

Option 2: Modelling transient groundwater flow to a qanat

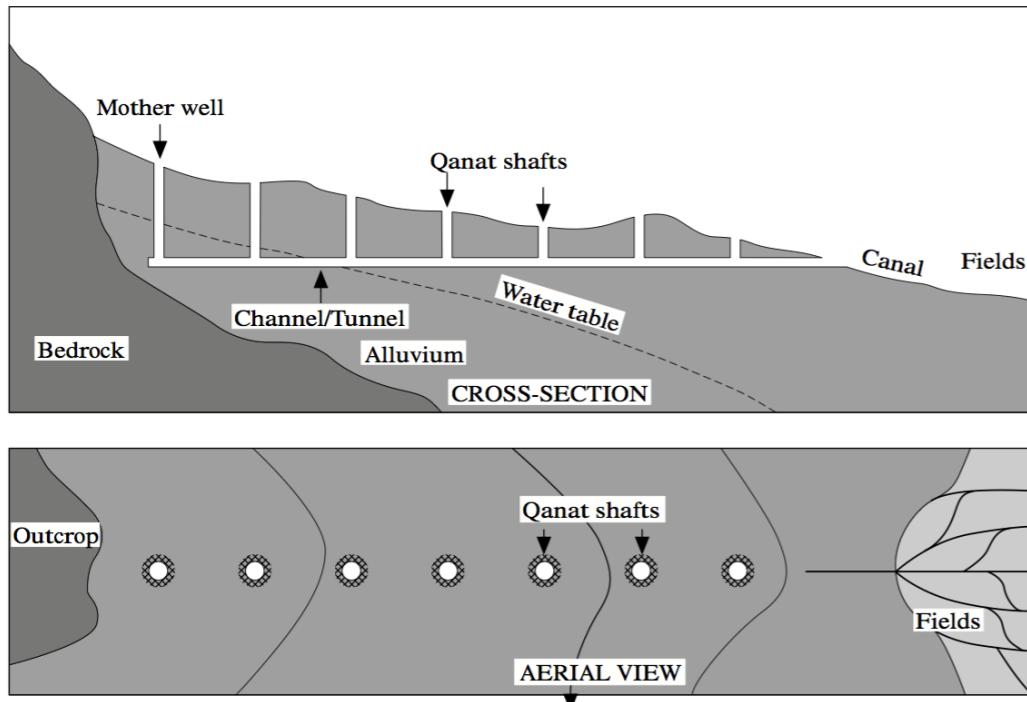


Figure 1. Plan and profile view of a typical qanat.



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Option 2: Modelling transient groundwater flow to a qanat

- Qanat = horizontal tunnels dug into alluvial fans or hillslope to tap the groundwater table

