

# The Paleozoic Era(them)

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## Grauwackenzone / Greywacke Zone

The Greywacke Zone (GWZ) in the Eastern Alps is part of the Upper Austroalpine Nappe System (TOLLMANN, 1977; SCHMID et al., 2004). It is subdivided into the Western Greywacke Zone (W-GWZ) in Tyrol and Salzburg and the Eastern Greywacke Zone (E-GWZ) extending from North-western Styria to areas around Gloggnitz in Lower Austria in the East. In addition to Alpine thrust tectonics the GWZ includes Variscan nappe structures. In total, the stratigraphic sequences cover Middle Ordovician to Moskovian (Westfalian) ages. The very low to low grade metamorphic overprint is of Alpine Cretaceous age (COLINS et al., 1980; RANTITSCH et al., 2004; RANTITSCH & JUDIK, 2009).

Major parts of the GWZ (W-GWZ and Noric Nappe of E-GWZ) belonged to the Noric Composite Terrane (FRISCH & NEUBAUER, 1989). This was part of the Paleozoic European Hun Terranes which have been separated from Gondwana during early Paleozoic times and accreted after a mid-Paleozoic drift stage during the early Carboniferous Variscan orogeny at the European continental margin

(FRISCH & NEUBAUER, 1989; NEUBAUER et al., 1998; STAMPFLI, 2001; RAUMER et al., 2003; EBNER et al., 2007, 2008). Contrarily, the Carboniferous of the Veitsch Nappe in the E-GWZ was formed in a marine molasse like foredeep in front of the already formed internal Variscan Median Crystalline Zone (FLÜGEL, 1977, 1990). Therefore, the Carboniferous of the Veitsch Nappe avoids any Variscan tectonic deformation and metamorphism (RATSCHBACHER, 1984, 1987; EBNER et al., 2008).

In the ASC 2004 (PILLER et al., 2004) the column of the GWZ is subdivided from left to the right into the W-GWZ and the E-GWZ. Previous summaries on the stratigraphy of the GWZ or major parts of it are published in FLÜGEL (1964, 1970), FLÜGEL & SCHÖNLAUB (1972a), TOLLMANN (1977), SCHÖNLAUB (1979, 1980a), EBNER et al. (1989, 1991), KRAINER (1993a), and SCHÖNLAUB & HEINISCH (1993). Due to some errors in the ASC 2004 a new conceptual base for the lithostratigraphic arrangement of the Western and Eastern Greywacke Zone is provided in Text-Fig. 2.

### W-Grauwackenzone / Western Greywacke Zone (W-GWZ)

The stratigraphic frame documented in the ASC 2004 (PILLER et al., 2004) was established mainly by the working group around H. MOSTLER (University of Innsbruck) in the early 1960s–1970s and by the group of H. HEINISCH (University of Munich) in the Kitzbühel – Saalbach area during the 1980s. MOSTLER (1973) recognized Variscan thrust tectonics resulting in four nappes (Alpbach, Hohe Salve, Jochberg and Langeck unit). The group of HEINISCH elaborated two distinct Paleozoic facies realms, presently occurring in two Alpine nappes (Wildseeloder and Glemmtal unit) separated by a cataclastic shear/thrust zone (Hochhörndler Schuppenzone; Silurian dolomite) (HEINISCH, 1988; SCHÖNLAUB & HEINISCH, 1993). However, the paleogeographic relationship of these two facies realms is not known although they occur presently in a relatively narrow area W of Zell am See (HEINISCH, 1986, 1988; HEINISCH et al., 1988; SCHLAEGEL-BLAUT, 1990). The sequence of the Wildseeloder Unit starts with thick Late Ordovician porphyroids followed after an early Silurian erosional gap by pelagic and shallow water carbonate environments up to the early Famennian. The Glemmtal Unit is dominated by siliciclastics which include thin layers of porphyroid materials, a late Silurian–Early Devonian basinal carbonate/lydite environment and a thick Devonian basic magmatic complex (HEINISCH, 1988; SCHLAEGEL-BLAUT, 1990; SCHÖNLAUB & HEINISCH, 1993). The lithostratigraphic subdivisions in the ASC 2004 (PILLER et al., 2004) are mostly informal working terms which correspond with the units/terms used by SCHÖNLAUB (1979: Tab. 3).

