Physical properties of the Canadian Malartic ore body and host rock

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To date a specific magnetic or electromagnetic signature has not been identified at the Canadian Malartic gold deposit, thus prospecting for this type of deposit in similar geological environments is poorly constrained. Physical properties of the ore and host rock are dependent on their mineralogical composition and textures which relates to their original composition, deformation, metamorphism, and fluid-rock interaction history. This study aims at measuring the physical properties of the various rock types from the core of the mineralized system to the outer zones of the gold deposit to help anticipate the geophysical signals that could be detected by surveying. So far, laboratory measurements were performed on 217 core samples representative of the various rock types and styles of alteration and mineralization. The density of each sample was measured because this mainly relates to mineralogical composition and texture. Magnetic susceptibility was measured to investigate how hydrothermal alteration affects the magnetic signature. Additionally, spectral induced polarization measurements were performed on the core samples to estimate their complex resistivity parameters, and natural gamma-ray spectra were analysed to determine the radiometric properties of the rock samples. To understand the variation in the physical properties, a subset of 12 samples was studied using Mineral Liberation Analysis. Microgeophysical surveys were also conducted at the outcrop scale to better constrain the scaling effect between laboratory measurements and explorative geophysical surveys. Multivariate statistical analyses of the physical properties show that rock porosity decreases when going towards the deposit and as a result the median resistivity increases by at least one order of magnitude, from 10^3 to 10^4, sometimes even 10^5 Ohm-m. With in-situ induced polarization, the time-domain definition of chargeability allows us to delimitate mineralized sectors in the Bravo outcrop zone. Moreover, the frequency-domain dependence parameter measured in the laboratory shows significant variations. The estimated density distribution of this parameter is multimodal, with the first mode being mostly attributed to rocks found in distal regions and granites (median: 0.14), the second to weakly mineralized greywackes (0.26), and the last, to very pyritized greywackes and mafic dikes (0.39). Error analysis of the spectral induced polarization measurements allows us to propose a new measurement setup that include both a two points and five points system. These results reveal that determination of the petrophysical properties integrated with the mineralogical and geochemical signatures allow mapping of the relevant features and could help to vector zones of mineralization.

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