The elevated $\Delta^{17}O$ composition of the Moon relative to the Earth

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We present the first isotopic evidence for giant impactor material in lunar rocks. The Moon presumably formed from the debris of a giant collision between two proto-planets ('*giant impact hypothesis*'). Most numerical models of the collision predict that the Moon dominantly formed from impactor material. Thus, the Moon should inherit the isotopic composition of the impactor. So far, however, no isotopic difference between the Earth and the Moon has been resolved.

We have measured the triple oxygen isotopic composition of APOLLO basalts using an improved protocol [1]. We show that the $\Delta^{17}O$ isotopic compositions of lunar APOLLO basalts is elevated by 12 ± 3 ppm relative to the Earth. We also show that enstatite chondrites (EC) comprise an even higher $\Delta^{17}O$ of 51 ± 6 ppm relative to the Earth. Thus, EC cannot be the sole building blocks of the Earth. Instead EC may resemble the composition of the giant impactor. If so, the Moon may be composed of ~40% impactor material, consistent with recent numerical models of the collision [2,3].

In an alternative scenario the lower $\Delta^{17}O$ composition of the Earth could reflect a late veneer with low $\Delta^{17}O$. Addition of 0.5% carbonaceous chondrites would be sufficient to lower the $\Delta^{17}O$ of silicate Earth by 12 ppm.

[1] Pack and Herwartz (2014) *EPSL* **390**, 138-145 [2] Ćuk and Stewart (2012) *Science* **338**, 1047-1052. [3] Canup (2012), *Science* **338**, 1052-1055.