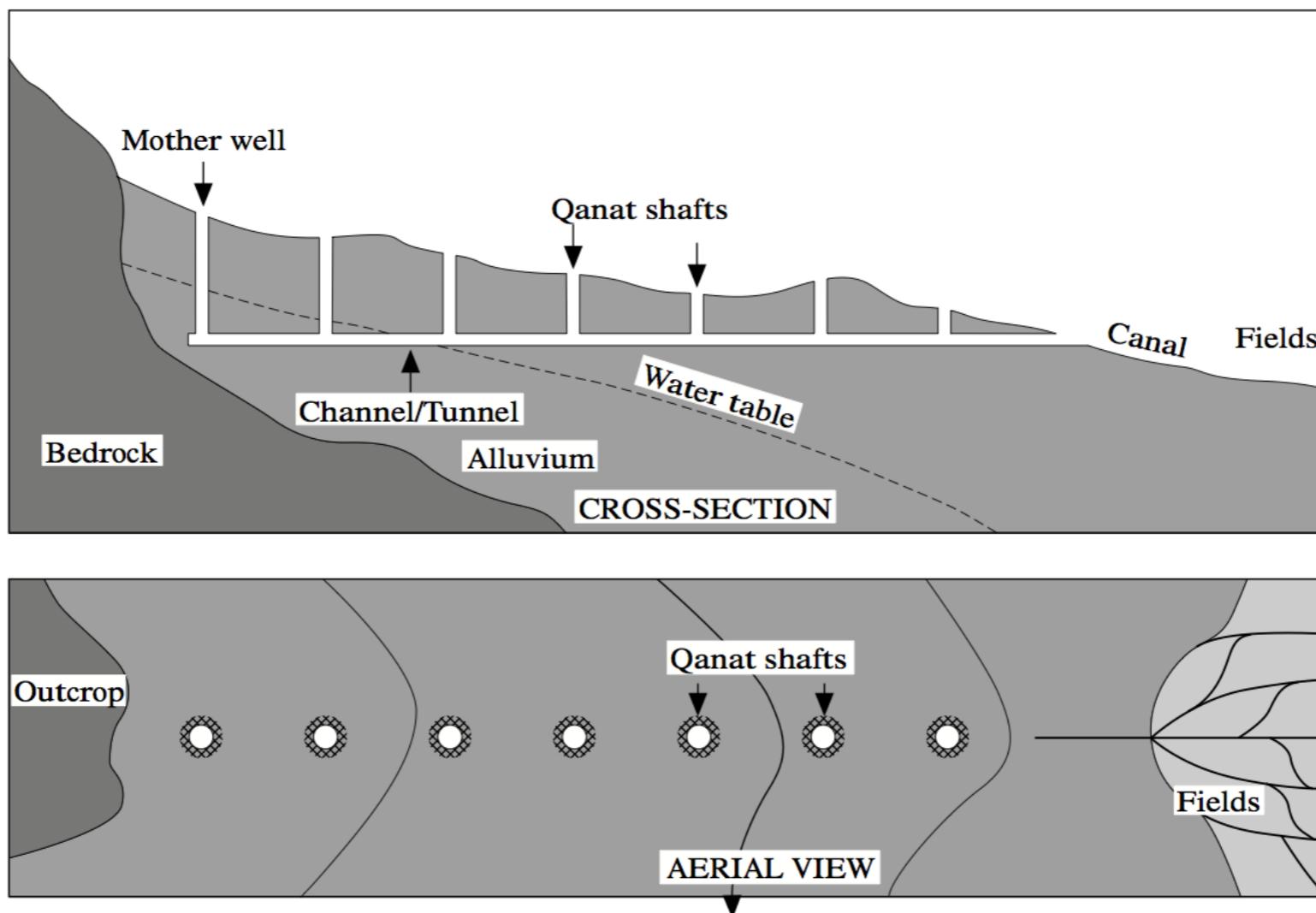
