ling und Unterkosten. Es sind einförmige, phyllitische Zweiglimmerschiefer mit Quarzitgneislagen. Die Lagerung ist mittelsteil gegen N und damit den angrenzenden Quarzphylliten im Kristeinbachtal (siehe oben) vergleichbar. Die westliche Grenze der schwach diaphthoritischen Glimmerschiefer bildet eine saigere N–S-verlaufende Störung. Im Hangfußbereich sind Porphyroidschiefer in den angrenzenden Quarzphylliten stark zerrüttet. Diese spröde Deformation gehört wiederum zu den Bewegungen entlang der Drautal-Linie.

Im Schloßberg W Lienz steckt ein größerer oligozäner Tonalit/Quarzdioritkörper (KREUTZER, 1992). Der Intrusionskörper ist auch in den Randbereichen sehr homogen. Der massige Tonalit ist fein- bis mittelkörnig, bestehend aus Amphibol, Biotit, Plagioklas und Quarz. Der ausgedehnte Kontakthof von mehreren hundert Metern zeigt, daß der Dachbereich der Intrusion aufgeschlossen ist. Die Quarzphyllite werden zu grünvioletten Hornfelsen mit Biotit und Hornblende, sowie zu Quarzitschiefern mit Biotit. Sulfidminerale sind als Akzessorien häufig. In zunehmender Entfernung vom Kontakt nimmt die Korngröße von Biotit ab und der phyllitische Glanz der Schiefer ist zunehmend noch vorhanden. Ein aufgelassener Abbau einer Magnetkies-Kupferkies-Vererzung befindet sich im Kontakthof gut hundert Meter westlich der Kreuzung auf 1061 m.

Die Phyllite der Kreuzeckgruppe bauen den westlichen Gebirgszug zwischen Dölsach – Lainach – Nikolsdorf auf. Die Übersichtsbegehungen erfaßten den Hangfuß bei Gödnach und Lengberg im Drautal. Lithologisch entsprechen die Phyllite den Thurntaler Quarzphylliten vom Deferegger Gebirge.

Bei Gödnach zeigt sich eine einförmige Folge aus Metapeliten und Metapsammiten. Die Quarzphyllite variieren von silbergrauen, eisenschüssigen Phylliten hin zu plattig brechenden Phyllitquarziten. Besonders die graugrünen Psammitschiefer führen Biotit und Granat. Auch diese Phyllitserie ist intern stark deformiert. Die unruhige Lagerung ist mittelsteil nach SE bis S oder mittelsteil nach NE bis N und damit eine mögliche Verfaltung um ostfallende Achsen angezeigt.

Vielfältiger ist die Lithologie nördlich von Lengberg mit Einschaltungen von Metavulkaniten und -tuffiten. Mächtige Horizonte von Porphyroidgneis sind begleitet von unreinen Porphyroidschieferlagen. Als basische Äquivalente kommen Grünschiefer und Chloritphyllite vor. Auch in diesem Bereich ist eine starke interne Verfaltung bei flacher bis mittelsteiler Lagerung gegen NE bis N.

In Bezug auf quartäre Bedeckung und Massenbewegungen liegt für die beiden Kartenblätter Lienz und Winklern ein inhomogenes und unvollständiges Bild vor.

Die Kartierung der quartären Bedeckung von der Arbeitsgruppe SPAETH ist unzuverlässig. So ist über die Schwemmkegel von Schleinitzbach und Göriacher Bach teilweise oder vollständig Kristallin kartiert. Im Bereich Schlaiten – Göriach ist die Ausscheidung von Kristallin und Bedeckung oft genau entgegengesetzt den Beobachtungen bei der Übersichtsbegehung.

Die Arbeitsgruppe PUTIŠ ist bei der Ausscheidung von Bedeckung großzügig. Als Beispiel seien die Stronacher Wiesen am Südhang des Stronachkogel genannt. Trotz schlechter Aufschlußverhältnisse ist entlang von Wegen und mit Lesesteinen das Kristallin verfolgbar. Als Bedekkung ist lokaler Hangschutt verbreitet, rechtfertigt aber nicht durchgehende quartäre Bedeckung.

