



## **UE PROJECT “CHEAP GSHPs”: THE GEOEXCHANGE FIELDLAB**

Antonio Galgaro (1,2), Matteo Cultrera (1), Giorgia Dalla Santa (1), David Bertermann (3), Johannes Muller (3), Michele De Carli (4), Giuseppe Emmi (4), Angelo Zarrella (4), Adriana Bernardi (5), Maria Di Tuccio (5), Arianna Vivarelli (5), Luc Pockel  (6), Giulia Mezzasalma (6), Mario Psyk (7), Davide Righini (8), and Michele Bernini (8)

(1) Department of Earthscience, Universit  degli Studi di Padova, via Gradenigo, 6, I-35131 Padova, Italy, (2) National Research Council (CNR), Inst. Geoscience and Earth Resources (IGG), via Gradenigo, 6, I-35131 Padova, Italy, (3) Friedrich-Alexander-Universit t Erlangen N rnberg (FAU), Schlossplatz 4, Erlangen 91054, Germany, (4) Department Of Industrial Engineering – Universita’ Degli Studi Di Padova (UNIPD), Via Venezia 1, 35131 Padova – Italy, (5) Institute Of Atmospheric Sciences And Climate – National Research Council (CNR-ISAC), Corso Stati Uniti 4, 35127 Padova, Italy, (6) R.E.D srl, Via Galileo Galilei 7 A 2, Teolo (PD) 35037, Italy, (7) REAHU, Rheniumhaus, Rehau 95104, Germany, (8) HYDRA s.r.l. Via Guiccioli 6, Molinella 40062 (BO), Italy

The CHEAP – GSHPs Horizon 2020 project (No. 657982) focuses on the development of more efficient and safe shallow geothermal systems and the reduction of time consuming and installation costs.

One of its most important objectives is the development of the design of new coaxial steel GSHEs and of newly designed helical heat basket type GSHE by means of innovative installation methodologies and drilling machines. For this purpose, in Molinella test site (Bologna, Italy) several types of borehole heat exchangers have been built. The Molinella test site is the open-air laboratory where several types of ground heat exchangers, such as helical heat basket and double-U and coaxial probes, can be directly compared by means of GRT tests, cores thermal measurement, and optical fibers measurements. Moreover, in this test site, new drilling machines and techniques are being tested.

Given a geological setting and thermal load, the heat exchange capacity of a ground heat exchanger depends on the used materials and probe dimensions (length, diameter and thickness). In Molinella, in an area of 300m<sup>2</sup>, 7 different probes are installed: 4 coaxial probes of different materials and different length (96 and 50m) and diameters of internal and external tubes, 2 heat baskets (15m length, different diameter and different pitch) and a traditional double-U (50 m length). The monitoring equipment is constituted by a piezometer 25m long, a monitoring point instrumented with a hybrid fibre optical cable 100m long, and a standard GRT device.

The local stratigraphy is known from a 100m core sample, made on purpose. The lithological sequence is typical of a quaternary floodplain deposition environment, rich in silt and silty clay deposits, alternated with sandy layers. For all the main recognized layers, the thermal properties (conductivity and capacity) have been directly measured on the collected core samples on site in order to maintain their natural water content. The thermal exchange capacities of the tested GSHEs are directly detected both by comparing the GRT test results and by means of numerical analysis based on different modelling approaches.

The Molinella test site is particularly remarkable for the possibility to directly compare the energetic efficiency of the tested GSHEs. The GRT results can be compared with the mathematical models outputs and with the thermal measurements directly performed on the sediments core samples. The coupling of traditional GRT and optical fibre temperature recording system allows sharing the data in order to obtain the thermal contribution of the different underground layers interested by the heat exchange processes.

The Molinella test site therefore represents a very extraordinary possibility to improve the knowledge of thermal exchange processes in shallow geothermal systems.