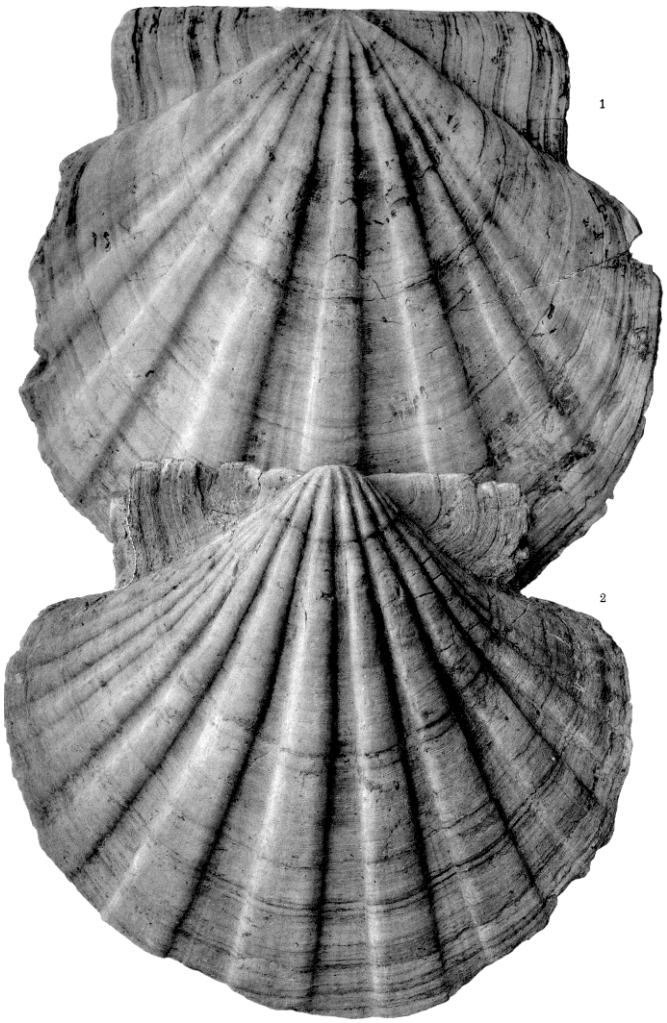
Field Trip

Korneuburg Basin - Alpine-Carpathian Foredeep - Bohemian Massif



Guided by
Reinhard Roetzel and Stjepan Ćorić

25th June 2015

Geologische Bundesanstalt

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Korneuburg Basin, Alpine-Carpathian Foredeep, Bohemian Massif

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Program

08.30 Start at Geological Survey, 1030 Vienna, Neulinggasse 38

09.00 **Stop 1**: Stetten - Fossilienwelt; Oyster reef with 15.000 specimen deposited in a shallow water bay during Lower Miocene (Karpatian) in the Korneuburg Basin

11.45 **Stop 2**: Zogelsdorf Johannes quarry; Shallow marine Lower Miocene (Eggenburgian-Ottnangian) sediments in the Eggenburg Bay at the westernmost flank of the Molasse Basin

13.00 Lunch at a local restaurant in Eggenburg

14.30 **Stop 3**: Limberg Hengl quarry; Thaya granite of the crystalline Upper Proterozoic basement and onlap of Lower Miocene (Eggenburgian-Ottnangian) sediments

16.30 **Stop 4**: Maissau Amethystwelt; Amethyst dyke in Cadomian Thaya granite

18.00 Dinner at a Heurigen in Maissau

20.00 Return to Vienna

21.00 Arrival at Geological Survey, Vienna

STOP 1: The geotainmentpark "Fossilienwelt Weinviertel", a crossover between science and entertainment

(MATHIAS HARZHAUSER)

The Korneuburg Basin is located about 20 km NW of the city of Vienna. It is famous for its extraordinary rich fossil record with more than 650 taxa of fossil animals and plants. This enormous dataset allows a relatively detailed reconstruction of the palaeoenvironments and the palaeoclimate. The small basin formed during the latest Early Miocene and is part of the Alpine-Carpathian thrust belt. It originated as a sub-basin of the Vienna Basin during its early piggy-back stage. The coastal mudflats were inhabited by biostromes of the giant oyster *Crassostrea gryphoides*, which formed colonies of several thousands of individuals with shell sizes of up to 80 cm length. One of these biostromes was excavated during 2005–2008 by the Natural History Museum Vienna. In a next step, the construction of a huge geotainmentpark with the oyster-biostrome as central attraction was started. The inauguration of this geotainment park took place in June 2009.

