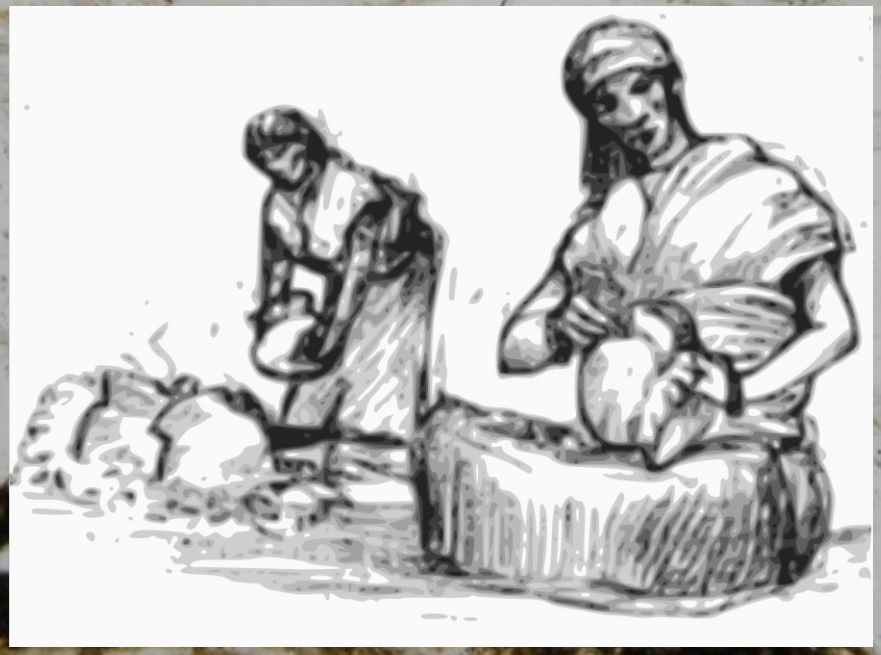
Advances in material analyses of ceramic

Jan Petřík



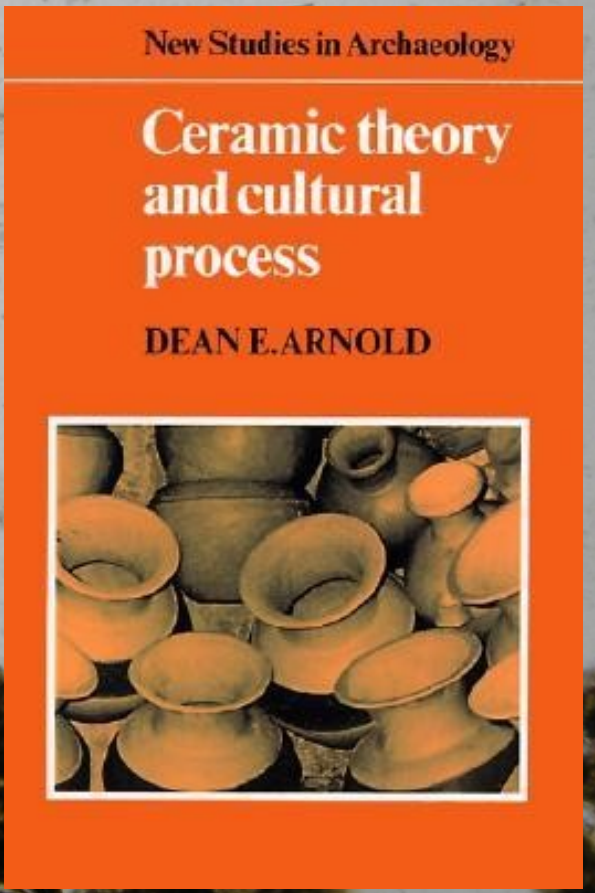
Basic concepts

Material Science Paradigm:

Materials selection and processing associated with production result in an artefact that, in addition to its style has a particular structure and composition (Kingery 1996)

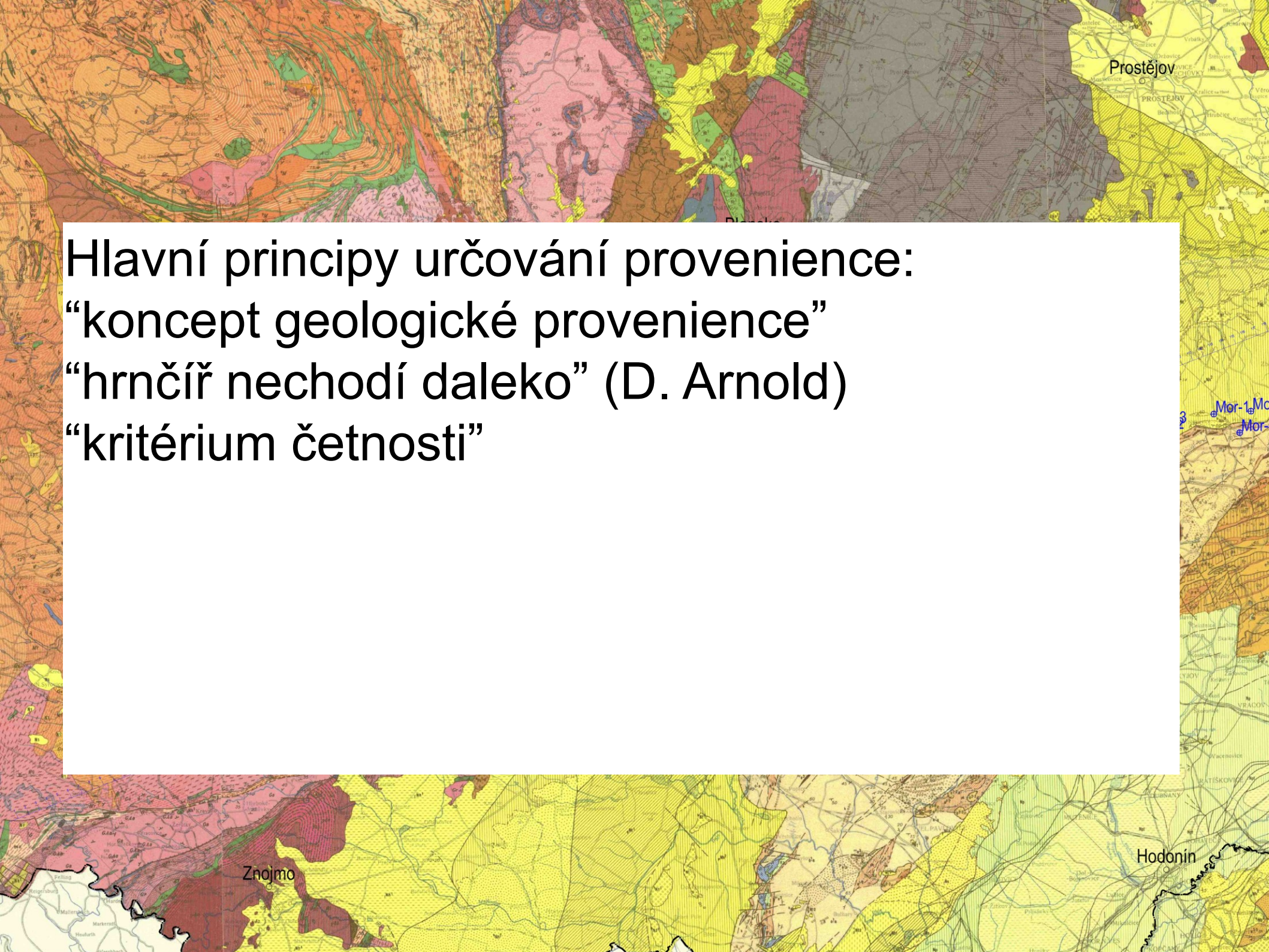
Material studies stages (Tite 2001)

1. stage - the reconstruction of production, distribution and use
2. stage - interpretation of this reconstructed life cycle in order to provide a better understanding of the people who produced, distributed and use them



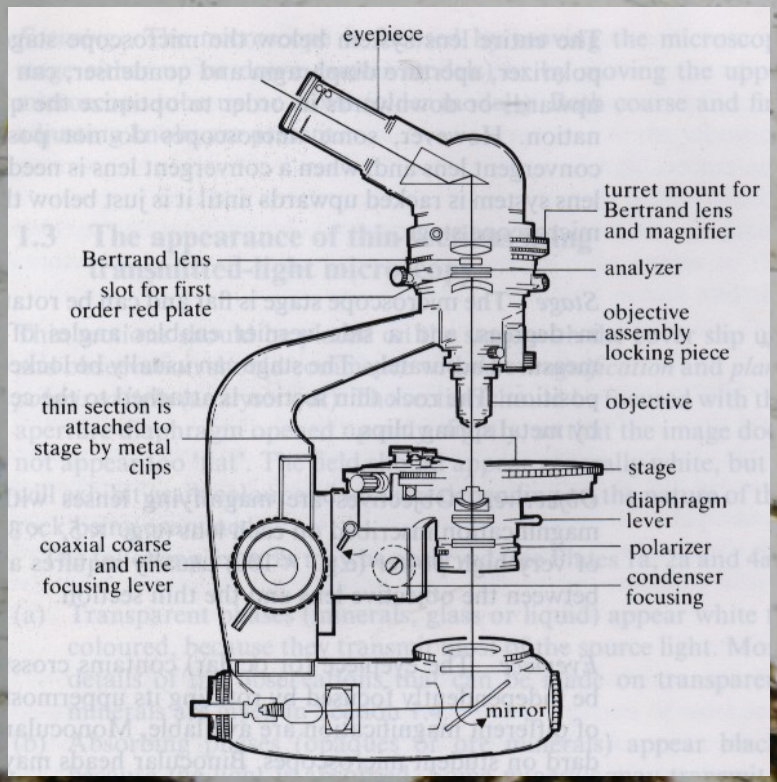
Etic x Emic Information (Arnold 1971)

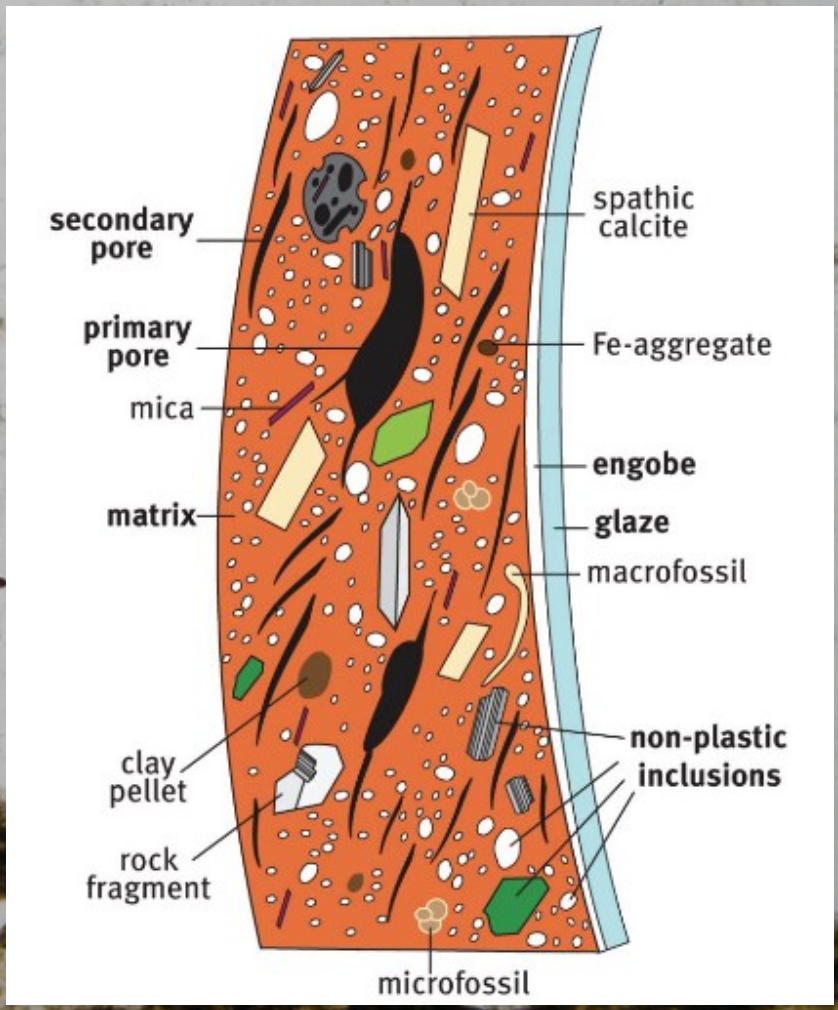
Etic – crosscultural and directly measurable
Emic – culturally embedded and its context specific nature must be therefore discovered



Hlavní principy určování provenience:
“koncept geologické provenience”
“hrnčíř nechodí daleko” (D. Arnold)
“kritérium četnosti”

