THE UNIVERSITY OF BRITISH COLUMBIA

Mineralogical and Geochemical Vectors within Advanced Argillic-Altered Rocks of British Columbia

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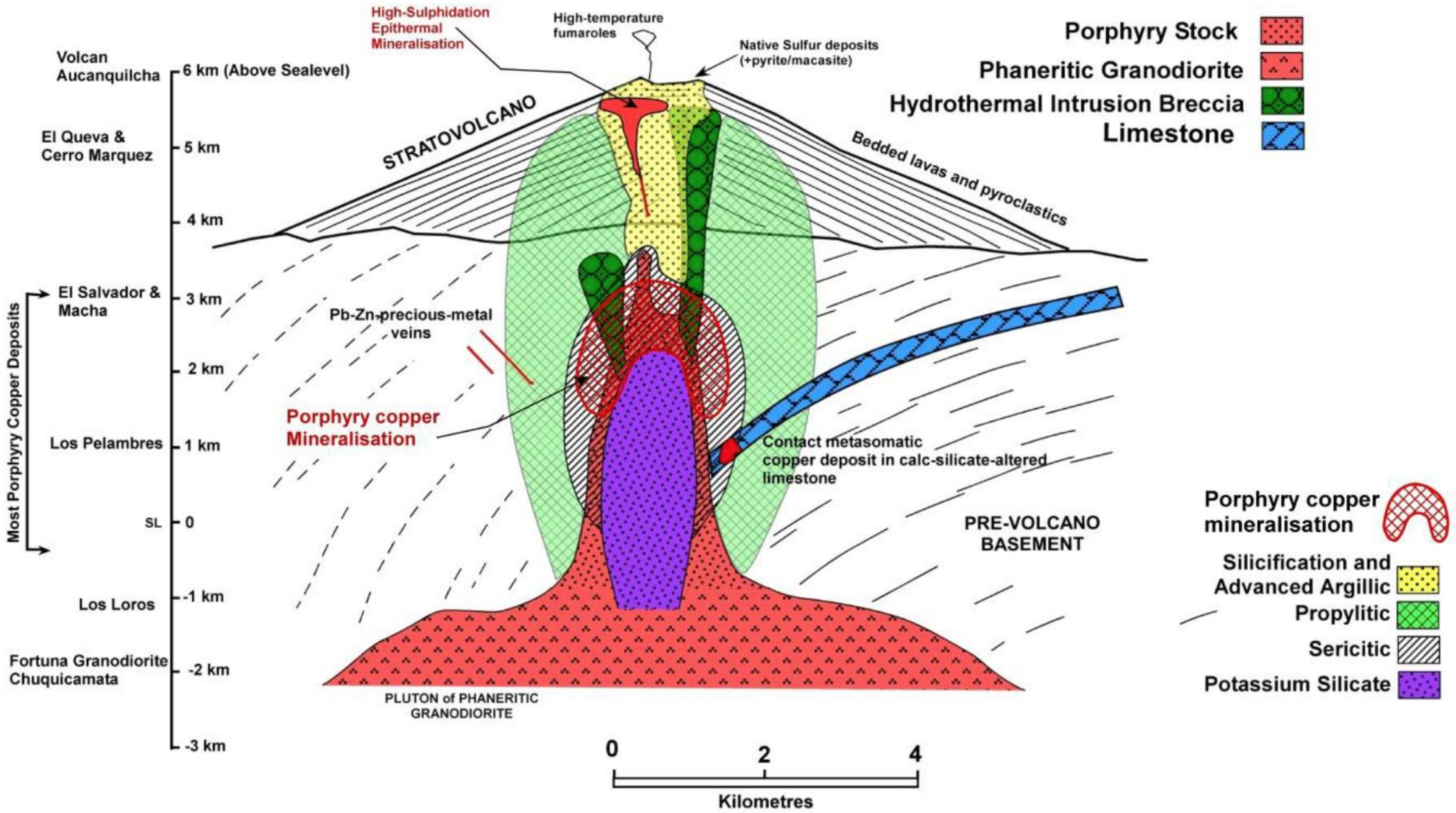
AME Roundup, Additions to the Geoscience Toolbox, 22 January 2021

Acknowledgement

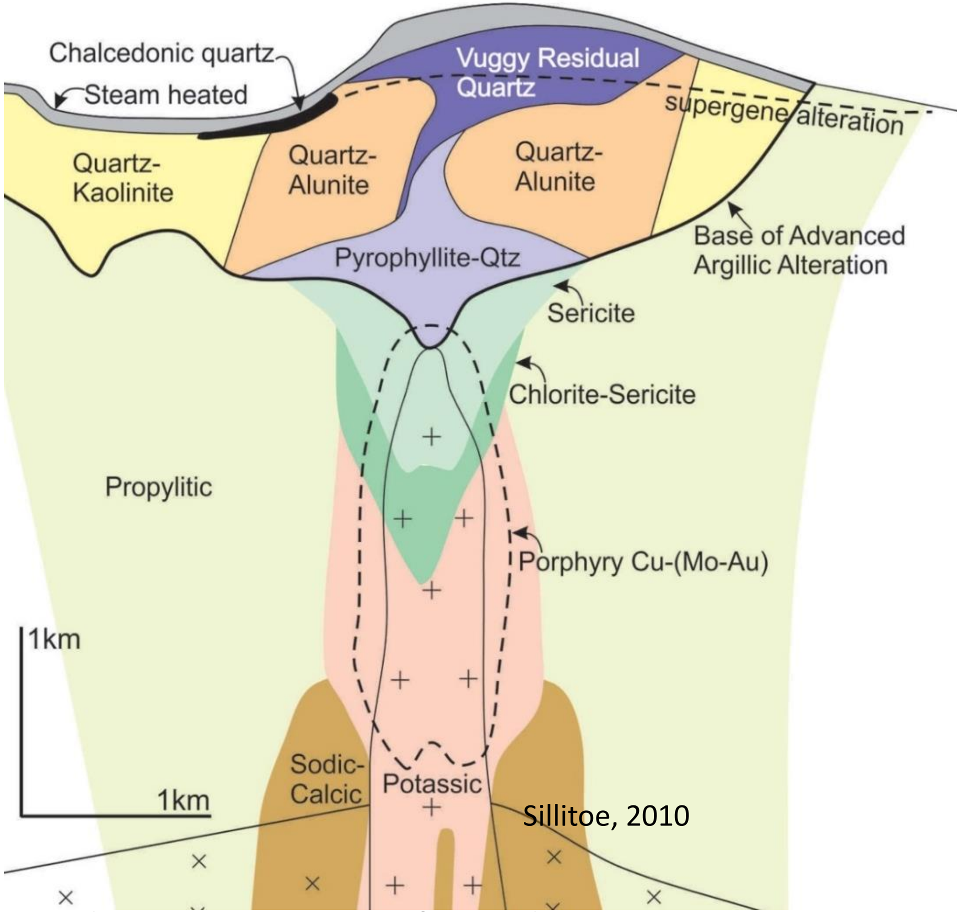
Geoscience BC is thanked for its generous financial contribution in support of MDRU's "vectoring within advanced argillic altered rocks of British Columbia" project.

