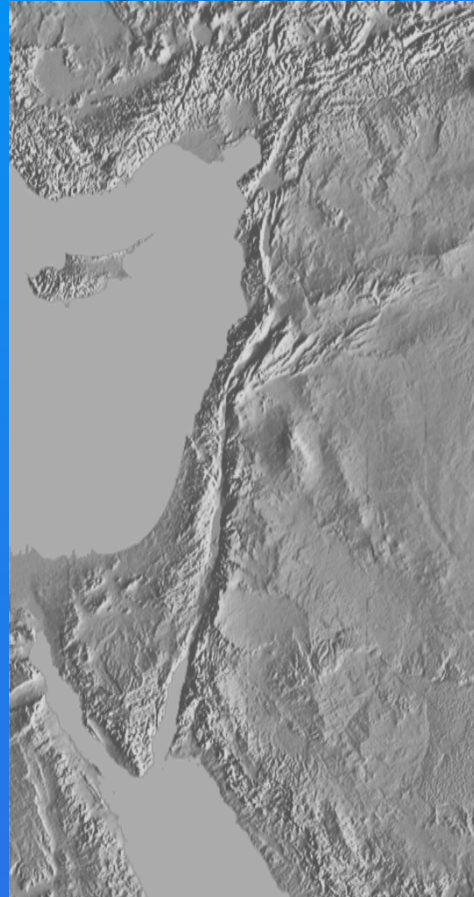
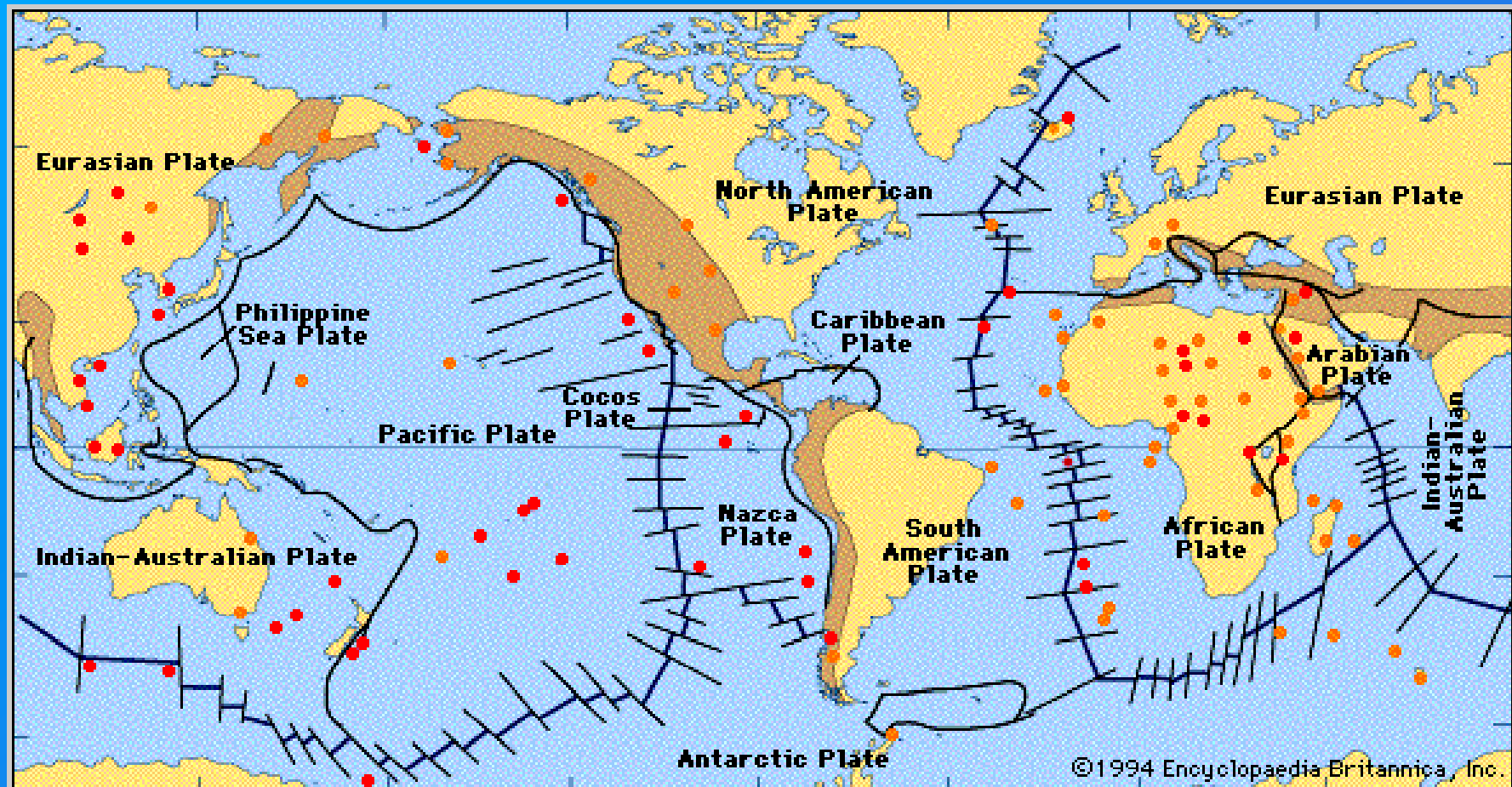


## Dynamics of the Dead Sea fault and its effect on civilization



Zvi Ben-Avraham

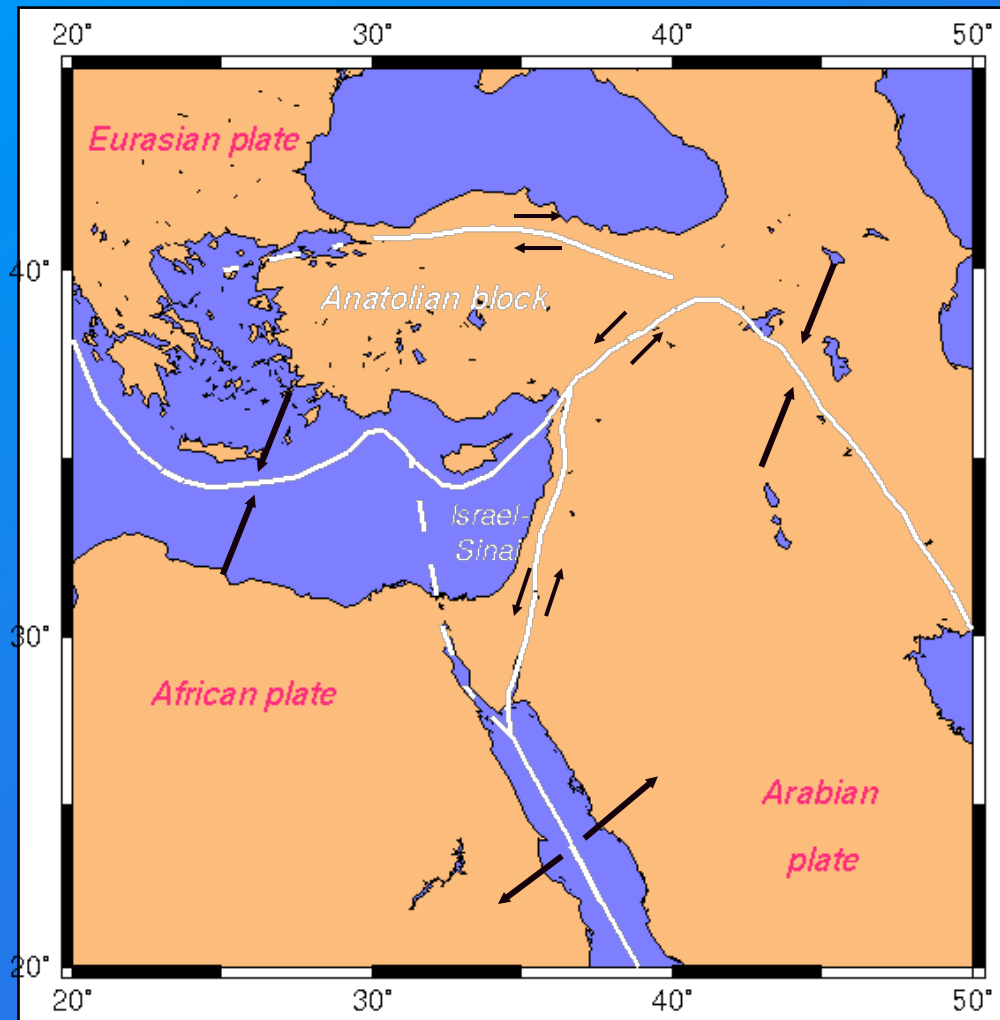


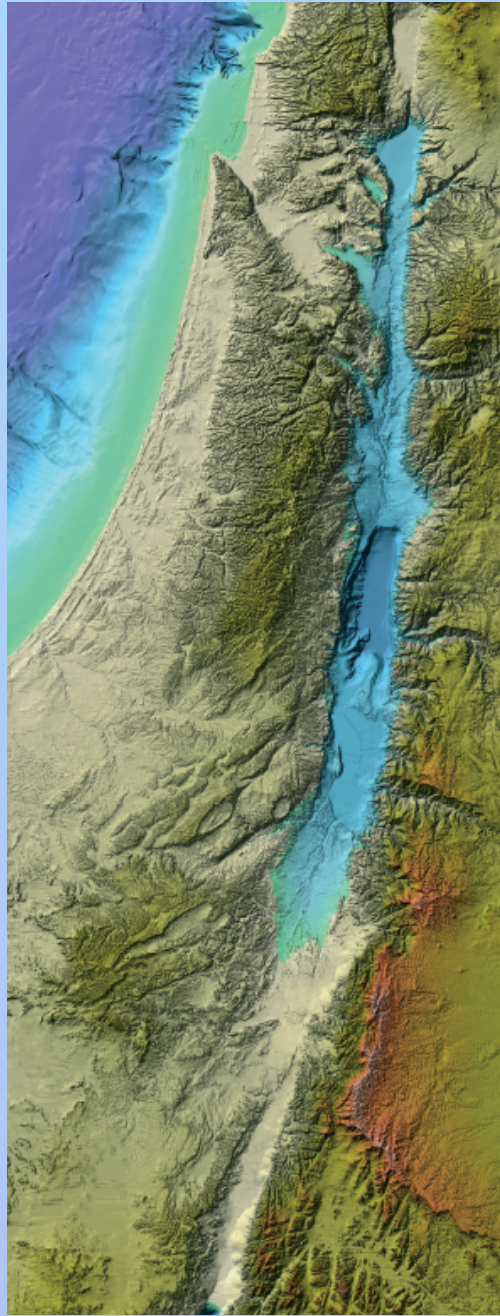
- |  |  |   |  |                          |
|--|--|---|--|--------------------------|
| ● Hot spot active more than 10 million years ago | ● Hot spot active in past 10 million years | ■ Young orogenic belts (Alpine and Tertiary, less than 100 million years) | ⊗ Fracture zones and transformation faults | — Major plate boundaries |
|--|--|---|--|--------------------------|





# Relative plate motion in the Eastern Mediterranean

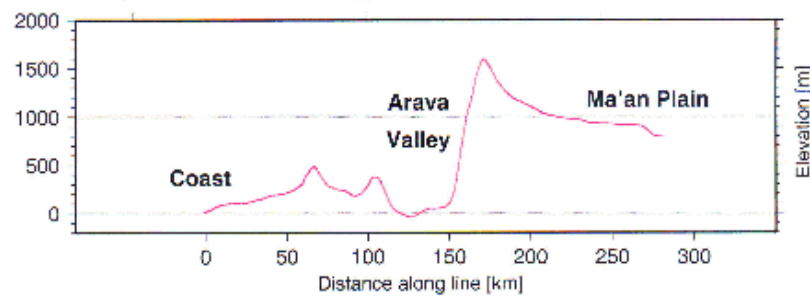
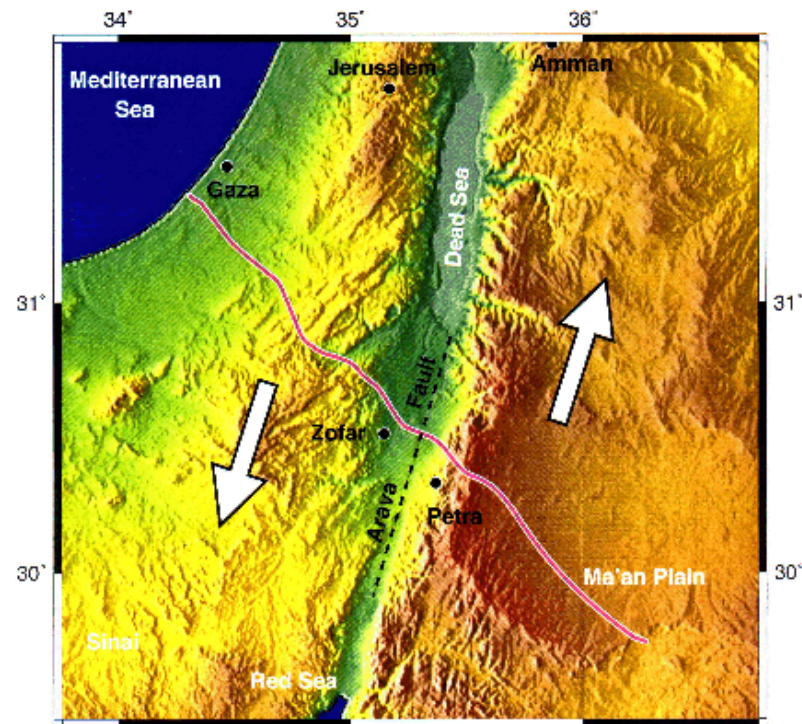