Petrography and optical microscopy





Inkluze – základní hmota – póry

Polarizační mikroskopie

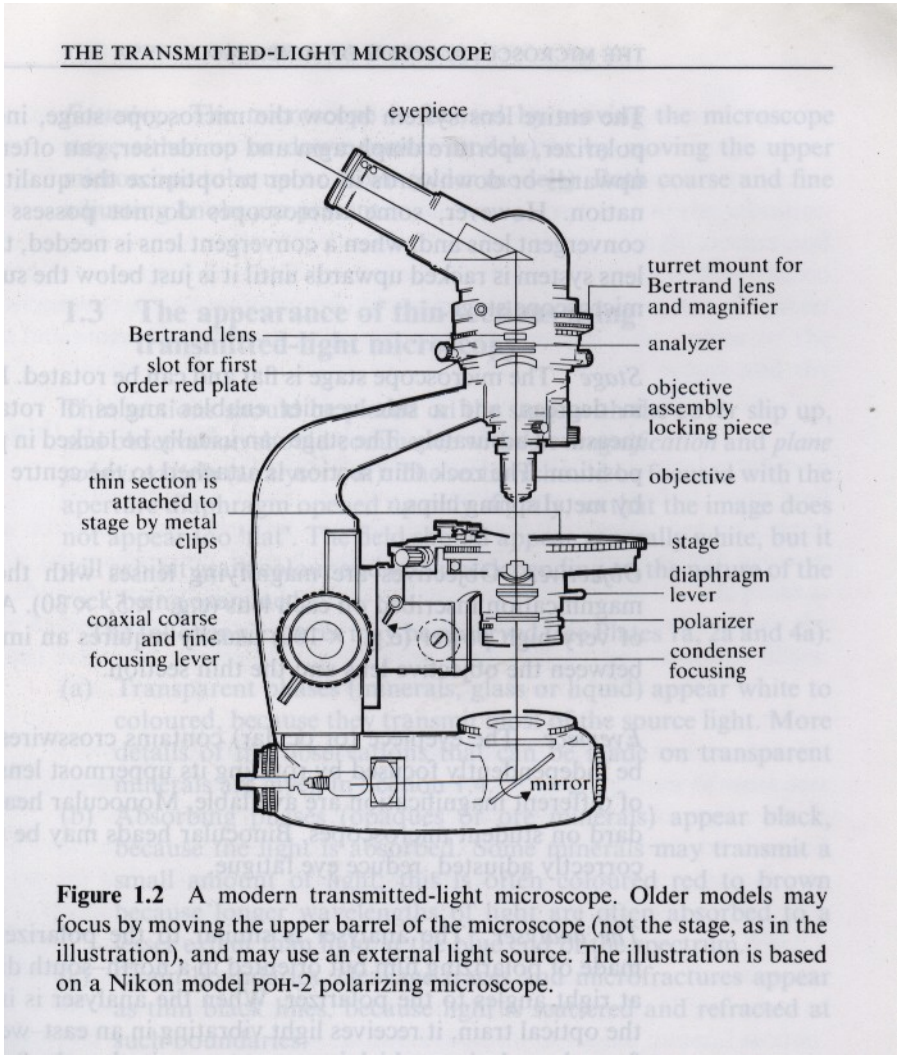
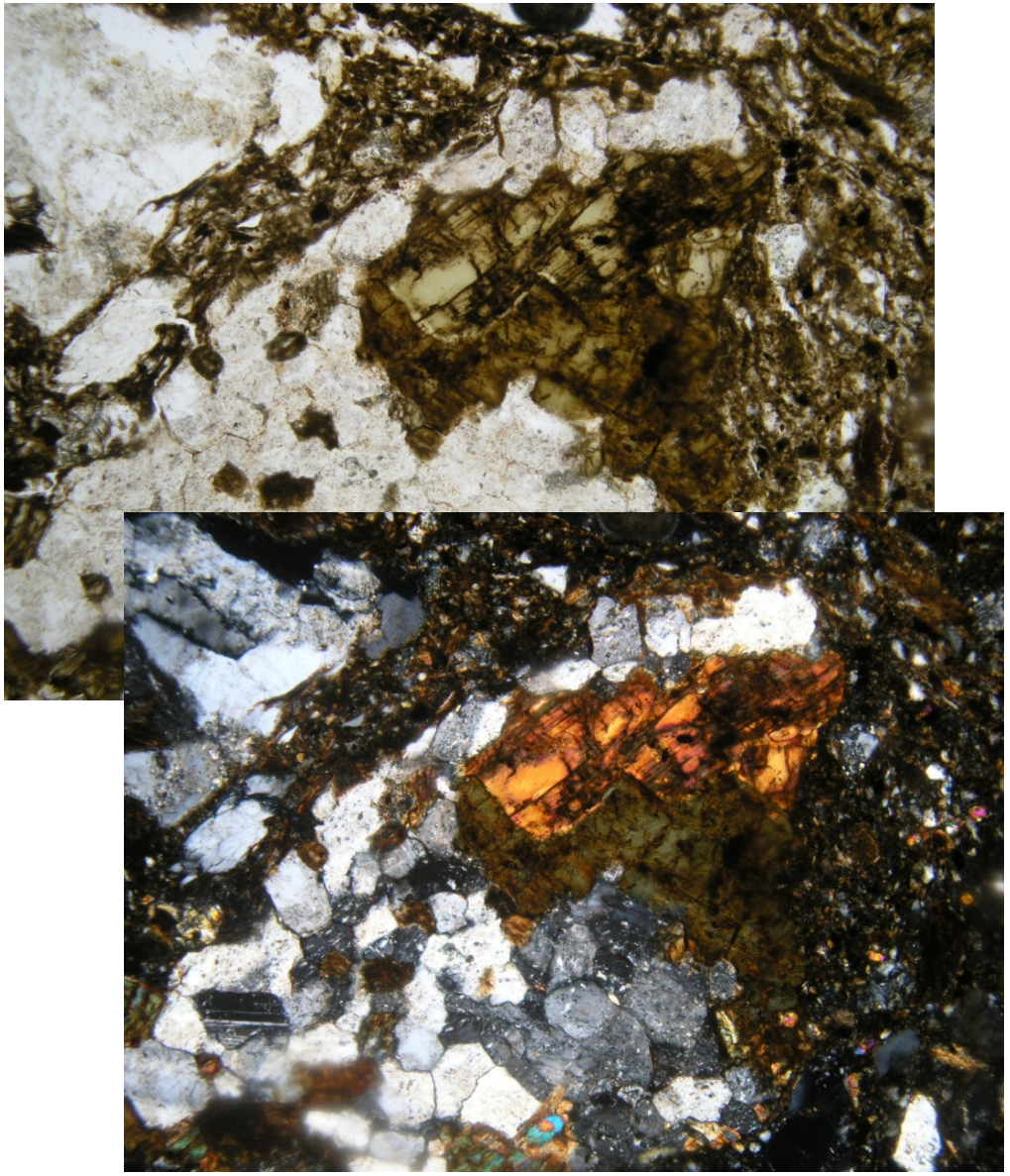
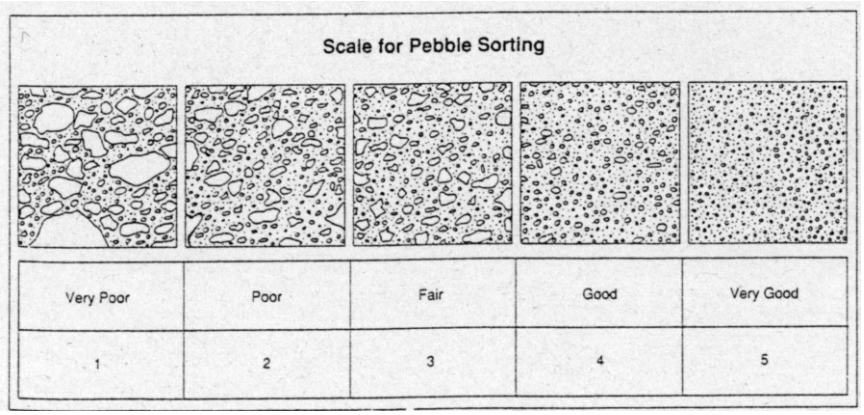


Figure 1.2 A modern transmitted-light microscope. Older models may focus by moving the upper barrel of the microscope (not the stage, as in the illustration), and may use an external light source. The illustration is based on a Nikon model POH-2 polarizing microscope.

