



PUMPING TEST RESULTS AT THE DJIBOUTI HES

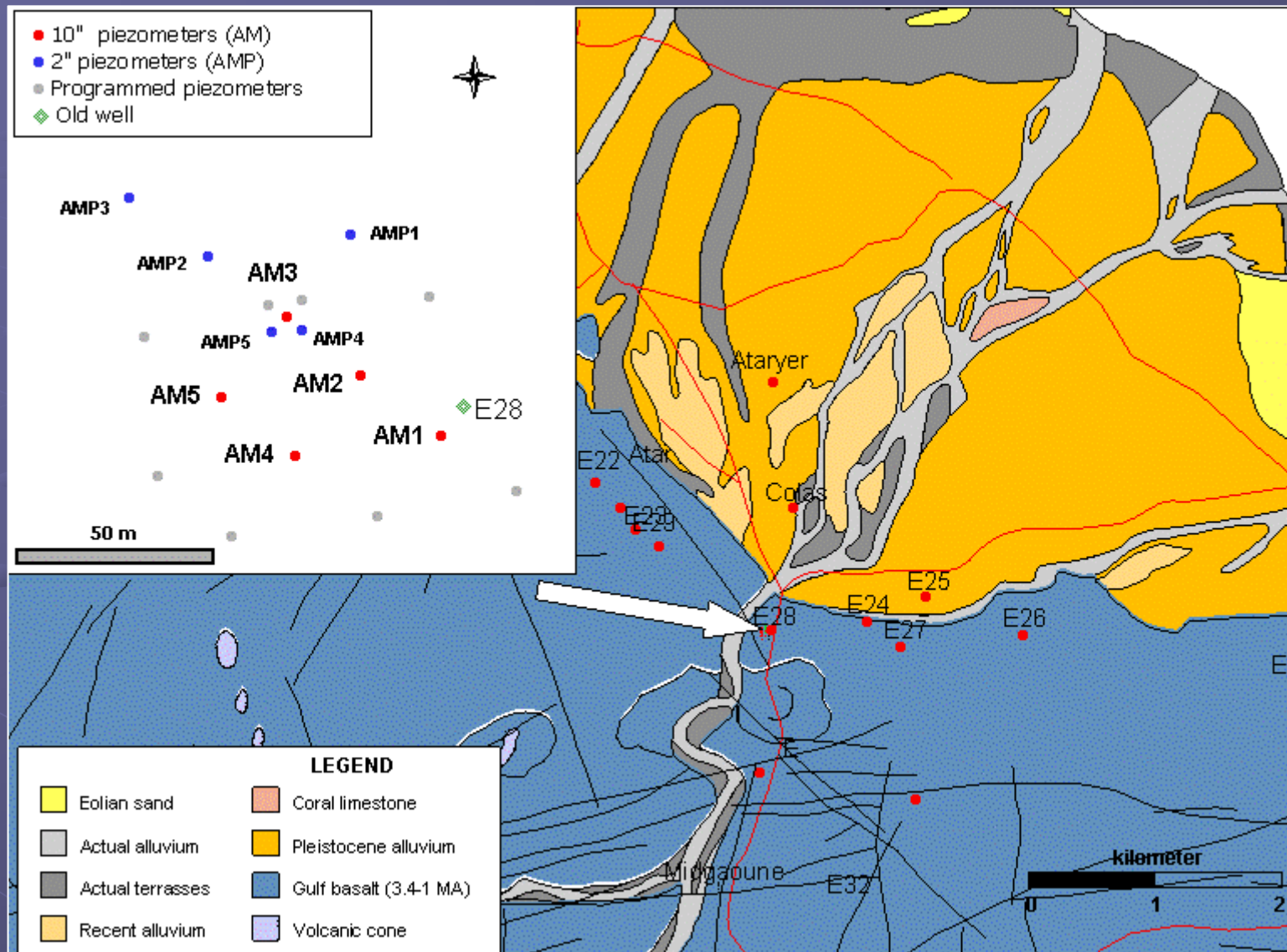
MAWARI PROJECT ADDIS MEETING 2014 November 2007

