Guide to Yamanashi Sake Based on Results from Geological Survey

Geologist Discusses Yamanashi's Water as a Source of Sake

Contents

Introduction to Survey

Aim of this Survey

The main ingredients of sake are water, rice, rice koji, and yeast, with water making up the largest component (80%). In the past, discussions about Terroir—the relationship between sake and the natural features of the region where it is produced—often delved into the importance of local rice production, while for the most part, adding a footnote about the use of locally available water. Although there have been research reports that analyze water quality, very few reports have explored the effects of geology on water. This project marks the first-ever attempt to decipher the local brewing water from the geological features of Japan.

Led by geologist Kenichiro Hisada, the survey seeks to systematize the diversity of the quality of groundwater used for sake brewing from a geoscience perspective. By clarifying the relationship between the source and the quality of the water that flows throughout Japan, the findings are intended to be used to increase the value of sake, not only by those involved in sake brewing and sake exporting throughout Japan but also by local governments, regional associations, and others interested in regional resource branding. This survey is of sake crafted in Yamanashi Prefecture, which is the most particular about its brewing water in the country, as demonstrated by the conditions in its GI (Geographical Indication): limiting to water from six water systems in the prefecture, with collection conditions defined for each water system.

Kenichiro Hisada Profile

Born in Tokyo in 1954, Dr.Hisada graduated from the Tokyo University of Education, the Faculty of Science in 1977 and earned a PhD in Geosciences at the University of Tsukuba. After working as an assistant at Osaka University of Education, he was a Professor at the University of Tsukuba until his retirement in 2020. He specializes in geosphere transition science. His research sites include various parts of the Japanese archipelago, Thailand, and Laos. He has recently been engaged in archaeological geology, surveying West and Central Asia. He has also served as Vice President of the Geological Society of Japan (2010-2012), President of the NPO Japan Earth Science Olympiad Committee (2014-2016), President of the Education and Science Division of the Mt.Tsukuba Regional Geopark Promotion Council (2016-2020), and President of the Japanese Society for Earth Science Education (2016-2022). He is a part-time lecturer at Bunkyo University and Chiba Institute of Technology and has appeared as a lecturer in the NHK High School Course Earth Science (1995-present).

How the Survey was Carried Out

- Survey Period: divided into two phases: Nov-Dec 2022 and Oct-Nov 2023
- Details of Survey:
    - First Phase (Nov-Dec 2022): the project visited multiple springs spread throughout the survey area, collected samples of the main spring waters at each location and brewing water from the breweries, and investigated the quality of the geology and the water characteristics. It also visited five sake breweries in the prefecture (Sasaichi Shuzo, Tanizakura Shuzo, Yamanashi Meijo, Ide Sake Brewery, Yorozuya Jozoten) and interviewed them about the

local climate, culture, and sake brewing with a focus on how they use the water in their brewing. The brewing water quality was analyzed at the Research Institute for Humanity and Nature.

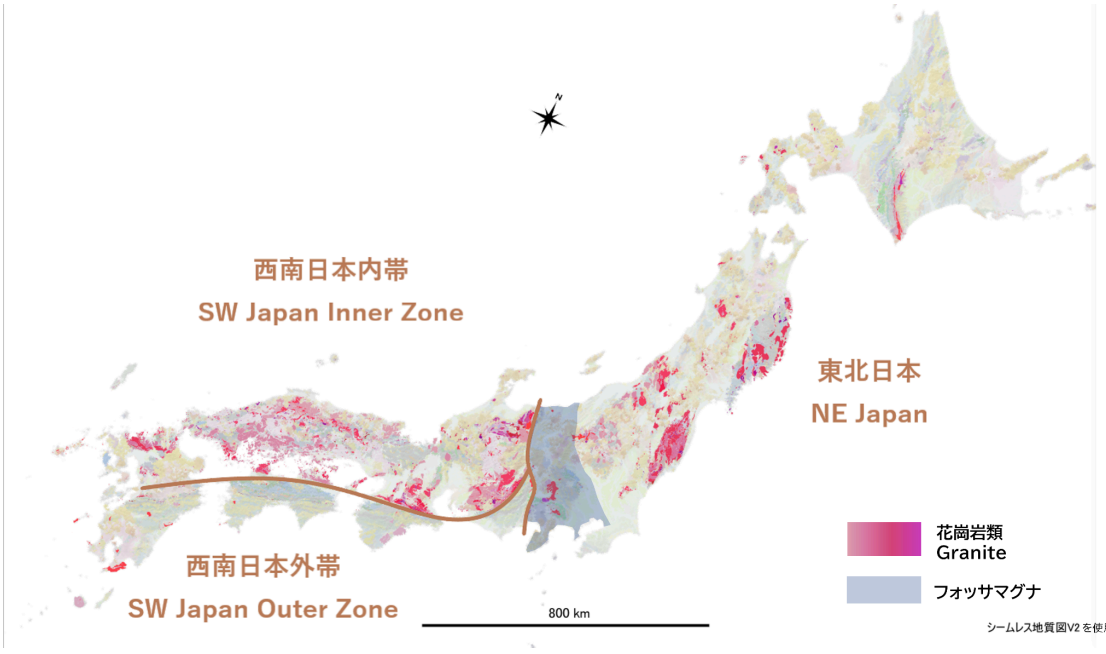
- Second Phase (Oct-Nov 2023): Tracing the topography of the southern Fossa Magna and Kofu Basin—which define the Yamanashi topography—and Jomon cultural remains, the project conducted more detailed water quality surveys at several sake breweries to estimate recharge areas and water ages.

- This survey report provides only an outline of the water quality survey carried out at each brewery; detailed data and considerations were shared with only the breweries at which the surveys were carried out.

1. Yamanashi: Headwaters of Japan's Sake Culture

Yamanashi Through a Geoscience Lens

Japan's Archipelago consists of a complex geology of rocks and layers that have been formed over hundreds of millions of years and are connected to its history. Throughout this history, around 15 million years ago, it was part of a vast continent on the eastern edge of Asia before breaking off and becoming an island. This origin is evident in the current geological distribution of rocks near the surface, which can be divided into either Northeast Japan or Southwest Japan; the latter can be further subdivided into the Japan Sea and Pacific Ocean sides. Geologically, the Japanese Islands show different characteristics in three zones: Northeast Japan, Southwest Japan Inner Belt, and Southwest Japan Outer Belt.



