

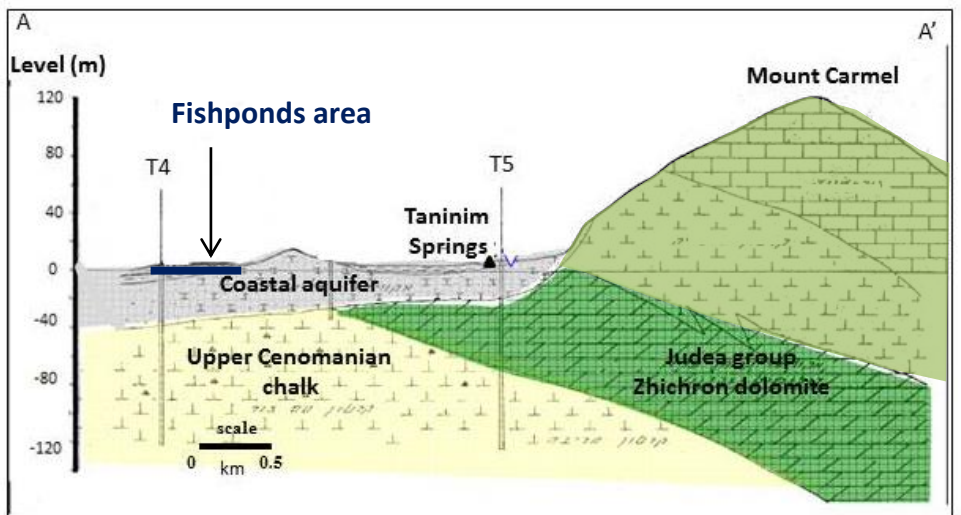
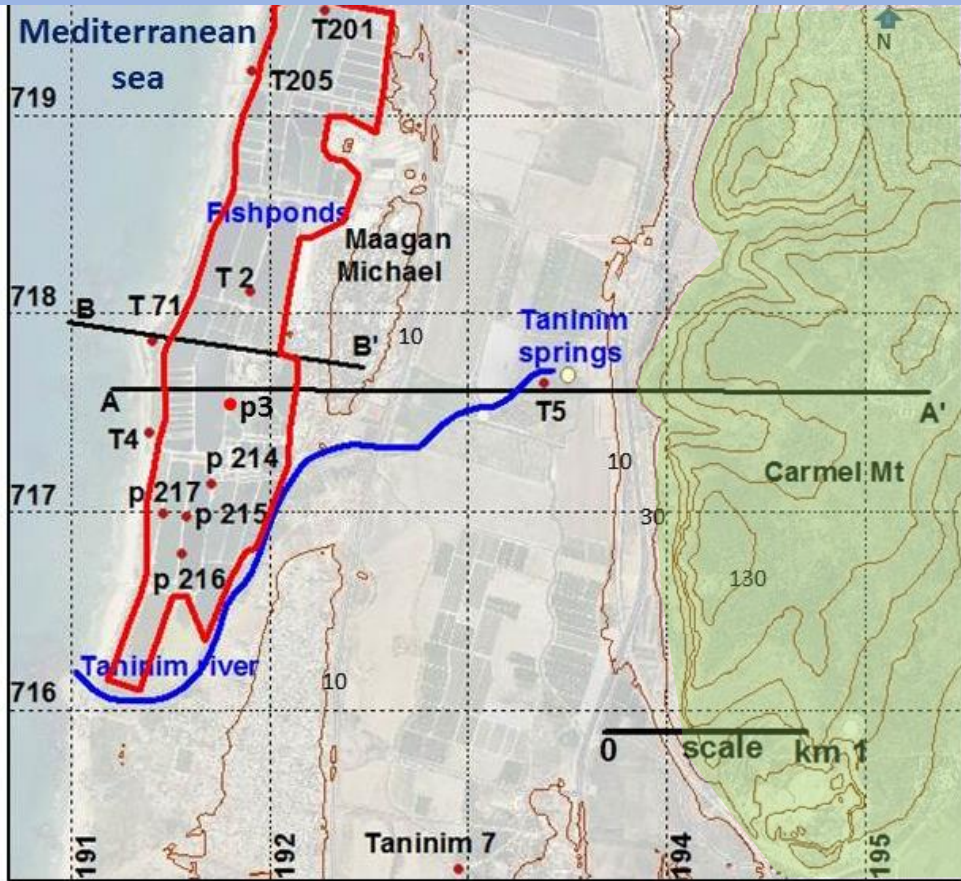
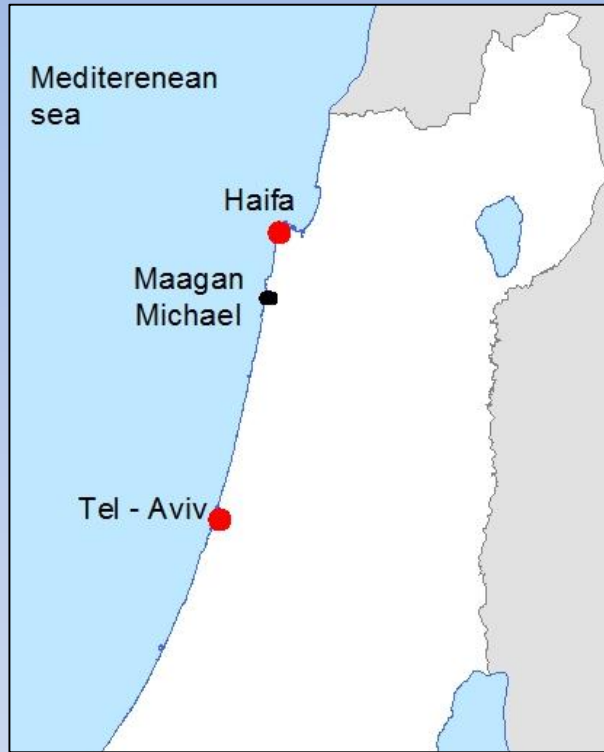
The interaction between surface reservoirs, multi-layered coastal aquifer and the sea

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- 2. Geological Survey of Israel**
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Location maps

