

**Vliv návštěvníků na mikroklima
Kateřinské jeskyně**

**Influence of Visitors on Kateřinská Cave
Microclimate**

**Český hydrometeorologický ústav, pobočka Brno
Mendelova univerzita**

H. Středová, T. Středa, J. Rožnovský

A photograph of a cave interior. The ceiling is covered in numerous stalactites of varying lengths and thicknesses, hanging from the rock. The walls and floor are also composed of brownish, textured rock. The lighting is warm and somewhat dim, highlighting the textures of the cave formations.

I. Project introduction

Projekt SP/2d5/07

PROGRAM VĚDA A VÝZKUM

Ministerstvo životního prostředí České republiky

**Stanovení závislosti jeskynního mikroklimatu
na vnějších klimatických podmínkách
ve zpřístupněných jeskyních ČR**

*Assessment of cave microclimate dependence on
external climatic conditions in accessible caves in CR*

Řešitelská organizace:
Správa jeskyní České republiky

Spoluřešitelská organizace:
**Český hydrometeorologický ústav,
pobočka Brno**

Project tasks:

PT 1 Evaluation of cave microclimate in relation to external environment

- Estimation of cave microclimate
- Establish of external climatic stations
- Analyses of relation between external and internal meteorological conditions
- **Assessment of visitors impact on cave microclimate**
- Prediction of external climatic conditions according to climate change scenarios with possible impact on cave conditions

CHMI

Areas of interest

1. Cave microclimatic conditions

- Punkevní cave
 - Stationary measurement system
- **Kateřinská cave**
 - Stationary measurement system
 - Mobile measurement
- Amatérská cave
 - Partial hydrological measurement

Areas of interest

2. Mezoclimatic conditions

- Macocha abyss
 - Vertical profile of air temperature and moisture
- Mezo-climatological stations
 - Macocha
 - Výtok Punkvy
 - Punkevní cave
 - **Kateřinská cave**

