

### Looking at Hakuba Happo-one's Hot Spring through the "Lens of Science"

Hakuba Happo-one attracts a steady stream of visitors keen to benefit from the rejuvenating properties of its natural baths. The onsen (hot spring) water's high alkaline content, which has a pH of over 11, means bathers emerge from the tranquil baths delighted with how smooth and soft their skin feels. But the onsen's appeal is more than skin deep. These hot springs are extremely valuable to science and can teach us a great deal about life on Earth.

### Beginning of Life

Scientists believe that the Earth was born approximately 4.6 billion years ago and that life began four billion years ago. At the Tokyo Institute of Technology's Earth-Life Science Institute, researchers study a variety of fields in order to better understand the origins of the Earth and of life itself. A leading hypothesis on the origins of life is the deep sea serpentinite vents theory, which suggests that layers of the hydrocarbons exposed on the Earth's surface and the seafloor reacted with hot water to form organic compounds, which became the basis of life.

### Hakuba Happo-one: An Unusual Place on Earth

The serpentinite vents theory is named for the snake-like patterns formed on peridotite rock when it reacts with warm water. Peridotite is predominantly found in the Earth's mantle deep within the planet, but tectonic movements can force it up, exposing it to the air or the seafloor. The Hakuba area has witnessed a great deal of this movement over the course of history, and has one of the largest surface distributions of serpentinite in the world. And thanks to its accessibility, Hakuba has become a leading site for scientific research.

### Onsen Similar to a Primordial Environment

Since 2007 a research team from the Tokyo Institute of Technology has focused its attention on the serpentinite exposed on the surface of Hakuba Happo-one's onsen, and since 2010 has continually analyzed the composition of the excavated hot springs. The results showed that the onsen are highly alkaline ( $\text{pH} > 11$ ) and that the hydrogen content is also extremely high, with hydrocarbons such as methane prominent. Moreover, the water quality is similar to that of water that has reacted with serpentinite. Most excitingly, the researchers discovered that although the number of bacteria is much lower at Hakuba than at other hot springs, the bacteria present are able to survive in highly alkaline environments, a trait similar to that of primordial lifeforms. Researchers believe that Hakuba Happo-one's onsen has the same water quality as that which existed four billion years ago, when life first emerged on Earth.

### Scientists Around the World with Eyes on Hakuba Happo-one's Hot Spring

It is hoped that continued research of Hakuba Happo-one's hot spring may enable us to understand the beginnings of life on primordial Earth. Another research team at the Earth-Life Science Institute presented their research results on Hakuba Happo-one's onsen in the 2014 publication "Earth and Planetary Science Letters." Additionally, a new research project on the origins of life was started in 2014, with funding from the Ministry of Education, Culture, Sports, Science and Technology's scientific research funds. Scientists from around the world have their eyes on Hakuba Happo-one, which is considered one of the most important places in the world for examining the origins of life.

### Pondering the Mystery of Ancient Times

Hakuba Happo-one is said to have the same aquatic environment as existed four billion years ago—and with further studies some of the mysteries of the origins of life on Earth may be solved right here. Why not ponder the mysteries of life on Earth yourselves while taking a soak in a bath at Hakuba Happo-one?