APPLICATION OF GEOPHYSICAL METHODS FOR RECOGNISING OF GYPSUM DEPOSITS IN URBAN AREAS

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Introduction

A part of construction investments is located in areas where karst phenomena occur. The limestone karst is quite well recognised and described in the geological and geophysical literature, therefore the authors focused on the gypsum karst which was much less studied than limestone karst. Occurrence of karst forms often cause the damages of buildings and other infrastructure. In order to ensure the safety of people and property, it is necessary to investigate the geological medium before starting of construction investments; in built-up areas, monitoring of the geological medium should be carrying out. For this purpose, invasive geological and geotechnical techniques and/or non-invasive geophysical surveys, should be applied. In the paper, the authors focused on non-invasive imaging of gypsum karst forms and on the analysis of the development of karst phenomena, to the depth of buildings foundation, i.e. up to few metres of the depth.

Among the wide range of geophysical techniques for high-resolution imaging of karst forms, occurring up to depth of few meters, the GPR (Ground Penetrating Radar) technique seems to be the most appropriate. This technique allows fast and cheap investigation of the geological medium with resolution of few centimeters. Therefore, the GPR method was used as the basic measurement technique and as an auxiliary methods, the micro-gravimetric and the Electrical Resistivity Imaging (ERT) methods were used; such complex investigations allowed to reduce interpretation ambiguity.

Samples and methods

Geophysical surveys as well as karst hydrology/hydrogeology analyses were conducted for the areas where gypsum deposits and gypsum karst occurred in Poland (Fig. 1A). The paper presents the selected results of investigations carried out in towns/villages: Wiślica (Fig. 1B), Siesławice (Fig. 1C) and Staszów (Fig. 1D).

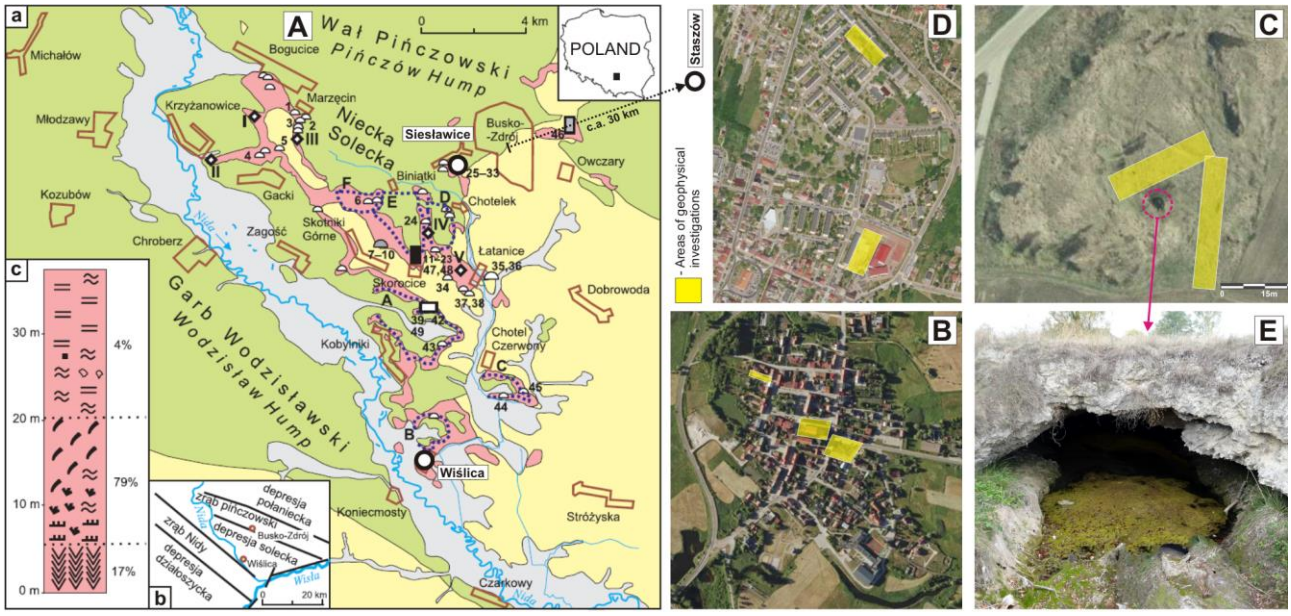

Figure 1. *(A) Locations of gypsum outcrops (Urban et al. 2015); Projects of geophysical surveys in towns/villages: Wiślica (B), Siesławice (C); Staszów (D) - base maps: ww.geoportal.gov.pl; (E) Example of gypsum karst from Siesławice site (Łój et al. 2014).*

