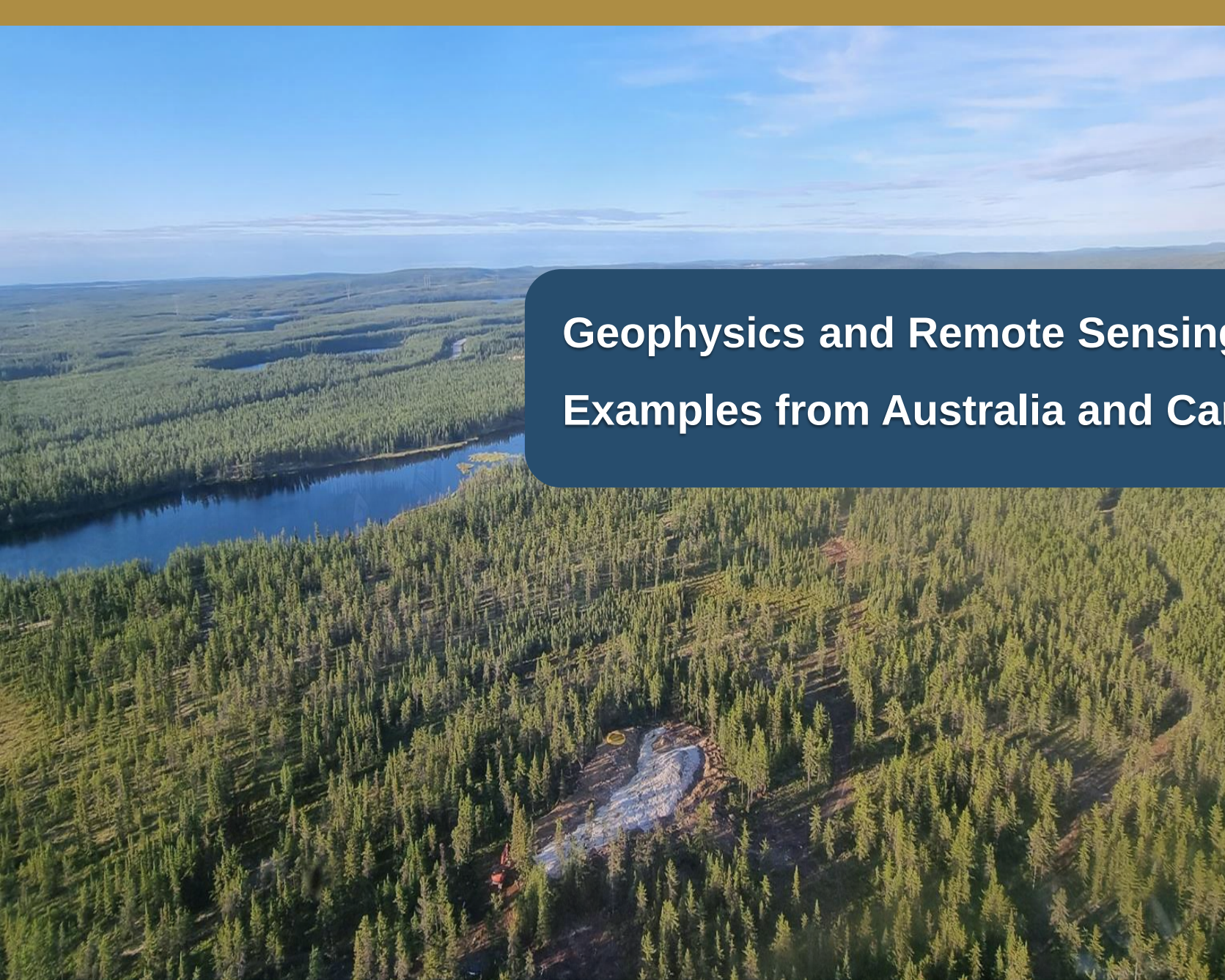
