

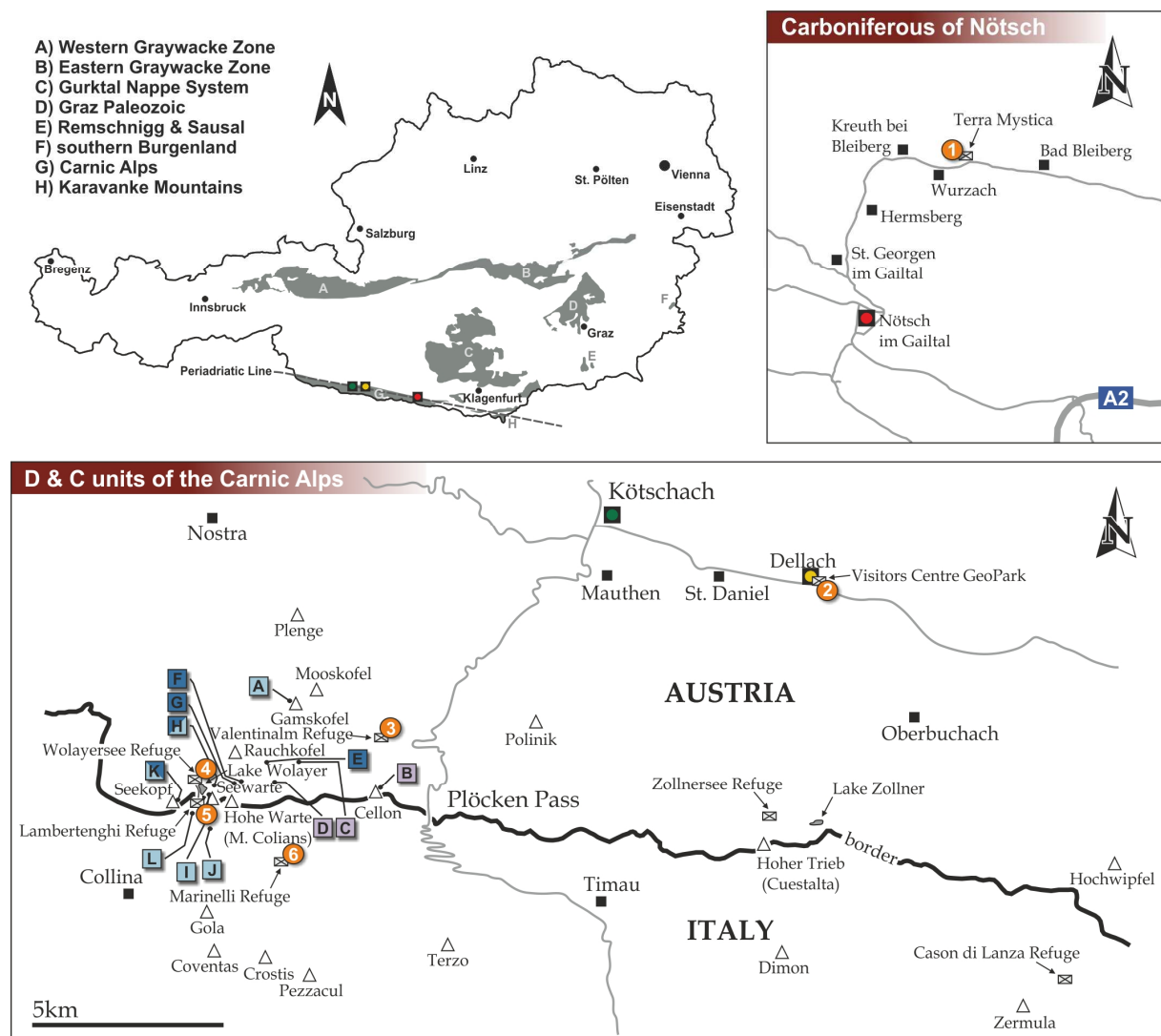
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Devonian and Carboniferous of the Carnic Alps