JALLUDIN M

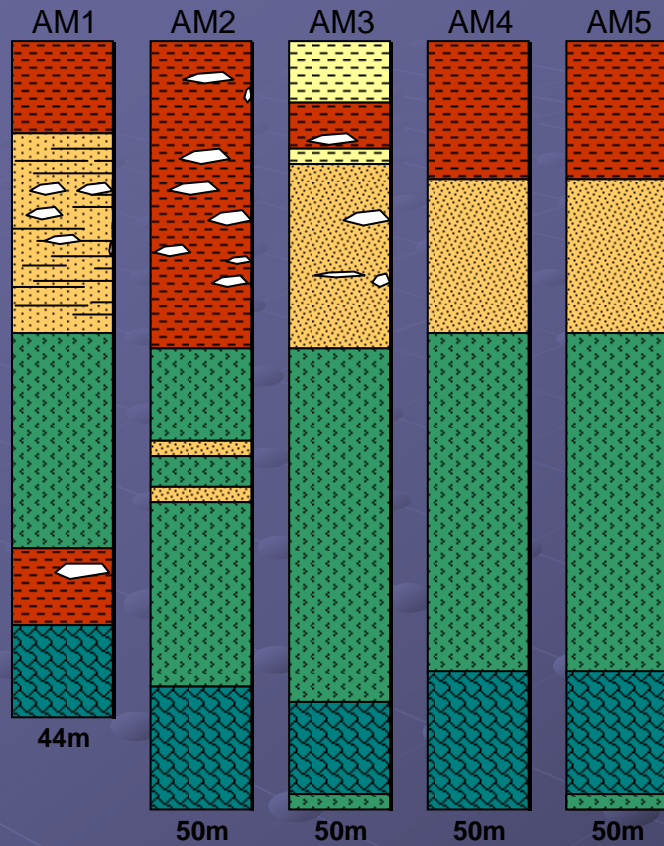
PUMPING TESTS CONDUCTED AT THE HES




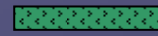

- **PHASE 1. 2006 (After drillings)**
Stepdrawdown tests
Long term tests
- **PHASE 2. 2007**
Stepdrawdown tests
Long term tests
Slug tests

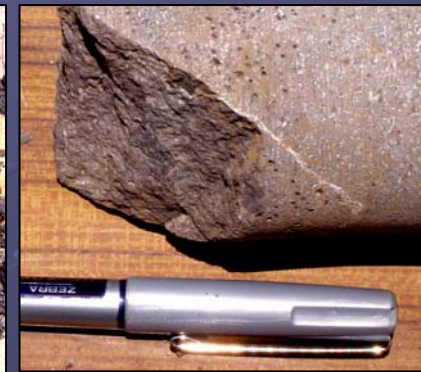
THE HYDROGEOLOGICAL EXPERIMENTAL SITE



GEOLOGICAL LOGS OF THE PIEZOMETERS



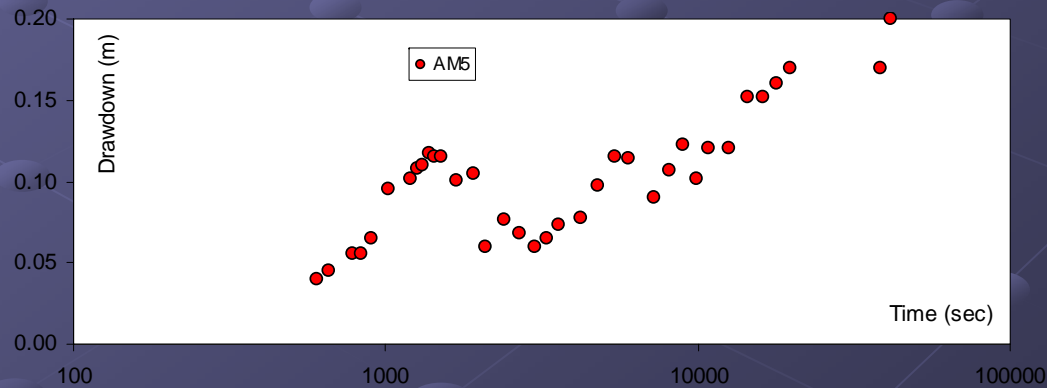
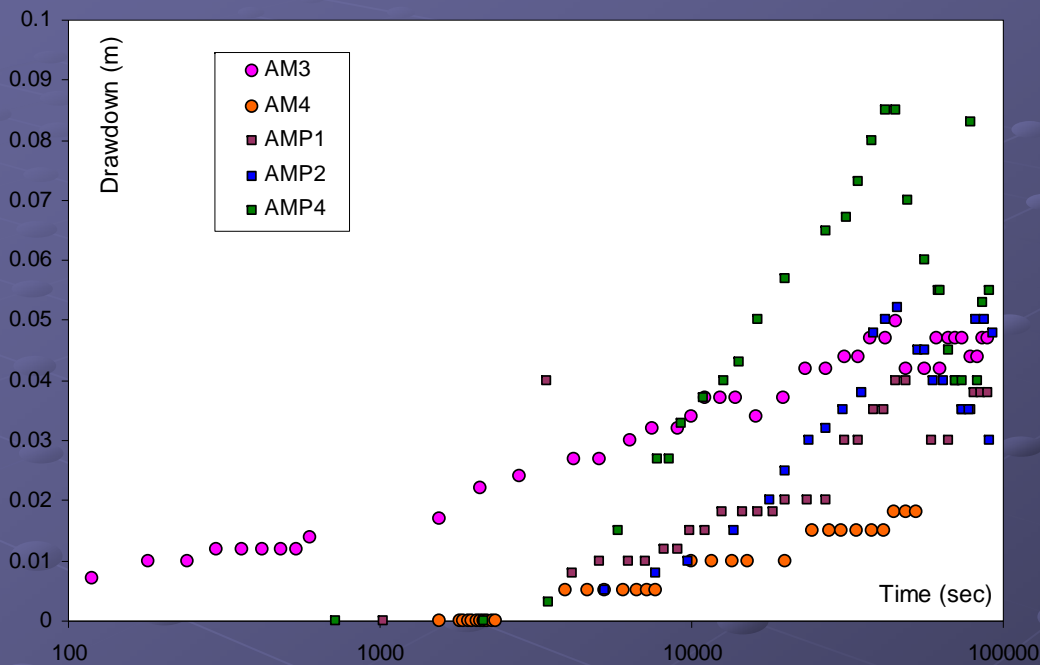
-  Redish clay with coarse alluvium
-  Silts
-  Coarse alluvium with sands and clays
-  Fissured basalts
-  Scoria



