XXXVIII IAH Congress

Groundwater Quality Sustainability
Krakow, 12–17 September 2010

Extended Abstracts

Editors:
Andrzej Zuber
Jarosław Kania
Ewa Kmiecik

University of Silesia Press 2010

abstract id: **220**

topic: **3**
Aquifer management

3.3
Geophysical, geological and geochemical methods in groundwater exploration

title: Hydrogeological researches for vertical closed loop heat exchanger system assessment in an experimental pilot site (Vicenza, Northern Italy)

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keywords: confined aquifers, heat transport, ground-coupled heat pump, ground heat exchangers

The geological assessment in the Province of Vicenza shows in general considerable thickness of alluvial quaternary sediments and subsurface materials. In the porous media, composed by sandy gravels, very important artesian aquifers, as concerns the water production for human use of the whole Veneto Region, are located.

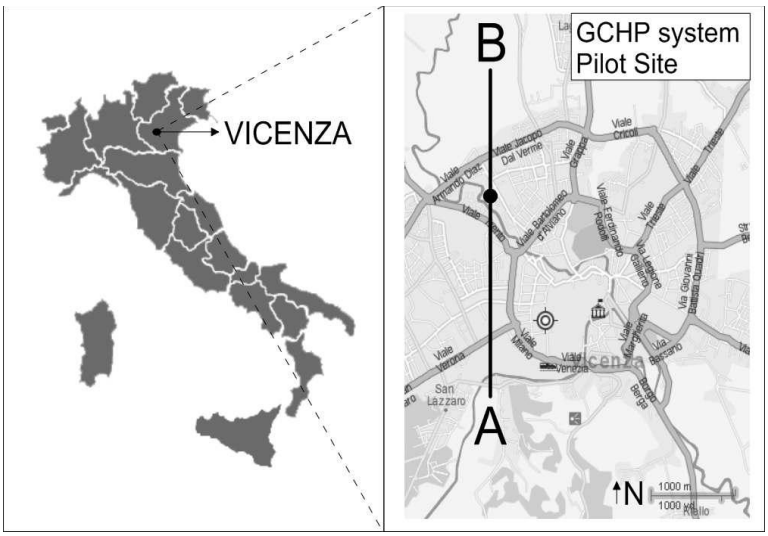

Figure 1. Location of the studied area.

In the town of Vicenza, in particular up to 100–120 m of depth from the ground there's an hydrogeological multiaquifer system, where some high hydraulic transmissivity structures are confined between clay and impervious layers. As in the rest of Europe also in this territorial context ground heat exchangers (GHEs) are quickly developing in order to ensure the best available technologies in environmental practices, by means of low-enthalpy geothermal energy exploitation.

The ground-coupled heat pump (GCHP) system, used for space heating and cooling, is discussed in the present case-study. Locally the GHEs systems aren't completely defined by any law in terms of operational and executive provincial regulamentation so, studies to acquire experimental data and researches to improve the in-situ parametric assessment are organized in partnership with the competent Autorities.

In this paper the objectives and the preliminary issues achieved in the pilot site of Vicenza are presented. The project of GCHP system, combining a heat pump with a ground heat exchanger (closed loop systems), is recently authorized with a temporary permission, waiting for the results of the following monitoring phase, which will start up in the next months.

The area of matter is located near the center of the town (Fig. 1), where an executive building is interested by restructuration and foundational works. In order to guarantee the energetic requirements of the building about 40 Borehole Heat Exchangers (BHEs) with a depth of 100 m are made. The method of drilling carried out using a double head rotary machine and provisional coating of the borehole, able to assure that the confined aquifers will not become in hydraulic and hydrochemical interconnection. After the Ground Response Test (GRT) performance the underground average values about initial temperature (14.9°C), geothermal conductivity (2.3 W/mK) and heat exchange rate (50 W/m) are estimated.

