

# SEARCHING FOR EARTH 2.0

The world is divided into those who insist 'We are not alone', and those who say 'We might be'. If Mangalyaan finds methane, the discovery will give alien-seekers heart

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One day in May 1950, the physicist Enrico Fermi and his colleagues were chatting about flying saucers and aliens as they went for lunch at the Los Alamos lab. There had been a rash of so-called 'sightings', and a cartoon in *The New Yorker* showed little alien beings carrying away trash cans — a comment on the trend of trash can stealing in the city. As they settled at the table, Fermi scribbled some calculations and then suddenly asked "But, where is everybody?" Everybody burst out laughing, knowing what he meant — extra terrestrial life.

What he had scribbled is now known as Fermi's Paradox. It goes like this: there are about 70 sextillion (seven followed by 22 zeroes) stars in the visible Universe, and each would have planets, and even if one in a million managed to evolve life in the 13.8 billion years since the Universe was formed, then there should be at the very least a million civilizations in the Universe. So how come we have never heard or seen even a whisper from any one of them?

The Mangalyaan is doing its bit to settle the question by trying to detect methane in the thin Martian atmosphere. And, methane could have come from life forms. Although the Nasa rover Curiosity hasn't found it on the surface that doesn't rule out methane completely, says Sushil Atreya, director of the Planetary Science Lab at University of Michigan and visiting professor at Jet Propulsion Lab, CalTech.

"Methane may yet show up in Curiosity's readings. I'm also anxiously waiting to see what MOM's methane sensor finds," he told STOI.

In the 1980s, scientists had ruled out life on Venus and Mars. Venus is like a pressure cooker, with average surface temperature of 460 degrees C, surface atmospheric pressure 93 times that of sea level on Earth and the "air" comprising of over 95% carbon dioxide. Mars is the opposite — its surface temperature ranges between -87 and +20 degrees C, and its surface pressure is just two-thirds of Earth.

But the discovery of water on Mars has resurrected the theory of life on that planet — albeit sometime in its past. "If we find no life on planets that once had abundant

liquid water, such as Mars, that would be a stunning discovery," Charles Cockell, professor of astrobiology at Edinburgh University, told STOI.

"What was special about Earth, and what was missing on Mars?" is a question Cockell says we'll then be asking.

Meanwhile, another possibility arose. Life could exist on exoplanets, that is, planets attached to stars other than our Sun. The Kepler spacecraft identified 3601 unconfirmed planetary candidates, of which, 974 have been confirmed as true exoplanets. But these exoplanets are too far for any physical verification. The nearest one is Gliese 674 which is 14.8 light years — that's 140 trillion kilometres away.



EUROPA

Hence, the search for life turned back to our own backyard, the Solar System.

"Besides Mars, Europa, a moon of Jupiter, with its likely subsurface ocean; Enceladus, a moon of Saturn, with possible liquid water in its interior; and Titan, another moon of Saturn with possible subsurface ocean; are likely candidates for microbial life," Atreya said.

Here is a summary of the current top candidates for the search and the reasons why.

## MARS

But wasn't Mars ruled out? Yes, but here's the thing: life could have existed in the past, and some remnants can be found, perhaps below the surface. Curiosity has found evidence of past water, but no life yet.

"Three things are essential for life as we know it: liquid water, nutrients, and energy. Amongst extraterrestrial bodies in our solar

system, Mars had, and could still have, the greatest potential of sustaining microbial life. Mars was warmer and wetter in the past; it has the minerals that contain key nutrient elements — C, H, N, O, P and S — and plentiful solar and chemical energy. If liquid water exists on Mars today, the water table would be several to tens of kilometres beneath the surface, where microbial life may be possible," Atreya explained.

## TITAN

It is the only moon in the Solar System that has a nitrogen and methane dominated atmosphere, analogous to Earth. But the mean surface temperature is a daunting -180 degrees C. The Huygens probe which land-



ENCELADUS

ed on Titan in 2005, found a bizarre world of methane lakes and seas, astride water ice and rocks with some frozen ammonia thrown in. Recent Earth based observations have suggested existence of several hydrocarbons and complex organic molecules. It is possible — say some scientists — that in 5 billion years when the Sun gets bigger and hotter, life might evolve on Titan's surface.

## EUROPA

Jupiter's moon Europa is an ice-ball with average surface temperatures at -170 degrees C. It is a rocky body covered entirely with ice that is crisscrossed by lines thought to be cracks caused by volcanoes and quakes. There is a very thin atmosphere of oxygen.

Scientists have evidence that the surface ice gives way to water further down, making a water/ice wrap 160 km thick. In the underground ocean, life might have evolved,

probably near vents of hot gases from a heated core. Nasa recently reported that it had found evidence of "clay like minerals" and water vapor plumes.

## ENCELADUS

This tiny moon of Saturn is full of intriguing possibilities because most of its surface is covered with water ice, cracked at many points giving the moon its characteristic 'Tiger Stripes'. It is geologically active shooting huge geysers of water. Cassini probe flying by in 2005 found traces of carbon, hydrogen, nitrogen and oxygen — the building blocks of life - in the flimsy atmosphere. In 2014, Nasa said that Cassini — still flying! — had found an ocean of water below the south polar surface.

## CERES

The largest asteroid in the Solar System, Ceres is going around the Sun between Mars and Jupiter. It is just 4% mass of our Moon. It has a rocky core surrounded by a thick ice cover. Scientists think that life may have evolved on it in hydrothermal vents deep inside the liquid water ocean hidden by the ice crust.

## IO, CALLISTO & GANYMEDE

Of these three Jupiter moons, Io is one of the most extreme worlds with over 400 hyper active volcanoes spewing sulfur fumes and lava. There is virtually no atmosphere allowing high radiation to hit the surface as measured by the space probe Galileo. Scientists believe that there might be underground sanctuaries with some leftover water from earlier times where microbes could possibly live.

Little is known about Callisto and Ganymede, but they may have underground oceans, which are probable habitats for microbial life. Both are frozen bodies with trace atmospheres. Ganymede is the largest moon in the Solar System, while Callisto is the most battered moon, entirely covered with craters formed due to unknown celestial bombardment 4 billion years ago.

As can be seen from this, no evidence of life has been found anywhere till now. But in the coming years, much more will become known as various space probes approach their destinations — Dawn will reach Ceres and New Horizons will reach Pluto in 2015, Juno will arrive at Jupiter in 2016, Rosetta is already orbiting a comet and ESA's JUICE will be launched in 2022 to study Europa. So, watch this space!