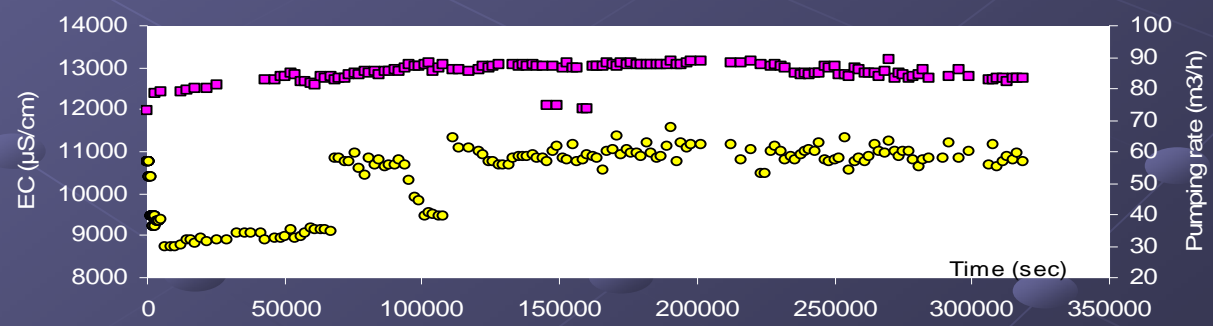
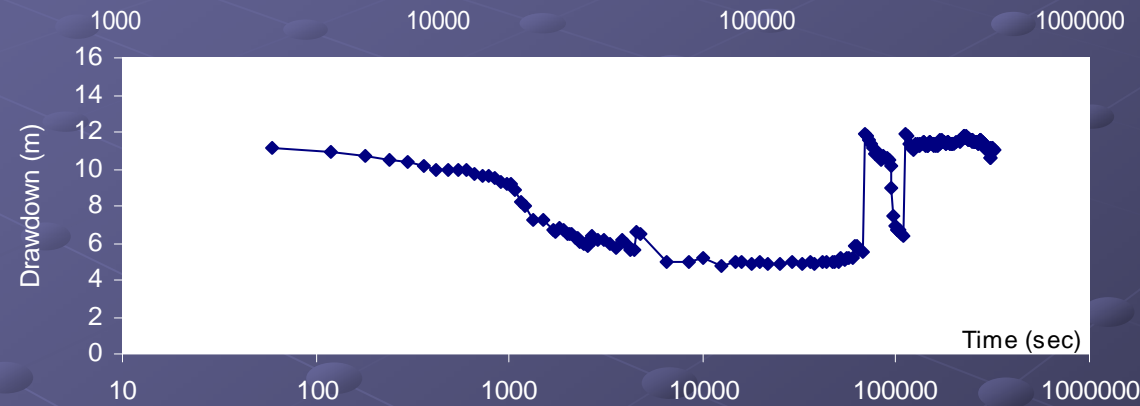
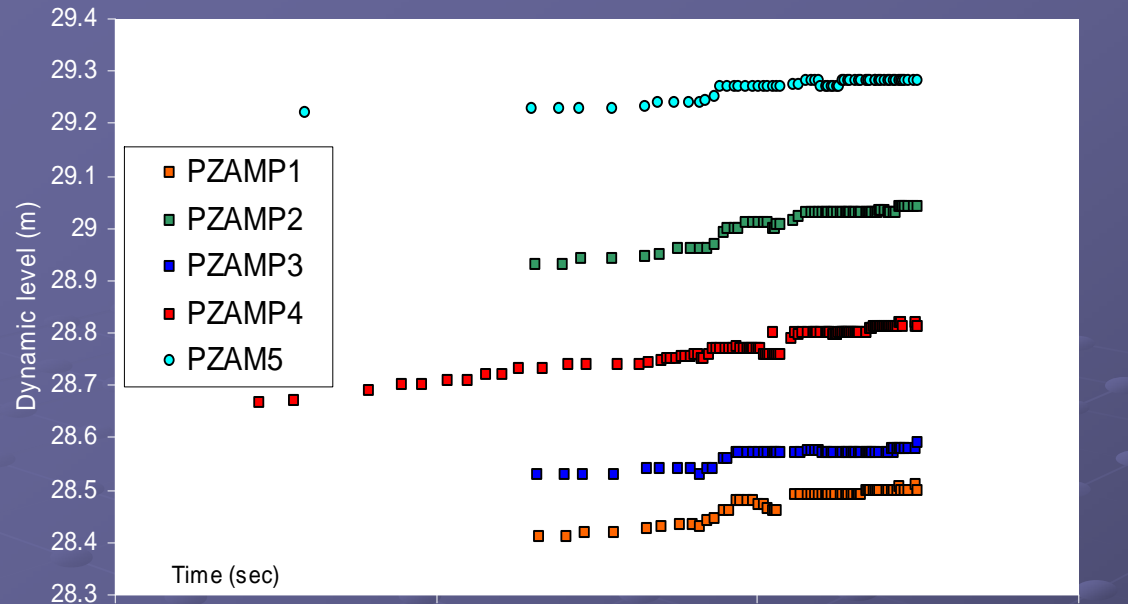
GEOLOGICAL OBSERVATIONS



