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Guidebook

Excursion, May, 28th-29th 2018

German part

Geology of the western Elbsandsteingebirge

Claystones, marls and sandstones of the *lamarcki*-Pläner in the abandoned clay pit Raum representing a major aquitard within the Middle-Turonian Postelwitz Formation (equivalent of the Jizera Formation, base of cycle Tu4).

ResiBil – Bilance vodních zdrojů ve východní části česko-saského pohraničí a hodnocení možnosti jejich dlouhodobého užívání

ResiBil - Wasserresourcenbilanzierung und –resilenzbewertung im deutsch-tschechischen Grenzraumes

LANDESAMT FÜR UMWELT, LANDWIRTSCHAFT UND GEOLOGIE
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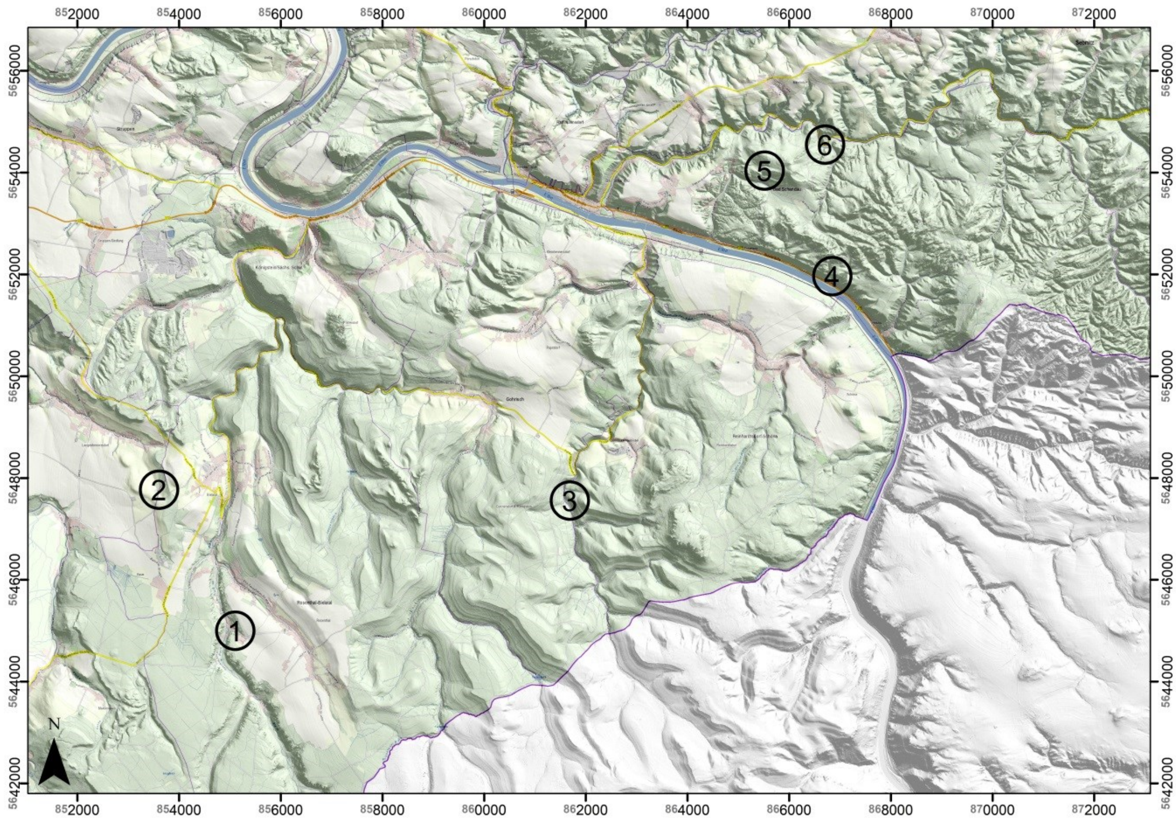

Figure 1. Position of the excursion localities

Excursion stops

1) Ottomühle (Schmilka-Formation – Bila Hora Formation)
2) Clay pit Raum (Postelwitz-Formation, *lamarcki*-Pläner – Jizera Formation)
3) Valley of the Krippenbach: springs at the boundary Schmilka Fm. – Postelwitz Fm. (top cycle T2) and on top of the *lamarcki*-Pläner (cycle T4)
4) Postelwitz quarries, type locality of the Postelwitz (Jizera) Formation
5) Hohe Liebe (sandstone a and b, Postelwitz Formation), upturned Cenomanian to Turonian succession
6) Nasser Grund (Lusatian Thrust and associated faults, water seeps at rock walls)

Introduction

The excursion will focus on the geology of the southwestern part of the Saxonian subbasin, where the transition from the pure sandstone facies to a mixed succession occurs. Here, the correlation to the Czech sections is possible, because a continuous succession, not affected by faults crosses the border.

We present a new concept of correlation of the formations on both sides of the basin, resulting from palaeontologic, sequencestratigraphic and borehole data (Fig. 2). The main problem is the subdivision of the between 200 and 380 m thick Postelwitz-Formation, which covers most of the region and is of essential importance for groundwater formation and transport (Fig. 3). The excursion will address some of the main stratigraphic units and their hydrogeological aspects.

<table>
<tr><td colspan="3">Saxony (Elbe Group)</td><td>Czech Republik</td></tr>
<tr><td colspan="2">Basin</td><td>Basin Margin</td><td></td></tr>
<tr><td colspan="2">-</td><td>-</td><td>Merboltice-Formation</td></tr>
<tr><td colspan="2" rowspan="2">Strehlen-Formation</td><td rowspan="2">Schrammstein-Formation</td><td>Brezno-Formation</td></tr>
<tr><td>Teplice-Formation</td></tr>
<tr><td colspan="2">Räcknitz-Formation</td><td>Postelwitz-Formation</td><td>Jizera-Formation</td></tr>
<tr><td colspan="2" rowspan="2">Briesnitz-Formation</td><td>Schmilka-Formation</td><td rowspan="2">Bila Hora -Formation</td></tr>
<tr><td>Briesnitz-Formation</td></tr>
<tr><td colspan="2">Dölzschen-Formation</td><td rowspan="2">Oberhäslich-Formation</td><td rowspan="3">Peruc-Korycany-Formation</td></tr>
<tr><td>Mobsch. Fm.</td><td>Oberh. Fm.</td></tr>
<tr><td colspan="2">Niederschöna-Formation</td><td>Niederschöna-Formation</td></tr>
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Figure 2. Correlation of formal lithostratigraphic units as a result of the work in the ResiBil-project.

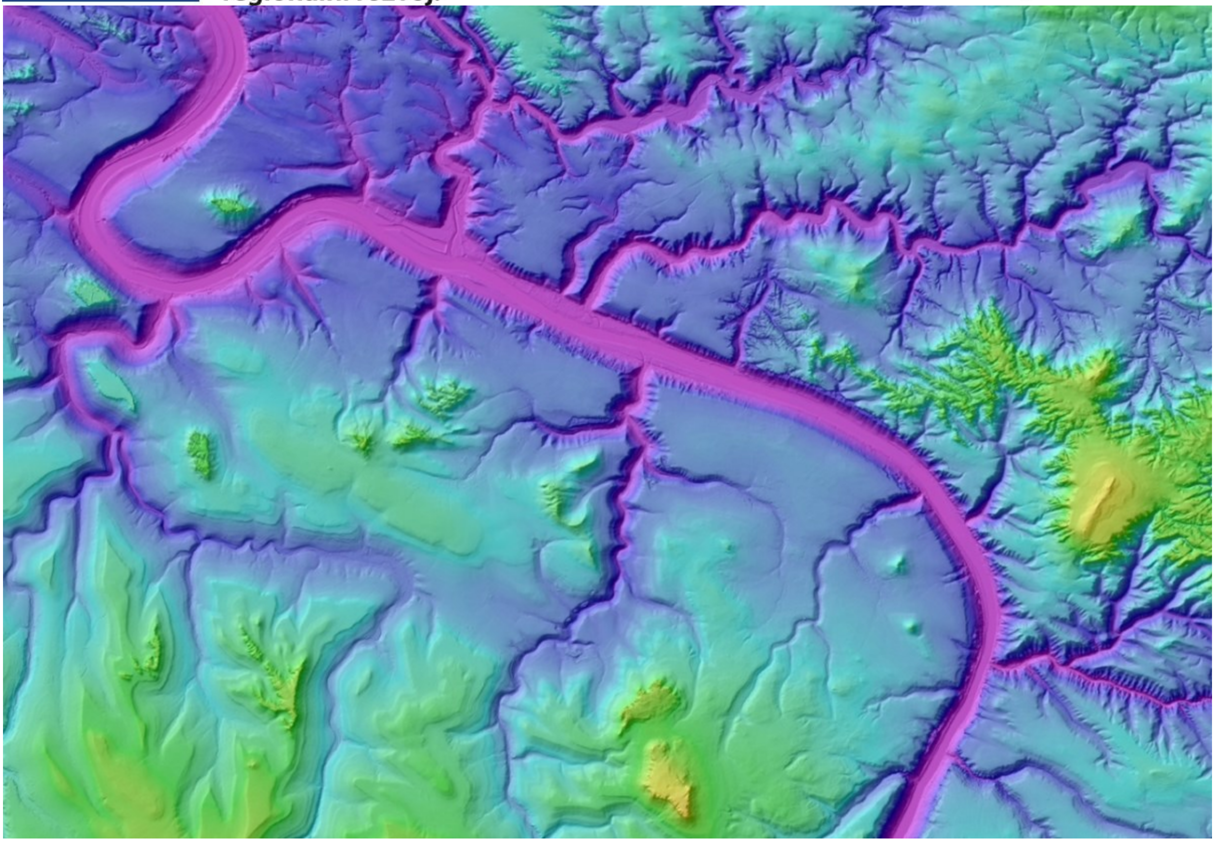

Figure 3. Morphology of the excursion area. The large peneplains are mainly formed by different units of the Postelwitz-Formation which are topped by the coarse-grained sandstones of the uppermost Postelwitz-Formation (sandstone c3) and sandstones (d and e) representing the Teplice formation. Note old Quaternary paleovalleys of the Elbe river south of the recent river course.