#### *Siliciclastic facies (partim Glemmtal Unit in the Kitzbüheler Alpen)*

#### **Wildschönauer-Schiefer / Wildschönau Schists**

FRITZ EBNER

**Validity:** Invalid; lithostratigraphic unit used since CATHREIN (1877) in terms of a formation but not formalized. Well characterized by MOSTLER (1968).

**Type area:** W-GWZ; around Wildschönau (N 47°25'28" / E 12°02'35"), ÖK50-UTM, map sheet 3213 Kufstein (ÖK50-BMN, map sheet 120 Wörgl).

**Type section:** Not selected.

**Reference section(s):** -

**Derivation of name:** After the area of Wildschönau, ÖK50-UTM, map sheet 3213 Kufstein (ÖK50-BMN, map sheet 120 Wörgl).

**Synonyms:** "Untere Grauwackenschiefer" (OHNESORGE, 1909); "Tiefere Wildschönauer Schiefer" (MOSTLER, 1968); "Pinzgauer Phyllit" (MOSTLER, 1968; BAUER et al., 1969); "Wildschönauer Schichten" (FLÜGEL, 1970).

**Lithology:** Monotonous sequence of light grey argillaceous and silty schists, and sandstones. The existence of extended Ordovician basaltic metavolcanics as suggested by MOSTLER (1968, 1984) is difficult to decide due to the lack of fossils and the severe Alpine tectonics (HEINISCH, 1986; SCHÖNLAUB & HEINISCH, 1993). Nevertheless pebbles of greenstones within the level of the "geröllführende Porphyroide" are a hint to Ordovician basic volcanics (MOSTLER, 1968).

**Fossils:** Acritarchs (REITZ & HÖLL, 1989, 1991).

**Origin, facies:** Basinal clastic environment.

**Chronostratigraphic age:** Ordovician (pre-Hirnantian).

**Biostratigraphy:** In parts of the unit Tremadocian to Dapingian acritarchs (REITZ & HÖLL, 1989, 1991) were recorded.

**Thickness:** Due to the heavy tectonics an estimation of the thickness is difficult. A thickness around 1,000 m seems realistic (MOSTLER, 1968).

**Lithostratigraphically higher rank unit:** -

**Lithostratigraphic subdivision:** -

**Underlying unit(s):** Primary basement unknown.

**Overlying unit(s):** Blasseneck Porphyry.

**Lateral unit(s):** -

**Geographic distribution:** W-GWZ; Tyrol, Salzburg; Kitzbüheler Alpen, Dientener Berge, N Pongau.

**Remarks:** MOSTLER (1968) subdivided the Wildschönau Schists by the intercalation of the Blasseneck Porphyry into Lower and Upper Wildschönau Schists. In the ASC 2004 the Wildschönau Schists represent only the Lower Wildschönau Schists. Due to the lack of detailed mapping and biostratigraphy the Wildschönau Schists of the Tyrolian Wildschönau – Kitzbühel area cannot be linked easily with the siliciclastics around Saalbach – Zell am Zee (Salzburg) where HEINISCH (1986) differentiated several Silurian/Devonian formations (Löhnersbach, Schattberg and Klinglerkar Formations) in domains previously assigned to Wildschönau Schists. W of Zell am See they are part of the Glemmtal Unit (HEINISCH, 1986).

**Complementary references:** OHNESORGE (1905), MOSTLER (1970), TOLLMANN (1977), SCHÖNLAUB (1979, 1980a), HEINISCH (1988), HEINISCH et al. (1987), SCHLAEGEL (1988), EBNER et al. (1989).

