An alternative theory: hydrothermal vents

One theory recently gaining a lot of support is that life on Earth started in the dark depths of the seafloor, around a hydrothermal vent. The so-called ‘black-smokers’ are certainly impressive displays and have received a lot of attention, but the super-heated water they pump out is far too hot and acidic for life.

Far more promising are the much cooler alkaline vents, such as the Lost City near the mid-Atlantic ridge. These vents aren’t found along the spreading centres of plate tectonics, but are driven by reactions of iron-rich rock in the Earth’s crust. The towering mineral chimneys formed by such vents last tens of thousands of years and are very porous, riddled with tiny cavities that can concentrate compounds and act as miniature reaction vessels. Most importantly, the difference between the alkaline vent fluids seeping out of the ocean floor and the slightly acidic seawater produces a gradient of pH, or protons. All organisms on Earth generate power using a similar proton gradient, and it seems as though the energy source of life could be inherited from our ancient crucible in alkaline hydrothermal vents.

The expert

Dr Zita Martins of Imperial College, London discusses her work with the Murchison meteorite

What do you work on?
I analyse organic molecules present in carbonaceous meteorites, which are some of the most ancient objects in the Solar System and contain building blocks that may have contributed to the origin of life on Earth. I also develop methods of detecting signatures of past and present life. I work in a chemistry lab and so I use lots of different equipment and techniques, including mass spectroscopy and fluorescence detection, to figure out which molecules are present in samples.

What’s been your biggest discovery?
One of my biggest discoveries was to prove that nucleobases present in the Murchison meteorite were extraterrestrial. This shows that components of the genetic code were already present in our early Solar System.

How can you be sure these organic molecules were extraterrestrial?
We analyzed the carbon content of the meteoritic nucleobases. Carbon in molecules can be a lighter form (carbon 12) or a heavier form (carbon 13). Biological molecules formed on Earth consist of the lighter form. However, the nucleobases in the Murchison meteorite were enriched in a heavy form of carbon that could only have been formed in space.

What does this mean for the possibility of life beyond Earth?
Between 4.6 and 3.8 billion years ago, a large number of meteorites bombarded the surface of planets like Earth and Mars. These contained the building blocks of cells (including nucleobases), and may have been important for the origin of life on Earth, and maybe in other parts of our Solar System.

What are you working on at the moment?
I have just analyzed some desert soils that host small amounts of living organisms and are Earth analogues for possible Martian life. They help us determine whether signatures of past and/or present life may still exist in the Martian soil. These studies also help when choosing target locations for future habitability and life-detection missions on Mars, such as the Mars Science Laboratory and ExoMars probes.