

What did the solar system look like before all the planets migrated?

January 28 2021, by Andy Tomaswick



Credit: NASA

Early planetary migration in the solar system has been long established, and there are myriad theories that have been put forward to explain where the planets were coming from. Theories such as the Grand Tack Hypothesis and the Nice Model show how important that migration is to the current state of our solar system. Now, a team from Lawrence

Livermore National Laboratory (LLNL) has come up with a novel way of trying to understand planetary migration patterns: by looking at meteorite compositions.

The researchers, led by postdoc Jan Render, had three key realizations. First, that almost all the meteorites that have fallen to Earth originated from the [asteroid belt](#). Second, that the asteroid belt is known to have formed by sweeping material up from all over the [solar system](#). And third, and perhaps most importantly, that they could analyze the isotopic signatures in meteorites to help determine where a given asteroid had formed in the solar system.

With that knowledge, they could then extrapolate out to other asteroids of the same type. There are approximately 100 different types of asteroids, with different isotopic signatures, in the asteroid belt. The team used a technique to measure the nucleosynthetic isotope signatures of several samples of basaltic achondrites, a type of stony [meteorite](#).

They were looking for concentrates of neodymium (Nd) and zirconium (Zr), which were lacking in some types of presolar material. This meant that understanding the amount of Nd and Zr in a specific type of asteroid will allow them to understand where in the pre-sun solar system that type of asteroid was formed.

Tying their terrestrial results back to the asteroids in the asteroid belt, and then to other models of how the different parts of the asteroid belt ended up where they were, and which planet they were closest to, allowed to researchers to create a completed map of the early solar system with models of how each of the [planets](#) moved into their current positions.



Examples of basaltic meteorites that came from the moon. Credit: NASA / JSC and R. Korotev

There is yet more data to collect regarding these planetary migrations. Using meteorites that have actually landed on Earth is a novel, and hopefully inspirational, way to make the best use of all of the data available. Maybe there are even more insights into the original of the solar system hidden away close by.

More information: Paul Voosen. Cataclysmic bashing from giant planets occurred early in our Solar System's history, *Science* (2020). DOI: [10.1126/science.aba9938](https://doi.org/10.1126/science.aba9938)

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