

Using sulphide indicator mineral chemistry for ore discrimination and targeting in the Churchill Province, northern Quebec, Canada

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The Churchill Province in northern Quebec consists of Archean to Proterozoic basement rocks, which have undergone a complex orogenic and metamorphic history. The vast majority of these rocks are covered by Quaternary glacial deposits that display a complex geomorphology reflecting important variations in the glacial dynamics. Occasional mineralized outcrops have been identified south from the Ungava Bay in the Churchill Province during mapping surveys. However, this area has been underexplored owing to the thick sedimentary cover, which limits the effectiveness of conventional exploration methods. Heavy mineral separation from till and esker samples reveals the presence of thousands of sulphide grains, namely pyrite and chalcopyrite, and lesser amounts of sulfarsenides (löllingite and arsenopyrite), which is indicative of the presence of underlying mineralized rocks. As a result, this area is ideal to test the use of sulphide indicator mineral chemistry for mineral assessment and vectoring. In this study, we focus on integrating sulphide indicator mineral chemistry determined by laser ablation inductively coupled mass spectrometry (LA-ICP-MS) with the geology of glacial deposits. Trace-element signatures of pyrite and chalcopyrite grains indicate two distinct compositions for the sulphide minerals present in the glacial deposits and suggest there is strong potential for magmatic and hydrothermal mineralisation. Integrated maps combining sample locations and sulphide grain compositions and populations allow to delineate vectors toward potential economic targets.