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PHASE IMMISCIBILITY AND SEDEX MINERALISATION AT NIDD, MACMILLAN PASS, YUKON

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Introduction: Macmillan Pass, Yukon, is located approximately 390 km NE of Whitehorse (**Figure 1**). It is host to SEDEX deposits, Tom and Jason, where inferred resources are 13.5 Mt and 11 Mt respectively (Scott Wilson RPA, 2007). Base-metal sulphides are hosted within late Devonian basinal sediments (**Figure 2**), which were formally defined as the Earn Group by Gordey et al. (1982). These sediments are interpreted to have been deposited in a basin with a stratified water column, whereupon base metal mineralisation occurs as a syn-sedimentary precipitate upon hydrothermal fluid exhalaton above the sediment water interface (Goodfellow and Lydon, 2007).

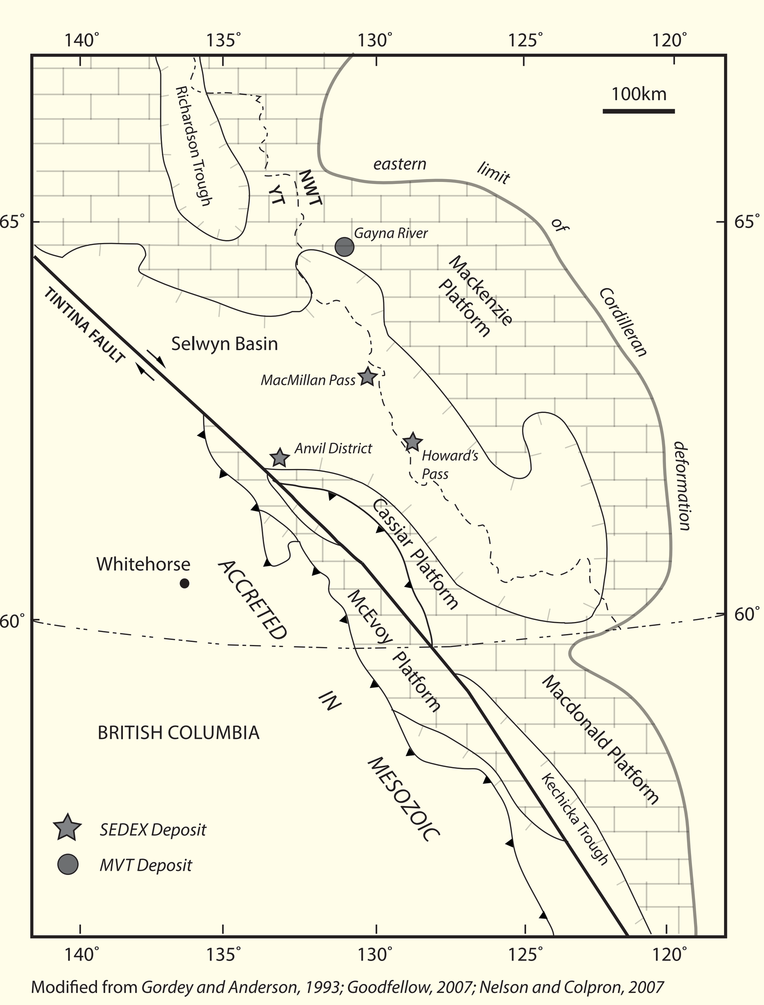


Figure 1: Regional geological setting of the Selwyn Basin and location of Macmillan Pass.

