

# Northern/alpine karst systems and Neanderthals migration: Paleoclimate during the onset of the last glacial period

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The bulk of skeletal remains that exhibit Neanderthal features are endemic to Europe and date from ca 300 ka to 28 ka, encompassing several climatic cycles (Zachos et al, 2001; Millard, 2008)

Neanderthal  
(apolo-aux-Saints)

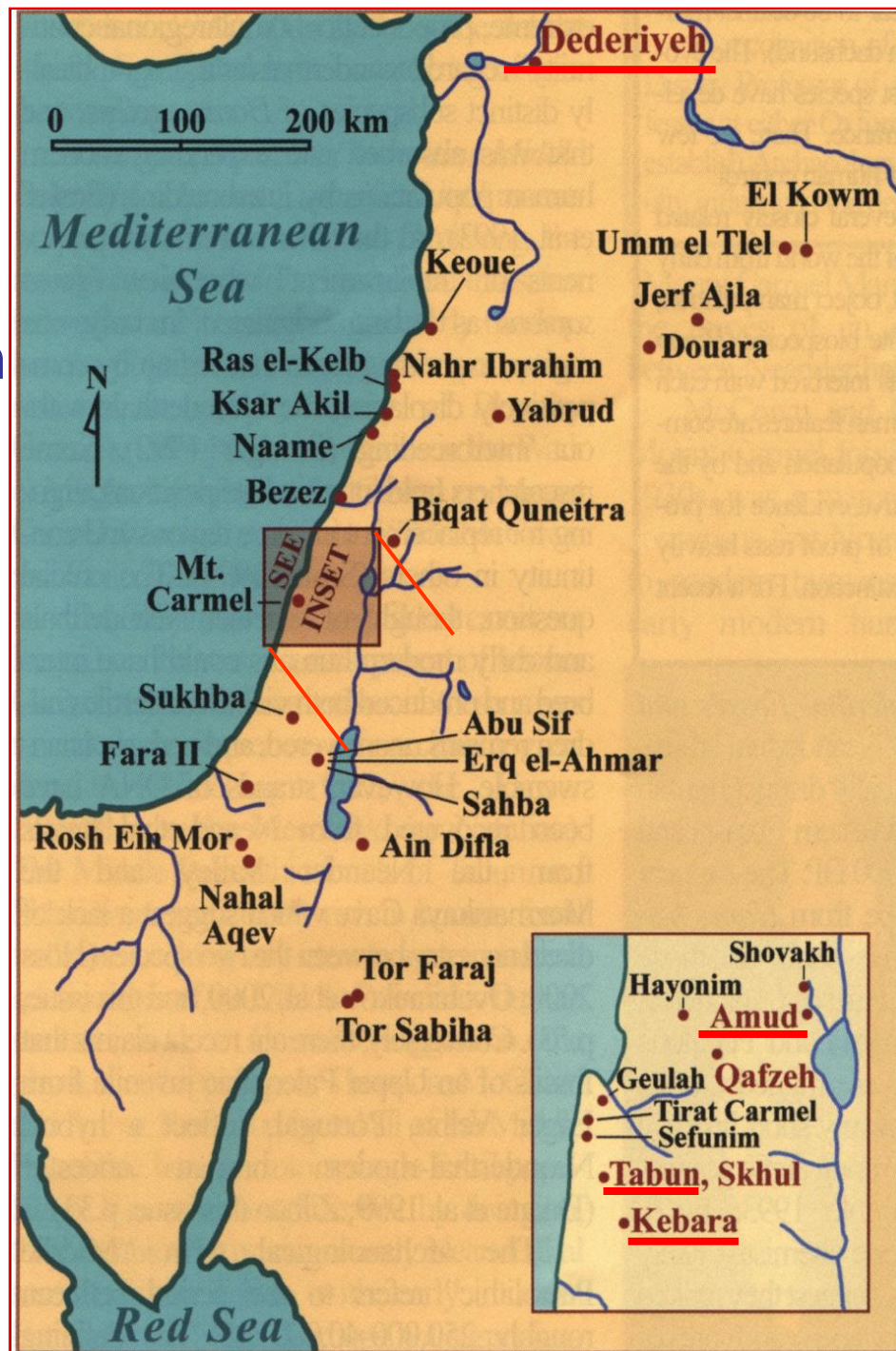


They are considered to be anatomically adapted to cold conditions, but they also penetrated the warm Levant, where they occupied caves in Syria and northern Israel.

Israel is the southernmost occurrence of skeletal remains of these hominins.



Neanderthal remains



Typical caves with Neanderthal remains in Israel:  
10-30 m large, semi-open chambers in a cliff face, at low altitudes.

Tabun



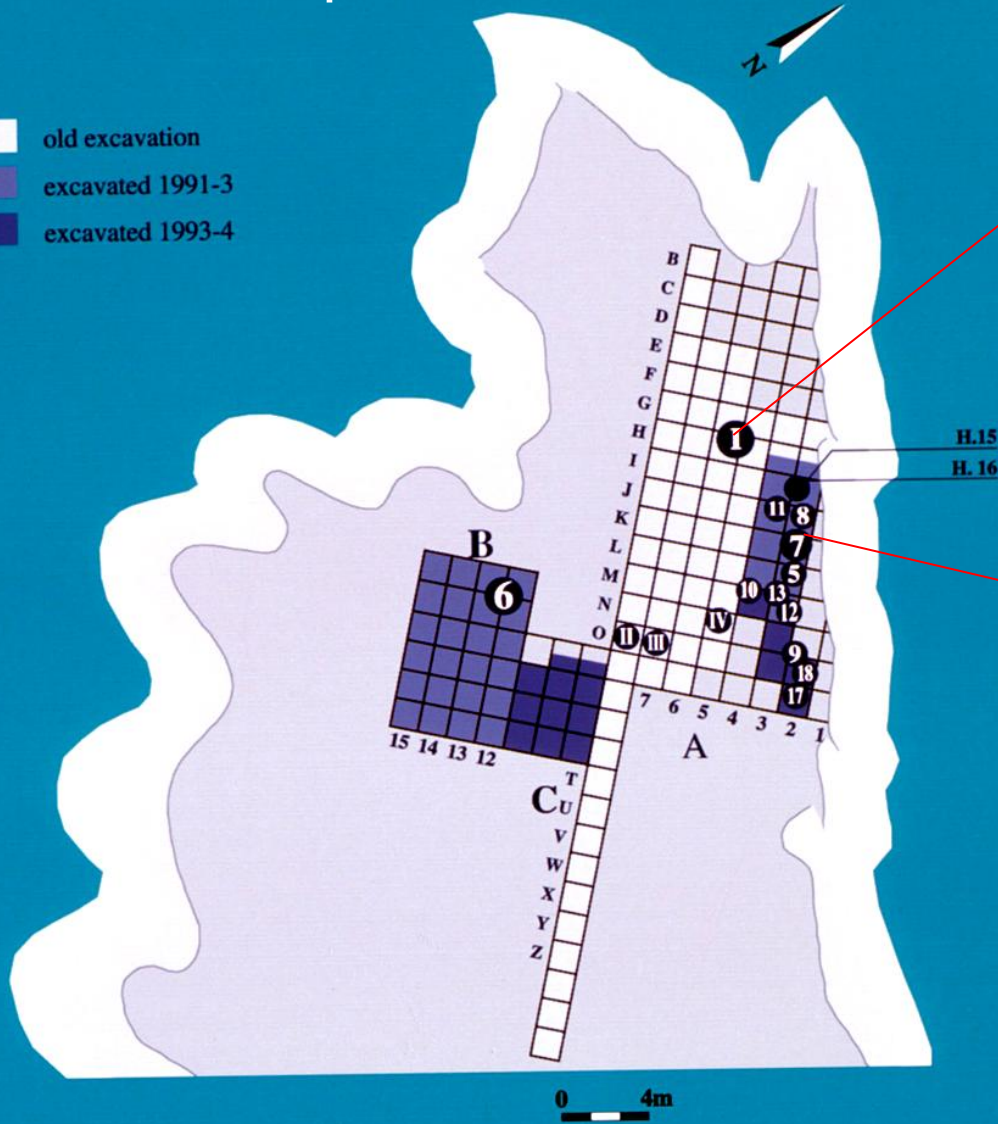
Amud



# Why did this northern hominid migrate to the warm Levant?

## Amud Cave plan

- old excavation
- excavated 1991-3
- excavated 1993-4



Adult skull



Infant skeleton

Neanderthals remains from Amud Cave, Israel.

