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**Excerpted
Chapter:**
Hot Springs &
Geothermal
Mineral Waters

GUIDE TO HYDROTHERMAL SPA & WELLNESS DEVELOPMENT STANDARDS

What You Need to Know Before Building Wet Areas

FOURTH EDITION

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Chapter Seven

Hot Springs & Geothermal Mineral Waters

This chapter covers the unique world of hot springs and geothermal mineral waters, including the health benefits of balneotherapy and was written in collaboration with the Global Wellness Institute’s Hot Springs Initiative, an international think tank dedicated to exploring the diverse values of geothermal waters for health, recreation, tourism and community.

Wellness travelers have sought the healing power of naturally warm, mineral-rich geothermal water for millennia and hot springs have inspired healing lore and bathing rituals in virtually every culture. Hot springs and geothermal bathing are now experiencing a renaissance as modern bathers actively seek out the healing properties of balneotherapy (defined as the immersion in mineral water for health benefits).

What makes hot springs special is that no two are alike—each has a unique spectrum of minerals, temperatures, natural environments and other qualities. While most hot springs provide the familiar benefits of bathing, relaxation and places of social gathering, the unique power of hot springs is attributed to their minerals and other sensory qualities including texture, alkalinity, odor and flavor that set hot springs apart from other waters.

Geothermal mineral water is typically formed when rain and snowmelt sinks through cracks and porosities in the ground to collect in underground permeable rock called “aquifers,” that are heated by underground volcanic sources. The hot water dissolves minerals from surrounding rock and carries those minerals to the surface as the water emerges in hot springs.

Hot springs and geothermal waters are enjoyed throughout the world and experiencing a renaissance. Pictured: Cunnamulla Hot Springs, Queensland, Australia opened in 2024.

Geothermal mineral waters are found as natural hot springs, geysers, streams, seeps, bogs or steam vents. They occur in mountains, valleys, deserts, and even under polar ice sheets, lakes and oceans. Hot springs may be extremely hot or barely warm; some have strong odors while others are neutral. The water may be salty, bitter, sweet, hard or soft, nutritious for microbes and plants or relatively sterile, even corrosive, radioactive or toxic to life.

In some cases, hot springs may be the only source of water in an area, while, in other cases, hot springs will be found adjacent to streams, lakes or seawater. In addition to bathing and soaking, the water from hot springs can also be used for drinking, mind/body cleansing, heating buildings and even generating electricity. Some hot springs facilities combine all of those functions, making them one of the earth's most sustainable and renewable resources.

Hot springs are the oldest and most sustainable place-based businesses with two Japanese Onsen operating continuously for over 1300 years. Today, regional, national and cultural preferences provide a guide for the design of hot spring facilities, and the experiences on offer and wellness travelers can seek out numerous types of hot springs—from rustic to luxurious or indigenous to modern urban. Visitors can soak for an hour or a day and can find hot spring facilities that suit their personal preferences—be it a contemplative spa with massage and yoga, family recreation with a water slide, or medical oversight with full laboratory services provided by doctors funded by health insurance.

Hot Springs have inspired healing and bathing rituals in cultures around the world. Modern day wellness travelers can explore these unique destinations to refresh, revitalize and re-connect with themselves, each other and the nature around them.



Bolian Hot Springs, Chongqing, China provide an idellic natural setting for re-connection.

Lake Heviz, Hungary is the largest swimmable geothermal lake in the world.



Hot Springs History

Archaeological evidence reveals our Cro-Magnon and Neanderthal hominid ancestors used hot springs sites for at least 200,000 years as health and wellness destinations. Our predecessors relied on hot springs year-round for hunting and foraging, drinking, easing the body, and harvesting of minerals including salt. The water and warmth provided year-round habitat for countless species of plants and animals through winters, ice ages and global catastrophes.

Natural undeveloped hot springs still exist today, often in remote wilderness or in areas that have challenging terrain and/or access. Adventurous hikers will often build basic pools and diverse systems that encourage air-cooling of the steamy water or devise a way to mix it with colder water, creating a comfortable soaking temperature.

Ancient Hot Springs and Drilled Wells

For much of human history, naturally flowing hot springs were the only source of warm water in which to bathe. In many places where hot water rises to the earth's surface under its own pressure early cultures used hand tools to dig small pools where they could submerge their bodies into the mysteriously warm water.

While springs naturally flow to the surface without the aid of pumps, today, well drilling technology and geological science enables access to geothermal mineral water from deep aquifers up to several kilometers down bringing hot water to the surface in places where natural springs have never freely flowed before.