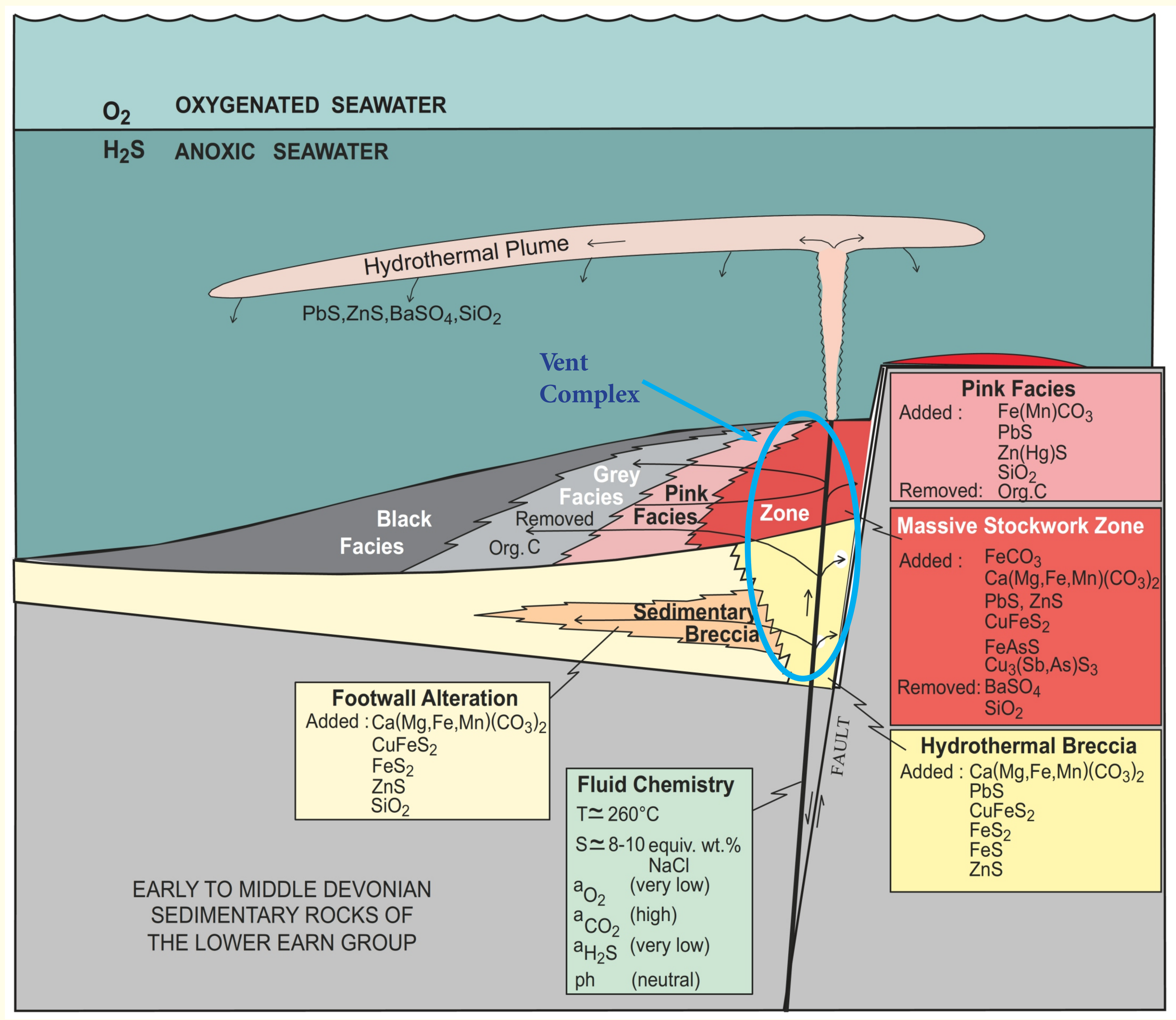