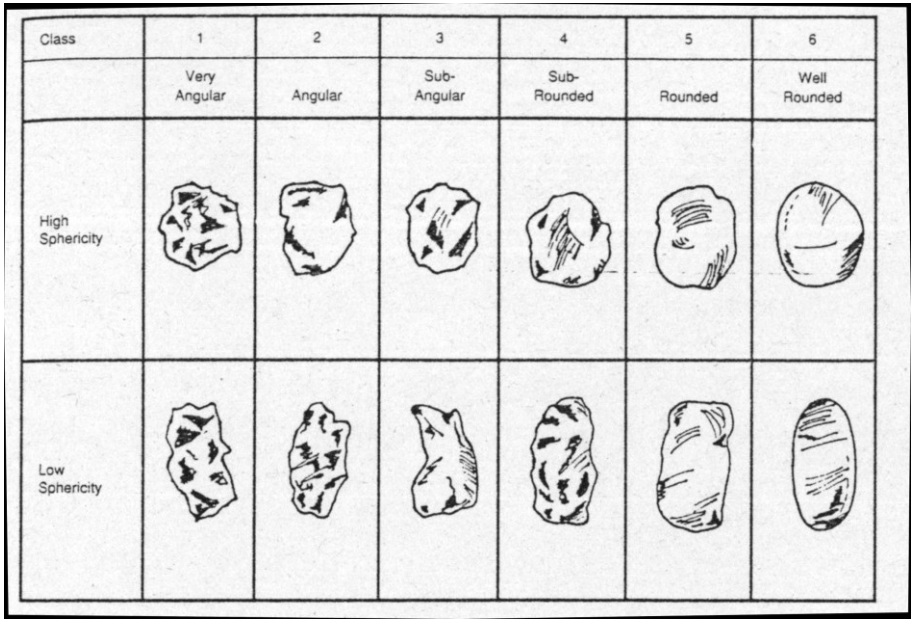


Optické vlastnosti

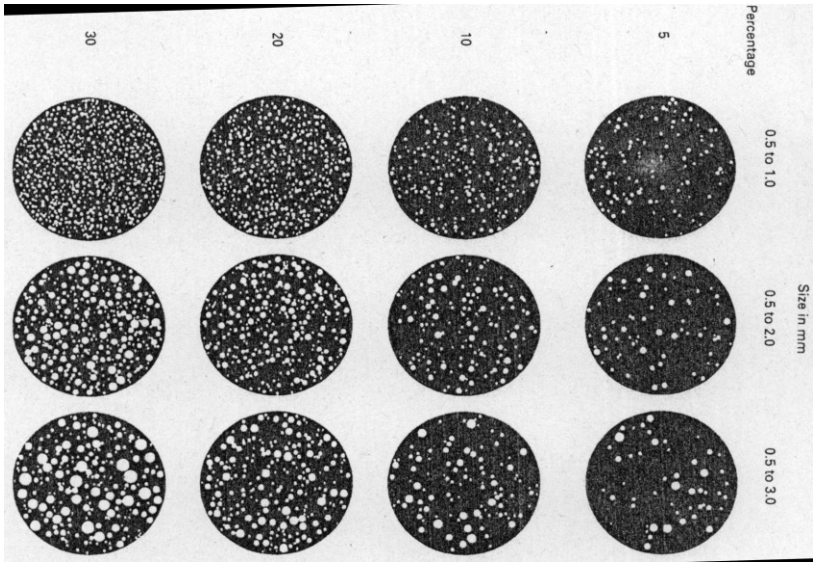
Zastoupení pórů, aplastik a matrix



Vytřídění

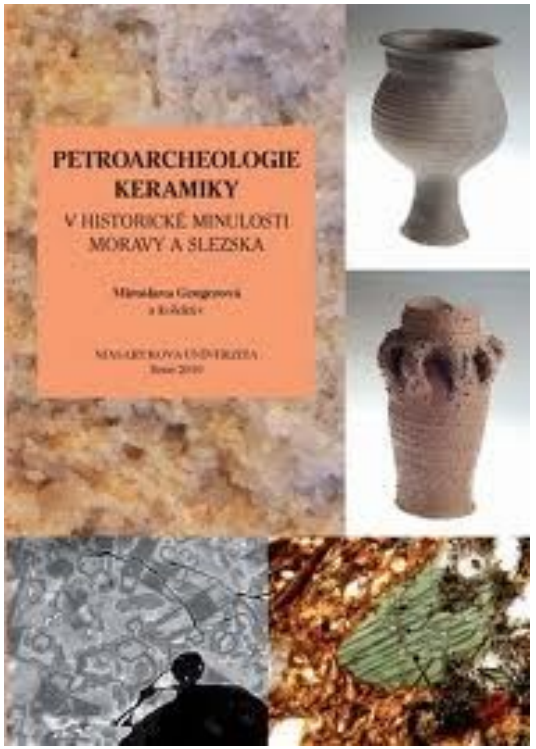


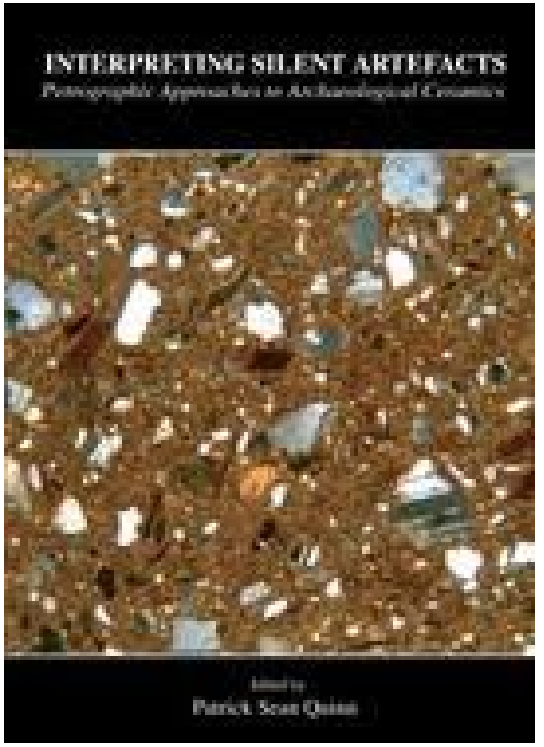
Sféričnost a zaoblenost zrn

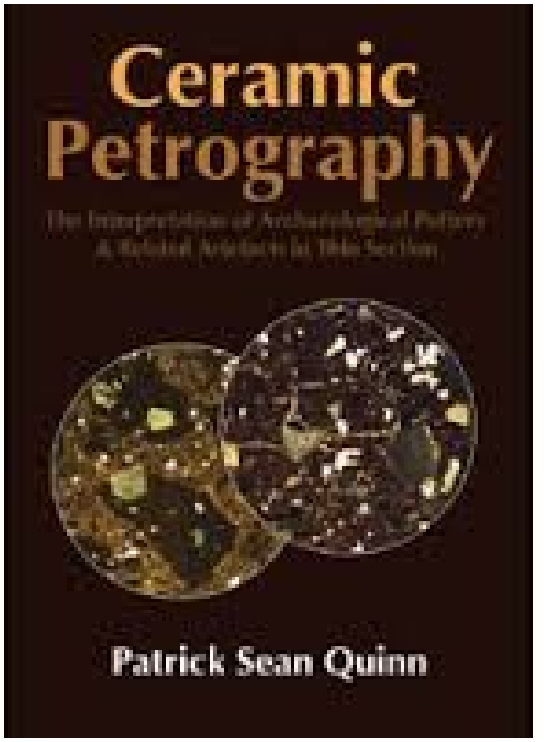


Množství inkluzí

Keramická mikropetrografie





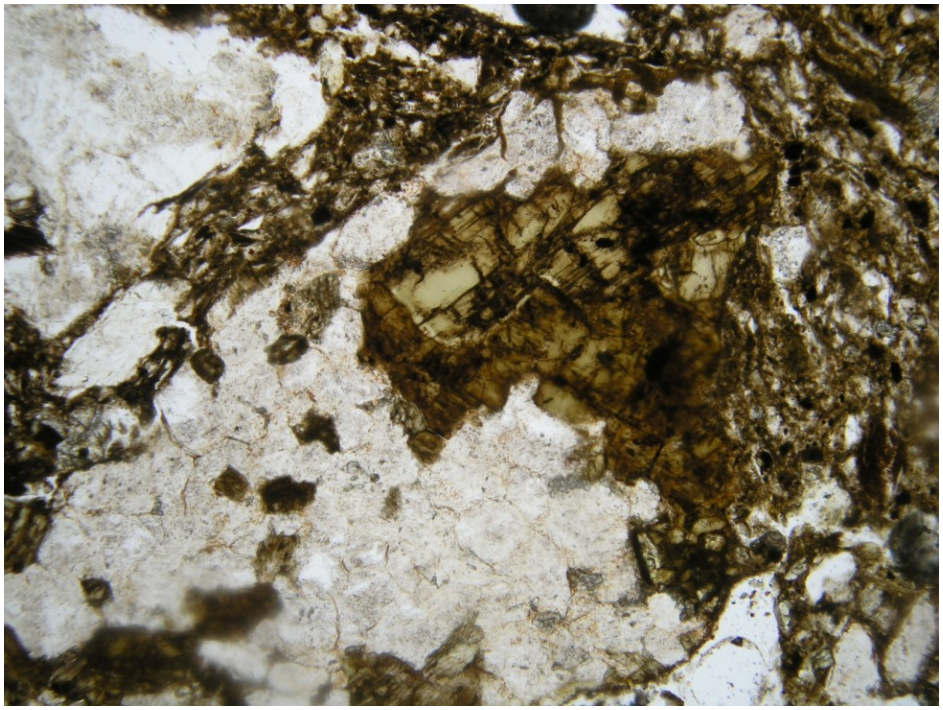


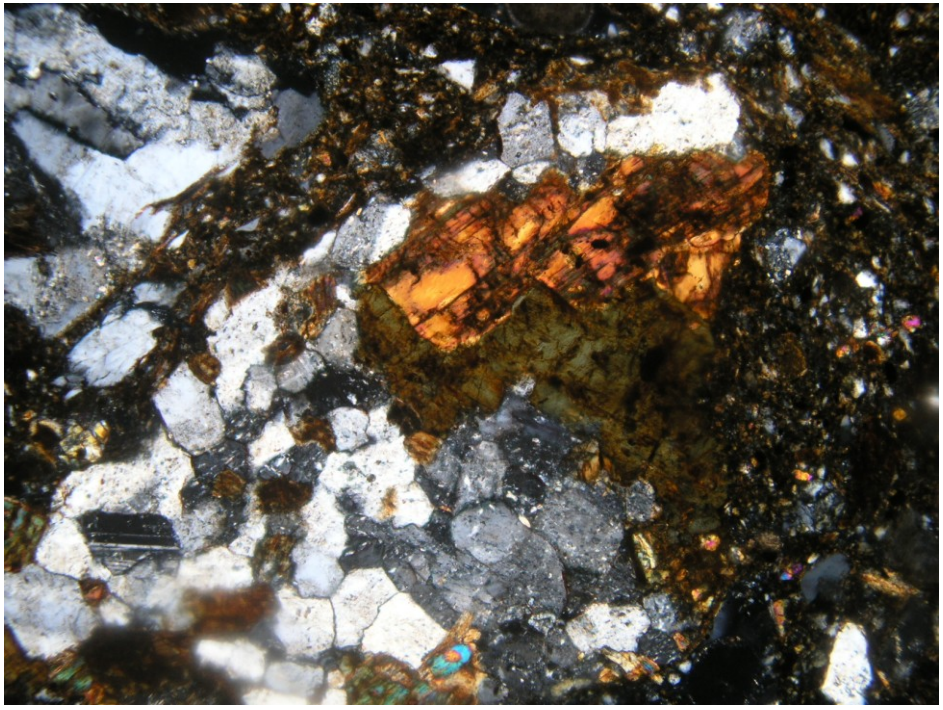
Inkluze (aplastika, ostřivo)

- Mohou a nemusí být přidávány záměrně
- Lze to zjistit jen v některých případech
- Některé inkluze mohou definovat konkrétní provenienční nebo technologickou skupinu

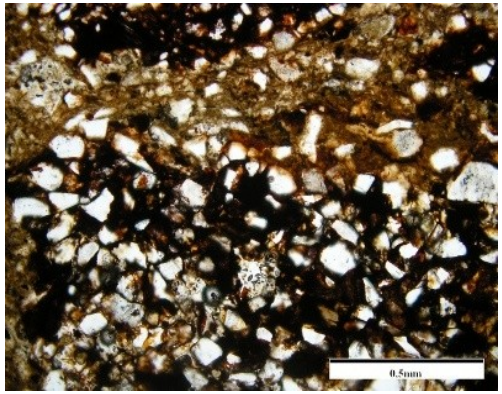
Určení úlomků hornin a minerálů

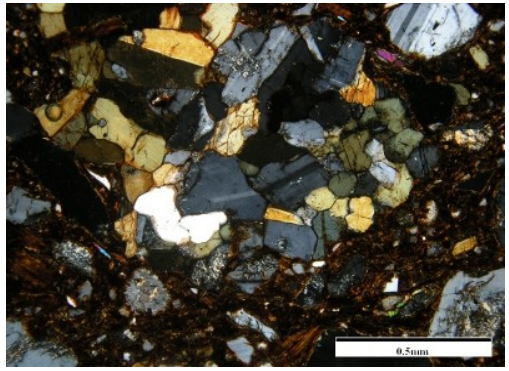
- určení suroviny
- informace o technologických postupech
- východisko pro zjišttění variability

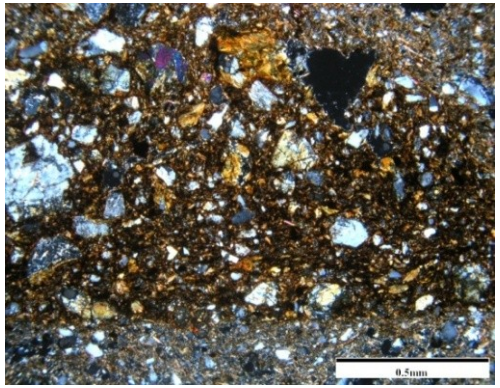


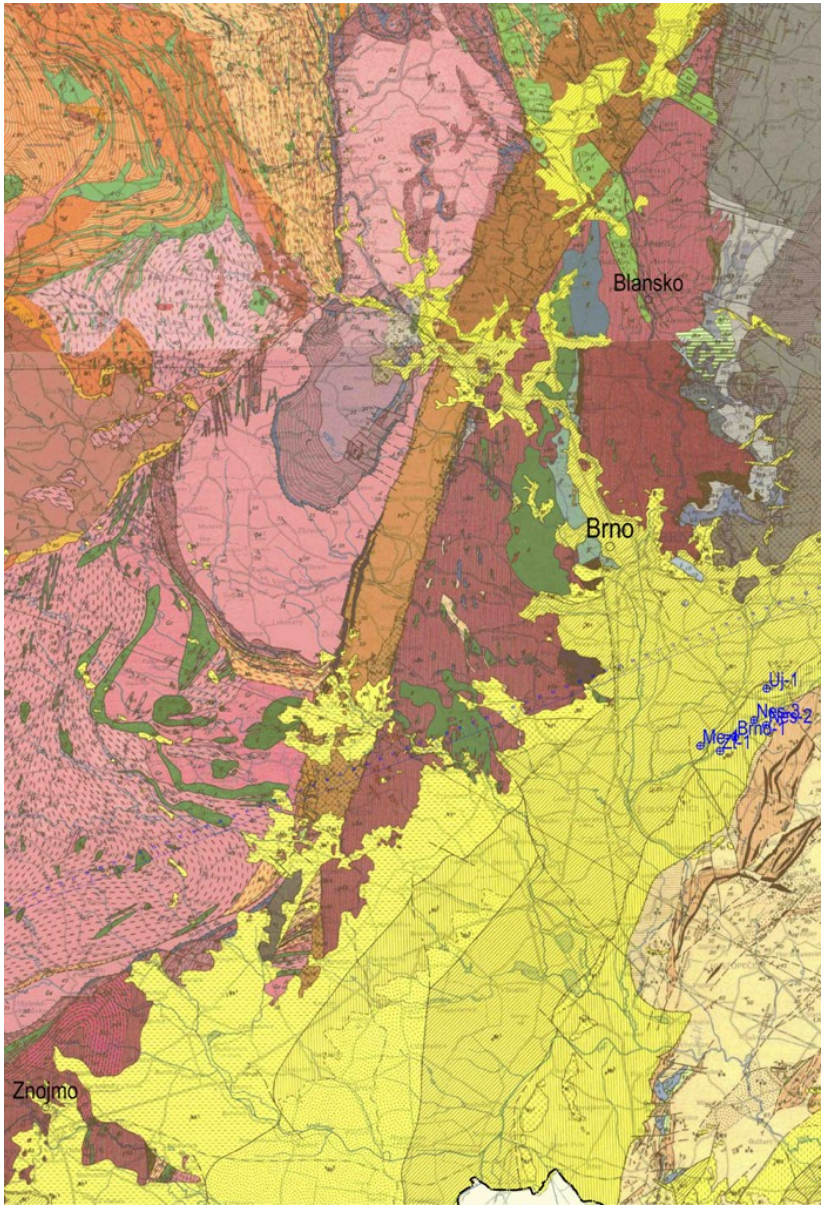


Geological provnience









Basic principles:

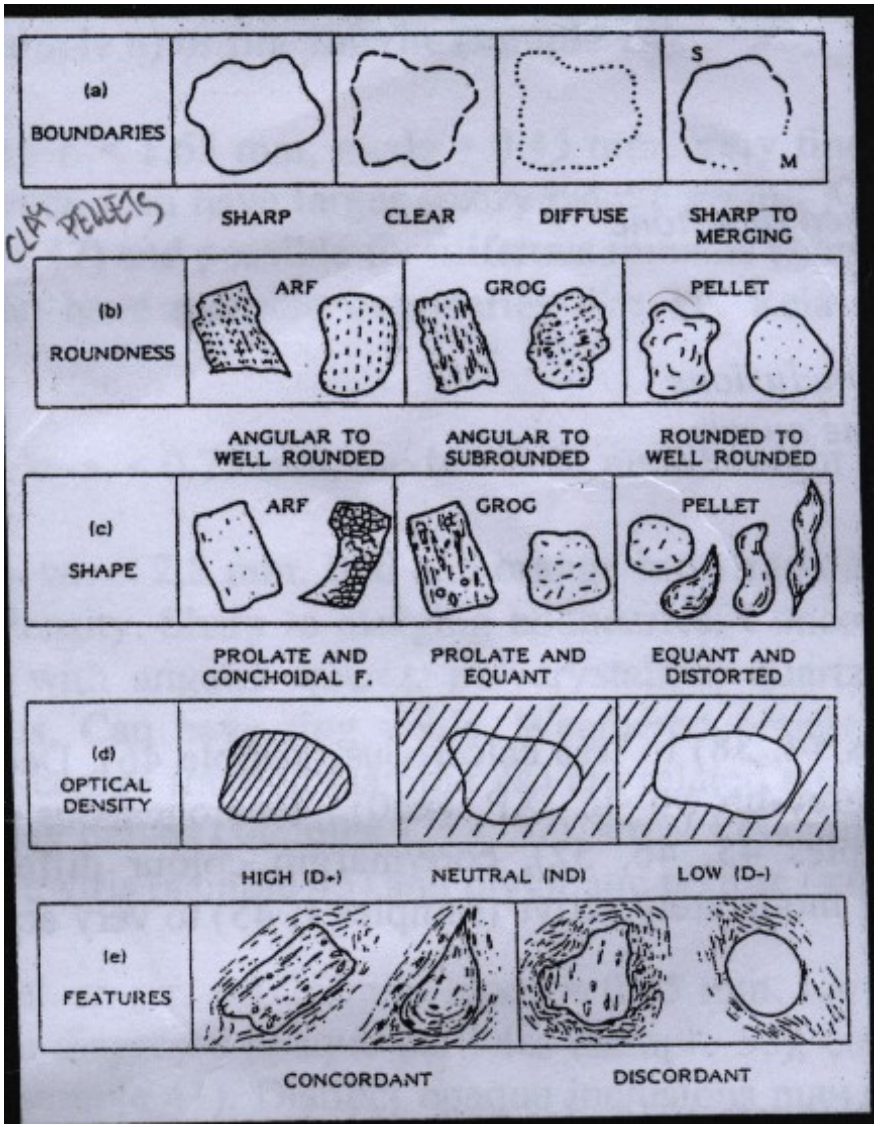
"Concept of geological provenance„
- unique rocks and minerals
Belongs to uniq geological unis

"The potter doesn't go far for clay„
- cca 3-5 km according to ethnography (Arnold)

"Criterion of frequency„
- most frequent ware is local

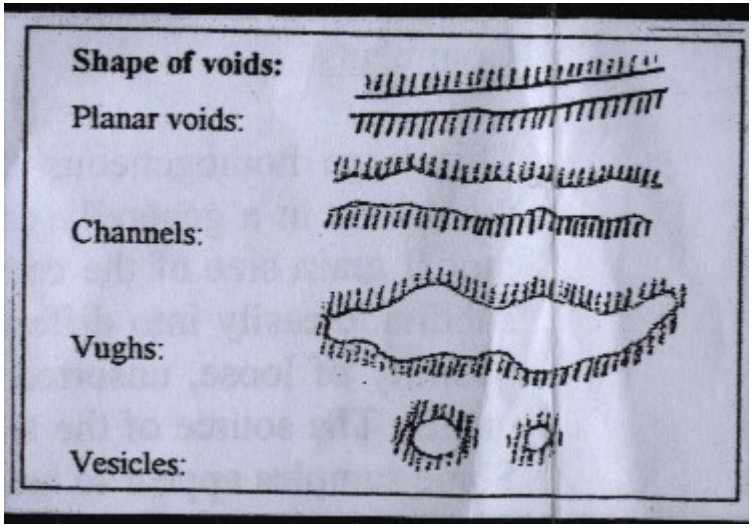
Plastické inkluze

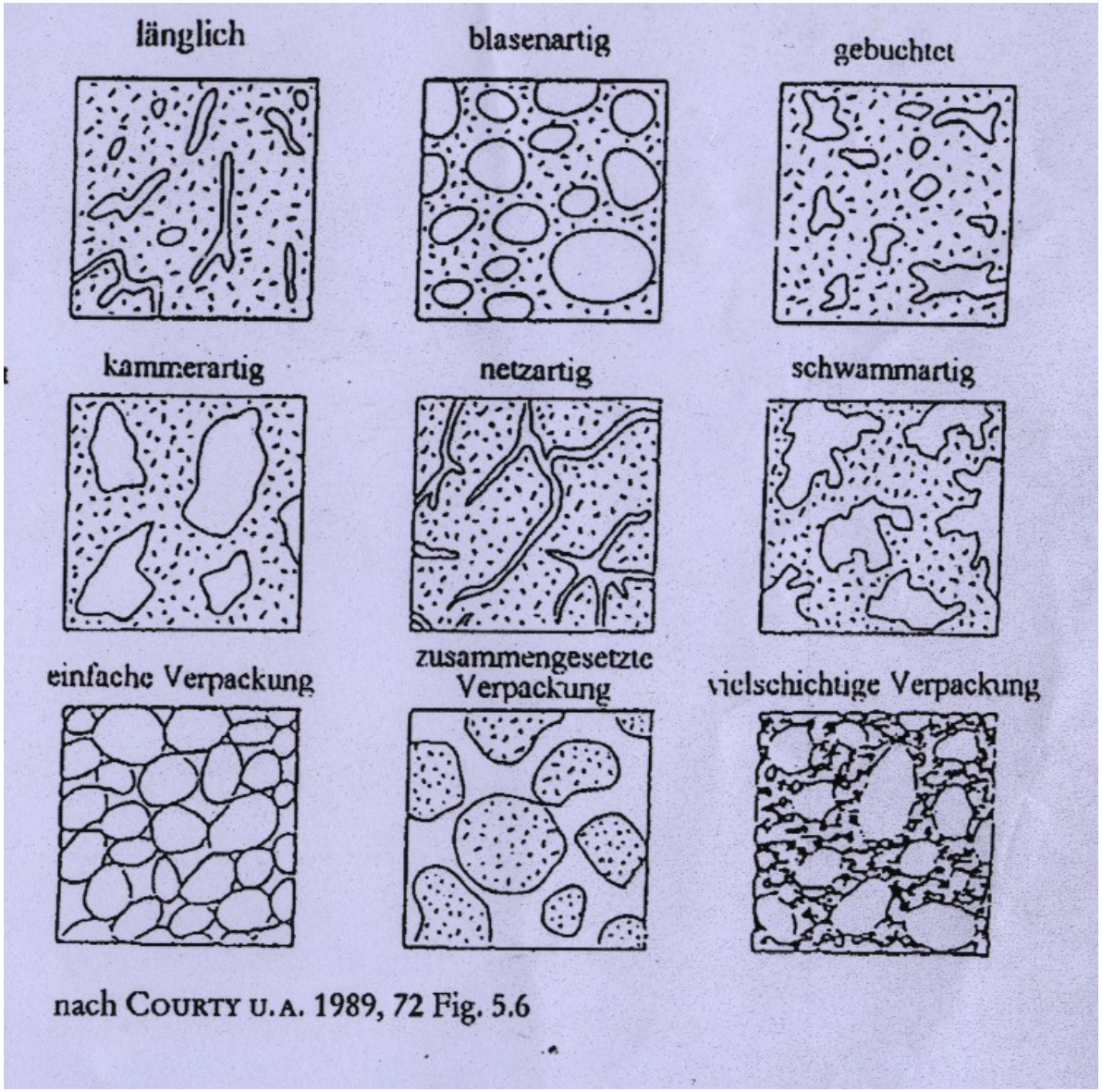
- Při makroskopické deskripci mohou být makroskopicky rozeznatelné podle barvy a stavby
- Jejich identifikace je však většinou možná až ve výbrusovém preparátu



