“Paleoclimate and possible life on Mars: Evidence from Martian meteorites”

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It is widely accepted that there was fluvial water on the surface of Mars about 3.5 billion years ago, and hence it is likely that extraterrestrial life could occur on Mars. In addition, Mars explorations have detected subsurface glacier and found strong evidence for recent activity of ground brine water.

Water and other volatile components (e.g. F, Cl, S) play a key role in partial melting of Martian mantle and significantly affect physical properties of Martian lithosphere. They were degassed from Martian interior via magmatism. Martian meteorites are the only available rocks from Mars, a probe to investigate the Martian mantle. The water and other volatile elements in magma inclusions in minerals (e.g. olivine, pyroxene and chromite), apatite and nominally anhydrous minerals can be determined with Nano-scaled Secondary Ion Mass Spectrometry (NanoSIMS), and the results can be used to achieve their concentrations in the parent magmas and the Martian mantle sources.

Some Martian meteorites have suffered aqueous alterations, producing phyllosilicate minerals. Evaporative salt minerals (e.g. sulfates) were found in the Nakhla Martian meteorite, and organic matter filling in thin fractures in silicates and a part of it as fine-grained inclusions capsulated in shock melt veins in the Tissint Martian meteorite. Furthermore, the magma inclusions and shock-induced melt pockets have also preserved water originated from the Martian atmosphere. All of these information can be achieved by NanoSIMS.

A comprehensive study of a set of Martian meteorites dated from 4.4 billion years to 180 million years will help us to understand the degassing history of Martian mantle and the evolution of paleoclimate on Mars.