Massenbewegungen wurden von der Arbeitsgruppe SPAETH nicht und von der Arbeitsgruppe PUTIŠ sporadisch kartiert.

Im Laufe der Übersichtsbegehungen wurden Massenbewegungen ergänzt. Kleine Zerreißungen, Sackungen und Rutschungen sind verbreitet und werden nicht separat aufgelistet. Größere Rutschungen sind im Ainetwald in den Krassbachgraben hinein und westlich St. Johann i. W. von beiden Seiten in den Gossenbachgraben. Zwischen St. Johann i. W. und Ainet erfassen zwei Massenbewegungen die gesamte Iseltalflank der Schobergruppe. Die nordwestliche Massenbewegung setzt am Hohen Trog (2439 m) an und reicht bis in den Talboden (730 m). Das zeigen die Auflockerung der Felswände im Eichholz und die großen Quellen beim Weirer und nordwestlich Schloß Weiherburg. Die zweite Massenbewegung setzt westlich vom Pitschedboden in 2500 m Höhe an und zerlegt den Rücken bis Oberalkus (1284 m). Typisch für diese tiefreichende Auflockerung sind unzählige hangparallele Wälle mit Vernässungen in den Mulden dahinter.

Blatt 180 Winklern

Siehe Bericht zu Blatt 179 Lienz von M. LINNER.

Blatt 181 Obervellach

Bericht 1996 über geologische Aufnahmen im Altkristallin auf Blatt 181 Obervellach

MARIAN PUTIŠ, VLADIMIR BEZAK, MILAN KOHÚT, MARTIN KOVAČIK, FRANTIŠEK MARKO & DUŠAN PLAŠIENKA
(Auswärtige Mitarbeiter)

The below listed Austro-Alpine tectonostratigraphical complexes have been recognized in the mapped area (from bottom to top, or from N to S):

1. Ragga Complex (medium-high grade; Lower?, Middle? Austroalpine)

The complex builds the northeastern part of the mapsheet S of the Möll valley. It is represented mainly by medium-grained to fine-grained biotite gneisses. Smaller or larger intrusions of granitic rocks occur within the gneisses. The complex comprises medium to high-grade paragneisses (schistose to quartzitic) which transformed into pearl gneisses and migmatites (stromatites to nebulites) with a lot of granitic, granodioritic and/or x m thick pegmatitic veins, mylonitized to orthogneisses. Monotonous pale quartzitic gneisses seem to occupy the lower part of the unit mainly in the Ragga valley near Ausserfragant. Porphyric orthogneisses are less common.

The gneisseous part of the complex is predominantly represented by the two main lithotypes:

Light-coloured gneisses prevail at the eastern edge of the map-sheet. They are relatively monotonous, locally with massive structure, built of medium-grained quartz-feldspar and lesser mica aggregates (garnet).

Dark biotite-garnet gneisses are enriched by graphitic substance in some layers. Anatectic segregation of light-coloured quartz-feldspar leucosome, rimmed by dark melanosome is characteristic in migmatitic parts of the complex.

Transition from gneisses into micaschists is characteristic within zones of superimposed diaphthorization where newly-formed muscovite and tiny garnet replaced former (Variscan ?) metamorphic minerals of gneisses.

Amphibolites to amphibole gneisses occur in form of long thin bodies, sometimes accompanied by coarse-grained dioritic orthogneisses (E of Klenalm). Fine-grained to medium-grained amphibolites sometimes contain macroscopic garnets.

This complex represents a HT/LP pre-Alpine mid-crustal rock-sequence. It was mylonitized at temperatures higher than 500°C (ductile behaviour of feldspars and quartz) during Alpine tectogenesis.

2. Strieden Complex (medium grade, Middle Austroalpine)

The complex was named by HOKE (1990) and occurs in partial synforms overlying the deeper Ragga Complex (e.g. the Strieden and Salzkofel areas). Gneisses (with higher content of feldspars) to micaschists with often macroscopic porphyroblasts of kyanite, staurolite and garnet predominate in the monotonous part of the complex. Some pale quartzitic (a few cm to dm thick) layers are present within metapelites. The macroscopically visible metamorphic foliation of micaschist-gneisses defined by the apparently newly-formed Ky-St-Gt-white mica assemblage does not bear any features of a newer reworking (excluding some phyllonite zones).

