The search for life on Mars: An early Earth perspective

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Our knowledge of life in the Universe is based on an example of one: the Earth. Currently, life is everywhere, from the deepest oceans to the highest mountains, from sun drenched to pitch black, from water to ice, and uses a wide variety of metabolisms and a broad swath of the chemical elements (and molecules) available on our planet. The complexity and size of organisms on Earth today is the result of billions of years of chemical interactions and water-based development of evolutionary complexity.

But on early Earth, life was simpler, occupied fewer niches, and perhaps utilised fewer elements. And in order to get life in the first place, specific conditions were required that - although not yet precisely known – have important implications in the search for life on Mars, whose active geological history and wet surface environments were restricted to its early history.

If life on Earth got started in deep sea hydrothermal vents, then Mars might not appear that attractive for life, as its early history apparently lacked a global ocean and plate tectonics to generate the deep sea vents. Alternatively, if life originated in hot springs, on land, then Mars is a more exciting target, as we know that its early history included both volcanism and liquid water.

In this talk, I review the pros and cons of the two currently promoted models for the origin of life and show why a life on land model provides both the required conditions and elemental concentrations required for prebiotic chemistry, as well as orders of magnitude greater complexity that their deep sea counterparts. And from this, I will explore how this can be used to guide the search for life on Mars and critically examine the current top three final sites for NASA's Mars2020 mission.