THE FIRST GREENSTONE AXE IN HUNGARY

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Abstract: *Greenstone (typically, metamorphic rocks of distinctive green colour) axes were in high esteem during Prehistory. They had special prestige and were obtained from great distances. Recently, the distribution network of the probably most popular type of greenstone, jadeitite was essentially extended due to the JADE 2 project organised by P. Pétrequin (Pétrequin et alii 2017). The first jade axes from Hungary were located and described in 2013 (Szakmány et alii 2013); by 2015, we had located and analysed 25 items (Bendő et alii 2014, 2015, 2016, 2019). In 2018, two new pieces were added (Biró et alii 2018).*

Quite recently a new piece was identified, located and analysed, part of the old museum collection of the Hungarian National Museum. This historical piece is presented here with the aim to integrate it again into the circulation of international science.

Cuvinte cheie: *rocă de culoare verde, topor de piatră șlefuit, Ungaria, analiza petro-arheologică*

Rezumat: *Topoarele din rocă (de obicei metamorfică) de culoare verde erau considerate foarte valoroase în preistorie. Li se atașa un prestigiu special, iar rocile veneau de la mari distanțe. Cunoașterea rețelei de distribuție a celui mai popular tip de rocă de culoare verde – jadeitul – a luat amploare recent prin proiectul JADE 2 organizat de P. Pétrequin (Pétrequin et alii 2017). În Ungaria, astfel de artefacte au fost identificate și descrise prima dată în 2013 (Szakmány et alii 2013), pentru ca până în 2015 să fie analizate încă 25 (Bendő et alii 2014 2015, 2016, 2019), cărora li s-au adăugat în 2018 încă două (Biró et alii 2018).*

Recent, o altă piesă, parte a colecțiilor Muzeului Național al Ungariei, a fost identificată și studiată. Din dorința de a o integra circuitului științific internațional, o prezentăm în prezentul articol.

INTRODUCTION

Excavations can be carried out at various locations and for various reasons - preventive surveys, scientific plans, thematical projects etc. However, we can also “excavate” in old collections and technical literature, to find objects of rare quality and value.

The identification of the axe

Probably all museums (collections) have a box/shelf/cabinet with objects marked „to be identified”. They may be stray pieces turning up here and there, or cherished items losing their mark-up (i.e., identity) for too much attention – such as exhibitions with enthusiastic designers who find ID numbers “ugly” and remove them for the show. Of course, proper documentation would prevent the catastrophe but in hundreds of years of collection management things can go astray. This had happened to some choice pieces in the Prehistoric Collection of the HNM and the careful collection managers show them to specialists from time to time with the aim to re-identify a certain piece on the basis of the technical literature or archive data (Fig. 1). That is how I met the so far biggest jade axe in Hungary (Fig. 2), extremely beautiful but unfortunately decontextualised. As the value and importance of the piece was quickly recognised, we have inventoried (in fact, re-inventoried) the piece to facilitate further investigations. The new inventory number is 2019.7.1.

The next step in the recognition of the piece was the 200-years anniversary since the birth of Flóris Rómer, pioneering personality of Hungarian archaeology. Among the many celebrations and reconsideration of his oeuvre (Arrabona 51 (2015), Archeometriai Műhely 12/2 (2015)) we had the possibility to commemorate him as the first student and promoter of Hungarian stone tools (T. Biró 2015). His monograph "Műrégészeti kalauz" [A guide for arts and archaeology] (Rómer 1866) had listed potential sources of Hungarian prehistory, presenting our greenstone axe in text and picture - but no location (Rómer 1866, p. 10, fig. 8, Fig. 3). As it was a common custom of the period to donate, among museums, outstanding pieces from significant sites to each other (e.g. Spiennes, St. Symphorien etc., see Dobosi 1982), it was possible that the remarkable greenstone axe came from a distant location where such finds might have been common, such as France, Italy or Switzerland. I have tried to locate the documentation for the piece in our archives as part of a former exhibition but was not successful. Presuming that the piece was among the early acquisitions of the Hungarian National Museum, Tamás Szabadváry, staff member of the Archaeology Department of the HNM made a careful search of the early inventories: from 1802 (foundation of the Museum), and prior to 1866, when the axe was published by Rómer. He found the following entry: 20/1852 (Fig. 4).

