Magyarhoni Földtani Társulat
Földtani Közlöny
Hungarian Geological Society

146/3, 223–232., Budapest, 2016

Re-evaluation of archive pebble distribution data for the Upper Permian Bakonya Sandstone Member of the Kővágószőlős Formation, Hungary — a comparison with the composition of cores BAF–1 and BAF–1A

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A felső-perm Kővágószőlősi Formáció Bakonyai Tagozatának újraértékelése archív kavicseloszlási adatok alapján — A BAF–1 és a BAF–1A fúrások összehasonlításával

Összefoglalás

A 20. század második felében a permi Kővágószőlősi Homokkő uránércesedésének köszönhetően a Nyugati-Mecsek térsége intenzív földtani kutatások célpontjává vált. Miután az 1980-as évek végén az uránércbányászatot beszüntették, a terület a '90-es években került újra az érdeklődés középpontjába, elsősorban a nagyaktivitású radioaktív hulladékok elhelyezésére alkalmas, szintén permi Bodai Agyagkő Formáció kapcsán. Ezen kutatás érdekében mélyítették 2014-ben Bodától délnyugatra a BAF–1 és BAF–1A mélyfúrásokat, amelyek vékony kvarter és pannóniai rétegeket követően a Kővágószőlősi Homokkő legalsó, Bakonyai Tagozatát érintették. A fúrás 474,6 m-es mélységben leállt a Kővágószőlősi Homokkőben, így nem érte el a Bodai Agyagkő Formációt. Bár ezt a tarka, durvaszemű, kavicsos, zömmel terresztriális homokkövet a Bakonyai Tagozatként azonosították, ez nem volt teljesen egyértelmű a riolitkavicsok szinte teljes hiánya miatt, hiszen irodalmi adatok alapján a tagozat egyik jellemző törmelékanyaga a Gyűrűfűi Riolit. Legújabb tanulmányok ezt a főleg vörös színű, rosszul osztályozott kavicsos homokkövet a permi üledékes rétegsor tagjaként értelmezik, bár jura mikrofosszíliák is előkerültek a rétegsor szürke szakaszaiból. További szokatlan jelenség volt a törmelékanyagban azonosított karbonátkavicsok jelenléte. Ahhoz, hogy eldöntsük, hogy a BAF–1 és BAF–1A fúrások valóban a Bakonyai Tagozatot érintették, olyan korábbi fúrások dokumentációival hasonlítottuk össze, amelyek biztosan megfúrták ezt a tagozatot. Ehhez 11, a MÉV (Mecseki Ércbányászati Vállalat) által az 1950-es és '60-as években mélyített fúrás dokumentációját vizsgáltuk át, és számszerűsítettük az akkoriban Bakonyai Tagozatnak határozott rétegsor kavicsban gazdag szakaszainak kavicsstatisztikáját. Eredményeinket térképen ábrázoltuk sávdiagramok formájában, hogy könnyebben meghatározható legyen az egyes kavicstípusok területi eloszlása a tagozaton belül. Az archív adatok alapján látható, hogy a permi lehordási terület igen nagy litológiai változatosságot mutatott, ahol a törmelékanyag egy viszonylag kis területen is erősen polimikt jellegű. Ez arra enged következtetni, hogy a Bakonyai Tagozat nem jellemezhető egyetlen jól meghatározott kavicstípus-eloszlással. A BAF–1 és –1A fúrásokban a karbonátkavicsok jelenléte megkérdőjelezi a homokkő Bakonyai Tagozat mivoltát.

Tárgyszavak: Kővágószőlősi Homokkő, Bakonyai Tagozat, kavics eloszlás, perm, Nyugat-Mecsek

Abstract

In the second part of the 20th century the Mecsek Mts were the target of intensive mineral exploration due to the Permian uranium mineralization of the Kővágószőlős Sandstone. The mining was discontinued in the 1980s; however, in the 1990s the western part of the mountains became a focus of interest once again due to the presence of a possible high-level radioactive waste disposal site in the Permian Boda Siltstone Formation (former name of the Boda Claystone Formation, abbreviated in Hungarian as BAF). The BAF–1, –1A boreholes were deepened in 2014 in a South Westerly direction from Boda. In its planned succession the following lithological units were recognized: Quaternary and Pannonian sediments and beneath these the Bakonya Member of the Kővágószőlős Sandstone Formation and Boda Claystone. The drilling was terminated at a depth of 474.6 m, with the Boda Claystone Formation still not having been reached. Although this mottled, coarse, dominantly terrestrial sandstone was identified as the Bakonya Sandstone Member, this was not determined unequivocally due to the absence of rhyolite pebbles in the drill core. This was due to the fact that, according to the available literature, the typical source rock (at least 20–40 %) of the Bakonya Sandstone was the Gyűrűfű Rhyolite. The most recent studies classified the dominantly red, poorly sorted, pebbly sandstone as a part of the Permian sedimentary rocks, even though Jurassic microfossils from the grey strata of the drill cores were also identified. Furthermore, the occurrence of carbonate pebbles was also a peculiarity. In order to confirm that the layers of

