



Geophysical modeling of electrical resistivity and induced polarization data for exploration of building stones: A case study - Atashkooh travertine

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Extended Abstract

Summary

The study area is situated near to the city of Nimvar, 15 km east of Mahallat, in Markazi Province. This area is located at the border of two structural zones of Sanandaj-Sirjan and Urmia-Dokhtar in terms of the geological division. The exposed geological units in the study area often include shale, marl, sandstone, conglomerate, and limestone sequences with strata extending (north)west-(south)east and a slope to the northeast. The low-slope Plio-Quaternary travertine stone has sporadically occurred within these geological units as an unconformity unit. In first step of geophysical investigations, to evaluate the

efficiency of the geoelectric method, laboratory measurements of the electrical resistivity property were performed on the samples taken from the travertine stone and associated tailings. As the laboratory results in differentiating geological units on the basis of electrical properties were acceptable, then electrical resistivity and induced polarization surveys using a combination of dipole-dipole and pole-dipole electrode arrays were carried out in Atashkooh travertine area. These surveys were conducted along three survey lines using electrode spacings of 10 and 15 meters, and as a result, 850 electrical measurements were collected by using Canadian GDD geoelectric measuring equipment with a power of 3600 watts. The ultimate goal of this study is to explore possible travertine deposits that are buried under an overburden layer or soil and tailings from old mining activities. After processing observations, the raw electrical data, obtained along each survey line, were inverted to image possible two-dimensional (2D) zones of travertine lens occurrence. The results of the 2D inverse modeling were also visualized in three-dimensional (3D) form to better capture the geological trend of the sedimentary units. Considering the electrical resistivity values of various geological units in the Atashkooh area and constructing a blocky model across each survey line, and also, estimating the values of resistivity and chargeability, a geological model was attributed individually to each survey line. Due to high electrical resistivity values of the travertine outcrops, we could only detect one target along the first survey line at a depth of 15 to 20 m that subsequently needed to be excavated for more details. In addition, the quality of the proposed geological models, based on the geophysical investigations, was confirmed by digging two exploratory boreholes in the area. The results indicate that the geoelectric surveys yield valuable information for the exploration of travertine building stones.

Introduction

Atashkooh travertine area is located in the northwest portion of the Delijan 1: 100,000 and Golpayegan 1: 250,000 geological maps. In the region of interest, a sequence of shale, marl, sandstone and conglomerate rocks with west-east and northwest-southeast trends exist. The thickness of the travertine lens embedded within the conglomerate varies considerably in the region. Its thickness decreases at the periphery of the travertine unit and increases inward. This study focuses on the electrical characteristics of the travertine lens and its distinct physical property contrast relative to its surrounding. This study also facilitates the exploratory plan of building stones through geoelectrical investigations. Thus, three electrical survey lines were designed to conduct 2D electrical profiling. Here, the modeling results and the geological interpretation have been presented in details. Note that the geophysical observations include geoelectric measurements at 850 points where a combination of dipole-dipole and pole-dipole electrode arrays with the electrode spacing of 15 and 10 meters was utilized.

Methodology and Approaches

The raw field geophysical data along along three survey lines have been modeled using a 2D smooth inversion algorithm with the help of RES2DINV software package. The 2D model sections are displayed in 3D form as well. According to the retrieved electrical resistivity and chargeability data, a geological model was proposed to each survey line.

Results and Conclusions

This study was conducted to investigate the ability of geoelectric method to identify geological structures and travertine building stones in the Atashkooch area. The results showed that high values of electrical resistivity were in association with the travertine rocks. Moreover, three main geological layers were identified in the area, presenting three ranges of geoelectrical values in the retrieved models. In order to evaluate the capability of the geoelectric method, used in this study, two boreholes were drilled along the second survey line indicating that this method has good accuracy in imaging the boundaries of the geological layers in the area.