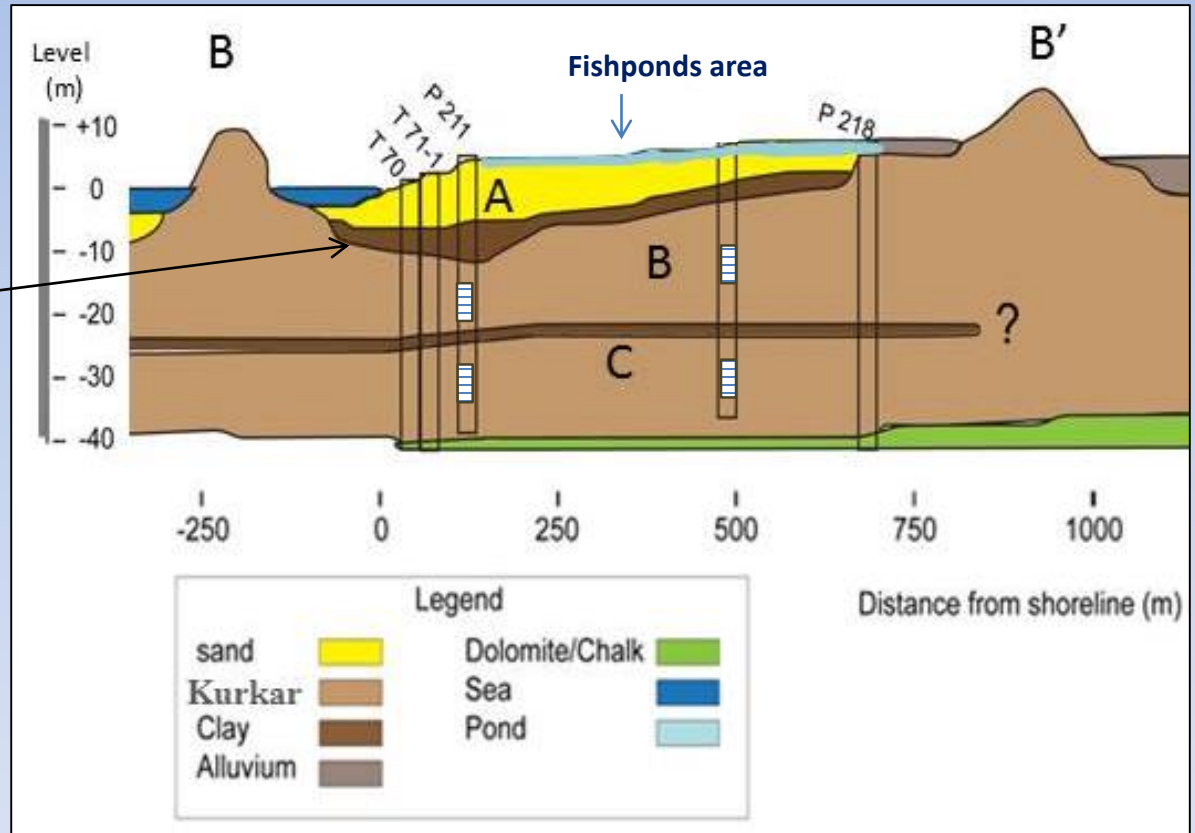
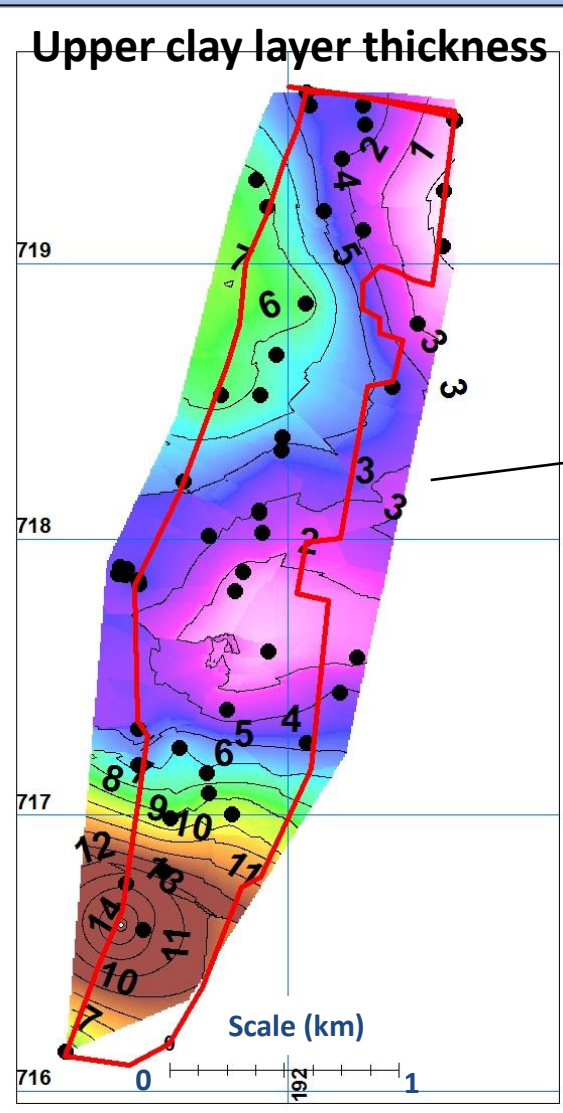


General topics

- interaction between the fishponds and the aquifer
- interaction between the aquifer and the sea

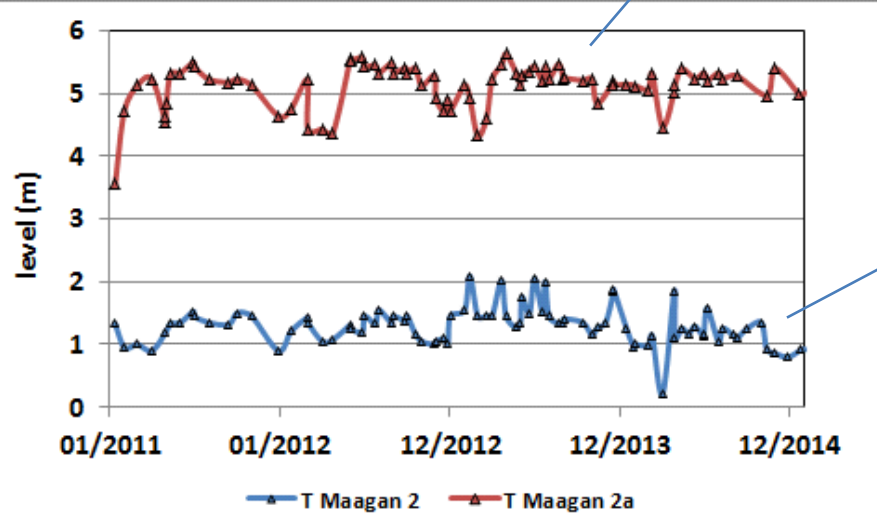
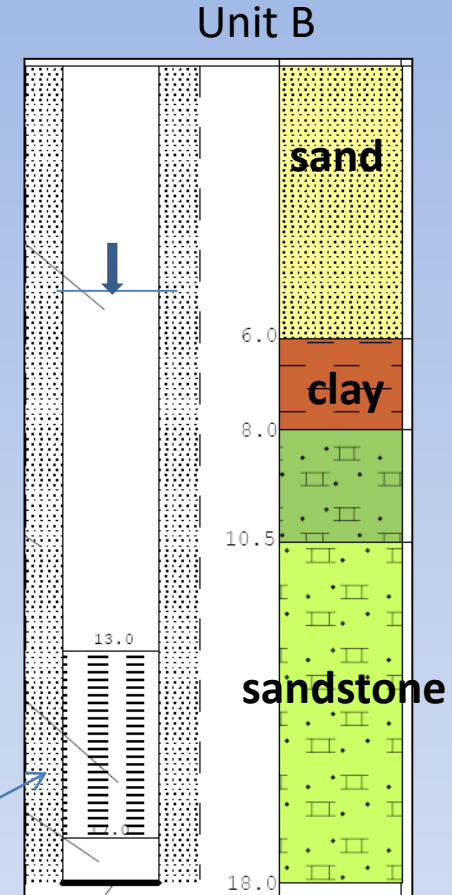
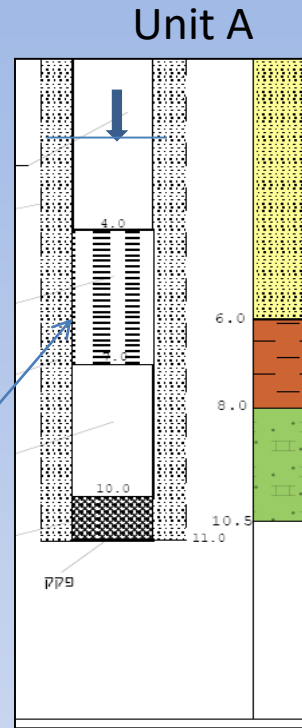
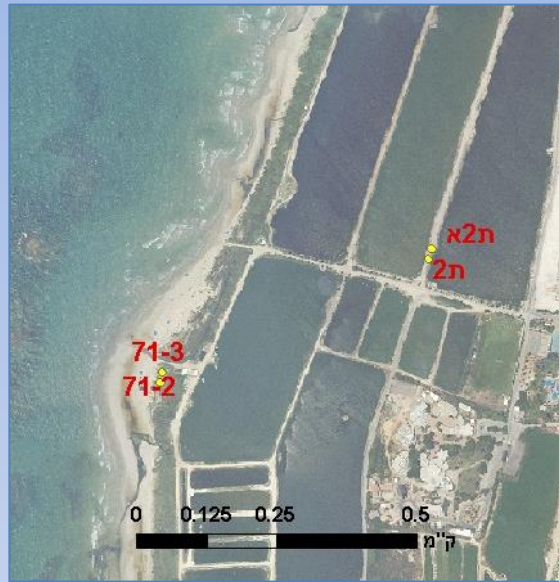
Geological structure