Well, Bakonyszücs is a classical site for a cultic (?) axe and sacral object depot found much later (in 1967; reference in MRT 1972 site 13/1, Regenye 1994) so I could use the data of the Archaeological Topography survey (MRT 1972, p. 54 site 13/2) that seemed to support the archaeological provenance of the piece.

Circumstances of discovery

According to the topographical survey data (MRT 1972, p. 55, Fig. 5), the find assemblage inventoried in 1852 (20/1852.1-4.) was found in 1851 at the Szőlőhegy (Vineyard Hills) part of the village during viticultural works, and sent by M. Bezerédy to the Hungarian National Museum. The find assemblage comprised one white stone ceremonial hatchet, one "kigyla" (greenstone) axe and ca 300 *Spondylus* beads, as well as three copper pickaxes. Unfortunately, part of these finds were lost. The trapeze shaped axe, assigned by MRT 1972, footnote 4 to site 13/2, was published by Rómer 1866 p. 10, Fig. 8 (see our Fig. 3). The Topographical Survey data also refer to an earlier publication by Rómer (1860, p. 205) where the respective assemblage is mentioned.

Recent studies

Macroscopical description of the axe

The axe is an elongated triangular specimen, extremely finely elaborated (Fig. 6). Its dimensions are 157 x 72 x 24 mm (382.26 g), making it the longest jadeite axe known so far from Hungary. By the classification of Pétrequin et al. 2012, it clearly falls into the Altenstadt / Greenlaw type, that was represented so far by one piece in Hungary (from Iszkaszentgyörgy, see Bendő *et alii* 2019, fig. 3, fig. 5a). The raw material of the axe is "greenstone", more specifically, Fe-jadeite, analysed in details below.

Methods for the investigation of the greenstone axe

The stone axe was investigated by the already established standard non-destructive technology developed for Na-pyroxenites presented in earlier works (Bendő *et alii* 2019). First, metric and macroscopical data were taken, including weight and magnetic susceptibility (MS) value (on the application of the method, see Bradák *et alii* (2005, 2009) and Szakmány et alii (2011a). After this, non-invasive SEM-EDX using the "original surface" method elaborated by Bendő *et alii* (2013, 2014) was used to determine the mineral chemistry, while PGAA (prompt gamma activation analysis; Szakmány & Kasztovszky 2004, Szakmány *et alii* 2011b) was used for the determination of the bulk chemical composition with the aim of exactly determining the relation of the new piece to the previously analysed greenstone implements (Bendő *et alii* 2019, T. Biró *et alii* 2018), and finding possible differences and petrographic/geochemical markers among the greenstone tools known so far.

The new axe has been analysed for PGAA at the Centre for Energy Research. PGAA is a bulk analytical method, applicable to determine most of the major, and some of the minor and trace elements in silicates, without any sampling or destruction of the object. Since neutrons of the irradiating beam can enter several centimetres inside the object, one can obtain an average composition of the irradiated volume. The Budapest PGAA facility was described in Szentmiklósi et alii 2010. The calculation of the elemental composition is based on the prompt k0-method (see Révay 2009). Due to the lack of the traditional detailed textural descriptions by petrographic microscope (which is a destructive method), textural characterization of the samples is restricted to a more general standard (which is based on the observation of the back scattered electron (BSE) images, and hence has limits concerning the visibility of e.g. grain boundaries, and phases of similar grey values).

These measurements were made at the Department of Petrology and Geochemistry, Institute of Geography and Earth Sciences, Eötvös Loránd University, Budapest. The instrument was an AMRAY 1830 scanning electron microscope equipped with EDAX PV9800 energy dispersive spectrometer. Conditions of analysis: accelerating potential: 20 kV, beam current: 1 nA, beam diameter: focused electron beam (~50–100 nm), measurement time: 100 sec (livetime).

RESULTS

Macroscopic petrography and MS (magnetic susceptibility) measurement

Macroscopically, the axe is made of a very fine grained and well crystallized, homogenous medium/dark green, massive and tenacious rock. The real MS value of the investigated stone tool is 0.54 x 10-3 SI which is a relatively high value among the HP metaophiolites, but it corresponds well to the relatively dark green colour of the piece, which is due to its quite high Fe content (see results of the chemical composition in Table 1). This value is quite consistent with the Fe-jadeitites of the previously analysed and published Na-pyroxenite axes found in Hungary (T. Biró *et alii* 2018, Bendő *et alii* 2019).

