

Research group finds ancient deep sea mud volcano as possible site for origin of life

18 October 2011, by Bob Yirka



Isua Supracrustal Belt Isua, south-west Greenland.
Credit: University of Washington.

(PhysOrg.com) -- An international consortium of scientists and researchers has been studying some ancient rocks found on the southwestern coast of Greenland. They believe the rocks were once part of a deep sea mud volcano, similar to those found today near the Mariana Islands in the Pacific Ocean and that they were likely part of an environment conducive to the synthesis of amino acids, which are believed to be necessary for life. What's most intriguing about them though is that their age indicates that they are from roughly the same time period as what is thought by many scientists to be when the first living creatures appeared here on Earth; i.e. some four billion years ago.

The group has published its findings in the *Proceedings of the National Academy of Sciences*.

Deep sea mud volcanoes, unlike those that grow to form islands, tend to be much cooler than other volcanoes (and deep sea hydrothermal vents) due to the cool ocean temperatures in which they exist. It's for this reason that many scientists consider them ideal environments for the beginning of life. Any new life that arose would need a consistently warm environment, but one that also didn't get too

hot. Also helpful would be an environment that is alkaline, rather than acidic (unlike hydrothermal vents). Deep sea mud volcanoes appear to fit the bill.

In studying the rocks, the team found that they were once saturated with reasonably warm alkaline fluids that had a lot of carbonates. Such fluids can be found today in existing deep sea mud volcanoes such as those near the Mariana Islands, which the researchers say would have been very nearly the perfect environment for the continued existence of newly formed living creatures. Because of this, the team believes that similar mud volcanoes existed off the coast of [Greenland](#) around the time that life was getting started, and if so, the area would have made an exceptionally good place for life to not only get going, but for it to thrive.

[Deep sea](#) mud volcanoes are rather rare today, but many scientists believe they were more abundant billions of years ago when oceans covered more of the Earth's surface. And of course, finding an environment conducive to supporting life once it's been started, still doesn't explain how it got started in the first place.

More information: Early Archean serpentine mud volcanoes at Isua, Greenland, as a niche for early life, *PNAS*, Published online before print October 17, 2011, [doi: 10.1073/pnas.1108061108](https://doi.org/10.1073/pnas.1108061108)

Abstract

The Isua Supracrustal Belt, Greenland, of Early Archean age (3.81 - 3.70 Ga) represents the oldest crustal segment on Earth. Its complex lithology comprises an ophiolite-like unit and volcanic rocks reminiscent of boninites, which tie Isua supracrustals to an island arc environment. We here present zinc (Zn) isotope compositions measured on serpentinites and other rocks from the Isua supracrustal sequence and on serpentinites from modern ophiolites, midocean ridges, and the Mariana forearc. In stark contrast to modern

midocean ridge and ophiolite serpentinites, Zn in Isua and Mariana serpentinites is markedly depleted in heavy isotopes with respect to the igneous average. Based on recent results of Zn isotope fractionation between coexisting species in solution, the Isua serpentinites were permeated by carbonate-rich, high-pH hydrothermal solutions at medium temperature (100 - 300 °C). Zinc isotopes therefore stand out as a pH meter for fossil hydrothermal solutions. The geochemical features of the Isua fluids resemble the interstitial fluids sampled in the mud volcano serpentinites of the Mariana forearc. The reduced character and the high pH inferred for these fluids make Archean serpentine mud volcanoes a particularly favorable setting for the early stabilization of amino acids.

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