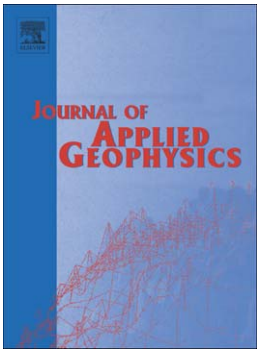

Time-lapse electrical resistivity imaging of the thermally affected zone of a Borehole Thermal Energy Storage system near Torino (Northern Italy)

N. Giordano, A. Arato, C. Comina, G. Mandrone

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Time-lapse electrical resistivity imaging of the thermally affected zone of a Borehole Thermal Energy Storage system near Torino (Northern Italy).

N. Giordano[1], A. Arato[2], C. Comina[1], G. Mandrone[1]

[1] Dipartimento di Scienze della Terra - Università degli Studi di Torino, Via Valperga Caluso, 35 – 10125 Torino, Italy
[2] Techgea Srl – Loc. Amerique, 9 – 11020 Aosta, Italy (formerly at: DIATI - Politecnico di Torino, Corso Duca degli Abruzzi, 24 - 10129 Torino, Italy)

Abstract

A Borehole Thermal Energy Storage living lab was built up nearby Torino (Northern Italy). This living lab aims at testing the ability of the alluvial deposits of the north-western Po Plain to store the thermal energy collected by solar thermal panels and the efficiency of energy storage systems in this climatic context. Different monitoring approaches have been tested and analyzed since the start of the thermal injection in April 2014. Underground temperature monitoring is constantly undertaken by means of several temperature sensors located along the borehole heat exchangers and within the hydraulic circuit. Nevertheless, this can provide only pointwise information about underground temperature distribution. For this reason, a geophysical approach is proposed in order to image the thermally affected zone (TAZ) caused by the heat injection: surface electrical resistivity measurements were carried out with this purpose. In the present paper, results of time-lapse daily acquisitions are reported with the aim of imaging the thermal plume evolution within the subsoil. Resistivity data, calibrated on local temperature measurements, have shown their potentiality in imaging the heated plume of the system and depicting its evolution within the day. Different types of data processing were adopted in order to face issues mainly related to a highly urbanized environment. The use of apparent resistivity proved to be in valid agreement with the results of different inversion approaches. The inversion processes did not significantly improve the qualitative and quantitative TAZ imaging in comparison to the pseudo-sections. This suggested the usefulness of apparent resistivity data alone for a rough monitoring of TAZ in this kind of applications.

Keywords: electrical resistivity; thermally affected zone; borehole thermal energy storage.

Corresponding author:
Nicolò Giordano
nicolo.giordano@unito.it
Dipartimento di Scienze della Terra
Via Valperga Caluso, 35
10125 – TORINO
tel. +39 011 6705325