GEO ALLIANCE
Driving Sustainable Urban Futures

GREEN TRANSITION AND GEOPHYSICS FOR SMART CITIES STAKEHOLDERS WORKSHOP

Bucharest, 15 November 2024
-on-site only-

ABSTRACTS OF THE PLENARY SESSION PRESENTATIONS

NOTE

This workshop is part of Activity 1 of the project: "**Driving Sustainable Urban Futures: A Romanian-Norwegian Innovation Geophysical Alliance for Green Transition and SMART City Development**", supported by EEA and Norway Grants and implemented by Pre Stack Solutions-Geo and the Faculty of Geology and Geophysics of the University of Bucharest.
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ANALYSIS OF THE EEA AND NORWAY GRANTS IMPACT ON THE ROMANIAN ENERGY TRANSITION BASED ON GEOTHERMAL RESOURCES

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This study is focused on the importance and the impact of the funding opportunities in several areas of Romania and to different beneficiaries redirected to support the Romanian Energy Transition by increasing the geothermal component in the country's energy mix.

Romania is assessed to possess abundant natural resources, which, harnessed adequately, could accelerate the country's goal for renewable energy production and achievement of the 2030 climate goals. A significant role to play in realizing targets in green transition as well as in energy security can be provided by the usage of geothermal resources. The geothermal resources discovered so far are mainly used in district heating and spas, but interest in electricity production is rising, as well as in assessing the geothermal potential in areas less explored. Although underdeveloped, there is significant potential and, with financial support from the Romanian Government, EU, EEA and Norway Grants, the uptake of geothermal energy could be sped up. For example, in the current programming period 2014–2021 EEA and Norway have contracted in the Energy Programme 63,81 million euros at a 109.3% contracting rate covering areas of the Green Transition. Out of the 155 projects contracted, 9 projects have targeted the Geothermal Energy. Therefore, Norway, Iceland, and Liechtenstein have contributed during this programming period with over €8 million to support nine projects related to geothermal solutions.

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BUILDING SUSTAINABLE FUTURES: AN INTRODUCTION ON GEOPHYSICS FOR GREEN TRANSITION AND SMART CITIES

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This study highlights the importance of having data-driven decisions in SMART City management to mitigate man-made and natural hazards and ensure a green transition, with a special focus on integrating geophysical data.

Geophysical data, if properly acquired and interpreted, can stay at the core of devising optimal solutions for managing urban built infrastructure as well as in guiding city investment planning, particularly in regions with complex geological settings, prone to multiple geohazards, and in urban areas with old underground systems, where component failure could exacerbate additional hazards. Geophysical data is equally valuable in green transition, by locating areas where underground heat sources or groundwater resources can be harnessed more efficiently.

Each city presents unique challenges and characteristics, shaped by natural factors (like local geology, hydrogeology, hydrology, and climate) as well as by historical urban planning decisions (such as land use, resource utilization, building standards, and surface or buried infrastructure age). Therefore, it is necessary to tailor SMART City strategies to these specific conditions, ensuring that technology, resources, and planning approaches are adapted to meet local needs.

However, despite their huge potential, up to today, geophysics remains underutilized in many European cities that are focusing on adopting SMART strategies for creating safer and economically prosperous urban environments capable of adapting to future needs. In many cases, achieving this vision is often challenging, as it requires decisions to be data-driven, relying on information collected through devices and sensors that continuously monitor and analyze the underground impact of natural phenomena, hazards, or urban processes or, when is the case, by well-timed and well-conceived measurement campaigns.

By promoting geophysical integration for green transition and SMART cities initiatives, we aim to raise awareness of the substantial benefits this data can offer for sustainable urban development and resilience specifically by: mapping underground systems and evaluating their health status, identifying optimal foundation sites, reducing construction impacts, enhancing urban green spaces by assessing root zone health and ground humidity variation down to the necessary depth, improving waste management by selecting safer landfill site and monitor the waste containment, identify suitable locations for geothermal resources exploration or renewable energy installation, supporting cultural heritage preservation actions, etc.

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TRANSITION TO RENEWABLES IN ROMANIA: HYDROTHERMAL VS GEOTHERMAL RESOURCES

Iulian POPA

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Renewable energy sources (RES) are a pillar of the clean energy transition, with multiple benefits for society compared with fossil fuels, such as mitigating climate change, reducing the emission of air pollutants and improving energy security. The transition to RES is a major goal in this period, all over the world. The EU is already a global leader in this competition, when it comes to technology development and deployment or legal framework. Since the introduction of the *Renewable Energy Directive* (2009/28/EC), the share of RES in EU energy consumption has increased from 12.5% in 2010 to 24.1% at the end of 2023. The revised *Renewable Energy Directive* (2023) increases the binding target from 32% to a minimum 42.5% share of RES in EU energy consumption, with the aim of achieving 45% by 2030. Romania's green economy transition needs to focus on sustainable energy, by following the recommendations of the European Commission and the provisions of the "Clean Energy for All Europeans" strategy. Under this strategy a 10-year National Energy and Climate Plan (NECP) for 2021-2030 period was established, and Romania assumed 41.1% in 2035, respectively 86.1% in 2050 share of RES in gross final energy consumption. These targets will be met mainly by increasing the installed capacity of energy production from wind, solar, hydropower and geothermal sources, the use of green gases (biomethane, hydrogen, synthetic methane, etc.), as well as the partial electrification of heating and cooling systems.

