PhD Thesis Abstract
Doctoral School of Earth Sciences

Morphological and sedimentological examination of the karst areas in the Southern Transdanubean Region (Hungary) and their comparative assessment with analogous formations

József Dezső

University of Pécs, Faculty of Sciences
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Title of the Doctoral School:	Doctoral School of Earth Sciences
School Leader:	Prof. Dr. Zoltán Dövényi DSc
Title of the Doctoral Program:	Geomorphology
Program Leader:	Dr. Ferenc Schweitzer DSc Professor Emeritus
Discipline:	**Physical geography**
Supervisor:	Dr. Ferenc Schweitzer DSc Professor Emeritus

1. Introduction and aims

In this dissertation I investigated karst fillings from the karst areas of the Southern Transdanubean Region, the Villány Hills and the Abaliget area of Mecsek Hills, as well as their genetic relations with paleosoils, recent soils and speleothems. During the investigations I measured those samples too, which contributed to the solution of the karstmorphological evolution, but are located out of karst areas. The karstic sediments of the Southern Transdanubean area have a very wide range of properties, and as for the measuring techniques they look more or less like their parent material, often used for a karsgenetic reconstruction, although a lot of questions arise about their genetics.Do all the red clays have clayish textural properties? In other words, those, macroscopically described similar by some authors are in fact different in their macromorphologic formula? If these fine deposited sediments become its particle distribution bimodal? And vica versa, if they have bimodal properties, are they deposited?

Does red clay exist in the Southern Transdanubian karstic area similar to the ones in the Mediterranenan or Southeast Asian red sediments? If yes, which parameters give the similarity? Can we identify the former rubefication in those micromorphological characteristics – or have they disappearred, or are they only covered by calcic and hematit?

I investigated the micromorphological, textural and minerological properties of the Southern Transdanubean karstic fillings, and composed the following questions which we would like to answer in this theses:

- Can red- and reddish clays be divided into more subcategories with new or rarely used laboratory analisys methods?
- What common similarities and differencies can be determined with recent samples often identified with Pliocen, Pleistocen sediments in scientific literature?
- How much are the particle size distributions of these samples similar to other typical areas in the nearby?
- How much can the above mentioned investigations and genetic interpretation of the speleothems formed by tepid karst water help us with the solution of the karst evolution?

In this dissertation I built the conclusions of the investigations in the karstgenetic scheme – however, these two researches, the sedimentologic and the morphologic, cannot be separated from each other. The application of the speleothems formed under water in case of the Villány Hills was obvious.

For a karst-genetical reconstruction we used this sediments and speleothems but the different character of the two karst area (Villány-hills and Mecsek mountains) required different way of thinking.

2. Applied methods

Our results consist the karstgenetic and methodical results as well. Relatively new (XRF-linescan, laser analysette for particle size distribution) or rarely used investigation - methods (micromorphological investigation with image analysis) were used in case of karst fillings, which have some disadvantages deriving from narrow database in scientific literature (only the mineralogical investigations are exceptions). As the first step, I chose investigated parameters, capable to characterise these samples the best. These parameters are built the input database of statistical analysis, such as discriminant-, and cluster analysis.

3. Results

1. Spherical cavities develop near and above tepid krastwater, such forms can be found in Váralja Cave, Siklós (Fig. 1.). They also mark the former level of karstwater. These formations may have occured in any geological period. Their development is restricted with the accumulation of weathered, reeled material.

