Workshop CNR IRPI
50 Anni di Attività

Istituto di Ricerca per la Protezione Idrogeologica

THE RISKS OF LOW ENTHALPY GEOTHERMAL SYSTEM ON GROUNDWATER OF THE CESINE WETLAD

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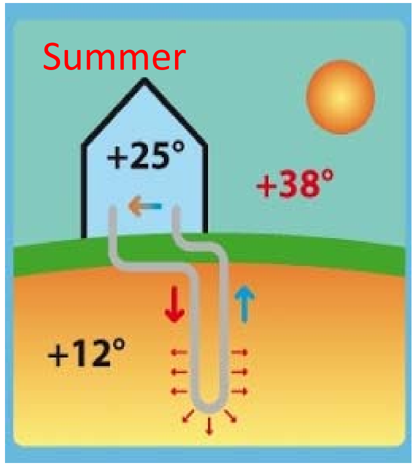
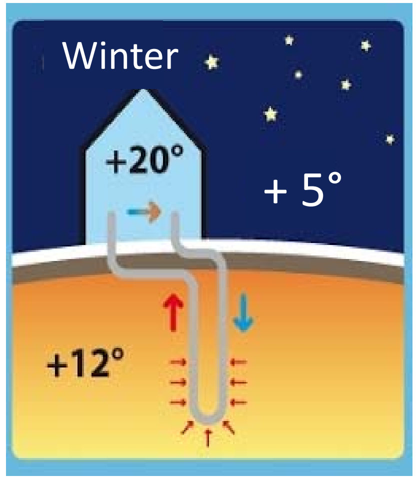




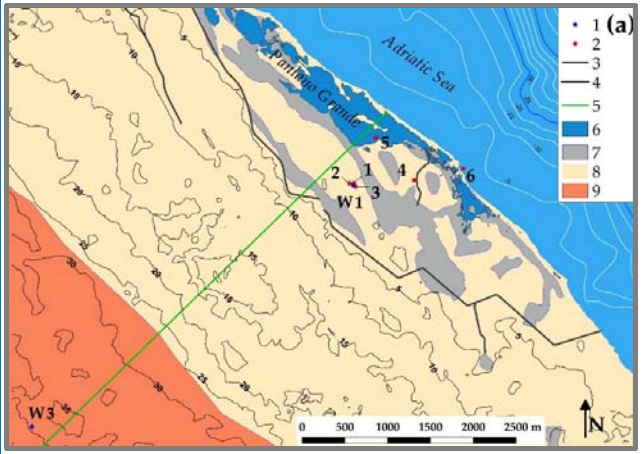
IL CONTRIBUTO DEL CNR IRPI AL SISTEMA PAESE PER LA MITIGAZIONE DEI RISCHI GEO-IDROLOGICI

Sala Congressi CNR, Roma 25-26 novembre 2021

GEOLOGICAL AND HYDROGEOLOGICAL SETTING

The Cesine Wetland was recognized as a Wetland of International Interest and a National Natural Park.

it is considered a groundwater dependent ecosystem which is affected by seawater intrusion. The site was selected to test the environmental compatibility of a low-enthalpy geothermal power plant (closed loop)



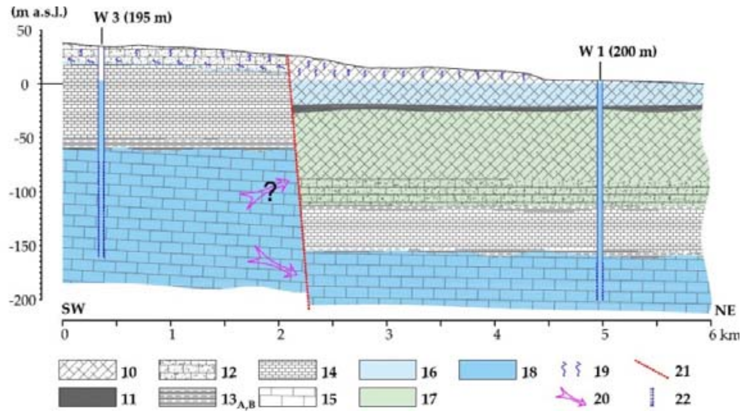
shallow aquifer - medium/high hydraulic conductivity ($K=1*10^{-4}$ m/s) and low salt content (0.5 - 6.5 g/l)