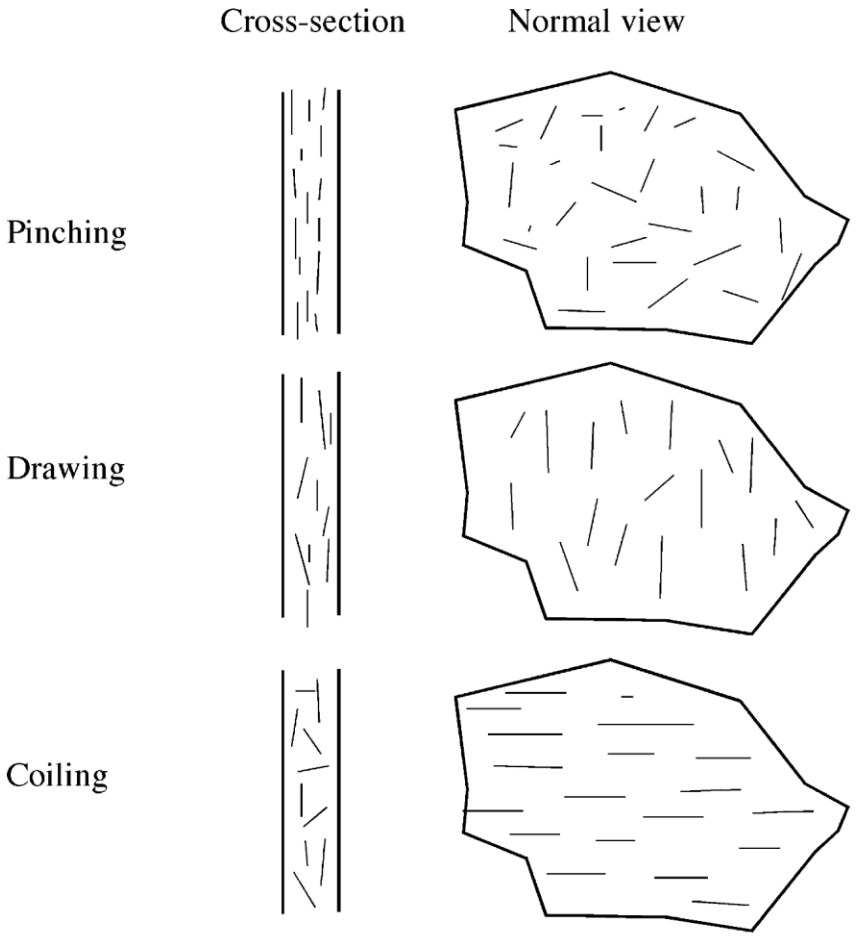
Póry

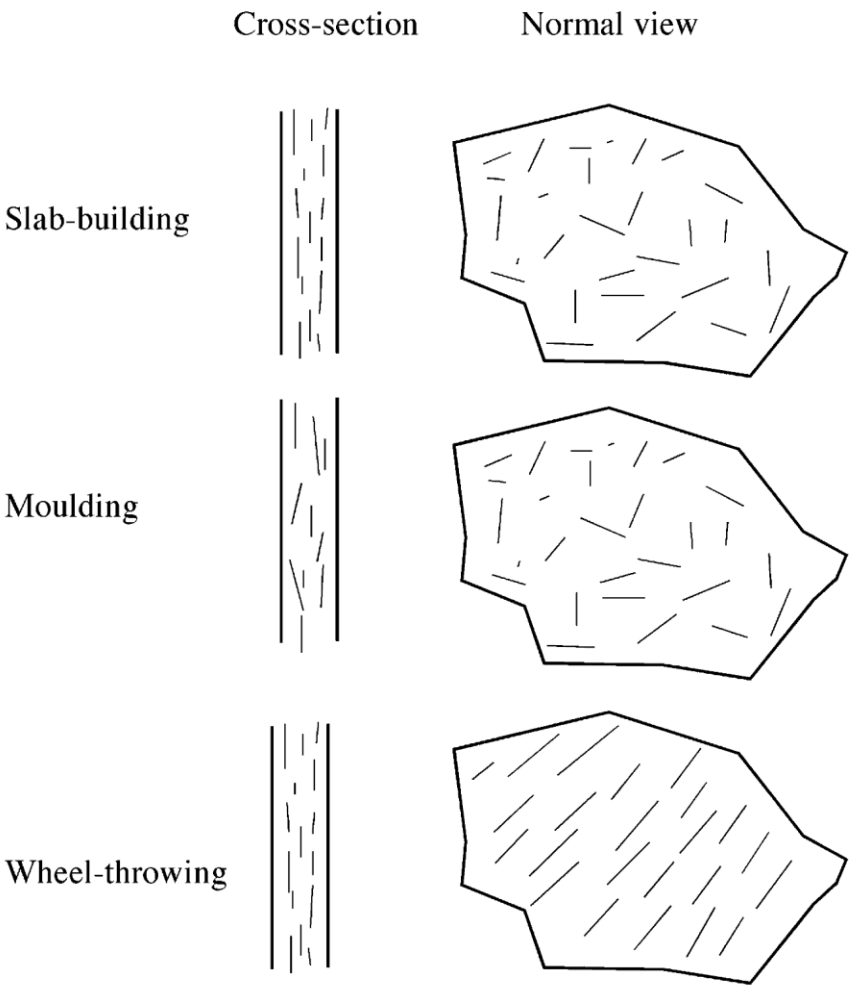
Velikost, tvar





Identifikace formovací techniky

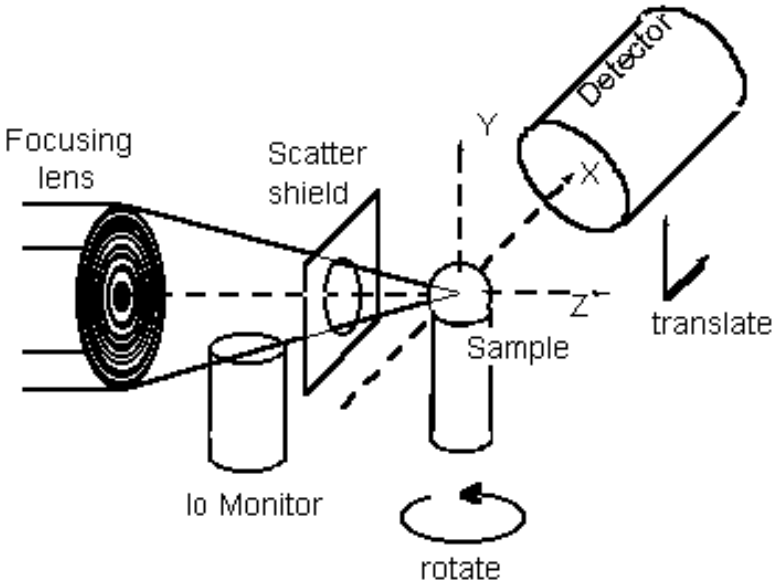


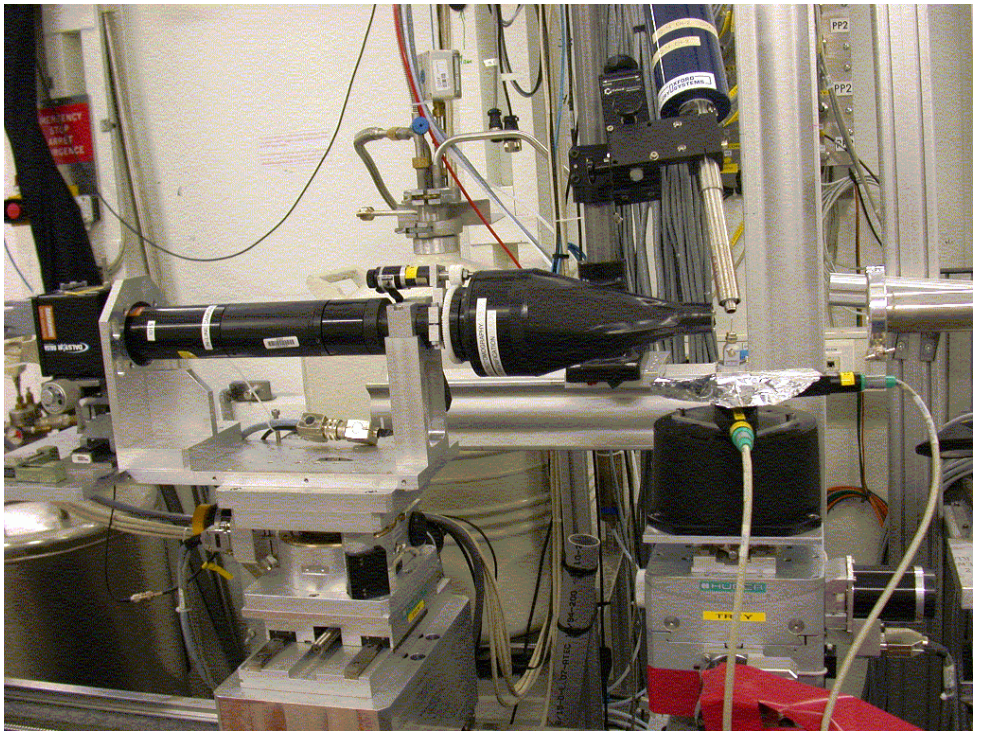


Microtomography

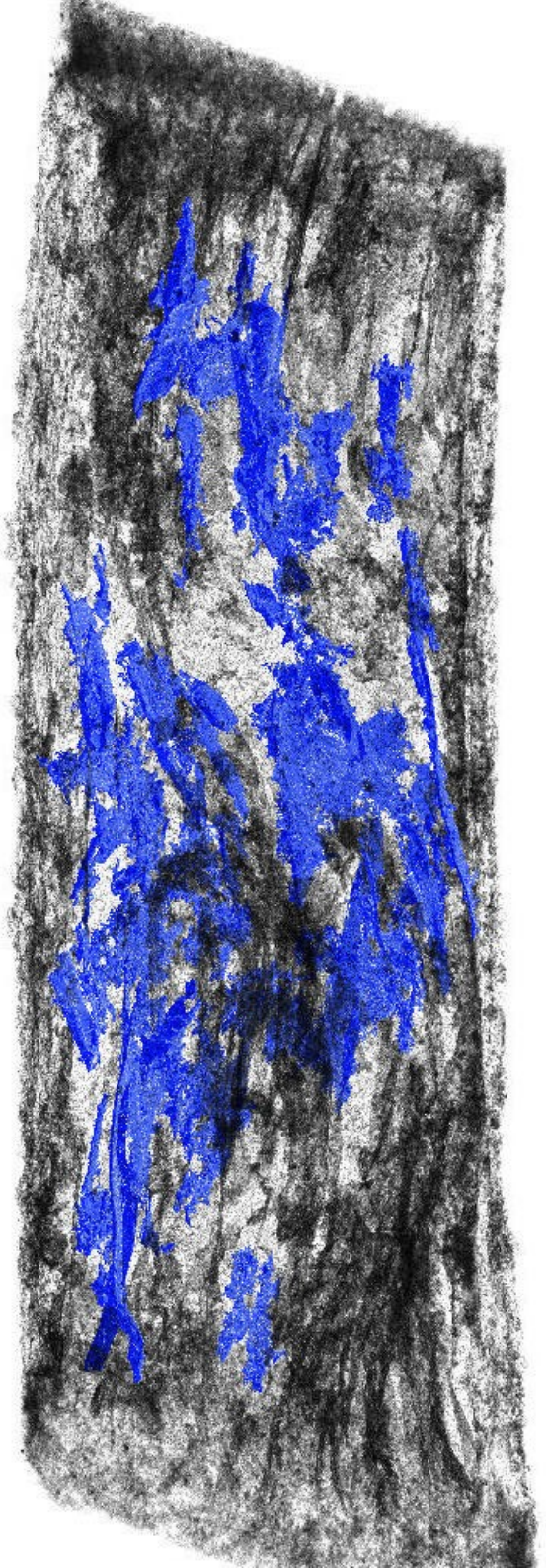
Application:
Identification and orientation of the temper and voids