### **Blasseneck Porphyroid / Blasseneck Porphyry**

(description see E-GWZ)

### **Löhnersbach-Formation / Löhnersbach Formation**

FRITZ EBNER

**Validity:** Valid; formal description by HEINISCH et al. (1987).

**Type area:** ÖK50-UTM, map sheet 3221 Zell am See (ÖK50-BMN, map sheet 123 Zell am See).

**Type section:** Southern parts of the Löhnersbachtal, W of Zell am See, NE of Klingler Törl (N 47°19'45" / E 12°37'17"); ÖK50-UTM, map sheet 3221 Zell am See (ÖK50-BMN, map sheet 123 Zell am See) (HEINISCH et al., 1987).

**Reference section(s):** -

**Derivation of name:** After the Löhnersbach valley in the Kitzbüheler Alpen ca. 11 km WNW of Zell am See (ÖK50-UTM, map sheet 3221 Zell am See; ÖK50-BMN, map sheet 123 Zell am See).

**Synonyms:** Partim the "Höhere Wildschönauer Schiefer" (MOSTLER, 1968).

**Lithology:** Alternation of phyllites, metasiltstones and metasandstones. Within this sequence the average content of metasandstones is ~50 %. Wide areas are dominated by thin-bedded metasiltstones. Turbidite Bouma sequences are differently complete (HEINISCH, 1986).

**Fossils:** -

**Origin, facies:** Basinal distal turbidite facies (distal channel facies of deep sea fans; HEINISCH et al., 1987).

**Chronostratigraphic age:** Lower Silurian–Emsian (HEINISCH et al., 1987).

**Biostratigraphy:** -

**Thickness:** Max. 1,300 m (HEINISCH, 1988).

**Lithostratigraphically higher rank unit:** Wildschönau Group (sensu SCHÖNLAUB & HEINISCH, 1993).

**Lithostratigraphic subdivision:** -

**Underlying unit(s):** Uppermost Ordovician–lower Silurian epiclastic porphyroid materials interpreted as equivalents or reworked parts of the Blasseneck Porphyry (HEINISCH & SCHÖNLAUB, 1993).

**Overlying unit(s):** Klinglerkar Formation (HEINISCH, 1988) and the Metabasite Group (HEINISCH, 1988; SCHLAEGEL-BLAUT, 1990; HEINISCH et al., 1995, 2003).

**Lateral unit(s):** In upper parts lower parts of the Klinglerkar Formation (SCHLAEGEL-BLAUT, 1990; HEINISCH, 1988).

**Geographic distribution:** W-GWZ; Tyrol, Salzburg, Kitzbüheler Alpen.

**Remarks:** This lithostratigraphic unit was proposed as a formation because MOSTLER's (1968) subdivision in Lower and Upper Wildschönau Shales is not applicable for the siliciclastic domains (Glemmtal Unit sensu HEINISCH, 1988) W of Zell am See (HEINISCH et al., 1987).

**Complementary references:** EBNER et al. (1989, 2008), SCHÖNLAUB & HEINISCH (1993).

### **Dienten-Schiefer / Dienten Schists**

FRITZ EBNER

**Validity:** Invalid; used for a long time in terms of a formation but not formalized.

**Type area:** Dientener Berge (ÖK50-UTM, map sheet 3221 Zell am See; ÖK50-BMN, map sheet 124 Saalfelden; ÖK50-UTM, map sheet 3222 St. Johann im Pongau; ÖK50-BMN, map sheet 125 Bischofshofen).

**Type section:** No type section is specified in the literature.

**Reference section(s):** -

Remarks: First descriptions (AIGNER, 1931; MOSTLER, 1966a) are related to the Lachtal-Grundalm SW Fieberbrunn (ÖK50-UTM, map sheet 3214 Kitzbühel; ÖK50-BMN, map sheet 122 Kitzbühel) and to the magnesite mine at Entachenalm (ÖK50-UTM, map sheet 3221 Zell am See; ÖK50-BMN, map sheet 124 Saalfelden) (FRIEDRICH & PELTZMANN, 1937).