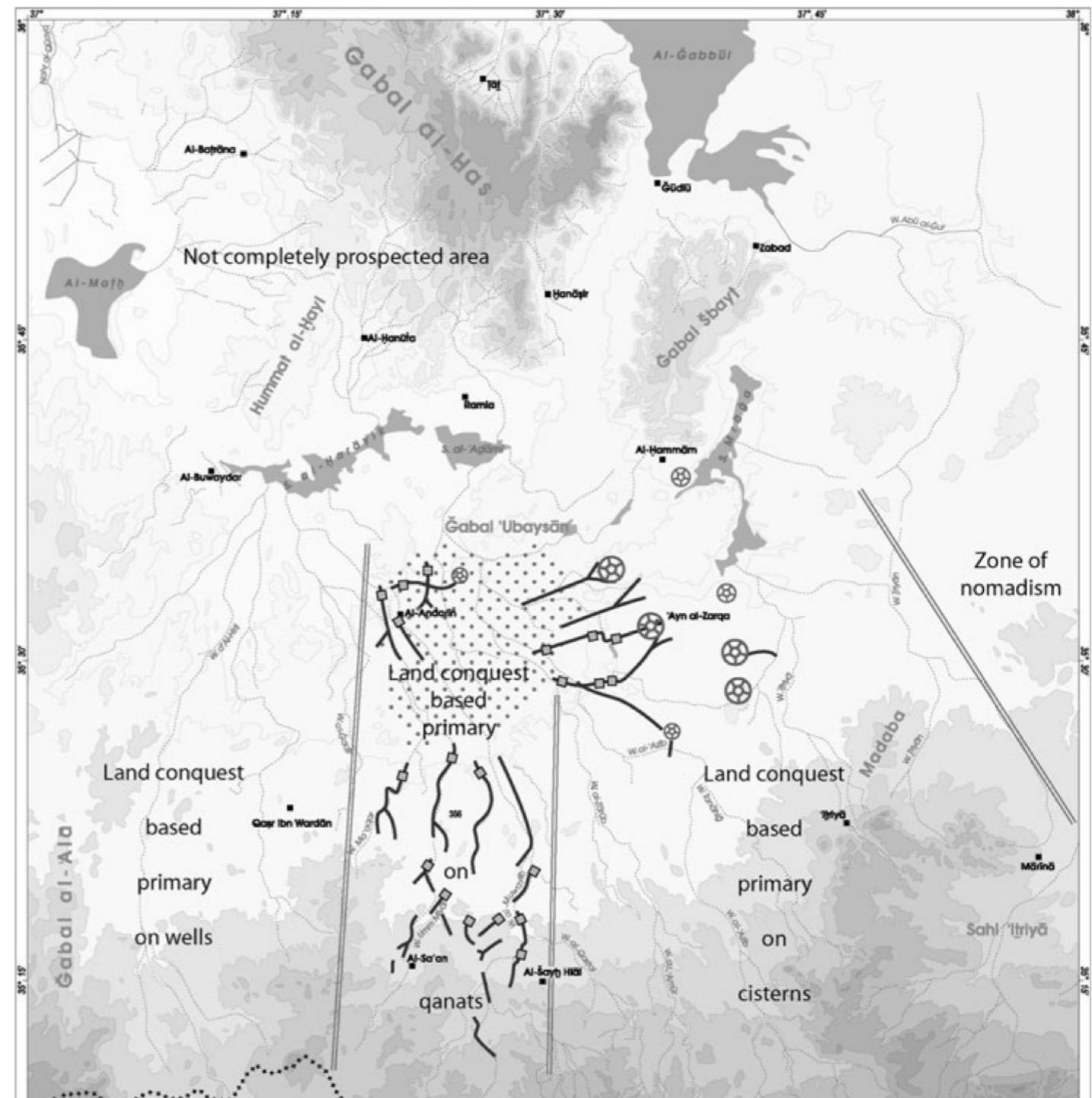