The lithologically more variegated and lower part of the complex comprises a few tens of metres thick bodies of amphibolites (garnet) and a marker 15–20 m thick bed of dolomitic marble (tremolite). Calc-silicate rocks (with garnet) appear to be intermediary layers between gneisses and marbles, or amphibolites and marbles. Other characteristic members are garnet amphibolites. Both, tremolitic marbles and amphibolites are located within the garnet micaschist gneisses. The whole sequence is cut by pegmatite veins, strongly deformed to orthogneiss.

The Berghaus Formation (low grade, or strongly diaphthoritic?) occurs in the upper part of the Ragga valley and might represent a part of the variegated sequence of the Strieden Complex (HOKE, 1990). It comprises calcitic and dolomitic marbles, laminated metatuffs to amphibolites, acidic metavolcanics (?) and granitic ultramylonites, pale quarzites, surrounded by biotite-chlorite quartzitic schists often with graphitic admixture. Mostly undeformed leucocrate muscovite granites to pegmatites with large black tourmalines (3–5 cm large) appear to have post-mylonitic origin and intruded mainly into tectonically strongly affected zones. The whole lithological formation is located within a steeply dipping fault zone. The strong hydrothermal alterations are connected with siderite, hematite and sulphide mineral zones.

The Strieden Complex represents a barrovian MT/MP rock sequence that seems to be a product of Alpine remetamorphism of a pre-Alpine basement complex. The Strieden Complex overlies the gneiss-migmatitic-granitic Ragga Complex, and is overlain by the Polinik (eclogite-bearing) Complex in the area around the Polinik peak. In the area N of Kreuzeck the Polinik Complex is missing and the Hochkreuz Complex is directly overlying the Strieden and/or Ragga Complexes.

3. Polinik Complex (HP/M-HT, Middle Austroalpine)

The complex represents a crustal piece that underwent Alpine A-type (intrasialic) subduction. It comprises typical HT-HP rocks like eclogites with macroscopically visible light-green omphacitic pyroxene, together with garnet. Garnet amphibolites and metaultramafics accompany the eclogites. Another characteristic feature of the complex are light-coloured granulitic-like gneisses to massive granulites which are overlain by eclogitic granitic micaschists only with some relics of feldspars. They built e.g. the Polinik peak.

The lowermost part of the complex is marked by granitic augengneisses that tectonically overlie the deeper Strieden unit in the area W of Polinik and E of Salzkofel peaks.

4. Hochkreuz Complex (medium-grade, Middle?, Upper? Austroalpine)

In the western part of the Kreuzeck Massif, the complex overlies both the Strieden and (deeper) Ragga higher-grade complexes. Low-grade metamorphic rocks of the Steinfeld Complex covered by the Permian metasediments, occur vice versa at the southern slopes of the Kreuzeck Massif overlying the mentioned higher-grade Hochkreuz Complex. The Hochkreuz Complex can be defined in the following partial domains:

- The Kreuzeck Massif is built of coarse-grained garnet micaschists to gneisses with a marker horizon of graphitic metaquartzites. Pale feldspar-rich medium- to fine-grained (granulitic-like) orthogneisses to gneisses enriched with biotite (10–40 m thick) occur within the schistosity of micaschist-gneisses. Some strongly schistose portions have leucophyllitic character. A huge layer of amphibolitic rocks (several tens of metres thick medium-grained amphibolites, coarse-grained metagabbros, banded high-temperature mylonites of amphibolites and gabbroamphibolites) occurs within the uppermost part of the Hochkreuz Complex around Kreuzeck peak. Scarce narrow serpentinite and calc-silicate lenses are present there too.
- A slice of garnet micaschists of the Hochkreuz Complex overlies the gneisses of the Ragga Complex (S of Rastl peak, 2165 m).
- Area north of Greifenburg. For a comparison, in the area Hochkreuz – Annaruhe the following rock-types have been distinguished:
  - Garnet mica-schists with abundant garnet up to 1–2 cm large, schistose with white mica and quartz as the main rock-forming components.
  - Quartz layers with graphitic admixture, where sulphidic mineralization (e.g. near Niedermueller Alm, 1770 m) occurs within hydrothermally altered zones.
  - Quartzitic gneisses to metaquartzites, forming several metres thick leucocratic and massive layers within the micaschists.

