Exkursionsprogramm (30. Jänner 2007)

Excursion programme (January 30, 2007)

Diffuse Einträge in das Grundwasser: Monitoring – Modellierung – Management

Landwirtschaft und Wasserwirtschaft im Fokus zu erwartender Herausforderungen

Diffuse Inputs into the Groundwater: Monitoring – Modelling – Management

Agriculture and Water Management in the Light of Future Challenges

13 Uhr/1 p.m.: Abfahrt in Graz/*Departure from Graz*
14 Uhr/2 p.m.: Ankunft in Wagna/*Arrival in Wagna* **(S1)**
15 Uhr/3 p.m.: Ankunft in Donnersdorf (Grundwassererschließung Fluttendorf-Donnersdorf)/*Arrival at Donnersdorf groundwater pumping station* **(S2)**
15.45 Uhr/3.45 p.m.: Abfahrt/*Departure*
16 Uhr/4 p.m.: Ankunft im Haus der Vulkane in Stainz bei Straden – Weinverkostung und Imbiss/*Arrival at the "Haus der Vulkane" ("House of Volcanoes") in Stainz near Straden – wine tasting and snacks* **(S3)**
17.10 Uhr/5.10 p.m.: Ankunft beim Kulturhaus Straden/*Arrival at Straden, House of Culture* **(S4)**
17.30 und 17.50/5.30 and 5.50 p.m.: Vorträge (siehe Vortragsprogramm)/*Lectures (see programme of oral presentations)*
18.30 Uhr/6.30 p.m.: Konferenzdinner/*Conference dinner*
22.00 Uhr/10 p.m.: Rückfahrt nach Graz/*Return to Graz* (via Gleisdorf)