Among them, the Fossa Magna, which marks the boundary between northeastern and southwestern Japan, is a prominent landform of the Japanese Islands, and its formation has

been a matter of concern for the developmental history of the geological structure of the Japanese Islands over the past several tens of millions of years. The Fossa Magna, described by geologist Kantaro Fujioka in his book “Fossa Magna: The Nature of the Gigantic Rift that Divides the Japanese Archipelago,” is a great rift valley that crosses Honshu and runs from north to south, including Yamanashi Prefecture. Of these, the northern Fossa Magna is thought to have been formed by crustal deformation related to fractures associated with the formation of the Japan Sea. At the same time, the southern Fossa Magna is said to have been created by at least two volcanic island collisions. The Kofu Basin in Yamanashi Prefecture is included in this southern Fossa Magna and is home to Mt.Fuji, Tanzawa - Misaka - Koma mountain ranges, and the Yatsugatake mountain range.

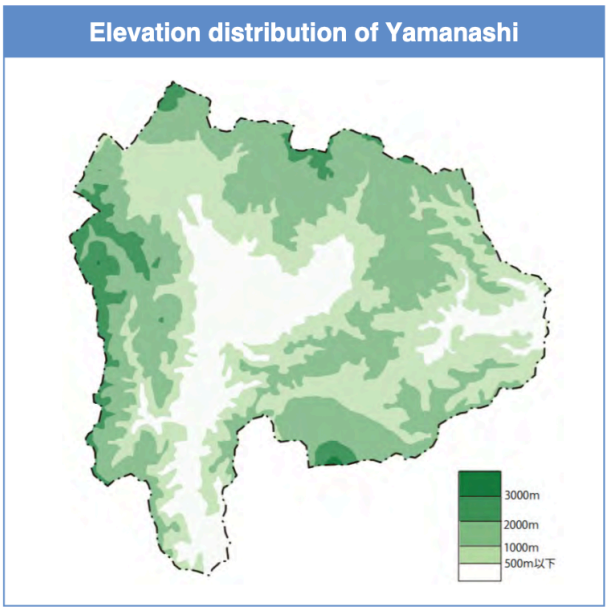
Yamanashi Prefecture and Fossa Magna Positional Relationship

This section proposes that analyzing this unique Fossa Magna zone reveals present-day Yamanashi Prefecture as the origin of Japan's sake culture.

Yamanashi’s Prosperity in the Jomon Period (14,000 – 300BC)

Yamanashi and Nagano prefectures are famous for their archaeological sites and excavated pottery and clay figurines, as introduced on Jomon World's website, registered as Japan Heritage in 2018. The website states that during the mid-Jomon period (about 5,000 years ago), when pottery production flourished, as much as one-fourth of the population of the Japanese archipelago was concentrated in the area. The region’s topography was what attracted them. Yamanashi’s topography can be summed up as follows: the Kofu Basin and surrounding highlands, with more than 2,000-meter elevation difference between the mountains and basin. Furthermore, with easy access from all four sides via the Fossa Magna, which acted as a natural road, the basin prospered as a trading hub for people who came from Shizuoka and the Kanto Flatlands to Nagano to collect obsidian. It is no

coincidence that the old name for Yamanashi, Kai Province, comes from the Japanese word for trade (kai or majiwaru).



Yamanashi Prefecture Elevation Difference

Potential as Japan's First Sake Brewing Region

One type of earthenware excavated in the Central Highlands is something called a yuko tsuba-tsuki doki. It is said that this vessel, which has equally spaced holes directly below its rim, was most likely used as a sake production tool. The holes would act as a vent to allow gases produced during fermentation to escape, and according to Yukikazu Noshiro of the Yamanashi Museum of Archeology, the discovery of traces of wild yam and elderberry found in these jars suggests that they were used to craft fruit wine and medicinal wine.

Yuko Tsuba-tsuki Doki (Yamanashi Museum of Archeology)

It is not unreasonable to assume that sake was brewed in Yamanashi during its heyday, a place where people from all over the country gathered. It is more than possible that the people who gathered in the basin were overwhelmed by the famous Kai-komagatake in the Southern Alps, facing the Yatsugatake Mountains. The mysticism of the Kai-komagatake led them to believe in the existence of deities, and they started brewing sake as an offering to get closer to them.

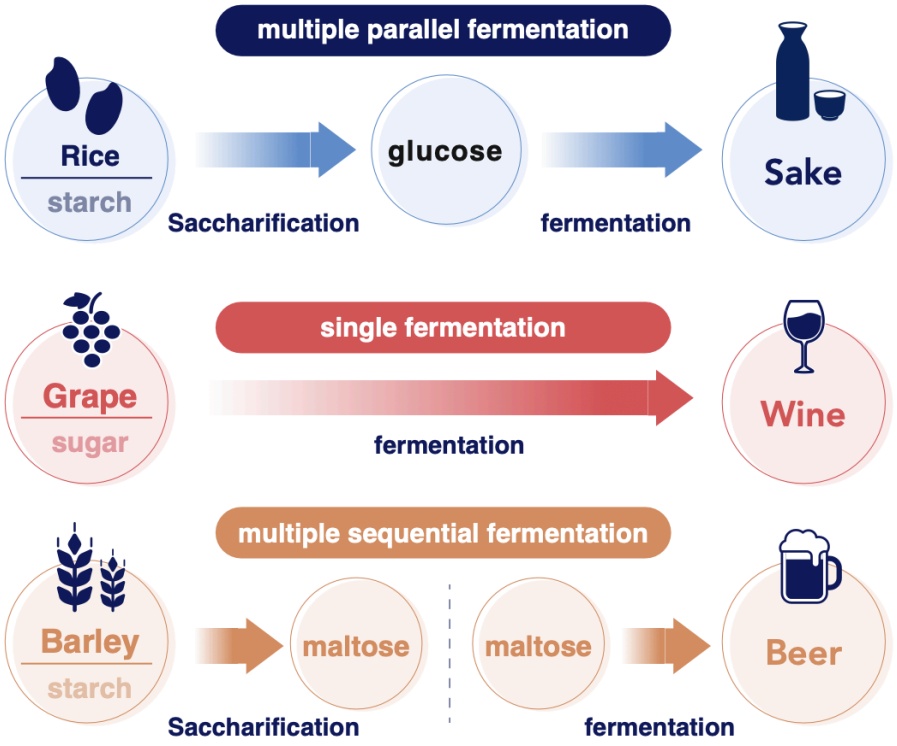
However, the next part of this study reveals the possibility that Yamanashi became familiar with sake culture. The following chapters look at how sake brewing developed in the region after rice cultivation was introduced from the mainland, from the perspective of water as the primary raw material.