- Amphibolites, medium to coarse-grained, with sporadically present garnet.
- Greenschists, fine-grained, with actinolitic amphiboles, chlorite, epidote and quartz, represent the products of diaphthoresis of amphibolites.

5. Steinfeld Complex (low-grade, Upper Austroalpine)

The complex is widespread in the southeastern part of the map-sheet and represents a continuation of a similar rock sequence mapped earlier (PUTIS et al., 1995, Lainach – Dölsach area), on the southwestern slopes of the Kreuzeck Massif.

Low-grade probably Early Paleozoic (Devonian?–Lower Carboniferous?) metasedimentary and metavolcanic rocks are exposed on both sides of the Drau valley. They are composed of dark-grey metapelites (chlorite-sericite phyllites) and metasandstones to quartzites, metagreywackes, which pass gradually into garnetiferous micaschists and biotite schists, respectively. Metavolcanics, mainly greenschists (to Ab-Ep amphibolites) represent thin intercalations within metasedimentary rocks. It was a thick (at least a few hundred metres) flyschoid sequence originally, enriched in thin basic volcanics and tuffs.

In general, the phyllite unit is folded into upright W–E trending macrofolds. Quartz-biotite to chlorite schists and quartzites dip generally moderately to the north. The other fold generation was found especially in more quartzitic parts. Axes of mezoscopic folds have approximately N–S orientation. Axes of intrafolial tight to isoclinal folds and parallel mineral lineation plunge steeply to the north.

The uppermost and frontal part of the complex is built of a volcano-sedimentary “porphyroid” formation which comprises a lot of alternating pale to white fine- to medium-grained metarhyolitic (quartz, feldspar, white-mica rich rocks) to metadacitic (albite, biotite, chlorite, epidote, less quartz) volcanics and metatuffs. Some of metadacitic rocks with scarcely preserved porphyric structures of plagioclase might indicate the presence of subvolcanics – porphyries. Other pale porphyric rocks look like granite-porphyries. Metasedimentary white mica and chlorite rich rocks locally contain chloritoid porphyroblasts.

The complex is overlain by the Permoscythian cover rocks, locally S of the Drau river by the Triassic carbonates of the Gailtal Alps. The contact zone between the low-grade basement and cover rocks is steepened, marked by fan-like steeply dipping schistosities also indicating strike slip movements. Brittle overprint is represented by steeply north dipping kink bands. In the Drautal near Kleblach village and the Kamp hill, the basement rocks are strongly mylonitized and phyllonitized along a steeply northward dipping to vertical shear zone with dextral kinematics.

5. (Upper-)Austroalpine Cover Complexes

Permian cover

Very low-grade Permian (possibly Permoscythian) Verrucano-type clastic metasediments build at least 3 km long and about a half kilometer wide synform along the ridge W of Radlberg (between Törl and Speikbichl peaks) northeast of Steinfeld in the Drau valley. They appear to be the cover of the Upper Austroalpine Early Paleozoic low-grade basement rocks exclusively.

Similar rocks build the about 1 km long and some 100 m thick lensoidal body on the Dolzer – Putzen ridge north of Steinfeld, best exposed in the Gnoppnitztörl saddle and Marbach Graben near Ederalm. They consist of variegated slates in places with carbonate nodules, arcosic and quartzitic metasandstones and quartzose metaconglomerates. The Permian sediments exhibit maximally anchimetamorphic recrystallization and contain very fine-flaked newly-formed white micas in schistosity. They consist of variegated greenish or violetish slates, arcosic and quartzitic metasandstones and metaconglomerates. The bedding planes are locally visible according to alternating lithological members.

Triassic cover

In the Obervellach map sheet, Triassic dolomites and limestones of the Gailtal Alps occur only in two small outcrops near the Fellbach village. They directly overlie dark phyllites of the Steinfeld Complex.

