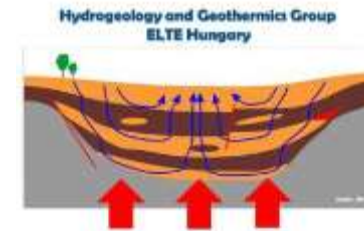


Investigation of marks for deep karstification in the carbonate aquifer system of Buda Thermal Karst



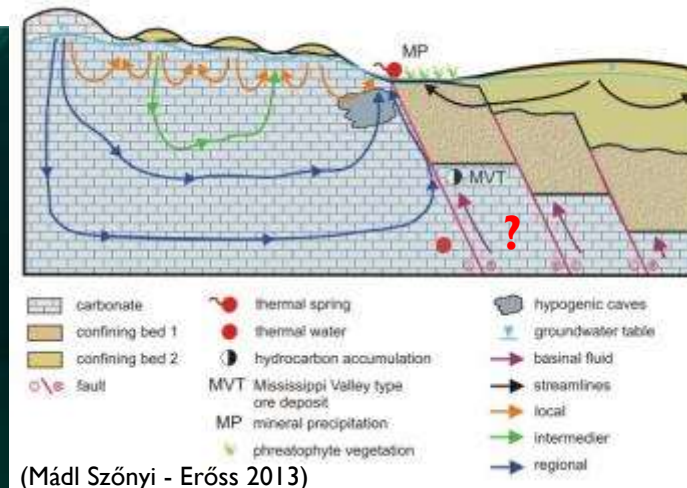
Edina Pável

Supervisor: Judit Mádl-Szőnyi

Consultant: Anita Eröss

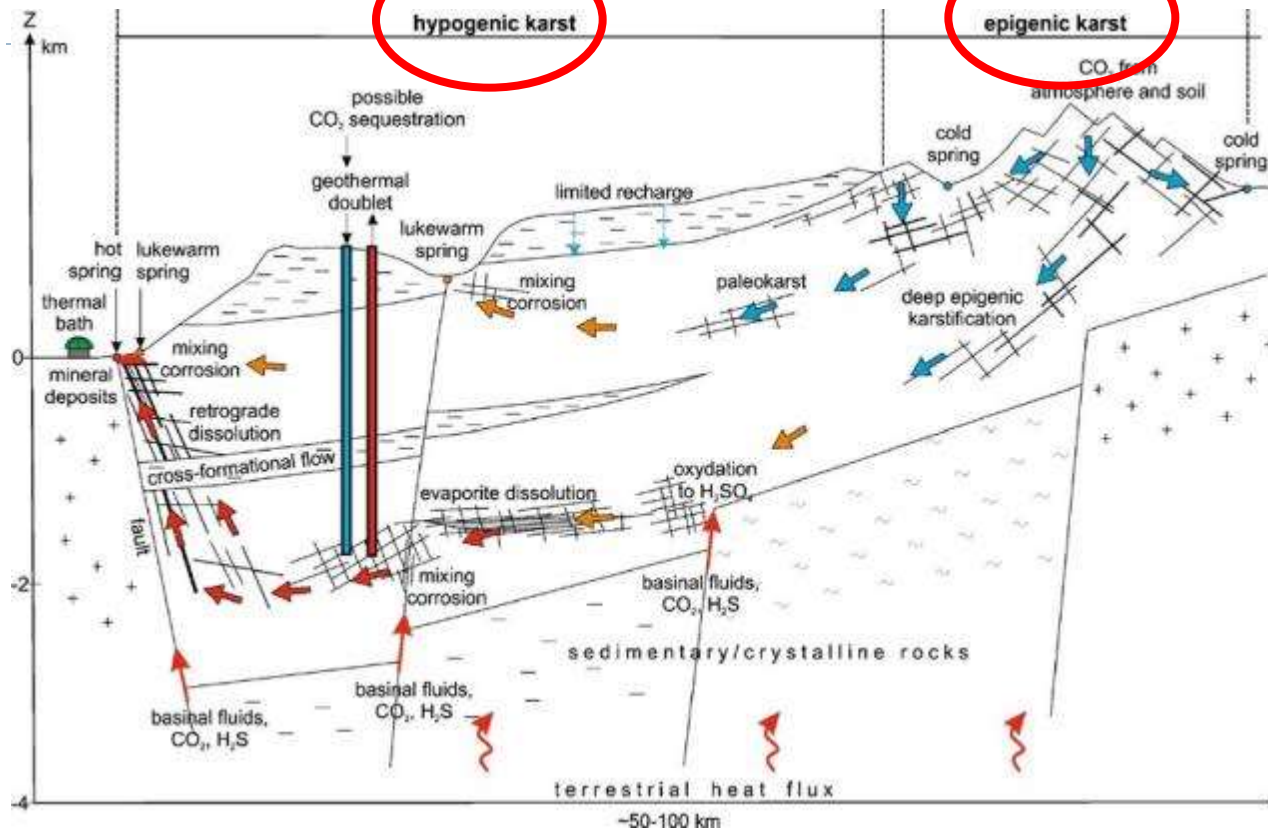
28th March, 2014

Institute of Geography and Earth Sciences, Eötvös Loránd University



András Hegedűs

Introduction



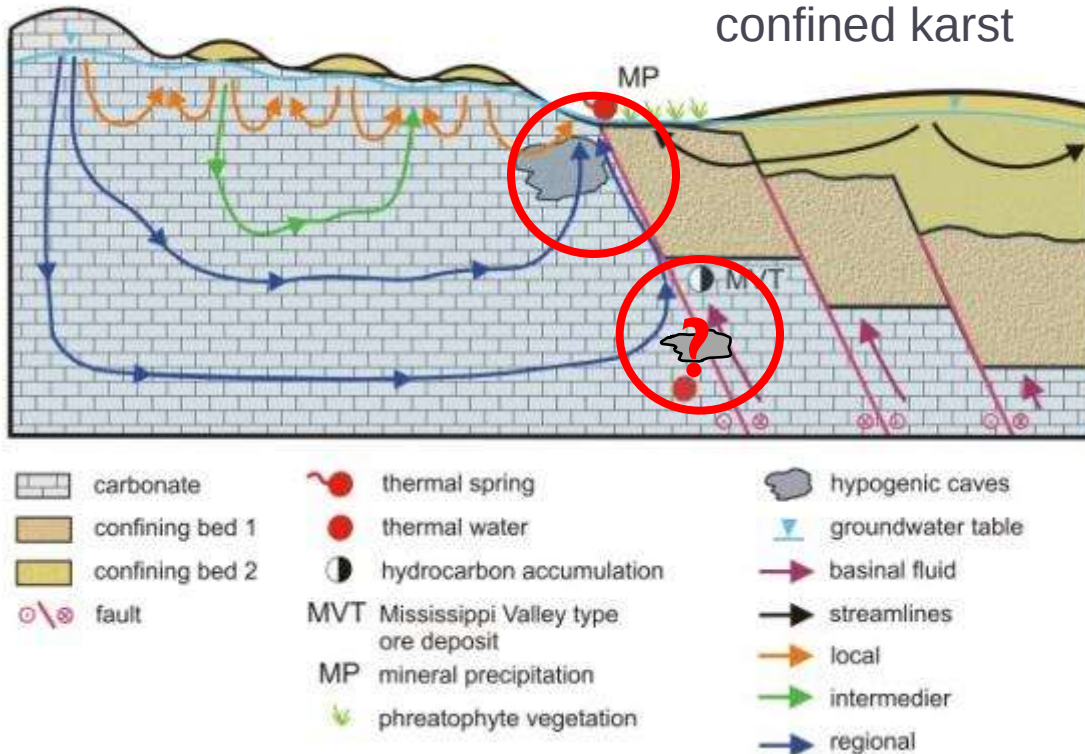
(Goldscheider et al., 2010)

- ▶ epigenic karst systems: form by the effect of meteoric water from the surface
- ▶ hypogenic karst systems: form by deep originated gases, fluids
- ▶ the understanding of the hypogenic karst systems have research and economic importance (e.g. thermal water, hydrocarbon reservoirs, Pb-Zn-Cu MVT mineralization)

Introduction

unconfined karst

confined karst



(Mádl-Szőnyi and Eröss, 2013)

- ▶ The epigene and hypogene caves formed by processes of the water-rock interaction