2. Sake Crafted by Japan's Topography

The Ingredients, Methods, and History of Sake

Before discussing the development of Yamanashi sake, the following section explains how Japan's national fermented beverage, sake, is made compared to other alcoholic beverages.

Sake, or nihonshu as it's called if made in Japan, is a fermented beverage made from rice. In order of ratio, the main four ingredients (sometimes additives are added) are water, rice, rice koji, and yeast. Sake belongs to the same category as wine and beer, but unlike grapes rice lacks the critical prerequisite for alcohol fermentation, glucose. However, rice does contain starch. In order to break the starch down in the rice into sugar, the rice is steamed to convert the starch into α type, which is then broken down by enzymes that the rice koji secretes into sugar that can then be fermented into alcohol. Whereas in beer making, saccharification (sugar conversion) and alcohol fermentation are carried out as separate processes, in sake making, the rice, rice koji, water, and yeast are loaded into a single tank, and both processes are combined. The processes used to make wine and beer are called single fermentation (the glucose in the grapes is fermented directly) and multiple sequential fermentation (starch is saccharified into a sugary liquid called a wort, which is then fermented), respectively. The process used to make sake is called multiple parallel fermentation. Due to sake's unique process, it is possible to create a beverage, which in its undiluted form, can have an ABV of up to 22%, making it the strongest fermented alcoholic beverage in the world.



Different fermentations of sake, beer, and wine

The prototype of sake brewing began during the Yayoi period (10th century B.C. to mid-3rd century A.D.), at about the same time that rice cultivation made its way from the continent to the Japanese archipelago. While most of what is now called sake is made by filtering/pressing and separating the solids (lees after fermentation) from the liquid, unpressed/unfiltered sake called doburoku was created around this time and took root as a home-brewed sake.

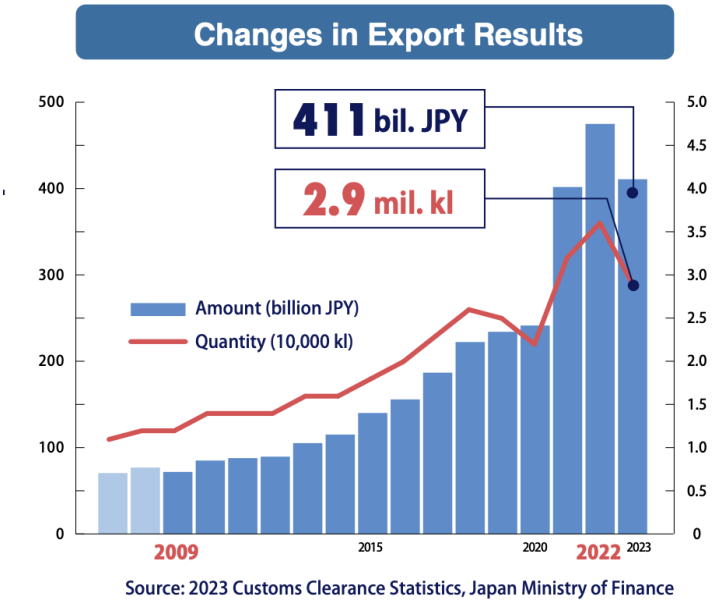
As a country with many national spiritual rituals, rice-based alcohol was essential to Japan, as evidenced by the establishment in the 7th century (689) of a department called Miki no Tsukasa, or sake department, in the Imperial Household Ministry, the country's national administrative organ.

The prototype for the current system of sake brewing was created during the Muromachi period (14th-16th century) and the Edo period (17th-19th century), with the introduction in 1657 of a “sake stocks” system, in which only those with a license were allowed to brew sake. Thus, the licensed sake brewery was born. Home brewing was banned in 1899, and since then, only those with a license have been allowed to produce alcohol, including sake, in Japan.

The Sake Crafting Brewery and Terroir

As of March 2024, there are approximately 1,500 sake breweries in Japan. Of the 47 prefectures in Japan, Niigata (89), Nagano (78), and Hyogo (66) have the most. Domestic demand for sake peaked in 1973 and has declined for over 50 years. The reasons for this are thought to include a declining population, an aging population with fewer children, and more choices due to the diversification of alcoholic beverages and tastes. This suggests

that the population segment that used to order sake at an izakaya (tavern) is now ordering beer, wine, shochu with water, soda, etc.
While the domestic market is shrinking, the international demand for sake is increasing due to the growing demand for Japanese food and the growing global health consciousness. Over the same period, the value of exports grew more than sixfold.



Every year, more breweries enter the international market. In this context, sake breweries have recently become keenly aware of the terroir concept, the relationship between sake quality and regional characteristics, often referred to in the wine industry to make products stand out.

Just as a wine terroir describes the natural environment in which the grapes are grown, the focus of the sake terroir is often the rice. However, unlike wine, which is made by fermenting grapes and their juice, sake comprises a wide range of elements, including water and yeast. Recently, brewers have been actively using locally developed yeast or brewing without yeast, using only microorganisms indigenous to the brewery, in pursuit of brewing methods unique to the region and the brewery.

GI - As an Extension of Terroir

In response to this trend, a GI (Geographical Indication) protection system for sake is gaining momentum to protect the identity of local products. The first GI for sake was the GI Hakusan in Hakusan City, Ishikawa Prefecture, in 2005, but this was just the start; many other prefectures have registered a GI since.

Yamanashi received its own GI, GI Yamanashi, in 2021. The requirements for certification are as follows.

- A clean taste with softness and clarity.
- It results from natural factors, such as gentle fermentation, and human factors, such as developing a sake brewing process to craft sake that pairs well with salty foods.

- Brewing water is limited to six water systems in the prefecture, with strict collection conditions.
- The sake must be made with domestic rice of grade 3 or higher under the Agricultural Produce Inspection Law, and alcohol addition is limited to 10% of the weight of the mass of the polished rice.

