoirs were born, pushing back the setting of habitability to the very first 100 millions of years of planetary systems.

Votre résumé doit tenir sur une page.

Mots-Clés : Georgia Taille 9

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Nicolas Simeaon *[1], Philippe Radinz [2], Thierry Becarro [3], Olivier Sideno [4], Benoît Isodire [5], Eric Limon [6], Sophie Laleu [7], Isabelle Tiron [8]

[1] ENSEGID – Institut polytechnique de Bordeaux - France
[2] Bureau de Recherches Géologiques et Minières (BRGM) - France
[3] ExxonMobil Upstream Research Company, PO Box 2189, Houston, TX 77252, USA – É
[4] Laboratoire d'Océanologie et de Géosciences (LOG) – CNRS : UMR8187, Université des Sciences et Technologies de Lille – France
[5] TOTAL SA - Centre Scientifique et Technique Jean Féger (CSTJF) – TOTAL – France
[6] School of Earth Sciences, University College Dublin – Irlande
[7] GEOMAR Helmholtz Centre for Ocean Research Kiel – Allemagne
[8] Department of Geosciences and Petroleum, Norwegian University of science and Technology (NTNU), Trondheim, Norway. (NTNU) – Norvège

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