SEM-EDX

The Bakonyszücs stone axe contains almost exclusively Na-pyroxene in four different types of composition. Three of these types occur as a zonality of pyroxene crystals of 25–50 µm size, while the fourth type of Na-pyroxene is a later form overprinting the previous phases, which is very well visible on backscattered electron images (Fig. 7). Despite the non-ideal original surface of the SEM-EDX analyses, the zonality can be followed in the mineral chemical composition too (Table 2). The core of the crystals is almost pure jadeite and contains no, or very low contents of aegirine (Jd83-97Ae0-11Q3-14) (Fig. 8). On the transitional zone between the core and the rim (known as mantle), we can find higher aegirine contents (transition to Fe-jadeite) (Jd60-66Ae19-31Q9-16). The rims have even higher Fe-content, and the composition is on the Fe-jadeite-aegirine border (Jd40-45Ae41-48Q12-17). The composition of the latest Na-pyroxene phase has the highest Ca-content and classify these into omphacite/aegirine-augite (Jd29-40Ae36-42Q23-29), showing a temperature increase during the formation of the raw material of the axe. Among accessory minerals, titanite and zircon occur exclusively; both are quite frequent and occur as small, dominantly euhedral crystals (generally less than 50 µm). Regarding the retrograde process, few xenomorphic albite grains appear in the sample (see Fig. 7).

PGAA

The results are presented in the form of a multi-element diagram normalised on UCC - (Table 1, Fig. 9). It is apparent that the studied axe made of HP metaophiolite is relatively rich in Na, Fe and Mn. The axe is poor in Mg, as its value did not reach the detection limit of the PGAA measurement system. Based on the chemical composition, the sample can be classified as Fe-jadeitite in f D'Amico's system (D'Amico et al. 2003). It fits quite well in the series of data obtained on the HP-LT metaophiolites known so far: mainly Fe-jadeitites are known and analysed from Hungarian archaeological localities (T. Biró et alii 2018, Bendő et alii 2019).

Discussion (analytical part)

Based on the analytical data, the raw material of the studied polished stone axe is a Fe-jadeitite. The composition fits well into the previously analysed 27 HP metaophiolite axes that have been found in Hungarian localities until now, and fairly similar to the previously described Fe-jadeitite axes. The composition of the raw material shows that the axe originates from one of the localities of present northwestern Italy, namely the MonViso area of the Western Alps, but the resedimented Oligocene conglomerates in Quaternary of River Po, or Staffora and Curone (the latter occurring near the foothills of Western Appennines) cannot be excluded (Váczi et alii 2017, 2019).

CONCLUSION

Polished stone artefacts represent evidence of the widest area of trade and contact of Prehistoric societies. Though known to us only for a few years, the number of jadeitite polished stone tools known from archaeological sites in Hungary is felicitously growing due to new excavation results as well as to digging deep into the collections. Modern analytical facilities help us to identify exactly the raw material of the polished stone tools with basically non-destructive methods; by the help of provenance data, we are able to understand more about prehistoric trade and habitation networks.

ACKNOWLEDGEMENT

The authors of this study are especially grateful to the Collection Management staff of the HNM, personally toErika Kovács and József Puskás for “digging out” this spectacular piece from the “lumber” of the Collection, and to Tamás Szabadváry for his invaluable help in re-identifying the axe in the old museum inventories. Also special thanks to the NKFIH (OTKA) project K-131814, lead by Zsolt Kasztovszky, for setting the framework for the analytical studies.

