Fossil find gives hope for animal life in 'lost cities'

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(PhysOrg.com) -- The world's oceans could be littered with thousands of undiscovered 'lost cities' housing communities of creatures that thrive in some of the Earth's most extreme conditions, a new discovery suggests.

A team of French and UK scientists have unearthed fossilised remains of mussels, clams and snails from the sea floor over a kilometer away from their usual home - the 'black smoker' hydrothermal vents on the Mid-Atlantic Ridge.

The find suggests that communities of larger invertebrates like mussels, clams and snails can survive away from the spreading ridge axis, at locations such as the famous 'Lost City'. These communities are of particular interest to scientists, because they would lead to a better understanding of how life first evolved on Earth, and potentially other planets.

Dr Crispin Little from the University of Leeds, a palaeontologist and co-

author of the study, said: "We've known since the 1970s that high temperature vents along the Mid-Atlantic Ridge can host amazing communities of weird and wonderful creatures which feed on bacteria that thrive in the extreme conditions.

"But these diverse communities have not been observed at Lost City, which has been a bit of a mystery for scientists because there are plenty of these bacteria there for them to feed on."

The Lost City hydrothermal vent field was discovered in 2000 by chance during a National Science Foundation expedition to the mid-Atlantic. The field, located 15km away from the Mid-Atlantic Ridge, is populated by around 30 large mineral chimneys, some up to 70m tall, which spew out highly alkaline methane and hydrogen-rich fluids.

The vents in Lost City are very different to the black smokers that exist at the Mid-Atlantic Ridge, which form when superheated water from below Earth's crust comes through the ocean floor.

At Lost City, exposed mantle rock reacts with the sea water to form calcium carbonate minerals that stack into tall cream-colour chimneys. The reaction - called serpentinization - also produces methane and hydrogen-rich gas, which is a good source of food for chemosynthetic bacteria.

Unlike high-temperature vents, which only occur where there is volcanic activity or mid-ocean ridges, serpentinization can occur anywhere where the mantle is exposed to the sea. Therefore the researchers are hopeful that living vent communities could be found in many locations in the global oceans.

"Our findings provide the first evidence that the serpentinization reaction, producing hydrogen and methane, which is probably quite

common on the sea floor, can support dense communities of specialised animals in addition to the high-temperature hydrothermal vent sites related to spreading ridge axis or volcanic activity.

"The other interesting thing is that sites like Lost City would have been more common in the early history of the Earth when more mantle was exposed. Therefore the communities of animals found at serpentinization sites could provide clues about how life itself could have first formed in a purely geochemical environment on this planet, and potentially others."

The discovery confirms that specialized deep-sea animals can be very efficient at using various kind of chemical energy that is made available on the deep-seafloor, which is deprived of photosynthesis, according to Nadine Le Bris, a chemist specialised in the interactions of biota and fluids at deep-sea hydrothermal vents and holder of the UPMC-Fondation TOTAL Chair in 'Extreme environment, biodiversity and global change'; and Franck Lartaud, a geochemist specialised in biomineralisation, both from the Benthic Ecogeochemistry Laboratory, Oceanologic Observatory of Banyuls, from the Université Pierre and Marie Curie and the Centre National de la Recherche Scientifique.

"This unique discovery further expands the hydrogen-driven world, described by microbiologists at serpentinite-hosted high-temperature vents, to disperse and abundant communities of multicellular organisms," added Nadine Le Bris.

The team made their discovery while studying the high-temperature Rainbow vent ecosystem, in a joint cruise with geology groups on board the R/V Atalante that involved dredging the ocean floor along the Mid-Atlantic Ridge as part of a geophysical survey.

Within their dredge they unexpectedly found chunks of white carbonate

mineral similar to the chimneys observed at Lost City. Their unique mineralogical composition was characterised by Dr. Franck Lartaud and Dr. Marc de Rafelis from UPMC.

They were particularly surprised to discover that the carbonate lumps were full of large shells, which were analysed by Dr Little in the UK. The fossils were found to be snails and mussels of the same species normally found at high-temperature hydrothermal vents along the ridge, and clams more common at sedimented vent fields. The carbonates samples were dated at 100,000 years old.

The findings are published in the journal *Proceedings of the National Academy of Sciences*.

Provided by University of Leeds