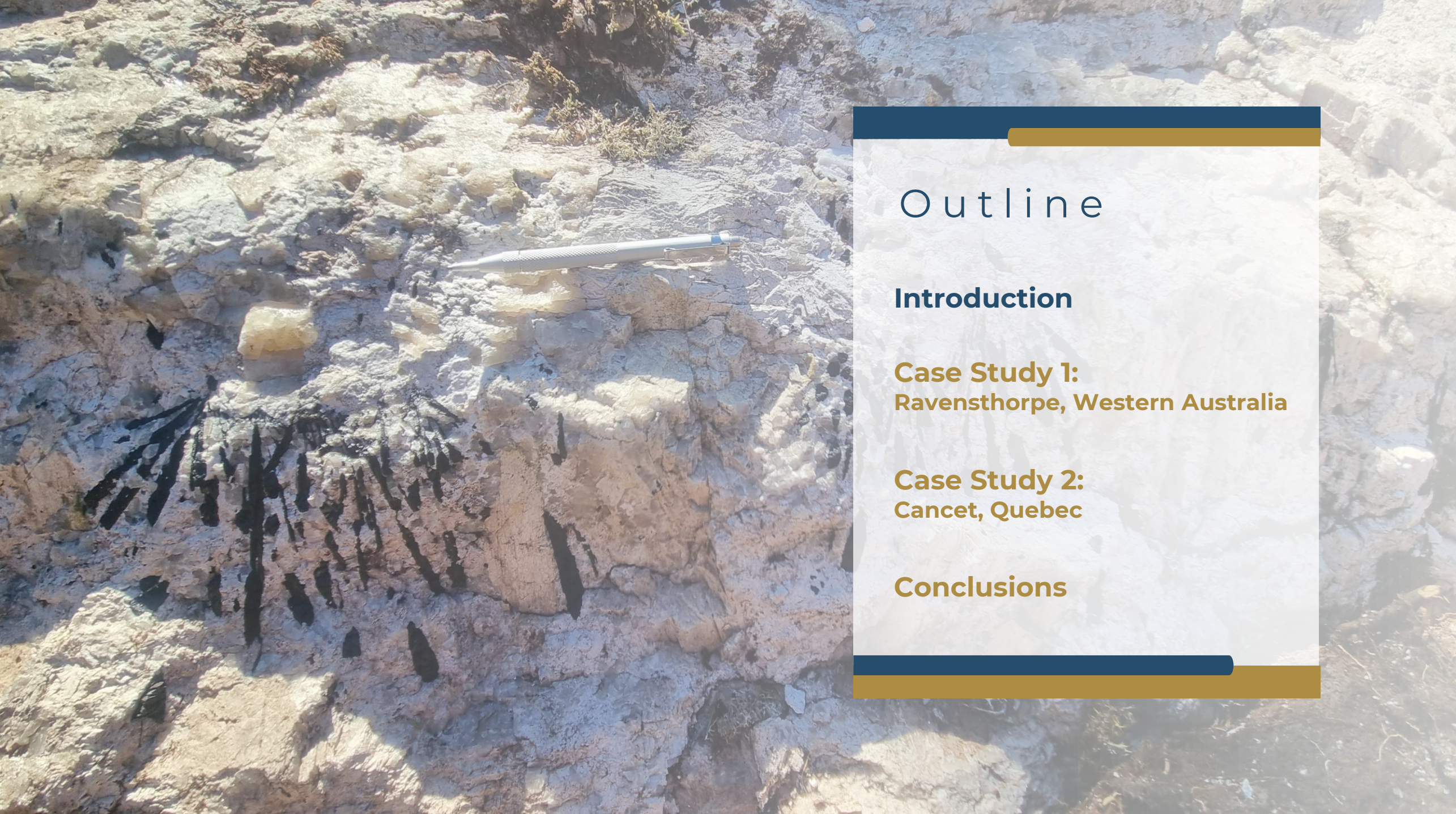