6. Tectonostratigraphy and Major Structures

General tectonic structure of the Kreuzeck Massif is affected by large-scale thrusts, strike-slips, reverse faults and back-thrusts. Tectonic superposition of divided lithological complexes is evident all over the mapped area. We observed the following tectonostratigraphical (structural) profile as the result of Alpine collisional tectonics and subhorizontal thrusting:

The lowermost tectonostratigraphic unit is represented by the large (medium–high grade) Ragga Complex, which occurs in the northern and central part of the mapped area. The complex was also found in the form of a tectonic window in the upper part of the Teuchlbach valley. The southernmost occurrence of the unit is connected with its south-vergent back thrust over Permoscythian cover the rocks of the southernmost and uppermost tectonostratigraphical Steinfeld Complex.

The medium structural level occupies the (medium grade) Strieden Complex in a synformal position on the Ragga Complex. Its eastern continuation has been found in the Salzkofel area.

The higher structural level of the tectonostratigraphic profile is built of the (HP/HT) Polinik Complex with a typical rock sequence spread around the Polinik peak (2874 m). We restricted the Polinik Complex defined by HOKE (1990) only to the HT-HP rock sequence (eclogites, etc.), and separated it on the geological map from the Ragga Complex which had been previously (sensu HOKE, 1990) incorporated into the Polinik Complex. The central part of the Kreuzeck-(Polinik) Massif is divided by a large E–W trending strike-slip shear zone (main mylonite zone, sensu HOKE, 1990). The internal structure of this zone is demonstrated by steeply dipping foliations and subhorizontal stretching lineations. The tectonic zone is marked by lenses of the Berghaus Formation of the Strieden Complex.

The higher (medium-grade) Hochkreuz Complex builds the area around the Kreuzeck peak, overlying both the Strieden and deeper Ragga Complexes, because the Polinik Complex is missing towards the south. The Eastern continuation of the Hochkreuz Complex represents garnet micaschists around Rastl peak (2165 m).

The (low-grade) Steinfeld Complex with Permoscythian cover (anchimetamorphic) rocks occupies the uppermost tectonic position, overlying both the Hochkreuz and Ragga Complexes in the SE part of the mapped area. The Steinfeld Complex is juxtaposed to the above mentioned northern 4 complexes along a large WNW–ESE trending strike-slip, where this complex submerges to the S or even to the N.

Tectonic contacts between the complexes represent the major thrust surfaces due to Alpine collisional shortening. These are steepened and cut by strike slips marked by dark to black ultracataclasites in E–W (Nigglaibach, Schwarzsee) or NE–SW (Kaisertalbach) direction.

The general strike of metamorphic foliations in the mapped area is WNW–ESE, they are often steeply dipping, not rarely vertical. There were observed zones of extense mylonitization, especially in the southern slopes of Nigglaibach, where also strike-slip slickensides parallel with the valley were observed.

These zones of ultramylonites to ultracataclasites with usually vertical foliation are structures developed due to the dynamics of Drau and Möll strike-slip megashear zones. Thus, they are second order shear zones, genetically related to the above mentioned first order ones. They rim tectonic megalenses which are between the Möll and Drau line.

7. Tertiary Volcanics

Porphyrites and subvolcanic dikes penetrating the above mentioned metamorphites in several places (e.g. area of Rennsfeld, 2418 m).

Southerly of the Striedenkopf in the terminal cars of Teuchl valley was observed in average 4 m thick steeply dipping, ENE–WSW striking dike of probably Tertiary andesites. This dike-vein can be followed across the valley to the opposite slopes (Dechant area).

8. Quaternary

The formation of Quaternary sediments is closely connected with the evolution of the morphology (influenced by neotectonics) and with the glacial activity. According to the history of their evolution a variety of genetic types of Quaternary rocks are distinguished. The slope cover occurs in great extent. The lower parts of slopes are covered mainly by stony-loamy, locally bouldery talus (debris cones), for higher altitudes stony scree is the most typical. Except usual stone and clay-stone debris at higher levels, there are several relicts of moraine deposits, e.g. S of Striedenkopf, and W of Salzkofel. Large debris cone has been found in the middle part of the Lesnigbach valley, southeasternly of Radlberger Alm. Moderate slopes between 1400 and 1800 m altitude are often affected by landslides, mostly inactive now (e.g. Pirkebner Alm, Radlberger Alm – Kuhberg).

