

GEOTHERMAL ENERGY IN HISTORY. THE CASE OF JAPAN: OUR COMMON HERITAGE

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Abstract

From pre-historic times to just before the industrial age in Japan, the history of geothermal energy is the history of hot spring bathing. The oldest vestige of this, dating from the pre-pottery period before 11,000 B.C., can be found near Oyu hot spring, Akita Pref. Archaeological evidences, myths and legends of bathing appear in several stories from ancient times. Of particular importance in early records are the visits made by Emperors to those hot springs spas. Some texts from the beginning of Heian era in 794 to the late Edo era describe both the primary characteristics of bathing in hot springs including the processes of making artificial hot spring water.

1. Introduction

As Japan is a volcanic country, she is blessed with many hot springs. The vestiges of bathing in hot springs in pre-historical ages have been excavated in every part of the country. This implies that ancient people had a habit of bathing in hot springs.

In the pre-Industrial Ages geothermal heat had not been recognized, any as hot springs for balneotherapy. Since baths in hot springs had shown various medical benefits, the discoverer as described in myths and legends of hot springs were frequently gods, Buddhas, high priests and marvelous animals.

In the present article, pre-historical vestiges of hot spring baths are listed in Section 2. In Section 3, myths and legends of volcanoes and hot springs are described with typical examples. Section 4 is assigned to bathing as it is described in old historical books. As Imperial visits to spas are symbols of the Japanese who like hot spring-bathing, they are noted in Section 5. In Section 6, the history of hot spring bathing from 794 to 1867 is described. Finally some conclusions and remarks are found in Section 7. Location of the hot springs cited here is indicated in Fig.1.

2. Pre-historical periods

Old stone implements used during the 3rd ice age (about 200 thousand years ago) were excavated at a site of Niisato, Gumma Pref. There is some evidence that the ancient people who knew neither pottery nor polished stone implements lived in Japan.

The ancient Japanese people lived in a warm and humid climate, particularly in summer, probably must have felt refreshed in mind and body after taking hot or cold baths. It is easily imagined that the ancient people brought up in a country blessed with pure Springs and clear rivers took a dip in them

to forget the summer heat and to sweat.

Moreover, since many hot springs are distributed along volcanic zones all over Japan, the people probably enjoyed baths in them all the year round. Thus, the bathing practice came into existence, and since people experienced also that bathing in hot springs is of medicinal value, the bathing may be connected with natural reverence. So reverence for hot springs promotes conversely bathing in hot springs, and the process gradually gives the Japanese people a passion for hot spring bathing.

Large stones with an odor of hydrogen sulfide arranged circularly were found at the depth of 5.5 m in Suwa, Nagano Pref. An expert opinion is that they were used about 6000 years ago as the frame for hot spring bathing, because broken pieces of pottery and polished Stone tools excavated together were coated with encrustations.

On the other hand, an ancient colony of about 6000 years ago was excavated on the east side of Lake Suwa, Nagano Pref., where large stones with encrustations were buried at 6 m in depth. This is considered to be the ruins of a public hot spring bath for ancient people. Moreover, at present, hot spring water wells up from the bottom near the east front of the lake. About ten thousand years ago, the Water level of the lake was estimated to be about 2 m lower than at present: thus the ancient people may have boiled fish seized from nearby rivers and were warmed by bathing in the hot spring.

Many vestiges of the ancient Japanese were unearthed near the site of present hot springs. Prominent sites are as follows:

During the pre-pottery period before 11,000 B.C.,

Yuda hot spring, Iwate Pref.

During the Jomon period from 11,000 B.C. to 300 B.C.,

Oyu hot spring, Akita Pref.,

Kaminodan hot spring, Nagano Pref.

and

Kawazu hot spring, Nagasaki Pref.

During the Yayoi period from 300 B.C. to 300 A.D.,

Kokanoe hot spring, Shimane Pref.

and

Kamanokuchi hot spring, Ehime Pref.

3. Myths and traditions

3.1. Volcanoes

Since Japan has many volcanoes, there are many myths and traditions associated with them.