Subdivison of the Postelwitz Formation (Jizera Formation)

The Postelwitz Formation was established by Prescher (1980) and summarizes the sandstone horizons a to c3 of Lamprecht (1927, 1931, 1934) to one mappable unit, because the distinction of the horizons is difficult in some areas. During the recent project, it became clear, that a lot of miscorrelations occurred both in the work of Lamprecht and Mibus (1975). Lamprecht and Mibus did not use any sedimentological features or depositional concepts; instead they correlated on the base of bed thickness and weathering resistivity. Some of their concepts, like the subdivision of the 120-140 m thick sandstone a into 3 units cannot be verified in the field (see figure 6) and was therefore completely rejected. Lamprecht defined thick-bedded sandstones as sandstone b and tried to trace this unit across the whole area with nearly the same thickness. During our mapping, sandstone b was considered as lithostratigraphic unit consisting of gravelly coarse-grained sandstones with distinct lower and upper boundaries. This unit is a significant marker horizon but is being reduced to the basin from 40 m close to Bad Schandau to only 2-5 m near Pirna. The new concept was very much supported by the use of DEM, mapping according to facies (sedimentary structures, grain-size, sorting) and a sequence stratigraphic correlation of the units according to Uličný et al. (2009).

The Postelwitz Formation starts above the Schmilka Formation (Lower to basal Middle Turonian) with bioturbated fine-grained sediments; either marlstones or fine-grained sandstones, reflecting the start of a new depositional cycle (Laurin & Ulichny 2010, Janetschke & Wilmsen 2013). The Postelwitz Formation in Saxony comprises three coarsening-upward cycles. In the area of mixed shoreface-foreshore sedimentation, the cycles can easily be traced, because clay-rich sediments of the deeper shoreface and the foreshore allow a good recognition both in the DEM and in the field to low weathering resistivity and rows of springs and wetlands accompanying the tops of marlstones. Sharp facies boundaries exist in vertical direction, because at the base of the sandstones sediments, shoreface erosion and amalgamation of sediments occurs. The top of these cycles are bounded by transgressive surfaces.

	Sachsen		**Böhmen**	
	borehole Graupa	**Winterberg**	**old correlation**	**proposal (Nadaskay, Valecka, Voigt)**
Unter-Coniac	Zatschker Mergel	Sandstein e	Jizera-Formation (Mittel-Turon)	Brezno-Formation
Ober-Turon	Herrenleite-Sandstein	Sandstein d		Teplice-Formation
	Zeichener Ton	gamma 3		
	Oberquader	Sandstein c3		Jizera-Formation
	Oberer Grünsandstein	Sandstein c1/2		
	glaukonitisch-sandiger Mergel			
	Sandstein b	Sandstein b		
Mittel-Turon	Mittlerer Grünsandstein	Sandstein a		
	Lamarcki-Pläner			

Figure 4. New stratigraphic concept of the correlation of Cretaceous deposits between Saxony and Bohemia.

After intense work and common excursions we are able to present a stratigraphic correlation scheme for Saxonian part of the basin with the main basin on the Czech side. The reason for problems were the lack of fossils in the sandstone facies and differences in depositional style of both basin parts. While most of the Saxonian succession of the Postelwitz Formation is influeneced by storms, the Jizera Formation on the southeastern coast was probably more dominated by deltas and tidal currents. The area close to the Elbe river allows to reconstruct spatial relationship reflecting rapid pinch-out of sandstone bodies within the Teplice Formation. According to boreholes and following the DEM, the *lamarcki*-Pläner corresponds to the middle part of sandstone a in the sense of Lamprecht. It marks the beginning of a depositional cycle which is closed by the deposition of the coarse-grained shore-face sandstone b (cycle Tu4 of Ulicny & Laurin 2004 and Tur 4 of Janetschke & Wilmsen 2013). This sandstone represents a marker bed which can be traced over large distances along the Jizera Formation and the Postelwitz Formation (e.g. Janetschke & Wilmsen 2013).

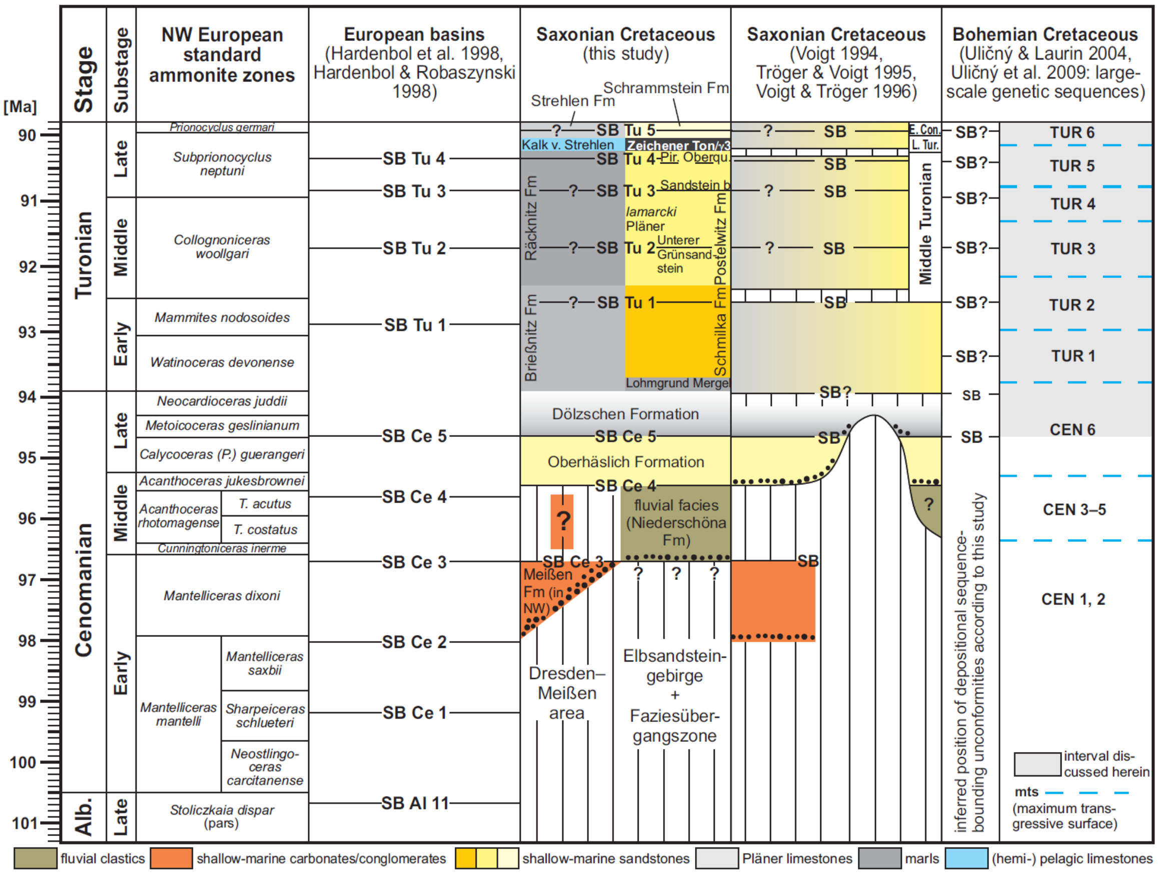

Figure 5. Cenomanian-Turonian sequence stratigraphic correlation chart (from Janetschke & Wilmsen 2013)

The last cycle of the Jizera Formation starts above this sandstone, comprising the sandstone c (Glaukonitisch-sandige Mergel, Oberer Grünsandstein und Pirnaer Oberquader) of the Saxonian stratigraphy. Digital elevation models give the opportunity to check this stratigraphic concept. Figure 6 displays the stratigraphic relationships of sandstones and marls within the Postelwitz Formation on the western side of the Elbe river. The red line marks its base (top Schmilka-Formation). The pink line marks the 5-20 m thick *lamarcki*-Pläner which disappears to the NE and is replaced by sandstones. Light green is the base of the coarse-grained sandstone b. All other lines mark resistant sandstone units within the sandstone a without stratigraphic significance. Sandstone c3 marks the conspicuous rocky top of the Postelwitz Formation and was not assigned with a line. It forms extended plateaus at the

Děčínský Sněžník in the south and the Nikolsdorfer Wände in the northwest. Some isolated minor rock-massifs are represented by the same stratigraphic unit. Only Pfaffenstein, Gohrisch and Papststein in the north and Großer Zschirnstein and Kleiner Zschirnstein in the south are covered by sandstones of the Schrammstein Formation which is an equivalent of the Teplice Formation and possibly of the lower part of the Brezno Formation. No significant faults cut the succession. All of the units within the Postelwitz Formation can be traced without interruption, suggesting a layer-cake structure of aquifers and aquitards. Only close to the southern border, east of the Děčínský Sněžník, a couple of parallel WNW-ESE striking faults are visible.

Although all marlstones and sandy claystones disappear along a line which runs approximately from the Pfaffenstein to Großer Zschirnstein, the same cycles of the Postelwitz-Formation can be traced through the whole Elbsandsteingebirge.