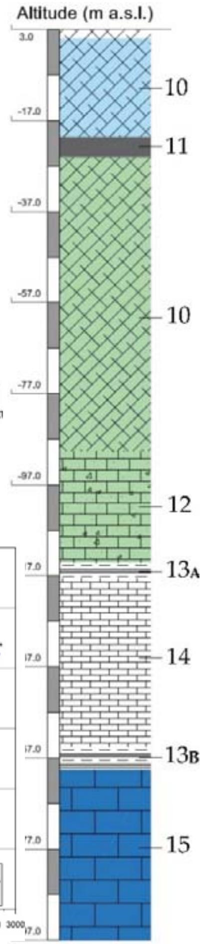
confined/semiconfined Intermediate aquifer - medium/high hydraulic conductivity ($K=1*10^{-4}$ m/s) and with salt concentration increasing with the depth (from 0.6 - 9 g/l around 27.5 - 39 m from ground level up to 23.5 - 33.85 g/l between 39 and 183 m from ground level)

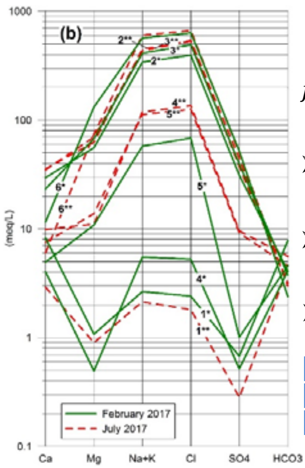
deep karst aquifer - confined aquifer with high hydraulic conductivity ($K=6*10^{-3}$ m/s) and high salt content (32-34 g/l, close to the sea water value).

lagoons | monitoring well | sampling point

calcarenite and sand | fine sand and silty clay | whitish limestone and calcarenite





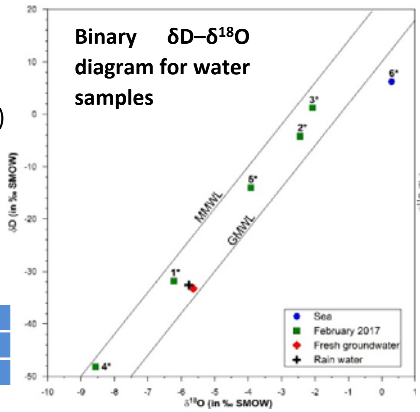


The fraction of seawater

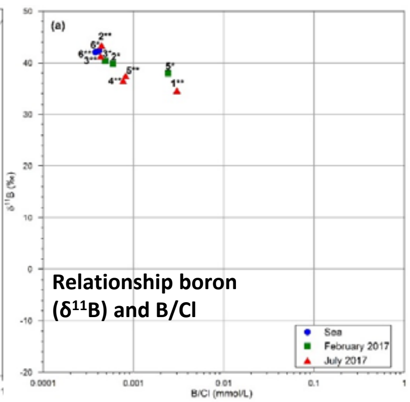
$$f_{sea} = \frac{m_{Cl^-,sample} - m_{Cl^-,fresh}}{m_{Cl^-,sea} - m_{Cl^-,fresh}}$$

- deep aquifers: 74.0% (wet season) 59.4% (dry season)
- intermediate aquifers: 81.2% (wet season) 79.7% (dry season)
- shallow groundwater: 0.3%

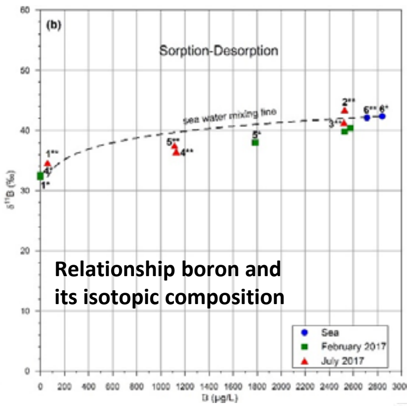
1	Shallow Aquifer	4	channel
2	Intermediate Aquifer	5	lagoon
3	Deep Aquifer	6	sea