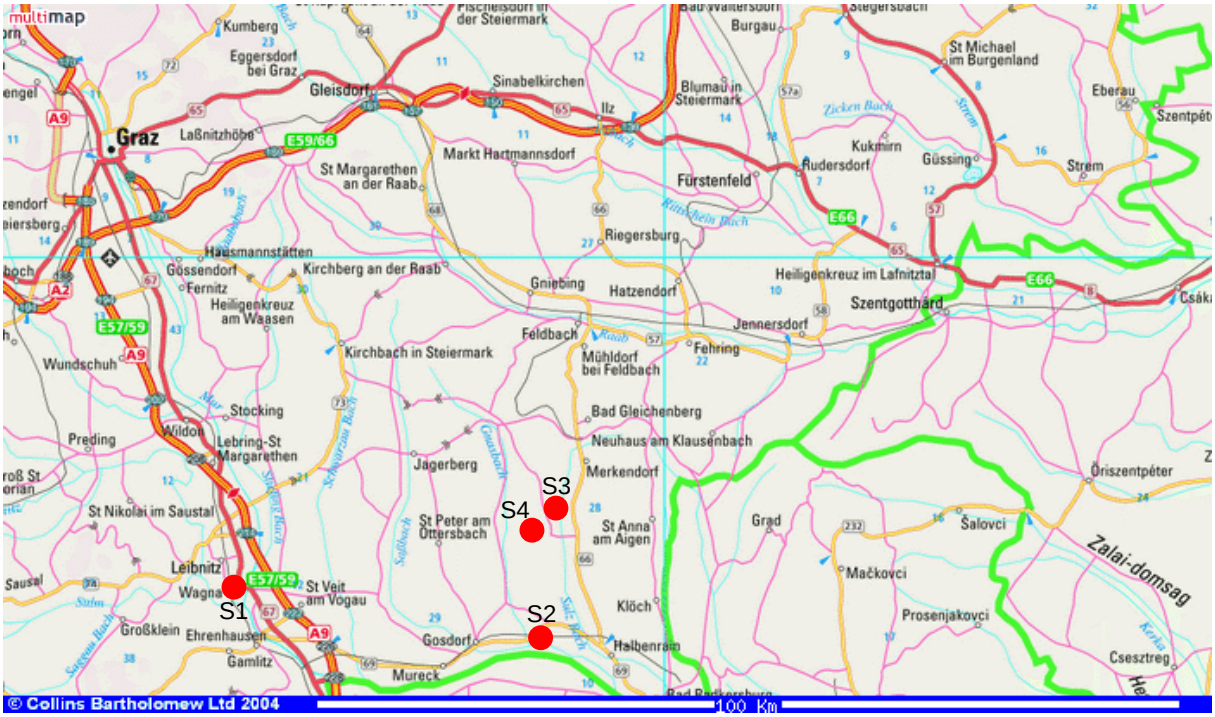

***Fig. 1**: Excursion stops/Exkursionspunkte (S1 = Wagna, S2 = Donnersdorf, S3 = Stainz bei Straden, S4 = Straden/Kulturhaus)*

The Unsaturated Zone of the Grazer and the Leibnitzer Feld and the Unteres Murtal (Lower Mur Valley)

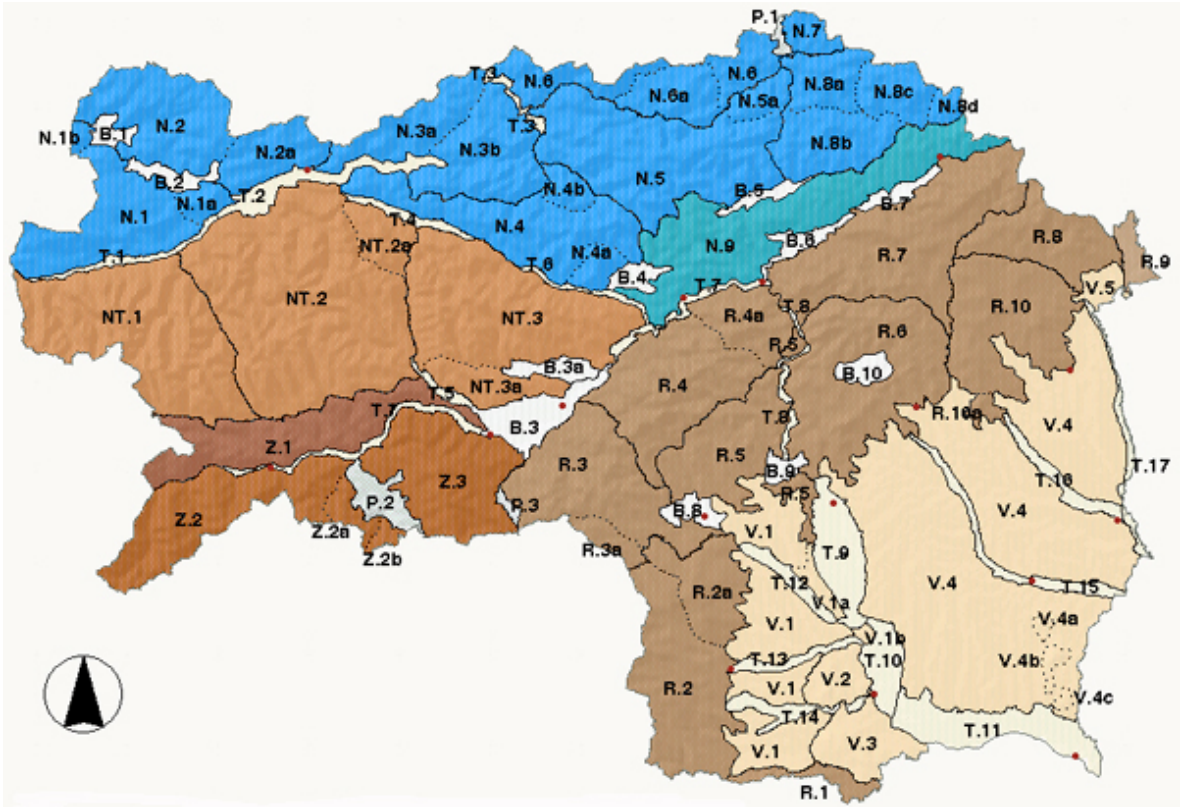

***Fig. 2**: Geographic sub-regions of Styria;T.9 = Grazer Feld, T.10 = Leibnitzer Feld, T.11 = Unteres Murtal; V.1b = Weststeirisches Riedelland – Wildoner Berg (according to http://www.umwelt.steiermark.at/cms/ziel/845054/DE/, LIEB G. K.)*
Naturräumliche Gliederung der Steiermark; Benennungen siehe oben