Upper clay layer thickness



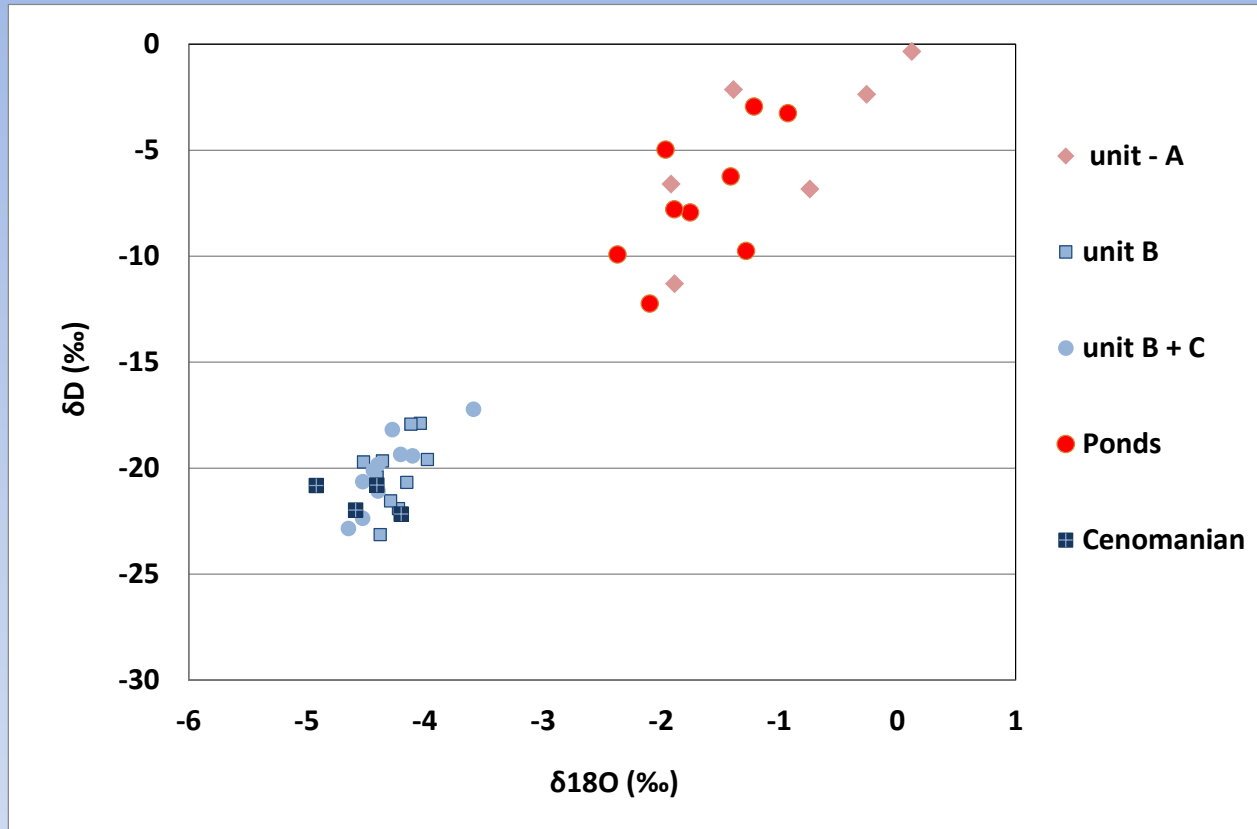
All the pumping is from units B and C

Hydrograph (water level)