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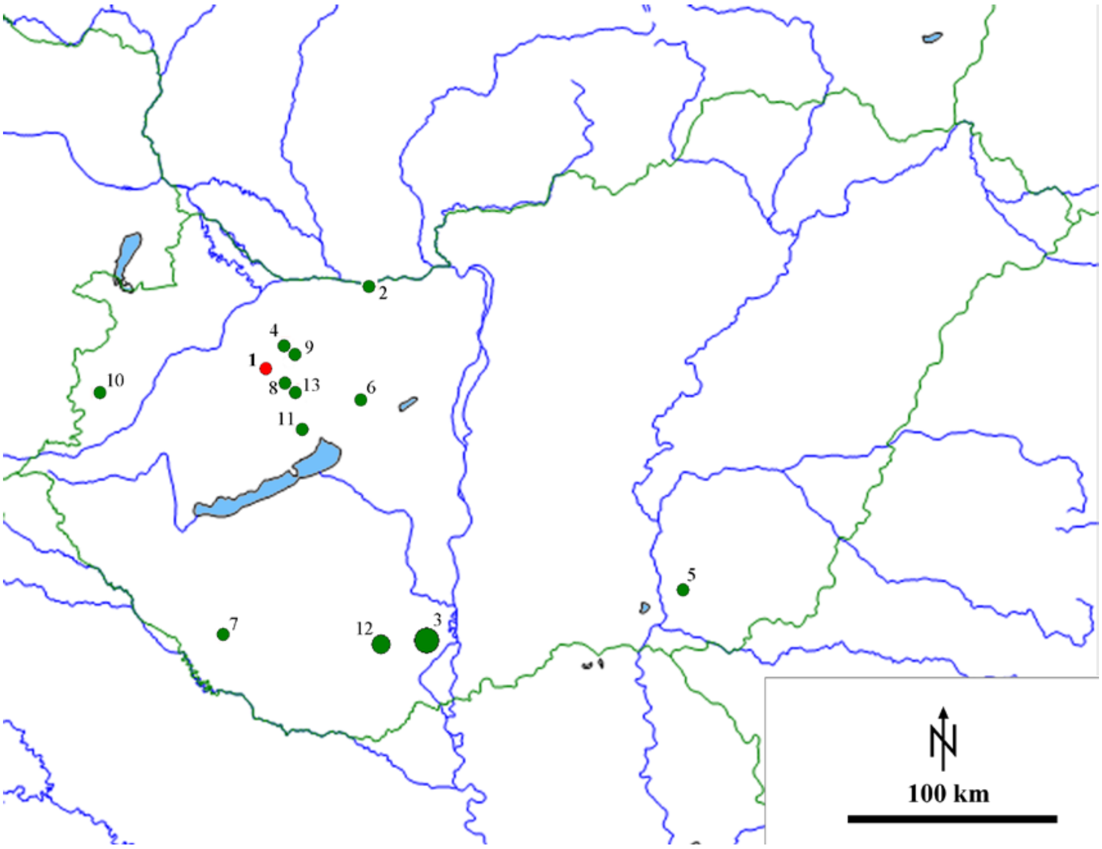


Figure 1. Map of the HP-LT metaophiolite axes located so far in Hungary. Key: 1. Bakonyszücs (current paper, marked by red circle and bold numbering); 2. Almásneszmély, 3. Alsónyék (6 pieces), 4. Bakonypéterd, 5. Gorzsa, 6. Iszkaszentgyörgy, 7. Lábod, 8. Porva, 9. Sikátor, 10. Szombathely, 11. Veszprém environs, 12. Zengővárkony (3 pieces), 13. Zirc.

Figure 2. 'Greenstone' axe from Bakonyszücs, reidentified after Rómer 1866 fig. 8 and HNM inventory data.