After: Hovers; Suzuki and Takai

# Most Neanderthal remains in the Levant are dated (by TL /ESR) to 70-55 ka (MIS 4 and early MIS 3)

Example of Amud Cave excavations and dates (A. Hovers)



Several other types of hominids passed and settled the Levant, which serves as a bridge between continents.

Neanderthals (N) Migrated from Europe to the Levant only once, during the transition from late MIS 5 to early MIS 4.

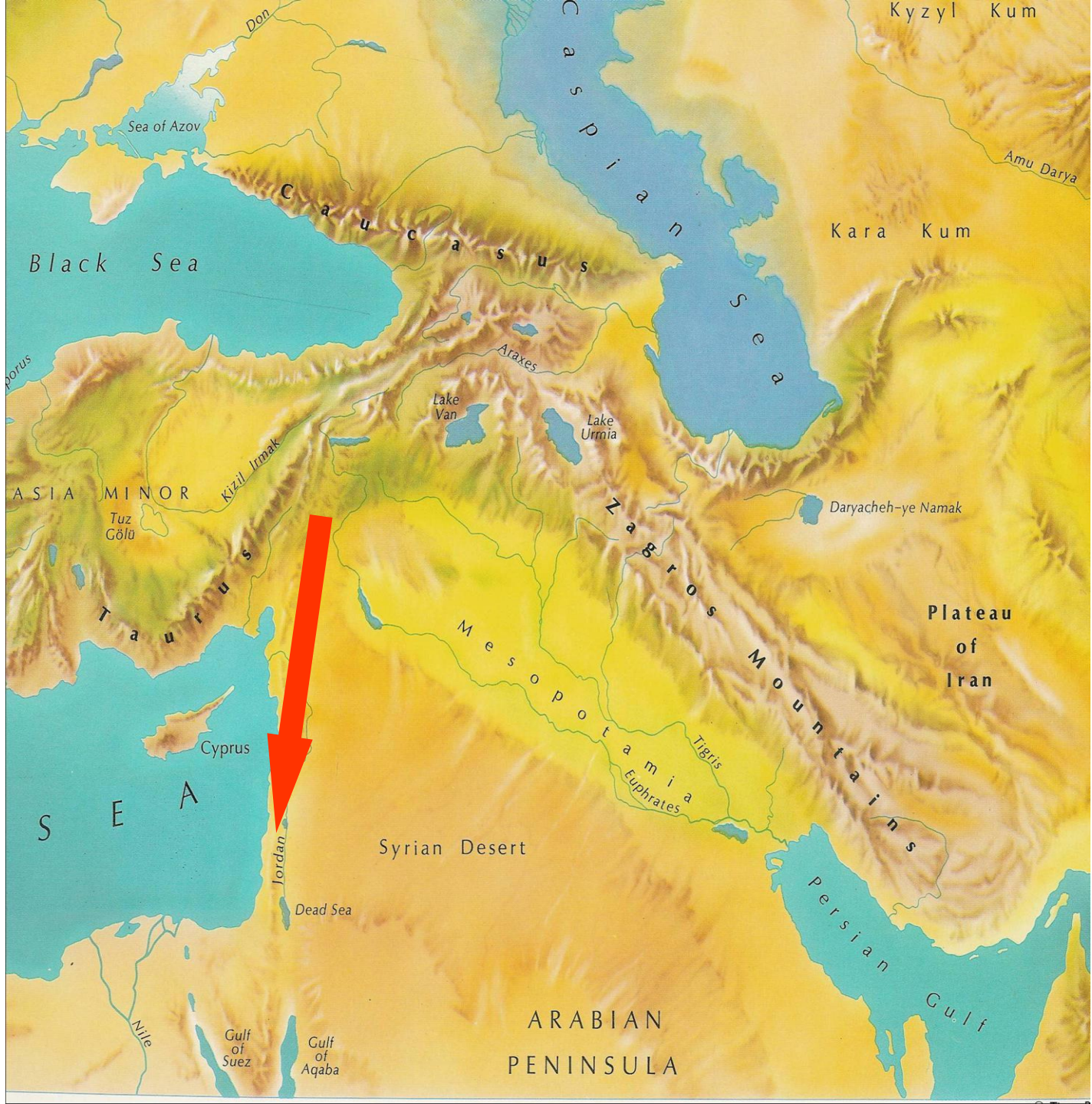
| Marine Isotope Stage | Ka B.P. | ENTITIES                           | HOMININS   | Combined TL and ESR chronology                             | Africa | Sahara     | Levant  | Taurus-Zagros | Europe        |
|----------------------|---------|------------------------------------|--|--|--------|------------|---|---------------|---------------|
| 3                    | 38/36   | Early Ahmarian Emiran              | <i>"Egbert"</i><br><i>Ksar Akil</i>                              | Upper Paleolithic  |        | warm arid  | cool wet  |               |               |
|                      | 46/47   |                                    |  |  |        |            |   |               |               |
| 4                    | 50      | "Tabun B-type"                     | <i>Dederiyeh</i><br><i>Amud Kebara</i><br><i>Tabun Woman</i>   N | Dederiyeh ?<br>Tor Faraj Amud Kebara<br>Tor Sabiha Tabun B |        | warm arid  | cool wet<br>N                                   | cold wet      | cold wet      |
|                      |         |                                    |  |  |        |            |   |               |               |
| 5                    | 100     | "Tabun C-type"                     | <i>Qafzeh</i><br><i>Skhul</i>   Hs<br><i>Tabun II (jaw)</i>      | Skhul<br>Tabun C   |        | warm moist | warm dry<br>Hs                                  | cool wet      | N<br>cool wet |
|                      |         |                                    |  |  |        |            |   |               |               |
| 6                    | 150     | "Tabun D-type"                     |  | Douara IV?<br>Tabun D                                      | Hs     | warm wet   | warm moist<br>warm arid                         |               | N             |
|                      |         |                                    |  |  |        |            |   |               |               |
| 7                    | 200     | Hummalian                          |  | Rosh Ein Mor<br>Yabrud I (1-10)                            | Hs     |            | Hayonim E upper<br>Hayonim E lower<br>Hayonim F |               | N             |
|                      |         |                                    |  |  |        |            |   |               |               |
| 8                    | 250     | Acheulo-Yabrudian                  | <i>fragments in Tabun E</i><br><i>Zuttiyeh</i>                   | Qesem Cave<br>Tabun E                                      |        |            | Hayonim G                                       |               |               |
|                      |         |                                    |  |  |        |            |   |               |               |
| 9                    | 300     | In the northern and central Levant |  | Tabun F  |        |            | Upper Acheulian in the Southern Levant          |               |               |
|                      |         |                                    |  |  |        |            |   |               |               |
| 10                   | 350     | Upper or Late Acheulian            |  |  |        |            |   |               |               |



Summary of prehistoric data from the Levant (Frumkin et al., 2011)

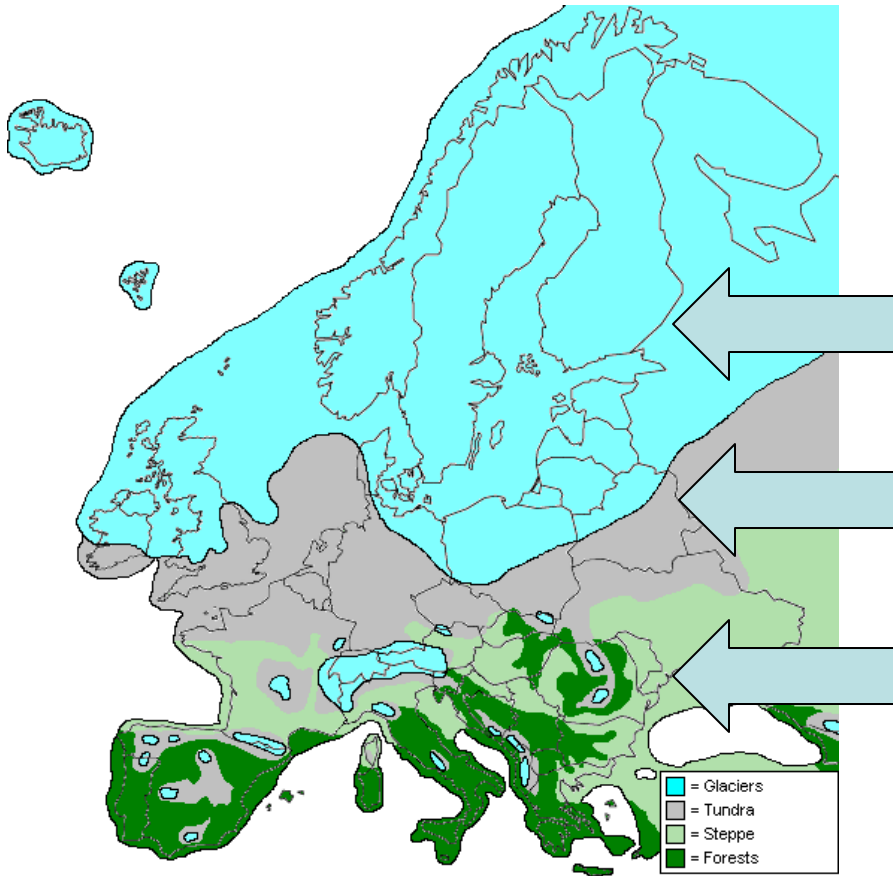
## Research questions:

- Is Neanderthal migration related to climate?
- If so, what climate conditions promoted their southward migration?
- What conditions did they encounter when they crossed on-route mountain chains?



