Geophysical Research Abstracts
Vol. 20, EGU2018-7001, 2018
EGU General Assembly 2018


# Sinkhole process interpretation based on shear wave seismic reflection results at Ghor Al-Haditha, Dead Sea

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Since nearly 30 years - apparently contemporaneous to the rapid decrease of the Dead Sea level - ongoing unknown sinkhole processes in the subsurface continuously compromise farming areas, housings, industrial sites, and infrastructure at the investigation site, resulting in massive destructions. Similar processes are observed also at the western border of the Dead Sea. Although many geophysical studies have been carried out at the site since more than 20 years, the subsurface structure and the process itself is quite unknown until yet. In recent years, a massive salt layer at 35-40 m depth was proposed below alluvial fan deposits, which was originally the target of this reflection seismic pilot study.

In October 2013 and October 2014, a shear wave reflection seismic study was carried out at the most destructive sinkhole site in Jordan, close to the village of Ghor Al-Haditha at the southeast border of the Dead Sea. The investigation was carried out as part of the Dead Sea Research Venue (DESERVE) project, a Virtual Institute Initiative of the Helmholtz Society, Germany. In December 2016, the last shear wave reflection seismic survey of DESERVE was carried out including a new profile (profile 6) of 960 m length along the Amman-Aqaba highway, east of the sinkholes area.

Our interpretation, supported by two boreholes, is that sequences of unconsolidated alluvial fan deposits dominate all of the seismic depth sections, starting from the top soil used by farming to a depth of at least 200 m. Regarding the boreholes, the alluvial fan is divided in at least two zones. The upper zone of 0-50 m consists of gravel and sand and is unstable, affected by fractures and landslides. The zone below consists of fine clastic grains, mostly silt and clay.

The profile 6 shows several stacked subsurface channel structures, also in the upper zone. Satellite images from 1970 show a natural stream channel system running in a SE-NW direction from the nearby Wadi Ibn-Hammad towards the Dead Sea shoreline; this now-extinct channel system coincided exactly with the sub-surface channel structures in the seismic profile. The direction of the actual hydraulic gradient is also SE-NW. Therefore, we assume that these channel structures enable freshwater inflow (now subsurface) to the sinkhole area further towards the Dead Sea shoreline. In all profiles no seismic evidence was found for massive salt layers in the shallow subsurface up to 200 m in depth.