The two imperial histories that include myths, "Kojiki" published in 712 and

"Nihonshoki" published in 720 tell of Prince Izanagi and Princess Izanami bearing the various gods of house, tree, wind, sea, river, mountain and field followed by the Japanese country consisting of many islands. Their youngest child was the god of fire. The god burned the genitals of Izanami and she died. The god may have implied the volcanic islands which appeared last after the other islands. It is well known in geoscience that the formation of the volcanic islands is very recent relative to the other ones in geologic time.

The two histories mentioned above also describe Prince Susano. He was exiled from the heaven due to his sin, descended to a village in Izumo (presently, Shimane Pref.), and saw a crying old couple surrounding their daughter. They replied to his question that a big red-eyed snake having eight heads and tails separated by its tree- and shrub-coated body across eight hills had descended from a mountain to attack the village and ate a daughter every year. Their daughter's turn came this year. Susano took pity on them. He changed her into a small comb to keep within his hair after he married her. Susano asked the old couple to make a strong liquor by fermenting it eight times and to pour it into eight large tanks placed in front of eight gates of the fence enclosing the "snake living mountain". After a while, the snake came to drink the eight tanks of liquor and emptied them. When the snake got dead drunk, Susano attacked and scattered the snake with his sword, and a nearby river was dyed red with blood of the snake. Lastly when he cut off the tail, he discovered a big sword. The scene is similar to that at the eruption of a volcano. If the snake is replaced with an erupting volcano, red scorching lava flows along eight ravines from the crater can be envisioned.

From ancient times the Japanese had faith in the gods. Since they believed that eruption of a volcano is due to anger of a god living within the volcano, they built a shrine at the volcano and decorated it with the order of merit from the Emperor.

Mt. Takachiho in the Kirishima volcanic range has been handed down as the site, to which the ancestor of the Emperor descended from the Plain of High Heaven or the Japanese Olympus.

These episodes imply that ancient Japanese might have combined the gods and man through the mysterious volcano.

Moreover, about 1150 a Buddhist priest saw a Buddhist saint, Sengen, disguised himself as a woman who appeared during his self-exile at the top of Mt. Fuji, the most famous and the highest volcano (3776 m) in Japan. He realized that the Buddhist saint Sengen was identical with the Prince Asama, the god of Mt. Fuji.

This was the beginning of the thought of mixture of Buddhism and Shintoism which had spread in Japan until the modern era. The thought was also born through volcanoes.

3.2. Hot springs

old hot springs in Japan frequently have their own myths and traditions associated with them. The following is prominent ones.

(a) Kami-Suwa and Shimo-Suwa hot springs, Nagano Pref.

When Prince Takeminakata and Princess Yasakatame residing at the main Palace of the Suwa Shrine at the southeast side of Lake Suwa divorced, the Princess received a cotton ball wetted by soaking it in a hot spring near the main palace as a sort of consolation. Holding the ball she passed over Lake Suwa and put it at the autumn Palace of the Shrine. A hot Spring began to well up and this hot spring was named Cotton hot spring (Shimo-Suwa hot spring at present). At the same time, the hot spring near the main palace decreased its temperature and flow.

A hot spring gushing hot and a great quantity of water appeared at a site where many hot water drops dripped from the cotton ball the Princess held. This is Kami-Suwa hot spring at Present. Since drops dripped also over the lake, some hot springs gushed from the lake bottom. In this manner, so many drops dripped out that the cotton ball gradually dried up and, therefore, Cotton hot spring was of weak activity in bath temperature and flow.

(b) Atami hot spring, Shizuoka Pref.

Before the descent to the earth of the descendants of the Sun-Goddess, the ancestor of the Japanese Emperor, Prince Omonachi who felt pity for pre-mature death of the Japanese people at that time, taught medicine manufacturing and the way of bathing treatment to Prince Sukunahikona. He was sent as the god of the hot spring in Izu Province (Shizuoka Pref. at present). The hot spring boiled and gushed hot water two times per day. All kinds of diseases were treated by soaking the patient in a tub filled with the hot water. This is Atami hot spring at present.

(c) Dogo hot spring, Ehime Pref.

When Prince Omonachi dipped Prince Sukunahikona in a state of apparent death in a hot spring, he revived him from death. At that time, the hot spring was believed to be introduced through an underground water way from Beppu hot spring, Oita Pref. across the sea. This is Dogo hot spring at present.

