

Magnitude and Frequency of the Largest Palaeofloods during the Late Holocene in Nahal Ze'elim and Nahal Rahaf, Judea Desert, Israel

Rami Zituni¹, Noam Greenbaum¹

¹University of Haifa, the Department of Geography and Environmental
Studies

Objectives

1. Reconstruct long-term hydrological databases for the Southern Judea Desert larger streams using Palaeoflood Hydrology method
2. Flood Frequency Analyses using Palaeofloods, historical and measured records if exist.
3. Constructing an envelope curve for the Judea Desert – a unique hydrological region.

Object

Methods

Study area

Appliance

Results

Summary

Palaeohydrological method

Object

- Paleo-stage indicators (PSI) – driftwood, erosion lines, maximum flood elevation

Methods

Study area

Appliance

Results

Summary



Upper Nahal Ze'elim – DWL after flood May, 2018

Palaeohydrological method

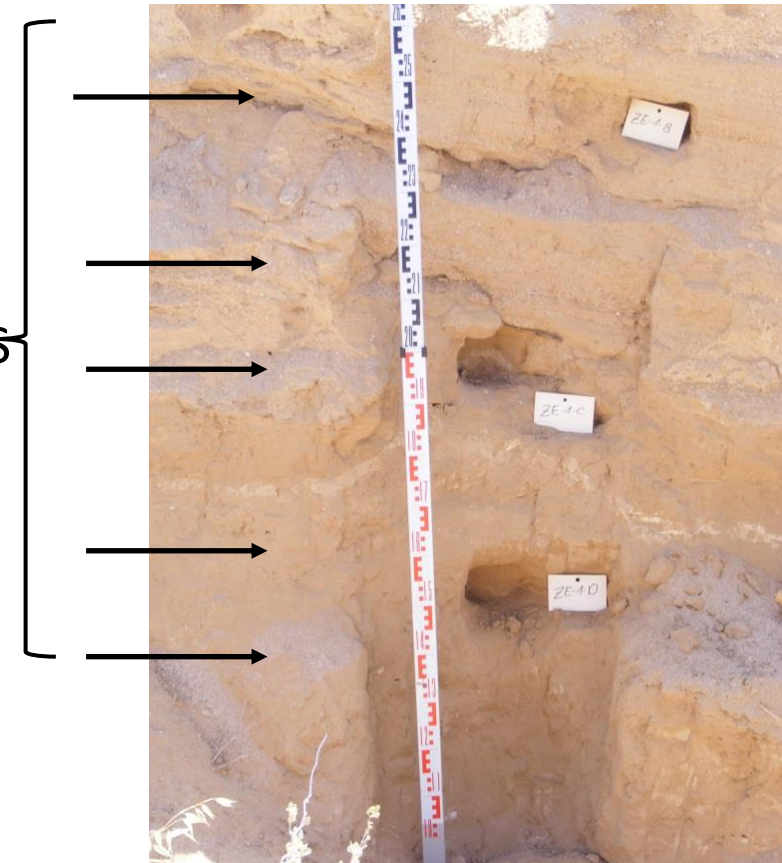
Object

- Slackwater deposits – fine grain sediment, minimum flood elevation

Methods



SWD's
CONTACTS



SWD's in Nahal Ze'elim; site ZE-1

Study area

Appliance

Results

Summary

Palaeohydrological method

Object

Methods

- Accumulation of SWD's in low energy sites in the stream provides record of numerous flood events.
- Preservation of SWD's in bedrock canyons where the cross sections and stream route are stable, can endure hundreds and thousands years.
- Obtaining the best palaeoflood record, using these natural sediment traps.

