Bericht 1995 über geologische Aufnahmen auf Blatt 180 Winklern

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The map-sheet 180 Winklern comprises both Penninic and Austro-Alpine basement and cover complexes.

PENNINIC COMPLEXES

Penninic Basement Complex

Innerfragant and Döllach Area

The Penninic basement of the area of Innerfragant (NW of Flattach) is mainly composed of "Zentralgneis", representing various types of deformed granitoids. Within the Zentralgneis, several granitoid types have been distinguished:

- Coarse grained, porphyric granite to granodiorite, with augen feldspars attaining the size up to 3 cm.
- Medium to fine grained massive to slightly mylonitized granite to granodiorite (W of Innerfragant).
- Muscovite to two mica leucocratic granite, slightly mylonitized (NE of Kammspitz 2757 m).
- Muscovite-rich granite, strongly mylonitized, schistose, occurring in the shear zones; it has the character of granite micaschist (Oschenikhütte), or even leucophyllite (Saustellscharte W of peak 2560 m).

Several layers, xenoliths, dikes and intercalations of metamorphic rocks have been identified in the Zentralgneis:

- Migmatitic paragneisses, biotite rich, with sporadic garnet, exhibiting segregation (anatectic ?) structures (NE of Innerfragant; Kammspitz).
- Amphibolites and garnet amphibolites, fine to medium grained, with leucocratic veins and pods (anatectic ?) of granite/trondhjemite/leucotonalite composition (Astromkar).

Metamorphic rocks are commonly deformed with granitoids, which can be mainly attributed to Alpine deformation and recrystallization, overprinting the earlier, Variscan structures. In some cases, where Alpine mylonitization is not penetrative, older fabric, i.e. metamorphic foliation or migmatitic layering is discernible. A long amphibolite dike-like body crosscuts the Zentralgneis in the area of Kammspitz and Astromkar.

Penninic Cover Complex

Innerfragant and Döllach Area

In this area, Mesozoic sequences show an intense Alpine metamorphism and deformation. Several lithological rock types have been identified:

- Black phyllites to schists ("Schwarzschiefer"), fine grained with abundant graphitic admixture and quartz veins.
- Green-schists ("Grünschiefer"), fine grained chlorite-actinolite-epidote schists (basic metavolcanics); sporadic coarse grained metagabbros with amphiboles have been observed.
- Calc-schists ("Kalkschiefer"), fine grained, impure metacarbonates to marbles with recrystallized calcite, dolomite and quartz-mica admixture.
- Metaquartzites, fine grained quartz-rich metasandstones to metaconglomerates.

The above mentioned Mesozoic sequences are most probably tectonically superimposed onto the Penninic Variscan basement.

Calcareous phyllites to mica schists ("Kalkschiefer") are the main constituent of the Penninic cover complexes. These are grey, pervasively foliated, often strongly lineated and folded rocks. The calcite content varies so that calcareous schists pass gradually into impure marbles on one hand, and, more often, into black schists on the other hand. Multiple alternating of calcareous and black schists may be observed e.g. eastwards of Großkirchheim (Zirknitzgraben).

Black phyllites and mica schists ("Schwarzschiefer") differ from the previous ones by lower content of calcite and by darker colour. Both are garnetiferous in places.

The metavolcanic complex consists of various types of greenschists and amphibolites, sometimes garnetiferous. They intercalate the metasedimentary rocks. The thickest greenschist layer (some 300 m) occurs near Zirknitz.

Serpentinites are massive dark-green fine grained rocks, forming a large body NE of Großkirchheim.

Chlorite-sericite quartzitic and arcosic metasandstones ("Serizitquartzit") occur sporadically as xenoblocks (Austroalpine?) in upper parts of the Penninic cover series (Putschall, Ranach). Small occurrences of rauhwackes and dolomitic marbles are probably of the same origin.