} Amet

Ekotechnika
- Standard climatological stations
 - Ostrov
 - Blansko

Ad 1.) Microclimatic cave conditions

Punkevní cave



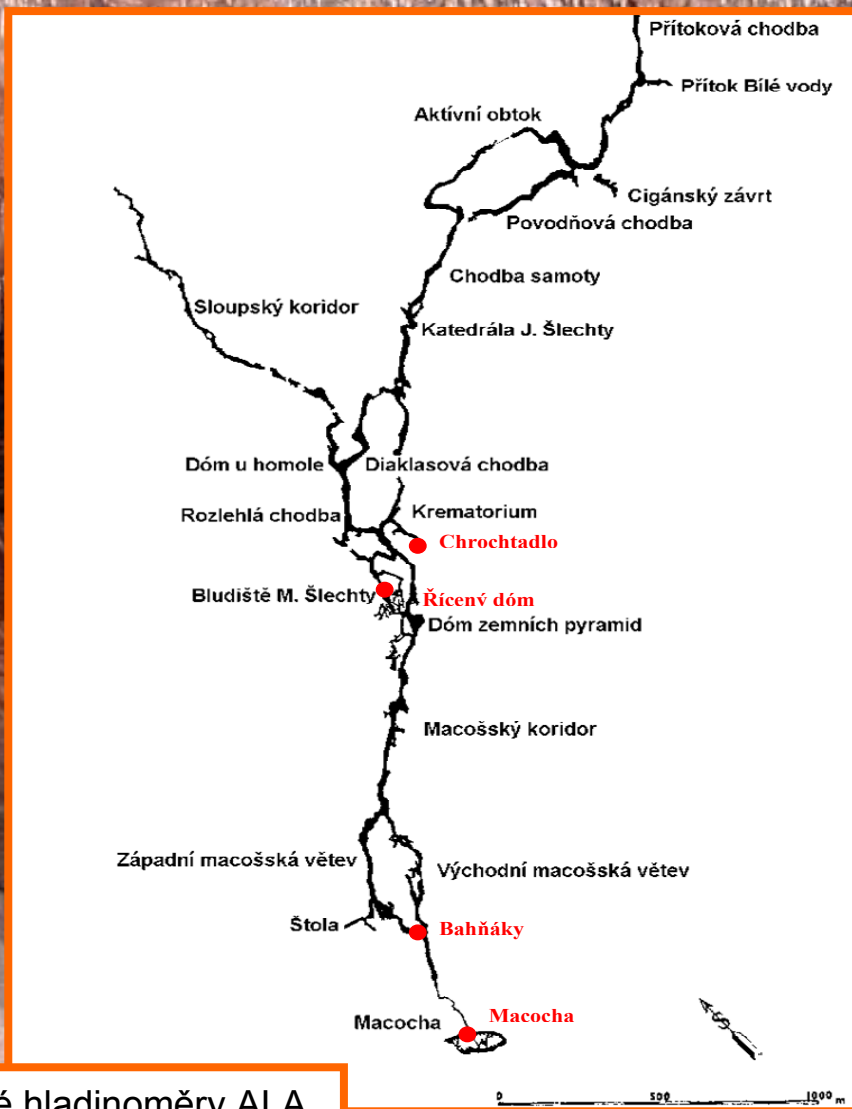
Microclimatic cave conditions

Kateřinská cave



Microclimatic cave conditions

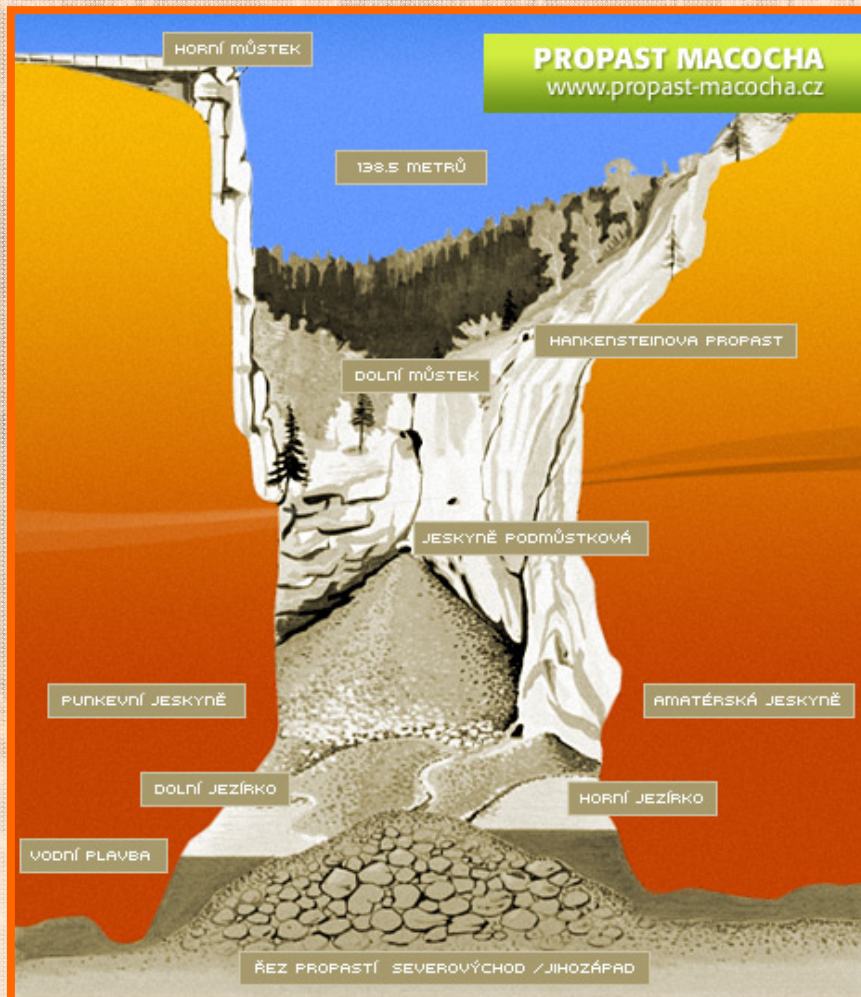
Amatérská cave



- tlakové hladinoměry ALA

Ad 2.) Mezoclimatic conditions

Vertical profile in Macocha Abyss



Mezoclimatological stations (Amet)



The background of the slide is a photograph of a cave interior. The ceiling is covered in numerous stalactites of varying lengths, some reaching down towards the ground. The rock walls and floor are a reddish-brown color. The lighting is dim, highlighting the textures of the cave formations.

II.

**Monitoring of microclimate
in Kateřinská cave**

Vchod do jeskyně



Fotografie

Bambusový lesík



Vrápenec, netopýr



Venkovní meteostanice



Čarodějnice



Vstupní chodba v zimě



Methodology (1)

Definition of critical areas with the highest dynamics of temperature and the most significant visitors influence on the microclimate on the basis of:

- observation results
- series of occasional measurements

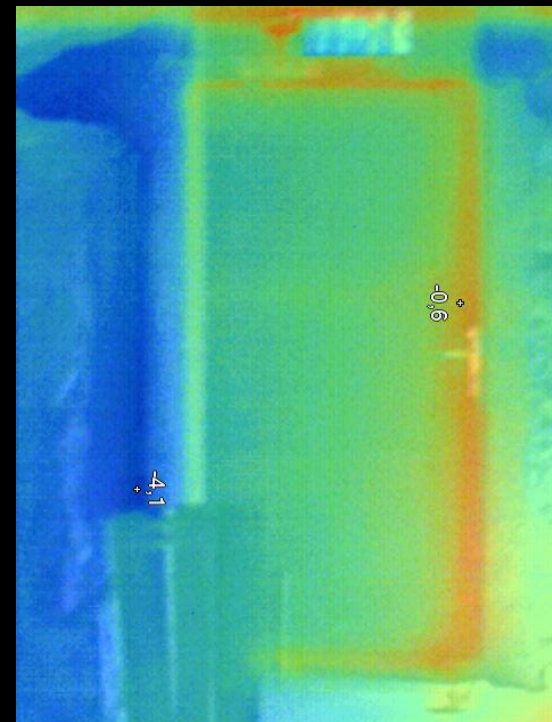
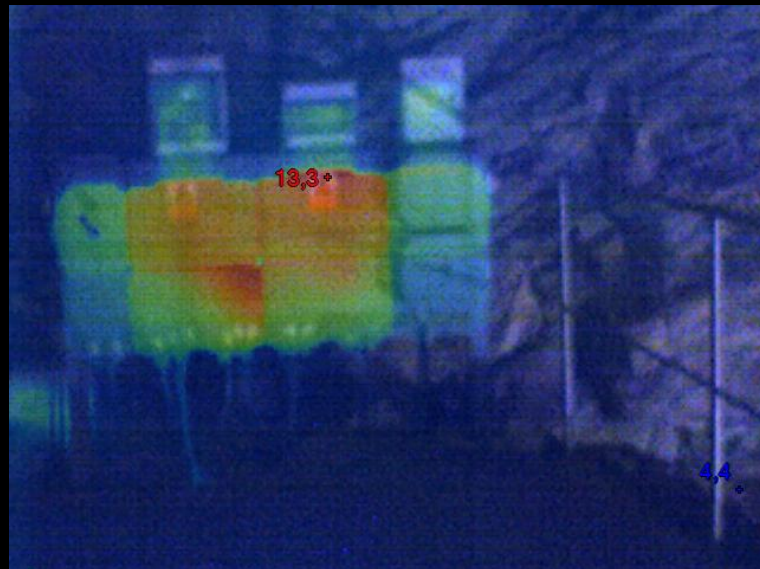
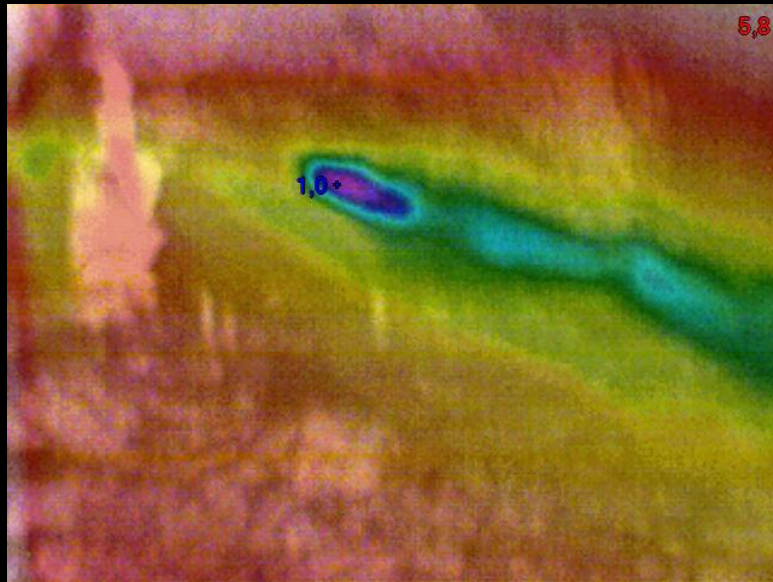
observed parameters:

- *air temperature*
- *rock surface temperature*
- *air moisture*

measurement intervals:

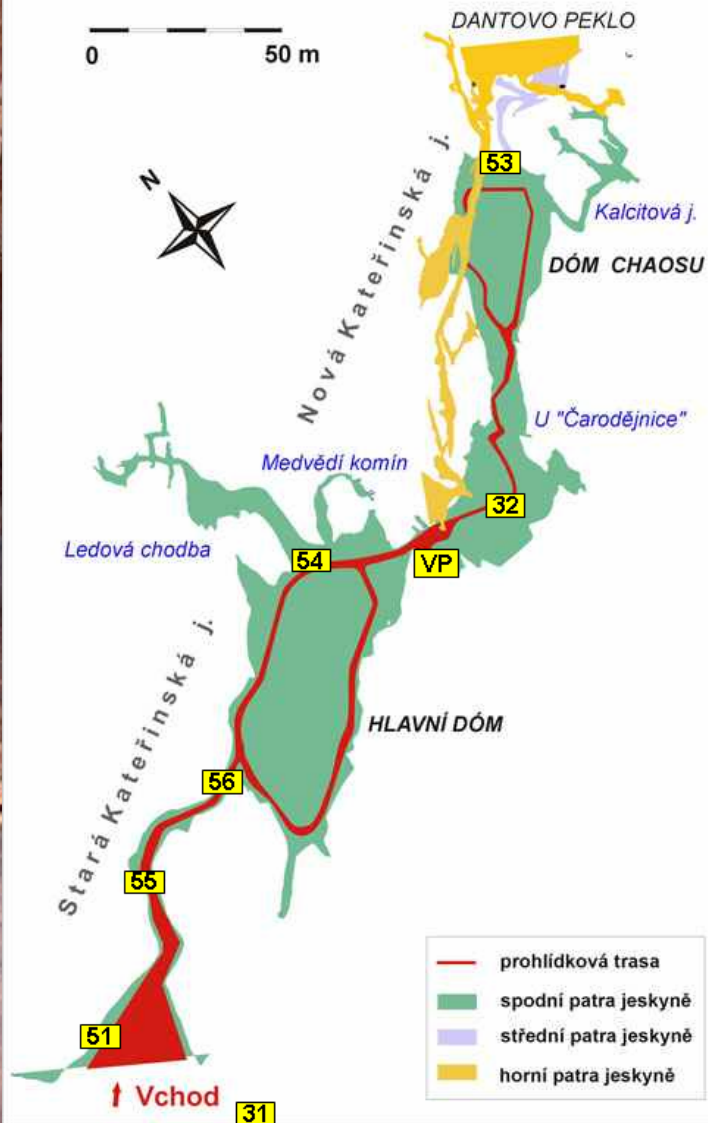
- 1 min – cave sensors
- 15 min – external sensors and control sensor in the cave

Methodology (2)



Measurement, sensors

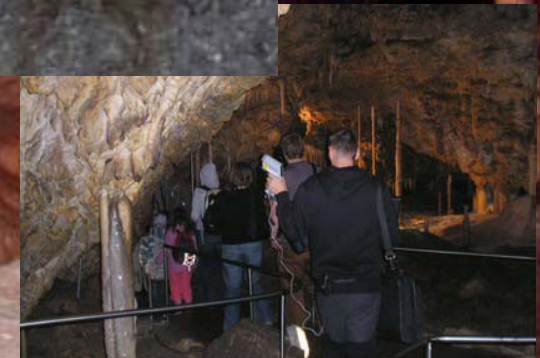
Prohlídková trasa s vyznačením umístění čidel HOBO