Some wells are able to produce water that flows to the surface by itself without a manual pump—this is called “artesian flow,” while other wells require pumps to lift the water to the surface. Facilities built on drilled wells are commonly called “hot springs” even though a man-made well is not technically a “spring”. and many modern hot springs today are a hybrid of a spring and well because they have utilized drilled wells and pumps to enhance the water flow rate and increase pool bathing capacity.

All languages have words to describe both natural springs and wells and for ease of understanding, the term “hot springs” is used to define all geothermal mineral water facilities built on either naturally occurring springs, drilled wells, or their combination.



Hot springs provide natural social setting as seen here at Australia's Peninsula Hot Springs.

“Hot Springs” vs “Wells”

Hot Springs

- Hot springs may have historic and pre-historic use by humans
- Hot springs generally have a unique biology and can be inhabited by extremophiles
- Hot springs have unique mineral compositions.
- Ancient animal migration paths lead to hot springs, where the waters were used for hydration, salt or other minerals, and healing.
- Hot spring aquifers may have elaborate underground channels emerging at springs

Wells

- Wells can provide geothermal mineral water in areas where no natural hot springs occur
- Wells rely on aquifers for their geothermal mineral water and risk depleting this precious water resource

Some geothermal water is prehistoric, having been underground for thousands of years—similar to oil deposits that don't have access to the surface until a well is drilled, and are non-renewable or replenish very slowly. Sustainable use of an aquifer depends on how long it takes to naturally recharge the water that is extracted. Most developed countries have regulations to ensure aquifers are used sustainably and that extracted water does not deplete them.

Naturally flowing hot springs can be endangered through over pumping from aquifers for agriculture and urban use. Because aquifers are hidden underground, their complex flow and replenishment dynamics are often debated as politics collide with theoretical assumptions and available science. Regional water-laws often rule who can use the water, and for what purposes, especially during drought cycles. Hot springs and any unique species inhabiting them may be disadvantaged by the demands of industry and

global population sprawl. For example, poorly understood microbiomes of hot springs have sometimes been destroyed before they are fully documented or understood. This highlights the ongoing issue of human need versus habitat and resource conservation.

Today's wellness travelers are increasingly conscious of their ecological footprint and the sustainability of resources. Many hot spring facilities act as guardians of their natural waters and share what they know about their water, from source-to-bathing, which is considered an industry best practice.

Facilities

Pool Design

Natural geothermal springs are likely the very first type of hot-water bathing humans experienced, and are the first “spas” and original wellness destinations. Cultures throughout the ages have endowed hot springs with magical or spiritual powers for mystical awakening, sacramental drinking, anointing, physical healing and various religious rituals, including baptism.

Modern wellness travelers can enjoy hot springs in diverse locations and regions, all with unique experiences. Some facilities are designed into natural landscapes for an organic, natural experience, while others are fashioned on ancient and modern architecture. Some hot springs facilities offer a quiet, meditative atmosphere for self-reflection where contemplative inner focus is enabled. Some are more social or interactive; and others are for family recreation with waterslides, campgrounds and other complementary activities.

Facility designs consider natural flow and form while providing the best possible user experience seen here at Germany's Toskana Therme Bad Orb.



Medical hot springs are popular in countries where the water is part of a health cure and some treatments are partially funded or fully funded by insurance companies or national health-care programs. They may offer full medical treatments prescribed by doctors that can include soaking, drinking and resting in hot springs waters and the surrounding environment.

To accommodate cultural, and often religious differences, some facilities offer designated areas or days for women, men, and families to bathe separately. Some regions have modest clothing requirements relative and appropriate to their culture, while in other regions nudity or clothing-optional is the norm.

Certain regions have long-standing cultural traditions to follow or honor, while others are entirely informal and non-traditional. For the global wellness traveler, it is important to be aware of these traditions since bathing against cultural practice may be offensive or even illegal. It is therefore advised to adhere to the general culture and specific rules regarding bathing in each location.

Practical pool design information can be seen in Chapter 6.

Wellness Experiences

A broad and growing range of wellness experiences can be found at hot springs globally, complementing the core bathing experience and often ‘packaged’ for guests within the operators’ options.

Wellness experiences offered at hot springs often incorporate traditional and complementary medicine. According to the Global Wellness Institute, this includes “diverse medical, healthcare, holistic, and mentally or spiritually-based systems, services and products that are not generally considered to be part of conventional medicine or the dominant health care system—including homeopathic, naturopathic, chiropractic, Traditional Chinese Medicine, Ayurveda, energy healing, traditional/herbal remedies and supplements, etc.”