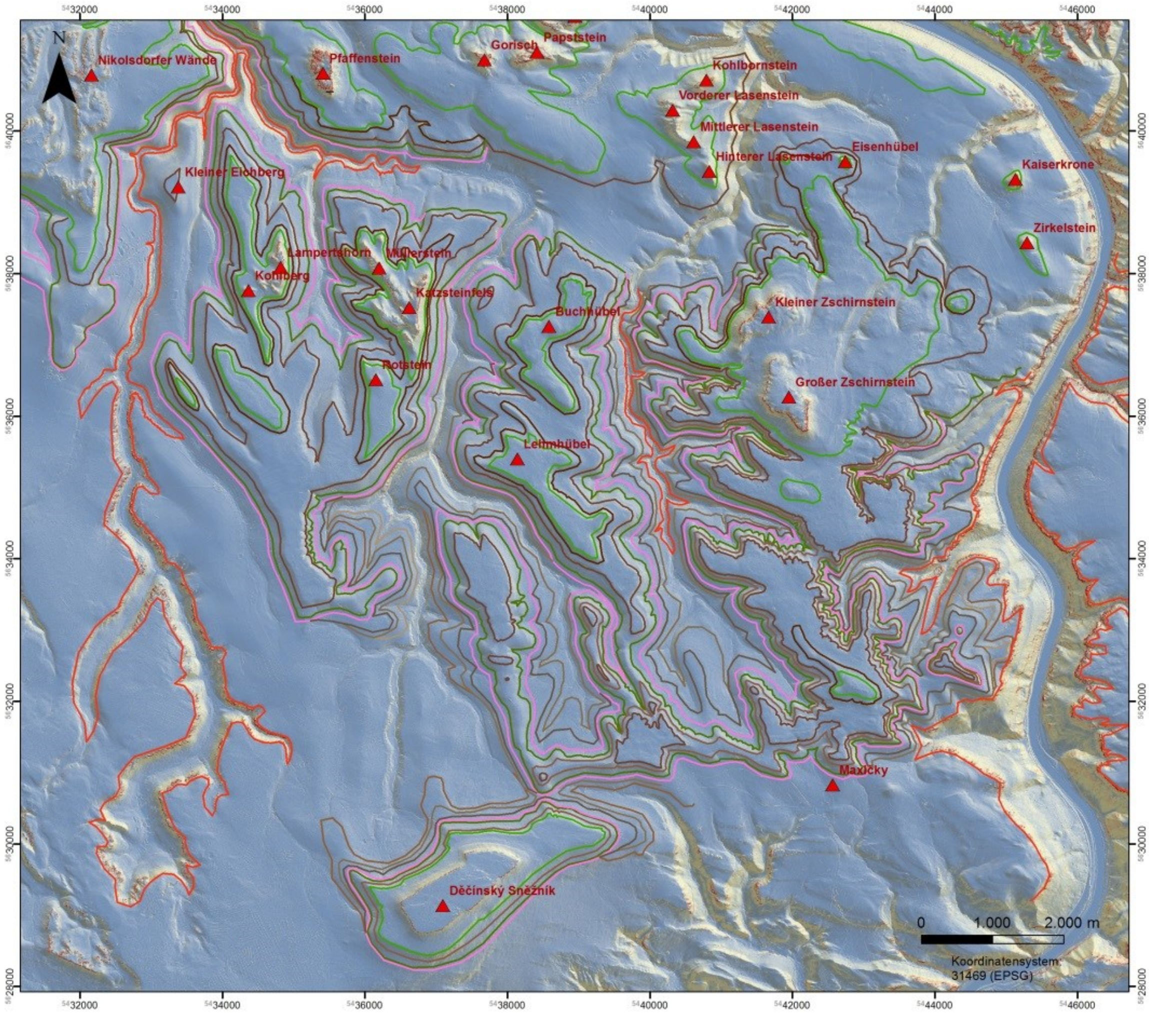

Figure 6. Geomorphological map showing the sandstone units of the Postelwitz Formation (Jizera Formation) between Děčínský Sněžník and Königstein. The canyon of the Elbe between Děčín, Hrensko and Schmilka at the eastern edge of the map is formed by the Bila Hora Formation (Schmilka Formation). For further explanation see text.

Stop 1
Ottomühle (Bielatal): Schmilka-Formation (Bila Hora Formation)

The slopes of the Upper Bielatal, close to the Czech-German border are formed by rockwalls and rock pillars of the Upper Schmilka Formation (Bila Hora Formation). They continue to the villages of Ostrov and close to the Děčínský Sněžník on the Czech side. The medium- to coarse-grained sandstones of Lower Turonian age follow above older Cretaceous deposits, represented by the Niederschöna Formation, the Oberhäslich Formation, Dölzschen Formation (summarized as Peruc-Korycany Formation in the Czech Republik) and sandy marlstones of the Briesnitz Formation (Lower part of the Bila Hora formation). Of particular interest are fluvial deposits of the Peruc member (0-30 m), cored in several boreholes on both sides during the uranium exploration in the sixties and seventies of the last century. They reflect a S-N directed Cenomanian fluvial valley with two branches in the headwaters, providing now an additional course of groundwater flow. According to boreholes on the Czech side, an E-W directed watershed is developed running SW-NE from of Usti nad Labem to Děčín and further in E-W direction to Česká Kamenice (Valečka 2014). The Late Cenomanian marine deposits attain about 20 m thickness in the valley and only few meters on the heights. In this area, the marls and calcareous siltstones of the Briesnitz Formation show a continuous distribution with only slightly varying thickness.

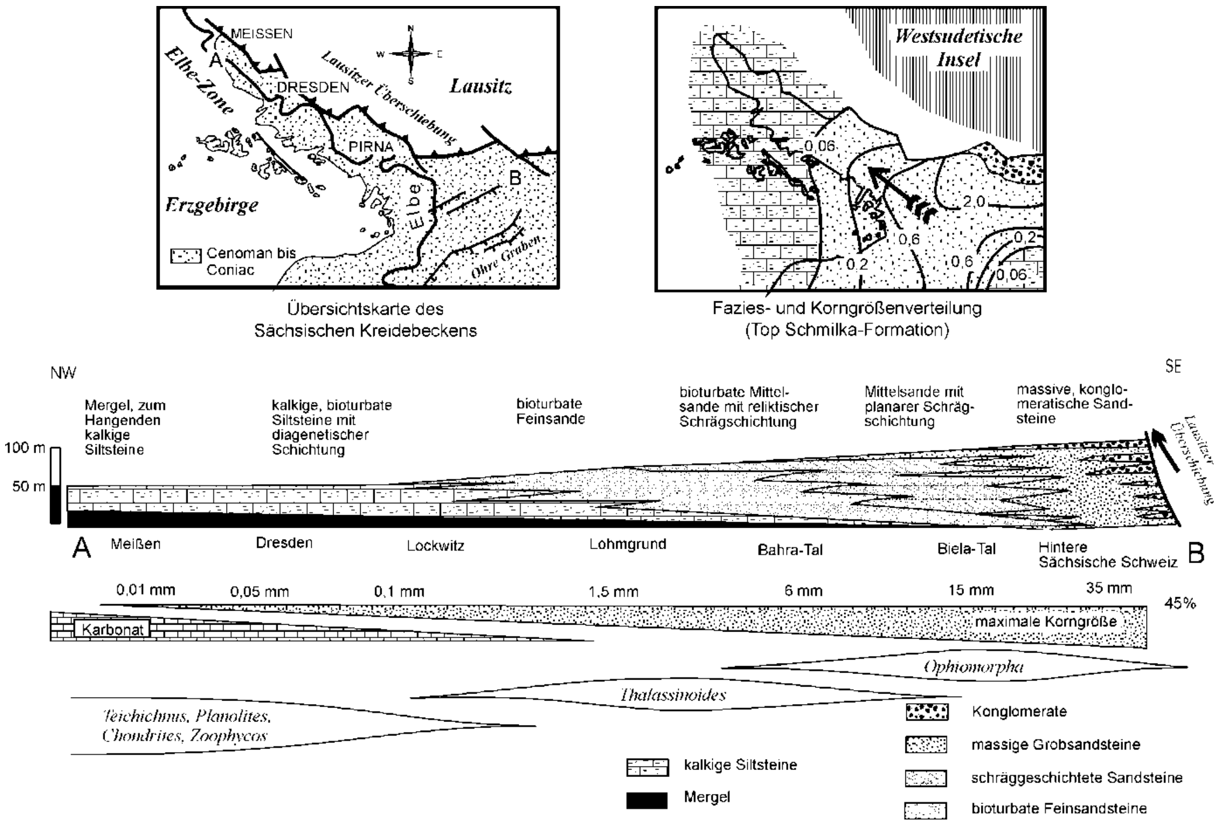

Figure 7. The Lower Turonian to Middle Turonian cycle (Tu1) shows the progradation of sandstones (Schmilka Formation) to the southeast. The sandy marlstones represent the Briesnitz Formation.

We visit the cross-bedded sandstones of the Schmilka-Formation. The outcrop starts somewhere in the middle of the Schmilka Formation, the base is covered by scree. At the first stop, the single cross-beds form continuous tabular bodies of 20-80 cm thickness. They are often bioturbated from the top by decapod crabs (*Thalassinoides* and *Ophiomorpha* trace fossils). Most foresets dipping to the northwest; but sometimes also reverse directions can be observed (especially at the "Schiefer Turm").

Figure 8. Cross-bedded sandstones of the Schmilka Formation near Ottomühle.

On the way to the viewpoint "Kaiser-Wilhelm-Feste", preserved thickness of the cross-beds decreases and bioturbation disappears. Trough cross-bedding becomes abundant, replacing the tabular cross-beds almost completely and transport directions are more variable. At the top of this cross-bedded succession, a 1.5 to 2 m thick unit of coarse-grained to gravelly sandstone is developed. It shows a bimodal grain size distribution, has an erosional base and almost no internal structures. The depositional environment of the cross-bedded unit was interpreted to be tidal, strongly controlled by a dominant component of one tidal current towards the northwest (Voigt 1994). This is supported by coarse grained foresets, arranged in a cyclic pattern, possibly reflecting high-water spring tides and dead neap tides. The uppermost part was seen as a very active tidal terrace comprising a variety of sedimentary sub-environments as subtidal, beach and intertidal deposits. The observed trends in grain size distribution were attributed to declining depositional space either to progradation or regression. In each case, it shows an increase in energy either by waves or by frequent current. The uppermost part above the gravel bed with the strongly varying cross-beds, low angle bedding and renewed bioturbation is thought to mark the start of a new depositional cycle. The number of cycles in the Bila Hora Formation remains unclear. Mibus (1975, Voigt (1994) and Valecka described one coarsening upward cycle in this unit. Uličný et al. (2009) recognized a second, although indistinct, cycle on the base of borehole log interpretation. In this outcrop, the uppermost sandstones represent for sure a new depositional cycle accompanied by deepening. It could represent either the first cycle of the Postelwitz Formation or the proposed second cycle of the Bila Hora Formation as proposed by Janetschke & Wilmsen 2013 (following Ulicny & Laurin 2010). This interpretation would reduce the thickness of the second cycle of the Schmilka Formation to only 6 meters. The plateau atop the Schmilka Formation is caused by the erosion of sandy marls and fine-grained sandstones of the basal Postelwitz Formation.