Binary δD–δ18O diagram for water samples



Relationship boron ($\delta^{11}B$) and B/Cl



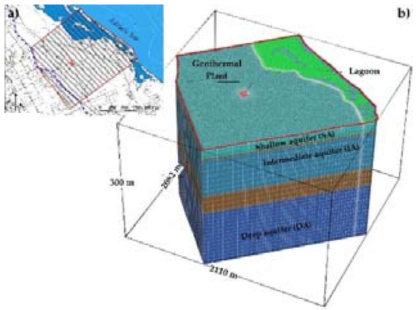
Relationship boron and its isotopic composition

NUMERICAL MODEL

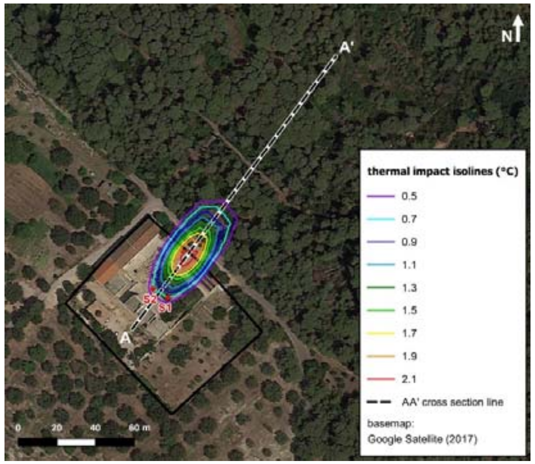
The long-lasting thermal impact on groundwater was assessed using a multi-methodological approach.

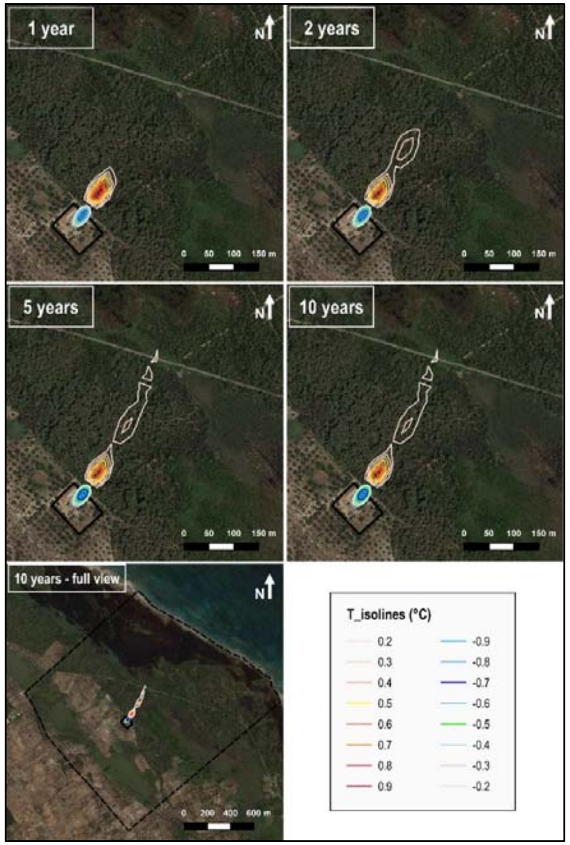
The thermal perturbation generated by the probes field of closed loop geothermal plant of "Masseria Le Cesine" was determined using the numerical model with finite element code **FeFlow**

Map of the model boundary (red line). 3D view and hydrogeological conceptualisation



Thermal variation plume after the latest summer operating cycle of the 10-year scenario





Thermal variation plume at the end of winter season which correspond at the end of an annual cycle.

Vertical cross section of thermal plume at the end of 10-year scenario: summer (a) and winter (b).