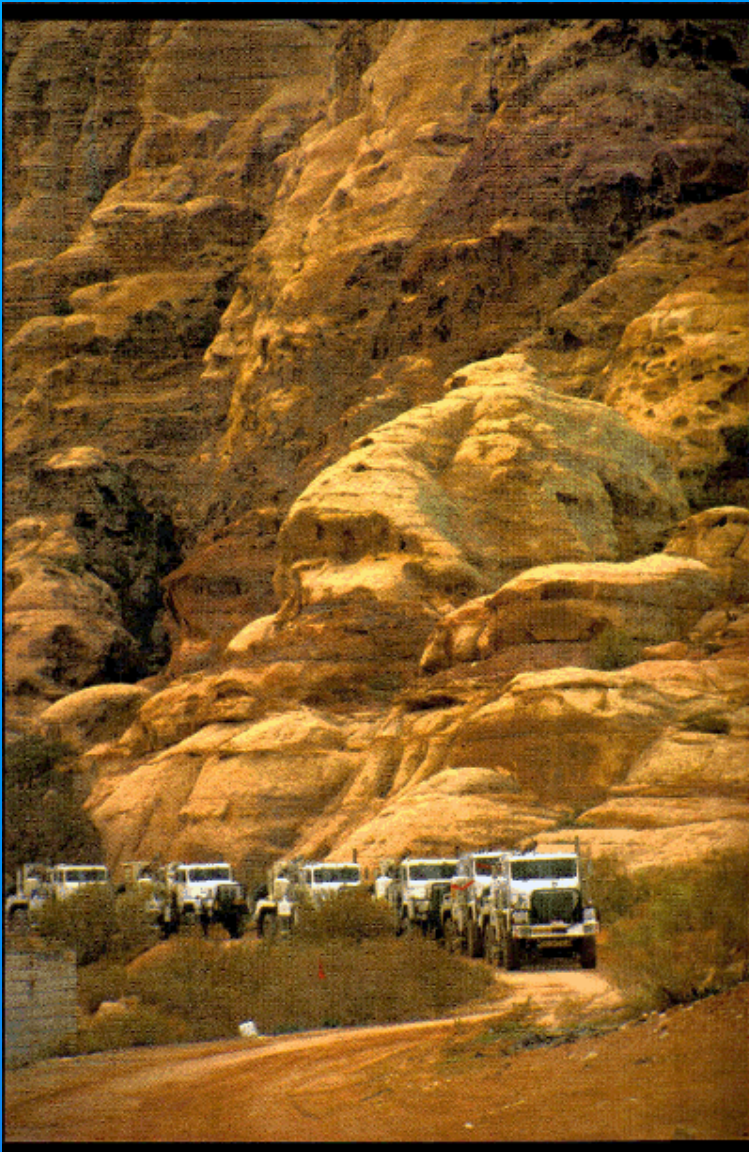


# DESERT 2000





## Vibrators in Jordan



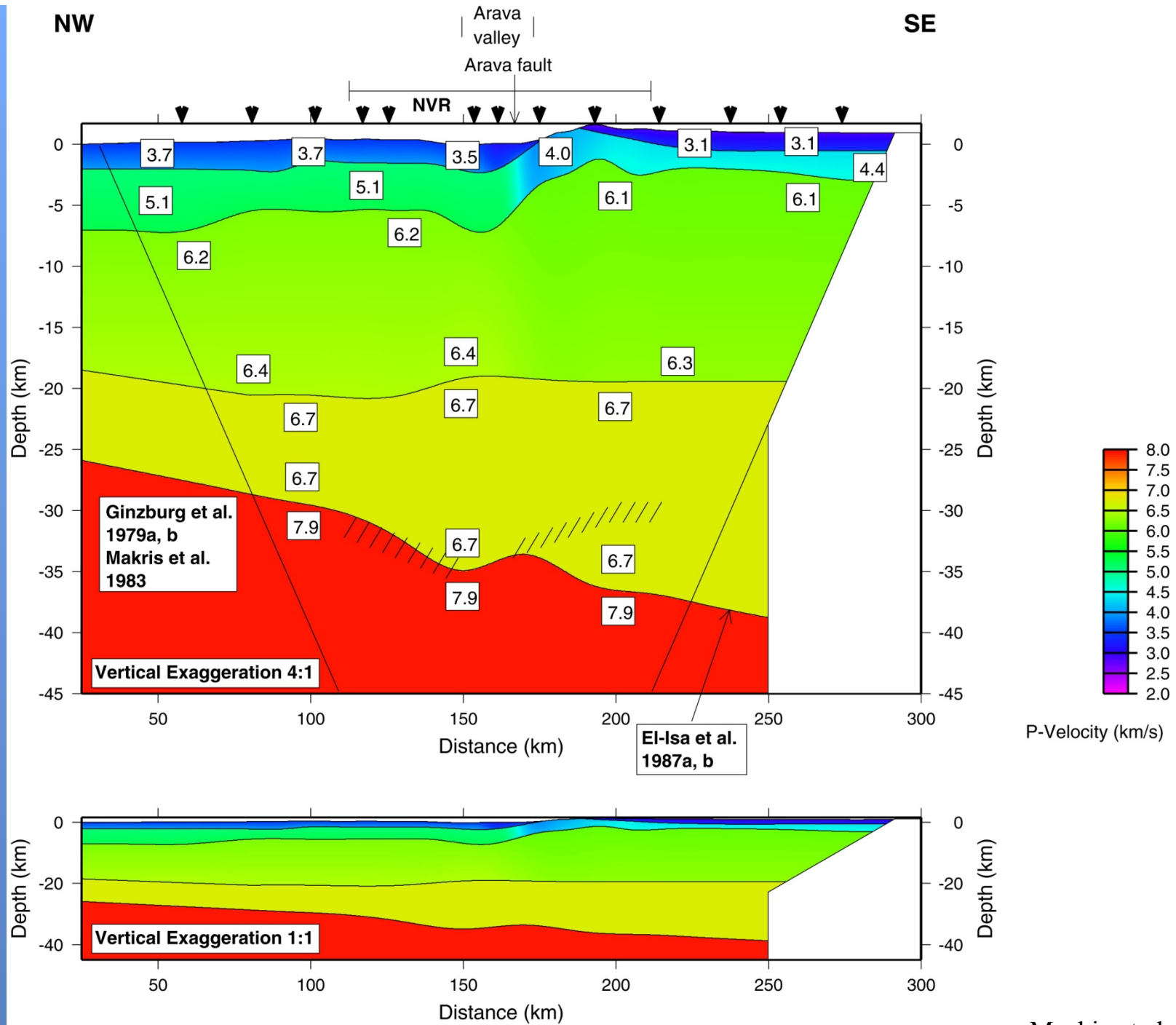


Fig. 2



# Geo-Desire

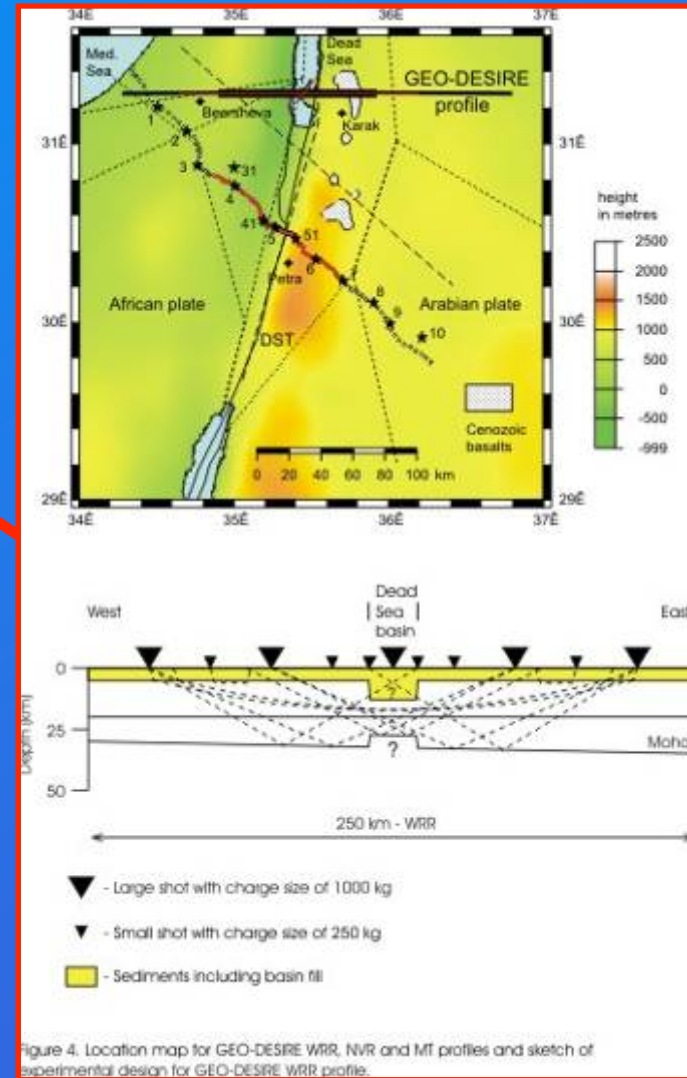
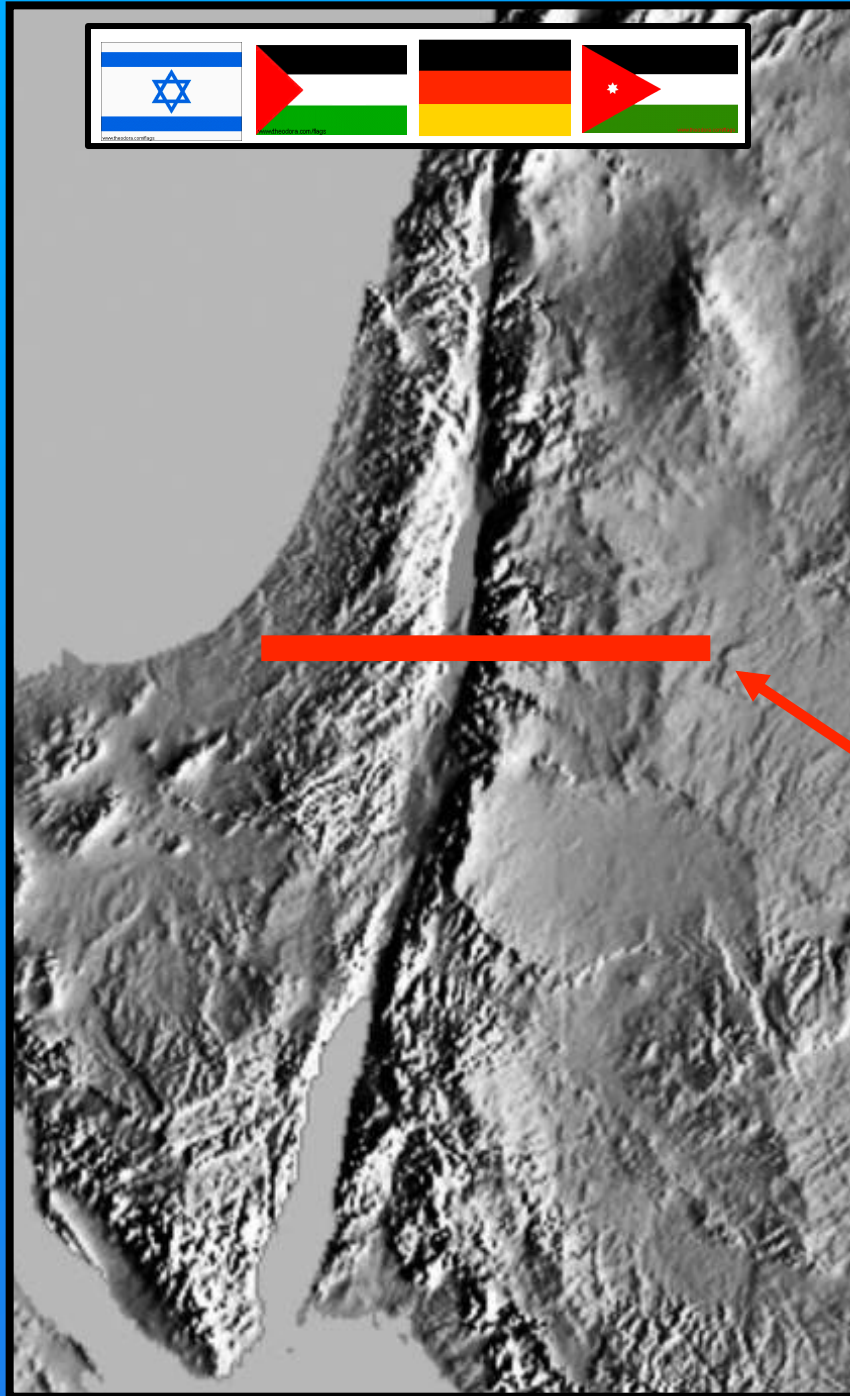
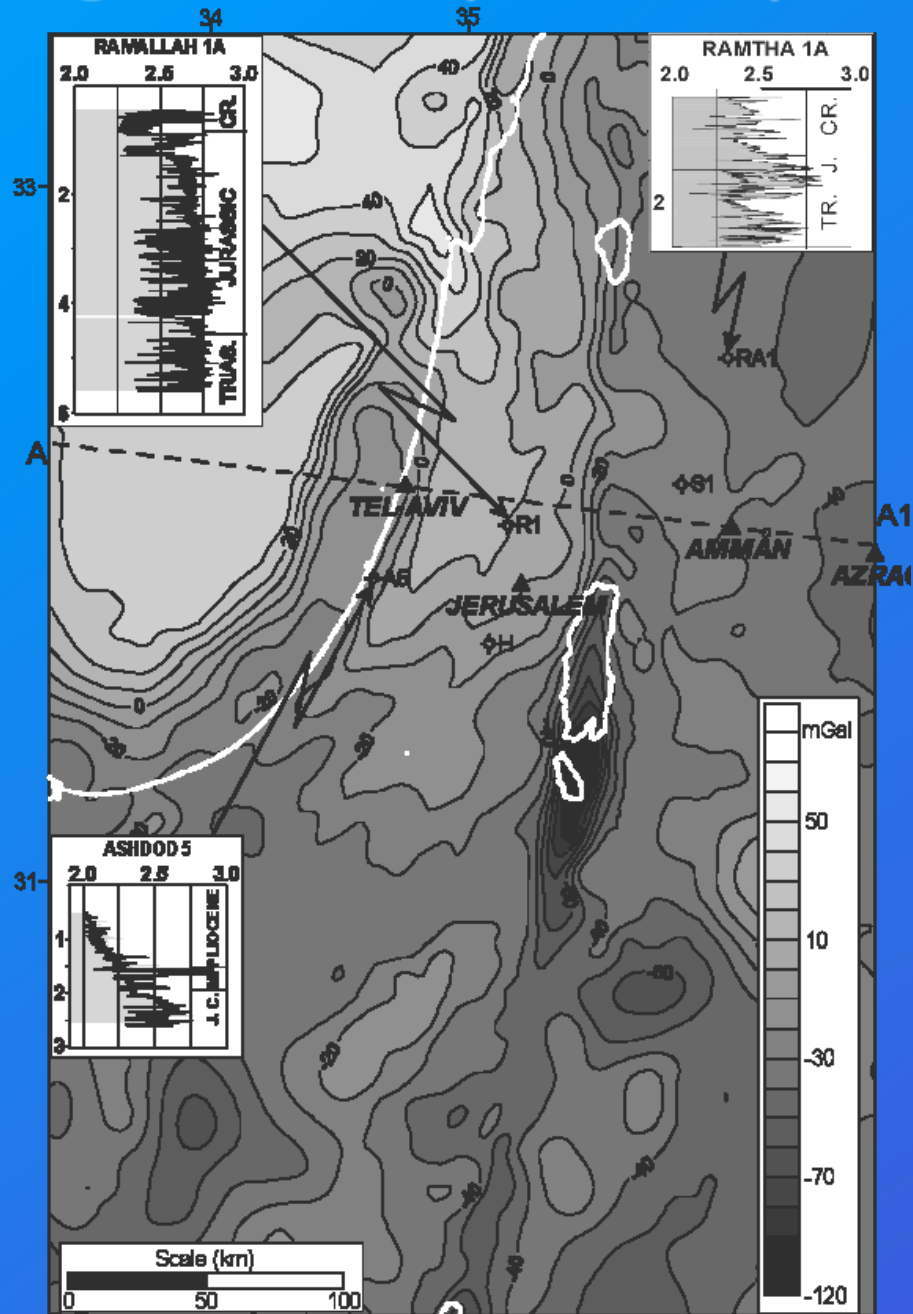
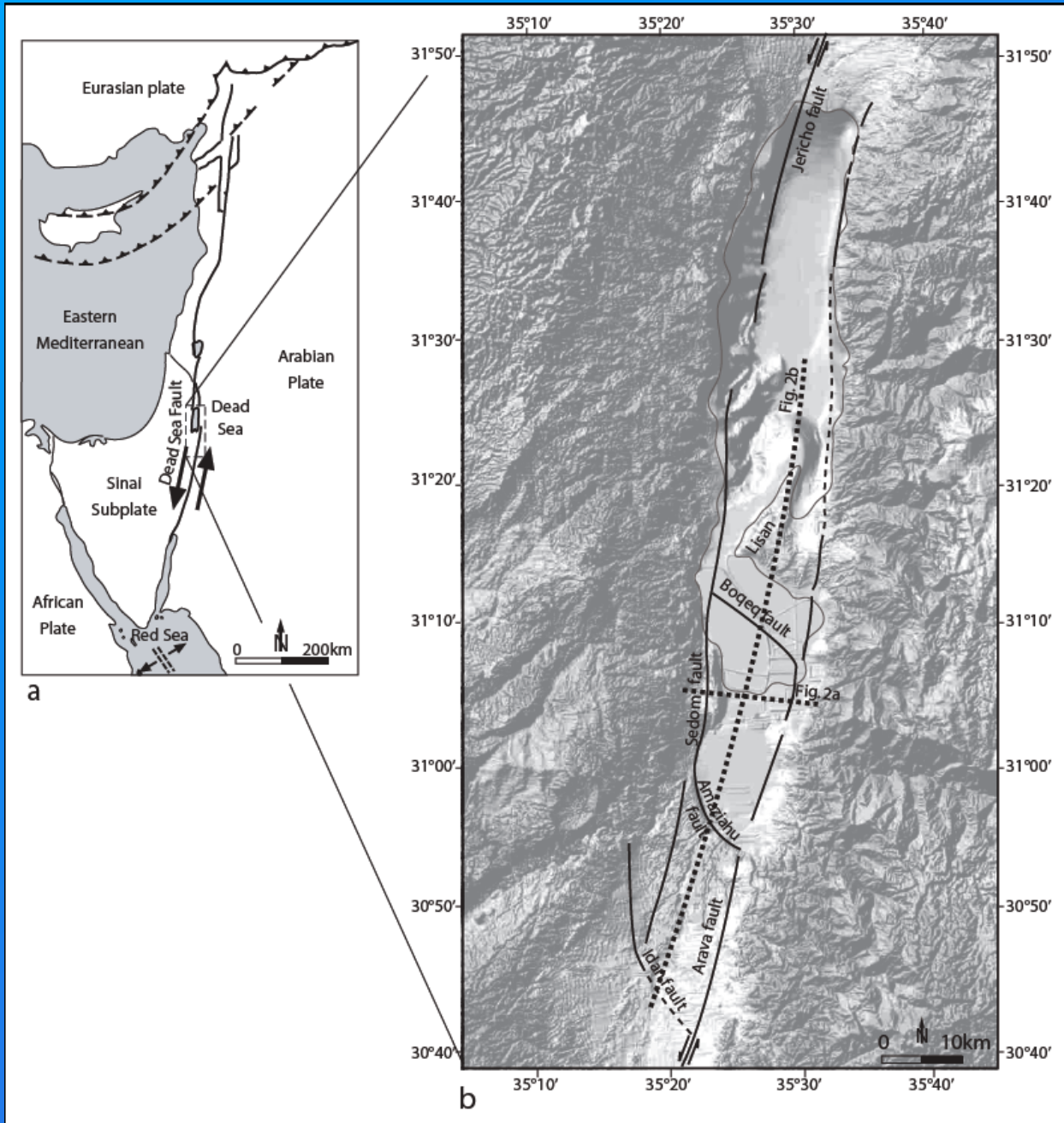


Figure 4. Location map for GEO-DESIRE WRR, NVR and MT profiles and sketch of experimental design for GEO-DESIRE WRR profile.

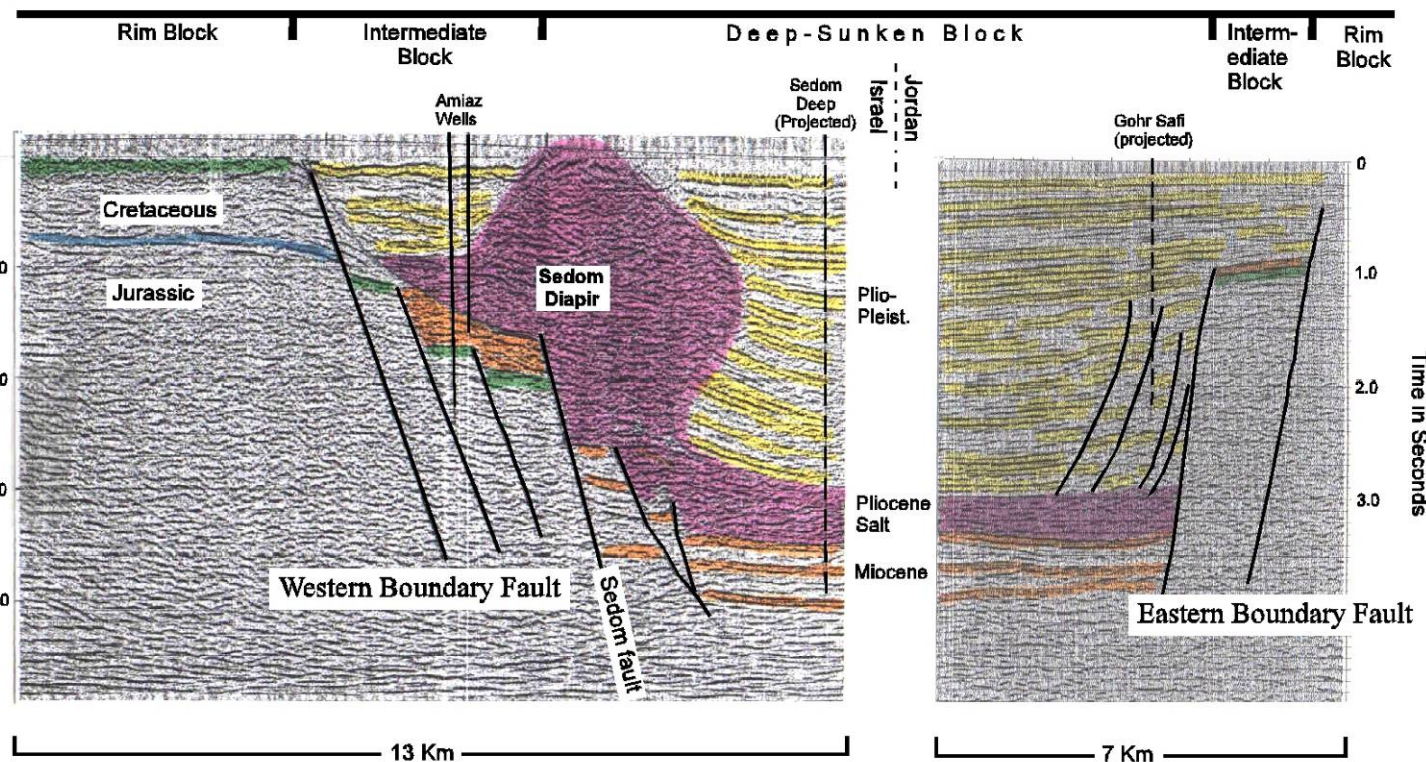
# Bouguer Gravity Anomaly Map







# Line Ds-7003





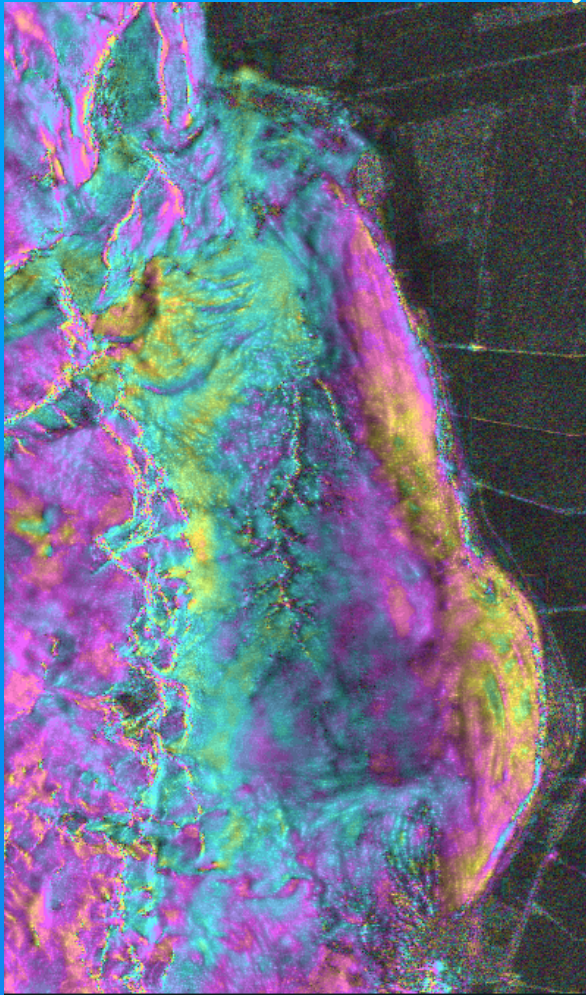
# Mount Sodom





# Interferograms of Mt. Sodom deformation

Each cycle ( $2\pi$ ) shows a 28 mm deformation



$8.27 \pm 0.28$  mm/yr  
in the north

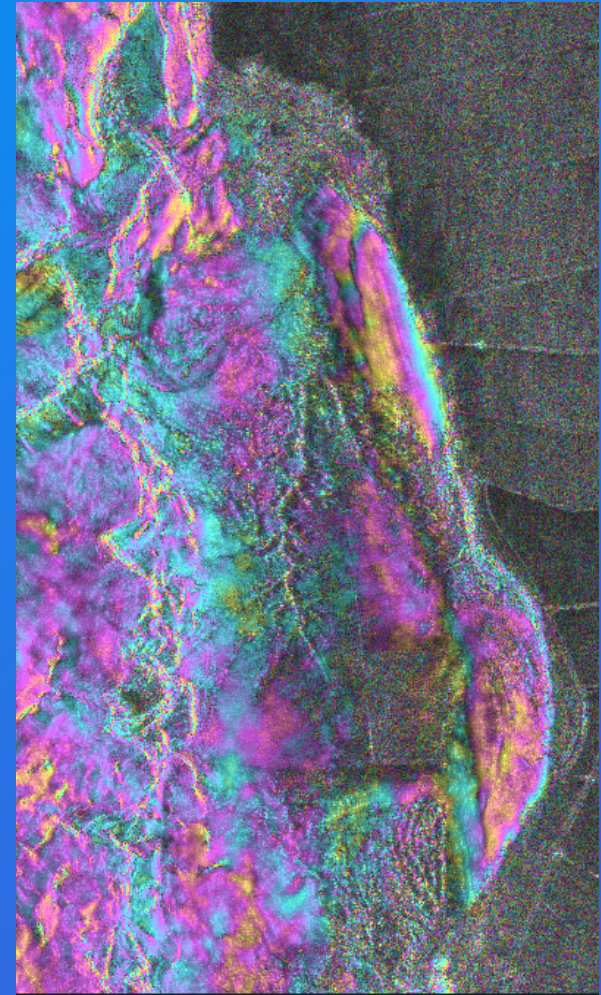
$6.88 \pm 0.31$  mm/yr  
in the south

Interferogram over a period of 421 days.

Total uplift is

$4.4 \pm 1.1$  mm - northern part

$8.7 \pm 1.3$  mm - southern part

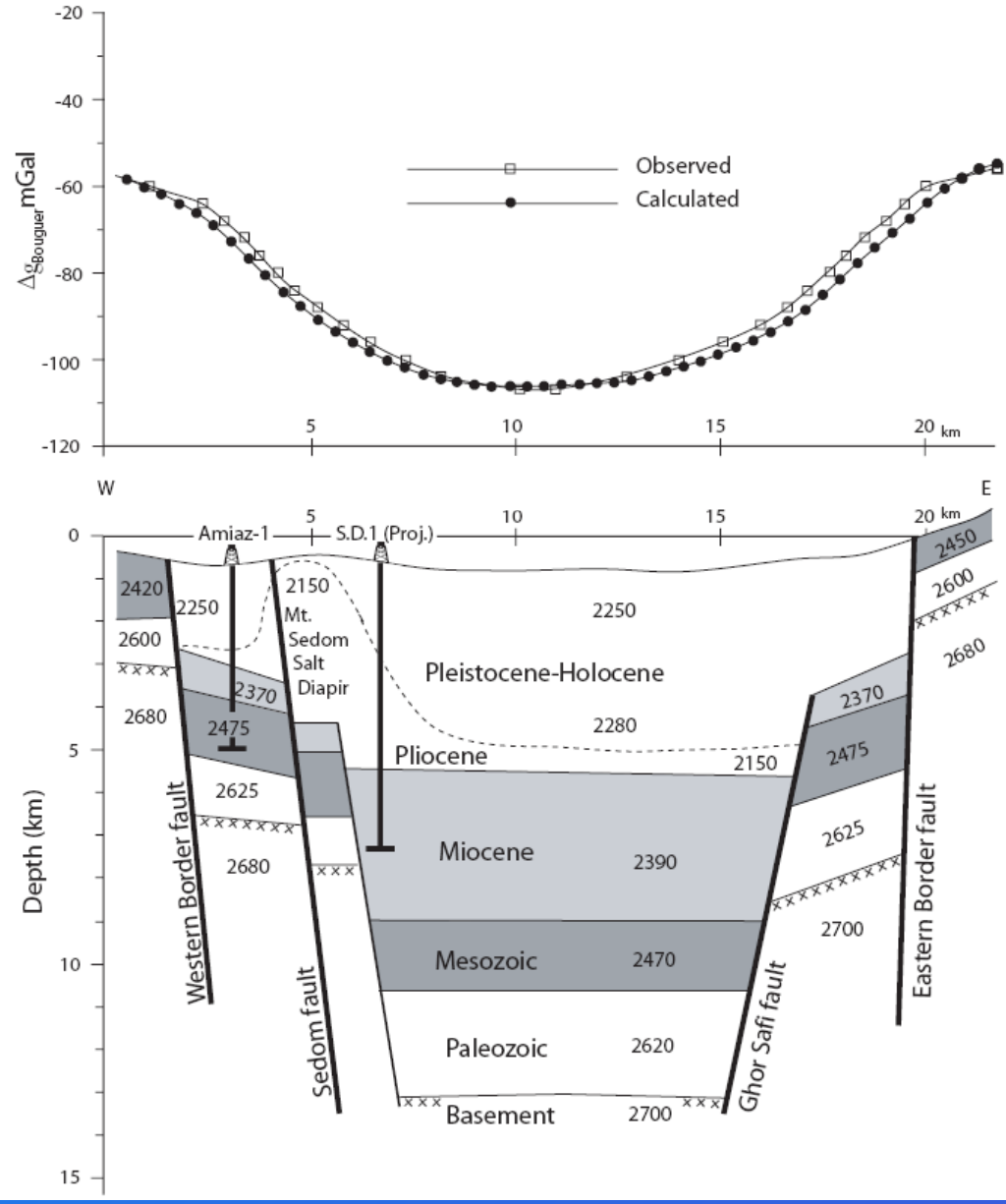


Interferogram over a period of 1949 days.

