

# *Condensation Corrosion in a Cold Climate Cave*



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# *Acknowledgements*



Decho People

Parks Canada  
and  
Steve Catto

# *Acknowledgements*



Derek Ford  
and  
Steve Worthington

# Condensation



- Found in caves of all rock types at all latitudes and altitudes
- It allows interaction between the cave atmosphere, and bedrock and speleothems
- Is an important water source for living organisms
- The classic review of condensation in karst hydrology and speleogenesis is by Dublyansky and Dublyansky

# Location of the Grotte Valerie

Canada

MB P

Nunavut

City

W

Nahanni National Park

Canada

Saskatchewan

Alberta

Edmonton

British Columbia

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Pointer 52°04'55.31" N 125°54'29.06" W elev 4155 ft

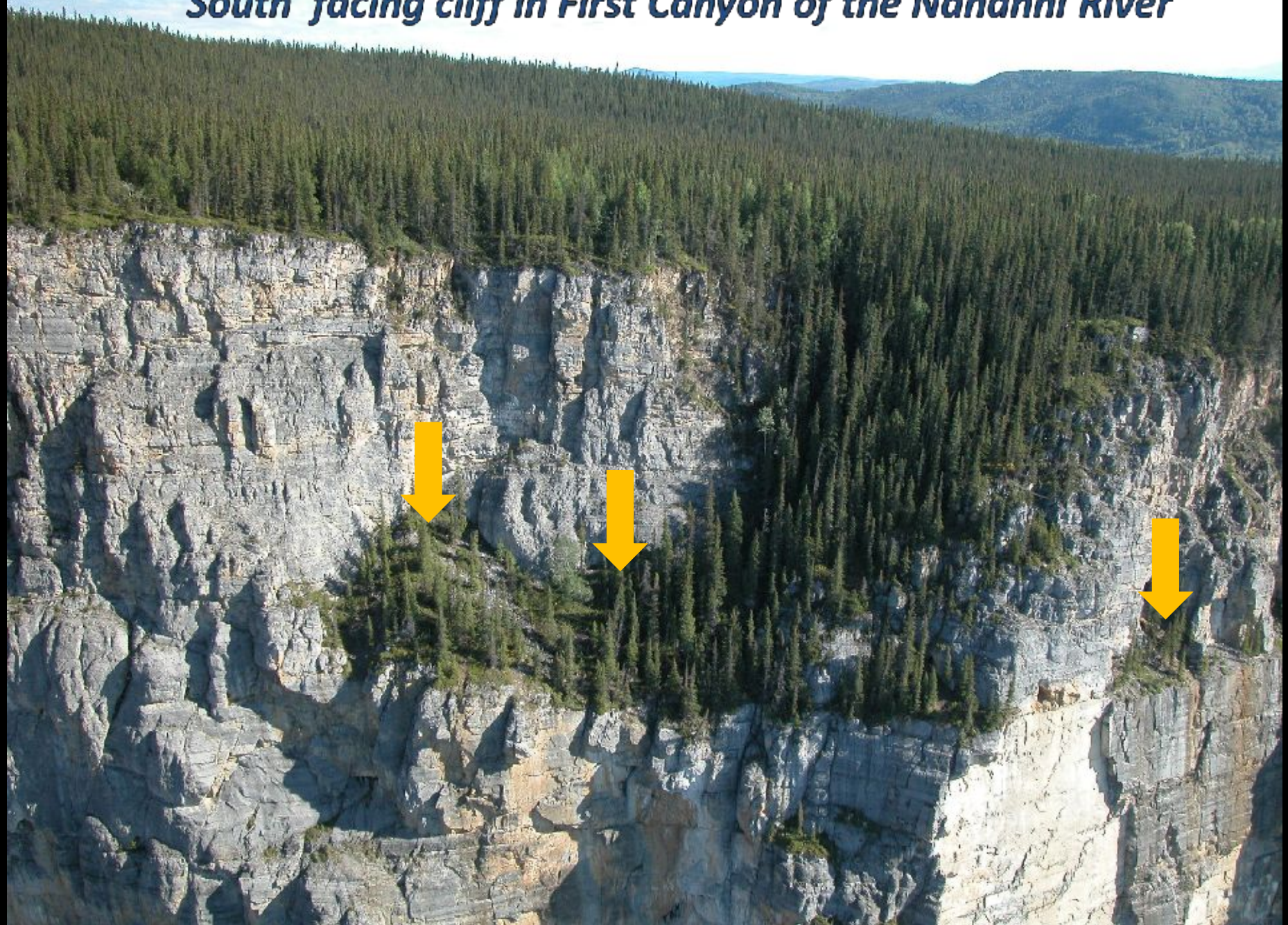
Streaming 100%

Eye alt 1435.40 mi

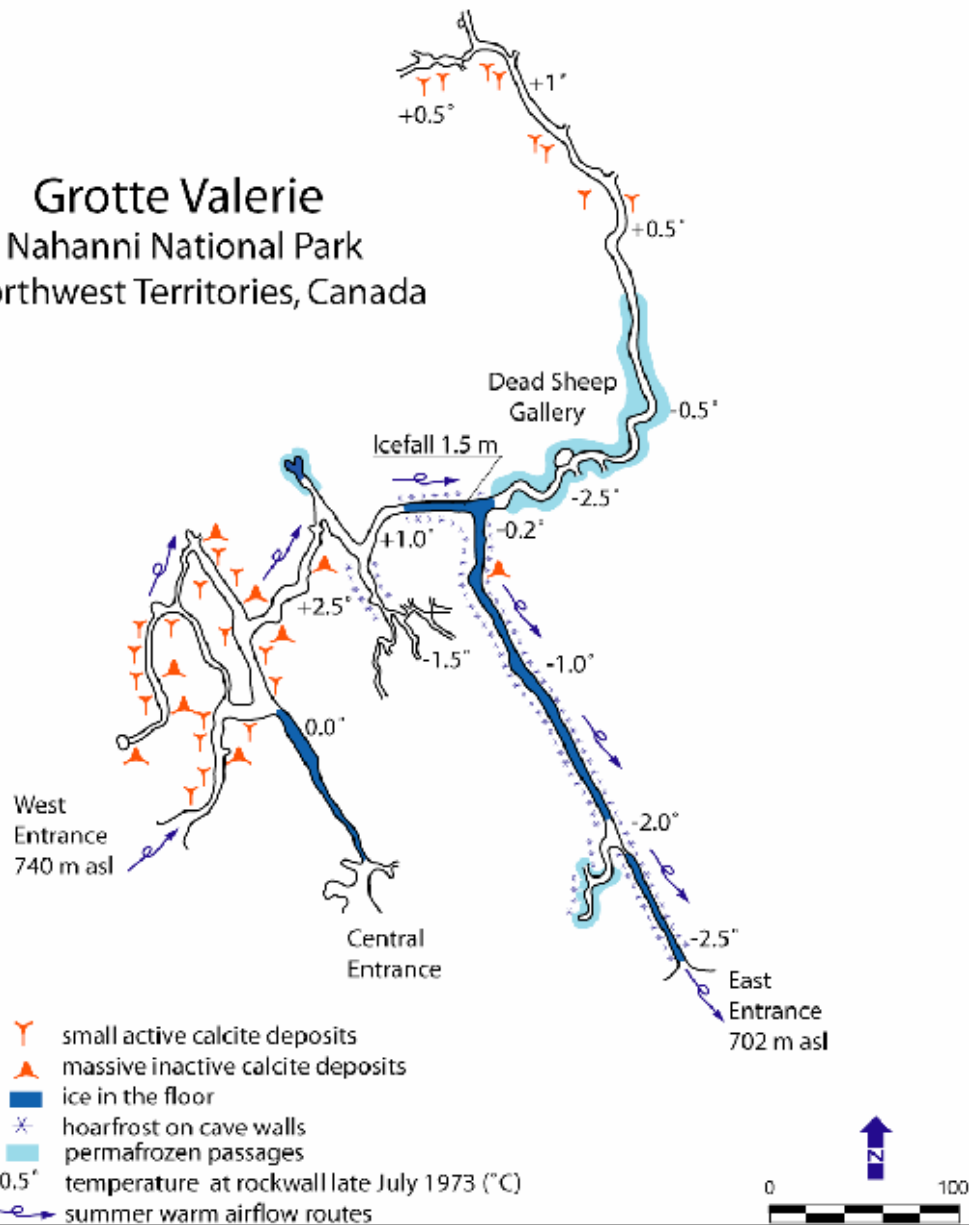
***Nahanni Base Camp,  
Late July 2006***