- ▶ The hypogene karsts are typical in the deep and discharge zones of the intermediate and regional flow systems
- ▶ Different mineral precipitates often accompany the cavities

- ▶ One of the type areas of the hypogenic karst systems is the Buda Thermal Karst
- ▶ The connection between the phenomena caused by water flows in the caves of Buda (unconfined karst) is proved and generalized (Eröss 2010; Mádl-Szőnyi and Eröss, 2013)
- ▶ The question is, what is below the **confined karst**? Do cavities, calcite- and iron oxide precipitates occur there too?

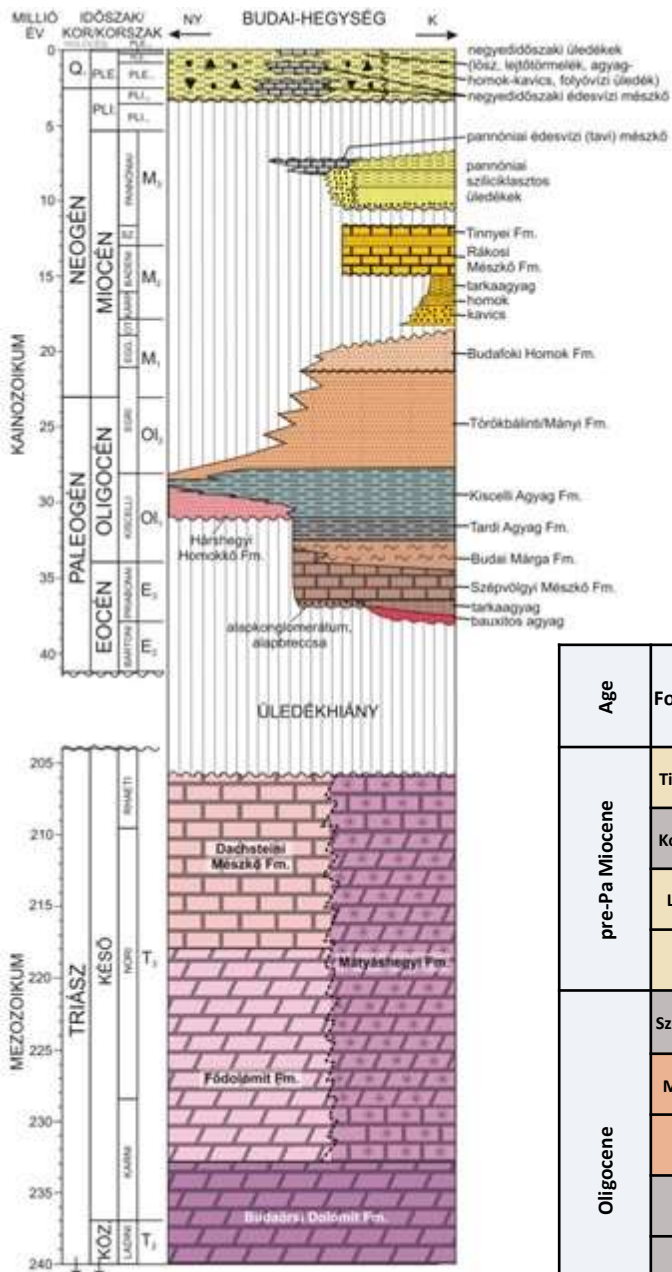
Objectives

- ▶ To collect the documentations of the water exploration wells drilled in the Buda Thermal Karst and examine systematically that are there any marks in the carbonate sequences which refer to **deep karstification** and **precipitation** from the groundwater.
- ▶ To answer that to **which carbonate formations** these marks are connected, and can **connection with structural elements** be detected, as well as **in what levels** these are located in the sequence.