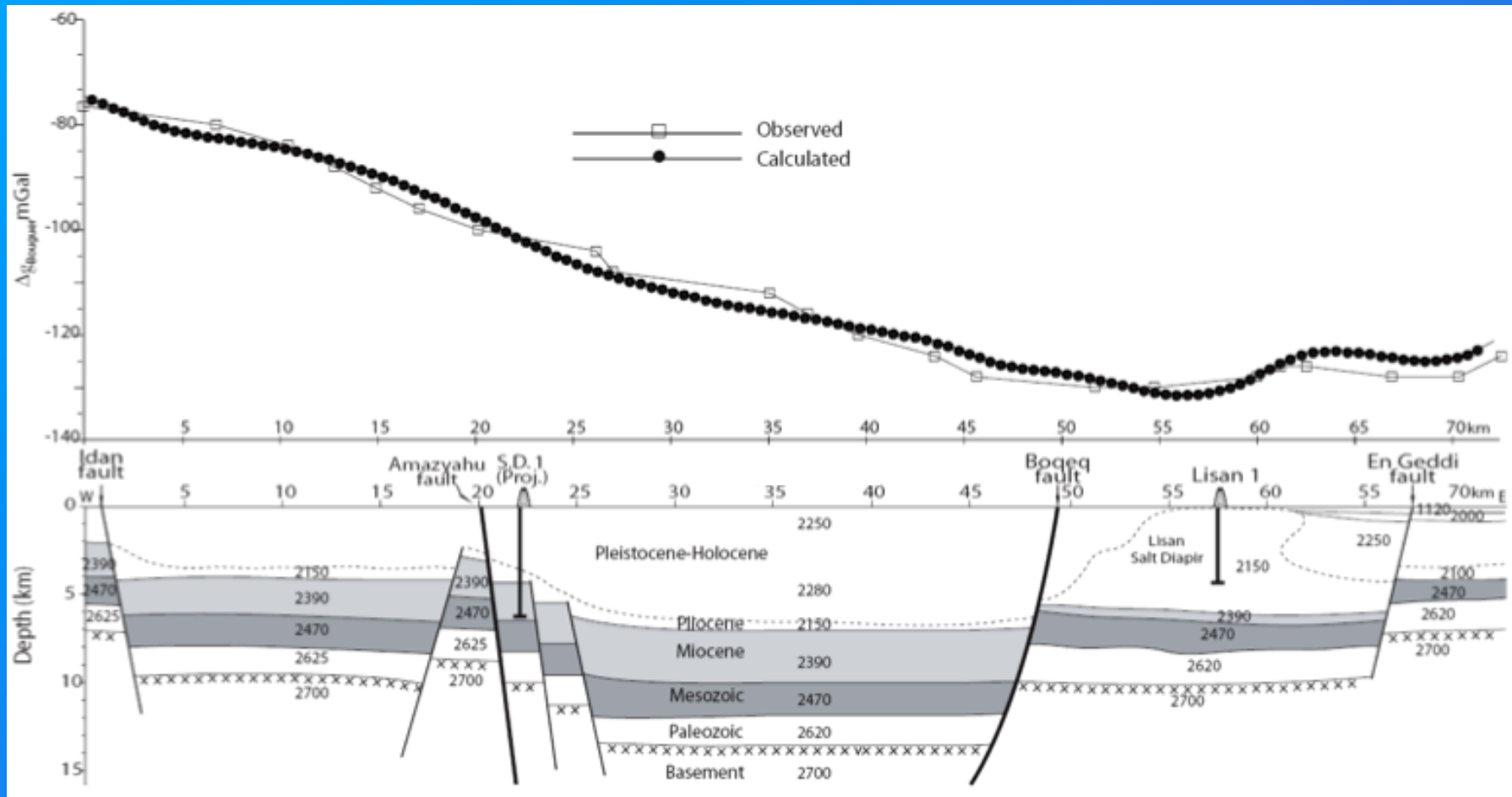
Total uplift is

$41.4 \pm 1.1$  mm - northern part

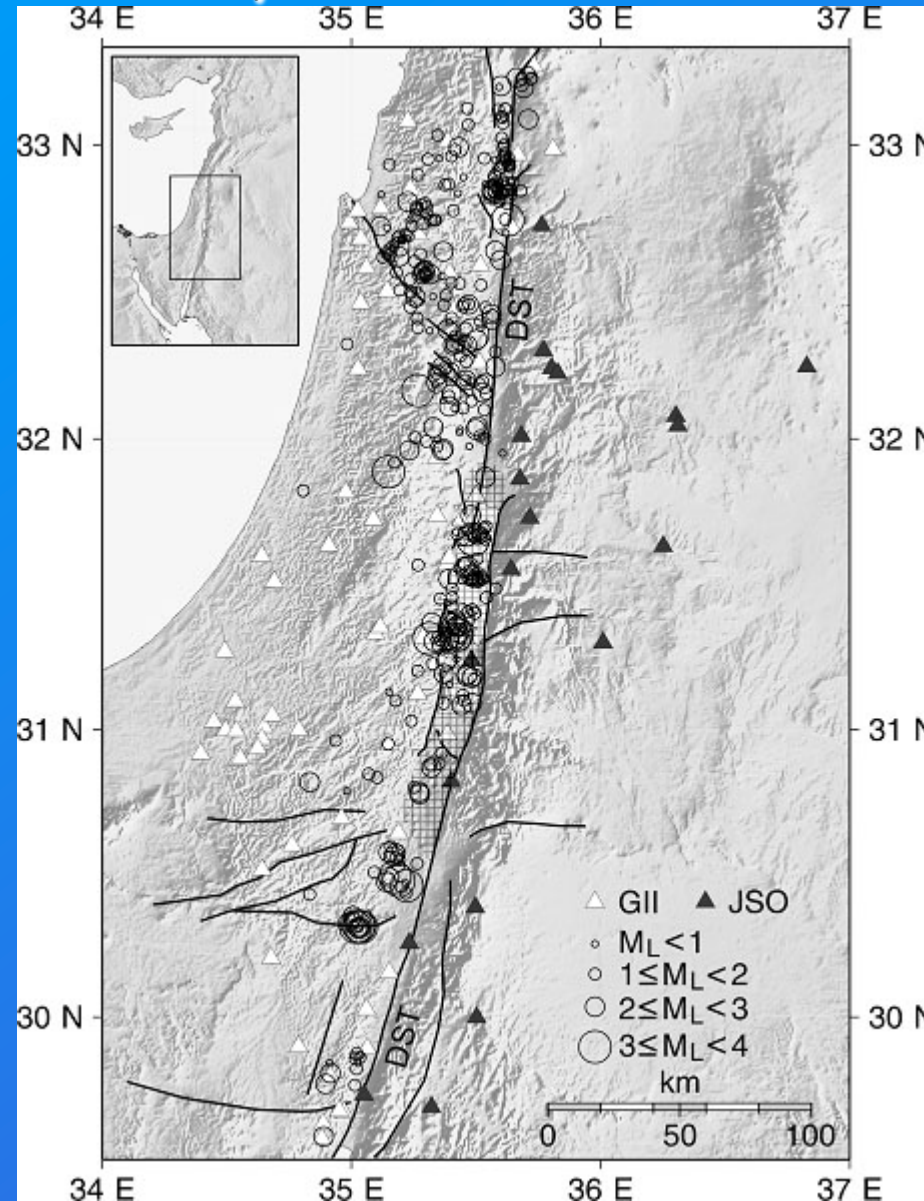
$39.5 \pm 1.5$  mm - southern part



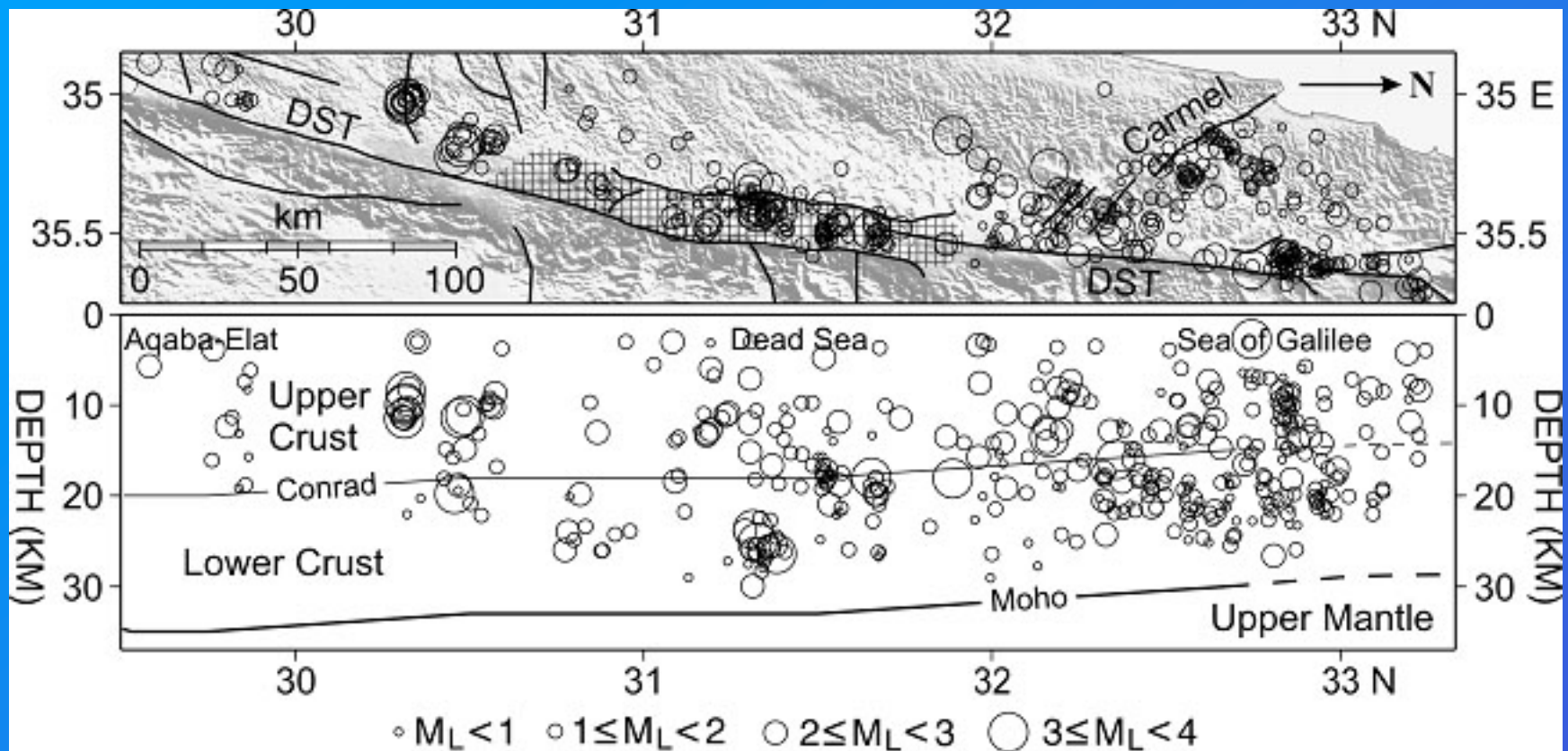




# Reliably Locatable Earthquakes 1984-1997 Recorded by Short-Period Stations



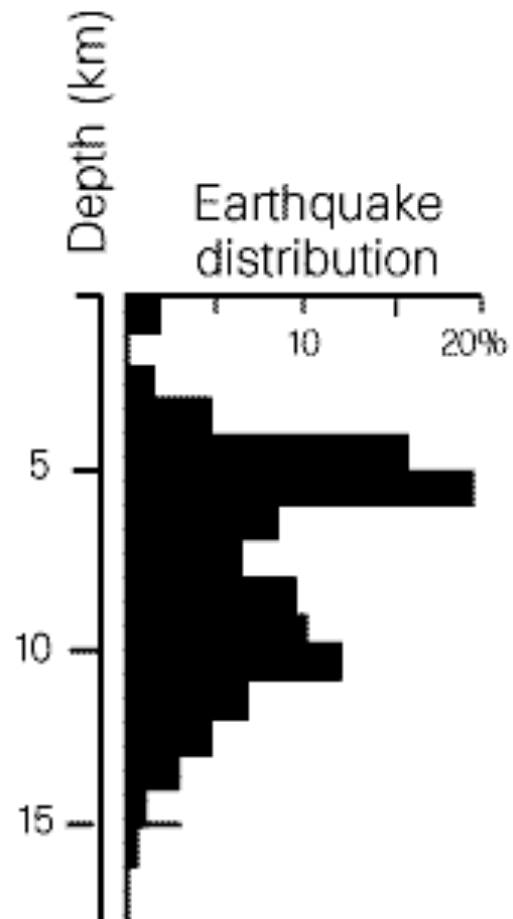
# Depth Section of well-constrained seismicity 1984-1997 along the DSF



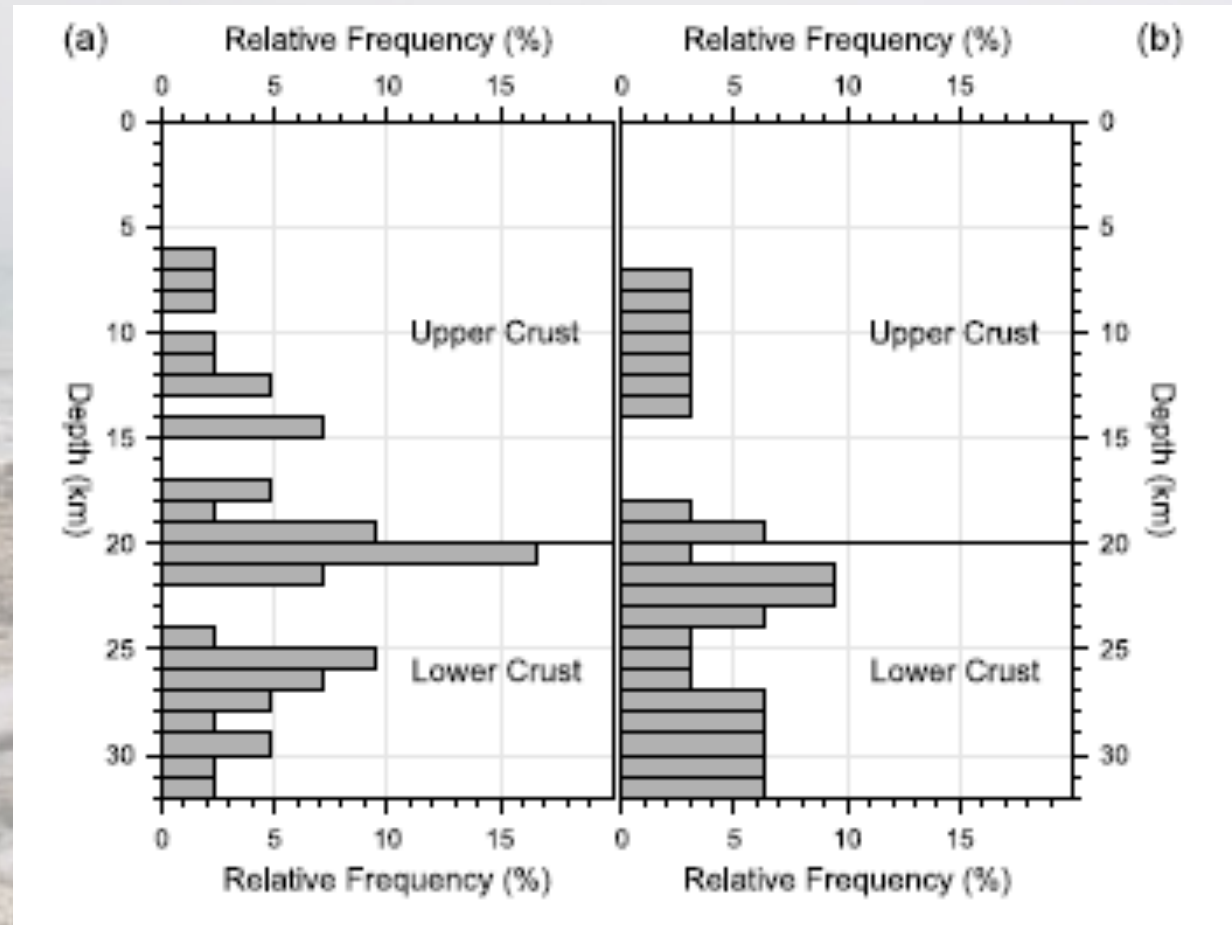
# Seismicity Depth

## San Andreas

## Dead Sea



Scholz, 1998



Alderson et al., 2003

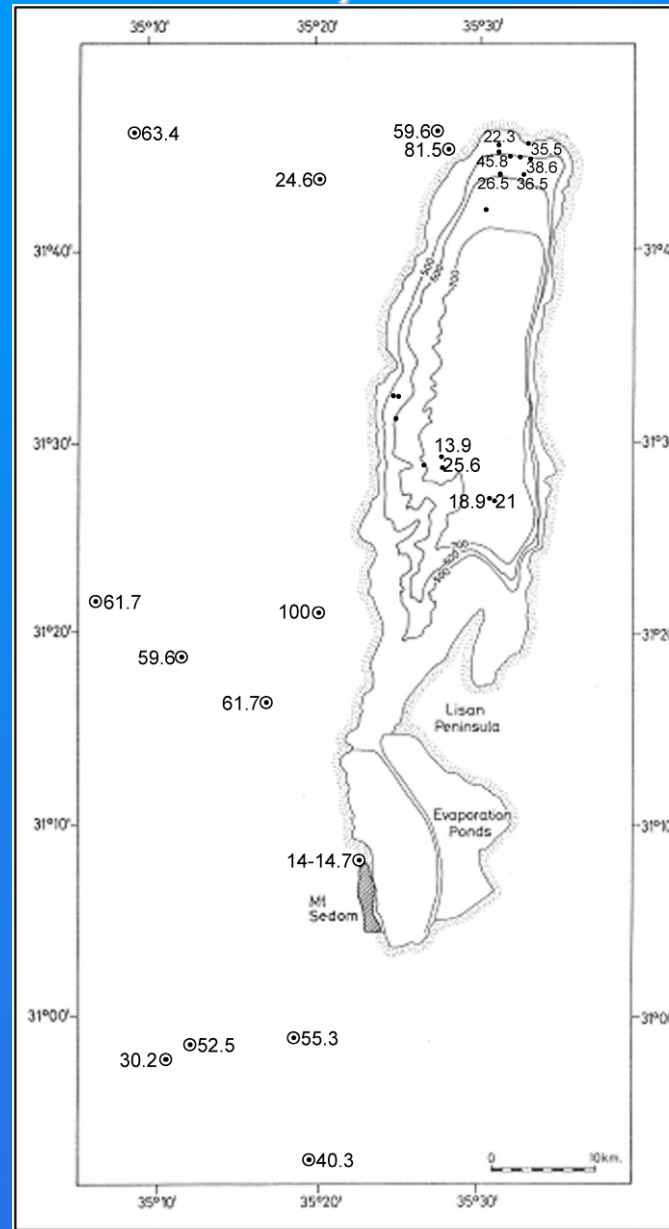


# Heat flow values in the Dead Sea and its vicinity in $\text{mW}/\text{m}^2$

Mean value on land  
(west of the Dead Sea basin)

$42 \text{ mW}/\text{m}^2$

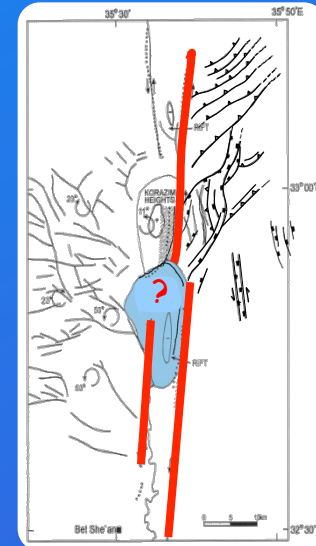
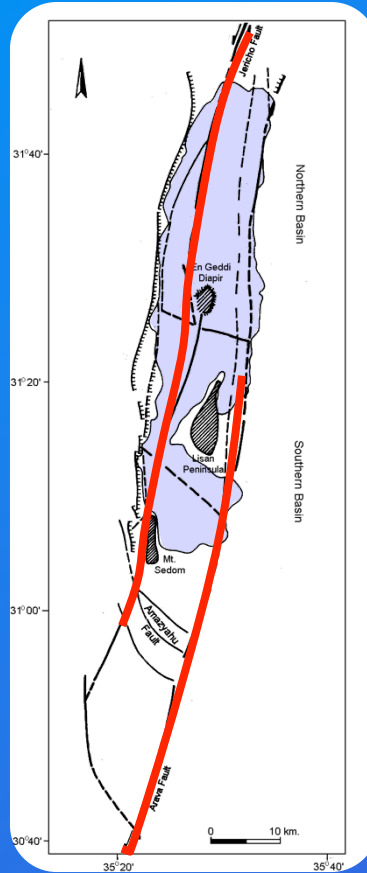
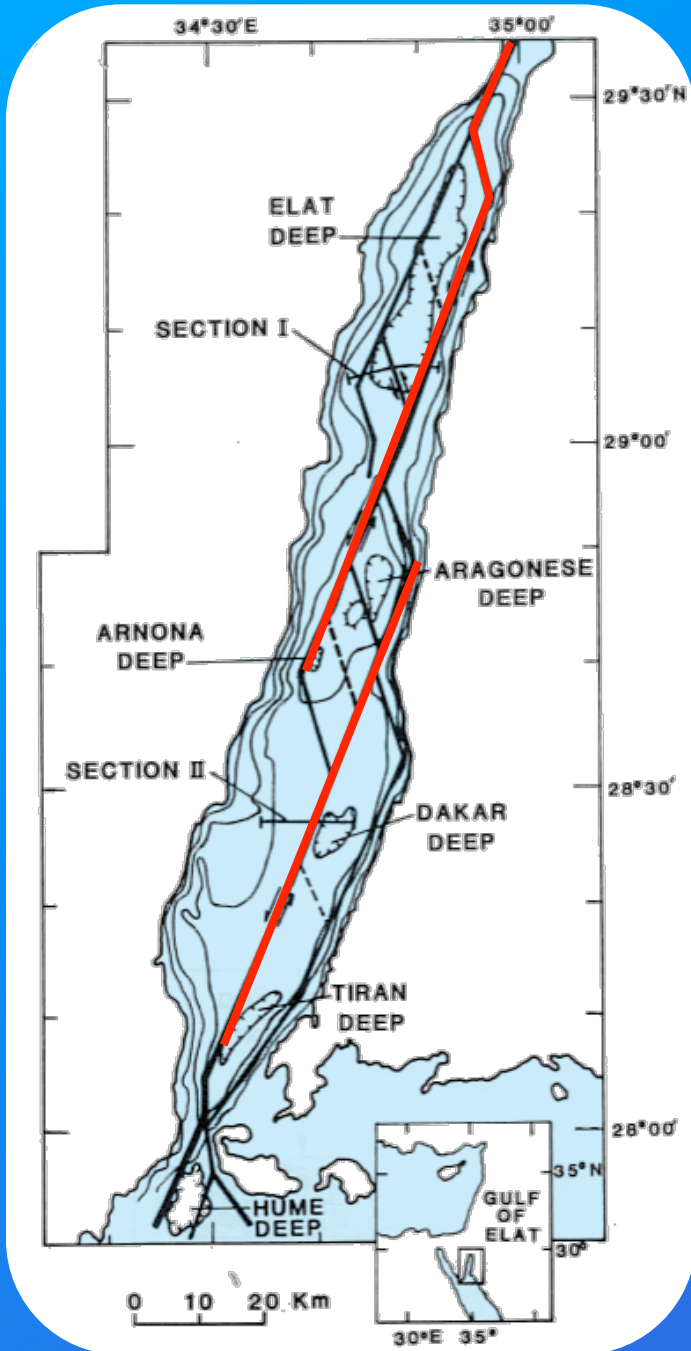
(Eckstein, 1975)

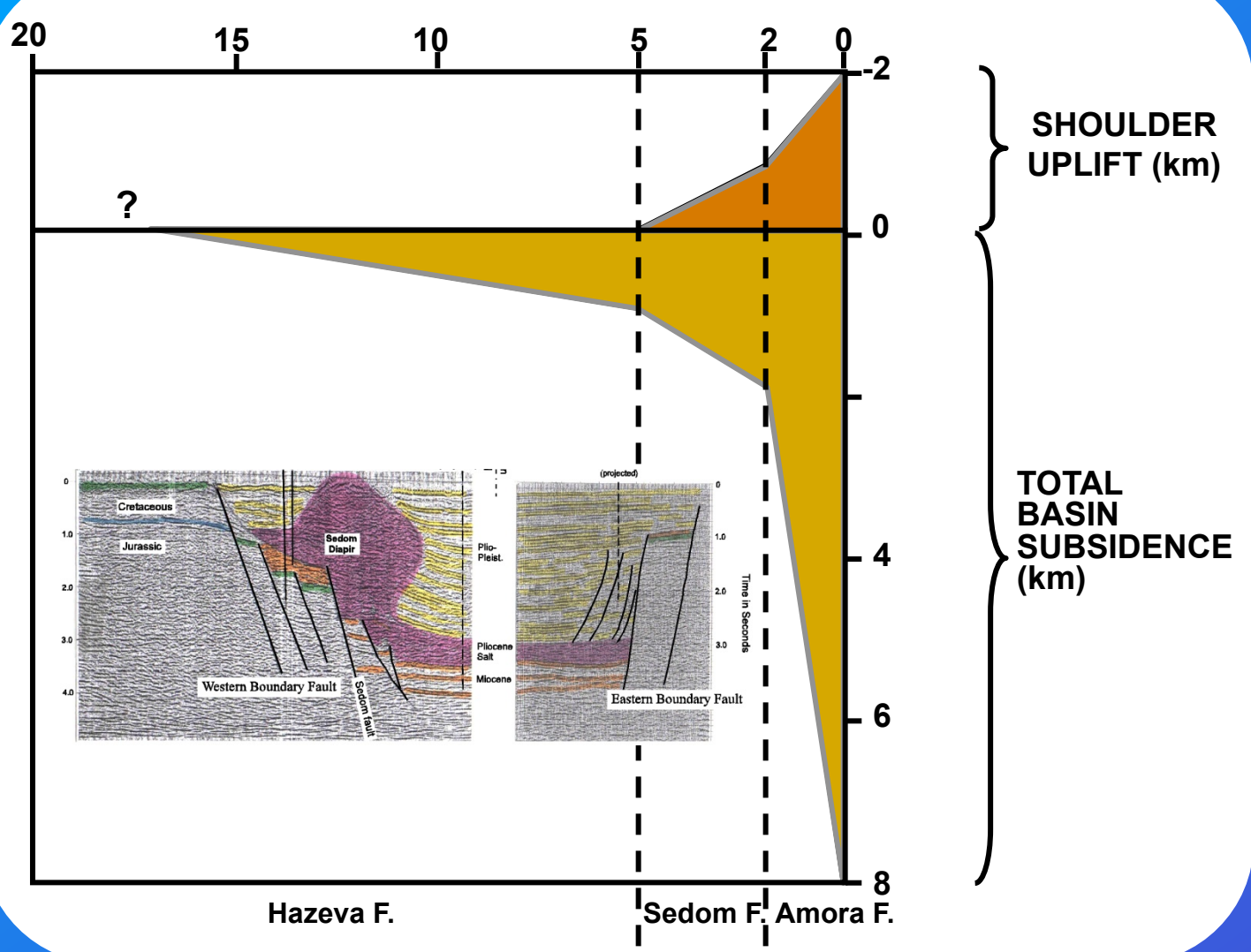


Mean value in the  
(northern Dead Sea basin)

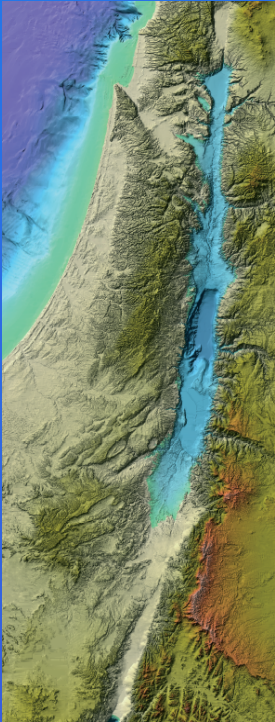
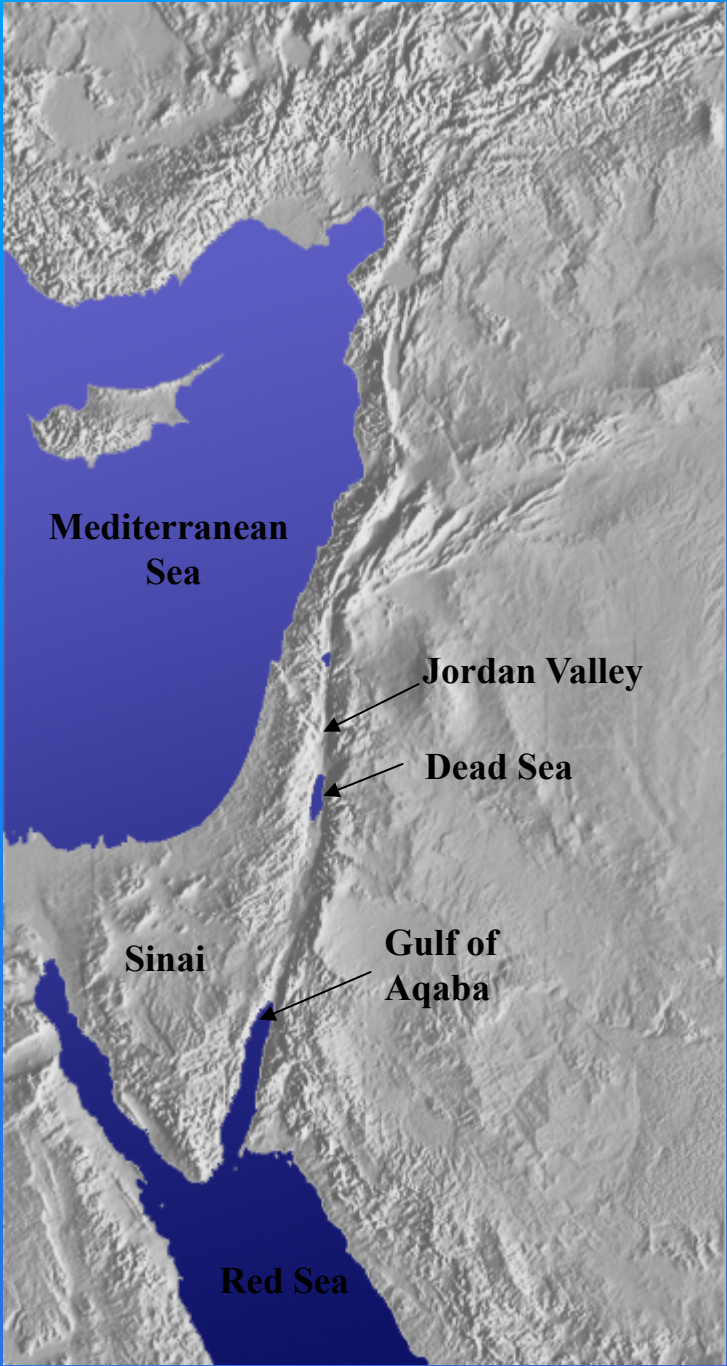
$38 \text{ mW}/\text{m}^2$