the BAF–1 and –1A drill cores which had been reached undoubtedly belong to the Bakonya Member, work was carried out in order to investigate and compare these cores with other pebble-rich parts of the Bakonya Member occurrences in the area. For this comparison documentation concerning 11 drill cores was examined carefully. This data had been produced by geologists of MÉV (Hungarian abbreviation for Mecseki Ércbányászati Vállalat) in the 1950s and 1960s. The results of the examination related to this paper were represented in line charts and placed on the geological map of the Mecsek Mts. This enabled a comparison to be made of the spatial distribution of different types of pebbles to that of the BAF–1 and BAF–1A drill cores, and thus to observe how the debris material had changed in space and time. Based on the archive data, it is possible to show that the provenance area could have been characterised by a diverse lithology in which the debris material also varied over a relatively small area. It would imply that the Bakonya Member cannot be characterised by one distinct pebble composition. In other words, the presence of carbonate pebbles in the the BAF–1 and –1A drill cores raises uncertainties with respect to the Bakonya nature of the drilled strata.gary, West Mecsek Mts, Permian, Kővágószőlős Sandstone, pebble distribution.

Tárgyszavak: Kővágószőlős Sandstone Fm, Bakonya member, pebble distribution, Permian, West Mecsek, Hungary

Introduction

In southern Transdanubia, Hungary, the BAF–1 and BAF–1A boreholes — which are 15 metres apart — were deepened to the SW from the village of Boda in 2014. This deepening was part of a high-level radioactive waste disposal research program (*Figures 1 and 2*). Based on the data of surrounding boreholes and in concordance with the anticline structure of the Western Mecsek Mts, the presumed succession was: Quaternary and Pannonian sediments, and beneath these Kővágószőlős Sandstone (Bakonya Member), followed by Boda Claystone.

Under the 2.78 m-thick Quaternary sediments, the drilling intersected the Pannonian Kálla Formation to a depth of 15.90 m. Beneath this, extending to a depth of 18.70 m, a pebble-rich strata of uncertain age (Miocene?) lies upon the mottled, coarse-grained basement sequence. The drilling was terminated in this sandstone formation at a depth of 474.6 m (SÁMSON et al. 2015).

The existing lithostratigraphical classification of this red, brown, grey and green coloured, dominantly terrestrial, coarse-grained sequence was questioned due to the absence of pebbles from the Gyűrűfű Rhyolite Formation. The latter – according to earlier published evidence (FAZEKAS 1987, BARABÁS & BARABÁSNÉ STUHL 1998) — should have been the primary source rock of the Bakonya Sandstone Member of the Kővágószőlős Sandstone Formation, Southern Transdanubia, Hungary. At this point it has to be noted that the Gyűrűfű Rhyolite Formation consists of differently- altered rhyolite and closely related rocks such as rhyolitic tuffs (FAZEKAS 1987, BARABÁS & BARABÁSNÉ STUHL 1998, BODOR & SZAKMÁNY 2009). However, in this study, all types of acidic volcanic and pyroclastic pebbles are referred as rhyolite.

The aim of this study is to investigate the Bakonya Sandstone Member from the point of view of rhyolite pebble occurrences. According to BARABÁS & BARABÁSNÉ STUHL (1998)), amongst the poorly or moderately rounded pebbles the most frequent ones are composed of rhyolite (20–40%); quartz is also quite frequent, while sandstone, phyllite, schist and granite pebbles are subordinate. In this work a comparison is made of the distribution of Bakonya Member pebbles from the BAF–1 and BAF–1A drill cores, with other occurrences of the same rock material in the area. The aim of this comparison is to see if the absence of rhyolite pebbles also characterize other strata of the Bakonya Sandstone layers. In this way it should be possible to acquire evidence showing that the lack of rhyolite pebbles does not exclude classification of the strata as being part of the Bakonya Member.

10 MÉV drill cores in the West Mecsek Mts (Gorica G–7, Gorica G–7–1, structure well VI, structure well VII, 7004, 9108, 9101, 4730, 4729, Keresztespuszta Kp–3 — and Gálosfa Gf–1) — were re-evaluated. Furthermore, the pebble distribution of the coarse-grained layers of the BAF–1 and BAF–1A drill cores were studied. The results obtained for the present study are illustrated by depth and spatial situation.

Geological background

The Mecsek Mts and their surroundings belong to the SE Transdanubian part of the Tisza Mega-unit. The region is built up of several smaller units, bounded by structural elements *(Figure 1)*. The Permian formations in the Mecsek Mts are part of a thick, non-metamorphosed molasse sediment sequence; this sequence was deposited in orogenic basins that were formed during the Variscan orogeny. An older sequence consists of Upper Carboniferous to Lower Permian clastic and felsic-neutral volcanic rocks, while a younger one is made up of Upper Permian and Lower Triassic clastic formations (BARABÁS & BARABÁSNÉ STUHL 1998, HAAS & PÉRÓ 2004, BODOR & SZAKMÁNY 2009).