Top of Porphyry Copper Deposits: Why Is it Important?



from Sillitoe, 1973: SEG Paper on tops and bottom of porphyry copper deposits

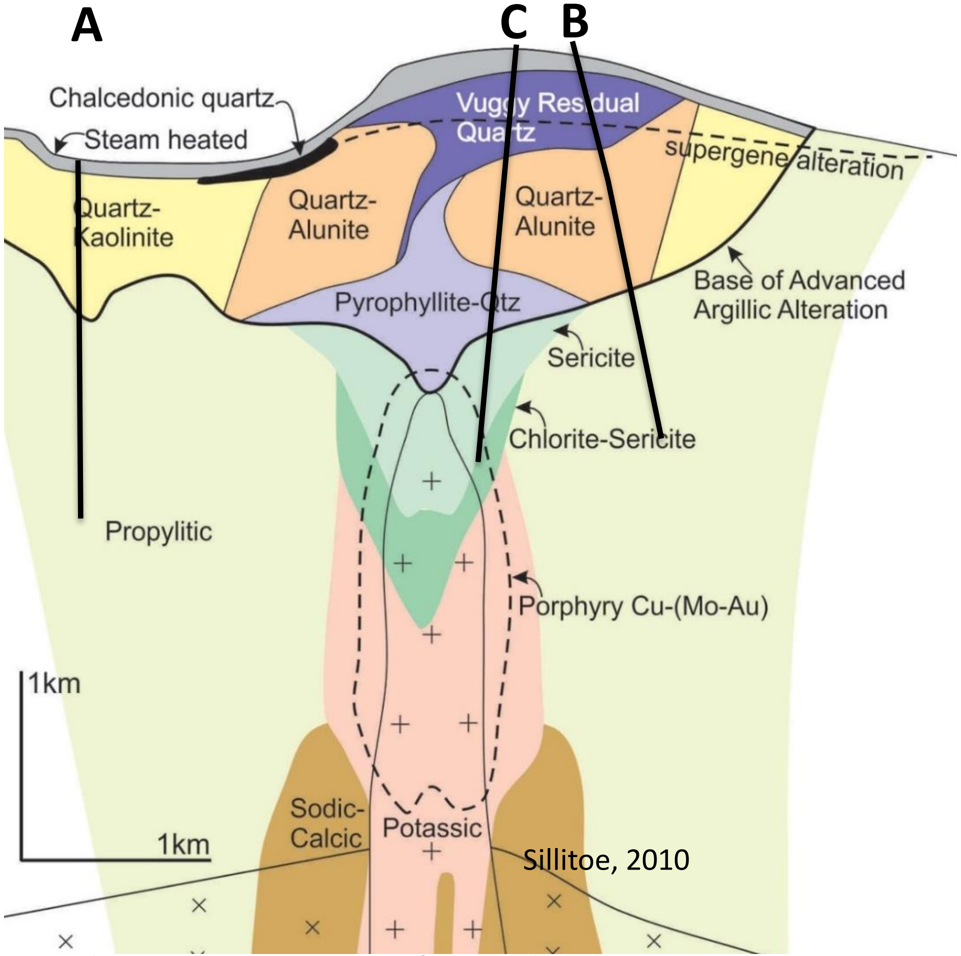
Anatomy of Advanced Argillic Alteration



Sillitoe, 2010

Advanced argillic-alteration zones in the upper parts of porphyry copper systems, also known as ‘lithocaps’, have a blanket-like geometry with areal extents of >10 km^2

Anatomy of Advanced Argillic Alteration

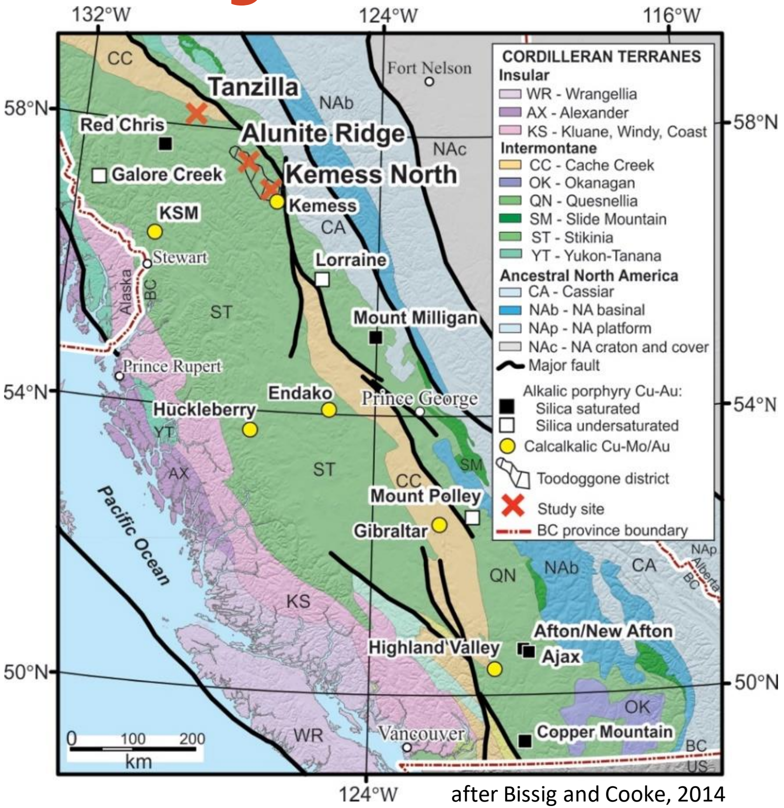


Sillitoe, 2010

From the top, how can we vector towards porphyry mineralization?

Advanced argillic-alteration zones in the upper parts of porphyry copper systems, also known as ‘lithocaps’, have a blanket-like geometry with areal extents of >10 km^2