(Ben-Avraham et al., 1978)

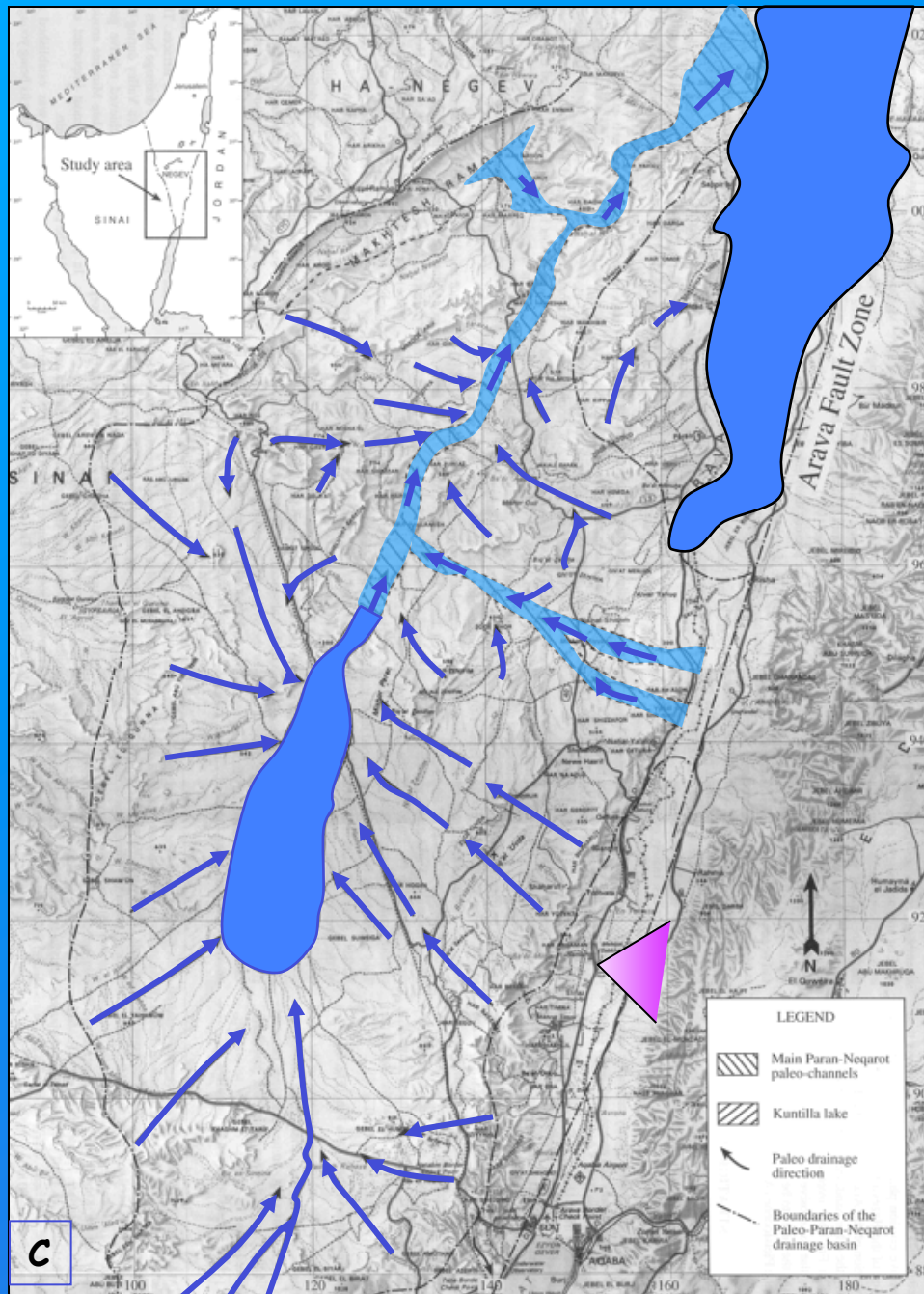








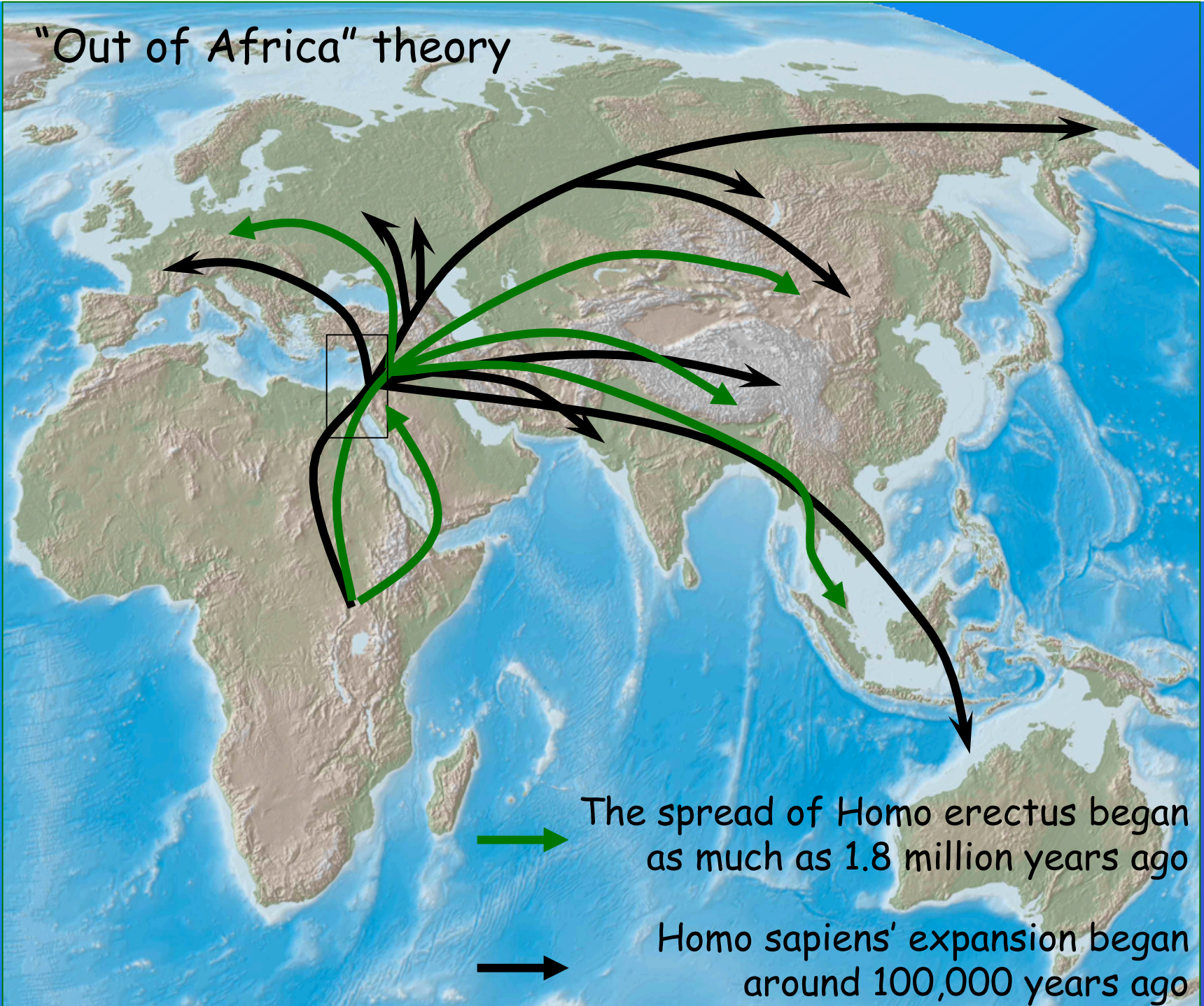
## Drainage System in the Negev about 2 Million Years ago

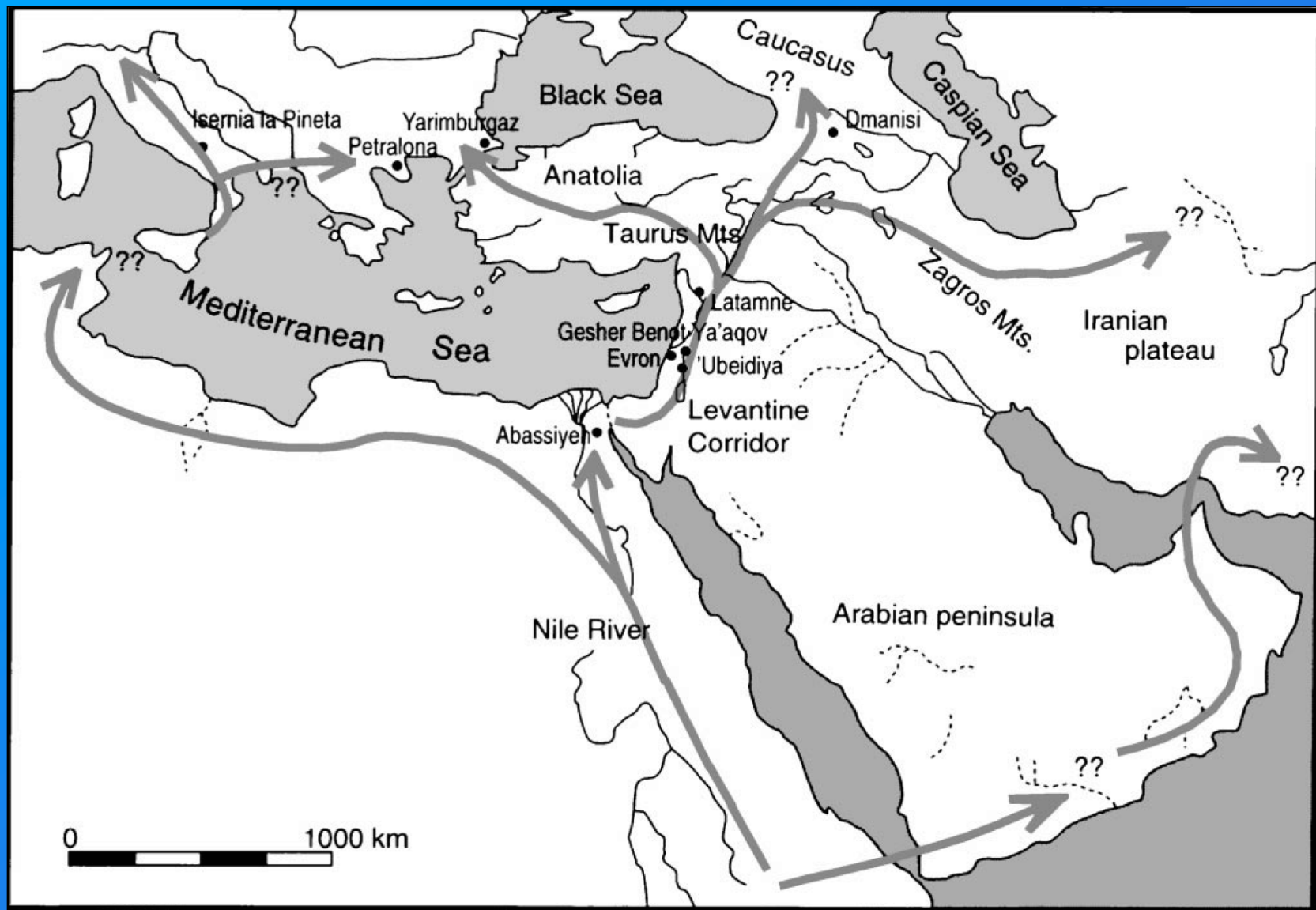


Present day topography of the rift valley. At this location between 20 m to 1200 m.



# "Out of Africa" theory



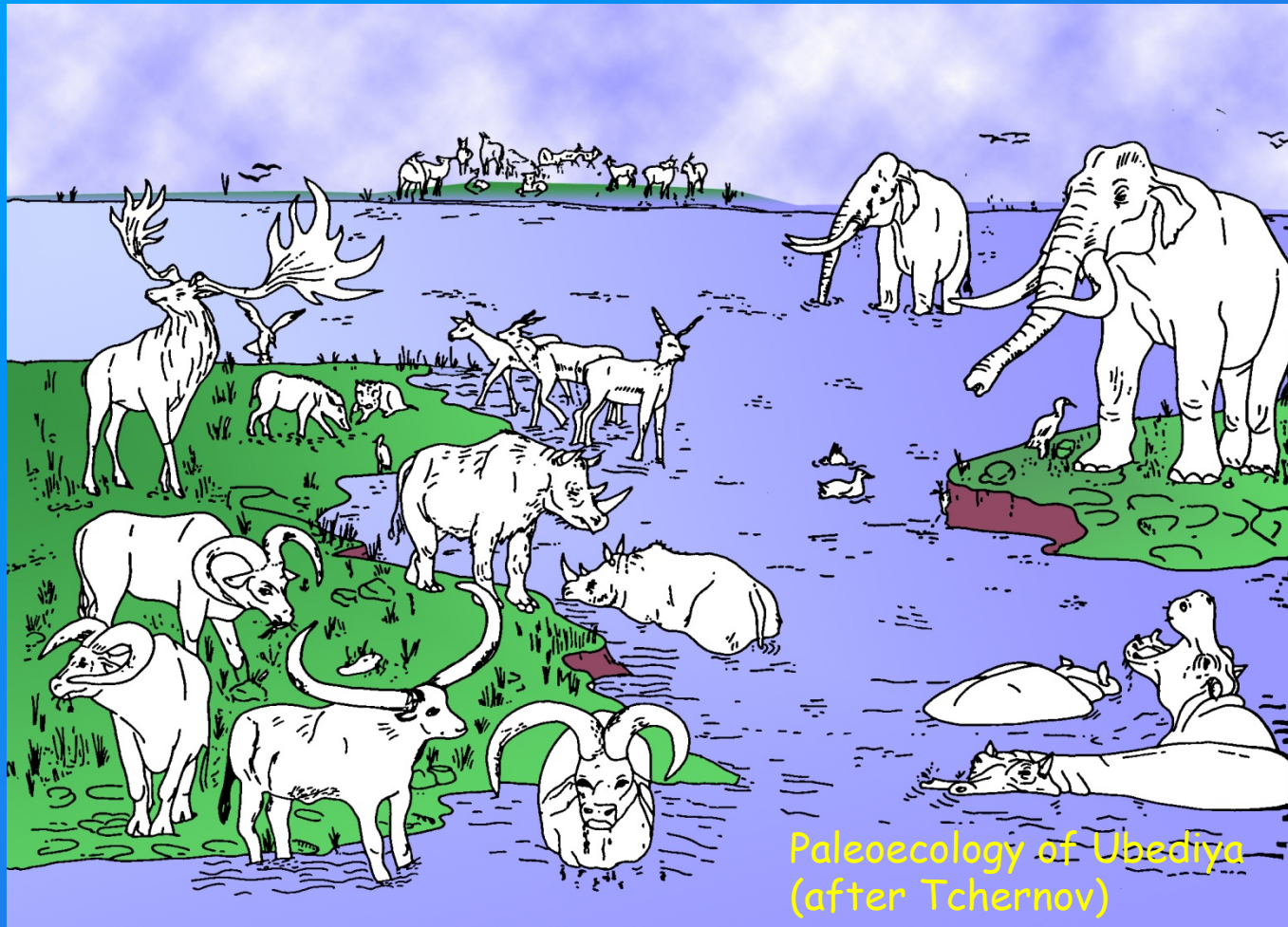




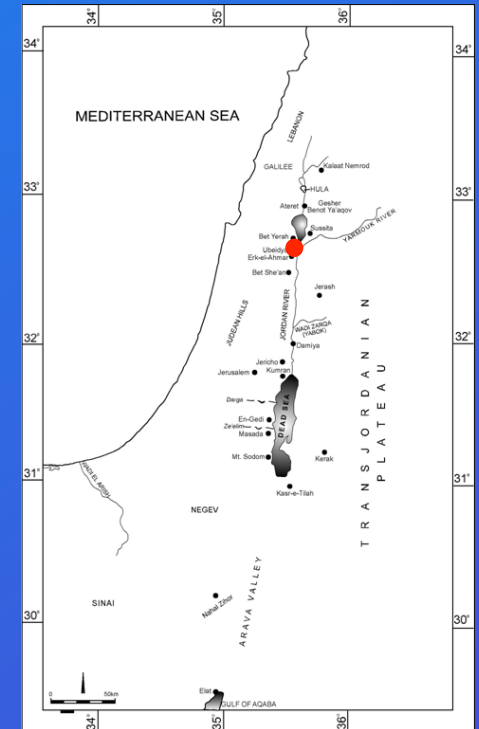
# Findings from Ubediya

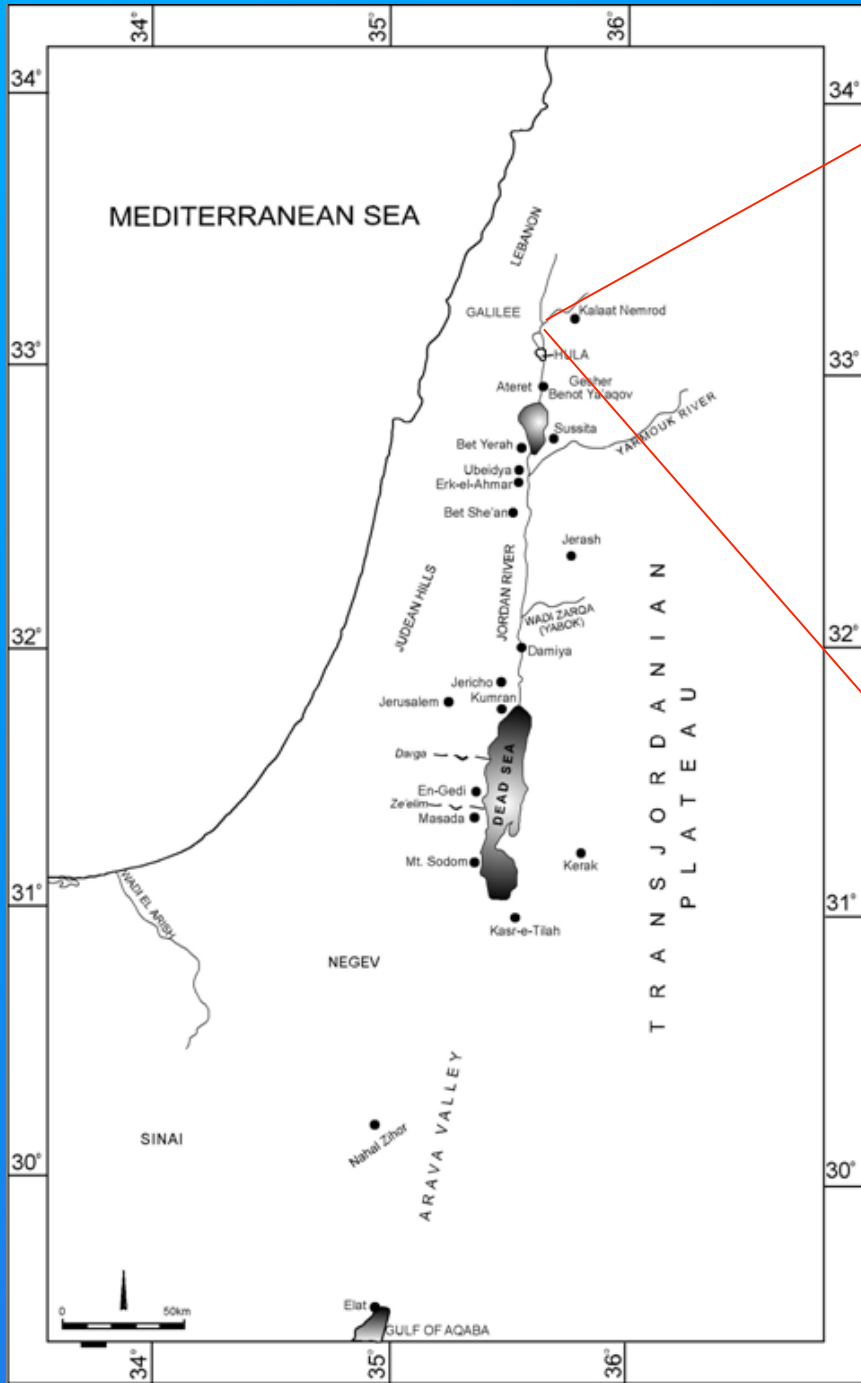


Reconstruction of Homo Erectus skull

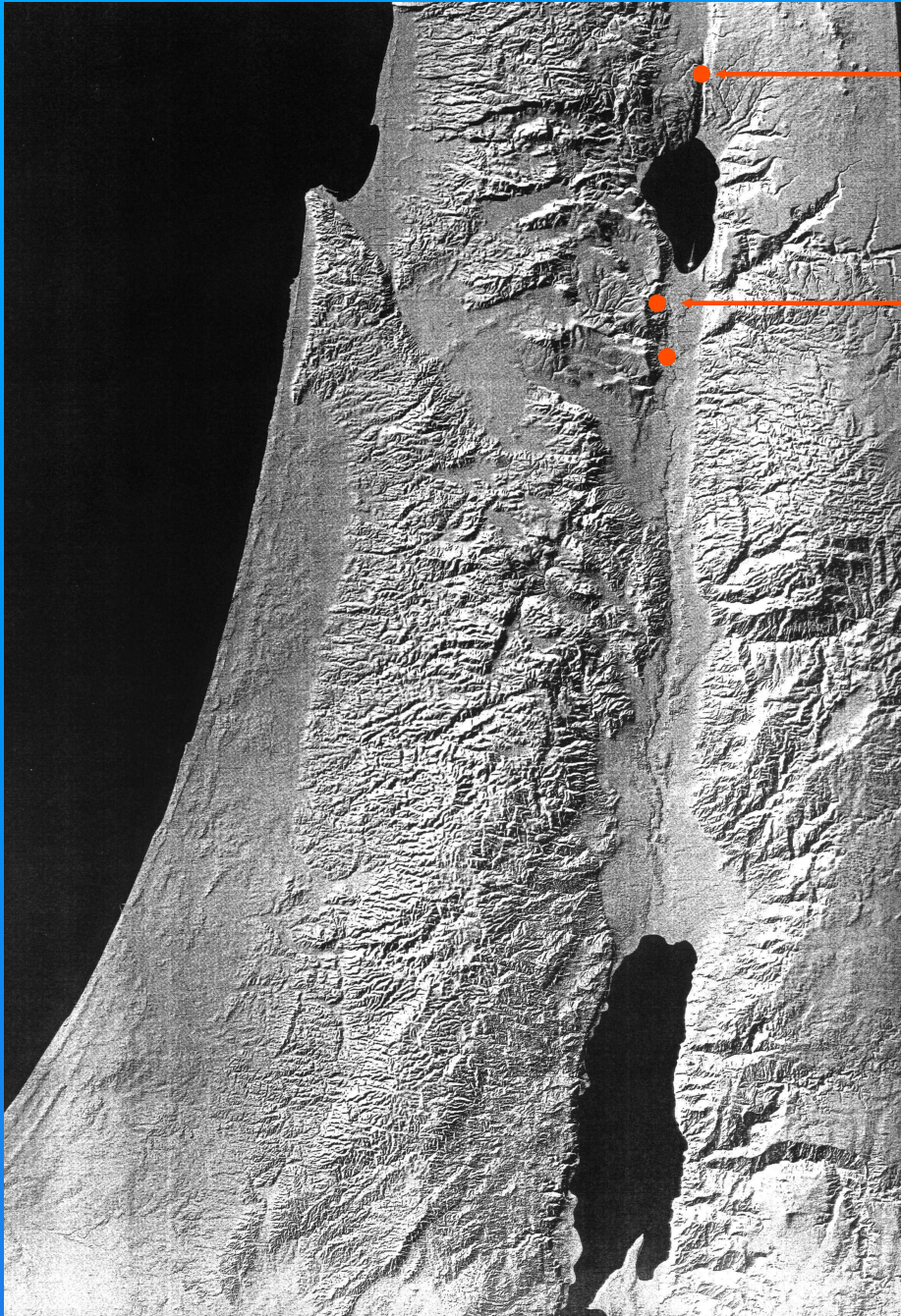


Paleoecology of Ubediya (after Tchernov)









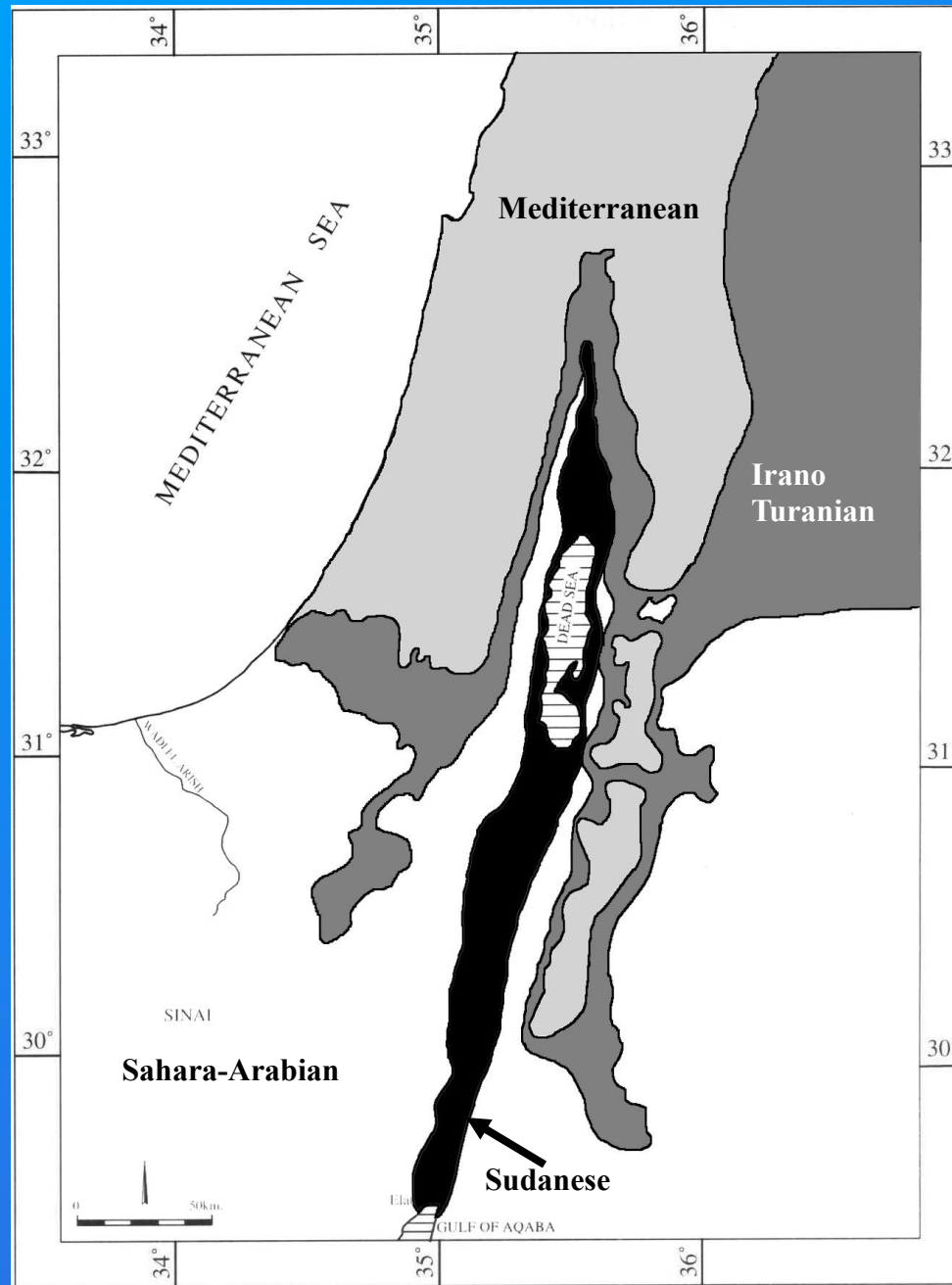
Gesher Benot-Ya'aqov, 0.78 My

Ubadiya, 1.4 My

It seems that the present physiography of the Dead Sea fault was established shortly before *Homo erectus* left Africa

A coincidence or a driving force?





