

Radiolarite: Questions and answers

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Archaeometriai Műhely 2009. 10. 29 - Horvát-Magyar együttműködési projekt



Introduction

Radiolarite is a siliceous rock formed in the bathial region - deep sea and ocean environment. It is composed of Radiolaria, unicellular organisms with siliceous skeletal elements. Radiolarians as a taxon have a long range, they are known since the Palaeozoic till recent times. In rock-forming quantities, however, they are typical of the Mesozoic period.

As raw material for chipped stone tools, radiolarite is frequently used. On the average, it is the most frequent component of lithic inventories in Hungary and even more, in Transdanubia. There are macroscopically separable types among the radiolarites, mainly on the basis of colour and other physical properties. They are currently named after the most characteristic geological source locality. It remains a question though, how much the 'raw material types' represent really different sources; how variability within each source is reflected in the archaeological lithic material and how much we can separate regional varieties, supported by objective methods of analysis. It is also imperative to know radiolarites from sources outside the present territory of Hungary that may have played a role in the raw material supply and 'fingerprint' the individual sources and regions.

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Former summary

Project kick-off meeting 30. 05. 2008.

Research of archaeological radiolarites in Hungary

- known sources of archaeological radiolarite
- macroscopically separable types
- distribution data
- existing analytical information

Lecture available at: <http://www.ace.hu/tet/am2008-05-03/TBK-08-05-30.pdf>

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Former summary

Project kick-off meeting 30. 05. 2008.

Research of archaeological radiolarites in Hungary

Concluding:

- Radiolarites are one of the most important elements of the lithic inventory in the Carpathian Basin
- They can be easily differentiated from other siliceous raw materials on the basis of the presence of microfossils *Radiolaria*
- Colour varieties are diagnostic but not unquestionable

Lecture available at: <http://www.ace.hu/tet/am2008-05-03/TBK-08-05-30.pdf>

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Current project

Questions:

- can we locate the radiolarite sources indicated by the archaeological evidence in Croatia?
- can we separate them from the known radiolarite sources on the basis of physical, chemical or palaeontological criteria?
- is it possible to draw 'borderlines' between interacting types like Szentgál radiolarite / Bosnian red radiolarite or Mecsek radiolarite / Croatian dark red, bluish grey radiolarites?

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Current project

Fieldwork

1.	Velka Bara	C1 obsidian
2.	Mala Bara	C1 obsidian
3.	Vinicky	C1 obsidian
4.	Bodrogszerdahely	C1 obsidian
5.	Tolcsa-Ciróka árok	C2T obsidian
6.	Mád-Kakas hegy	C2E obsidian
7.	Felsőtárkány	radiolarite
8.	Lábatlan-limestonebánya	limestone
9.	Lábatlan-Tüzköves barlang	radiolarite
10.	Szomód-Lőtér	radiolarite
11.	Héreg	radiolarite
12.	Vértestolna	radiolarite
13.	Bakonycsernye-Tüzköveshegy	
14.	Nagytevel-Kőbánya	flint
15.	Lókút-Legelő	radiolarite
16.	Hárskút-Gyenespuszta	radiolarite
17.	Szentgál-Gombáspuszta, táborhely	radiolarite
18.	Városlőd-Savóölgy, Tama patak	
19.	Városlőd-Savóölgy	radiolarite
20.	Sűrmeg-Mogyorósdomb	radioláris flint
21.	Magyaregregy-Somosi csörge	siliceous limestone
22.	Kisújbánya-Szószer	radiolarite
23.	Kisújbánya-Óbányai völgy	radiolarite
24.	Magyaregregy-Singödör	radiolarite
25.	Komló-Szöge hegy	radiolarite
26.	Hosszúhetény-Csengőhegy	radiolarite
27.	Zengővárkony	archaeological site
28.	Hosszúhetény-kőbánya	tephrite
29.	Ljubešćica	radiolarite
30.	Medvednica	radiolarite
31.	Velika	limestone
32.	Kremešnica	radiolarite
33.	Labinštica	flint
34.	Kozjak Mountain, Starosevski gaj	flint
35.	Island Čiovo, Saldun	flint
36.	Vela Luka, Bradat	siliceous limestone
37.	Island Sušac, Velo polje	archaeological site
38.	Vela Palagruza	archaeological site

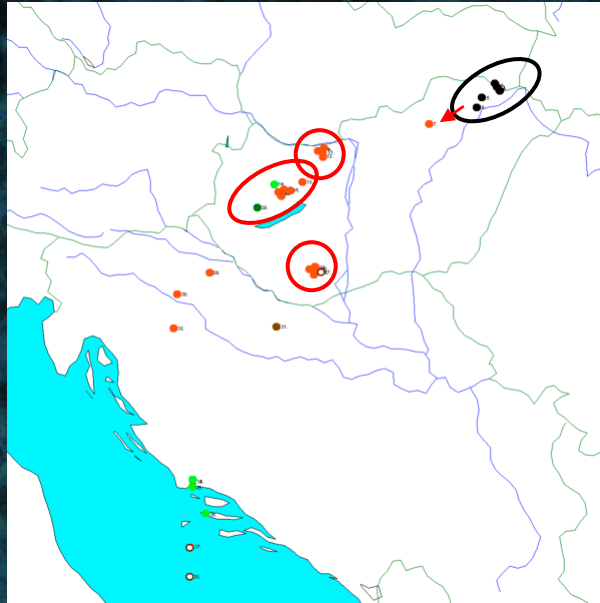
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Current project

