

Schwarzensee

Schwarzenseer Marmor

Schwarzensee Rot

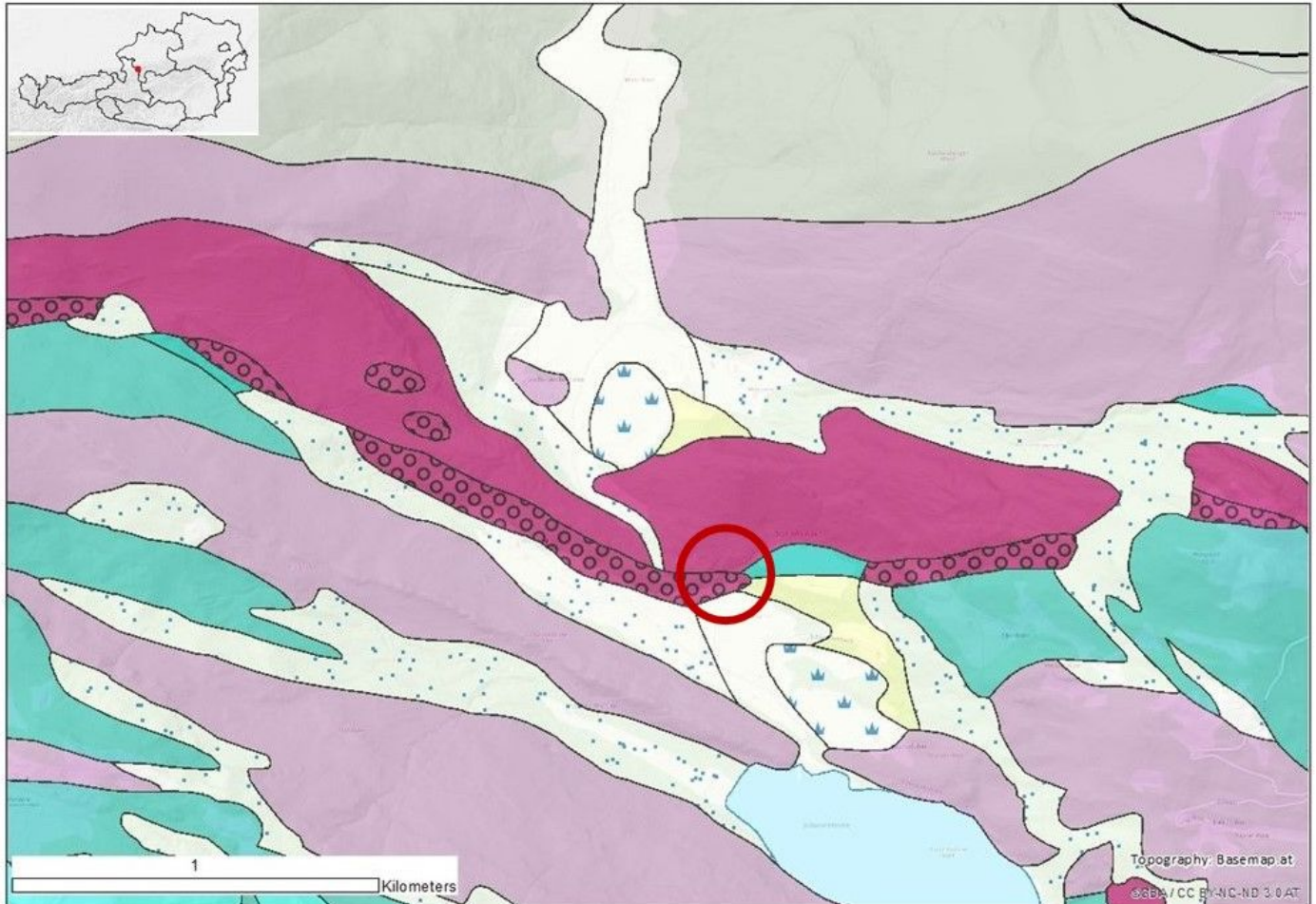


2m

Short description: The rock known under the name of Schwarzenseer Marble (earlier Straubinger Marble) is actually a heavily crushed breccia of different coloured uppermost Triassic to Lower Jurassic limestones. The components of this breccia consist of brick-red to yellowish-white, sometimes also grey, greenish-grey or pale olive-ochre coloured limestones, often interspersed with white calcite veins and rare dark stained iron and manganese oxide crusts. The lively colour change and the unusual ornamentation are characteristic. In some areas there is a high fossil content (crinoids, brachiopods, ammonites, foraminifera, ostracods, bivalves, gastropods). The photo shows a section of the quarry wall measuring about 4x4 m.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Commercial Limestone	Limestone (breccia)	Red	Austria	Gmunden / Oberösterreich (Upper Austria)	St. Wolfgang im Salzkammergut	Schwarzensee