The Mur valley from Graz to Bad Radkersburg and its aquifer is divided into **three parts**, which were filled with gravel and sands of the river Mur after the last ice-age (about 10 000 years ago). Several river terraces dominate the landscape of the major parts of this area. Although the Mur valley was **not covered by ice during the last ice-age** the development of several levels **terraces** result from the conditions during this period. The **basement**[i] is formed by rocks of the **Palaeozoic** era and is superimposed by **Tertiary** sediments which act as an aquiclude/a confining bed[ii]. See Fig. 2 for the location of the three parts of the Mur valley: Grazer Feld, Leibnitzer Feld and Unteres Murtal (T.9, T.10, T.11).
The **unsaturated/vadose zone**[iii] above the aquifer is built up of fluvio- and fluvioglacial sediments (gravel and sands) of several meters thickness. Soil layers are not very thick (about 1 m); the typical soil type is **loamy-sandy Dystric Cambisol (Braunerde)**. Due to the good quality of the soils (silty soils have a large amount of water available for plants) the area is intensively used for **agriculture**.
The **aquifer** shows a thickness between **2 and 20 m**; from Graz to Radkersburg, the aquifer thickness and the fractions of sediments **decrease** because of the growing distance to the end/terminal moraine of the Mur glacier and the aquifer has less water in that parts which are far away from the moraine. **Groundwater recharge** amounts to **250 to 450 mm/year** and is dependent on the soil composition and the **precipitation amounts** that are recorded with about **800 to 950 mm/year** (mean annual values). Groundwater also interacts with the surface water of rivers or lakes. The three basins (Grazer Feld, Leibnitzer Feld, Unteres Murtal) with an extent of ca. 300 km² and its groundwater is used to supply inhabitants within a radius of 100 km.
In the Grazer Feld, only some big waterworks are situated but they have a **high rate of groundwater withdrawal**; in the Leibnitzer Feld, there are **many smaller waterworks** which extract high amounts of groundwater; no additional natural resources exist any more in this area. In the Unteres Murtal, at the border to Slovenia, withdrawal rates are **lower** but water may be needed for irrigation.

The Grazer Feld

The landscape of the Grazer Feld is characterised by large areas of **terraces** consisting of **Quaternary gravel** (of Würm age). In these lower terraces, the river Mur eroded the deeper river meadow; distances from the lower terraces to the river meadow amount to 2 to 5 m. The surface of the lower terraces heads from north-west to south-east but shows a steeper gradient to the underlying Tertiary material to the south-east therefore, rather significant differences in the aquifer thickness occur.
The sandy-silty **Tertiary sediments act as an aquiclude** for the groundwater. The confining bed looks like a deep furrow in the Grazer Feld but the furrow flattens and gets broader in the southern part of the Graz basin. In Kalsdorf, the flattest area was determined and the basin is divided into two parts. The furrow structure also occurs in the Tertiary basement at the most southern part of the Graz basin. In the fluvioglacial gravel layers, we can find the **aquifer**, the thickness of this gravel layer amounts to 25 m.
The bottom gravel layer is filled with **unconfined groundwater.** Groundwater is recharged by infiltrating and percolating precipitation water but at the border to the river Mur and to other rivers, groundwater interacts with the surface water. Differences of groundwater recharge throughout a year influence the groundwater table that is fluctuating about 2.5 m.

