Aquifer Recharge of Flash Flood Water – How to Prevent Clogging

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Flash floods occur from time to time in the same Wadi system but without any frequency. The longer the time between two events the more erosion products are transported in the flood. Alluvial fans are the result of the sediment transport. The grain size is an indicator for the energy of the flood.
Millions of cubic meters of fresh water are lost due to evaporation or to the sea. In countries with little or almost no rainfall it is of the highest interest to store the flood water underground where it is protected from evaporation. Also dams with big reservoirs are an option to store the water. In such a reservoir lots of water evaporate. A combination of dams and subsurface dams might be a solution for the problem. But in all cases a high turbidity shows the content of clay and silt in the stored water. The settling time of the sediments is uncertain and therefor the use of the water is problematic.
Studies of the rock type in the catchment can be an indicator for the next flood. The erosion products must be held back in small reservoirs close to the collection areas. Energy still is low and alluvial sediments built up a thin layer not important for any storage of groundwater. The maximum amount of flood is to predict with numerical models. If the water in the reservoir is more alkaline than the acid rain water sediments precipitate faster. The clear water can be removed from the small reservoirs to artificial trenches or infiltration basins. During the dry years the settled sediments can be removed and used in agriculture.

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The importance of fractures

- Fractures store water
- rock type and tectonics determine the storage capacity of the fractures
- stored water is part of a base flow
- base flow has low turbidity

Groundwater in fractures

- Groundwater in the Andes
- Circulating water in 250 m depth
- The storage capacity of the fractures must be measured in the field

Storage of water

- Fractures
- Fissures
- Retention of water

Too much water – too much fine sediments

The picture taken from the driver of Hadidi and Askar shows the enormous amount of water in Wadi Bili. Any dam in this place makes no sense.

Artificial recharge of this run of is impossible because of the high amount of sedimentin the wate

Clogging of the aquifer will be the result

Hadidi, 2015

Khor Arbaat - Sudan

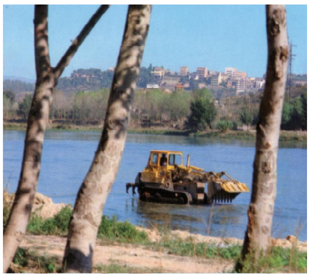
Clear water in hte permanent run off can be used for artificial recharge

Sedimentation of clay is the result of low energy

Numerical modeling of clay transport can show still water

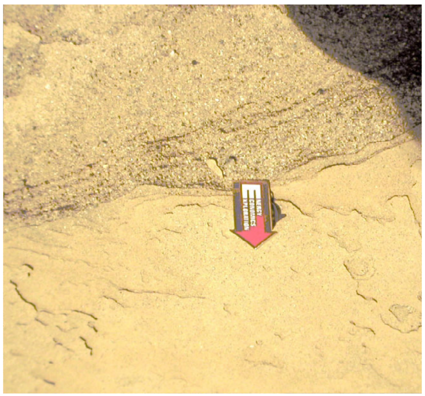
Coarse sediments are changing with clay deposition

Conditions for artificial recharge

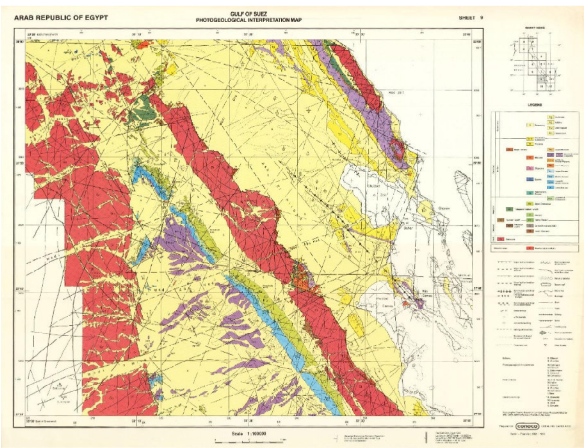


- Artificial recharge from a temporary river in Barcelona
- The water must have a low turbidity
- The river bed is scraped from time to time (permanent maintenance)