Geological and hydrostratigraphical background

- ▶ The hydrostratigraphical classification of formations in the area based on the research of the Department's Hydrogeological Working Group
- ▶ Special attention to carbonate formations – marks for karstification/precipitation



Age	Formation name	K (m/s)		Hydrostratigraphical classification	Age	Formation name	K (m/s)		Hydrostratigraphical classification
		min	max				min	max	
pre-Pa Miocene	Tinnye Formation	10-5	10-3	AQ	Eocene	Buda Marl	10-6	10-4	AQ
	Kozárd Formation	10-10	10-8	AT		Szépvölgy Limestone	10-4	10-3	AQ
	Lajta Limestone	10-5	10-3	AQ		Kosd Formation	10-7	10-6	AQ
	Budafok Sand	10-6	10-4	AQ	Triassic	Dachstein Limestone	10-4	10-2	AQ
Oligocene	Szécsény Schlieren	10-10	10-9	AT		Hauptdolomit Formation	10-4	10-2	AQ
	Mány Formation	10-8	10-6	mAT		Mátyáshegy Formation	10-4	10-2	AQ
	Törökbálint Sandstone	10-8	10-6	mAT		Budaörs Dolomite	10-4	10-2	AQ
	Kiscell Clay	10-12	10-10	AT		Csopak Marl	10-9	10-7	AT
	Hárshégy Sandstone	10-8	10-6	AT		Arács Marl	10-8	10-6	mAT
	Tard Clay	10-12	10-10	AT					

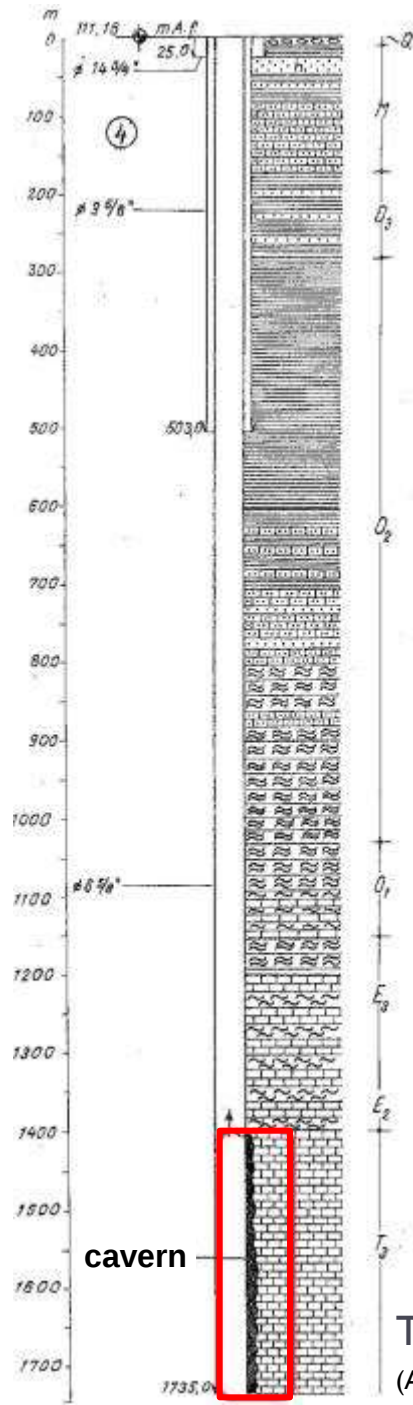
AQ - aquifer, AT - aquitard, mAT - medium aquitard

Research for marks of hypogene karstification in sequences of water exploration wells – Data Background

- ▶ Attention was paid on cavities below the confined karst firstly in the drilling of the well Paskál-malom → about 335 m long cavern in Dachstein Limestone
- ▶ 78 water exploration wells was chosen from the hydrostratigraphical data base (Hydrogeological Research Group, 2013), these data was collected from the MFGI data repository
- ▶ After data culling 46 wells remained in which there were marks for karstification or mineral precipitation

The sequence of well Paskál-malom with the cavern

(Alföldi et al., 1968)

