

Activity report about field measurements in W-Bohemia pilot area

Deliverable D.T3.2.2 Updated database of existing and additionally measured data at the pilot areas

Template
012019

J. ŘIHOŠEK, J. FRANĚK, J. HOLEČEK, L. RUKAVIČKOVÁ & THE GEOPLASMA-CE TEAM.

¹ Czech Geological Survey





Contact details of author: jan.holecek@geology.cz

The involved GeoPLASMA-CE team

<i>PP05_CGS</i>	J. ŘIHOŠEK, J. FRANĚK, J. HOLEČEK, L. RUKAVIČKOVÁ



Content

1. Executive summary in English language	3
2. Shrnutí v českém jazyce	4
3. Introduction	5
3.1. Aim and scope of this report	5
3.2. Overview of the chosen strategy for field measurements	5
4. Documentation of field measurements.....	6
5. Data processing	13
5.1. Transfer of field data to the joint databases	13
6. Summary and conclusions	13



1. Executive summary in English language

This report describes a summary of the fieldwork activities in the pilot area of the GeoPlasma-CE project. The aim of these activities was the field reconnaissance of the selected area, verification of the validity of available older measurements and sampling and measurements of new samples. The pilot area was explored both from geological and hydrogeological point of view. The goal of the work was to fill data gaps and obtain data needed to produce the main outputs of GeoPlasma-CE project - maps of geothermal potential, maps with limiting phenomena for the development of geothermal energy in the given territory and other project outputs.

In the field of geology, samples of the major rock types were taken, which were subsequently analysed for the petrological description of the studied rocks and for the analysis of the geothermal parameters. These data are an input to geothermal potential calculation.

In the field of hydrogeology, the basic physico-chemical parameters of the groundwater, their temperature. The selected documentation points were sampled for groundwater to determine the basic chemical composition. This is necessary for the assessment of areas with problematic groundwater chemistry.

The data of all the newly acquired measurements were stored in a database of new measurements (D.T3.1.2), which is freely available for further use and can be downloaded from the GeoPlasma-CE portal at: <https://portal.geoplasma-ce.eu/>.



2. Shrnutí v českém jazyce

Tato zpráva popisuje souhrn aktivit provedených při terénních pracích v pilotní oblasti projektu GeoPlasma-CE. Cílem těchto aktivit byla terénní rekognoskace vybraného území, ověření platnosti dostupných starších měření a odběr a měření nových vzorků. Území bylo zkoumáno jak z geologického, tak i hydrogeologického pohledu. Smyslem prací bylo doplnění chybějících informací potřebných pro tvorbu hlavních výstupů projektu GeoPlasma-CE - map geotermálního potenciálu, map s omezujícími jevy pro rozvoj geotermální energie v daném území a dalších výstupů.

V oboru geologie byly odebrány vzorky hlavních horninových typů, které byly následně analyzovány pro petrologický popis zkoumaných hornin a pro analýzu geotermických parametrů těchto hornin. Tyto údaje jsou vstupem do výpočtu geotermálního potenciálu.

V oboru hydrogeologie byly měřeny základní fyzikálně-chemické parametry podzemních vod, jejich teploty a u vybraných dokumentačních bodů byly odebrány vzorky vod pro stanovení základního chemického složení. To je nezbytné pro posouzení oblastí s problematickým chemismem podzemních vod.

Data všech nově získaných měření byla následně uložena do databáze měření (D.T3.1.2), která je volně dostupná k dalšímu využití a je možné ji stáhnout z portálu GeoPlasma-CE na adrese: <https://portal.geoplasma-ce.eu/>.



3. Introduction

3.1. Aim and scope of this report

This report describes the field measurements performed in the pilot area W-Bohemia, which have been performed within the frame of Activity A.T2.3.2. It aims at a full documentation of the assessed field data, which will be published at the GeoPLASMA-CE web portal (www.geoplasma-ce.eu).

This report contains:

- An overview of parameters measured in the pilot areas for creating the aimed project outputs
- A brief description of the methods applied for measurement and data processing
- A documentation of the field measurements performed in the PA area.
- A short description of the results achieved and how these results contribute to the generation of thematic outputs.

3.2. Overview of the chosen strategy for field measurements

Field measurements serve for creation of, geo-environmental maps which will enable to determine the extent of the areas where the potential conflicts, i.e. difficulty, danger or exclusion - related to the future applications of GHPs may exists. Another area of special attention is the area of the water protection. The maps of the GeoPLASMA-CE project associated with the explanatory texts will provide planning tools to develop, in cooperation with the local authorities, a regional strategy for the development of renewable energy sources indicating favourable sites for practical use of GHPs, eg. heating and cooling of public buildings. The resulting maps and strategy will be published through a dedicated web portal of the GeoPLASMA-CE project and, if possible - via already existing- e-portals managed by the local authorities.