(d) Arima hot spring, Hyogo Pref.

Princes Omonachi and Sukunahikona discovered Arima hot spring from fumes in a ravine.

(e) Discoverer

Old spas are almost always associated with the legends of a discoverer. The results of the classification of these legends by discoverer are as follows, with Prefecture in parentheses:

Gods and Buddhas: Arima (Hyogo), Dogo (Ehime) and Tamatsukuri (Shimane).

High priests: Ryujin (Wakayama), Goshiki and Atsumi (Yamagata), Atami, Izusan and Shuzenji (Shizuoka), Kusatsu and Hoshi (Gunma), Awazu, Yamanaka and Yamashiro (Ishikawa) and Yumura (Shimane).

Marvelous animals: Yuda (Iwate) and Kinosaki (Hyogo).

4. "Fudoki" or Description of the natural features of Province

In 713, the Imperial Court of Japan ordered all the Provinces of Japan to compile the "Fudoki" or description of the natural features of the province. The origin and de-

scription of hot springs are found in several Fudokis as follows:

(a) Fudoki of Izumo Province (Shimane Pref. at present) published in 733

The Fudoki describes that when the Governor of Izumo went up to the Imperial Court in Yamato to present new year greetings to the Emperor at every new year, he always performed his ablutions at a Site of a hot spring in Izumo. Usually, men and women gathered at the hot spring to enjoy baths, drink sake (Japanese rice wine) and celebrate. This hot spring was also popularly believed to cure many diseases. This is the Tamatsukuri hot spring at present.

Moreover, the Fudoki described Yumura, Yunokawa and Ushio hot springs.

(b) Fudoki of Bungo Province (Oita Pref.)

The Fudoki said that the Water of Red hot spring is red and provides red mud which is used to paint pillars of houses. The red mud water become clear as it runs out eastward from the spring after depositing red mud on the bottom of river.

Red hot spring is Chinoike-jigoku (blood pond in hell) in Beppu hot spring at present. Here the hot spring gushed clay mud with the red hot water colored from ferric sulfide. In ancient times, red was held in esteem to avert evil.

Also the Fudoki describes that when a man cries in a loud voice near the erupting hole, very hot water with steam will boil out and wither the surrounding vegetations. This geyser survives in Beppu at Present.

(c) Fudokis of Settsu Province (Hyogo Pref.)

This Fudoki describes Arima hot springs in simple farm.

5. Imperial visits to hot springs

The first visit of the Emperor of Japan to hot springs was the visit by the Emperor Jomei in 631. His Majesty the Emperor went to Arima in September and returned to the Imperial Court in December. Hot springs may have been so appealing to him that he went to Arima again in October of 637 until the next year. Two years later in 639, he visited Dogo hot spring, Ehime Pref.

Legends say that the Emperor Keiko (71-130) visited Dogo hot spring, Ehime Pref, and the others. The Prince Shotoku also visited Dogo in 596.

6 Hot springs in history

6.1. The Heian era (794-1192)

During this era one of the largest scale developments of the country took place; in particular paddy lands were developed in a warm and mild climate. Many new villages appeared and, therefore, there were frequent movement of population to those villages. A stepped-up agricultural production from newly reclaimed paddy fields fostered the growth of commerce. Thus the reign by the Emperor extended his control over this era.

On the other hand, noblemen frequently went to spas for bathing and to try the bath for medical purposes. A poem composed by Lord Kanetsuke Fujiwara, a famous poet, on his way to Kinokuni spa, Hyogo, was found in an old

anthology "Kokin" published in 913. It was recorded in history books that in 998 Lord Yuken Fujiwara took a vacation to improve his health in a hot spring in Nagano Prefecture. Lord Michinaga Fujiwara went to Arima spa for the baths in 1024 and Lord Sadatsugu Hamuro went to Arima spa in 1086.

6.2. The Kamakura era (1192-1393)

In the Kamakura era, in which Samurai or Japanese warriors governed the country, noblemen still went to spas for baths. For example, it is on record that Lord Karumitsu Fujiwara went to a spa in 1231. In September of 1287, Emperor Gofukakusa had hot spring water brought from Arima spa over a distance of about 100 km to have a bath in the Imperial Palace in Kyoto.