***South facing cliff in First Canyon of the Nahanni River***

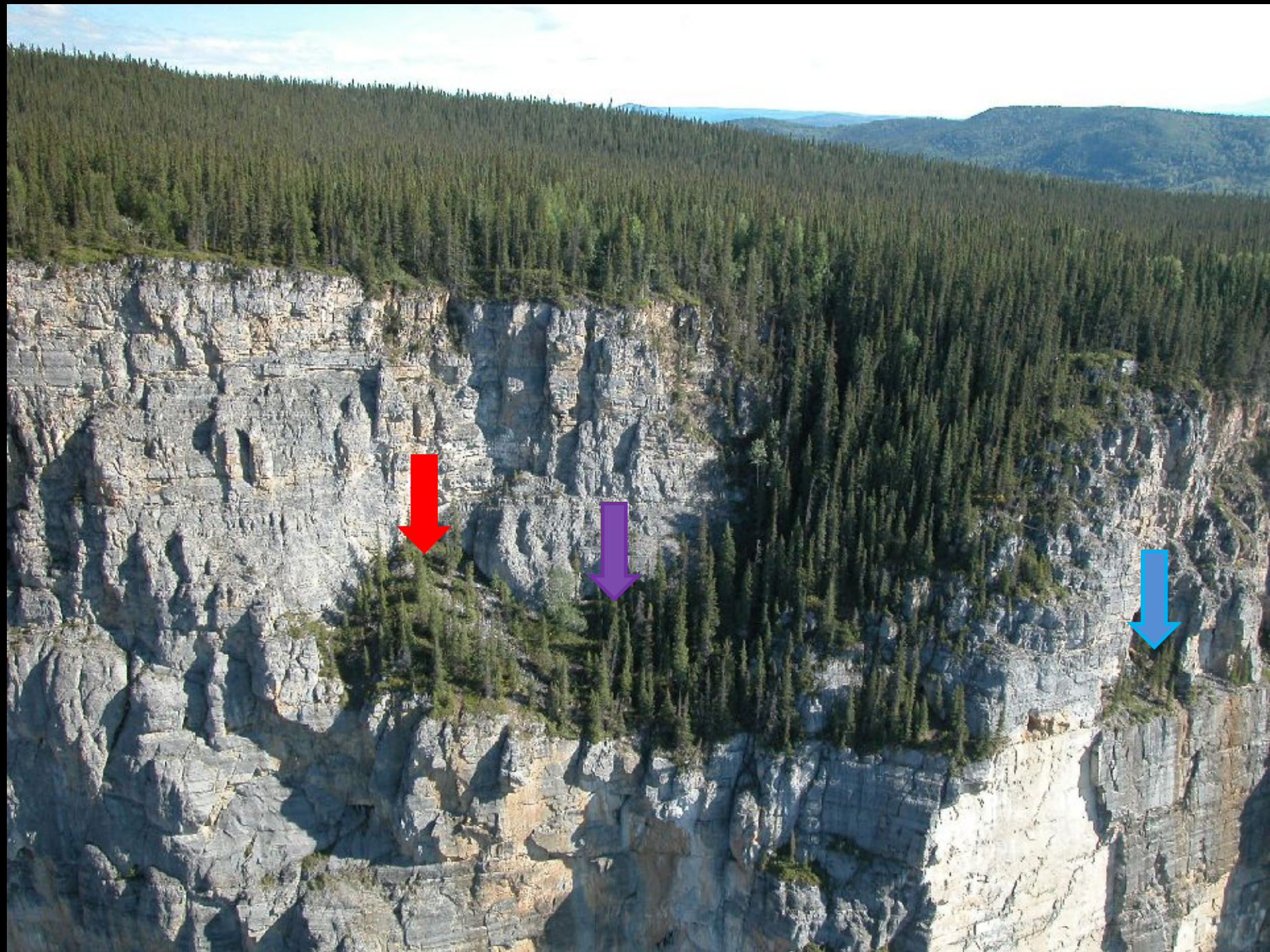


Grotte Valerie  
 Nahanni National Park  
 Northwest Territories, Canada

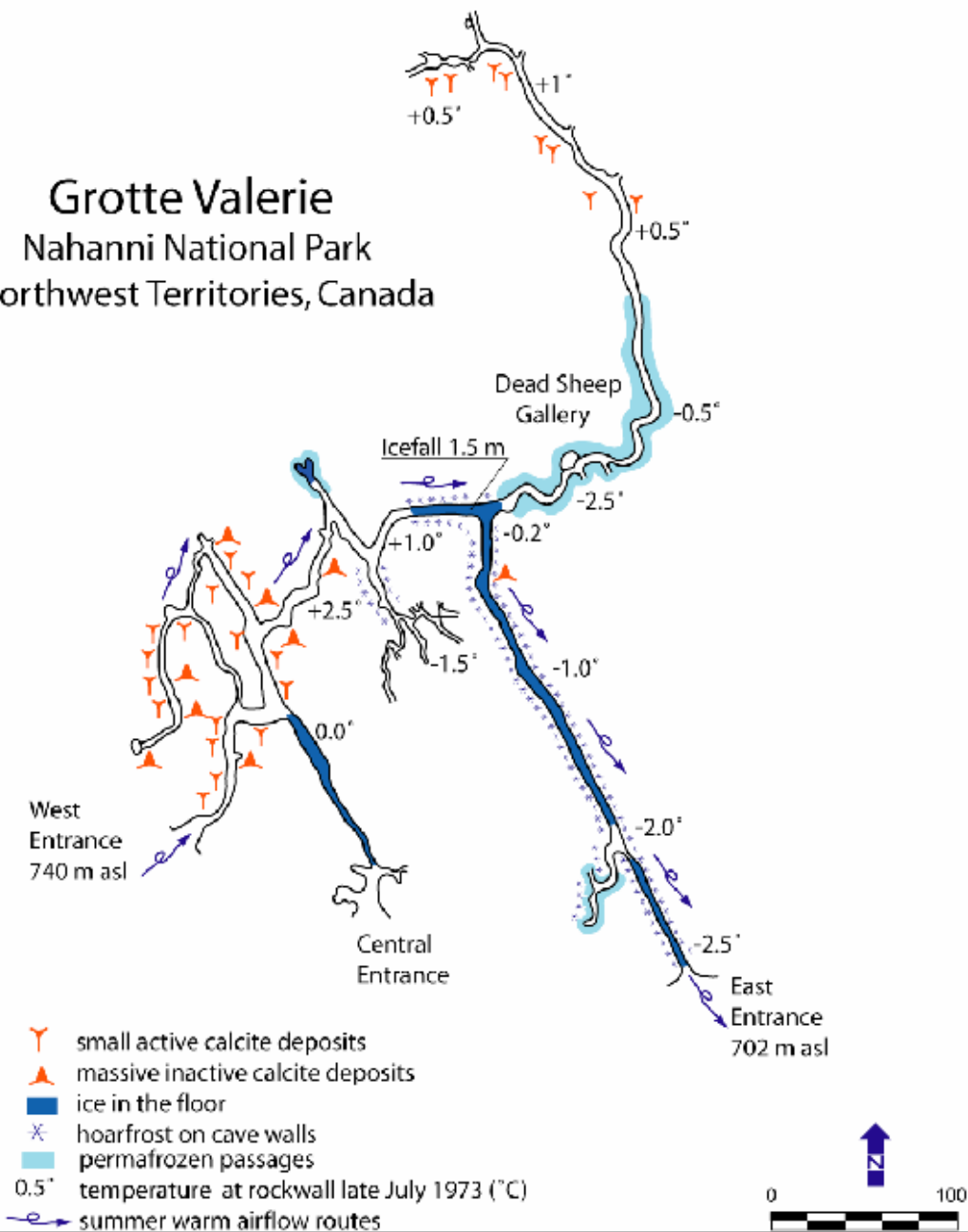


Central Entrance  
 Late July 2006



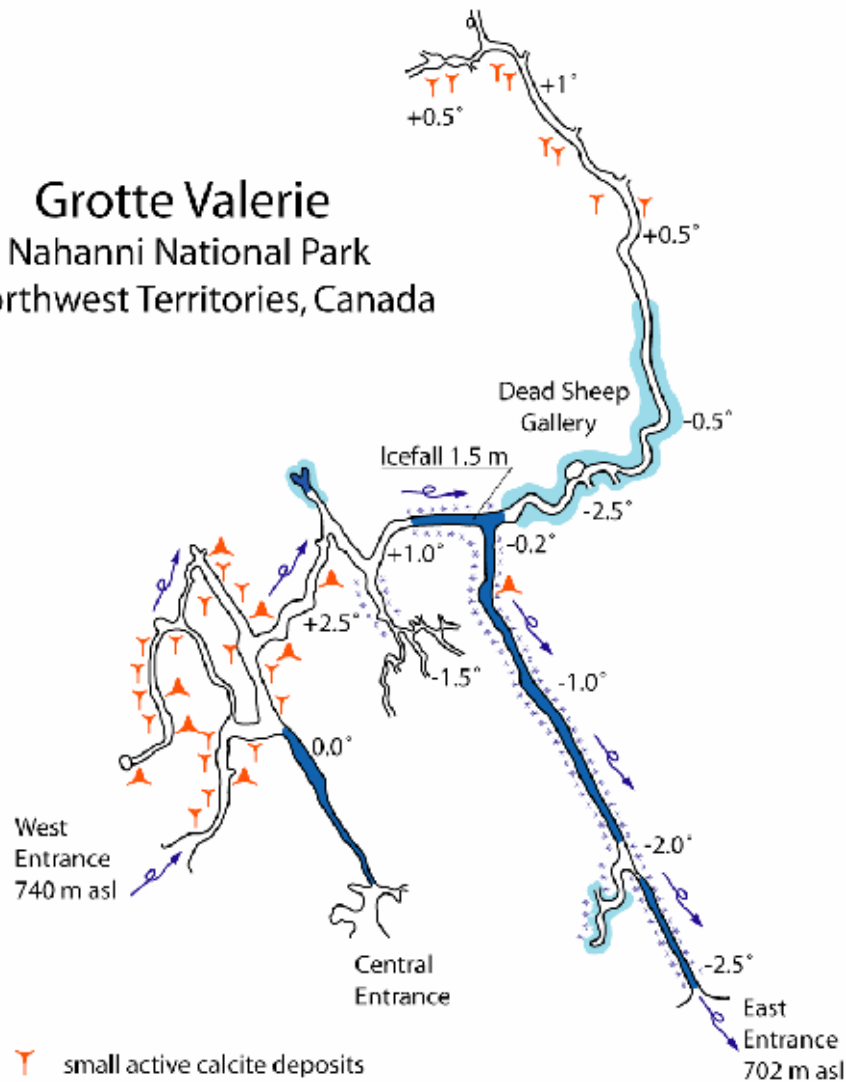


**Grotte Valerie**  
 Nahanni National Park  
