# APPLICATION OF 3D GIS IN A RESEARCH PROJECT PLANNIG – AN EXAMPLE FROM THE UNDERGROUND RESEARCH CENTRE JOSEF, CZECH REPUBLIC

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## INTRODUCTION

Underground storage of thermal energy is an actual topic worldwide (e.g. Dincer & Rosen 2011). An influence of thermal loading and periodic temperature change however still has to be assessed.

A comprehensive research project "Rock thermal loading research – perspectives of underground storage of thermal energy" is located in a gallery of the Underground Research Center (URC Josef, Pacovský et al. 2007) in central Bohemia. The project studies multidisciplinary aspects of in-situ thermal loading of granitic rock. Complex thermo-hydro-mechanical and chemical coupling approach has been adopted.

After careful consideration a suitable locality was chosen within the URC Josef (gallery SP-47, Fig. 1). Subsequently, long-term in-situ heating experiment was designed to describe changes in geomechanical, chemical, petrological and hydrogeological properties of granite during and after repeated heating and cooling cycles.

To reach aims of the project it was essential to adjust the experiment design to geological settings of the selected locality. Thorough survey of the locality and preliminary modelling were applied. The information was viewed and compiled using ArcScene GIS software. Visualization provided a basis for detailed project planning including borehole and sensor localisation.

## DATA PROCESSING AND VISUALIZATION

At the begining shape of the selected locality was acquired using 3D laser scanning technology. Walls of the gallery were also documented photographically. Detailed structural geological survey pointed out tectonic situation at the locality.

Laser scan data were transferred into ArcScene environment using the VRML data format. Multipatch geometry type was utilized to present surface of the gallery. Moreover the multipatch type is suitable for VBA macro based automated generation of 3D objects. In this way the fracture system at the gallery was reproduced. The gallery and structural model were combined.

*Figure 1 – Gallery SP-47, URC Josef.*

## IMPLICATIONS FOR THE PROJECT PLANNING

Following aims of the project: location, diameter, orientation and dip of the boreholes were discussed within the research team. Methodology and sensor requirements were taken into account as well. Large diameter (850 mm) horizontal borehole was decided to be situated in the centre of the gallery's head. Ten thin (60 to 76 mm in diameter) boreholes were placed in head and walls of the gallery surrounding the central borehole.

Analogical model of the planned boreholes was prepared using ArcScene. All three models (the gallery model, the structural model and the borehole model) were merged into a site descriptive model of the experimental locality (Fig. 2). The site descriptive model of the experimental locality provided localisation of boreholes stored in attribute table (x, y, z, trend, dip, length, diameter). For drilling companies this information is in combination with 2D view of borehole localisation sufficient enough to place the boreholes precisely.

The site descriptive model also provided a basis for an extensive project conception. The conception includes localisation of boreholes and sensors, enlists planned methods and specifies methodology.

During drilling new data were gathered. Core description and optical borehole inspection extend knowledge of the local granite characteristics and fracturing. Consequently additional in-situ tests are planned to describe hydraulic, geomechanical and chemical characteristics of the experimental locality. Thermal, geomechanical, hydraulic, petrological and chemical properties of the core samples are tested in laboratory. Both the research conception and site descriptive model of the experimental locality were kept up to date using learned facts. Finally, sensors for monitoring rock temperature, stress conditions, strain, hydraulic parameters and acoustic signals during the in-situ experiment were installed in the thin boreholes and on the gallery's head surface. Again the positioning was discussed over the actualized 3D site descriptive model of the experimental locality.

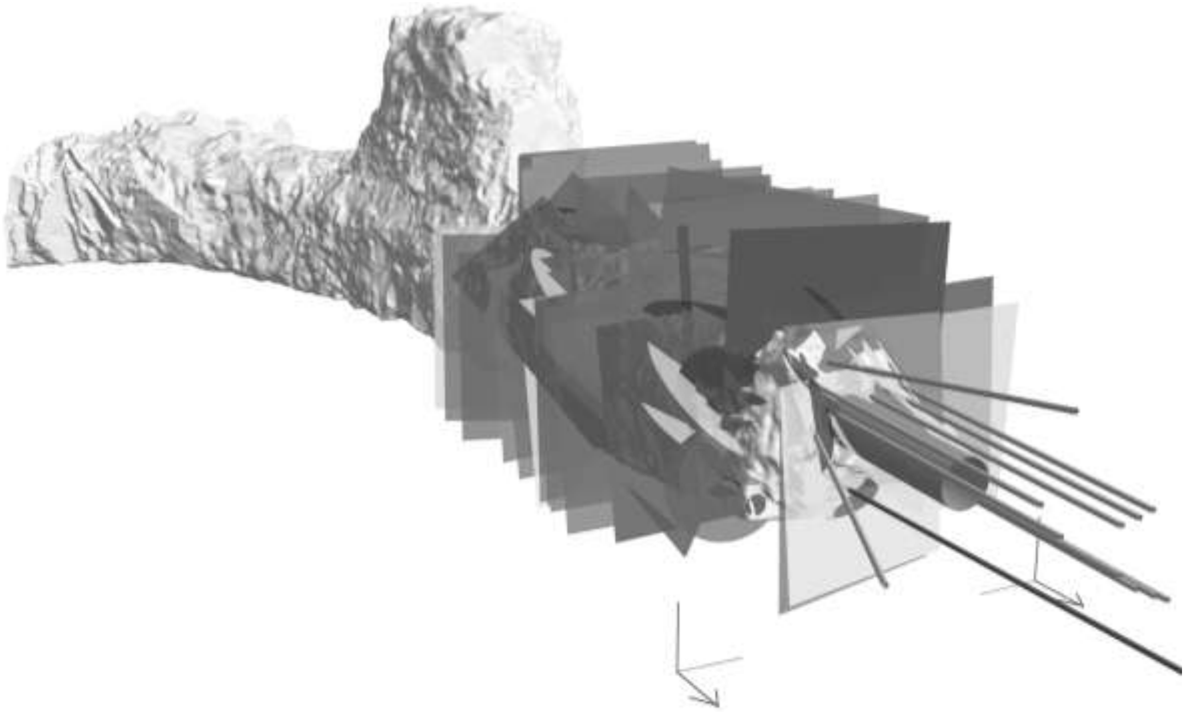

*Figure 2 –Site descriptive model of the experimental locality including fracture net and boreholes.*

## LESSONS LEARNED

- User friendly environment of ArcScene and detailed visualization of a locality allow planning of sophisticated drilling without technical drawing knowledge.
- The VRML data format enables colleagues without GIS licence to work with a model.
- 3D visualization of the experimental locality simplifies sharing information within research team and the planning process of the research significantly.
- Combination of 3D laser scan, photodocumentation and structural geological survey provided a reliable information for inicial planning of the project.

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