How has Yamanashi Prefecture's sake industry progressed over the years to reach this level of recognition? The following section will unravel the history of sake brewing in Yamanashi Prefecture, focusing on the 12 existing sake breweries.

3. What Makes Yamanashi Sake Unique?

Basic Data About Sake Made in Yamanashi Prefecture

As of 2024, 12 sake breweries belong to the Yamanashi Sake Brewers Association. According to the most recent data, the production volume is 7,547 Kl, of which the percentage of Tokutei Meishoshu (Special Designation or Premium Sake) is 38% and the percentage of Junmaishu is 24% and that of Junmai Ginjo is 12%.

Yamanashi Prefecture ranks 43rd among Japan's 47 prefectures in terms of rice production. While no sake rice has been developed in Yamanashi Prefecture, many sake breweries use the table rice Asahi no Yume for sake brewing. Despite the aforementioned strict limitations on the brewing water source, the only restriction on rice is that it must be domestic.

The oldest existing sake brewery in Yamanashi Prefecture is Sasaichi Shuzo in Otsuki City, founded in 1661. This was when the Kofu domain was established, and the social infrastructure was being developed under the rule of the Edo shogunate. Yamanashi Meijo started sake brewing at Daigahara on the Koshu Highway in 1750. Having initially operated in Takato, Shinshu (Nagano), it was wooed there by Hakushu’s water quality.

Later, Yorozuya Jozoten (1790), Tanizakura Shuzo (1848), Yoro Shuzo (1849), Ide Sake Brewery (around 1850), Yamaki Shuzoten (1862), Takenoi Shuzo (1865-7), Yokouchi Shuzoten (1872), and Taikan Shuzo (1877) were established successively.
The volume of traffic on the Fuji River increased from the end of the Edo Period in 1867 to the start of the Meiji Restoration the following year. As the flow of people and goods changed, sake shops flourished along the busy roads, which is thought to have spurred the establishment of these breweries in rapid succession.

Mt.Fuji Worship and Sake Brewing

As in other regions, the origins of Yamanashi’s rice-based sake brewing are believed to lie in the Doburoku crafting culture, which began when rice cultivation was introduced from the continent. Furthermore, Mt.Fuji has been a symbol of worship in Yamanashi Prefecture since ancient times, and people would carry out rituals to prevent eruptions. In Shinto rituals, sake played an essential role as an offering called omiki. The Kitaguchi Hongu Fuji Sengen Shrine began as a miniature Shinto shrine on Otsuka Hill during the reign of Emperor Keiko (110 AD) before the main shrine building was built in 788 AD. The presence of this shrine,

where local breweries still serve sake, demonstrates the deep connection between the belief in Mt Fuji and sake brewing.

Sake Industry Development as a Castle and Inn Town

Sake brewing in Yamanashi took off in the Edo period (1603-1867) when Tokugawa Ieyasu established the Gokaido (five highways) and made Kai Province a castle town protecting the western part of Edo (present-day Tokyo). Around this time, the Koshu Kaido, a conduit connecting Edo to Shimosuwa via Kofu (capital of Yamanashi), was created, and Kai Province (present-day Yamanashi) became a base for samurai and their families. Because of its convenient location, four days from Edo, the population at that time was 18,000, making it one of the most prosperous castle towns around Edo.

With its long history as a travel hub for people from all over Japan, Yamanashi prospered as an inn town for Edo (Tokyo) visitors and Mt. Fuji sightseers. When the river construction work by Ryouchi Kadokura was completed in 1607, the Fuji River water transportation between Kadokawa and Iwafuchi in Shizuoka Prefecture also played an important role. The Fuji River supported residents' lives and development as a route to transport timber not available inland from Yamanashi, which had an abundance of trees and salt.

According to Kenji Nakano, curator of the Yamanashi Prefectural Museum, the birth of sake breweries in Yamanashi Prefecture is thought to be tied to this development as an inn town during the Edo period. According to descriptions from that time, local and Matsumoto (Nagano Prefecture) sake was bought and sold to people from all over Japan, including Edo and Mt.Fuji. However, there are records that Kofu sake breweries, while establishing breweries in castle towns close to consumption areas, brought in brewing water from areas such as the Takane district, where water was more plentiful.

To summarize, the development of sake brewing in Yamanashi was a function of the belief in the sacred mountain Mt. Fuji and its role as a travel hub for people from all over Japan to come and go. The final section that follows deciphers the characteristics of water in Yamanashi and explains how it makes the sake of this region unique.

4. Yamanashi's Sake Terroir as Reflected in the Water

Water as a Differentiating Factor Between Sake and Wine

Despite sharing the same fermented beverage category, one differentiating factor between sake and wine is the addition of water. 80% of the total volume of ingredients added to sake is water, so for sake breweries across the country, water was a primary consideration when selecting their location; breweries like Yamanashi Meijo, who fell in love with Hakushu's water, as explained in the previous chapter. While rice is easily transportable due to its preservability, water is not, or at least not in as large quantities as required for sake brewing. That is why water has a more substantial regional bias in the terroir of sake.

In the Yamanashi GI, there are no specific restrictions regarding the growing location of the rice. The strict restrictions on water used for brewing, on the other hand, are a unique feature of Yamanashi sake.

To Control Yamanashi is to Control its Water

Since ancient times, Yamanashi and water have been inseparable. In the legend of the Kofu Basin lake, there is a saying, "Kumotte sansun, tsukiyo dake de yakeru” (lit. clouded over and three sun, scorched by only the moonlight), which means that as soon as it clouds over, the surface of the water rises by about 10 cm, and as soon as the moon rises (clears), it dries up, indicating that this area has long suffered from both flooding and drought.

This meant Yamanashi was faced with the urgent task of taming the water. Mt. Kinpu is the source of the Fuefuki and Chikuma Rivers and is symbolic of Yamanashi's water religion. Ceremonies to appease the water and pray for its blessings are still practiced today, such as the Tendushimai Dance in Oze-cho, Kofu City; the Sekisonsai Festival in Fuefuki City; and other festivals that worship the Japanese water deity Suijun. In Yamanashi, flood control was equal to controlling the area. It is known that Shingen Takeda, the warlord who ruled Kai Province, devoted himself to flood control and irrigation maintenance, and his Koshu-style flood control technology is still in use today as one of the best in the country.