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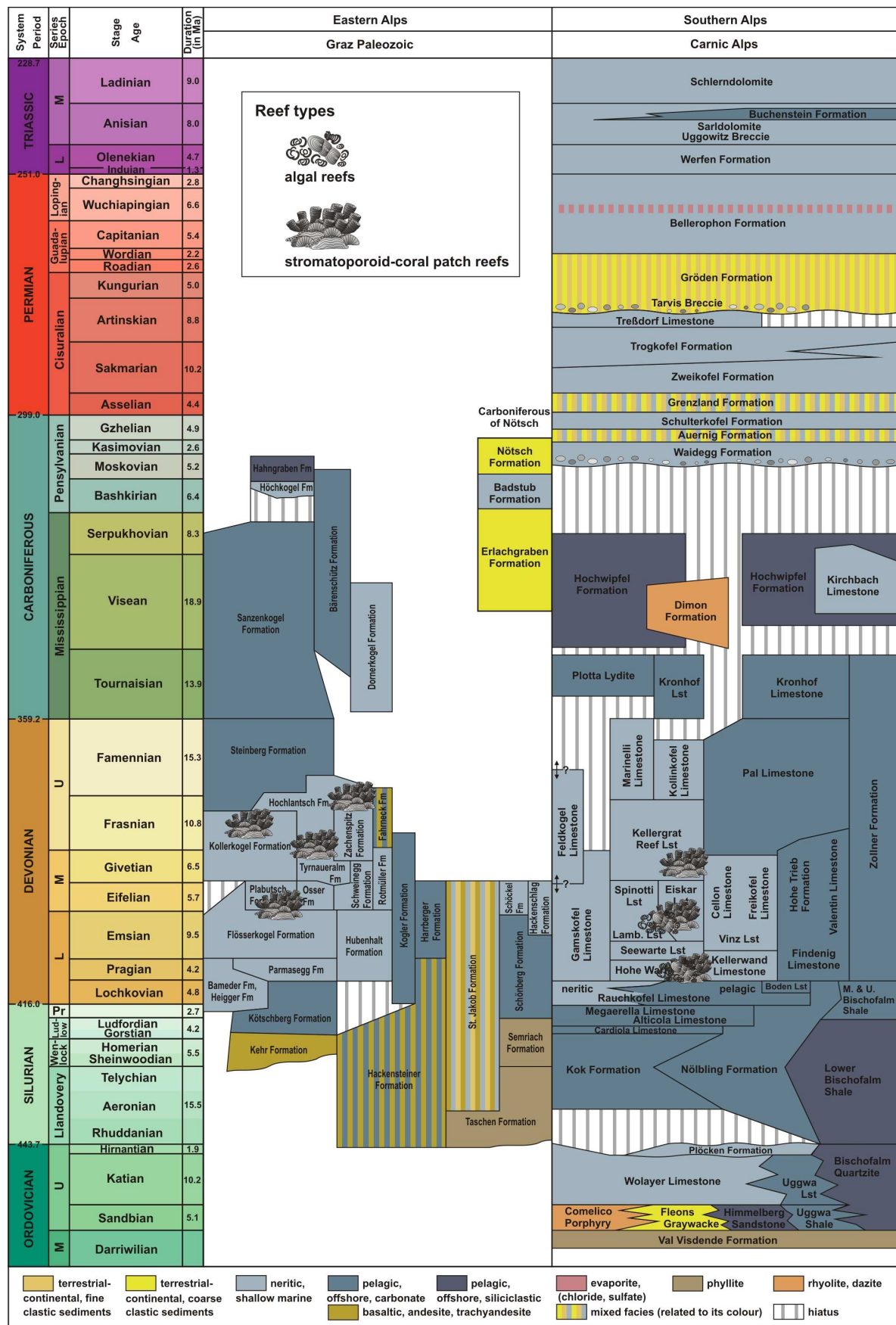
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Within the frame of the IGCP 596 field-workshop, Devonian and Carboniferous outcrops mainly of the southalpine sequence of the Carnic Alps will be discussed in field. The following figures and shortcuts of lithostratigraphic units shall provide an overview for a better understanding of the regional geological settings. Apart from this the most important key sections of the central Carnic Alps are compiled under *Geological Highlights*.



Locality maps of Devonian & Carboniferous units of the Carnic Alps north (Carboniferous of Nötsch, upper right map) and south (central Carnic Alps, lower map) of the Periadriatic Line.

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Lithostratigraphic units of the Graz Paleozoic & the Carnic Alps (Austrian Stratigraphic Chart, 2004).

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Devonian & Carboniferous units of the Carnic Alps

Short characterisation of Devonian and Carboniferous units of the Carnic Alps deposited south of the Periadriatic Line. This summary mainly follows PÖLSLER (1969a, b), KRAINER (1992), SCHÖNLAUB *et al.* (1980), SCHÖNLAUB (1985a), KREUTZER (1992a, b), HUBMANN *et al.* (2003), SCHÖNLAUB *et al.* (2004) and FORKE *et al.* (2006), where further details on the single units are provided.

DEVONIAN SEQUENCE

NORTHERN SHALLOW WATER FACIES (FELDKOGEL NAPPE)

Feldkogel Limestone

Lithology: algal laminite with dolomite layers
Fossils: conodonts, foraminiferans, ostracods, stromatolites

Chronostratigraphic age: Eifelian - Upper Devonian

Biostratigraphy: Upper Devonian is based of the occurrence of *Palmatolepis* sp. from sediments of the Mooskofel

Thickness: >330 m

SOUTHERN SHALLOW WATER FACIES (KELLERWAND NAPPE)

Gamskofel Limestone

Lithology: algal laminite with *Amphipora* limestone and loferite layers

Fossils: algae, brachiopods, corals, foraminiferans, ostracods

Chronostratigraphic age: Pragian - Givetian(?)

Biostratigraphy: -

Thickness: approx. 800 m

Rauchkofel Limestone (neritic)

Lithology: lithoclastic limestone, dark nodular limestone, mega-conglomerate horizon, well bedded dark grey crinoidal limestone

Fossils: brachiopods, conodonts, crinoids, gastropods

Chronostratigraphic age: Lochkovian - Pragian

Biostratigraphy: ?*woschmidt*, *delta*, *pesavis*, and *steinachensis* conodont zones

Thickness: about 180 m

Hohe Warte Limestone

Lithology: massive, light grey limestone

Fossils: brachiopods, algae, conodonts, corals, crinoids, cyanobacteria, gastropods, stromatoporoids

Chronostratigraphic age: Pragian

Biostratigraphy: ?*serratus* - *celtibericus* conodont zones

Thickness: 350 m

Seewarte Limestone

Lithology: black bituminous limestone

Fossils: algae, bivalves, corals, crinoids, gastropods, ostracods

Chronostratigraphic age: Lower Emsian

Biostratigraphy: -

Thickness: 40 m

Lambertenghi Limestone

Lithology: well bedded laminated limestone, birdseye limestone, crinoidal debris limestone

Fossils: algae, bivalves, brachiopods (e.g. *Karpinskia consuelo*), corals, echinoderms, foraminiferans, gastropods, ostracods, stromatoporoids

Chronostratigraphic age: Emsian

Biostratigraphy: -

Thickness: 130 m

Spinotti Limestone

Lithology: massive limestone, layers of crinoidal debris and *Amphipora* limestone, birdseye limestone

Fossils: algae, bivalves, brachiopods, corals (rugose and tabulate corals), echinoderms, gastropods, stromatoporoids