In Western countries, the offering of such wellness experiences is growing, alongside consumer adoption of traditional/indigenous, complementary, alternative and integrative medical practices outside of the conventional/western medical system.

Landscaping

Hot springs destinations very often hold outdoor appeal, with pools and other relaxation areas/activities set into the local surroundings. Landscaping is therefore usually fundamental to the experience.

Hot springs destinations are often referred to as ‘therapeutic’ or ‘healing’ landscapes. The best landscaping examples tend to embrace the visitor and accentuate the local natural surroundings.

For the same reasons that shinrin-yoku (forest bathing) is an important complementary therapy worldwide, effective hot springs landscaping can enhance the guests’ experience immensely.

Hot springs often provide a connection to local culture as seen at Peninsula Hot Springs, Australia.



Arts, Culture and Events

Worldwide, industry leaders are discovering cultural tourism is a popular offering at hot springs and the Global Wellness Institute Hot Springs Initiative (GHSI) reported arts, culture and events at hot springs is a key global trend in 2023. Among the top five trends GHSI members reported was: “connecting visitors to the local culture and nature helps deliver higher yields and longer stays in destinations”.

The report further detailed benefits of this trend as: “Hot springs-lead wellness destinations focus on working with local communities and the natural environment to provide the best possible guest experience. This results in extended stays, higher yields and repeat visitation for the businesses and the entire region.”

Culture & Etiquette

In designing, constructing, and operating hot springs facilities, it is important to accommodate cultural and often religious differences. Some facilities offer designated areas or days for women, men, and families to bathe separately. Some regions have modest clothing requirements relative and appropriate to their culture. While in some regions nudity or clothing optional is the norm, in other countries this may be strictly forbidden.

Certain regions have long-standing cultural traditions to follow or honor, while others are entirely informal and non-traditional. For the global wellness traveler, it is important to be aware of these traditions since not bathing to cultural practice may be offensive or even illegal.

Ensuring cultural and etiquette sensitivities are met in facility design and guest behavior is a fundamental responsibility of the hot springs owner and operator. This is best done through consultation with local communities and following local regulations and guidelines.



Sand bowls and other creative wellness experiences can be offered at hot springs in all weather conditions. Winter at The Springs Resort, Pagosa Springs, Colorado, USA.

Hot Springs Temperature Range

Some hot springs emerge from the ground at the perfect temperature for human bathing, while others are either too hot or barely warm, so they must be cooled or heated by non-natural means for human use.

Water temperature is easily described as “hot, warm, tepid and cold.” The temperature of a baby’s bath is probably good for long-term soaking, while very hot or ice-cold water is good for a quick dip. The word “hot” can mean many different degrees of temperature, which varies from culture to culture.

Human bodies tolerate a narrow range of water temperature for bathing. Generally, a comfortable range is between 35°C (98°F) to a high of 42°C (106°F). Hot temperatures above 43°C (111°F) are typically too hot for most people.

Unique Biodiversity and Species

Many unique species have evolved to inhabit certain springs, including aquatic plants, algae, fungi, fish, crustaceans, amphibians and insects and a wide range of microorganisms. Some of these are extremophiles, meaning they tolerate extreme environments such as heat and high mineral concentrations. One classic example is the Julimes Pupfish that lives in a single Mexican hot springs location, with temperatures up to 45°C (114°F), along with a hot water snail and the various algae they eat. That temperature is far too hot for most humans to tolerate and very few organisms can survive in such hot water.

Green and blue-green colonies of single-celled photosynthetic plants thrive in mineral-rich waters and are often used as scrubs and masks for the body and skin. Muds, peats and surrounding soils can also be used for body treatments, each with their own complex of microbiome species unique to each hot spring.

The genetic repertoire of these “hot spring specific species” offers a glimpse into how adaptation can occur within challenging concentrations of minerals.

Conservation of these species is critical to maintain their genetic diversity and future benefit to science and medicine. Encroaching developments and aquifer threats have led to closure of some hot springs to protect threatened species from extinction.

Hot Springs Sanitation

Like all public bathing waters, hot springs must be monitored for pathogens that could cause disease. Some facilities have sufficient water flow and/or drain and clean the pools each day so that no sanitizing chemicals are needed. Other facilities may require sanitizing chemicals or treatments to maintain healthful water quality.