With the maps developed during the GeoPLASMA-CE project it will be possible to identify the specific locations with favourable conditions for shallow geothermal use. One will be able to see the values of the heat extraction rate obtained from the 1 m depth of the borehole (given in W/m-1) and values of thermal conductivity (W/m-1.K-1), and thereby determining the amount and the depth of wells needed to make GHPs with the required power parameters. The project will thus contribute to greater reliability of the data contained in preparation of future geological projects and documentation elaborated in order to use the "never ending" Earth's heat.



4. Documentation of field measurements

Geological mapping

The field geological research was primarily focused on sampling of representative lithologies for further laboratory measurements (thermal properties, density, porosity and in case of granitic rocks also radioactive heat production). Second purpose of the fieldwork was verification of archive geological maps of the area, including structural documentation of outcrops focused on character and orientation rock internal fabrics, to ensure that the archival structural and lithological data can be used for construction of the 3D geological model of the pilot area. The targets of the fieldwork were primarily crystalline rocks (in this pilot area comprising metasediments, orthogneisses and granites). During the fieldwork, no suitable outcrop of Tertiary to Quaternary sediments of the Cheb basin was found, so that samples from these rocks had to be taken from archive drill cores owned by the Czech Geological Survey. The work did not include either systematic geological mapping or technical works.

For the described purposes common geological tools were used - various hammers and chisels for rock sampling, as sufficiently large blocks were needed for the following laboratory analyses (Fig. 1, Fig. 2), and a Freiberg-type geological compass for measurement of orientation of significant structures (foliation planes, fold axes, fold axial surfaces and fault planes).

During the fieldwork, 15 outcrops were documented and rock samples have been taken for the laboratory treatment, usually directly from these documented outcrops (Fig. 3, Fig. 4). Around 70 structural measurements (mainly foliation planes and related lineations) were acquired on the outcrops, from which 25 measurements were subsequently selected as most representative for the given localities and used further during GIS data preparation and following 3D geological modelling. Additionally, 12 sedimentary samples have been taken from the core archive (Fig. 5).

The structural and petrographic documentation confirmed the petrographical classification of the studied crystalline rocks as they are delineated on the archive geological maps, and confirmed also that structural data in these maps - mainly general orientation of foliation planes on rock outcrops - are also correct.

Except of the samples, the field documentation comprises rock petrographic description that is in a simplified form involved in the project database, and a spatial database of structural measurements in an ESRI shp format suitable for GIS and 3D modelling SW.



Fig. 1 View of a part of the apparatus for measuring thermal properties with the attached rock sample



Fig. 2 Rock sample prepared for measurement of thermal properties, with indication of measurement trajectories (red lines)



Fig. 3 Sampling of phyllite in an abandoned quarry at Czech - German border near Aš



Fig. 4 Sampling of an orthogneiss from loose blocks where no fresh rock on outcrop was available.



Fig. 5 Sampling of sediments from the Cheb Basin in a drill core archive of the Czech Geological Survey.

Hydrogeological mapping

During hydrogeological mapping 150 documentation points representing springs, wells and natural seeps were localized and described in detail and documented by photos (Fig. 6). The spatial distribution of documentation points is depicted on Fig. 7. Conductivity, pH, and groundwater temperature were measured in the field by portable combined pH/conductivity meters (HachLange H40d or WTW devices) at each documentation point. Springs discharge was measured by bucket and stopwatch method or estimated. If documentation point was found representative for the geothermal project, measurement was repeated in another season. In a case when dissolved free CO₂ in groundwater was detected, its' concentration was measured by Haertl's apparatus. 21 documentation points with dissolved free CO₂ were identified in pilot area (Fig. 7).



Fig. 6 Examples of photos of overflowing well and natural spring of mineral water precipitating Fe oxides and hydroxides coupled with CO₂ release.

