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Changes in compositional convection account for the strength variations in the early Martian magnetic field

A. Aitta

Institute of Theoretical Geophysics, Department of Applied Mathematics and Theoretical Physics, University of Cambridge (A.Aitta@damtp.cam.ac.uk)

The very young Mars has been at least partially molten. Here it is considered how its molten part solidified from the surface inwards. At the solidification front, some of the molten elements are bound into the solid as the rest are enriching the existing melt. If the density of the released fluid is higher than that of the existing melt, compositional convection is generated. The strength of this convection influences the strength of the planet's magnetic field. The changes in compositional convection has been analysed using a ternary phase diagram Fe-Si-Ni. Fe and Si are the main elements of any rocky planet and they have rather similar solidification temperatures so that they are likely companions in the early melt. A small amount of Ni is included since it is the only abundant element heavier than iron generally expected in planetary core melts. By employing a simple time-calibration to the front propagation it is possible to compare favourably the changes in the density ratio of the released fluid and the existing melt to all the observed [Lillis & al., Lunar and Planetary Science 36 (2005) 1578.pdf] ups and downs in the Martian magnetic field strength during its first 1.5 billion years.