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On the magmatic processes building habitable worlds

Fabrice Gaillard
(gaillard@cnrs-orleans.fr)

In addition to the stability of liquid water, the availability of the volatile elements (C-O-H-S-N-Cl), which dominate surficial biochemical, climatic, and geochemical processes, is crucial for habitable worlds. These elements were mostly incorporated in Earth during accretion, and their abundances at the planetary surface are controlled by degassing of the deep Earth. Planetary degassing is however manifold and involves core-mantle differentiation, decompression melting in plumes and rift and recycling via subduction processes.
Planet Earth, with its dense atmosphere and a C-O-H-rich surface, is unique in the solar system: the Martian atmosphere is thin, its surface is C-depleted and a dense, dry CO_2-rich atmosphere covers Venus. Can we relate this variability to the conditions and the geological history of the interiors of each planet that controlled the types and amounts of volatile degassing? To address this challenge, models quantifying the "magmatic pipeline", the processes that control volatile transfer from the planetary interior and link mantle melting, melt extraction and degassing into the atmosphere, are needed.
Using such types of model so far developed at a very preliminary stage, I will discuss the large scale transfers of C-O-H-S-N species from the interior to the surface of planet Earth. Relating the geophysical and astrophysical characteristics of each planet to its surface chemistry can have the capacity of predicting water-world, CO_2- or CH4-rich, or C- or S-depleted surfaces. These magmatic events, being common and enduring planetary process, can be used for the investigation of exoplanets.