The Water Produced by Yamanashi’s Unique Topography

The unique topography of the Kofu Basin and surrounding highlands influences the water quality. Yamanashi Prefecture has some of the lowest rainfall in Japan, but its funnel-shaped topography allows precipitation from a wide area to be concentrated in the central basin. Therefore, the groundwater in Yamanashi Prefecture is abundant compared to the lack of rain. In addition, as mentioned earlier in the description of the Fossa Magna, Yamanashi comprises a diverse geological formation of two plates. As rain falls from the sky and flows down through the ground, the components of the underground strata and rocks are dissolved into the groundwater. For this reason, the quality of groundwater in Yamanashi Prefecture, which is composed of complex geological formations, differs from one catchment area to another, and these characteristics reflect the characteristics of each brewery.

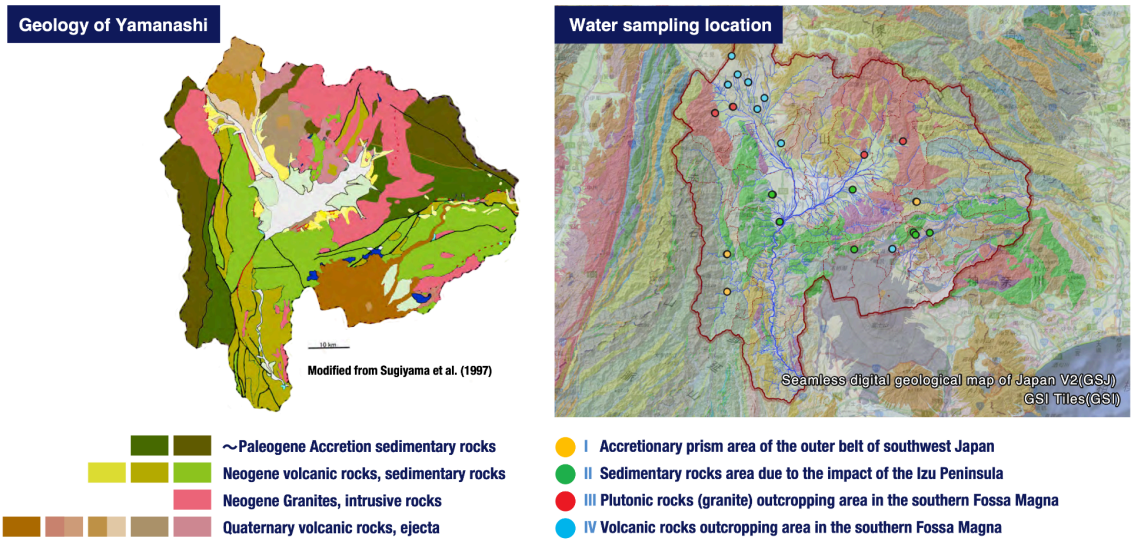
Features of Each Brewery’s Brewing Water

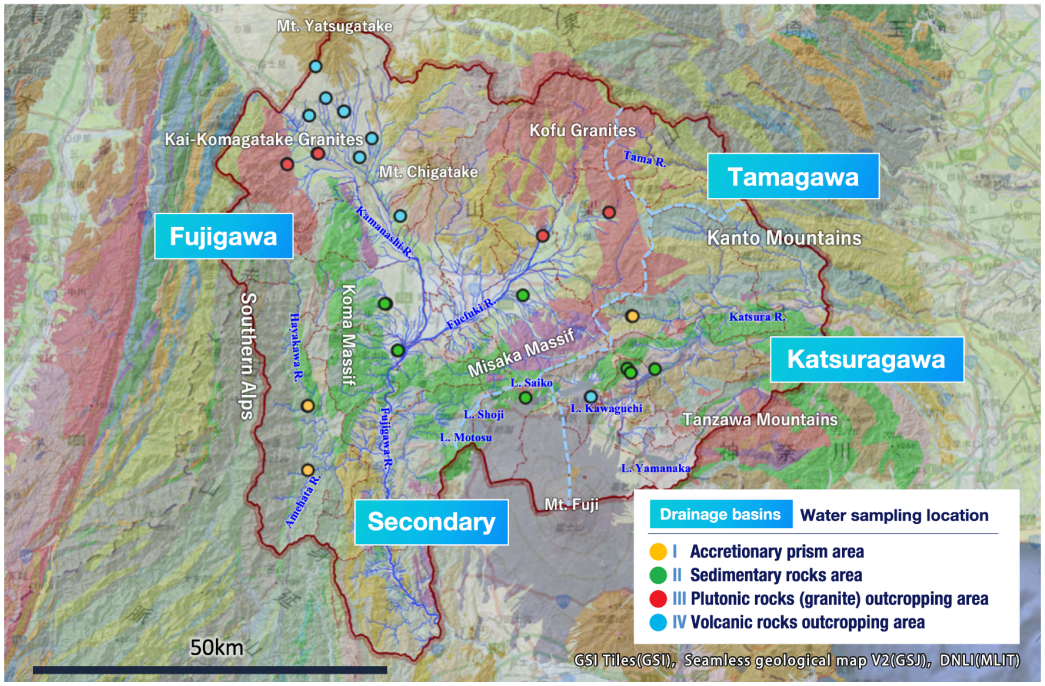
Sake brewing water is often discussed based on the water system, but when looking at the actual water quality, it is essential to identify its recharge area (water source) and flow area.

In this document, geological areas are defined as follows according to the geological features distributed in Yamanashi Prefecture and the distribution of sake breweries.

I. **Accretionary prism area of the outer belt of southwest Japan**
II. **Sedimentary rocks area due to the impact of the Izu Peninsula**
III. **Plutonic rocks (granite) outcropping area in the southern Fossa Magna**
IV. **Volcanic rocks outcropping area in the southern Fossa Magna**

Characteristics of Each Brewery's Brewing Water





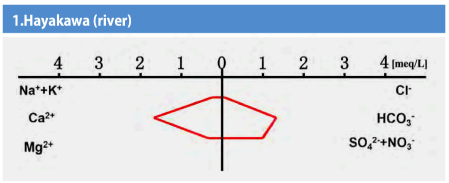
The graphs and main terms used to describe water quality in this section are also explained below.