Geological Setting

During the Late Miocene the Alpine-Carpathian thrust belt moved into today's position overthrusting clastic formations of the Molassezone which are underlain by the autochthonous sequence of Upper Cretaceous and Jurassic units. The latest thrust movements are recorded during the Ottnangian. With the start of the Karpatian, reactivation of thrusts as strike-slip faults in the Lower Miocene caused a rapidly subsiding pull-apart type basin. The basin margins are formed in its Northern part by the Waschberg Unit and towards the South by the Rhenodanubian Flysch Unit. Consequently, the basement of the Korneuburg Basin is formed by these units.

The asymmetric SSW-NNE-oriented basin is ca. 20 km long and attains a maximum width of 7 km. The basin subsided on its western border along the Schliefberg fault down to 880 m depth. By contrast, the eastern margin of the basin which is also formed by the Flysch Zone lacks faults except for its northernmost part. The considerable increase of sediment thickness towards this Western fault zone witnesses synsedimentary tectonic activity during the Karpatian.

Paleogeographic reconstruction of the Korneuburg Basin during the Karpatian.

Sedimentary history and facies development

In the Korneuburg Basin the main phase of deposition started in Karpatian times. The majority of the Karpatian basin fill is comprised as the Korneuburg Formation. This depositional sequence is represented mainly by grey to yellow marly silt and fine to medium sand. Rarely gravel and boulder may occur close to the Flysch Zone. A second lithological unit is formed by clayey marls with intercalated diatomites ("Diatomeenschiefer mit Fischresten") which crop out in the Northern part of the basin in the vicinity of Großrußbach.

The Karpatian deposits of the Korneuburg Basin are dated into the latest Early Miocene. The correlation of the mammal fauna with paleomagnetic data allowed a dating into the mammal zone MN 5 spanning a time of about 16.5-16.7 my. Magnetostratigraphic and palaeomagnetic data suggest a counter-clockwise rotation of the basin of 20 degrees since the Karpatian. Additionally, a rather southern position of the Korneuburg Basin 16 my ago in 34 degrees palaeolatitude can be deduced.

The oyster reef in Stetten.

During the Karpatian, the basin was nearly cut off from the open Paratethys Sea. In the neighbouring Vienna Basin limnic/fluvial environments of a meandering river system were established. The distinct fluvial input along the Eastern margin of the Korneuburg Basin in the area of the Obergänserndorf - Mollmannsdorf swell suggests that the influence of the meandering river system of the Vienna Basin reached the Korneuburg Basin. This situation is

also reflected in the internal facies patterns. Thus the small, elongated basin was divided into a southern, estuarine part and a northern, predominately marine part. In the latter, shallow marine settings of 20-30 m water depth formed where corals scattered dwelled the silty to sandy bottom. The southern basin, separated from the marine northern basin by the Obergänserndorf - Mollmannsdorf swell, is characterised by estuarine settings. A broad array of coastal-terrestrial habitats became established, ranging from patches of an impoverished *Avicennia* mangrove via Taxodiaceae swamps to riparian forests. Tidal mudflats with extended *Crassostrea* bioherms developed along large parts of the coasts. Small-scale fluctuations of the relative sea-level caused repeated marine floodings in the Southern basin.

A subtropical climate with a minimum value of the mean annual temperature (MAT) of 17° C based on the requirements of crocodiles and cordylid lizards was proposed by Böhme (2002). The winter months were frost free; the minimal cold month temperature (CMT) ranged from at least 3° C to about 8° C.

The Geotainementpark "Fossilienwelt Weinviertel" (Stetten)

This 5 million Euro project required intense negotiations and co-operations with the federal state "Lower Austria", the municipal area "10-vor-Wien", the town Stetten and several private enterprises. The concept was to communicate the scientific results in a modern way by implementing multi-media installations and to avoid classical "museum-approaches". Visitors are introduced to the "deep time" of earth history, realising that even the 16.5 million years old fossils are rather young from the view point of a geologist. A huge, roofed cross section through the tilted sediments visualises the rapid shifts of ecological conditions expressed by changes in sedimentology. The mascot, a 12-metre-high *Turritella*-gastropod (left), turns out as watchtower, which offers a view into the Vienna Basin. Finally, the gigantic oyster-biostrome is the highlight of the tour, which ends in a showroom with some of the most spectacular fossils, such as the largest fossil pearl ever found.

Turritella watchtower at the "Fossilienwelt Weinviertel".

Text from: SEIFERT, P., et al.: 33rd EGS General Meeting & Workshop. – 2012 September 17-21, Vienna, Austria, Field Trips, Vienna 2012.

