Solar system

Distant object is being hugged by a large moon

Jonathan O'Callaghan

AN OBJECT on the outer edges of the solar system may have a large moon orbiting it at an unusually close distance. The find could help explain how such binary objects evolved.

José-Luis Ortiz at the Institute of Astrophysics of Andalusia in Spain and his team observed the object, known as 2002 TC302, in January 2018, when it eclipsed a distant star, casting a shadow on Earth and allowing its properties to be studied.

The researchers deduced that the object was likely to be about 500 kilometres across. But they also found something unusual: what appears to be a large moon about 200 kilometres across orbiting less than 2000 kilometres from it (arxiv.org/abs/2005.08881).

This distance is around five times the height of the International Space Station above Earth, meaning the moon would loom large in 2002 TC302's sky.

The object is one of many trans-Neptunian objects (TNOs), and orbits the sun at an average distance of 55 times the distance between Earth and the sun. Other TNO satellites are normally much further from their parent body, says Ortiz.

Objects made of two bodies that touch each another, known as contact binaries, may be abundant in the solar system – one example is the two-lobed object Arrokoth, which was visited by NASA's New Horizons spacecraft in early 2019.

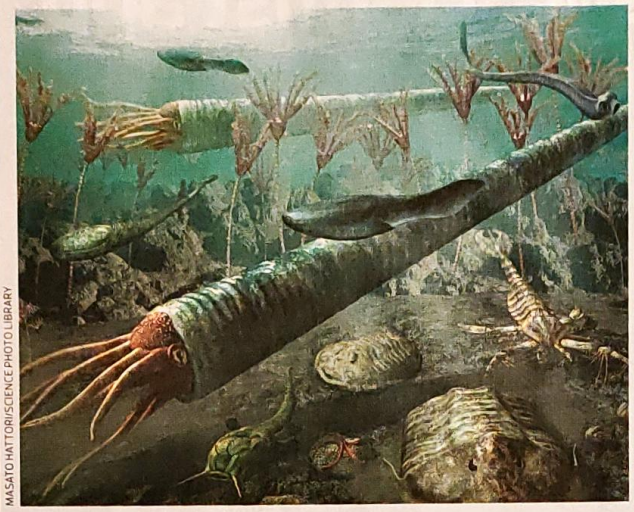
But finding a non-touching binary like 2002 TC302 and its moon orbiting so closely would be a first, providing some useful information about these dual systems.

It may suggest a lot of TNOs were born with a large amount of angular momentum, spinning themselves into pieces to create satellites. Close satellites could also cause large tidal interactions with the parent body, producing wobbles in the orbit that could reveal details about both bodies' interiors, says Ortiz.

Geology

All five mass extinctions are now linked to global warming

Colin Barras



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Ancient marine life may have been wiped out by volcanic activity

THE second-most severe mass extinction in Earth's history may have been triggered by global warming. The discovery means that, for the first time, all of the largest known extinctions can be linked to a rapid rise in the planet's temperature.

"It completes the jigsaw puzzle in many ways," says Andrew Kerr at Cardiff University, UK. Geologists recognise five points in time when huge numbers of species were wiped out, although recent research suggests at least one of these might have been too slow to be a mass extinction.

But the second-most severe of these five extinctions, the late Ordovician event about 445 million years ago, has always seemed different. The others coincided with epic volcanic activity that smothered millions of square kilometres with lava to create what is called a large igneous province.

In each case, the volcanic activity triggered global warming that is likely to have contributed to extinction. In contrast, the consensus had been that the late Ordovician extinction was prompted in part by global cooling.

David Bond at the University of Hull, UK, thinks it wasn't so different after all. With his colleague Stephen Grasby at the Geological Survey of Canada, Bond took samples from a site in Scotland where rocks that formed on the late Ordovician sea floor are well-preserved. They found a spike in the level of mercury

445

million years ago, the late Ordovician extinction occurred

in rocks that formed just before and during the extinction (*Geology*, doi.org/dwd3).

"Large volcanic eruptions put anomalously high levels of mercury into the atmosphere," says Bond. There seems to have been large-scale volcanic activity during this period after all.

"It's a great boon to the mass extinction story, which now links all past mass extinctions to large igneous province volcanism," says Gerta Keller at Princeton University.

Bond thinks this might have led to global warming that heated the oceans, reducing their ability to hold dissolved oxygen and suffocating marine life. This would explain why the Scottish rocks also contained high levels of uranium, as this element precipitates out of seawater and accumulates on the sea floor when oceans lose their oxygen.

Confusingly, there was global cooling at the time too. Bond says it looks as if this only began after the volcanism and global warming had triggered the mass extinction. "Everything lines up nicely," he says, although he accepts that the new extinction scenario will be controversial.

Charles Mitchell of the University at Buffalo, New York, remains to be convinced. He says the global cooling and a severe glaciation may well have begun before, and contributed to, the extinction. But he says volcanic activity and global warming could have played a part in the latter stages of the extinction. "You need a way to end the glaciation, and global warming from a large igneous province could do that," he says.

Kerr is more enthusiastic. He has long argued that volcanic activity and associated effects such as global warming are the key drivers of mass extinctions.

Keller says the finding means there might be a new odd one out among mass extinctions: the one we may currently be in is also due to warming, but the carbon dioxide responsible was produced by us, not volcanoes.