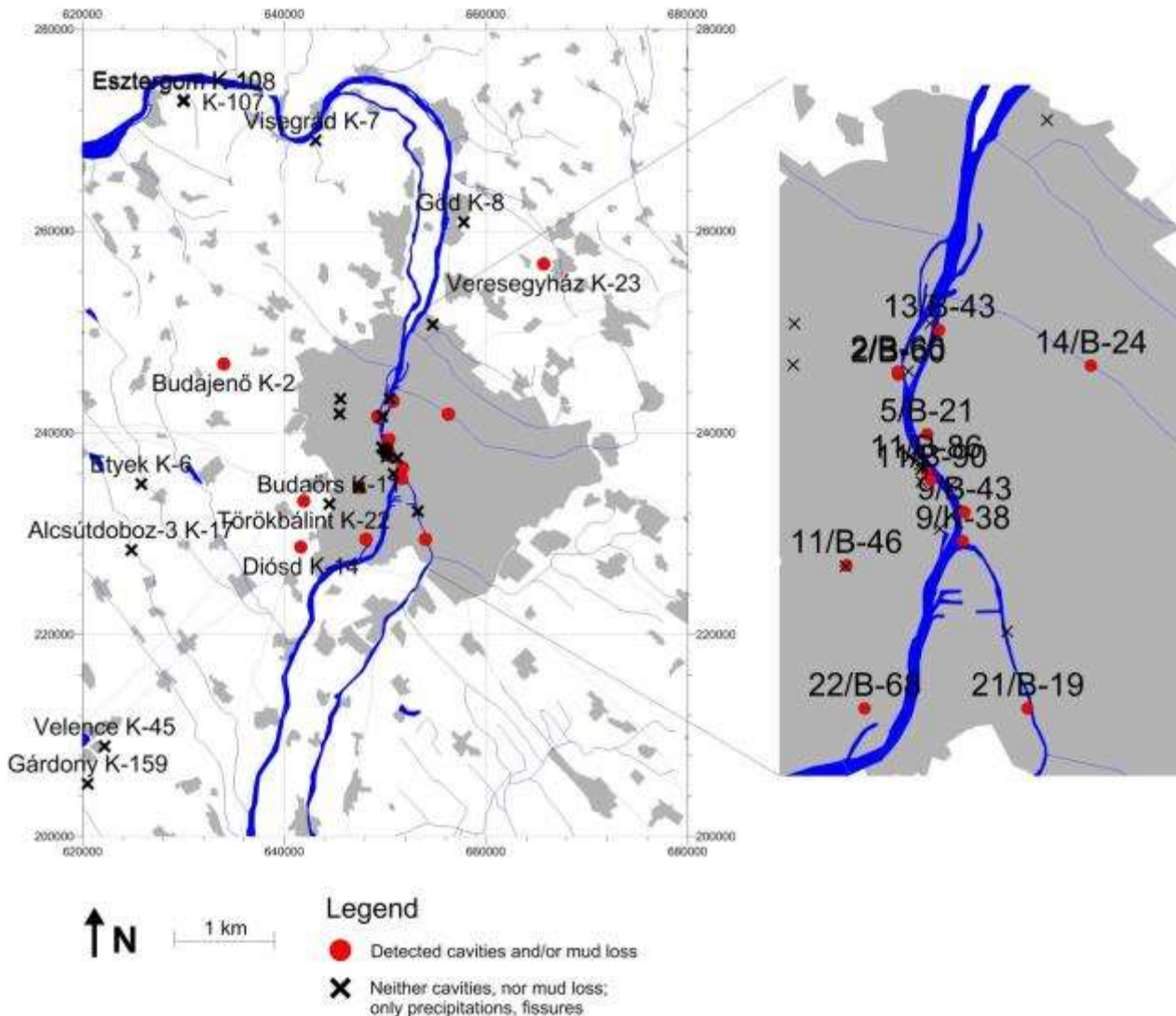


Water exp. well identification	Settlement	Short name/ cad. number	Hydrostr. classification of carbonate formation	Surface elevation (mBf)	Formation top (mBf)	Formation base (mBf)	Data of karstification collected from the documentations, etc. (data in depth, m)	Important sections in terms of karstification (depth, m)
I295	Törökbálint	K-22	Buda Marl VV, Budaörs Dol VV	132			593-634 m: Dolomite: many, small, irregularly shaped dissolution caves, its wall is filled out with tiny, grown-up dolomite- and calcite crystals	593-634 m
I295	Törökbálint	K-22	Buda Marl VV	132	-437	-448		
I295	Törökbálint	K-22	Budaörs Dolomite VV	132	-448	(-502) (base)		



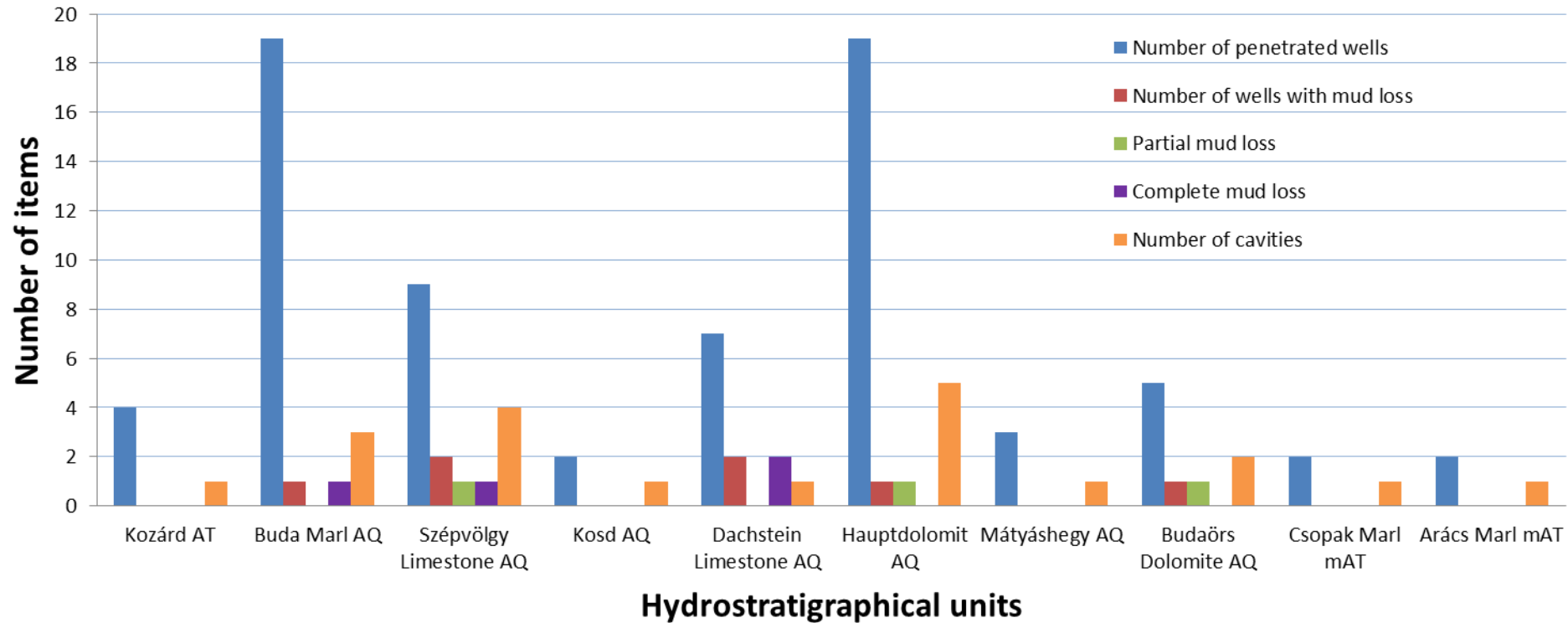
Intact rock sections (from-to) (mBf)	Position of fissured sections (mBf)	Carbonate rock debris	Position of fault, structure, suspected fault zone (mBf)	Stylolite	Calcite fillings, calcite vein (mBf)	Fissure filled with clay, silt	Iron-oxide, pyrite precipitates	Position of dissolution caves and size of caves (mBf)	Mud loss and it's quantity %
(-437) - (-448)									
(-448) - (-461)					(-461) - (-502) base			(-461) - (-502) base, small dissolution caves	