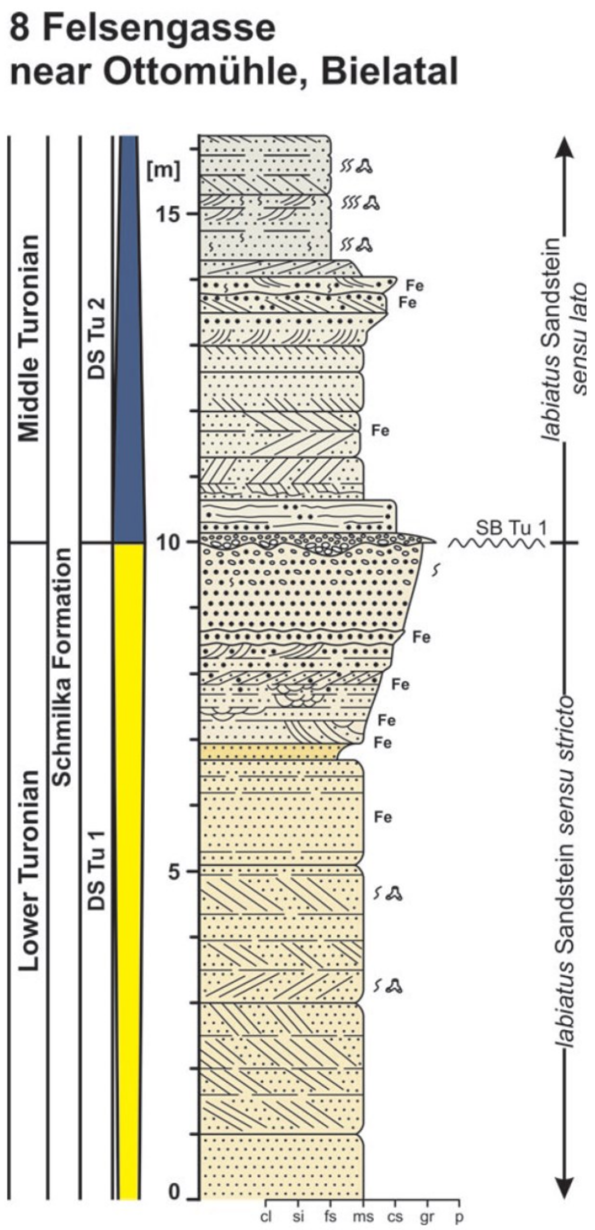

Figure 9. Section between Felsengasse and Kaiser-Wilhelm-Feste: Upper parts of the Schmilka Formation with top of one depositional cycle and the base of another one.

Figure 10. Cross-bedded sandstones of the Schmilka-Formation in the Biela-valley (Große Herkulessäule and Kleine Herkulessäule)

Back at the parking place Ottomühle, we have a look back at the visited section. The cross-bedded units form a larger cross-bedded sandstone body (first order), strongly prograding to the northwest. Only five kilometres in this direction, cross-beds disappear and are replaced step by step by completely bioturbated, fine- to medium-grained sandstones, indicating low energy conditions. For that reason, at Königstein the differentiation of the Postelwitz and Schmilka Formations is complex, because both are composed of bioturbated sandstones. That is why Voigt (1994) interpreted those relationships as an ebb-tidal delta. Concerning hydrogeology, sandy marls of the Briesnitz Formation act as an aquitard and causing springs (Nymphenbad, Singeborn) in the headwaters of the Biela valley: Dürre Biela, Glasergrund and Nasse Biela. At the latter Briesnitz-Formation reaches the surface.

Stop 2

Clay pit Raum (Postelwitz-Formation, *lamarcki*-Pläner)

The clay-pit Raum (front cover) is the only preserved outcrop of the marlstones intercalated in the Postelwitz Formation in Saxony. It exposes the *lamarcki*-Pläner, which represents the base of the second cycle of the three sequences of this formation. A second, very instructive clay-pit close to Pirna (clay-pit Zehista) at the base of the Formation (Unterer Mergel and Unterer Grünsandstein) was completely re-naturated and the section was destroyed.

Figure 11. Sand-filled burrows of decapod crabs (tubular tempestites) in the clay-pit Raum. The diameter of the central tube is about 10 cm.

Also the clay-pit Raum is not in the best condition, because scree covers the lower slopes. The exposed succession consists of sandy marlstones with some interlayers of fine-grained, strongly cemented sandstones. The marls are bioturbated, especially small Thalassinoides traces, Chondrites burrows and Planolites traces can be found. Additionally, well preserved fossils are abundant: Inoceramus lamarcki, Inoceramus cuvieri, and Collignoniceras woolgari prove a Middle-Turonian age. Even, a variety of bivalves and gastropods occur.

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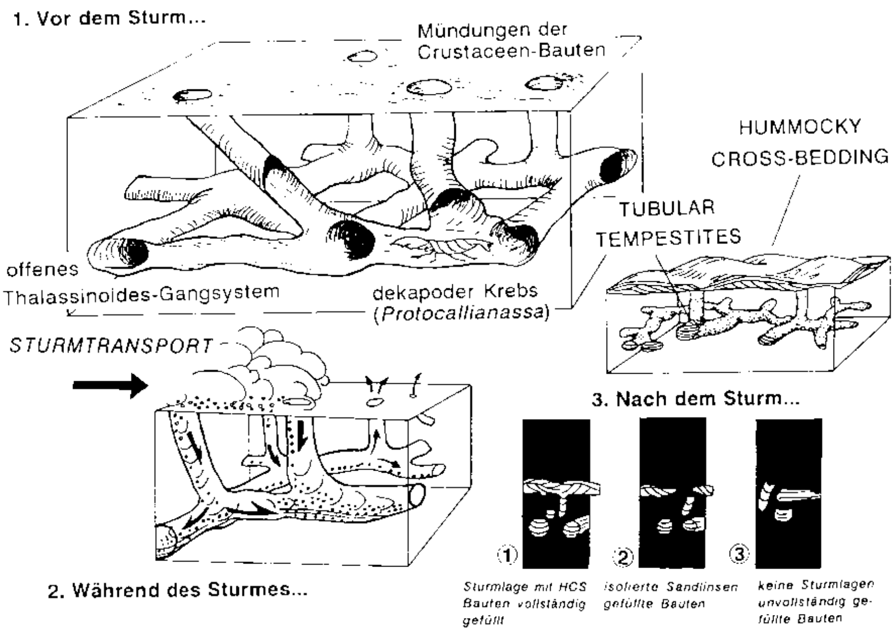

Figure 12. Model of "tubular tempestites" formation observed in the clay-pit Raum (Voigt 1994).

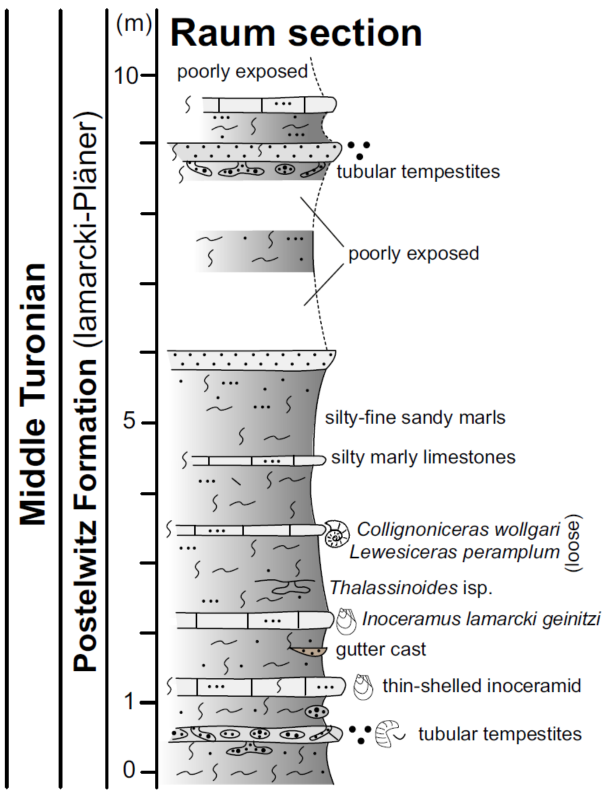

Figure 13. Section of the clay-pit Raum (Wilmsen & Niebuhr 2009).

Unfortunately, only remnants of the interesting sedimentary structures have left, for which the pit was famous for. Some are hidden below the scree, some were taken out during excursions and by people collecting fossils. Especially interesting were finger-like to arm-thick tubes in the homogeneous marlstones, filled with coarse-grained, glauconitic sandstones. They were interpreted to represent tubular tempestites: open burrows in a foreshore environment which were filled with sand from the shore-face during storms. Some thin storm layers with lamination and low angle unconformities can still be observed. On the second level of the platform, the transition to bioturbated fine-grained sands is exposed. They represent the lower parts of the “Mittlerer Grünsandstein” (Middle Greensandstone) corresponding to the upper parts of sandstone a. From a sedimentological point of view, it marks the transition from the foreshore to the lower shoreface and indicates progradation or a regression within the third cycle of the Postelwitz Formation (Jizera Formation).

The thickness of the marlstones with intercalated sandstones exceeds 15 m in this section. The *lamarcki*-Pläner is the most prominent aquitard within the Postelwitz Formation and is often marked by a number of springs at its upper boundary. Nevertheless, the isolated Harteberg (on its slopes the clay pit is situated) is too small in scale for allowing springs to develop, but the top of the *lamarcki*-Pläner is mostly wet and marked by typical wetland vegetation.