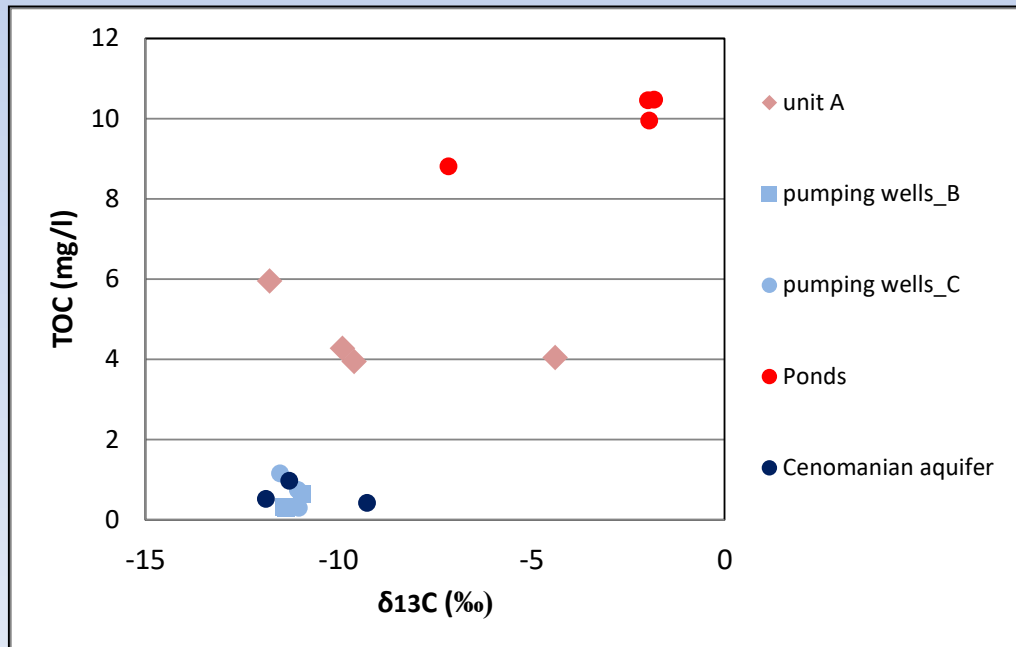
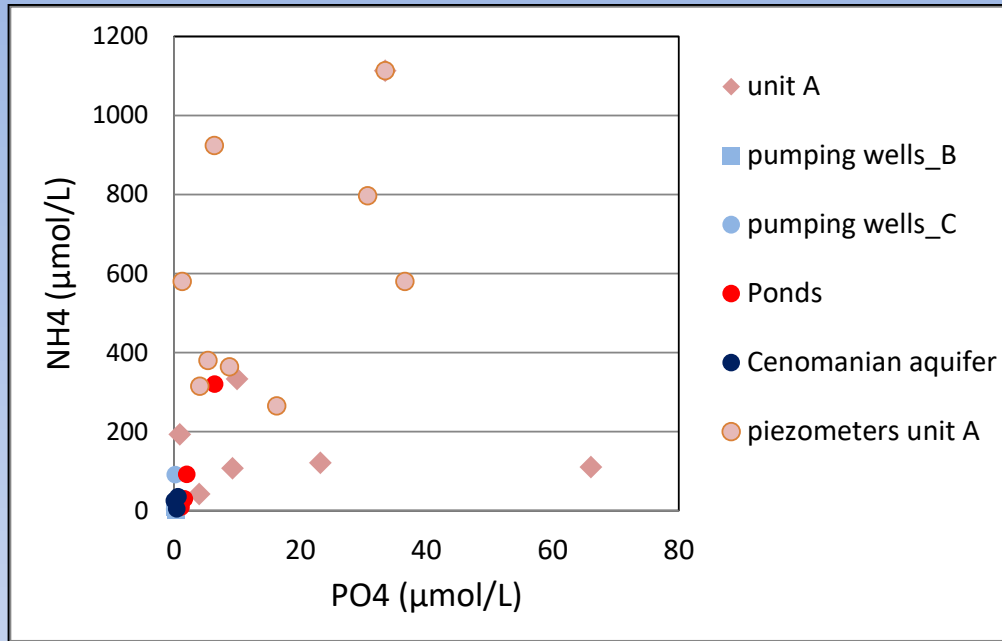
Water level in unit A is higher in 4 m than in unit B

Chemical and isotopes results



NO_3^-	HCO_3^-	SO_4^{--}	Cl^-	K^+	Na^+	Mg^{++}	Ca^{++}	observ ation	source
1	204	262	1978	31	1032	148	113	9	Ponds
11	331	277	2111	37	1115	160	181	32	Units B and C (pumping wells)
15	332	233	1976	24	1033	138	182	12	Cenomanian