**Derivation of name:** After the village of Dienten (N 47°23'04" / E 13°00'15"); ÖK50-UTM, map sheet 3221 Zell am See (ÖK50-BMN, map sheet 124 Saalfelden).

**Synonyms:** "Dientener Schiefer", partim: "Höhere Wildschönauer Schiefer" (MOSTLER, 1968; TOLLMANN, 1977).

**Lithology:** Black, aluminian and siliceous schists and lydite with some intercalations of bituminous limestone. Typical black Dienten Schists develop by the increase of black organic matter from light grey and much more sandy phyllite (Pinzgauer Phyllit = equivalent of the Wildschönau Schists; MOSTLER, 1968).

**Fossils:** Entachenalm and Lachtal-Grundalm: graptolites (HAIDEN, 1936; FRIEDRICH & PELTZMANN, 1937; JAEGER, 1978). Nagelschmidpalven/Dienten: bivalves, nautiloids (HAUER, 1847; STACHE, 1879; HERITSCH, 1929).

**Origin, facies:** Partly euxinic basin.

**Chronostratigraphic age:** Llandovery–middle Ludlow.

**Biostratigraphy:** Graptolite zones 27–29, 33 and 34/35 (JAEGER, 1978).

**Thickness:** Up to 200 m.

**Lithostratigraphically higher rank unit:** -

**Lithostratigraphic subdivision:** -

**Underlying unit(s):** Conglomerates.

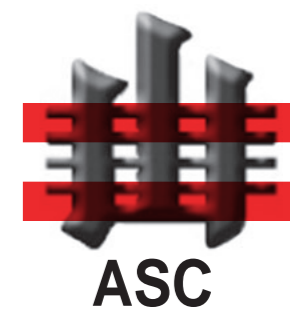
**Overlying unit(s):** Dolomite Lydite Group (MOSTLER, 1968; SCHÖNLAUB, 1979, 1980a).