 Northwest Territories, Canada



# Grotte Valerie

Nahanni National Park  
Northwest Territories, Canada

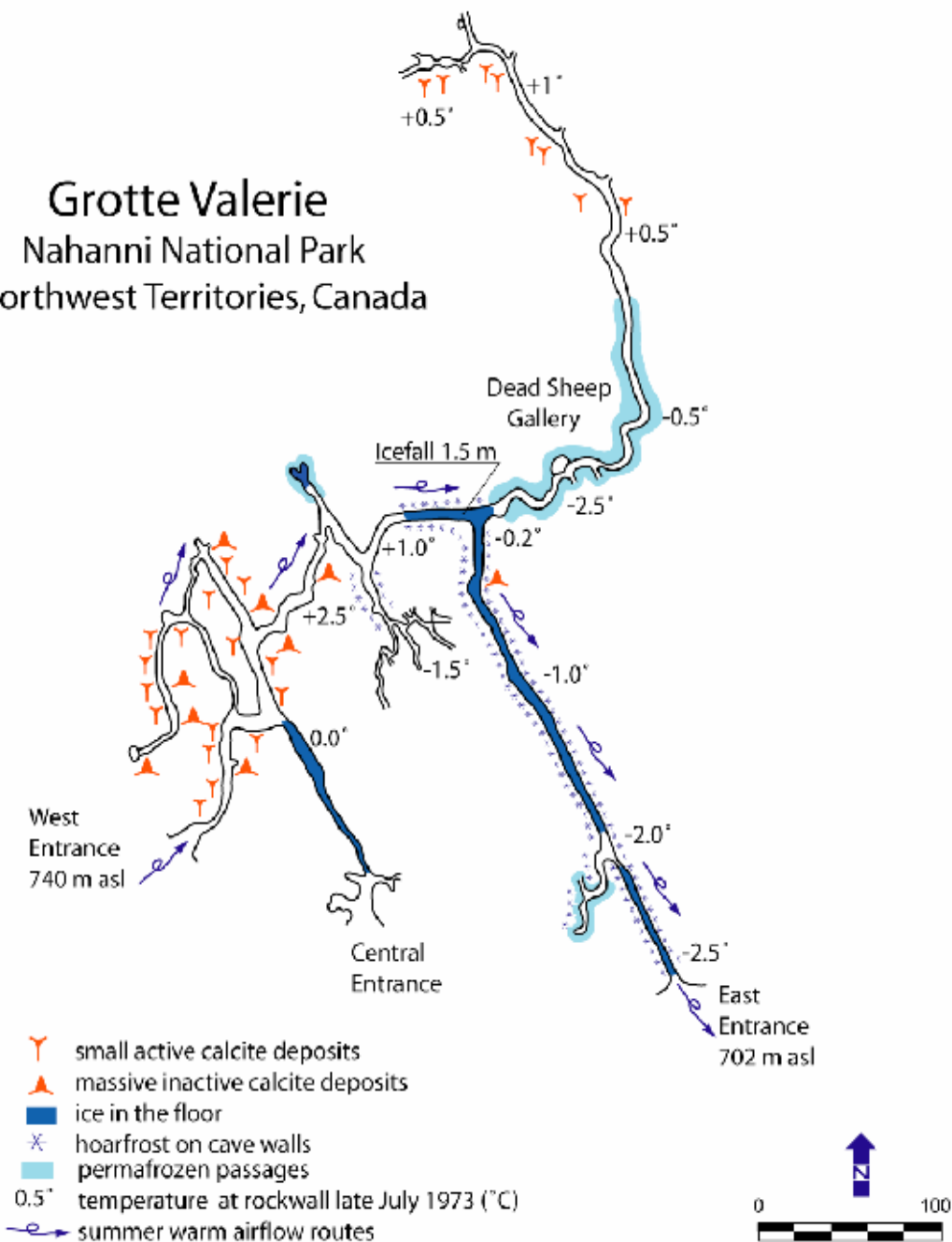


- small active calcite deposits
- massive inactive calcite deposits
- ice in the floor
- hoarfrost on cave walls
- permafrozen passages
- 0.5° temperature at rockwall late July 1973 (°C)
- summer warm airflow routes