Organic and nutrients results

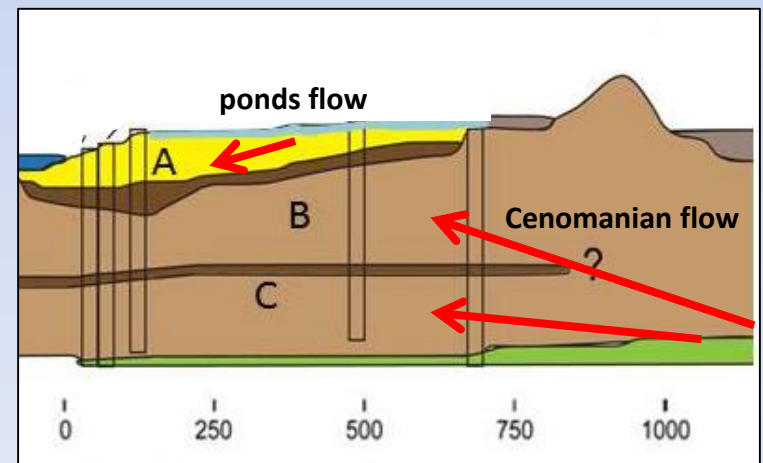


Summary of chemical result

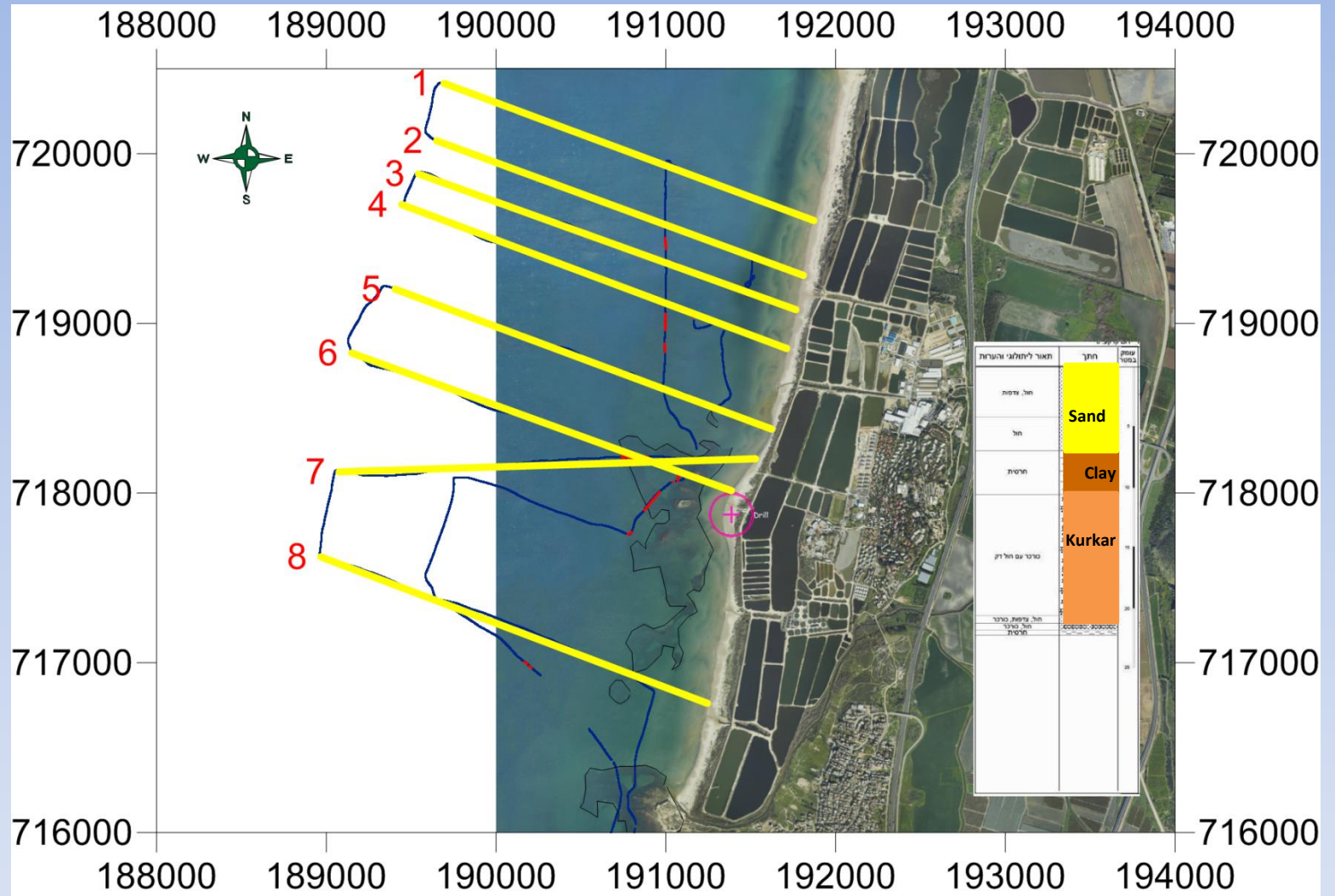
Cl mg/l	Eh	DO	NH4 (μ M)	NO2 (μ M)	NO3 (μ M)	PO4 (μ M)	TOC mg/l	C-13 ‰PDB	dD ‰ SMOW	d18O ‰ SMOW	source
1978	-29	3.4	445	0.8	32	11.9	6.6	-5.7	-8.4	-1.8	pond
2260	-165	1.2	555	0.8	36	14.8	3.8	-8.6	-4.9	-1.0	Unit A
2111	91	2.8	6	0.1	176	0.3	0.5	-11.2	-20.4	-4.3	Units B and C
1976	55	3	5	0.1	194	0.4	0.7	-10.3	-21.7	-4.6	Cenomanian

Two main groups:

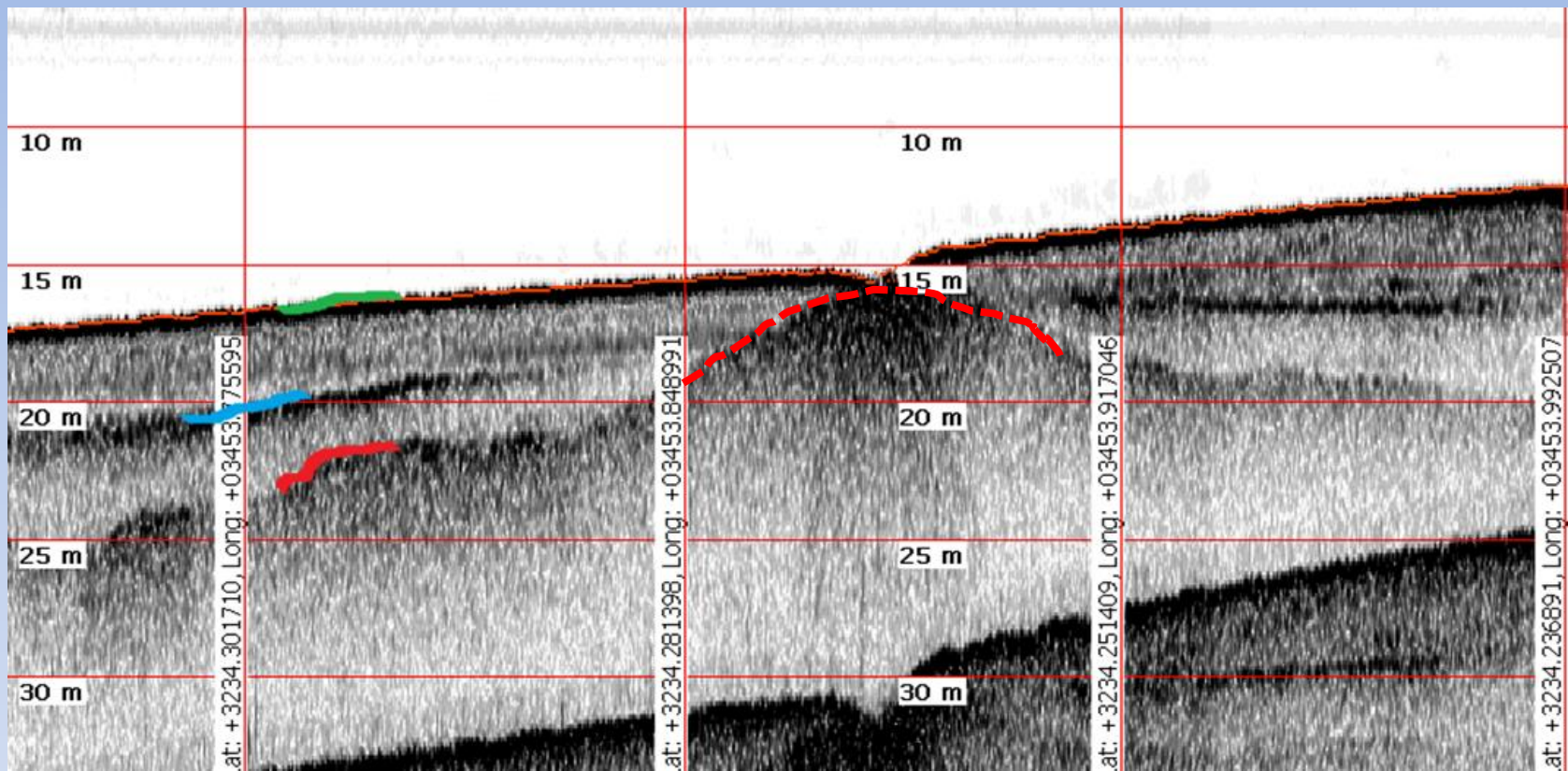
1. fishpond and unit A
2. units B + C and the Cenomanian (Judea)