Figure 1. Plan and profile view of a typical qanat.

Lightfoot (1996)

Qanats

- Qanats date back 3000 years
- Played an important role in enabling settlement and agriculture in dry areas in history



Braemer et al. (2010)

Qanats

- We will try to answer the question: How sensitive are these systems to change in climate/recharge?

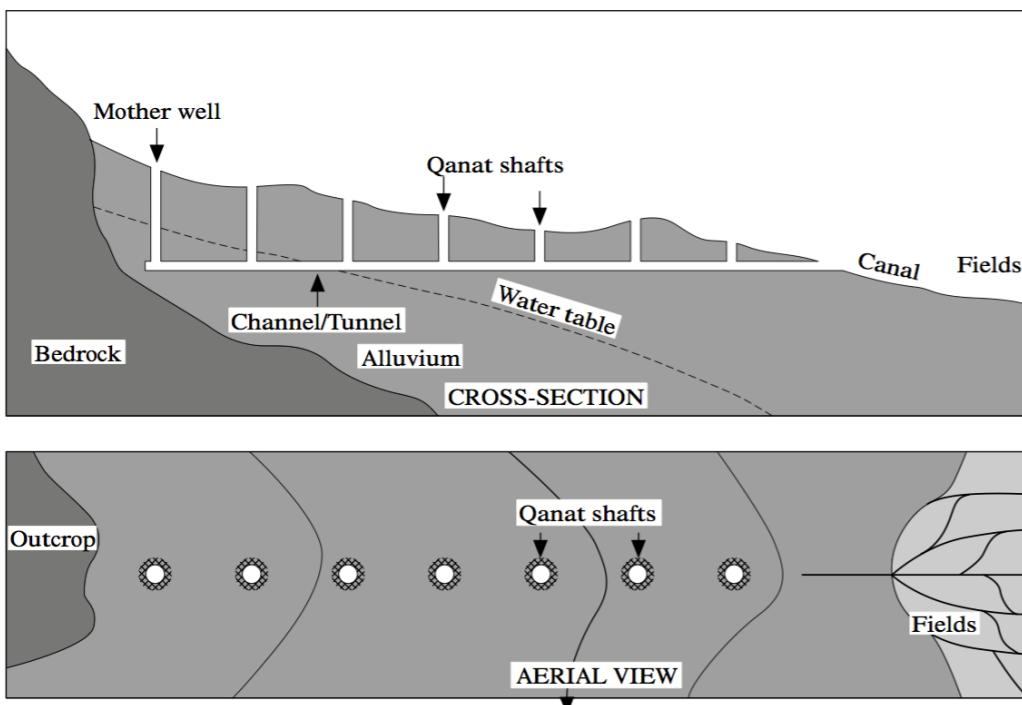
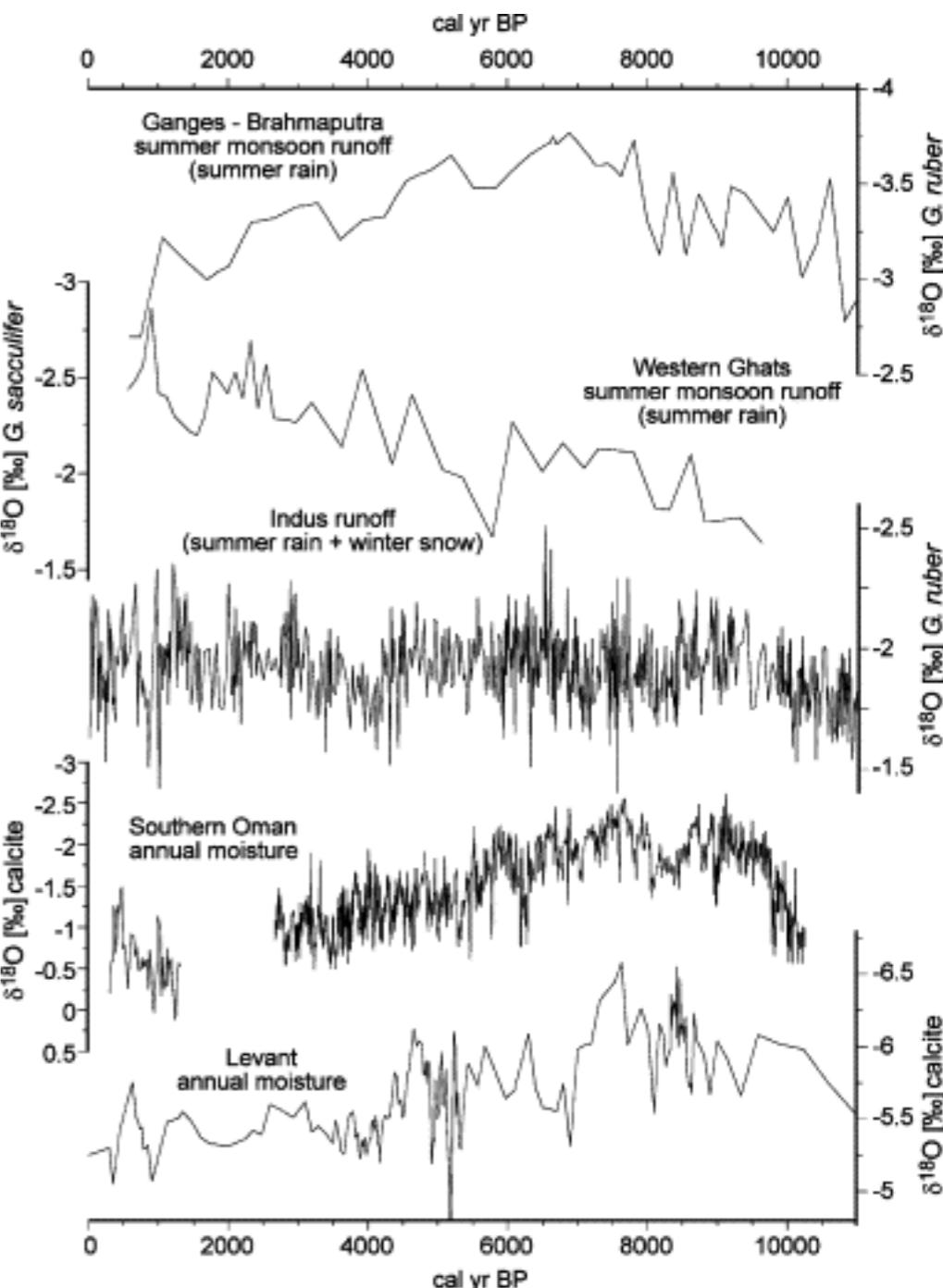


