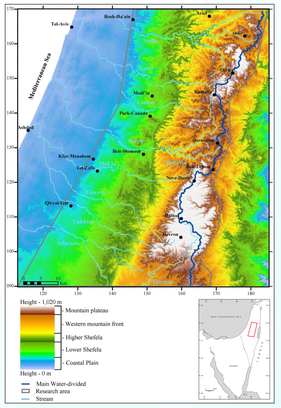
Detailed morphostratigraphy analysis as a key to reconstruction of uplift and paleogeography – a case study from the Judea Mountains

O. Bar [1,2*], E. Zilberman [1], Z. Gvirtzman [1], S. Feinstein [2]

1- Geological Survey of Israel, Jerusalem, Israel 2- Department of Geological and Environmental Sciences, Ben-Gurion University of the Negev, Beer-Sheva, Israel
*(farago@bgu.ac.il)

Introduction

The 800-1000 m high Judea Mts, form part of the mountain backbone of central Israel. This area was submerged under the sea until the Middle Eocene. Post Middle Eocene rocks, however, were largely eroded from the uplifted ridge. Therefore, reconstruction of the uplift stages and paleogeography of the Judea Mts. in this study is based mainly on a detailed morphostratigraphic analysis.



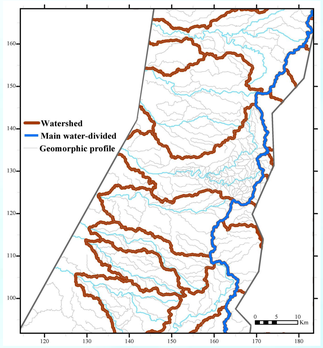
Research Goals:

The goals of this research is to identify:

1. The stages of the mountain backbone uplift and their age.
2. The amount of uplift during every stage.
3. The style of the uplift (folding, tilting or epirogenic).
4. The formation age of the western flank of the mountain backbone.

Work principals:

Geomorphic surfaces (GS) are low-relief terrains, formed by subaerial erosion or marine abrasion during periods of tectonic stability. The relicts of the GSs are best preserved along major and secondary water divides. Only widely distributed, continuous and close GSs remnants, discordant to geological structure and lithology, are reliable in reconstruction of GSs. The height of the slopes that separate between the GSs represents the amount of uplift during tectonic events, followed by stream incision and denudation.



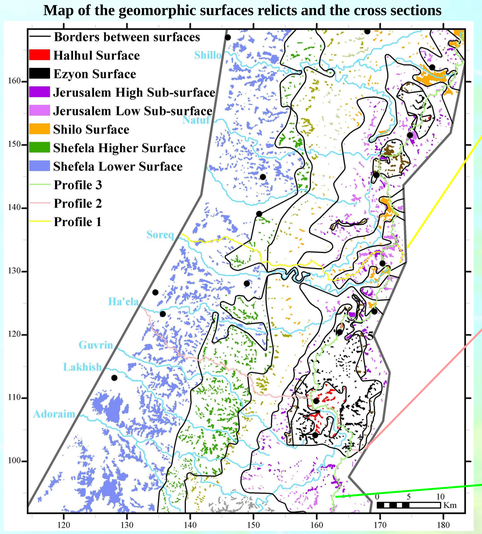
Methods:

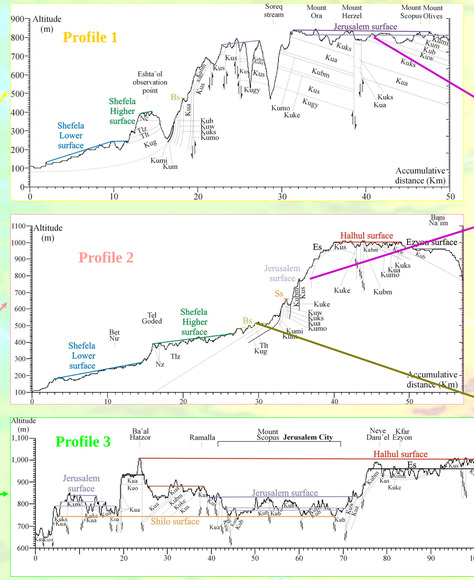
The morphostratigraphic analysis is based on identification and mapping of geomorphic surfaces:

1. Identification of GSs relicts and the slopes that separates between them by analysis of about 300 topographic profiles along main and secondary water divides.
2. Establishing a morphostratigraphic order of the relicts.
3. Paleogeographic reconstruction of the GSs along the mountain ridge.
4. Identification of the main uplift stages and the amount and age of each stage.

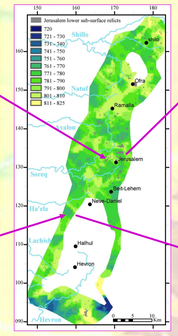
Analysis and results

Map of the geomorphic surfaces relicts and the cross sections

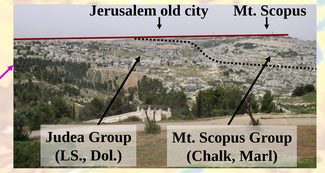




Structural map of Jerusalem surface



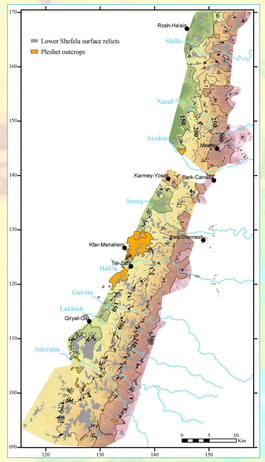
The Jerusalem surface around Jerusalem



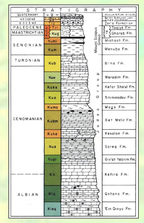
Abrasion terrace of Jerusalem surface cut into the westward tilted strata of the western mountain front

Abrasion terrace of Barkan surface cut into the tilted strata of the western mountain front

Structural map of the Lower Shefela surface



Legend for the geological section



Results

Results – Five major geomorphic surfaces, separated by ca. 100 to 200 m high slopes, were recognized:

The Lower Shefela surface: was formed under multiple Middle Miocene to Late Pliocene abrasion and denudation events. The surface is capped by shallow marine rocks of this age.

