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# A mechanism for the stubborn persistence of contaminants in arid environments – a case study from the Judean Desert, Israel

**ROEE KATZIR**[1], ITTAI GAVRIELI[2], URI NACHSHON[1], GALIT SHARABI[2] AND ROTEM GOLAN[1]

[1]the Institute of Soil, Water, and Environmental Sciences, Agricultural Research Organization, Volcani Center, ISRAEL
[2]Geological Survey of Israel

Presenting Author: roeek@agri.gov.il

On June 2017, ca. 300,000 $m^3$ of highly toxic industrial acidic mixture that included high levels of F and $SO_4$, spilled into an ephemeral stream, Ashalim Wadi, in the Judean Desert, Israel. The Wadi course crosses arid to hyper arid climatic zones, with average annual precipitation of 50-100 mm. The evaporation potential in the region is >2,500 mm and thus, the basin is dry most of the year, excluding short sporadic rain events that occasionally trigger winter flash floods.

The upper Ashalim basin consists of a sedimentary sandy unit. During the spill event, the acidic flow stretched beyond the mainstream channel, resulting in contamination of sandy alluvial terraces that are only exposed to minor wetting during natural rain episodes. This work examined the fate of the major contaminants in these terraces.

Two runoff plots, approximately 6 $m^2$ each, were set on sandy terraces and monitored for more than 30 months. Soil profile samples were collected periodically and after rain events. In addition, runoff water were collected twice following rain events that generated surface flow. Water and soil-water extractions were analyzed for their major ionic composition.

Results show that removal of contaminates off the sandy terraces is minor due to the sand's hydrological properties and local meteorological conditions. The capillary length of the sand is longer than the wetting depth of the soil under typical rain events. The contaminates were leached down during rain events, and as rain ceased they were transported upward by capillarity. Since the contaminates are mobilized downward during rain events, they are not present to be flushed downstream when surface runoff evolves. Moreover, the limited depth of infiltration and the upward flow by capillarity maintains high levels of contamination near the soil surface, where it may be readily consumed by plants and pass on through the food chain.