Research for marks of hypogene karstification in sequences of water exploration wells – **Data distribution and processing**



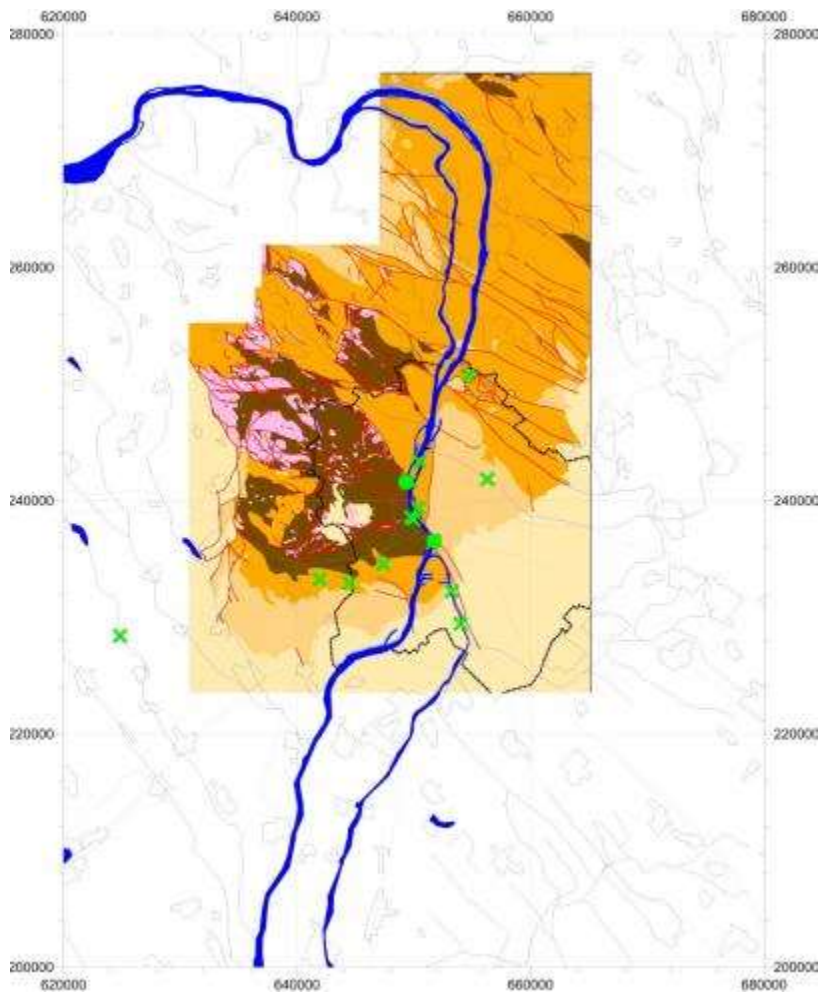
- Direct: cave in carbonate formation
- Indirect: mud loss in carbonate formation
- Mineral precipitates: calcite and iron sulphide
- ▶ Cavities and/or mud loss were remarked in 16 wells of the examined 46 water exploration wells (red points)
- ▶ In the others: precipitates, fissures (black x)

Marks for hypogene karstification in different carbonate hydrostratigraphical units



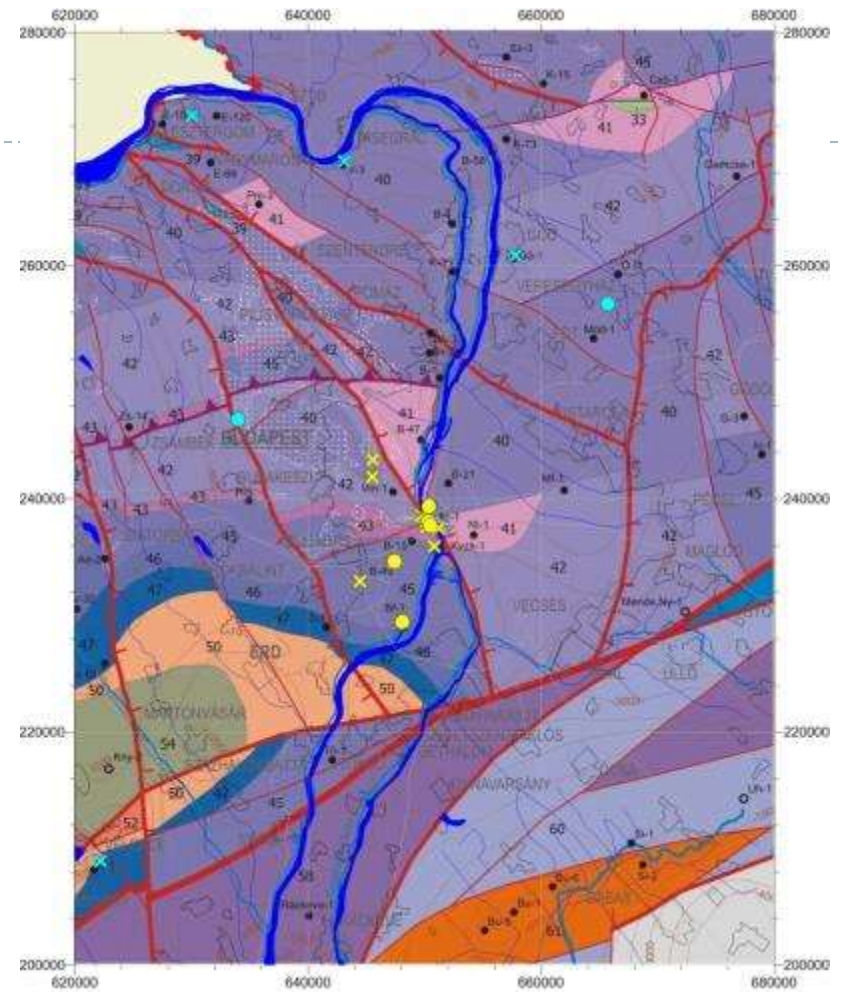
- ▶ Based on the bar charts cavities and mud losses can be derived from all carbonate formations (even from marl)

