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# Thermal-Mineral Waters of Felix – 1 Mai Spas. Present and Prospective Usage of their Touristic Resources

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## Introduction

The Băile Felix and 1Mai spas that capitalize thermal-mineral waters for a curative and recreational purpose are the best-known spas in Romania. The hydrothermal aquiferous Felix-1 Mai is a fissural system developed in Lower Cretaceous carbonatic rocks at a depth of 45-500 m. The water temperature varies for different wells between 33-49<sup>0</sup> C. The mineralization is around 1 g/l. From the chemical point of view the thermal-mineral waters are bicarbonated, sulphated, calcic, siliceous and oligometallic. The main natural curative factors are the microclimate, the thermal-mineral waters and the therapeutical mud. The two spas can accommodate 7 810 people in hotels and treatment bases, 5 000 for year-round leisure in the pools and 25 800 people in lidos on a seasonal base. The amenities encourage the development of several types of tourism: medical, congress, event, recreational, leisure.

Felix and 1 Mai spas are situated in the northwestern part of Romania, 9 km from the city of Oradea and 23 km from the Hungarian border. The two spas are located at the contact between the Western Hills and the eastern Plain, at an altitude of 150-160 m.

## The Genetic Characteristics of the Thermal-Mineral Aquiferous Felix-1 Mai

From the structural point of view the zone Felix-1 Mai is situated at the contact of some major structural units, the Pădurii Craiului horst and the Pannonic Basin with its graben-shaped eastern parts (Borod and Beiuş Basins).

The hydrothermal aquiferous Felix-1 Mai is a fissural system developed in Lower Cretaceous (barrenian-aptian) carbonate rocks with different degrees of fissuration. The collector of the deposit is the fossilized karstic relief of the cretaceous deposits (cracks, diaclases, galleries, cave-like voids) made up by organogenous limestone with a thickness of 1200-1400 m rarely with of marl-limestone, conglomerates and argillaceous schists interspersed. The collector bed is assured by the gradual disappearance of the fissures and the covering formations, either permeable or with the role of a screen, are cretaceous marl-limestone and pannonian clays. The aquiferous rock, a carbonate-fissured one, has at least two kinds of fissures, first major fissures, which ensure the main flow ways (fault planes and erosion surfaces) and the second little fissures, of a mechanical nature or created through dissolution.

In the northwestern part of Romania, the fault system with perpendicular directions, the pannonic NE-SW one and the carpatian one (NW-SE) determined the occurrence of a structure similar to a chess table which played an important role in the outline of the thermal aquiferous strata. Placed on a tectonically lowered compartment and separated from the longest limestone ramification of the Pădurea Craiului Mountains, the small zone of the baths (around 20 square km) shows a strong tectonization and deep fractures that secure the ascension ways of the hot water in depth, an advanced degree of karstification in the upper part of the limestone pack, the ideal way of sheltering and a waterproof cover constituted of Pliocene formations that allows the conservation of the aquiferous and of the energetic potential of the deposit.

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In the 1 Mai area, where the Pliocene deposits are very shallow, the thermal-mineral waters appeared along Peșa valley as a chain of underlacustral springs with a total debit which varied in time between 200-300 l/s, in exceptional cases growing to 400 l/s as in 1970. This discharge had as a consequence a lower deposit pressure in the area of 1. Mai compared to the area of Felix where the Pliocene deposits with a thickness of 50 m conserve better the potential of the aquiferous.

The barrenian limestone contains three fissural systems of thermal-mineral waters. Complex I, the most important, is situated in the upper part of the cretaceous limestone where it forms a fissural system of voids and large underground channels, with high debits. In the structural compartment 1 Mai, due to the elevated position of the collector complex and to the intersection of some major faults, powerful thermal-mineral springs were formed in the points in which erosion removed more of the quaternary cover. In the structural compartment Felix at the end of a fault there is only one natural spring with a lower debit, Felix. Complex II, little researched, forms in limestone a network of finer fissures. Complex III is made up of a very weak Fissure system, extended over hundreds of meters, with debits that eliminate the possibility of capitalising it. This aquiferous has a low thermality and is known more theoretically.