Concerning the geothermal energy sector, on the Romanian territory several areas have been identified where the geothermal potential is estimated to allow economic applications, mainly for direct use. The main geothermal systems are found in porous permeable formations such as sandstones and siltstones (Western Plain and the Olt Valley) or in fractured carbonate formations (Oradea, Bors, North Bucharest).

Geothermal energy has a high potential to supply the district heating and cooling sector, while emerging technologies, improving energy efficiency and recovery of critical materials from geothermal brines offer promising opportunities.

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GEOPHYSICAL INVESTIGATIONS IN GEOTHERMAL FIELDS. BASIC CONCEPTS AND APPLICATIONS FROM ICELAND

Ilias FIKOS

Aristotle University of Thessaloniki, Greece

The exploration of geothermal resources is essentially related to understanding the structure of the geothermal field and the fluid circulation mechanism. To that purpose, the three main disciplines applied are geology, chemistry of the fluids and geophysics.

Despite the complexity of the geothermal systems the approach involves geophysical methods that explore physical parameters of the host rock such as magnetic properties, density etc that provide information on the geological structure. At the same time, it also involves geophysical methods that focus on parameters that are directly influenced by the geothermal activity such as resistivity and thermal properties.

It is often that different methods may be applied in cases of low-temperature fields compared to high temperature systems. Furthermore, it is very important to combine different methods because the knowledge of single parameter usually does not give adequate information for understanding the geothermal system.

The geothermal field of Iceland has been elaborately studied by Iceland Geosurvey and their results provide valuable insight on the use of geophysical methods. The thermal methods can identify and delineate the geometry of areas of interest and resistivity methods are proved to be of significant importance in high temperature geothermal fields where the alteration of mineral play significant role in the resistivity of the formations.

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GEOPHYSICAL STUDIES FOR LOCATING NEW GEOTHERMAL RESOURCES IN ROMANIA

Dumitru IOANE[1], Florina CHITEA[1], Irina STANCIU[2], Mihaela SCRADEANU[1]

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Geothermal resources have been prospected and explored in Europe, using geological and geophysical techniques, especially during the XXth century. Geothermal areas, characterized by high-temperature groundwater, have been mapped in Romania, few of them being exploited for spa development and for buildings or hotels heating. Other areas, characterized by lower-temperature thermal springs or aquifers, are considered to represent possible future targets for geothermal exploration and exploitation. By "Geophysical studies" we refer to other geophysical methods, than those usually employed in Geothermics (e.g., Gravity, Magnetics, Resistivity), while by "New geothermal resources", we mean finding locations where either low-temperature or high-temperature groundwater should be found and possibly exploited.

In the Toplita geothermal area (East Carpathians), some 15 years ago, one of its thermal pools was not operating. There was the need to make a new drill and extract thermal water to stay at the core of a new spa project. Using Vertical Electric Sounding (VES), Electric Resistivity Tomography (ERT) for positioning the exploration well and Gravity for understanding the source of groundwater heating, a spa has been constructed using the newly discovered thermal water resource.

In the Calimanesti-Cozia geothermal area (Southern Carpathians), deep boreholes drilled in the Olt river valley are exploiting for a few decades hot groundwater used in hotel heating. New geophysical interpretation of aeromagnetic and gravity anomalies, as well as recent geological observations in outcrops, led to a new understanding of the geological source of heat location, with good possibilities for enhancing the geothermal exploration in this region.

The Mangalia geothermal area situated in Southern Dobrogea (Moesian Platform) is less studied being situated in the vicinity of the border with Bulgaria and on the Black Sea shoreline. The on-going scientific study, involving interpretation of geological and geophysical data (Gravity, Magnetics, Heat Flow), is going to locate and characterize the heating groundwater source location in SE Romania and NE Bulgaria.

Acknowledgments: This work has been developed in the frame of the project: "Driving Sustainable Urban Futures: A Romanian-Norwegian Innovation Geophysical Alliance for Green Transition and SMART City Development", supported by EEA and Norway Grants, Pre Stack Solutions-Geo and the Faculty of Geology and Geophysics of the University of Bucharest.

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EVALUATING THE USE OF ACTIVE SEISMIC SURVEY IN LOW ENTHALPY GEOTHERMAL PROJECTS: A VOI BASED METHODOLOGY

Juri MUZI[1], Alessandro BROVELLI[2]

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[2]ISAMGEO, Italy

Historically, collecting active source 3D seismic data has been seen as costly and of little benefit in a low-enthalpy geothermal prospect. Seismic data, however, can successfully be used to measure the anisotropy generated by the typical fracturing state of the reservoir, which is responsible for the permeabilities allowing the circulation of the substantial amount of fluids involved in geothermal systems.