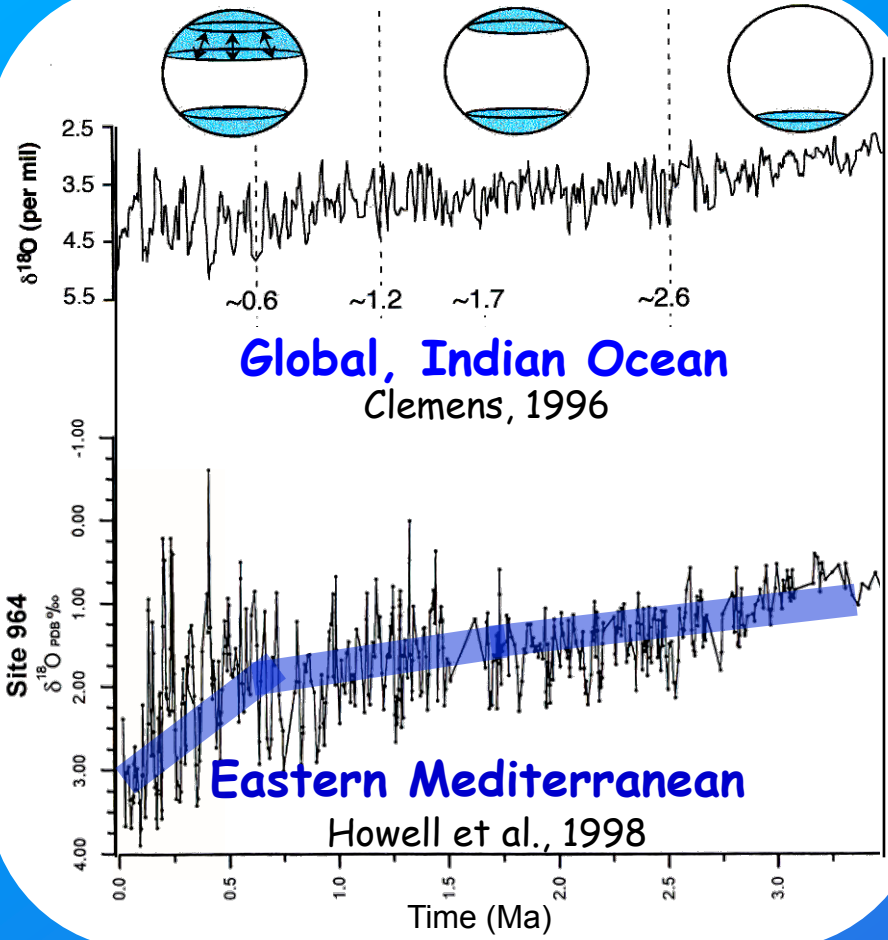




# The Dead Sea fault: 500 million migrating birds twice a year

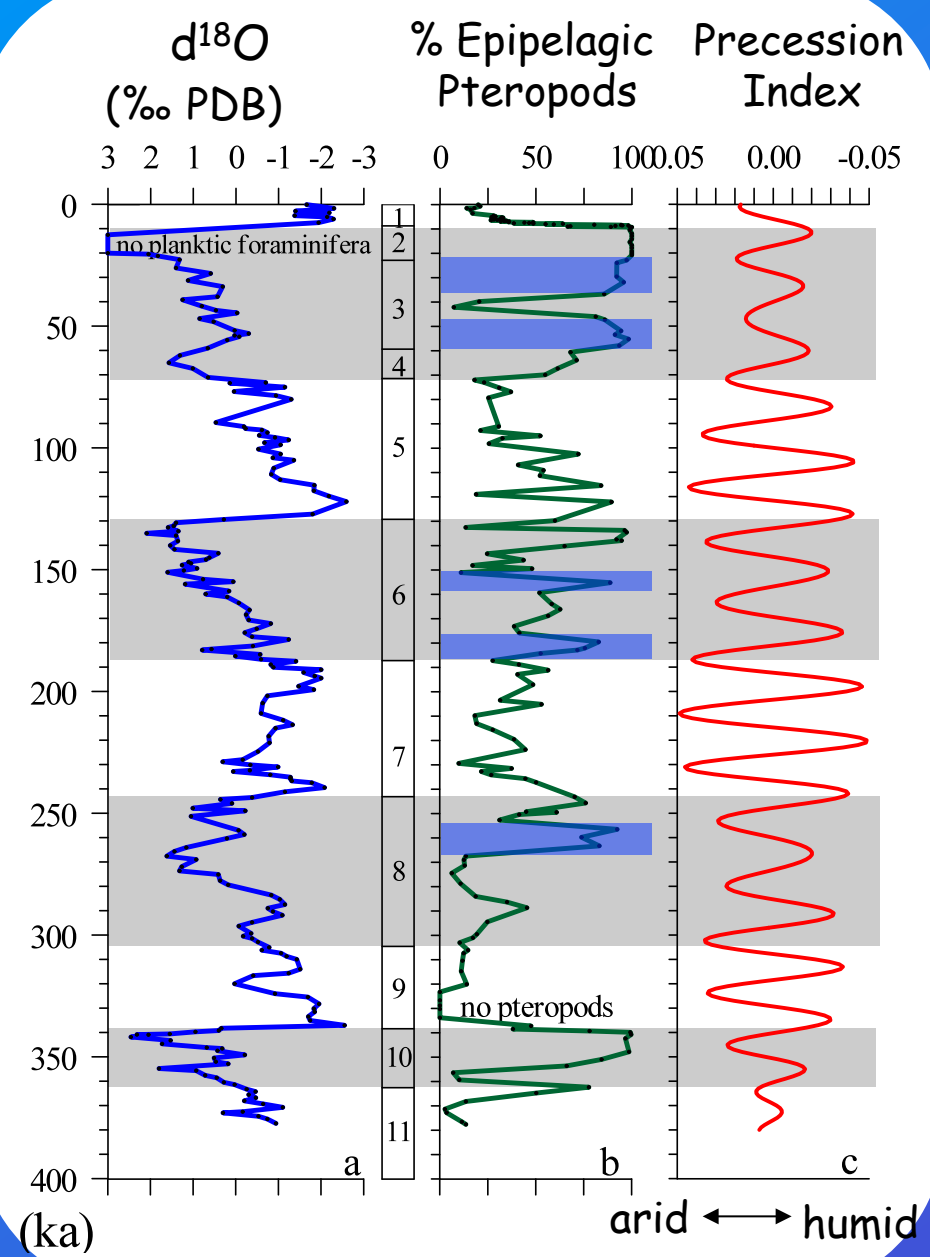






Global ice volume & Eastern Mediterranean records

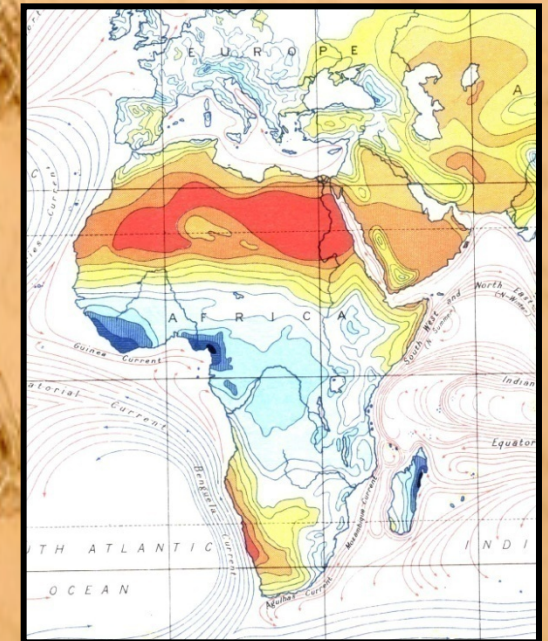
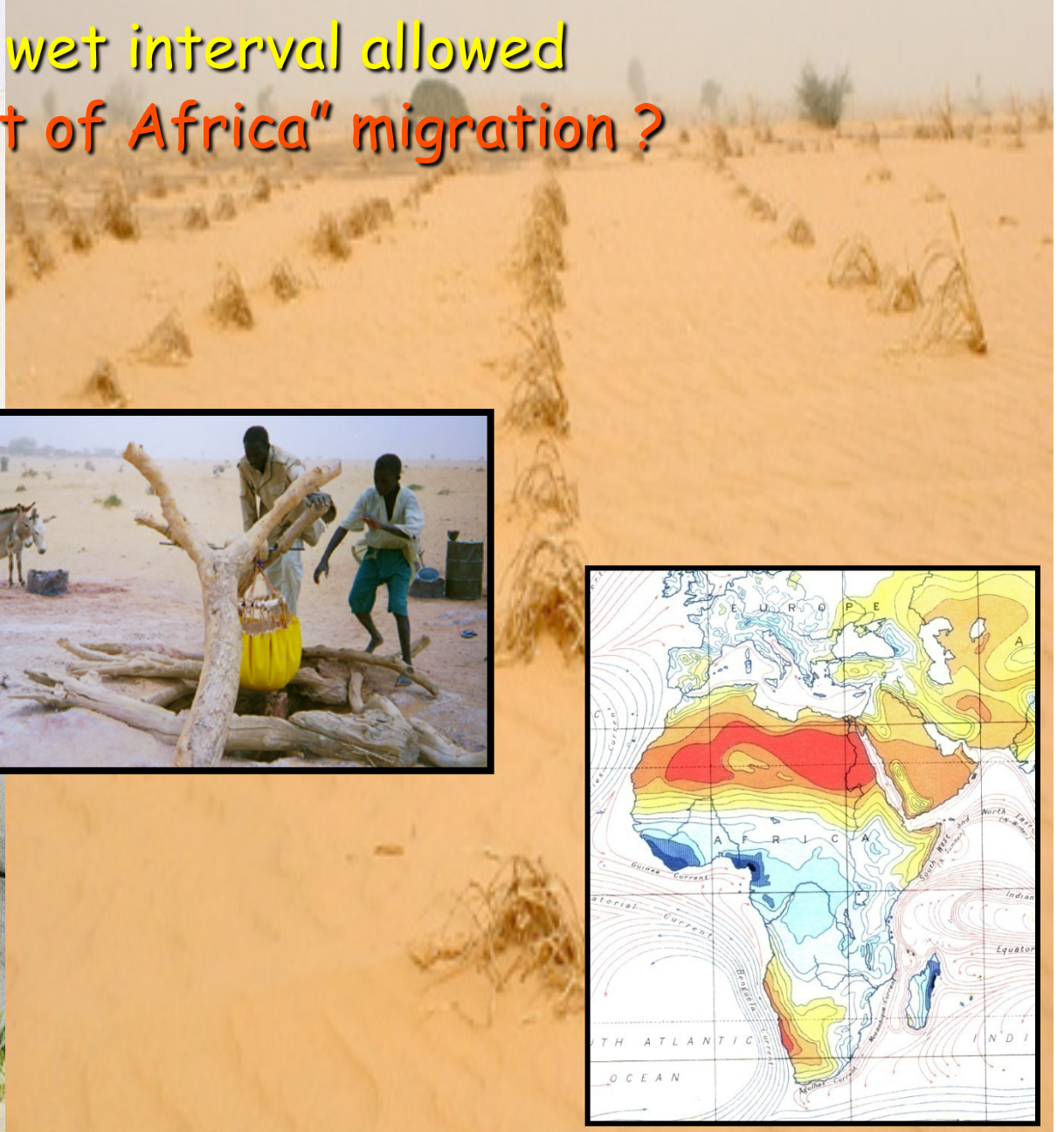
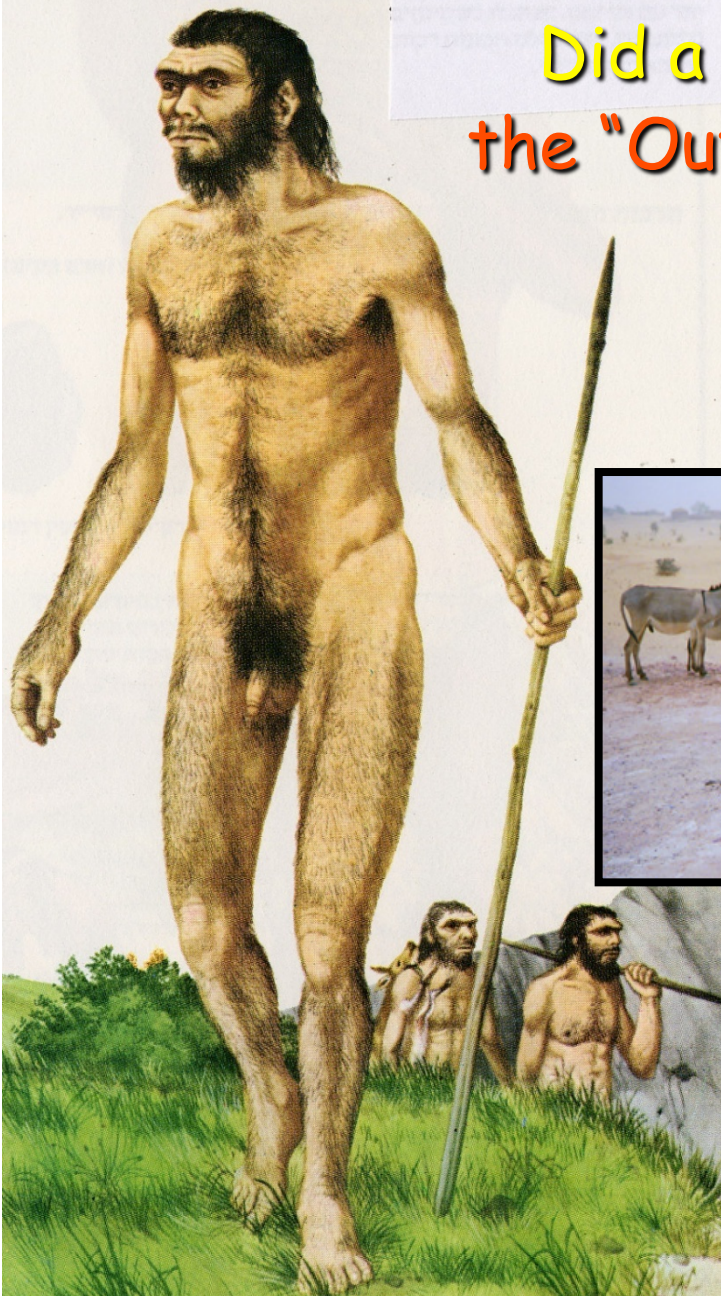
Almogi-Labin, 2004

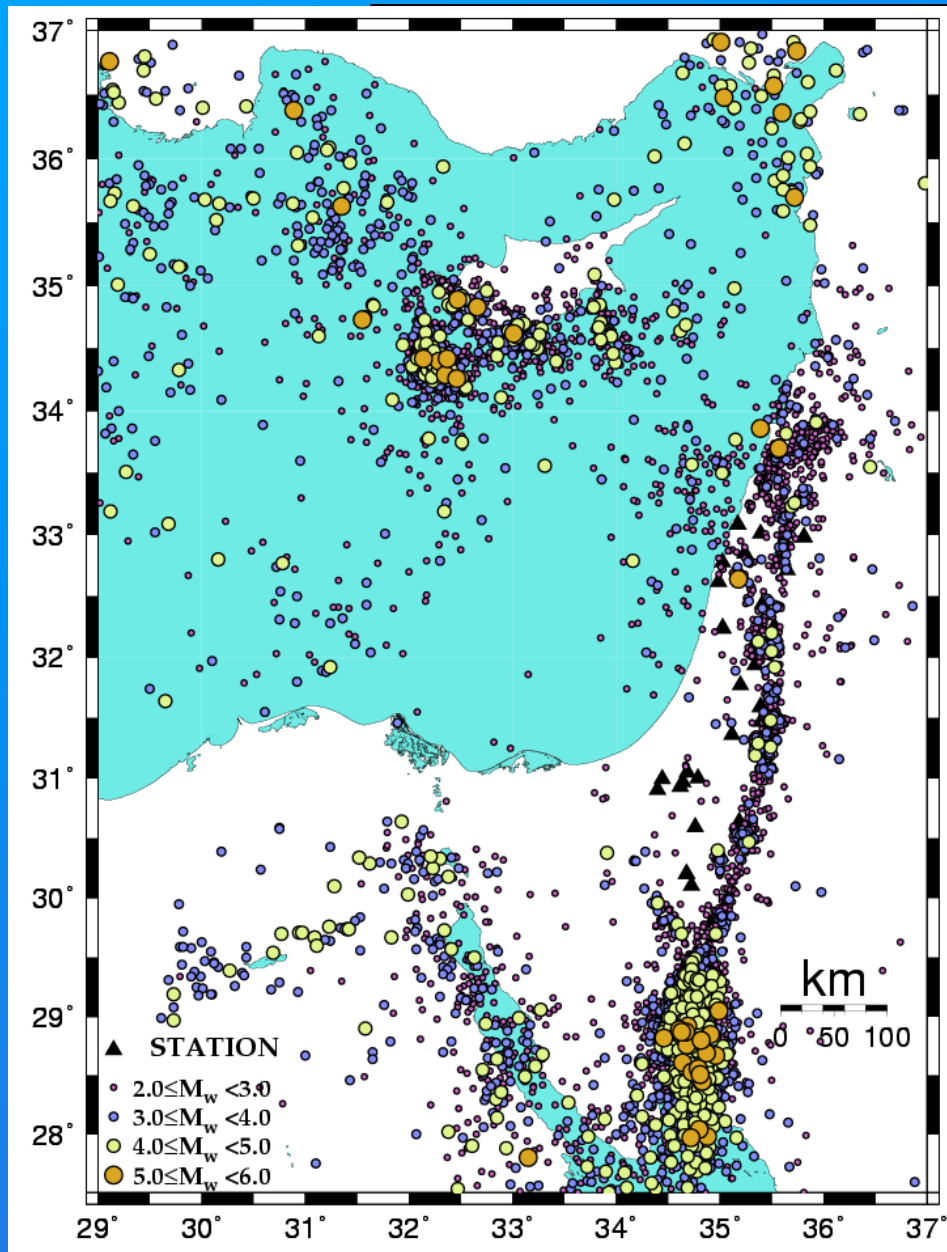


Red Sea - Glacial "humid" interval



# Did a wet interval allowed the "Out of Africa" migration ?





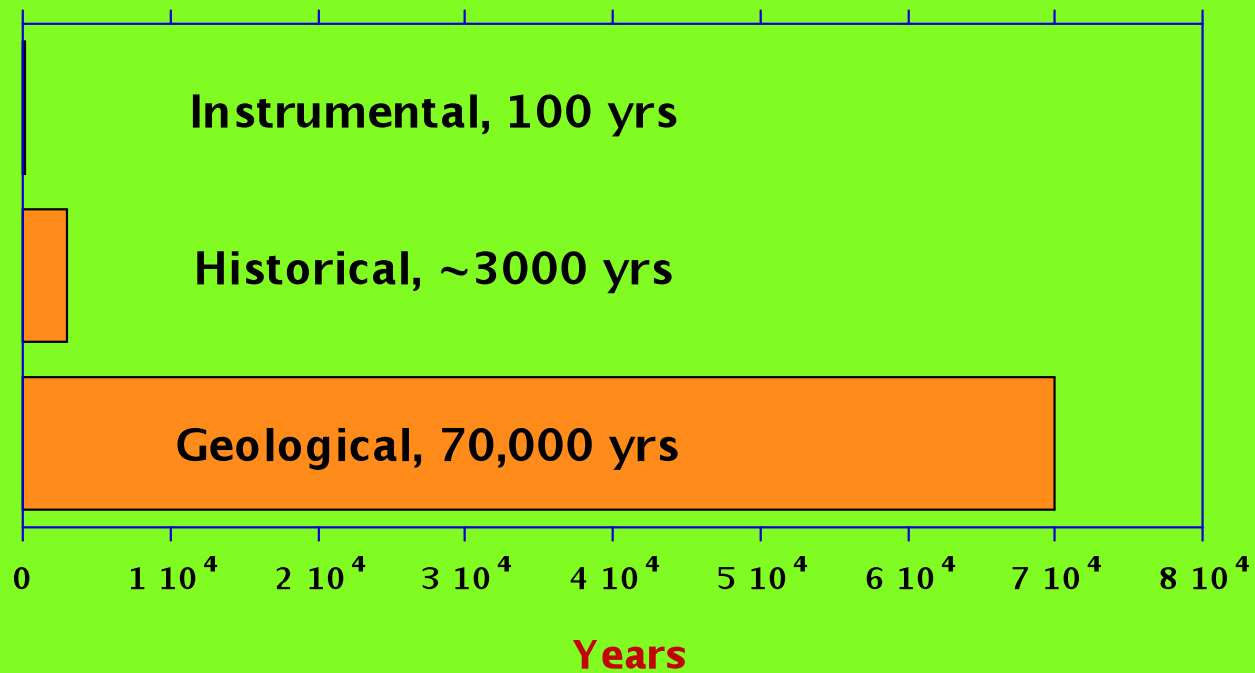
Earthquakes along the Dead Sea fault result from relative motion of Arabia and Sinai plates