The Higher Shefela surface: An early Middle Miocene surface, capped by shallow marine rocks of this age.

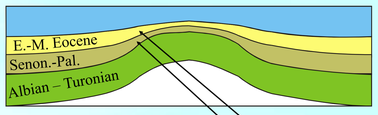
The Shilo surface: An Early Miocene surface, composed of terrace systems, gradually merge into narrow abrasion terrace.

The Jerusalem surface: A Middle Oligocene surface, expressed as a wide E-W oriented valleys, crossing the Judean Mt.

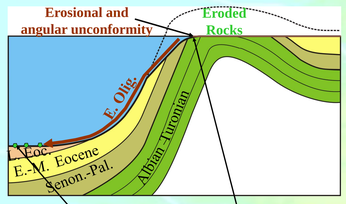
The Halhul surface: A Late Eocene to Early Oligocene surface, which is the western part of the regional Arabian Plateau.

Reconstruction of Paleogeographic and main uplift stages:

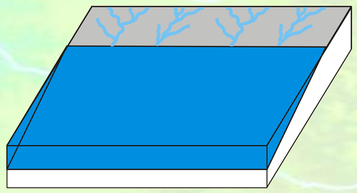
Middle Eocene: Mild structure, pelagic environment



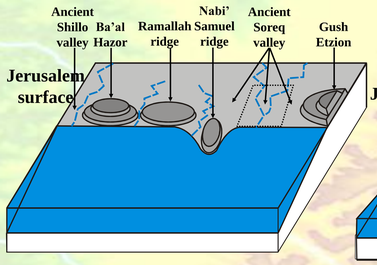
Late Eocene: Major folding and uplift followed by erosion



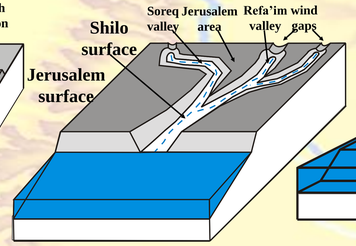
Early Oligocene: Development of the extensive Halhul surface (the Arabian Plateau)



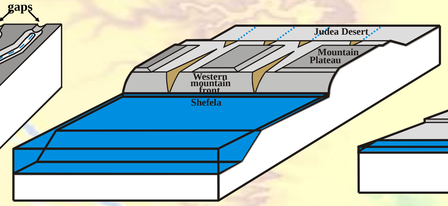
Middle Oligocene: 100-200 m minor uplift
Late Oligocene: Wide valleys of the Jerusalem surface crossed over the mountain plateau



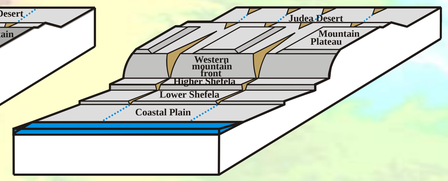
Early Miocene: Fast major 400 m uplift; Deep incision formed the present regional water divide; A short break is represented by the Shilo surface



Middle Miocene to Middle Pliocene: Stability period, minor ~100 m uplift phases; Transgression produced abrasion and formation of the Shefela surfaces



Late Pliocene to Present: 100-150 m minor uplift phase, subtle regional tilting to the west; Sedimentation, progradation and building up of the Coastal Plain



Western mountain front – formation age:

Constraints for the earliest age:

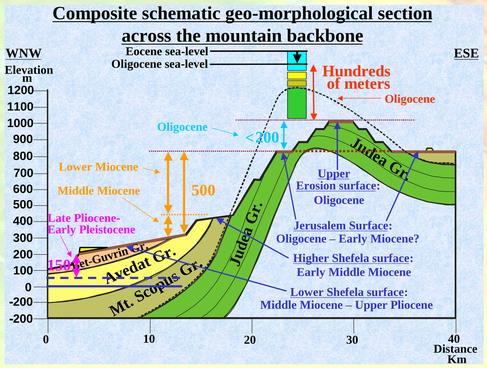
1. Only a third of the present inclination was achieved in the Senonian.
2. E. to M. Eocene mild ramp and phases of shallow slumps (Buchbinder et al., 1988).

Constraints for the youngest age:

1. Early Oligocene deposition of clasts derived from the mountain backbone.
2. The mountain plateau truncates the folded layers of the western mountain front.

Conclusion: the folding and formation of the main morphology of the western mountain front occurred during the L. Eocene – Early Oligocene

Uplift stages:



The morphological steps between the surfaces represent two major and three minor phases of uplift:

1. A Late Eocene - Early Oligocene phase of a few hundred meters.
2. A Middle Oligocene phase of about 200 m or less.
3. An Early Miocene fast uplift of about 400 m.
4. A continuous Middle Miocene phase of about 100 m.
5. A Late Pliocene phase of 100-150 m