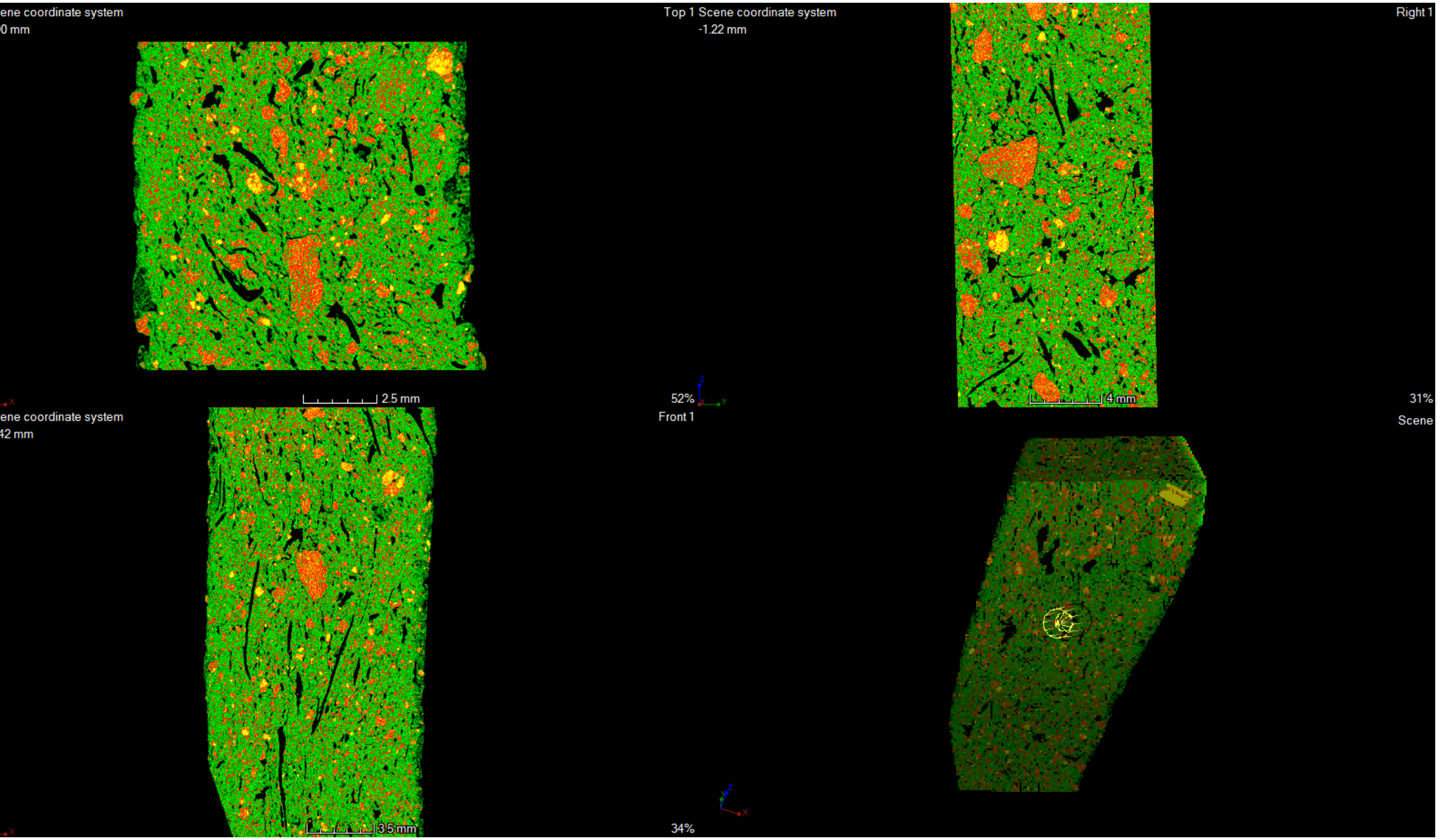
= identification of forming techniques





Coiling (válečky)

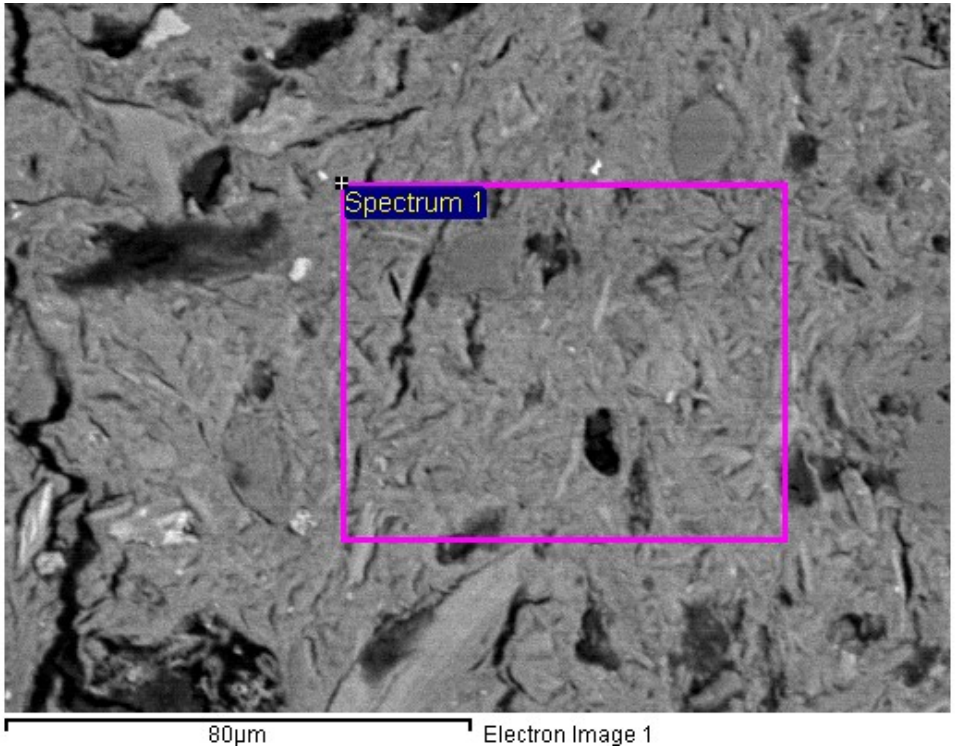


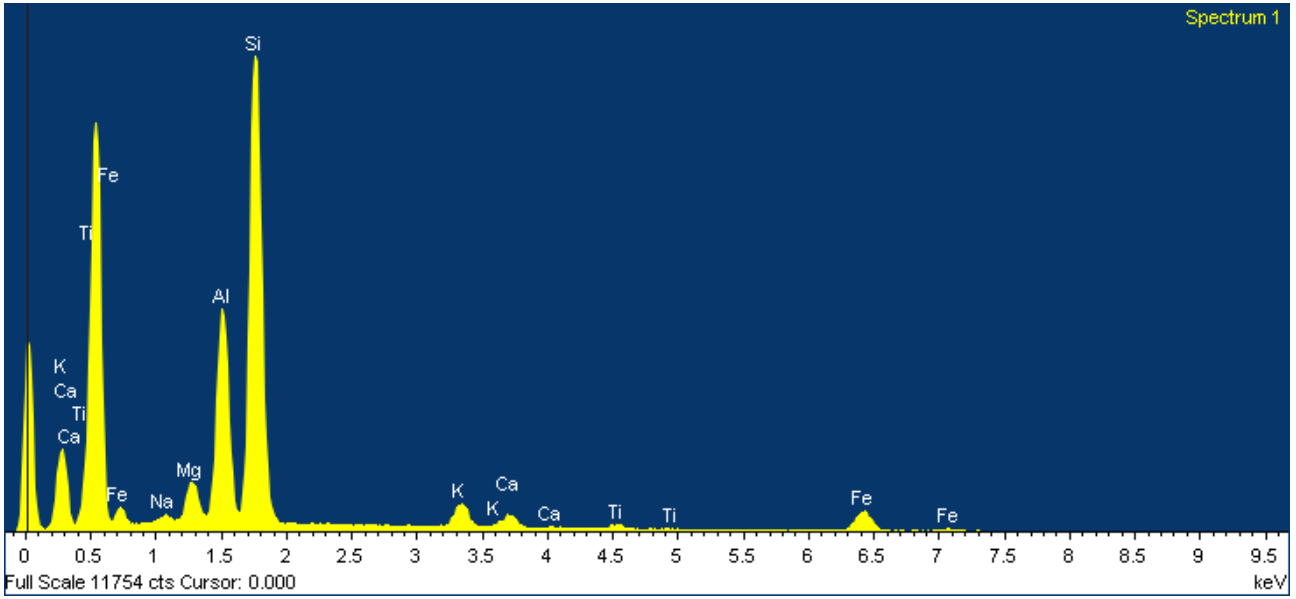

ene coordinate system
0 mm
2.5 mm
Top 1 Scene coordinate system
-1.22 mm
52%
Front 1
Right 1
4 mm
31%
Scene
ene coordinate system
42 mm
3.5 mm
34%

Matrix

- Optickými metodami lze stanovit pouze barvu
- Minerály tvořící matricx jsou pro optické studium příliš malé
- LA-ICP-MS, SEM -EDX

SEM - EDX


Spectrum 1
80µm
Electron Image 1


Spectrum 1
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0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5 6 6.5 7 7.5 8 8.5 9 9.5
Full Scale 11754 cts Cursor: 0.000
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Závěr:

1) Aplastika umožňují identifikovat surovinu a její provenienci
2) Póry odráží vlastnosti suroviny, ale svou morfologií také formovací techniky
3)Základní hmotu nelze studovat jen opticky

Identifikace provenienčních a produkčních skupin

Isaac Button Country Potter, Filmed by John Anderson Robert Fournier, Slide Loans (Ceramics) 1965,m Yorkshire film archive

Obsah

- Produkční skupina
- Makroskopická klasifikace
- Mikroskopická klasifikace
- Celkový chemismus
- Mikrochemické analýzy
- Provenience

Jaura, India (wikimedia commons)

Produkční skupiny (Fabric group, technologická skupina)

- - Specifická kombinace inkluzí, základní hmoty a pórů vytvářející určitý kus keramiky (nebo výbrus), či složením si odpovídající skupinu keramiky (nebo výbrusů) označujeme jako “fabric”
- - Jedna PS by měla souviset s určitou surovinou zpracovanou určitou technologií

???

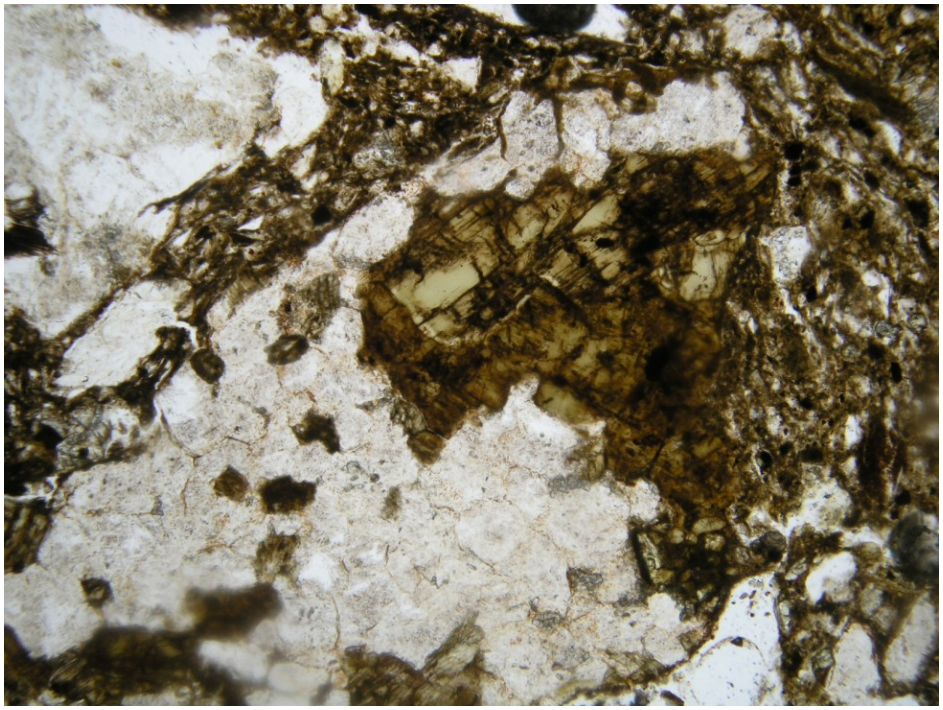
- Neexistuje jednoduché kritérium, které je charakterizuje (jsou to mnohorozměrné entity)
- Některá kritéria není možno kvantifikovat
- Autoři mají rozdílný přístup

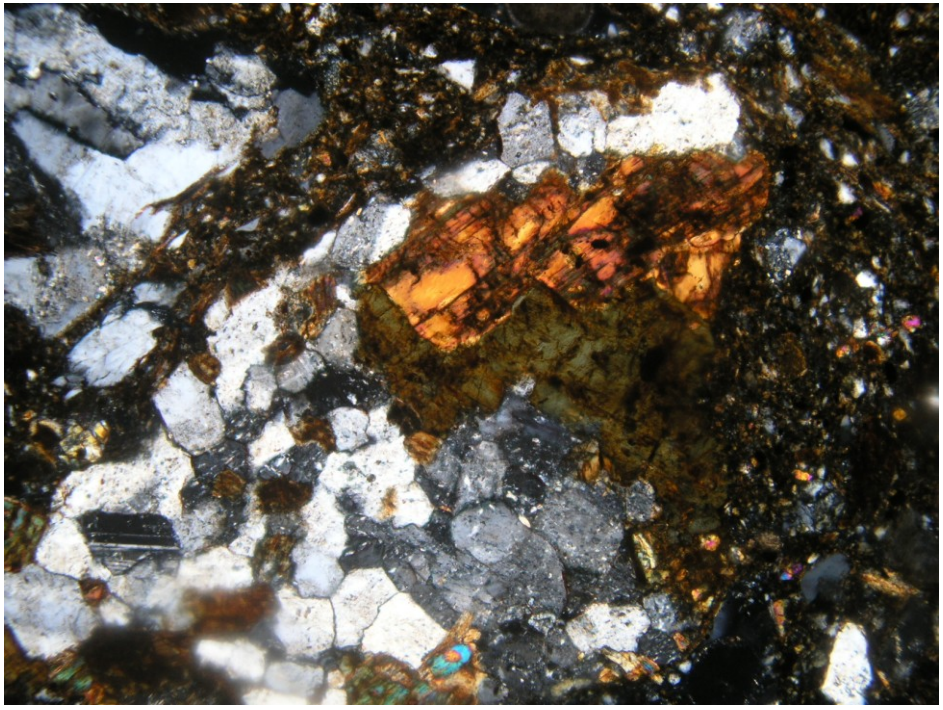
Grouping

- Lumpers x Splitters
- Produkční typ (Fabric type) – může být i variace v jedné nádobě (např. ox a redox. Části)
- Na základní úrovni je třízení výbrusů za určitých okolností zvládnutelné i bez znalosti mineralogie a petrografie

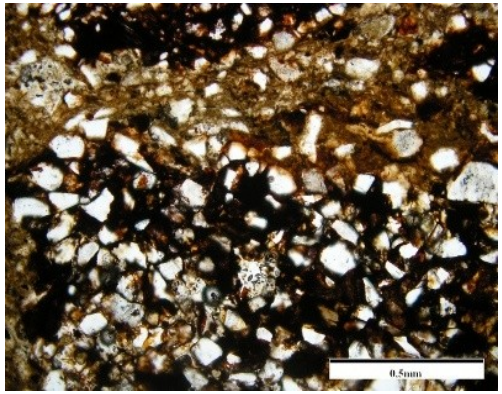
Určení úlomků hornin a minerálů

- určení suroviny
- informace o technologických postupech
- východisko pro zjištění variability a provenience

