

Supplementary Material Figure Captions

- S1 Multi-channel seismic reflection profile DS-2014 showing two basins Kefar Baruch (B2) and Gennigar (B3). Post-Miocene shear vertically offsets (10s of meters) the volcanic flows of the Lower Basalt Formation and the overlying Clay Series and Bira Formations. Most of the shear centers on the Kefar Baruch and Gilboa West faults. The flows thicken towards the Gennigar basin (B3) depocenter. The Nazareth fault borders B3 from the ENE (growth fault).
- S2 Multi-channel seismic reflection profile DS-2008 showing NW oriented faults cutting the Kefar Baruch basin fill. Vertical shear is accompanied by small-scale folding (1 km width). A possible common deep root for this faults is suggested.
- S3 Multi-channel seismic reflection profile DS-3007 across the Ta'anach basin (B5). The profile parallels the strike of the basin. Cretaceous structures- Umm El-Fahm anticline and Shekhem syncline are offset and distorted. Note the Eocene sediments of the Avedat Group are missing northwest of Avital fault where Hayogev-Mizra high (HM) stayed high. Taanach 4 crossed the Lower Basalt Formation unconformably overlying the Santonian chalks of Mt. Scopus Group.
- S4 Multi-channel seismic reflection profile MI-2181 showing Neogene sediments dipping towards the Nazareth fault at the northeastern margins of B3 (Kesulot basin; see S1). Chaotic reflectors at HMH (H2) may denote a subsurface volcano (Segev et al., 2006).
- S5 Multi-channel seismic reflection profile DS-2015 showing the top of Bira Formation horizon flattened along Harod basin. The flattening application enhances the sedimentary fill of the basins leading to a pene-horizontal surface that prevailed in uppermost Miocene-Early Pliocene. Mild landscape of the southern Galilee area allowed incursion of seawater into the land via the basins corridor. H4 (Sede Nahum high) is the western border of the Hordos formation.
- S6 Multi-channel seismic reflection profile MI-2179 showing volcanic flows of the Lower Basalt Formation at the margins of the Ta'anach basin (B5). The flows thicken towards the Taanach basin depocenter. Basalt and post-basalt conglomerate outcrops occur in the west. Normal faulting bordering the Taanach basin from the Umm El-Fahm anticline is absent in this profile but is known further to the west.
- S7 Um Sabune Formation and Clay Series Formation outcrop extent. The Clay Series populates the depocenters, more or less similar to the current soil distribution in the valleys. The conglomerates border the basins, adjacent to fault planes. Abbreviations: TVN- Tivon, AFL- Afula, JEN- Jenin, NZR- Nazareth, Y-Yizreel (H3), G.H.- Givat Hamore; MGD, YQN see locations in Fig. 7; BSN, HAS, MH, Q, K, see locations in Fig. 6.
- S8 Multi-channel seismic reflection profile GP-5004 crossing the northwest margins of the Bet Shean basin (location in GE). Erosional products of the Revaya block accumulate in a local graben during the Oligocene. Rewaya 7 borehole (location in GE), crossed by few seismic lines of the GP series enables interpretation into the deeper parts of the basin. A slide unit, characterized by high amplitude reflectors has been mapped between the

elevated block and the graben (see also S2). It is assigned here as a syn-truncation unit. Note that the Hordos Fm. shows two types of orange: lower, deep orange (conglomerate member, Mho1 of Shaliv et al., 1991) and upper, light orange (clastic-carbonate member, Mho2 of Shaliv et al., 1991). The outcropped Gefet graben (Hatzor, 1988) is imaged in subsurface as well. Younger Neogene deformation folds and offsets the sediments. Discontinuous reflectors at the upper part of the Revaya block were not interpreted. These are assigned to the Gefet fault shear.

- S9 Isopach map of the top of the Mt. Scopus Group (thickness in meters) according to the seismic reflection and well data. The southern portion of the Shekhem syncline is from Rosenthal et al (2000). This map refers to Upper Cretaceous structures predating the Neogene subsidence that are part of the Carmel-Fari'a line of Segev and Rybakov (2011) modelling. Depocenters include the Shekhem syncline, Afula (AFL), Nahalal (NHL) and Shefar'am. The isopach map tracks the suggested right lateral offset of the above authors' model. For example the Gideon fault (H2 of this study) shifts the Nahalal basin to the right in relevance to Afula basin (see Figure 12a). B. Shean- Bet Shean.

- S10 Multi-channel seismic reflection profile DS-3007 crossing the buried Umm El-Fahm anticline in the southern section of the Taanach basin. The Lower Basalt Formation diminishes to the east. Avedat Group occurs in the Shekhem syncline (subsurface extent).

- S11 Structural map of the top of the Judea Group surface. Grey polygons- truncated terranes. In these terrains the exposed geological units are older than the mapped surface. Contours in meters.

- S12 The Tel Kashish shear zone- a narrow corridor between Mt. Carmel and H1 (location in GE). The margins of H1 (Tivon Hills) are the westernmost known occurrence of the Lower Basalt Formation. Construction drills have crossed the Eocene Avedat Group chalks of Eocene age unconformably overlain by the Lower Basalt Formation covered by alluvial fan deposits along the Kishon stream drainage. This area is a structural junction between the Gilboa and Yoqneam faults (Figs. 10c, 12).

- S13 Structural map of the top of the Mt. Scopus Group surface. Grey polygons- truncated terranes. In these terrains exposed geological units are older than the mapped surface. Contours are in meters.

- S14 Multi-channel seismic reflection profile MI-3651 crossing B7 in the west-east direction. Miocene sediments are unconformably overlying Oligocene sediments (Susita Fm., celeste) that in turn unconformably overlie Cretaceous (Judea and Mt. Scopus Groups) and Jurassic (Arad Group) marine sediments. Note folding adjacent to fault planes in both the Rewaya and Bet Shean faults.

- S15 Paleogeography of the Bira Formation sedimentation during a marine transgression from the west according to Shaliv (1991), modified by Inbar (2012). Three coeval facies show in map: Pattish Formation in the west (Gvirtzman et al., 2011), Bira Formation in the center (Shaliv, 1991 and this work, contours in purple) and Sedom Formation in the east (Shaliv, 1991; Gvirtzman et al., 2011)

- S16 Multi-channel seismic reflection profile MI-2177 crossing the Taanach basin in a north-south direction (location in GE). Neogene sedimentary fill is generally thinner in the

marginal B3, B5 basins. The lowermost section is an image of the Oligocene truncation, by flattening the RTS celeste horizon. Note the northern thicker fill of Neogene sediments within the Afula basin (B4).