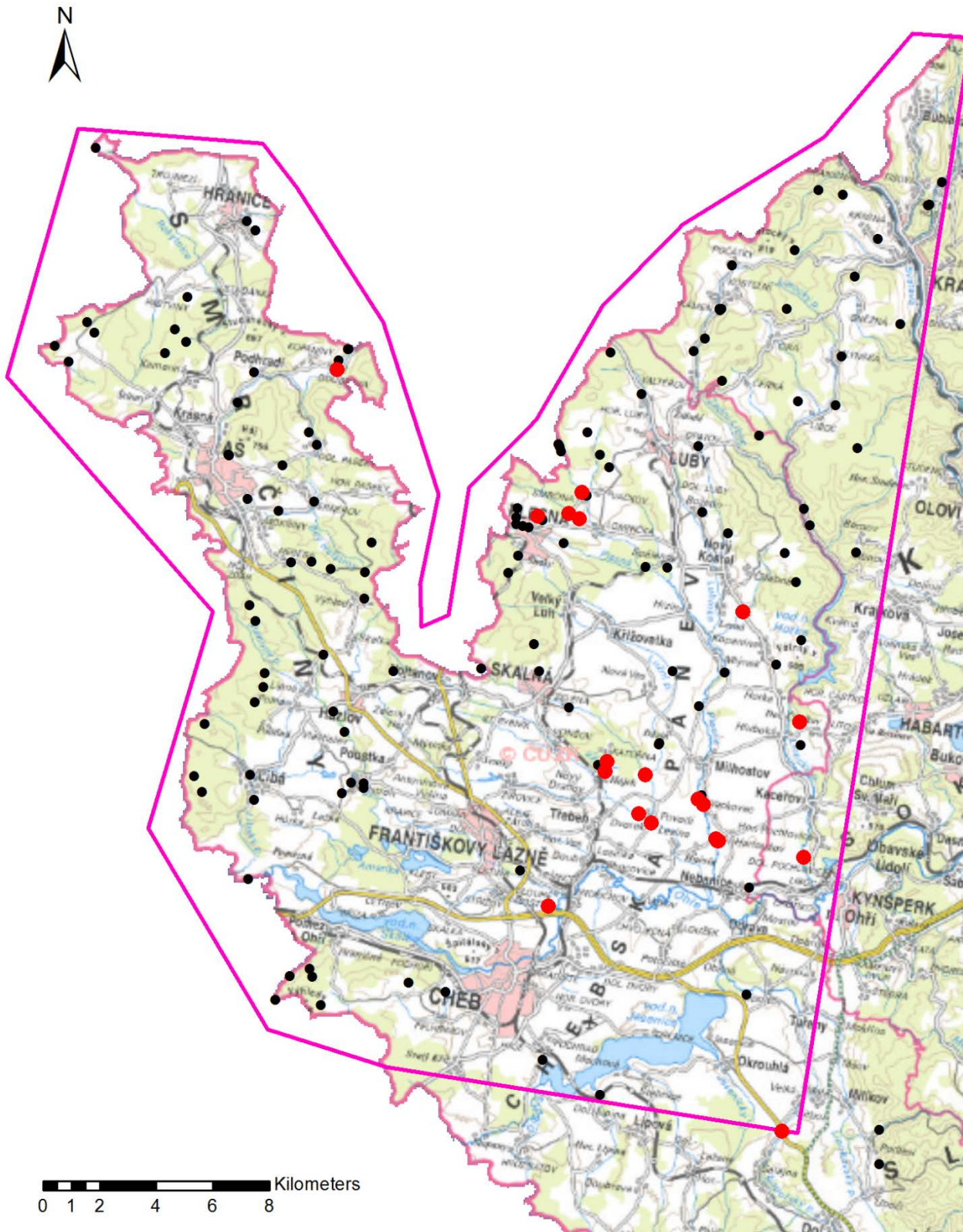


Fig. 7 Locations of documentation points in the pilot area (black and red dots). Red dots mark documentation points with measured concentration of dissolved free CO₂.



Hydrogeological sampling

Subsequently to hydrogeological mapping 47 representative documentation points covering homogeneously pilot area were selected in order to carry out field groundwater sampling. Major ions (cations NH_4^+ , Na^+ , K^+ , Ca^{2+} , Mg^{2+} , Mn^{2+} ; anions HCO_3^- , SO_4^{2-} , Cl^- , F^- , NO_3^- , $(\text{PO}_4)^{3-}$; Fe_{tot} , CO_2 , TDS, pH and conductivity) were determined for all 47 documentation points. If higher concentration of Fe_{tot} was expected, Fe^{2+} and Fe^{3+} were determined as well (19 samples). Samples of volume 1l and 60 ml were intended for major ions analysis, additional samples of volume 60 ml were intended for Fe^{2+} and Fe^{3+} analysis. All samples were analysed in laboratory ALS Czech Republic, s. r. o. Spatial distribution of samples locations in pilot area is depicted on Fig. 8.