Chronostratigraphic age: Eifelian - Lower Givetian

Biostratigraphy: -

Thickness: 220 m

Eiskar Limestone

Lithology: bioclastic limestone, birdseye limestone

Fossils: algae, bivalves, corals, echinoderms, gastropods

Chronostratigraphic age: Emsian - Lower Givetian

Biostratigraphy: -

Thickness: 330 m

Kellergrat Reefal Limestone

Lithology: massive reef limestone

Fossils: brachiopods, calcareous algae, calcispheres, conodonts, corals, echinoderms, gastropods, stromatoporoids

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Chronostratigraphic age: Lower Givetian - Frasnian

Biostratigraphy: *gigas* conodont zone

Thickness: >180 m

Marinelli Limestone

Lithology: loferites and crinoidal debris limestone

Fossils: calcareous algae, conodonts, echinoderms, gastropods

Chronostratigraphic age: uppermost Frasnian - Famennian

Biostratigraphy: -

Thickness: 10 - 20 m

Kollinkofel Limestone

Lithology: dark brachiopod-rich limestone

(rhynchonellids) with sparry lithoclastic layers

Fossils: brachiopods, conodonts, echinoderms

Chronostratigraphic age: uppermost Frasnian - Famennian

Biostratigraphy: *gigas* to *postera* conodont zones

Thickness: >40 m

TRANSITIONAL FACIES (CELLON NAPPE)

Rauchkofel Limestone (pelagic)

Lithology: dark, platy limestone

Fossils: acritarchs, brachiopods, chitinozoans, conodonts, crinoids, gastropods

Chronostratigraphic age: Lochkovian - Pragian

Biostratigraphy: *woschmidtii* zone

Thickness: 80 – 120 m

Kellerwand Limestone

Lithology: yellow tentaculite limestone with bioclastic layers

Fossils: bivalves, brachiopods, conodonts, corals, echinoderms, ostracods, nautiloids, tentaculites, trilobites

Chronostratigraphic age: Pragian - Lower Emsian

Biostratigraphy: *serotinus* and *patulus* conodont zones

Thickness: max. 145 m

Vinz Limestone

Lithology: dark grey platy limestone with debris layers

Fossils: bivalves, cephalopods, corals, conodonts, echinoderms, foraminiferans, ostracods, tentaculites

Chronostratigraphic age: Emsian

Biostratigraphy: -

Thickness: 120 m

Cellon Limestone

Lithology: massive grey limestone with pelagic biogenes with debris layers

Fossils: bivalves, cephalopods, corals, conodonts, echinoderms, foraminiferans, gastropods, stromatoporoids, trilobites

Chronostratigraphic age: Eifelian - Givetian

Biostratigraphy: *partitus*, *costatus*, and *varcus* conodont zones

Thickness: 210 m

Freikofel Limestone

Lithology: light red to greyish pelagic limestone

Fossils: cephalopods, conodonts, corals, crinoids, trilobites

Chronostratigraphic age: Eifelian - Givetian

Biostratigraphy: *costatus* conodont zone

Thickness: >100 m

PELAGIC CARBONATE FACIES (RAUCHKOFEL NAPPE)

Boden Limestone

Lithology: light flaser limestone

Fossils: cephalopods (orthoconic and coiled nautiloids), conodonts, tentaculites (dacryoconarids)

Chronostratigraphic age: Lochkovian

Biostratigraphy: *delta* and *pesavis* conodont zones

Thickness: about 20 m

Findenig Limestone

Lithology: red flaser and nodular limestone

Fossils: cephalopods, conodonts, foraminiferans, ostracods, tentaculites

Chronostratigraphic age: Pragian - Emsian

Biostratigraphy: *serratus* and *kitabicus* conodont zones

Thickness: 40 - 60 m

Hohe Trieb Formation

Lithology: flaser and platy limestone with clay and chert layers

Fossils: cephalopods, conodonts, corals, crinoids, trilobites

Chronostratigraphic age: Eifelian - Givetian

Biostratigraphy: -

Thickness: 30 - 40 m

Valentin Limestone

Lithology: well bedded limestones (wackestone), nodular phosphorite horizon (at Givetian/Frasnian boundary)

Fossils: brachiopods, conodonts, echinoderms, gastropods, ostracods, styliolinids, trilobites

Chronostratigraphic age: Eifelian – Givetian

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Biostratigraphy: *costatus* to early *hassi*
conodont zones
Thickness: 15 m

Pal Limestone

Lithology: limestone beds (mudstone and wackestone), thin biosparitic and quartz-rich layers, black shale

Fossils: bivalves, clymeniids, conodonts, corals (rare), echinoderms, goniatites, ostracods, styliolinids, trilobites

Chronostratigraphic age: Frasnian - Famennian

Biostratigraphy: ammonoid zones (*acuticostata* and *piriformis* *Clymenia* zones; upper *paradoxa* and *prorsum* *Wocklumeria* zones); late *hassi* to *praesulcata* conodont zones

Thickness: >100 m

DISTAL SILICICLASTIC FACIES (BISCHOFALM NAPPE)

Middle and Upper Bischofalm Shales

Lithology: black alaun shale and lydites, greyish green shale

Fossils: conodonts, graptolites

Chronostratigraphic age: Ludlow to Pridoli (M. B. Shale); Pridoli to Lochkovian (U. B. Shale)

Biostratigraphy: M. B. Shale: *vulgaris*, *nilssoni*, *chimaera*, and *transgrediens* graptolite zones; U. B. Shale: *transgrediens*, *uniformis*, *praehercynicus*, and *hercynicus* graptolite zones

Thickness: 4 - 5 m (Middle Bischofalm Shale) and 10 m (Upper Bischofalm Shale)

Zollner Formation

Lithology: greyish green lydites and siliceous shales

Fossils: conodonts, radiolarians

Chronostratigraphic age: Lochkovian - Tournaisian

Biostratigraphy: -

Thickness: >100 m

CARBONIFEROUS SEQUENCE

Kronhof Limestone

Lithology: grey to reddish flaser limestone, black shale at the base ("Kronhof Shale")

Fossils: cephalopods, conodonts, trilobites

Chronostratigraphic age: Tournaisian

Biostratigraphy: *Gattendorfia* and *Merocanites* ammonoid zones; *sulcata* to *isosticha* conodont zone and *anchoralis* conodont zone

Thickness: 10 m (+ 0.2 m Kronhof Shale at the base of the unit)

Plotta Lydite

Lithology: discontinuous silcrete layers consisting of weakly bedded breccias or massiv and laminated cherts

Fossils: radiolarians?