Tectonics

Mylonitic foliation and stretching lineation are the most conspicuous structural elements in the Zentralgneis. The foliation is slightly (10–35°) dipping to the SW below the Mesozoic cover complex. The stretching lineation is slightly (10°) submerging to the SE. Both elements can be interpreted as the result of NW-ward ductile shearing and thrusting, sometimes also visible according to asymmetric structures of feldspar porphyroclasts.

Detachment of the Mesozoic cover from the basement can be connected with this deformation event. Some tectonic lenses of Permo-Scythian quartzites outcrop along the detachment fault, between Zentralgneis and Mesozoic (mainly carbonatic) complex.

The younger appear to be steeper shear zones crosscutting the subhorizontal tectonic structures. In general, they are NW–SE striking, dipping to the SW. The accompanying mesostructures are tight, chevron-like folds with steeply dipping axial plane cleavage, especially present within gneisses, granitic micaschists and leucophyllites.

The youngest elements appear to be kink folds of NE–SW direction and accompanying NE–SW, or N–S directed tension systems filled in by quartz.

The most distinct fault system is NW–SE, accompanied by rauhwackes within Mesozoic carbonates SE of Schöberltörl 2360 m (Innerfragant region).

In the Innerfragant-Kammspitz area there are observable also large antiforms and synforms performed by attitudes of metamorphic foliation. Wave lengths of these

large open fold-bends are hundreds of metres to km in size (Astromkar, S of Höhe Nase).

The Penninic cover complex in the Döllach region dips generally to the SW in the area investigated, being overlain by the Austroalpine basement units. The overall trend of the penetrative stretching lineation is W–E to NW–SE. Superimposed extensional structures with top-to-the S to SW shear-sense criteria are also present.

AUSTROALPINE COMPLEXES

High-Grade Complexes (MAA ?)

Migmatite-Orthogneiss Complex

E of Stall Area

Migmatitized gneisses, with inhomogeneous, stromatitic to ptygmatitic structures, leucocratic veins and segregates of quartzo-feldspatic composition indicate the incipient migmatitization, most probably due to anatexis. Larger segregations and veins of granitic composition have also been observed.

Orthogneisses, exhibiting mylonitic texture, apparently deformed former igneous (granitoid) rocks with strongly deformed feldspar augens, are alternating with migmatites.

Gneiss-Amphibolite-Granitoid (Orthogneiss) Complex

W of Döllach

The main mass is prevailingly composed of granitoids and relics of their metamorphic mantle consisting of biotitic gneisses and amphibolites. This complex was later deformed and metamorphosed, producing orthogneisses and diaphthoritic gneisses. Specific members of this complex are mica schists, in places garnetiferous. At the base of the complex, diaphtoritic gneisses, phyllonites and, at the very base, quartz phyllites (Unterostalpin?) are present.

Granitoids are mostly evenly grained, biotitic or two-mica, in places porphyric, often strongly sheared. Leucocratic types are deformed to leucocratic orthogneisses.

Higher tectonic position occupies an eclogitic mica schist-amphibolite complex, which is represented mainly by garnetiferous mica schists and garnetiferous amphibolites to gabbroamphibolites (Stronachkogel).

W of Winklern

This territory is formed by a variegated complex composed of metamorphic amd magmatic rocks as well. The dominating metamorphic rocks are represented by a high-grade metamorphic complex and locally their partially sheared analogues are present. Principal rock types are muscovite-biotite gneisses occasionally with porphyroclastic feldspar “augen”. The foliation plane is created by biotite. Grayish-brown gneisseous rocks are intruded by veins of leucocratic granites forming stromatitic structures at the Pirkachberg. Dark-gray two-mica gneisses rich in garnet and depleted in feldspar content occur near Törlkopf and Alpinsteig. Layered amphibolitic complex is nearby the Pichleralm and partially at Kuhleitenkopf as well. Magmatic rock – coarse-grained porphyric granodiorite (similar to Zentralgneis type) occurs only sporadically near Luggeralm.

Medium- to Low-Grade Complexes (LAA ?)

