



# Cost-Benefit-Analysis of Geological Expertise

International Symposium  
October 15-16, 2005  
Vienna, Austria

Programme Abstracts Excursions



Geological Survey of Austria



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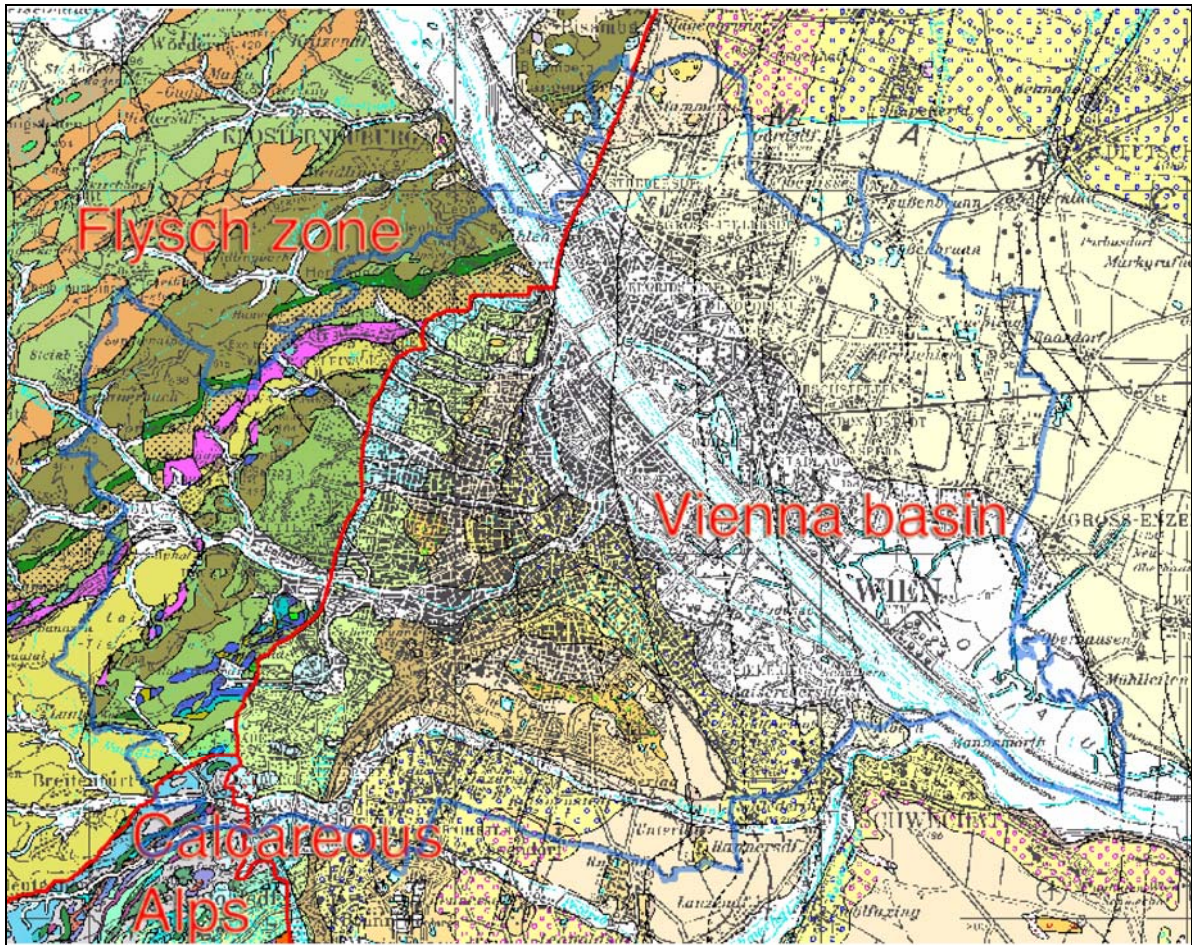
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## Excursion 2

# *The reef on the roof* - a „geological” walk through the city of Vienna

guided by

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Geological map of the city of Vienna (from W. Schnabel, 2002: Geological Map of Lower Austria 1:200.000); city limits in blue, tectonic units in red.

