Chemistry of Pyrite from the Selwyn Basin Area, Yukon: From Established SEDEX Zinc District to Emerging Sediment-Hosted Gold District

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The Selwyn basin area in Yukon, Canada, is widely known as a sedimentary exhalative (SEDEX) base metal province due to extensive base metal exploration success prior to the mid 1980s. More recently, the Selwyn basin area has become an emerging sediment-hosted gold district with significant discoveries of Carlin-type and orogenic gold. Most of the sediment-hosted gold mineralization is hosted by sandstones and shales of the late Neoproterozoic to Cambrian Hyland Group, the oldest known rocks in Selwyn basin, and their lateral equivalents in the Upper Windermere Supergroup of the Mackenzie Platform. SEDEX Zn deposits are associated with fine-grained sedimentary rocks that overlie the Neoproterozoic stratigraphy, as well as the Gull Lake and Rabbittkettle formations and the Road River Group, which host the Anvil and Howards Pass deposits, respectively. Overlying Selwyn basin stratigraphy, the Earn Group is also characterized by fine-grained siliciclastic rocks and associated with SEDEX Zn deposits such as those in MacMillan Pass, but locally contains intrabasinal conglomerates and minor mafic volcanic rocks. Selwyn basin area stratigraphy was intruded by several Cretaceous and younger plutonic suites, including the Tungsten suite, which is associated with tungsten skarn deposits such as Mactung and Cantung.

In this contribution we use the chemistry and interpreted genesis of pyrite from samples collected across the Selwyn basin area and throughout the stratigraphy to demonstrate the usefulness of pyrite as an exploration tool. The Yusezyu Formation of the Hyland Group is regionally enriched in Au and associated trace elements, suggesting that it is a potential gold source for sediment-hosted gold deposits. Syngenetic and diagenetic pyrite in Road River and Earn Group samples are locally enriched in trace elements near SEDEX Zn mineralization, as well as locally in other parts of the Selwyn basin area, suggesting the enrichment in these samples may be related to local effects such as syngenetic hydrothermal fluid input. Finally, near the Mactung skarn deposit, coarse-grained epigenetic pyrite contains anomalous Au but shows no enrichment in associated trace elements.

We propose that early sedimentary pyrite with anomalous trace element content (Au, Te, Ag, As) can thus be used to inform sediment-hosted gold exploration programs at a regional scale by indicating the fertility of basin strata. We further propose that individual samples can be used to coarsely vector toward mineralization in a manner similar to the way stream sediment samples are used. That is, when a sample consistently has anomalous pyrite—syngenetic or epigenetic depending on the exploration target—pyrite can be thought of as a record of hydrothermal fluids potentially related to a mineralizing system and thus requiring more detailed follow-up to determine the source of the anomaly. Both as a gold fertility indicator and as a vector, the chemistry of syngenetic and epigenetic pyrite appears to be a powerful exploration tool for both base and precious metal exploration programs.