# Ice Age Europe was associated with southward migration of bio-climatic belts

www.geocities.com/regenheim/europeiceage.gif

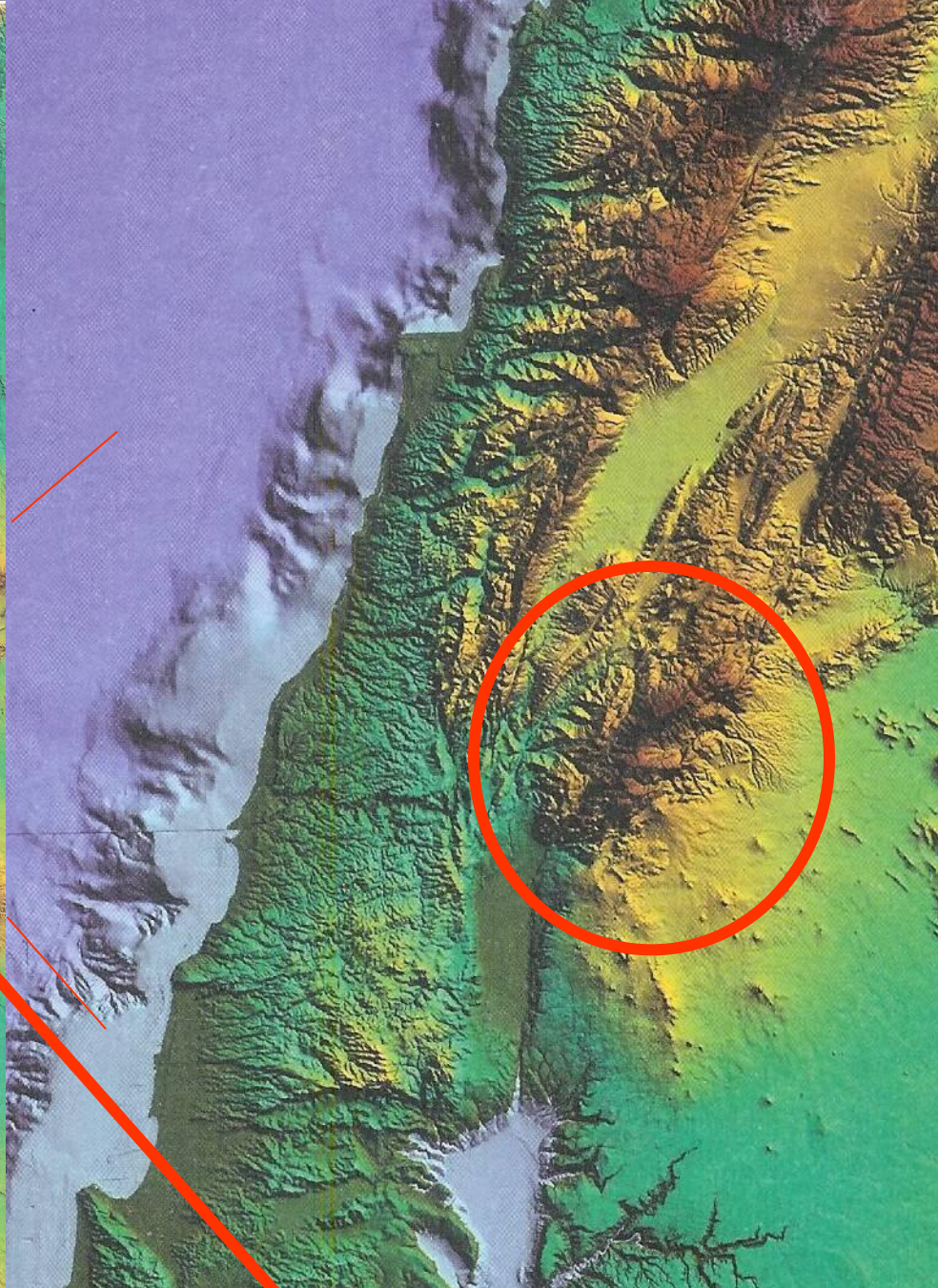
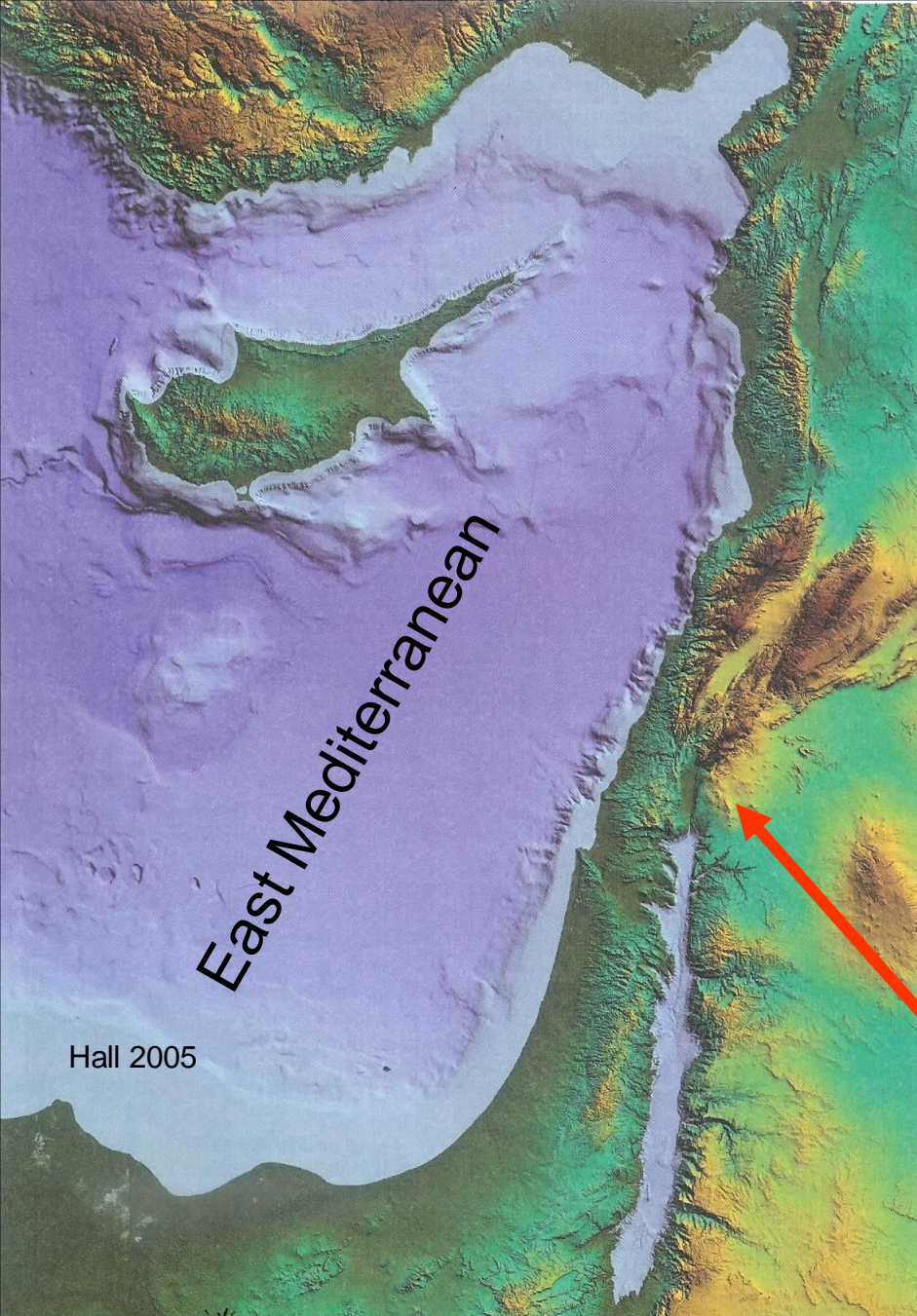