### Therapeutical Qualities of the Thermal-Mineral Waters

The physical and chemical properties of the thermal-mineral waters depend in their area of origin and on the characteristics of the collector rocks. The hydro geothermal system Felix-1 Mai, of a convective type, with a rich feeding and an active dynamics, receives water of a meteoric origin from the zone where the Bihor Autochthonous appears at the surface in Pădurea Craiului Mountains, which is continued in the subsoil of the Vad-Borod Depression and even appears at the surface in the neighbourhood of the baths. It was proved that the debit of 955 l/s of water from an endoreic surface of the Pădurea Craiului Mountains (525 square km) is collected underground and is never discharged within this area, where it determines a deficit in the hydrological balance (Orășanu et al., 1982 - 1983). The water flow in the system is through preferential ways and is oriented towards the point of the natural discharge of Felix-1 Mai Baths, formed at the intersection of some major accidents, out of which some are permeable and some are tight. The faults in the area of the baths are routes of ascending feeding of natural emergences, the aquiferous complex situated in the fissured parts of the lower cretaceous being too small to justify the large water volume extracted through the baths. From the comparative chemical analysis of rocks of Pădurea Craiului Mountains, Oradea and Felix – 1 Mai it resulted that they are carbonated rocks, with a dominance of magnesium and calcium oxide. The rock composition is reflected in the chemical composition of the waters which are of a bicarbonated-calcic type (surface waters) and calcic-magnesian (underground waters). The water mineralization is 0.2 – 0.3 g/l. The age of the cretaceous waters corresponding to the carbon 14 content is at 1. Mai spring of 21 150 (+/- 550 years), at 4 012 drill of 17 500 years (+/- 250), at 4 087 drill of 22 500 years (-700/+800) (Șenu et al., 1979). The relative young age of the waters situates them in the field of waters belonging to the active hydrological circuit.

The curative action of the water is due to the thermality, the specific radioactivity and to the chemical composition. The thermal water produces a peripheral vasodilatation, favours the mineral changes between the organism and the environment, calms the pains, relaxes the muscles and has a comforting effect upon the chronic inflammations. The water temperature for Complex 1, situated at depths of 45-200 m is of 45<sup>0</sup> C, and for the Complex II situated at a depth of 250-500 m is of 38<sup>0</sup> C. The radioactivity stimulates the function of the endocrine glands and the general metabolism. The geothermal fluid contains radioactive elements, especially Ra-226 and Rn-222. In the zone 1 Mai Ra-226 has values of 0.7-3.2 pCi/l, and at Felix Baths 0,8-3,3 pCi/l. The Rn-222 concentration is comparable with that specific for the surface waters: 0.6 – 2.1 x 10<sup>-10</sup> Ci/l (Dincă et al, 1980). The chemical analysis of the thermal-mineral waters of 1 Mai was done in 1891 for the first time.

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At the world exhibition of 1896 the waters from these spas were awarded the gold medal and the diploma of honour. The geothermal fluid of the hydrodynamic system Felix-1 Mai Baths is a complex solution made up of dissolved salts and gases, subsaturated in deposit conditions. The chemical analysis performed during 1976-1986 indicated the stability of the chemical composition. The waters of the aquiferous have a low mineralization with values ranging between 500-1300 mg/l and they are of the bicarbonated-sulphated-calcic-magnesium type. The dissolved gases are in small quantities with the predominance of the hydrocarbons (CH<sub>4</sub>).

### **Tourist Capitalization of the Thermal Waters**

The curative value of the thermal-mineral waters of these spas was recognized from the Roman period, but they were intensely capitalized from the end of the 19<sup>th</sup> century. Between 1886-1998 this Mesozoic hydro geothermal system produced over one billion cubic metres of water, without major implications upon the pressure of the deposit.

The oldest written testimony about the existence of these baths dates from 1221 during the time of the abbey Hevius of Magno-Varadino. In the written documents of the Middle Ages these baths have several names: Therma Varadienses (Băile Oradei), Băile Episcopopești and Băile Haieului (Băile 1 Mai), Băile Sânmartin (Băile Felix). Information about these baths are mentioned by Ianus Pannonius, the poet of the king Matei Corvin (1465), Giovanni Antonio Magni (in "Geography or the universal description of the Earth"), Antonio Possevino (1533 – 1611), Nicolaus Olahus, Szalardi Janos (in his chronicle), Stephanus Hatvany (in "Thermae Vardienses", 1777), Anton Mayer (in the baths monography of 1861) and others.