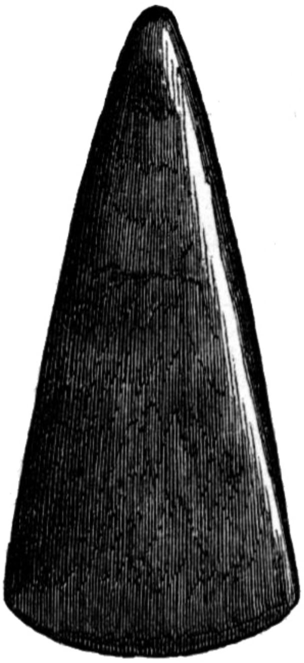
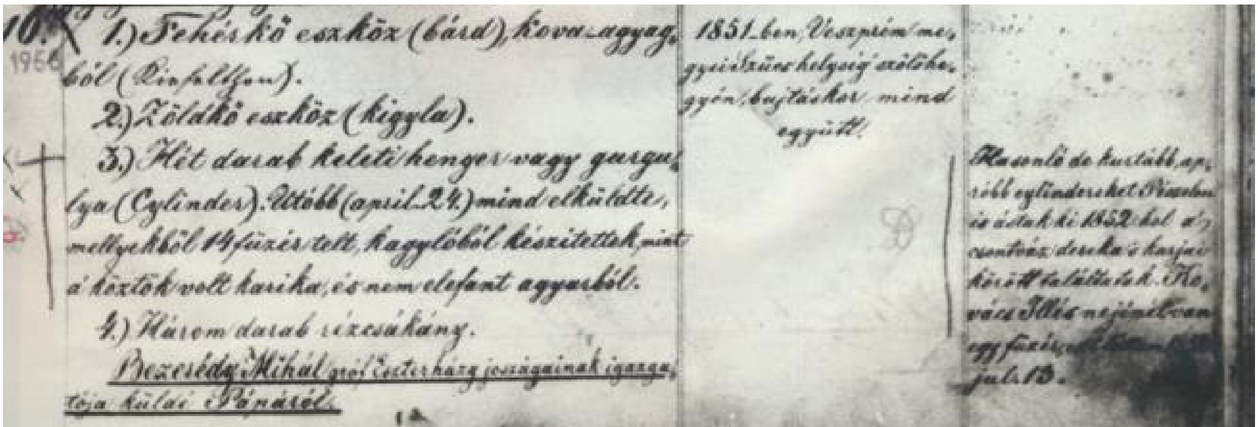


Figure 3. The axe as published by Rómer 1866 (p. 10, fig. 8)



10. 1956 1.) Fehérkő eszköz (bárd), kova-agyagból ([illegible]).

2.) Zöldkő eszköz (kigyla).

3.) Hét darab keleti henger vagy gurgulya (Cylinder). Utóbb (april 24.) mind elküldte, mellyekből 14 füzért tett, kagylóból készitettek, mint a' köztök volt karika, és nem elefánt agyarból.

4.) Három darab rézcsákány.

Bezerédy Mihál gróf Eszterházy jószágainak igazgatója küldé Pápáról.

1851-ben, Veszprém megyei Szücs helység szőlőhegyén, kapáláskor mind együtt.

Hasonló de kurtább, apróbb cylindereket [illegible] is ástak ki 1852 [illegible] a' csontváz derekán 's karjai között találtatok. Kovács Illés nejénél van egy füzér [illegible] jul. 13.

Figure 4. Inventory data for the greenstone axe. Transcription of the text: (Inv. nr. 20/1852) item 2: Greenstone implement (kigyla), found in 1851 in Veszprém county in the vineyards of the village Szücs (*Bakonyszücs*), together with a whitestone hachet (item 1), several cylindrical beads (*probably Dentalia*) (item 3) and three copper axes (item 4). The finds were sent to Rómer by Mihály Bezerédy, ispan (*comes parochialis*) for count Eszterházy.