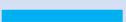



CHIRP survey - mapping the clay layer at the sea area

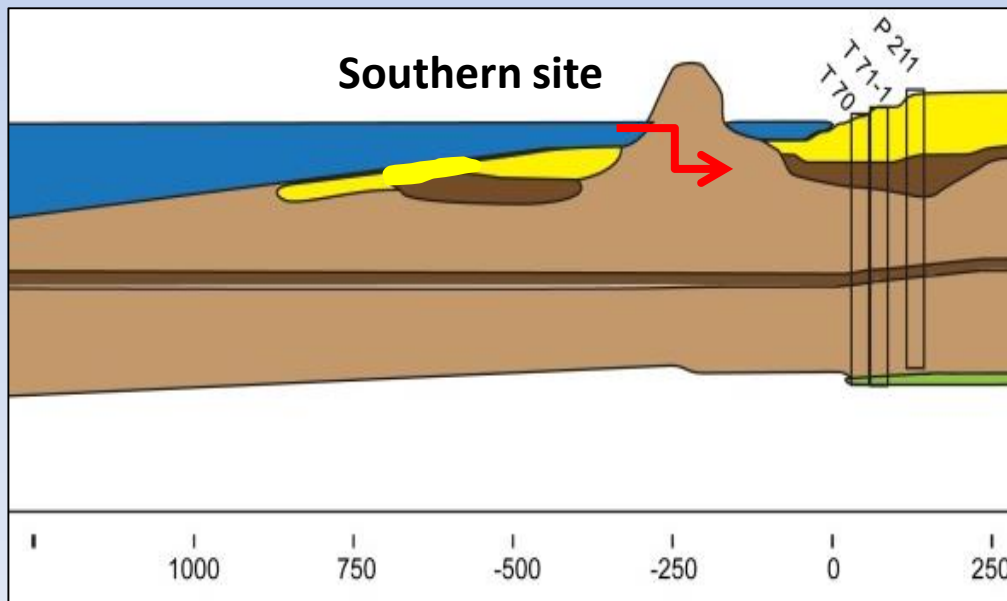
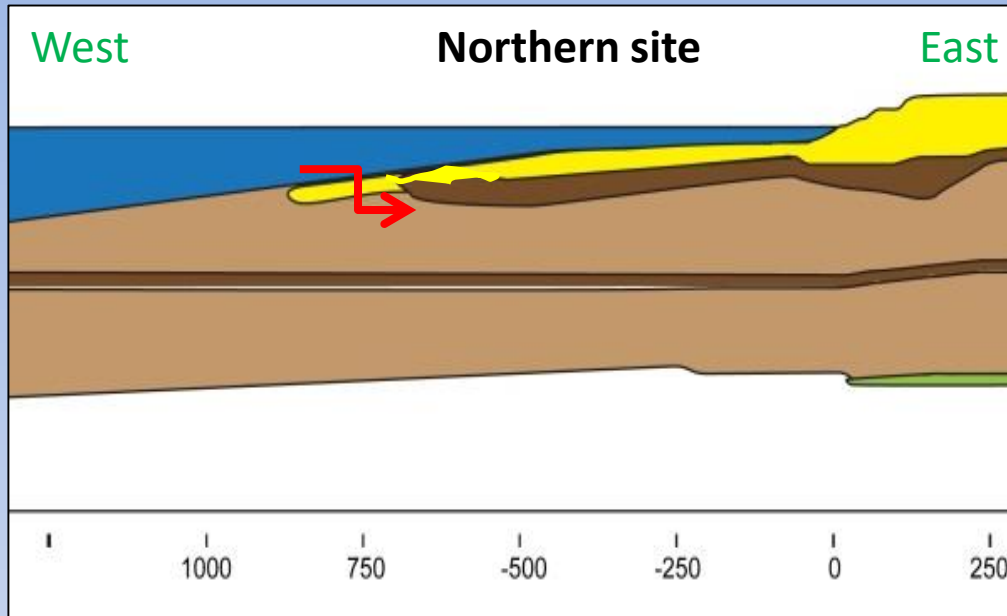


Seismic interpretation

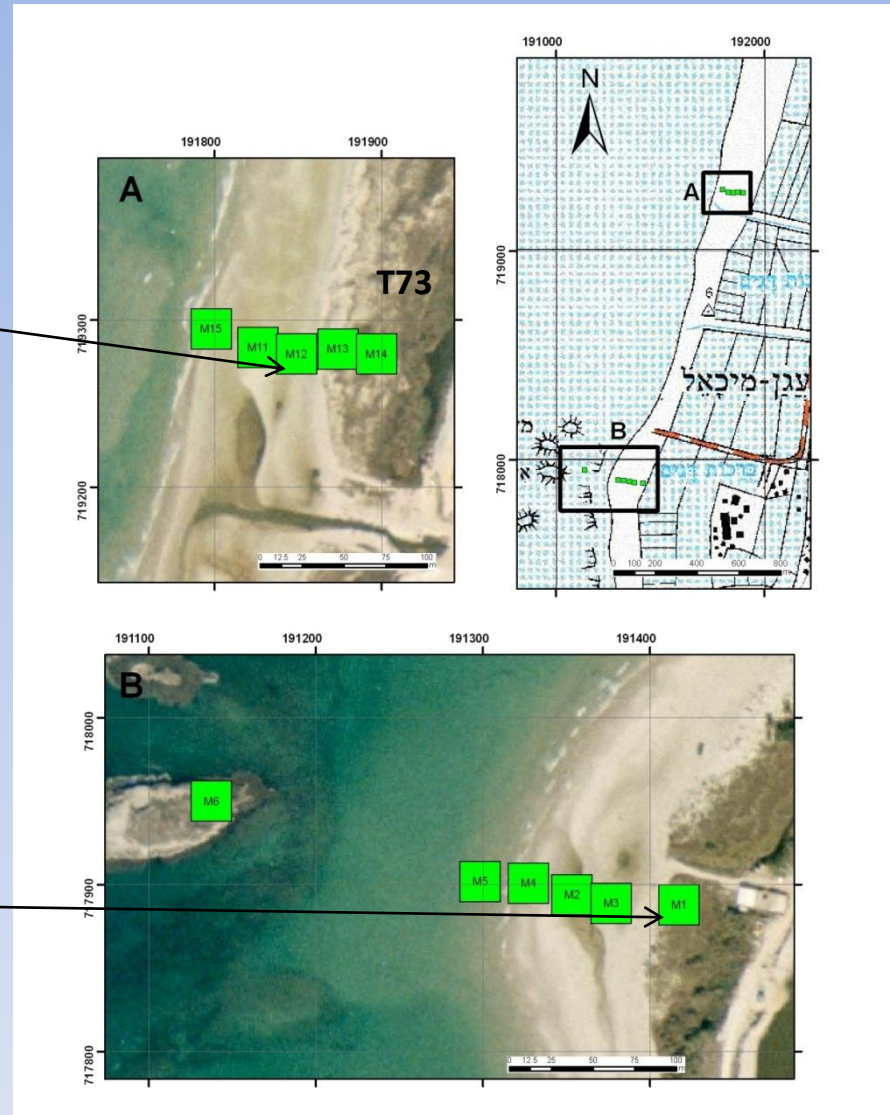
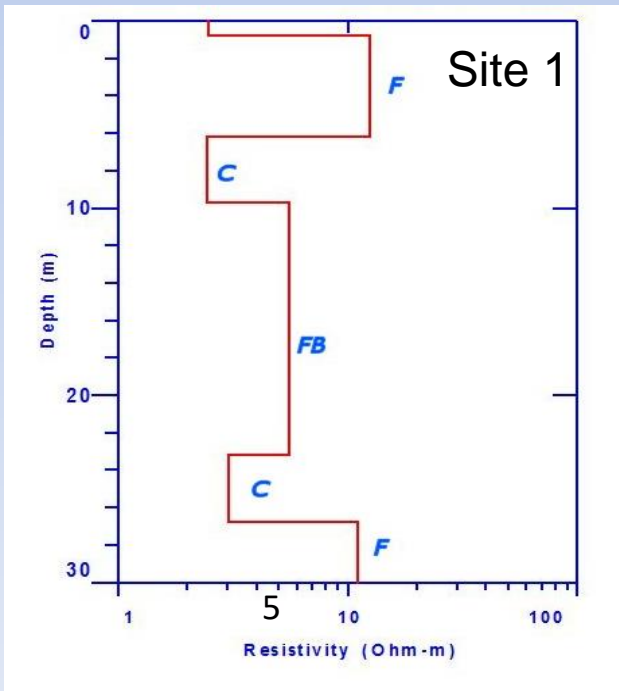
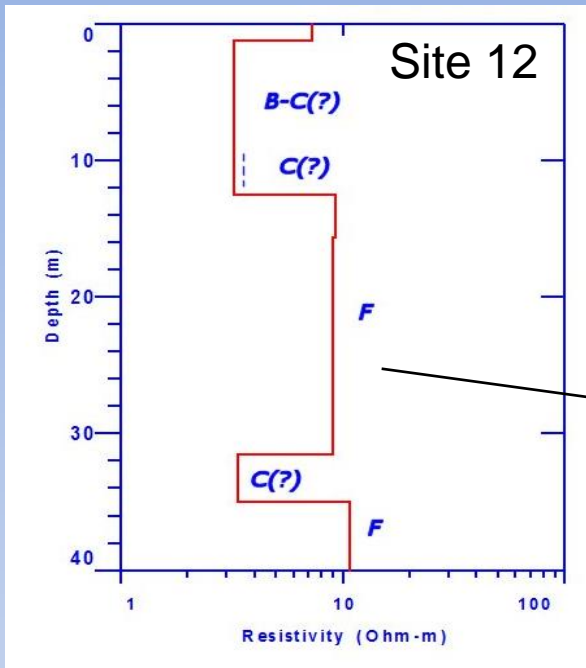