Thermal-mineral water resources. The geologic research of the area through drills started in 1885 when the Balint drill intercepted a fissure at 47.5 m in depth from where an artesian started a debit of 196 l/s at a temperature of 49<sup>o</sup> C. It generated permanently 15 l/s in the Felix and Apollo swimming pools at Felix. Well 4 011 (1962) in Felix generates a potential debit of 105 l/s with a temperature of 49,5<sup>o</sup> C in Complexul I, from a depth of 147-151 m. It feeds permanently (65 l/s) through the two pumps the Crișana swimming pool with a capacity of 500 persons/day and seasonal pools for the intensive growing of carp saplings at the fish enterprise Cefa. It secures the treatment water and the domestic water in the Crișana, Someș and Mureș hotels. Well 4003 (1969) generates from a fissure situated at a depth of 59 m a debit of 122 l/s at a temperature of 45<sup>o</sup> C. The two pumps generate without stop the necessary of treatment water at the following bases: Felix, Termal, Pavilionul 2, Belvedere and UGSR, which totalise an accommodation and treatment capacity for 2900 people. The well secures domestic hot water for 2100 people. Well 4087 (1973) generates from a depth of 200 m a debit of 45 l/s at the temperature of 42<sup>o</sup> C. The two pumps (33 l/s) secure the necessary for the treatment base belonging to the UGSR complex (1500 places) and feeds the Uranus swimming pool (capacity 1200 people). Well 4012 (1963) in Felix generates a debit of 25 l/s at a temperature of 39<sup>o</sup> C from complex II situated at a depth of 400-650 m. Through the pump that functions 8 hours/day it produces directly (9 l/s) in Apollo I and II swimming pools. Well Izbuca (1887) in 1 Mai generates artesian a debit of 25 l/s at a temperature of 42<sup>o</sup> C. Partially out of use, it generates water for the showers of the treatment base (3 l/s) and seasonally for Venus camping site. Well 4013 (1964) in 1 Mai generates from complex II a debit of 25 l/s at a temperature of 33<sup>o</sup> C. It secures through a pump 6 l/s for the olympic swimming pool Venus. Well F 2 in 1 Mai (1975) generates from complex I at a depth of 145-170 m a debit of 200 l/s at a temperature of 42<sup>o</sup> C. Equipped with two pumps (28 l/s) it supplies domestic hot water in more than 500 flats in the settlement of Sânmartin and treatment water for the treatment base belonging to UNCAP (250 places) in 1 Mai spa. In the hot season it even pumps 50 l/s to secure the water necessary for Venus swimming pool (capacity 12000 people/day). When the pumps don't work (12 hours/day) a debit of 30 l/s flows in Peșca brook. Well Izbuca Nou (1986) in 1 Mai produces a debit of 80 l/s at a temperature of 40<sup>o</sup> C. It feeds the treatment bases 1 Mai and the Sanatorium for children with post-polio (capacity 140 places). For wells F2, 4013 and Izbuca Nou the exact debit is not known, there is no record of the functioning hours of the pump, and the installations are degraded.

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Wells Fp1 Venus and Fp4 Camping (1986) in 1 Mai obtain debits of over 50 l/s at a temperature of 33-38<sup>0</sup> C from a depth of 500 m. Ochiul Pompei Spring secures 4 l/s for the wave swimming pool at 1 Mai Baths.