## Vienna: geography and geology

### Location:

48°07' - 48°19' northern latitude

16°11' - 16°34' eastern longitude

### Dimensions:

North-South-extension: 22.4 km; East-West-extension: 29.2 km

Highest Point: 543 m Peak of Hermannskogel

Lowest Point: 151 m Lobau at the River Danube

Total Area: 414.90 km<sup>2</sup> (95,33 % land; 4,67 % water)

Population: 1,550,123 inhabitants (May 15, 2001), i.e. 3,736 / km<sup>2</sup>

Vienna is situated at the western margin of the Vienna basin, a tectonic depression existing since the Miocene. The western edge of the city area overlaps the Flysch zone which consists mainly of sandstones and marls (Cretaceous - Paleogene), the most south-western corner of Vienna includes limestones and dolomites of the Northern Calcareous Alps (Triassic - Jurassic). These two units display the most pronounced relief with high peaks and deep, narrow valleys. To the East, Neogene sediments overly the older tectonic units. They were deposited in a marine environment and form a narrow band of outcrops stretching North-South. Further to the East, Vienna displays the characteristic topography of fluvial terraces resulting from alternating erosion and deposition by the river Danube during the Pleistocene.

## Meeting Point: The Opera at the „Ringstraße“

### The Opera

The architects Eduard van der Nüll (1812-1868) and August Sicard von Sicardsburg (1813-1868), awarded with the first prize by the reviewing committee, had chosen for their prize-winning project the motto: „Fais ce que dois, advient que pourra.“ It was especially tragic, that criticism of the building, which started in the autumn of 1868, only came to an end after the untimely deaths of the two architects. Criticised was the style: for in 1861 the opera house had been started in a romantic concept, which however, at the latest in 1865 had been replaced by the monumental conceptions of the strict style of historicism. Finally some Viennese people said, that the Opera looks rather like a turtle; despite all those troubles the new house was opened on 25<sup>th</sup> May 1869 with Mozart's *Don Giovanni*.

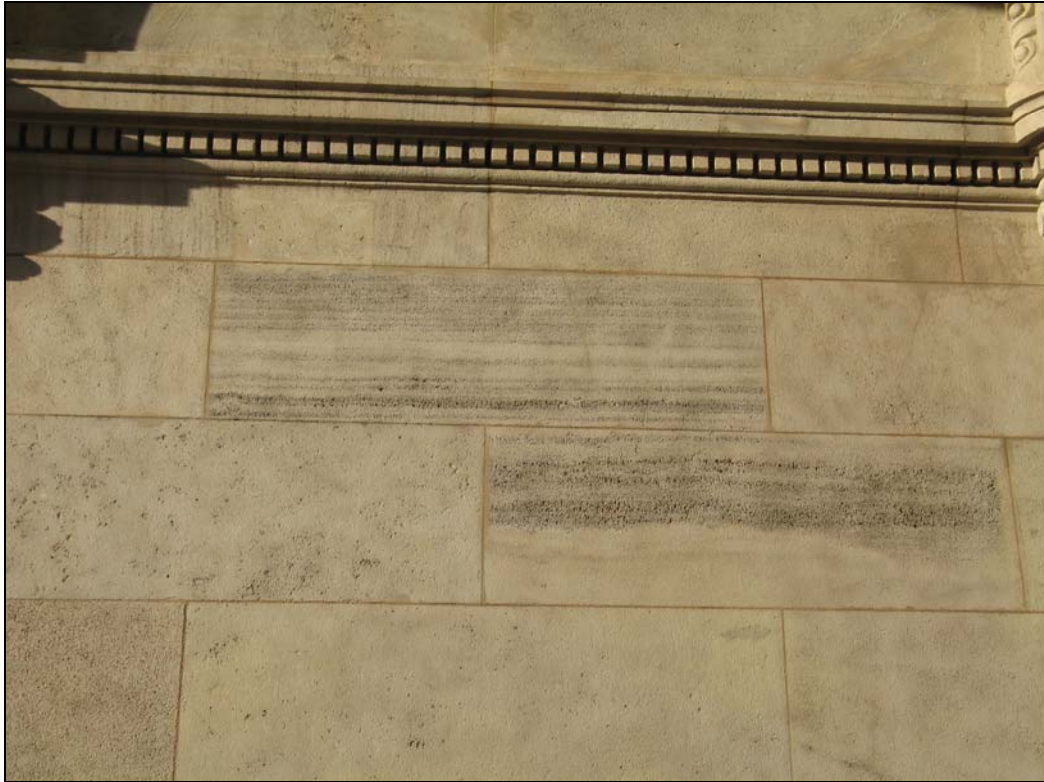
Following the destruction of the opera house on 12<sup>th</sup> March 1945 due to the effects of war, the facade was restored, whereas a faithful restoration of the interior gave rise to differences. The reopening of the opera house was celebrated on 5<sup>th</sup> November 1955 with Beethoven's *Fidelio* with Karl Böhm conducting.