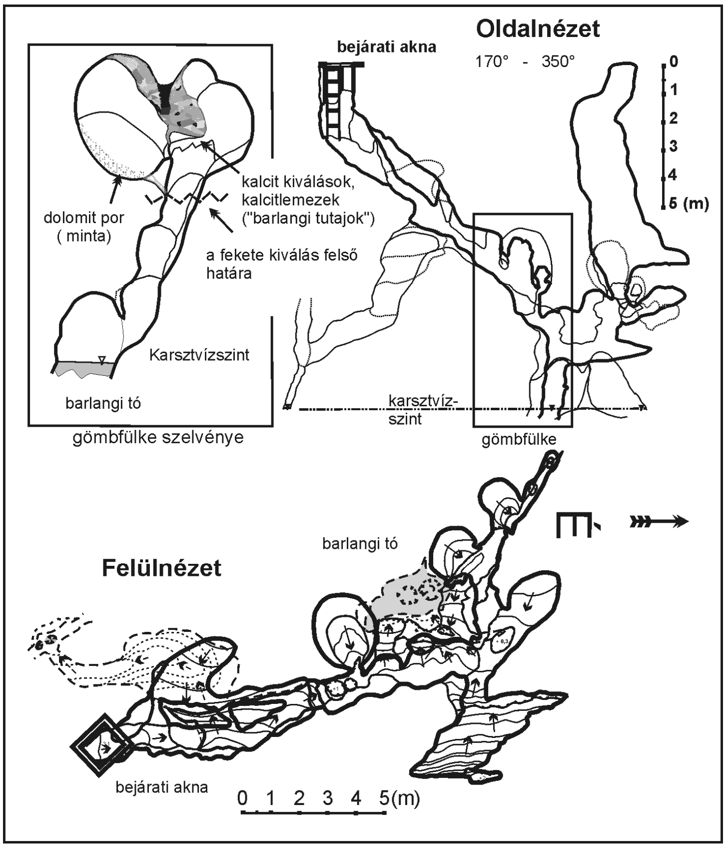

Fig. 1. The map of theVáraljai Cave (Dezső J., Mangult I. 2005)

2. The Szőlő-hegy of Beremend developed as autonome morphological unit during the Pliocene and Pleistocene. The parent materials of red clay deposited by aeolian transport on the horst area. The moderate weathered reddish clays mount in the surroundings of the Northwest – Southeast fracture zone of the hill.
3. The sediments and morphological characters in the Abaliget Cave assume six main phases of the karst development (Fig.2.)
   a. The accumulation of the sediments in the cave vault of „Állkapocs-hall" (Jaw-hall) include the jaw of the Miocene rhinoceros.
   b. The Pliocene red clays above the present active passages in the 'Nagy-terem' and its surroundings can be correlated with the Csarnotanum biostratigraphical epoch.

c. Black sediments on the vault and the abrasion platform of the ’Fő-ág’ in the cave accumulated under anoxic environ conditions, and also contain todorokit. The formation of the todorokit and the light blue silty clay might have already been a phase of the Pleistocene, which ended in the accumulation of sandy detrital filling (Mésztufás-hall, layer VII.)
d. In a later period, after the middle-Pleistocene, the karst newly became active, since the pieces of the pale blue aleurits deposited.
e. Loamly sediments (Mésztufás-hall, layer VI-V.) accumulated as an effect of the forming clay-plug.
f. As a consequence of a late-Pleistocene tectonical event, a tetarata formed between Mésztufás-hall and the Western No.2 line of the cave.

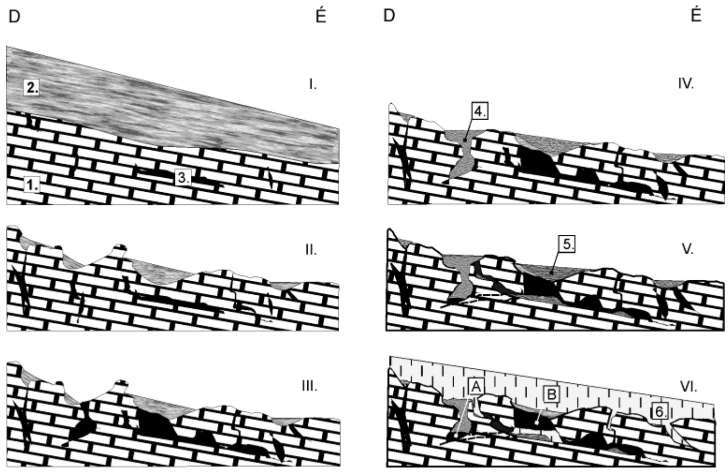

Fig. 2. Genesis of the Abaliget Cave, Cave halls at the end of Western No.2 line Notations: I-VI. karst genetical periods; 1: trias (Misinai F.); 2: Miocene sediments; 3: cavern; 4: Miocén (?) sediments mit mollusken; 5: pale-blue loamly sediments (Pleistocene); 6. loess. A: Jaw-hall; B: Tetarata-hall

4. Evaluating the particle size distributions 3 new parameters were introduced: α_1, α_2 and the m % < 7 φ values (Fig. 3.). This way we can present sample characteristics which help us identify different genetic groups. In case of Pliocene, and Pleistocene fissure- and cave fillings, particle size distributions are effected by the particle components of the weathered material and the traction in the cave. Bimodal distribution of karst fillings deposited down from the surface is largely similar to the particle size distribution of the original superficial material. In this distribution we attribute the first modal-peak to the content of the former aeolian material, and the second occured by weathering. The aeolian transport is confirmed by the similarity with loess; they also have a Modus at 5,5φ approximetly.