Thick ice sheets in north

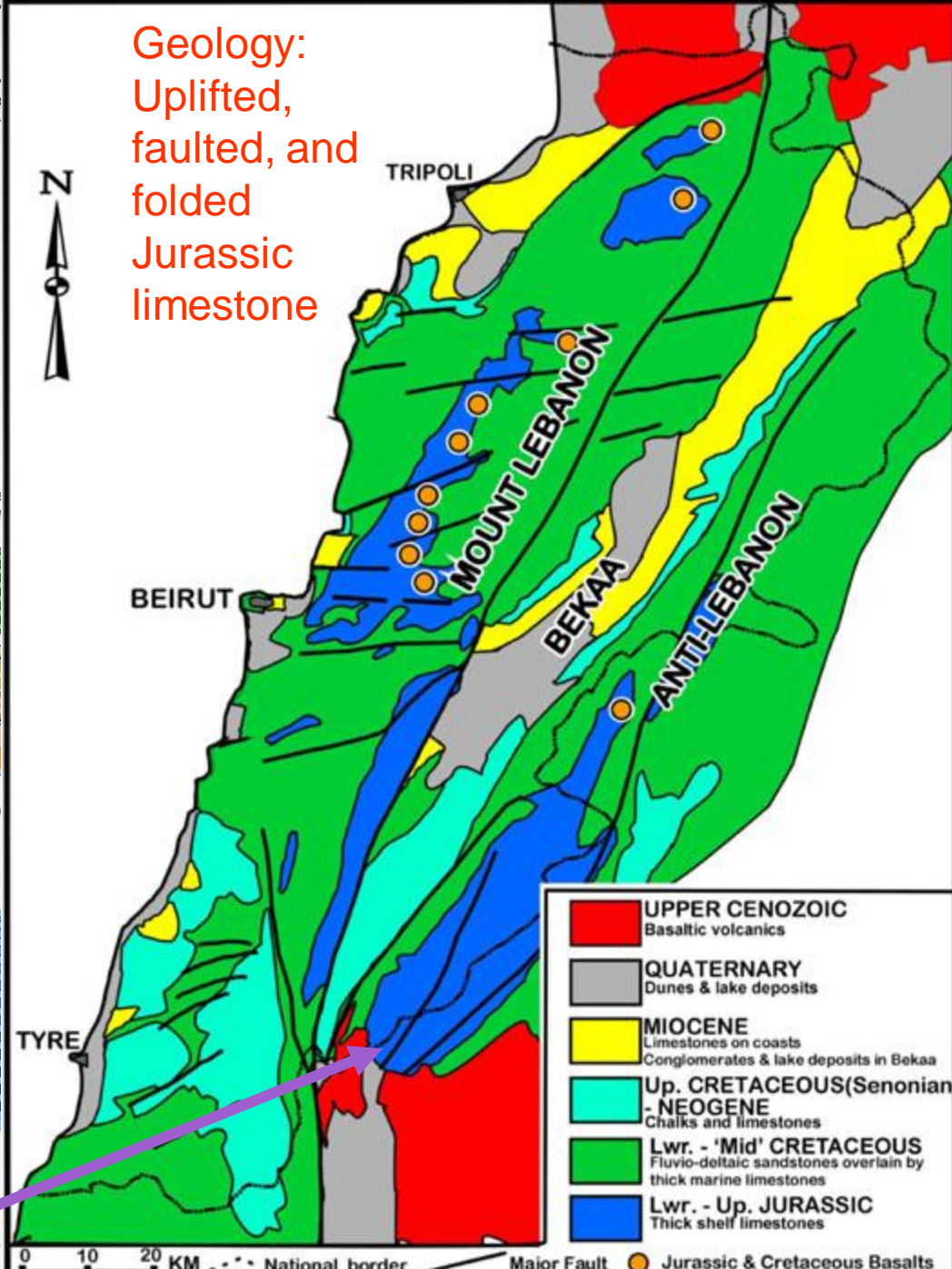
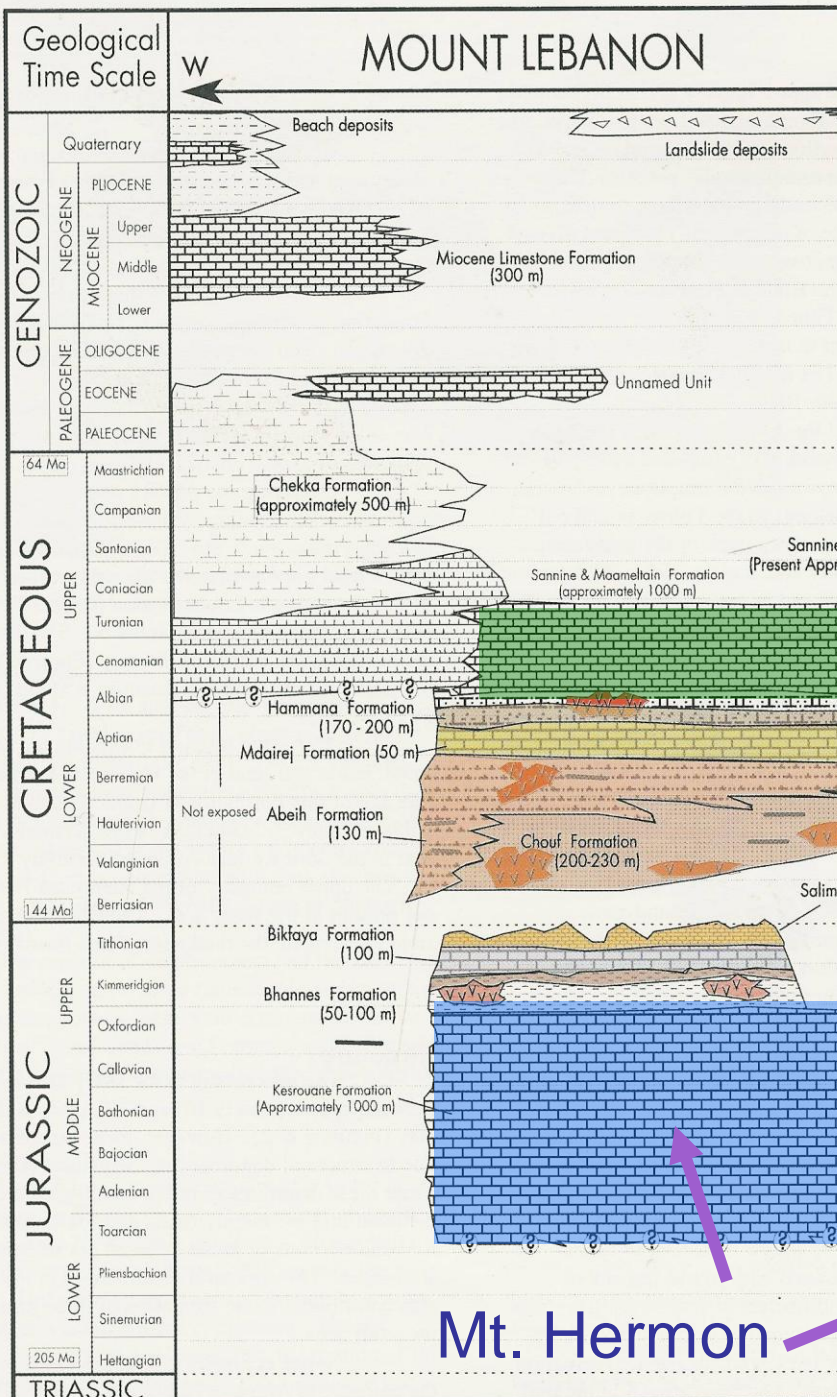
Frozen tundra in centre

Conifer forests in south

We explore the southernmost limit of cold conditions (e.g. year-round snow cover) in the Levant during the last glacial period