EARTHQUAKES IN AND AROUND ISRAEL 1984-2003

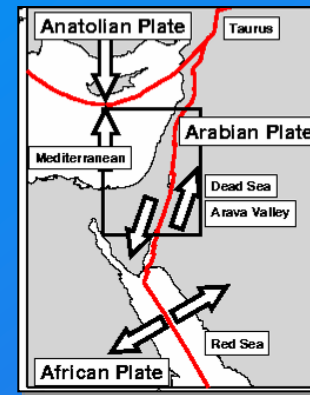
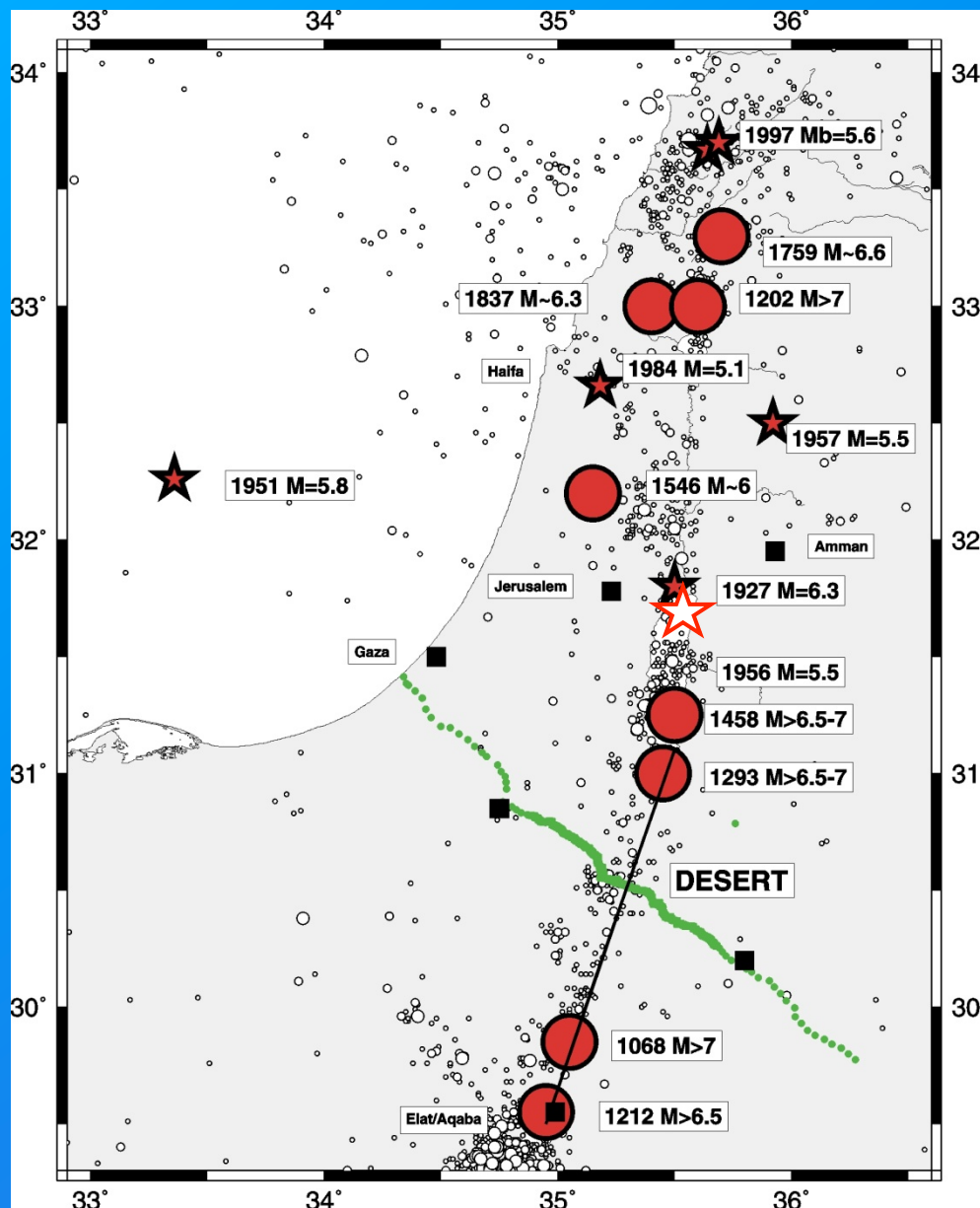


## Sources of Data in Israel

### Earthquake records







- Large earthquakes 1000 to 1900
- ★ Large earthquakes 1900 to 2000
- Seismicity 1980 to 2000
- ★ February 11 2004 Mb 5.1 earthquake

Unique geological conditions with a 4000 year catalogued earthquake history and a 70,000 year record of continental sedimentation



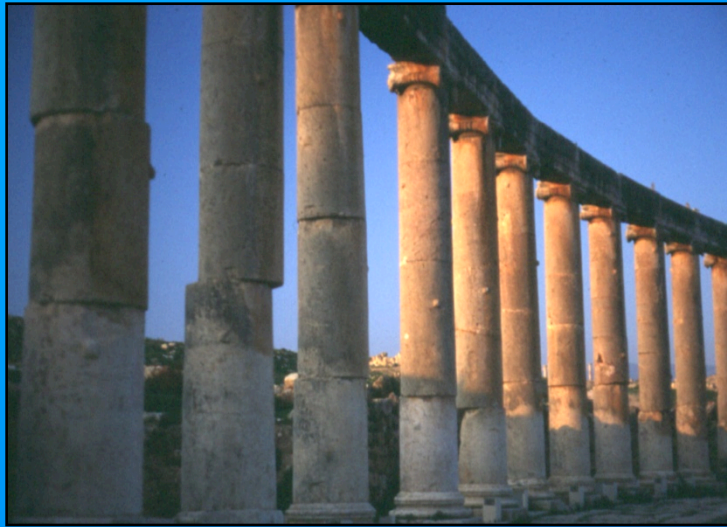
Nablus, 13:04, July 11, 1927



Near the Jordan River,  
east of Jericho

“The waters which came down from above stood and rose up in one heap, a great way off, at Adam, the city that is beside Zaretan: and those that went down toward the sea of the Arabah, even the Salt Sea, were wholly cut off: and the people passed over right against Jericho” Joshua 3:16.

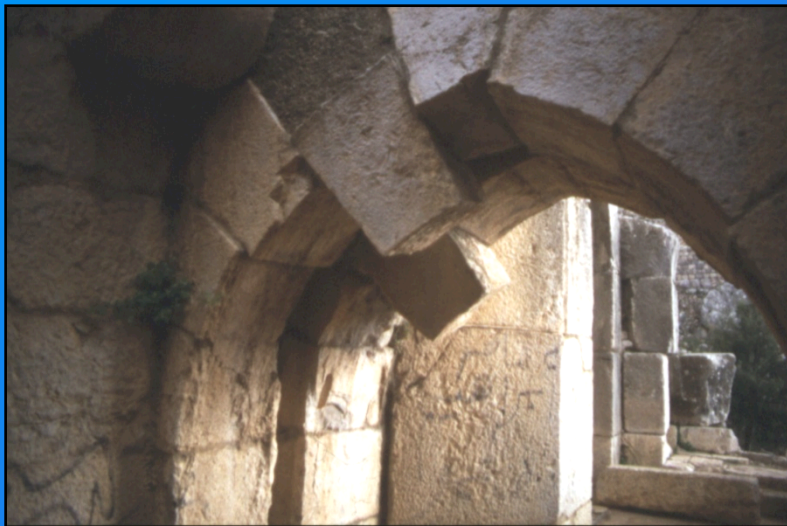




Jerash 749 AD



Sussita 749 AD



Kal'at Nemrod 1759



Jericho 1927

“At this time it was that the fight happened at Actium, between Octavius Caesar and Anthony in the seventh year of the reign of Herod and it was also that here was an earthquake in Judea, such a one as had not happened at any other time and which earthquake brought a great destruction upon the cattle in that country.

About 30,000 men also perished by the fall of houses, but the army, which lodged in the field, received no damage by this sad accident”

Josephus

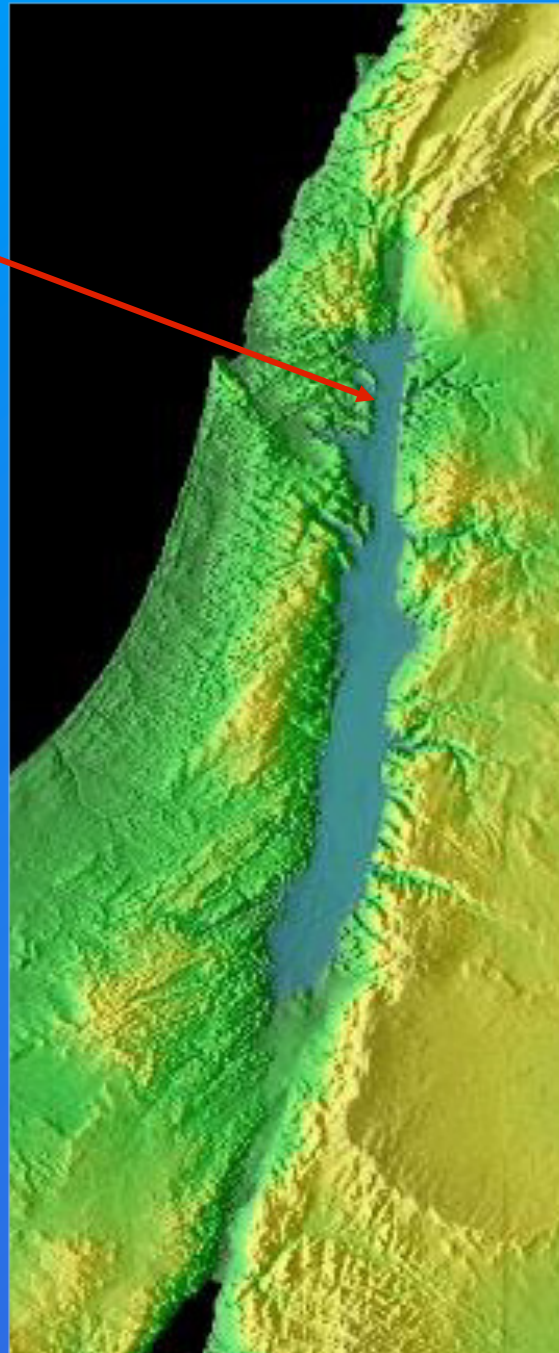
Antiquities of the Jews, Book XV, ch. 5,2



Qumran

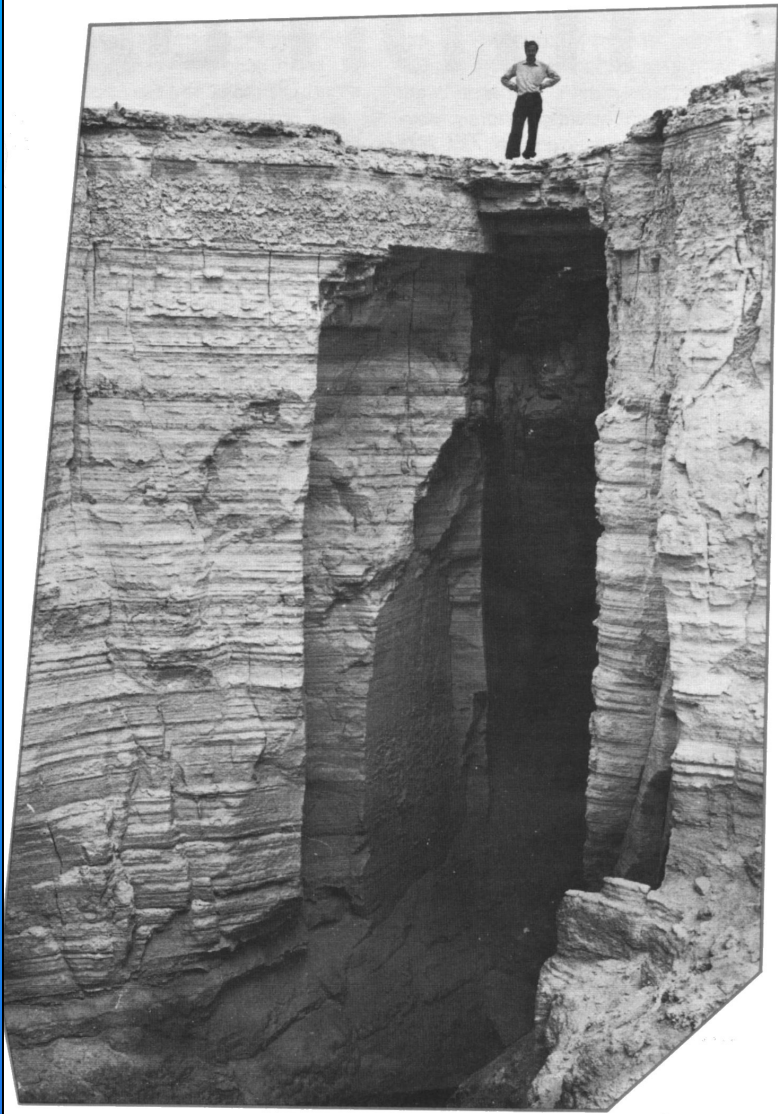


Lake Lisan  
68-15 kyr BP

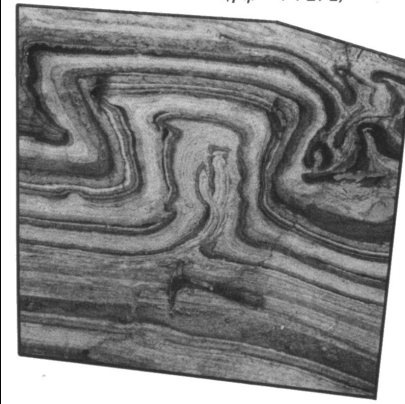




תצורת הלשון בנחל פרצים ובה  
 חילופים בין הלמינות הכהות והבהירות. סלעים  
 רכים אלה נחתרים בקלות ויוצרים נוף מבוהר.  
 (צילם ד"ר י' קרץ, המכון הגיאולוגי).

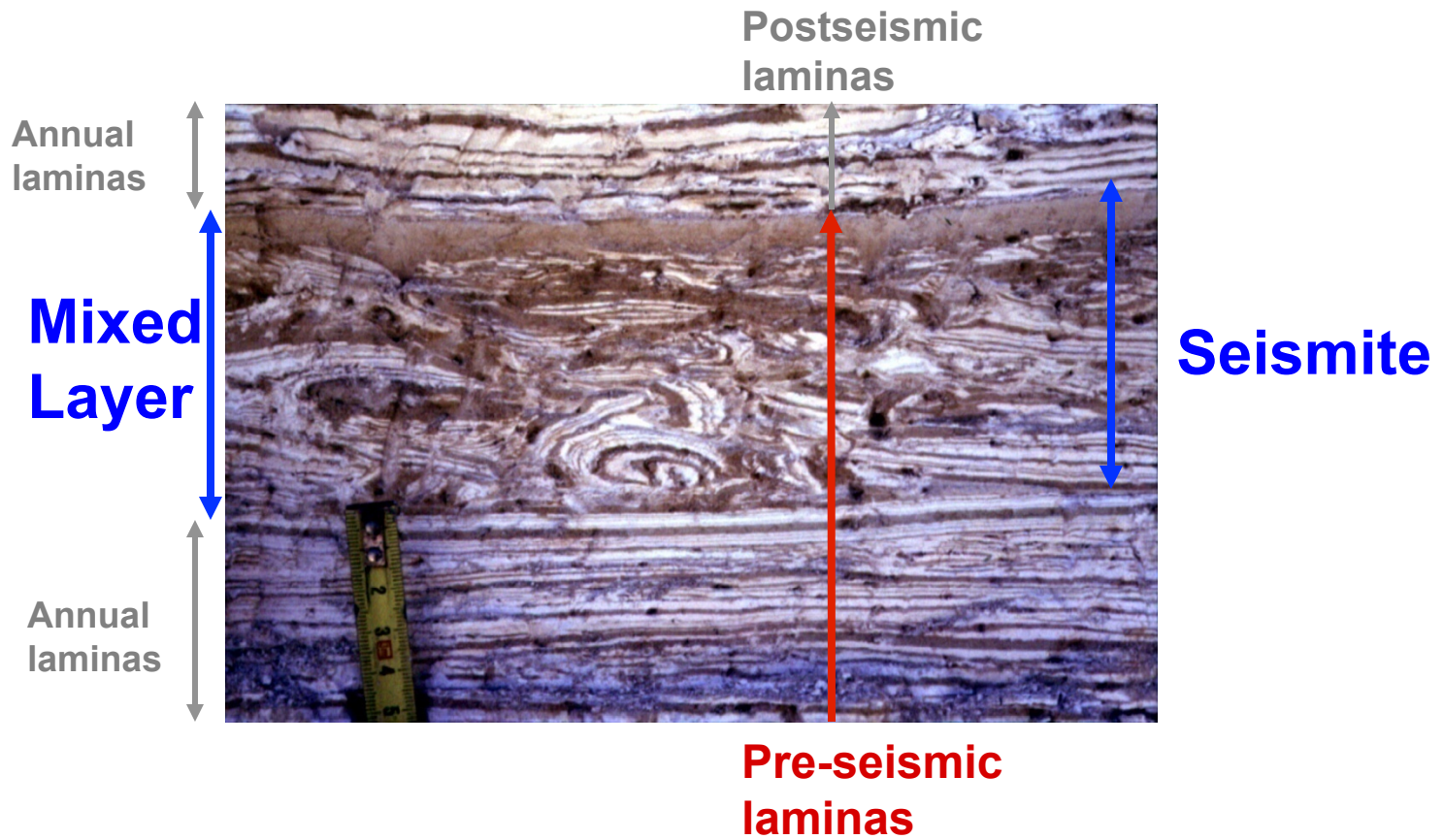


קמטים חריפים בתצורת הלשון בנחל  
 פרצים, בהם נראים בבירור חילופי למינות כהות  
 ובהירות. הפטיש משמש כקנה מידה. קמטים אלה  
 מצויים במקומות רבים בתצורת הלשון, אך מקורם  
 אינו ברור. חוקרים אחדים מניחים שהקמטים  
 נוצרו כתוצאה של רעידות אדמה בבקעי ים־המלח.  
 (צילם ד"ר י' קרץ).



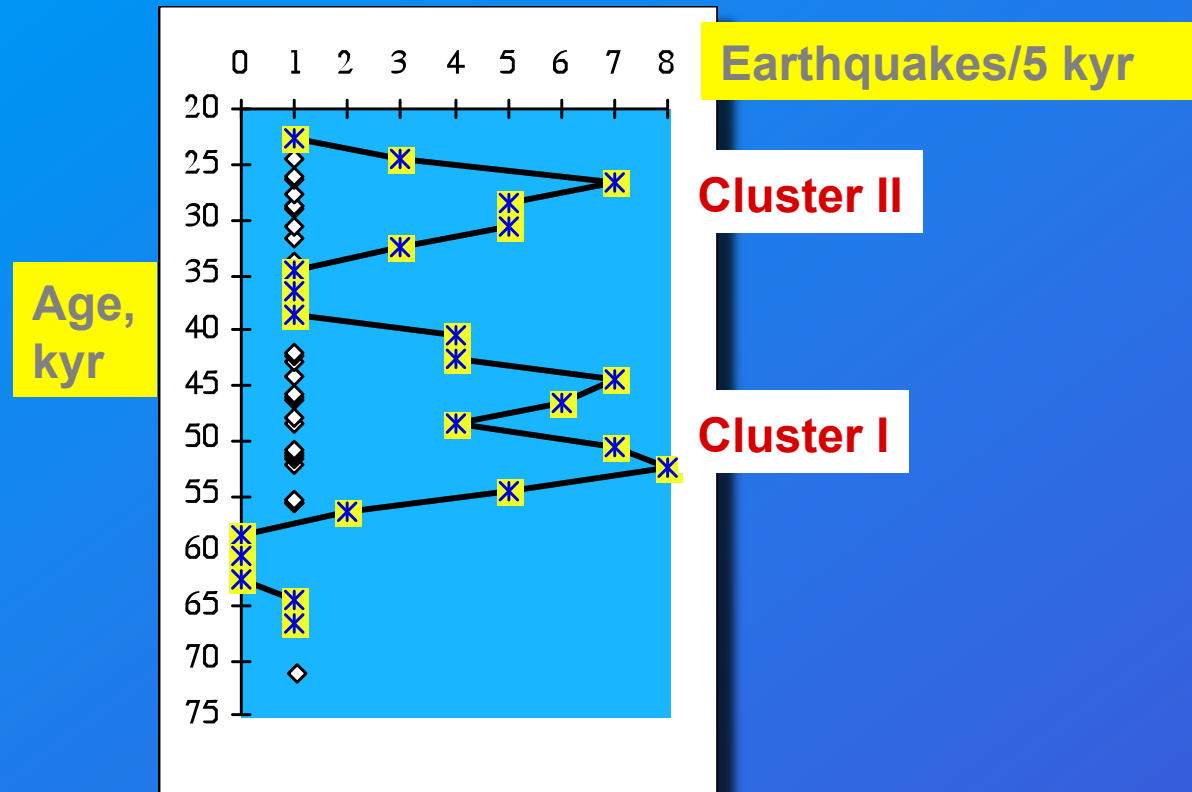
# Observation

# Interpretation





# Distribution of Seismites in the Lisan Formation



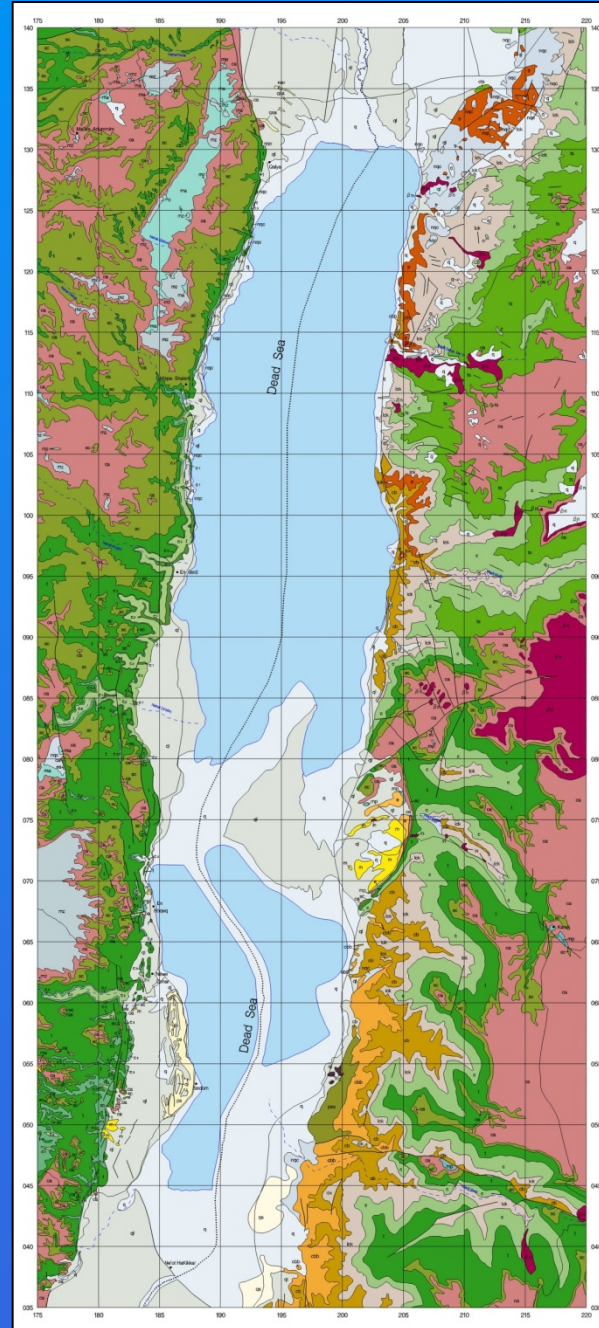
“...Large earthquakes could have ...  
contribute to both the physical and political  
collapse of the great centers of civilization  
at the end of the Bronze age ...

This probably began by an earthquake  
storm that unzipped the plate boundaries in  
the eastern Mediterranean between 1225  
BC to 1175 BC.”

Nur, 1998

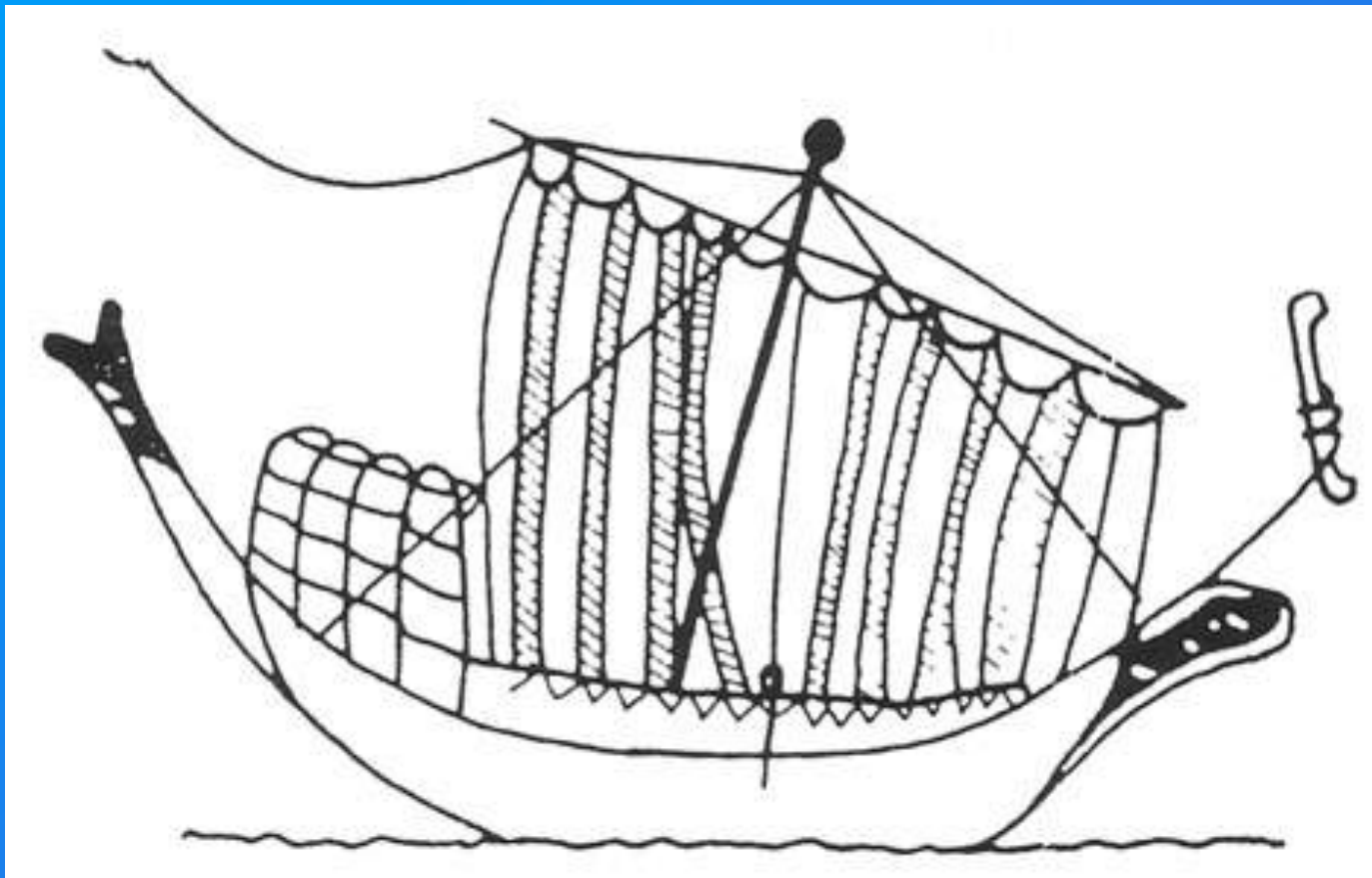


Shaded Topography Map



**חריט ספינה הלניסטית שנמצא במצדה**

**Etching of Hellenic vessel in Masada**





## Moline Boat 1847





270 li. 11. 1987  
23.11.1987  
Picard.