# Grotte Valerie

Nahanni National Park  
Northwest Territories, Canada

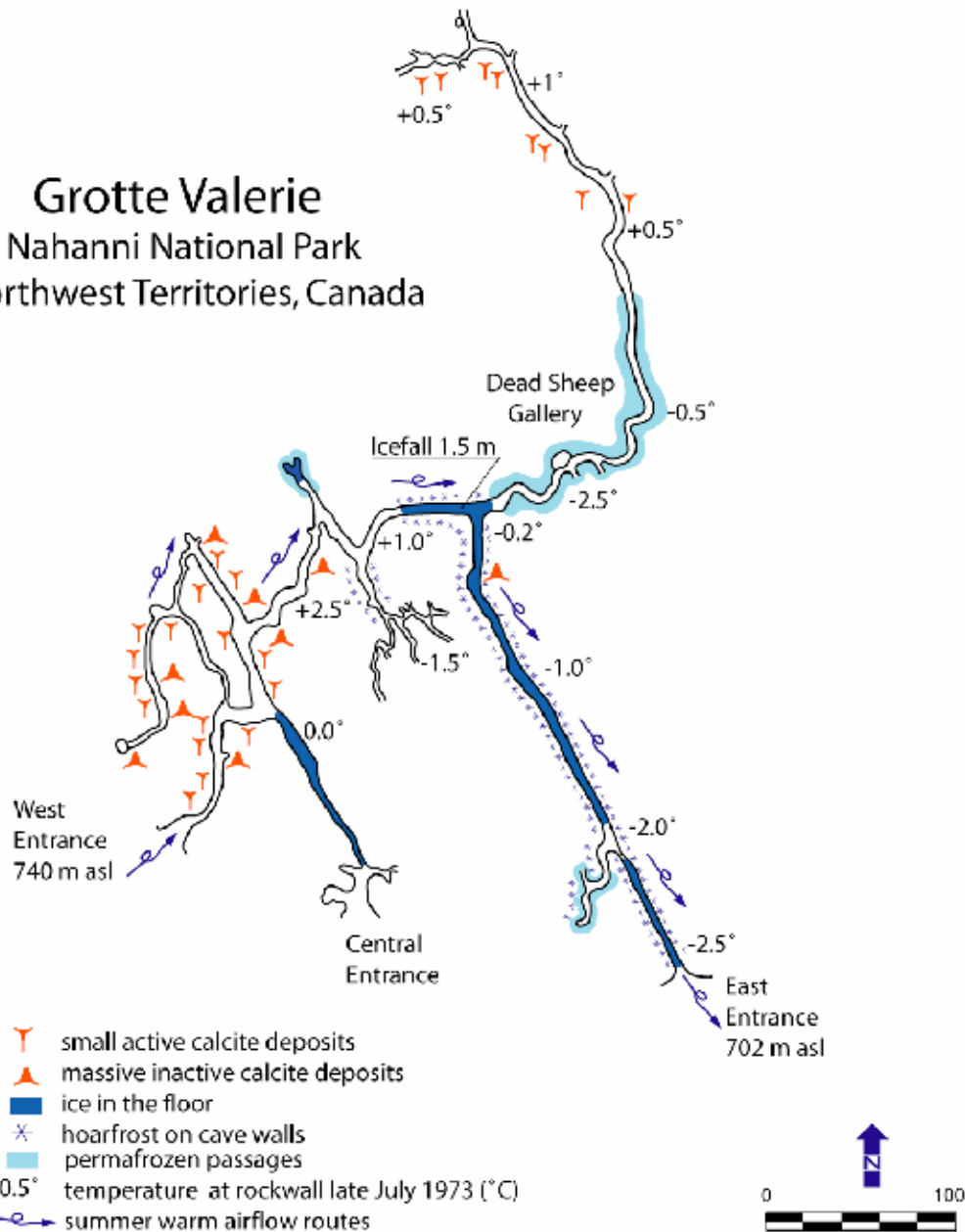




# Grotte Valerie

Nahanni National Park

Northwest Territories, Canada



## Edge of the Ice Fall



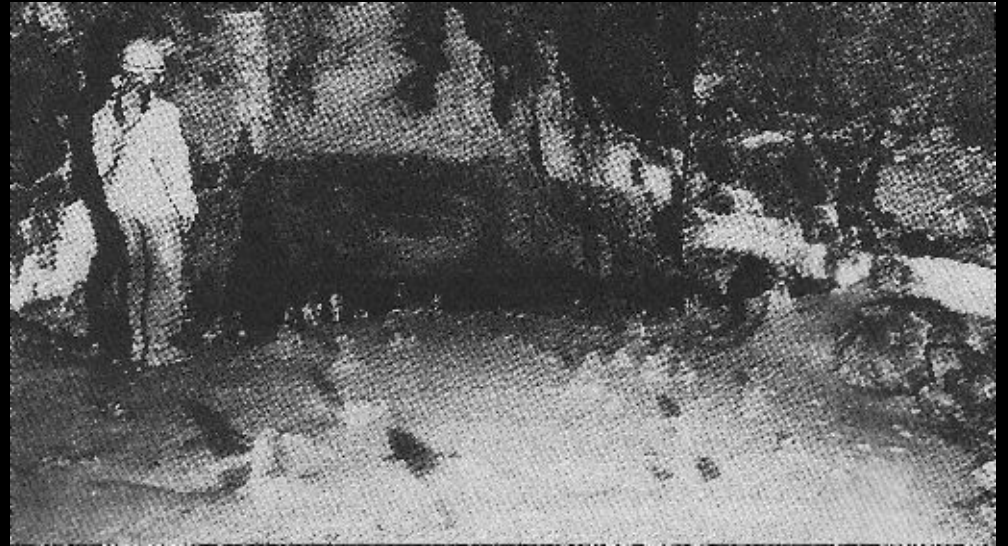


Late July , 2006



Late July , 2006

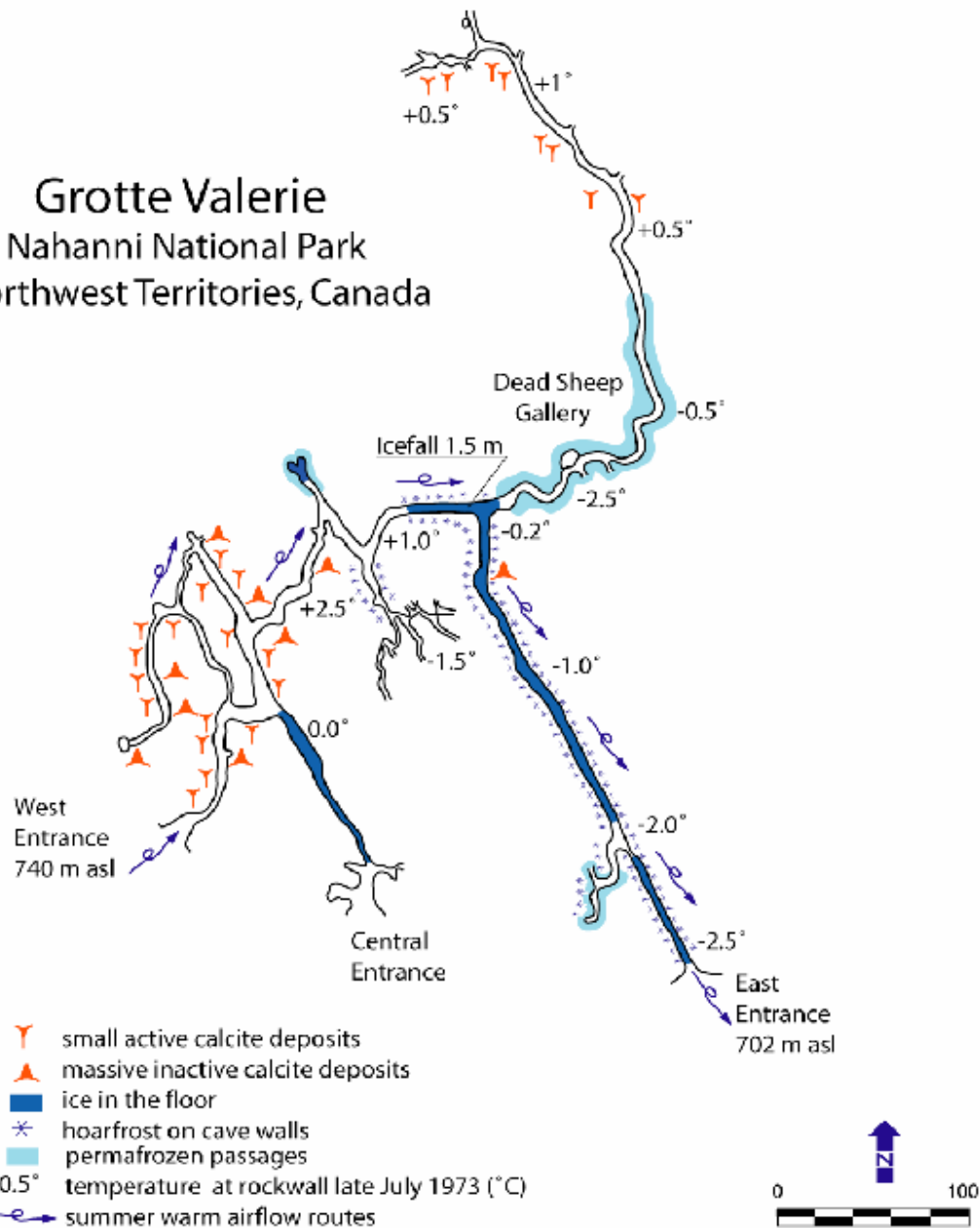
Late July, 1973