Building material: The building stands partly in the former moat in front of the fortification wall, partly on the fundamentals of the fortification, as well as in a mediaeval clay pit. The fundament is built of reused material (bricks, etc) from the old fortifications.

Most parts of the facade are made of Mid Miocene (Badenium) „Leithakalk“ coming from Wöllersdorf situated at the western margin of the southern Vienna Basin.

The material of Wöllersdorf is a coralline algal limestone with distinct sedimentary layers. This material is rather common in late 19<sup>th</sup> and early 20<sup>th</sup> century. At this period up to 900 men worked in the quarries of Wöllersdorf to get enough stones for several buildings of the „Ringstraße“, like the „Burgtheater“, the „Rathaus“ and so on.





The facade of the Opera: sedimentary layers characterise the miocene „Leithakalk” from Wöllersdorf.

Thin sections can be classified as rudstone/grainstone – packstones, having a rich foraminiferal fauna (58% benthonic elements versus 42% planktonic elements) representing a shallow marine environment.

### **The „Ringstraße”**

The Opera, like many other prominent buildings in the centre of Vienna, are part of the „Ringstraße”. The architecture of the „Ringstraße” is dominated by historicism. In Historicism various stylistic elements of the past were combined into a style in its own right. Nowadays the „Ringstraße” together with the „Franz-Josefs-Kai” surrounds the city of Vienna. The city or „Innere Stadt” with an area of 2.88 km<sup>2</sup> is the 1<sup>st</sup> of 23 districts of Vienna. The 1<sup>st</sup> district is situated on the whole on the „Stadtterrasse” (Riss-age), only the „Franz-Josefs-Kai” is at the lower level of the „Praterterrasse” (Würm-age).

Geology: The top of the „Stadtterrasse” lies between 190 and 163 meters above sea level, the bottom varies between 182 and 146 m. Pleistocene sediments are overlying Pannonian sediments (blue and grey clay and silt with some intercalations of fine sandlenses). At the bottom of the sequence there are coarse gravels („Rundsotter”) transported by the Danube during the Riss-period. There are also some rare crystalline blocks up to the size of one m<sup>3</sup> which were transported embedded in some larger iceblocks coming down the Danube from the Bohemian massif. This 6 or 7m thick layer of gravels is covered by a more or less continuous layer (4-6m) of silt and clay which some sandy intercalations („Zwischenlehm”). The next higher level is the level (6-7m) of the so called „Plattelsotter”. These platy gravels are derived from the Flyschzone at the western border of Vienna. This upper layer of gravels is covered by Loess and or Loam and/or anthropogene deposits.

## First Stop: Albertina and Hrdlicka's „Monument against War and Fascism”

### The Albertina

The Albertina is nowadays a museum housing one of the largest and most important graphic arts collections in the world with approximately 70,000 designs and approximately one million pressure graphic sheets. There are works by artists like Leonardo da Vinci, Michelangelo, Raffael, Dürer, Rembrandt, Rubens but also works by Lorrain, Delacroix, Manet and Cézanne. Among the artists of the 20<sup>th</sup> century Schiele, Klimt and Kokoschka from Austria should be mentioned as well as Warhol, Rauschenberg and Baselitz.

The Albertina Palais is 12m higher than the pavement. This „Augustiner Bastei” (= bastion) is one of the last relics of the fortification which surrounded the City of Vienna; all other parts of the fortification were destroyed in 1857/58. After the 1<sup>st</sup> siege of the Turkish Army in 1529 the fortification was extended.



The „Danubius-Brunnen” covers the „Augustiner Bastei” (= bastion), part of the old fortification.

The Fountain („Danubius-Brunnen”) has been designed by Moritz von Löhrs (1810-1874) and was built between 1864 and 1869. The figures show allegories of Austrian rivers (Mur, Salzach, March, Raab, Enns and Traun).



## Monument against War and Fascism

This walk-in monument was carried out by the famous Austrian sculptor Alfred Hrdlicka (\*1928) to preserve the memory of one of the darkest periods in history. It is dedicated to all victims of war and facism. The monument was ordered by the city council of Vienna in 1983 and uncurtained in 1988, the Austrian commemorative year.

