

# PHASE I - REPORT ON RESEARCH

## - ENGLISH SUMMARY

Geophysics research - input into  
documentation on possibility of closing the  
loop of water flow

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Deliverable D.T2.5.1  
Croatia (PP6)

Final version  
09 2020

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## ENGLISH SUMMARY

In the underground of the City of Križevci, the existence of rocks containing thermal waters (geothermal aquifers) was proven several decades ago. Since then, this valuable resource has been researched periodically and in accordance with the possibilities. Currently, the City of Križevci is a partner in a project co-financed by the European Union through the Interreg Central Europe regional cooperation program - "HealingPlaces" and has hired Croatian Geological Institute as an external expert for the start of pilot action: deliverable D.T2.5.1 Documentation on the possibilities of using thermal water in a closed system (loop) in Križevci. This thematic activity is organized in two phases: the implementation of non-invasive geophysical research by the method of magnetotellurics (Phase I) and the preparation of a multidimensional study of the circular use of a geothermal resource (Phase II). This report presents geophysical research conducted in the area of the City Križevci in September 2020 (Phase 1) with the aim of gaining additional knowledge about spreading a geothermal aquifer to consider possible sites for construction future production and injection wells that are a necessary prerequisite for sustainable use geothermal resource.

The magnetotellurics method or magnetotellurics is an electromagnetic (EM) method surface geophysical research. It can be used to determine the electrical properties underground (distribution of electrical conductivity / resistance by depth). It's about methods which registers existing (natural) fields of external origin. The Earth's magnetic field is variable, while the Earth acts as a good conductor which is why electrical ones are induced (telluric) currents in the crust and mantle. The density distribution of telluric currents depends on the resistance horizontal conductive layers. The current flow at shallower depths in the Earth's crust depends of underground structures that are of different resistances. Telluric currents in turn induce secondary magnetic field, which is also registered by this method (Naidu, 2012). Magnetotellurics has the largest electromagnetic geophysical methods potential for application in deep research.

Data acquisition was conducted from 14 to 18 September 2020. There was one set equipment set as a remote reference point (magnetotelluric (MT) probe RR, from engl. Remote Reference) near Vrbovec (about 20 km from measuring points), while the other two sets were set as points of interest: one right next to the exploration well Križevčanka-1 (MT probe DHMZ) and Križevci-1 in Križevački Lemeš (MT probe KL), then at the College of Economics in Križevci (MT probe VGU) and at the foot Holy Trinity Cathedral (MT probe FOK). On this way it is possible to determine the lateral distribution of the aquifer, which is an important data for planning injection sites and / or new production wells when use begins.



Also, in line with the planned activities of the HealingPlaces project, in research, there were also students involved in one-day fieldwork. The activity of new geophysical research should also be used as an opportunity to educate students on this topic.

Therefore, City of Križevci and Croatian Geological Survey had established contact with the Faculty of Geotechnics, University of Zagreb and professors Mr. H. Meaški Ph.D. and Mr. M. Gazdek Ph.D. who organized the arrival of a group of students who attended geophysical research course in order to inform them about the method of magnetotellurics and external expert Ms. Staša Borović, Ph.D. showed what the implementation of such research looks like in practice. She also held short presentation of the method and the first two points were set together with students (DHMZ and VGU points).

Processing of collected data, results and their interpretation in the context of others relevant existing data will be presented in a multidimensional study in as part of the second phase of this DT251 Deliverable.