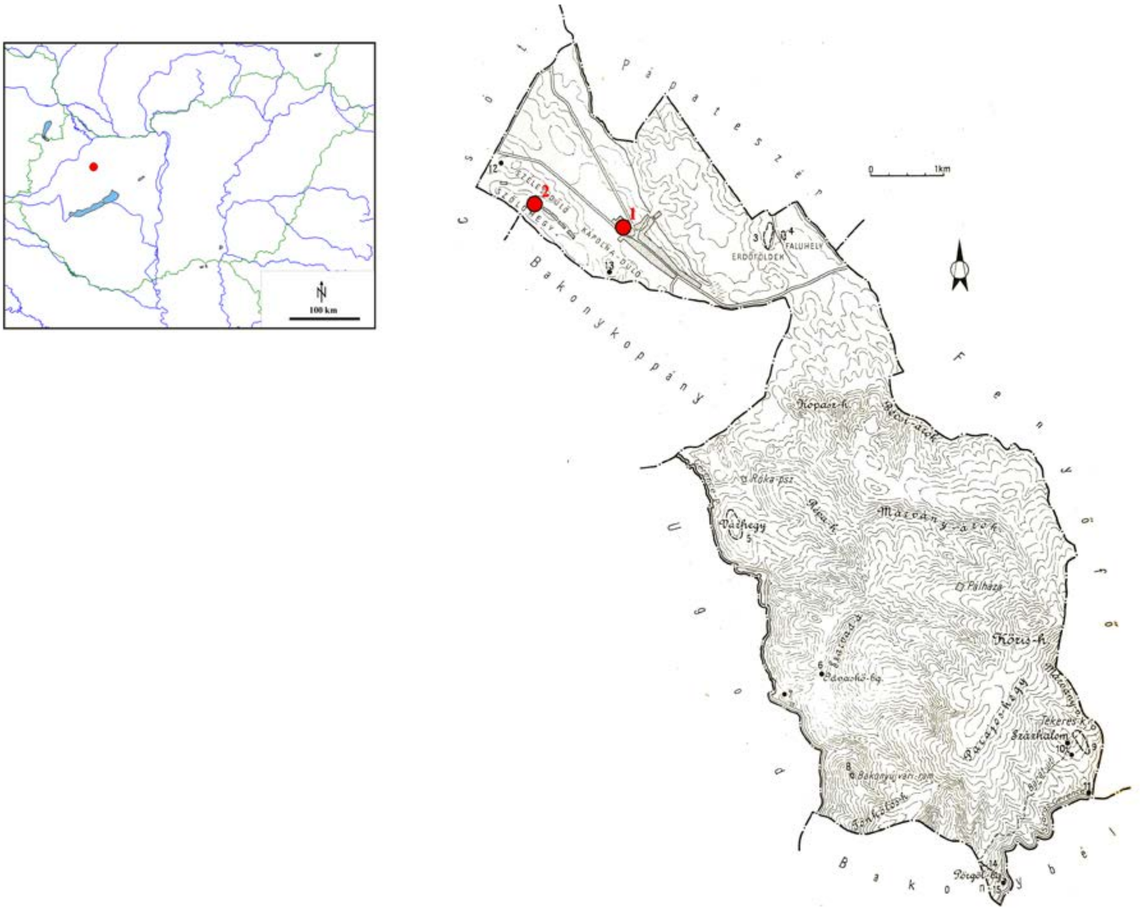


Figure 5. Bakonyszücs and localities with axe finds from MRT IV. Key of symbols: 1.: Bakonyszücs-Belterület (within settlement limits), 2.: Bakonyszücs-Szőlőhegy (Vineyards),

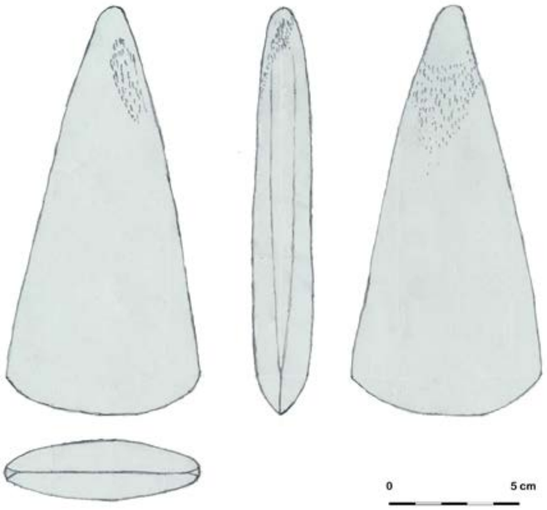


Figure 6. Drawing of the axe from Bakonyszücs.

