

Jubiläumsschrift 20 Jahre Geologische Zusammenarbeit Österreich – Ungarn			A 20 éves magyar-osztrák földtani együttműködés jubileumi kötete		
Redaktion: Harald Lobitzer, Géza Császár & Albert Daurer			Szerkesztette: Lobitzer Harald, Császár Géza & Daurer Albert		
Teil 2	S. 379–382	Wien, November 1994	2. rész	pp. 379–382	Bécs, 1994. november
ISBN 3-900312-92-3					

Penninic and Upper Austroalpine Units (Paleozoic of Graz ?) in the Borehole Szombathely-II (Western Hungary)

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With 2 Text-Figures and 1 Table

Österreichische Karte 1 : 50.000
Blatt 139

*Ungarn
Penninikum
Penninikum
Grazer Paläozoikum
Metamorphite*

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Penninische und Oberostalpine Einheiten (Grazer Paläozoikum?) in der Bohrung Szombathely-II (Westungarn)

Zusammenfassung

Die Kernbohrung Szombathely-II in Westungarn durchteuft unter einer mächtigen Schichtfolge des Tertiärs von 2063,7–2081,0 m eine Serie sehr gering metamorpher Karbonatgesteine, die getrennt von einer Störungsbreccie von 2085,3–2150 m (Endteufe) von einer Schichtfolge metamorpher Gesteine der Grünschieferfazies unterlagert wird. Basierend auf einer geochemischen Korrelation wird angenommen, daß die liegende Einheit, die überwiegend aus Grünschiefern und Prasiniten besteht sowie untergeordnet aus Epidot-Chlorit-Schiefern, mit dem Rechnitzer Penninikum parallelisiert werden kann. Die überlagernden Karbonatgesteine führen spärlich Echinodermentfragmente, wobei auch Zwischenlagen von schieferigen und quarzitischen Sedimenten sowie laminierte Lagen mit wechselndem organischem Anteil, auftreten. Auffällig ist der Metamorphosesprung zwischen den beiden Einheiten, wobei überwiegend duktile Deformation für die Penninische Einheit charakteristisch ist, während eine Vielfalt von duktilen bis spröden Deformationsbildern für die hangende Karbonatgesteinsfolge des (?) Grazer Paläozoikums typisch ist.

Pennini és Felső Keletalpi egységek (Graci Paleozoikum?) a Szombathely-II sz. fúrásban

Összefoglalás

A Szombathely-II sz. fúrás vastag neogén sorozat alatt metamorf kőzeteket tárt fel. A Rechnitzi Penninikumba sorolható zöldpalák felett tektonikus breccsa kontaktussal nagy valószínűséggel a Felső-Keletalpi egység Graci Paleozoikumába sorolható, agyagpala és kvarcit betelepüléseket tartalmazó breccsás mészkő és dolomit települ. A mészkőben néhol echinodermata vázelemek találhatóak. A két tektonikai egység között metamorf ugrás mutatkozik, a zöldpalák a zöldpala fáciesnek, a karbonátos sorozat az anchizónának megfelelő ásványegyüttesel jellemezhető. A két egység deformációs stílusa is eltér, a zöldpalákat főként rugalmas, a karbonátokat változatos, rugalmas és rugalmatlan alakváltozás határozta meg.

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Abstract

The borehole Szombathely-II, Western Hungary, has penetrated metamorphic rocks below a thick Cenozoic sequence. On the basis of geochemical correlation greenschists of the Rechnitz Penninic unit are directly overlain by carbonate rocks, probably belonging to the Paleozoic of Graz (UAA). Beside the dominating greenschists and prasinites the lower unit also contains epidote chlorite schists. Static crystallization of albites is characteristic in some horizons. The carbonate rocks of the upper unit contain sparse echinoderm fragments and slaty and quartzitic layers and laminations with varying organic content. The contact between the two units is a fault breccia, and the upper unit is extremely thinned out. There is a hiatus in metamorphic grade between the two units, mainly ductile deformations under greenschist facies conditions are characteristic for the Penninic rocks, while a variety of ductile-brittle features formed under very low grade conditions are typical for the UAA rocks.