Leibnitzer Feld

Due to the hydraulic conditions in the aquifer and the interaction between the receiving water course and the aquifer, only the **lowest part of the Quaternary sediments is filled with groundwater**. The gravel and sand and soils above this zone build the unsaturated zone of the groundwater reservoir[iv]
The **thickness of the unsaturated zone** is important for the ability and the amount and course of groundwater recharge as well as for the leaching of pollutants percolating through the vadose zone into the groundwater (FANK et al. 1994, p. 23 and Fank 1999, p. 8 and10. Characterisations of the unsaturated zones and the soils are provided separately for the Leibnitzer Feld and the Unteres Murtal; sub-sections describe the sediments of the unsaturated and partly the saturated zone as well as the most important soil types.

Flood plain area/river meadow

The thickness of the sediments in the river meadows ranges from 4 to 6 m; above the slight silty and sandy gravel a 1.5 to 3 m thick loam layer was determined.

Lower terrace

The lower terrace can be divided into a higher and a lower part but the slope is just a few meters. It contains of slight silty and sandy gravel with stones which are composed of quartz, gneiss, metamorphous schist and limestone. Within these terraces, sandy or silty lentil-shaped layers occur.

Upper terrace (Helfbrunner Terrace)

In the landscape, the upper terraces are hardly recognisable and often cannot be marked off against the Tertiary hills. The “Helfbrunner Terrace”, a part of the upper terrace in the western part of the Leibnitzer Feld, consists of a 3 to 4 m thick gravel layer and a several meters high loam layer[v].

The **distance from the surface to the groundwater level** is influenced by the characteristics of the surface, the type of natural landscape, for example the terraces. In the river meadow, the distance is about 3 m but amounts to 4 to 7 m at the area of the lower terraces in the north-eastern Leibnitzer Feld. For the upper terraces in the northern and north-eastern area, the values are even higher: the distance is about 7 to 9 m due to Quaternary fluviatile gravel and Tertiary sediments. In the western Leibnitzer Feld, the distance is below 2 m, at the lower terraces between 3 to 8 m. The maximum values are reached in the southern part of the western Leibnitzer Feld and around the upper terrace of Jöß. In the area around the Tillmitsch gravel lakes, the distance was reduced enormously due to excavation of gravel (FANK 1999).

Unteres Murtal (Lower Mur Valley)

Flood plain area/river meadow

In the flood plain areas – especially at the borders of the lower terrace – water logging[vi] from the shallow aquifer may occur, sometimes even natural discharge[vii] can be observed. The thickness of the Quaternary sediments in the **river meadow** of the Unteres Murtal lies between 9.1 m (Unterpurkla) and 3.8 m (near Mureck). Most of the times, the sediments can be divided into a confining stratum[viii]

(fine sand, silty fine sand or silt) and a gravel layer[ix] (coarse sand and gravel). The **confining stratum** can have a thickness between 0 m (W9) and 3 m (Laafeld and Unterpurkla). At the border from the river meadow to the lower terrace, the thickness can reach 4.1 m (near Unterpurkla) due to local erosion of the sediments.

The **gravel layer** consists of water-bearing coarse material and the thickness ranges from 2 m to about 7 m (Bad Radkersburg, Laafeld and around Mureck). Due to the decrease of the transport power of the river Mur the grain sizes fall from west to east; this is also valid for the lower terrace.

Lower terrace

The edge from the **lower terrace** to the flood plain area cannot be seen everywhere in this area. Using drillings the thickness of Quaternary sediments was estimated to be 5.4 and 10.4 m; the impermeable silty layer reaches 3 m in this area but it ranges between 0.8 and 1.5 m most of the time (including a 20 to 30 cm thick soil layer). The thickest gravel layer was detected near Brunnsee with about 10 m but in general, the thickness is between 6 to 8 m. From west to east the grain size diminishes again.