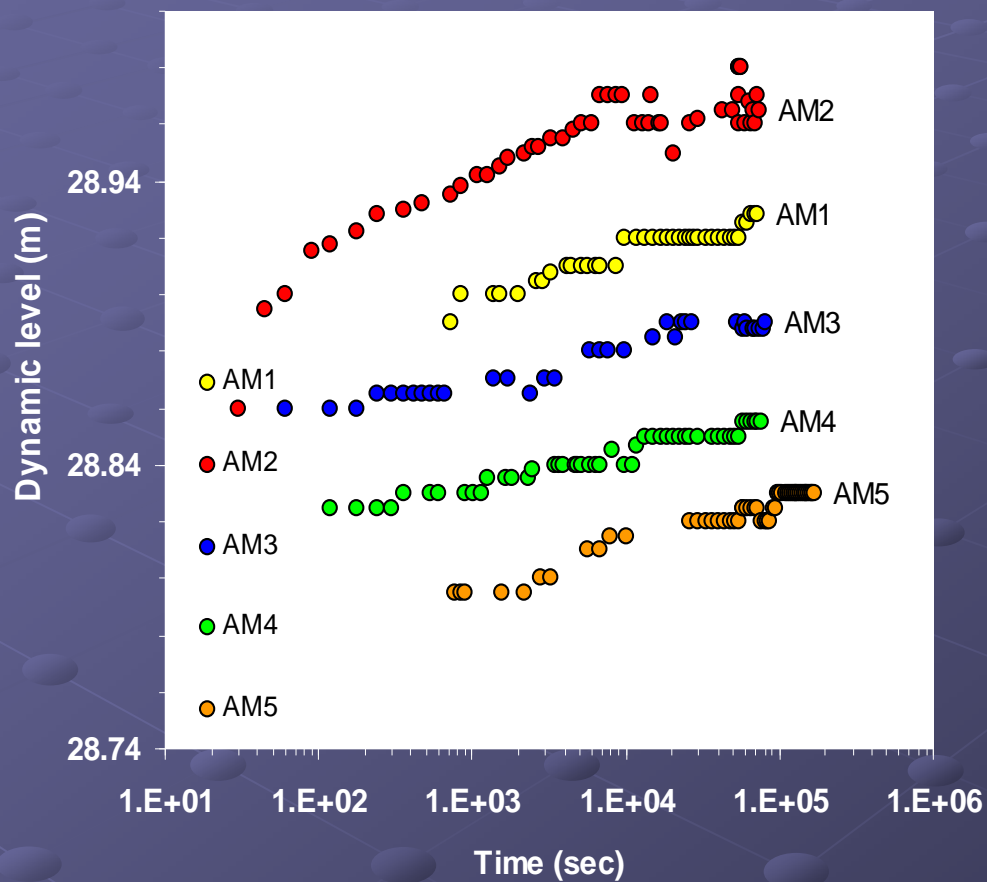
LONG TERM PUMPING TESTS ON AM5



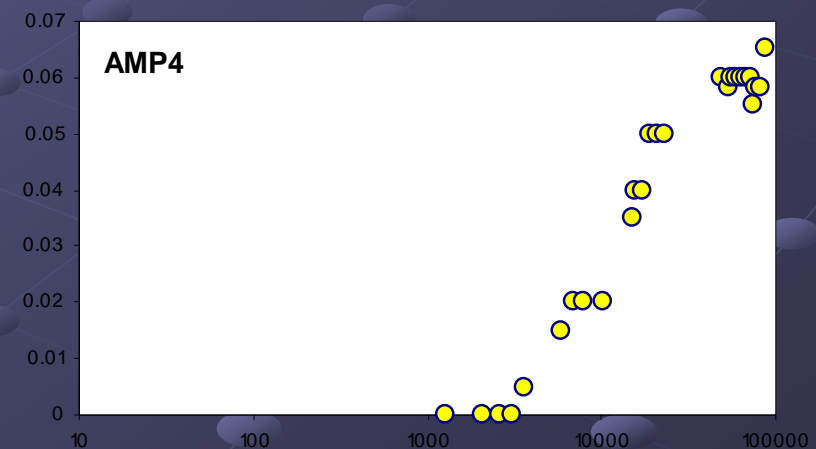