-  Seabed
-  Top clay layer
-  Top Sandstone layer (unit B)

Schematic hydrogeology sections

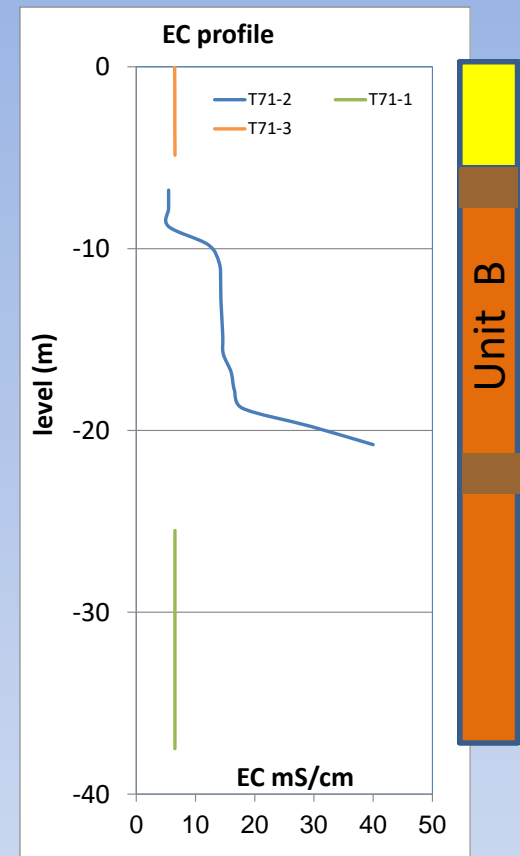
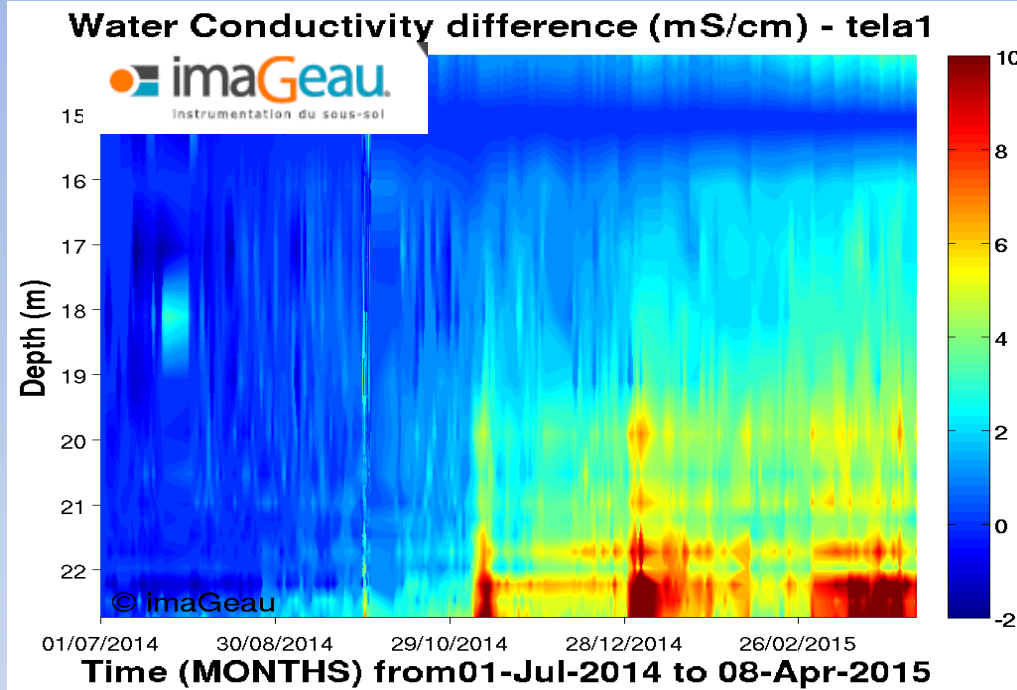