Upper terrace (Helfbrunner Terrace)

The upper terrace is marked off by a clear edge to the lower terrace and is 2 to 2.5 km wide. Springs often occur at this edge because it is the boarder of the Tertiary material. A thick loam layer lies above a minor gravel layer in this area; the carbonate-free gravels are highly soluble and can easily weathered. They also contain cohesive material and are therefore only of little importance for the aquifer system. The highest values of the Quaternary sediments were measured in Helfbrunn and Seibersdorf with about 12 m.

Because of the surface and the landscape, the **distances from the surface to the groundwater level** are different. The distance decreases from the lower terrace to the river meadow. At some small rivers deep incision of the river adjustment can be determined in a linear reduction of the distances. The distances amount to more than 3 m in areas of the lower terraces, the values are lower than 3 m for the river meadow. In the Diepersdorf area as well as in Dietzen (Sulzbach), the distance decreases to about 1 m (FANK et al. 1994, pp. 23-24).

Grundwassererschließung Fluttendorf-Donnersdorf mit Tiefbehälter und Pumpstation Donnersdorf

Nach umfangreichen Voruntersuchungen durch JOANNEUM RESEARCH wurde im Herbst 2002 die wasserrechtliche Bewilligung zur Herstellung der Versuchsbrunnen und Durchführung der Pumpversuche erteilt. Sodann wurden 4 Schachtbrunnen mit einer Tiefe von durchschnittlich 8 m niedergebracht. Die anschließenden Pumpversuche brachten positive Ergebnisse, sodass sofort mit der notwendigen Detailplanung begonnen werden konnte. Nach Vorliegen der erforderlichen Bewilligungen für die Grundwassernutzung konnte mit der Projektumsetzung im November 2003 gestartet werden. Die Anlage wurde bereits 5 Monate später in Betrieb genommen. Die Gesamtkosten des Bauvorhabens haben rd. EUR 1.900.000 betragen.

Das gegenständliche Bauvorhaben umfasste:

- 30 Grundwasserpegel, 4 Stück Schachtbrunnen mit einer Konsensmenge von insgesamt 43 l/s bzw. 3.715 m^3/Tag, wobei die bewilligte Spitzenentnahme 57 l/s beträgt,
- die Verbindungsleitungen von den Brunnen zum Tiefbehälter Donnersdorf, Gesamtlänge rd. 5.050 m, Durchmesser 90 bis 355 mm,
- den Tiefbehälter Donnersdorf mit einem Nutzinhalt von 200 m^3 inkl. Entsäuerungs- und UV-Entkeimungsanlage sowie der Pumpstation zur Einbindung in die bestehende Haupttransportleitung DN 500,
- die notwendigen Hoch- und Niederspannungsanlagen für die Stromversorgung der Brunnen und der Pumpstation und
- und die Fernwirk-, Steuer- und Überwachungsanlage mit insgesamt rd. 5.000 m Kabelverbindungen und Einbindung in die zentrale Überwachungsanlage am Unternehmenssitz in Fehring.

Tapping of new groundwater resources in Fluttendorf-Donnersdorf using an underground tank and the Donnersdorf pumping station

After comprehensive research by JOANNEUM RESEARCH the rights to build the test well and to perform pumping trials were granted by the respective authorities in autumn 2002. Then 4 dug wells with a depth of an average of 8 m were installed. The trial pumpings carried out afterwards showed positive results, which made it possible to begin detailed planning. In November 2003, the project started after the use of the groundwater was approved. The facility went live only 5 months later. The costs for the entire construction project came up to about EUR 1,900,000.

The construction project included:

- 30 groundwater gauges, 4 dug wells with a consensus of 43 l/s (3715 m³/day), whereby the peak withdrawal amount allowed is 57 l/s,
- the connecting pipelines from the wells to the Donnersdorf underground tank with a length of 5050 m and a diameter of 90 to 355 mm
- the Donnersdorf underground tank with a capacity of 200 m³ including a neutralising (deacidification) facility as well as an UV sterilisation device and the pumping station to connect to the main transport pipeline DN500,
- necessary high and low voltage facilities to supply the wells and pumping station with electricity and
- the outstation (master station), the control and surveillance system including around 5000 m of cables and the connection to the central surveillance system at the headquarters in Fehring (eastern Styria).