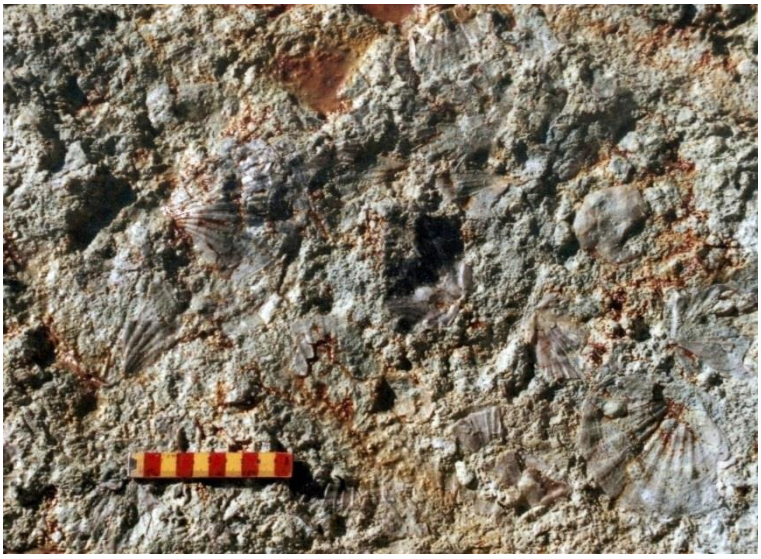
STOP 2: Zogelsdorf Johannes quarry

(O. MANDIC, F. STEININGER & R. ROETZEL)

Locality: The quarry is positioned on the northwestern margin of Zogelsdorf, about 2.5 km southwards from Eggenburg. The stone production began here around 1870 when the large scale reconstructions around the capitol's old city, initiated by the Austro-Hungarian Emperor, triggered an outstanding demand for building materials. Among others also blocks for the four Hercules statues at the Michaelertor in the Vienna City originates from here. The quarry was at that time the property of the famous female writer, pacifist and 1905 Nobel Peace Prize laureate Bertha von Suttner with the domicile in the neighbouring Harmannsdorf. Today the quarry represents the natural and industrial monument and contributes the exhibition of the stonemason museum "Steinmetzhaus" on the main road of Zogelsdorf. The original traces of old production methods together with the typical ancient tools can be checked up already at site.

The Johannes quarry in Zogelsdorf.

Section: The Johannes quarry represents the type section of the **Zogelsdorf Formation** in a bryozoan dominated facies. This detritic, muddy biogene limestone succession with about 3 m in thickness reflects a fining and thinning upward trend upsection. The position and the character of the foot wall is unknown. The basal part of the succession shows one single 1 m thick homogenous bed. It is overlaid by a well bedded part consisting of 10 to 30 cm thick packages. Finely the topmost 50 cm is intensively bedded comprising the 5 to 10 cm thick sediment packages. These rudstones are throughout dominated by bryozoan remains and characterized likewise by a high muddy content. The significant contribution, with up to 30 % of additional biogene material in the lower half of the succession, dominated by bivalves, barnacles, echinoid and coral algal remains, diminish definitely upsection with values pushed down to only 10 %. The bryozoan colonies are mostly celleporiform. Hence they form commonly macroids build by several, interchanging bryozoan taxa as well as other incrusting organism groups like serpulids or coralline algae. Accompanied with dominant Celeporidae the following bryozoan genera are additionally present in the type section: *Cellaria, Sertella, Porella, Schizoporella, Myriapora, Crisia, Entalopora, Lichenopora, Frondipora, Mesenteriopora, Tetrocycloecia, Tervia, and Hornera*. Moreover characteristic are monospecific pectinid layers bearing disarticulated and articulated, horizontally oriented shells of *Pecten hornensis*. Among echinoderm remains the representatives of Echinoidea, Asterozoa, Ophiuroidea as well as Crinoidea can be found.



The monotypic, mass occurrence of the *Pecten hornensis* in the Zogelsdorf Formation of the Johannes quarry. Note the large left valve in the lower-right edge of the picture.