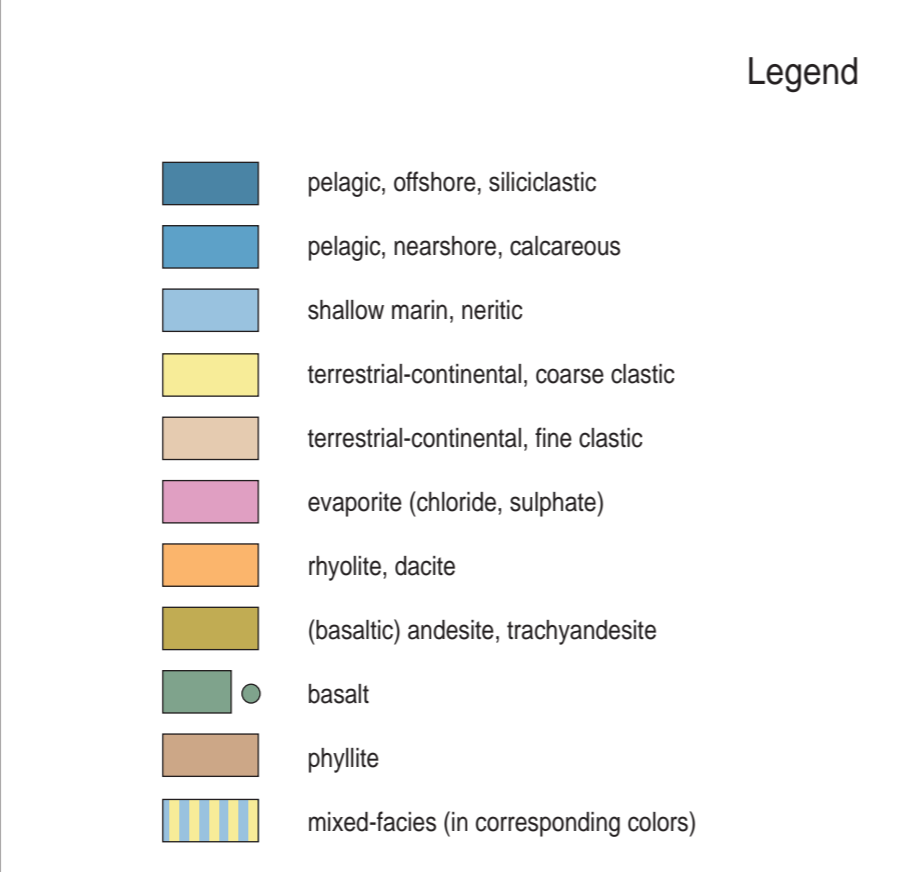
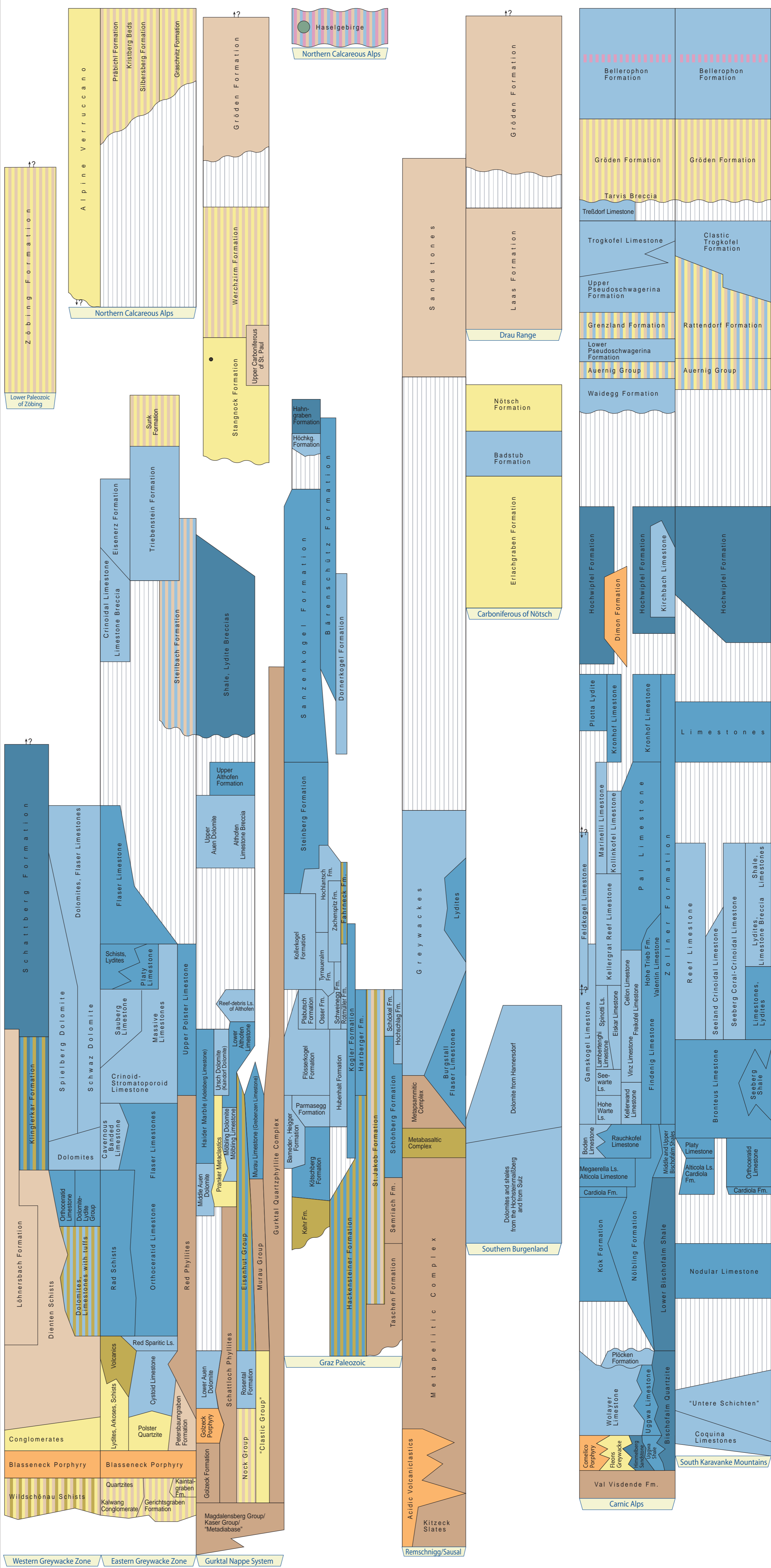
# Austrian Stratigraphic Chart 2004 - Paleozoic