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Stop 3

Krippenbach close to Kleingießhübel: springs at the boundary Schmilka-Formation - Postelwitz Formation and within the Postelwitz-Formation (top *lamarcki*-Pläner)

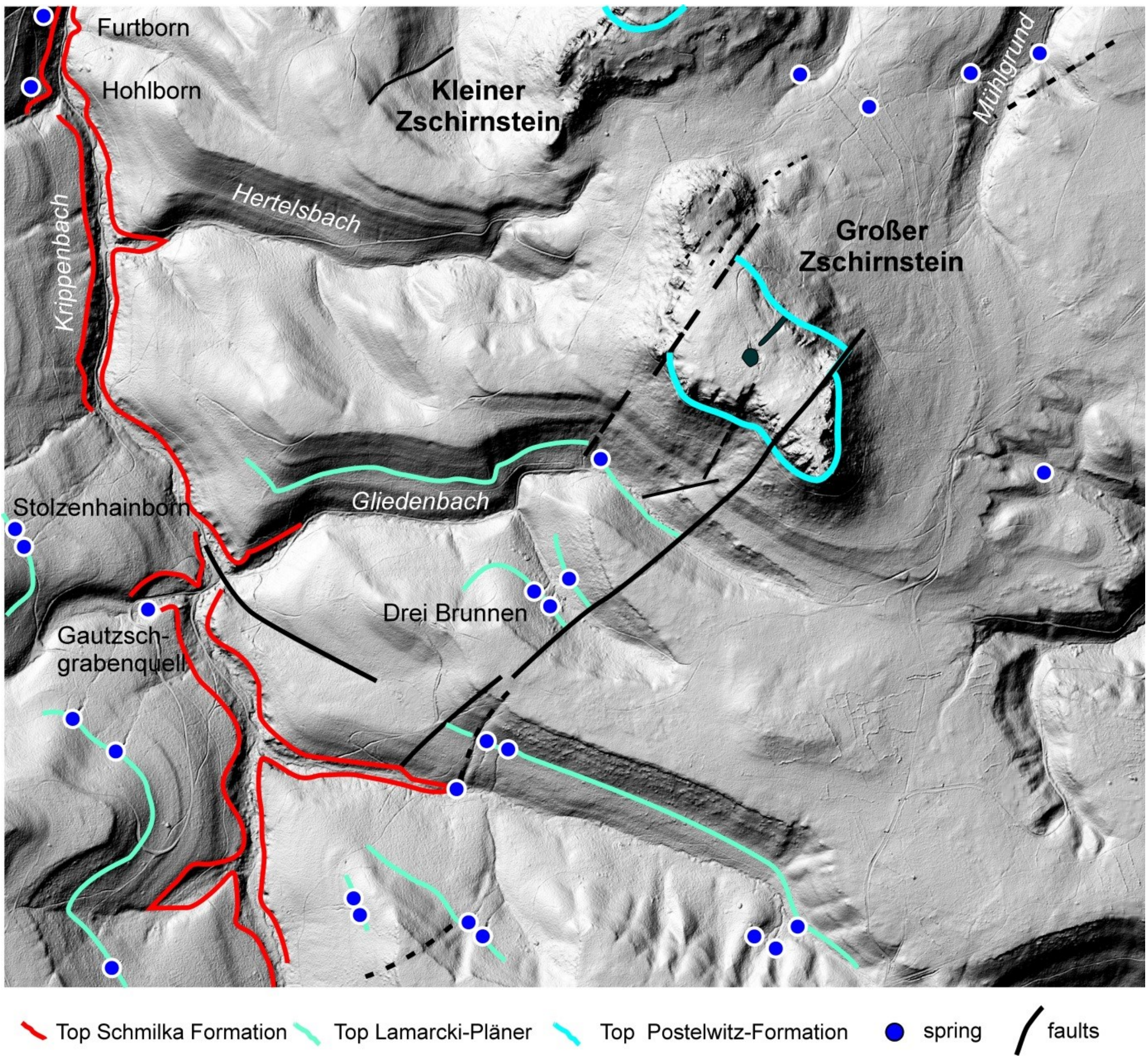

Figure 14. The Krippenbach and its surrounding valleys are very rich in springs. They are mainly caused by the distribution of aquitards within the Postelwitz Formation. Additionally, some minor faults support the water outlet.

Numerous springs occur between the valleys of the Bielatal and the Elbe valley, because the area is characterized by marl intercalations in the Postelwitz-Formation. The main aquitards are at the base of the Postelwitz Formation ("Unterer Mergel", base of the Lower Greensandstone or fine-grained marly sandstones at the base of sandstone a) and in the Lower third of the formation (*lamarcki*-Pläner). In each case we visit one of the major springs at the boundary of the Schmilka Formation to the Postelwitz Formation. With sufficient time we will also see the Furtborn which is a water-rich spring close to Kleingießhübel (3-4 l/s). It has its source above the Schmilka-Formation, probably above the lowermost clay-rich unit of the basal Postelwitz Formation. The Gliedenborn and the three springs "Drei Brunnen" are typical contact springs which developed on top of the low permeable *lamarcki*-Pläner. They are mostly situated on the northern and northeastern slopes of the mountains which was already mentioned by Beyer (2013). This is caused by the constant dip of the aquifers and aquitards towards the north, which allows a continuous gravity-driven flow on top of *the lamarcki*-Pläner.

Stop 4

Postelwitz quarries: type locality of the Postelwitz Formation

The Postelwitz quarries are situated high above the Elbe and represent the type locality of the Postelwitz Formation. The base of this formation is approximately at the level of the river Elbe, where the cross-bedded medium- to coarse-grained sandstones of the Schmilka-Formation crop out. It reaches about 280 m thickness here and is nearly completely accessible on the way from Schmilka to the Großer Winterberg. We visit the middle part of the Postelwitz Formation, approximately 50 metres above its base. The slope is covered by scree (quarry waste).

Figure 15. The Postelwitz Formation in the Postelwitz quarries exposes a succession of fin- to medium-grained sandstones of Middle Turonian age. Intercalated conglomeratic sandstones with ripples (left) and clay units of limited thickness and lateral distribution are abundant. Bioturbation (right; diameter of burrows is 2-3 cm) is the most striking feature of this facies and indicates a lower shoreface environment, affected by storms.

The Postelwitz-Formation in this area is completely composed of sandstones, but shows a similar cyclic pattern as in the more basinal sections. Sandy marls like the "*lamarcki*-Pläner " or the "Glaukonitisch sandige Mergel" are replaced by bioturbated sandstones.

The sandstones in the outcrop display a variety of sedimentary structures and a lot of fossils. Bioturbated (trace fossils Thalassinoides and Ophiomorpha), fine- to medium-grained sandstones are prevailing, but layers of coarse-grained and even gravelly sandstones occur.

These layers mostly show an erosive base, are laminated or had been reworked by currrents and waves into ripples. In some cases they are covered by claystone - or siltstones layers which reach up to 10 cm thickness. Most of them are penetrated by burrows of decapod crabs, which were subsequently filled by coarse sand.

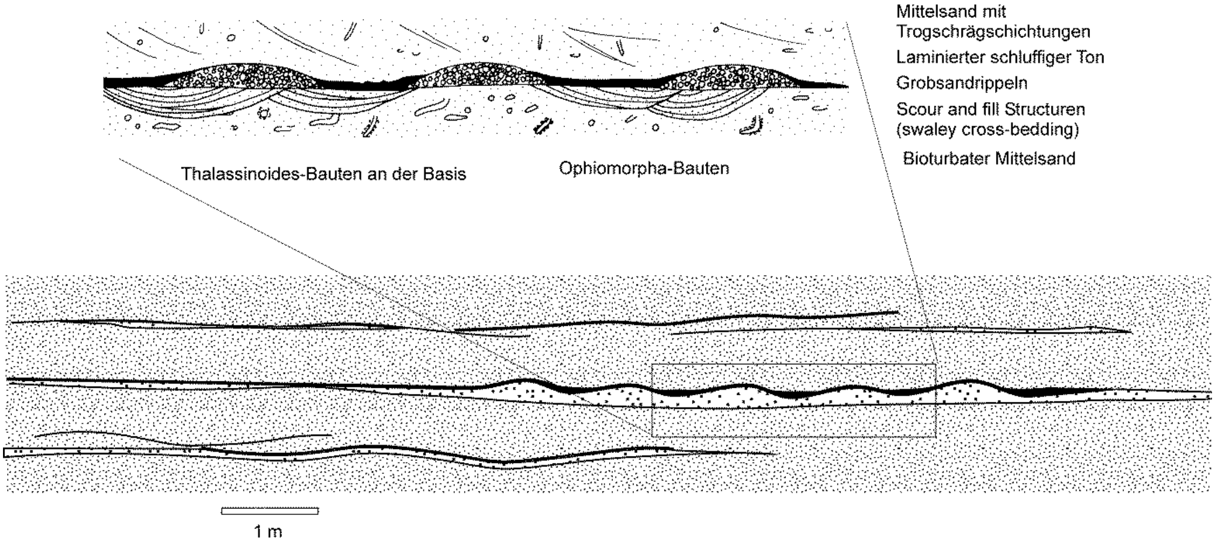

Figure 16. Most units pinch out laterally. Coarse sand or gravel layers are characteristic, followed by fine-grained deposits, which were strongly bioturbated. They are interpreted as couplets produced by storm activity.

These units were interpreted as stormlayers by Voigt (2010). Further, showing similar structures like the deposits in the Raum clay pit. From a hydrogeological point of view, the clay-layers act as local aquitards and dominantly influence the vertical flow of water. As the whole succession dips with 3-5° apart from the quarry walls, no water seeps are visible.

Stop 5

Teufelsmauer near Ostrau: Postelwitz Formation and tectonics

The Teufelsmauer rock is part of an upturned Cretaceous sandstone succession close to the Lusatian Thrust (Hohe Liebe Block). The exposed thick-bedded sandstone unit is dipping 10-15° to the south and culminate at the top of the Hohe Liebe mountain. From the summit of this mountain, a resistant, 20 m thick sandstone bed crosses to both sides and forms on the western side the "Teufelsmauer" (devil´s wall). The rock wall can be reached through a gap between the sandstones, caused by N-S-striking vertical fault, well indicated by slickensides at the bounding rock walls. This strike-slip fault with a minor vertical component divides the strongly upturned succession from units which dip only slightly to the south. The erosion of the valley in the south was supported by a fault which runs E-W and separates the upturned units from the main tabular sandstone body dipping with 2-3° towards the Lausitz Thrust (Schrammsteine, Falkenstein).

