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The lithogeochemical and mineralogical alteration footprint of the George Fisher CD-type Zn-Pb massive sulfide deposit

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Clastic dominated (CD-type) massive sulfide Zn-Pb deposits (formerly known as SEDEX deposits) comprise a large proportion of global Zn-Pb reserves. Many of the world's highest value CD-type deposits (>100 Mt at >10 % Zn+Pb) are located in the Carpentaria province in northern Australia. These deposits are typically stratabound and hosted in fine-grained sedimentary rocks. In the 100 years since the discovery of the first giant Carpentaria CD-type Zn-Pb deposit at Mount Isa, debate over the genesis of these systems was generally focussed on whether mineralization formed via syn-sedimentary exhalative (SEDEX) processes or due to epigenetic host rock replacement. In contrast, there have been relatively few systematic studies on the mineralogy and lithogeochemistry of the mineralization and stratigraphically equivalent un-mineralized host rocks. In this study, we present mineralogical, lithogeochemical, and petrographic data of drill core samples from drill holes that intersected the main ore bodies at the George Fisher deposit (169 Mt at 8.9% Zn, 3.4% Pb) and from a drill hole that intersected correlative un-mineralized host rock lithologies of the Urquhart Shale Formation. Relative to the barren Urquhart Shale, hydrothermal alteration during the first stage of sulfide mineralization (stratabound, Zn-dominated) has led to albite, chlorite, and calcite depletion and dolomite and K-phyllosilicate enrichment in the host rocks. These mineralogical changes are consistent with minor and trace element enrichment (Tl and Mn) and depletion (Na and Sr) at George Fisher. A geochemical alteration index based on these elements (George Fisher index = 10((400Tl+Mn)/(10Sr+Na))) is highly effective in differentiating mineralized from barren host rocks and may be a useful tool for future geochemical exploration programs in the Carpentaria province. This study highlights the benefit of establishing the baseline composition of barren host rocks by combining geochemical, mineralogical, and petrographic data in order to investigate the alteration footprint of basin-hosted mineral systems.