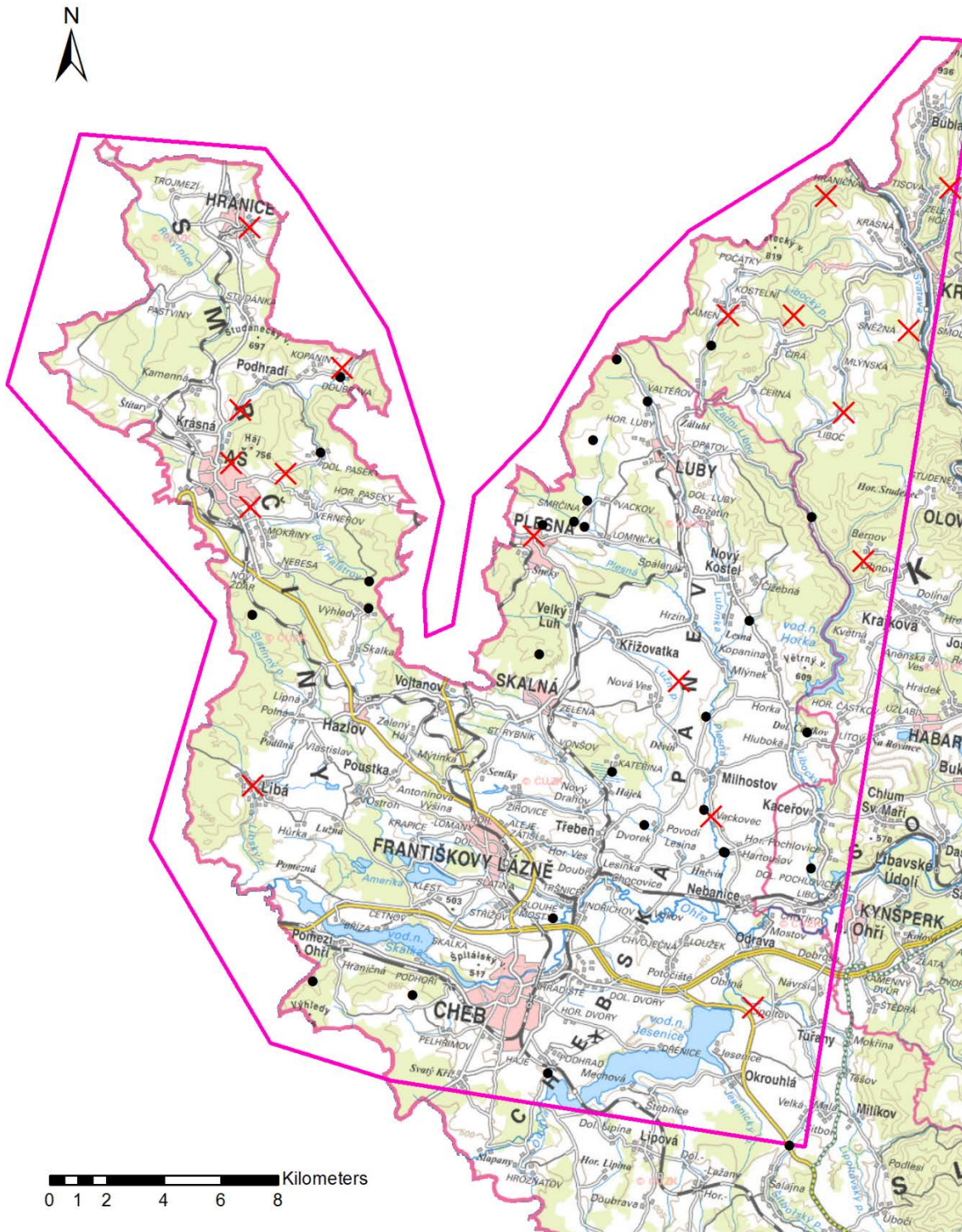


Fig. 8 Locations of sampling points in the pilot area (black dots and red Xs). Black dots mark sampling locations of both major ions and Fe (II) and Fe (III) analyses, Red Xs mark locations of major ions analyses.



5. Data processing

5.1. Transfer of field data to the joint databases

In a last step, the processed field data have been summarized and documented for a transferring them to the following databases:

- Metadata database of relevant input data (D.T3.1.2) for a full documentation of the achieved datasets.
- Key value database for publishing the achieved results (D.T3.2.1).

The metadata description of the produced datasets follows the joint concept on geodata management, which is described in Deliverable D.T2.3.1.

The summarized of datasets, shown in the key value database are characterized by:

- Number of individual measurements (≥ 1)
- Presentation of either alpha-numeric (e.g. $<0,01$ mg/l) or numeric values
- The dataset is characterized by a single or mean-, minimum- and maximum value as well as by the standard deviation (in case of at least 3 single datum points).
- All presented values are allocated to a measurements period, a surface location and a depth interval of the measurements.

6. Summary and conclusions

A total number of 1543 individual measurements were performed in the W-Bohemia pilot area. This is quite large dataset which will help to fulfil expected project deliverables. No special problems were solved during the field and laboratory works, because well established procedures and analyses were used.