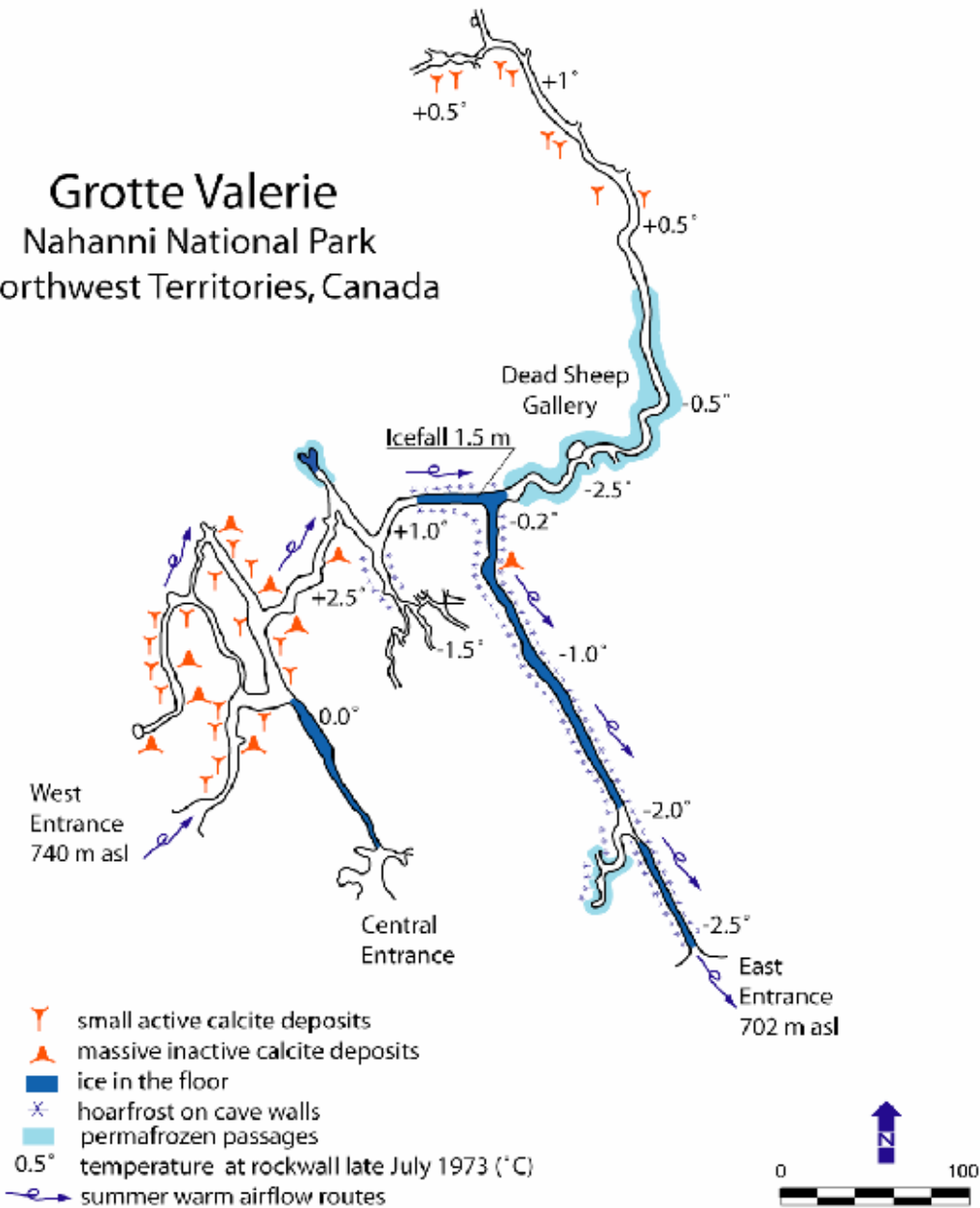
# Grotte Valerie

Nahanni National Park  
Northwest Territories, Canada



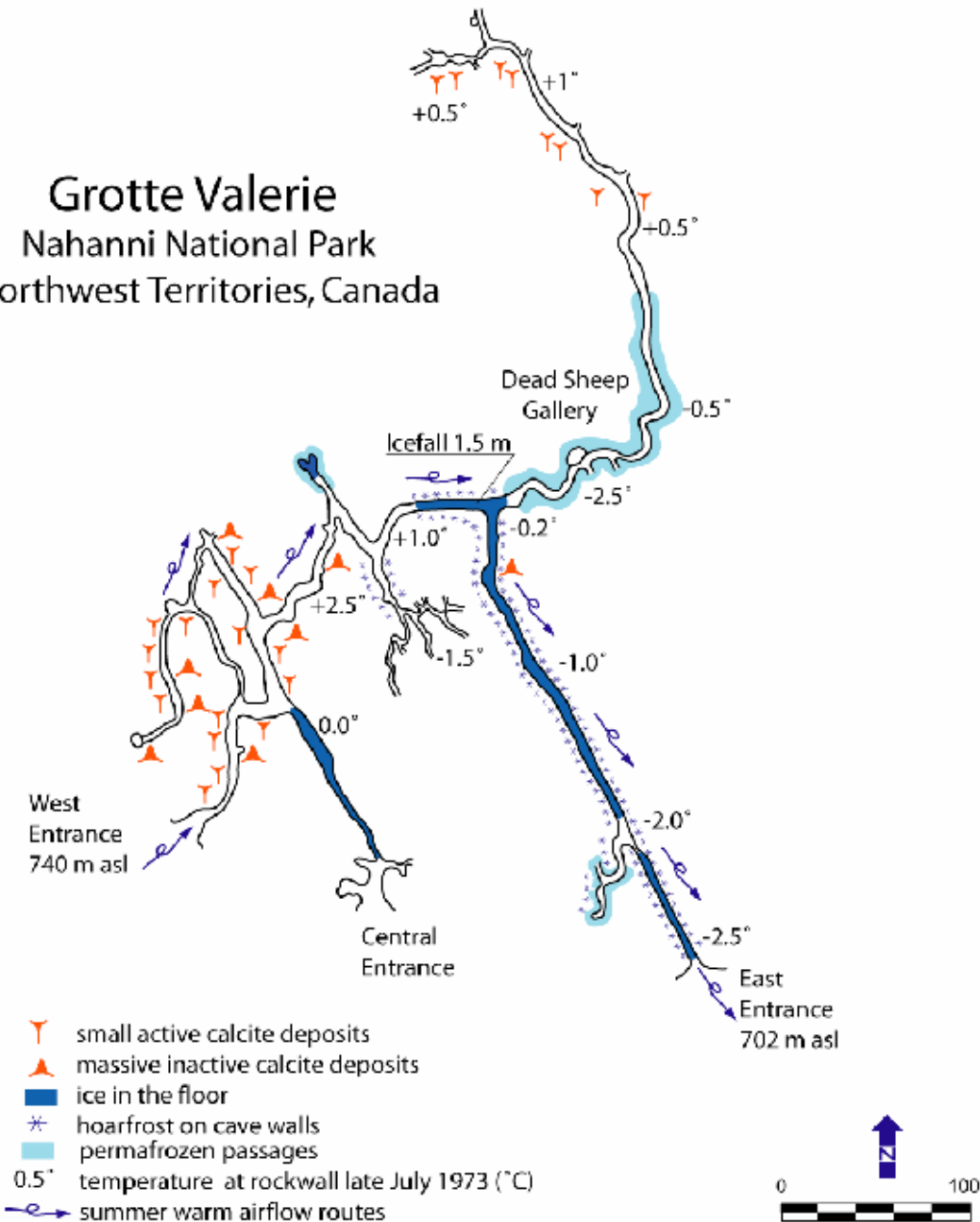
# Grotte Valerie

Nahanni National Park  
Northwest Territories, Canada



# Grotte Valerie

Nahanni National Park  
Northwest Territories, Canada



Is condensation corrosion taking place in this cold climate cave?