Čidlo HOBO
- měření teploty
a vlhkosti vzduchu



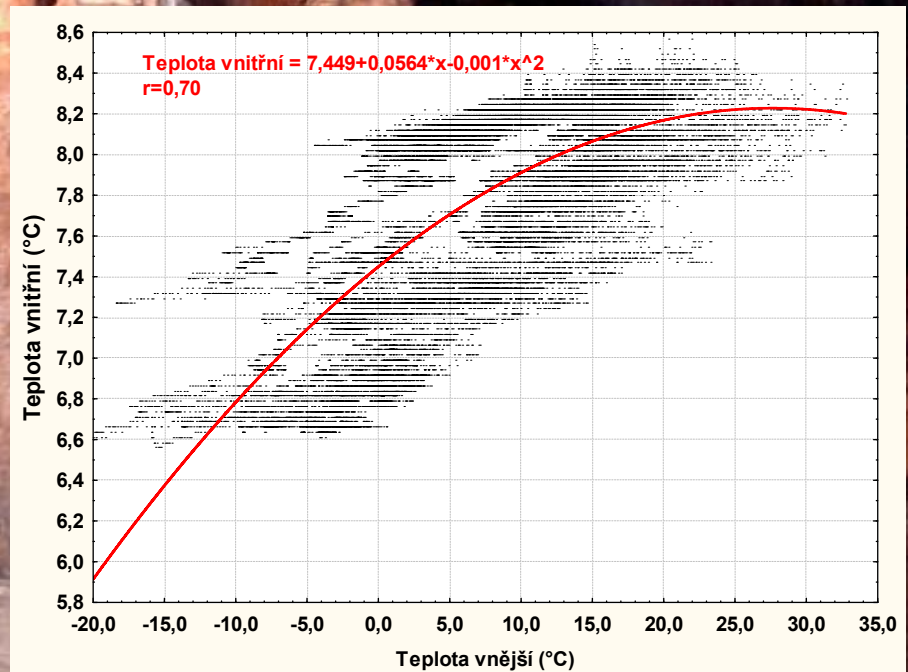
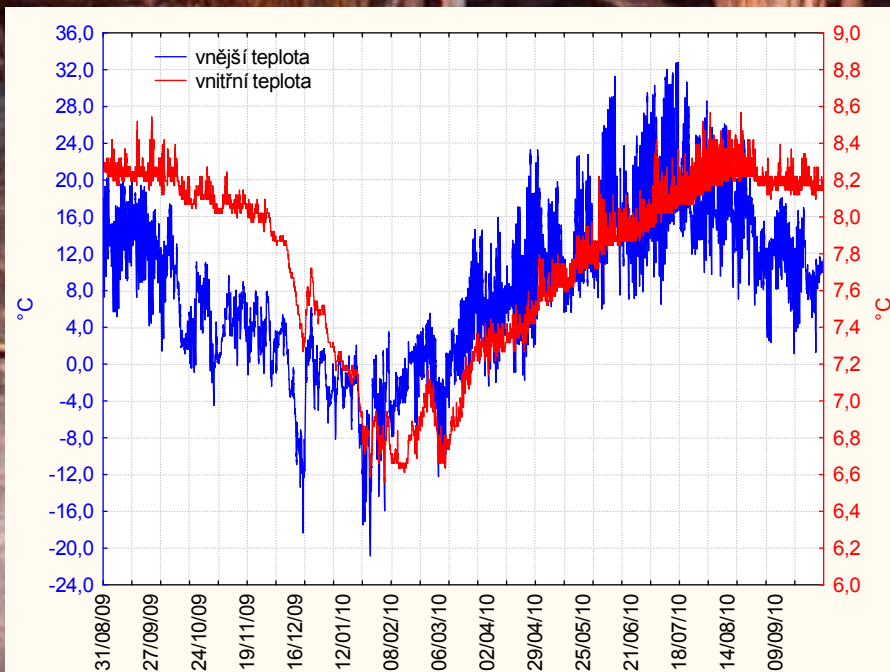
IČ teploměr
- měření teploty
skalní stěny



Monitoring results

(Annual air temperature dynamics inside and outside the cave)
patrný vliv vnější teploty, způsobující
teplotní změny uvnitř jeskyně o 2 °C
(minimum 6,56 °C, maximum 8,56 °C).

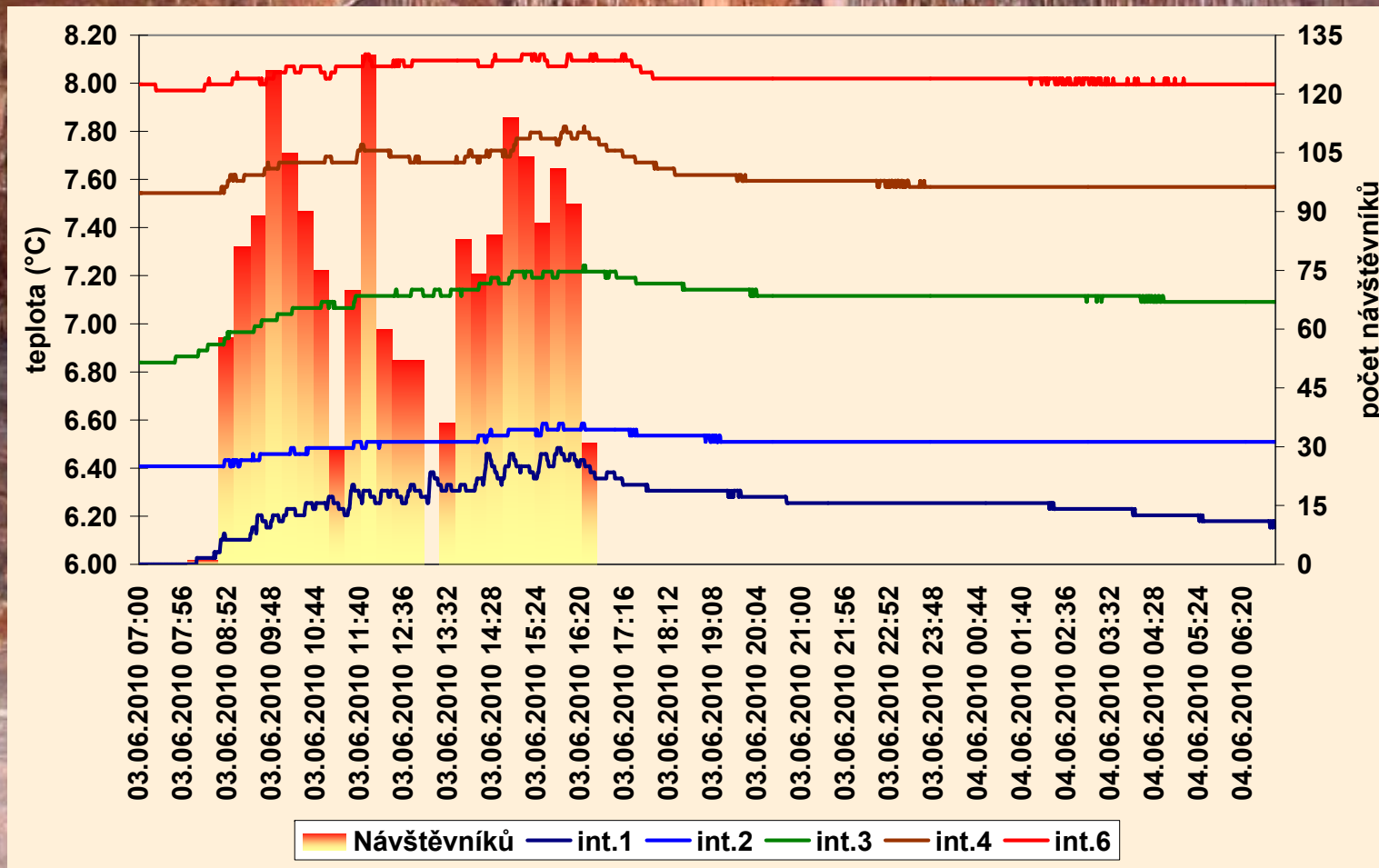
(Dependence of internal
temperature on external
temperature)
vyjádřená polynomem 2. stupně
s odhadem trendu