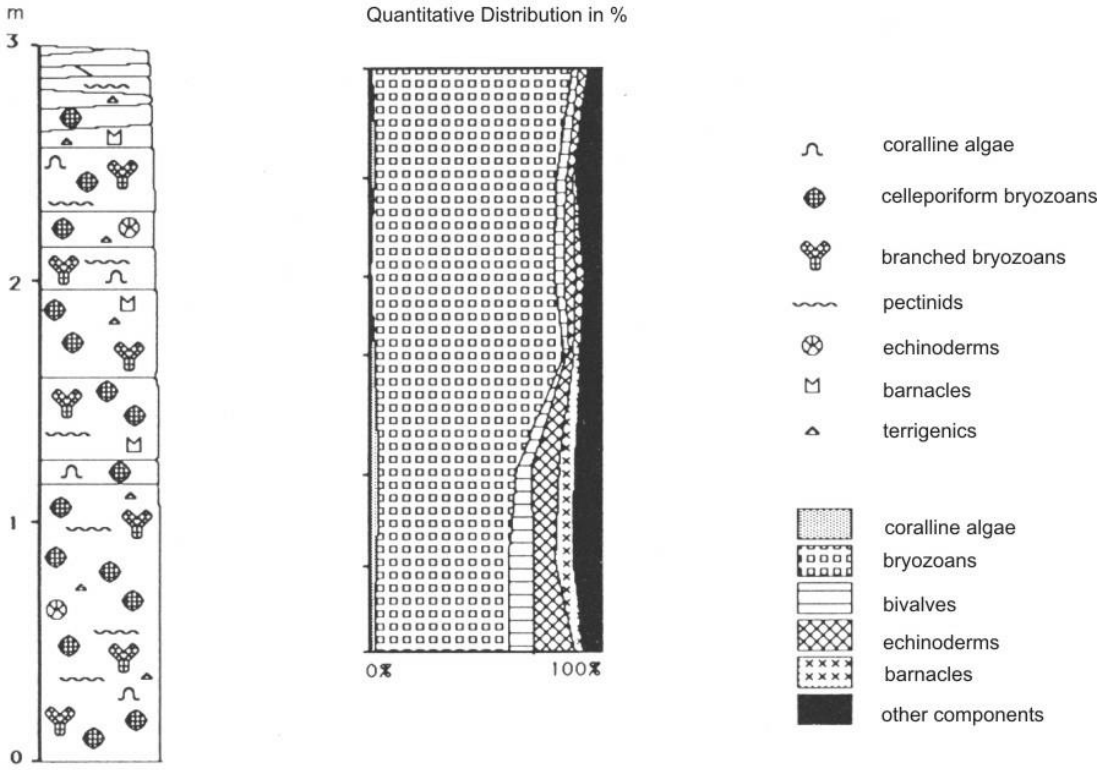
Interpretation: The site is positioned in the southern part of the Eggenburg Bay that was originally sheltered from the influence of the open sea by roughly north-south striking submarine, crystalline swells, islands and peninsulas. In consequence the Zogelsdorf

Formation, topping therein the basal Late Eggenburgian siliciclastics is developed in a typical terrigenous poor, bryozoan rich facies.

Yet the absence of the bryozoan genus *Crisia*, being in contrast common in many other sites of the Eggenburg Bay, appears indicative for the succession. Hence this could point to the absence of the submarine vegetation at the depositional site. Indeed the common incrusting byozoans as well as other incrusting organisms dominating the biogene composition indicate the lowered sedimentation rate resulting possibly from the missing vegetational sedimentary trap on the sea bottom. Moreover the high mud content of limestones points to a less agitated hydrodynamic regime certainly below the fair weather wave base at the depositional site. The fining upward along with the thinning upsection reflects the deepening of the depositional environment. That goes together with the diminishing upsection of the shallow subtidal depth indicators like barnacles or common echinoid remains. The pectinid shell beds are remains of their original colonies typically inhabiting detritic, shelly bottoms at medium subtidal depths around the storm weather wave base.

Illustration shows the original traces of the production made by hand tools of the 19th century as demonstrated by the worker's shadow.

The mass occurence of *Pecten hornensis* in the Zogelsdorf Formation represents important regional biostratigraphic signal. Hence along with the remarkable facies change during the latest Eggenburgian (basal marine siliciclastic sequence in the base vs. detritic carbonate sequence on top), the FAD of that pectinid species in the carbonates enables their clear stratigraphic distinction.



The section of the Johannes quarry. The diagram shows the vertical distribution of the biogene components. Note the increase of the bryozoan contribution upsection (NEBELSICK, 1989).

Text from: MANDIC, O., HARZHAUSER, M., STEININGER, F. & ROETZEL, R.: RCMNS 2005. Excursion C: Miocene of the Eastern Alpine Foredeep – The Bohemian Massive southeastern margin. – 52 p., Vienna 2005.

NEBELSICK, J.H.: Temperate Water Carbonate Facies of the Early Miocene Paratethys (Zogelsdorf Formation, Lower Austria). – Facies, 21: 11-40, Erlangen 1989.

NEBELSICK, J.H.: Die fazielle Gliederung der Zogelsdorf Formation (Untermiozän: Eggenburgian) in Niederösterreich anhand mikrofazieller Untersuchungsmethoden. – Diplomarbeit an der Formal- und Naturwissenschaftlichen Fakultät der Universität Wien, 242 p., Wien 1989.