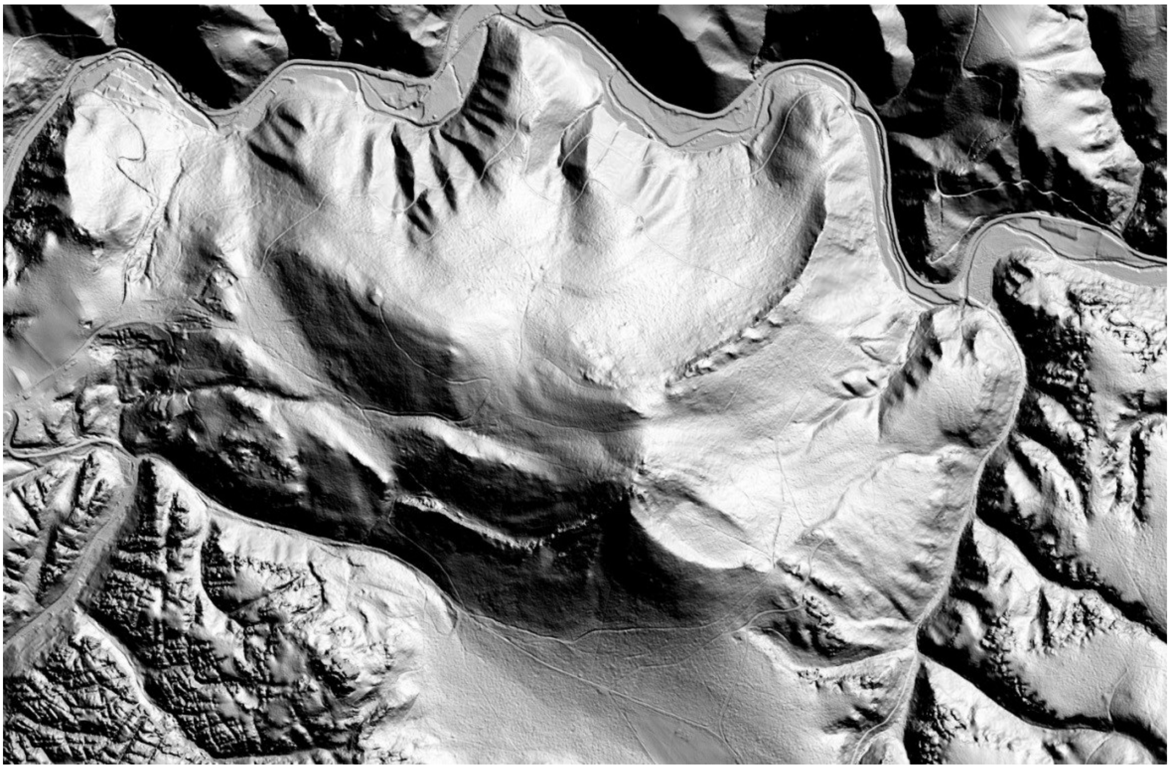

Figure 17. Digital elevation model of the Hohe Liebe mountain close to the Lausitz Thrust. The valley "Nasser Grund" follows the N-S trending fault between the upturned succession and the flat-lying sandstone a in the west. Especially the conspicuous sandstone ridges of the Schmilka Formation and the Sandstone b of the Postelwitz Formation provide a steep morphology.

The Teufelsmauer displays bioturbated fine- to medium-grained sandstones (sandstone a) overlain by a massive, coarse-grained sandstone (sandstone b). Both belong to one cycle (Tu4) of the Postelwitz Formation. The boundary of both units is sharp and erosive, caused by the transition of lower shoreface sands to high-energetic sands of the upper shoreface. The difference in grain size is accompanied by a change in weathering resistivity: sandstone b forms a conspicuous overhang at the northern side of the rock wall. The sandstones are cemented by quartz. Porosity and permeability of the gravelly sandstone b is higher than of sandstone a, caused by the lower grain size.

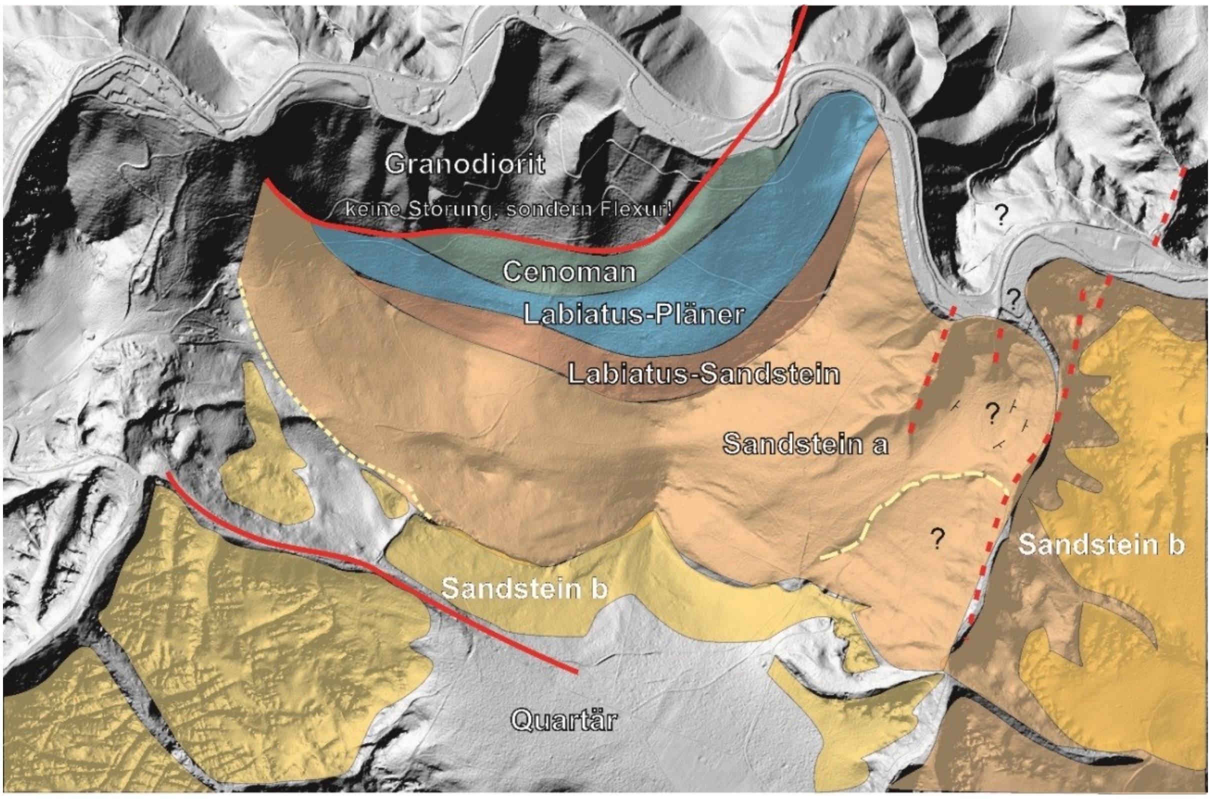

Figure 18. Close to the valley of the "Nasser Grund", the Kirnitzsch cuts through the Lausitz Thrust and exposes the granodiorite. In this part, the succession is upturned and an almost complete section of the Cenomanian and Turonian is preserved. Several faults border this block to the flat-lying, thrusted units to the East and West.

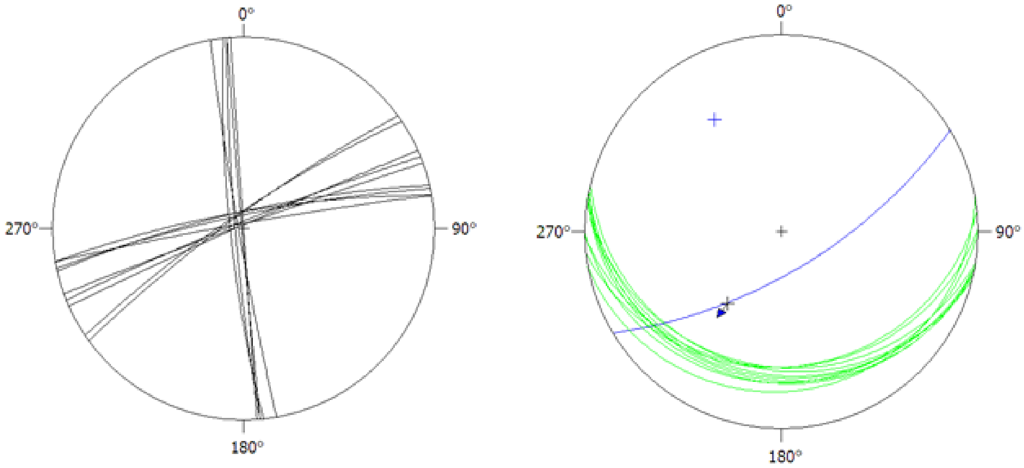

Figure 19. (*Left*) Main joint directions in the region around Hohe Liebe and Nasser Grund. (*Right*) Upturned sandstone units (green) and steeply dipping fault line with slickensides indicating slip direction (blue).

Figure 20. Large scale slickensides on the surface of the coarse-grained sandstone b (Postelwitz Formation) of an almost vertical fault mark the break in the Teufelsmauer.

Stop 6

Nasser Grund (tectonics and groundwater monitoring pipes)

The valley of the Nasser Grund was cut by a temporary tributary of the Kirnitzsch, using the fault which separates the Hohe Liebe Block to the east from sandstone units dipping to the south. Two boreholes were drilled during uranium exploration at the mouth of the valley (Wismut 1222/1962 and 1222E/1965). The wells reached the base of the Cretaceous in a depth of 261 m (-122 m below sea level). The Cenomanian is very thick (about 80 m), fully marine and consists of conglomerates and sandstones of varying grain size. The Briesnitz Formation (sandy marls of the Bila Hora Formation) reaches a thickness of 41 m, the overlaying sandstones of the Schmilka Formation are 44 m in thickness. Followed by fine-grained sandstones of the Postelwitz Formation (Jizera Formation); sandstone a has a thickness of 95 m. The upper parts of the same unit are exposed at the eastern edge of the valley (about 30 m thickness). They are similar to the sandstones of the Teufelsmauer which is only 2 km apart from this place.