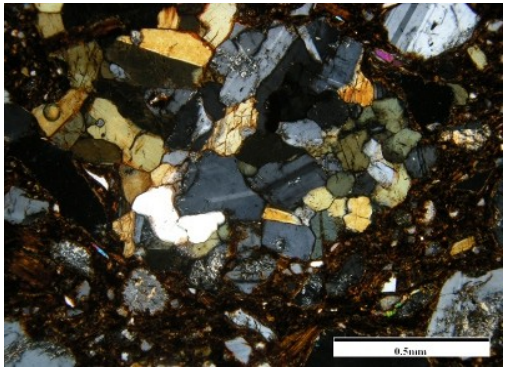




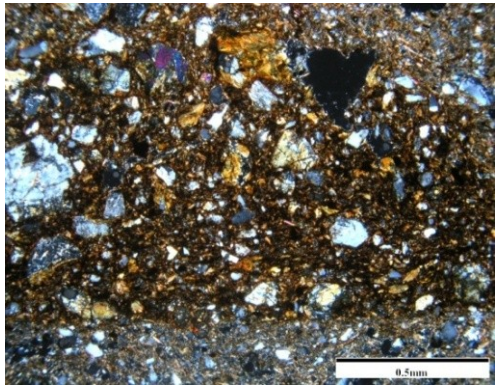
Micropetrography
Fabric groups



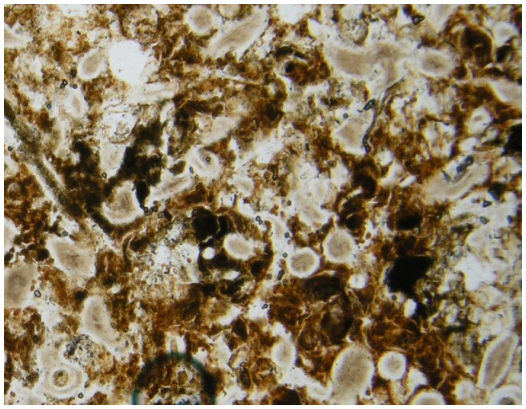
ferrous sandstone fabric



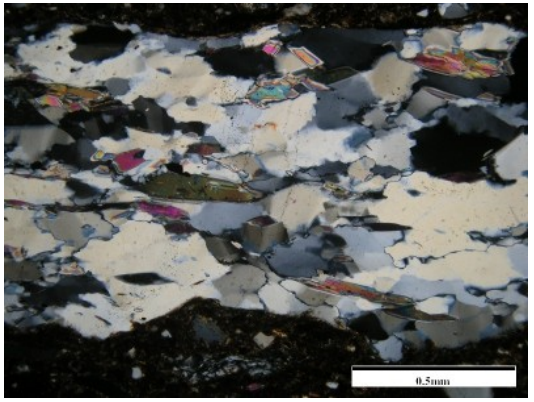
amphibolitic diorite fabric



Epidote schist fabric



Limestone and che



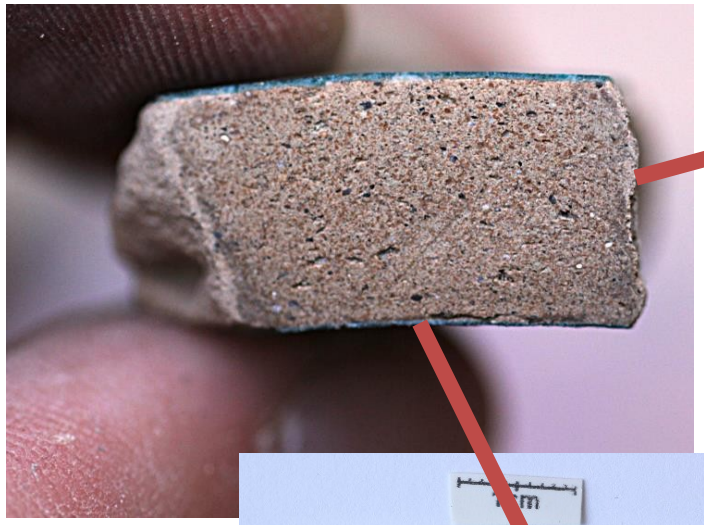
metamorphic rock fabric

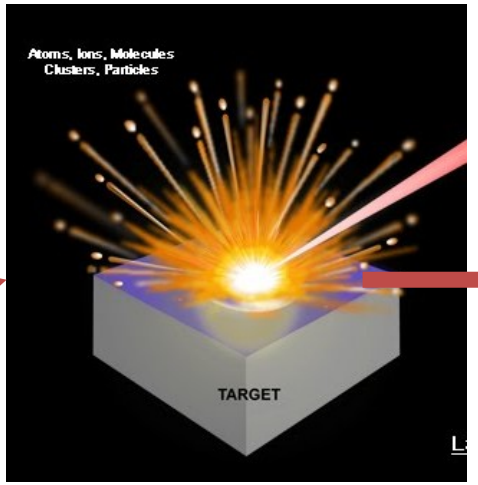
Celkový chemismus

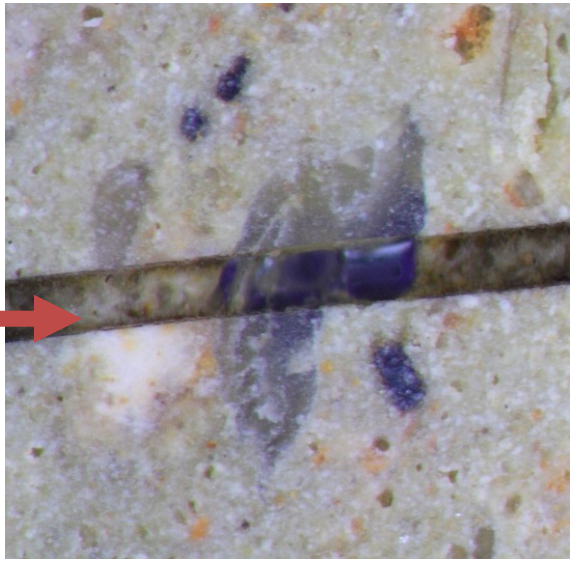
- lab XRF, portable XRF

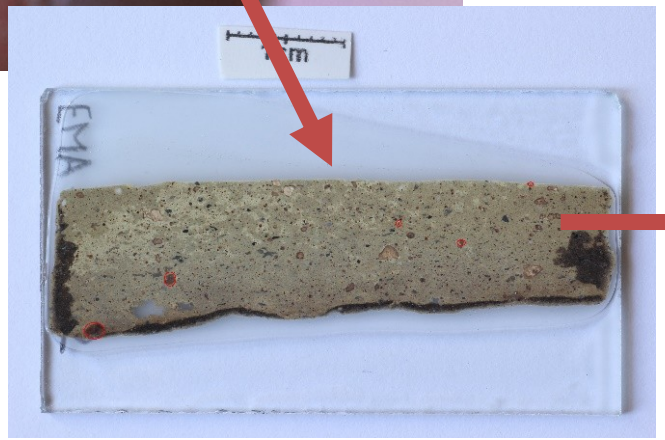
Stopové prvky a vzácné zeminy
- NAA
- ICP-MS, LA-ICP-MS, WD-XRF

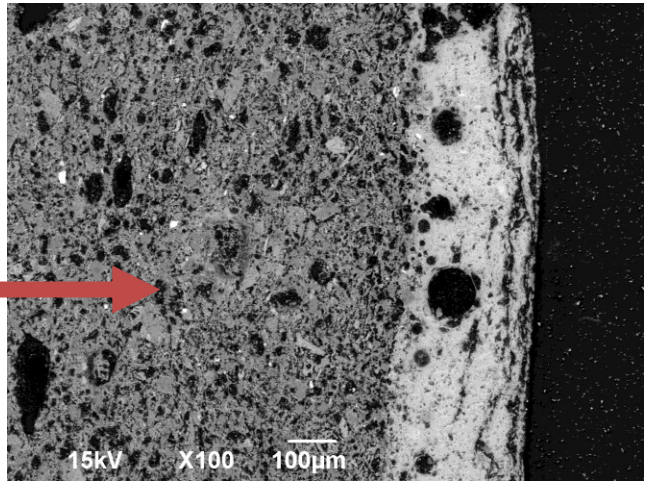
Laser ablation (LA-ICP-MS) and scanning electron microscopy (SEM-EDX)



