***Section S1. TEM method: efficiency and use around Dead Sea***

Kafri et al. (1997) and Yechieli et al. (2001) have suggested empirical classifications of DS aquifers based on bulk resistivity to characterize the degree of water salinity. Levi et al. (2008) have studied with TEM the distribution of resistivity-salinity relationships for deep horizons of the western DS shores down to 1.5-2.0 km. Recently, TEM resistivity measurements using TEM FAST portable equipment (Barsukov et al., 2007), has been applied in the sinkhole development areas along the DS shores for studying water salinity (Ezersky et al., 2011; Legchenko et al., 2009). A characteristic feature of the geoelectrical structure of the shallow subsurface (down to 100m) throughout the DS coastal area is very high resistivity contrast between sandy gravel sediments above and below the water table (in the order of 10 and (2-5)10-1 , respectively) (Yechieli, 2000). Such contrast in the resistivity of adjacent layers (~2 orders of magnitude) allows exact determination of depth (with accuracy about 0.5-1.0m) to the low resistivity layer.

There are various possibilities for estimating groundwater salinity in the DS area using electromagnetic methods. They are based on: (a) qualitative characterization of the water salinity (Goldman et al., 1991; Kafri et al., 1997); (b) combined use of TEM and other geophysical methods, for instance, Magnetic Resonance Sounding (MRS) (Descloitres et al., 2011; Legchenko et al., 2009), and (c) resistivity-salinity calibration (salinity is determined on water samples from boreholes, whereas bulk resistivity is measured from the surface using TEM) (Kafri and Goldman, 2006; Yechieli et al., 2001):

(a) Qualitative estimation of the groundwater salinity is based on the finding of Kafri et al. (1997), that bulk resistivity lower than 1 unambiguously defines the presence of DS brine in the pores of alluvial sediments without respect to lithology. Therefore, pores of sediments with bulk resistivity of less than 1 are filled with DS brine (either concentrated or slightly diluted). Based on electrical resistivity measurements, Kafri et al. (1997) suggested the following classification for groundwater in the DS coastal area: (1) very saline water (brine), with resistivity  < 1 (easternmost zone, nearest to the DS); (2) less saline (brackish) water, with  > 3  (westernmost area in the rift, away from the DS); and (3) diluted brine, with 1 <  < 3  (intermediate zone between end members 1 and 2). Somewhat different classification has been recently suggested by Levi et al. (2008).

(b) Use of the TEM-MRS combined methodology has allowed comparative estimation of the water resistivity in relation to lithology. TEM is known as an efficient tool for investigating electrically conductive targets like saline water, but it is sensitive to both the salinity of groundwater and the porosity of rocks. MRS, however, is sensitive primarily to groundwater volume but it also allows delineating lithological variations in water-saturated formations. MRS response is less sensitive to variations in groundwater salinity in comparison with TEM (but very low resistivity layers can limit the investigation depth of the method, see (Legchenko, et al., 2009). It was shown that MRS enables us to resolve the fundamental uncertainty in TEM interpretation caused by the equivalence between groundwater resistivity and lithology in terms of porosity and grain size (Legchenko et al., 2009).

(c) For the Dead Sea region, an empirical correlation between the groundwater resistivity and the chloride concentration (or total dissolved solid – TDS) was established by Yechieli (2000), based on laboratory measurements of DS water samples diluted by distilled water. Kafri and Goldman (2006) found an empirical correlation between the bulk resistivity of the sandy sediment and the chloride concentration. They also suggested the empirical Archie's law expression to connect, and effective porosity  for sandy sediments with a little silt located under the water table (Kafri and Goldman, 2005).