Chronostratigraphic age: Tournaisian

Biostratigraphy: The above mentioned age is based on a mixed conodont fauna (*anchoralis* - *latus* zone) from the uppermost limestone bed disconformably overlain by the Plotta Lydite.

Thickness: approx. 3 m

Hochwipfel Formation

Lithology: turbidite sequence consisting of graded sandstones alternating with siltstone and shale, siliceous shale, lydites (breccias and conglomerates), tuffs

Fossils: plants, spores

Chronostratigraphic age: Tournaisian - Visean

Biostratigraphy: *anchoralis* to *texanus* conodont zones

Thickness: approx. >1000 m

Dimon Formation

Lithology: pillow lavas and breccias, vulcanoclastic sediments, green and red argillites

Fossils: -

Chronostratigraphic age: Visean

Biostratigraphy: -

Thickness: approx. 300 m

Kirchbach Limestone

Lithology: micritic, light grey nodular limestone; it occurs only in lenticular bodies which laterally grade into silty shale.

Fossils: conodonts, crinoids

Chronostratigraphic age: Visean

Biostratigraphy: according to SCHÖNLAUB (1985a), the conodont assemblage points to Visean age

Thickness: 8 - 10 m

Waidegg Formation

Lithology: breccia and conglomerate horizons, in upper part coarse clastic layers are intercalated by silty and sandy shale

Fossils: plants

Chronostratigraphic age: uppermost Moscovian - lowermost Kasimovian (age is

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inferred on the above deposited and well constrained Auernig Formation)

Biostratigraphy: -

Thickness: 40 m

Auernig Formation

Lithology: quartz conglomerates, cross-bedded sandstones, bioturbated siltstones, and bedded, massive or nodular limestones

Fossils: calcareous algae, brachiopods, bryozoans, conodonts, echinoderms, foraminiferans (e.g. fusulinids), gastropods, ostracods, plants

Chronostratigraphic age: Kasimovian - Gzhelian

Biostratigraphy: *permirus* to *communis* fusulinid zones; *expansus* to *elegantulus* conodont zones

Thickness: 600 - 800 m

Schulterkofel Formation

Lithology: bedded and massive limestones (represented by up to 20 m thick

Anthracoporella mounds), with subordinate silt- and fine-grained sandstones

Fossils: algae, brachiopods, bryozoans, echinoderms, foraminiferans (e.g. fusulinids), gastropods, ostracods

Chronostratigraphic age: Gzhelian

Biostratigraphy: *communis* to *versabilis* fusulinid zones

Thickness: 140 m

Carboniferous of Nötsch

The Carboniferous of Nötsch is located north of the Periadriatic Line and is subdivided into three units by SCHÖNLAUB (1985b). The sequence has become famous due to the occurrence of certain fossils like the well-known brachiopod species *Gigantoproductus giganteus*, abundant trilobites and ostracodes (SCHRAUT 1996, HUBMANN *et al.* 2003).

Erlachgraben Formation

Lithology: quartz conglomerates and sandy shales in the lower part of the unit; grey to dark grey siltstone, shale and limy marls in the upper part of the unit

Fossils: algae, bivalves, brachiopods (e.g. *Gigantoproductus*), cephalopods, corals, crinoids, foraminiferans, gastropods, plants

Chronostratigraphic age: Visean - Bashkirian

Biostratigraphy: *granosus* goniatite zone

Thickness: approx. 80 m

Fossils: bivalves, brachiopods (e.g. *Gigantoproductus*), bryozoans, corals, echinoderms, gastropods, trilobites

Chronostratigraphic age: Bashkirian - Moscovian

Biostratigraphy: *nodosus* conodont zone

Thickness: 350 - 400 m

Nötsch Formation

Lithology: brown to dark grey sandy shale, sandstone, fine-grained to coarse conglomerates

Fossils: bivalves, brachiopods, bryozoans, corals, echinoderms, gastropods, ostracods, scaphopods, trace fossils, trilobites, plants

Chronostratigraphic age: Moscovian - Kasimovian

Biostratigraphy: -

Thickness: 400 - 600 m

Badstüb Formation

Lithology: breccia consisting of amphibolite, gneiss, granite, muscovite-rich shale, quartzite, marble, limestone clasts, intercalated by a few meters thick black graphite horizon in the lower part, and a 10 - 17 m thick fossiliferous shale horizon