TDEM survey - Seawater intrusion



Unit B
 South: brackish water
 North: fresh water

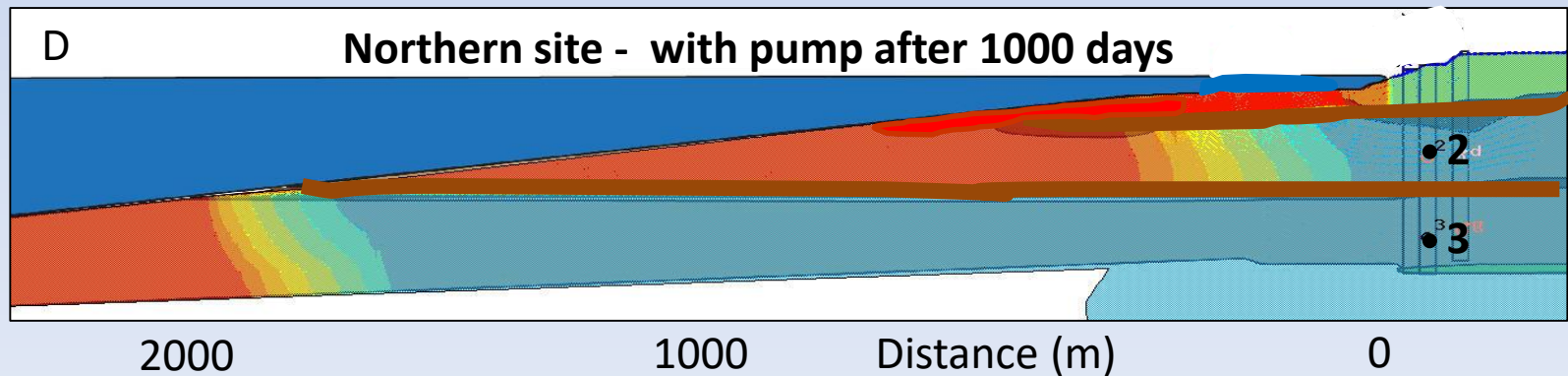
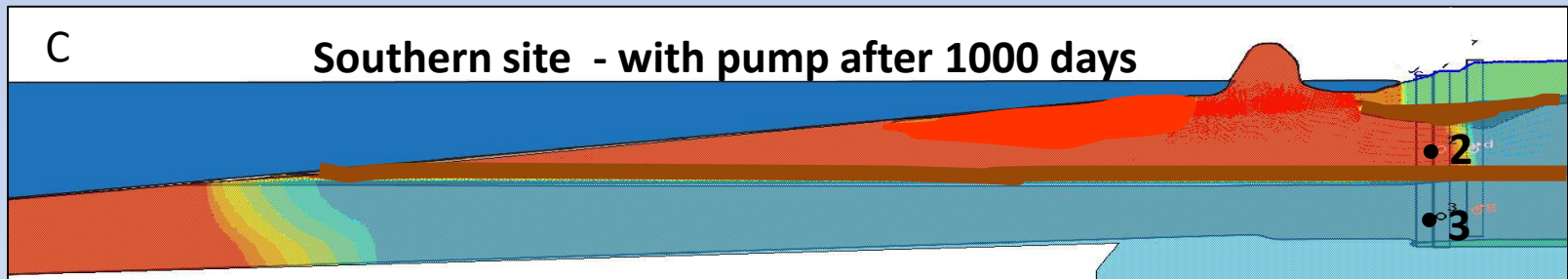
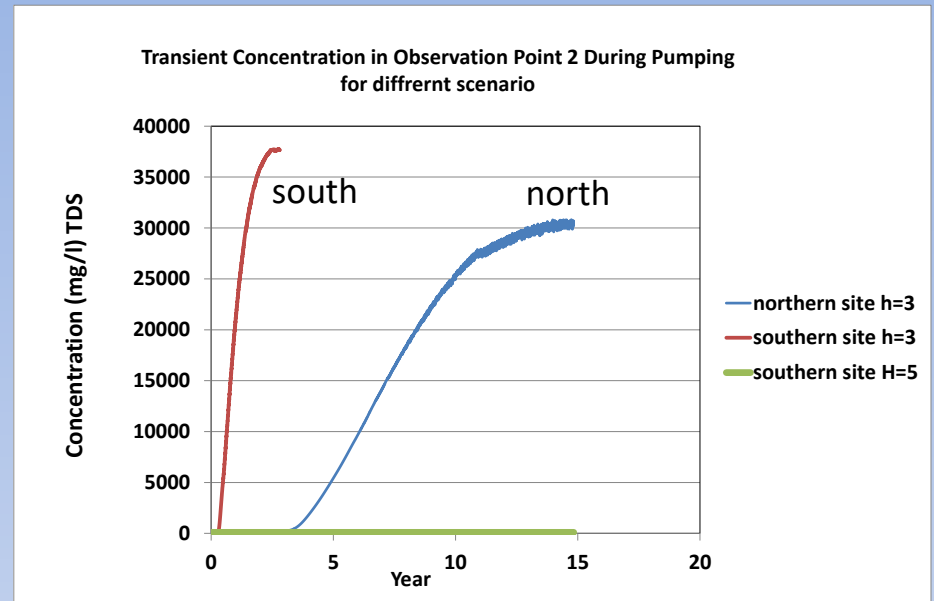
Seawater intrusion



SMD result

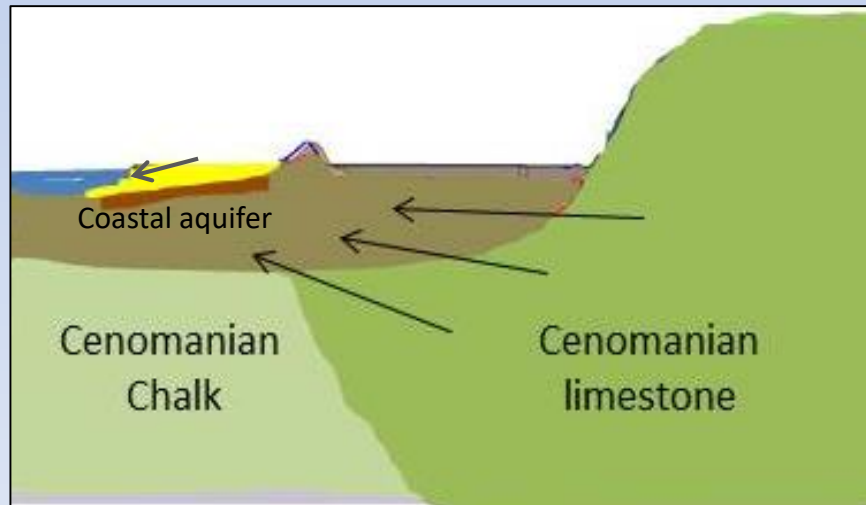


2D Feflow simulation



Feflow simulation – relation between the coastal aquifer and the underline Cenomanian aquifer

Q (mcm/year – 1 km) With pumping	Q (mcm/year – 1 km) Without pumping	East boundary head (m)
5.4	2.2	H = +5



summary

- Ponds water can be recognized in the aquifer by its high Nutrient and OM concentration, low dissolve Oxygen, redox condition and enriched stable isotope of Oxygen, Deuterium and Carbon. This is very different from the water in the lower units.
- We showed that the clay layer can be very effective with prevent the ponds water reaching to the lower units
- In multi-layer coastal aquifer, the seawater intrusion effected by the continuity of the confining clay layers into the sea.
- The limited seawater intrusion is explained by the inflow from the major aquifer in the east, which was increased due to that over-pumping .