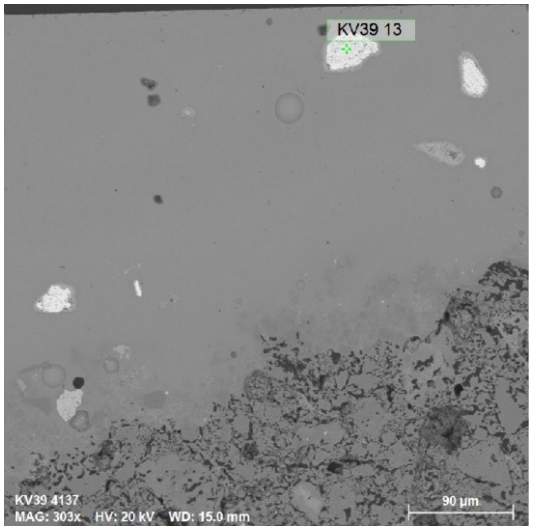


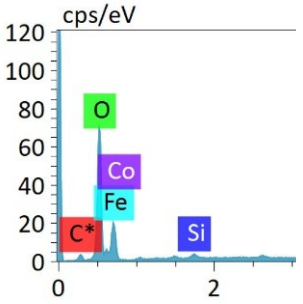


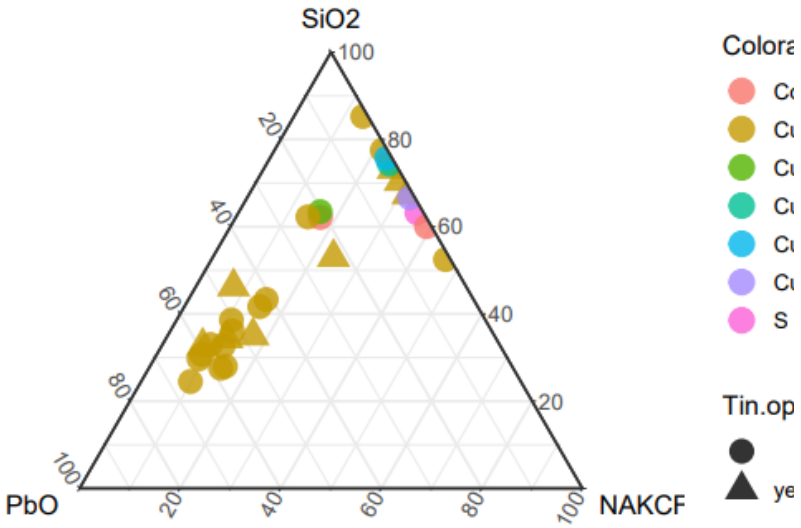


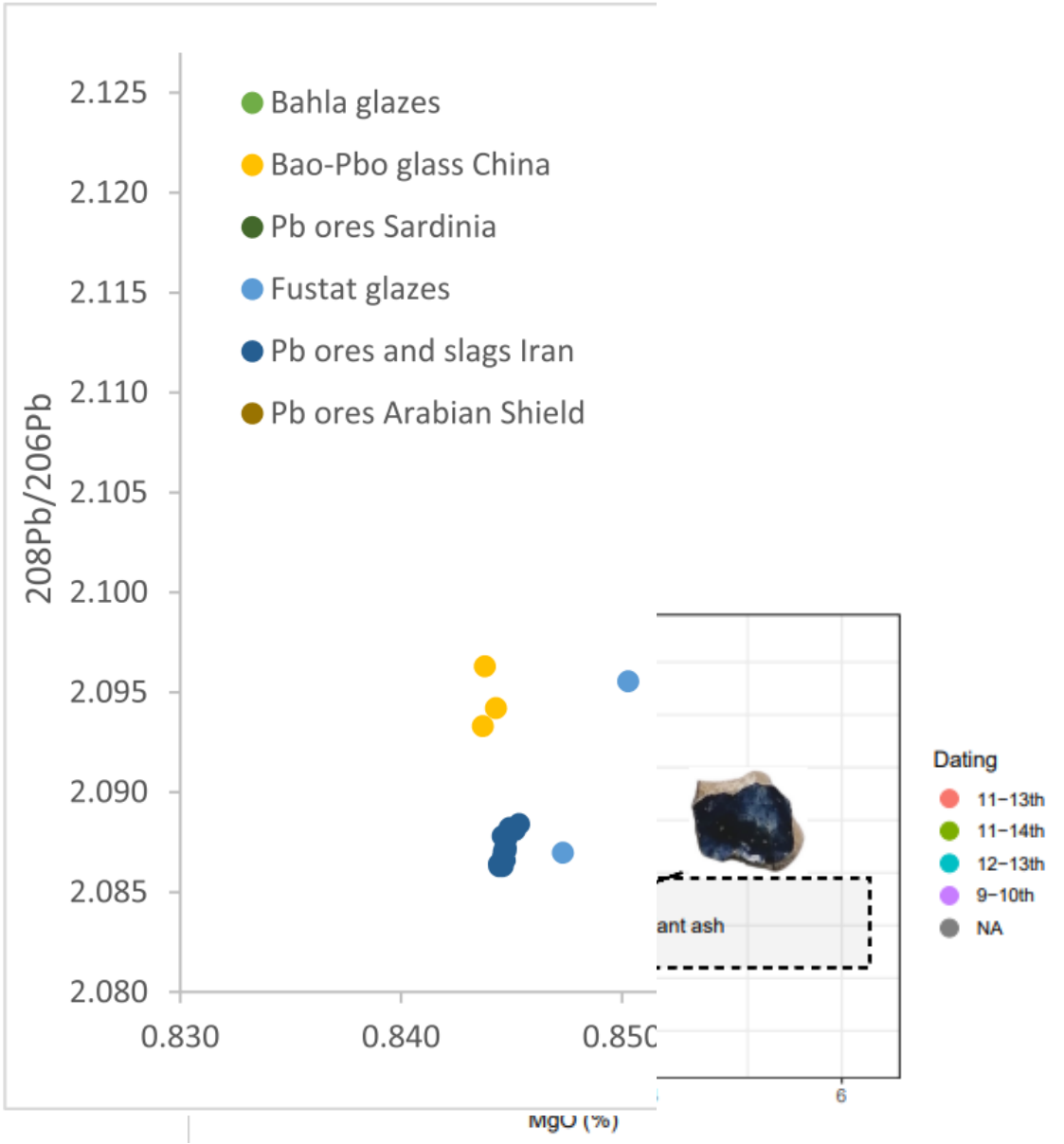


Glazes: colorants and classification









According to Tite and Freestone

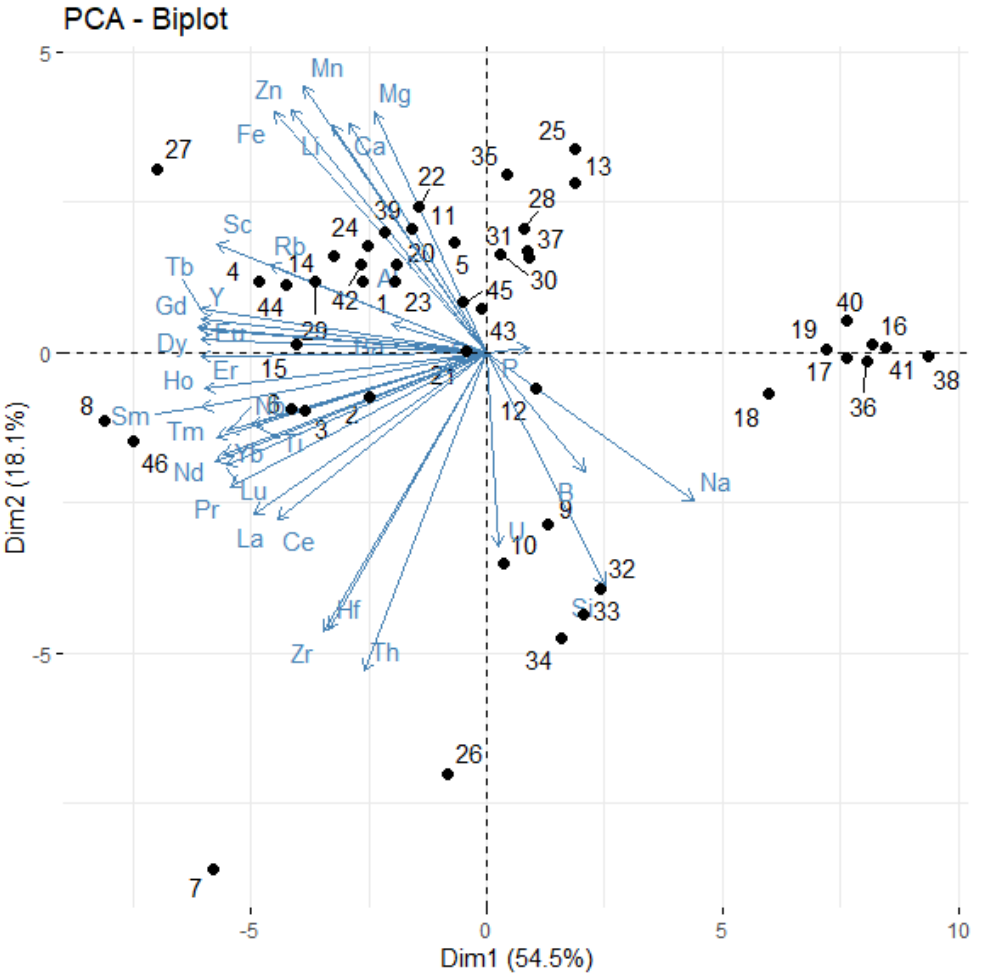
Chemical composition of ceramic paste: Key to provenance?

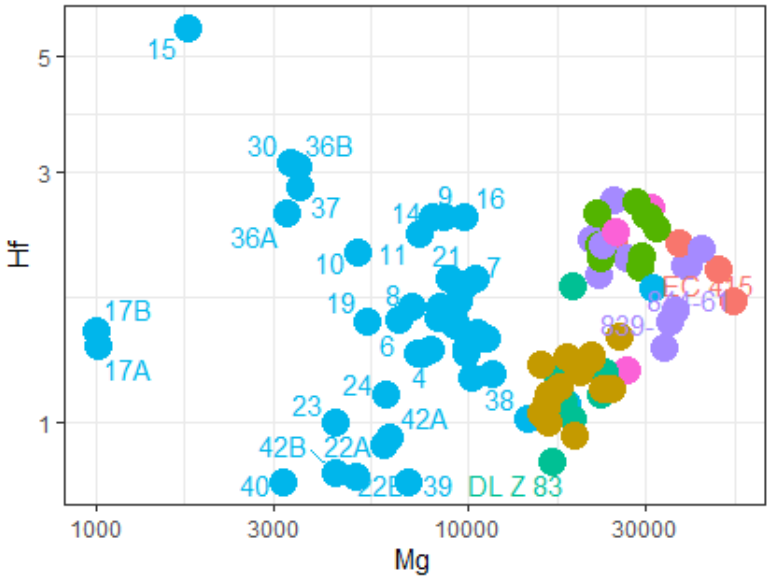
THE MATERIALS AND TECHNOLOGY OF GLAZED CERAMICS FROM THE DEH LURAN PLAIN, SOUTHWESTERN IRAN: A STUDY IN INNOVATION

David V. Hill

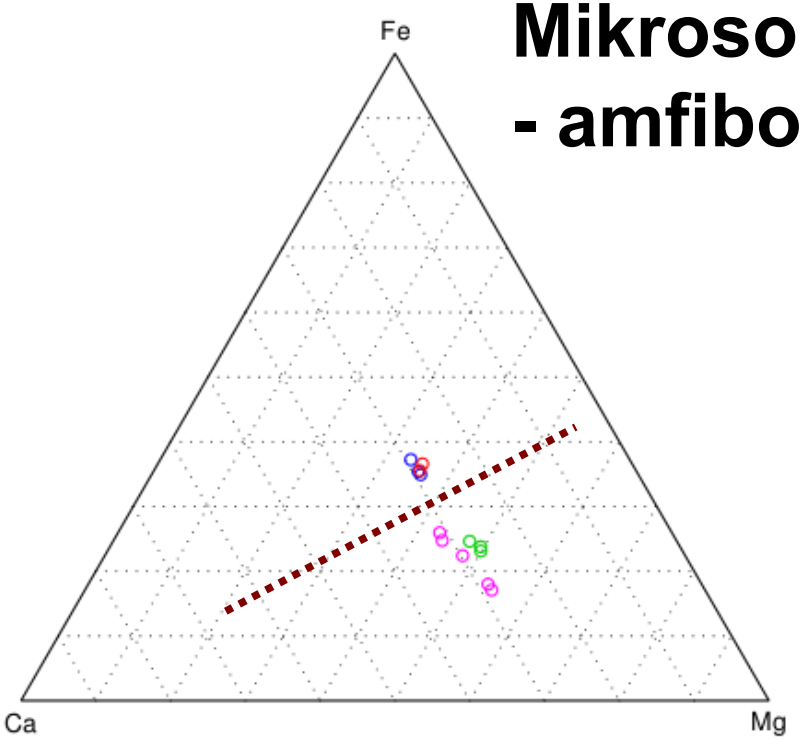
Islamic glazed pottery from Adiabene (Iraq, Kurdistan): multianalytical research into its technological development and provenance

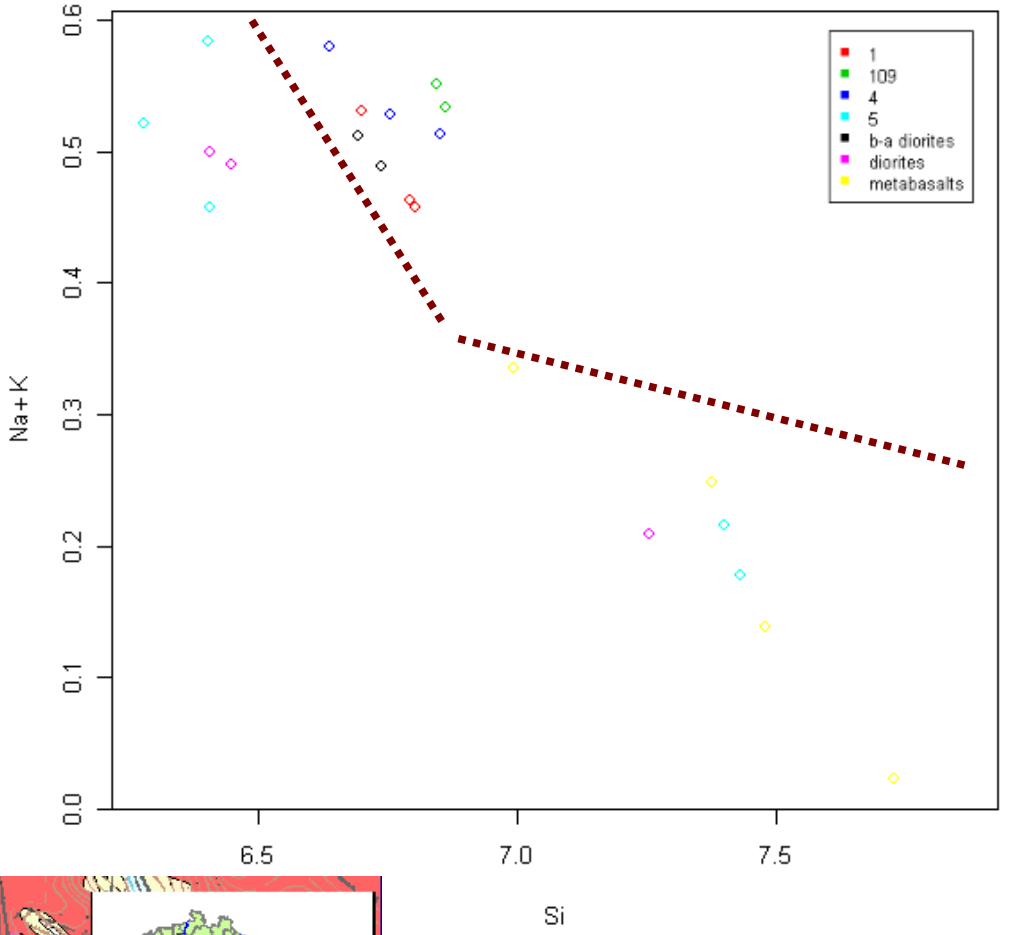
Jan Petřík[1] · Karel Nováček[2] · Dalibor Všianský[3] · Ali I. Al-Juboury[4] · Karel Slavíček[5]