- **Major dissolved ion concentration:** Indicates the content of basic ionic components (anions: Cl^-, HCO_3^-, SO_4^{2-}, NO_3^-, cations: Mg^{2+}, Ca^{2+}, Na^+, K^+) and their component ratios Graph
    - **Stiff Diagram:** A graph showing the concentration of each dissolved constituent as an equivalent value (meq/L or me/L). The straight line drawn in the center is 0, the cation values are plotted on the left, the anion values are on the right, and the water quality characteristics are seen from the shape of

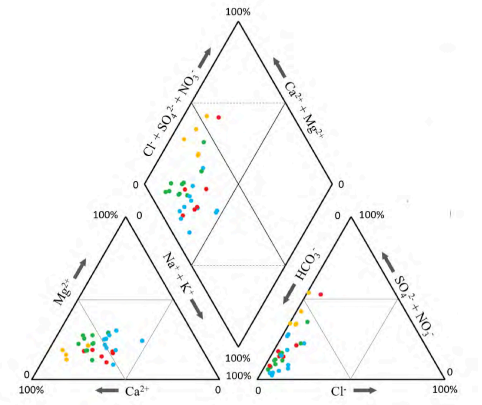
the connected dots. It reveals hexagonal groundwater flow, factors of water quality formation, and evolution of water quality formation.

- **Trilinear Diagram:** Displays dissolved component (dissolved ion) concentrations and dissolved ratios (component ratios), which can be plotted on two triangular coordinate plots and one diamond coordinate plot to visually classify the water and estimate its origin. It is also used to compare multiple samples.

Stiff Diagram



Trilinear Diagram

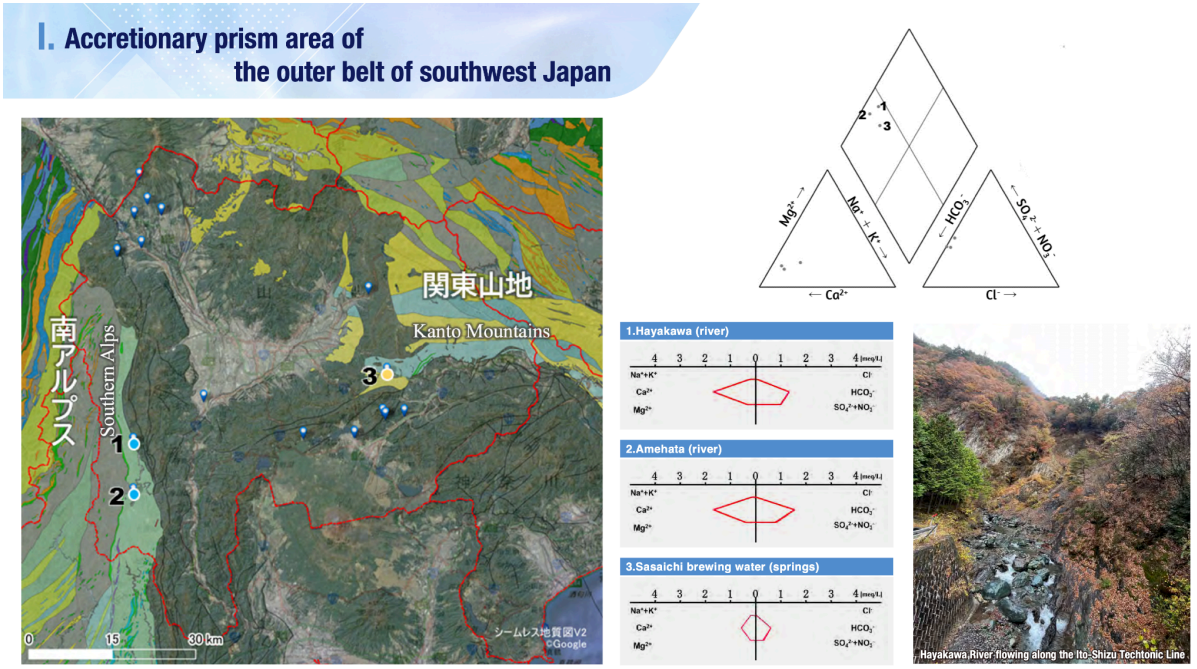


- **Residence Time:** In general, the longer the residence time, the greater the amount of soluble components in water, which often results in higher hardness.
- **$Ca^{-}HCO_3$ type／$Na^{-}HCO_3$ type:** The differences in the characteristics of the amount of dissolved constituents (dissolved inorganic ions) are shown in the following table. In general, the $Ca^{-}HCO_3$ type indicates relatively young (short residence time) water, while the $Na^{-}HCO_3$ type indicates older (long residence time) water. However, there are many exceptions, and it is important to consider the total amount of other dissolved constituents and isotopes.

I. Accretionary prism area of the outer belt of southwest Japan

- Collection Location: Southern Alps/ River Hayakawa tributary or near Amehata Dam
  - Geological Features: Abundance of sedimentary rocks such as sandstone, mudstone, and conglomerate.
  - Water Quality: It shows $Ca^{-}HCO_3$ type and a relatively high percentage of sulfate ion (SO_4^{2-}) concentration. Among all the surveyed sites, the amount of dissolved constituents is high, and the concentration is characterized as high for an area unaffected by drainage or agriculture, such as in urban areas. This may be due to the influence of geology.
- This area's brewery is Sasaichi Shuzo
  - Brewing Water
    - Water source is 35-40m deep well
    - $Ca^{-}HCO_3$ type

