

Building a Sedimentological Framework of the Earn Group During SHMS Zn-Pb Mineralization in the Kechika Trough of Northeast British Columbia

Benjamin Johnstone¹, Kenneth Hickey¹, Emilia Caylor¹

¹Mineral Deposit Research Unit, University Of British Columbia, Vancouver, Canada

Late Devonian deep-marine fine-grained clastic sedimentary rocks of the Yukon and northeastern British Columbia host numerous sedimentary-hosted massive-sulfide (SHMS) Zn-Pb and critical metal (Ga, Ge) deposits. Significant examples include Macmillan Pass in the Selwyn Basin, and the Cardiac Creek and Cirque deposits in the Kechika Trough. Genetic models invoke either seafloor hydrothermal venting with direct sulfide precipitation or subseafloor replacement of barite during early diagenesis. Both scenarios indicate a strong stratigraphic control on mineralization, highlighting the need to understand sedimentary processes and basin evolution to inform regional exploration strategies. This study aims to build a sedimentological and sequence stratigraphic framework for the Kechika Trough to contextualize SHMS mineralization within a broader spatial, temporal, and tectonic setting. Sequence stratigraphy investigates changes in depositional trends that are caused by the interplay of sediment supply and accommodation (space for sediments). Relative sea-level is used as a proxy for accommodation, with tectonics being the dominant controller at timescales greater than 1Myr. We hypothesize that back arc extension and crustal thinning in the Kechika Trough (Nelson et al., 2006) drove rapid accommodation creation, forming a transgressive systems tract (relative sea-level rise) during SHMS mineralization. This study integrates drill core observations from Cardiac Creek and Cirque with laboratory analyses including X-ray fluorescence, organic carbon isotopes, neodymium isotopes, petrography and detrital zircon U-Pb geochronology. Depletion in terrigenous elements such as Ti and Zr, along with hemipelagic sedimentation of fine-grained turbidites, suggests increasing distance from the continental margin and supports a relative sea-level rise. Additionally, variations in neodymium isotopes of mudstones and detrital zircon age spectra provide further insights into sediment provenance and basin compartmentalization through time. This research enhances current understanding of the tectonic and sedimentological controls on SHMS mineralization, while also refining tectonic reconstructions for western Laurentia during the Devonian period.