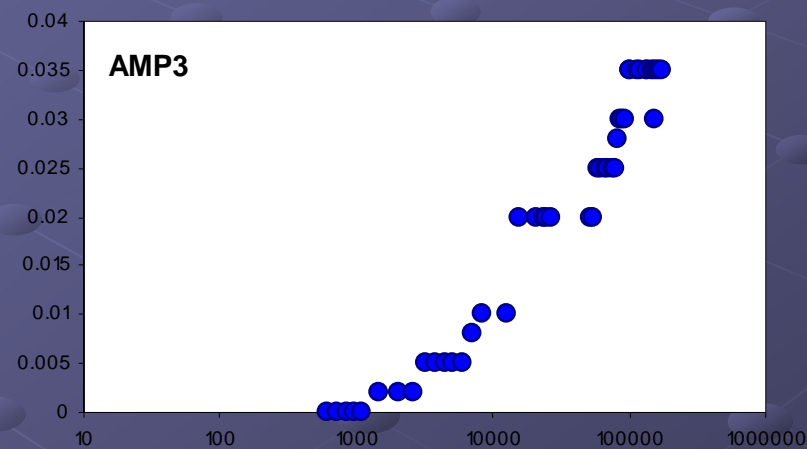
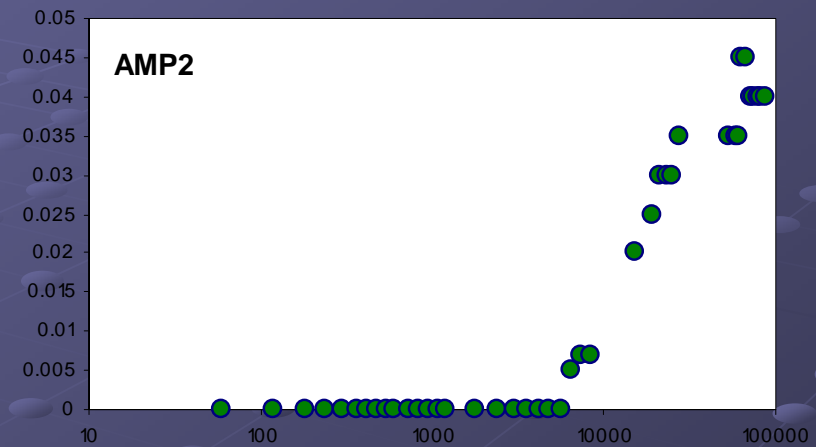
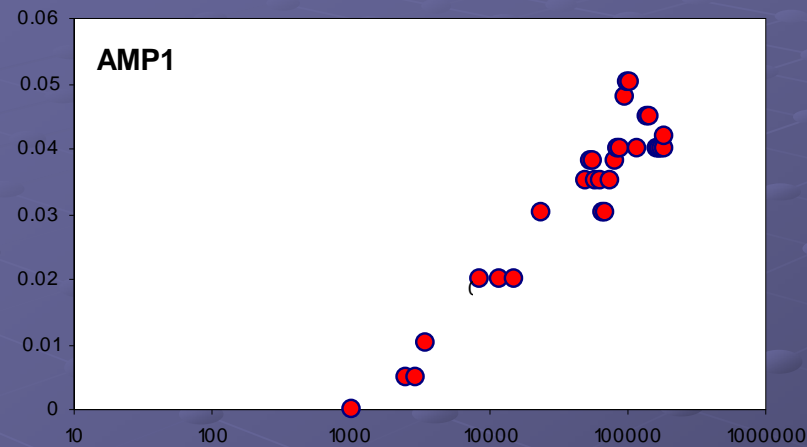
LONG TERM PUMPING TESTS ON AM3