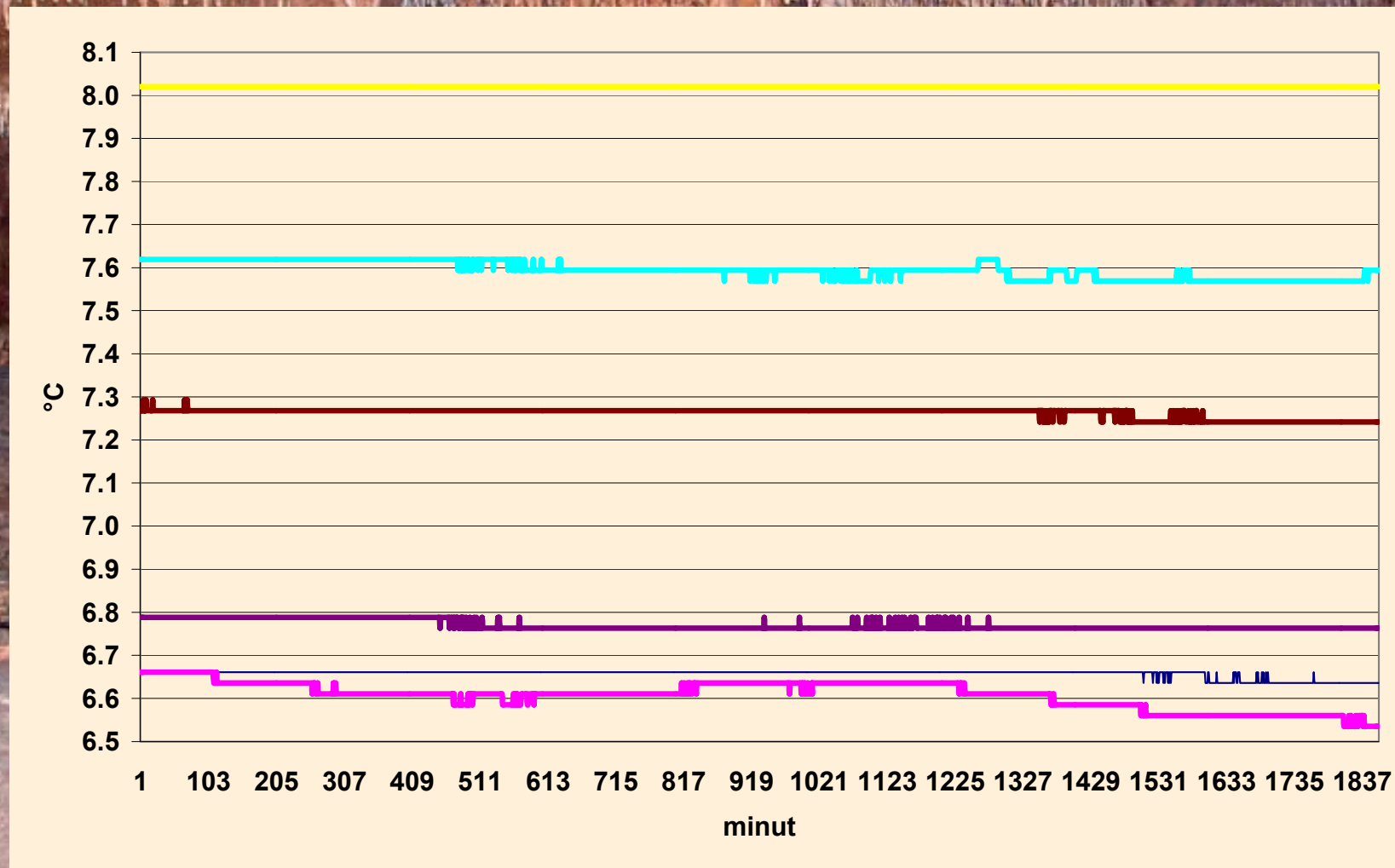
Basic statistical parameters (3.3.2010 – 3.3.2011)

sensor	average	Minimum	Maximum	Amplitude
out	6,98	-15,55 (-20,83*)	32,77	48,32 (53,60*)
Int1	4,35	-3,81	7,62	11,43
Int4	7,50	6,74	8,12	1,38
Int5	7,28	6,64 (6,56*)	8,56	1,92 (2,00*)
Int6	7,97	7,59	8,77	1,18