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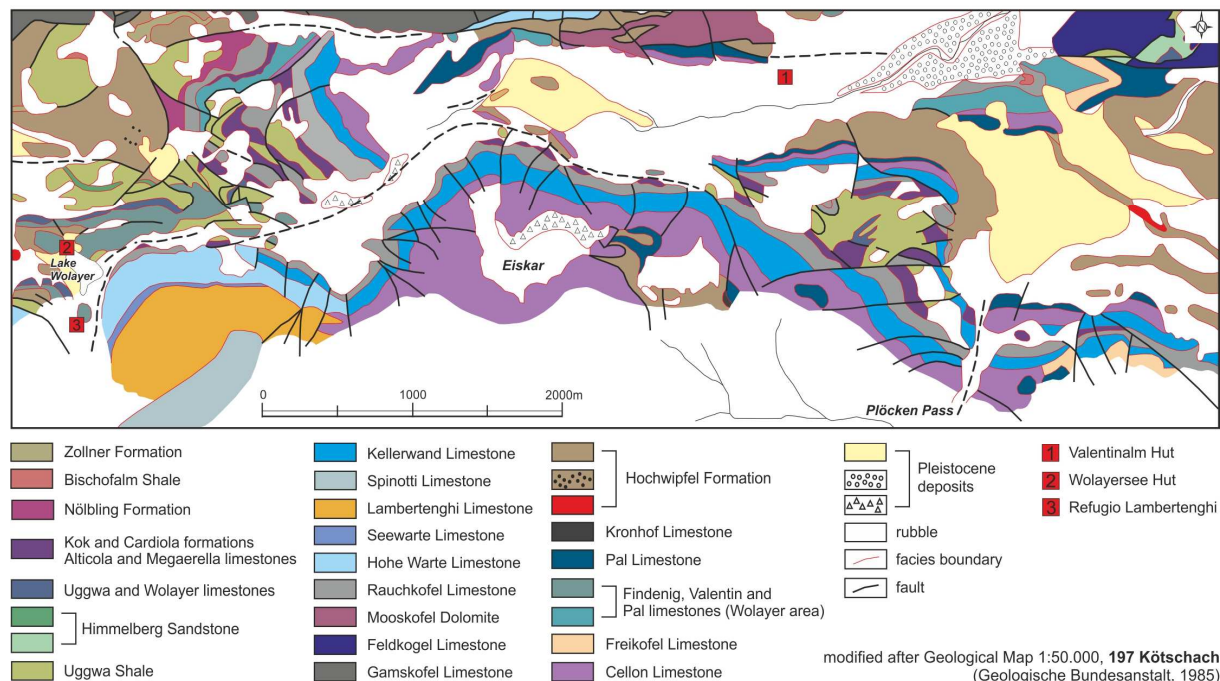
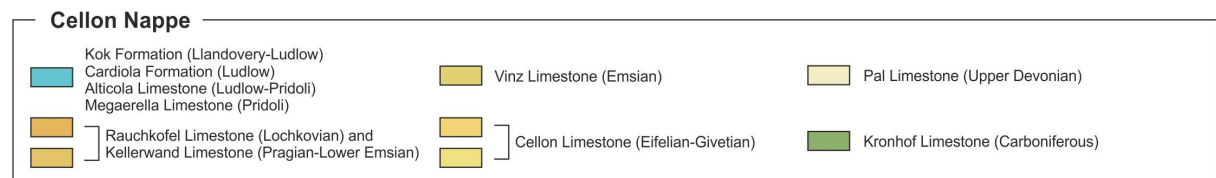
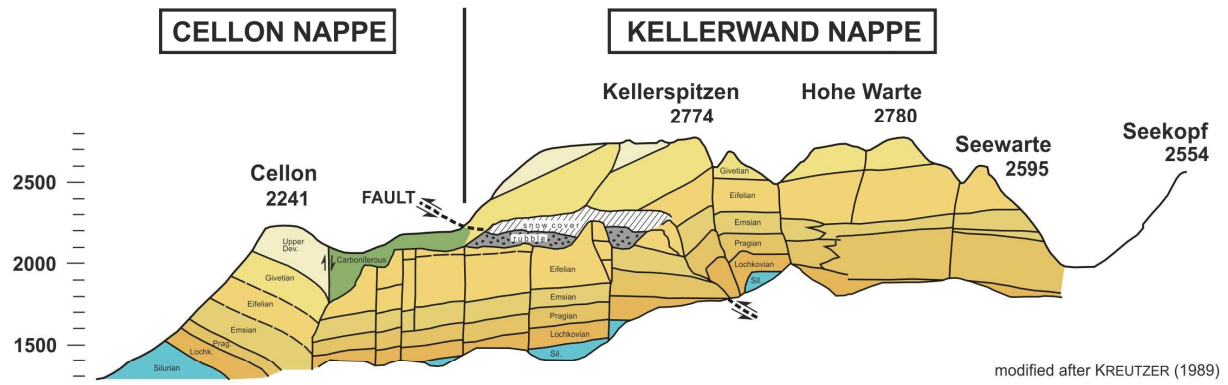
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Field-Workshop: Regional Geology



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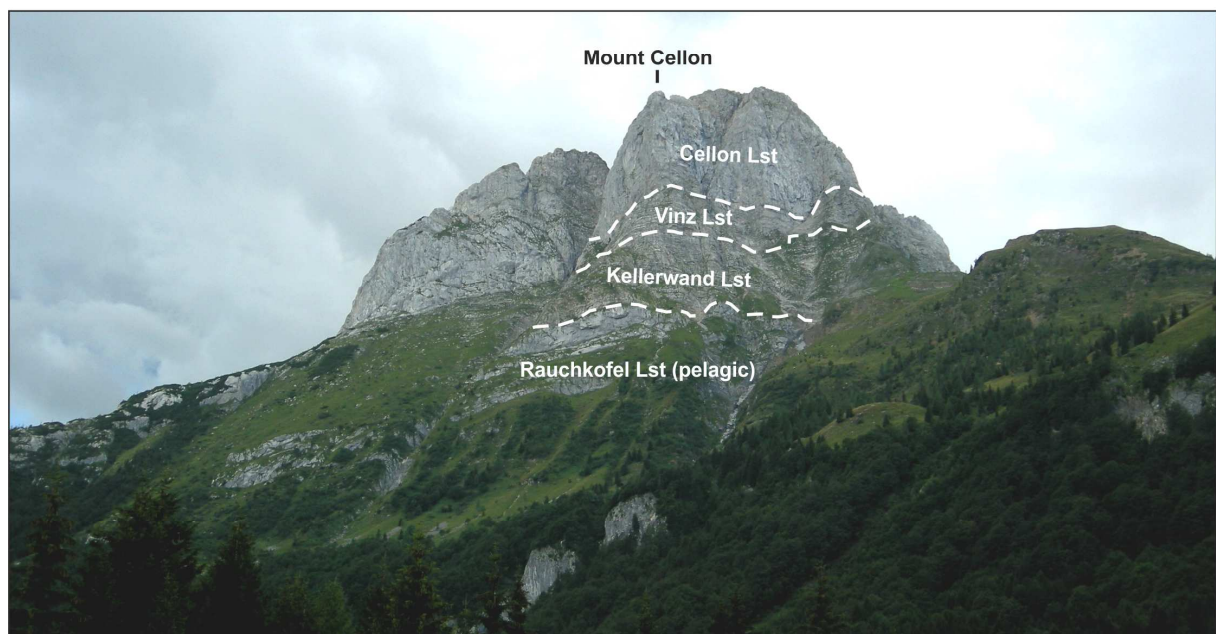
Field-Workshop: Geological Highlights



