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Article

Exploration of Thermal Resource Utilisation Characteristics in Treatment and Wellness Tourism Through International Experience

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Abstract: This article explores the utilization of thermal resources in treatment and wellness tourism, analyzing international experiences with a focus on geological processes and their implications. The introduction highlights the lack of visitor awareness regarding the geological phenomena enabling the therapeutic use of natural hot springs, especially in spa tourism. The knowledge gap lies in a comprehensive understanding of how these geological resources can be optimally utilized for wellness tourism while preserving environmental integrity.

The research methodology involves a comparative analysis of various thermal resorts, examining their geological characteristics, mineral compositions, and the associated wellness benefits. Data was gathered from renowned thermal locations worldwide, focusing on their geochemical properties and their impact on human health.

The findings reveal significant variations in the mineral content and therapeutic potential of thermal waters based on geographic and geological factors. The results emphasize the importance of mineral composition in enhancing wellness tourism, with particular attention to regions with active volcanic activity, such as Japan and Iceland.

Implications of this study include a call for more strategic utilization of thermal resources in wellness tourism, incorporating both medical and recreational purposes, and promoting greater awareness of the geological processes at play. This research contributes to the field by providing insights into optimizing the use of thermal resources while preserving their natural and cultural significance.

Keywords: Thermal resources, Wellness tourism, Spa tourism, Geothermal springs, Mineral composition, Balneology, Geochemical properties, Therapeutic tourism, Health tourism

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1. Introduction

Many visitors to natural thermal resorts lack knowledge about the geological processes occurring worldwide that enable them to benefit from this valuable natural resource. This paragraph provides a concise overview of the key geological processes essential for states offering health and velnes services in SPA-tourism, particularly on thermal or hot springs. Elaborate data on the geological elements and the most prominent locations has been presented and thoroughly examined. Furthermore, the cohabitation of other attractions resulting from the same geological processes, such as volcanoes and other geothermal manifestations, is also examined.To facilitate our analysis, these geothermal resources can be categorised into two primary classifications:

Numerous thermal resorts are renowned for their curative qualities and therapeutic advantages. These resorts may be linked to adjacent geothermal features, including geysers and other similar phenomena.

Mineral springs can exhibit either cold or warm temperatures and possess therapeutic qualities, making them appropriate for internal ingestion. Balneology, balneotherapy, hydrotherapy, and crenotherapy extensively utilise natural mineral and thermal waters. Both hot and cold mineral springs are prevalent worldwide, but their deposits are typically concentrated in locations characterised by volcanic activity (e.g., New Zealand, Iceland, Japan) or areas with extensive groundwater horizons, such as the vast Australian Artesian Basin or Guarani in South America. In this chapter, many manifestations of thermal springs are provided as examples. Furthermore, the mineral composition of thermal springs, together with their unique geochemistry, has become highly intricate in the establishment of wellness and relaxation pathways (wellness and wellness-SPA centres) worldwide. These centres are designed for various purposes, which vary based on factors such as location, temperature, mineral composition, and flow rate.

Methodology

The methodology of this study is based on a comparative and analytical approach to exploring the utilization of thermal resources in wellness and treatment tourism across different geographical regions. The research primarily focused on the geological and geochemical characteristics of thermal springs in several internationally recognized spa tourism destinations, including Japan, Iceland, New Zealand, and other regions with active volcanic activity.

Data collection involved the identification and analysis of primary sources such as geological reports, government regulations, and scientific literature on the formation, mineral composition, and therapeutic properties of thermal springs. Information was also gathered on the operational practices of wellness centers, including the types of treatments offered and the integration of thermal resources into their services.

The analysis was carried out by categorizing thermal resources based on temperature, mineral content, and the types of treatments they facilitate, including balneotherapy, hydrotherapy, and other wellness practices. A comparative framework was developed to evaluate the effectiveness of different regions in utilizing these resources for tourism, considering factors such as sustainability, economic impact, and visitor health outcomes.

Results and Discussion

A spring can be defined as a natural water outflow from the Earth's surface, facilitated by geological, hydrological, or anthropogenic processes that enable water to pass through layers of groundwater and rocks under high pressure. The water volume from the springs is influenced by many parameters, such as the volume of voids in the rocks (water volume), the water pressure within the Water Horizons, the reservoir's size, and the required precipitation to fill the Water Horizons sufficiently. Human activities exert a substantial impact on the water volume originating from the spring as a result of excessive discharge of groundwater. This, in turn, can ultimately cause a reduction in pressure within the water horizons and a decline in the flow of all adjacent natural springs. The sources of groundwater from which thermal and mineral waters can originate include:

Table 1.

