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Magnetic Susceptibility Applied in Bom Jardim de Goiás Deposit

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Introduction

The Bom Jardim de Goiás region has been under investigation since 1972, during the aerogeophysical survey of the Iporá Project, when potassic radiometric anomalies were observed at the western edge of the Serra Negra granite, exhibiting a semi-circular structure (Costa et al., 1979).

Initial research involved geological mapping and regional stream sediment geochemistry, which led to the definition of the Bom Jardim de Goiás Metavolcanosedimentary Sequence. After defining the targets for further investigation, geological mapping, soil geochemistry, and E-W oriented magnetometry and VLF geophysical surveys were carried out at a 1:20,000 scale. This led to a new research phase with additional magnetometry, VLF, and IP geophysical surveys, as well as the execution of 18 diamond drill holes in two targets (Costa et al., 1979).

Finally, subsequent geophysical work focused solely on target 01, named Capibaribe, where new detailed studies were conducted. These included 1:2,000 scale geological mapping, geophysical surveys (Mise à la masse), and the delimitation and estimation of mineral resources for the sulfidic copper deposit (chalcopyrite and pyrite). This defined a total reserve (Measured + Indicated + Inferred) of 4.575 million tons @ 0.92% Cu and 0.9 g/t Au (Costa et al., 1979).

The data were acquired from three boreholes drilled by AXIA Mineração S.A. using the GDD MPP equipment, which measures conductivity and susceptibility; however, the initial data were not used in this study. A sample interval of 10 cm was adopted for the mineralized interval and 30 cm for the barren sections, with each point measured in triplicate and the values averaged. Geochemical data for Cu, Fe, and S were also used. With this data, we can verify the correlation of susceptibility with the quantity of chalcopyrite and/or pyrrhotite, which will be important in future surveys.

Method

Magnetic susceptibility (χm) measures a material's ability to become magnetized when subjected to a magnetic field. The proportionality coefficient (χm) fines the magnetic susceptibility of the environment or material under consideration. The relationship is given by. $\vec{M} = \chi m * \vec{H}$ where $\vec{M}$ s the induced magnetization in amperes per meter (A/m); $\vec{H}$ is the magnetic field induction in amperes per meter (A/m); and is the magnetic susceptibility of the material (dimensionless). The value of $\chi m < 0$, the material is considered diamagnetic, meaning its magnetic field combines with the external magnetic field, causing a decrease in the latter. If $\chi m > 0$ 0, the material is considered paramagnetic, as its magnetic field combines with the external field to produce a stronger magnetic field (Machado, 2005).

Both paramagnetic and diamagnetic materials generally have very small magnetic susceptibility values, $|\chi m| \ll 1$. However, in the case of ferromagnetic materials, the value of χm can be large (Machado, 2005).

Magnetic anomalies can be associated with the alteration of magnetic minerals in rocks hosting mineral deposits linked to hydrothermal systems (Hanna, 1969; Criss & Champion, 1984; Clark, 2014). Porphyry systems commonly produce or destroy magnetite in host rocks (Hoschke, 2008).

The magnetic method is a key tool for inferring subsurface structures and mapping anomalous concentrations of magnetite, which is the primary magnetic material in the crust. This method can also be used to map magnetite concentrations that occur in many economic mineral deposits where this mineral is associated (Clark, 2014; Hoover et al., 1992).

Results

Figures 1 to 3 present the Strip Logs generated for the analyzed boreholes.

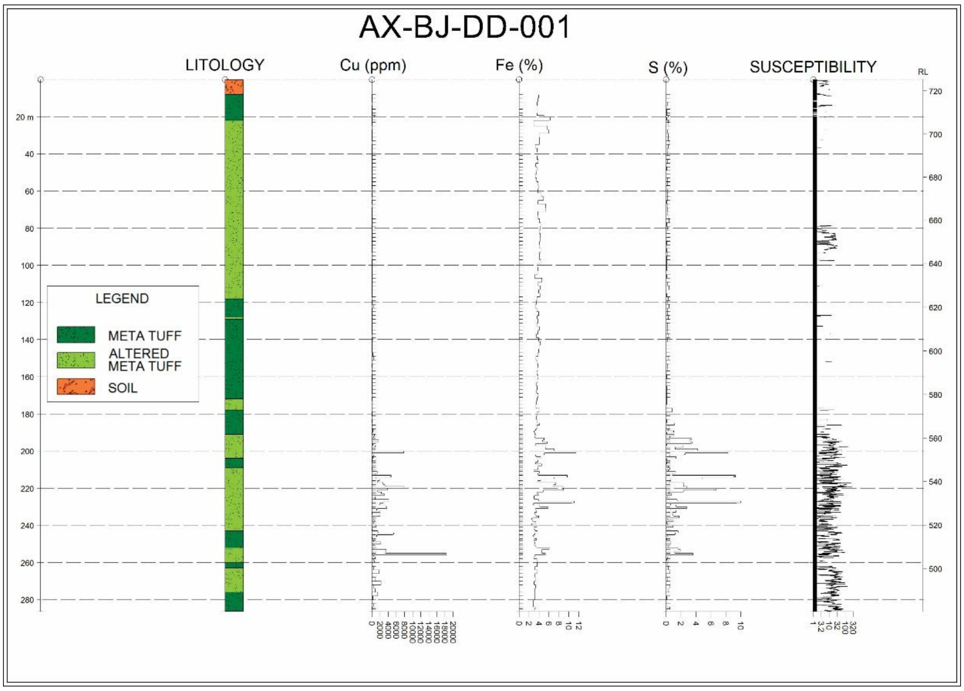

Figure 1: Strip Log of borehole AX-BJ-DD-001.