STOP 3: Quarry of Hengl Company, Limberg

(R. ROETZEL & F. STEININGER)

Topic: Late Proterozoic granites of the Bohemian Massif, transgressively overlain by Lower Miocene sediments of the Alpine-Carpathian Foredeep (Molasse Zone)

Thaya Granite

Featuring a radiometric age of 570 to 600 Ma, the Thaya granite is the oldest granite in the Moravian Unit, the easternmost tectonic unit of the Bohemian Massif. Hence it is not only the oldest granite in Lower Austria, but also in the whole of Austria. It was formed during the Cadomian Orogeny at the end of the Proterozoic. The Thaya granite occupies the tectonically deepest position in the Moravian Unit at the eastern limit of the Waldviertel region. Its rooftop rocks consists of a Proterozoic para-sequence (mica-schists, quartzites), which towards the west are tectonically overlain by orthogneisses as the Bittesch Gneiss or the Weitersfeld gneiss. Various granitic to granodioritic varieties (Hauptgranit, typus Gumping, typus Passendorf, etc.) occur in the widespread plutonic rock mass of the Thaya pluton.

The granite of the Hengl quarry is a medium-grained metagranite, which is often characterized by pale pink coloured potassium feldspars. The primary mineralogical composition consists of approximately 30 % potassium feldspar, about 35 % relatively acidic plagioclase, 27 % quartz and 4-5 % biotite; accessory minerals are apatite, zircon and titanite.

Several alkaline lamprophyre dykes which cut discordantly through the granite are exposed in the Hengl quarry. They consist of fine-grained, quartz-poor to quartz-free, magmatic, dark dyke rocks of porphyritic fabric. The main components are biotites in a potassium feldspar matrix. Additionally, widely carbonated, short prismatic pseudomorphs after pyroxene and/or hornblende as well as much apatite occur.

Today, this granite is mainly used for construction of river embankments, as crusher products for roadbeds for railway and roads and as frost protection layer. Historically, it has also been used as a décor stone, f.e. for buildings in the city center of Vienna at Stephansplatz at Kärntnerstraße 2. Today, it is rarely used also as stone for sculpturing and buildings. Well exposed outcrops are found around Maissau, in the quarries of Limberg at the base of the city wall of Eggenburg or in the natural monuments area “Kogelsteine” (granite boulders) at Grafenberg and “Feenhaube” (fairy cap) at Stoitzendorf.

The Thaya granite is transgressively overlain by Lower Miocene coarse sands of the Burgschleinitz Formation and the calcareous sandstones of the Zogelsdorf Formation in the Hengl quarry.

In terms of macro-tectonics, the Burgschleinitz Formation and the Zogelsdorf Formation represent Neogene deposits of the Alpine-Carpathian Foredeep (Molasse Zone).

Thaya granite transgressively overlain by sands and sandstones of the Burgschleinitz Formation (Eggenburgian) and Zogelsdorf Formation (Late Eggenburgian – Early Ottnangian).

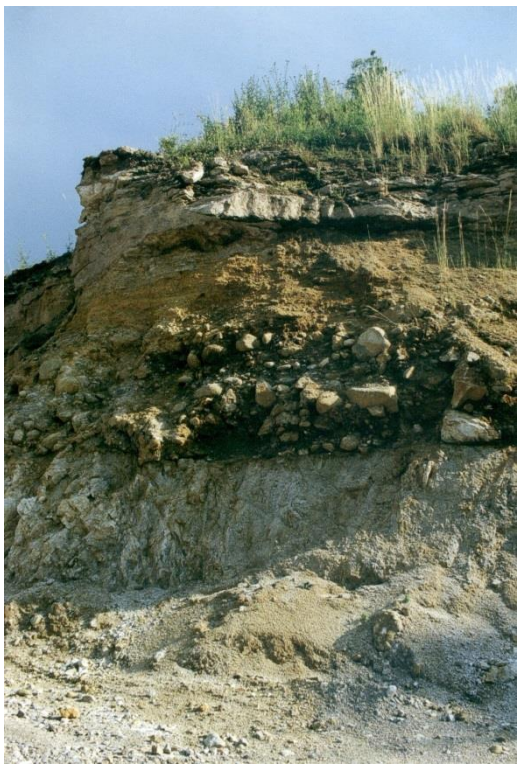
Lamprophyre dyke discordantly cutting through the Thaya granite which is overlain by Lower Miocene sediments.

Burgschleinitz Formation

The sediments of the Burgschleinitz Formation are frequently the deepest lithostratigraphic unit of the Lower Miocene stratigraphic sequence and represent the onset of the marine transgression of the (Upper) Eggenburgian in the Eggenburg Bay.

