Geophysical Research Abstracts
Vol. 16, EGU2014-11217, 2014
EGU General Assembly 2014

Multiple sensor tracking of submarine groundwater discharge: concept study along the Dead Sea.

Christian Siebert (1), Ulf Mallast (1), Tino Rödiger (1), Danny Ionescu (2), Friedhelm Schwonke (3), John K. Hall (4), Aharon R. Sade (5), Thomas Pohl (6), and Broder Merkel ()

(1) Helmholtz Centre for Environmental Research, Catchment Hydrology, Halle, Germany (christian.siebert@ufz.de), (2) MPI for Marine Microbiology, Bremen, Germany, (3) Federal Institute for Geosciences and Natural Resources, Hannover, Germany, (4) Geological Survey of Israel, Jerusalem, Israel, (5) University of Haifa, Charney School of Marine Sciences, Haifa, Israel, (6) TU Bergakademie Freiberg, Freiberg, Germany

As a result of the continuously declining water level of the Dead Sea, vast areas of its former lakebed are exposed. That unconsolidated sequence of clay minerals and evaporates (e.g. aragonite, gypsum, halite) generally reacts as aquiclude – preventing direct drainage of the surrounding mountain freshwater aquifers. The high density differences between the hypersaline Dead Sea (1.24 g/cm3) and the approaching fresh water generates a flat dipping and stable Ghyben-Herzberg interface. However, a network of open fissures and cracks enables these freshwaters to regionally penetrate both, aquiclude and interface and to finally enter the Dead Sea on- and offshore. These offshore springs, also termed sublake groundwater discharge (SGD), are neither qualitatively nor quantitatively analysed yet. This is the reason why it is one of the most doubtful variables in existing balances of the lake's water budget and strongly requires improvement. To disclose pathways from the feeding mountain aquifers to the springs, intense hydrochemical and microbial investigations were carried out both, onshore and submarine. The waters have their origin in a variety of hard rock aquifers of Cretaceous age. After draining into the Dead Sea sediments, waters carry the easily soluble components (gypsum, halite) and the abundant organic matter, erodes and transports the hardly soluble minerals (clay and aragonite) and admix with briny pore water, respectively, which are all hosted in the sediment body.

Diving campaigns allowed to map at least parts of the submarine spring cluster and to correlate their locations with neo-tectonic patterns. However, comprehensive mapping solely by divers is unfeasible due to the complexity and density of spring locations. The subsurface morphology is characterised by craters, walls, gullies and cones, occasionally nested and intensely anastomosed. To comprehensively understand reasons for specific discharge locations and their shapes, high-precision and high-resolution bathymetric campaigns, coupled to side-scan sonar imaging are revealed to be of highest importance. Respective information will be provided by an unmanned surface vehicle (USV), supported and supplemented by detailed seafloor mapping by divers and quantitative and qualitative measurements of discharging groundwater and the resulting buoyant plume. The entity of the afore-mentioned approaches is coupled to thermal investigations of the sea-surface-temperature using a thermal imaging system mounted on an unmanned aerial vehicle (UAV). Earlier airborne thermal imaging investigations proved the suitability of this approach as thermal anomalies directly indicate SGD abundance. We even hypothesize that the anomaly size reflects discharge quantities, which would allow a quasi-continuous SGD monitoring of the observed randomly pulsating, fluctuating discharge and the evolvement or falling dry of springs.

The aim is to integrate all ground truth measurements with USV and UAV remote sensing approaches to develop transfer-functions, which allow quantifying SGD from remotely sensed thermal anomalies.