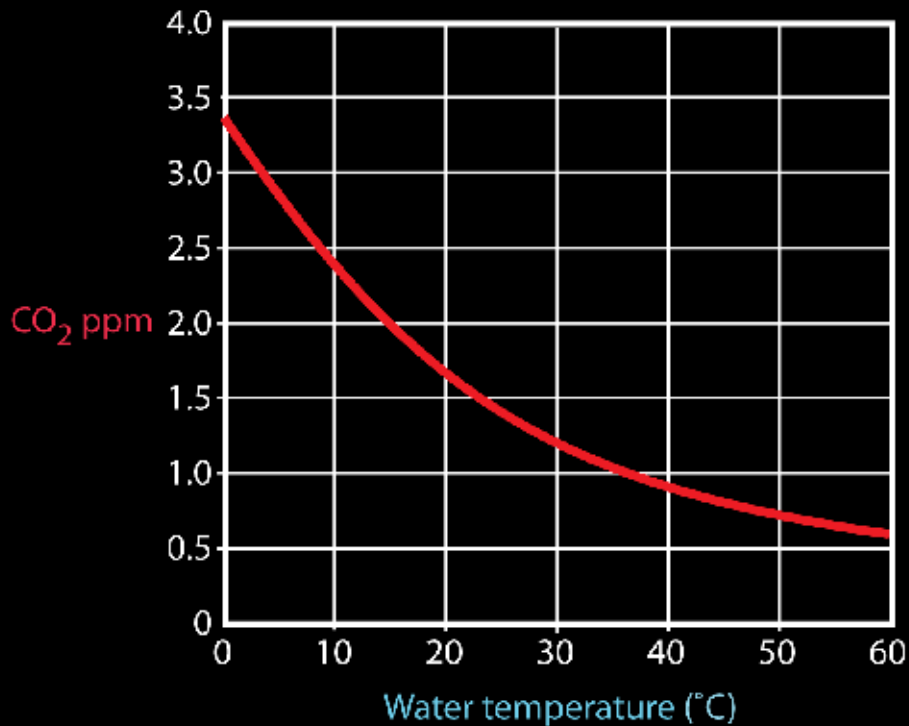
The modest evidence available indicates that it is.

Next step - additional evidence from experiment and modeling .

Various groups commenting on Condensation Corrosion - worldwide

- Dublyansky and Dublansky – Caucasus and Crimea
- Wolfgang Dreybolt and his students - Germany
- Derek Ford and Rosemary Tharule - Lips - Neotropics