Geophysics and Remote Sensing for Pegmatite Exploration: Examples from Australia and Canada

Regis Neroni

Toronto, 5-8 March 2023, PDAC Convention



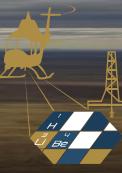
Outline

Introduction

Case Study 1:
Ravensthorpe, Western Australia

Case Study 2:
Cancet, Quebec

Conclusions



“the pegmatites are usually non-responsive for geophysical methods and thus the nature of relationship between a dataset and the deposits is difficult to estimate”, Leväniemi (2013).

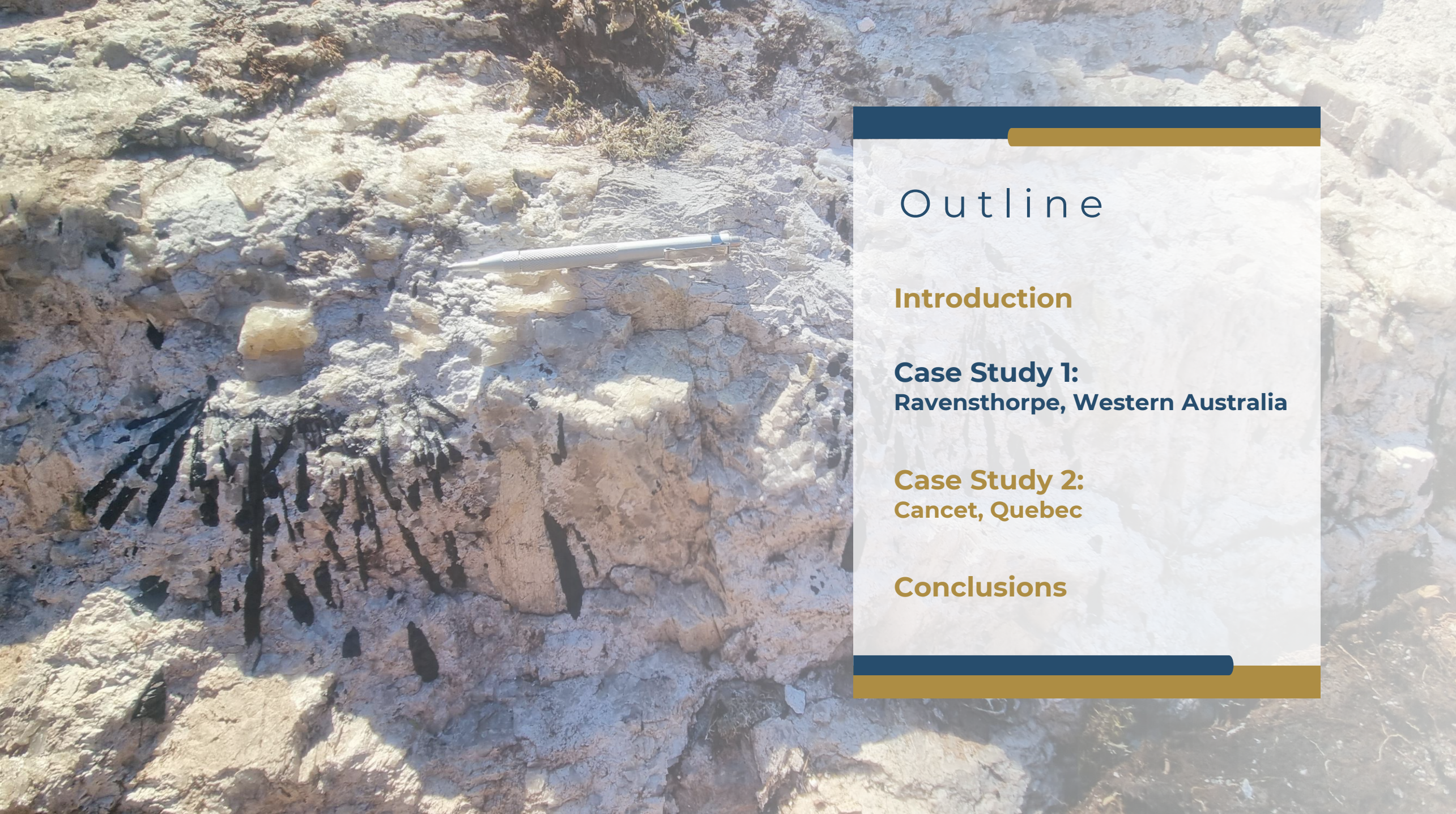
“Rare element pegmatites are best described as geophysical non-responders”, Trueman and Cerný (1982).

“Geophysical surveys cannot readily distinguish between pegmatite and adjacent granite intrusions”, Barber, Trench and Groves (2022).

“Pegmatites are commonly considered as geophysically invisible because the physical property contrasts between pegmatites and their wall rocks are too small to distinguish using geophysical methods”, Haase and Pohl (2022).

“The results, however, did not confirm a geophysical signature of the pegmatites”, Steiner (2019).

“In general terms, using geophysical surveys to locate or delimit contacts between pegmatites and host rocks in the Kaustinen area turned out to be very challenging.”, Ahtola et al (2015).