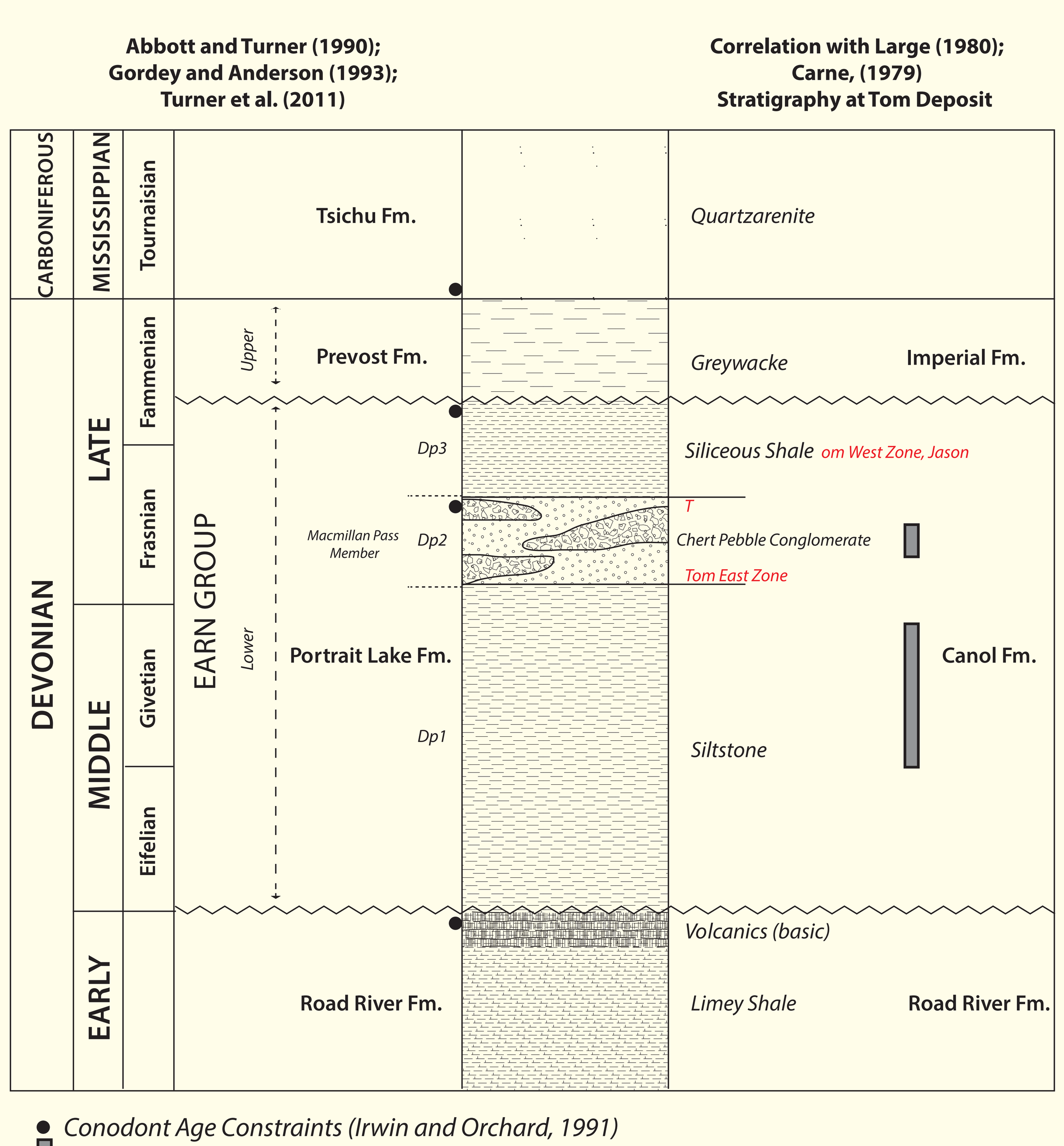