There are many descriptions of the samurai that used the baths at hot springs for healing injuries suffered in their wars.

An episode, found in a famous history book, "Heike Monogatari", describes a Buddhist priest exiled to a southern lonely island. He dug for sulfur by climbing a nearby volcano to exchange for foods that merchants provided. In this period, various parts of the country made a present of sulfur to the Imperial Court as raw material for medicines and gunpowders.

6.3. The Muromachi era (1393-1574)

In the Muromachi era, temples and Shrines had large territories all over the country and the custodians came and went everywhere to administer them. The conditions of hot springs distributed nearby were described by reports. At the same time, many tours including pilgrimages to several spas took place.

6.4. The Azuchi-Momoyama era (1574-1603)

In the Azuchi-Momoyama era or the late Japanese warlike age, many warlords and their subordinate personnel were in the habit of salving wounds by bathing in hot springs in their territories. They had, therefore, several of their own secret spas for healing wounds.

6.5. The Edo era (1603-1868)

From early in the Edo era gift of hot Spring water was made from Atami spa to the tycoon or the sovereign entrusted with full Power from the Emperor. This was accomplished by transporting 300 kiloliters of water in barrels about 100 km several times a Year.

The gift extended to Hakone spa about 100 km west from Edo (Tokyo at present). Transportation of barrels of hot spring water began in 1644.

Under such circumstances, the Daimyos or feudal lords, warriors and populace were attracted to take a bath in Hakone and Atami spas.

On the other hand, since about 1654 the Kaga (Ishikawa Pref. at present) local government had exported hot spring water put in barrels from Wakura spa to Kyoto, Osaka and Edo at a relatively expensive rate. This greatly enriched the local government.

In the Edo era Japan had one of the most advanced publishing activities in the world, even though it was before the invention of modern printing machines. The two medical books, one, "Yojokun" published in 1710, is

very famous in Japan. It published a description of diseases for which hot spring bathing is capable of treating at different spas. Some guidebooks were also printed in 1710 to 1730 for many spas describing medical benefits, ways of bathing, lines of travel, nearby sight-seeing resorts and Souvenirs

In the mid-Edo era, old medicine and pharmacy began to put experimental techniques into use. A famous medical doctor Konzan Goto selected Kinosaki spa, Hyogo, as the experimental field for balneotherapy to test medical benefits of hot springs for oedemata, lumbago, gout, palsy, paralysis, beriberi, gonorrhea, anal fistula and menopause. The four-volume books he and his follower, Shuan Kagawa, published in 1734 said that sickness for which balneotherapy had medical benefits were chronic ones. This opinion is also warrantable today.

They gave another conclusion that Kinosaki hot spring had such excellent medical benefits that many people came from every place to Kinosaki to take the hot spring cure. Thus, Kinosaki spa flourished at that time.

Another follower of Dr. Goto, Tsuan Yamamura concluded that medical benefits of Kusatsu hot spring were equal to Kinosaki by comparing various hot springs in many places. Fig.2 shows a Scene of bathing in Kusatsu spa in the Edo era.

Since he considered that travel to any spas was difficult for a sick person, he developed a kind of artificial hot spring water for bathing in their home by adding sulfur into rice bran Concentrated in Salt water

The attempt to make artificial hot spring water was achieved by some medical doctors who studied Western Sciences by means of the Dutch language. Kondai Utsugi made the water by heating pulverized sulfur, alunite, arsenious sulfide after pouring salt water into them. He claimed this water could serve the same medical benefits as Arima hot Spring water, but unfortunately it was very expensive for the masses. He improved the price by dissolving natural geyserite in salt water.

In the late Edo era, Yoan Utagawa chemically analyzed water sampled from 36 spas from 1828 to 1843 to classify them as to acidity, saline, sulfur and chalybeate (salts of iron) and to identify medical benefits for every hot spring.