Fieldwork

In Hungary

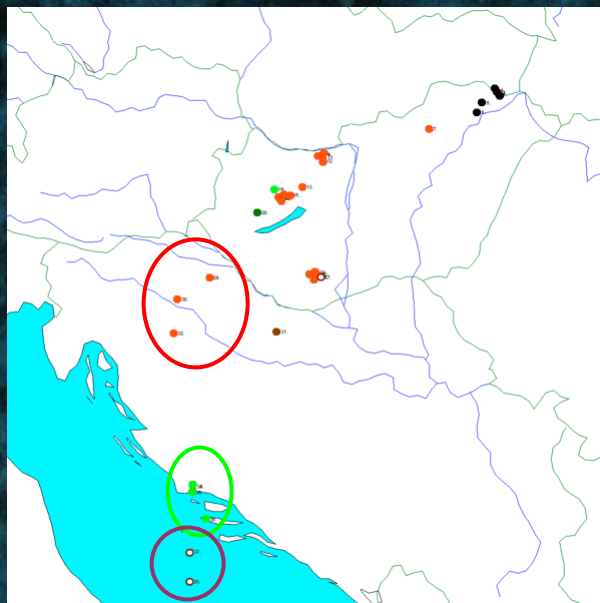


Archaeometria Hungary 2008-10-27-1101vaid-2008-2009 project

Current project

Fieldwork

In Croatia



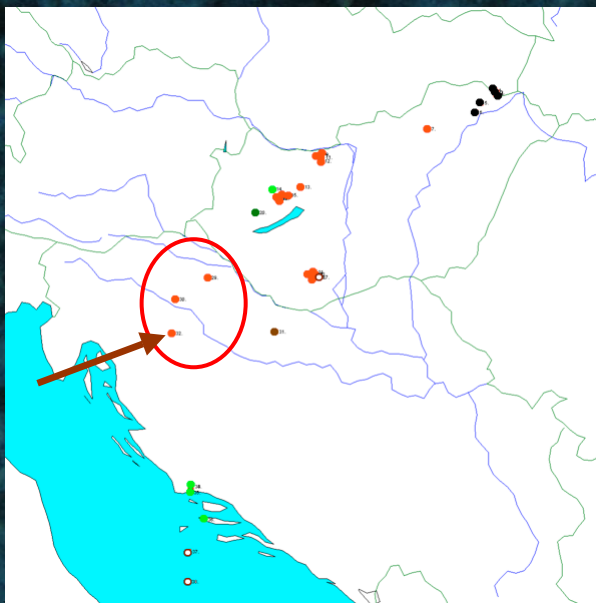
Archaeometria Hungary 2008-10-27-1101vaid-2008-2009 project

Current project

Fieldwork

In Croatia

Kremesnica



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Current project

Fieldwork

In Croatia

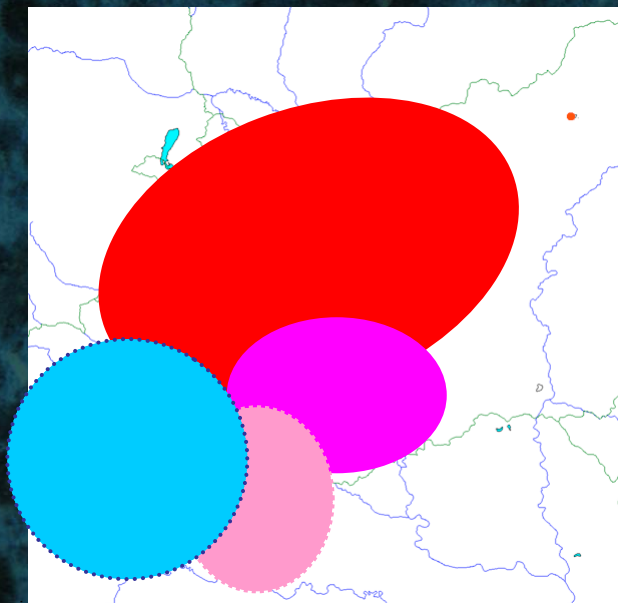
Kremesnica



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Current project

Radiolarites



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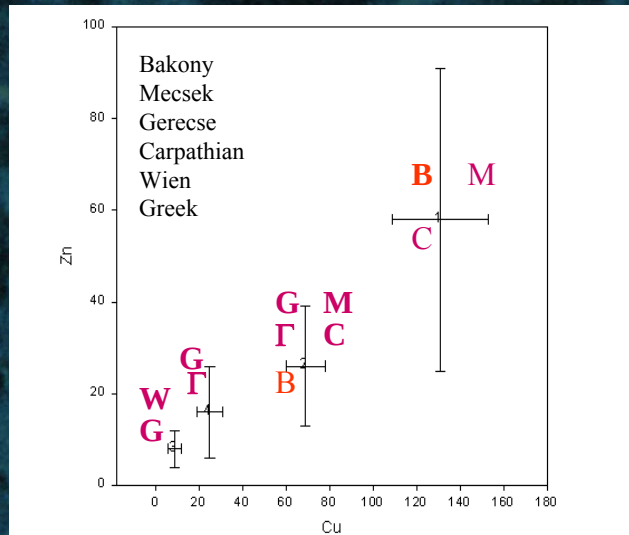
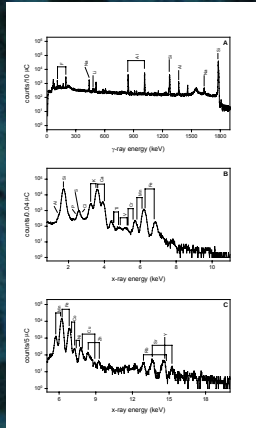
Previous analyses