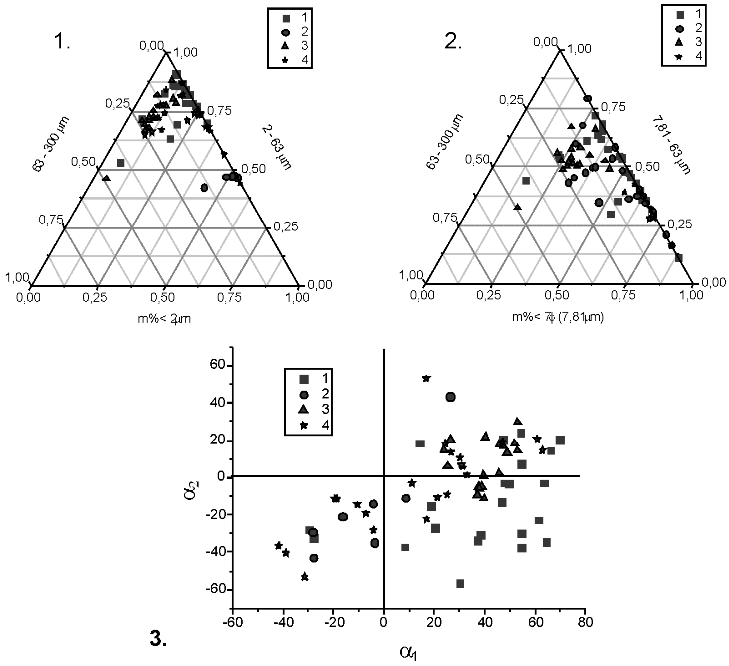

Fig. 3. Representation of particle size distributions with (1.) traditionary, (2.) newly statistical parameters; and with parameters α_1 α_2 (3.) on red clays
Notations: 1. samples from Villány-hill; 2. samples from Mecsek; 3. Red Mediterranean soils; 4. Southeastern Asian soils. The + α_1 és – α_2 samples are dimodals.

5. Since cave sediments are remainées, theoretically we should have got bimodal particle size distribution. However, this does not happen either in caves, nor in case of superficial young sediments. The frequency distributions of particle size are reflected in micromorphologycal properties such as coarse/fine rate, regardless of one-, or bimodal characteristics. As a result, we suppose that such bimodal characteistics depend on weathering processes.

6. Mediterranean and SE-Asian samples only have conditional similarities with Transdanubian (Hunagrian) samples. The often used collective designations such as 'Mediterranean' and 'SE-Asian' don't consider the wide range of soil formations of these areas. The red 'mediterranean' or 'terra rossa', and other terms are out-of-date, they can maximum be used as comprehensive names, because classification based diagnostical horizonts give better solutions. Weathering rate and micromorphologycal properties may mostly refer to the preserved diagnostical horizons of the former soil (Fig. 4.).

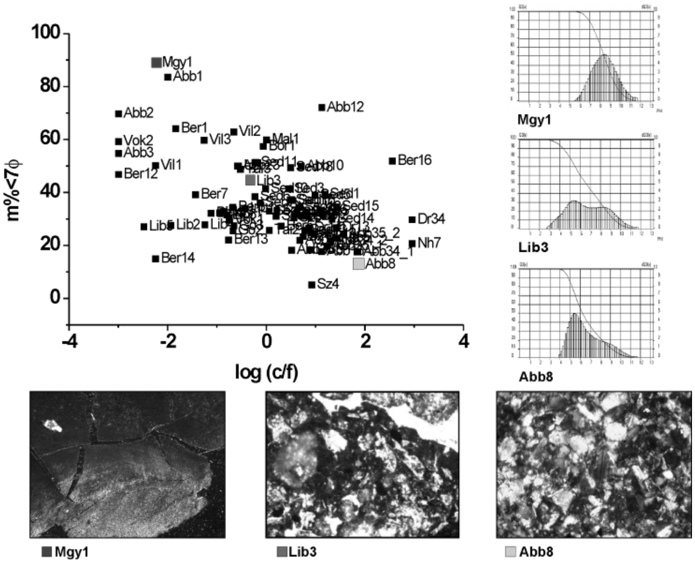

Fig. 4. The comparison of log(c/f) and m%<7φ value. Picture size: 0,8 mm.

7. Karst fissure fillings and cave sediments are classified by mineralogical, textural, and micromorphological properties, and we have groupped them according to the knowledge we learnt during the researches.