Types of groundwater, thermal and mineral springs

Type	Shape
Natural groundwater	Meteor water
Rain or lake water	Percolation and filling
Infiltrated seawater	Virgin
Artesian water	Water trapped in the aquifer and raised under pressure through artificial Wells
	Unifying water
Water caught in sediments	Young water
Water from magmatic processes	Round water

Historically, oral traditions were used to transmit myths and legends regarding the genesis of thermal springs via successive generations. Historical accounts suggest that hot springs originated from the combustion of alum, sulphur, and asphaltite, resulting in the heating of the earth above and the water flowing through it. Modern research validates many sources of heat originating from beneath the Earth's surface: direct volcanic activity, geothermal temperature gradient, water flowing through subterranean rocks, and the formation of pressure and subsequent heating of rocks due to cracks and fissures in the rocks.

The hydrological discharge of these thermal springs, ranging from moderate to extremely hot, is aided by fractured rocks and subterranean fissures (cracking refers to the approximately level surface of the fissure in the genus body). Sometimes, the fault lines are delineated by the emergence of springs, in which the surface discharge of the springs is regulated by pressure and temperature. Thermal springs are uncomplicated springs that contain warm and, in extreme cases, hot water. Specifically, they inhabit regions characterised by recent volcanic eruptions and subsist on water that has been heated through contact with warm rocks located beneath the surface.

Irrespective of its source, warm water is less dense than cold water and readily ascends to the surface if not retained. Upon reaching significant voids in rocks or soil, the water can ascend at a faster rate than it descends and subsequently starts to cool down on the surface. Geothermal springs can manifest in any location. Uunartoq, Greenland, features thermal springs accompanied by gracefully floating icebergs against a backdrop of the sea.

During the formation of volcanic hot springs, surface water seeps through subsurface rocks and flows into regions of elevated temperature that surround the magmatic reservoir. These regions are characterised by their recent hardening and the subsequent release of heat. In such an environment, the water undergoes heating, experiences a decrease in density, and ascends to the surface once more via fissures and crevices. Subterranean heating can occur through various mechanisms: groundwater can circulate around a magmatic chamber or a solidified magmatic rock, or it can undergo pressure-induced heating when it needs to pass through seams or fissures in the substrate. Hot springs exhibit a higher degree of mineralisation compared to cold springs due to the dissolution of surrounding rocks by rising temperatures, resulting in the release of substantial amounts of minerals to the groundwater. Hydrodynamics governs the velocity of water flow and the duration of interaction between water and the adjacent rocks along the river's course, therefore influencing the quantity of minerals that the water can dissolve. In addition to mixing with ancient seawater pockets in the subsurface horizon, the concentration of dissolved minerals in the water may also be influenced by the presence of contemporary seawater along Ocean beaches. The water discharged by hot springs can exhibit considerable variation based on the quality of the recharge water and the composition of rocks that interact with the groundwater. This phenomenon can be elucidated by examining the configuration and productivity of the Guarani aquifer located on the boundary between Argentina and Uruguay.

There could exist a disparity in the depth of the heat discharge. By virtue of an active heat source in the shape of a magmatic chamber or a body of a hardened magmatic rock, volcanic hot springs can bring their temperature closer to the surface. Spring Water absorbs heat at depth due to the combined effects of pressure, friction, and spinning beneath the Earth's surface. Conversely, the mineral chemistry of thermal groundwater is influenced by the temperature, composition of the surrounding rocks, and the length of time the water moves horizontally and vertically underground.

Typically, the primary source of spring recharge is derived from meteor water emanating from the atmosphere, which can occur either as precipitation in the form of rain and snow, or as leaks from lakes and rivers. Other techniques, such as deliberately injecting water into the fissures of "hot rocks", are employed in many nations where the excessive mining of groundwater has resulted in a depletion of hot water supplies.

The average geothermal gradient for water temperature, typically at depths below 200 m, is 24°C/km. Water, reaching a depth of 2-3 km, can reach temperatures significantly above those of the Earth's surface. Through the analysis of this data, it is possible to determine that hot springs are emerging from a natural geothermal system that comprises a rotating system of groundwater that is activated by a significant geothermal gradient. In general, hot springs are defined as springs that release water at temperatures much higher than the ambient air temperature in the vicinity, as this is precisely how individuals evaluate the impact of differential temperatures.