Advanced Argillic Alteration in British Columbia



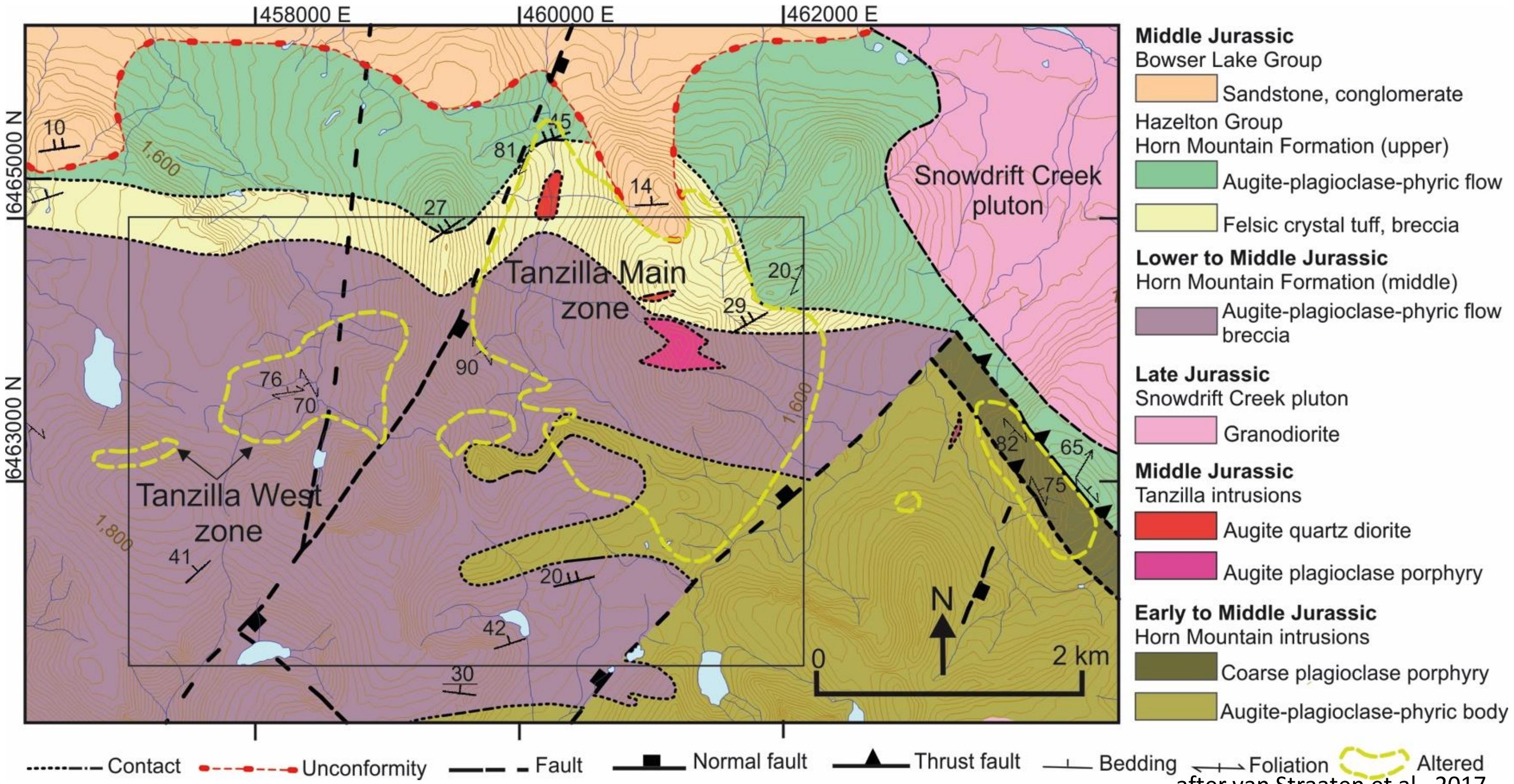
after Bissig and Cooke, 2014

Property	AAA	HS	PCD
Sutlahine River area:			
- Thorn, Daisy, Ink, Camp Creek	X	X	X
- Kay, Lin, Lin 1-8	X	X	
Iskut River area:			
- Johnny Mountain/REG/Quartz Rise	X	X	
- Treaty Glacier	X		
Dease Lake area:			
- Tanzilla-McBride	X		X
Toodoggone River area:			
- Alunite Ridge	X	X	X
- Quartz Lake	X		
- Brenda	X	X	
- Black Gossan	X		X
- Silver Pond	X		
- Baker	X		X
Central BC:			
- Equity Silver mine	X		
- Limonite Creek	X		X
Taseko River/Mount McClure area:			
- Empress	X		
- Taylor-Windfall	X	X	
Vancouver Island:			
- Hushamu	X	X	X
- Macintosh, Pemberton Hills	X		
- Red Dog	X		
- Wanokana	X		
- Island Copper mine	X		X
Kyuquot Sound (Easy Inlet)	X		
Southern BC:			
- Riverside	X		
- Pyro	X		

after Panteleyev, 1992

Advanced argillic alteration is not a common feature in BC but zones are preserved in some locations, typically within districts that are highly prospective to host porphyry-type copper mineralization.

Tanzilla

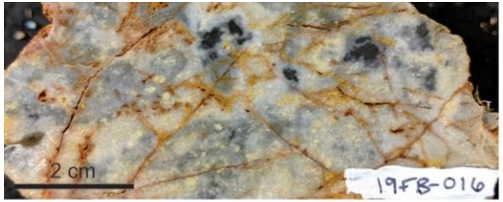


after van Straaten et al., 2017

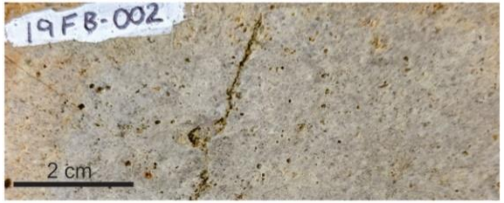
The Horn Mountain Formation hosts aerially extensive advanced argillic alteration at the Tanzilla-McBride property for at least 17 km along strike (van Straaten and Gibson, 2017)

Tanzilla

Alteration is characterized by a green sericite-chlorite–assemblage zone that grades to a pale green sericite and then to a white sericite assemblage with pyrophyllite, topaz and locally highly silicified rock. K-silicate alteration occurs at lower elevations.



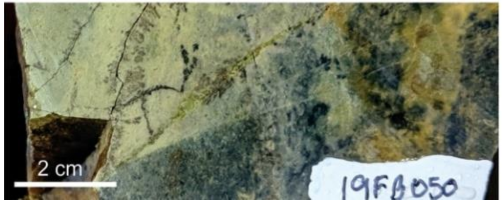
Silicified



White sericite-topaz

Green sericite

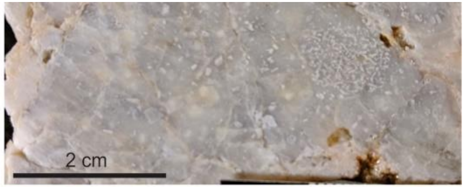
Chlorite-sericite



Chlorite-epidote

Alunite Ridge

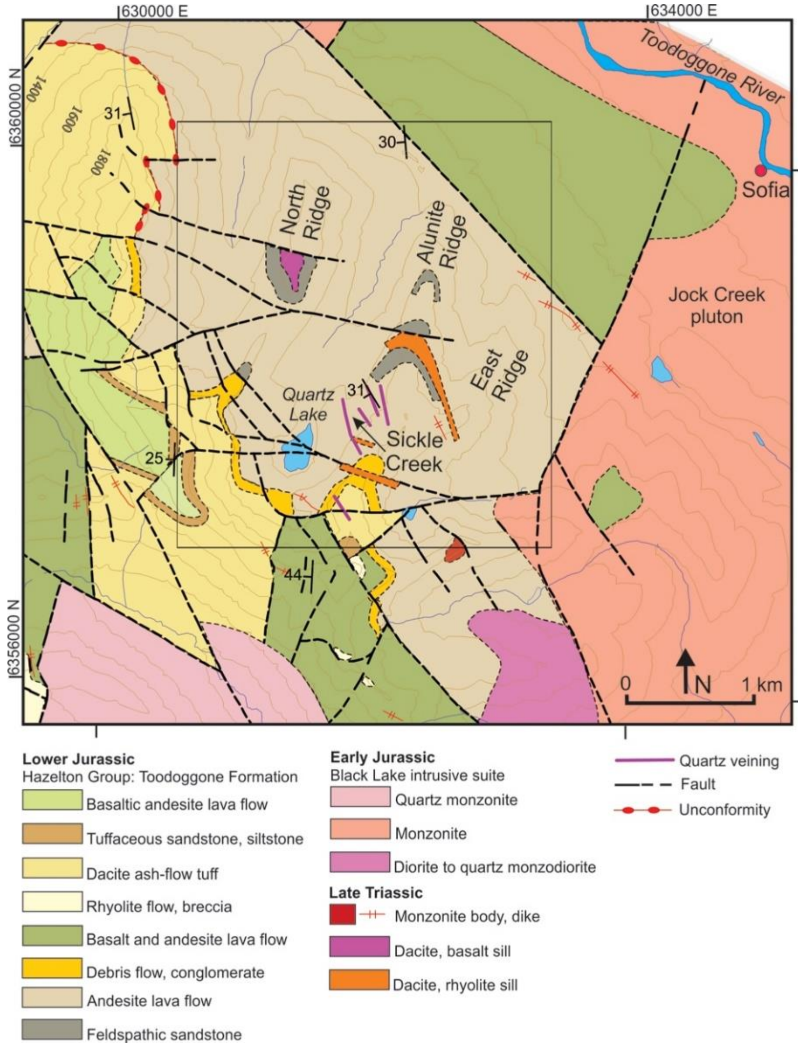
Silicification with alunite, kaolinite, dickite, sericite and locally pyrophyllite, surrounded by pale green sericite and green sericite and transitions to green alteration of chlorite-sericite and locally epidote.