Micaschist-Gneiss-Amphibolite Complex

Stall-Irschen Area

In this area, S of Mölltal, Austroalpine basement complexes (“Kreuzeckgruppe“) composed of micaschists, paragneisses, amphibolites, less orthogneisses and their diaphthorites (greenschists, phyllonites) are cropping out.

They are cut by young (Tertiary ?) dikes of porphyrytes, granites to andesites and basalto-andesites. The following rock-types have been distinguished:

- Garnet mica-schits, with abundant garnet up to 2 cm in diameter, schistose, with muscovite and biotite and often quartz veins.
- Phyllonites, most probably the products of diaphthoresis of garnet micaschist because of their position in the shear zones crosscutting the micaschists.
- Amphibolites, medium to fine grained, sometimes also coarse grained, green to dark green; the structure shows preferred orientation of amphibol, plagioclase and quartz.
- Green-schists appear to be a product of retrogression and diaphthoresis of amphibolites because of their position in shear zones crosscutting the amphibolites; they are fine-grained, pale green, chlorite and actinolite rich.
- Pale plagioclase and quartz rich gneisses probably come from originally sandstone beds in pelites (micaschists).
- Pale and black quartzites built a few meter thick layers in micaschists.
- Paragneisses built an extra area along Wöllatraten valley; they contain a high amount of plagioclase, biotite and/or muscovite, locally abundant garnet; quartzitic layers are characteristic too.

Low-Grade Complexes (UAA ?)

Low-Grade Metavolcanosedimentary Complex

Area between Lainach and Dölsach

Three formations can be distinguished.

- Sericite-chlorite schists are dominant, in places quartzitic schists (locally with biotite and garnet), with layers of sericite quartzites, quartzitic phyllites, black schists with graphitic admixture and green chloritic schists (with abundance of basic volcanic material).
- Dominantly metasandstones, metagreywackes, metaquartzites with layers of phyllites and schists.
- Leucocratic acid metavolcanics (porphyroids, orthogneisses).

This complex comprises of a mixture of clastogenous metasediments with products of acid and/or intermediate volcanism and their tectonically deformed (sheared) analogues in form of phyllonites. Principal rock types are fine- to medium-grained phyllitic metasandstones and common phyllites, silver- to dark-gray in color and finely crenulated. Contents of sedimentary and volcanic components are variegated therefore one can observe places where sediments – quartzitic arcose (near Feuerboden and Marchbach) or volcanic material – metatuffs (Fritzental) are dominated.

Austroalpine Cover Complex

Permomesozoic cover is built of quartzites, arcoses, sericitic-chloritic schists with carbonate intercalations and forms a fault-bounded slice in the Frühaufgraben near Gödnach.

Tectonics

Stall-Irschen Area

Tectonic relationship between micaschists and gneisses in the area E of Stall is not entirely clear because of a restricted occurrence of gneisses and orthogneisses on the map sheet near its eastern edge.

The gneisses in the Woellabach valley seem to be a deeper sequence than the micaschist sequence in the Griedelkopf surroundings. The mutual relationship is also

complicated by a SE-ward reverse-fault-thrust of the northern micaschist segment over a more southerly situated gneiss-micaschist segment.

The top of the gneiss-micaschist lithological sequence is built of large amphibolite bodies, often accompanied by black quartzites (Mokarspitz 2305 m area). They indicate cores of large recumbent folds with diaphthorites of micaschists (phyllonites) and amphibolites (greenschists).

The top of the tectonic sequence of the complexes in this area is built of a high-grade migmatite-orthogneiss complex (Stadlberg NE of Stall).

Near Bilitzhütte in Lamitzbach valley occurs a thick layer of pale quartzite which is very similar to the Triassic one. It is probably a tectonically incorporated slice in between two above suggested subunits of the Austroalpine unit.

By mapping there was recognized a large E–W striking fault cutting Austroalpine complexes southward of Hochkreuz. Along this zone the foliations are subvertically arranged, there took place mylonitization, even hydrothermal alteration.