The maximal necessary of thermal water for the treatment base in Felix Baths (Felix – Lotus, Pavilion II, Termal – Nufărul, Belvedere) with a capacity of 6700 places is of 9140 cubic metres/day, and for the swimming pools (Apollo I and II, UGSR, Felix) with a capacity of 17000 is of 5400 cubic metres/day (62.5 l/s). The maximal necessary of thermal water for the treatment bases in 1 Mai spa (1 Mai, Children Clinic, UNCAP) with a capacity of 1 110 places is of 1 240 cubic metres/day (14.4 l/s), for the swimming pools (Venus, with waves) with a capacity of 12 600 places is of 2 100 cubic metres/day (24.5 l/s) and for the camping site with a capacity of 1 800 places is of 180 cubic metres/day (2 l/s). Balneophysical treatment. The spas Felix and 1 Mai Baths are specialized for the treatment of the following groups of diseases: inflammatory and degenerative rheumatic diseases, articular diseases, post-traumatic conditions, diseases of the peripheral central nervous system, gynaecological diseases, and as associated diseases some metabolism, nutritional and endocrine diseases. The main natural cure factors are: the climate, the thermal-mineral waters and the therapeutical mud. The climate is temperate-continental, with oceanic influences. Sheltered by afforested hills the spas have a sedative bioclimate, with mild winters and summers without excessive heat. The winds predominantly southeastern are weak, and the rainfall is low (615.8 mm/year). The annual average temperature is 10.4<sup>0</sup> C. The mud extracted in 1 Mai spa has the form of a natural paste that was formed through long-lasting geologic and biologic processes from the mixture of water with organic and inorganic insoluble microparticles. The mud uniformized in “mud kitchens” and heated at a temperature of 40 – 46<sup>0</sup> C is used for wrappings. The thermal-mineral waters used for the treatments have a mineralization that varies around 1 g/l, a temperature between 41<sup>0</sup> C and 49<sup>0</sup> C and a radioactivity of 1.15 UM/l. From a chemical point of view the thermal-mineral waters are bicarbonated, sulphated, calcite, siliceous, oligometallic. The water is used in external cure, as bathings in the tubs, in indoor or outdoor pools, as well as in internal cure. For the external cure with thermal water, a specially arranged sink provides the water. The thermal-mineral waters drunk at a temperature of 39-40<sup>0</sup> C calm the stomach movements, diminish the gastric secretion, calm the digestive pains and the abdominal spasms, increase the diuresis, stimulate the bile action, etc. In the two spas many adjuvant procedures are applied: hydrotherapy (subaquatic showers), electrotherapy (galvanization, faradisations, ionisation, ultra-violet and short-length rays), medicinal gymnastics, massage, kinetotherapy, vertebral therapy, paraffin and mud wrappings etc. The average thermal water consumption for a person under treatment is 1 cubic metre/day.

Facilities. Within the spa of Felix Baths there are Apollo I pool, functional all year round, Apollo II outdoor pool, the Felix and UGSR lidos, each of them with two pools that are operative on a seasonal basis. The pavilions have different utilities. Pavilion no. 1 has 86 beds at a second-rate comfort, and a consulting room. Pavilion no. 2 has 128 beds second-rate comfort, two consulting rooms, a nose, ears and throat consulting room and a treatment base. Pavilion no. 3 has 128 beds second and third-rate comfort, a consulting room and a gymnastics hall. Pavilion no. 4 has 116 beds third-rate comfort and a consulting room. Pavilion no. 6 has 95 places second and third-rate comfort and a consulting room. Pavilion no. 8 has 14 beds second and third-rate comfort. The cure hotels all have first-rate comfort. Belvedere hotel (400 beds) has treatment bases and consulting rooms on each floor. Nufărul hotel (150 beds) has a direct connecting hall to the treatment base of Termal hotel. Termal hotel (300 beds) has an outdoor pool, four consulting room, a geriatric consulting room and a treatment base. Felix hotel (290 beds) has consulting rooms and a treatment base. The hotel has a direct passage to the clinic. Lotus Hotel (400 beds) has five consulting rooms and a geriatric consulting room. The tourist use the treatment base of Felix hotel. The hotel complex Poienița (1300 beds) has its own treatment base. The balnear children recuperation sanatorium (Pavilion no. 5) (100 beds) treats within its own base children aged 6-16 affected by rheumatism, in series of three weeks. The sanatorium complex UGSR (1 700 beds, first and second-rate comfort) has three interconnected buildings. There are two treatment bases within the complex, two sinks for internal cure and consulting rooms on each floor. The boarding house in the

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spa (400 beds) serves meals according to the medical prescriptions. At the spa entrance there is a parking place for around 500 cars. In the 1 Mai spa there is Venus lido with several pools (12 000 places) and the seasonal wave pool. The 1 Mai treatment base has a capacity of 450 places, and the UNCAP hotel and annex have a capacity of 450 beds first and second-rate comfort.

