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Use of eletrical resistivity in studies of the mining potential of ornamental rocks

Gustavo Gosling (Universidade de São Paulo), Felipe Carvalho Vieira Santos (TGS), Vagner Roberto Elis (UNIVERSIDADE DE SÃO PAULO (USP) - INSTITUTO DE ASTRONOMIA; GEOFISICA E CIENCIAS ATMOSFERICAS (IAG).), Leonardo Rama (Universidade de São Paulo), Jen Jesus Rosa (Universidade de São Paulo), MARCELO STANGARI (UNIVERSIDADE DE SÃO PAULO (USP) - INSTITUTO DE ASTRONOMIA; GEOFISICA E CIENCIAS ATMOSFERICAS (IAG).), Laura Silva (Universidade de São Paulo)

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Introduction

The environmental licensing of mining activities is one of the measures that must be taken by a company after obtaining rights for mineral exploration in an area. To obtain the license, it is necessary to conduct environmental studies such as a restoration plan for the degraded area, or a preliminary environmental impact study. The environmental impact caused by exploration activities depends on the extent of the area to be explored, the degree of harm of the minerals to fauna and flora, and the ease of dispersion of waste in the event of accidents and during normal exploration. The objective of this work is to investigate the shallow geo-electrical characteristics of a region of possible open-pit black marble mining in the municipality of Itaoca – SP – Brazil and to characterize possible fracture zones in the bedrock. If fracture zones exist, there is a possibility that they are permeated with water and that this water may be transported to nearby tributaries of the Rio Ribeira. This type of information in environmental studies is of fundamental interest, as it affects the granting of environmental licenses due to the facilitation of particulate matter transport. Furthermore, the presence of fractures indicates a decrease in the potential for extracting large massive rock blocks, reinforcing the importance and applicability of geophysical methods for exploring mineral resources.

Method and/or Theory

For the acquisition of the electrical resistivity data, the Electrical Resistivity Tomography (ERT) technique was employed, using the dipole-dipole arrangement. Four electrical surveys were conducted, three parallel to each other and the control survey perpendicular to the others, following the terrain gradient. The spacing between the electrodes was 20 m and the total extent of each of the parallel lines varies between 500 m and 600 m, while the control line has an extent of 300 m. The Res2DInv software was used for data inversion, which enabled the identification of zones of high and low resistivity under the inversion models.

Results and Conclusions

The results show a model with a gradual increase in resistivity with depth, consistent with a succession of relatively less resistive surface layers than the unaffected bedrock. The surface soil layers exhibit resistivity interpreted between 10 ohm.m and 100 ohm.m, while the bedrock shows resistivity above 2000 ohm.m. The inversion models allowed the identification of regions with potential fractures, marked by low resistivity anomalies, especially on the eastern side of the potential open-pit. The study indicates that there is a likely fracture zone that may extend from the highest region of the pit to the base, where the Córrego da Lavra, a tributary of the Rio Ribeira, flows. To better understand the likely fracture zone, it was proposed in future studies to acquire new ERT data in various parallel profiles over this zone, with smaller spacing between electrodes, in order to improve the spatial resolution of the inversion model sections.