Mir R, Perrouty S, Astic T, Bérubé CL, Smith RS, 2019, Identification of structurally complex gold-mineralized zones using airborne EM and ground IP in the Canadian Malartic district, Quebec, Canada, Geophysics, in press

Structurally complex zones within orogenic terranes typically correspond to areas where there is interference between multiple fold generations, and are known to be favorable pathways for fluid flow because of their higher permeability. In the Canadian Malartic district, gold anomalies have been linked with zones of structural complexity that have been quantified by outcrop bedding orientation measurements and calculation of bedding variance maps. In this work, historical apparent resistivity and induced polarization data in the Canadian Malartic district were reprocessed and combined with new surveys to create a compilation of inverted chargeability and resistivity, which were then interpreted together with airborne electromagnetics and outcrop structural data. The results show chargeability anomalies, up to 5 times the background value, associated with the sulfide mineral content in monzodioritic dikes that are thickened in folds and hydrothermally altered. While the airborne apparent half-space resistivity is mostly sensitive to conductive surficial cover, the inverted ground resistivity method is sensitive to deeper structure and likely represents bedrock signal at depths greater than 25 m. Inverted ground resistivity exhibits strong anisotropy in areas of subvertical bedding, where measured resistivities can vary by up to a factor of 2, over the same location, depending on whether the survey lines are perpendicular or parallel to the strike of bedding. This result is observed at scales of 50 cm up to 100 m. Analysis of inverted ground resistivity together with bedding variance, shows a strong correlation between structurally complex zones with high bedding variance and a decrease in resistivity at depths below 25 m. This suggests that in places where presence of disseminated gold cannot be directly detected, or where outcrop exposure is limited due to overburden cover, geophysical data may still succeed in identifying structural complexity zones that could potentially host mineralization.

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