The fluvial Kővágószőlős Sandstone Formation belongs to the younger sequence and lies upon the Boda Claystone Formation (BARABÁS 1979). The latter has been studied intensively due to uranium ore mining, and a summary of its description was published by BARABÁS (1979), FÜLÖP (1994) and BARABÁS & BARABÁSNÉ STUHL (1998). Its thickness varies between 150 and 1400 m. In an earlier study, the Kővágószőlős Formation was subdivided into four members (GYALOG 1996). However, KONRÁD et al. (2011) suggested a more detailed classification with five members, namely Bakonya Sandstone, Kővágótöttös Sandstone (grey sequence), Kajdácsvölgy Sandstone (productive green sequence), Cserkút Sandstone (overlying red sequence) and the Tótvár Sandstone (purple, pebbly sequence). The Bakonya Sandstone Member consists of mottled (grey, green and

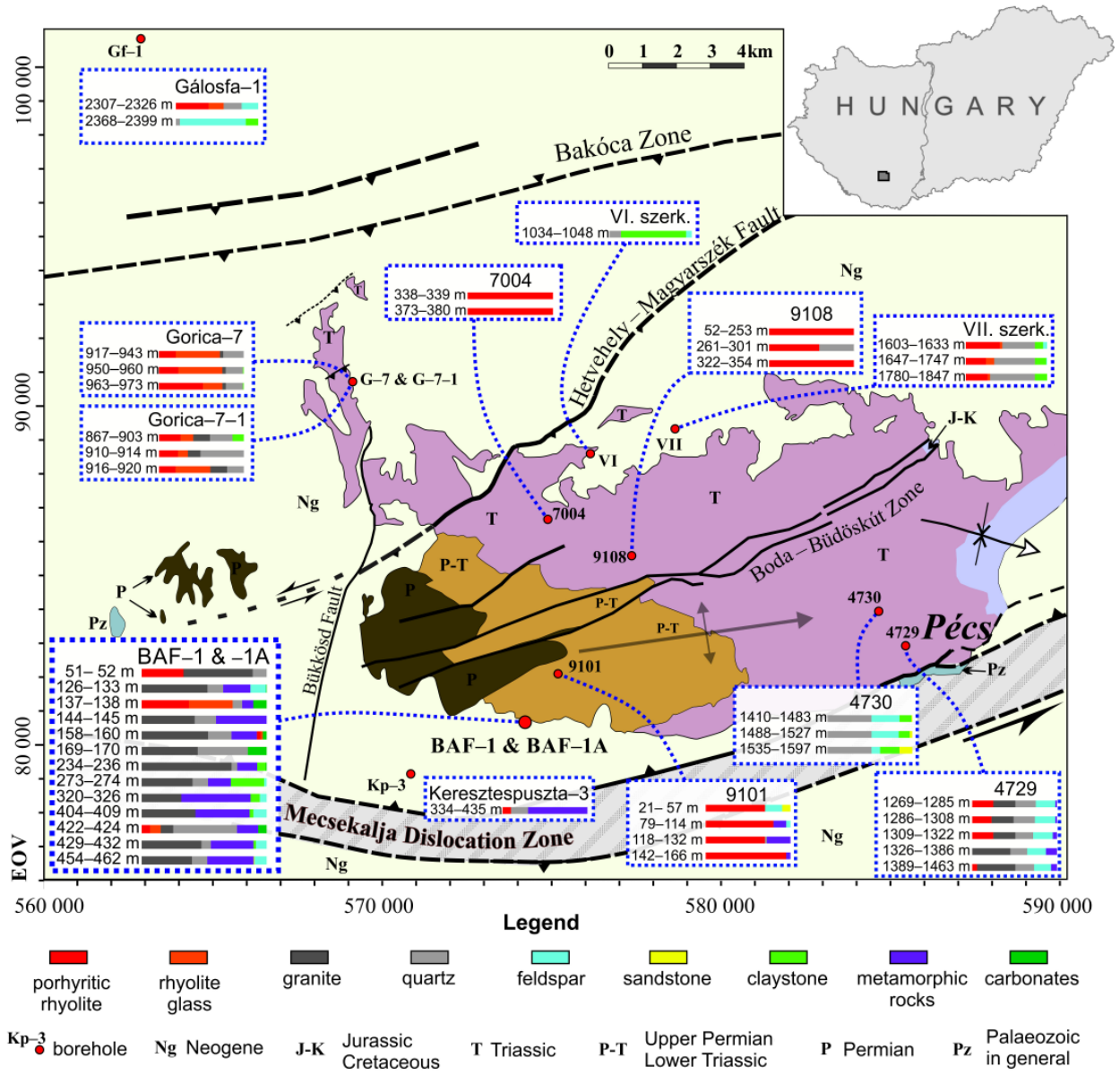

Figure 1. The studied drill cores and their pebble distribution according to depth, illustrated on the structural geological map of KONRÁD & SEBE (2010)
1. ábra. *A vizsgált fúrások és mélység szerinti kavicseloszlásaik KONRÁD & SEBE (2010) szerkezetföldtani térképén ábrázolva*