Results

Due to the limitation of the abstract, only selected GPR and ERT results are presented below (Fig. 2), while a full karst hydrology/hydrogeology analyses combined with complex geophysical interpretation (for GPR, ERT and micro-gravimetric methods) will be presented in the full version of the paper. In Fig. 2A radargram recorded in Siesławice site, with the use of 500 MHz antennae was presented. In Fig. 2A, reflections from the roof of the cave (see Fig. 1E) and from horizontal washing-out zones as well as from near surface karst/weathered zone are easily recognised. Result of ERT survey (Schlumberger array) presented in Fig. 2B was obtained during the measurements carried out by the building where damages in this construction were observed. In Fig. 2B two main, shallowly located anomalies were recorded; low resistivity Anomaly I depicts to the karst/weathered zone filled with water or colmatated with sandwater; higher resistivity observed in Anomaly II was caused by the presence of dry fractures/void located in the near surface zone. Very low resistivities shown in Fig. 2B as well as the results presented in other publications depicted to the high attenuation of electromagnetic wave which caused the lack of reflections from greater depths (Fig. 2A).

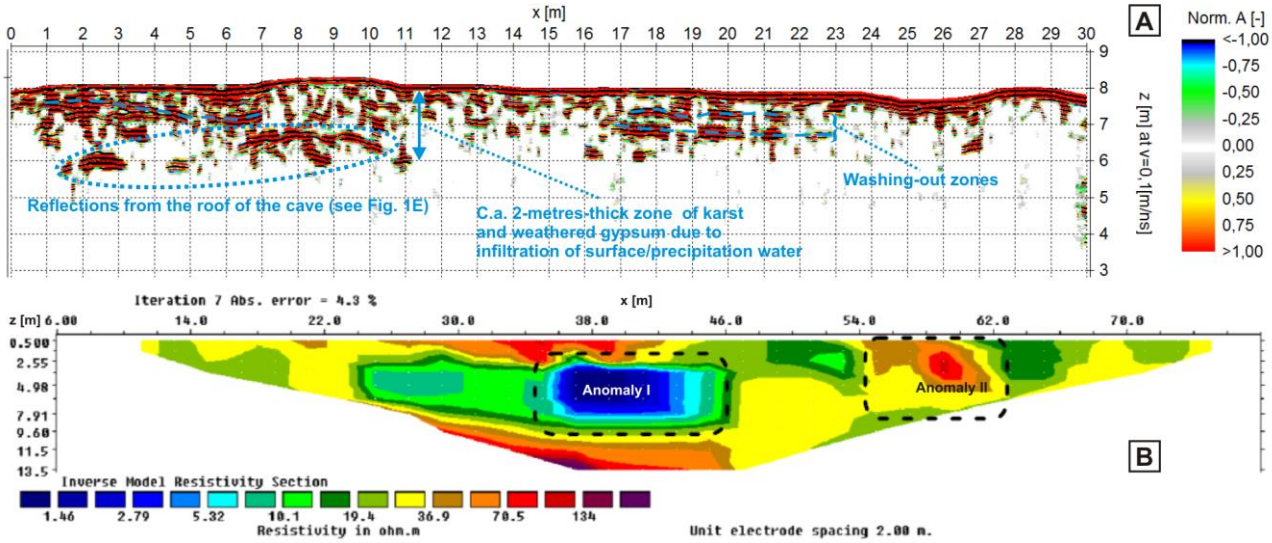

Figure 2. *(A) Result of GPR survey from Siesławice site; (B) Result of ERT survey from Staszów site.*

Conclusions

As it was shown in the paper, the GPR and ERT methods can be successfully used for non-invasive detection of karst forms occurred in gypsum deposits. As it will be presented in full version of paper also micro-gravimetric method delivers satisfied results for recognizing of gypsum karst. Karst phenomena analysed in the paper occurred up to the depth of few metres, therefore the geophysical interpretation should be carried out along with the analyses delivered by mainly karst hydrology and further karst hydrogeology.

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