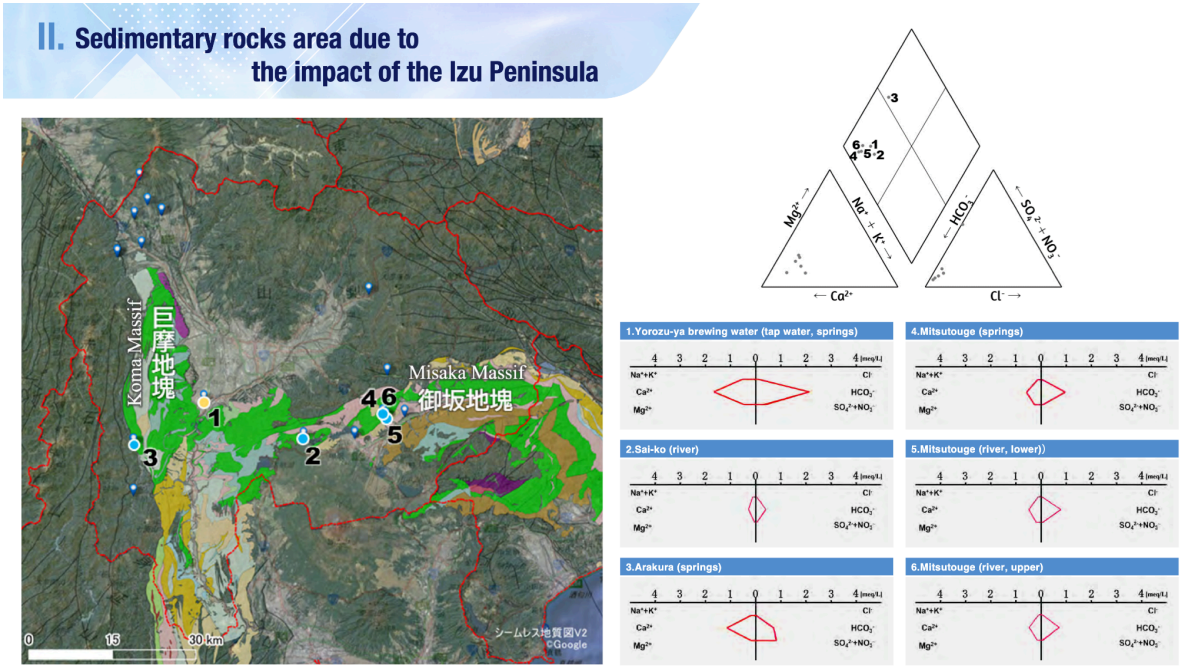
- Identification of the recharge area is important because the site is near the boundary between the Kanto Mountains and the Misaka massif.
- The abundant underground water recharged near the boundary between the Misaka massif and the Kofu granite body contains moderate mineral content, making it suitable for delicious brewing water.



II. Sedimentary rocks area due to the impact of the Izu Peninsula

- Collection Location: Three passes (spring, upstream, downstream) of the Misaka massif, north shore of Lake Nishiko
  - Geological Features: Sedimentary rocks, such as conglomerates, are distributed at the foot and summit of Mt.Mitsutoge, and igneous rocks are in the middle. The igneous rocks of the Misaka massif are distributed on the northern shore of Lake Nishiko.
  - Water Quality: Both are $Ca\text{-}HCO_3$ type. The dissolved components of the spring water are slightly higher than those of the other two river waters. The $\delta^{18}O$ (oxygen stable isotope ratio) and $\delta^{2}H$ (hydrogen stable isotope ratio) values are slightly lower, suggesting that the water is not river water itself but water flowing in the shallow underground area. V (vanadium) and P (phosphorus) are low, suggesting that the water did not originate from Mt.Fuji.
- Collection Location: Arakura Springs
  - Geological Features: igneous rocks
  - Water quality: It shows $Ca\text{-}SO_4$ type, with a relatively high proportion of sulfate ion (SO_4^{2-}) concentration.
- This area's brewery is Yorozuya Jozoten
  - Brewing water
    - $Ca\text{-}HCO_3$ type

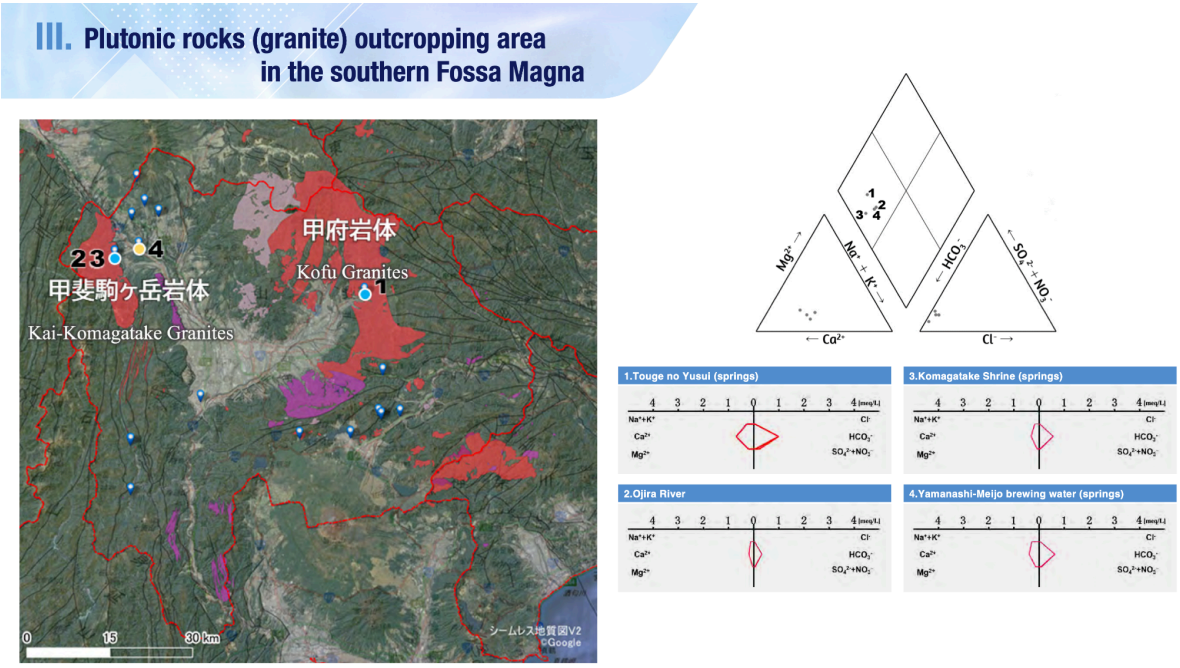
- Many dissolved constituents. Groundwater is considered to have many dissolved constituents of geological origin because it is from an alluvial fan.