Study area

Appliance

Results

Summary

PSI's within a cross section in the stream

Object

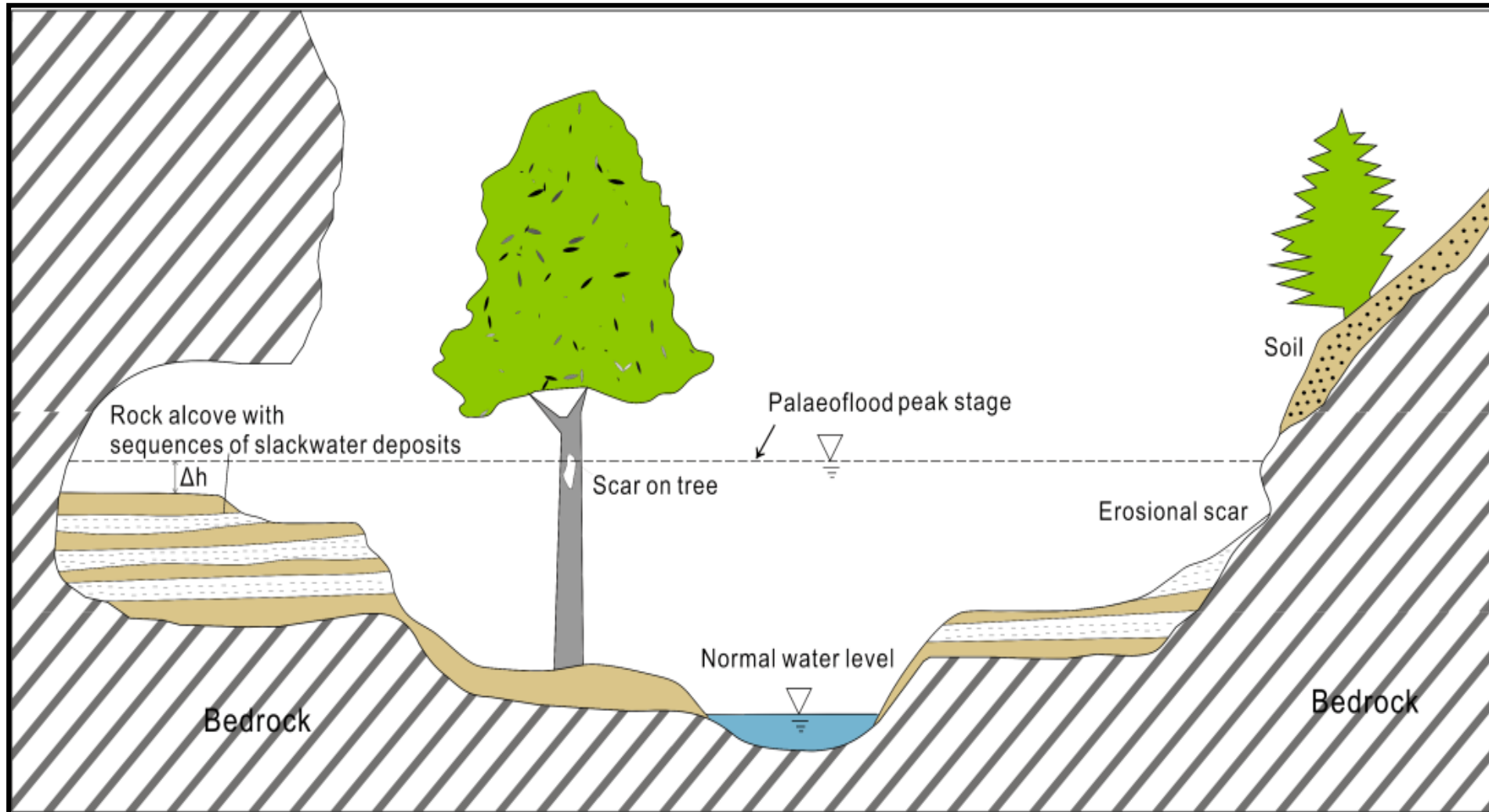
Methods

Study area

Appliance

Results

Summary



Research process

Object

Methods

Study area

Appliance

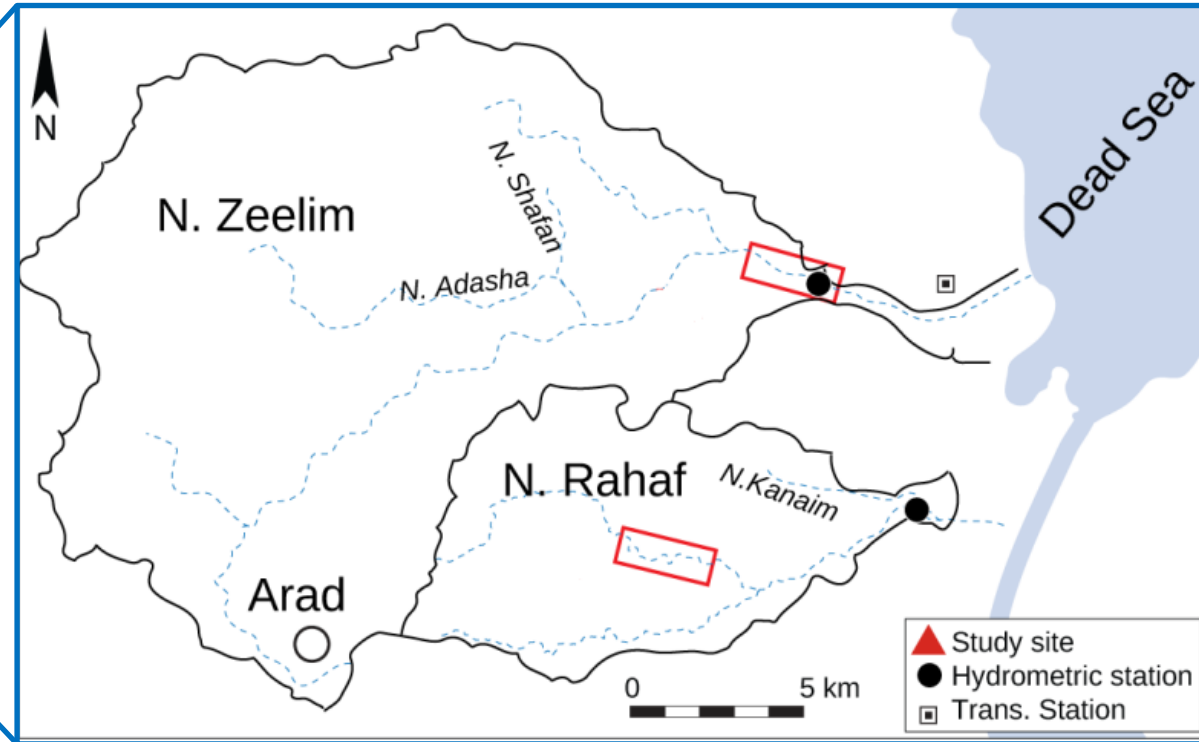
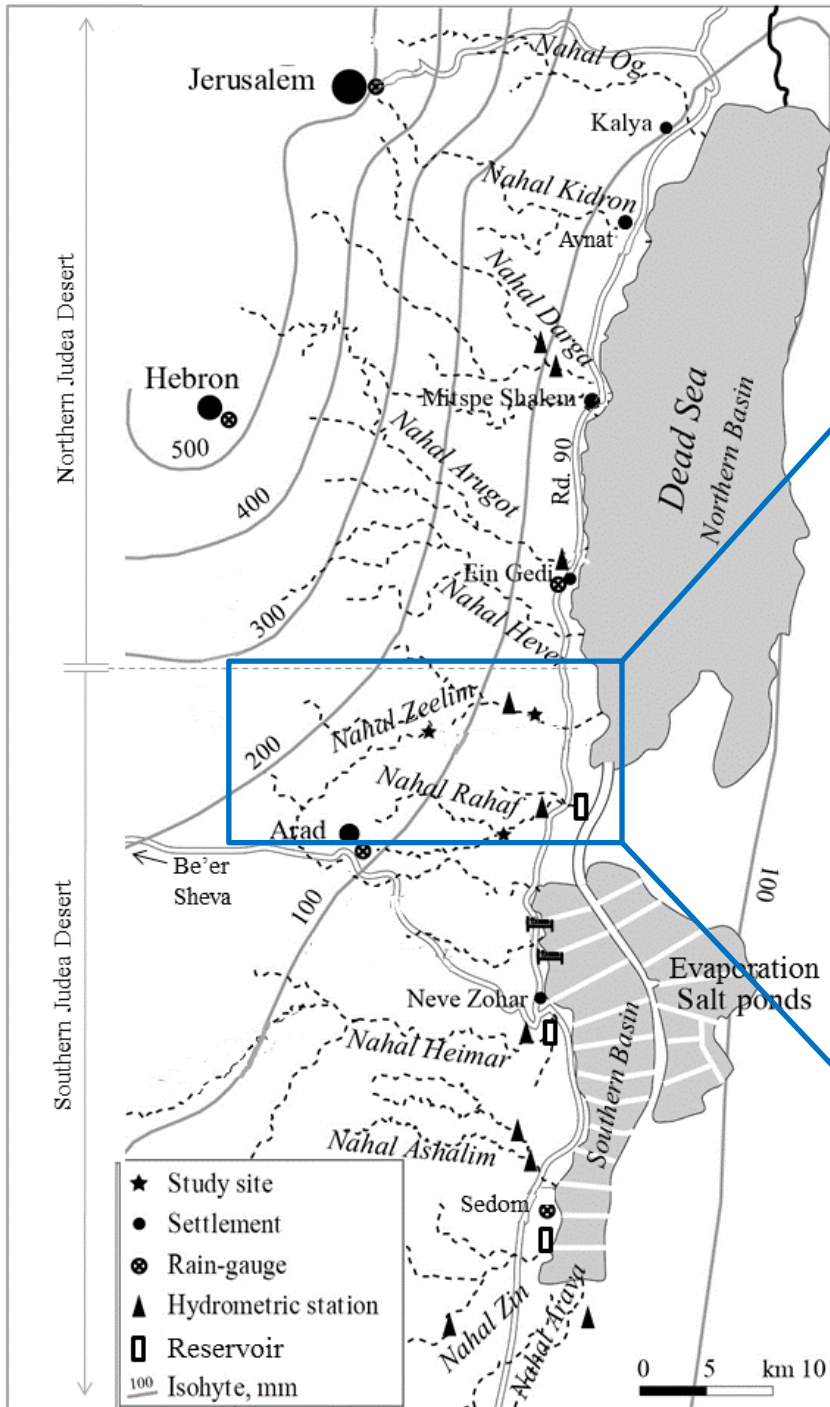
Results