In the valleys incised by larger streams alluvial deposits of fluvial plain have been developed. In smaller valleys the alluvial valley-floor deposits are obviously not preserved, due to intense valley-floor erosion. At the valley mouths a system of alluvial fans originated, often causing the curvation of flow direction of main rivers and/or partial damming of the valleys entered. The material of alluvial fans is derived from the talus material. The largest fans occur in the Drau River valley. In the higher altitudes, where gravitation dominates comparing water activity, cone debris are the most common. Slopes of the Drautal valley with wide alluvial plain is marked by numerous debris and alluvial fans.

Another important type of Quaternary deposits are gravelly and loamy-gravelly terraces (in the Drau River valley mainly). The residual gravel bodies form a terrace system in higher altitudes on the valley sides. Remnants of terraces occur on the Kamp hill near Lengholz. The terraces are commonly geomorphologically discernible by their more flat relief in contrast to steep erosional slopes. The older terraces are intensively eroded both by small tributaries and slope erosion.

The role of neotectonics is expressed by block fissures on mountain ridges, rock falls, for instance in the vicinity of the Boden See (Polinik), by huge thicknesses of alluvial fans, by river terraces and by some stream-like landslides. Ridges above 2000 m are mostly instable with numerous splittings and fissures (e.g. Kreuzeck, Lenkenspitz, Rastl, Platteckspitz, Wallneralm).

Blatt 184 Ebene Reichenau

Bericht 1996 über geologische Aufnahmen in der Gurktaler Decke auf Blatt 184 Ebene Reichenau

ROBERT HOLZER & CHRISTIAN GORITSCHNIG
(Auswärtige Mitarbeiter)

In Weiterführung der Kartierung wurden Aufnahmen im nördlichen Teil des Kartenblattes im Einzugsgebiet des Hinteren Seebaches, des Geißeckbaches sowie im Bereich des Weitentales, des Rauterriegels und an den südlichen Abhängen von Eisenhut und Wintertalernock durchgeführt.

Eine gute Aufschlußsituation ergibt sich nur entlang der Höhenrücken zwischen Eisenhut und Wintertalernock bis hinunter zur Baumgrenze. Große Teile des Gebietes mußten daher anhand von Hangschutt und Lesesteinen kartiert werden. Selbst Weganschnitte zeigen nur wenig Aufschlüsse, sondern eine in der Regel mächtige Hangschuttbedeckung. In der Talsohle des Geißeckbaches findet sich polymikter alluvialer Schutt aus allen kartierten Einheiten.

Tektonisch gesehen gehört das Kartiergebiet der oberostalpinen Gurktaler Decke an, deren maximal epizonal metamorphen Gesteine vor allem dem Altpaläozoikum angehören.

Die Kartierung läßt folgende Seriengliederung zu:

– Kaserserie (nach H. MULFINGER, 1987): Vulkanite
– Gurktaler Phyllite: Quarzphyllite bis Glimmerschiefer
– Klastische Serie: Metasandsteine, Siltschiefer, etc.
– Eisenhutschiefer: Tuffe.

Innerhalb der Kaserserie treten vor allem Chloritflatschentuffe und feinkörnige grüne und violette Tuffe auf. Nördlich der Gesgeralm sind entlang der Forststraße grobkörnige, dunkelgrüne Laven mit Pyroxen-Porphyroblasten aufgeschlossen, die mit hellgrauen Tuffen mit Pyroxen-Einsprenglingen wechsellagern. Im Hangenden dieser Serie findet sich am W-Abhang des Engeleriegels ein bräunlicher, kaum metamorpher Vulkanit mit langen, schmalen Feldspatleisten. Auch helle Quarzporphyre treten in diesem Gebiet auf. Die Wechsellagerung der verschiedenen Tuffe und Laven ist sowohl im Zentimeter- als auch im Zehnermeterbereich zu beobachten, was auf einen häufigen Wechsel von Laven- und Aschenförderung