red) conglomerate, sandstone and silt strata. On the surface its outcrops can be found to W, W–NW and SW from Kővágószőlős. Its thickness varies between 30–330 m (BARABÁS & BARABÁSNÉ STUHL 1998). The Kővágótöttös Sandstone Member is composed of grey sandstones and siltstones with distinctive (Upper Permian) plant remnants. The Kajdácsvölgy Sandstone is green in colour, and due to its elevated uranium ore level it was part of the productive sequence during the period of uranium mining. The Cserkút Sandstone Member is composed of red sandstone beds and the Tótvár Sandstone Member is made up of a purple gravel-rich sandstone. On the basis of the presence of sporomorphs, the uppermost part of the Kővágószőlős Formation can be dated as Triassic, and therefore the Permian-Triassic boundary can be drawn within the formation (BARABÁS & BARABÁSNÉ STUHL 1998).

Methods

The data for this study was obtained by processing the archive data (KÁLLAI 1958a, b, 1959, GÁRDONYI 1963, GLÖCKNERNÉ 1965, RÓZSÁS 1975, HETÉNYI 1980, KIS 1980, BARABÁSNÉ 1980) of eleven drill cores. The latter were documented by MÉV geologist mainly in the 1950s and 1960s and are now are in the possession of Mecsekérc Ltd. From the eleven drill core documentations, the present investigation focussed on the Bakonya Member of the Kővágószőlős Sandstone Formation; the data gathered included the depth, lithology and relative frequency of occurring pebbles. Although the written documentation was carried out thoroughly, it has to be mentioned that there is a factor of slight uncertainty regarding the documentation of these drill cores. This is because the mere macroscopic identification of

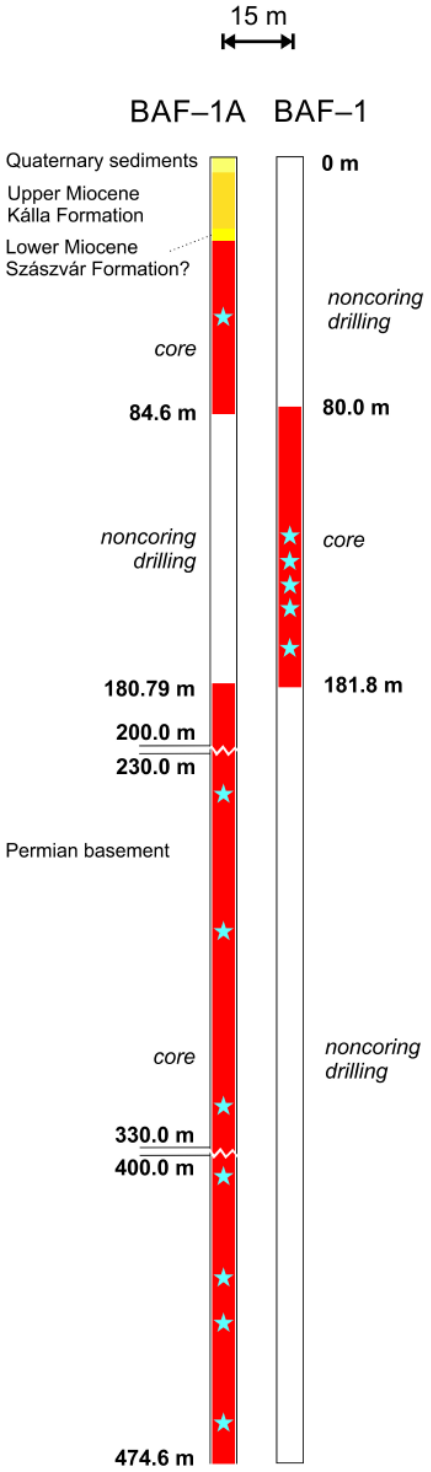

Figure 2. The simplified succession of the BAF-1A and BAF-1 drill cores
Blue stars mark pebble-rich parts, where macroscopic observations on pebbles were made

2. ábra. *A BAF-1A és BAF-1A fúrások egyszerűsített rétegsora*
A kék csillagok a kavicsban gazdag részeket jelölik, ahol a kavicsokra vonatkozó makroszkópos leírások készültek

different pebble types — especially the ones of a few millimetres in size — can lead to the possibility of making mistakes (e.g. the differentiation of porphyric rhyolite from rhyolite glass). There is also no information on how the MÉV geologists documented the studied the drill cores (e.g. did they use grain counting continuously on the visible side of the drill core, or was this carried out along a given line or at certain intervals?). Taking these factors into consideration, after sorting and organizing all the hand-written data in digital spreadsheets, these were then depicted by line charts.