The Burgschleinitz Formation consist of rapidly changing, well to moderate sorted coarse, middle and fine sands with intercalations of gravel. They are deposits from the shallow marine foreshore to the shallow neritic zones, which are wave-dominated and characterised by storm events. Large-sized bivalves and gastropods can be noticed in the species-rich mollusc fauna. The rich Chondrichthyes- (cartilaginous fishes) and Osteichthyes- (bony fishes) fauna is noteworthy too, as well as the frequent occurrence of marine mammals like sirens and whales. At the base of the Burgschleinitz formation in Limberg lies a boulder horizon of well to moderately rounded granite boulders. This is followed by poorly sorted and poorly rounded, partly angular bedded, very silt-rich middle to fine sands, coarse sands and gravels. In tectonic sags in the granite, these sediments are well preserved. Fragments of balanids, bryozoans, brachiopods, oysters, scallops, etc. are frequently found in the deposits. The upper part of the Burgschleinitz Formation is overlain by the Zogelsdorf Formation by an erosive and transgressive sedimentary contact.

The deposits have an age of approximately 20 Ma (Lower Miocene, Upper Eggenburgian). Further interesting outcrops lie in the Eggenburg Bay in Burgschleinitz, Kühnring or Maigen.



Thaya granite overlain by basal granite boulders and sands of the Burgschleinitz Formation followed by sandy limestones of the Zogelsdorf Formation.

Zogelsdorf Formation

The deposits of the Zogelsdorf Formation prevail especially in the Eggenburg Bay. They reach towards west until the Horn Basin. Within the protected marine areas of this Bay around Eggenburg and Zogelsdorf, the sediments are richer in carbonates than at the wave dominated outer edge of the bay between Retz, Pulkau, Maissau, Grübern and here in Limberg, where they are coarser and contain more clastic debris from the crystalline basement.

As in Limberg, the Zogelsdorf Formation follows mostly transgressively on top of the Burgschleinitz Formation, but can also lie on top of older formations or directly on the crystalline basement in the Eggenburg Bay. At the basis of the Zogelsdorf Formation usually an erosional relief can be observed. A shorefacies conglomerate is exposed in the Hengl quarry. The sediments are yellow-greyish, coarse, rich in debris of crystalline rocks, pebble-bearing, fossil-rich, middle to fine grained calcareous sandstones with a variety of remnants of calcareous organisms (bryozoans, red coralline algae, bivalves, sea urchins, balanids, brachiopods, etc.). Those sandstones have been deposited in a wave- to strong wave-dominated shallow water coastal region.

The sediments of the Zogelsdorf Formation mark the further advance of the sea in the Lower Miocene after its temporary retreat. They are about 18 Ma old (Lower Miocene, Upper Eggenburgian/Ottnangian).

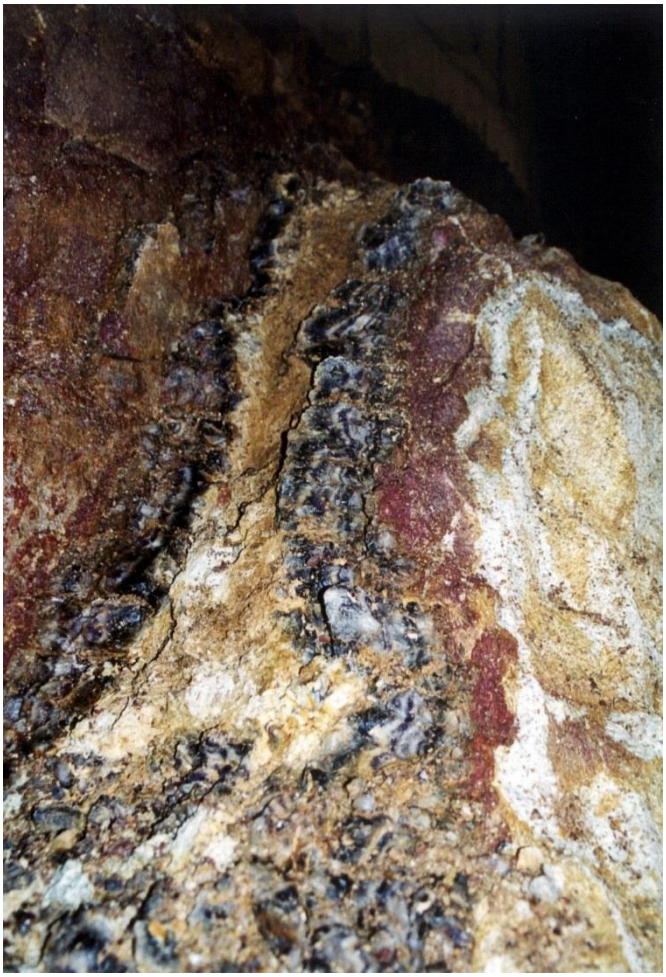
The calcareous sandstones were widely used in Baroque époque (17th to 18th century) and were used as building and sculpture stones until the beginning of the 20th century. Excellent outcrops are located in the Johannes quarry in Zogelsdorf and in the Brunnstube in Eggenburg.

