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8.25 Badgastein Spa of Austria

8.25.1 Location

The communities of Badgastein (47°14' N, 13°08' E; 930 to 1083 m a.s.l., population of 5600), Bad Hofgastein (869 m a.s.l.), Dorfgastein (830 m a.s.l.) and Böckstein (1331 m a.s.l.) occupy the area of the Gastein Valley, a political district of Salzburg country (Fig. 8.70 and 8.71).

Being the most important spa in Austria, Badgastein has 7519 guest beds, among them 2769 in four- and five-star hotels. Badgastein is easy to reach by car, rail or plane; bus and taxi transfer to the next airport, Salzburg (see Sect. 8.26.7). The importance of Badgastein is attributed to its thermal springs and the Badgastein-Böckstein geothermal heat and radon gallery which are considered to be special geological phenomena.

Fig. 8.70. Gastein Valley; view N-S; background "Hohe Tauern"

8.25.2 History

Gastein thermal springs are mentioned for the first time in a document which reports the healing of the emperor Friedrich III after a hunting accident in 1350. In 1725 Gastein thermal waters were described in medical remarks by Paracelsus. The use of the springs by people of importance began in the 19th century. The high aristocracy included Kaiser Franz Josef I (Austrian-Hungarian monarchy), the German emperors Wilhelm I and Wilhelm II, the Czar of Russia and Bismarck and King Carol of Rumania had villas or apartments at Badgastein. Other well-known visitors include Grillparzer, Schubert, Toscanini, and Thomas Mann.

The most important step in the development of the spa was the discovery of the radon in water from the thermal springs by H. Mache, M. Curie and A. LaBorde during the second half of the 19th century.

In 1936 the Research Institute of Gastein, later Research Institute of the Austrian Academy of Science, was established. Under the long-term director F. Scheminzky (†1979), the institute was very active in radon research. The success of the spa and Badgestein-Böckstein heat gallery in treatment of rheumatic diseases made the spa well known worldwide.

8.25.3 Geology

With the Tertiary era, the elevation of the Alps became a dominant agent. Despite drastic local tectonic events, the general elements were the uplift which began with the Oligocene and is still going on. Its rate is episodic as is the intensity of denudation and erosion. A. Tollmann

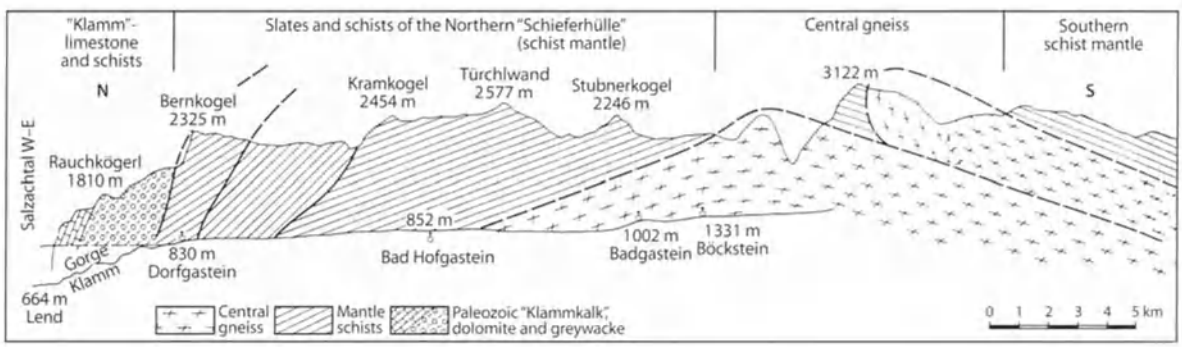

Fig. 8.71. Geological profile of Gastein Valley. Central gneiss window with remnant of mantle schist

(1986) estimates the amount of denudation around the Tauern region west of Gastein as much as 11 000 m since the Upper Oligocene.

The fundamental tectonic rules together with the difference of rock types of nappes and basement resulted in the separation of the Central Alps and the Northern Limestone Alps. In the Central Alps the continuing uplift caused the denudation of the "Schieferhülle" (schist cover). Thus, in wide areas, the "Zentralgneise" (Central gneiss), the oldest rock of the basement, built up the highest peaks of the Eastern Central Alps (Großglockner 3797 m a.s.l.). But all of these areas are surrounded by rocks of the former schist cover. The geologist therefore gives these areas the term "window" (Fig. 8.71).

Gastein lies within the "Tauern window". The Central gneiss has the quality of a fine crystalline rock with the joint-systems necessary for ore enrichment and (hot) water circulation.

8.25.4 Hydrology

The individual thermal springs of Badgastein discharge from the main joint system or bedding joints of the Central gneiss.