The place of the monument is the former place of the „Philippshof“, a prestigious apartment house of the late 19<sup>th</sup> century. The object was destroyed on the same day like the Opera (March, 12<sup>th</sup> 1945), when hundreds of people had taken refuge in the cellars of the building. Their bodies were never recovered and even their exact number is still unknown.



Monument against War and Fascism: Granodiorite from Neuhaus (Upper Austria).

Building material: The two basal blocks of the „Gate of Violence“ as well as the „Stone of the Republic“ and the Block of „Orpheus entering Hades“ are made of granite from the Bohemian Massif coming from the quarry (Fa. Poschacher) of Neuhaus (St. Martin) in Upper Austria.

This granite (Typus: Neuhausen) is a granodiorite belonging to the Southern Bohemian Pluton as part of the Moldanubian tectonic unit. The intrusion during the Carboniferous corresponds with the Variscan orogenesis.

The statues are made from white marble from Carrara.

## Second Stop: The Hofburg, Michaelerplatz

The „Michaeler Platz“ is dominated on the one side by the Hofburg, on the other side by the Looshaus and finally by the Michaelerkirche. In the centre is an excavation complex which was planned and laid out by the architect Hans Hollein (\*1934) in 1991. It shows the relics of several time levels.

### The Hofburg

The Hofburg originates from a medieval castle, which was enlarged step by step up to the 19<sup>th</sup> century, so the complex of the Hofburg is nowadays rather a conglomerate. Today only the castle chapel ('Burgkapelle') is left as oldest part from a medieval past.

The Hofburg was extended over the centuries as a magnificent residence when the Habsburg's power increased. This is reflected in various architectural styles from gothic to art nouveau. Nowadays in this enormous complex is the home of many collections and institutions, such as the National Library, the Imperial Treasury („Schatzkammer“), and several collections, like the one of musical instruments or another collection of weapons. The Museum of Ethnography as well as the famous Spanish Riding School with its renaissance architecture are also incorporated in the complex of the Hofburg. Until 1918 the Hofburg Palace was the seat of the Habsburg dynasty.



Michaelerplatz: The four Hercules statues at the entrance („Äußeres Burgtor“) of the Hofburg.

Building material: Various dimension stones were used in the Hofburg, one of them, the „Zogelsdorfer Kalksandstein“ (Zogelsdorfer calcareous limestone) is of special interest. This bioclastic limestone from the Lower Miocene (Upper Eggenburgium) comes from several localities near Eggenburg, a



medieval town in the north of Lower Austria. This dimension stone is together with the „Leithakalk“ the most important decoration stone in the eastern parts of Austria, southern Moravia and even in western Hungary. During the baroque period „Zogelsdorfer Kalksandstein“ was very important for sculptors; hundreds of statues, especially those of Saint Nepomuc and other saints are made of this stone. Whereas „Leithakalk“ is still quarried, there has not been an active quarry of „Zogelsdorfer Kalksandstein“ for many decades.

The four Hercules statues by Edmund Hofmann, Josef Lax, Johann Scherpe and Anton Wagner at the Michaelertor originate from the „Johannesbruch“ in Zogelsdorf. This quarry was at the late 19<sup>th</sup> century property of the famous female writer, pacifist and 1905 Nobel Peace Prize laureate Bertha von Suttner (1843-1914) who had her domicile in the neighbouring Harmannsdorf. One reason for using this stone was the excellent preservation of Lorenzo Mattioli's (1688-1748) statues of Herakles (1727-1729) at the „Reichskanzlei“ – a part of the Hofburg.

The „Johannesbruch“-quarry, the type locality of the Zogelsdorf Formation, is positioned on the northwestern margin of Zogelsdorf, about 2.5 km southwards from Eggenburg. The stone production here began around 1870 when the intensive building activities triggered an outstanding demand for building materials. The „Johannesbruch“ shows a bryozoan dominated facies. Moreover monospecific pectinid layers bearing disarticulated and articulated, horizontally oriented shells of *Pecten hornensis* are characteristic. Among echinoderm remains the representatives of Echinoidea, Asterozoa, Ophiuroidea as well as Crinoidea can be found.

The „Johannesbruch“ is located in the southern part of the Eggenburg Bay that was originally sheltered from the influence of the open sea of the Molassezone 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.

### **The archeological site**

There are the remains of walls and a floor heating system as well as building foundations from the seventeenth, eighteenth and nineteenth centuries visible. Red gravel now marks two roman roads crossing here.