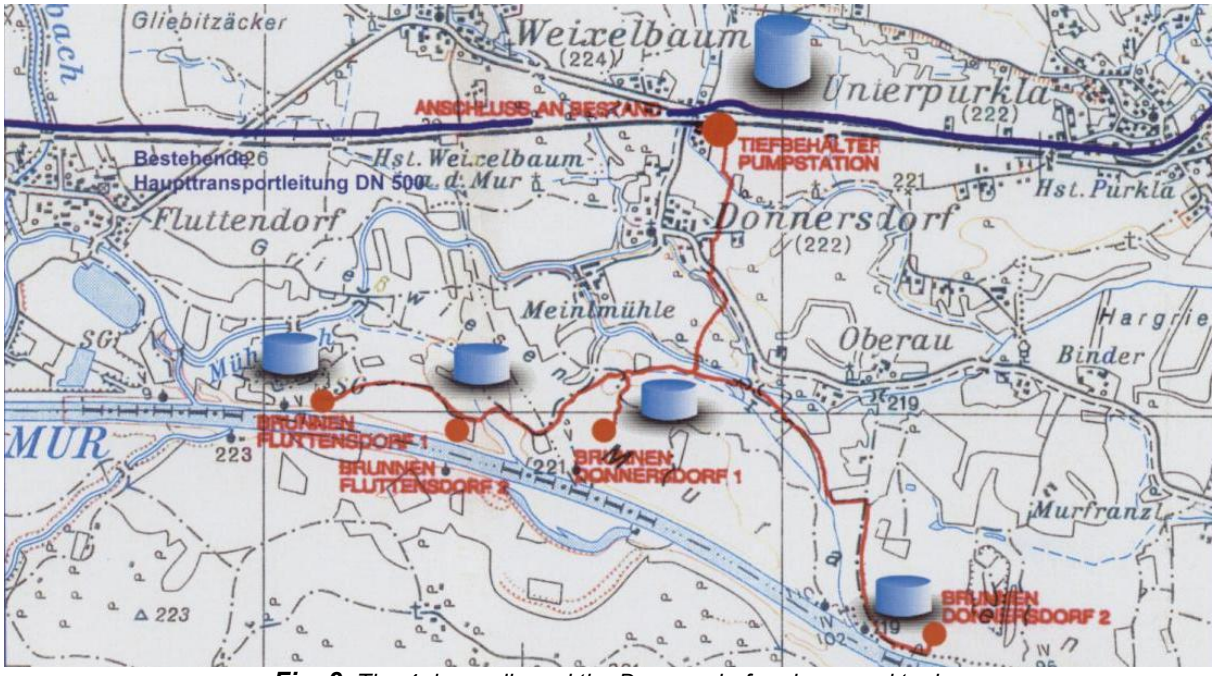

***Fig. 3**: The 4 dug wells and the Donnersdorf underground tank*
Die 4 Schachtbrunnen und der Tiefbehälter in Donnersdorf

Die Exkursion wird von Waterpool gesponsert.
The excursion is sponsored by Waterpool.

Das Konferenzdinner im Rahmen der Exkursion wird vom „Wasserverband Grenzland Süd-Ost“ finanziert.

The conference dinner during the excursion is financed by “Wasserverband Grenzland Süd-Ost” (water supplier for southern and eastern Styria).

Translation English/German

[i] basement = Grundgebirge
[ii] aquiclude/confining bed = Grundwasserstauer
[iii] unsaturated/vadose zone = ungesättigte Zone
[iv] groundwater reservoir = Grundwasserspeicher
[v] loam layer = hier: gemeint ist Staublehmdecke
[vi] water logging = Vernässung
[vii] natural discharge = Grundwasseraustritt
[viii] confining stratum - impermeable rock formation preventing horizontal or vertical outflow out of aquifer = Deckschicht (undurchlässige Schicht)
[ix] gravel layer = Kieskörper