Summary

- Remote sensing and Field survey for potential SWD's sites.
- Stratigraphy and description of the sediment units
- Cross section geometry for the relevant reaches of the stream.
- Discharge calculation using HEC-RAS
- Dating flood units with OSL and Radiocarbon
- Flood frequency analysis

Study area – Southern Judea Desert

Streams: Nahal Ze'elim and Nahal Rahaf



Object

Methods

Study area

Appliance

Results

Summary

Nahal Ze'elim stream

Object

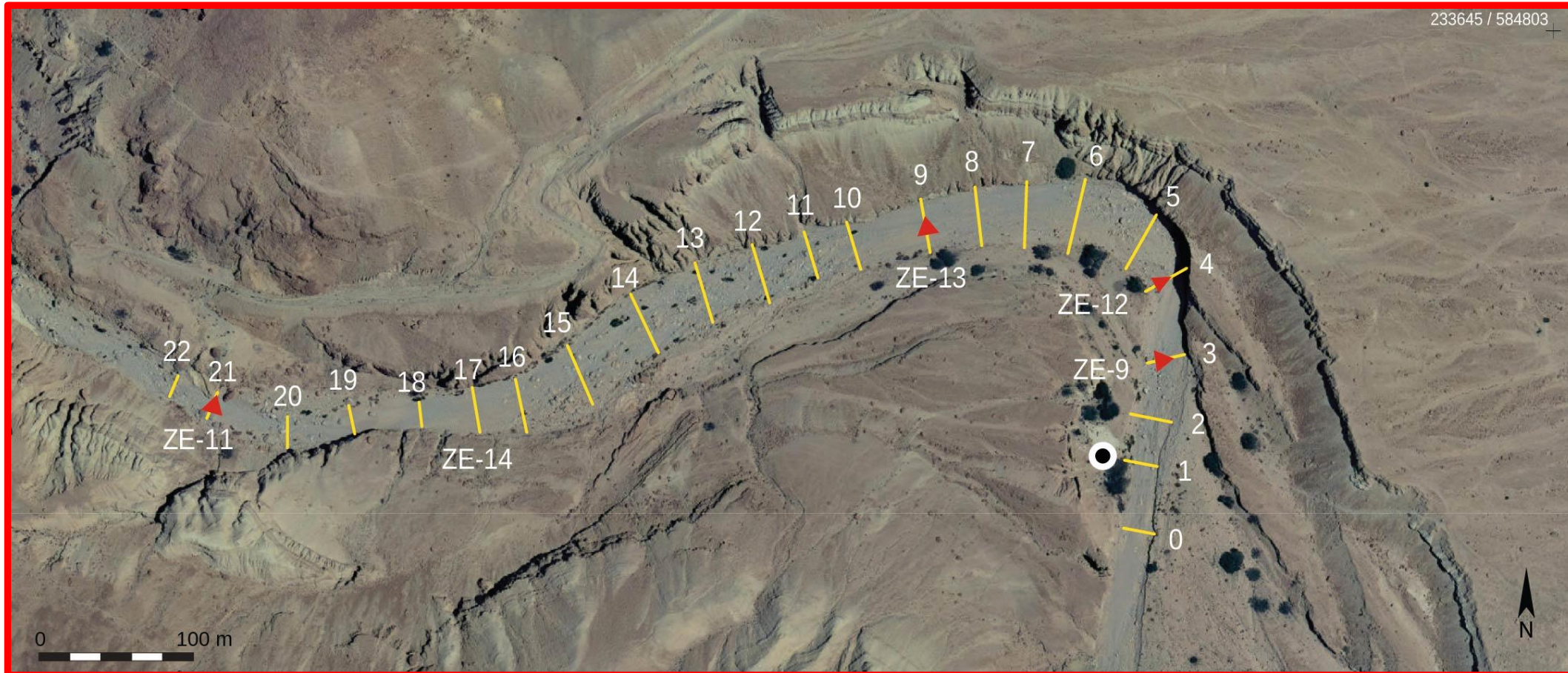
Methods

Study area

Appliance

Results

Summary



Nahal Rahaf stream

Object

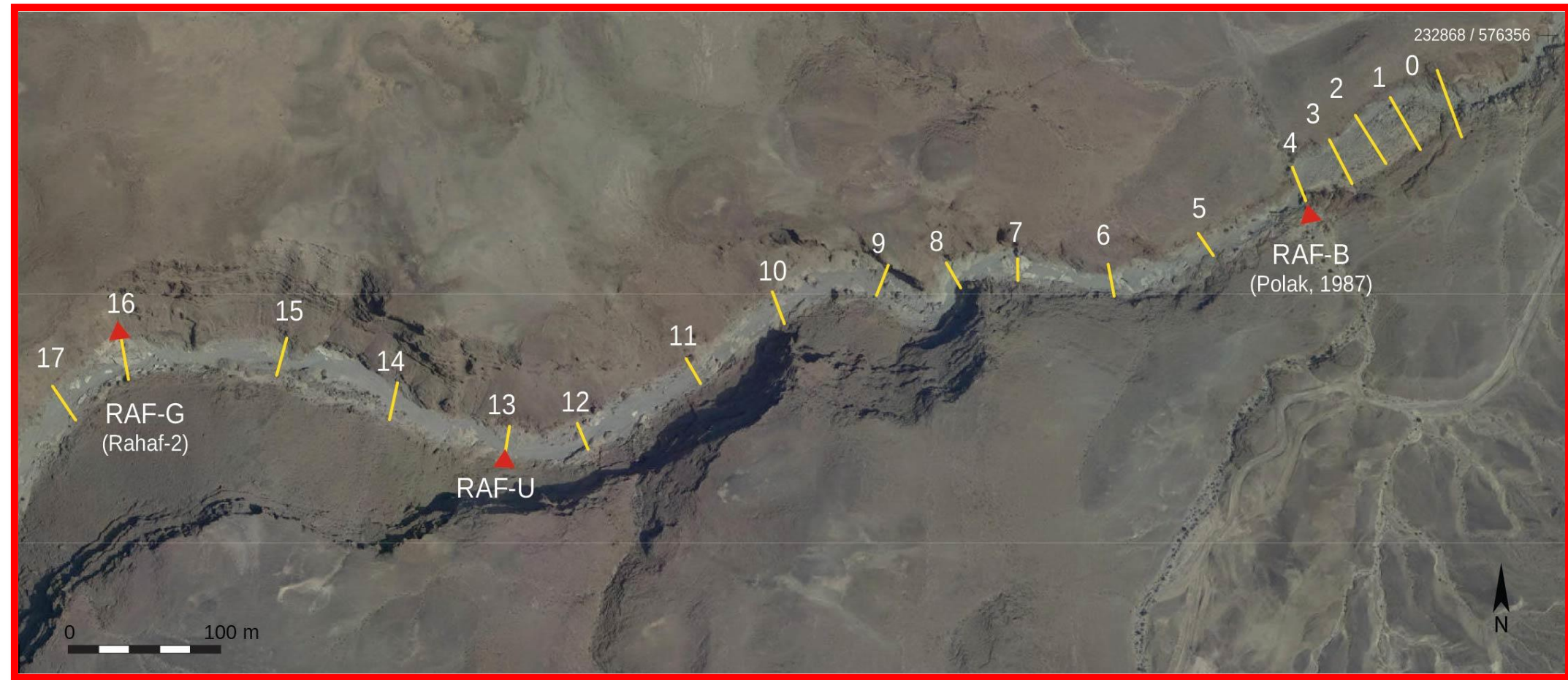
Methods

Study area

Appliance

Results

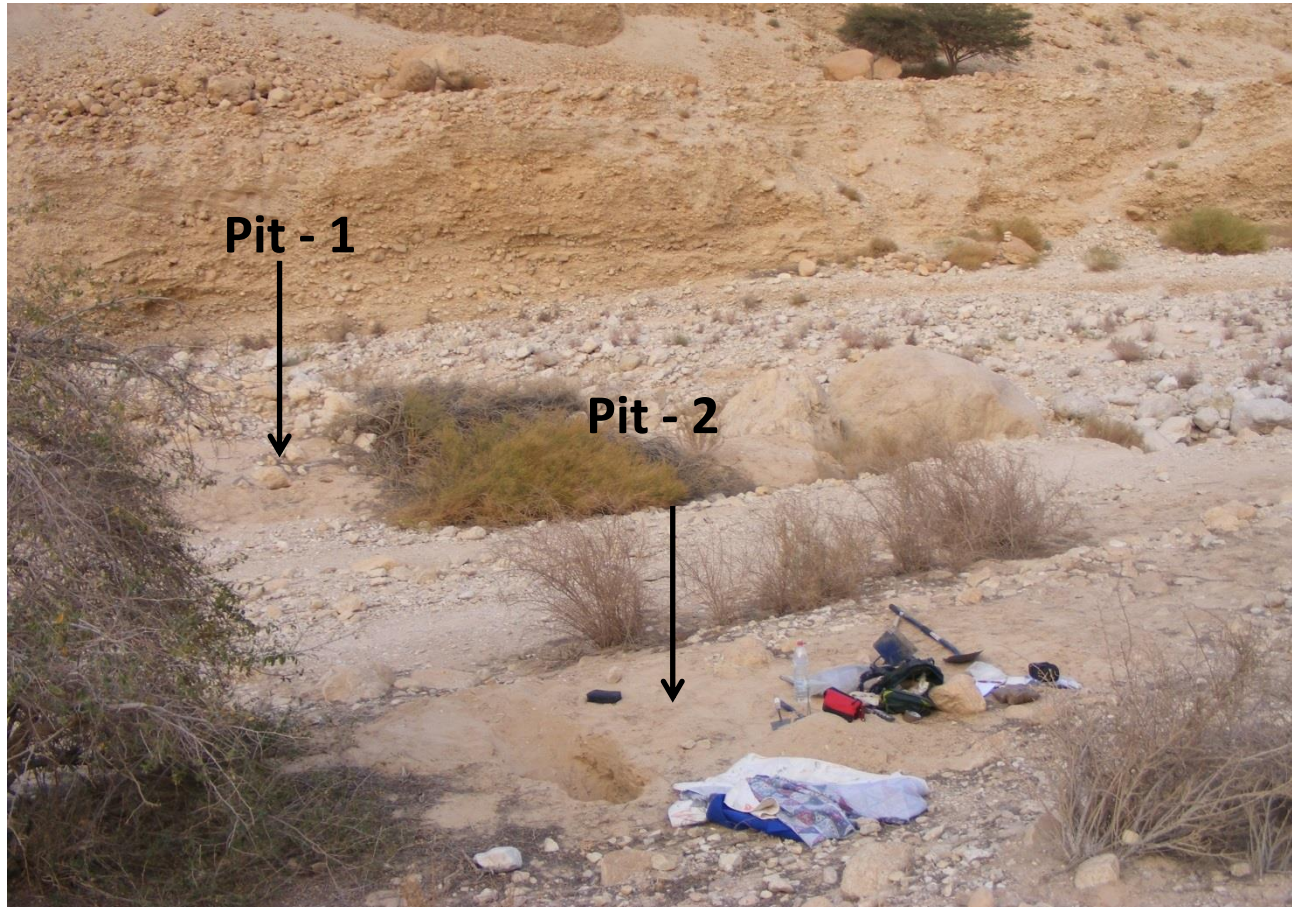
Summary



Appliance in Southern Judea Desert

- Sites with adjacent relicts

ZE-9 (723679/3471232 UTM)



