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Chemical signature could help locate Earth-like planets

Oct 16, 2009 2 comments

A distinct lack of refractories

New insights into the Sun's chemical composition may provide a new way to search for Earth-like planets orbiting distant stars – claims an international team of astrophysicists.

Astronomers have already discovered hundreds of planets (called exoplanets) orbiting stars other than the Sun. However, most of the known exoplanets are gas giants like Jupiter – rather than rocky Earth-like worlds. This is probably because the two techniques currently used to find exoplanets work best on large planets.

Now a team led by Jorge Meléndez of the University of Porto believes that the Sun's unusual chemical composition could be related to the formation of Earth and the other rocky planets – and this chemical fingerprint could be used to identify other stars with rocky satellites.

'Excellent news'

"Very excitingly, the star most similar to the Sun in this respect that we have found so far is Alpha Centauri A, the second nearest star," said Martin Asplund, team member and director of Germany's Max Planck Institute for Astrophysics. He said that this is "excellent news" because, if Earth-like planets do exist in that system, it is close enough for them to be observed directly.

The team came up with this idea after comparing absorption spectra of the Sun with that of 11 "solar twins" – stars that are physically similar to the Sun – and 10 "solar analogues", which are slightly less similar. The measurements were made using the Magellan telescope at Las Campanas Observatory in Chile and the Keck telescope in Hawaii.

Whereas previous, less accurate, studies had suggested that the Sun's chemical composition is typical of stars, Meléndez and Asplund say that in fact the sun's composition is "quite unusual". Compared to the solar twins, the team found that it has about the same amount of light elements like carbon and oxygen. Heavier elements, such as aluminium, iron and nickel, show a 10–20% lower abundance.

Dust-cleansed gas

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Astrophys. J. Lett. **704** L66-L70, doi: 10.1088/0004-637X/704/1/L66

Meléndez points out that this distribution in elemental abundances correlates strongly with their condensation temperatures. He suggests that the higher condensation temperature elements – referred to as refractory elements – were involved in the planet-forming process in our solar system. "The scenario we are proposing is that during the formation of the Sun some of the gas condensed into dust and eventually became the planets," Asplund told *physicsworld.com*. "The largely dust-cleansed gas then continued being sucked into the Sun."

About 10–20% of the stars in the study have a close chemical resemblance to the Sun. However, stars with giant planets orbiting round them are not chemically similar to the Sun, according to Meléndez.

Other characteristics of the solar system add to the argument that the Sun's lack of refractory elements could be tied to the presence of rocky planets. For example, the total mass of elements missing from the Sun is similar to the total found in its four rocky planets. Also, the Earth's crust contains relatively fewer light elements and more refractory ones compared with the Sun.

However, José Robles, a researcher at the Kennedy Space Centre in Florida who previously worked with Meléndez to identify solar twins, calls into question how significant the difference between the Sun and the average of the 11 twins is. Together with Australian National University astronomer Charles Lineweaver he points out that the amount of lighter, more volatile, elements in stars is known to vary. "Their statement that the Sun is depleted in refractories could probably more legitimately be described as the average twin being more depleted in volatiles than the Sun is," said Robles.

'Work in progress'

Robles applauds the accuracy of the measurements and describes the idea that the abundance differences between the Sun and solar-twins might be explained by planet formation as "thought-provoking". According to Robles, using this approach to spot terrestrial planets "is an interesting idea that we may be able to do someday, but not yet. It is a work in progress."

Meléndez's team will now go on to study a further 100 stars in search of similarities with the Sun, having been allocated three nights' observing time with the European Southern Observatory's Very Large Telescope in Chile.

This work was published in *The Astrophysical Journal Letters*.

About the author

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2 comments

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1 **Oliver K. Manuel**
Oct 17, 2009 11:02 PM
United States

Most Abundant Elements: Fe, O, Si, Ni and S

The five most abundant elements in ordinary meteorites, Earth, and the Sun (Fe, O, Si, Ni and S) have high nuclear stability and are produced in the deep interior of supernovae, near where the pulsar forms.

ESA SP-517 (2003) 345-348: tinyurl.com…yl9vxtt

36th Lunar & Planet. Sci. Conf. (2005) #1033: tinyurl.com…yz6gx78

With kind regards,
Oliver K. Manuel

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2 **gjw284**
Oct 19, 2009 8:21 AM

chemical anlysis

If it does indeed turn out that the suns composition is related to rocky body formation its a huge step towards finding other earths as other stars that are similar to the sun have to exist.although im not sure they are in the sights of the astronomers yet but it wont be long now,im sure we all are aware that we will need a new home soon judging by the way we are ruining this 1 so lets wish em luck eh.