Geological setting



Geology: The Schwarzenseer Marble only occurs in a narrowly defined area north of the Schwarzensee in the Upper Austrian Salzkammergut. The formation of this sedimentary, in-situ Lower Jurassic calcareous breccia is interpreted as a multiphase event - the main phase of breccia formation had occurred contemporaneously with or immediately after sediment deposition. A second, later phase resulted in the fracturing of the already consolidated, brecciated overall sequence. The components of the breccia consist of colourful limestones of the Jurassic respectively the Upper Triassic.

Production: The quarrying of the Schwarzenseer Marble is limited to a small quarry north of the Schwarzensee (red circle). In the immediate vicinity, there are some other small, abandoned quarries. The material is currently only extracted periodically and is obtained as gently as possible using diamond wire technology. The extraction of blocks of 3-5 m³ is possible.

Geological age: Lower Jurassic

Geological unit: Breccia (Schwarzenseemarmor) /bunte Unterjura Kalke: Adnet, Enzesfeld and Hierlatz Limestone
(URI: <http://resource.geolba.ac.at/GeologicUnit/421>; <http://resource.geolba.ac.at/GeologicUnit/505>;
<http://resource.geolba.ac.at/GeologicUnit/587>)

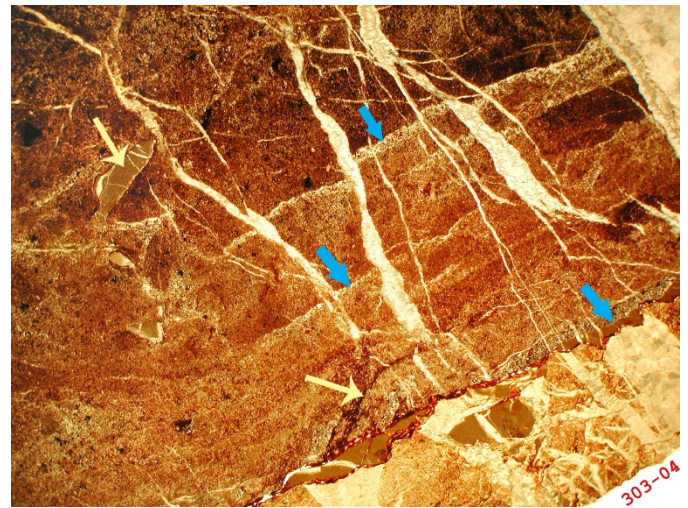
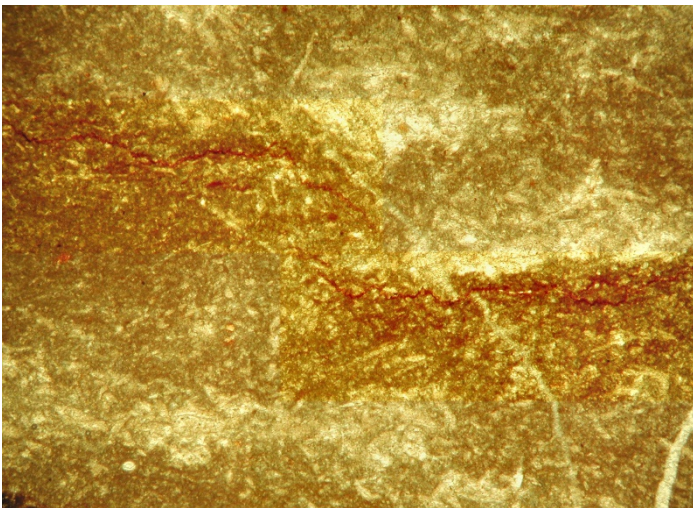
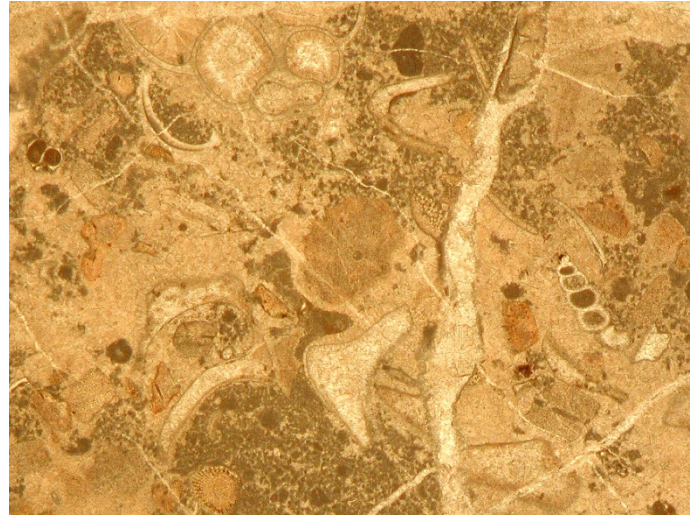
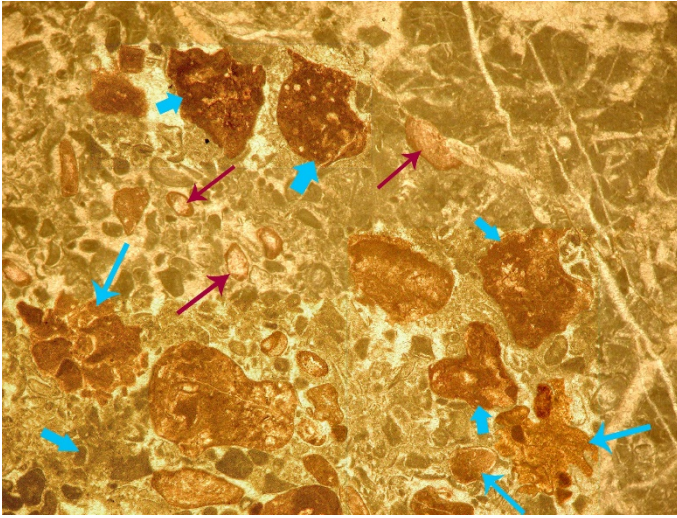
Application, use and heritage