While there is no consensus on best practice, most “hot springs” facilities, spas and resorts are monitored for water quality and regional governments often mandate specific sanitization requirements. Wild hot springs may have signs warning of various water-borne pathogens, aquatic insects or hazardous elements in the water.

Most facilities have excellent information about their waters—reviewing these is highly recommended. Be sure to inquire ahead of time regarding clothing and bathing protocols. Some facilities encourage silence in pool areas to allow a meditative atmosphere, while others are more social and interactive.

It is considered good etiquette and a standard operating procedure to require all guests to shower before entering a public hot springs to keep soil, lotions, oils, scents and sunscreen out of the shared water to ensure a clean and healthy bathing experience.

Before You Visit

Most facilities have excellent information about their waters—reviewing these is highly recommended. Be sure to inquire ahead of time regarding clothing and bathing protocols as some countries require specific clothing and may segregate women and men, while others will be clothing-optional or no clothing allowed. Some facilities encourage silence in pool areas to allow a meditative atmosphere, while others are more social and interactive.

Generally, it's good etiquette to privately bathe or shower before entering a public hot springs to keep lotions, oils, scents and sunscreen out of the shared water.

Taking the Cure

Throughout history, people have reported “cures” of various ailments and a general boost in health and vitality from soaking in the waters. Nearly all hot springs facilities can provide health benefits derived from their unique mineral waters. Robust medical research, particularly in Europe, has proven the benefit of hot springs for specific ailments— often referred to as “cures.” Some cures are directly related to trace minerals or major concentrations of macro minerals, many of which are directly absorbed through the skin and then circulated through the body. Other cures are related to temperature, viscosity, alkalinity or other properties of the water.

“Feeling better” is difficult to quantify scientifically, but it is evident that humans throughout history have been feeling better from bathing in hot springs (balneotherapy). Many visitors to these waters believe them to be healing in a physical or spiritual way. Muds and algae from hot springs may be used as body scrubs or masque spa treatments, with benefits coming from the minerals and their unique microbial species and thermal mass.

Cold-water springs can also hold many of the properties found in geothermal mineral water as they are usually created water that was very hot underground but has cooled on its way to the surface, retaining much of the dissolved mineral content. Health claims for cold water springs usually relate to drinking water, since it's too cool for soaking. This water is often bottled and shipped globally.

Ancient humans relied on their senses and local lore to understand the merits of hot springs, the same process used to discern medicinal and nutritious plants throughout history. Modern technological analysis can supplement and validate the ancient lore while providing additional levels of knowledge that expand the story of water.

Many hot springs facilities provide detailed laboratory analysis of their water chemistry, along with recommendations for bathing and drinking, however, not all hot springs waters are healthful or nutritious—some may contain harmful levels of elements including radium, arsenic or fluoride, while some minerals are beneficial only in small amounts and can be hazardous if consumed in excessive quantities.

Balneology

Classically, the study of Balneology (the science) and Balneotherapy (the treatment) have looked to three realms of application:

- Prevention/Wellness - The use of geothermal mineral springs and geothermal wellness facilities to keep the body healthy.
- Active Treatment - The use of geothermal waters and geothermal health facilities as part of a medically supervised course of treatment for a variety of active diagnosis.
- Rehabilitation - The use of geothermal waters and geothermal rehabilitation centers for recovery of function after injury or post-acute disease states.

Geothermal mineral water has long fascinated both scientists and physicians. Herodotus, one of our earliest historians (born around 484 BC) was the first to describe the use of springs and spas for the treatment of various diseases, prescribing a 21-day limit to therapy duration, while Hippocrates, Asclepieades, Pliny the Elder and Galen all advocated bathing for a range of conditions in different types of water. In addition, the Austrian physician Caspar Schober wrote a treatise in the early 16th century that described a method for analyzing the German Gastein hot springs to examine their therapeutic effects.

In the 1900s, research into hot springs explored their benefits for a wide range of clinical conditions. There is a 1940s paper on the treatment of venereal diseases; research on the benefits of thermal springs treatment for polio survivors, including Franklin D. Roosevelt's rehabilitation at Warm Springs, Georgia; and post WWII research hypothesizing a potential cure for deafness through vapor from the Brazilian Pocos de Caldas hot springs. In this century, studies have aimed to explain the functions of the various specific mineral elements in balneotherapy—such as sulfur, magnesium or radon—linking individual minerals to the treatment of particular diseases, like sulfurous-rich water and recurrent upper respiratory tract infections.¹

An example of balneotherapy's effectiveness comes from research published in *Clinical Rheumatology* (May 2018), which studied 100 patients with fibromyalgia syndrome over

a 15-day balneotherapy cycle at Levico Terme Spa Center located in Trento, Italy. Half the patients participated in passive balneotherapy in highly mineralized sulfate water, while the other half bathed in plain tap water. The 50 patients that were randomly selected for balneotherapy treatment showed significant improvements in pain and other symptoms—even when measured at two weeks, three months and six months post treatment—while the 50 patients in the control group showed no significant changes.