Sedimentation is crucial for artificial recharge

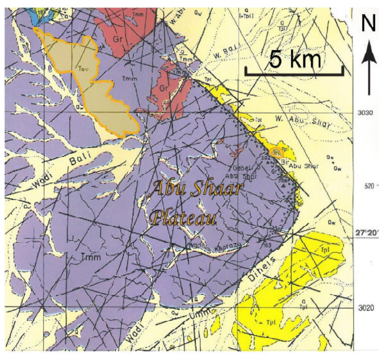


Geological map of the Red Sea Hills (Ras Gharib)



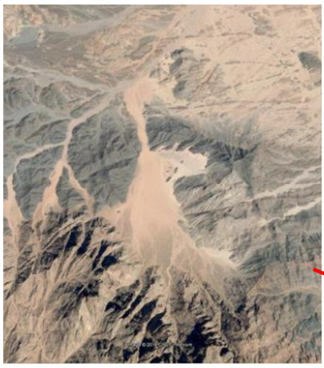
Different geology – different sediments

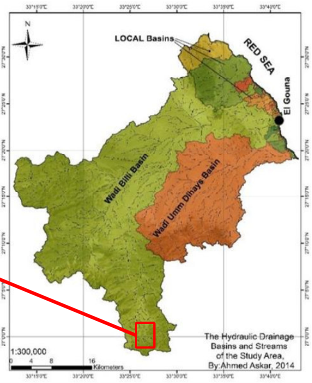
- Weathering and erosion of different rocks is different
- Some rocks have a high content of clay minerals
- The catchment area must be divided in small basins with a limination of the rock type and the slope
- The bigger the clay content the smaller the basin for a small dam



Hadidi, 2015 after Klitzscj&Linke, 1983

Steep and low gradient of Wadis





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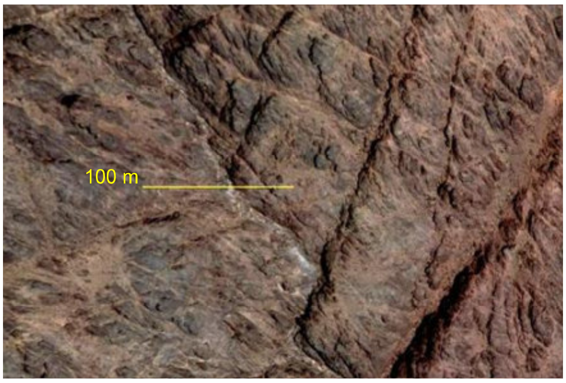
High energy – coarse material



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Small catchment

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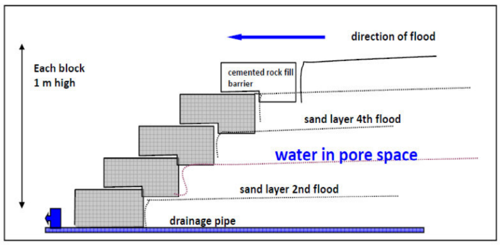
Dams for small catchment



A simple method to construct a barrier in narrow valleys is shown in the diagram on the left. This method is used where no or little sediment is found in the valley. Cement blocks are put on the valley ground at the end of the dry season. The height of the blocks is determinated with the sediment transported in the river during the flood. In the shown example that corresponds with the photo from Kenia the blocks are 1,2 m high and extend 8 m.

Photo:A fully submersed sub-surface dam at Kwa Kusa/Mwingi District/Kenya (GPS WGS84: 37M 0431817, UTM 9907871, WGS 84 Year 1998 T. Diettrich)

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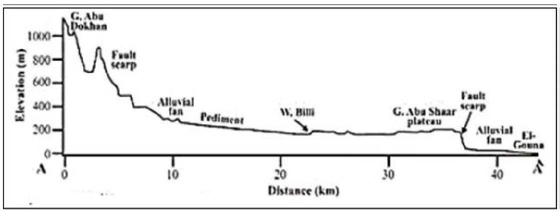
Catchment aera and dam construction

- Size of catchment
- Slope
- Roughness
- Sediment transport
- Sedimentation
- Numerical models



Ahmed Askar, 2014

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The lesson we learned

- Catchment area must be small or adopted to transport energy
- Modeling of run off and precipitation is essential
- Sedimentation of fines in flat zones
- Many small dams are better than a big one because of the control and the economy
- For artificial recharge the transport of clay and fine silt must be prevented
- Maintenance of the Wadi is important
- Artificial recharge can be carried out in different forms

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