### **Perspectives of Curative Tourist Development**

The present situation of thermal-mineral waters usage in the Felix and 1 Mai spas demonstrates a waste of water and energy. The distribution network of thermal water (45<sup>0</sup> C) leads the water from the wells straight to the treatment bases. Because the cooling station is no longer functional due to the lack of cold water, the hot water is introduced in the evening directly into the treatment bases to cool down until morning, which generates an intense condense and the destruction of the installations. To heat the domestic water liquid fuel is used in thermo stations. Due to the lack of water in the distribution network, with the exception of the UGSR complex, the thermal-mineral water is distributed in the network of domestic hot water, fact that determines the consumption of approx. 25 l/s of thermal-mineral water and the corrosion of the zinc - steel pipes. In the spa there are large thermal-mineral water losses on the transport network due to the breakdowns. For Venus pool the change of the water and the pool cleaning is planned to take place twice a week, but in fact it is done daily. Felix pool should be washed clean once as week according to the plans, but in reality it is filled 2-3 times a week, which determines a consumption of 30 l/s. The renewal water for the pools and the showers is running permanently during the treatment programme due to the breakdowns and the negligence of the personnel. The renewal debit equals the filling debit, when it should be only the third part of the latter. The present situation of the usage of thermal-mineral waters extracted from the deposit Felix - 1 Mai requires immediate interventions from the owner of the geothermal fluid (Ministry of Tourism and Sport) which is committed by the law to rationally exploit and protect the deposit from the other users (UNCAP, Sanitary direction Bihor, Fish Enterprise Cefa, Sânmartin city hall). For the optimal capitalization of the geothermal fluid resources some measures should be taken: the construction of the filtering station for the water of Peșa brook that feeds Venus pool; the completion of unique administration of the treatment thermal water at 1 Mai through the necessary couplings; surveillance and centralized control of the functioning of the transport, distribution and utilization network of the thermo-mineral water with the aid of a computerized system; the ensurance of the preparation of domestic hot water at the blocks in Sânmartin using water from the network heated with the help of a thermo agent from Oradea Power Station; the immediate closure of the F2 well. The completion of all these measures would determine the re-equilibration and even the increase of the debit potential of the hydro geothermal structure Felix - 1 Mai, which plays the role of storing the geothermal waters. The two spas own a total of 7 810 beds and the same capacity for treatment, 5 000 places in the pools for treatment and leisure that are open all year round and a capacity of over 25 000 people/day for seasonal use. This capacity was not capitalized in an optimal way, especially after 1989, due to the transition from a socialist economy to a market economy that determined a growth in the costs of all services in the spas and a decrease in the income of the population that needed most these services (especially retired people). If before 1989 these spas received around 15 000 foreign tourists, at present their number decreased very much as a result of a bad management, of the increase in prices correlated with services of a very poor quality compared with other foreign offers, of the negative image created by the western media regarding the social climate that shows a great degree of risk for the tourists. The two spas possess the largest capacity for treatment and leisure with thermal-mineral waters in Romania and this should be an important income resource. To achieve this, the following steps should be necessary: the renovation of the receptive tourist bases (hotels, restaurants), of the infrastructure (roadways, communication system, parking lots, sport facilities, the green, the water lily pools etc.), the improvement of the superstructure (facilities for cultural, artistic and sport events, catering etc.). If at the moment the main function of the spas is medical, in perspective the utilities allow and

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encourage the development of other types of tourism, extremely profitable: congress (including international), event, leisure, and relaxation. To build a positive image of the two spas a more aggressive and diversified presentation (leaflets, posters, web pages on the net, TV commercials, etc.) would be advisable, oriented to the centres that would bring tourists.

### Conclusions

Knowing that the average debit extracted is of 180 l/s out of which 50 % is used for treatment, 30 % for domestic hot water and the rest wasted through the transport and distribution network there should be a rational exploitation which would ensure the conservation and the protection of the deposit. Taking all the compulsory measures regarding the maintenance and upkeep of the tourist base, the infrastructure and the superstructure, corroborated with the diversification of the tourist offer, a proper management and an aggressive tourist advertising, the two spas could provide varied well-paid services for a number greater than the 250000 tourists that come each year for treatment and for an equal number of people coming for recreation and treatment.

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