Types of Balneotherapy

Balneotherapy is the immersion in mineral water and/or peloid (geothermal mud/clay) for specific health benefits. Balneotherapy is sometimes confused with hydrotherapy (the use of water for relaxation, pain relief and other treatments). Maintaining a universal definition of ‘balneotherapy’ is important both for global research and the industry as a whole. Readers should note that the standardized definition of balneotherapy as agreed by the Global Wellness Institute’s Hot Springs Initiative is “passive bathing in geothermal mineral spring waters with water content that is regarded as having unique health properties.”

Various types of balneotherapy can be identified, including:

European Program: European balneotherapy programs are well documented and often studied. They usually consist of passive 20-minute bathing sessions two or three times a week over a course of three weeks.

Peloid Therapy: Refers to the use of mud/clay from geothermal environs.

Hot-cold Immersion: Hot springs bathing followed by cold plunge (or increasingly, ice immersion) is a common balneotherapy practice. Saunas, hammams and steam rooms can also be used as heat sources.

Inhalation: Refers to therapies that focus on inhalation of geothermal mineral spring water gases.

Some hot springs emerge from the ground at the perfect temperature for human bathing, which is often referred to by experts as the “Goldilocks Zone” because the water is considered “just right.” Pictured: Maruia Hot Springs, South Island, New Zealand.





Mud is used in Peloid Therapy as seen at Piestany, Slovakia.

Watsu: Increasingly common treatment that utilizes the elements of Shiatsu while floating in hot spring waters.

Geothermal Water Exercise Programs: Unlike passive balneotherapy, these programs involve performing yoga and other stretches in geothermal waters. These can also involve the use of underwater aqua bikes designed to provide resistance.

Reflexology: Stone walks through geothermal mineral water.

Thermal Sound Therapy: Floatation while music is played underwater.

Health Resort Medicine: Balneotherapy within a resort setting and including related treatments during the visit/stay. These additional balneotherapy program treatments might include massage, nutritional programs, yoga, pilates, meditation, hydrothermal exercise therapy, physiotherapy and many more.

Hammams and Steam Rooms: High temperature and humidity rooms designed to encourage sweating and within which specific scrubbing and massage treatments can be provided.

Classification Confusion

Unfortunately, there's no global agreement on hot springs classification. Instead, balneologists around the globe often create classifications of geothermal mineral springs in silos, with little or no collaboration. The lack of a unifying and globally-accepted classification system means that researchers—along with industry groups—continue to create their own.

For the purposes of this guide, we present a classification list created by the Australian Hot Springs industry, which published a national classification protocol in 2018 that is based on the fundamentals of the more regulated definition of Japanese 'onsens' (the term for the popular hot springs and bathing experiences found all over Japan).

Australian Hot Springs Classification

Hot springs are classified according to four criteria: well temperature, pH, osmotic pressure and type of spring.

1: Well Temperature

Cold Spring: up to 20°C (up to 68°F)

Warm Spring: 25°C to 34°C (77°F to 93°F)

Hot Spring: 34°C to 42°C (93°F to 108°F)

Extra Hot Spring: over 42°C (over 108°F)

2: PH

The pH of the water has a large effect on how the water feels. The more alkaline the baths, the softer and soapier the water feels. Alkaline baths are thought to be good for the skin and are also called “beauty springs”. Acidic baths will, conversely, feel much harder or firmer on the body. Both sensations are enjoyable and a matter of personal preference.

Acidic: pH of 3 or lower

Weak Acidic: pH of 3 to 6

Neutral: pH of 6 to 7.5

Weak Alkaline: pH of 7.5 to 8.5

Alkaline: pH of 8.5 or greater

3: Osmotic Pressure

This is the total weight of the dissolved solids in a given amount of the spring water and the water’s ability to hold those minerals in suspension. The difference is often visible as spring water that contains a high percentage of dissolved solids will typically be opaque.