Text from: SEIFERT, P., et al.: 33rd EGS General Meeting & Workshop. – 2012 September 17-21, Vienna, Austria, Field Trips, Vienna 2012.

STOP 4: Maissau - "Amethystwelt", Amethyst dyke in the Thaya Batholith

(O. MANDIC, G. KNOBLOCH, R. ROETZEL)

Locality: The Amethyst dyke of Maissau is outcropped in an exhibition hall representing the central part of the "Amethystwelt" centre located on the federal road B4 to Horn, about 500 m off Maissau. The dyke was originally discovered during the production works in the Thaya granite quarry in the first half of the 19th century. Hence the first description of the amethyst idiophanous axis projections phenomenon was based on therein sampled material, by famous mineralogists and founder of the Austro-Hungarian Geological Survey WILHELM VON HAIDINGER (*Denkschriften math.-naturwiss. Cl. Akad. Wiss. Wien*, 1848). The author discovered thereby the typical optical property of the amethyst resulting from alternating superposition of right-handed and left-handed quartz lamellae. Soon however the quarry production stopped and its amethyst occurrence slid into oblivion. The modern rediscovery of the dyke was triggered in 1986 through extensive exploration campaigns by the Krahuletz Museum (Eggenburg). Hence in the early 2005 the "Maissau Amethyst Gesmbh" launched a unique tourist centre on the dyke exploiting now commercially the natural phenomenon.



Amethyst dyke at the site in the “Amethystwelt”.

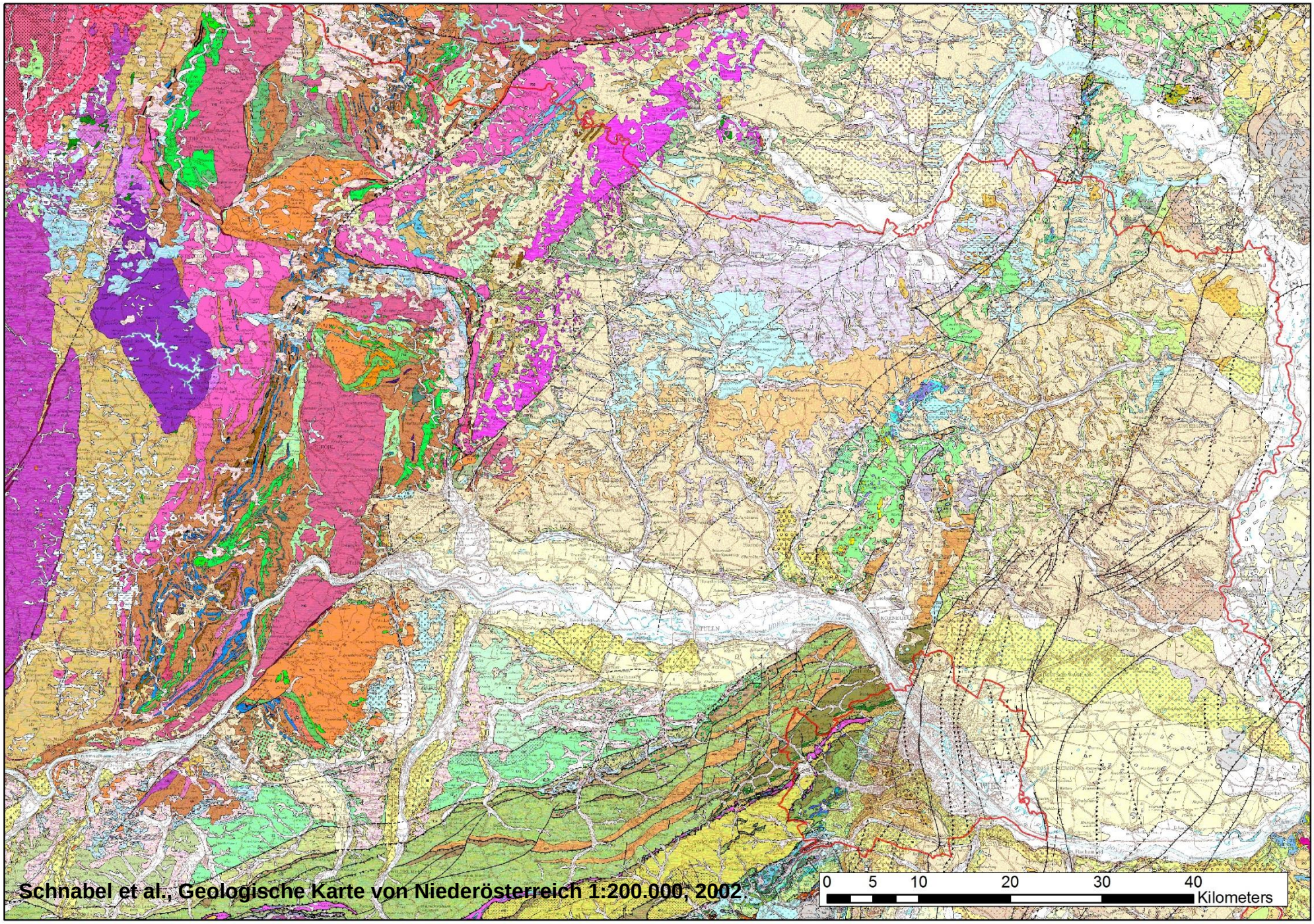
Section: It is a WNW-ESW striking, vertically oriented dyke with maximal thickness of 2 m. The prospecting works have proved its continuous extension for at least about 400 m. This classified it to the larger occurrences of its kind. Additional parallel striking dykes are present in the region as well. One such famous occurrence, known already for about 250 years, is positioned about 7 km northwards from the site and crosses the graveyard of Eggenburg. In Maissau moreover spectacular are neighbouring sites with large well rounded amethyst pebbles at places where the Early Miocene marine transgression eroded the dykes. One such site was discovered below the centre's parking place eastwards to the hall.