Silicified-alunite

Pale green sericite-chlorite

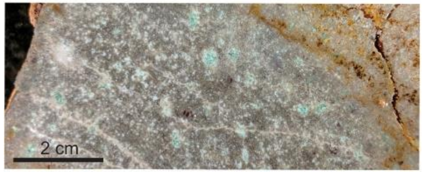
Chlorite-sericite-epidote



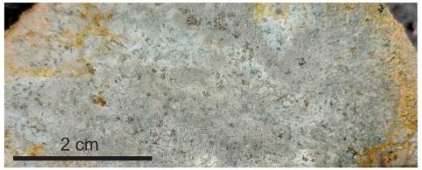
Kemess North

Green sericite-chlorite transitions northward to a green-grey sericite and then to white sericite-dickite-kaolinite typically with silicification.

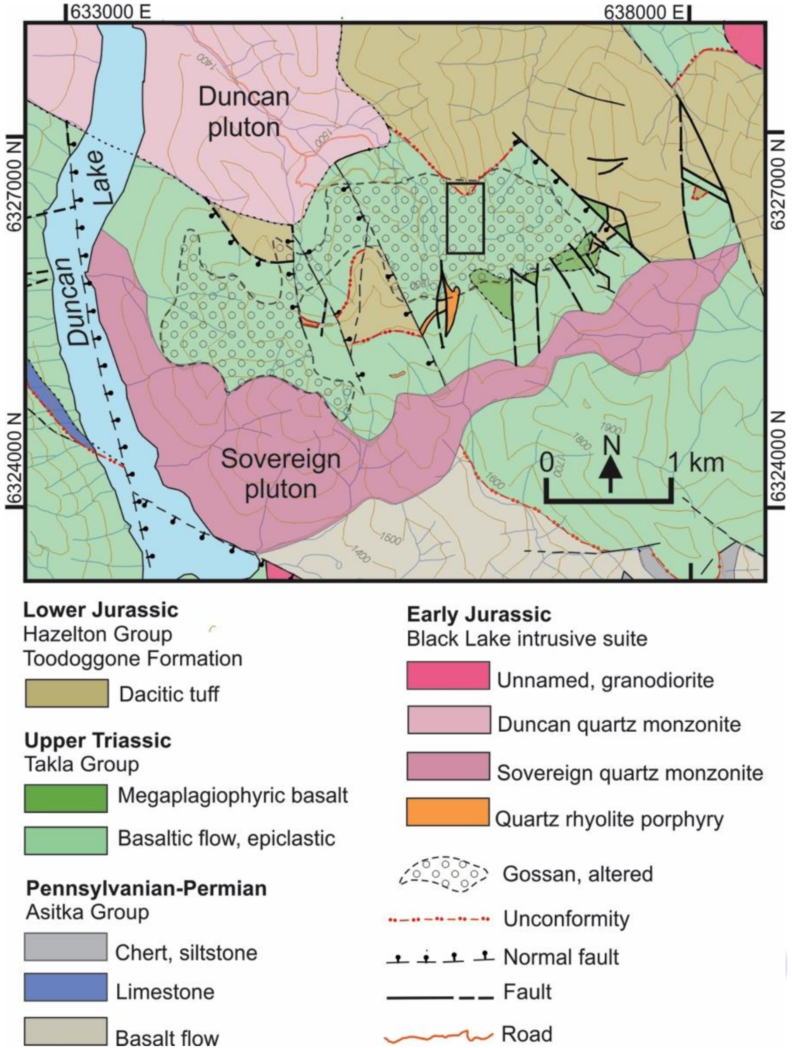
White sericite-silicified



White and green sericite



Green sericite-chlorite



SWIR Alteration Mineralogy