Low: 8g/kg of dissolved solids or lower and a freezing point of -0.55°C or higher

Isotonic: 8g/kg to 10g/kg of dissolved solids with a freezing point of -0.55°C to -0.58°C

High: 10g/kg or higher and a freezing point of at least -0.58°C

4: Hot Spring Types (More Details On Next Page)

- Simple Hot Spring
- Chloride Springs
- Carbonated Springs
- Sulfuric Acid Springs
- Iron Springs
- Aluminum Springs
- Radioactive Springs

4: Hot Spring Types (Based On Japan's "onsen" classification.)

Simple Hot Spring: Water that does not contain enough minerals to be classified in detail but are still considered onsen.

- Simple hot spring
- Simple alkaline hot spring

Chloride Springs: The most common type of hot spring in Japan. The salt content helps clean the body of sweat while helping the body retain heat.

- Sodium chloride spring
- Strong sodium chloride spring
- Sodium chloride carbonated spring
- Sodium chloride sulphate spring
- Sodium and calcium chloride carbonated spring

Carbonated Springs: These may have a softening effect on your skin and leave the body feeling refreshed and cool after bathing.

- Sodium and calcium bicarbonate spring
- Calcium and sodium bicarbonate chloride spring
- Calcium and sodium bicarbonate sulphate spring

Sulfuric Acid Springs: These springs help reduce pain, combat liver disease and constipation. The calcium type also has a calming effect. The magnesium helps lower blood pressure.

- Calcium sulphate spring
- Sodium sulphate chloride spring
- Magnesium sulphate spring

Iron Springs: The iron in the spring is absorbed by the water and helps in blood production. Although these springs are clear when they emerge from the earth, the iron in them will oxidize and turn a brownish color.

- Iron carbonated spring
- Acidic iron sulfuric acid spring

Aluminum Springs: These springs may have disinfectant properties and benefit some skin diseases.

- Aluminum and iron sulphate spring

Radioactive Springs: The radon is absorbed into the body and breathed in as the gas escapes from the water. The use of radioactivity for positive medical effects is greatly debated but has been done for many years. Radon caves where people go to breath in the gas for therapeutic reasons are still in operation in parts of North America. One should use their own judgment when deciding to expose themselves to radioactivity like this.

- Simple radioactive spring
- Simple weak radioactive spring

The Chemistry of Mineral Water

Hydrogen sulfide is a chemical compound known for its “rotten egg” smell, and its role as an analgesic has received the most scientific attention, including a 2013 study that appeared in the *European Journal of Inflammation*² and another in the same year entitled “Sulfureous thermal water increases the release of the anti-inflammatory cytokine IL-10 and modulates antioxidant enzyme activity.”³

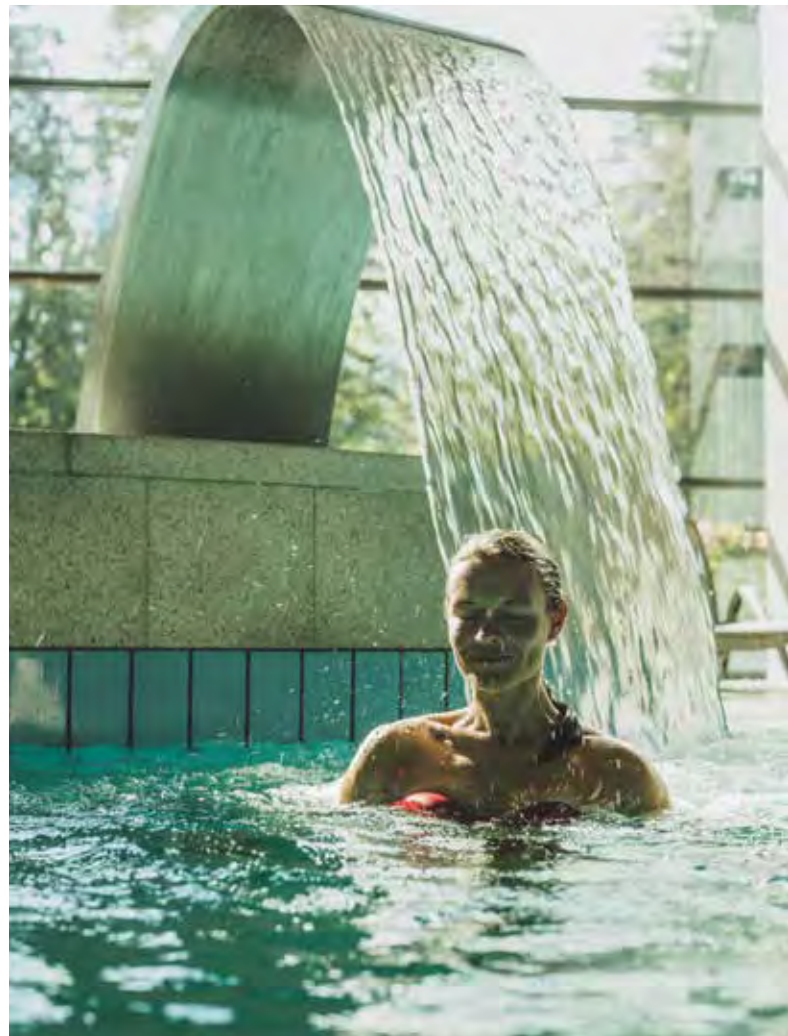
Magnesium in geothermal water has been attributed to successfully treating dermatological conditions,⁴ while radon-enriched hot springs are thought by some to increase the body’s resistance to cancer by elevating p53 protein levels.⁵