Figure 1. Plan and profile view of a typical qanat.



Staubwasser & Weiss (2006)

Case study: a qanat in northern Syria

- Case study: a Roman qanat in northern Syria



Case study: a qanat in northern Syria

- Recently restored:



Source: Wessels (2000)

Case study: a qanat in northern Syria



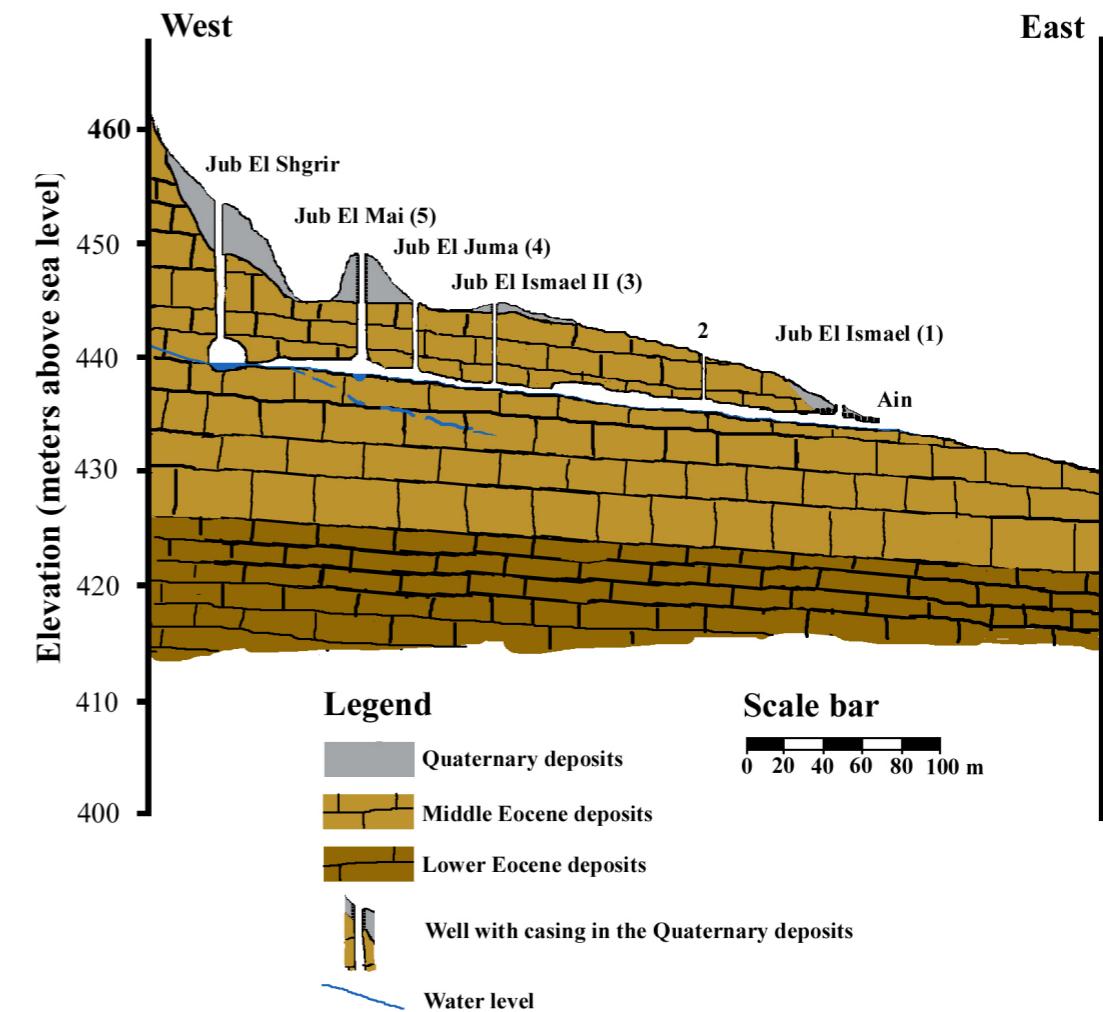
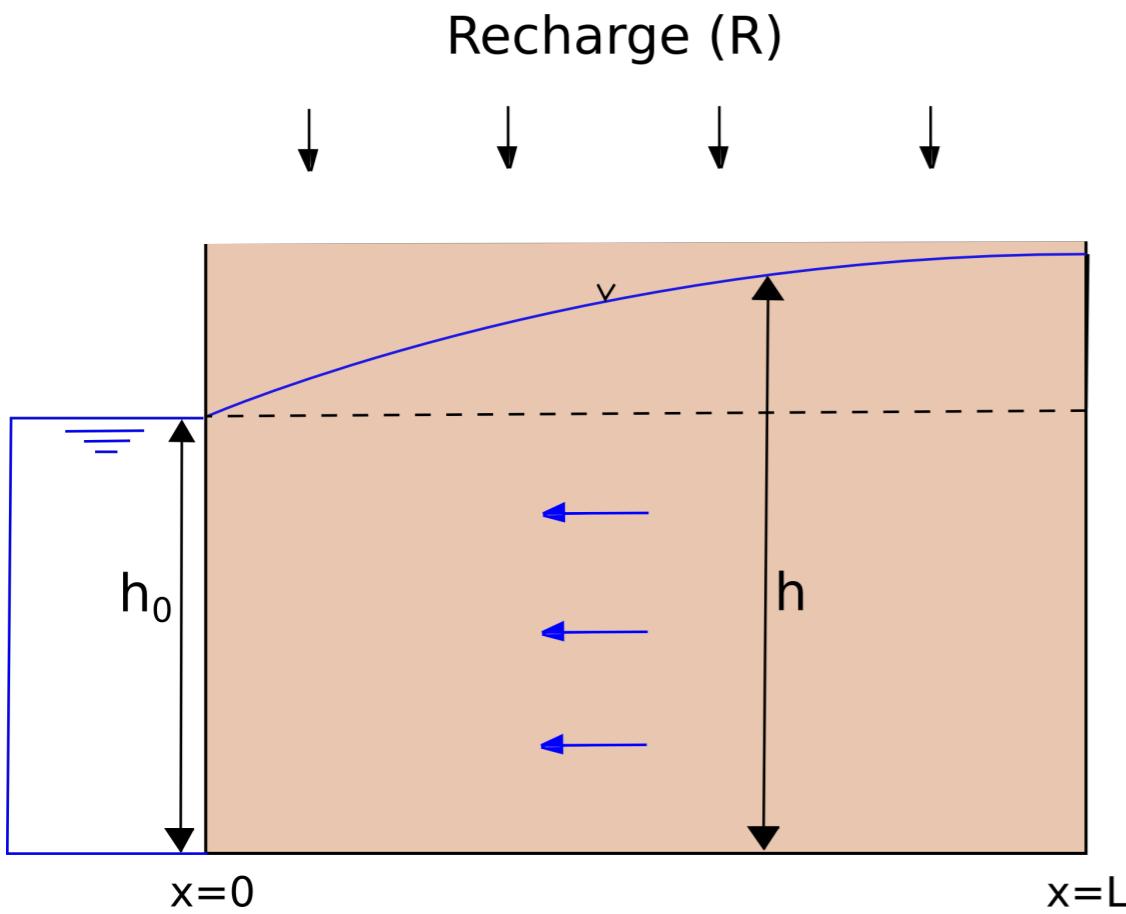
Air shaft