The possible economic benefit of collecting seismic data in a low-enthalpy field can be ascertained using the Value of Information (VOI) approach: investing in a survey can be justified only when the prospective Value of the Seismic Information is superior to the expense required for gathering the required seismic data.

A methodology is here created by modifying the magneto telluric survey's VOI assessment for geothermal prospects (Trainor-Guitton et al, 2014). This methodology is first developed in a theoretical mono-dimensional manner, considering a single drilling location and the corresponding single Common Depth Point (CDP) seismic gather. It is subsequently extended to cover a full 3D prospect. The Grado low-enthalpy geothermal system in Northeast Italy, which produces hot water for direct use (home heating and agriculture), is then tested to ascertain the VOI assessment method's validity.

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APPLICABILITY OF GEOPHYSICAL SURVEYS IN GEOTHERMAL PROJECTS IN ROMANIA – STATUS AND POTENTIAL VALUE FOR RESERVOIR DERISKING: BEIUS AND ORADEA CASE STUDY

Alena FINOGENOVA[1], Marian BORDEIANU[2], Alexandru SCHLETT[1]

[1]PSS-GEO, Norway
[2]TRANSGEX S.A., Babeș-Bolyai University, Romania

Currently, geophysical methods are underutilized in exploration and appraisal campaigns for geothermal projects in Romania, primarily due to low-budget constraints. Most pre-drill subsurface modelling relies on regional knowledge, supplemented by detailed observations from existing well data. However, implementing electrical and seismic surveys can enhance subsurface understanding and reduce the risks associated with well drilling, which can incur substantial costs, particularly in low-enthalpy geothermal projects.
An analysis of two low-enthalpy geothermal projects, Beiuș and Oradea, located in Northwestern Romania and operated by TRANSGEX S.A., was conducted to understand the current exploration planning methodologies and the potential benefits of 2D seismic and electrical surveys in reducing risks associated with the Triassic hydro-geothermal system. The localities are situated in distinct sedimentary sub-basins, but exhibit a comparable tectonic framework.
This presentation outlines the geological and tectonic characteristics of the hydro-geothermal system, highlights the key challenges faced in creating accurate subsurface models, and explores how these challenges can be addressed through 2D seismic and electrical surveys.

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17:00–17:30 GEO-EXPO

"Geophysical and remote sensing technology for Green Transition & SMART City Development"
Guided tour hosted by Dragoș TĂTARU (National Institute for Earth Physics, Romania)
Place: Expo rooms

17:30–19:30 PLENARY SESSION

Place: Conference Room

17:30 – 17:50 **Building Sustainable Futures: An Introduction of the project "Geo-Alliance" powered by EEA and Norway Grants**

Analysis of the EEA & Norway Grants Impact on the Romanian Energy Transition based on Geothermal Resources – Ana-Maria AXENIA (*Innovation Norway*)

Building Sustainable Futures: An Introduction on Geophysics for Green Transition and Smart Cities – Florina ȚULUCA (*University of Bucharest, Faculty of Geology and Geophysics, Romania*) and George APOSTOLOPOULOS (*NTUA, School of Mining and Metallurgical Engineering, Greece*)

17:50 – 18:10 **Transition to Renewables in Romania: Hydrothermal vs Geothermal Resources** – Iulian POPA (*University of Bucharest, Faculty of Geology and Geophysics, Romania*)

18:10 – 18:30 **Geophysical Investigations in Geothermal Fields. Basic Concepts and Applications from Iceland** – Ilias FIKOS (*Aristotle University of Thessaloniki, Greece*)

18:30 – 18:50 **Geophysical Studies for Locating New Geothermal Resources in Romania** – Dumitru IOANE1, Florina CHITEA[1], Irina STANCIU[2], Mihaela SCRADEANU[1] ([1]*Faculty of Geology and Geophysics, University of Bucharest, Romania,* [2]*National Institute for Marine Geology and Geoecology – GeoEcoMar, Romania*)

18:50 – 19:10 **Evaluating the Use of Active Seismic Survey in Low Enthalpy Geothermal Projects: A VOI Based Methodology** – Juri MUZI[1], Alessandro BROVELLI[2] ([1]*PSS-GEO, Norway,* [2]*ISAMGEO, Italy*)

19:10 – 19:30 **Applicability of Geophysical Surveys in Geothermal Projects in Romania – Status and Potential Value for Reservoir Derisking: Beiuș and Oradea Case Study** – Alena FINOGENOVA[1], Marian BORDEIANU[2], Alexandru SCHLETT[1] ([1]*PSS-GEO, Norway,* [2]*Transgex S.A., Babeș-Bolyai University, Romania*)

Place: Meeting Room

19:30 – 19:50 Discussions – chaired by Viktória Försterné Nán (*Foratherm Kft., Hungary*)

19:50 – 21:00 Networking Moments powered by Geo-Alliance

The venue: No 46 Dionisie Lupu Street

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