# OFFICIAL REPORT

OF THE

## United States' Expedition

TO EXPLORE THE

### DEAD SEA AND THE RIVER JORDAN,

BY

LIEUT. W. F. LYNCH, U. S. N.



Published at the National Observatory, Lieut. M. F. MAURY, U. S. N., Superintendent,  
BY AUTHORITY OF THE HON. WM. A. GRAHAM, SECRETARY OF THE NAVY.

BALTIMORE:  
PRINTED BY JOHN MURPHY & CO.  
No. 178 MARKET STREET.  
1852.



30th Congress, 2d Session.]

[SENATE.]

[EXECUTIVE, No. 34.]

### REPORT OF THE SECRETARY OF THE NAVY, WITH A REPORT MADE BY LIEUTENANT W. F. LYNCH, OF AN EXAMINATION OF THE DEAD SEA.

FEBRUARY 26, 1849. Read February 27, referred to the Committee on Commerce, and ordered to be printed.

NAVY DEPARTMENT, February 24, 1849.

SIR: In compliance with a resolution of the Senate, of the 8th instant, I have the honor to transmit herewith a copy of the report made to this department by Lieutenant William F. Lynch, of the United States Navy, of the examination by himself, and other officers of the Navy, of the Dead Sea.

I have the honor to be, very respectfully, your obedient servant,

J. Y. MASON.

HON. GEO. M. DALLAS,

Vice-President of the United States, and President of the Senate.

WASHINGTON, February 3, 1849.

SIR: In obedience to your order, I herewith submit my official report of the late expedition to the Dead Sea. It does not include the geological portion which will not be complete for several months. The maps and appendix will be sent as soon as copies can be taken.

The report is but a synopsis of my copious notes, but comprehends all that is material of a scientific nature. They embrace much matter, incidentally elicited by visiting such interesting places, which is wholly unfit for an official paper.

I therefore respectfully ask permission to publish a narrative after the official report has been called for.

I have the honor to be, your obedient servant,

W. F. LYNCH,

HON. J. Y. MASON,

Secretary of the Navy.

Lieutenant United States Navy.



REPORT OF THE SECRETARY OF THE NAVY,  
WITH A  
REPORT MADE BY LIEUTENANT W. F. LYNCH,  
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Hon. J. Y. MASON,

*Lieutenant United States Navy.*

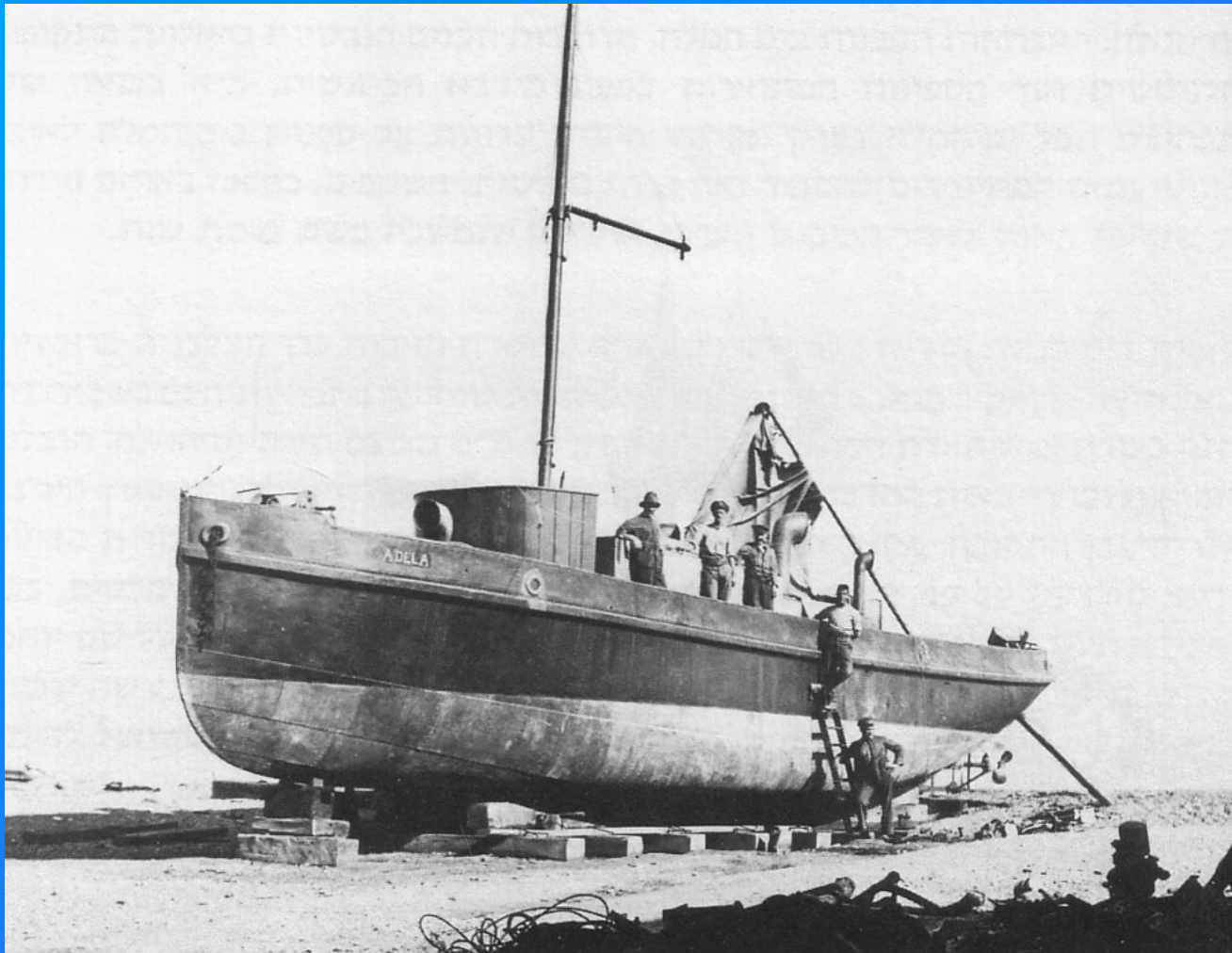
*Secretary of the Navy.*



## Dead Sea 1880



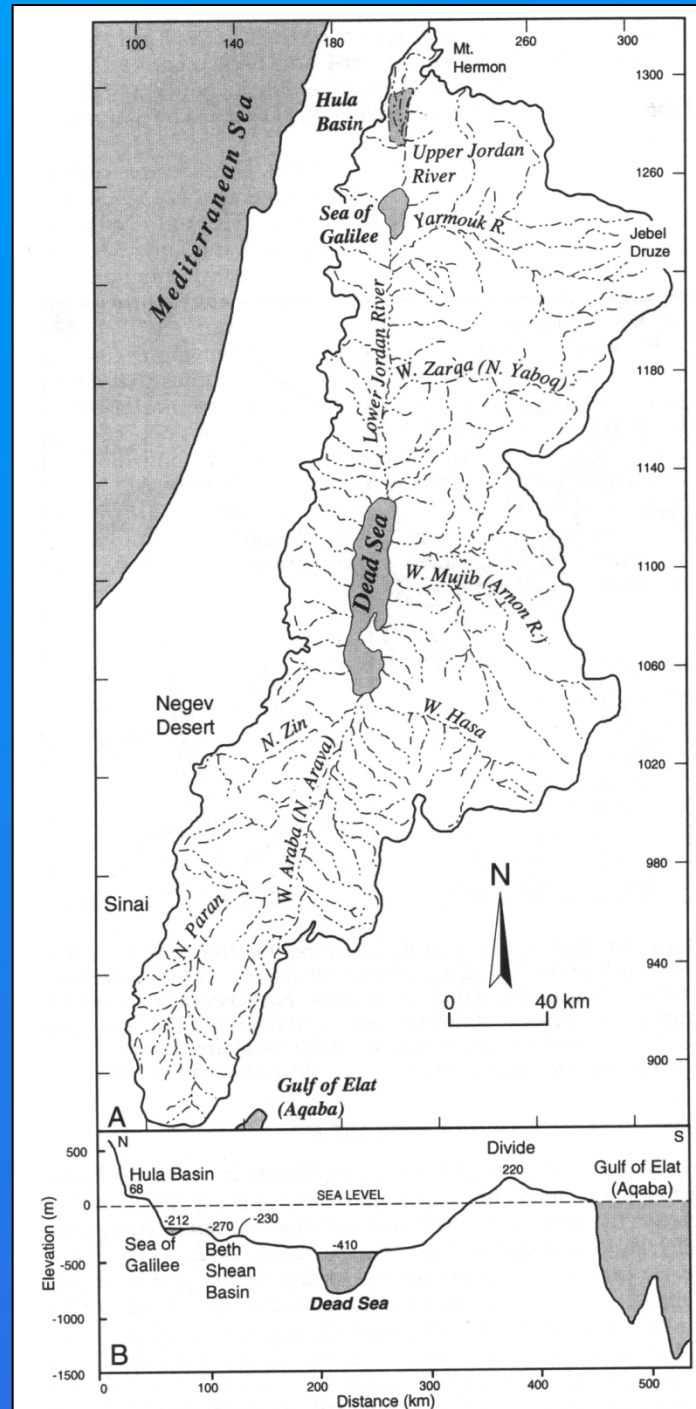
# The German Boat Adela, World War I



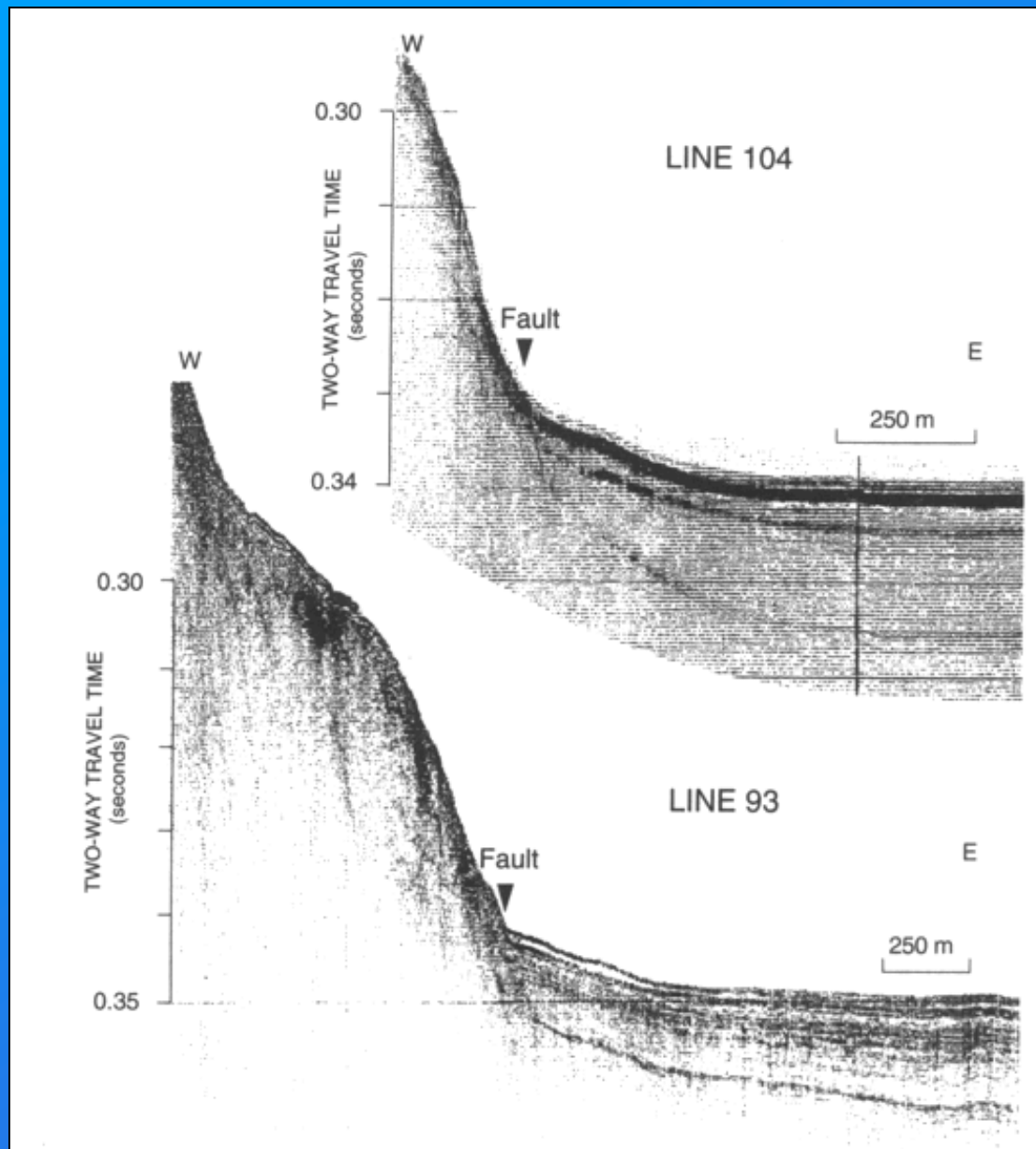


## Special characteristics of the Dead Sea basin:

- Situated on a plate boundary
- Can be served as a model for continental break-up
- Its surface is the deepest place on Earth
- Thick atmosphere
- Very deep basin
- Deep crustal earthquakes
- Hypersaline waters
- Its sediments serve as an excellent recorder of paleoclimate
- Its sediments provide evidence for paleoseismicity
- Large concentration of evaporitic salts
- Specialized forms of life
- Influenced the course of human history

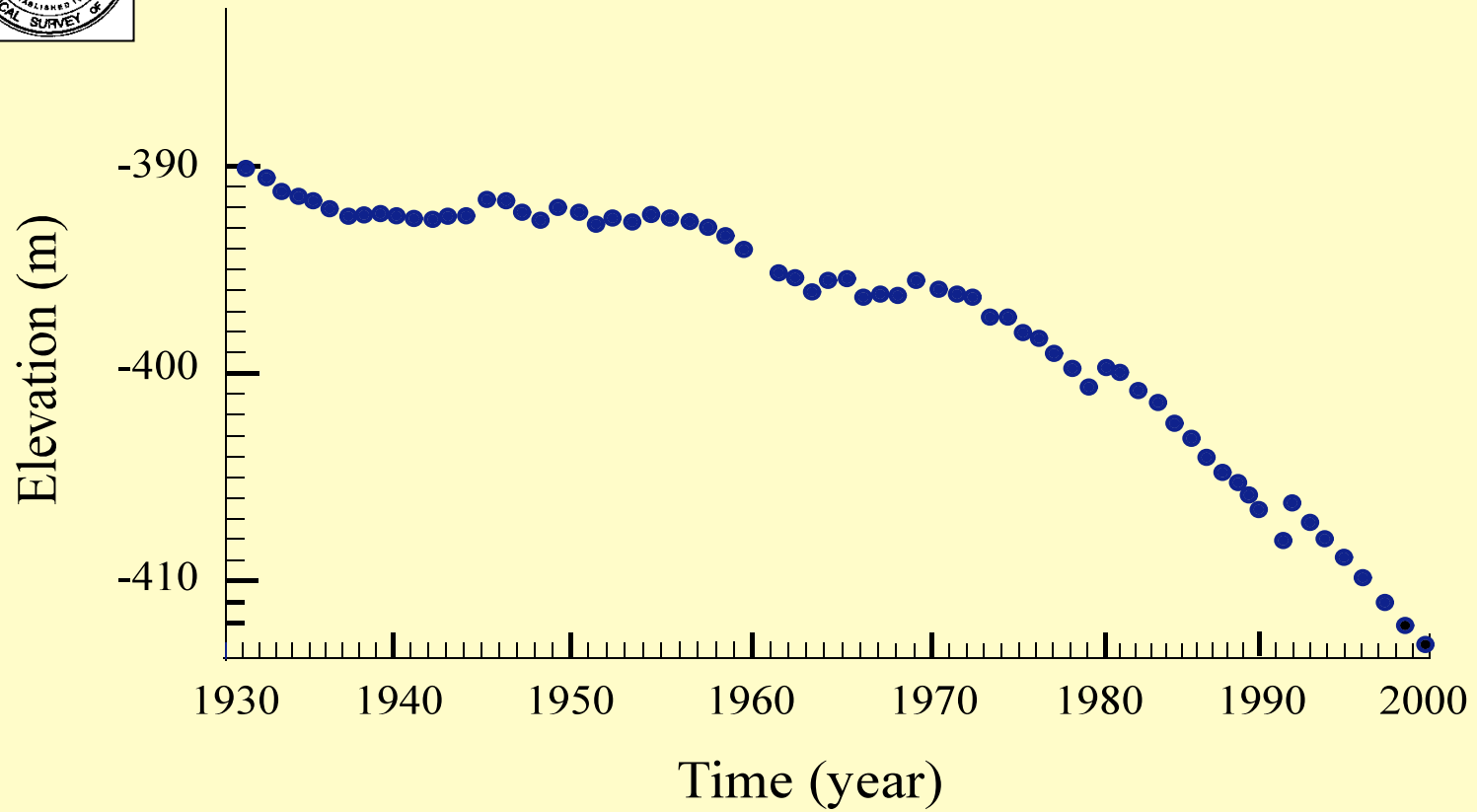








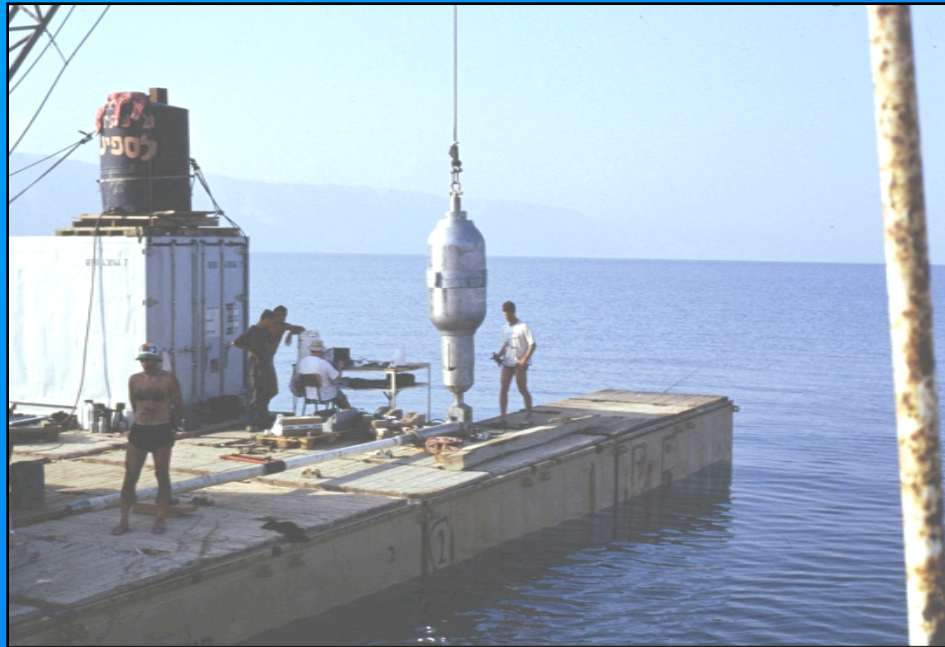
## Dead Sea water level since 1930





# Selcore corer in the Dead Sea







# Photograph showing the lithology of Core 7 in the Dead Sea

USS = Upper Salt Sequence

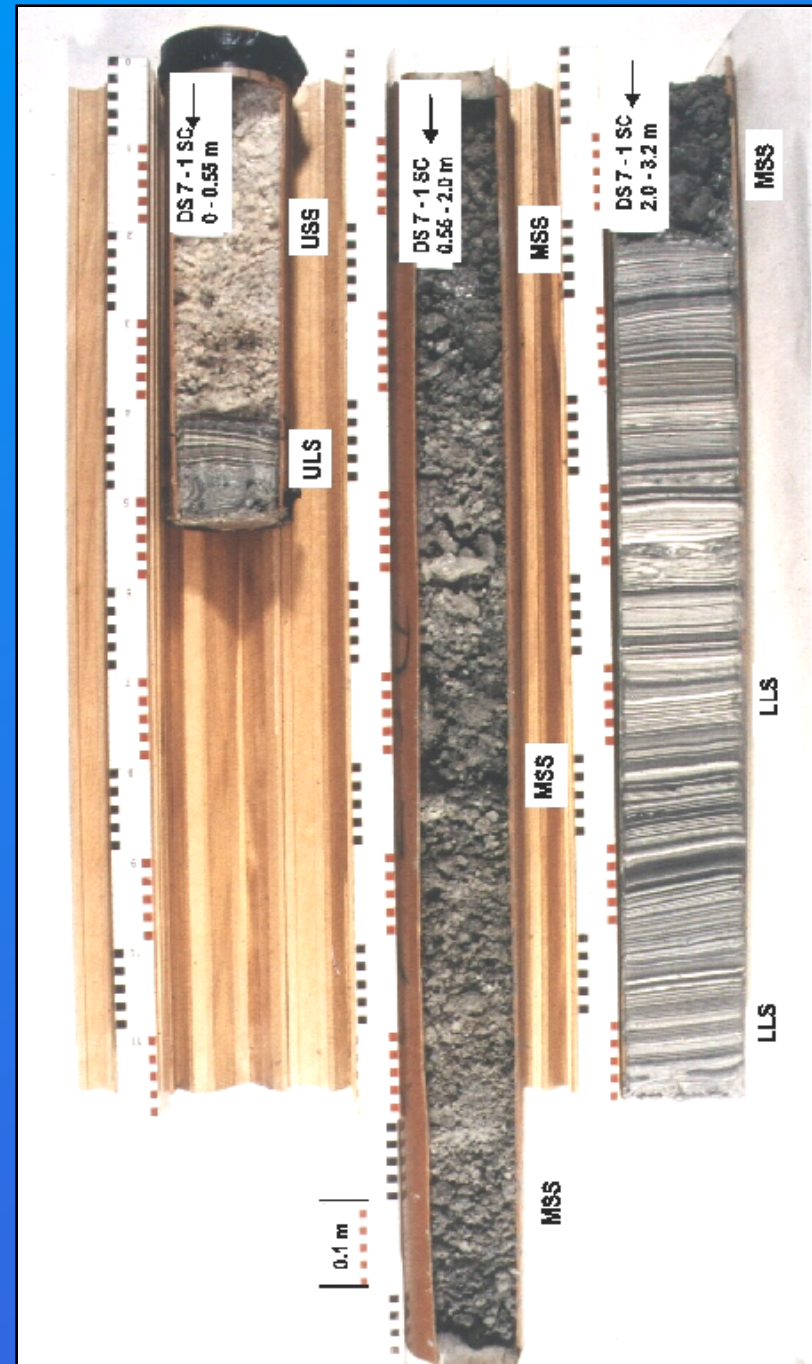
ULS = Upper Laminated Sequence

MSS = Middle Salt Sequence

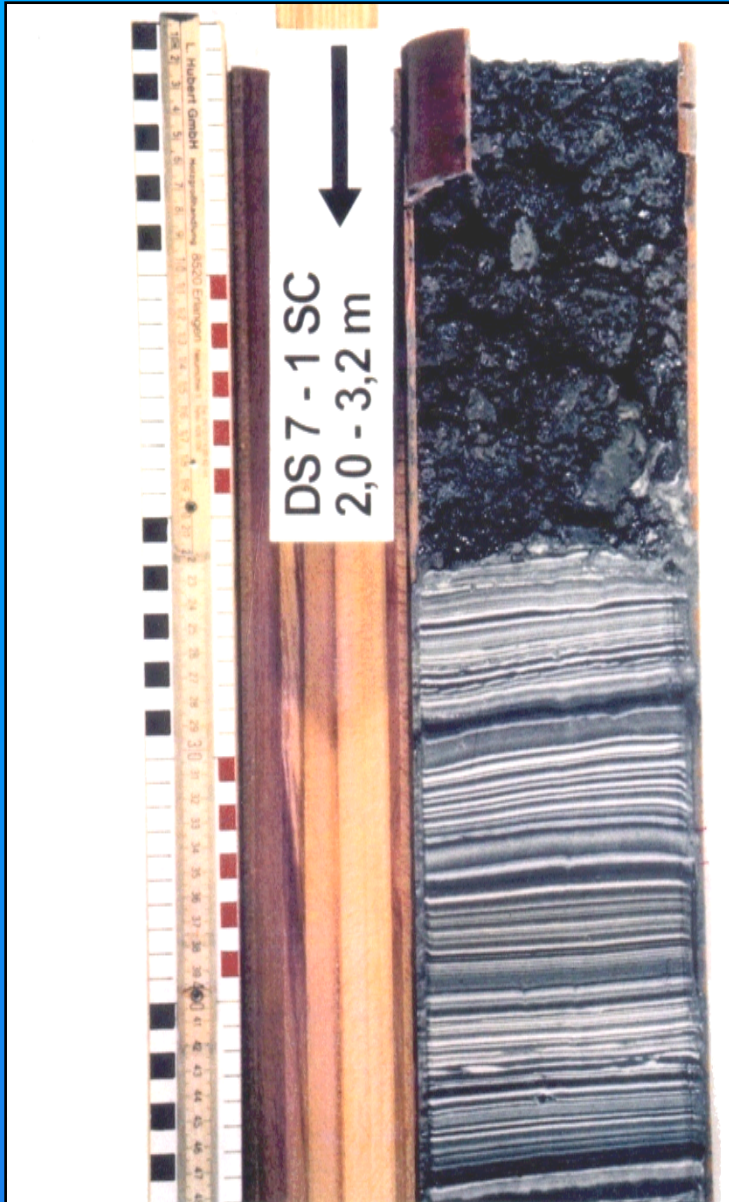
LLS = Lower Laminated Sequence

Length of entire core is 3.65 m

Age at bottom of LLS is 2270 years



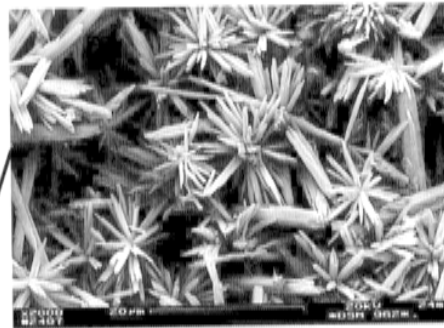
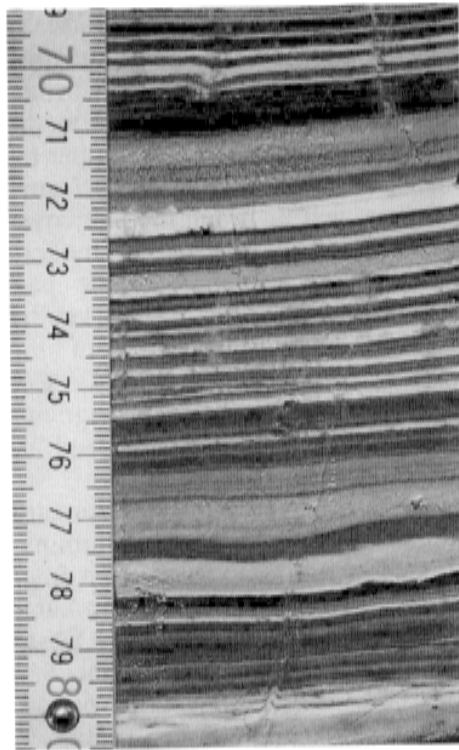