- Peter Smart and Augusto Auler - Brazil
- De Freitas *et al.* - New Zealand
- Andy Baker *et al.* - UK
- Art Palmer - USA
- Nadja Zupan-Hajna - Slovenia

## Solubility of carbon dioxide in water



Using the modeling program  
Wateq4F

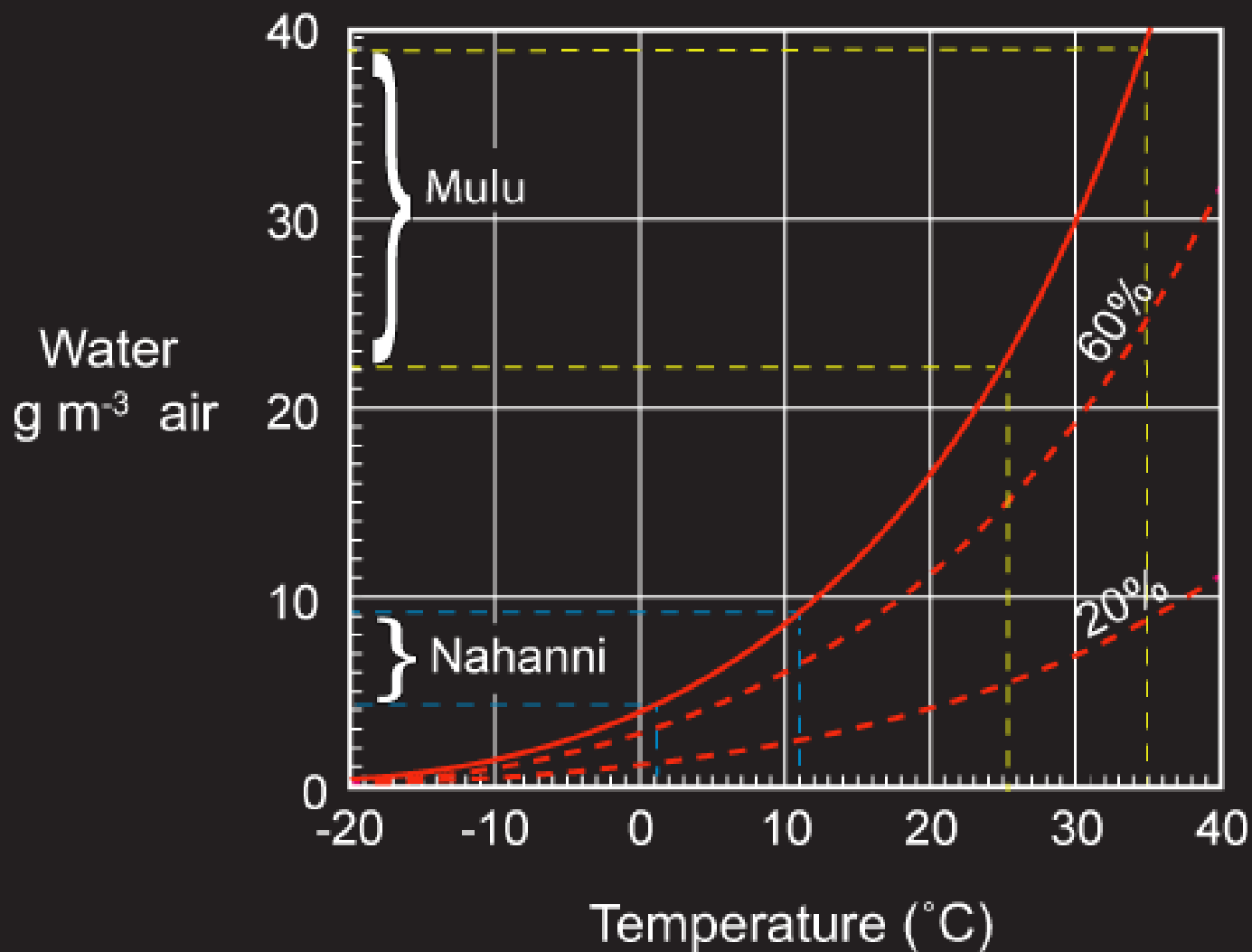
And making the assumption  
That the carbon dioxide  
partial pressure would be  
atmospheric in the Grotte  
Valerie

