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Late Cretaceous Superimposed Porphyry Systems in the Yukon Cordillera: Insights from the Klaza Epithermal System, Dawson Range

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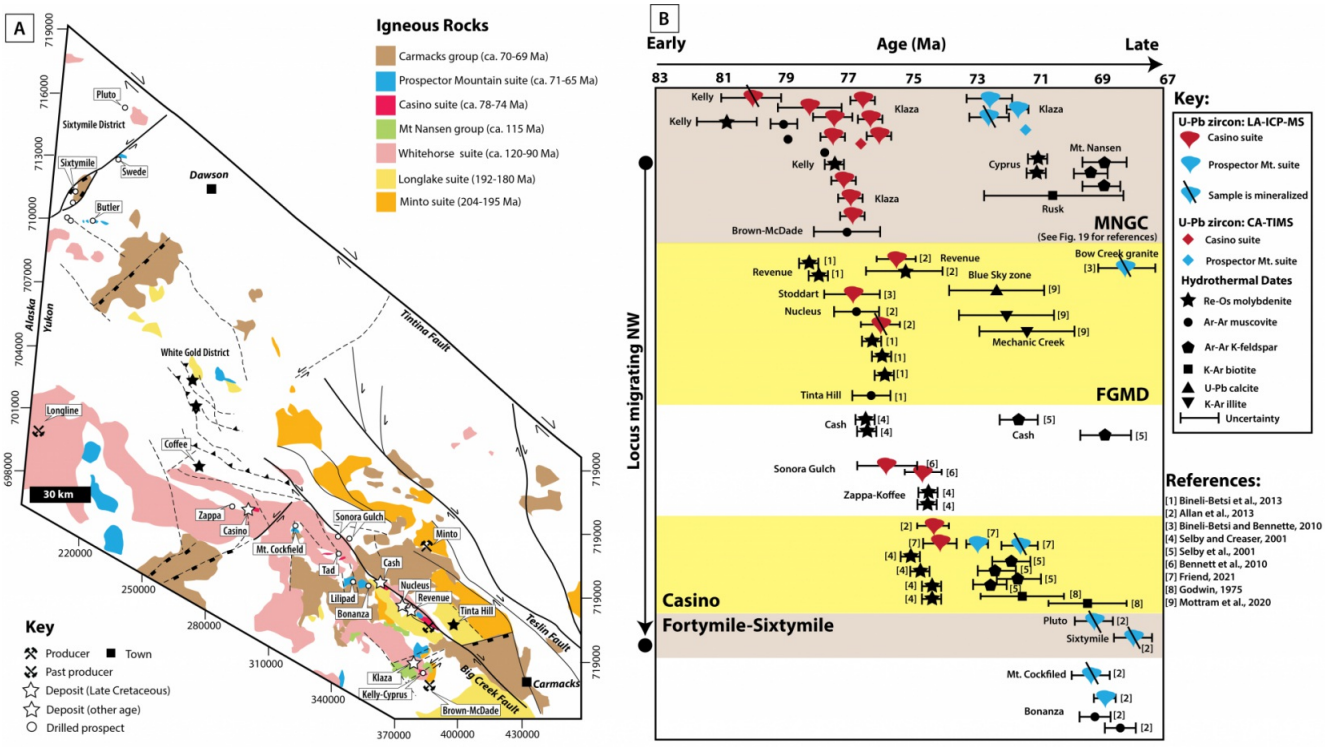
The Canadian Cordillera of British Columbia and contiguous Yukon contains a substantial metal endowment, including many porphyry Cu-Au ± Mo deposits (PCDs) clustering at specific intervals in the geological record. Understanding specifically one of these metalliferous periods, the Late Cretaceous event in the Yukon, was previously hindered due to the resolution of conventional geochronologic methods in addition to the lack of modern petrogenetic models and data for magmatic suites. By integrating field studies with newer high-quality age and lithogeochemical data, it is now possible to address the temporal and spatial distribution of Late Cretaceous PCDs. This work will help to refine models for PCD formation, which will contribute to brownfield and grassroots exploration for such deposits in the Yukon.