The areal distribution and structural determination of the cavities



Buda Marl AQ

(Geological map: Fodor in Mindszenty ed. 2013 in press)

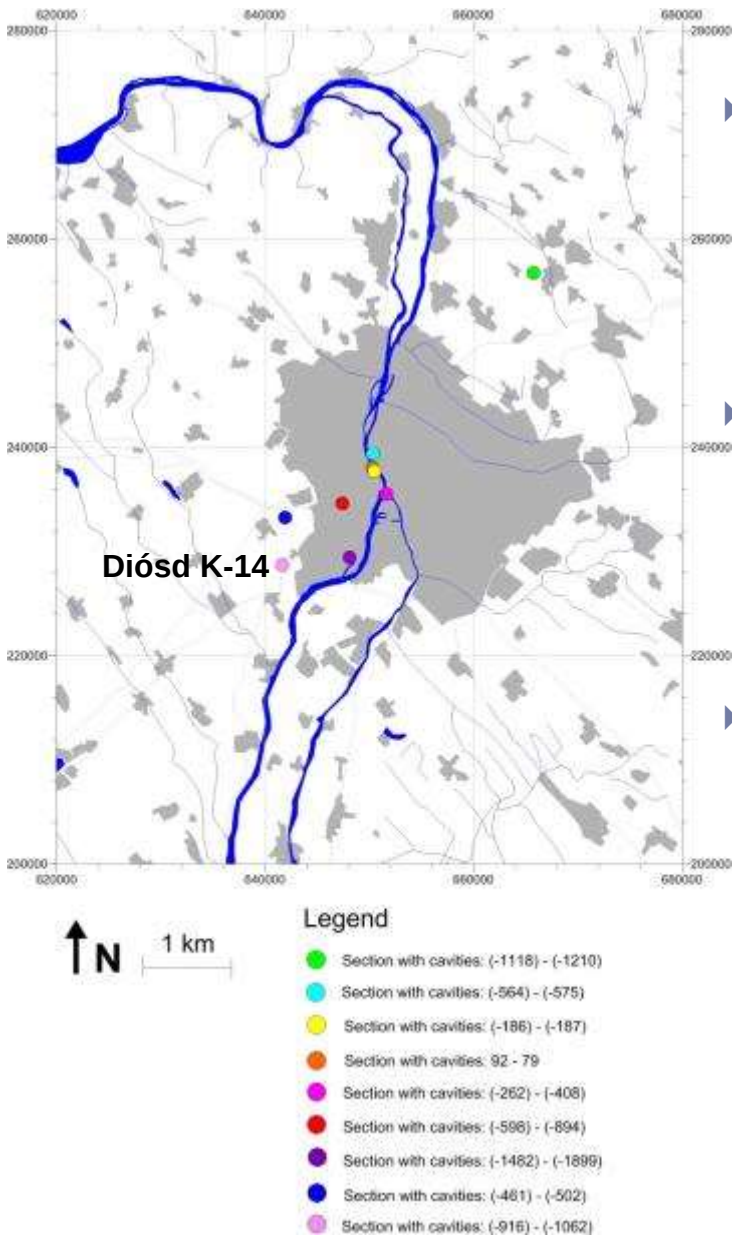


Dachstein Limestone AQ and Hauptdolomit AQ

(Geological map: Haas ed. 2010)

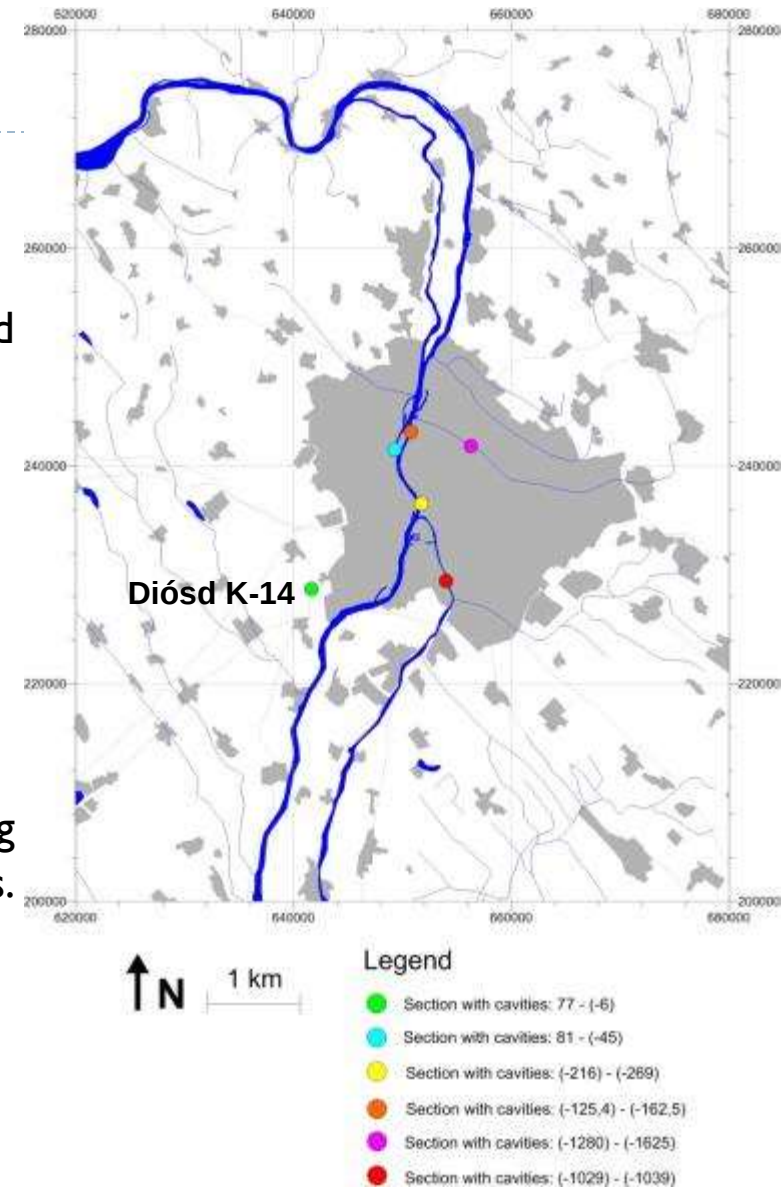
- ▶ 6 maps about important carbonate formations
- ▶ Cavities occur in all carbonate hydrostratigraphical units, independently from lithology
- ▶ The connection of cavities with structural elements is detected in some cases, in other cases it is not demonstrable (maybe there are structures but not indicated)
- ▶ Cavities can be observed in more well logs from the confined karst compared to the unconfined karst