Since the uplift of the Central Alps goes on in the form of vaulting, the main joints are tension joints, and are open to great depths. They provide the avenues for infiltration of rain and melt water, as well as rising gas and hot water and the formation of zones of mineralization (ancient gold mines).

All the thermal water of Badgastein is meteoric water from its infiltration around the "Reed See" (Fig. 8.72) that outflows at Gastein thermal springs. The age of the water is 3600 to 3800 years as calculated (Job and Zötl 1969).

The temperature of the thermal water does not depend on the thermal gradient of the region (1 °C/49 m) but on the ascending heat, hot water and gases from the earths mantle, as shown by traces of mantle helium. This indicates open joint systems down to a depth of 30 km.

The total discharge from the developed Gastein thermal spring (No I–XIX), is 4500 m^3/d (52 l/s), captured directly at the joints of the bedrock.

The water from the springs is a mixture of hot water from great depths and cold water. The mixing occurs in a joint zone at a certain depth. This is shown by a lower tritium content than that of precipitation and shallow groundwater. Table 8.24 shows the percent of cold water in selected thermal springs.

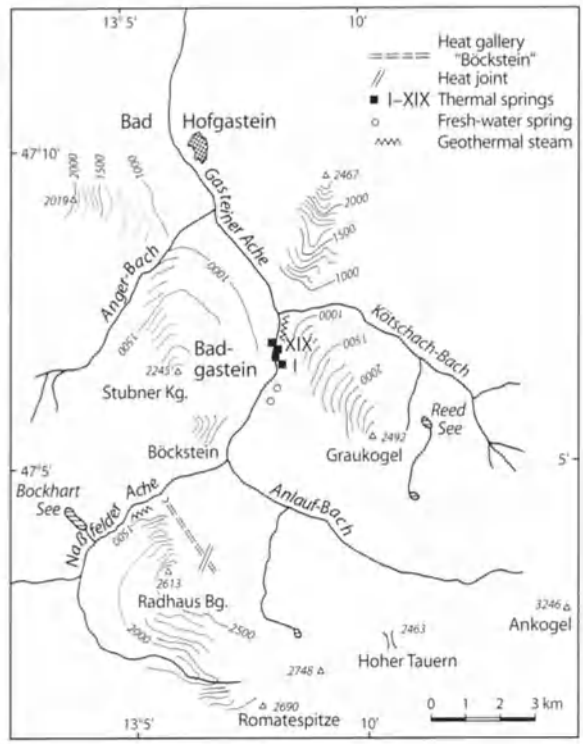

Fig. 8.72. Gastein region: location of Badgastein with thermal springs. Reed See infiltration area, Böckstein heat gallery

The high temperature of Gastein Springs is one of the special features of the spa. Another unusual characteristic is the radon content of the thermal water. Radon (^{222}Rn) is a daughter of radium (^{226}Ra) from the uran-thorium-radium succession row of radioactive elements born in the core of the earth. Being a gas of 3.8 days half-life it emanates from radium into water and air. Consequently, radon is introduced into the human body mainly by respiration and a minor amount through the skin. The question with regard to being helpful or toxic depends on the quantity. Radioactivity of Gastein thermal springs lies between 4.8×10^{-9}Ci/l (= 4.8 nCi/l) and 124.0 nCi/l (spring No. X, Table 8.24). Distinctly influenced by altitude are tritium content, mineralization and temperature. The Rn-content goes its own way (depending on the different Ra traces in the joints). Spring No. XIX discharges at the lowest position on the Gastein cascade from rock fall material, the great part of the water comes from the Gastein cascade.

Table 8.24. Chemical and physical characteristics of various springs at Badgastein Spa

Spring No.	Altitude (mNN)	Freshwater percentage (%)					Thermal water temp. (°C)	Spring discharge (m^3/d)	Radon content (*n*Ci/l)	Remarks
		T[a]	Na	Cl	SO_4	Average				
I	1034	5.4	6.2	5.7	6.5	6.5	45.6	195	4.8	Not used
VIIa	1005	6.5	–	–	–	–	41.4	18	53.5	3 Outflows
IX/1,2,3	995	13.3	11.3	12.1	10.5	11.8	46.3	68 – 1887	21.0 – 51.0	5 Outflows
X	983	21.7	21.7	23.3	19.3	21.15	33.3 – 37.0	14	60.6 – 124.0	
XII	975	24.0	26.0	24.9	23.8	24.7	39.5	378	52.8	
XIV	968	23.8	25.8	27.6	22.8	25.0	36.8	106	39.6	
XVIII	954	38.7	39.5	37.1	36.1	37.8	23.0	?	3.5	Not used
XIX	937	75.8	72.8	62.8	68.0	70.0	16.1	261	0.19	Not used

[a] Calculated from the tritium content (1967; 608 TU = 100% in freshwater).