Thaya granite: This is a homogenous, medium grained, slightly metamorphic biotit-granite, which is in the surroundings of Maissau characterised through a typical red colour of its feldspars. North of the dyke it is only slightly weathered although commonly brownish in colour through iron oxyde ingressions from the cleavage system. In contrast the granite in the southern wing of the dyke is partly completely altered to kaolin.

Amethyst dyke: The dyke comprises a main vein that is in the outcrop 40 to 60 cm wide and is lateral exposed for about 40 m. The main vein splits into several parallel striking veins and also feather joins where single veinlets can be followed several meters off the main one. The quartz mineralization of the node, showing typical elongated zigzag pattern, is intensively striped, alternating different intensities of black (morion), whitish (milk quartz), grayish (smoky quartz) and violet (amethyst) colors. The mainly only several centimeters wide veinlets of the feather joins are commonly filled only by a single colored quartz mineral. Moreover common are cm-wide cavities that can elsewhere reach several meters in diameter. They comprise geodes where crystal generations end toward the cavity with six-sided pyramids.

Lower Miocene amethyst gravel.

Text from: MANDIC, O., HARZHAUSER, M., STEININGER, F. & ROETZEL, R.: RCMNS 2005. Excursion C: Miocene of the Eastern Alpine Foredeep – The Bohemian Massive southeastern margin. – 52 p., Vienna 2005.


Schnabel et al., Geologische Karte von Niederösterreich 1:200.000, 2002
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Kilometers


Stop 1
Stop 2
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Stop 4
KORNEUBURG
KLOSTERNEUBURG
STOCKERAU
HOLLABRUNN
MISTELBACH
ZISTERSDORF
POYSDORF
WOLKERSDORF
GÄNSERNDORF
GERASDF.
DEUTSCH-WAGRAM
MARCHEGG
GROSS-ENZERSDF.
FISCHAMEND
SCHWECHAT
WIEN
PURKERSDF
NEULENGB.
ST. PÖLTEN
HERZOGENBURG
TRAISMAUER
TULLN
KREMS
DURNSTEIN
MAUTERN
LANGENLOIS
EGGENBURG
HORN
ALLENTSTEIG
GFÖHL
WAIDHOFEN
GROSS SIEGHARTS
RETZ
SCHRATTENTHAL
PULKAU
MAISSAU
HOLLABRUNN
STOCKERAU
WILHELMSBURG
WIESELBURG
MELK
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HAINFELD
BADEN
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LAXENBURG
BRUCK a.d. Leitha
TRAISKIRCHEN
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GUMPOLDSKIRCHEN
BRECLAV (Lundenburg)
VALTICE
LAA a.d. Thaya
HOHENAU a.d. March
MARCHEGG
Donau
Thaya
March
Leitha
Wienerwald
Weinviertel
Waldviertel
Mostviertel
Industrieviertel
Nationalpark-Donau-Auen