Lainach and Dölsach Area

The whole complex of low-grade metamorphosed rocks outcrops in a block eastwards from a marked SW–NE fault zone between Dölsach and Lainach villages (probably strike-slip fault), locally with relics of Permian–Triassic rocks. The fault zone separates the low-grade complex from the gneiss-granitic complex. In the south, the Drautal fault zone creates a limit between the low-grade complex and Triassic carbonates of the Drauzug zone. The internal structure of this complex is rather complicated, with frequent isoclinal folds. Foliation S1 is generally moderately dipping to the N or NE. Subsequent foliations S2 and S3 are connected with superimposed tectonic movements – normal faults, overthrust faults and strike-slip faults.

TERTIARY (?)

Porphyries to granites and porphyries to andesites and scarcely andesito-basaltes (lamprophyres) occur in dikes, crosscutting the basement rocks – micaschists, amphibolites and gneisses in the area between Möll and Drau valleys. They are undeformed and could represent Tertiary volcanics and subvolcanics connected with the extensional and strike slip tectonics filling in the tension gashes in form of dikes.

Garnet is abundant in some varieties of andesitic to rhyodacitic composition. Granites, present in granitic veins, contain characteristic large flakes of fresh biotite. In the minor mafic types (basalto-andesites, dolerites) amphibole phenocrysts in the grey groundmass have been identified.

Dikes of the garnet-hornblende andesites are scarcely present in the area Steinscharte (2599 m), W of Winklern too.

QUATERNARY

In the area mapped following genetic types of Quaternary sediments occur:

– Slope sediments: Loamy-stony slope debris are prevailing. On steeper slopes boulders and blocks are frequent. In the higher altitudes stony debris and talus fans occur. In places a part of the content of these sediments is represented by material from outwashed morains and glacial terraces.
– Fluvial sediments (alluvium): In the area investigated this type occurs in the form of deposits of fluvial plain or terrace (generations not distinguished in the map). A special type represent the fluvio-deluvial deposits of tributary valleys. Here mutual action of running water and gravitational movements on slopes take part in the forming of this type of sediment.
– Proluvial cones: They are very frequent mainly in the gorges of tributary valleys. Material is unassorted, locally lithified.
– Glacial sediments – terminal and marginal morains.
– Landslides, extensional gashes.

The distribution of Quaternary sediments as well as their facial diversity is strongly influenced by the high-mountain character of the area mapped.

The high youngest glacial kars of the NW border of the map sheet (between the Lacknerhöhe and Weißer Kopf) are characteristic by some generations of glacial morains. At the toes of mountain chains the most typical feature is the generation of debris- and proluvial fans, often active till present. Behind the ancient frontal moraines sometimes fans and glacier lakes originated.

The geomorphic interaction between the moraines and the fans give an opportunity to measure their development in time. The large majority of fans developed later than the moraines. Only the youngest moraines in front of kars northwards of Weisser Kopf are not attached by both debris and proluvial fans.

On the bottom of valleys also the development of brooks alluvia were controlled by lateral input of proluvial fans. Small alluvia originated mostly at the back sides of entering lateral proluvial fans.

The largest proluvial fans were observed at the entering of Gradenbach, Gartlbach, Wangenitzbach and Zirknitz valleys into the main Möll-river valley.

On the western and eastern slopes of the Möll-river valley there are present some relics of ancient fluvioglacial sediments, represented by non-sorted coarse black-gravel deposits.

In the lower altitude as the fluvioglacial relics, there were recognized some ancient Möll-river terrace gravel horizons.

The system of terraces is relatively well preserved on the right side of the Möll-river valley in Winklern and eastwards of it. There are also preserved some relics of morains between the Zwischenbergen and Lainach. Both the moraines and the terraces are cut by large proluvial cones entering from the Diebsbach and the Zleinitzbach valleys into the Möll-river valley.

The recent very active vertical movement in the area studied caused the development of numerous slope breaks with debris and landslides. On the crest of the mountain ridges the gravitational extension caused the development of subvertical tension cracks (e.g. Stronachkogel). In the flatter parts of mountain slopes subrecent slope loams, loamy debris and slope debris accumulated.

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