Object

Methods

Study area

Appliance

Results

Summary

Appliance in Southern Judea Desert

- Short hydrological record

Object

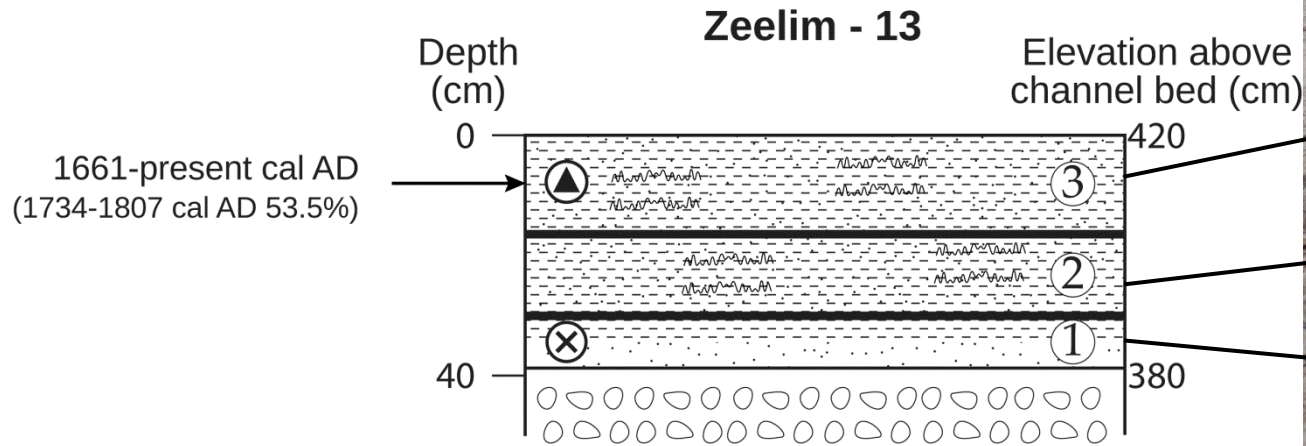
Methods

Study area

Appliance

Results

Summary



Appliance in Southern Judea Desert

Object

Methods

Study area

Appliance

Results

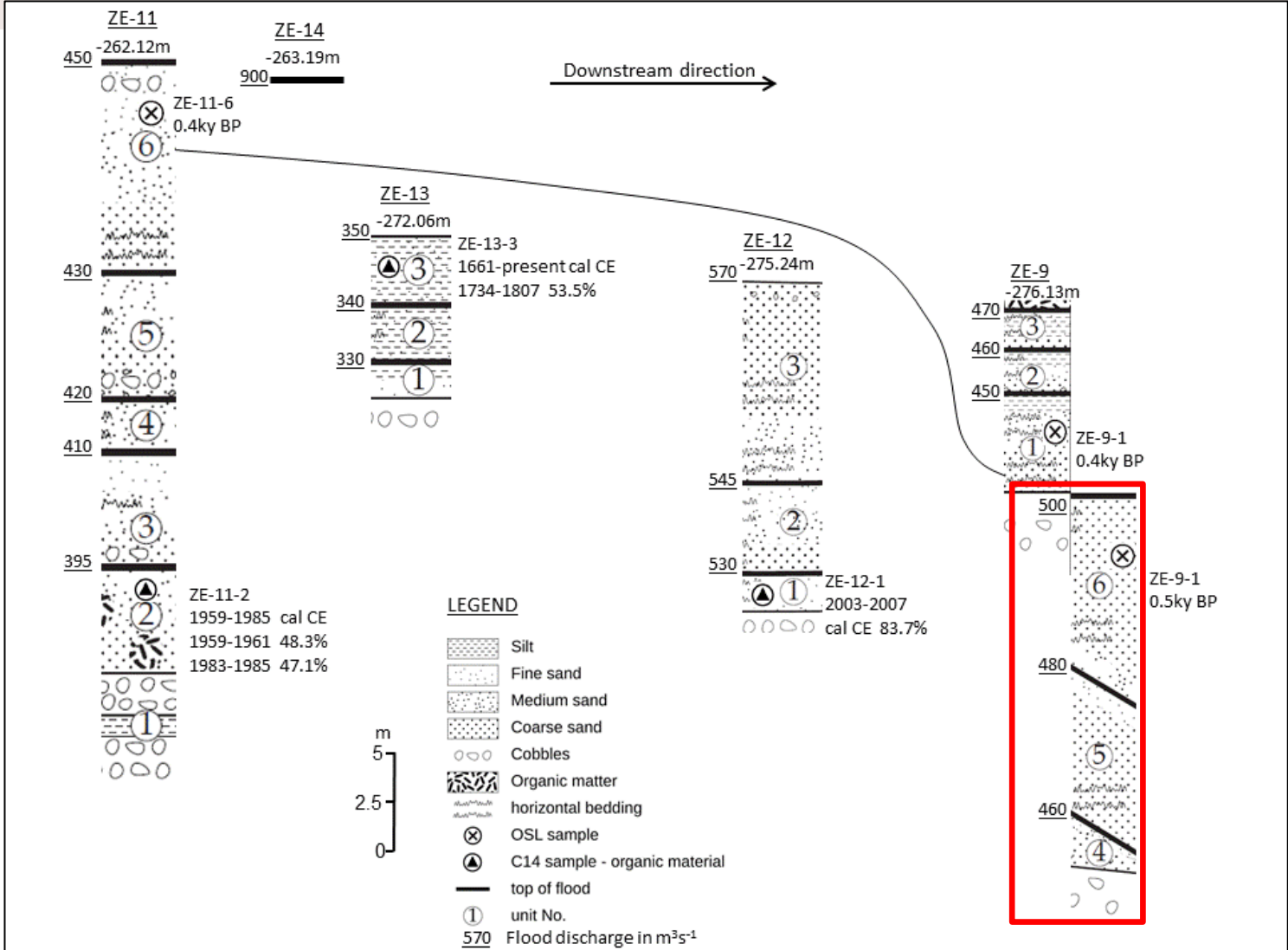
Summary

Hydraulics –

- Irregular stream profile consists of waterfalls and slopes
- Reaches of expansions and contractions



Stratigraphy of Palaeofloods in Nahal Ze'elim stream



Stratigraphic profiles in the study reach of Nahal Ze'elim indicating dated samples (OSL dates in years BP and C14 dates in cal CE) and proposed correlation between sections. Elevation (in m bsl) of the stratigraphic site is indicated above the profile.

