Space hunt for secrets of metal giant

Jonathan Leake, Science Editor

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Psyche, one of the largest known asteroids, is located between Mars and Jupiter

ALAMY
smashed apart early in the life of the solar system.

The massive asteroid, known as 16 Psyche, is thought to be the planet’s molten core, stripped of its rocky mantle by a series of titanic collisions and since slowly cooled into a solid mass of iron and nickel. The asteroid is so unusual that Nasa is considering sending a spaceship to study it.

“Psyche is by far the largest metal object in the solar system,” said Benjamin Weiss, professor of planetary sciences at the Massachusetts Institute of Technology, who is planning the mission. “Psyche would be the first and only metal world to be visited by humanity. This is true exploration.”

Psyche is located between Mars and Jupiter, with its distance from the sun averaging about 280 million miles, and is regarded as one of the largest known asteroids, about 125 miles in diameter. What intrigues scientists most, however, is that it is among the densest bodies ever found in the solar system, meaning that it is solid metal.

“All the physical measurements — from radio telescopes bouncing waves off the body — indicate that it consists largely of iron and nickel,” said Linda Elkins-Tanton, a geologist and the director of the School of Earth and Space Exploration at Arizona State University, who works with Weiss. “Psyche looks like it is a stripped-naked planetary core, a remnant of the hit-and-run collisions that disrupted the early solar system.”
4.6bn years ago as a cloud of dust and gas coalesced from debris left behind when earlier stars reached the end of their lives and exploded. Eventually the cloud collapsed in on itself, forming the sun at its centre surrounded by a vast disc of debris which also began coalescing, into asteroids, comets — and planetesimals, the smaller forerunners of planets such as Earth and Mars.

It was thought that this was a smooth process taking hundreds of millions of years. The destruction wreaked on Psyche, however, is part of growing evidence that it was more violent and far faster, with planets forming just 3m years after the solar system's birth — and some being destroyed again.

“Often large things blew apart into small again,” said Elkins-Tanton. “Planets could be built, torn asunder and rebuilt in 10m years or less.”

Another clue to Psyche's origin as a baby planet comes from Weiss's 2009 discovery that some metallic meteorites that have hit Earth bear signs of a magnetic field like Earth's. Such fields can, however, be created only by intensely hot, liquid metal flowing in a planet's core — as happens inside the Earth. It suggests such meteorites were once part of a planetary core — of which Psyche is an intact example.
The solar system formed from a cloud of gas and dust 4.6 billion years ago. Small planets formed but the heat from radioactive elements rapidly melted their centres. Heavy elements sink downwards, forming a spherical core of iron and nickel overlaid by rock.

Some young planets were then smashed apart in collisions, leaving just the iron core.

Nasa could send a probe to visit the asteroid Psyche in the next few years.
has a magnetic field then it was [once] the molten core of a little planet that was stripped of its rocky exterior,” said Elkins-Tanton. “It’s original body might have been as small as Vesta [an asteroid with a diameter of 326 miles], or as large as Mars.”

Another key question is just how early planets, including Earth, grew hot enough for their insides to melt at all, especially if they formed so fast. The most likely source of that heat, say scientists, was radioactive aluminium, which was so abundant in the early solar system that the core of any sizeable body would have rapidly heated to melting point. This process would have lasted only a few million years, however, as this form of aluminium is relatively short-lived and would have largely transformed into other elements within a few million years of the solar system’s formation.

For scientists the lure of Psyche lies partly in what it could tell us about the centre of our own planet. Nasa’s final decision on sending a probe to the asteroid will be made in the next few weeks — it could be launched within two to three years, arriving in 2021.

“What is the exterior of a planetary core like?” said Elkins-Tanton. “Earth’s core is at 3m times the pressure on the surface and 5,000C. Psyche is the only large metal world in the solar system, and therefore the only planetary core that humankind will ever see.”

@jonathan_leake
Delicious gluten-free cobbles laced with stilton are the perfect match for a hearty beef stew.

9 comments

Richard Pursehouse  Nov 20, 2016
Rainbow in a song "Can't Happen Here" sang "People out of work/ yet there's people on the moon". If there is funding for this sort of thing how about the funds being spent on something worthwhile - medicine or clean water spring to mind.....

Tim Locke  Nov 20, 2016
@Richard Pursehouse Long term science is pretty cheap. If you want governments to find the money for expensive short term projects maybe they should be persuaded to take it out of useless things...like military spending and benefits , both of which are incredibly expensive and do little good.

Chris Huckle  Nov 21, 2016
Yes that's what we need, resources spent on increasing the global population,where we have a shortage and not on
"Such fields can, however, be created only by intensely hot, liquid metal flowing in a planet's core — as happens inside the Earth."

And as happens inside stars such as the sun. Since all metals are produced inside stars or as a result of the vast temperatures and pressures created when they explode there is no reason to exclude the possibility that this body is a stray piece of 'star-dust' from another part of the galaxy that has been captured by the gravitational field of the sun.

@Freebooter I think that except for hydrogen all naturally occurring elements are made in stars. Virtually all planetary material was therefore stardust before it was formed into planets or re-formed into asteroids by the mechanisms postulated in this article.

When stars start fusing into iron in their cores they blow up.

@Tim Locke @Freebooter Only if they are above a critical size - I think about 7 or 8 solar masses. Stars that are just below that size are able to fuse iron and wind up as white dwarves. Stars that are above 7 or 8 solar masses die as a supernova. Naturally-occurring elements with an atomic number greater than 26 (iron) are only made in a supernova which is why they are less common.
If it was just stardust, it would have a fairly uniform mix of all the other 92* elements that occur naturally. Not just a concentrated mass of those particular elements which would tend to form a planet core and displaying signs of magnetic polarisation.

* I checked and found that my chemistry learned many years ago had moved on. As I hoped that original number is apparently wrong:  

@Freebooter

The metal giant's orbit essentially being that of the asteroid belt as a whole--between the orbits of Mars and Jupiter--is strong evidence the giant's origin lies in the solar system. Odds of the contrary are negligible.
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