pyrophyllite, alunite, topaz

↑

dickite, kaolinite

↑

sericite-clay

↑

sericite

↑

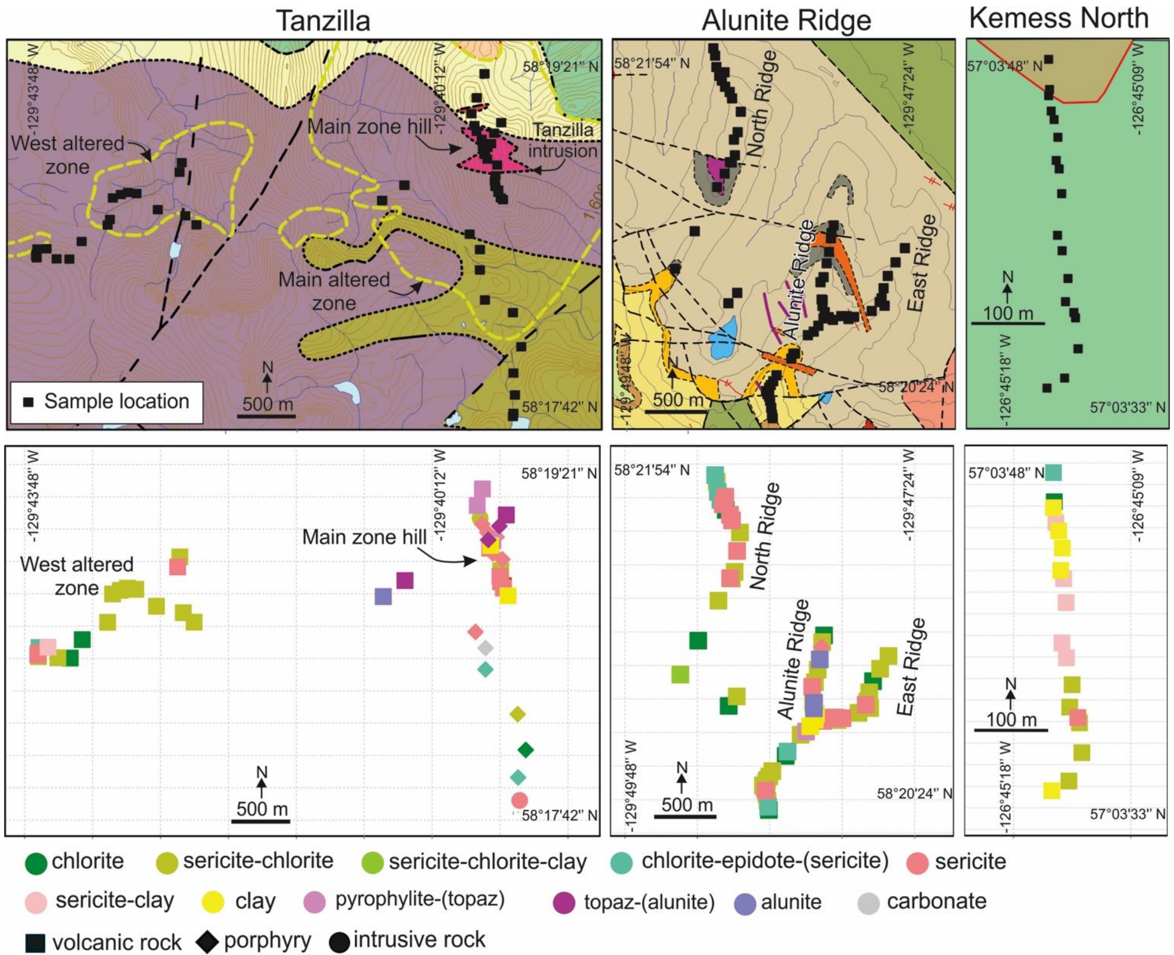
sericite-chlorite

↑

chlorite-sericite

↑

chlorite-epidote



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↑

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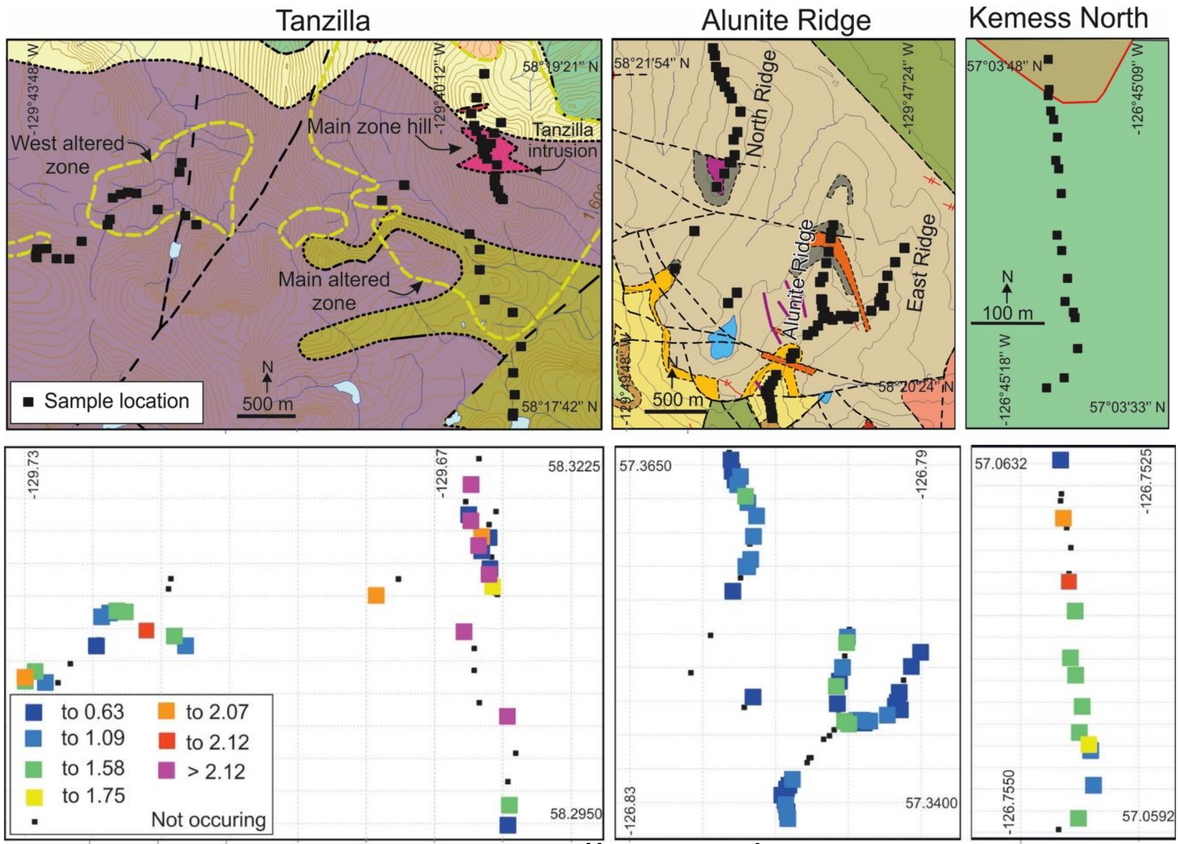
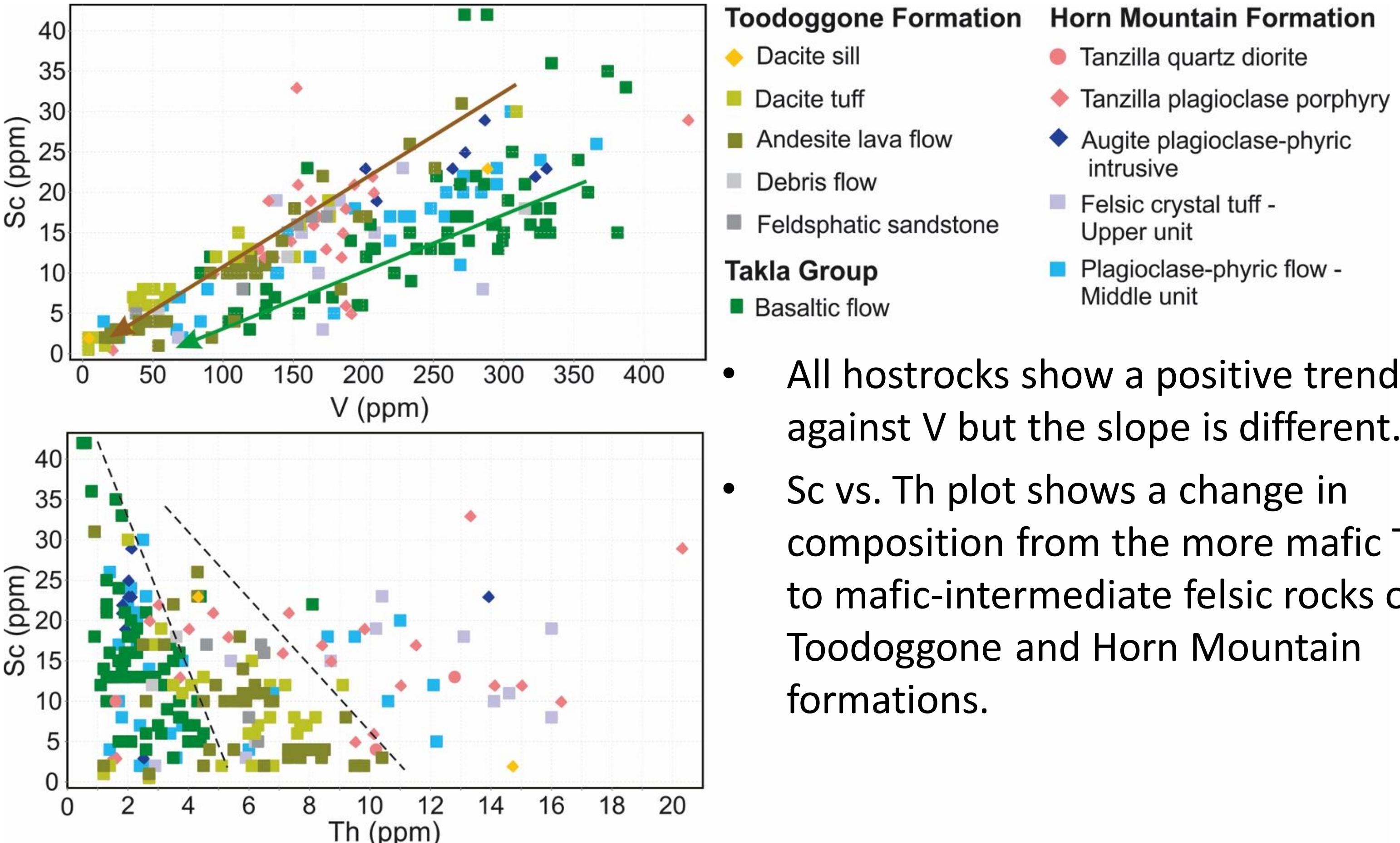


Sericite Crystallinity Index

↑

Increase in sericite crystallinity

Hostrock effect on alteration?



