

# 'Super Earths' Will Have Plate Tectonics, Scientists Predict

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The discoveries of large Earth-like planets outside our Solar System, so-called “super-Earths,” has prompted much speculation about just how Earth-like they may be. Recently, scientists from Harvard University suggested that these planets will, like Earth, have plate tectonics.

Plate tectonics, the movement of the giant plates that make up Earth's solid outer shell, are responsible for earthquakes, volcanoes, and other major geological events. In essence, they have dominated Earth's geological history. Earth is the only known planet that has plate tectonics, and this activity has been proposed as one necessary condition for the evolution of life.

However, in a paper published in *The Astrophysical Journal*, Harvard planetary scientist Diana Valencia and her colleagues predict that super-Earths – which are between one and ten times as massive as Earth – will fulfill one of the requirements for sustaining life by having plate tectonics.

“Some of these super-Earths may be in the 'habitable zone' of their solar systems, meaning they are at the right distance from their mother star to have liquid water, and thus life,” Valencia, the paper's corresponding author, told *PhysOrg.com*. “Ultimately, though, only these planets' thermal and chemical evolution will determine whether they are habitable. But these thermal and chemical properties are closely tied to plate tectonics.”

Using detailed models they developed of the interior of massive terrestrial planets, Valencia and her group determined how the mass of a super-Earth is related to the thickness of its plates and the magnitude of the stresses the plates experience. These stresses, part of the slow, slow convection of Earth's mantle, are the driving force behind the deformation and subduction (when one plate sinks below another) of the plates. For planets more massive than Earth, this driving force is larger than Earth's.

The group found that as planetary mass increases, there is an increase in the shear stress and a decrease in the plate thickness. Both of these factors weaken the plates and contribute to plate subduction, which is a key component of plate tectonics. Therefore, the scientists say, the conditions required for plate deformation and subduction are easily met by super-Earths. Their results show that this is particularly true for the larger super-Earths.

“Our work strongly suggests that super-Earths, even if they have no water, will exhibit plate tectonic behavior,” Valencia said.

In the future, it may be possible to verify these results using NASA's Terrestrial Planet Finder devices or the European Space Agency's Darwin project, which will consist of three telescopes to search out Earth-like planets.

Citation: Diana Valencia, Richard J. O'Connell, and Dimitar D. Sasselov “Inevitability of Plate Tectonics on Super-Earths” *The Astrophysical Journal*, volume 670, part 2 (2007)

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