Sediments with detrial, positive skewnwess, skeletal (monic) properties.

The frequency distribution and its columns of particle size of the the sandy, fluvial sediments, sandstones show declining tendency. The karst fissure fillings in Nagyharsány content sandstones, are similar to sandy soils of Dráva floodplain. Some sediments from Abaliget-cave have this kind of histogram-type; wich helped in its identification. Characteristic distribution („fingerprint-like" frequenty distribution) occur on dolomit karst area when dolomit powder are developed by the aerosol, in the same way the case of the mediterranean samples. On the Abaliget karst area the detrital karst sediments are very characteristic, they are young loess-like sediments, dominant with quartz, illite phases. In this group may be found the recent bed sediment, and the upper parts of the Mésztufa-hall fillings.

Its weathering rate (Z_D) have low value betwen the investigated samples. They differents from superficial sediments, because its micromorphological properties have clayish, accommodated particles. The typical loess mainly has an clastic, enaulic micromorphological characteristic. During the solification the groundmass growing, often develop an crumbish microtexture. If the topsoil deposited by the erosion, the groundmass-aggragation occur. After the significant choking, slow sedimentation the microstructure develop, that sign the differentiation of skeletal particles. This structures sheltered in caves.

Weakly weathered, gefuric, chitonic sediments

These kinds of typical samples derived from Abaliget Cave Fő-ág, the doline of Nyárás-valley and the older loess from Beremend; they have similar micromorphological properties. On floodplains hydromorf structures (ferruginous and manganieus nodules) are dominant features, but thely are absent in caves. The groundmass-concentration develop by the effect of the periodically appearing groundwater – a typical pedofeature, which are absent in caves as well. Moderately weathered crumby microtextural reddish clays and their recent formations. In

Beremend, along the NW-SE fault, underlying the middle-Pleistocene loess and in some karst fissure fillings, non weathered reddish clays may be found (mineralogical). Their relative weathered rates are mostly between {-40 - +10}, in most cases they are around -10. The clayish sediments of Borpince Cave in Villány and the Templom-hill aven are moderately weathered, too. Their micromorphologycal properies are characterized by very fine crumby structures, sometimes with blocky deep red and yellowish birefringent parts. The leptosols from the Mediterranean area have crumby micromorphological characteristics, and the ferruginous fine material b-fabric around of the structures indicate rubefication. The Southeastern Asian samples have more silt, fine sand and porphiric texture. The fine material b-fabric commonly occur in the samples from higher areas, and at the same time, the distance grow betwen coarse materials. Crumby microstructure is typical in the moderately weathered samples from Villány, so we call them 'paleo-leptosols'.

Extremely weathered, porphyrickarstic fissure fillings with negatíve skewness
Several red clays belong to this group, supposedly they had a strong weathering at their initial stage due to paleoclimate or deposition by slow-flowing filtration. Their micromorphological properties are dominantly hematit, depp red, yellowish braun b-fabric with porphyric c/f related distribution. Bimodal particle size distributions are typical, these curves already occured on the surface, during the formation of different soils. The weathering stage of samples deriving from the Villány Hills may be identified by kaolinite and gibbsite, this latter mineral is absent in the Mediterranean and Southeastern Asian samples. The most crumbled cave sediments, fissure fillings have b-fabric, or masked with ferruginous material (hematite). Most red clays, which seem homogeneous, build microaggretaes, micro-crumbs when high magnification. This form may have occured as a result of bacterical activity. These kinds of samples are totally reorganized with limited coarse particles, high (Zw {40-100}) weathered rate and negative skewness. We can explain the genesis of this group the least.

8. The XRF-linescan device can be applied for the investigation of undisturbed finely layered sediments, where along the split axes we can detect the distribution of the main elements. Using the multi-covariance, we can improve the results marking the boards of the fine layers. They serve with important information about sedimentations.

4. Further development

The main task is going on with cave excavations to get to know the karst areas better. Processing the data of sediments and layers during our work supplies us with the most relevant information. There could be more exact investigations carried out on red clays. Among them the most important are mineralogical investigations under 2 μm and geochemic investigations. Using an electronmicroscope, the nodules and opaque parts would give more information about the genetic of the samples. During thin section preparations, we can use a lot of painting technics. With this method certain structures could be made more visible, and combinated with selective solution we can get closer to the genetic development of sediments. With an XRF we can scan and create element maps of relatively big (8 x 10 cm) thin section preparations.

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