Heim, 1995



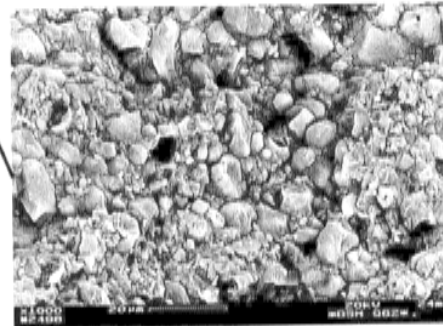
Ein Geddi Synagogue



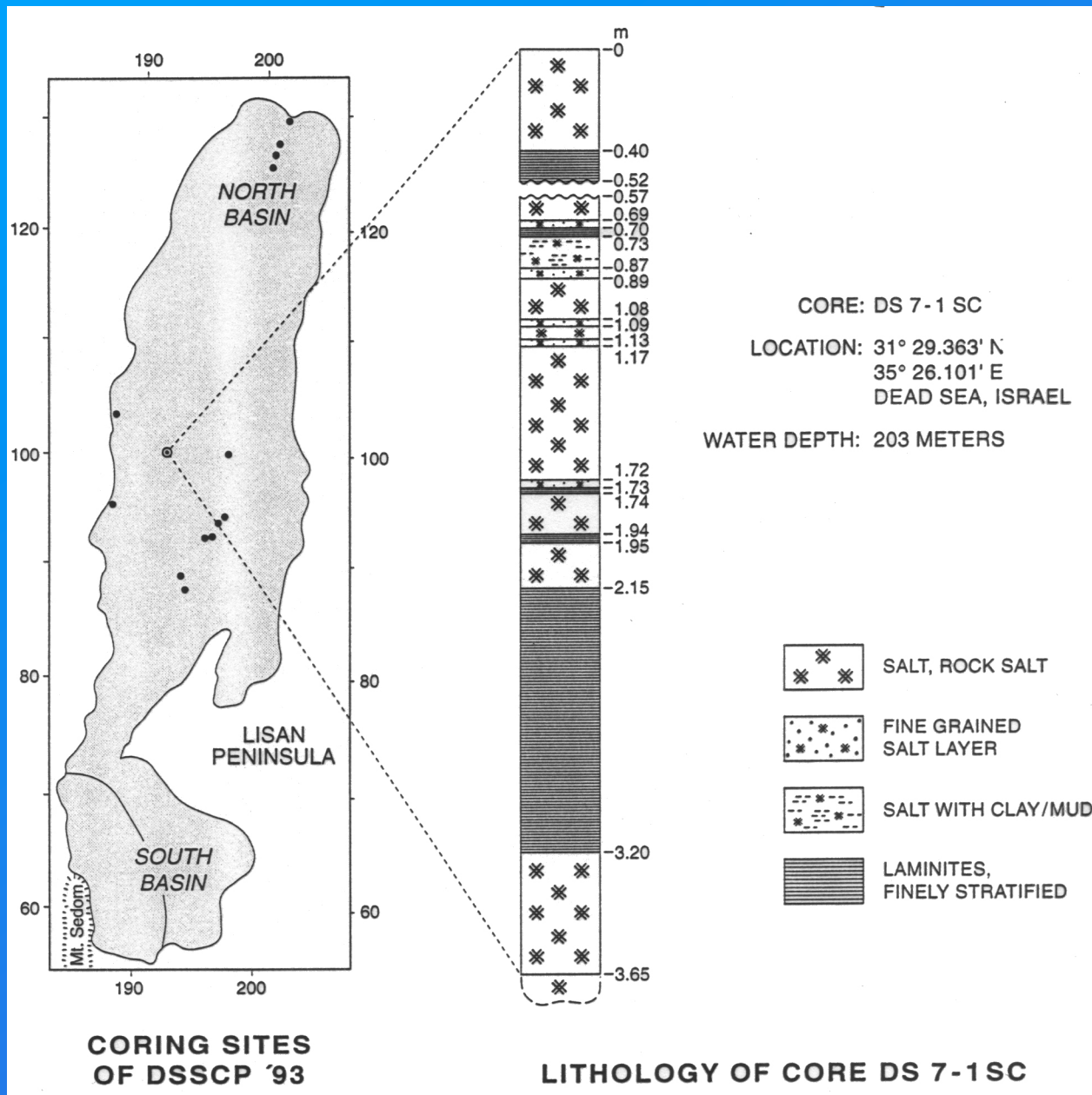
Aragonite needles  
and aggregates



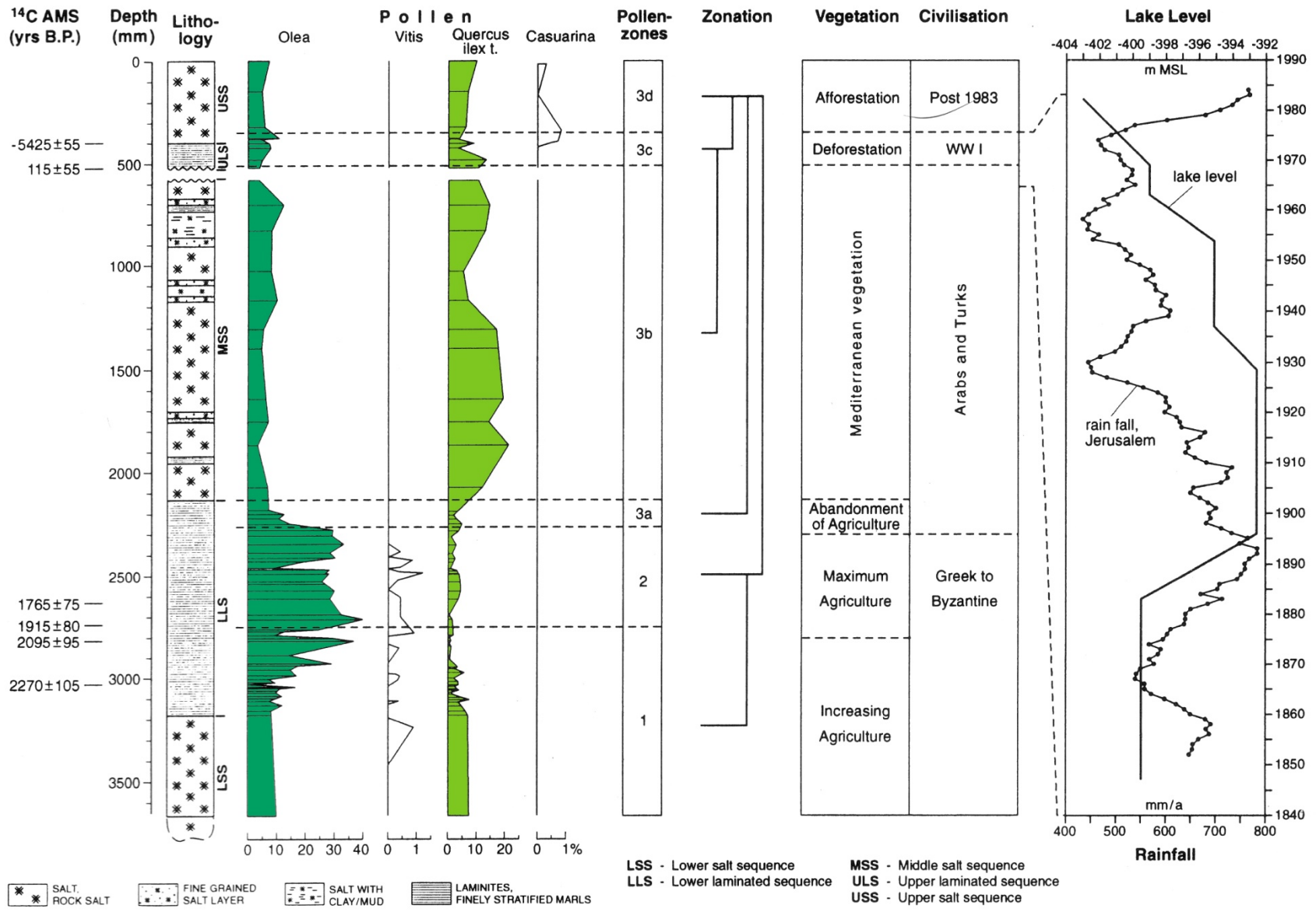
Gypsum crystals



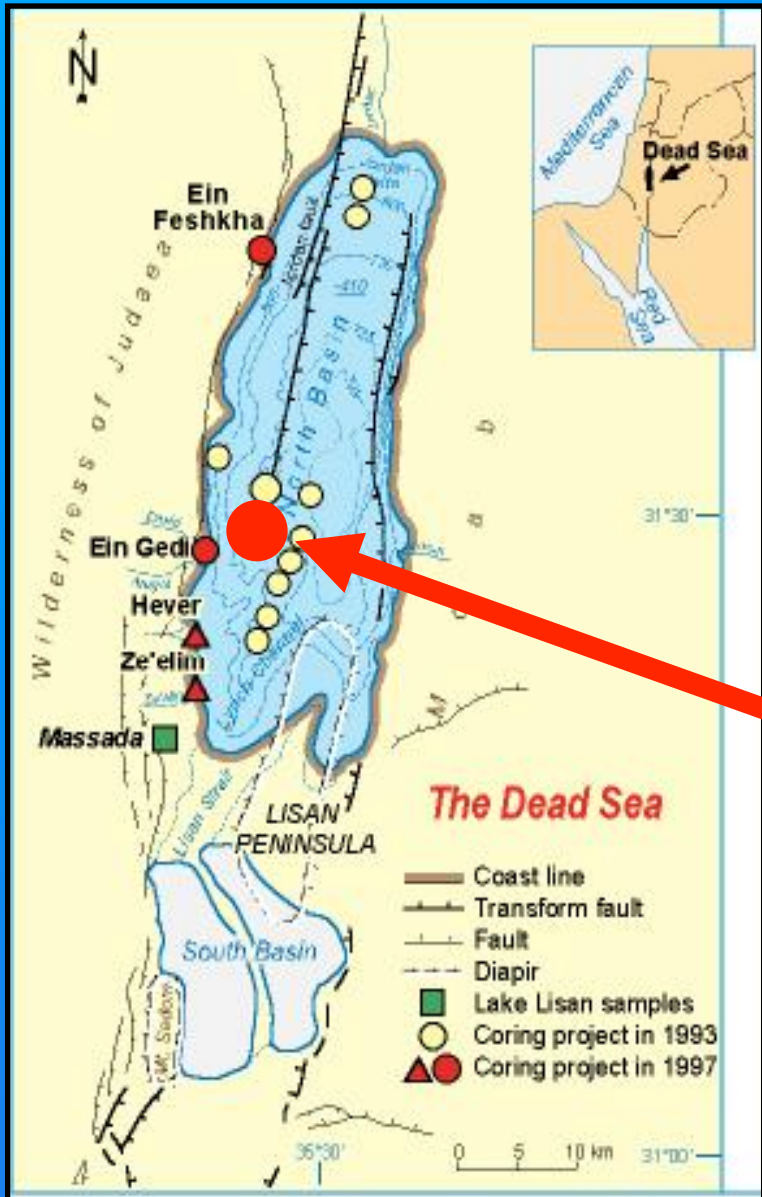
Detrital clasts and minerals







# ICDP-drilling project



## The GLAD800 drilling platform





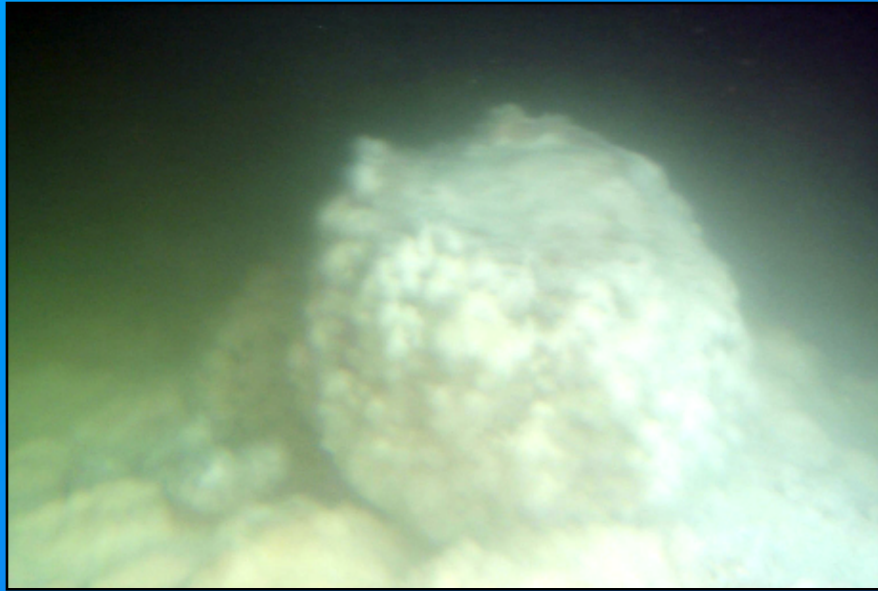
**Submersible "Delta"  
in the Dead Sea  
November 1999**

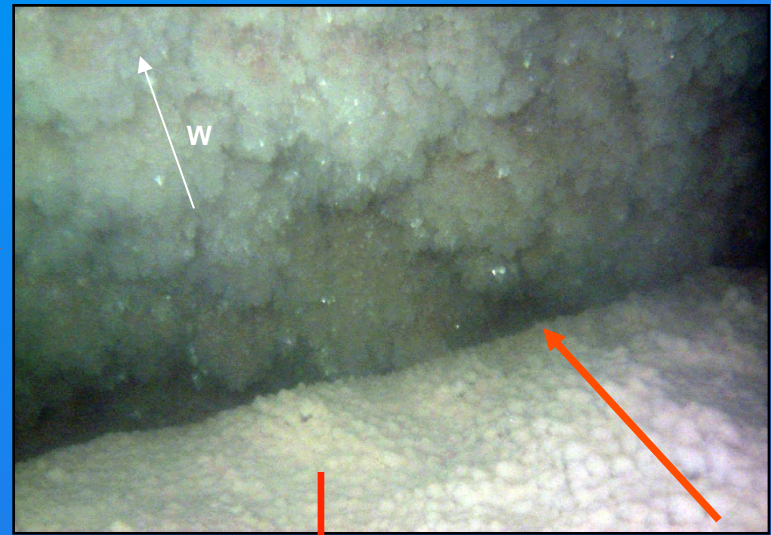
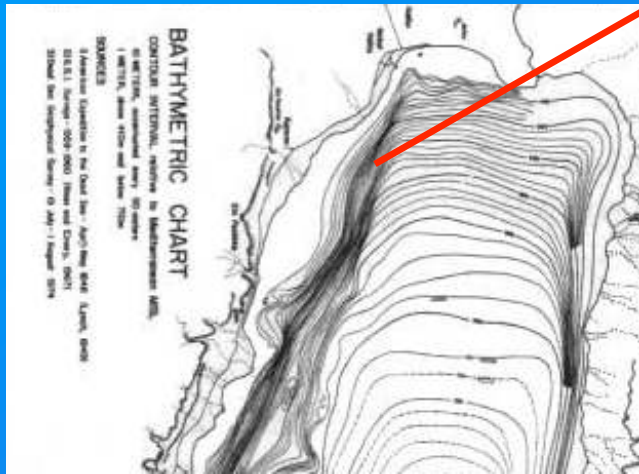










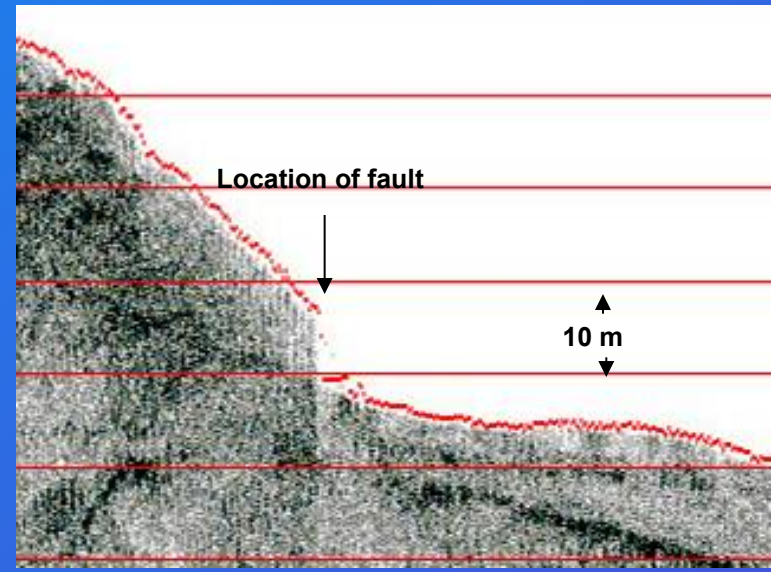


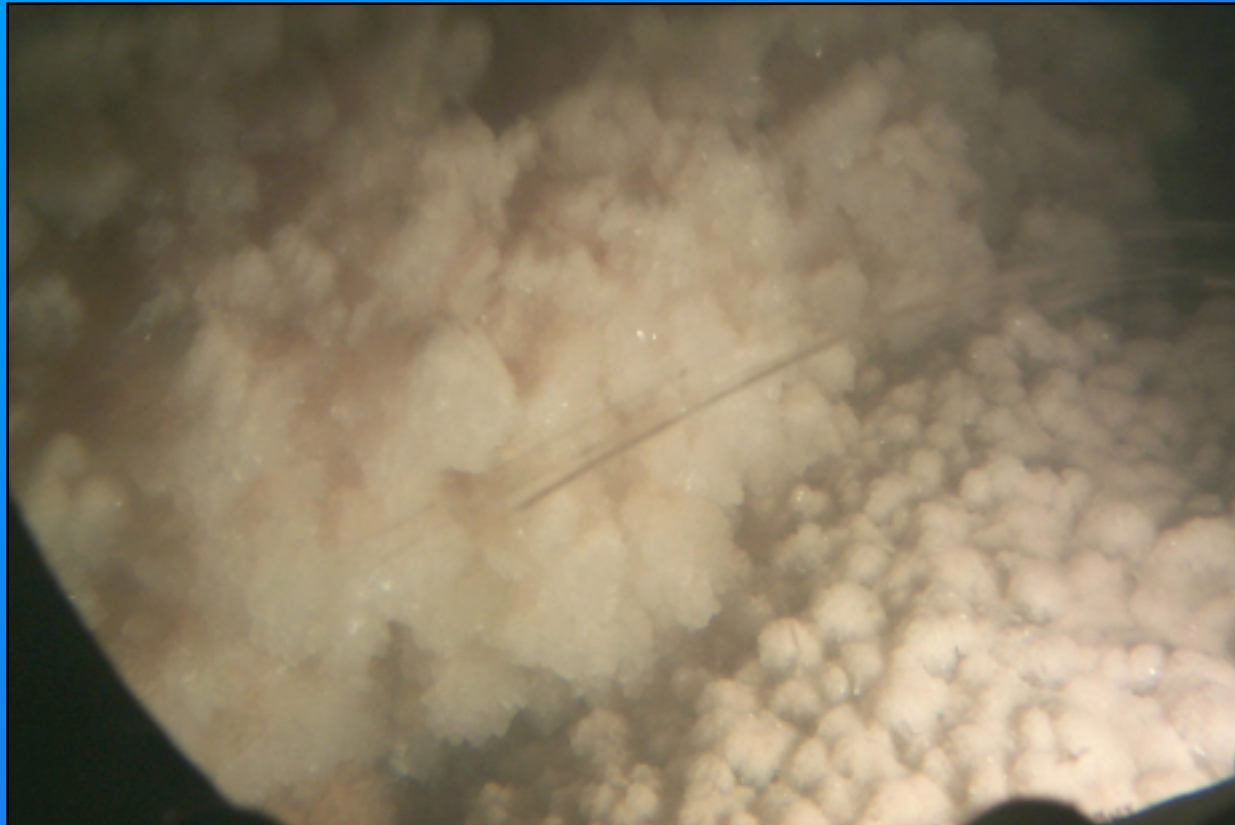
2 m

OPEN!!

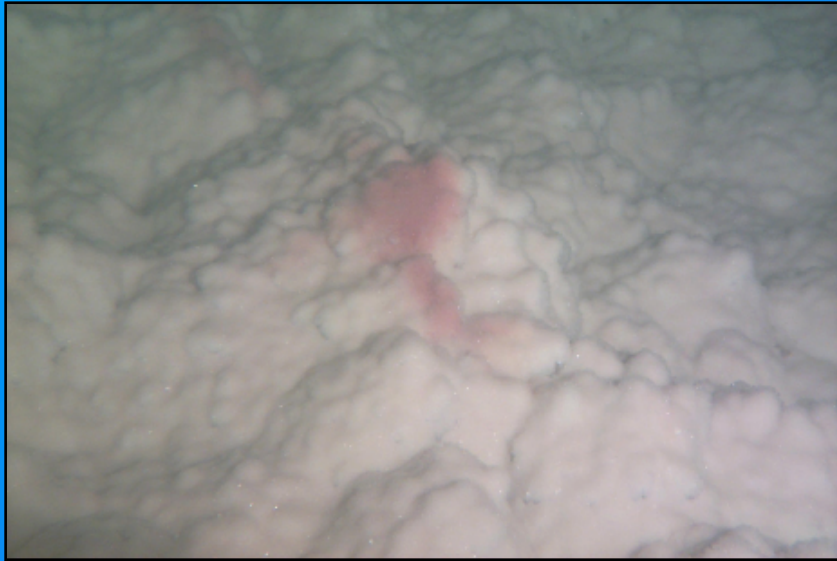
W

E









# Summary

- Active tectonic processes in the Dead Sea region have influenced a wide variety of phenomena, such as:
  - Ground water regime
  - Earthquakes activity
  - Migration of hominids
  - The course of human history
  - Migration of birds
  - Distribution of flora
  - Distribution of fauna
  - Formation of life
- The investigation of these and other phenomena is interdisciplinary in nature and requires coordination and collaboration between scientists from several fields in the region and elsewhere.
- Dead Sea research serves as an example of peaceful cooperation between the region's neighbors.

# The Dead Sea Peace Triangle

Jericho

Ein Gedi

Wadi Mujib





# Summary and Questions

- The crustal structure under the Dead Sea fault is different than under its surroundings.
- Uplift of the northwest Arabian plate and subsidence of the Dead Sea fault took place in two stages, 5 My and 2 My years ago.
- Is there a connection between tectonic processes, such as uplift and earthquakes, and human migration?
- Large-scale climatic changes took place in the Mediterranean and Red Sea regions in the last 2 My.
- What is the influence of climatic changes on human migration?
- Are these the only factors that triggered and controlled human migration?



**THANK YOU**