We use the southernmost high ridge in the Levant: Mt. Hermon, 2814 m asl



Present conditions

# Mt. Hermon in winter: few m of snow



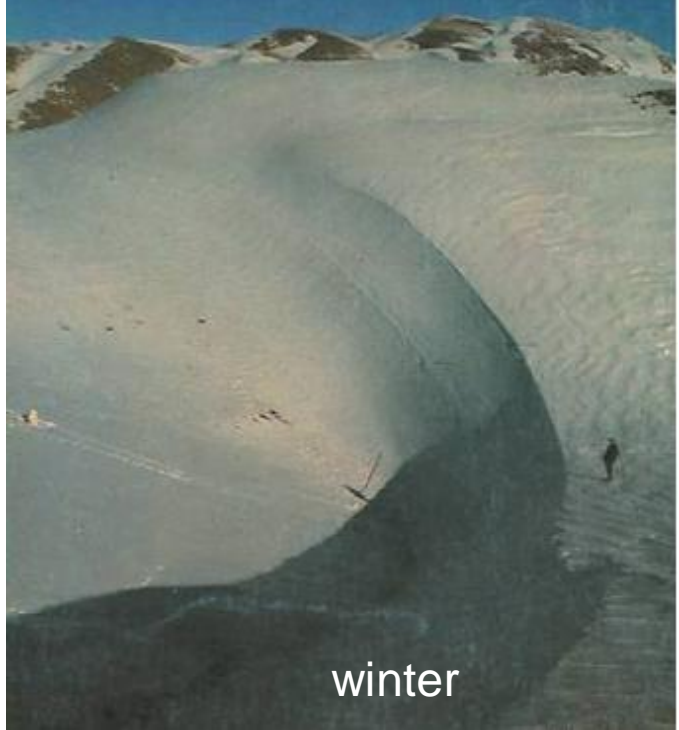
Short spring, snow melts rapidly



Dry long summer, no snow remains



Extensive doline-karst system



winter



spring

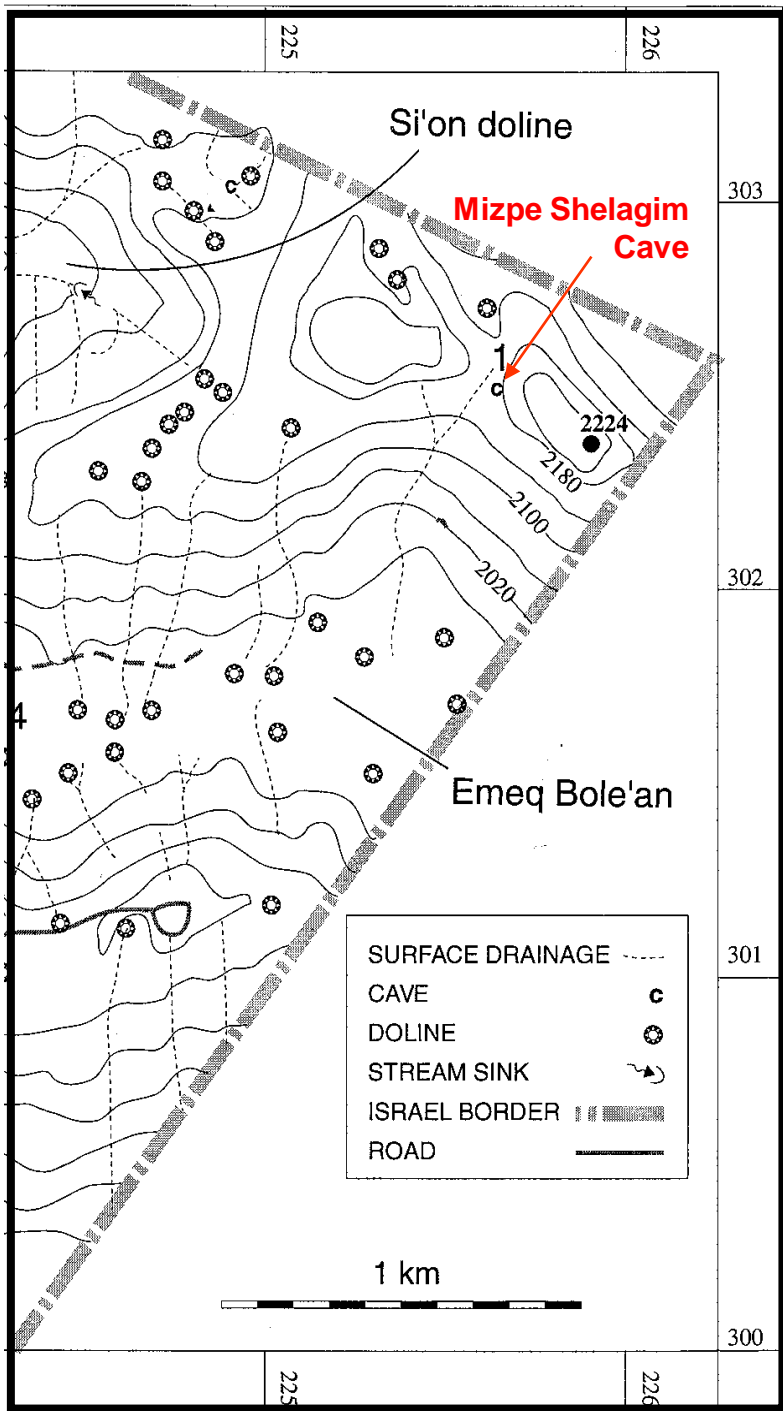


summer



Winter snow accumulation in a Mt. Hermon doline may exceed 10 m due to wind, supporting short spring blooming