Figure 3: The Goodfellow Model for SEDEX mineralisation at Macmillan Pass. Fluid chemistry is inferred from previous fluid inclusion studies (Gardner and Hutcheon, 1985; Ansdell et al., 1989). The vent complex is highlighted by the blue box. Source: Goodfellow (2007).

Figure 2 (right): The stratigraphy of Earn Group sediments at Macmillan Pass. Mineralisation is hosted within siliceous shales mudstones, and siltstones and coarser-grained siliciclastic rocks. Periods containing barren barite mineralisation are indicated by the vertical grey bars.



15km west of Jason, the epigenetic deposit, Nidd, displays similar ore mineralogies to Tom and Jason and is also hosted within Earn Group sediments. It is likely that mineralisation here represents a feeder zone to a system that either did not form or preserve bedded sulphides. Importantly the vent complex that is preserved at Nidd offers the rare opportunity to sample fluid inclusions and more accurately constrain the geochemistry of mineralising fluids in a SEDEX system (**Figure 3**).

Nidd: Mineralisation at Nidd occurs in 2 lithologically controlled styles. Coarse clastics are host to a fine-grained interstitial cement comprising predominantly of sphalerite, whereas finer grained sediments have been brecciated by higher grade vein mineralisation (**Figures 5**).

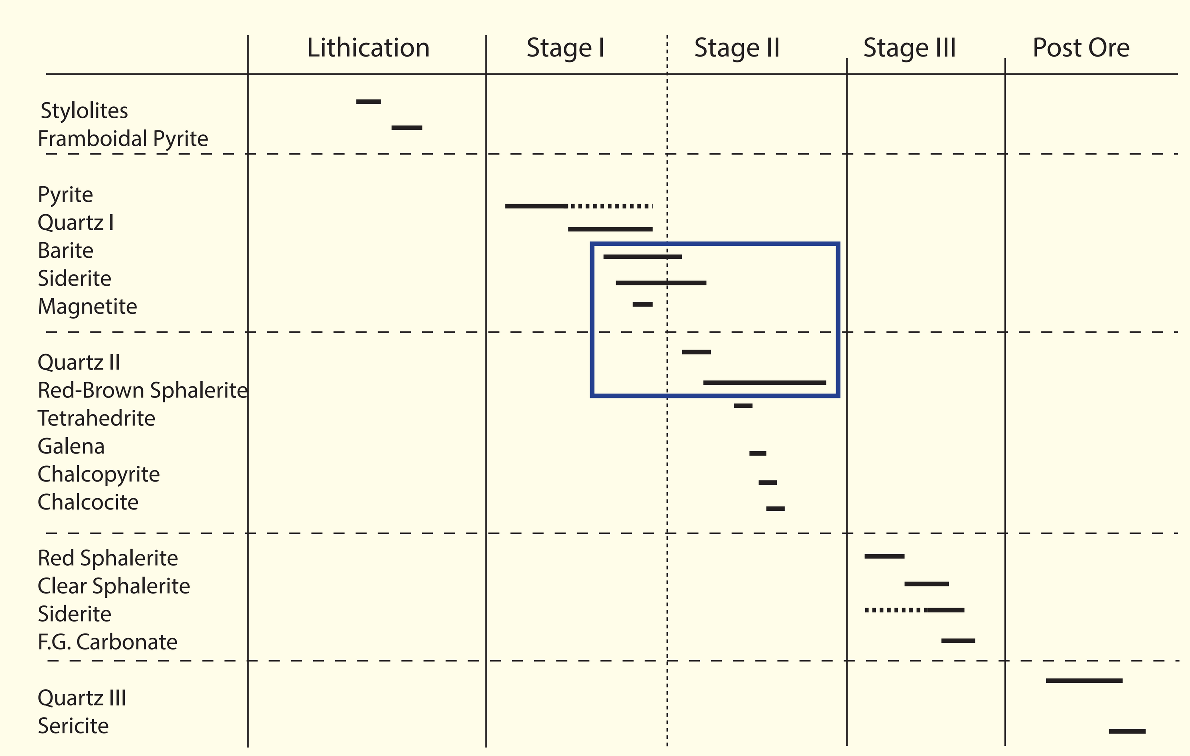


Figure 4: Paragenetic sequence. Highlighted box shows material targeted for fluid inclusions.

A paragenetic sequence (**Figure 4**) was produced following detailed transmitted and reflected light microscopy. Paragenetic observations indicate sulphide mineralisation in both lithologies to be coeval. Vein mineralisation forms the target material for fluid inclusion analysis and is characterised by early quartz and barite intergrown with red-brown sphalerite and iron carbonate.

Figure 5 (below): High grade vein mineralisation at Nidd (drill-hole NB84-10).

Fluid Inclusions: Detailed petrography is currently underway to establish the fluid inclusions assemblages (FIA) that are present and their relation to ore mineralisation. Work is focused on quartz and sphalerite, with the first objective being to determine whether they are primary or secondary in origin.

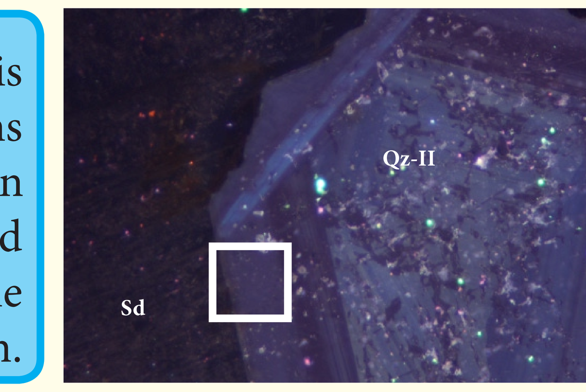


Figure 6: A euhedral Qz-II crystal under cathodoluminescent light. The white box highlights the area from which the photomicrograph in Figure 8 is taken. This region is uniform in its CL response indicating one stage of crystal growth.