Analytical achievements

- ◆ Petrographic thin section (TS)
- ◆ X-ray diffraction (XRD)
- ◆ Obszidián hidratációs korhatározás (OHD)
- ◆ Electron- and X-ray spectroscopy (EDS, XRF)
- ◆ Fluid zárvány vizsgálatok (FLA)
- ◆ Neutron activation analysis (NAA)
- ◆ Proton-induced X-ray and γ -ray spectroscopy (PIXE-PIGE)
- ◆ Hasadási nyomvonal detektálás (FTD)
- ◆ Prompt-gamma activation analysis (PGA)
- ◆ Elektron mikropróba vizsgálat (EMPA)

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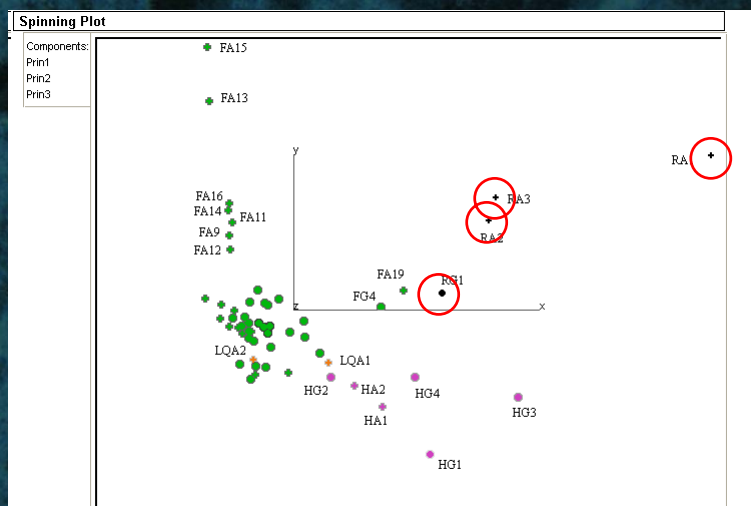
Previous analyses



PIXE-PIGE, Elekes et al. 2000 (NIM)

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Previous analyses



PGAA, Spin-plot on PCA, Kasztovszky-Biró Quebec (2006) 2009

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Current project

Concentrated on PGAA application

15 geological sites, 30 samples

16 archaeological sites, 53 samples

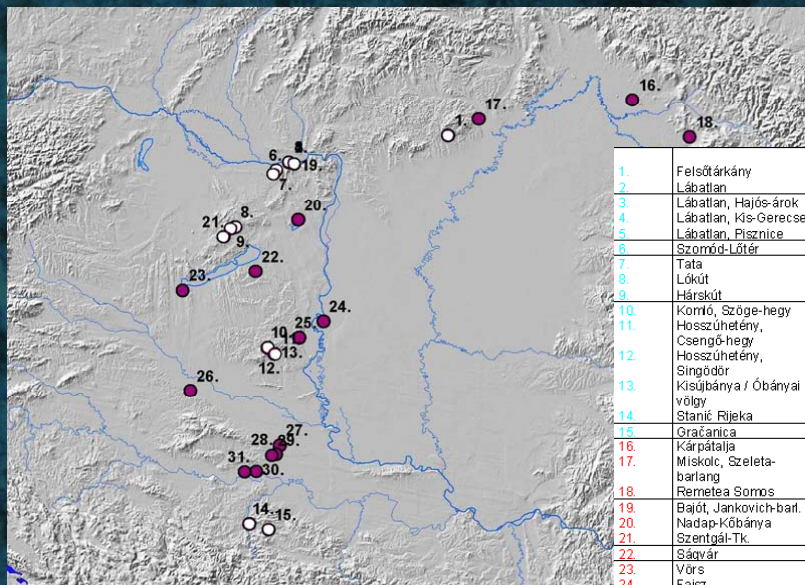
- altogether 83 radiolarite samples analysed

?

enough?

- this is an impressive number but not enough to solve the problem

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		Radiolant
1.	Felsőtárkány	g
2.	Lábatlan	g
3.	Lábatlan, Hajós-árok	g
4.	Lábatlan, Kis-Gerecse	g
5.	Lábatlan, Piszence	g
6.	Szömöd-Lőtér	g
7.	Tata	g
8.	Lókút	g
9.	Hárskút	g
10.	Komló, Szőge-hegy	g
11.	Hosszúhetény	g
12.	Csengő-hegy	g
13.	Singödör	g
14.	Kisújbánya / Óbányai völgy	g
15.	Stanić Rijeka	g
16.	Gračanica	a
17.	Kárpátalja	a
18.	Miskolc, Szeleta-barlang	a
19.	Remetea Somos	a
20.	Bajót, Jankovich-barl.	a
21.	Nadap-Kőbánya	a
22.	Szentgál-Tk.	a
23.	Sárvár	a
24.	Vörö	a
25.	Fajsz	a
26.	Szálka	a
27.	Virovitica	a
28.	Tomašanci	a
29.	Ivándor	a
30.	Cernička Šagovina	a
31.	Zadubravlje	a
	Galovo	a

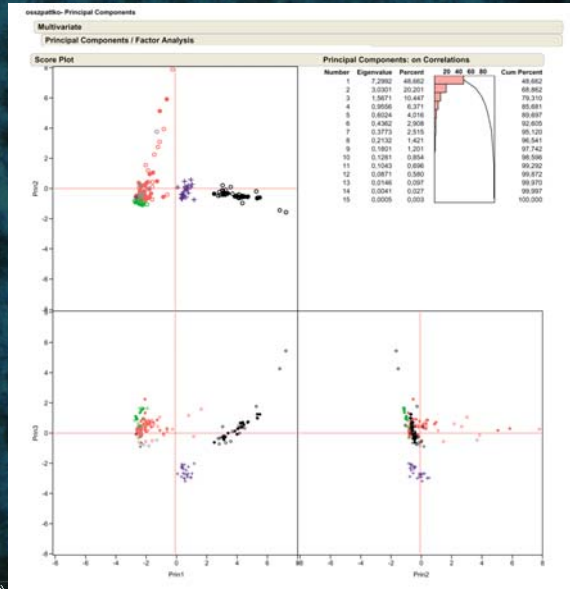
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Current analyses

