Ice tubes in polar seas—'brinicles' or 'sea stalactites'—provide clues to origin of life

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Life on Earth may have originated not in warm tropical seas, but with weird tubes of ice — sometimes called “sea stalactites” — that grow downward into cold seawater near the Earth's poles. Credit: Credit: Rob Robbins; image archived by EarthRef.org

Life on Earth may have originated not in warm tropical seas, but with weird tubes of ice—sometimes called "sea stalactites"—that grow downward into cold seawater near the Earth's poles, scientists are reporting. Their article on these "brinicles" appears in ACS' journal *Langmuir*.

Bruno Escribano and colleagues explain that scientists know surprisingly little about brinicles, which are hollow tubes of ice that can grow to several yards in length around streamers of cold seawater under pack ice. That's because brinicles are difficult to study. The scientists set out to gather more information on the topic with an analysis of the growth process of brinicles.

They are shown to be analogous to a "chemical garden," a standby demonstration in chemistry classes and children's chemistry sets, in which tubes grow upward from metal salts dropped into silicate solution. But brinicles grow downward from the bottom of the ice pack.

The analysis concluded that brinicles provide an environment that could well have fostered the emergence of life on Earth billions of years ago, and could have done so on other planets. "Beyond Earth, the brinicle formation mechanism may be important in the context of planets and moons with ice-covered oceans," the report states, citing in particular two moons of Jupiter named Ganymede and Callisto.

The article is titled "Brinicles as a Case of Inverse Chemical Gardens."

More information: Brinicles as a case of inverse chemical gardens, *Langmuir*, Just Accepted Manuscript DOI: 10.1021/la4009703

Abstract
Brinicles are hollow tubes of ice from centimetres to metres in length that form under floating sea ice in the polar oceans when dense, cold

brine drains downwards from sea ice into sea water close to its freezing point. When this extremely cold brine leaves the ice it freezes the water it comes into contact with; a hollow tube of ice —- a brinicle —- growing downwards around the plume of descending brine. We show that brinicles can be understood as a form of the self-assembled tubular precipitation structures termed chemical gardens, plant-like structures formed on placing together a soluble metal salt, often in the form of a seed crystal, and an aqueous solution of one of many anions, often silicate. On one hand, in the case of classical chemical gardens, an osmotic pressure difference across a semipermeable precipitation membrane that filters solutions by rejecting the solute leads to an inflow of water and to its rupture. The internal solution, generally being lighter than the external solution, flows up through the break, and as it does so a tube grows upwards by precipitation around the jet of internal solution. Such chemical-garden tubes can grow to many centimetres in length. In the case of brinicles, on the other hand, in floating sea ice we have porous ice in a mushy layer that filters out water, by freezing it, and allows concentrated brine through. Again there is an osmotic pressure difference leading to a continuing ingress of sea water in a siphon pump mechanism that is sustained as long as the ice continues to freeze. Since the brine that is pumped out is denser than the sea water, and descends rather rises, a brinicle is a downwards growing tube of ice; an inverse chemical garden.

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