Building Material: Some of the exposed bricks show the letters **H** and **D** standing for **Heinrich von Drasche-Wartinberg** (1811-1880). As an industrialist he was head of many clay-pits south of Vienna; the later „Wienerberger Baustoffindustrie AG“. Today this company is the world's largest producer of bricks with more than 230 plants in 24 countries.

The material of millions of bricks having these initials derives from southern regions of Vienna, where numerous large pits of middle Pannonian clay existed. They date back to the mid of the 18<sup>th</sup> century, when the first brick-kiln was erected at the „Wiener Berg“. So already in 1780 one million bricks were made. 1820 some nearby places of production were integrated thus being able to produce 30 millions of bricks per year (1849). 1865 the first circular kilns were erected. Two years later, 10.000 people, men, women and even children were producing bricks for the rapidly growing city of Vienna. At the end of the 19<sup>th</sup> century the annual production could be increased to up to 225 million bricks per year.



**H** and **D** stand for **H**einrich von **D**rasche-Wartinberg, an industrialist famous for brick production.

The material, a blue, to grey silty clay is known in the old geological literature as „Congerientegel“ due to the occurrence of the bivalve *Congeria subglobosa*. A common name is also „Inzersdorfer Tegel“, due to the locality of Inzersdorf in southern Vienna, close to the southern slopes of Wiener Berg and Hennersdorf, the only active clay pit. The terminus „Tegel“, derived from the Latin word „tegulum“ which stand for bricks, is commonly used for fine sediments (clays, marls) in the Vienna Basin.

Nowadays all former clay pits are recultivated, except the one of Hennersdorf, south of Vienna. According to recent investigations the sediments represent a deep bottom lake setting environment. Based on bivalves a repeated change in the oxygenation could be described. Analysing the clay minerals there is a dominance of smectite in Pannonian sediments reflecting dry conditions and seasonal variations in the climatic environment of Lake Pannon. The predominantly smectitic composition documents gentle erosion of smectite-rich soils on a relatively stable, distant source area.

### **The Looshaus**

When Adolf Loos (1870-1933) was building his famous „Loos-Haus“ (1909-1911) the Emperor of Austria, Franz Josef (1830-1916), was outraged, because he was confronted with a „house without eyebrows“ – a modern monstrosity directly opposite the Imperial Palace. It was like an architectural declaration of war. Adolf Loos, not only a famous architect but also an aesthetician and cultural philosopher, formed an alliance together with the writer Karl Kraus (1874-1936), founder of the polemic periodical „Die Fackel“ (1899), to attack the overblown style of Historism and the decorative style of the Secession. Loos advocated buildings that were plain, honest, and functional. Loos was then obliged to add the ten window boxes to calm the critics.



Building Material: The entrance with the columns is covered with green Cipolino Marble from Euböa (Greece), whereas the basis is made of „Light Lambrador” from Norway (Oslo Fjord).

### **Third Stop: The Heldenplatz**

#### **The Heldenplatz**

The great „Heldenplatz“ with its two Equestrian statues of Archduke Karl (1771-1847), who won the battle of Aspern against Napoleon's troops (1809), and Prince Eugene of Savoy (1663-1736), who defeated the Turks, is a tribute to Austria's glorious past. The „Heldenplatz” is more than just a square, it is one of Austria's symbols of national identity and gives also the title to the drama „Heldenplatz” (1988) by the famous Austrian writer Thomas Bernhard (1931-1989).

The „Heldenplatz” is part of the „Kaiserforum” a large project by the two architects Gottfried Semper (1803-1879) and Carl von Hasenauer (1833-1894) dating back to 1869, which was never completed. However the symmetry of the two museums (Museum of Natural History and the Kunsthistorisches Museum Vienna) on the other side of the “Ringstraße” as well as the two great Equestrian statues together with the “Neue Burg”, the newest part of the Hofburg, give an impression of how the “Kaiserforum” could have looked liked.



The statue of Archduke Karl first carried out by Dominik von Fernkorn between 1853 and 1859. The sculptor Anton Dominik von Fernkorn (1813-1878) created the statue Archduke Karl (1853-1859), before he started the monument of Prince Eugene of Savoy (1860-65).



„Untersberger Marmor“: Rudists and tiny bauxite clasts are typical for this cretaceous slope sediment.