Principal components

All chipped stones



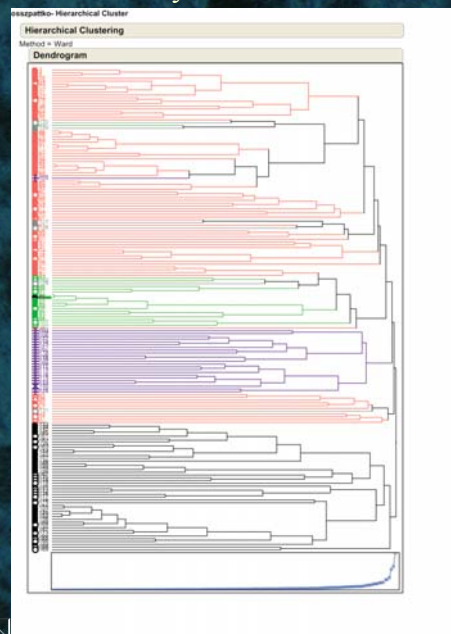
- A radiolarite
- G radiolarite
- A hornstone
- G hornstone
- A obsidian
- G obsidian
- A flint
- G flint
- + Szeletian felsitic porphyry

gyüttműködési projekt

Current analyses

Cluster analysis

All chipped stones



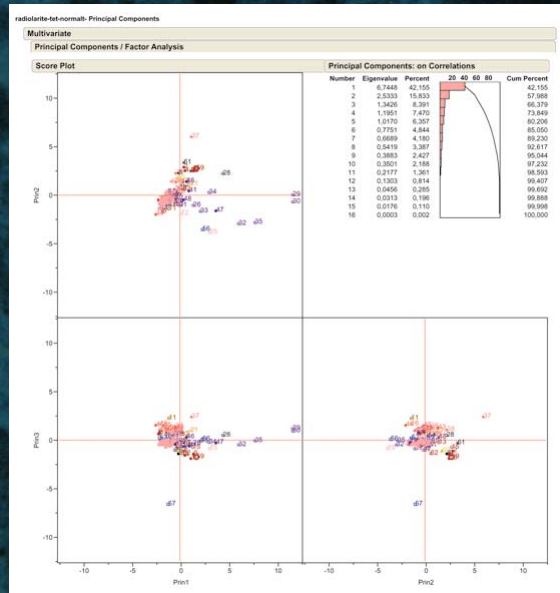
- A radiolarite
- G radiolarite
- A hornstone
- G hornstone
- A obsidian
- G obsidian
- A flint
- G flint
- + Szeletian felsitic porphyry

Magyar együttműködési projekt

Current analyses

Principal components

All radiolarites

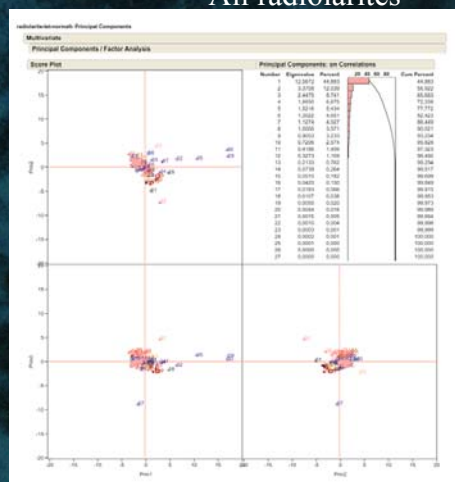
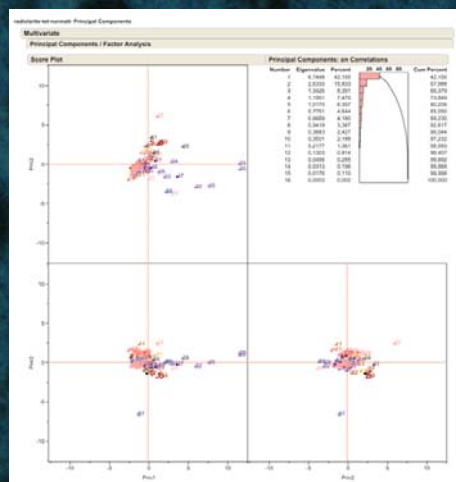