To obtain the same data for pebbles, macroscopic studies were carried out on the BAF–1 and BAF–1A drill cores; these are the property of Mecsekérc Ltd at its Kővágószőlős drill core warehouse. Although confidence can be placed in the observations obtained for the present study, still one has to count with the chance of misidentification due to the merely macroscopic nature of those observations. In total 462 m of the drill core of the Bakonya Member was studied. 80.00–181.80 m of this total belongs to the BAF–1, while 0.00–80.00 and 181.80–462.00 belongs to the BAF–1A drill core. At pebble-rich intervals observations were made with respect to the number of occurring grains which were intersected by the drilling (and thus this could be seen on the drill core side). Besides these details the roundness, maximal size and average size of pebbles were taken into account.

During the macroscopic observations a few carbonate pebbles were found. In order to identify these pebbles, thin sections were prepared from three of therm. Furthermore, a petrographic study of the pebbles was carried out by Gyula KONRÁD.

Results

In the 1950s and 1960s the geologists of MÉV documented the drill cores and distinguished the following types of pebbles in the mottled sequence (today known as the Bakonya Member): rhyolite, granite, quartz, rhyolite glass, feldspar, metamorphic rocks, claystone and sandstone. This study summarizes the archive data together with clast composition data of the BAF–1 and –1A drill cores. The location of the boreholes and the pebble distribution of their Bakonya Member part can be seen on *Figure 1.* Line charts were used to show the depth-varying distribution of the different types of pebbles. On these diagrams each band represents one pebble-rich strata with depths increasing downwards. *Table 1* contains the depth ranges and proportions of pebbles of each drill core, *Table 2* contains the same data for the BAF–1 and BAF–1A drill cores.

During macroscopic observations on the BAF–1 and BAF–1A drill cores it was observed that the pebbles are subrounded and rounded; this point is also referred to in the literature by BARABÁS & BARABÁSNÉ STUHL (1998). The BAF–1 and BAF–1A drill cores are peculiar due to the fact that they contain carbonate pebbles in their grey conglomerate layer between 137.8 m and 138.0 m (HÁMOS et al. 2015). Some similar, few millimetre-sized carbonate fragments were also found in the red conglomerate part of the BAF–1A drill core at depths of 169–170 m, 235.7 m and 422–424 m (*Table 2, Figure 3)*. These carbonate pebbles are subrounded and rounded. According to the thin section

Table 1. Pebble distribution of coarse clastic beds in selected cores of Bakonya Member based on data from previous unpublished reports (KÁLLAI 1958a, b, 1959; GÁRDONYI 1963; GLÖCKERNÉ 1965; RÓZSÁS 1975; HETÉNYI 1980, KIS 1980, BARABÁSNÉ 1980)

1. táblázat. *A Bakonyai Tagozatot tartalmazó, durvatörmelékes rétegek kavicsanyag-eloszlása (KÁLLAI 1958a, b, 1959; GÁRDONYI 1963; GLÖCKERNÉ 1965, RÓZSÁS 1975; HETÉNYI 1980; KIS 1980; BARABÁSNÉ1980 alapján)*

Name of borehole	Depth range (m)	Number of described pebble-rich layers	Average distance of pebble-rich layers (m)	Size of grains (mm)	Porphyritic rhyolite pebbles %	Rhyolite glass pebbles %	Granite pebbles %	Quartz pebbles %	Feldspar pebbles %	Sandstone pebbles %	Claystone pebbles %	Metamorphic pebbles %
Gf-1	2307-2326	8	2.5	8-30	40	18	0	22	20	0	0	0
	2368-2399	4	8.0	5-25	0	0	0	5	80	0	15	0
G-7	917-943	11	2.5	12-50	20	52	4	24	0	0	0	0
	950-960	8	1.4	12-60	23	52	4	20	0	0	1	0
	963-973	5	2.2	20-60	52	23	4	20	0	0	1	0
G-7-1	867-903	8	4.6	2-70	26	15	20	27	0	0	12	0
	910-914	5	1.0	5-26	23	10	15	52	0	0	0	0
	916-920	5	1.0	25-35	20	40	20	20	0	0	0	0
VI.	1034-1048	14	1.1	15-30	0	0	0	14	7	0	79	0
VII.	1603-1633	22	1.4	5-30	42	3	0	40	5	0	10	0
	1647-1747	9	11.2	2-18	25	10	0	50	1	0	14	0
	1780-1847	8	8.5	3-20	27	3	0	55	0	0	15	0
7004	338-380	10	4.3	10-70	100	0	0	0	0	0	0	0
9108	52-253	21	9.6	15-70	100	0	0	0	0	0	0	0
	261-301	11	3.7	7-40	60	0	0	40	0	0	0	0
	322-354	16	2.1	10-50	100	0	0	0	0	0	0	0
9101	21-57	21	1.8	9-50	70	0	0	0	20	10	0	0
	79-114	17	2.1	6-70	80	0	0	0	5	0	0	15
	118-132	12	1.3	15-100	70	0	0	2	0	0	0	28
	142-166	16	1.6	20-70	95	0	0	0	0	0	0	5
4730	1410-1483	25	3.0	2-60	0	0	0	52	33	1	14	0
	1488-1527	33	1.2	2-46	0	0	0	52	32	3	13	0
	1535-1597	52	1.2	2-95	0	0	0	52	10	15	23	0
4729	1269-1285	13	1.3	2-56	25	0	26	24	23	0	0	2
	1286-1308	20	1.2	4-58	23	0	26	25	24	0	0	2
	1309-1322	13	1.1	15-78	25	0	26	21	23	0	0	5
	1326-1386	54	1.1	7-90	0	0	45	20	22	0	0	13
	1389-1463	66	1.1	8-73	6	0	45	22	20	0	0	7
Kp-3	334-435	72	1.4	80-150	10	0	0	20	0	0	0	70

