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Leitha Limestone of eastern Austria
a mineral resource for high quality filler, cement, and dimension stone

This poster supplements the paper: Neogene pure limestones in eastern Austria for multiple applications

Introduction

Providing mining-archives and data collections, and the search for mineral commodities on Austrian territory are among the fundamental tasks of the Department of Mineral Raw Materials at the Geological Survey. Herein research about distribution, availability as well as lithological / geochemical and further characterizations are included and used as contribution to assess mineral raw materials. This poster focuses on a selected lithologic unit and exhibits in general the current mining situation and the applications with regard to these special sedimentary limestones, called Leitha Limestone. Furthermore, their great importance for historic architecture, masonry constructions and sculptures is pointed out.

Geological setting, distribution, lithological and mineral commodity parameter of Leitha Limestone s. l.

Leitha Limestone sequences consist of calcareously cemented and sandy whitish or light brown strata which are characteristically composed of the rock building coralline red algae, forming crusts, discrete particles or rhodoliths, that developed, besides other places, around the eponymous Leitha Mountains. As shown in the geological map of Austria, their connection to the Vienna basin with transitions to the east, and to the Styrian basin is evident. As few decametre thick (Vienna basin: about up to 60 m, Styrian basin: up to 40 m) calcareous strata, they are overlying older clastic sediments or basement rocks. Due to eustatic sea level changes, depositional gaps and intercalations of deeper clayey or coarser terrigenic sediments were developed. Syn- and postsedimentary tectonics in the Alpine Carpathian orogeny caused further disturbances in the sequence. Few volcaniclastic horizons are intercalated in the synchronous successions of the Styrian basin.
According to the Standard Stratigraphy they are roughly between 11 and 16 million years old, which corresponds to the Middle Miocene. Expressed in Central Paratethys Stratigraphy, this stands for the Badenian and Sarmatian stages. Biogenic carbonates composed of corallinacean algae are widespread in the Cenozoic record up to present and need shallow water tropical to temperate environments. Grown coralline algae platforms are known from some Mediterranean and Red Sea coasts for example. In addition, fine sandy-gravelly sediments of unattached algae, bryozoans and mollusc particles, known as maërl, accumulated also on temperate shoals, e.g. of the European Atlantic. Like today, the unique development of algal platforms in the Badenian regarded special conditions, as there are shallow marine shelves, tropical climate and protection against terrestrial influx. The faunal spectrum of Leitha Limestone, besides its coralline algae plants, is likewise spectacular and made up of varying amounts and combinations of small and large foraminifers, bivalve shells and also gastropods, bryozoans, sea urchins, corals, worm tubes, arthropods, and less likely preserved vertebrates. Palaeoecological and palaeogeographical constraints are inferred from the organisms, e.g. water depth (molluscs in shallower, versus bryozoans in deeper water), geographical latitudes from corals, and the existence of sea trenches from similar faunas. The organically bioconstructed coralgal and even coral limestones flourished during the Middle Miocene climatic optimum. In contrast, apart from restricted frameworks of the serpulid worm tubes, the Sarmatian and younger parts, called 'detrital Leitha Limestone', consist mainly of the eroded and redeposited material from the just previously sedimented Badenian strata. Distinctive Sarmatian developments are further oolithic sediments, but they stand separate in lithostratigraphy. The diagenesis of Leitha Limestone lead to overwhelmingly calcitic, porous, either cemented or sandy rocks, with minor skeletal magnesium and with up to a certain content of terrestric material. The original aragonitic parts diminished or were replaced during diagenesis (DULLO, 1983).

Averaged chemistry shows intermediately to highly pure limestones. With regard to the Austrian Law on Mineral Raw Materials they are grouped in the “free for mining mineral raw materials”, which requires a minimum of 95 % calciumcarbonate. Their whiteness properties are variable. The ones of the most whitish occurrences, like those on the southern slopes of the Leitha Mountains, like Müllendorf, do exceed the whiteness of chalk (80 - 86, according to the Mini-Encyclopedia of Papermaking Wet-End Chemistry). Often however, their colour shows a yellowish tint.
Geotechnical parameters for samples from important quarries in the Vienna basin, Leitha Mountains, and Ruster Hills, given by ROHATSCH (2005), span large ranges due to composition and fabric: bulk density from about 1,77 to 2,7 g/cm3, water absorption coefficient from 1,4 to 14 % by mass, uniaxial compressive strength dry about 10 to 100 N/mm2. These data reflect the heterogeneous facies encountered in the different quarries. Sculptors and masons knew by experience how to make appropriate use of the stone varieties: from construction elements with high loading capacity to suitable carving stones.