The effects of balneotherapy on chronic pain have been studied extensively. A 2015 review of 27 studies, concluded there is a high level of evidence that spa interventions reduce chronic pain and analgesic consumption and improve function and quality of life, in chronic low back pain and knee osteoarthritis cases. Another review found “100% positive outcomes for clinical improvement, pain alleviation and improved quality of life,” a finding that was backed five years later by another systematic review which concluded that balneotherapy “is an effective remedy for lower back pain, as well as knee and hand osteoarthritis.”

An overview of minerals and their benefits:

- **Boron** encourages healthy bone development and building muscle mass. It helps manage arthritis and osteoporosis and boosts brain activity.
- **Calcium** promotes healthy bone growth. Maintaining proper levels of calcium reduces chances of colon and breast cancer.
- **Chloride** is essential for the proper balance of body fluids. An electrolyte, it helps maintain proper blood volume, blood pressure, and pH.
- **Fluoride** promotes hardness and stability of bones and teeth.
- **Iron** increases resistance to stress and disease, as well as preventing fatigue. It also promotes healthy skin, hair and nails.
- **Lithium** has a calming and mood-stabilizing effect. It promotes brain health and alleviates depression.
- **Magnesium** is important for the breakdown of fatty acids and cholesterol. It helps maintain hormone levels, along with regulating heartbeat and blood pressure.

Thermal bathing in Slovenia.





Connecting with nature at Metung Hot Springs, Victoria, Australia.

- **Manganese** also assists in the breakdown of fats and cholesterol. It contributes to healthy bone metabolism and growth.
- **Nitrogen** is needed to make proteins in muscles, skin, hair and nails.
- **Phosphate** is critical for energy storage and metabolism. It assists in kidney, muscle and nerve function.
- **Potassium** reduces high blood pressure and cholesterol. It is also vital for heart and kidney health.
- **Silica** is not considered an essential nutrient, but studies have shown that it can prevent the thinning of hair and plays a vital role in assisting calcium in bone growth.
- **Sodium** is another electrolyte that is necessary for life and plays a pivotal role in fluid balance, enzyme operations, and nerve and muscle functions.
- **Sulfate** is a compound found in every cell of the human body. It helps relieve nasal congestion and is essential for production of collagen and maintaining healthy skin, hair and nails. It also helps flush toxins and purify the body.
- **Zinc** helps with proper functioning of the immune and digestive systems. It plays a key role in thyroid function and healthy vision.

Social, Environmental and Economic Impacts

As of 2023 a PhD research study at Victoria University in Australia were finalizing a set of indicators as a tool to measure hot springs' socio-cultural, environmental and economic impacts and potential regenerative impacts in communities and highlight ways they can contribute to the regenerative improvement in the quality of life.

Progress on and delivery of the indicator set can be found at the Global Wellness Institute's Hot Springs Initiative resource library. Operators can access these tools to understand and enhance positive impact within their local communities. The Hot Springs Initiative welcomes hot springs to join a long term global best practice study enabling participating facilities to share knowledge and learning.

Hot Springs Derivatives

Throughout the globe a variety of hot springs derived and related products have been developed to enhance and extend the bathing experience. Examples of these include:

- Hot springs sprays and mists
- Hot springs face masks
- Foods cooked in hot springs such as eggs, breads, meat and vegetables
- Hot springs bath salts
- Hot springs mineral water for drinking

Staffing, Education and Skillsets

Hot springs staff education and training is emerging to create career paths for the industry sector worldwide.