Description: Due to its vivid and unique colouring, Schwarzenzeer Marble was used at an early stage as a decorative stone. The stone was very popular during the Baroque period (St. Florian Abbey, Mondsee Monastery, Irrsdorf Parish Church, St. Wolfgang Parish Church). Another phase of intensive use took place in the second half of the 20th century (restoration of the Vienna Burgtheater, Linz General Hospital, church in Pfandl, churches in Vienna like Antonskirche). Currently, the stone is used almost exclusively for interior applications (floor slabs, columns, balustrades, door frames, chimney linings). It is also increasingly used for restorations.



Description: Famous examples for the uniqueness of this ornamental stone are the floor and the balusters in the foyer of the Burgtheater in Vienna, where two different types of this stone are seen. The more grey-green breccia (more contribution of Oberrhät Limestone) and the vivid vermilion breccia (dominated by the components of Lower Jurassic limestone) which is the most typical. The stone was used here for the renewal of the Burgtheater after the Second World War.

Petrography



Description: Illustration of components and evolution of the breccia:

Upper left: up to 2.3 m³ big breccia clasts of former lithified shallow marine uppermost triassic limestone, here with micritized foraminifera-ooids (red arrows) and aggregate grains (blue arrows). Upper right: Hierlatzkalk, represented here by crinoidal biomicrite with gastropods and thick radial fibrous cements, occurs either as clasts or as fissure fills. Lower left: vermillion spiculitic calcilutite of deepened environment. Lower right: highly condensed calcilutite with dark brown to black staining through iron and manganese oxides; sedimentation gaps (blue arrows), and disruptions by ongoing tectonic movements (yellow arrows) forming the uppermost thin part of the succession that ended in the final brecciation process.