alkotórész projekt

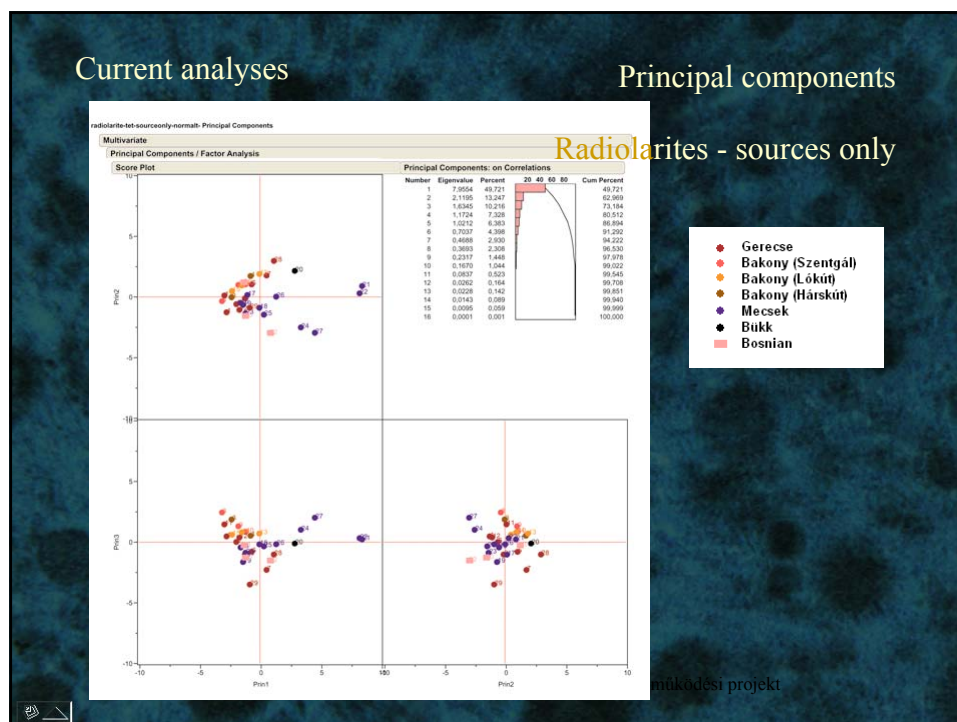
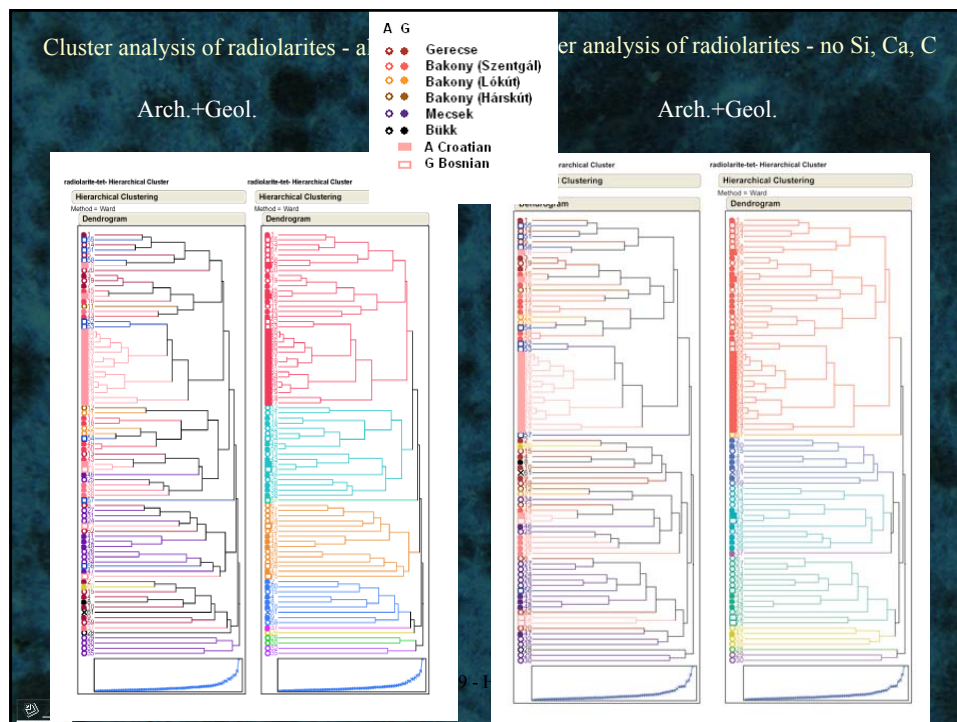
Current analyses

