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LIFE ON ENCELADUS?

Ken Tapping, 25th September, 2018

Carbon is an unusual element. Its atoms can join directly together to form huge molecules consisting of long chains and other structures. As my High School science teacher said, “carbon atoms are four-armed things”; when linked together in a chain, they have two spare “arms”, which they can use to grab onto other sorts of atom, such as hydrogen, oxygen, phosphorus, nitrogen etc., or to other carbon atoms. In cosmic clouds and other places, chains of up to half a dozen or so carbon atoms can come together, forming chemicals such as aminoacids, the building blocks of life. However, the only place other than the laboratory or plastic manufacturer where we find molecules containing tens, hundreds or thousands of carbon atoms joined directly together is in living things. This is why we refer to the chemistry of all but the simplest carbon-based molecules as organic chemistry. Organic means, “to do with life”. This provides us with a powerful tool in our search for life. If we find complex carbon molecules (CCM’s), living things had something to do with it, either now or in the past. For example, coal and oil are loaded with CCM’s, because they formed, millions of years ago, from buried plant remains. If we take a sample of seawater from any of our oceans, we will find CCM’s. They could be from the decay of dead things, skins or scales moulted off, by-products of life processes, or small creatures unlucky enough to get caught up in the sample.

We are pretty sure life got started in Earth’s oceans. For most living things, the Sun’s light and warmth are crucial to their survival. However, in the cold, deep oceans there are huge communities of exotic creatures surviving on the hot, mineral-laden water spewing out of hydrothermal vents. Sunlight plays no role in the life of these animals. That raises an interesting possibility. There are moons of the giant planets Jupiter and Saturn, so far from the Sun their surfaces are cold and covered with ice, but which we believe to have oceans of liquid water beneath those icy crusts. These oceans are kept liquid by the huge amounts of heat released by the tidal “kneading” those moons experience as they orbit their respective giant planets. This heat will, almost certainly, drive hydrothermal vents. One great advantage those oceans have over ours is that they are heated from the bottom, so convection passes the heat throughout the water. On Earth, our oceans are heated from the top, and as we go down deeper, they get cold, not far above freezing. Except for around the hydrothermal vents, the population per square kilometre of Deep Ocean bottom is low.

A good way to search for life in the oceans on those tidally heated moons is to look for CCM’s in the water. That is, if we can get at the water. With Enceladus, one of the moons of Saturn, we have been lucky. The tidal heating is so strong there are geysers of liquid water coming up through the ice and rising high into space. While it was exploring Saturn and its moons, the Cassini spacecraft observed these geysers. It has just been discovered there are traces of CCM’s in that ejected water. The early results look encouraging.

Europa, one of the moons of Jupiter, is an object of particular interest. It has an icy envelope covering a tidally heated ocean. Images from spacecraft show an ice cover that is continually breaking up and healing, with some of the ocean water finding its way onto the surface, where it evaporates, leaving its chemicals behind. There is a proposed experiment for a spacecraft to look at Europa’s surface for the infrared signatures of CCM’s. But more exciting is the plan to land a spacecraft on Europa, to drill down through the ice, lower a robot submarine and have a direct look at what might be swimming around down there.

During the evening Mars, the red planet, is conspicuous low in the southeast. Saturn lies low in the south and Jupiter very low in the southwest. The Moon will be reach Last Quarter on the 2nd.

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