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News

Earth-like planets get life assessment

Fresh models suggest only one planet around Gliese might be habitable.

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The most Earth-like planet discovered so far is not quite in the right place to be habitable after all, researchers say. But its neighbour might be.

Out of the zone: Gliese 581c is probably too hot to handle.

ESO

Discovered in April, the planet Gliese 581c caused a lot of initial excitement. It seemed to be about five-and-a-half times the mass of Earth, and rough calculations predicted that it might be in a region known as the habitable zone — an area the right distance from its star to support liquid water (see **The most Earth-like planet yet** (http://www.nature.com/uidfinder/10.1038/news070423-5)).

Since the planet's discovery, researchers have been busy using atmospheric and geological models to test this prediction, and to work out with more accuracy the size and location of the habitable zone around the red dwarf star Gliese 581. The results now suggest that Gliese 581c is too close to its star; but that the bigger Gliese 581d, discovered at the same time and thought to be eight times the mass of Earth, may sit just inside the outer edge of the habitable zone. This less well-characterized planet might have the same conditions as early Mars, which is thought to have harboured water ice.

The air we breathe

Franck Selsis at the Astrophysics Research Centre at the University of Lyon, and his colleagues, tackled the problem by modelling what the atmosphere of an Earth-style planet would be like at different distances from the star.

The results? Too close and water vapourizes — the planet is too hot to support life. Too far and carbon dioxide in the atmosphere crystallizes, producing more of a reflective cooling effect than an insulating warming one, which makes the planet too cold. Selsis estimates the inner edge of the habitable zone to be at 0.075-0.105 times the distance between Earth and the Sun (a distance known as an astronomical unit), and the outer edge at 0.2-0.3 times this distance. His team's work has been accepted for publication in *Astronomy and Astrophysics* [1 (#B1)].

Gliese 581c lies 0.073 astronomical units (AU) from its star - just outside the habitable zone. "Gliese 581c is probably hotter than Venus," says Selsis, "We would never say Venus is a second Earth." But Gliese 581d might just make it into the right region, sitting 0.25 AU from the star.

The rocks beneath our feet

Werner von Bloh at the Potsdam Institute for Climate Impact Research and his colleagues have taken a different approach, modelling the geology of these planets and assessing how that would generate different atmospheres in different locations. Von Bloh's model, also accepted for publication in *Astronomy and Astrohpysics* [2] (#B2), assumes that both Gliese 581c and Gliese 581d have the same geological composition as Earth, and have a carbon cycle.

The model then factors in how much carbon dioxide is released through volcanoes and ridges, which depends on a planet's age and the temperature of its mantle; and how geological 'weathering' sucks carbon dioxide from a planet's air and turns it to carbonate minerals, which depends on a planet's temperature and its proximity to a star.

Too close to the star and weathering effects dominate, so there isn't enough CO_2 in the atmosphere to support photosynthesis, the team reports. At a greater distance, temperature becomes the main problem for anything trying to photosynthesize: it gets too cold. And as a planetary system ages, any planets producing insulating CO_2 will produce less and less, cooling them further and shrinking the habitable zone.

Ultimately von Bloh's analysis came to the same conclusion as Selsis — Gliese 581c is too close to its star to be habitable, but Gliese 581d might be able to support some primitive forms of life.

Too many assumptions

Selsis cautions that it's almost impossible to know what the geology of an alien planet is like: lots of assumptions have to be made, he notes. But he says that von Bloh's study complements his own.

Stephane Udry, from the Geneva Observatory in Switzerland who was part of the team that discovered Gliese 581c, says it is important to remember that any such calculations are based on assumptions that will be verified only with further observations. "All we have from the planets are information on the planet mass and star–planet separation," he says. Nevertheless, he adds, it is exciting how close these planets seem to be to the habitable zone. "We have found candidates at both edges," he says.

Jim Kasting, an expert on habitable zones from the Pennsylvania State University in University Park, and who worked with Selsis, says that the work bodes well for future discoveries. “It’s about certain that within the next one or two years someone will find at least one planet within the habitable zone of an M-star [like Gliese 581],” he says.

References

1. Selsis, F. *et al. Astronomy and Astrophysics* (in the press) **http://arxiv.org/PS_cache/arxiv/pdf/0710/0710.5294v1.pdf** (http://arxiv.org/PS_cache/arxiv/pdf/0710/0710.5294v1.pdf)
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Comments

How Much Earthlike Should A Human-Viable Planet Be? At the beginning of the Universe there was the energy singularity. At its end will be near zero mass and an infinite dispersion of the beginning energy (which might be the beginning of re-evolution towards singularity). In-between, the universe undergoes continuous evolution, consisting of myriad intertwined energy-to-energy and energy-to-mass-to-energy transformations. The cosmos evolution process comprises, though, phenomena of forms of temporary energy storage pockets, of energy dispersion constraints. Examples of such temporary pockets are black holes of all sizes, and all forms of biospheres, if/wherever they are. The temporary constrained energy pockets are far-removed versions, up-fractionally evolved, scattered cosmic fragmants of singularity-akin energy sources. Energy stored in the temporary constrained energy pockets resists dispersion; we do not yet comprehend why and how. However, we comprehend that we, All Earth Life, are real virtual products evolved from Earth's Biosphere energy, for maintaining Earth's biosphere bio as long as possible. Earth's life is a uniquely Earth's Biosphere phenomena, and all species of life - of which presently are known 1.8 million genomes - are interdependent, having evolved from-and-with Earth's Biosphere and doing their task to maintain this Biosphere Bio. Our off-Earth life experience is zero. In our zero experience the off-Earth life survives briefly with umbilical cord to Earth. We do not yet know how much of our womb, of Earth's Life, must be there on another planet for Us to survive there. This is not a simple science fiction matter, but a matter of transfer and growth of some of Earth's Biosphere onto an undefined planet... Dov Henis

Posted by: **Dov Henis** | 04 Nov, 2007

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