1. Introduction

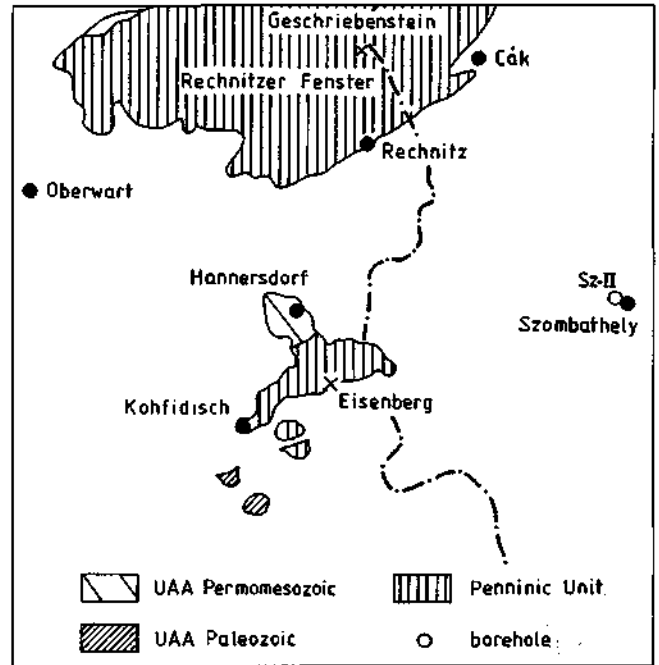
The borehole Szombathely-II, situated in the outskirts of Szombathely, Western Hungary (Fig. 1) has penetrated metamorphic rocks at the bottom of a thick Cenozoic sequence. Its lower part is characterized by greenschists, the upper part by a brecciated carbonate sequence. Their contact is a fault breccia. According to their lithology, metamorphic grade and structural features these metamorphic rocks can be assigned to two different tectonic units (Fig. 2).

2. Petrographic Description

2.1. Greenschist Sequence

This sequence is built up of green schistose rocks, schistosity planes are parallel or folded, sometimes with sigmoidal folds. Layering or laminations displayed by differences in mineral composition and grain size are widespread. The sequence is crosscut by carbonate veins.

Chlorite, albite, epidote, actinolite are the main mineralogical constituents of these rocks associated with sphene, minor quartz and white mica. The most widespread rock-types are greenschists and prasinites (albite + chlorite + epidote + sphene + actinolite). Chlorite-epidote schists and albite rich rocks make up thin layers in the former rocks. In some layers epidote-albite and actinolite-albite felsels are abundant. They contain statically crystallized albites incorporating folded inclusion trails outlined by minute epidote and actinolites. In some layers white mica occurs associated with quartz. Zoning in amphibole and epidote is common. The relationship of crystallization to deformation of the minerals reveals a poly-phase history for these rocks.



Text-Fig. 1.
Location map of the borehole Szombathely-II.
After TOLLMANN (1978) and HERRMANN et al. (1988).

According to the mineralogical associations and textural features the metamorphic grade of these rocks corresponds to the greenschist facies (low grade).

2.2. Carbonate Sequence

This sequence is made up of pure carbonates containing interlayered slaty and quartzitic horizons. The whole sequence is strongly folded and brecciated, reflecting a wide variety of structures of composite ductile-brittle deformational style.

The pure carbonates contain fragments of marbles of different texture and composition, they are lined or granoblastic with subordinate, dispersed quartz, albite and/or preferentially oriented sericite crystals.

Fragments often are outlined by stylolitic surfaces high in organic content.

Rock types of the interlayered slaty and quartzitic

Table 1.
Means of chemical analyses of greenschists from the Paleozoic of Graz, Hannersdorf, Eisenberg and borehole Szombathely-II.