SOUTHERN SHALLOW WATER FACIES

A

KELLERWAND NAPPE
Locality: Mount Gamskofel

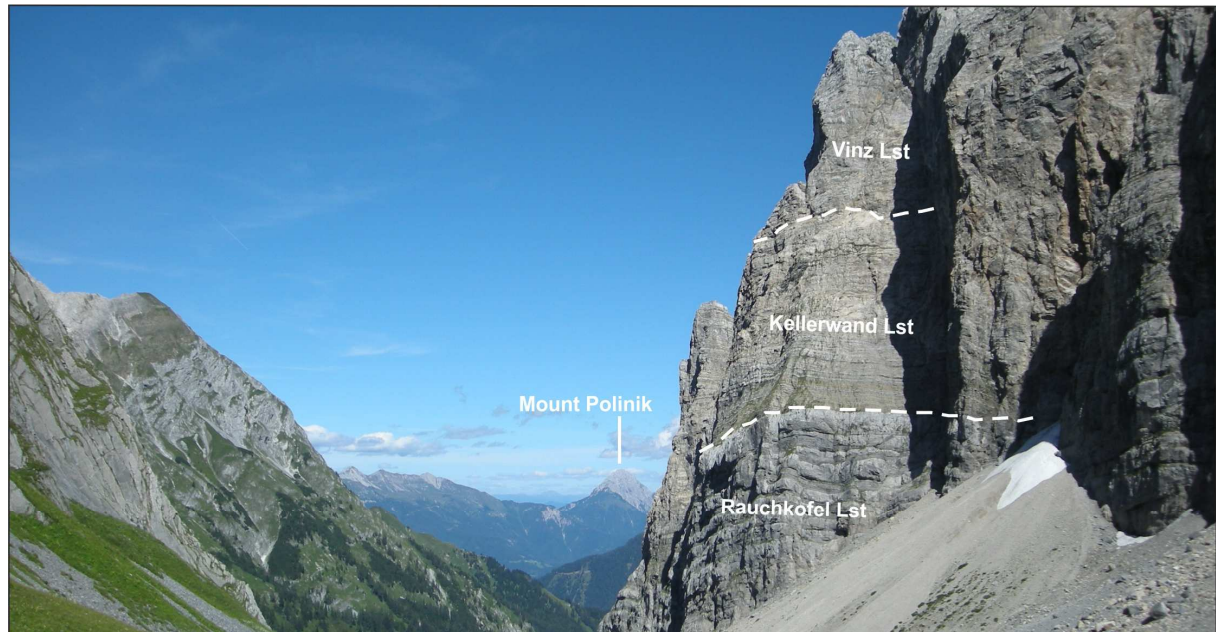


TRANSITIONAL FACIES

B

CELLON NAPPE
Locality: Mount Cellon

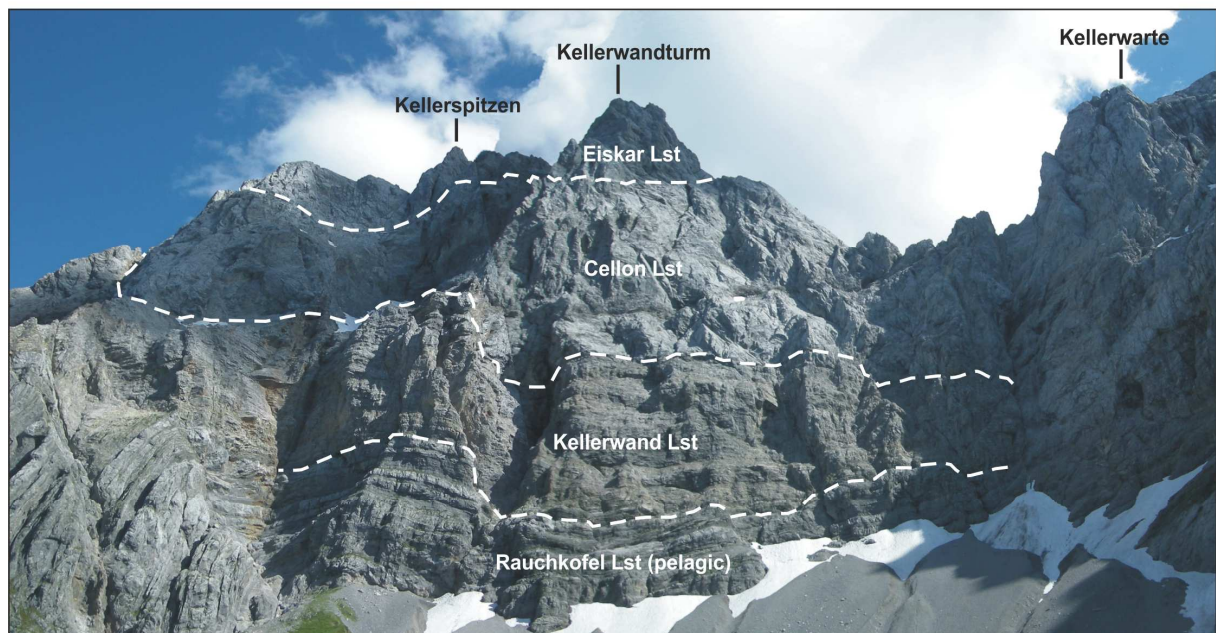
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TRANSITIONAL FACIES