Table 2. The results of macroscopic studies on the BAF-1 and BAF-1A drill cores
2. táblázat. *A BAF-1 és BAF-1A fúrómagok makroszkópos vizsgálatának eredményei*

Name of borehole	Depth range (m)	Observation	Porhyric rhyolite	Rhyolite glass	Granite	Quartz	Feldspar	Sandstone	Claystone	Metamorphic	Carbonate
BAF-1A	51-52	number of pebbles	9		15	3					
		maximal pebble size (mm)	30		20	20					
		average pebble size (mm)	20		20	15					
BAF-1	126-133	number of pebbles			97	23	23			29	1
		max pebble size (mm)			20	15	15			30	10
		average pebble size (mm)			10	10	10			20	10
BAF-1	137-138	number of pebbles	25	23		5				6	7
		max pebble size (mm)	20	20		15				10	20
		average pebble size (mm)	15	15		10				10	15
BAF-1	144-145	number of pebbles			20	8				19	
		max pebble size (mm)			20	15				40	
		average pebble size (mm)			10	10				20	
BAF-1	158-160	number of pebbles	2	1	34	12				13	2
		max pebble size (mm)	20	15	15	15				30	10
		average pebble size (mm)	15	15	10	10				15	10
BAF-1	169-170	number of pebbles			9	8					3
		max pebble size (mm)			15	25					20
		average pebble size (mm)			10	10					20
BAF-1A	234-236	number of pebbles			96	6			9	21	
		max pebble size (mm)			50	10			60	50	
		average pebble size (mm)			15	10			30	20	
BAF-1A	273-274	number of pebbles			20	6	1		13	9	
		max pebble size (mm)			30	10	5		30	40	
		average pebble size (mm)			10	10	5		15	15	
BAF-1A	320-326	number of pebbles			35		6		8	61	
		max pebble size (mm)			20		40		30	40	
		average pebble size (mm)			10		10		15	20	
BAF-1A	404-409	number of pebbles			57		14		4	57	
		max pebble size (mm)			50		10		30	40	
		average pebble size (mm)			15		10		20	20	
BAF-1A	422-424	number of pebbles	4	5	6	30				10	4
		max pebble size (mm)	30	30	15	20				20	30
		average pebble size (mm)	15	15	10	10				10	10
BAF-1A	429-432	number of pebbles			101	16	18		4	72	
		max pebble size (mm)			20	20	10		25	30	
		average pebble size (mm)			10	10	5		20	20	
BAF-1A	454-462	number of pebbles			75	23	18	1		69	
		max pebble size (mm)			20	15	15	20		90	
		average pebble size (mm)			10	5	10	20		25	

observations, there are significant amounts of angular, up to 0.1 millimetre-sized quartz and feldspar grains in them. The cement material is silica and this appears in the form of veinlets and as crystalline infillings of irregular-shaped cavities. The texture of the carbonate part is micro-crystalline and stylolitic; furthermore, in one case, coarse (> 1mm) calcite spars were observed. No fossils could be seen.