		TiO ₂ %	P ₂ O ₅ %	Ni ppm	Cr ppm	V ppm
PALEOZOIC OF GRAZ n = 5	min	1.74	0.45	-	8	193
	max	3.80	0.76	7	25	403
	mean	2.63	0.56	1.6	16.4	275
HANNERSDORF n = 5	min	2.76	0.41	19	36	317
	max	3.48	0.76	27	50	418
	mean	3.14	0.54	22	43.4	360
EISENBERG n = 8	min	0.80	0.08	227	88	146
	max	1.45	0.16	319	125	209
	mean	1.16	0.12	274	103.8	185
SZOMBATHELY-II Ti, P n = 8 Ni, Cr, V n = 11	min	1.03	0.06	60	60	100
	max	1.53	0.28	400	160	250
	mean	1.36	0.11	249	105	146

Abb. 2.
Section of the metamorphic part of the borehole Szombathely-II.

horizons and laminations are sericite slates containing laminae high in organic content, quartz-sericite-chlorite schists and carbonate and sericite bearing quartzites. The thin carbonate layers are pure or contain minor quartz, albite and sericite. The grain size of the recrystallized carbonate is different in single layers, sometimes they contain scattered coarse carbonate monocrystals which can be interpreted as echinoderm fragments.

A singular mylonitic shear zone a few cm in thickness, characterized by compositional layering, fluxion structures and undulating trails of crushed material around porphyroclasts cross-cuts this sequence.

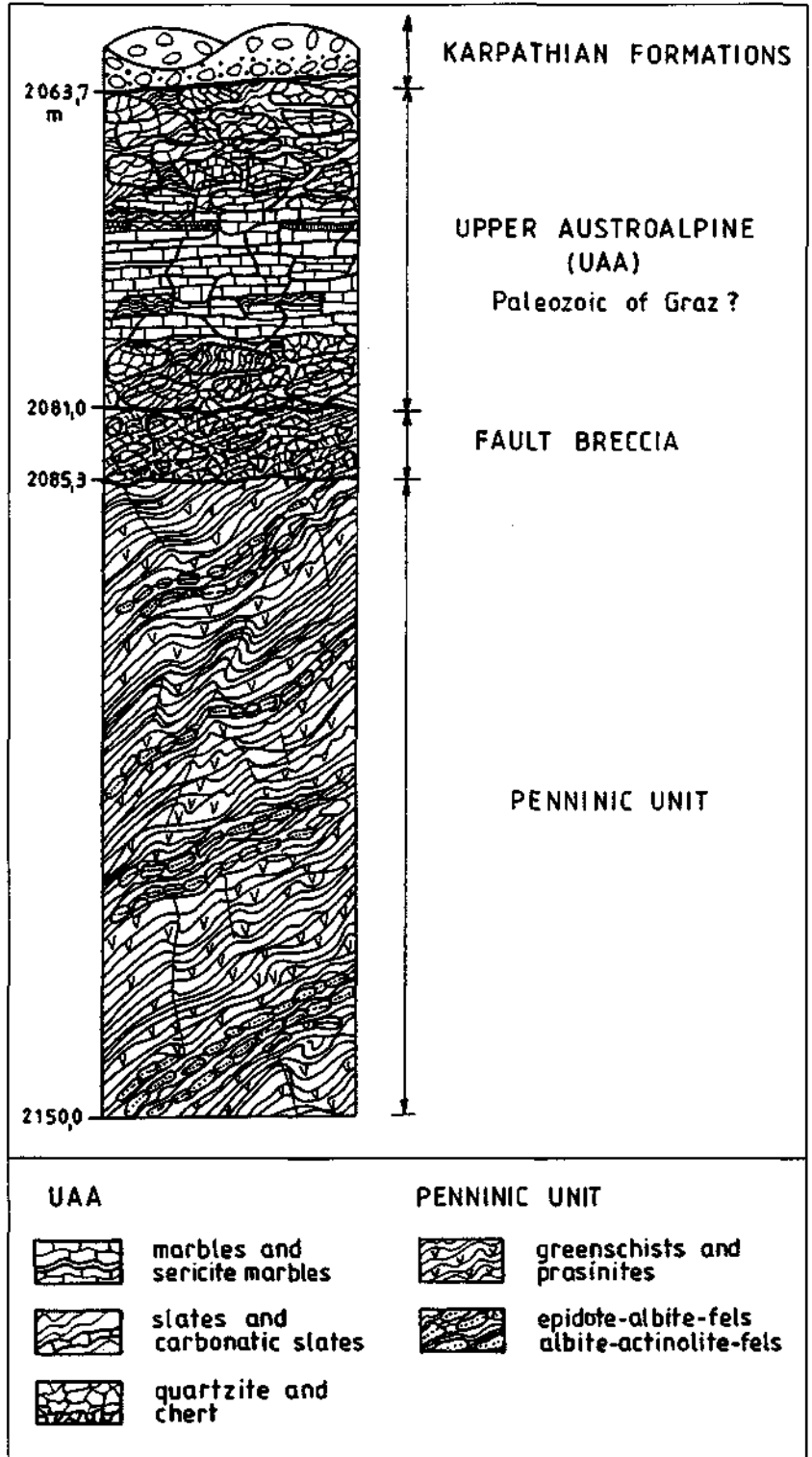
For defining the metamorphic grade of the carbonate sequence, only textural features are available at present, which reflect very low-grade conditions for these rocks.