7. Conclusions and remarks

As the author is not a historian and English is not his mother language, the author has gone through all sorts of hardship. But it is a pleasure to compare the Japan's geothermal history with the histories of other countries at the history session of the World Geothermal Congress. Since each section of this article was composed by mainly citing Yatsuiwa (1993), the other auxiliary literatures listed in References were not noted in the text.

The sole regret is that the materials of Geothermal Energy in History --- The Case of Korea --- is not available. Mr. Kwan-Sik Hong, Secretary General of Korea Hot Spring Association, said that in Korea there are no ancient records of hot springs.

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References

- Aoki, K. (1965). *A History of Japan: Vol. 1.* Chuokoronsha, Tokyo. 504pp. (in Japanese)
- Inagaki, M. (1990). *Kamisawa Hot Spring, Geothermal Energy*, 15, 109-123. (in Japanese)
- Inoue, M. (1965). *A History of Japan: Vol. 3.* Chuokoronsha, Tokyo. 528pp. (in Japanese)
- Kinosaki-cho (1988). *A History of Kinosaki-cho*. 1227pp. (in Japanese)
- Kusatsu-cho (1976). *On Kusatsu Hot Spring*. 1123pp. (in Japanese)
- Tanaka, Y. (1986). *Mechanism of volcano*. Hakuryukan, Tokyo. 183pp. (in Japanese)
- Yatsuiwa, M. (1993). *Thermal springs and the Japanese*. Seikyusha, Tokyo. 197pp. (in Japanese)
- Yuhara, K. (1993). *Atami Hot Spring, Geothermal Energy*, 18, 253-269. (in Japanese)

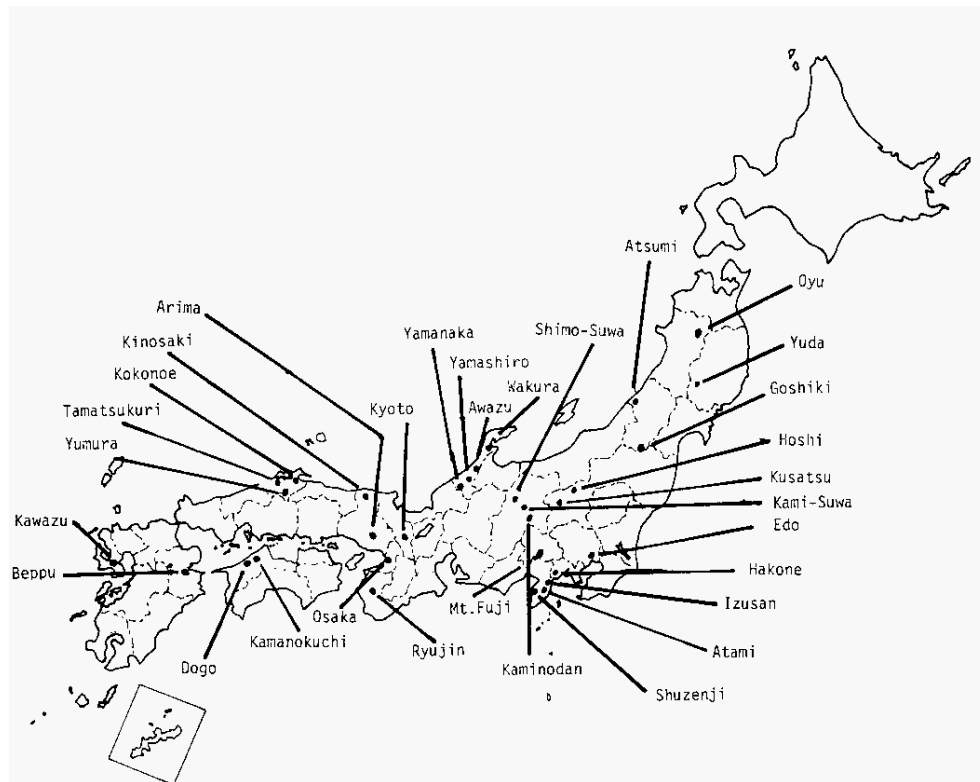


Fig.1. Location of the hot springs and the three big cities. Edo (Tokyo), Kyoto and Osaka. cited in the text.



Fig.2. A scene of bathing in Kusatsu spa in the Edo era