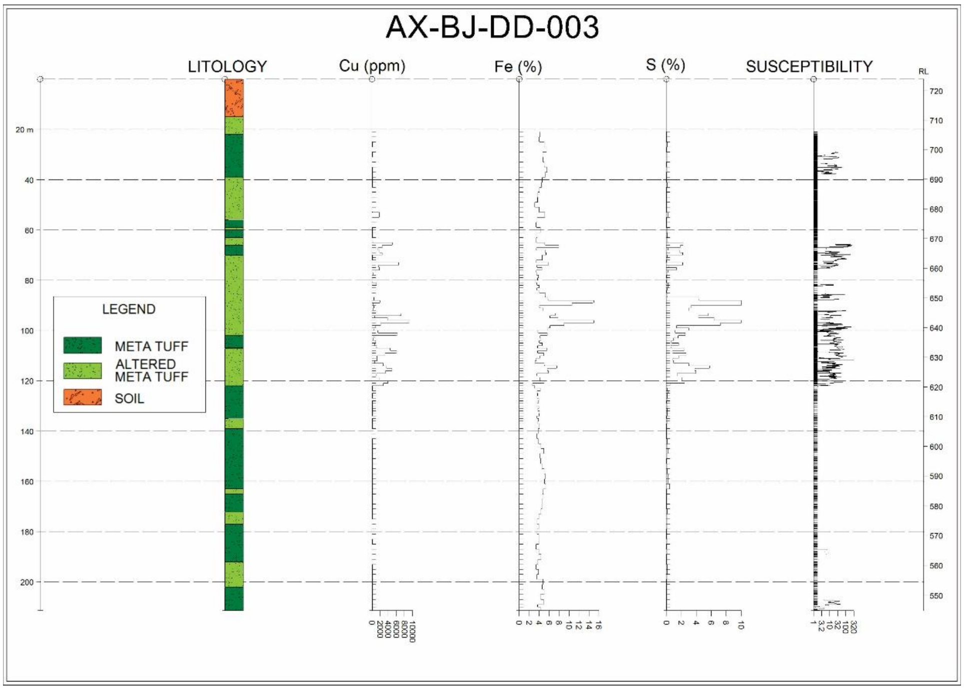

Figure 2: Strip Log of borehole AX-BJ-DD-003.

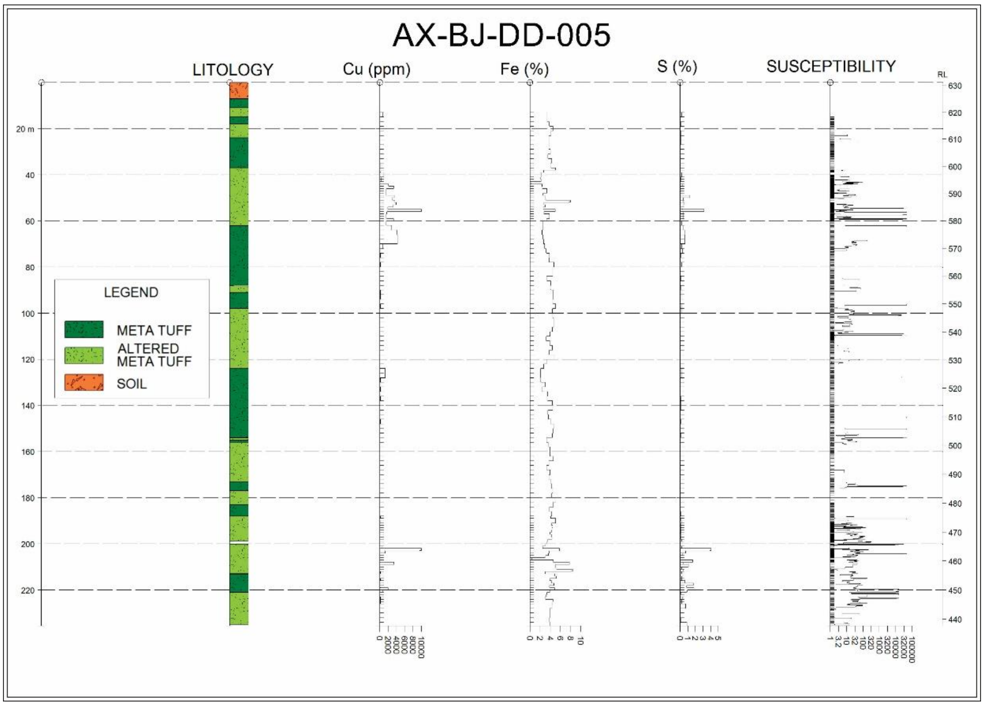

Figure 3: Strip Log of borehole AX-BJ-DD-005.

Conclusions

Since this deposit's mineralization is primarily characterized by veins and veinlets filled with pyrite and chalcopyrite, and with alteration halos composed of carbonate + chlorite + magnetite, the susceptibility data show excellent correlation with the geochemical results for copper.

Furthermore, the results show small intervals with anomalous Fe and S values accompanied by a depletion in Cu values, which is indicative of pyrrhotite. The results obtained from the boreholes allowed for the generation of a correlation between susceptibility and higher copper grades, which can serve as a prospective guide for future explorations in the area. The next steps for this work will involve characterizing the petrophysical footprint by incorporating other petrophysical surveys and continuing the correlation with other geochemical data to understand the deposit as a whole.

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