- All hostrocks show a positive trend of Sc against V but the slope is different.
- Sc vs. Th plot shows a change in composition from the more mafic Takla to mafic-intermediate felsic rocks of the Toodoggone and Horn Mountain formations.

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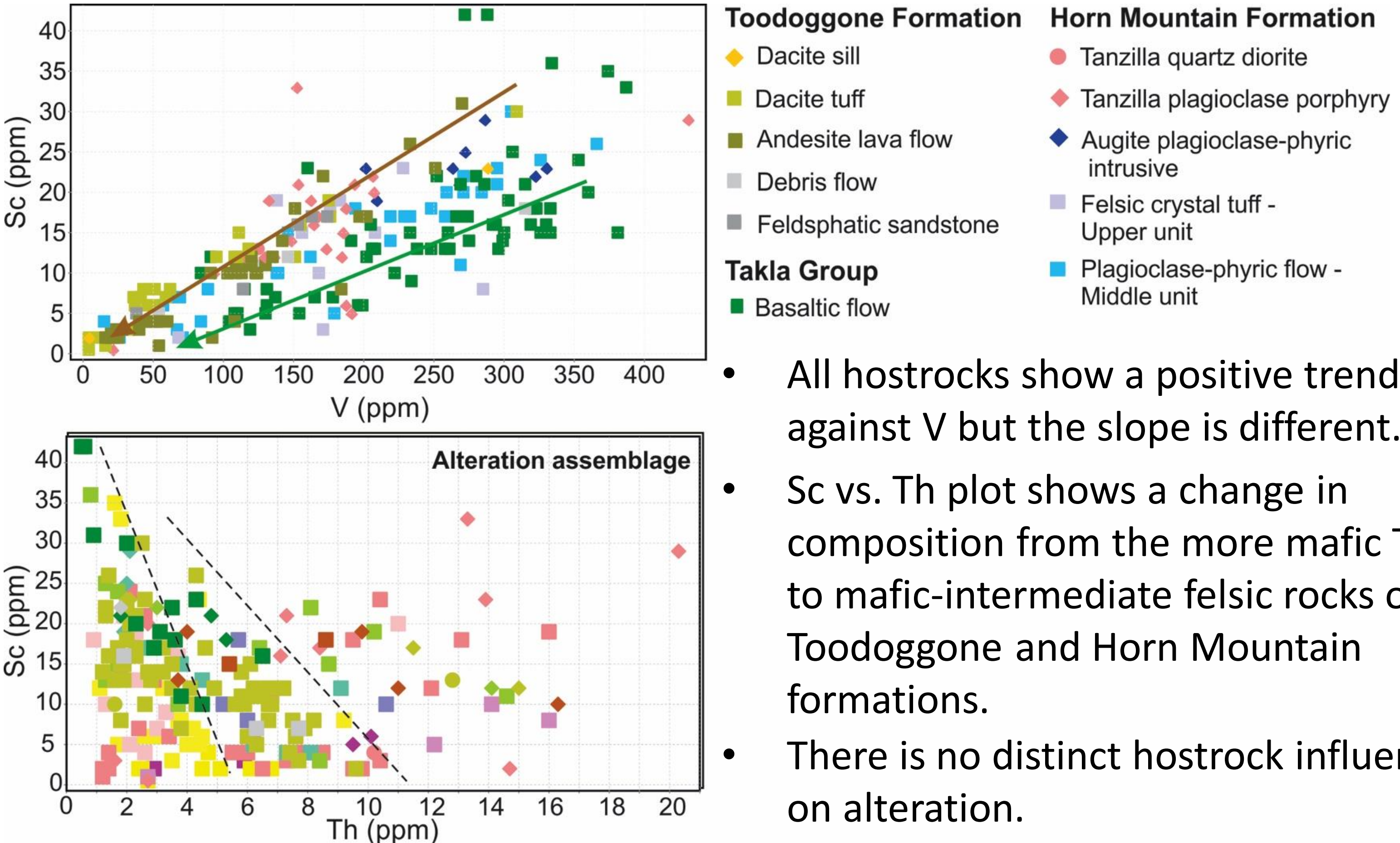
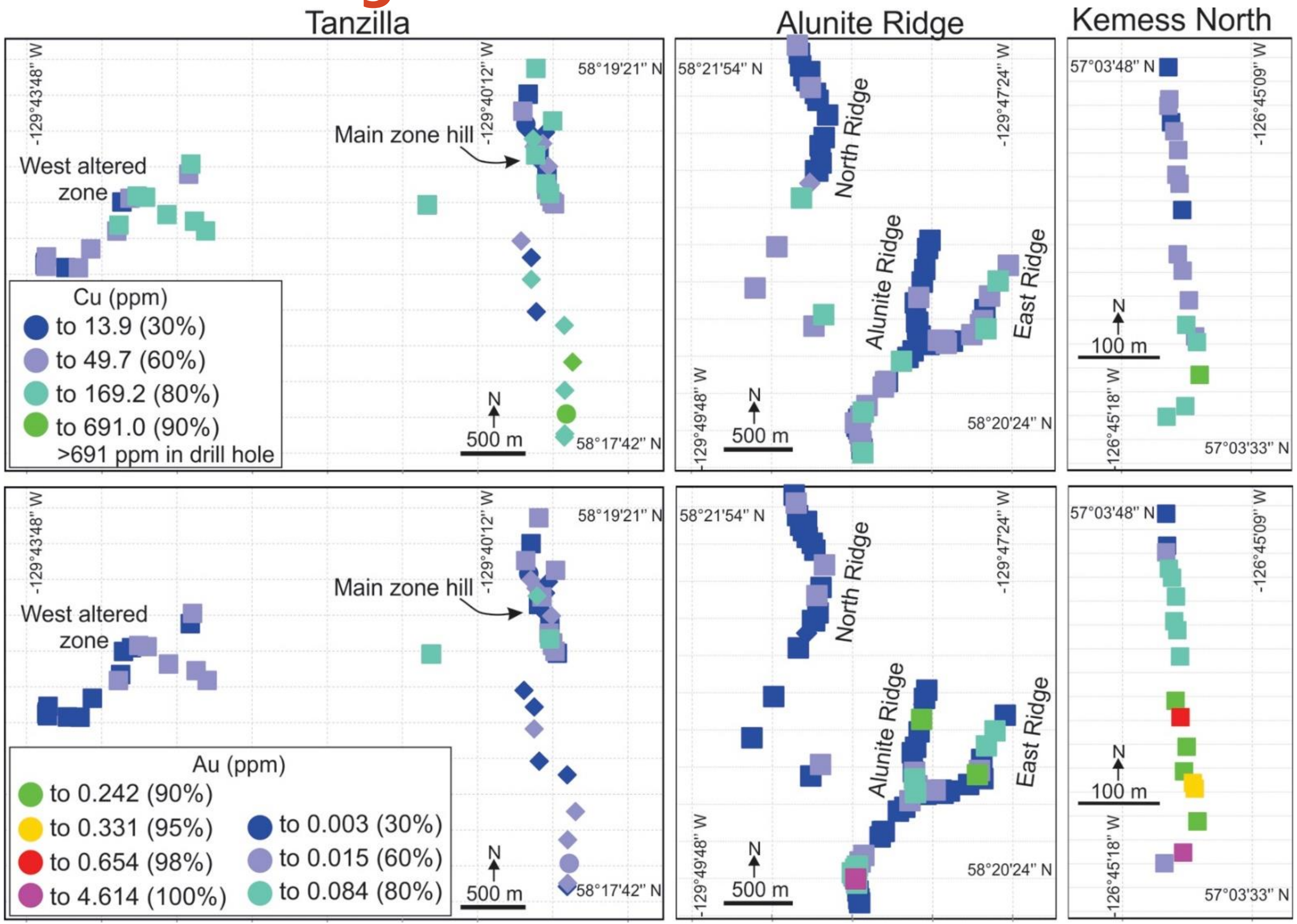
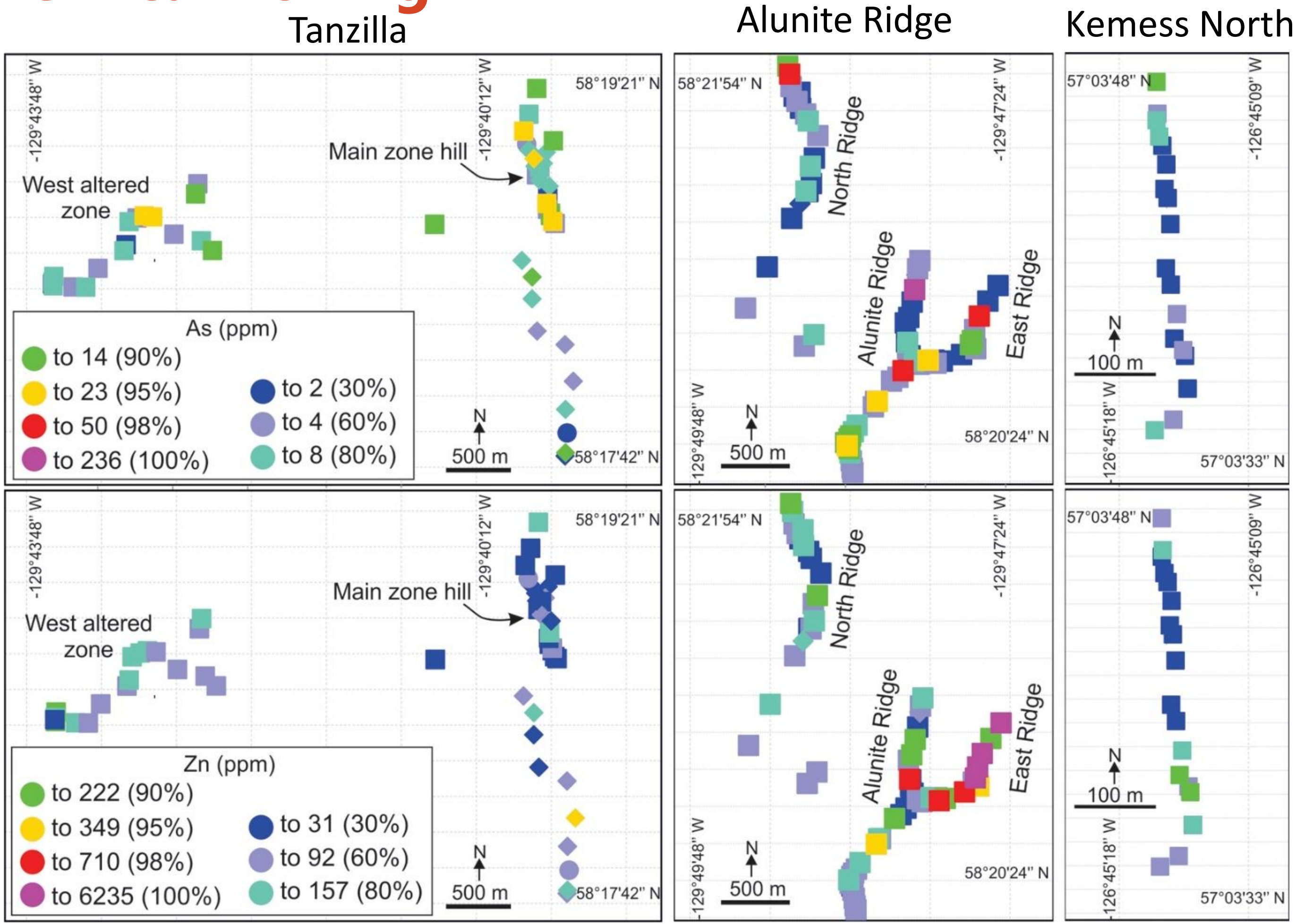