Source of information: Geological Survey of Austria (GBA)

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Mineral 1 (%)	Mineral 2 (%)	Mineral 3 (%)	Mineral 4 (%)	Mineral 5 (%)	Mineral 6 (%)	Mineral 7 (%)
Mineral 8 (%)	Mineral n (%)					

Source of information:

Physical properties

Apparent density (EN 1936) kg/m ³	Open porosity (EN 1936) % vol	Water absorption at atmospheric pressure (EN 13755) % wt	Uniaxial Compressive strength (EN 1926) MPa	Flexural strength under concentrated load (EN 12372) MPa

Real density (EN 1936) kg/m ³	Total porosity (EN 1936) % vol	Water absorption coefficient by capillary (EN 1925) (g/m ² x s ^{0,5})	Flexural strength under constant moment (EN 13161) MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -) %	Change in open porosity (increase: +; decrease: -) %	Change in ultrasound pulse velocity (increase: +; decrease: -) %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			Resistance to salt crystallisation (EN 12370)	Breaking load at dowel hole (EN 13364)	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm ³ / 50cm ²	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			Rupture energy (EN 14158), Joule	Thermal Conductivity (EN 1745), W/m·K
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		

Source of information:

Chemical properties

Main elements

SiO ₂ (%)	Al ₂ O ₃ (%)	Fe ₂ O ₃ (%)	TiO ₂ (%)	MgO (%)	CaO (%)	Na ₂ O (%)	K ₂ O (%)	MnO (%)	P ₂ O ₅ (%)	SO ₃ (%)	LOI (%)
1,0	0,89	0,18	0,03	0,77	53,7	<0,10	0,08	0,05	<0,01	0,08	43,3

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
< 10	< 5		3	8	4	18	
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
188		20	4		5		
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
	10					4	
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
							1
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information: the sample originates from a mixed type rich in calcite fissures, consisting mainly of micritic hierlatz limestone and red, spiculitic calclutit; method of analysis: energy dispersive X-ray fluorescence analysis (Geological Survey of Austria)

Sources of more information

Type of information	Name of provider	URL
This data sheet	Geological Survey of Austria (GBA)	https://www.geologie.ac.at
Non-commercial directory		
Commercial directory		
Scientific publication		
Other publication		

Van Husen, D. & Egger, H. mit Beiträgen von Ahl, A., Braunstingl, R., Draxler, I., Heinrich, M., Hofmann, Th., Hradecka, L., Lobitzer, H., Moshhammer, B., Pavuza, R., Plöchinger, B., Rupp, Ch., Schedl, A., Schubert, G., Siblik, M., Slapansky, P., Sperl, H., Svabenicka, L., Svobodova, M & Szente, I. (2014): Erläuterungen zur Geologischen Karte der Republik Österreich 1:50.000 Blatt 65 Mondsee.- 143 S., 30 Abb., 4 Tab., 7 Taf., Geologische Bundesanstalt, Wien.

Moshhammer, B. (2003): Die Verwendung von Kalkstein der Obertrias und des Jura im Salzkammergut.- In: Beiträge zur Geologie des Salzkammerguts. Begleitband zur Tagung Erde-Mensch-Kultur-Umwelt 28-32. August 2003, Gmunden, Österreich, S. 297-309, 4 Abb., Gmunden.

Moshhammer, B. & Leuprecht, M. (2005): Zur Stratigraphie, Fazies und Geochemie des Schwarzenzeemarmors (Lias, Schafberg-Tirolikum, Oberösterreich).- S. 79-106, 1 Abb., 1 Tab., 9 Taf., Jahrbuch der Geologischen Bundesanstalt, 145/1, Wien.

Picture of stone surfaces: Source: Taf.7/Fig.1 from: Moshhammer, B. & Leuprecht, M. (2005): Zur Stratigraphie, Fazies und Geochemie des Schwarzenzeemarmors (Lias, Schafberg-Tirolikum, Oberösterreich).- Jahrbuch der Geologischen Bundesanstalt, 145/1, Wien.

Geological map: Van Husen, D. (1989): Geologische Karte der Republik Österreich 1:50.000 Blatt 65 Mondsee.- 1 Bl., Geologische Bundesanstalt, Wien.

Topographic map: Basemap.at (<https://basemap.at>)

Compiled by:	Geological Survey of Austria (GBA) https://www.geologie.ac.at	 Geologische Bundesanstalt
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