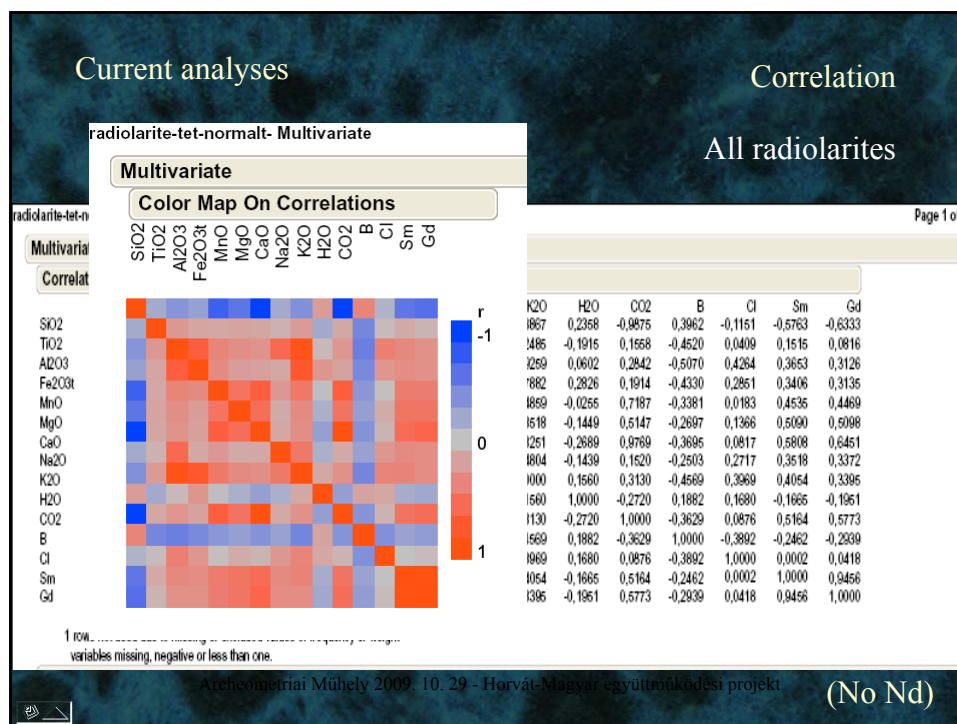
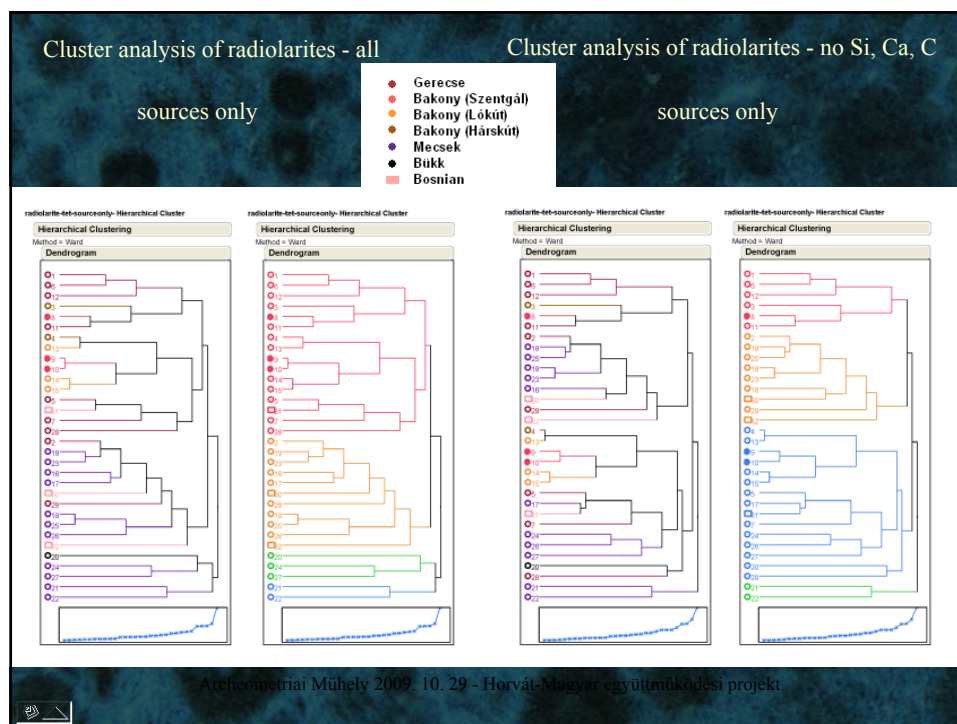
Principal components

All radiolarites



all elements 2009. 10. 29. - Horvát-Magyar egy. No Si, Ca, C, Nd

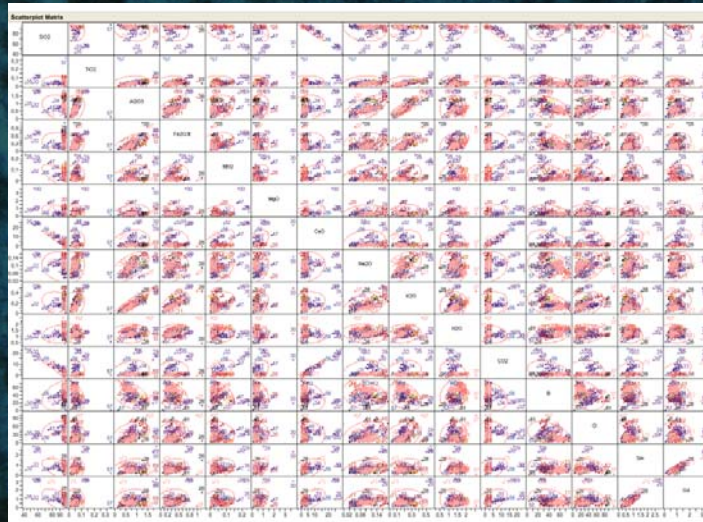




Current analyses

Scatterplot matrix

All radiolarites



(No Nd)

Current analyses

Scatterplot matrix

All radiolarites

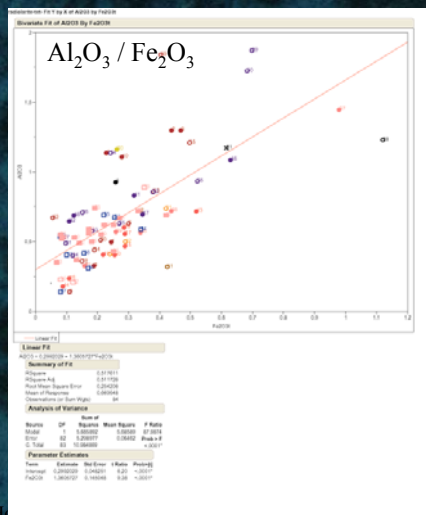
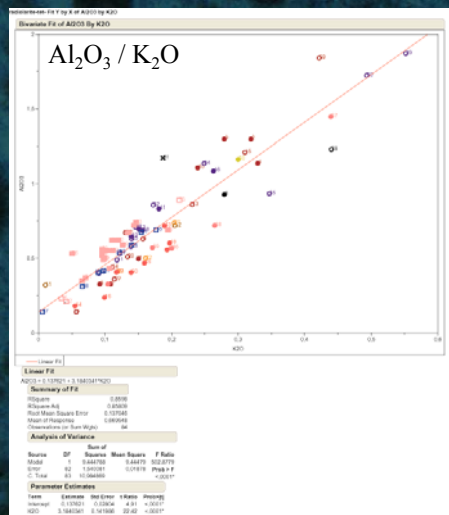
- For all elements;
- For all elements / SiO_2 ;
- For all elements / TiO_2 ;
- For all elements / Al_2O_3

(promise not to show all...)