Object
Methods
Study area
Appliance
Results
Summary

Stratigraphy of Palaefloods in Nahal Ze'elim stream

Object

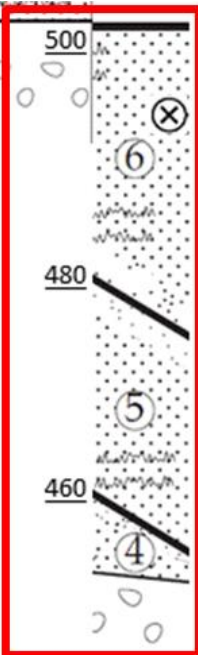
Methods

Study area

Appliance

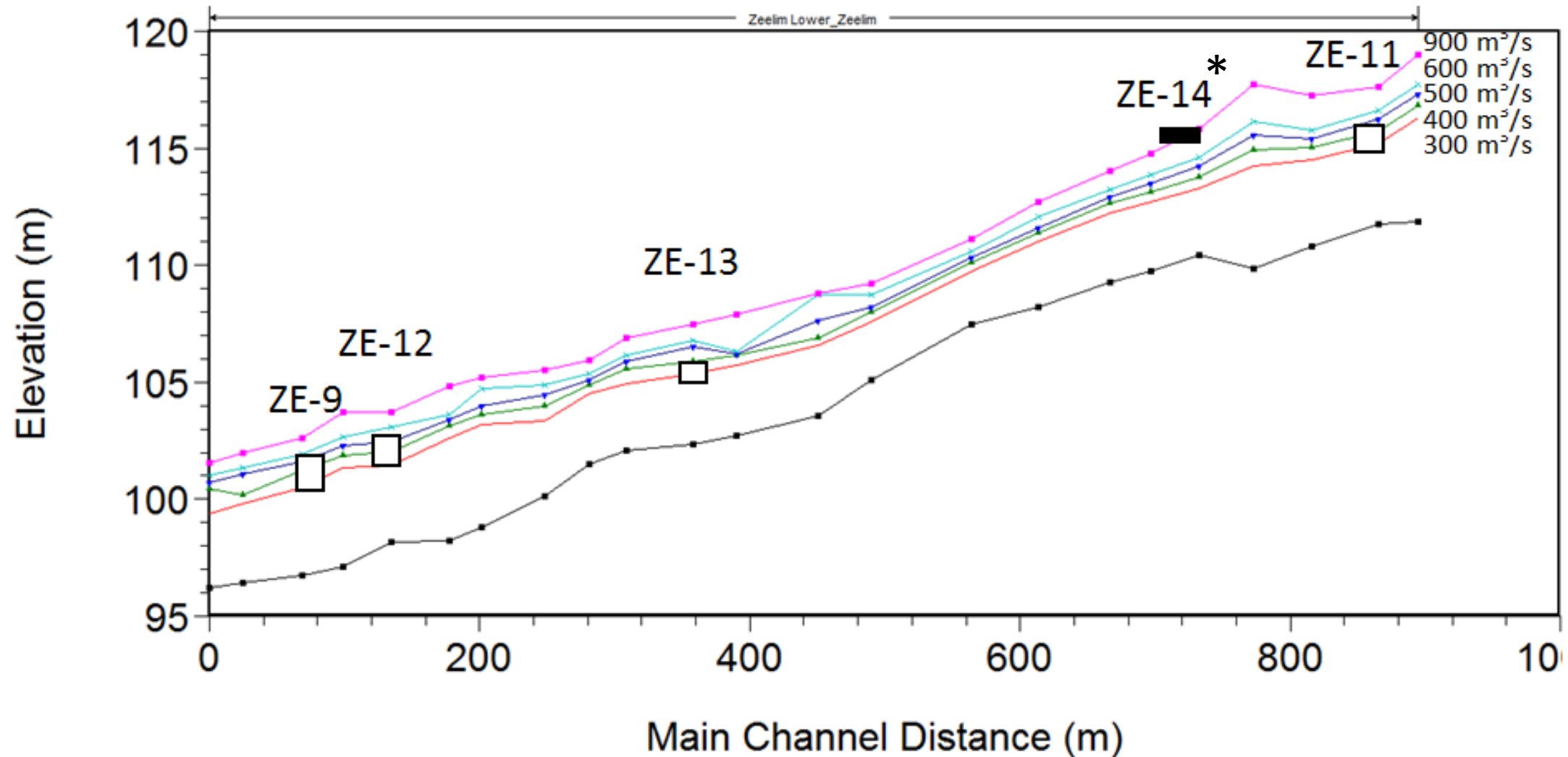
Results

Summary



Flood stratigraphy for ZE-9 site pit-2.