Elevation ranges of cavities



Triassic formations

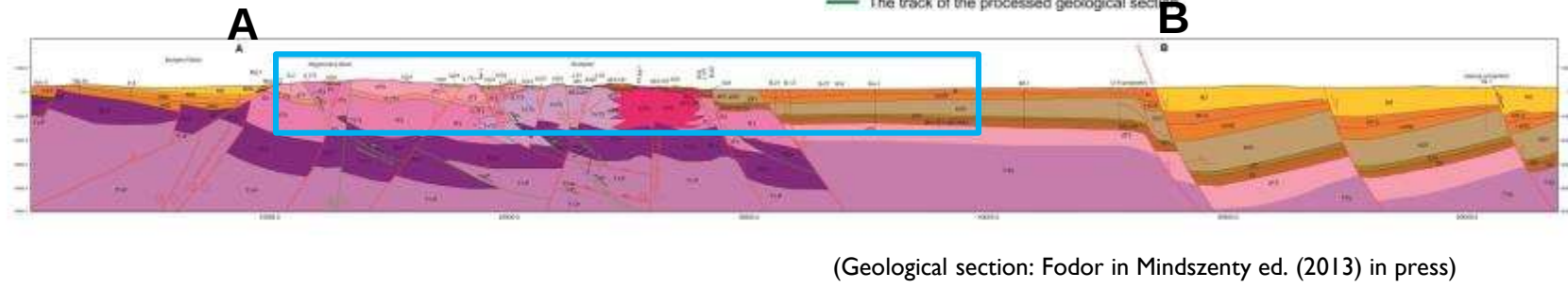
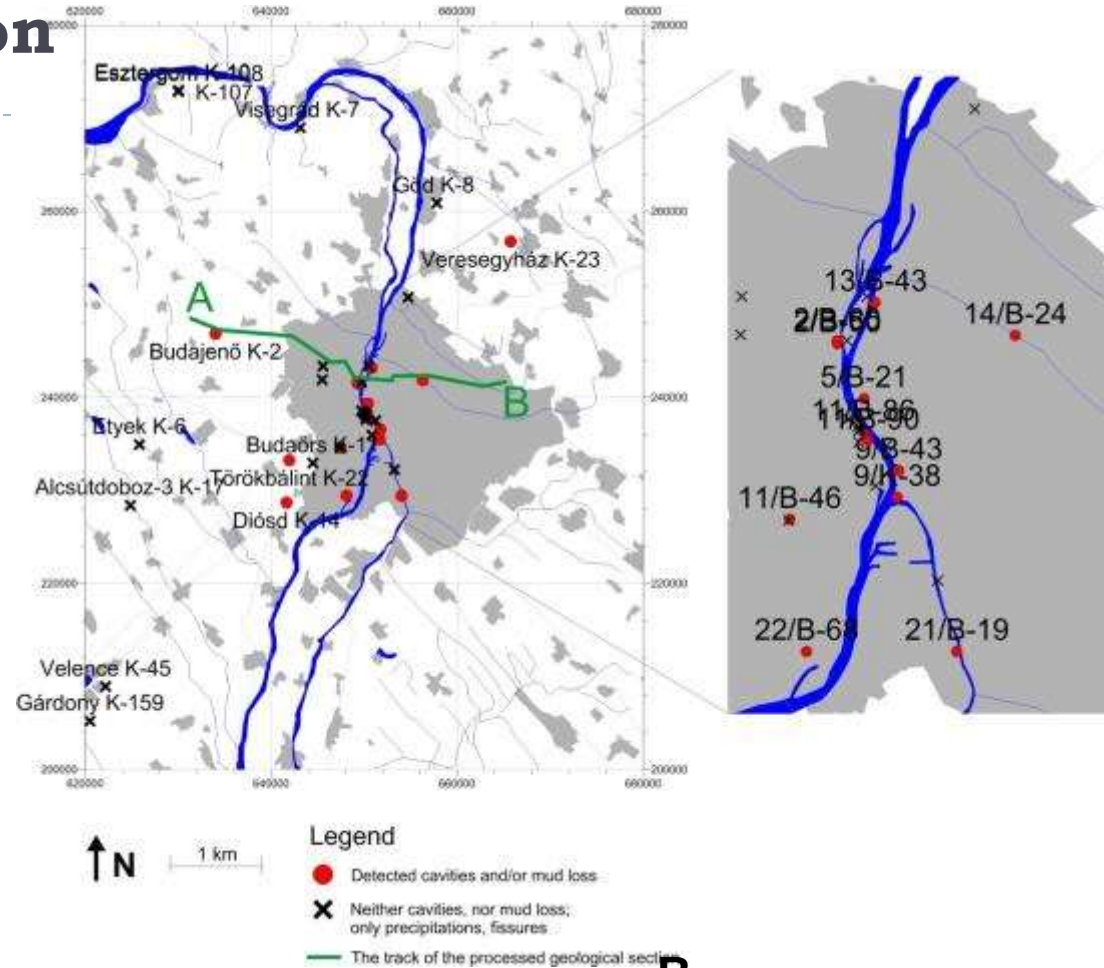
- ▶ Taking into consideration the elevation range of the cavities great variability was found
- ▶ The occurrence of cavities in the wells extends from some meters to 300-350 meters
- ▶ In the wells multilevel cavities were found effecting different formations. However there were no cavities effecting both the Triassic and the Eocene formations together