In this study, new field-based observations are integrated with geochronological, lithogeochemical, and mineral paragenetic data from the Klaza-Mt. Nansen district with data additional data collected from the giant Casino deposit and the Freegold Mountain district to update the temporal and genetic understanding of the Late Cretaceous PCDs in west-central Yukon. High-quality age data generated for zircon (LA-ICP-MS, CA-TIMS), molybdenite (Re-Os) and muscovite (Ar-Ar) display a bimodal distribution for timing of intrusions, mineralization, and alteration. The early-Late Cretaceous pulse (80-74 Ma) coincides with PCD formation (Casino, Revenue, Nucleus, Kelly) and the Casino suite intrusive activity, whereas the late-Late Cretaceous pulse (72-69 Ma) correlates with IS epithermal deposits (Au-Ag-Pb-Zn; Klaza, Mt. Nansen, Frog) and a previously unrecognized pulse of Cu-Mo porphyry-type mineralization (Cyprus), which may also overprint earlier mineralization (Kelly, Casino).

The four intrusive suites noted display weak arc-like signatures, with strong depletions in HREEs relative to LREEs, signifying delayed plagioclase fractionation. A progressive overall depletion in REEs is observed as intrusive suites evolve from the Late Triassic to the late-Late Cretaceous with each successive suite displaying a greater degree of HREE depletion. Differentiation of the intrusive suites is possible using La/Yb vs. Yb and Zr/TiO_2 vs. Nb/Y plots. Thus, the Prospector Mountain suite contains the highest La/Yb values and is slightly more alkaline relative to the Casino suite. Both suites plot in the adakitic field due to increased Sr/Y, signifying increased garnet fractionation and water content. These results suggest increasingly higher pressures of melting for each successive magmatic suite.

While the Casino suite intrusions have long been understood to be highly prospective for ca. 75 Ma porphyry Cu-Au potential, the younger, less voluminous Prospector Mt. suite intrusions have been significantly overlooked. We propose (based on current field and geochronologic evidence) that several localities in the Dawson Range display evidence of superimposed Casino- and Prospector Mt. suite magmatism and hydrothermal acitvity. These superimposed porphyry systems contain heightened potential for enriched hypogene ore shells at depth, thus representing significant untapped resources in the Yukon Cordillera.


A
Igneous Rocks
Carmacks group (ca. 70-69 Ma)
Prospector Mountain suite (ca. 71-65 Ma)
Casino suite (ca. 78-74 Ma)
Mt Nansen group (ca. 115 Ma)
Whitehorse suite (ca. 120-90 Ma)
Longlake suite (192-180 Ma)
Minto suite (204-195 Ma)
Pluto
Sixtymile District
Sixtymile
Swede
Butler
Dawson
Alaska
Yukon
Tintina Fault
White Gold District
Longline
Coffee
30 km
Zappa
Casino
Mt. Cockfield
Sonora Gulch
Minto
Tad
Cash
Nucleus
Revenue
Lilipad
Bonanza
Tinta Hill
Teslin Fault
Big Creek Fault
Klaza
Kelly-Cyprus
Brown-McDade
Carmacks
Key
Producer
Town
Past producer
Deposit (Late Cretaceous)
Deposit (other age)
Drilled prospect
719000
716000
713000
710000
707000
704000
701000
698000
220000
250000
280000
310000
340000
370000
400000
430000
B
Early
Age (Ma)
Late
83
81
79
77
75
73
71
69
67
Locus migrating NW
Kelly
Klaza
Cyprus
Mt. Nansen
Rusk
Brown-McDade
MNGC
(See Fig. 19 for references)
Revenue
Bow Creek granite
Blue Sky zone
Stoddart
Nucleus
Mechanic Creek
Tinta Hill
FGMD
Cash
Sonora Gulch
Zappa-Koffee
Casino
Fortymile-Sixtymile
Pluto
Sixtymile
Mt. Cockfiled
Bonanza
Key:
U-Pb zircon: LA-ICP-MS
Casino suite
Prospector Mt. suite
Sample is mineralized
U-Pb zircon: CA-TIMS
Casino suite
Prospector Mt. suite
Hydrothermal Dates
Re-Os molybdenite
Ar-Ar muscovite
Ar-Ar K-feldspar
K-Ar biotite
U-Pb calcite
K-Ar illite
Uncertainty
References:
[1] Bineli-Betsi et al., 2013
[2] Allan et al., 2013
[3] Bineli-Betsi and Bennette, 2010
[4] Selby and Creaser, 2001
[5] Selby et al., 2001
[6] Bennett et al., 2010
[7] Friend, 2021
[8] Godwin, 1975
[9] Mottram et al., 2020