Surface topography: tectonic ridges with doline fields

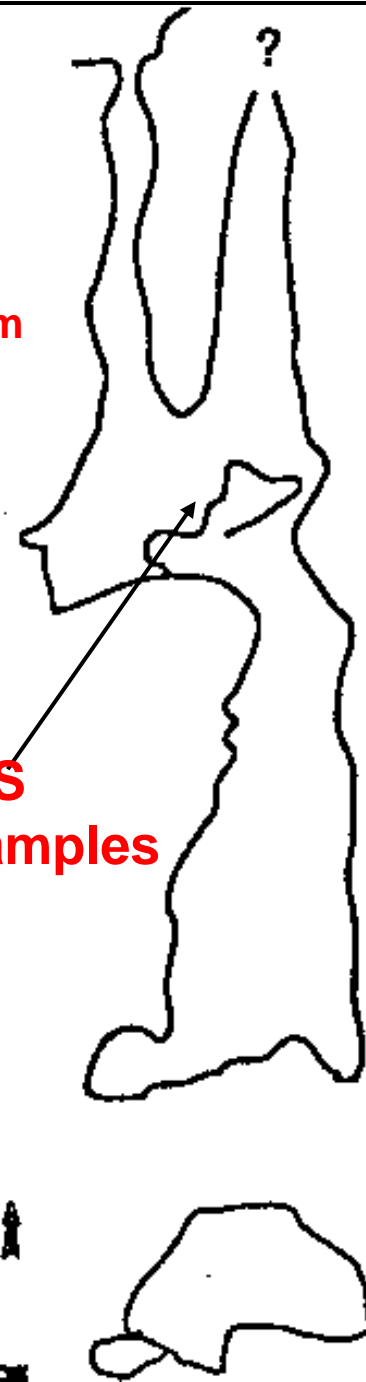
profile

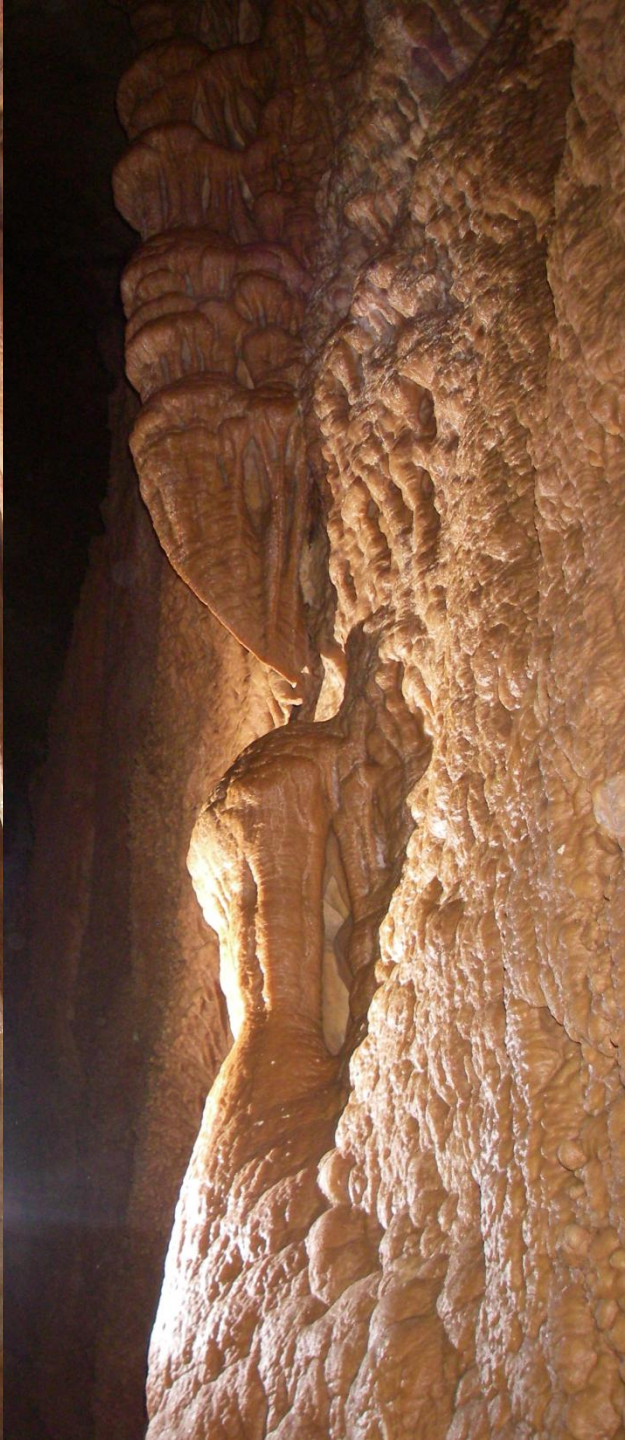
Mizpe Shelagim Cave

MS samples

plan

10 m





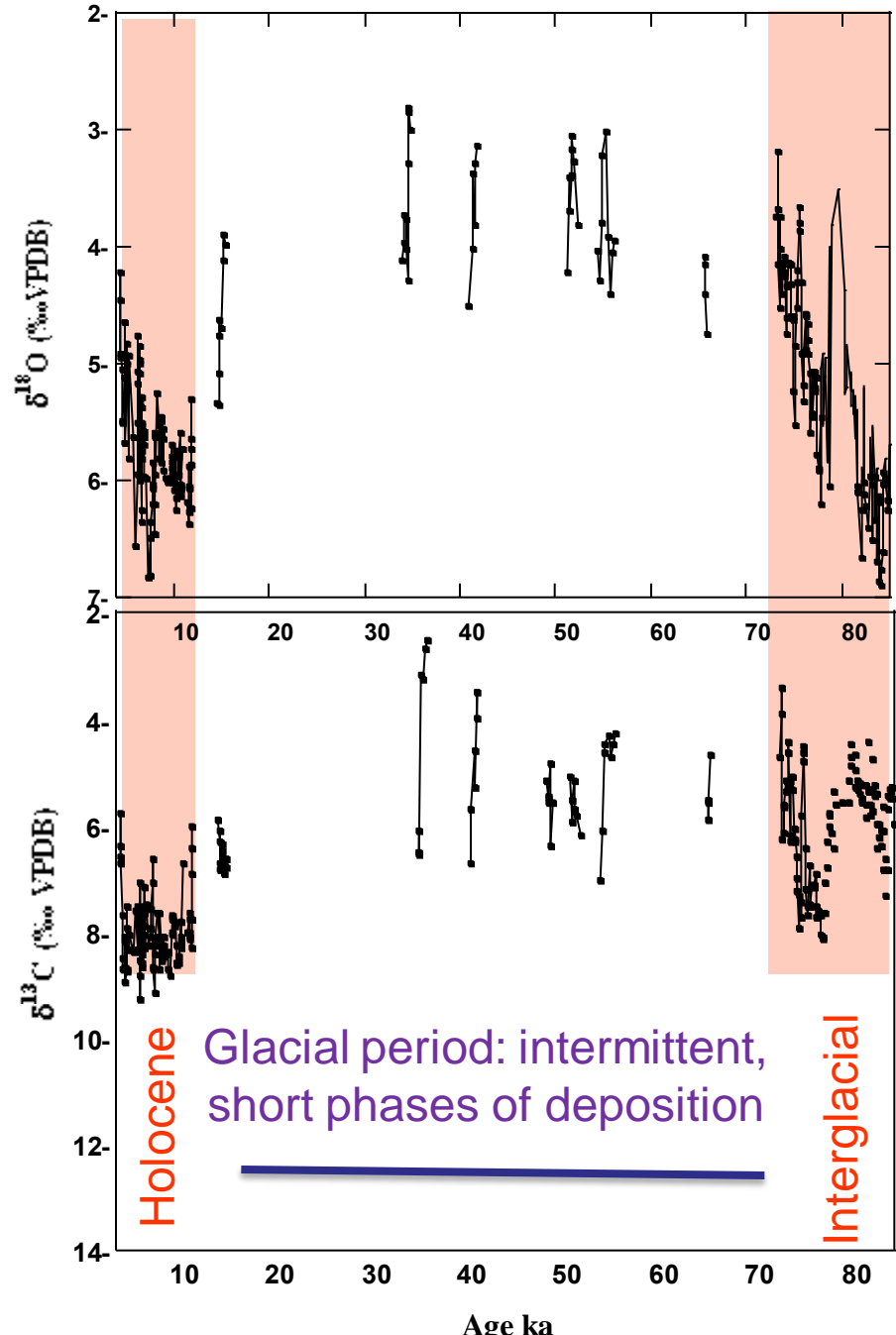
Mizpe Shelagim Cave



No ice damage or permafrost morphology is observed in the cave or on the surface.



MIS: 1 2 3 4 5



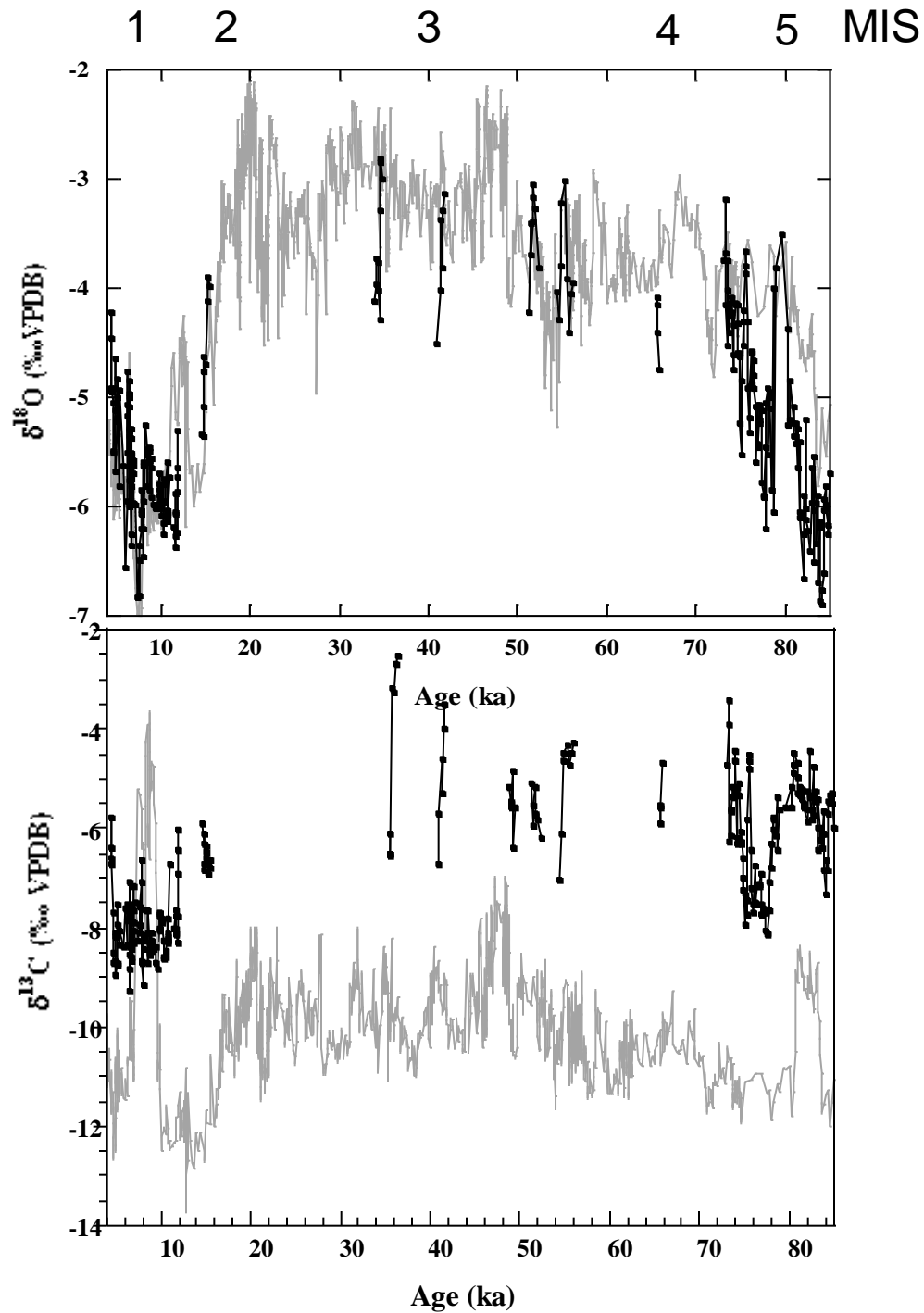
U/Th dates of Mizpe Shelagim speleothems show that most deposition occurred during warm periods: interglacials and short interstadials



Comparison between isotopic records of MS (high mountain, black) and Soreq (low hills, gray) :

MS carbon is heavier, associated with less vegetation.