LONG TERM PUMPING TESTS ON AM2 ($Q = 83 \text{ m}^3/\text{h}$)



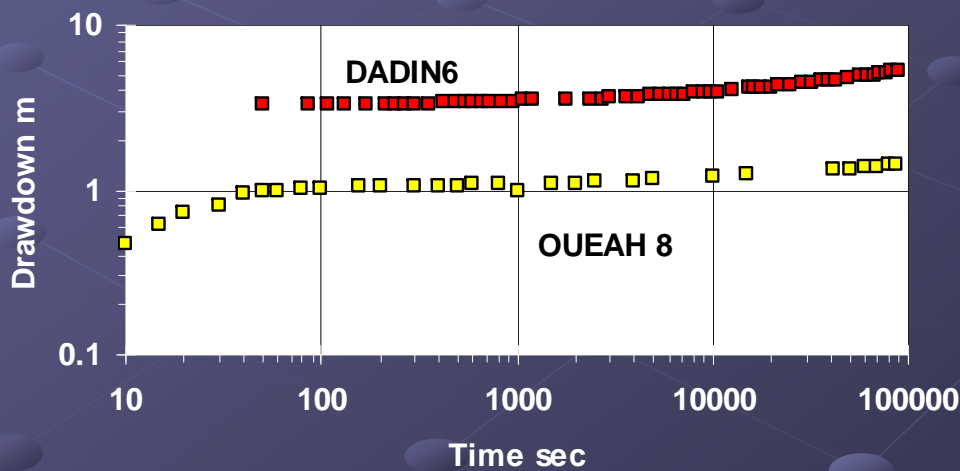
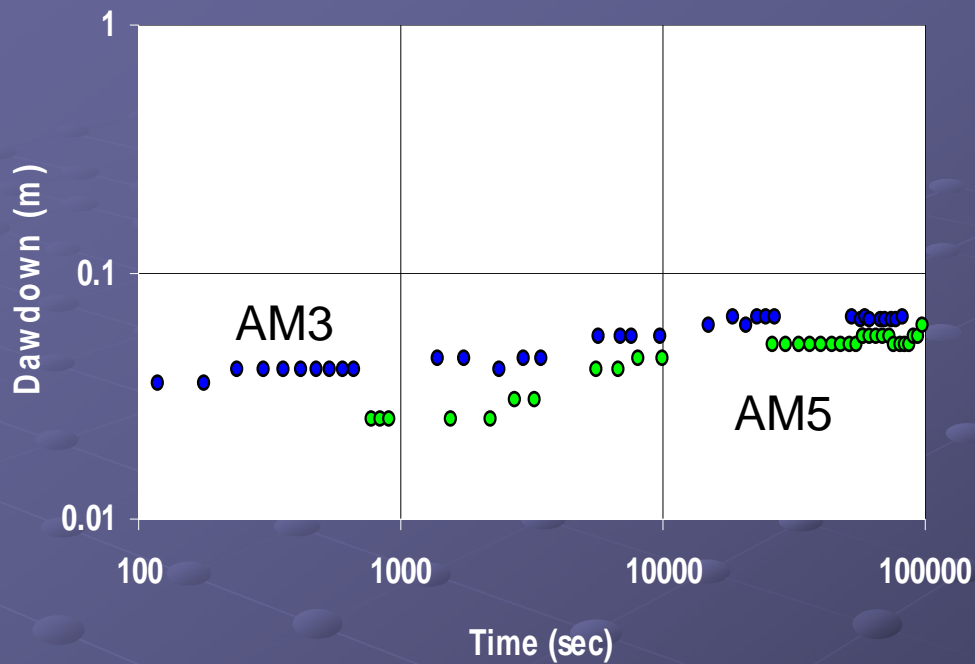
Drawdowns in AMP piezometers: D_s (m) versus time (sec)