Outline

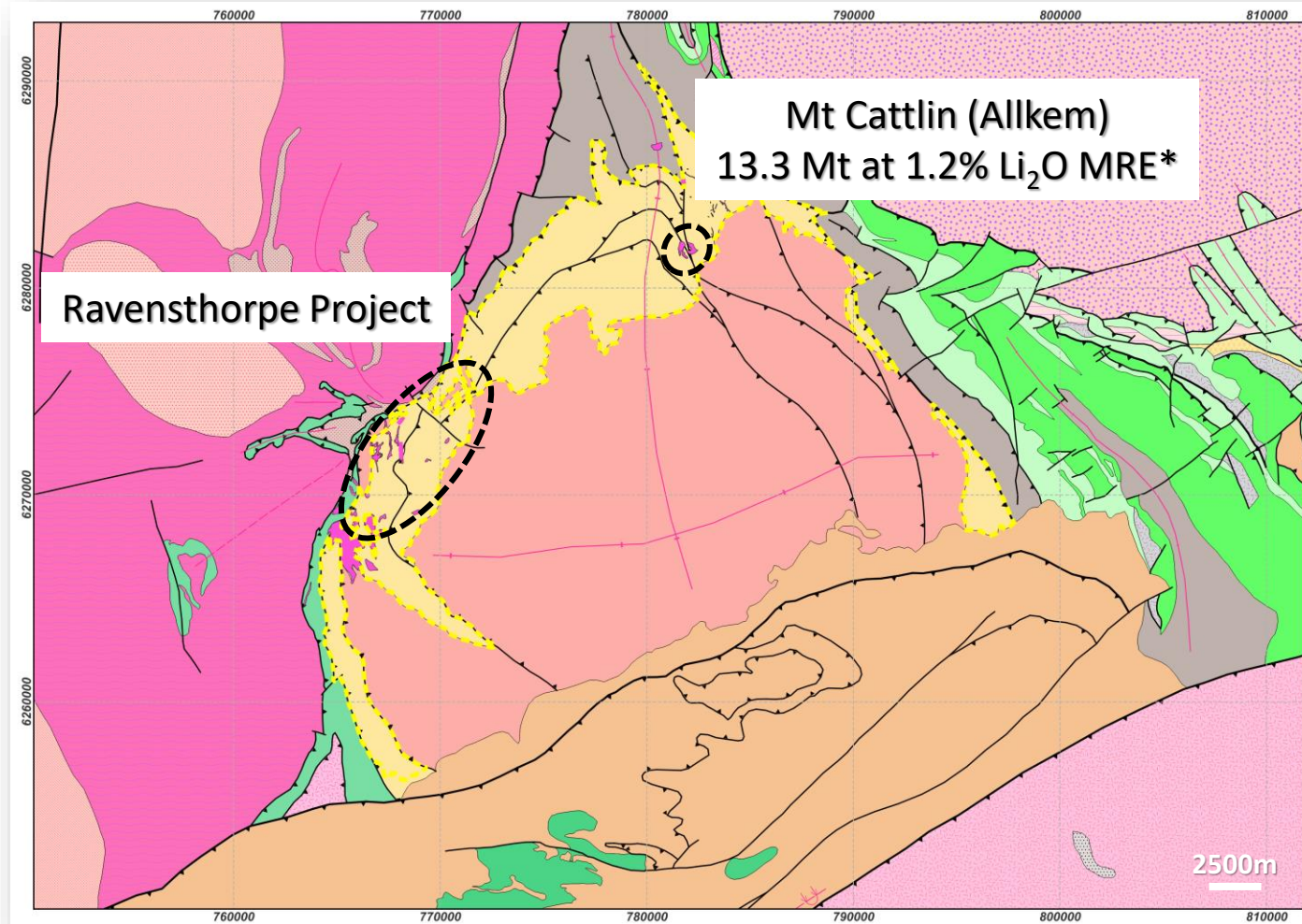
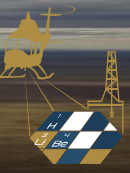
Introduction

Case Study 1: Ravensthorpe, Western Australia

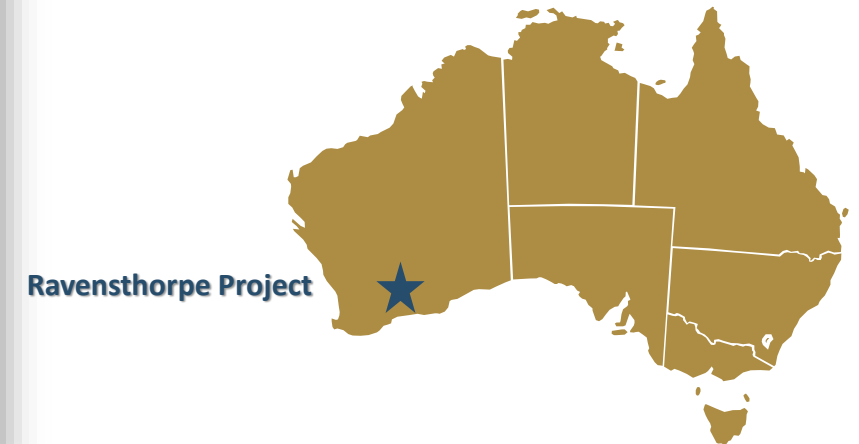
Case Study 2: Cancet, Quebec

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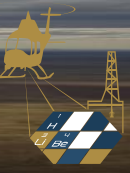
Ravensthorpe Project - Regional Geology