According to the Hot Springs Act of 1948 in Japan, a natural thermal spring is not considered a hot spring unless it satisfies two conditions: "hot water, mineral water, water vapour, and other gases (excluding natural gas containing hydrocarbons as the main component) released from the Earth must contain specific substances at temperatures above 25°C or surpass a predetermined threshold". Japan's hot springs are specifically safeguarded by the Hot Springs Act to encourage the appropriate utilisation of natural geothermal resources. Therefore, in Japan, a prominent hot spring culture globally, the distinguishing features of hot springs encompass not only thermal parameters but also serve to evaluate chemical properties and guarantee their preservation, thereby showcasing a profound understanding of the essence and advantages of hot springs.

The classification of temperature into cold, warm, and hot or thermal water is based on three factors: the subjective perception of the individual, the ambient air temperature, and the temperature of the water being received. The existence of several detections and their inconsistent application has caused significant perplexity in the quest for a universally acknowledged definition, not only among scientists and researchers from many fields, but also among the general public. Furthermore, several nations employ diverse categorisations for hot springs, which may also be influenced by the unique characteristics of each language and their respective translations into English, without relying on any objective standards. Hence, this book employs the phrases "hot springs" and "thermal springs" by their original origins. When temperatures exceed the appropriate range for Nature Baths, the phrase "extreme hot springs" might be used to differentiate between thermal waters utilised for hydrotherapy and balneology. Nevertheless, these very high temperatures springs can be lowered to levels appropriate for bathing and medicinal procedures, therefore permitting their transformation into a resort asset categorised as "thermal" water. Occasionally, the conditions under which artificially heated pipe water is presented as a "genuine" hot spring or "thermal" water may not accurately reflect reality. An unannounced visitor or tourist may experience genuine disappointment as a result of this.

Although many countries have their laws and restrictions concerning the use of natural hot or thermal springs, the prevailing classification of thermal springs worldwide is predicated solely on temperature.

Table 2
Classification of thermal and mineral springs by temperature

Species	Degree
Cold Springs	Temperatures below 25 ° C
Warm Springs	temperatures range from 25 ° C to 34 ° C
Hot Springs	temperatures range from 34 ° C to 42 ° C
Hot Springs	Temperatures above 42 ° C

Through an analysis of definitions and classifications gathered from many countries, this study enhances our understanding of resource diversity and offers examples of specific terminology used to describe natural hot springs. Moreover, what is deemed as hot in one country can be categorised as warm or downright freezing in another country. Japan, Taiwan, Korea, Germany, France, and Italy have specific legislation in place to regulate the appropriate utilisation of natural hot springs. These regulations also establish the specific temperature and mineral composition criteria that must be met for a spring to be designated as a natural hot spring suitable for medical applications.

Minerals are naturally occurring chemical elements or compounds present in the Earth's crust. Subsequently, they are introduced into the flow of groundwater, which may potentially include minerals and microelements with significant concentrations. The specific composition of the subsurface rock environment directly influences this phenomenon. The classification of primary hot springs and filter hot springs is based on their thermal origin and physical distinctions, such as their mineral and gas composition. Prior to coming to the top, these substances are absorbed by washing and heated up as they rotate at a significant depth. Table 3 provides a compilation of many standard categorisations of hot springs according to their chemical composition.

Table 3.
Examples of different types of Springs according to the basic mineral composition

Thermal springs (warm and Hot Springs)	Surface runoff from a natural geothermal system - the water temperature is usually higher than 25C. It can contain any of the following minerals.
Mineral springs (cold, hot or hot springs)	Chloride Springs
	Sulfur Springs

	Iron Springs
	Carbonate Springs-lead to the formation of tufa or travertine deposits around the spring (e.g. Pamukkale, Turkey)
	Alkaline springs-known as natural saunas or steam labels
	Real Bitter Springs-magnesium sulfite
	Acidic Springs-mainly in active volcanic zones
	Gypsum Springs-Bitter Springs
	Heavy carbon soil Springs
	Mirabilite Springs-Bitter Springs
	Mirablite sodium chloride Springs
	Nitrogen thermal springs
Radium Springs	Contains a certain amount of radioactive radium or thorium
Artesian Springs (hot and Hot Springs)	A spring fed from a limited aquifer (Artesian Basin). May include any of the above minerals
Geysers(very hot springs	Springs that periodically erupt boiling water-bicarbonates
Underwater ventilators	Usually known as black smokers-sulfur

Nitrogen thermal waters, however having very low mineral content, are a significant category of mineral waters extensively utilised in several countries (Russia, Bulgaria, Hungary, France, Italy, and Austria) for their therapeutic qualities. Among the nitrogen-containing thermal waters, Barabanov and Disler identified six distinct groups:

Table 4
Classification of nitrogen thermal waters

1	Bicarbonate
2	Sulfate-bicarbonate
3	Sulfate
4	bicarbonate-sulfate-chloride
5	Bicarbonate-chloride

Primarily resulting from precipitation and infiltration of grunt water, these formations are also influenced by the predominant presence of air gases in their composition and the absence of organic matter accumulation in the formation area. Gesetić and Lotti define mineral waters as solutions of natural origin that are generated under specific geological conditions and are characterised by "chemical-physical dynamism". The Oxford Dictionary of Earth Sciences defines a mineral as a naturally occurring material that possesses a distinct chemical makeup and often exhibits a crystalline arrangement. The mineral composition in Hot Springs is a consequence of the upward movement of dissolved minerals from subterranean reservoirs to the Earth's surface, when water is heated by subsurface pressure or volcanic activity. Natural hot and mineral waters obtain their primary components by the process of filtration through rock layers, such as calcium from limestone or magnesium from dolomite deposits. Fluorine and numerous other trace elements, together with iron, can exist in a suspended condition which are classified as small elements. There exists a positive correlation between water temperature and the presence of mineral content. Geothermal water derived from volcanic sources may also have a significant amount of salt and bicarbonates, resulting in a natural splashing phenomenon.

The legal categorisation of mineral composition varies throughout different regions of the world. Under the majority of legal systems, the mineral source typically contains a concentration of natural dissolved solids above 1000 mg/l. Resource waters are categorised as acidic, neutral, or alkaline based on the hydrogen equilibrium and pH analysis.

Table 5
Classification of thermal water sources

Species	Hydrogen balance in water
Acid waters	<7,0 pH
Neutral waters	=7,0 pH
Alkaline waters	>7,0 pH

Minerals are usually applied externally in form of solutions, lotions, and ointments for the treatment of specific ailments. Consuming mineral waters by ingestion is a global habit that is being resuscitated in the current popular trend of alternative medicine. Parish and Lottie hypothesise that the act of immersing oneself in mineral water could potentially represent a more efficacious therapeutic approach for skin disorders such as atopic dermatitis and psoriasis. To demonstrate the significance of the mineral composition of hot springs for medical purposes, the following tables present a comprehensive summary of the general chemical composition of hot springs (Table 6).

Table 6
The most common elements found in natural thermal springs

The main elements found in spring water	There are other substances from time to time	Main gases in solution
Calcium	Arsenic	Carbon dioxide
Carbonates	Brom	Hydrogen sulfide
Chlorides	Caesium	Nitrogen
Fluoride	Cobalt	Oxygen
Iron	Copper	Radon
Magnesium	Yod	Argon and helium can occur in some simple thermal and thermal sulfur waters
Sodium	Lithium	
Sulfates	Potassium	

Sulfides	Radii	
Sodium	Silica	
	Zinc	

Traditional usage of minerals involves their external use in solutions, lotions, and ointments for the treatment of different ailments. Dietary consumption of mineral waters is a global practice and is experiencing a resurgence in popularity due to the rise of alternative medicine. Parish and Lotti propose that the application of mineral water baths could be a more efficacious therapeutic approach for skin disorders such as atopic dermatitis and psoriasis. In order to demonstrate the significance of the mineral composition of hot springs for medical purposes, the following tables include data on the general chemical composition of hot springs (Table 6).
As previously said, minerals and microelements are the most sought-after components of natural hot and mineral springs for SPA resorts and treatment centres. Therefore, a crucial characteristic of these tourism routes is not just the agreeable temperature or natural surroundings of the water, but also the mineral makeup of the water, which is linked to enhancing health. The intended therapeutic outcome is directly correlated with the consumption of mineral constituents and metal microelements, which exert a medicinal impact on the human body, facilitating the treatment of diverse ailments. Throughout history, scientists worldwide have extensively investigated the correlation between minerals and other components and the potentially advantageous characteristics of thermal springs, particularly in Europe.

Conclusion

The exploration of thermal resource utilization in wellness and treatment tourism reveals the significant influence of geological factors, particularly the mineral composition and geothermal characteristics, on the therapeutic potential of natural hot springs. The findings indicate that regions with active volcanic activity, such as Japan, Iceland, and New Zealand, exhibit a higher degree of thermal resource diversity, which contributes to the enhancement of health and wellness tourism. These resources, when properly managed, can offer substantial benefits in terms of both medical treatments and recreational activities. The implications of this study underscore the need for strategic management and preservation of these natural resources, ensuring sustainable tourism development. Further research should focus on the long-term environmental impacts of thermal resource exploitation and investigate innovative methods for enhancing the therapeutic qualities of thermal waters without compromising ecological balance.

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