Soggy invaders from space

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Credit: George Hodan/public domain

Is there a water shortage out there? It's an important question if you're looking for biology beyond Earth. Experts will tell you that, while other fluids may be able to incubate life (ammonia and liquefied natural gas come to mind), water is always first choice. On Earth, we think that life first arose in the oceans, and was so content with its pelagic birthplace, it stayed there for more than 3 billion years.

We can now estimate that there are a trillion other planets dotting the Milky Way, and the obvious assumption is that many of them are similarly awash in the wet stuff - and some have also produced life. But recent research on asteroids - the wild boys of the solar system - could call this seemingly sensible scenario into question. It also opens the door to the possibility that most temperate, Earth-size worlds are as dry as British humor.

It all depends on how Earth acquired its agua. Our planet is (famously) described as a blue marble, unlike the yellow and red marbles that are our planetary neighbors. Two-thirds of Earth's surface is lapped by water, and the average depth of the oceans is a little over two miles. That works out to 350 billion billion gallons, which is certainly an impressive amount of damp. Mind you, it's only about 0.02 percent of Earth's mass, which is roughly the same fraction as your hair is to the rest of your body. But water is the essential and remarkable topping to our planet.

However, this liquid veneer wasn't always part of terra firma. My childhood books on geology had dramatic drawings of volcanoes belching steam into the atmosphere of a prehistoric and still-sterile Earth, suggesting that our planet was born with a subcutaneous reserve of the wet stuff, waiting to be lanced to the surface by accommodating eruptions. As a kid, that sure seemed reasonable.

But it's not true.

Earth was formed of small grains of dust in the imploding cloud that was begetting our Sun. Although there was certainly water in this mix, the Sun's heat ensured that it was in the form of vapor. So yes, Earth's conception was steamy, but there was no way that our planet's anemic gravity could snag those soppy clouds.

The water that now limns the continents came from somewhere else. For a long time, many astronomers figured that "somewhere else" was comets - frequently portrayed as dirty ice balls. According to this conventional wisdom, your local ocean was just comet juice.

But that idea isn't popular anymore. It's hard to imagine how enough comets - which normally just hang out in the solar system's distant nether regions - could have taken a detour to our planet and delivered their watery goods.

What's trending now is the suggestion that asteroids - those dark, hard-to-see rocks that routinely threaten starships on TV - were the suppliers of Earth's wet blanket. They did so by colliding into our planet. Although you probably think of asteroids as dry, peanut-shaped boulders, they also contain considerable amounts of water ice.

Of course, you need a lot of asteroids to make a blue marble. If an average asteroid is a mile in size and is one-fifth water, then it'll take about five billion of them to fill up the Atlantic, Pacific, and all the other areas of blue ink on the globe.

So what induced these soggy rocks to become kamikazes and crash to Earth? Here's the suggestion: the asteroids were goaded into our neighborhood by a weird dance of Jupiter and Saturn. It seems possible that, 4 or 5 million years after the solar system began to form, primordial dust grains caused nascent Jupiter and Saturn to spiral inward. The larger planet eventually got as close to the Sun as the present orbit of Mars. (If you'd been around 4.5 billion years ago to experience this planetary do-si-do, you'd have seen Jupiter as a disk in the sky, rather than as merely a bright star.)

This dance of the giants shook up the asteroids, and brought many of them close enough to the Sun that they could collide with Earth. The "bug spots" they left behind merged to form the oceans that dapple our planet. This unusual situation didn't last long: after a half-million years or so, Jupiter and Saturn had retreated to their present locales - to what we now label the "outer solar system." But their handiwork on behalf of Earth's liquid laminate was done.

Now all this is a modestly interesting tale, but the real question is, is it a "just so" story? Would planets around other stars also experience a comparable chain of events? Or was there something special about our solar system, implying that most other planets are dried up and dead?

We don't know. Earth could be special - it could be truly rare. But many astronomers are optimistic that there are other mechanisms besides an intricate dance of giant planets that could provoke water deliveries to rocky worlds.

Kevin Walsh, a planetary scientist at Boulder's Southwest Research Institute who has helped unravel the source of Earth's water, notes that "while our own history may seem special, we don't really know if it's all that unusual. Besides, it's not difficult to imagine other scenarios for depositing water on planets, some of which involve asteroids and some of which involve comets."

Walsh says that determining whether such scenarios are rare or generic will require time. Only when we've built the large telescopes that can actually detect water on Earth-size worlds will we know the bottom line. Meanwhile, for those who would like to share the universe with other biology, you'll just have to hope that our galaxy has many more than seven seas.

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