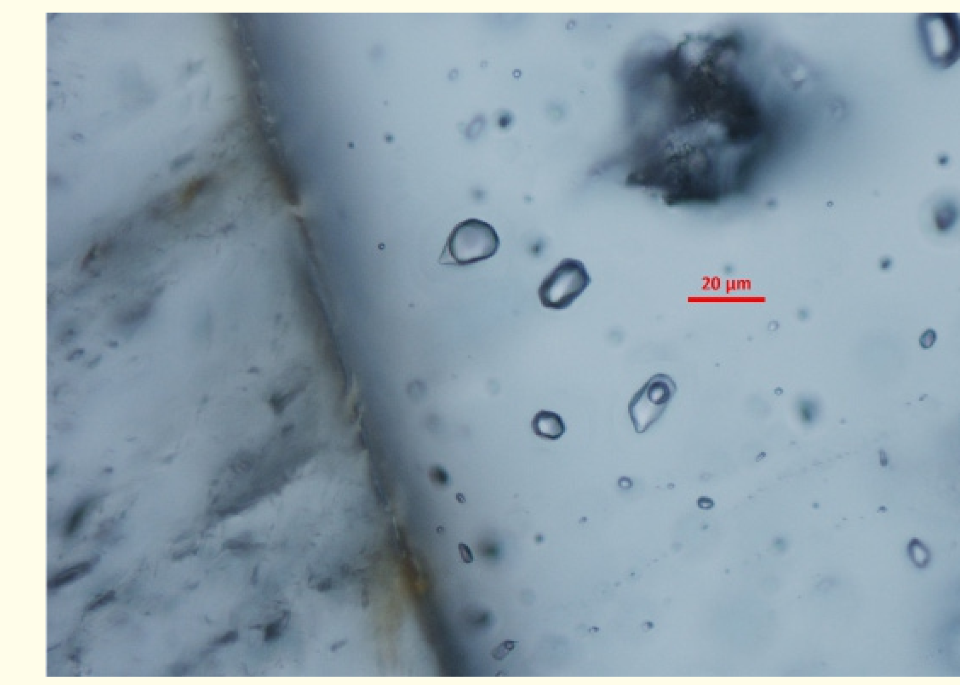


Figure 7: The fluid inclusion assemblage (FIA) hosted by Qz-II comprising of 3-phase aqueous-rich, 2-phase aqueous-poor and dark single-phase inclusions. Note the different phase proportions of inclusions with this FIA.

Cold-cathodoluminscence petrography has been used to constrain the presence of multiple quartz generations. Results indicate an early low-response phase (Qz-I) followed by a euhedral, higher response (turquoise) phase (Qz-II; **Figure 6**) which hosts the FIA displayed in **Figure 7** and which is associated with sphalerite (**Figure 8**).

Initial microthermometry demonstrates this FIA to contain low salinity, CO_2-rich inclusions. Importantly variable phase proportions provide evidence for fluid immiscibility. It is possible that fracture controlled fluid flow produced a switch from lithostatic to hydrostatic pressure conditions and lead to fluid boiling, producing an efficient mechanism for sulphide precipitation in this system.

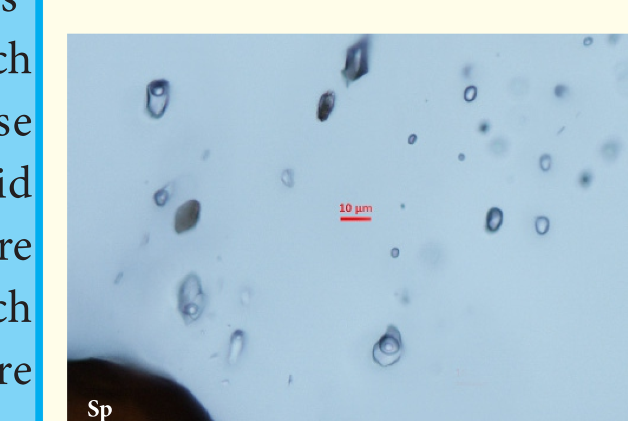


Figure 8: Qz-II fluid inclusion assemblage in close proximity to sphalerite mineral inclusion.

Conclusions:

- Mineralising fluids contain a low-salinity, CO_2-bearing fluid inclusion assemblage.
- This assemblage displays evidence of fluid boiling.
- Co_2 has previously been recognised at Tom and Jason (Ansdell et al., 1989) but was suggested as being related to later tectonic fluid flow.
- Evidence reported here is to the contrary and highlights the need for further detailed study on the origin and role of Co_2 in this system.

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