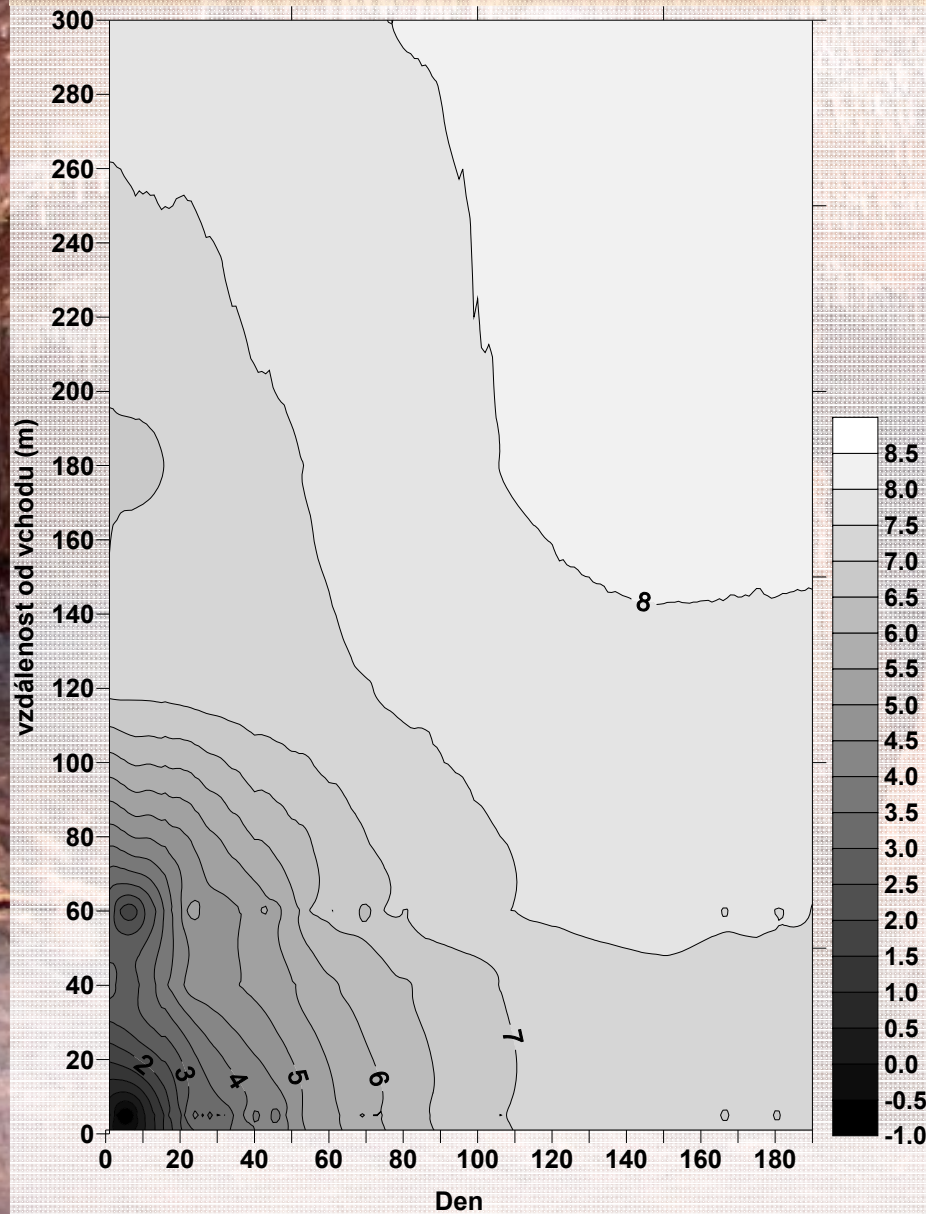
Course of temperature in cave interior and number of visitors in given time in day with the highest visitors amount (3.6.2010)



Course of temperature in cave interior and number of visitors in given time in day with the lowest visitors amount (13.6.2010)



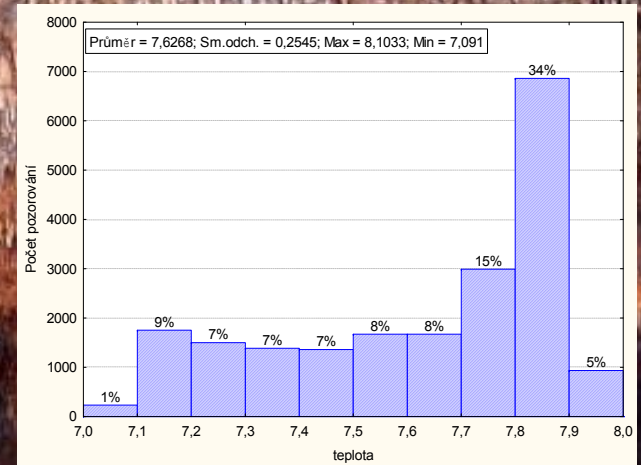
Course of temperature during the year in dependence on the distance from entrance