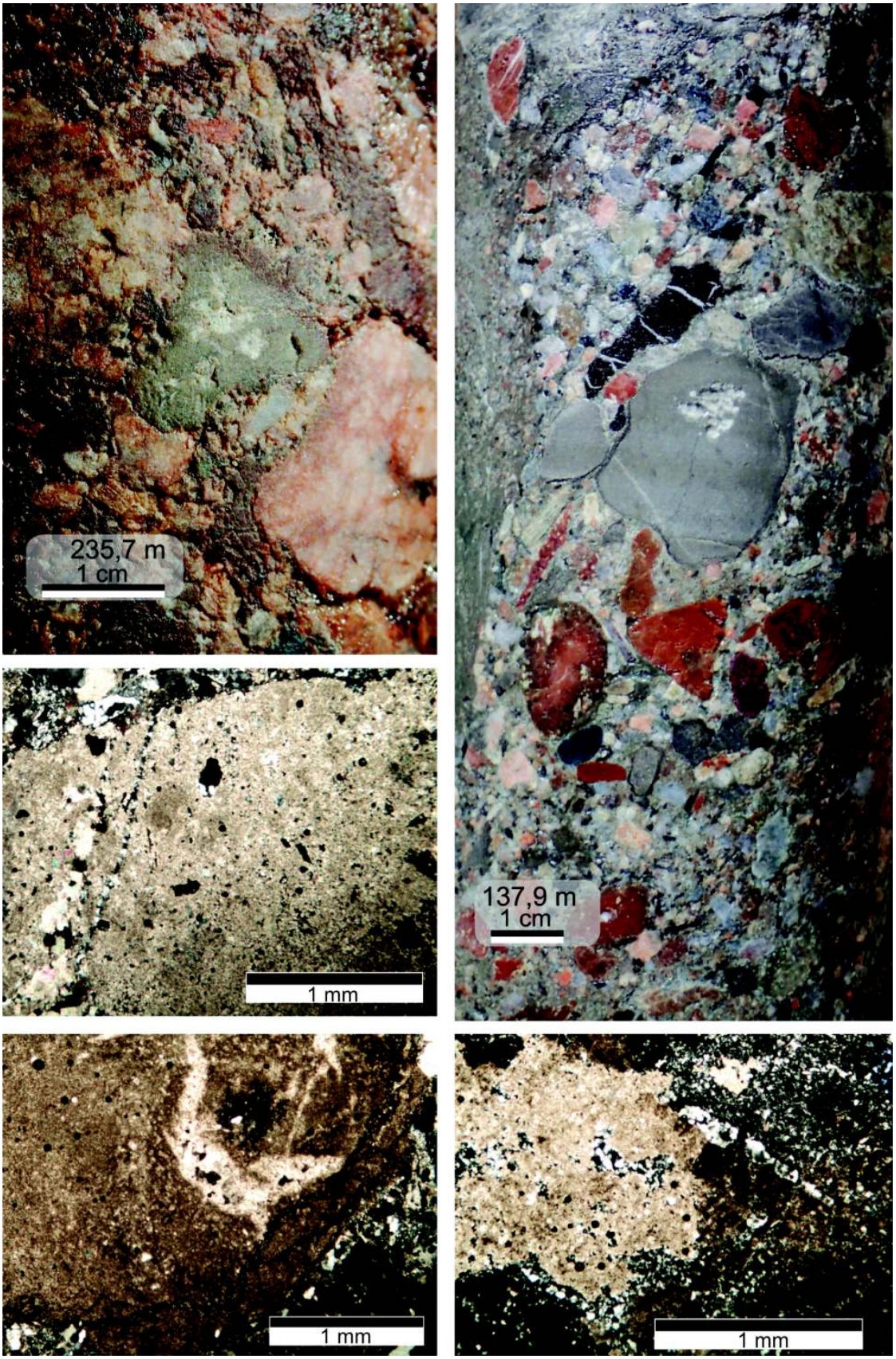

Figure 3. Conglomerate with carbonate pebbles from 235.7 m of the BAF-1A drill core (top left) and from 137.9 m of the BAF-1 drill core (top right). The other three photos show the thin sections of carbonate pebbles from 137.9 m, taken under crossed polarized light

3. ábra. *Mészkőkavicsos konglomerátum a BAF-1/A fúrás 235,7 méteréből (balra fent), a BAF-1 fúrás 137,9 méteréből (jobbra fent). A másik három fotón a 137,9 méterből származó mészkőkavicsok vékonycsiszolati képe látható keresztezett nikolállás mellett*

Discussion

By illustrating the data of drill cores on a map, one can make conclusions which carry more details about the (up until now) suggested theories concerning the member's (and the formation's) provenance area and about the distance over which the debris material was transported. As it was experienced, the coarse debris material of the Bakonya Member was very diverse both in time and space.

The lowest proportions of porphyritic rhyolite and rhyolite glass can be found in the Gálosfa–1 drill core and in the southern part of the studied area, while the highest proportions are at the centre territory (with the exception of structure well VI, where it was absent). At the southern boundary of the area, metamorphic pebbles show a raised proportion. However, to the North of the Boda–Büdöskút Zone there were no documented metamorphic pebbles.