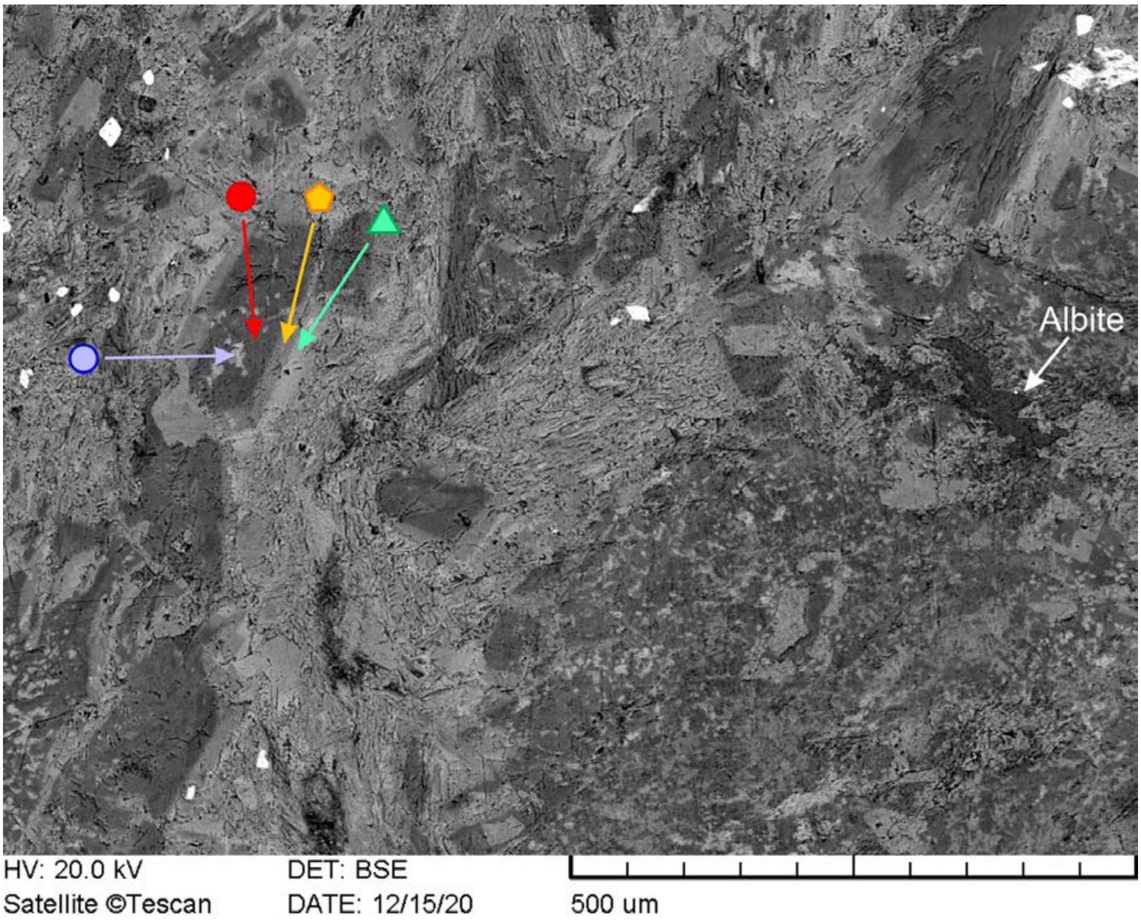


Figure 7. BSE image (Back scattered electron image) photo) on original surface of the Bakonyszücs axe: symbols of the zoned and late phase of the pyroxene: red - core, yellow - mantle, green - rim, blue - late phase.

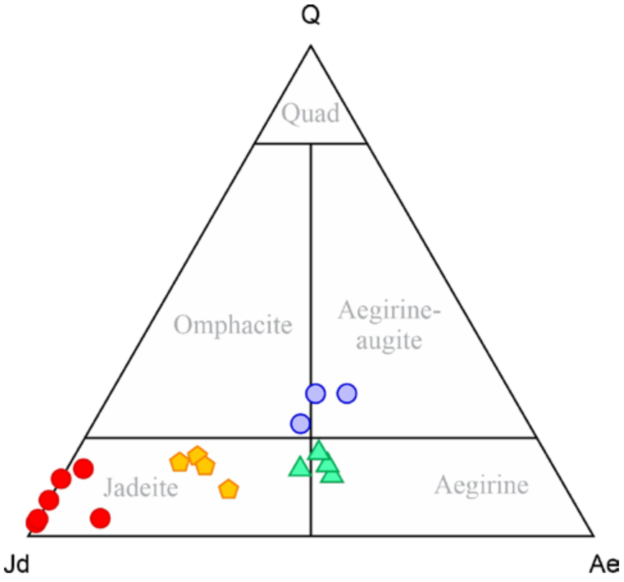


Figure 8. Compositional diagram of alkaline pyroxenes by Morimoto *et alii* (1988) Jd – jadeite, Ae – aegirine, Q – Ca-Mg-Fe-pyroxenes