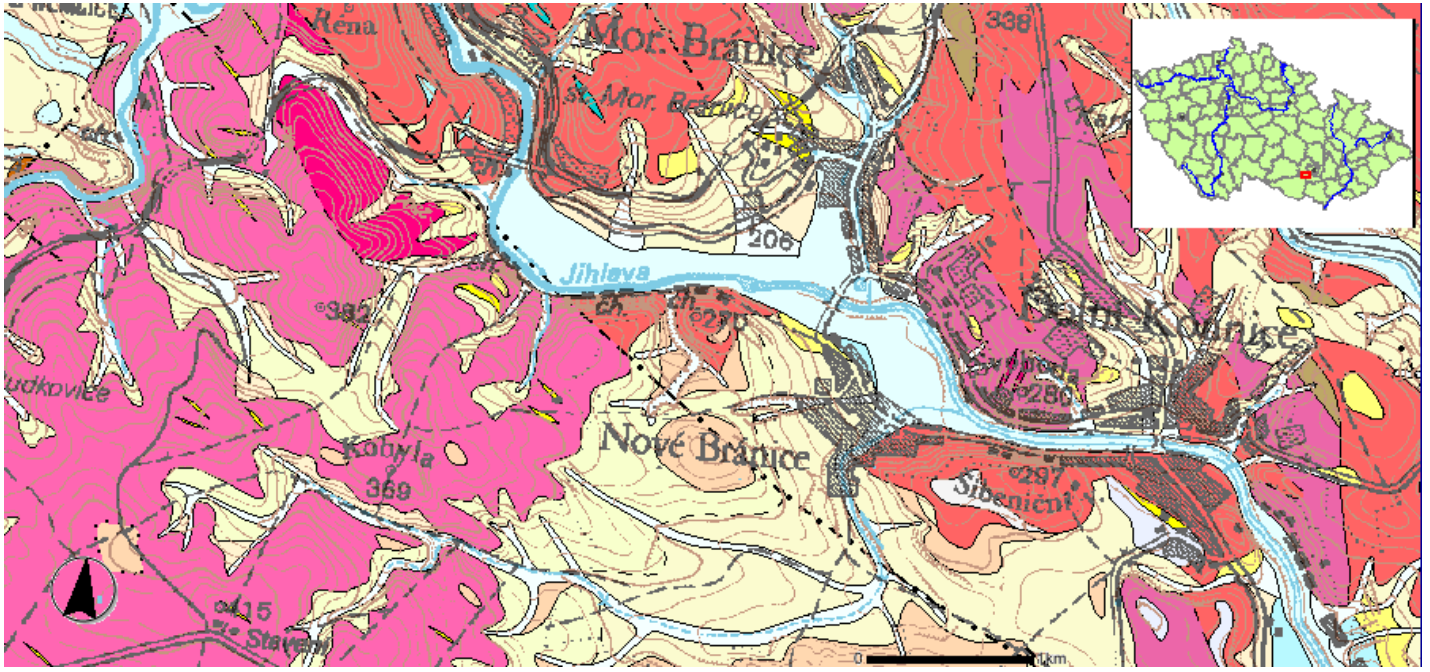


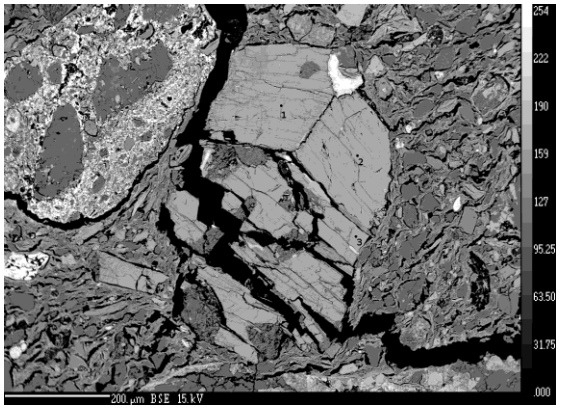


Mikrosonda - amfiboly

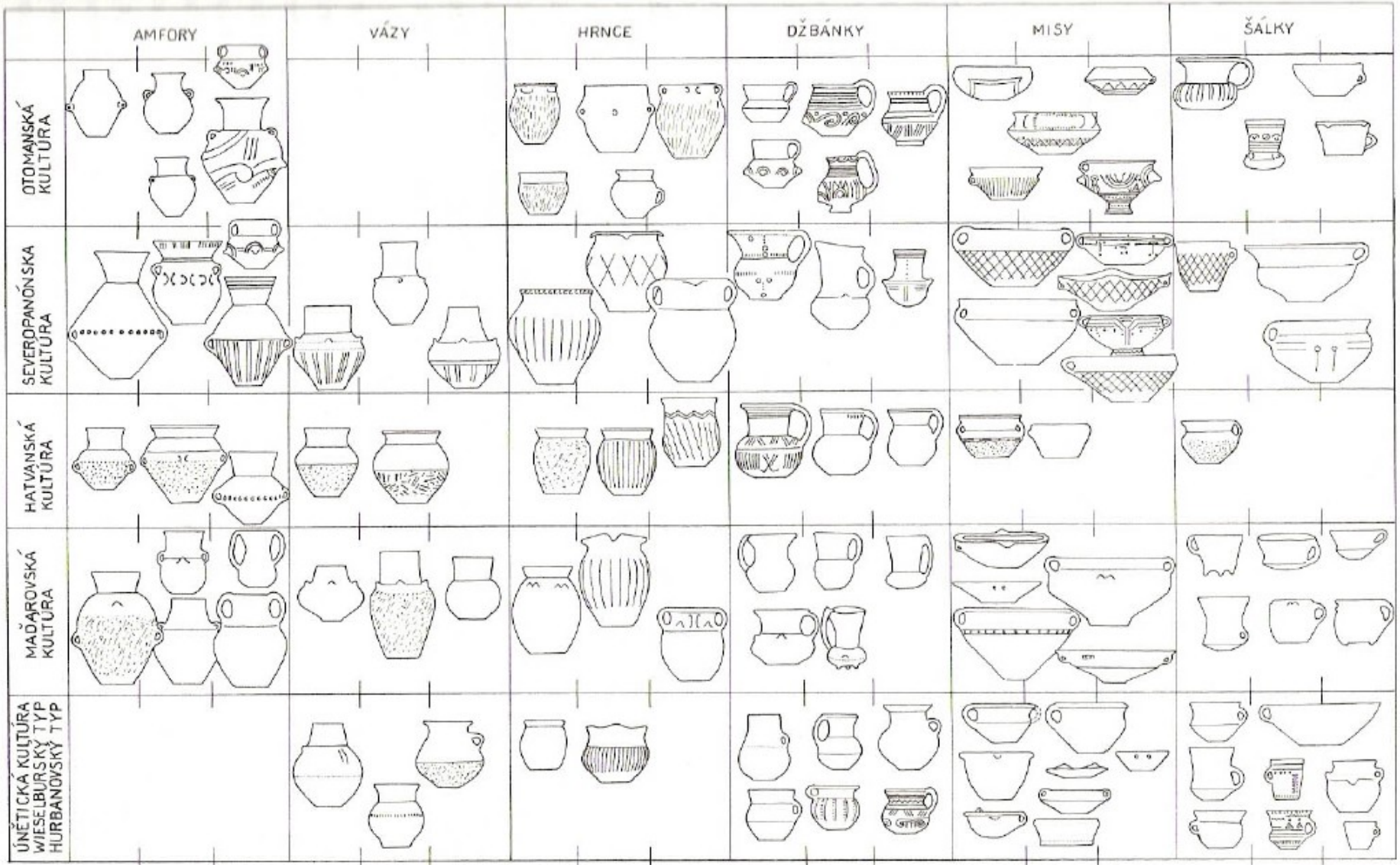


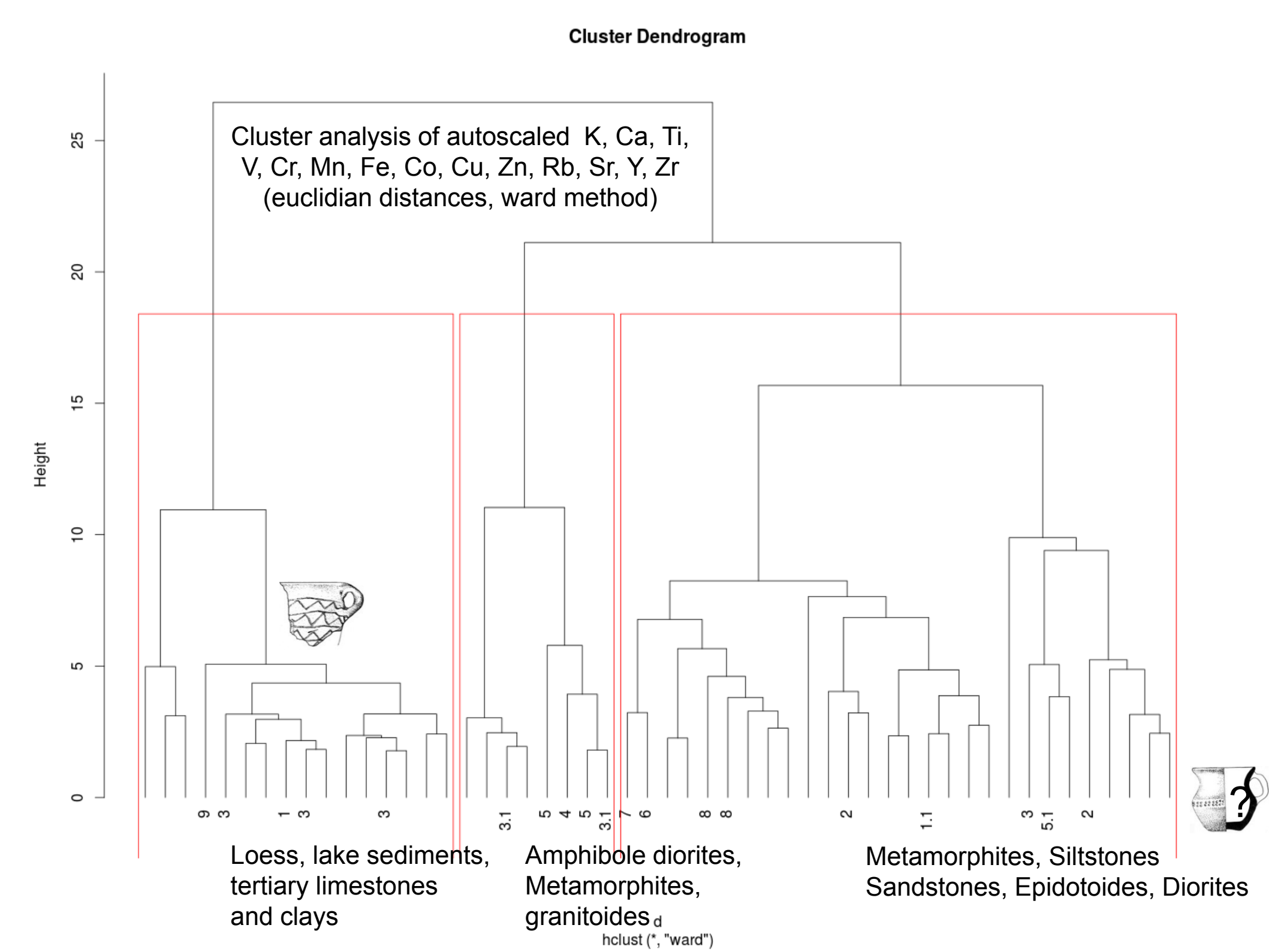




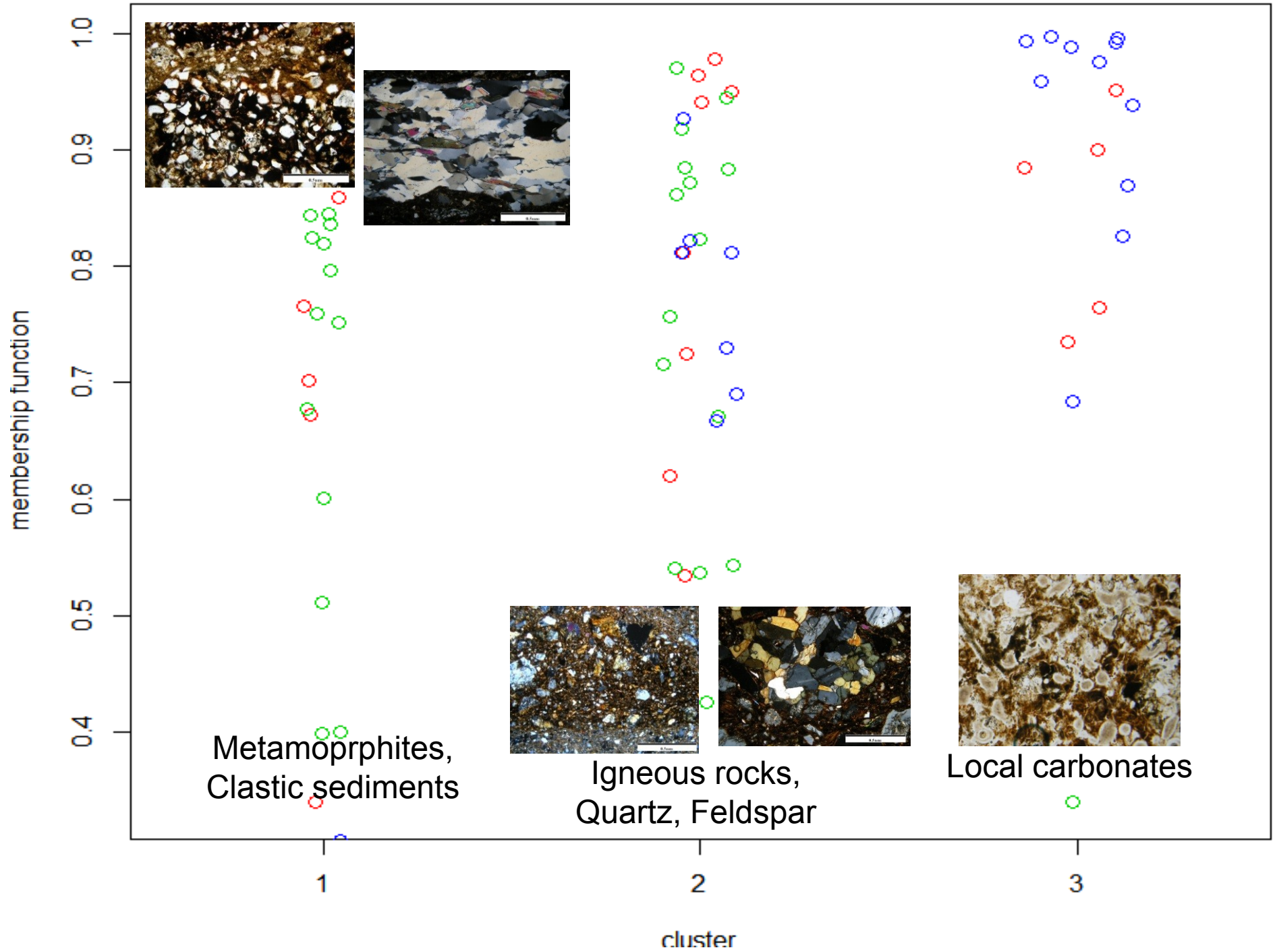


Syntéza makroskopických, geochemických a mikroskopických dat



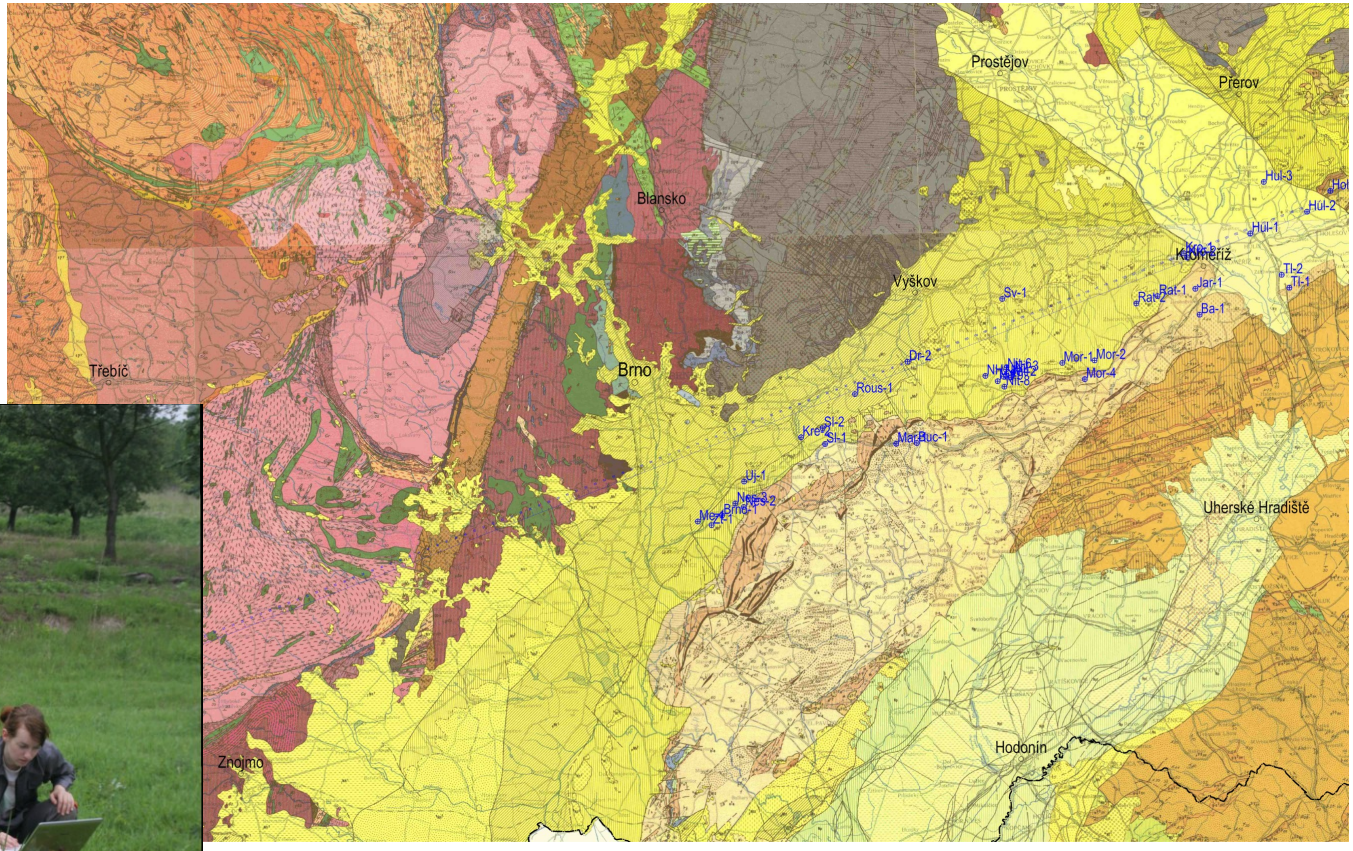

Cluster Dendrogram
Cluster analysis of autoscaled K, Ca, Ti, V, Cr, Mn, Fe, Co, Cu, Zn, Rb, Sr, Y, Zr (euclidian distances, ward method)
Height
0
5
10
15
20
25
9 3 1 3 3
3.1 5 4 5 3.1
7 6 8 8 2 1.1 3 5.1 2
Loess, lake sediments, tertiary limestones and clays
Amphibole diorites, Metamorphites, granitoides
Metamorphites, Siltstones Sandstones, Epidotoides, Diorites
d
hclust (*, "ward")

Fuzzy clustering



Provenience

- Rešerše
- Terén
- Další analytika



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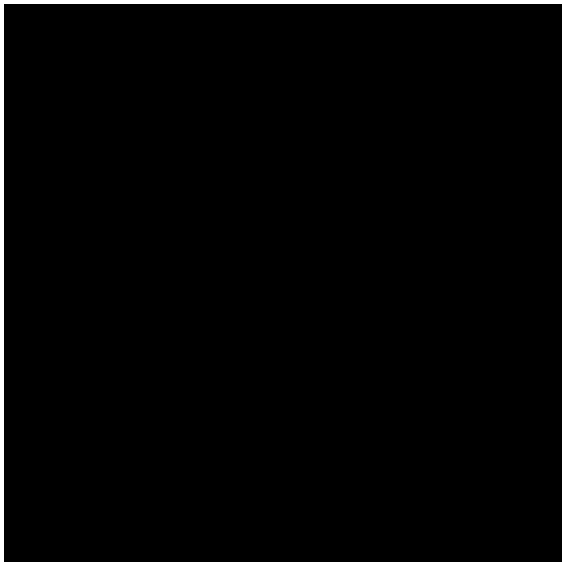
Thank you for your attention



After O. Nieuwenhuyse 2006

Děkuji za pozornost