

Plate tectonics or not: a parameter study for rocky exoplanets

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Short description:

Plate tectonics is essential for the habitability of the Earth: it influenced the chemical evolution of the atmosphere and regulates the carbonate-silicate cycle which stabilizes climate. In the solar system, only the Earth clearly displays a regime of plate tectonics, however, it is not clear which conditions are required to establish the current plate tectonic regime, how its onset depends on the size and internal structure of the planet. With now several rocky exoplanets for which we have good estimates of mass and radius, we will study for which of these planets plate tectonics could be active and for which internal structure/properties.

Using a 2D interior code (Aspect: <https://aspect.geodynamics.org/>) which models planetary interior dynamics, the student will investigate the heat transfer regime inside planets (conduction vs convection). Considering planets of a fixed composition and viscosity, for a given set of mass and radius, the student will begin by investigating how the internal properties influence the heat transport regime, varying the Rayleigh number. Second, the student will investigate the influence of several parameters, such as the masses and radii of the planets, the size of their core, the composition of their mantle. The student will then attempt to establish the relationships between planetary parameters (e.g. radius and mass distribution) and determine for which kinds of planets plate tectonic is more likely to occur.

This project will be happening in the context of the newly created Center for Life in the Universe (CVU: <https://www.unige.ch/sciences/cvu/>) and is shared between the department of Astronomy and the Department of Earth Sciences located at Uni Maraîchers in downtown Geneva. The student will share time between the two departments.

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