Researcher simluate characteristics of planetary cores

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University of Minnesota researchers Renata Wentzcovitch and Koichiro Umemoto and Philip B. Allen of Stony Brook University have modeled the properties of rocks at the temperatures and pressures likely to exist at the cores of Jupiter, Saturn and two exoplanets far from the solar system.

They show that rocks in these environments are different from those on Earth and have metallic-like electric and thermal conductivity. These properties can produce different terrestrial-type planets, with longer-lasting magnetic fields, enhanced heat flow to the planetary surfaces and, consequently, more intense "planetquake" and volcanic activity.

This work builds on the authors' recent work on Earth's inner layers and represents a step toward understanding how all planets, including Earth, come to acquire their individual characteristics. The research is published in the Feb. 17 issue of *Science*. In the previous work, Wentzcovitch and her colleagues studied the D'' ("Dee double prime") layer deep in the Earth. D'' runs from zero to 186 miles thick and surrounds the iron core of our planet. It lies just below Earth's mantle, which is largely composed of a mineral called perovskite, consisting of magnesium, silicon and oxygen. Wentzcovitch and her team calculated that in D'' the great temperatures and pressures changed the structure of perovskite crystals, transforming the mineral into one called "post-perovskite."

In the new work, the researchers turned their attention to the cores of the giant planets of our solar system--Jupiter, Saturn, Uranus and Neptune--and two recently discovered extrasolar planets, or exoplanets, found elsewhere in the Milky Way. One, referred to as Super-Earth, is about seven times the mass of Earth and orbits a star 15 light-years away in the constellation Aquarius. The other, Dense-Saturn, has about the same mass as Saturn and orbits a star 257 light-years away in the constellation Hercules.

The researchers calculated what would happen at temperatures and pressures likely near the cores of the two exoplanets, Jupiter and Saturn, where temperatures run close to 18,000 F and pressures 10 million bars (a bar is essentially atmospheric pressure at sea level). They found that even post-perovskite could not withstand such conditions, and its crystals would dissociate into two new forms. Focusing on one of those crystals, the researchers discovered that they would behave almost like metals. That is, electrons in the crystals would be very mobile and carry electric current. This would have the effect of supporting the planet's magnetic field (if it has one) and inhibiting reversals of the field. The increased electrical activity would also help transport energy out of the core and toward the planet surface. This could result in more severe activities such as quakes and volcanoes on the surface. The effect would be much stronger in Dense-Saturn than in Super-Earth.

The interiors of the icy giants Uranus and Neptune don't exhibit such extremes of temperature and pressure, and so post-perovskite would survive in their cores, she said. "We want to understand how planets formed and evolved and how they are today. We need to understand how their interiors behave under these extreme pressure and temperatures conditions. Only then it will be possible to model them. This will advance the field of comparative planetology," said Wentzcovitch. "We will understand Earth better if we can see it in the context of a variety of different kinds of planets."

Source: University of Minnesota