These hills provide recharge for the qanat

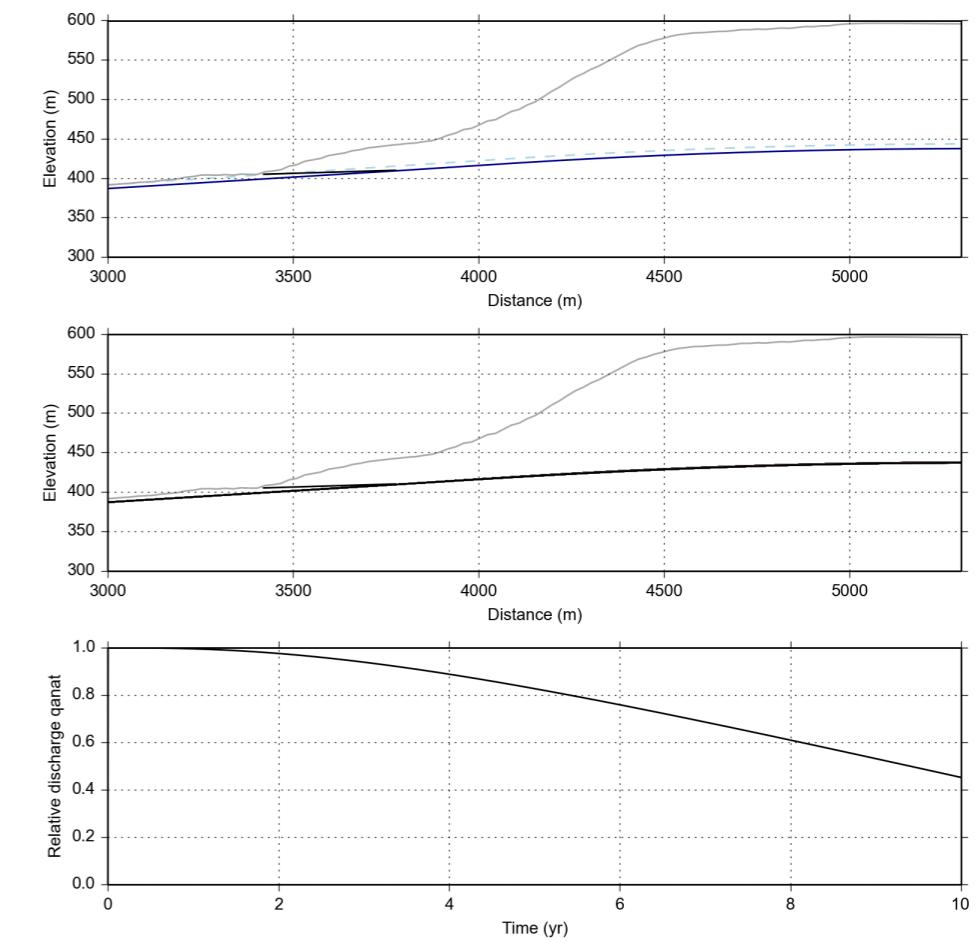
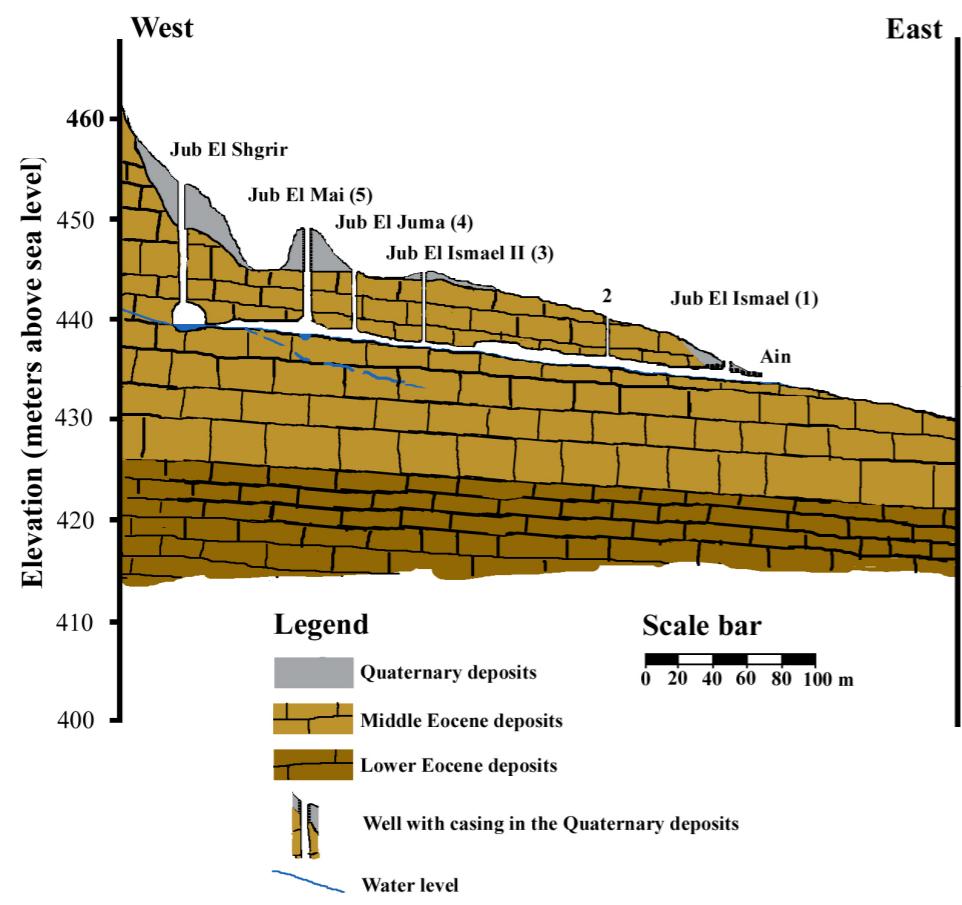
Case study: flow towards a qanat

- Question: how long does the flow to the qanat last in case of a multi-year drought, when recharge=0?



Case study: flow towards a qanat

- Qanat outflow simulated with a second fixed hydraulic head node at the source of the qanat
- We will make this a conditional fixed head: if the simulated water table starts to fall below the qanat we will remove this condition



Transient modelling workflow

1. Calculate steady-state hydraulic head
2. Apply a fixed hydraulic head condition at the source of the qanat and recalculate steady-state h
3. Use steady-state as initial condition, set recharge to 0 and run the transient calculations