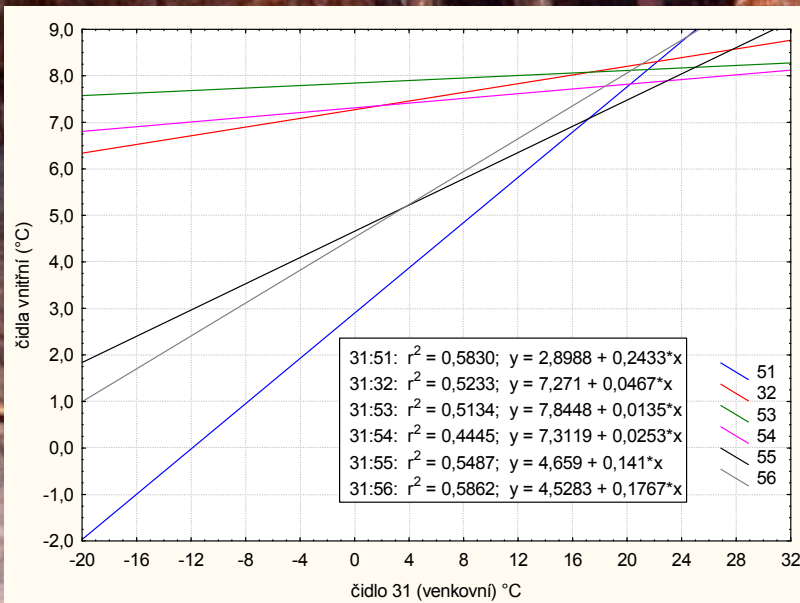
Dynamika teploty vzduchu:

- poměrně výrazná ve vstupní části
- slábne s vzdáleností od vstupu
- od části „Bambusový les“ - v podstatě homogenní teplota

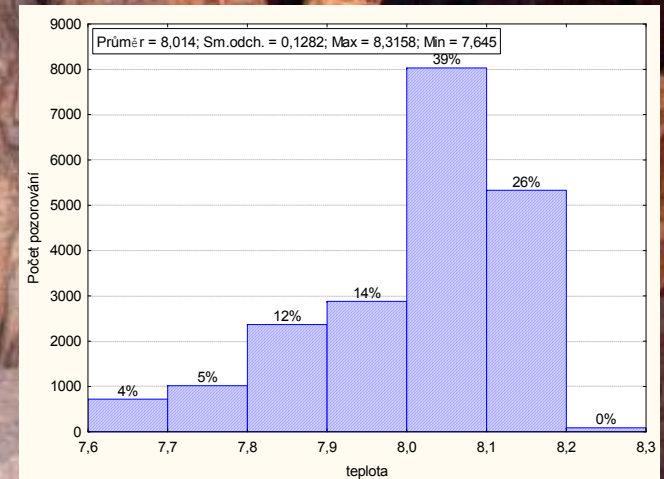
čidlo 54 – Medvědí komín



Závislost vnitřní teploty na vnější
(všechna vnitřní čidla a čidlo vnější)
Dependence of internal on external
temperature (all sensors)



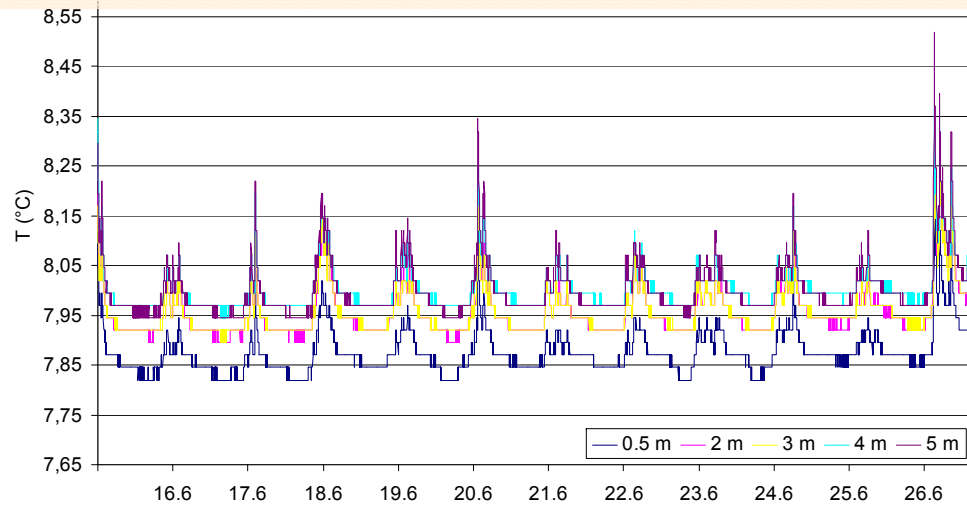
čidlo 53 – Dóm Chaosu



Teplota vzduchu ve vertikálním profilu

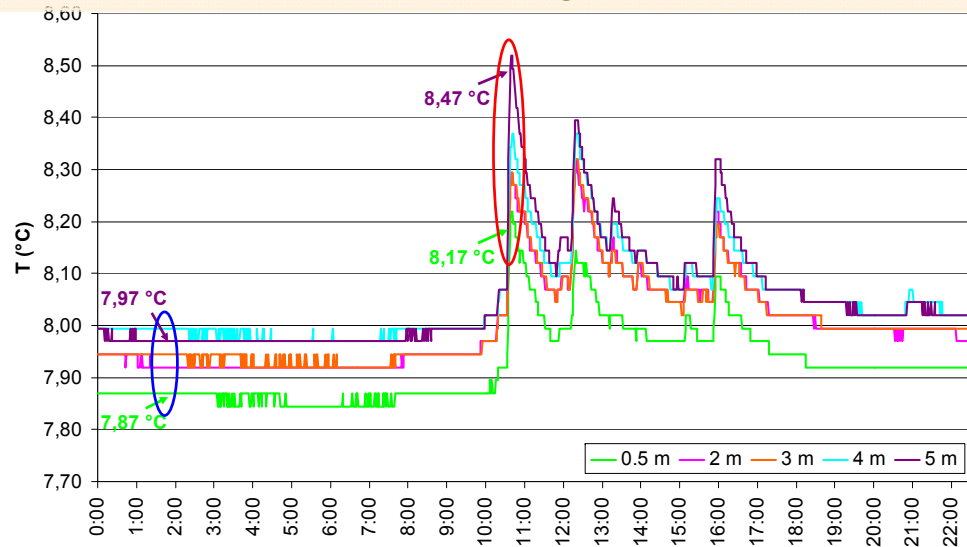
0,5 ;2; 3; 4; 5 m (Př: 15. - 26.6.2010)