At the time of this edition, development of a Diploma of Hydrothermal Wellness was underway in Australia. This one-year full time Diploma will develop cohorts of graduates to fill the many job opportunities and lead to career pathways arising from the growth of the Australian hot springs and urban bathing sectors. Similarly, a degree in hot springs management was developed in China at the Hot Spring College of Hezhou University. The program began recruiting students nationwide from September 2023 to cultivate hot spring professionals.

With gratitude to the organizations that made this chapter possible:

BATHING
AUSTRALIA

Bathing Australia
www.bathing.org

Chisholm

Chisholm Institute (Australia):
www.chisholm.edu.au



Hot Springs Association (USA):
www.hotspingsassociation.com



Peninsula Hot Springs (Australia):
www.peninsulahotspings.com





Hot springs in natural surroundings let bathers get in touch with nature, while experiencing the wellness benefits of their unique water properties. Pictured: The Springs Resort, Pagosa Springs, Colorado, USA.

Hot Springs Terminology

Algae: informal term for a large and diverse group of simple organisms of aquatic or moist habitats

Aquifer: an underground layer of water bearing permeable rock

Balneotherapy: the practice of immersing in mineral water or mineral-laden mud

Extremophiles: an organism that thrives in physically or geochemically extreme environments

Balneology: the scientific investigation of geothermal mineral water effects on health and wellness

Gas: a substance possessing perfect molecular mobility and the property of indefinite expansion, as opposed to a solid or liquid

Geothermal: energy, generated and stored in the Earth that determines the temperature of matter

Geothermal Mineral Water: heated water flowing from underground sources

Ground Source Loop Heat Exchange: drilling a dry well deep enough to access the natural underground heat of the Earth, bringing that heat to the surface with fluids and transferring the heat to municipal water

Halophyte: a saline-tolerant plant species

Hot Springs: geothermal mineral water facilities whether they're naturally occurring hot springs or modern drilled wells, or a combination of both spring and well

Hydrology: the scientific study of the movement, distribution, and quality of water

Microbiomes: the microorganisms in a particular environment

Mineral: a mineral is a naturally occurring substance that is solid and inorganic and has an ordered atomic structure

Mud: wet, soft earth or earthy matter occurring in or around hot springs.

Peloid: mud, or clay used therapeutically, as part of balneotherapy, or therapeutic bathing. Peloids consist of humus and minerals formed over many years by geological and biological, chemical and physical processes

Peat: brown soil-like material characteristic of boggy, acid ground, consisting of partly decomposed vegetable matter

Primordial: ancient, prehistoric, from the beginning.

Replenish Rate: the rate at which an aquifer's water is naturally replaced

Additional Hot Springs Industry Resources

Key industry organizations and associations within the hot springs sector include:

Global Wellness Institute Hot Springs Initiative:

<https://globalwellnessinstitute.org/initiatives/hot-springs-initiative/>

World Federation of Hydrotherapy and Climatotherapy (FEMTEC):

<https://www.femteconline.org/>

China Hot Springs Association: <http://www.chsta.cn/>

Hot Springs Association (USA-based): <https://hotspringsassociation.com/>

Termatalia: <https://www.termatalia.com/>

European Spa Association: <https://europeanspas.eu/>

ESPA also has a library of balneological research: <https://europeanspas.eu/e-library/>

Polish Geothermal Association: <https://energia-geotermalna.org.pl/> and <http://www.pga.org.pl/>

European Spa Fundation: <https://fundacjaspa.org/>

The Association of Polish Spa Communities: <https://sgurp.pl/en/>

Australian Hot and Mineral Springs Bathing Alliance: <https://www.bathing.org/>

Academic journals which regularly publish industry-relevant articles:

Geothermics: <https://www.sciencedirect.com/journal/geothermics>

Environmental Research: <https://www.sciencedirect.com/journal/environmental-research>

Journal of Hydrology: <https://www.sciencedirect.com/journal/journal-of-hydrology>

International Journal of Spa and Wellness: <https://www.tandfonline.com/toc/rspa20/current>

Wellness tourism studies:

Wellness Tourism is consistently one of the fastest growing tourism segments. The Global Wellness Institute's Wellness Tourism Initiative monitors worldwide trends each year. The 2023 trends can be found at <https://globalwellnessinstitute.org/global-wellness-institute-blog/2023/06/26/wellness-tourism-initiative-trends-for-2023/>

Endnotes

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⁵ Yamaoka, K., F. Mitsunobu, S. Kojima, M. Shibakura, T. Kataoka, K. Hanamoto and Y. Tanizaki (2005). "The elevation of p53 protein level and SOD activity in the resident blood of the Misasa radon hot spring district." *J Radiat Res* 46(1): 21-24.



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