As the whole succession dips to the north towards the Lausitz Thrust, and the Briesnitz Formation forms an aquitard of 40 m thickness, the Cenomanian aquifer (aquifer A in the

Czech hydrogeology) is artesian confined. The groundwater level is about 8 m above valley surface, leading to impressive fontains if penetrated.

A second groundwater monitoring pipe was installed about 300 m to the south, where the Eulentilke reaches the valley of the Nasser Grund. These observation pipes are in the aquifer B, which is not separated from all overlaying aquifers. The groundwater level is about 30 m below the valley floor (not artesian confined).

Figure 21. Groundwater monitoring pipes in the valley of Nasser Grund.

The Kirnitzsch-valley gives the opportunity for observations, related to the activity of the Lausitz Thrust. From the bridge across the Kirnitzsch, the tilted Hohe Liebe Block can be observed in sandstones of the Postelwitz Formation (about 20°) at the western part of the valley, while the eastern sandstone rocks show an obvious flat laying succession (in fact they dip with a few degrees to the northeast), thus indicating a fault following the valley.

Thrust faults can be observed at a block on the western slope (path) and especially in an old quarry at the mouth of the "Kroatenschlucht".

Figure 22. Impressive ice curtains form in cold winters at the western border of the Nasser Grund and indicate groundwater seeps at the SE-dipping clay-intercalations of sandstone a.

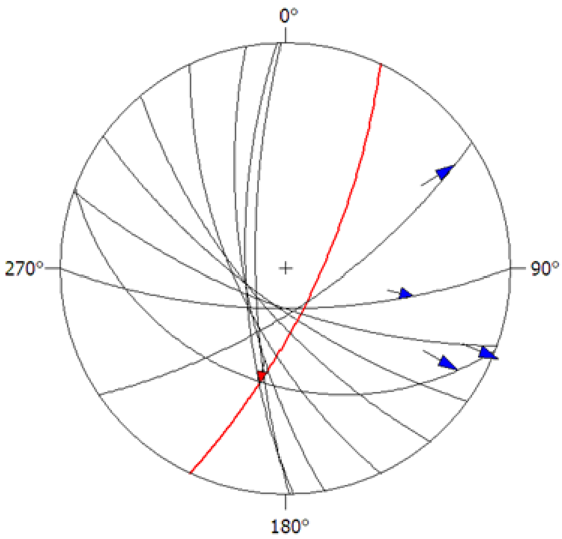

Figure 23. Red line showing the main fault in the "Kroatenschlucht" together with other faults observed in the surrounding of "Nasser Grund" (black), implying a sinistral strike slip movement in the sandstones.

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Figure 24. Slickensides close to the Lausitz Thrust in the "Kroatenschlucht".

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References

Beyer, O.(1913): Über Quellen in der Sächsisch-Böhmischen Schweiz. – Mitt.Ver. f. Erdkunde zu Dresden. **2**: 803-909, Dresden.

Herčik, F. Herrmann, Z, Valečka, J. (2003): Hydrogeology of the Bohemian Cretaceous Basin. – 91 p., Czech Geological Survey, Prague.

Janetschke, N. & Wilmsen, M. (2013): Sequence stratigraphy of the lower Upper Cretaceous Elbtal Group (Cenomanian-Turonian of Saxony, Germany). - Z. Deut. Ges. Geowiss.

Lamprecht, F. (1934): Die Schichtlagerung des Turons im Sächsisch-Böhmischen Elbsandsteingebirge. – Berichte der mathematisch-physischen Klasse der sächsischen Akademie der Wissenschaften zu Leipzig, **86**: 155-186.

Mibus, H. P. (1975): Abhandlungen des staatlichen Museums für Mineralogie und Geologie zu Dresden, Band 22, 121 S. Verlag von Theodor Steinkopff, Dresden.

Prescher, H. (1981): Probleme der Korrelation des Cenomans und Turons in der Sächsischen und Böhmischen Kreide. – Z. geol. Wiss. 9: 367-373.

Seifert, A. (1955): Stratigraphie und Paläogeographie des Cenomans und Turons im sächsischen Elbtalgebiet. Freiberger Forschungshefte, C, 14, 1-218.

Uličný, D. (2001): Depositional systems and sequence stratigraphy of coarse-grained deltas in a shallow-marine, strike-slip setting: the Bohemian Cretaceous Basin. – Sedimentology, 48: 599–628.

Uličný, D., Laurin, J., and Čech, S. (2009): Controls on clastic sequence geometries in a shallow-marine, transtensional basin: the Bohemian Cretaceous Basin, Czech Republic. – Sedimentology, 56: 1077–1114.

Valečka, J. (1989): Sedimentology, stratigraphy and cyclicity of the Jizera Formation ((Middle-Upper Turonian) in the Decin area (N-Bohemia). – Vestnik Ustredniho ustavu geologickeho 64/2, 77-89.

Valečka, J. (2015): Říční sedimenty peruckých vrstev české křídové pánve u Benešova nad Ploučnicí. – Zprávy o geologických výzkumech = Geoscience Research Reports 48, podzim, 31 -36. ISSN 0514-8057.

Voigt, T. (1994): Faziesentwicklung und Ablagerungssequenzen am Rand eines Epikontinentalmeeres - Die Sedimentationsgeschichte der sächsischen Kreide. – Dissertation TU Bergakademie Freiberg, 130 S., Freiberg.

Voigt, T. (1999): Ablagerungsbedingungen und Taphonomie der Schmilka-Formation (Unter-Turon) südlich von Pirna (Sächsisches Kreidebecken). – Greifswalder Geowiss. Beitr., 6: 193–207.

Voigt, T. (2009): Die Lausitz-Riesengebirgs-Antiklinalzone als kreidezeitliche Inversionsstruktur: Geologische Hinweise aus den umgebenden Kreidebecken. – Z. Geol. Wiss., 37: 15–39.

Voigt, T. (2010): Sturmdominierte Sedimentation in der Postelwitz-Formation (Turon) der Sächsischen Kreide. – Freiberger Forsch.-H., C 540 (Karl-Armin-Tröger-Festschrift): 3–25.

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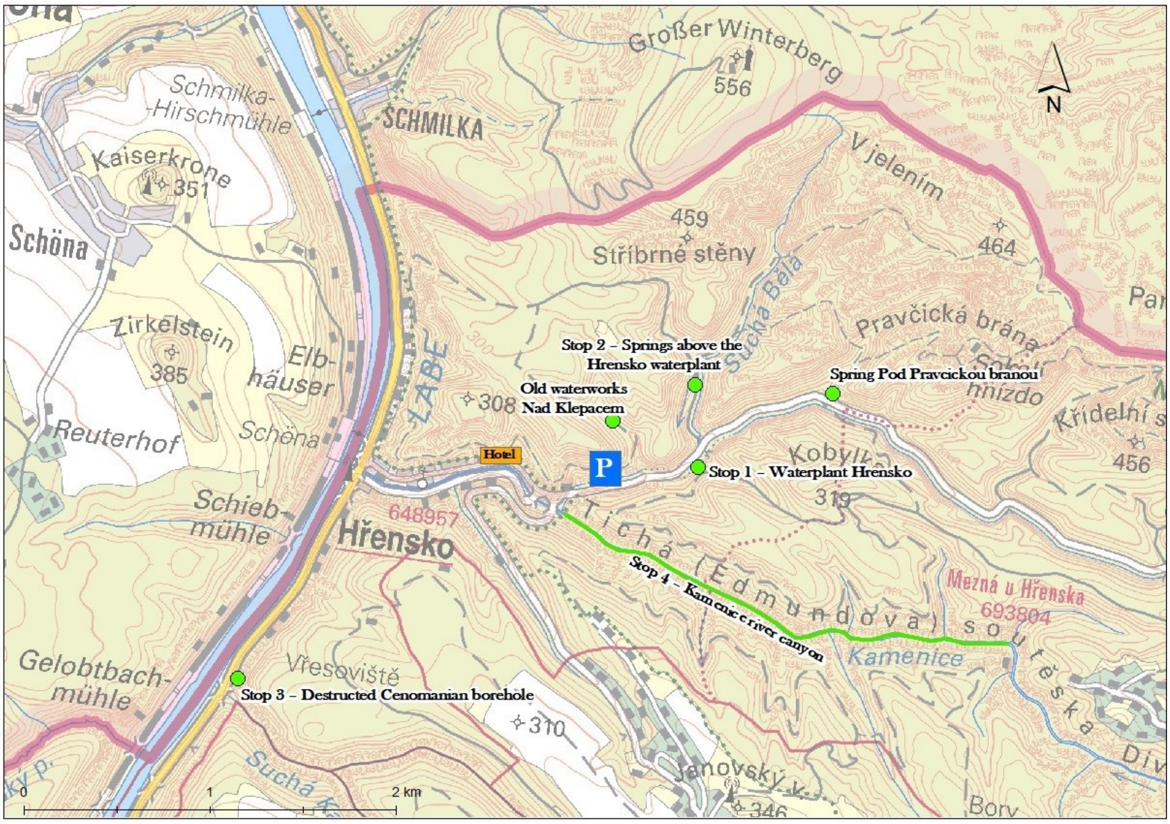
Guidebook

Excursion, May, 28th-29th 2018

Czech part

Hydrogeological excursion



Excursion stops near Hřensko

ResiBil – Bilance vodních zdrojů ve východní části česko-saského pohraničí a hodnocení možnosti jejich dlouhodobého užívání

ResiBil – Wasserressourcenbilanzierung und –resilienzbewertung im Ostteil des sächsisch-tschechischen Grenzraumes

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Stop 1

Water plant Hřensko

The Hřensko waterworks is located in the Dlouhá Bělá valley, east of the small town Hřensko in Czech Republic. The facility exploits groundwater from a Lower Turonian aquifer (according to the Czech nomenclature aquifer BC and according to German nomenclature: aquifer 3). The Lower Turonian aquifer is built of sandstones with high transmissivity and stratigraphically occurs in the so called Bílá Hora and Jizera Formations.

Figure 1. Hřensko waterwork.

