Doctoral Thesis

Geologie der östlichen und südlichen Urirotstock-Gruppe

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Geologie der östlichen
und südlichen Urirotstock-Gruppe

Abhandlung
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vorgelegt von
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I. ABSTRACT

This paper deals with the structure and stratigraphy of the Urirotstock chain, a mountain range with peaks up to 2980 m which extends from the southernmost tip of Lake Lucerne near Flüelen to the valley of Engergelb (fig. 1).

The middle helvetic Urirotstock-Nappe, consisting of two recumbent fold systems, the Rimistock-Digitation below and the Walenstock-Digitation (see Tab. III, section 1-6) above, rests on a thick "cushion" of Flysch, which can be subdivided into an upper thinner zone containing a tectonic mixture of south-helvetic and north-helvetic elements, and a lower thick sequence of north-helvetic Flysch, which in turn is lying with a structural contact on the steeply north-dipping sediments of the autochthonous Aare Massif. The southhelvetic elements slid off their mesozoic substratum - the Drusberg Nappe - in an early phase, came to rest some distance north of it and were later overridden by the main helvetic nappe, the southern part of which - the Drusberg Nappe, consisting mainly of Cretaceous and Tertiary rocks - finally overtook the middle helvetic elements, separating the Urirotstock-Nappe from the Axen-Nappe (s. Tab. III/IV), dragging the Cretaceous units of the Border Chain to the north. The Axen-Nappe and the elements of the Border Chain originally formed the Cretaceous and Tertiary cover of the Urirotstock-Nappe, which is built up mainly of Jurassic rocks. Only in the inverted limb of the Rimistock-Digitation are the post-Jurassic rocks of the Urirotstock-Nappe, forming the slices and folds of Chilat, preserved in contact with the Jurassic. The Glischen thrust block in the NE (see Tab. IV, section 11) the Wiesenberg slab in the SW (see Tab. III, sections 1-3) and the peculiar Firzenband slice (see fig. 28) are isolated masses of north helvetic origin which were dragged along at the base of the Urirotstock-Nappe.

Lower Jurassic (Lias) rocks form the core of the Rimistock-Digitation and klappe-type remnants of the Walenstock-Digitation. The sequence can be subdivided into the formations described by R. TRÜMPY (1949) in the Glarus Alps. Present are the Lower Spitzmeilen fm., white quartzites and interbedded red to green weathering sandstones with sandy limestones; trusses of the Upper Spitzmeilen fm. with reworked phosphorite casts of Ammonites indicating an upper Sinemurian age (probably raricostatum zone); the Lower Sexnner fm., slightly cherty, grey, argillaceous limestones with shale layers and the Upper Sexnner fm., yellow weathering sandy limestones with brown sandstone layers, white chalk masses and many sedimentary features indicating strong current activity in shallow water (fig. 4). These rock units are overlain by a thick, massive, light colored Echinoderm limestone with sand layers and great amounts of dolomite pebbles. Outside the Urirotstock group and the Triebsee-Jochpass region only traces of this limestone can be found. It is therefore named Brunnstock fm. (see fig. 2, 32).

In the middle Jurassic (Dogger) the nomenclature introduced by S. DOLLFUS (1965) in the mountains E of the Linth valley is applied, except for the name Mola fm. This formation has been incorporated in the Bonnerstein fm., which, at the bottom consists of massive, brownish yellow weathering, sandy limestones with dolomite pebbles, massive Echinoid fossils and the characteristic "Chaatetitade" (fig. 9, 10). The middle part is taken up mainly by black argillites with thin interbeds of quartzite, sandstone and hemiatomic or cherty echiatomic limestones. At the top a massive, more calcareous sequence occurs, in which a hemiatomic eastern facies can be distinguished from a western facies with less iron. This could indicate the existence of a Mesozoic scarp E of the sedimentation area of the Urirotstock-Nappe. The Bonnerstein fm. approximately covers the Aalenian stage. With the Reischiben fm. (middle Bajocian) light grey massive crinoidal limestones reappear. Two geographically isolated lenses of coral-bearing limestones occur in the middle of this unit. Towards the SW argillaceous, cherty limestones and calcareous shales similar to the Schwarzhorn beds of the Bernese Oberland gradually replace the crinoidal limestones which often contain very coarse calcic material. Chert nodules are very common; however they disappear in the eastern part of the Urirotstock group. It is postulated that the silica migrated from the shaly Schwarzhorn facies into the crinoidal limestones under compaction pressure. The many observed T-cherts show that - probably due to a still available supply of connate water - the silica was remobilised during the alpine deformation.

The rocks of the Reischiben fm. occupied a bay-like basin open to the SW, characterised by strong sedimentation and lined by areas with meager deposition on the three other sides. Erosion areas in the E and SE which were active throughout the upper Lias and the middle Jurassic supplied debris of Triassic Röti dolomite and probably Permocarboniferous, mainly acidic igneous rocks. The paleogeographic analogy to the middle Jurassic of the Dolhenhorn Nappe (parautochthonous, Bernese Oberland) indicates that the boundary between the shaly Dauphins facies in the SW and the calcareous facies in the NE obliquely traversed the area which was to become the Aar massif in a SW-SE direction. It reached the middle helvetic realm in the sector of the Urirotstock-Nappe and formed embayments the position of which was controlled by the paleogeography of the Liassic Allemannic Land (R. TRÜMPY 1949).

