Evaluation Process for Natural Stone – Best Practices

Introduction

Natural stone evaluation is a systematic (regional) process with the aim of locating prospects for natural stone and to evaluate the profitability of production. The process consists of individual stages of desk study, field mapping, and detailed examination of prospects (Luodes 2015). The beginning of the exploration process (desk study and field mapping) can be defined as a "reconnaissance phase", where the purpose is to identify areas worthy of further investigation towards deposit identification (Selonen et al. 2014). In the detailed examination of a prospect ("target phase"), the production properties of the prospect are studied (Luodes 2015, Vartiainen 2017). The best practices of execution of the process involves understanding of the main aims of the individual stages of the process.

Evaluation process

Desk stage

The preliminary evaluation of the exploration area is done with geological, geophysical, and topographical data. A geological model and a geological exploration model of the exploration area is prepared (e.g. Selonen et al. 2011).

Field mapping

The field mapping is focused on observations of characteristics of rock like texture, soundness, fracturing and homogeneity. In addition, colour variations are observed. Target selection is largely based on the geological exploration model. Evaluation is made on the outcrop surface; important is to have a good knowledge of the criteria for feasible natural stones. The samples are used in evaluation of the colour and texture as well as the mineralogical composition of the rock.

Detailed examination of the prospect

This stage includes *detailed mapping* of the rock and its properties (in scale of 1:100) along traverses (Fig. 2.) together with *sampling* with a hand-held diamond saw. For evaluation of the aesthetical properties and homogeneity of the rock larger block samples are extracted by drilling and wedging. Slabs with different surface finishing are produced to show the variation of characteristics and commercial potential of the rock. Essential at this stage is to define the subsurface properties of the prospect.

Figure 1. Sampling is also an essential part in field mapping. Photo: Paavo Härmä, GTK

Figure 2. Detailed examination of the prospect along traverses. Photo: Risto Vartiainen, GTK.

The main *geophysical method is* the ground penetrating geo-radar (GPR) (Fig. 3). The horizontal and subhorizontal fractures appear clearly in the geo-radar profiles, while the vertical and subvertical fractures are more difficult to interpret (Luodes 2015). Other geophysical methods can include, *e.g. electrical resistivity tomography (ERT) & IP measurements* (Fig. 4.), *magnetic ground measurements, electromagnetic VLF-R and EM31, seismic ground survey methods, and microgravimetrical methods* as well as the use of *LiDAR data* (Härmä & Selonen 2008, Luodes et al. 2014, Vartiainen 2017).

Core drilling gives invaluable information on the quality of the prospect by producing a drill core in which the variation in colour, mineralogy and fracturing can be observed in depth (Vartiainen 2017). However, the correct placing of the vertical or inclined drill holes is very important (Leinonen 2005, Luodes et al. 2015).

The detailed examination can be associated with *test quarrying* in which typically a few hundred cubic metres are extracted. The extracted material is processed into final products to *determine the production properties* such as sawability, flaming ability, honability, and polishing ability.

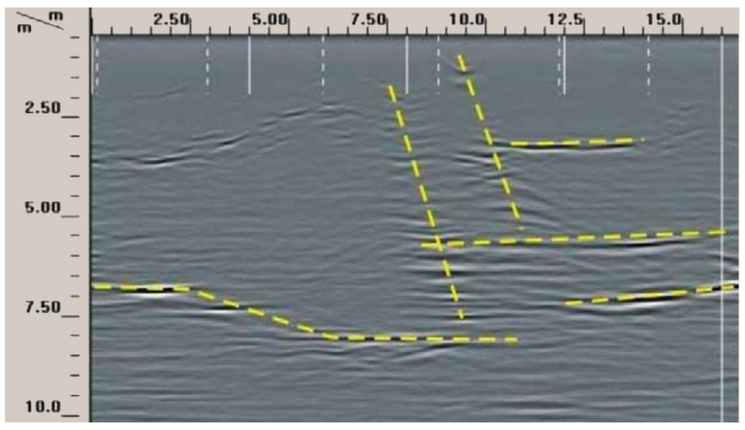

Figure 3. An example of the GPR measurements carried out in a prospect. Yellow dashed lines marked in the profile are interpreted fractures. (Luodes 2015).

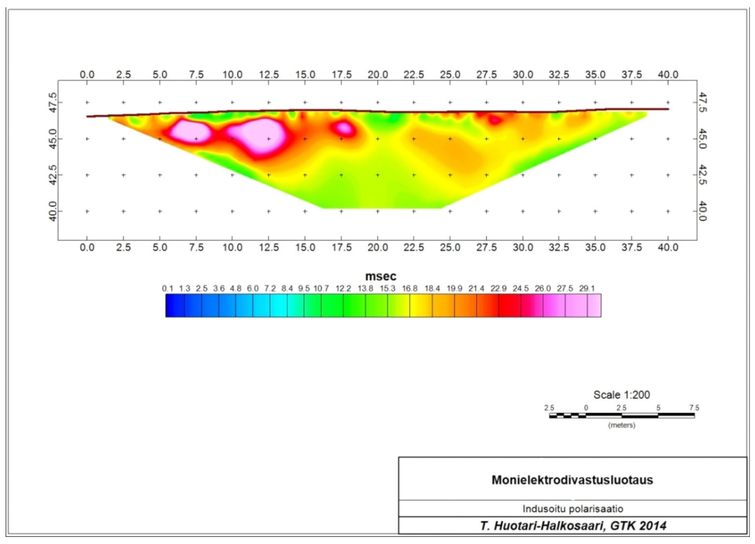

Figure 4. An example of the IP measurements carried out in a prospect. Photo: Taija Huotari, GTK.

Figure 5. Measuring the geophysical properties inside a drill hole. Photo: Paavo Härmä, GTK.

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