First some monitoring vertical installations are expected in the geothermal low enthalpy field, to verify the long-terms behavior of the temperature, due to the working of the plants. Two of these are respectively located upgradient and downgradient at 65 m of distance in the experimental field, compared to the regional groundwater flow, whereas the third takes a central position. Finally into the boreholes thermometric probes are installed with a regular spacing of 10 m below the ground level to the maximum depth of BHEs (Fig. 2).

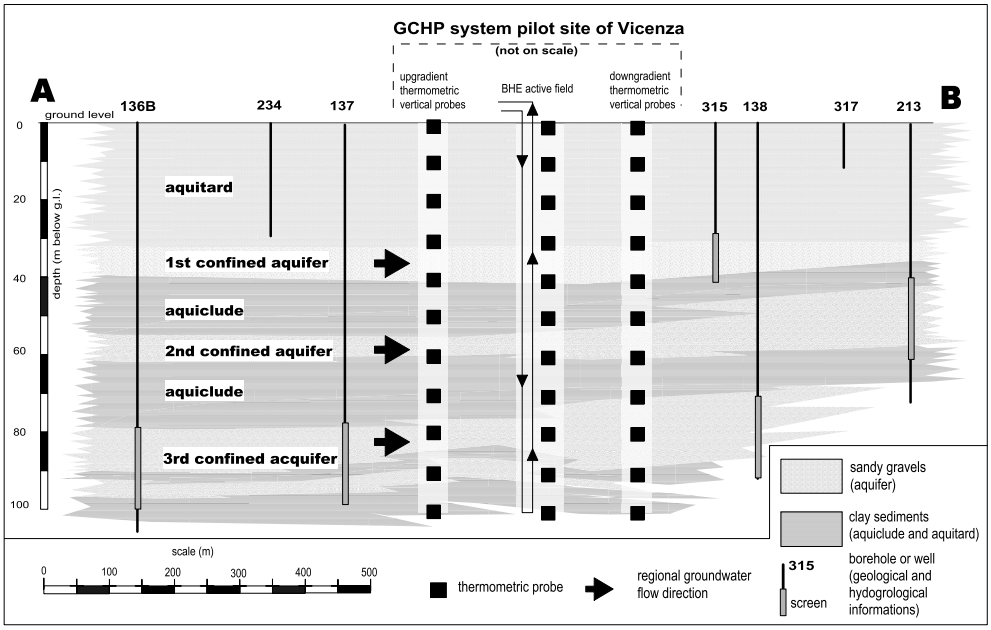

Figure 2. Section assessment of the pilot site.

In the external installations the thermometers are directly dipped into the concrete-bentonite sealing mixing of grouting. The central monitoring point presents the probes skin-coupled with the tubes where the anti-freeze liquids used in borehole heat exchangers are pumped.

The thermal measurements net actually consists in 30 probes, connected with appropriate electronic circuits for signal amplification and filtering and then with data loggers.

In the next period initial data concerning the ante-operam spatial and temporal geothermal log will be collected, while, after the beginning of heat pumping, the same measurements can be used to understand the amount of possible interferences related to the GCHP system.

In progressing of researches a numerical modeling study is planned: the model will be calibrate using field-survey data to simulate the temperature trends into the aquifers intercepted from the public water board wells. The numerical analysis can consider also the effects of heterogeneous subsurface conditions and the groundwater thermal dilution due to the natural and artificial groundwater flow. These technical argumentations will also help Authorities in a reference protocol arranging about BHEs drilling procedures and in a GCHP systems regulamentation improving.

Afterwards the conclusions of this pilot study can be useful in order to complete the specific knowledge of the local application for vertical closed loop heat exchanger system in particular hydrogeological and environmental situation, marked from the presence of most excellent aquifers in Italy, both in terms of qualitative features and quantitative peculiarities.

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International Association of Hydrogeologists

AGH University of Science and Technology

2-vol. set + CD
ISSN 0208-6336
ISBN 978-83-226-1979-0