Current analyses

X / Y plots

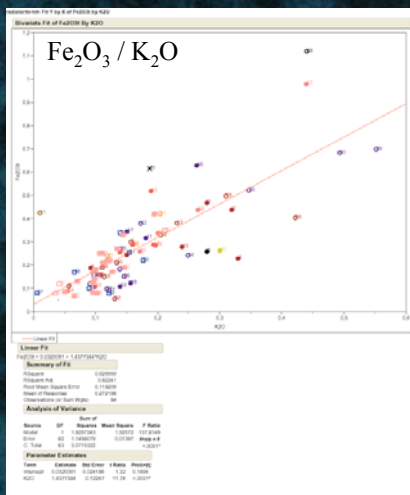
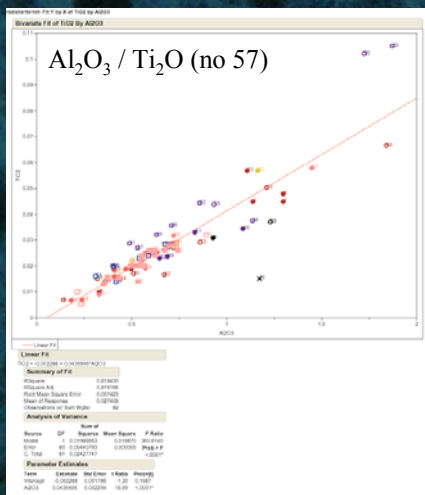
observed strong correlations



Current analyses

X / Y plots

observed strong correlations



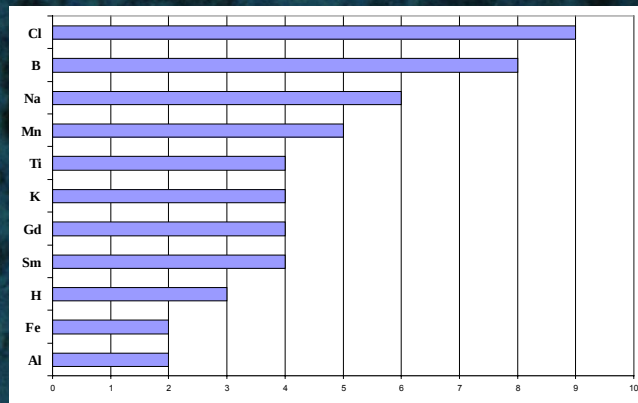
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Current analyses

X / Y plots

best discriminant pairs

Elements considered visually as good discriminants:



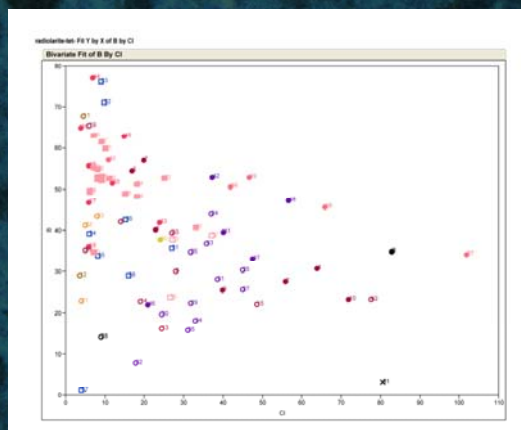
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Current analyses