2.3. Fault Breccia

The contact between the sequences described above is a fault breccia. This is a matrix supported breccia: in a greenish-reddish clayey-carbonatic matrix randomly oriented, angular, and unsorted fragments of marbles, quartzites and various rock-types of the greenschist sequence are present.

3. Correlation of the Sequences

As concerns the correlation of the metamorphic rocks penetrated by the borehole Szombathely-II, for the greenschists a good tool is given by some geochemical data. Comparative studies of greenschists coming from the Rechnitz Penninic unit, Hannersdorf area and Paleozoic of Graz (GRATZER, 1985) have specific differences in TiO_2 and P_2O_5 among the major elements and of Ni, Cr, and V among the trace elements. Thus these elements are usefully applied to prove the affinity of the greenschists described here. Comparing the means of analyses of the above mentioned elements of rocks from the borehole Sz-II to those published by GRATZER (Tab. 1), greenschists of this log can be clearly classified as belonging to the Rechnitz Penninic unit.



For the correlation of the carbonate sequence, due to the lack of biostratigraphic data (samples supplied no conodonts, SCHÖNLAUB, pers. comm.), only lithological comparison can be applied.

From among the various rock-types described by EBNER (1988) from the Paleozoic basement of the "Oststeirisches Tertiärbecken" the similarity of our rocks to the dolomites, limestones with quartzitic and phyllitic layers and calcphyllites from the borehole Blumau 1a is the most striking.

If this correlation is valid, the carbonate sequence from the borehole Sz-II should belong to the Paleozoic of Graz.

4. Conclusions

In the borehole Szombathely-II greenschists of the Rechnitz Penninic unit are directly overlain by carbonate rocks probably belonging to the Paleozoic of Graz (UAA). The upper unit is extremely thinned out. The contact between the two units is a fault breccia originated under brittle conditions. There is a hiatus in metamorphic grade: greenschists belong to low grade, while carbonates underwent only very-low grade metamorphism. Deformation in the lower part has taken place mainly under ductile conditions, while the great variety of structural features of the carbonate sequence can be explained in terms of a set of ductile-brittle deformation.

Acknowledgements

The author is very grateful to Prof. F. EBNER, Prof. F. NEUBAUER, Dr. PAHR, Mrs. Dr. S. SCHARBERT and Prof. SCHÖNLAUB for fruitful discussions.

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