- All hostrocks show a positive trend of Sc against V but the slope is different.
- Sc vs. Th plot shows a change in composition from the more mafic Takla to mafic-intermediate felsic rocks of the Toodoggone and Horn Mountain formations.
- There is no distinct hostrock influence on alteration.

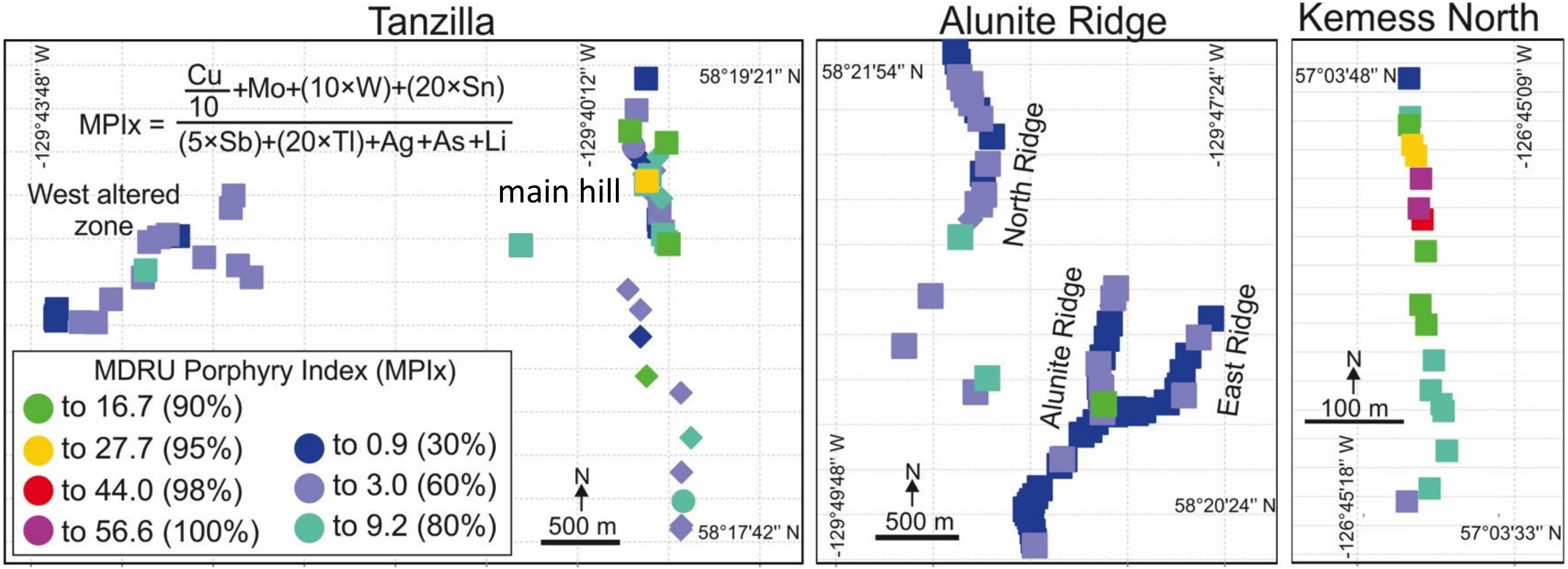
Geochemical Zoning



Geochemical Zoning

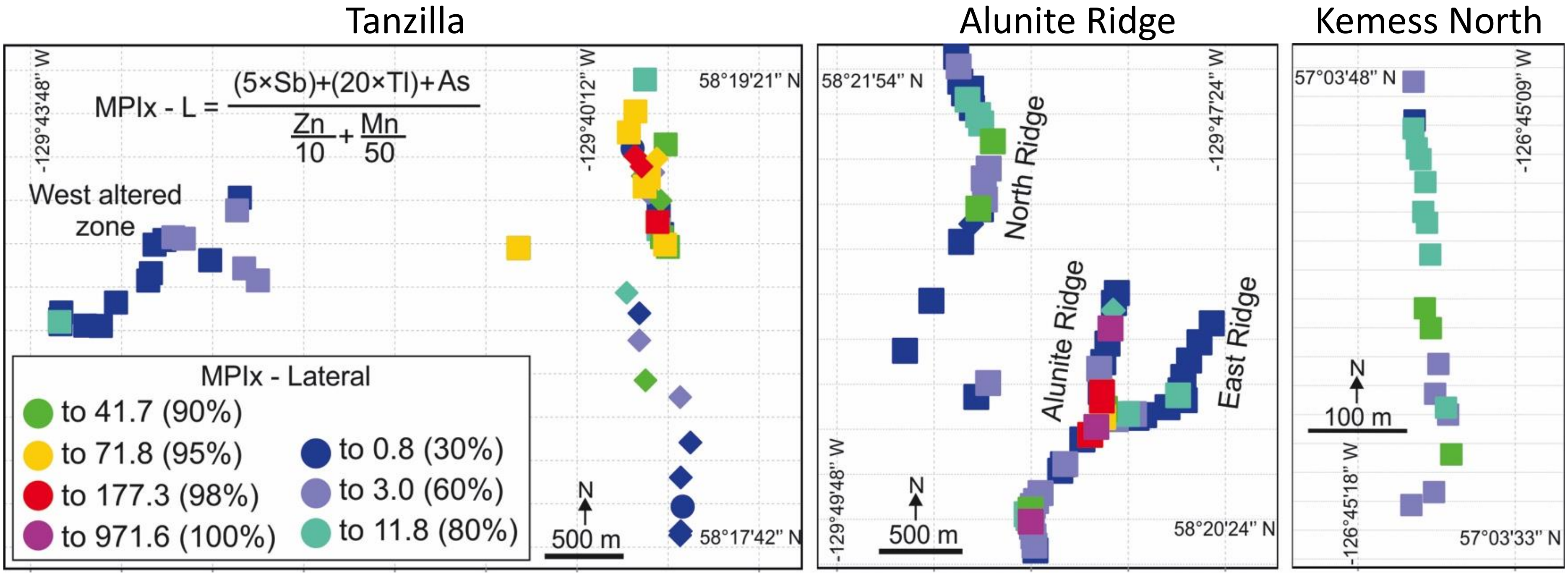


MDRU Porphyry Index



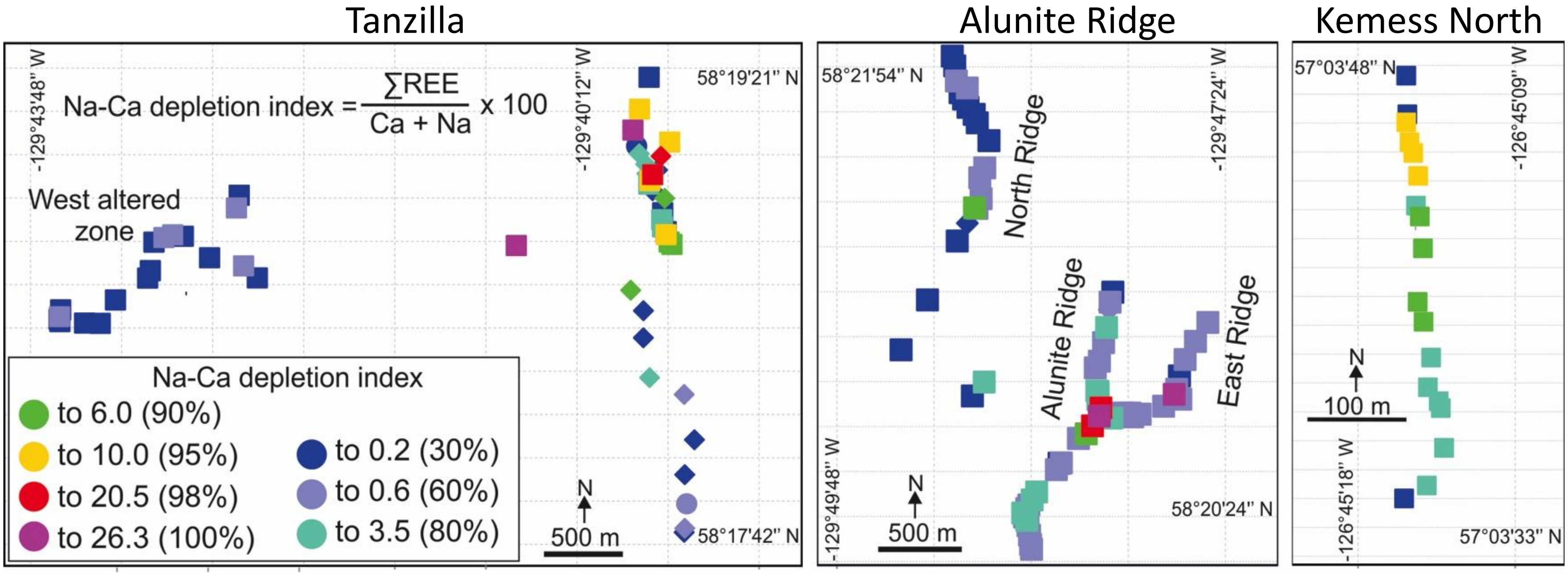
The MPIx vector toward the zones of intense central alteration, especially toward the northern side of the ridge at Kemess North and toward the main hill in the Tanzilla

MDRU Porphyry Index - Lateral



MPIx-Lateral compares metals that are enriched in the shallow parts of a porphyry system (Sb, As, Tl) to those that are more laterally dispersed (Zn, Mn)

Na-Ca Depletion Index



Zones of advanced argillic alteration are characterized by intense removal of Ca and alkali metals such as K and Na by low-pH fluids. Ca and Na depletion, in most cases, correlates with the intensity of advanced argillic alteration.

Toolbox Notes

- Alteration zoning consists of (central to outward): strong **silicification** locally with **topaz, andalusite, alunite and pyrophyllite**, **white sericite** and clay (kaolinite-dickite), **pale green sericite**, **green sericite-chlorite** alteration, and **chlorite-epidote-(sericite)**.

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- The MDRU Porphyry Index-Lateral **(MPIx-Lateral**) maps the geochemical vectors on a horizontal profile and provides **lateral vector at shallow-level** porphyry environment.
- **The Na-Ca depletion index** maps Ca and alkali depletion within and around zones of advanced argillic alteration and provides a **vector toward zones of high fluid flow** and potentially to the more central parts of alteration above a porphyry centre