OBSERVATIONS ON THE PUMPING TEST DATA

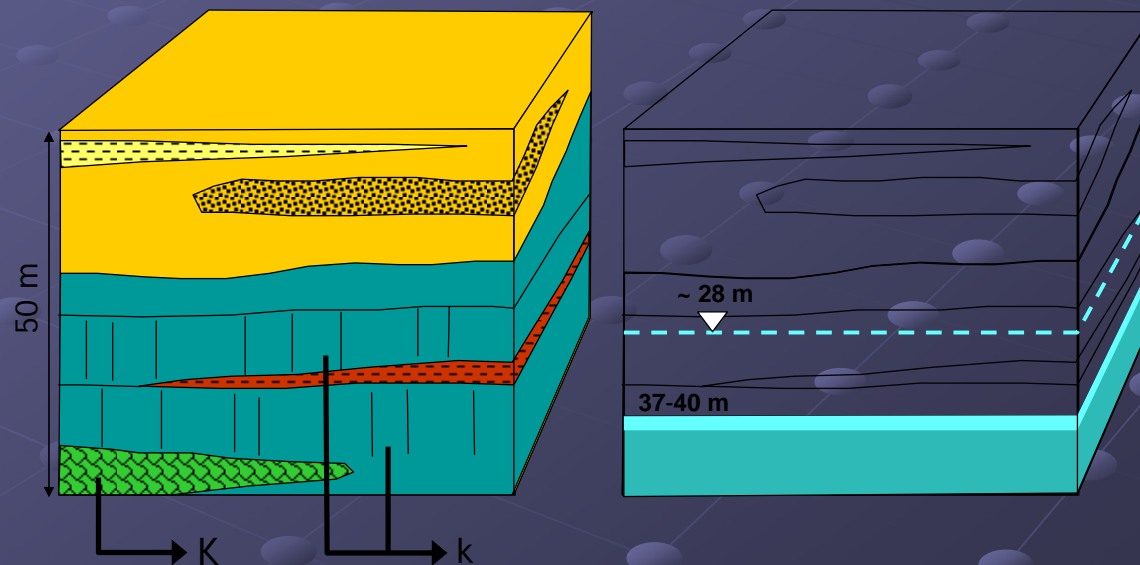
- The drawdowns are relatively small in the order of magnitude of some centimeters except the pumping well which drawdowns remain under 1.5 meters
- The AM piezometers react within 5 minutes from the beginning of the pumping and the AMP piezometers react later between 35 and 85 minutes.
- AMP3 located further than AMP2 reacts long before the latter.
- AMP3 and AMP4 plots could be interpreted as a curve instead a linear trend.
- The plot of the drawdowns data on a semilog graph describes globally a linear trend. The pumping well AM2 describes almost a stabilized state for a short period before a linear evolution followed by a stabilisation. AM3 and AM5 would show a stabilised regime at the start and then a linear trend.
- The stabilisation that occurs on the pumping well is quite well correlated with the AM piezometers, but AM1 shows a limit effect and AM5 seems still to evaluate. On the other hand drawdowns on the AMP piezometers continue to evolve after the stabilisation of the pumping well.