- Pegmatites are hosted in basaltic, andesitic and dacitic volcanoclastic rocks of the Neoproterozoic Annabelle Volcanics formation within the Yilgarn Craton of Western Australia.



Why gamma-ray spectrometry for pegmatites?



✓ High silica content

- ✓ Often form discrete (paleo-) topographic highs more likely to outcrop.
- ✓ Can break down into a lag footprint often much greater than the parent dyke.

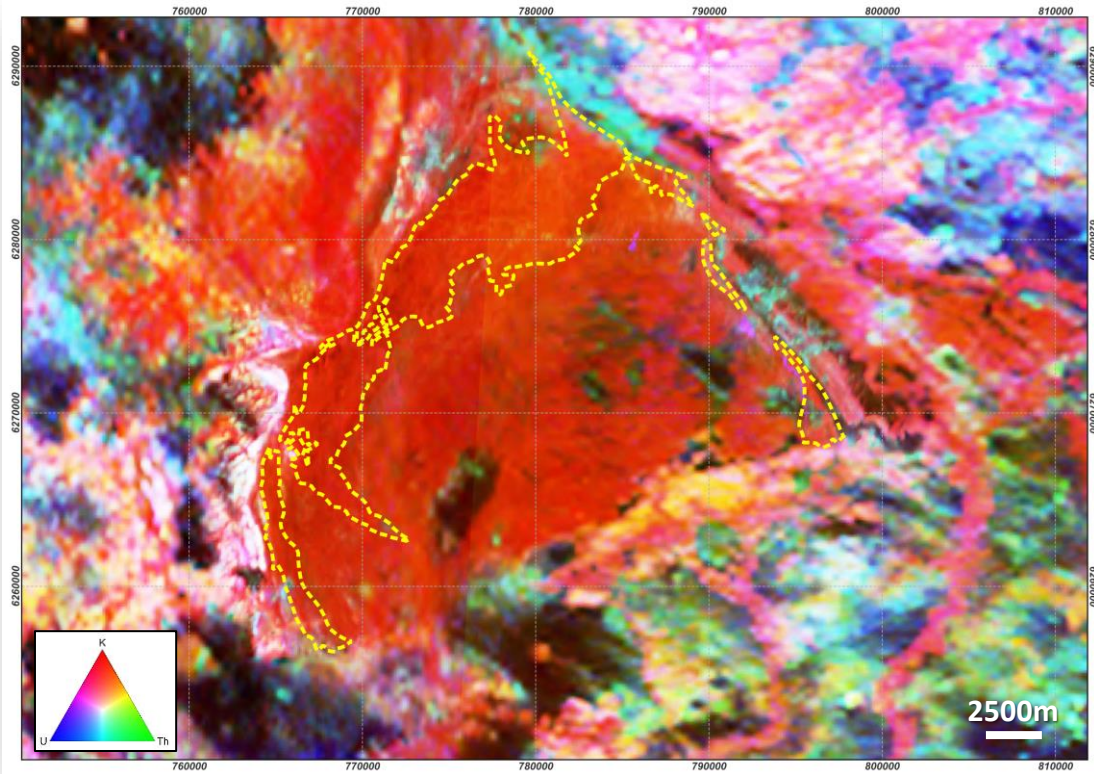
✓ High potassium content

- ✓ Large K-feldspar phenocrysts persist longer in soil.
 - ✓ K is easily absorbed in the lattice of clays.
 - ✓ K can be taken up by plants and recycled or concentrated in topsoil.
- Airborne gamma-ray spectrometry can detect higher potassium content in and above the granitic pegmatites compared to the volcanic complex host.