Applications of Leitha Limestone based on active quarries

Ground calcium carbonate

In no other occurrence does Leitha Limestone appear in comparable quantities in such soft, unconsolidated state. This is reflected in the company's name: **Müllendorfer Kreidefabrik [D]**. Although it is certainly dissimilar from the chalks of northern Europe, its manufactured product was yet the same: chalk. The quarry and factory have been in existence for over 100 years and in the early times, the site was also worked for building stones and an intensive lime production was going on. The quarry area, in which the material is now excavated by rippers, is about 650 m long and 200 m wide, however, partly reclaimed. The product range changed according to demands. The material is nowadays ground, processed and sieved into fractions, which are sold under the brand *TRITON* , the averages of grain size range from 8 to 1,4 µm, and some of them are surface treated. The coarsest grade *TRITON 80*, with 96,5 % carbonaceous content (cc) and Ry 86 whiteness, is suitable for paints, plaster, ceramics and fertilizers. The finest grade *TRITON 10T* with 98,5 % cc and Ry 88 is used in the rubber, paint and plastic industries. Very recently, geological investigations (WIEDL, et. al., in press 2013, cum lit.) compiled sequences of 12 m up to 37 m thicknesses, and set up the bio- and lithostratigraphic record. Accordingly, this deposit belongs to the Middle Badenian and testifies the northern margin of the coral reef belt of that time. This quarry is situated only 2 km northwest of the Badenian facies stratotype for Leitha Limestone, set up at Fenk Quarry of Großhöflein, which was quarried for lime burning.

Cement

Both large surface mines for cement production, which are based on Leitha Limestone, are owned by Lafarge company. Likewise, the former owner of both were the Perlmooser Zementwerke AG, and both commenced at the end of the 19th century. The history of the place **Mannersdorf [C]**, situated near the north-west slopes of the Leitha Mountains, has been intrinsically connected to stone manufacturing. Building and ornamental stone were delivered to Vienna notably in the 15th century for St. Stephen's Cathedral. A benchmark in industrial history constituted the lime kiln of Baxa, which was in use from 1893 to 1972, and which is now reclaimed as museum. In the main museum of Mannersdorf, the department for working of Leitha Limestone is unique.
The whole quarry area stretches roughly over one km2, of which 80 % comprises reclaimed area. The active part is still about 880 m long and 250 m wide. Quarry operation is carried out with drilling and blasting. The material is carried to the plant via conveyor belt and truck. The clay component is derived from a nearby clay pit as well as from recycled bricks. Various cement types are produced (product data sheets are online). According to geological investigations by WIEDL et al. (2012), the 80 m thick assembled sequence has the same age as the one in Müllendorf quarry. However, the palaeoenvironment here was partly deeper and more changeable due to tectonic faulting, which created slightly different corallinacean limestones, often with molluscs and rhodoliths, but without corals.
A further Leitha Limestone deposit, which serves the other cement plant, is located in the Styrian basin and developed on the Middle Styrian Swell. The nearby cement plant is located in **Retznei [F]**. Both cement plants, Retznei and Mannersdorf, are linked together by railway, which favours rationalization through exchanged alternative fuels, additives, etc. The production of lime and cement started in the middle of the 19th century, but with further industrialization and takeover of Perlmooser, only the cement production was expanded. A quarry sequel reshaped a huge area, from where the crushed limestone and marl has been transported by belt conveyors.The older western part covered about 1/3 km2, the eastern, still active part, about a third of the preceding area. The Leitha Limestone succession reveals more marl intercalations, a different composition, in which abundant coral patch reefs and larger rhodoliths occur, less and more variable thicknesses with facies transitions to siliciclastic near and off-shore environments (REUTER et al., 2012, cum lit.). Above all, in the Styrian Basin the Leitha Limestone development ceased in the Middle Badenian and was formalized in lithostratigraphic terms as part of the Weissenegg Formation (FRIEBE, 1990). About 800 m further to the northwest, the famous subsurface dimension stone quarry of Aflenz is located within the same carbonate platform. A second cement raw material base was established in the 70ties in the Leitha Limestone platform of Wildon in a quarry near **Weissenegg [E]**, about 20 km to the NNW, from where similar, partly marly limestones are carried by trucks to Retznei.