C

CELLON NAPPE
Locality: Kellerwand



TRANSITIONAL FACIES

D

CELLON NAPPE
Locality: Kellerwand

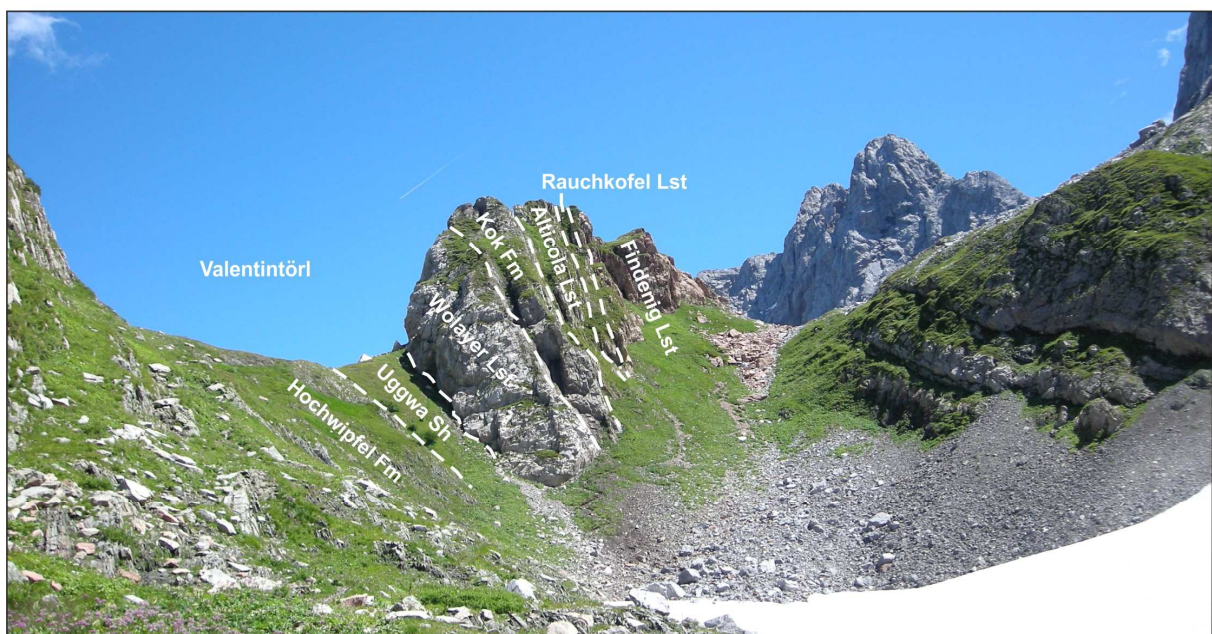
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PELAGIC CARBONATE FACIES