X / Y plots

best discriminant pairs

B



Cl

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Current analyses

X / Y plots

Matrix of observations

best discriminant pairs

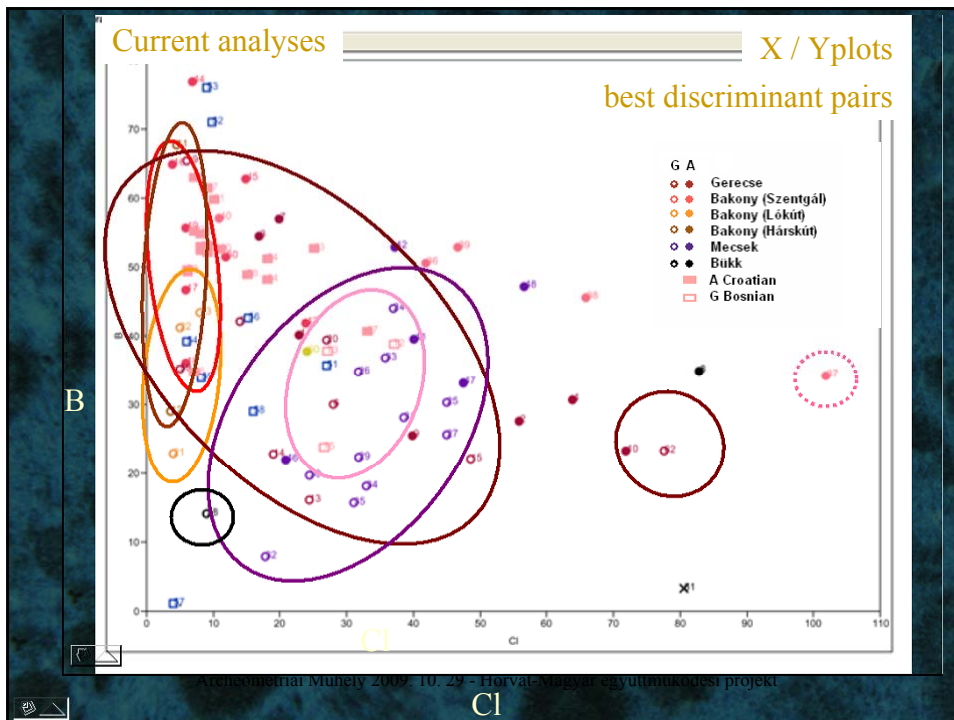
GS data concentrated by GS

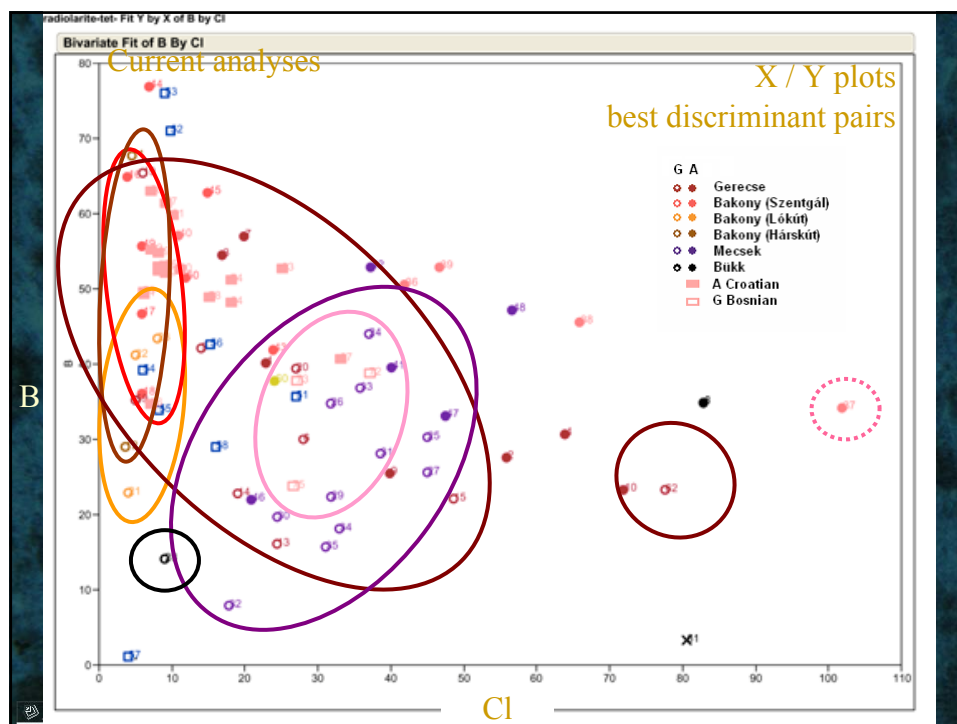
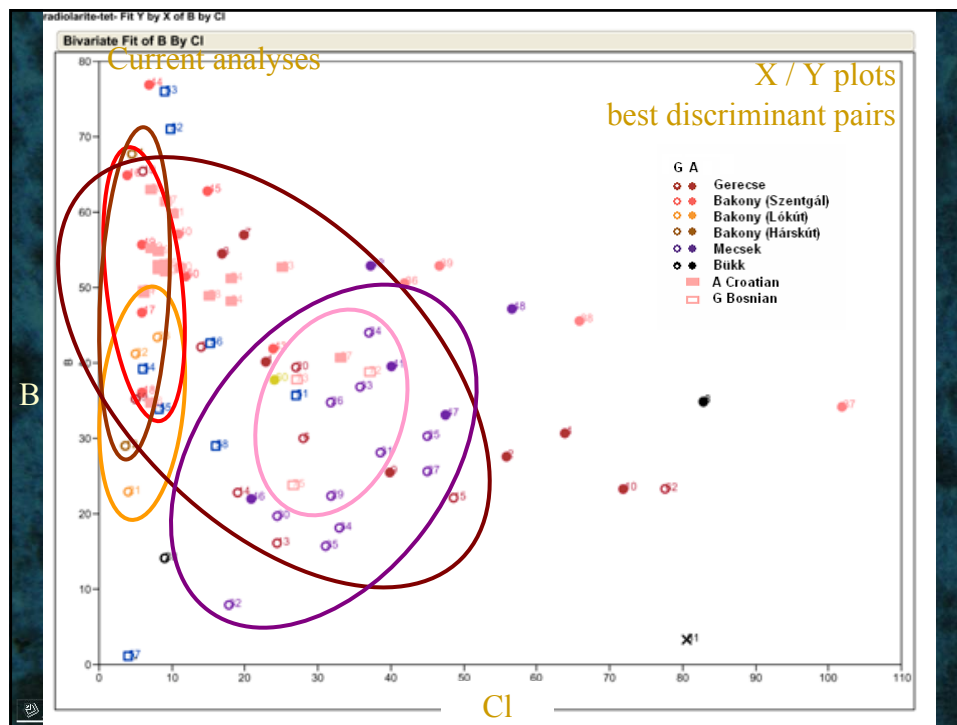
GS data separated by pair

AS data seem to center by pair

Outliers

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Conclusions (1)

- Bakony sources (Szentgál, Hárskút, Lókút) typically interact and are seemingly separable by several pairs of elements
- Gerecse is mostly very wide range: regular outliers observed
- Mecsek is fairly distinct from the rest by several pairs of elements: items from Csengőhegy mainly outliers
- Bosnian samples are similar but not always: they are closer to Bakony but separable by some pairs of elements
- hypothesed provenance of AS items mostly close to GS
- AS pieces seem to be more close to each other esp. Croatian

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Conclusions (2)

Questions and answers

- can we locate the radiolarite sources indicated by the archaeological evidence in Croatia?

yes, partly

- can we separate them from the known radiolarite sources on the basis of physical, chemical or palaeontological criteria?

seemingly yes

- is it possible to draw 'borderlines' between interacting types like Szentgál radiolarite / Bosnian red radiolarite or Mecsek radiolarite / Croatian dark red, bluish grey radiolarites?

not yet

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Acknowledgements

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