Do hazardous sinkholes reveal a buried tectonic fabric within the Dead Sea rift?

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Abstract

It has been suggested that the formation of the Dead Sea's sinkholes is resulted from the solution of a salt layer buried between 20-70 m deep. The solution is caused by invasion of water under saturated with respect to halite, triggered by the decline of the Dead Sea's level. The present work presents new insights for the controls on sinkholes formation and distribution using seismic reflection, aerial photographs, and radar interferometry from ERS-1 satellite (SAR interferometry).

The distribution and evolution of sinkholes along the Dead Sea's coast have been tracked from aerial photographs. It appears that in most sites where a cluster of several sinkholes is observed, the cluster displays elongated shape or a clear line. Statistics of the elongation and/or lines directions show a bimodal distribution, similar to directions observed in the major faults on the western rift shoulder. These observations suggest a linkage between sinkholes formation and 'blind' faults buried in the rift fill. This notion is strongly supported by the following observations: 1) the trend of sinkholes' lines displays no relations to surficial features such as alluvial fans, current and ancient shorelines, creeks, etc. 2) Seismic reflections profiles from 5 sites of sinkholes show significant discontinuities beneath or at the extension of sinkholes lines.

The SAR interferometry technique recorded small surface subsidence along the Dead Sea's coast including around sinkholes sites. The sinkholes distribution superimposed on SAR interferograms may depict the buried tectonic fabric at several areas, Mitspe Shalem, En Gedi, Lisan Peninsula, and Newe Zohar, hence defining risk zones for sinkholes development. These new observations demonstrate a mechanism of sinkholes formation by opening of faults as a result of differential compaction of clays, thus enabling the access of under saturated water to the salt layer.