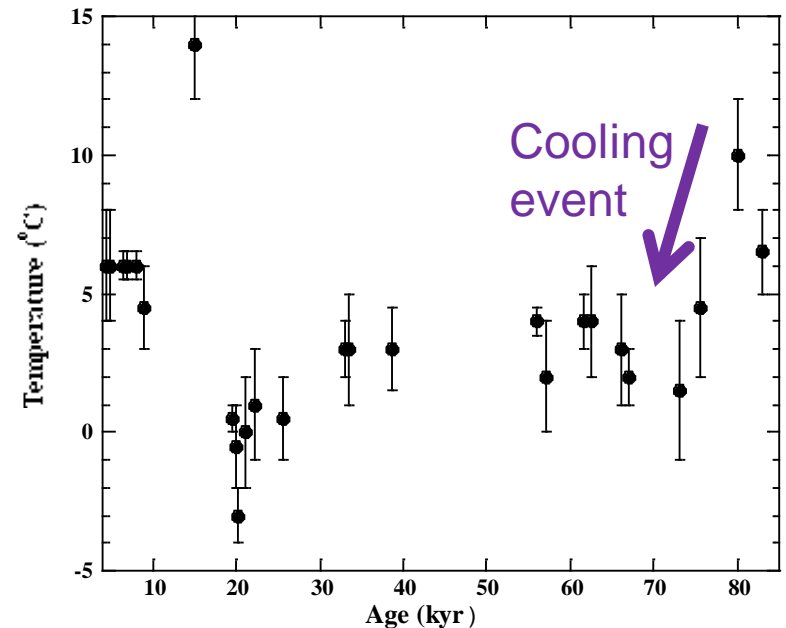
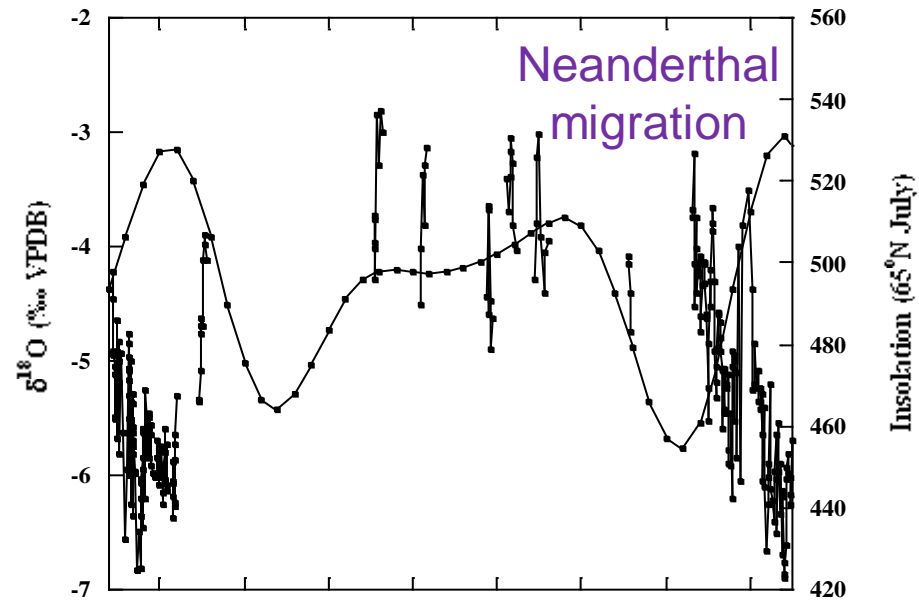
Why did speleothem deposition stop during most of the last glacial period?

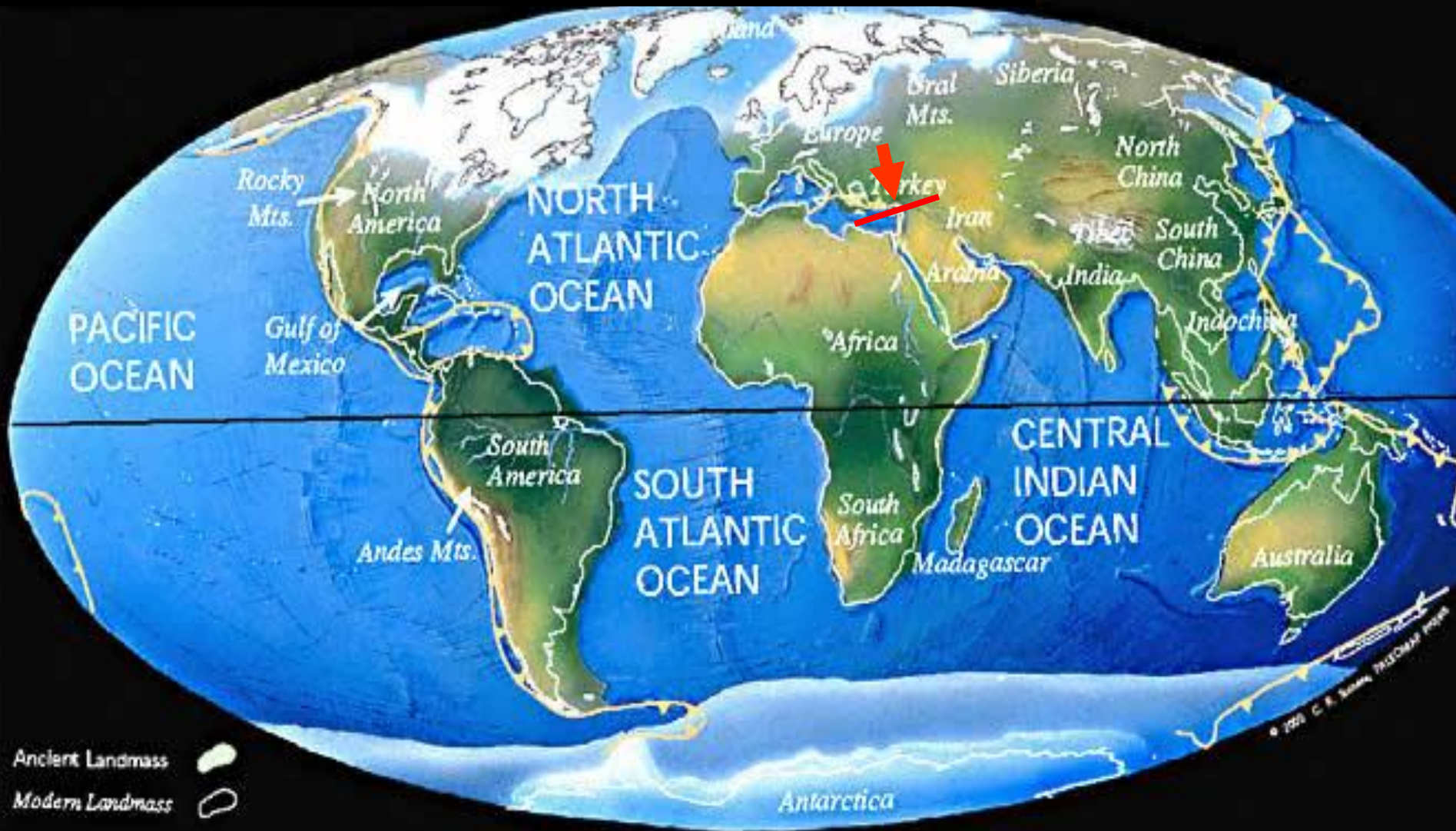


MS Cave  $\delta^{18}\text{O}$   
superimposed on  $65^\circ\text{N}$   
insolation (after Berger  
and Loutre, 1991)