(sedimentary successions)

Austrian Stratigraphic Commission



ERA	SYSTEM / PERIOD / SERIES / EPOCH	STAGE / AGE	DURATION Ma	Global Classification					
				ERATHM / ERA	SYSTEM / PERIOD / SERIES / EPOCH				
PALEOZOIC	PERMIAN	CHANGHSINGIAN / Dorashanian	251	PERMIAN	MID PERMIAN / GUADALUPIAN / LOPINGIAN				
		WUCHIAPINGIAN / Dufuflian	255						
		CAPITANIAN	260						
		WORDIAN	265						
		ROADIAN	270						
		PERMIAN	LOWER PERMIAN / CISURALIAN			KUNGURIAN	275		
						ARTINSKIAN	280		
						SAKMARIAN	285		
						ASSELIAN	290		
		PERMIAN	TRIAS			GZHELIAN	295	TRIAS	U. CARBONIFEROUS / PENNSYLVANIAN
KASIMOVIAN	300								
MOSKOVIAN	305								
BASHKIRIAN	310								
TRIAS	LOWER CARBONIFEROUS / MISSISSIPPIAN			SERPUKHOVIAN	315				
				VISEAN	320				
				TOURNAISIAN	325				
PERMIAN	DEVONIAN			FAMENNIAN	350	DEVONIAN	UPPER DEVONIAN		
				FRASNIAN	355				
				GIVETIAN	360				
		EIFELIAN	365						
		DEVONIAN	MIDDLE DEVONIAN	EMSIAN	370				
				LOCHKOVIAN	375				
				PRAGIAN	380				
		PERMIAN	DEVONIAN	Zlichovian	385			DEVONIAN	LOWER DEVONIAN
				Dalejian	390				
				WEN-LUD-LOCKLOW	395				
HOMERIAN	400								
SHEINWOOD	405								
DEVONIAN	LOWER DEVONIAN			TELYCHIAN	410				
				AERONIAN	415				
				RHUDDANIAN	420				
PERMIAN	DEVONIAN			HIRNANTIAN	425	DEVONIAN	UPPER ORDOVICIAN		
				LLANDOVERY	430				
		WEN-LUD-LOCKLOW	435						
		LUDFORDIAN	440						
		GORSTIAN	445						
		DEVONIAN	UPPER ORDOVICIAN	DARRIWILIAN	450				
				MIDDLE ORDOVICIAN	455				
				LOWER ORDOVICIAN	460				
		PERMIAN	CAMBRIAN	TREMA-DOCIAN	465			CAMBRIAN	UPPER CAMBRIAN
				PAIBIAN	470				
CAMBRIAN	MIDDLE CAMBRIAN			475					
				480					
				485					
CAMBRIAN	LOWER CAMBRIAN			490					
				495					
				500					
PALEOZOIC	CAMBRIAN			505	CAMBRIAN	LOWER CAMBRIAN			
				510					
		515							
		520							
		525							
		530							
		535							
		540							
		542							



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Cutout and English adaptation of the "Die Stratigraphische Tabelle von Österreich 2004": Geological Survey of Austria

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