Study of meteorites suggests Earth's composition was changed by collisional erosion

September 30 2022, by Bob Yirka

Credit: CC0 Public Domain

A team of researchers from Université Clermont Auvergne, working with a colleague from Universität Bayreuth, has found evidence that suggests the Earth's composition changed over time during its early years via collisional erosion. In their paper published in the journal *Science*, the

group describes their study of the amounts of samarium and neodymium in meteorites and what it showed them about the processes that led to the current makeup of the Earth. Zoë Malka Leinhardt, with the University of Bristol, has published a Perspective piece in the same journal issue outlining theories regarding the formation of the Earth and the work done by the team on this new effort.

Prior research has suggested that planets form from collisions of material in accretion disks that build up around stars during their early years. The characteristics of such collisions are believed to play a role in the resulting makeup of the resulting planets, such as their tilt angle. Prior research has also shown that Earth has a core of iron and nickel—surrounding that is a layer of iron silicate mixed in with magnesium. The top layer is described as a layer of silicate. The density of the material decreases from the core to the crust, which, Leinhardt notes, makes the crust more vulnerable during collisions.

Prior research has also uncovered a mystery—why does the crust contain heavier minerals? A theory has suggested that they may have been pushed upward due to incompatibilities with other materials. Unfortunately, these theories do not explain why there are higher quantities of some minerals in the crust, such as neodymium, than there should be based on how much can be measured in the core.

Three main theories have been developed to explain this anomaly. One suggests it is an illusion; there is actually more of it in the core than can be measured. Another suggests that it is because material from the accretion disk had differences in makeup. The third suggests that as heavier materials were pushed up and accumulated in the crust, some were knocked into space during new collisions.

In this new effort, the researchers have found evidence supporting the third theory. They measured the amounts of neodymium in meteorites,

assuming they were similar in makeup to Earth's building blocks, and found that up to 20% of the Earth's outer layers could have been removed by collisions, which would explain the ratio of heavy minerals such as neodymium in the crust compared to other, lighter minerals such as samarium.

More information: Paul Frossard et al, Earth's composition was modified by collisional erosion, *Science* (2022). DOI: 10.1126/science.abq7351

Zoë Malka Leinhardt, Earth was seasoned by countless blows, *Science* (2022). DOI: 10.1126/science.add3199

Citation: Study of meteorites suggests Earth's composition was changed by collisional erosion (2022, September 30) retrieved 21 September 2024 from https://phys.org/news/2022-09-meteorites-earth-composition-collisional-erosion.html