Air temperature measured in vertical profile



Maximální a minimální vertikální gradient

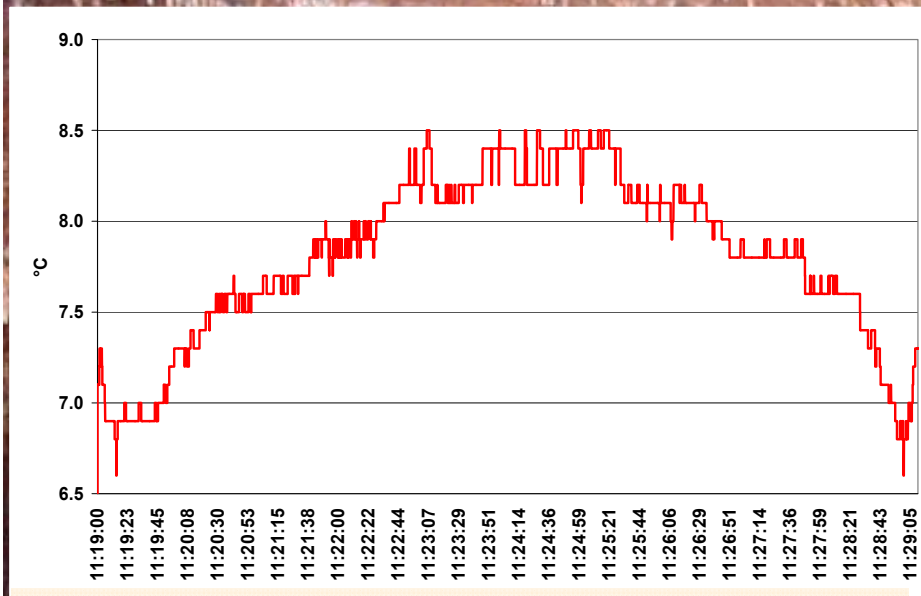
Max and min vertical gradient (26.6.)



Vertikální profil

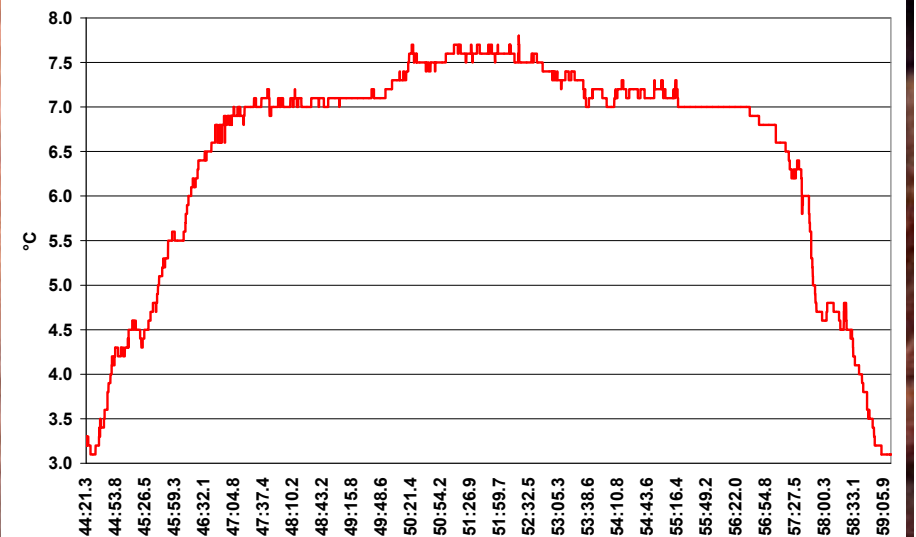
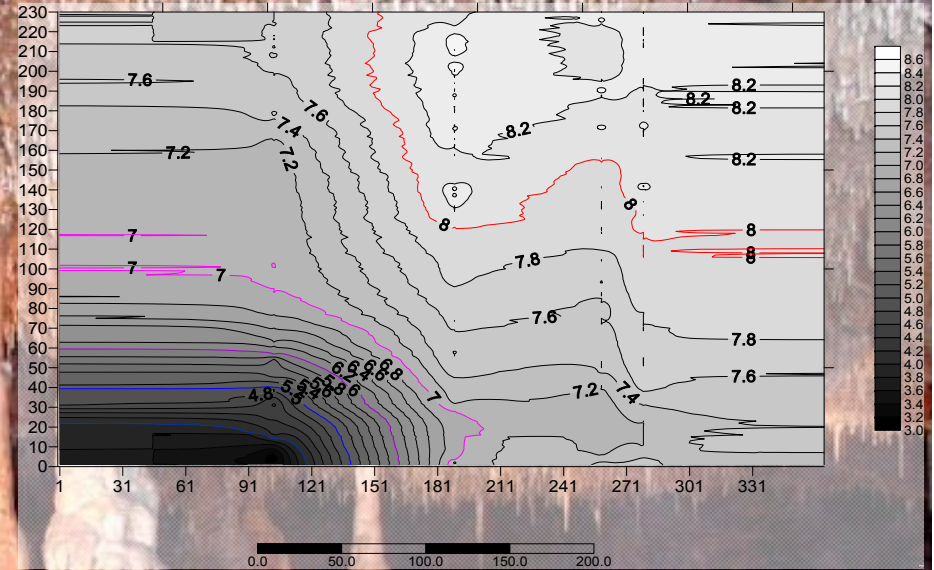


Teplota skalní stěny (Rock surface temperature)



8.7.2010

(max. 8,5; min. 6,6; avg. 7,81 °C)



13.4.2010

(max. 7,8; min. 3,1; avg. 6,48 °C)

A photograph of a cave interior. The ceiling is covered in numerous stalactites of varying lengths. In the foreground, several stalagmites rise from the ground. The lighting is warm and focused on the rock formations.

*Děkujeme za Vaši
pozornost*