Calculated  
paleotemperatures  
of MS Cave, based on  
fluid inclusions

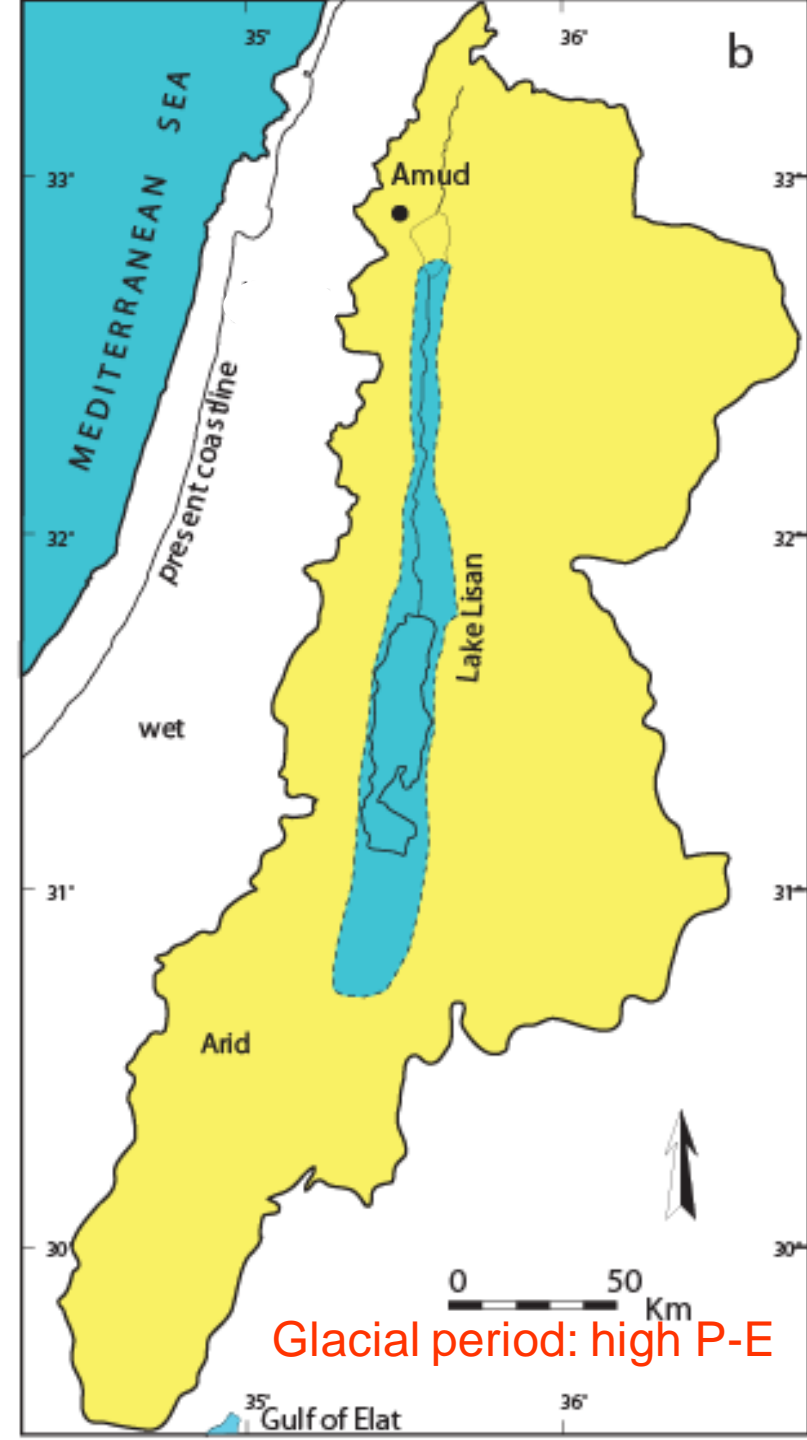
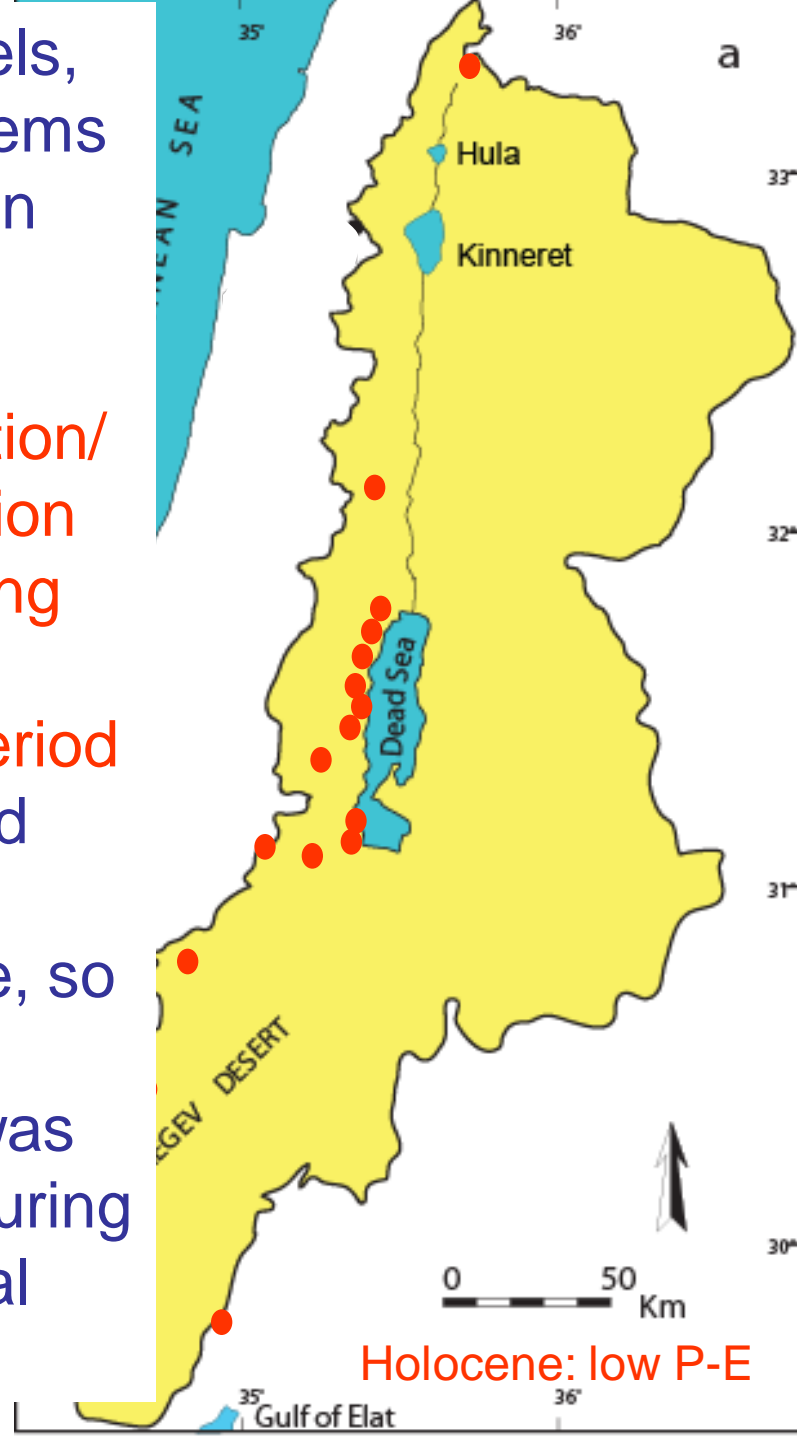
Lower summer T could  
allow snow to remain on  
the ground year-round,  
eliminating plants and  $\text{CO}_2$





Is Neanderthal migration associated with the southward movement of climatic and ecologic belts during the onset of the last glacial period?

Lake levels, speleothems and pollen indicate higher precipitation/evaporation ratio during the last glacial period compared with the Holocene, so the karst system was not dry during the glacial period



# Conclusions

Neanderthals were adapted to cold conditions and endemic to Europe;

They penetrated into the Levant only once, during MIS 5/4 cooling event.

Their southernmost limit was in Israel, where their skeletal remains were found in Amud, Kebara and Tabun caves

The MIS 5/4 cooling event is reflected by several independent proxies in Mt. Hermon MS Cave, suggesting continuous cover of snow ~2200 m asl, without significant ice accumulation.

Neanderthals southward migration could be promoted by the MIS 5/4 cooling event