8.25.5 The Gastein-Böckstein Thermal Gallery

In 1940 a last effort was started to reactivate the gold mining in the Central gneiss sequences of the Radhausberg SW of Böckstein (Fig. 8.73). The entrance to the gallery is at an altitude of 1280 on the NW slope of the Radhausberg. The total length of the gallery is 2425 m, where the mining was terminated.

At that time, only old miners were available to work on the project. A remarkable number of them had the unexpected experience of being cured of rheumatism and arthritis, painful illnesses which had bothered them for decades.

In the 1940s people of the research institute in Gastein began systematic ivestigations. Measurements of the air temperature showed the highest value (ca. 45 °C) at that point where the gallery crosses the main joint system, gallery meter 1999 (Fig. 8.74).

The zone of the highest air temperature is around that of a joint set between the gallery meters 1600 and 2000. The rock temperature of the heat joints also reaches 45 °C. Towards the inner part of the gallery, the air and rock temperatures decrease, though those in the overlying rock increase. The radon content of the air in the gallery has an average of 4.99 nCi/l air. The gallery became the most important place for treatment of rheumatic diseases and polyarthritis (Fig. 8.74, station IV in the gallery).

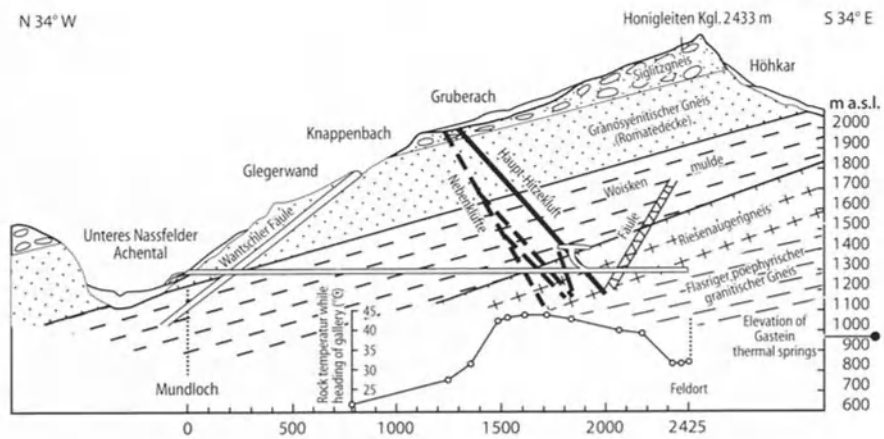

Fig. 8.73. Geological profile of the Radhausberg with Böckstein heat gallery. Pay attention to the main joint system and the scale of temperature in the gallery

Fig. 8.74. Treatment station No. IV in the Böckstein heat gallery. Distance of entrance 2 238 m, air temperature 41.5 °C, humidity 99%

Fig. 8.75. Traffic service

8.25.6 Indications and Medical Treatment: Bottled Water

The knowledge and therapeutic use of radon have developed rapidly. At the spa Badgastein together with Gastein-Böckstein, radon is successfully used in all kinds of chronic inflammatory and degenerative rheumatic diseases including rheumatic nerve and muscle diseases and polyarthritis, collagen diseases like scleroderma and priasis, sequelas after traumatic and infectious paralysis, chronic inflammatory diseases of the respiratory tract, chronic inflammatory adnexa diseases, geriatric symptoms, premenopausal and menopausal disorders, endocrine and vegetative disorders and last but not least, healing of wounds and ulcers. The Böckstein gallery has four treatment stations at different distances from the gallery entrance (Fig. 8.74).

The thermal water of Badgastein has a larger treatment hall as well as thermal water pipes to some of the hotels for individual treatment. Bottled water: registered under "Gasteiner Tafelquellwasser" the former Gasteiner thermal water, cool and purified from the high fluoride content is sold as refreshing drinking water; 1992 capacity of sale 30 million l.

8.25.7 Conventions and Meetings – Recreation and Sports

Badgastein has a well equipped congress center (capacity 1 220 people) with a simultaneous interpreter's system for six channels. For summer relaxation, Badgastein offers 39 tennis courts, a 9-hole golf course, riding excursions and parcours, paragliding with instructions, and more.

Highlights of the wintersports are international ski races (World Cup and Company championships), 250 km of ski runs with 50 lifts and cable ways ranging from 800–2 800 m a.s.l. are available (30% of ski runs are easy ones). Three ski schools offer their assistance (Fig. 8.75).

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