Results - Nahal Ze'elim stream



Object

Methods

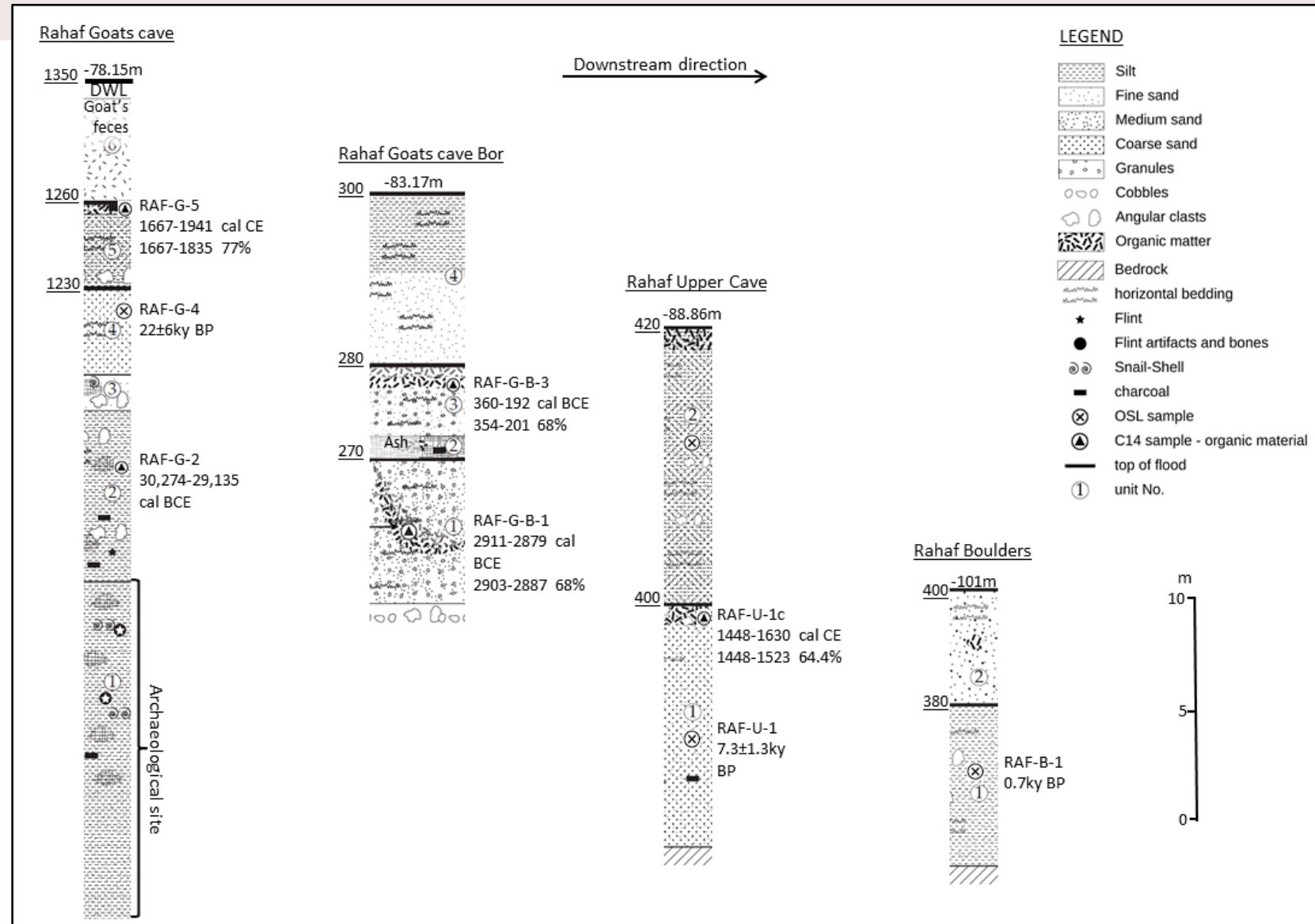
Study area

Appliance

Results

Summary

Results - Nahal Rahaf stream



Object

Methods

Study area

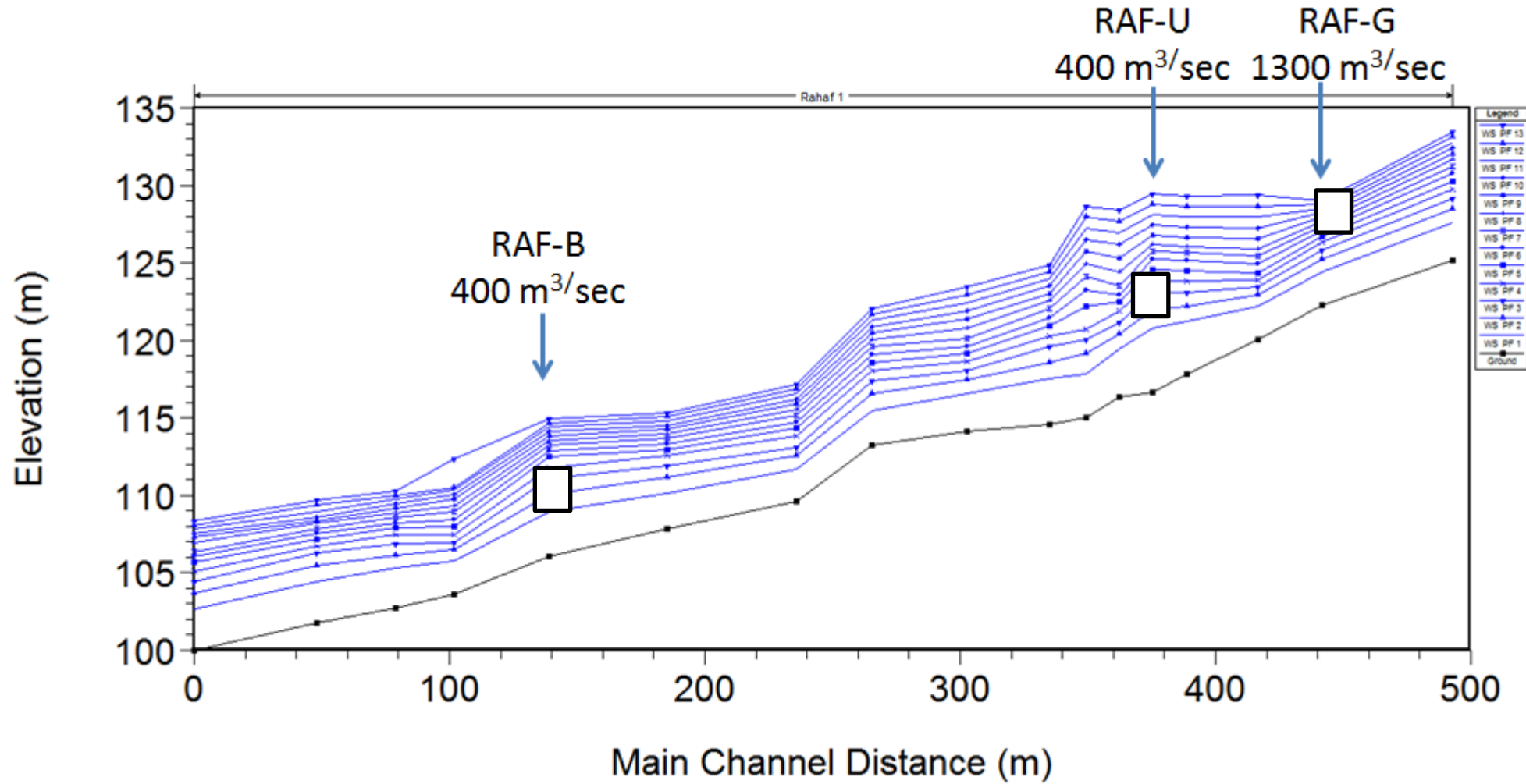
Appliance

Results

Summary

Stratigraphic profiles in the study reach of Nahal Rahaf indicating dated samples (OSL dates in years BP and C14 dates in cal CE/BCE). Elevation (in m bsl) of the stratigraphic site indicated above the profile