E

RAUCHKOFEL NAPPE
Locality: Mount Rauchkofel



PELAGIC CARBONATE FACIES

F

RAUCHKOFEL NAPPE
Locality: Valentintörl

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PELAGIC CARBONATE FACIES



RAUCHKOFEL NAPPE

Locality: Wolayer Glacier section



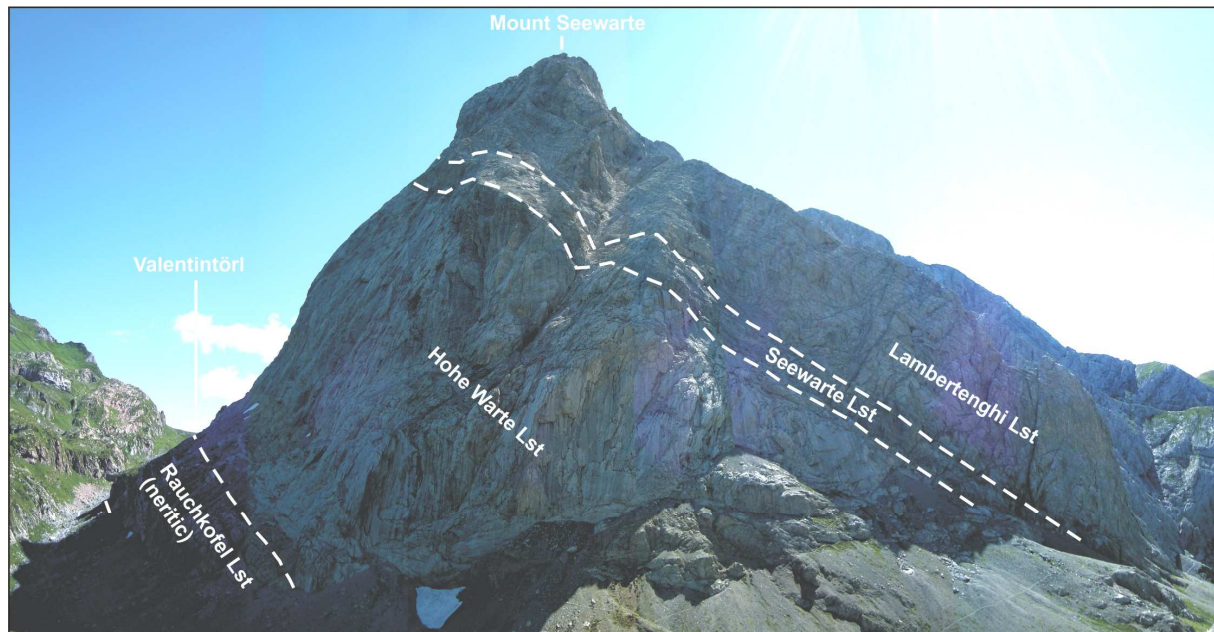
SOUTHERN SHALLOW
PELAGIC
CARBONATE FACIES



RAUCHKOFEL NAPPE / KELLERWAND NAPPE

Locality: Mount Rauchkofel & Mount Seewarte

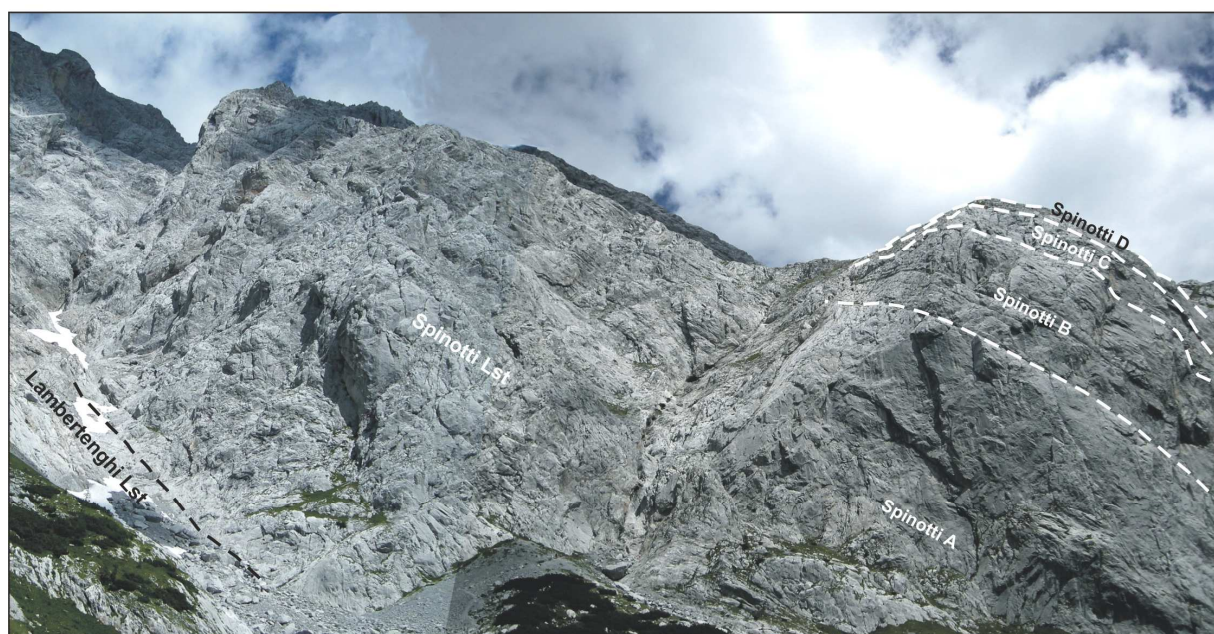
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SOUTHERN SHALLOW WATER FACIES



KELLERWAND NAPPE
Locality: Mount Seewarte

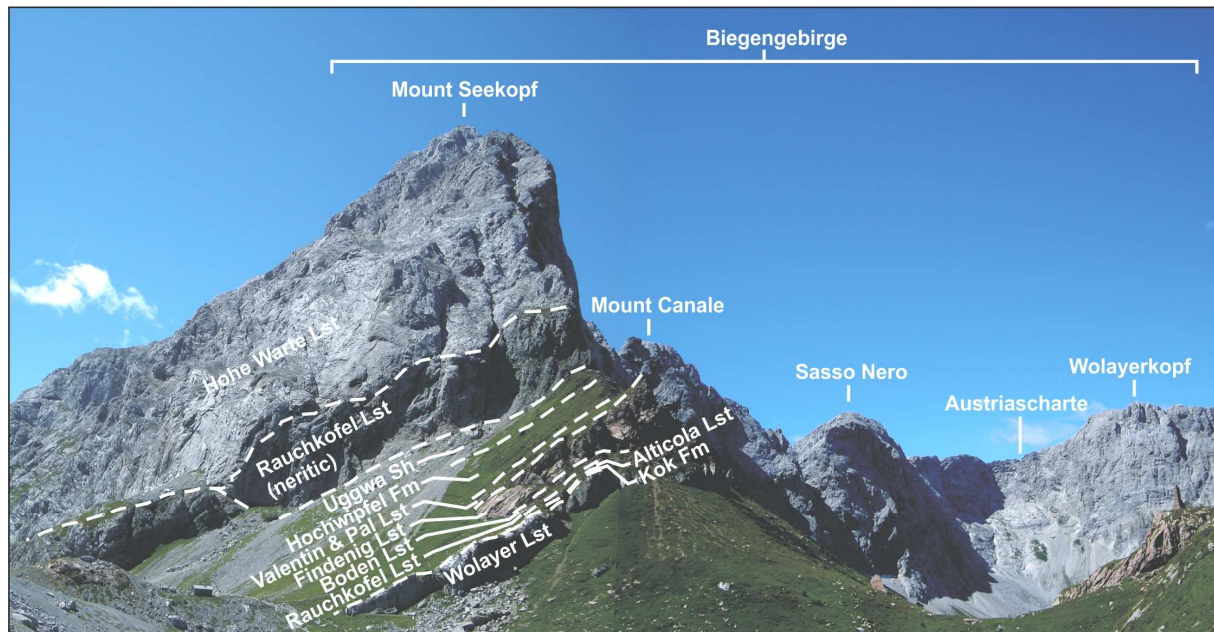


SOUTHERN SHALLOW WATER FACIES



KELLERWAND NAPPE
Locality: Spinotti Trail

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SOUTHERN SHALLOW
WATER FACIES $\rightleftharpoons$ PELAGIC
CARBONATE FACIES

K

KELLERWAND NAPPE / RAUCHKOFEL NAPPE
Locality: Mount Seekopf & Seekopfsockel



SOUTHERN SHALLOW WATER FACIES

L

KELLERWAND NAPPE
Locality: Passo Volaja area (RLF III section)

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Field-Workshop: Infrastructure



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