

Hakuba Happo Onsen Newsletter

Hakuba Happo Hot Springs (Onsen) and Romantic Reminiscence of the Primordial Times

~ In search of clues to determining the grand mysteries of origins of life
at Hakuba Happo Onsen ~



Observing Hakuba Happo Onsen from a scientific perspective

The Hakuba Happo Onsen are well known as *Bihada no yu* – spring water that beautifies your skin. The high alkaline property of over pH11 makes your skin soft and smooth. Bathing makes you relax and refresh, and some believe that it has rejuvenating effects.

While Hakuba Happo Onsen offer these benefits as baths, from a scientific perspective the area has many traces of the dramatic history of Earth and reminiscence of the primeval time. That is because the spring water of Hakuba Happo Onsen contains properties that are extremely valuable and significant to the study of Earth-life.

When, where and how did life emerge on Earth?

The Earth was said to have formed approximately 4.6 billion years ago, and life on Earth about 4 billion years ago. The question is how was life originated?

The three major mysteries that we still pursue of today are: the origin of the universe, the origin of life, and the origin of our brain. Several times in the past, these research areas had been interrupted due to a number of obstacles, but recently there has been a sudden boost in academic interest lead by the participation of various disciplines, particularly in the study to determine the origins of life. Founded in December 2012, the Earth-Life Science Institute of Tokyo Institute of Technology (Meguro-ku, Tokyo, JAPAN; Director Kei Hirose) pursues the question of “the origins of Earth and life” from an interdisciplinary approach with the collaboration of researchers specializing mainly in earth science, life science, and planetary science.

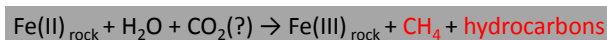
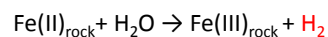
One popular hypothesis is that life could have emerged from submarine hydrothermal vents (in particular, serpentine hydrothermal vents) leading to the formation of life. Exposed peridotite on the seafloor and earth surface reacted with hot water to form hydrocarbons and other organic compounds which may have evolved into life.

Where and how did life emerge?

- Hypothesis: life may have originated from submarine hydrothermal systems (in particular, serpentine hydrothermal vents)

peridotite (mantle) + water = serpentine

- high alkalinity (pH > 10)
- high hydrogen concentration ($H_2 > \text{mM}$)



Rocks made of peridotite are not exposed on the surface of the Earth
The seabed must have been covered with peridotite at the time Earth was formed.



Source: reference material at the briefing by Tokyo Institute of Technology

Hakuba Happo, a rare site on Earth

Serpentine was named from the Latin *serpentinus* for its serpent-like appearance. The formation of serpentine occurs when peridotite from the earth's mantle is brought to the seafloors or earth surface due to crustal movements and reacts with water.

Hakuba is famous for its exposed serpentine, but the volcanic chains in that cut through create the unique coexistence of serpentine and Onsen. Being one of the largest areas with exposure of serpentine and combined with good accessibility, Hakuba is becoming a popular research destination for many geoscientists.

Water property resembles the environment in which life emerged

Since 2007, the research group at Tokyo Institute of Technology has recognized the significance of Hakuba Happo Onsen and the exposed serpentine. They have been conducting water analysis of excavated Onsen since 2010.

Results revealed that the spring water of Hakuba Happo has high alkalinity (pH11 or higher) and very high hydrogen content, and contains methane and other hydrocarbons that form the basis of life on Earth. The water quality is remarkably similar to the property of water that is produced when reacting with serpentine. The research group further discovered that Hakuba Happo Onsen contain very few types of bacteria compared to other Onsen, and that these bacteria could survive under high alkaline environments and resemble the state of primitive life. In other words, Hakuba Happo Onsen could have the same quality as the water 4 billion years ago when life emerged on Earth.

Hakuba Happo is a hot spot among scientists worldwide

There is an emerging expectation among scientists that the study of Hakuba Happo Onsen will eventually allow us to elucidate the biggest event in Earth history – how life originated on early Earth. The clues to solve this mystery are here in Hakuba Happo Onsen.

The research team lead by ELSI associate professor Yuichiro Ueno published their findings at Hakuba Happo in a prestigious scientific magazine, “Earth and Planetary Science Letters” issued on January 15, 2014. Led by professor Ken Kurokawa, the team also initiated a new MEXT grant-in-aid scientific research project to understand the formation of life starting FY2014. Hakuba Happo is now gaining the attention of scientists around the world – it is a precious site and possibly the most appropriate place to exchange opinions on the origins of life.



In Kurokawa's words, "Hakuba Happo Onsen could be a sacred land for those studying the origins of life."

Reminiscing the primordial times

From the Onsen of Hakuba Happo we could trace the aquatic environment 4 billion years ago, and close in on the mystery of how life emerged on Earth.

Bathing in the Onsen and imagining the turbulent drama of Earth formation could also be a unique experience. In Hakuba Happo's ski and mountain resort setting, you will now discover the fascinating Earth-life science treasures. The local residents of Hakuba Happo will enjoy the romantic reminiscent of the primordial times and will continue to support these research activities.

◆ Supervised & reference provided by:

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◆ Location of Research

Hakuba Happo Onsen

Hakuba-mura, Kita Azami-gun, Nagano Prefecture, Japan

(Property management: Happoone Kaihatsu K.K.)

◆ Planning

Happoone Kaihatu K.K.

"Happo 50 Years Ahead" Project