Building Material: The basis of both monuments is made of “Untersberger Marmor”; this is not a marble in the petrographic sense, it is a limestone with initial stages of nodular limestone formation. The “Untersberger Marmor” (Late Turonian to Coniacian - Santonian) is part of the Gosau-Group within the Northern Calcareous Alps. This limestone represents one of most traditional decoration stones, which is still quarried in the Salzburg region. It was deposited on a slope or represents a toe-of-the-slope development. Geopetal fabrics indicate an original inclination of the slope of 10-15°. The typical “Untersberger Marmor” is a detritic carbonate sediment-mixture derived from the Gosau carbonate-platform and from the slope, with a considerable share of extraclasts; the latter consist predominantly of Upper Triassic Dachstein and Upper Jurassic Plassen Limestone. Ubiquitous recrystallization renders determination of biota difficult. Due to staining by fine-dispersed bauxite-mud the basal part of the Untersberg Marmor is characterized by pink colour and tiny bauxite clasts and ore grains. The most important bioclasts are rudists, more scarcely corals, bryozoans, hydrozoans, coralline algae and foraminifera.

#### **Fourth Stop: The Theseustemple**

The Theseustempel, in the “Volksgarten“ was built 1820-23 by Peter von Nobile (1774-1854) a leading architect of the late classicism in Vienna. Another object of Nobile is the nearby “Äußeres Burgtor“



(1821-1824), a memorial to the “Battle of the Nations” in Leipzig (1813), part of the “Kaiserforum”, connecting the “Heldenplatz” with the “Ringstraße”.

The Theseustemple is a replica of the antique Theseion in Athens. It was originally built for the statue “Theseus fighting the centaur” by Antonio Canova (1757-1822), which since 1890 has been in the foyer of the Kunsthistorisches Museum Vienna.

Building Material: The columns are made of Mid Miocene (Badenium) “Leithakalk” showing large rhodoliths. These rhodoliths are typical for the quarries of St. Margareten in Burgenland. In contrary to the “Leithakalk” coming from Wöllersdorf (western border of the southern Vienna Basin), this “Leithakalk” comes from the Eisenstadt Basin, a subbasin of the Vienna Basin east of the Leithagebirge, a crystalline ridge, which is part of the southeastern border of the Vienna Basin.

One quarry of St. Margareten, the “Römersteinbruch” (Roman Quarry), has been active as Steinbruch “Hummel” since of the Roman times.



Large rhodoliths are typical for the miocene “Leithakalk” of St. Margareten in Burgenland.

The “Leithakalk” of St. Margareten represents several microfacial types ranging from foraminiferal facies, foraminiferal algal debris facies and foraminiferal rhodolite facies to pavement facies. Generally, foraminifers, echinoids, bryozoans, and coralline algae are the dominant sediment constituents. The pavement facies is developed in layers with rhodoliths up to 10 cm in diameter. Molluscs are represented mainly by oysters - in some layers enriched - and pectinids. The large rhodoliths of the pavement facies are multispecies aggregates, however pre-dominantly built by crustose coralline algae. Foraminifera, bryozoans and serpulids are of subordinate importance. The sandy carbonates can be interpreted as shallow water sands, where, in shallow depressions, an accumulation of rhodoliths (pavement facies) occurred. The laminated marls and marly limestones may be interpreted as deposits in depressions inside a lagoonal environment.

## **Fifth Stop: The Burgtheater and Rathaus**

### **The Burgtheater**

The Burgtheater (1874-1888), the most important theatre in Austria, is the work of the famous architects Gottfried Semper (1803-1879) and Carl von Hasenauer (1833-1894).

Building Material: The light facade looks rather homogenous, but going into details it becomes evident, that this is a mosaic of various stones, like "Leithakalk" from Wöllersdorf or some cretaceous Limestones from Istria with remains of rudists. This situation results from the great need of masses of stones. After the destruction of the fortification many great buildings at the "Ringstraße" were built at the same time.

### **The Rathaus or Vienna City Hall**

The City Hall is one of the most splendid buildings at the "Ringstraße". Designed by Friedrich Schmidt (1825-1891), it was erected between 1872 and 1883. The City Hall was built in gothic style, with a tower similar to gothic cathedrals. Today the City Hall is the head office of Vienna's municipal administration. More than 2000 people work in the building.

Building material: The City Hall is built of about 30 millions of bricks, which are covered with "Leithakalk" coming from different localities such as Wöllersdorf (Vienna Basin), Mannersdorf, Oslip, St. Margarethen and Breitenbrunn (all coming from Eisenstadt Basin), as well as some parts with the "Zogelsdorfer Kalksandstein" from the Lower Miocene (Upper Eggenburgium) of the Molassezone.

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