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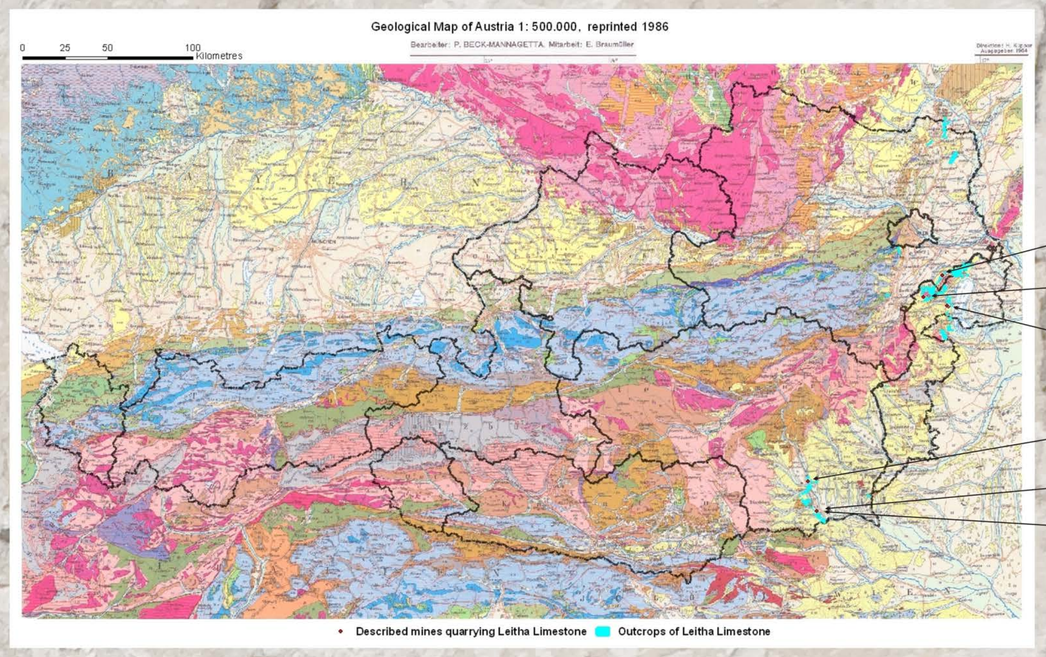


A Römersteinbruch St. Margarethen


B Römerbruch Aflenz


C Mannersdorf am Leithagebirge


D Müllendorf


E Weissenegg bei Wildon


F Retznei Rosenberg

Building and ornamental stone

Leitha Limestone has always been an esteemed building and sculpture stone and was widely used and distributed. It shaped the image of the villages in the nearby countries, and is the prominent stone of Vienna, Graz, the neighbouring parts of Hungary, Slovakia, Czech Republic, etc., according to its favoured use in certain periods (Gothic, Baroque, Ringstrasse era 1857 - 1914). It was evidently substituted with time, yet serves for prestige buildings up to present. It was exploited in certain quarry districts, of which each experienced its individual history. Apart from the following exceptions, the sites are abundant or reclaimed.
Gustav Hummel Company produces the St. Margarethener detrital limestone from **Römersteinbruch St. Margarethen [A]**. Here, the Leitha Limestone comprises at least a thickness of thirty metres, is of Middle to Upper Badenian age, and has a characteristically porous, light brown, stratified appearance, made up predominantly of well sorted algae detritus and sometimes intercalated layers of rhodoliths. It is a famous geological and biological excursion point. Examples of where this stone was used in Vienna are: St. Stephen's Cathedral and Maria am Gestade (restoration works), New Main Hall, National Bank of Austria, Dominikaner, Franziskaner, St. Othmar and other churches, parts of Schönbrunn Castle with park sculptures and buildings, Wiener Musikverein, Palace of Justice, and the new facades of Western Station. Fifty percent from the current production is dedicated to restoration works. A part of the large quarry area is reclaimed as scenery for open air theatre, and an on-site symposium on sculpture attracted high notice.
The underground quarry, **Römerbruch Aflenz [B]**, already mentioned with Retznei, is known since Roman Times. Intensive mining occurred during the Middle Ages and Ringstrasse era, but ceased in the 20th century. It is operated periodically by Stein von Grein Company. The underground chambers are also used for a variety of public events. During 2nd World War it formed a part of concentration camps in housing a war factory.
The underground quarry extends over a length of 300 m and a width of 200 m, with heights of between 6 and 8 m (although the limestone horizon is 40 m thick). It has been almost completely excavated, with only large pillars remaining to maintain the stability of the workings. This Leitha Limestone variety consists of a light beige foraminifer-algal-debris facies, is but loosely cemented, very porous, and easily worked in moist state. Examples from building-elements are numerous, especially in Graz (cathedral and other churches, castle and clock tower, opera house, universities), but also from restoration works (St. Stephan's Cathedral in Vienna).

Future research

Quarries provide valuable outcrops for studying the various sequences according to facies relationships and other characteristics. One of the nearer targets is the compilation of former geological studies in updated terms of sequnce stratigraphy for local and regional comparisons accompanied by facies studies. A further target is the establishment of facies types of Leitha Limestone s. l. fitted into time and space, within given limits of facies varieties. This was put forward by previous scientists, like A. KIESLINGER, but should be updated. It will be aimed not only at identifying the stones of historic and antique objects but moreover, if possible, at locating their provenance. Essential quarry areas for restoration purposes could then be identified, and the cultural aspects of this stone highlighted.

Large rhodoliths forming a pavement layer in Leitha Limestone (from Aflenz area), seen in an ashlar at the entrance gateway of Technical University Graz.