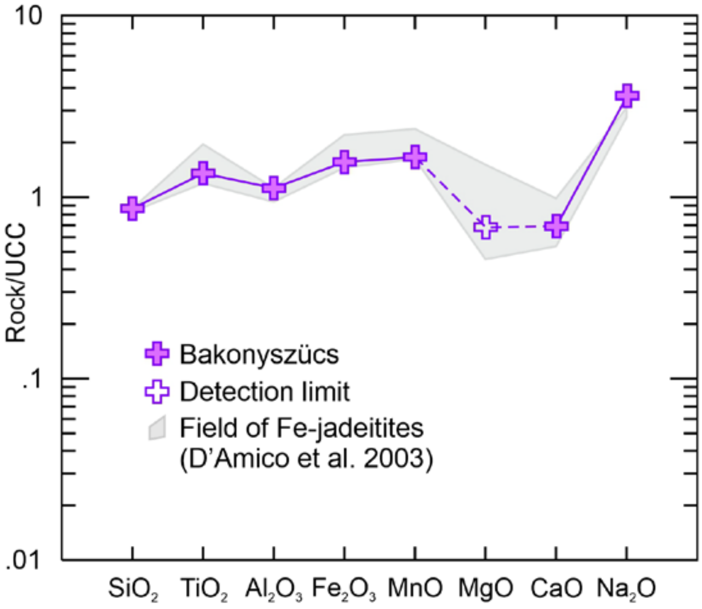


Figure 9. Multi element diagram normalised on UCC (Upper Continental Crust - data after McLennan (2001) of the Bakonyszücs axe.

Compound / Element	Conc. / wt%	Abs. unc. (±)
SiO_2	57.1	1.1
TiO_2	0.92	0.03
Al_2O_3	17.0	0.3
Fe_2O_3	7.8	0.2
MnO	0.133	0.01
MgO	<1.5	
CaO	2.9	0.1
Na_2O	14.1	0.3
K_2O	<0.24	
H_2O	0.07	0.01
B	0.00017	0.00001
Cl	<0.0050	
Sm	0.0048	0.0002
Gd	0.0019	0.0001

Table 1. Chemical composition of Bakonyszücs axe measured by PGAA

Sample	cpx01	cpx02	cpx03	cpx04	cpx05	cpx06	cpx07	cpx08	cpx09	cpx10	cpx11	cpx12	cpx13	cpx14	cpx15	cpx16	cpx17
Text. Pos.	core	mantle	rim	late	core	core	mantle	rim	late	core	core	mantle	rim	core	mantle	rim	late
SiO_2	59.24	57.27	56.42	55.41	61.44	60.69	57.75	55.88	54.6	61.23	59.38	57.33	55.65	59.58	57.61	56.07	56.11
TiO_2	1.09	0.23	1.03	0.54	b.d.l.	0.63	0.29	1.07	0.38	b.d.l.	b.d.l.	b.d.l.	1.04	0.8	b.d.l.	0.99	0.39
Al_2O_3	20.3	15.09	11.1	8.84	22.28	20.14	15.67	10.43	8.06	21.99	19.23	15.12	10.27	19.8	14.99	9.87	10.24
MgO	1.75	1.64	2.57	4.12	b.d.l.	b.d.l.	2.01	2.53	3.33	b.d.l.	1.89	1.86	2.31	1.55	1.97	2.77	3.93
FeO	1.95	9.57	13.7	14.19	1.28	3.27	8.97	14.57	16.89	1.53	4.32	10.24	15.66	3.49	9.8	15.27	12.76
MnO	b.d.l.	b.d.l.	b.d.l.	0.27	b.d.l.	b.d.l.	b.d.l.	b.d.l.	b.d.l.	b.d.l.	b.d.l.	b.d.l.	b.d.l.	b.d.l.	b.d.l.	b.d.l.	0.26
CaO	0.76	2.78	2.44	6.45	0.38	1.2	2.59	2.7	6.7	0.58	1.97	3.07	2.61	1.27	2.89	2.86	5.15
Na_2O	14.93	13.41	12.74	10.17	14.62	14.07	12.71	12.82	10.04	14.67	13.21	12.38	12.45	13.5	12.74	12.17	11.17
end members (%)																	
Q	4	9	14	29	3	7	15	12	29	3	14	16	14	12	14	17	23
Jd	85	60	45	35	97	93	66	40	29	97	83	62	40	88	62	40	40
Ae	11	31	41	36	0	0	19	48	42	0	3	22	46	0	24	43	37
b.d.l.: below detection limit																	

Table 2. Results of chemical analyses of pyroxenes by 'original surface method' on SEM-EDS of of Bakonyszücs axe