Water condensing in the  
Grotte Valerie is aggressive to  
limestone and calcite.


The condensed waters will be  
more aggressive if additional  
carbon dioxide and non  
common ions are present in



# Water available in cave atmosphere for condensation



*Condensation*

A photograph showing a close-up of a cave wall. The wall is covered in numerous small, glistening droplets of water, which are the result of condensation. The droplets are most densely packed in a horizontal band across the middle of the frame. The background is a light-colored, textured rock surface, and the foreground is a darker, shadowed area.

Langs Cave, Mulu



Lagang Cave

Stone Horse Cave, Mulu National Park, Sarawak, Malaysia

# *Tablet Experiments*



Mafeking Cave

Jenolan Show  
Caves

Site Specific

Considerably  
greater  
corrosion values  
than  
modeling



# Conclusions

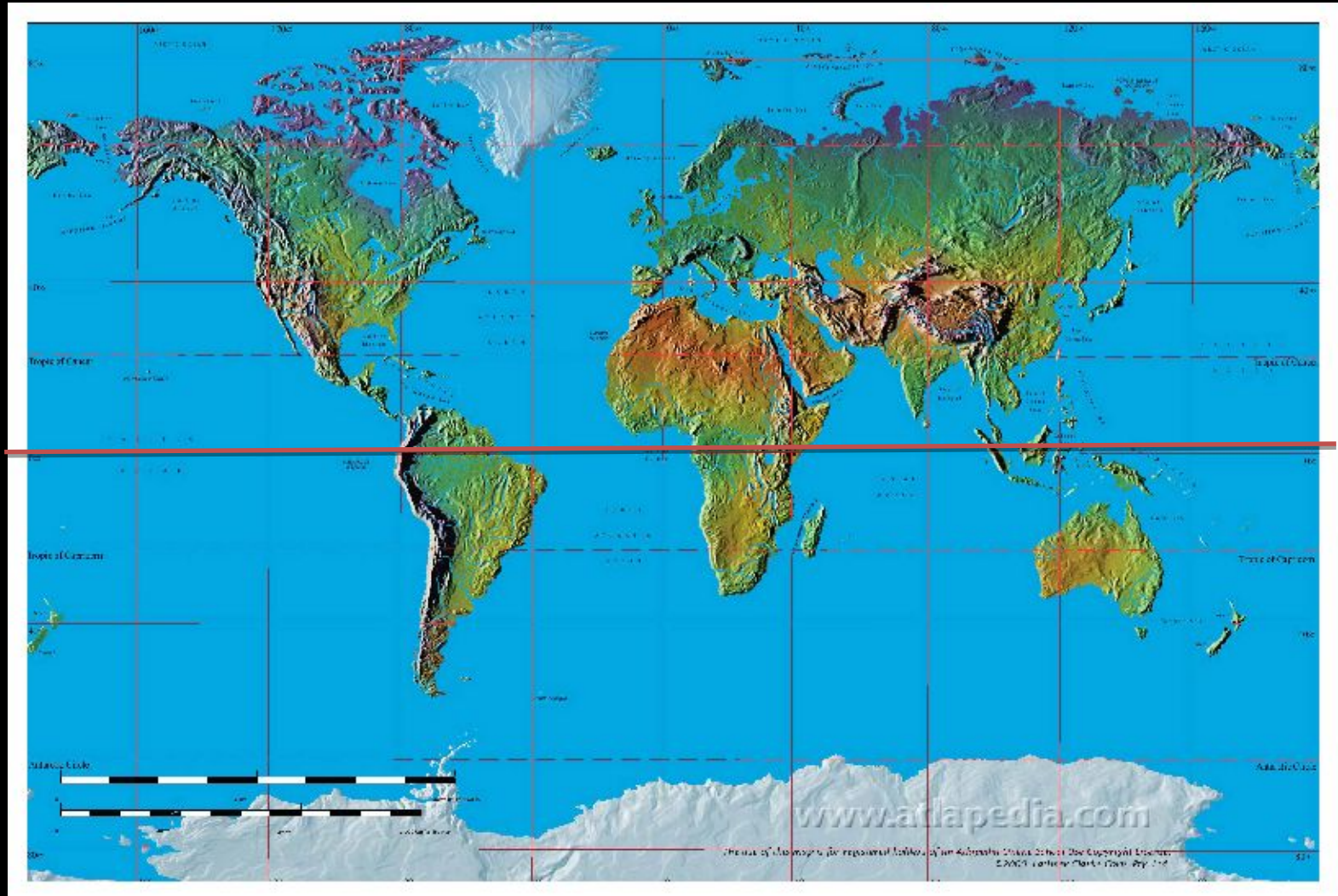
## In the Grotte Valerie

- Condensation corrosion will be seasonal – ie in the short summers.
- The rate of condensation corrosion will be extremely slow and vary.
- Condensation corrosion will be episodic and may have stopped in the past all together

## In general

- For corrosion to occur condensation must be present as water
- This puts in doubt that it occurs at all altitudes and latitudes
- Probably the only way to prove these conclusions is by experiment

# *There is no equivalent to the Northern karsts in the Southern Hemisphere*



# Australia's moved to the Northern Hemisphere!!!!