Delayed yield



OBSERVATIONS ON THE PUMPING TEST DATA

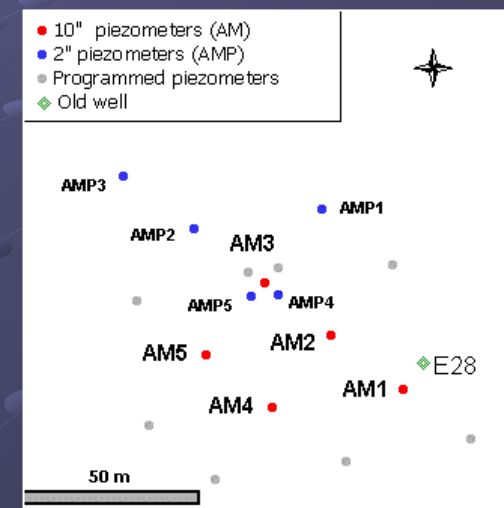
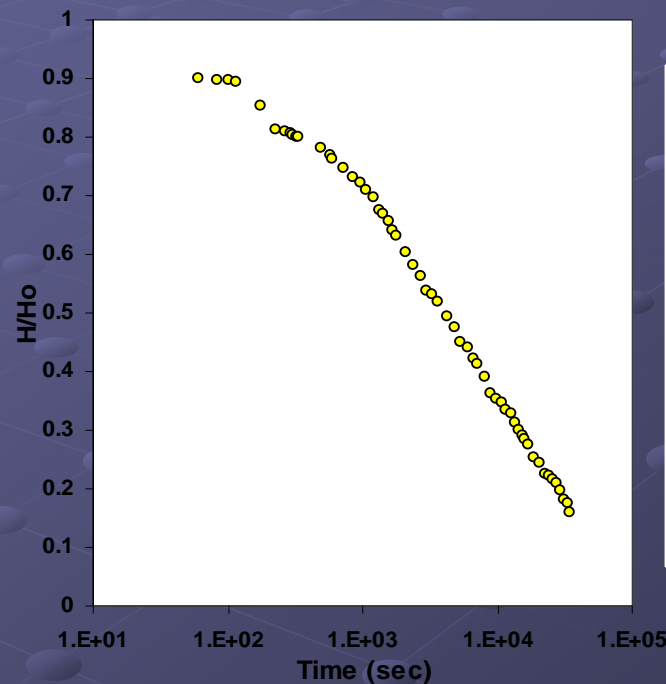
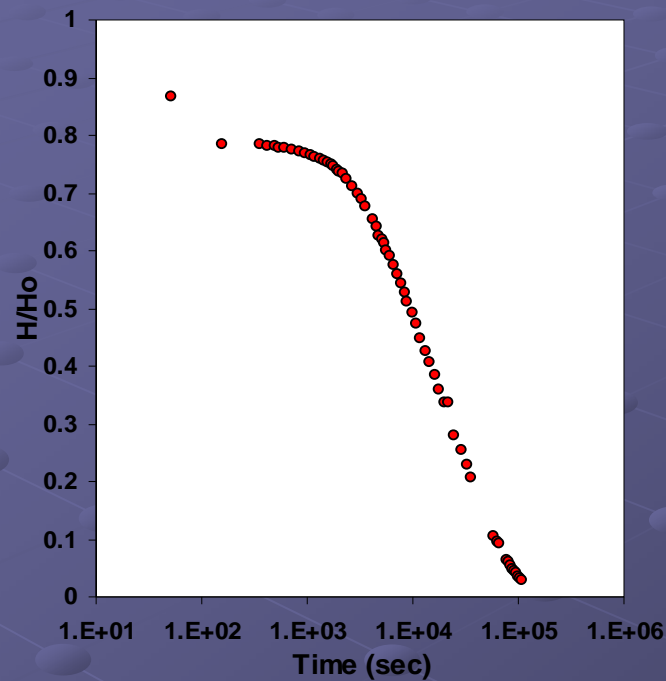
- Observations suggest that the overlying fissured basalts layer behaves as a semi-unconfined layer
- In this layer, drainage of water occurs after pumping has begun and a delayed yield phenomenon is observed . The delay yield would be generated from the storage in the fissures network of the basaltic lava flows and the vesicles transected by these fissures. It is only apparent on AM3, AM5 and the pumping well.
- From the measured data on AM3 and AM5, only the second and the third part of the curve from the model of Boulton can be identified. On the pumping well, all of the three parts can be identified, the two first parts being short in duration. The drainage factor B for AM3 and AM5 are respectively 250 m and 88.7 m. The time t_{wt} from which the drainage does not influence the drawdowns are 3000 seconds for AM3 and 6900 seconds for AM5.



HYDRODYNAMIC CHARACTERISTICS

WELL	JACOB		THEIS			BOULTON			
	Tdrawdown	S	Tdrawdown	S	Trecovery	T	S	B	tw
	m ² /s		m ² /s		m ² /s	m ² /s		m	sec
AM2	0.16				0.26				
AM1	0.28	0.698	0.33	0.034	0.38				
AM3	0.23	0.0067			0.105	0.26	0.0042	250	3000
AM4	0.38	0.012	0.36	0.0083					
AM5	0.13	0.094				0.18	0.048	88.75	6933
AMP1	0.16	0.197	0.14	0.776					
AMP2	0.078	0.33	0.073	0.559					
AMP3	0.11	0.056	0.403	0.013					
AMP4	0.11	0.61			0.095				

SLUG TESTS



Almost no change of water table after injection in AMP3 and AMP1

Conclusions

- The volcanic medium is characterized by a fissural porosity in the lava flows and an interstitial porosity in the scoriaceous layer allowing hydraulic interconnectivity between the volcanic system layers;
- The fissured basaltic lava flows overlying the scoria behave as a semi-unconfined layer where drainage occurs during pumping tests;
- Very high transmissivities are found in the scorias in the order of $2 \times 10^{-1} \text{ m}^2/\text{s}$ and the fissured basalts reveal a wide range of transmissivities which lowest values are around $5 \times 10^{-9} \text{ m}^2/\text{s}$;
- Fresh water is contained in the fissured basalts and the brackish water is recognized in the scoriaceous level. The brackish water would represent an old sea water that would have reacted with the volcanic rock minerals.



Thank you