The Hřensko waterworks was built in late 60s and early 70s of the last century. The groundwater extraction was gradually increasing and in years 1990-1991 it had reached its maximum at 130.0 l/s (liters per second). Then the extraction rates successively decreased to present volume of approximately 60.0 l/s (Fig. 2).

The company SČVK (N-Bohemian waterworks and sewage system) pumps groundwater from 6 wells and exploits 2 springs, which supply water through a gravitational pipeline. The excursion points include a pumping well and one spring. One of the exploited springs is named „Pod Pravčickou bránou“ (Fig. 3) and provides approximately 11.0 l/s, even with intensively pumped wells in front of this spring. Historically, before it was started to pump, it was the largest spring in this area with a discharge of around 20.0 l/s.

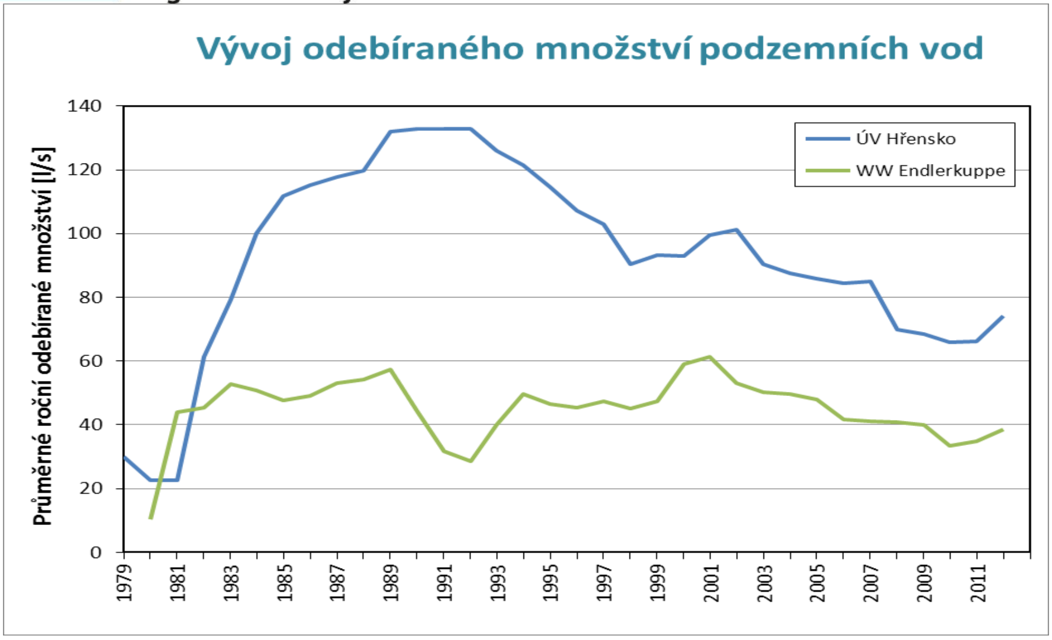

Figure 2. Graph of groundwater extraction rates in the Hřensko area (blue line) and in the Kirnitzsch area (green line).

Figure 3. The exploited spring „Pod Pravčickou bránou".

The raw groundwater is good in quality, with low mineralization and a moderate acidity. The treatment of water in the waterworks includes the addition of limewater (to increase the concentration of calcium as well as the mineralization level and to neutralize the acidity) and chlorination (antibacterial treatment).

The treated groundwater from the Hřensko waterworks directly supplies public waterworks of the town Děčín and its surrounding and is part of a large North Bohemian water supply system.

Stop 2

Springs above the Hřensko waterplant

Interesting springs are situated in Suchá Bělá valley. They are located between the Hřensko waterworks and the Großer Winterberg in close range to the Czech-German state border. The waters of those springs are clean and mostly low mineralized.

The groundwater of the springs comes from a Mid Turonian aquifer (Czech Republic: aquifer BC or Germany: aquifer 2). Another spring in the same hydrogeological situation is nearby the spring in the Malinový důl valley named „Nad Klepáčem“, it has been used for drinking water supply of the small town Hřensko since 1898 (we can see the old waterworks; Fig 4).

Figure 4. Old waterworks „Nad Klepáčem“ is supplying Hřensko with drinking water.

In the Suchá Bělá valley there are another 7 considerable springs located. The largest of them (Suchá Bělá 3) has a discharge of approximately 4.0 l/s and is observed by ČHMÚ (Czech Hydrometeorological Institute) as a part of Czech hydrogeological monitoring network (Fig. 5). In the years of the highest pumping rates in Hřensko waterworks, the discharge of the spring was generally lower.

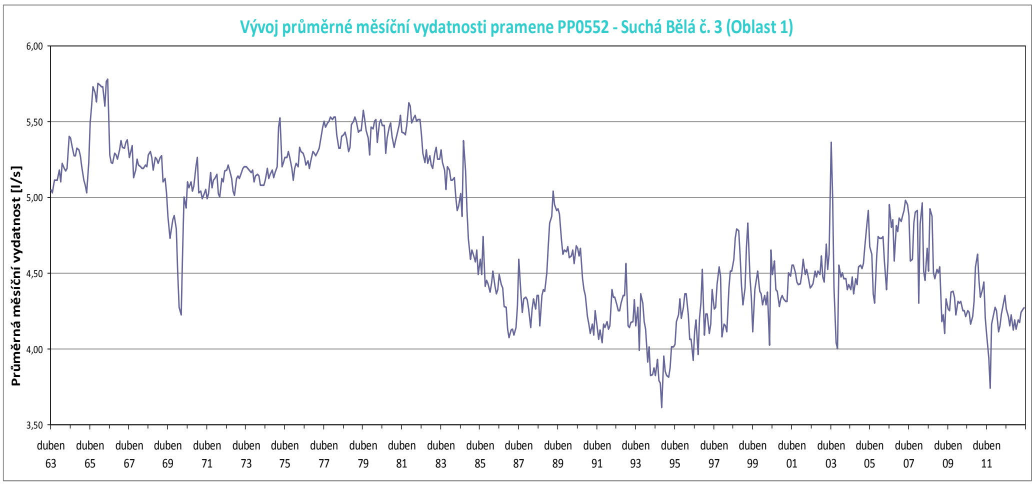

Figure 5. The spring „Suchá Bělá 3“ is observed by ČHMÚ. At the bottom, the pumping rate log chart of the spring illustrates a declining trend from 1965 to 2011.

The second one (Suchá Bělá 2) has currently a discharge of approximately 1.0 l/s (Fig. 6). This spring with clean water was observed by ČHMÚ till 1992. In the years with the highest pumping rates in Hřensko waterworks, the spring sometimes has gonedry.

Both springs are located on an aquitard formed by Turonian sediments (Jízera Formation). The aquitard is well distinguished in Saxony, but has not been clearly defined in the Czech Republic.

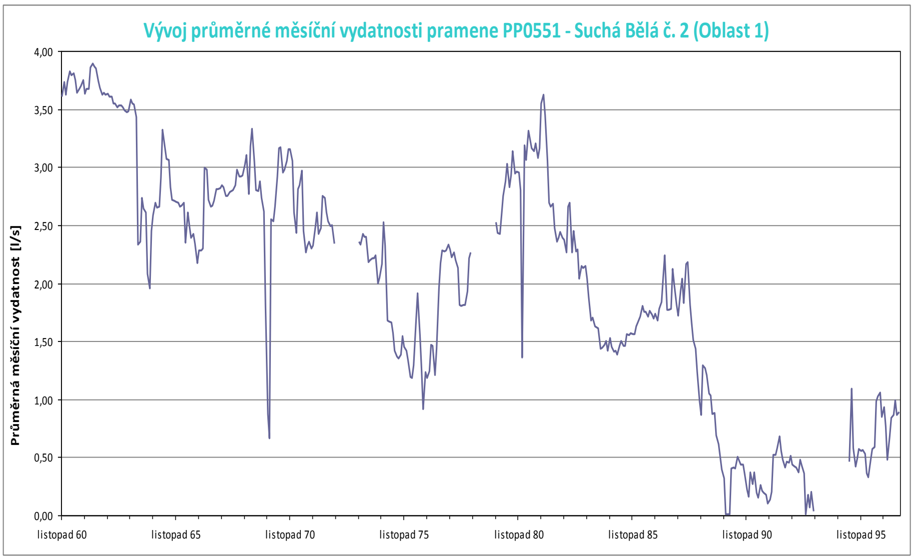

Figure 6. The spring „Suchá Bělá 2“ had been observed by ČHMÚ until 1992.

Above those two springs in the Suchá Bělá valley we can see some other natural springs and one old monitoring borehole.

Figure 7. Natural springs in the mid part of the Suchá Bělá valley.

Stop 3

Destructed Cenomanian borehole near Labe/Elbe River

An old hydrogeological borehole was situated by the Labe/Elbe River and the Suchá Kamenice brook. The borehole reached the base of the Cretaceous aquifer (Czech Republic: aquifer A or Germany: aquifer 4) made up of Cenomanian sandstones (Peruc-Korycany Formation). The borehole, named DN-14/61, was drilled in 1961 with a total depth of 91.6 meters.

The groundwater of the artesian aquifer flows up to the surface, naturally. The shutdown of the borehole was not successful and therefore approximately 4.0 l/s of groundwater from the Cenomanian aquifer is now being discharged to the Suchá Kamenice creek. The groundwater at the base of the Cretaceous collector has low mineralization but is rich in iron, which causes red sediments in the Suchá Kamenice creek (Fig. 8).

Figure 8. Overflow from the destructed Cenomanian borehole with iron sediments.

In general, groundwater from the Cenomanian aquifer has not been used for drinking water supply in this region. In the Děčín and Ústí nad Labem area, this aquifer has locally higher temperatures (around 25°C) and is, for example, used as a source for thermal swimming pools.

Stop 4

Kamenice River canyon

In Hřensko the Kamenice River flows into the Labe/Elbe River. The Kamenice River shaped the canyon where the town Hřensko is situated. The canyon walls consist of the Bílá Hora and Jizera Formation. Along the river there is the possibility to see the interaction of groundwater and surface water. Mostly, springs are located in fissures of the sandstones. The valley is part of the National park „České Švýcarsko“ (Czech Switzerland).

Figure 9. Kamenice River in sandstone canyon near Hřensko.