

Favourable conditions for magnetic field generation in Earth-like planets

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The magnetic field of Earth-like planets, which can protect the atmosphere against strong solar erosion and life against cosmic rays, is generated in their iron-rich cores. To generate a magnetic field, the fluid (or partly fluid) core must be convecting. The convection is either caused by purely thermal instabilities in a totally fluid core or by thermal and compositional instabilities in a core with a growing inner core. In both cases the core needs to cool although the strength of cooling can differ. For a purely thermally driven dynamo the core heat flow needs to be higher than a critical heat flow that corresponds to the heat flow along the core adiabat. Whereas for a core with a growing inner core, the cooling can be less efficient but the core temperatures have to be between the solidus and liquidus of the core material. Thus, whether convection takes place depends on various parameters such as the core composition, the efficiency of heat transfer (plate tectonics versus one-plate dynamics, mantle rheology), and the initial temperature distribution after the core has formed.

In the present paper I will discuss different scenarios and conditions of Earth-like planets which are favourable for core convection and thus dynamo generation.