Eocene and Miocene formations

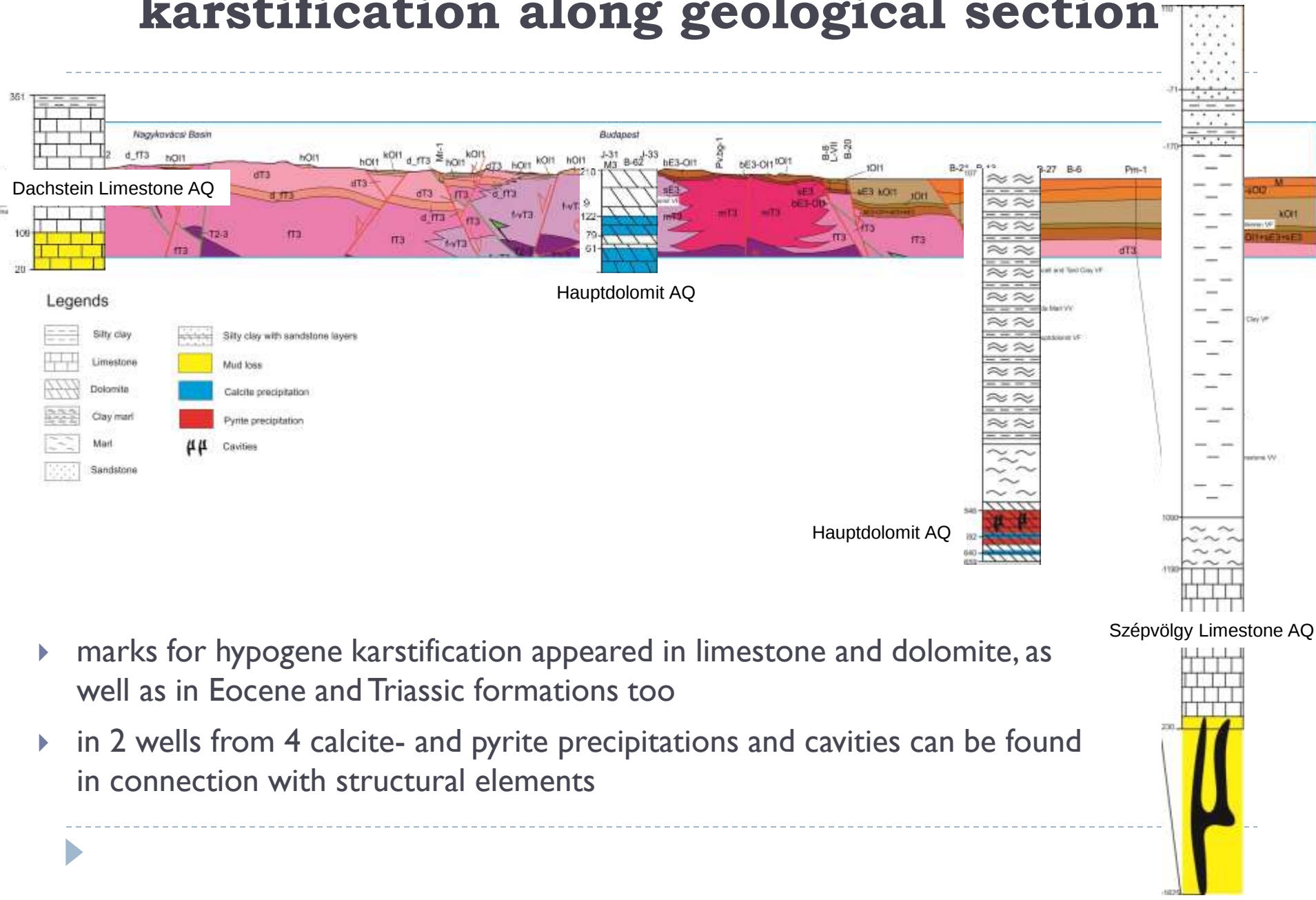
Visualization of marks for hypogene karstification along geological section

- ▶ The evaluation was prepared for the section highlighted with blue from the geological section of Fodor
- ▶ 4 wells with any phenomena



(Geological section: Fodor in Mindszenty ed. (2013) in press)

Visualization of marks for hypogene karstification along geological section



- marks for hypogene karstification appeared in limestone and dolomite, as well as in Eocene and Triassic formations too
- in 2 wells from 4 calcite- and pyrite precipitations and cavities can be found in connection with structural elements

Summary and suggestions for further research

Goals: investigation of marks for hypogene karstification in the Buda Thermal Karst based on the sequences of water exploration wells

Documentations of 78 water exploration wells were used, from these based on analysis of 46 wells it can be determined that:

- ▶ Cavities and mud losses can occur in all carbonate hydrostratigraphical units
 - ▶ The connection of cavities with structural elements is detected in some cases, in other cases it is not demonstrable (but it can not be excluded)
 - ▶ Cavities can be observed in more well logs from the confined karst compared to the unconfined karst
 - ▶ Taking into consideration the elevation range of the cavities along the section great variability was found
 - ▶ The occurrence of cavities in the wells extends from some meters to 300-350 meters
 - ▶ In the wells multilevel cavities were found affecting different formations. However there were no cavities affecting both the Triassic and the Eocene formations
 - ▶ In the future, in my thesis I would like to investigate the presence of cavities in carbonate formations of well compared with geological logs
-



Acknowledgements

- ▶ I would like to thank my supervisor, **Judit Mádl-Szőnyi** for her excellent advices.
- ▶ I would like to express my thanks to **Anita Erőss** for her useful suggestions.
- ▶ Thanks to **Szilvia Simon** for her help with use Surfer.
- ▶ I would like to express my thanks to the workers of **MBFH** and **MFGI repository**
- ▶ The research was carried out within the framework and with the support of the **OTKA NK 101356 (Supervisor: Judit Mádl-Szőnyi)**.



Thank you for your kind attention!

