

Eli Raz: Study of sinkholes formation along the Dead Sea shore – sub aerial survey, second report (in Hebrew), GSI/31/2000, Geological Survey of Israel, Jerusalem 2000

### **Abstract**

The phenomenon of subsidence and collapse of the land's surface and the appearance of sinkholes on the western side of the Dead Sea from Ein Gedi southward have been known since the late 1970's. In the 1990's the phenomena spread to the north of Ein Gedi as well as continuing in the south. The rate of its spread to the north along the coast, the frequency of subsidence and collapse events have increased and have caused injury and damage to property as well as delayed plans for development.

All the sinkholes are formed in weakly consolidated Holocene sediments and most of them are located between several tens to several hundred meters from the shoreline up to minus 382 meters (mean sea level); some are even located on or below shoreline. On the eastern shoreline, to the south of the El-Mazra'a bay, sinkholes began to form approximately 16 years ago. Sinkholes appear in different sizes; the maximum dimensions found to date 25 meters depth and 40 meters diameter, but adjacent sinkholes might joint and form gigantic ones. The appearance of tension fissures follows the subsidence and sinkhole formation; these become slip surfaces for sliding blocks into sinkholes as the process develops. There is no necessary connection between the age of a sinkhole and its dimensions. The rate of development of adjacent sinkholes may vary. No correlation has been found between the patterns of distribution of sinkholes and springs and any kind of natural surface water flows. In certain sites, a statistic connection between timing of sinkholes appearances and heavy rains and flash floods, has been found

Sinkholes and subsidence result from the collapse and sinking of the uppermost sedimentary section into underlying cavities that apparently developed because of the dissolution of subterranean salt layer. The level of the Dead Sea is falling rapidly at a rate that has increased to about 1 meter a year as a result of the intervention of man in the recent decades. As a consequence, the subterranean interface between the Dead Sea water and the overlaying ground water is falling too. The salt layer that once was surrounded by saturated water in respect to salt is now exposed to aggressive dissolution by ground water. Dissolution can also occur along confined sub-aquifers whose sub aquatic outlets were formerly blocked by the overlying pressure of the high and dens Dead Sea water column. A considerable decrease in that pressure due to the fall of the lake's level enabled the flow of sub-aquatic ground water adjacent to the salt layer, and apparently led to the formation of sub-aquatic sinkholes.

Surface waters from springs or seasonal flash floods do not appear to be a factor in the creation of the deep sinkholes. In certain sinkholes sites, lineaments are definitely factor in the distribution pattern of the phenomenon and perhaps of the rate of the phenomenon development.

In research conducted up to now, the present one included, the rapid drop of the lake's level in the past decades remains the basic underlying factor associated with the development of the sinkholes. Sinkholes that occurred in the past along the rising shorelines of the evaporation ponds maintained for industrial purposes at the southern basin of the sea are apparently in contradiction, but the fact is that no new sinkholes have been detected in the last several years, and the phenomena as a whole is apparently declining there, as consequence of the rising level. The mechanism of piping cannot be ruled out in regard to those shallow sinkholes appearing along lines perpendicular to the shore.

The results of this work do not enable prediction of where or when sinkholes will appear. At this point it appears that they may develop in any of the exposed Holocene material along the coast under which exists a layer of salt. Where sinkhole are located exists a high likelihood of development of other sinkholes, and with the appearance of one sinkhole one must take into account the possibility of the appearance of others in close proximity. The discovery of a subterranean cavity by means of a geophysical measuring device may well indicate the possibility of the appearance of a sinkhole, but the absence of such findings does not rule out the near or distance future development of such a cavity.