Dominant amounts of rhyolite glass pebbles were found only at the north-western part of the region in the studied drill cores. The frequent occurrence of granite pebbles characterises the western, eastern and southern parts of the territory, where the respective amounts of quartz pebbles also showed higher values. Significant quantities of feldspar pebbles were observed in the northernmost areas; these were also present in moderate amounts in the southern and south-eastern parts.

This work was carried out to compare the pebble dis–tribution of different parts of the Bakonya Member. In order to obtain data, archive drill core documentations were re-evaluated and observations were made on the coarse-grained parts of the BAF–1 and BAF–1A drill cores. During this investigation the research was hindered by the unexpected occurrence of carbonate fragments in the mottled sequence.

The presence of carbonate pebbles is quite unusual in the Permian clastic beds, since the debris material of the Carboniferous–Permian molasses derive primarily from the Variscan magmatic and metamorphic rocks, supplemented by rhyolites (FÜLÖP 1994). Although one of the types of carbonate pebbles has a coarse sparry texture — and thus it could indicate a recrystallized metamorphic origin — it is possible that these fragments did not go through any metamorphic events; this would suggest they might not have an Early Palaeozoic origin. Neopalaeozoic limestones have not been documented in the studied area and are not likely to have been in the provenance area, given that the region is of a siliciclastic terrestrial origin from the Late Carboniferous to the Late Permian (BARABÁSNÉ STUHL in FÜLÖP 1994). The provenance area of the Lower Triassic Jakabhegy Sandstone was the same as it was in the Permian, so its pebble composition is similar; this is shown by the absence of carbonates. During the Middle Triassic transgression–regression cycle different carbonates were produced. These were later eroded and were contained as pebbles in the Karolinavölgy Sandstone Formation. Thus it is possible that those parts of the beds which have carbonate fragments do not belong to the Bakonya Member, but instead they are of Late Triassic origin (e.g. Karolinavölgy Sandstone Formation) and were dislocated by tectonic events.

It also has to be noted that several boreholes in the vicinity (Szigetvár–I, Szigetvár–III, Becefa–1) intersected some Palaeogene pebble-rich strata. These strata have a similar composition (felsic volcanics, granitoids and metamorphic rocks) to the BAF–1 and BAF–1A drill cores and also occur with carbonate fragments. These — possibly Mesozoic — fragments are of fine crystalline dolomite and cryptocrystalline limestone (WÉBER 1985). However, these Palaeogene strata are not thought to be related to the pebble-rich strata of the BAF–1 and BAF–1A drill cores. This is because there is a much greater abundance of carbonate grains in the former and there are no palaeontological data supporting a Palaeogene origin for the studied succession (GÖRÖG & TÓTH 2015, GÖTZ 2015).

It also has to be taken into consideration that the lithostratigraphical interpretation of the BAF–1 and –1A boreholes is not totally unequivocal. The presence of Jurassic microfossils from grey strata identified by GÖRÖG & TÓTH (2015) raises the possibility that (i) either the intersected rocks are not of Late Permian but Jurassic in age, or (ii) tectonic scales of Jurassic rocks occur in the Bakonya Sandstone. The ambiguity is further increased by the fact that from the same type of grey strata of the drill core by GÖTZ (2015), microfossils of Late Permian age have also been described. In order to determine the age of the intersected rocks in the BAF–1 and –1A boreholes with certainty, and to define the origin of carbonate pebbles, more extensive petrographic investigations — including maturity and composition studies — are needed.

Conclusions

In contrast to the account given in the literature of BARABÁS & BARABÁSNÉ STUHL (1998), the pebbles of the Bakonya Sandstone show a much wider rock type diversity in drill cores. The moderately rounded shape of the debris material might suggest a short distance of transport; therefore the observations of this study seem to confirm FAZEKAS (1987) — namely, that the debris might have been eroded from a proximate territory, which must have been a lithologically diversified provenance area. Fragments of granite occur in the western, eastern and southern parts, metamorphic rocks characterise the southern territories, while rhyolite was present in central areas.

Based the on the re-evaluation of archive data, it can be stated that the low abundance of rhyolite pebbles in the BAF–1 and –1A drill cores would not exclude the classification of the mottled, coarse-grained sandstone as being part of the Bakonya Sandstone Formation. Other, similarly low rhyolite pebble-containing parts of the Bakonya Member evolved along the southern borders of the Mecsek Mts. On the other hand, the occurrence of carbonate pebbles in the BAF–1 and –1A drill cores raises questions about whether the reached strata truly belong to the Bakonya Member.

Based on the results of the present study, the hundreds of drill core documentations from the West Mecsek Mts seem to require further processing so as to gain a more detailed description of the Late Permian, Early Triassic provenance area.

Acknowledgements

First of all, we would like to express our gratitude to Gyula KONRÁD for his support and professional suggestions. We are also very grateful to all the employees of Mecsekérc Ltd. and PURAM Ltd. for granting us access to the archive data of the drill cores in order to carry out a re-evaluation.

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Kézirat beérkezett: 2015. 12. 05.