Results - Nahal Rahaf



Object

Methods

Study area

Appliance

Results

Summary

Flood Frequency Analysis

Object

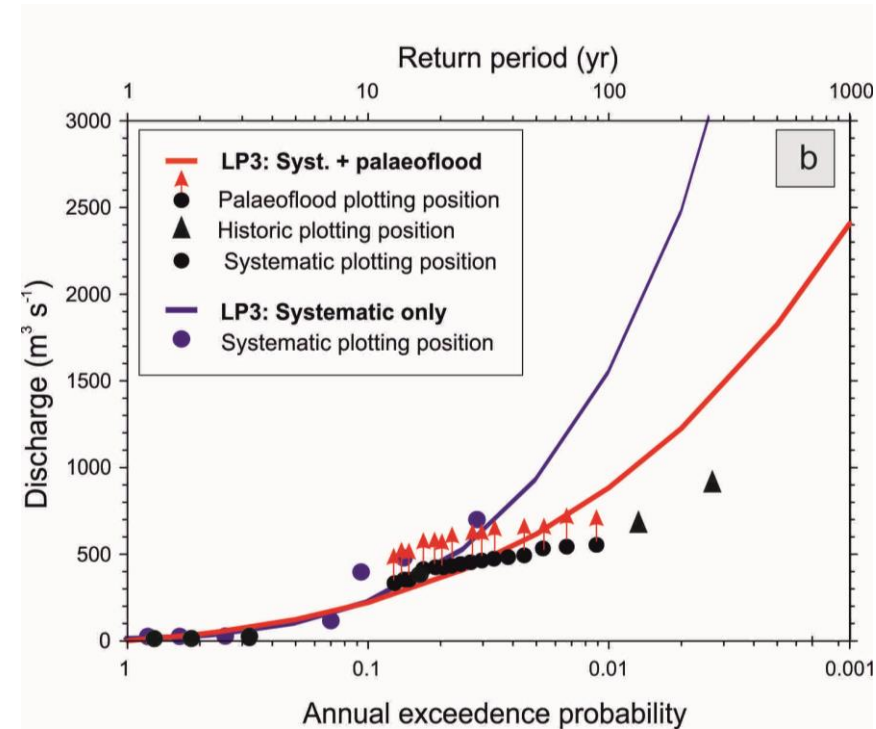
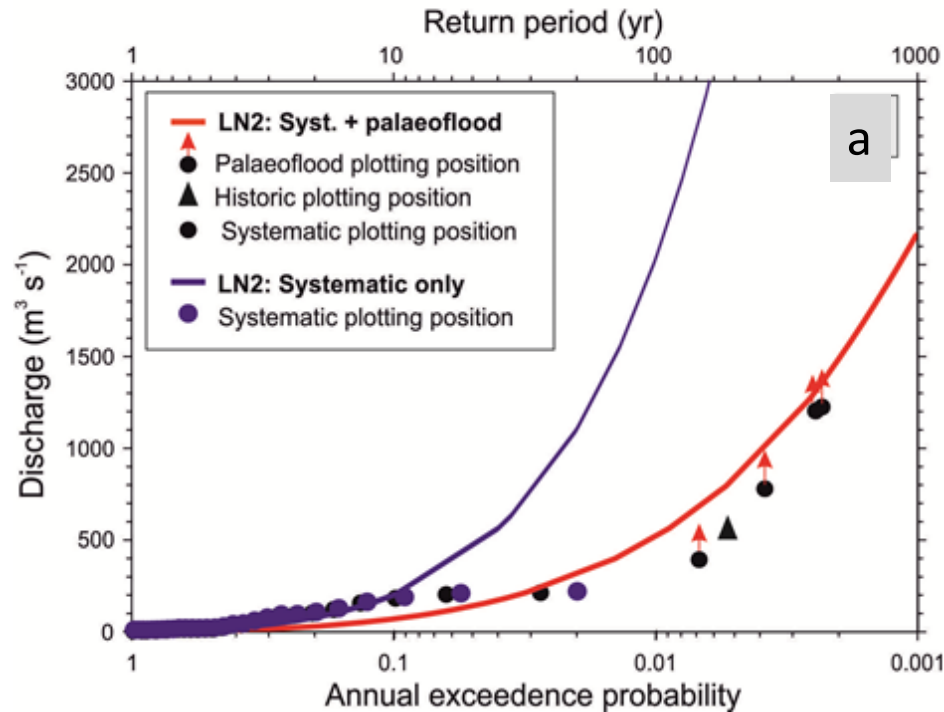
Methods

Study area

Appliance

Results

Summary



- a) Log Normal 2 (LN2) distribution function fitted to annual series systematic peak discharges and palaeoflood data for Nahal Rahaf.
- b) Log Pearson 3 (LP3) distribution function fitted to annual series systematic peak discharges and palaeoflood data for Nahal Ze'elim.

Flood Frequency Analysis						Object
						Methods
Exceedance	Average	Peak discharge m ³ s ⁻¹				Study area
annual	recurrence	Ze'elim		Rahaf		
probability	interval	Log Pearson 3		Log Normal 2		
(%)	(yrs)	Systematic data only	Pf and Systematic	Systematic data only	Pf and Systematic	Appliance
20	5	90.1	123	93	30	
10	10	209.5	221	259	69	
4	25	512.8	413	770	168	Results
2	50	912.4	616	1559	300	
1	100	1530	883	2937	503	
0.2	500	4336	1824	10595	1434	Summary
0.1	1000	6462	2407	17348	2146	

Summary and conclusions

Object

Methods

Study area

Appliance

Results

Summary

- The SWD's preservation together with other PSI's allows the reconstruction of long-term flood record with reliable FFA for the Southern Judea Desert streams.
- Palaeoflood evidences were found to be greater 1.3 and >2 fold comparing to the maximum measured floods.

Drainage basin	Drainage area km ²	Measured peak discharge m ³ /s	Maximal peak discharge of PF m ³ /s	No. of PF's	Duration of record (years)
Ze'elim	287	680^a	900	15	500-700
Rahaf Up.	55	525^b	1,300	10	1,000
^a Oct. 1997 (SERS, 2003)					
^b Oct. 1987 (Polak, 1988)					

Thank you ☺



Nahal Ze'elim stream