III. Plutonic rocks (granite) outcropping area in the southern Fossa Magna

- Collection location: springs at the pass in Kofu rock body
  - Geological Features: granitic
  - Water quality: $Ca\text{-}HCO_3$ type. The water is considered relatively high in dissolved constituents for spring water and has some residence time.
- Collection Location: Komagatake Shrine on the rock body of Mt. Kai-komagatake, Oshiro River
  - Geological Features: granitic
  - Water quality: $Ca\text{-}HCO_3$ type.Komagatake spring water has slightly more dissolved constituents than the Oshiro River, but its lower concentration than others suggests it is a short residence time spring.
- This area's brewery is Yamanashi Meijo
  - Brewing water
    - $Ca\text{-}HCO_3$ type
    - High ratio of Na
    - The water quality is somewhat different from that of the Oshiro River and Komagatake Shrine and is not directly infiltrated by water from the Oshiro River.
    - Due to the 10m depth of the well, it is thought that mountain spring water percolated into the ground and contributed components from geology.
    - Since $\delta^{18}O$ and $\delta^{2}H$ values are generally the same as those of the Komagatake Shrine spring, it is assumed that the recharge area (recharge elevation) is similar or that the recharge elevation is slightly

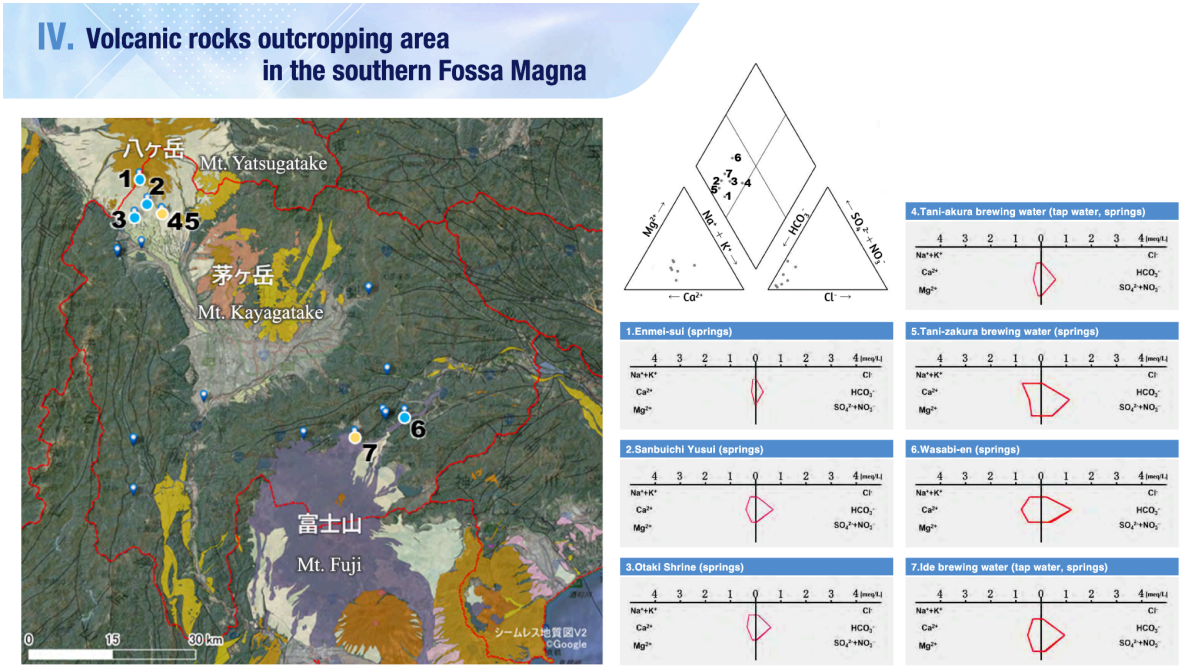
lower for the groundwater at Yamanashi Meijo than for the Komagatake Shrine spring.



IV. Volcanic rocks outcropping area in the southern Fossa Magna

- Collection Location: Yatsugatake, Chigatake (Enmeisui (lit. longevity water), Sanbunichi spring water, Otaki spring water)
    - Geological Features: Lava, volcanic debris, and volcanic mudflows are deposited, forming complex groundwater flow zones.
    - Water quality: The low dissolved minerals of the Enmeisui at the higher elevation suggest that it is close to the recharge area and has a short residence time. The relatively similar concentrations of $\delta^{18}O$ and $\delta^{2}H$ at the three sites suggest the recharge area (recharge elevation) is the same elevation.
- Collection Location: Mt.Fuji lava flow, Wasabi gardens
    - Geological feature: layers of lava and eruption deposits
    - Water quality: $Ca\text{-}HCO_3$ type, with high concentrations of V and P. It has the characteristics of spring water and groundwater recharged from Mt.Fuji. The higher levels of dissolved constituents compared to springs in the upstream areas of Oshino Village and Fujikawaguchiko Town suggest a longer residence time.
- This area's breweries: Tanizakura Shuzo, Yamaki Shuzoten
    - Brewing water (groundwater)
        - $Na\text{-}HCO_3$ type
        - Characteristics of long residence water
        - P concentrations as high as 100 μg/L or more.
    - Brewing water (tap water)
        - $Ca\text{-}HCO_3$ type
        - Similar to other springs in Yatsugatake (Enmeisui, Sanbunichi Spring, Otaki Spring).

        - P concentrations as high as 100 μg/L or more.
- This area's brewery：Ide Jozoten
    - Brewing water
        - $Ca\text{-}HCO_3$ type
        - Slightly higher ratio of Na^+ and Mg^{2+}
        - High concentrations of P and V indicate that the water is from Mt.Fuji
        - All of the water supply sources in Fujikawaguchiko Town are groundwater (well water), but there are several water source wells with different characteristics depending on the location, so it is necessary to trace the information of the source wells from which the water supply used by the Ide Brewery is derived.



Thus, although Yamanashi Prefecture is one of the few regions in Japan with only 12 sake breweries, its brewing waters are diverse. In other words, the unique topography and geology of Yamanashi Prefecture, which the Fossa Magna crosses, gives birth to the diversity of Yamanashi's water, which makes Yamanashi sake so attractive.

Conclusion

As described above, the six water systems in Yamanashi Prefecture have been found to have diverse water qualities from a geological perspective. This is possible only in Yamanashi, a unique region in Japan with the Fossa Magna and even more varied geological features. The 12 sake breweries in the prefecture have taken root in their current location, each attracted by the different qualities of sake, and are brewing unique sake that makes the most of the water quality.