During the upper Bajocian, sedimentation became extremely slow. In the Urirotstock group only the thin Bathonian shales, containing a rich fauna, were deposited. The upper Jurassic (Malm) begins with the mottled Schilt shales and limestones which at the base contain lenses of black limestone with serpulids and reworked components of upper Bajocian rocks (especially the iron rich Blegioolite, which is missing in this region). The Quinten Limestone mainly consists of dark grey, fine grained, massive limestones. In the upper part various kinds of dolostones, breccias with graded bedding, iron - rich horizons, stylolite limestones, chert nodules and beds with patch reef-type coral and sponge growths appear.

The Lower Cretaceous of the Urirotstock-Nappe is about 300 m thick and is similar to the section of other north - and middle - helvetic nappes. Important features are the shaly nature of the Debrili Beds (Berriasian) which only in the northernmost exposures becomes massive and calcareous again; the disappearance of the Valanginian Shales in the North and the occurrence of blue amphibole crystals in the glauconitic Lidermen Beds (Hauterivian). Pre-Eocene Erosion cuts down to the Lower Schrattenkalk fm., in the S and only to the lowest part of the Upper Schrattenkalk fm. in the N, indicating pre-Eocene deformation, probably faulting. There is a gradual increase in thickness from the Cretaceous of the Urirotstock-Nappe to the same formations of the Axen-Nappe.

In the Eocene sequence, a thick, banded lower unit with limestones, quartzites, sandstones and glauconitic beds, containing Nummulites can be distinguished from an upper shale part consisting of the Pectinaten Shales below and the
foliated Globigerina Shales above. There are certain similarities with the Tertiary of the Axenmättli Syncline E of the Reuss valley. The Kleintal Conglomerates in the Globigerina Shales show that erosion of Cretaceous and Tertiary beds took place north of the Urirotstock Nappe.

The Gitschen thrust block contains Upper Jurassic to Tertiary rocks. The upper part of the Quinten limestone is replaced and overlain by the massive, light colored Troskalk fm., a coarse limestone, rich in fossil debris. The Cretaceous is cut down to the Drusberg Beds by pre-Eocene erosion, is rather similar to the section of the Schilt Nappe or the Clariden Elements in the Glarus Alps and still very close to the Cretaceous of the Urirotstock Nappe.

In the Wissberg slab the Quinten Limestone is dominant. Only the lowermost formations of the lower Cretaceous are preserved. The occurrence of charophytes and the generally higher limestone content, as well as some indications of erosion show the Wissberg slab to be a more northerly element than the Gitschen thrust block. It is probably comparable to the Griesstock Nappe of the Klausen Pass (see W. BRUCKNER, 1937, 1943).

In the Hauterivian Kieselkalk fm. of the Firrenband slice Tertiary sandpockets occur which could have been reactivated as sandstone dikes (fig. 27).

Structures in the Wissberg slab show that it was rotated into a parallel trend to the principal direction of movement of the Urirotstock Nappe at an early stage. The Firrenband slice is still enigmatic in many respects.

The thrust passing above the Wissberg slab and below the Gitschen thrust block was an important glide plane in one of the later movements of the nappes.

In the overturned limb of the Urirotstock Nappe two fold generations can be distinguished. The later one produced antiforms closed to the N with the youngest beds at the core. The principal fold axes in the Rimistock Digitation are arculate. Lower folds disappear toward the SW and are replaced by higher ones. Whereas the general trend of the strike in the Rimistock Digitation is NE - SW, it changes to E - W and ESE - WNW in the Walenstock Digitation, which draws back very much in the area of the EngelbergetRotstock and Wissigstock. Because of this and its lower position, the summit pyramid of the Urirotstock cannot be an outlier of the Walenstock Digitation, but is part of the Rimistock Digitation.

T-dolostones which occur in the Rimistock Digitation are shown to be associated with the high magnesia content of the Quinten Limestone. There are several phases of dolomitisation. Young, steeply dipping fractures postdate the dolomites, which especially often occur on the older, deformed, south-dipping normal faults.

The folds of the Scheideggstock-Bocktistock group NW of Engelberg are the approximate lateral equivalents of the combined Rimistock-and Walenstock Digitations. In the Axen Nappe E of the Reuss there are no folds corresponding to the lowermost structures of the Rimistock Digitation.

The deformational history of the Urirotstock group is tentatively tabulated on p. 149. Important events are the braking of the helvetic nappe on an early predecessor of the Aar massif (Folds steepened, disharmonic tectonics near the boundary Upper Jurassic/Cretaceous, first formation of the later deformed Bühlritti Fault, see p. 134 - 136), the overriding of the obstacle (Connection Gitschen thrust block / Urirotstock Nappe left behind, Wissberg slab separated from the autochthonous sedimentary cover), the forward movement of the Drusberg Nappe beyond the Axen Nappe (Cretaceous sheared off Urirotstock Nappe, Walenstock Digitation turned in E - W direction) and several later phases in which the movements of the Aar massif played a certain role and the main thrusts, as well as the overturned limb of the Rimistock Digitation underwent secondary deformation.