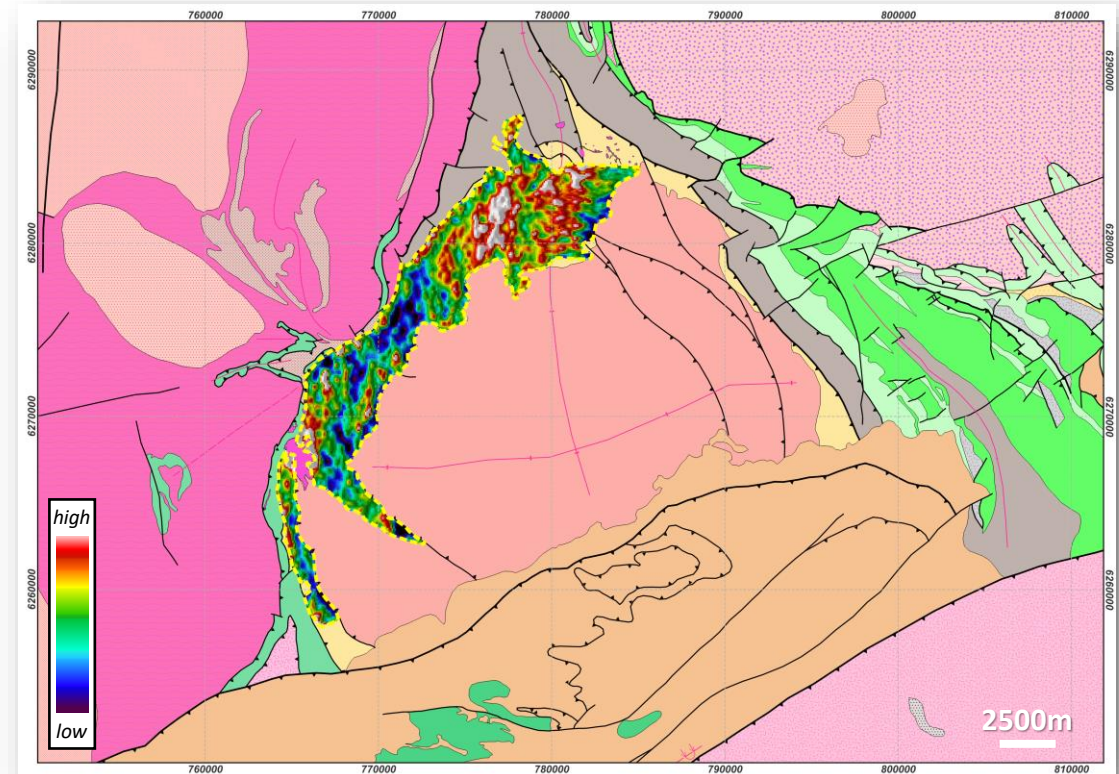


Picture of an eroded narrow pegmatitic dyke in the Pilbara region of WA

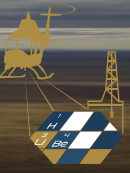
Understanding background levels



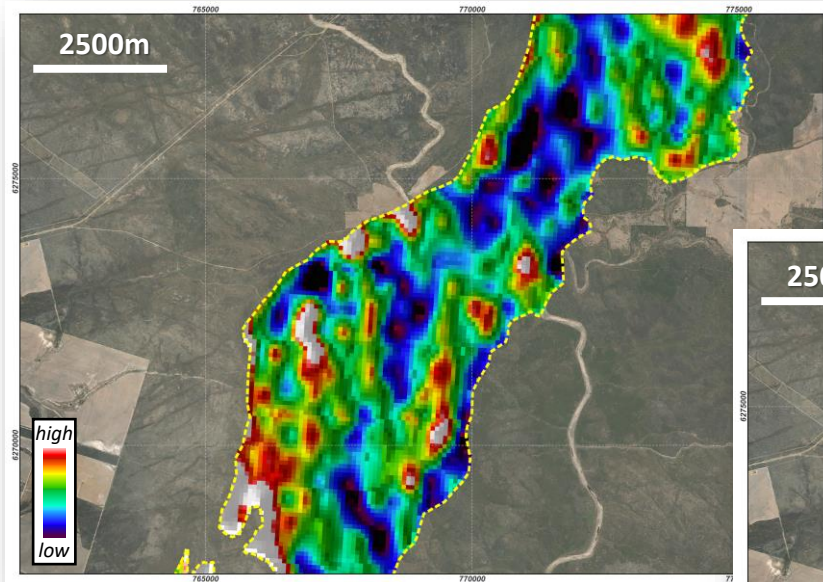
- It is important to interrogate the data compartmentalised by lithology and understand the subtle variations within.



The need for resolution

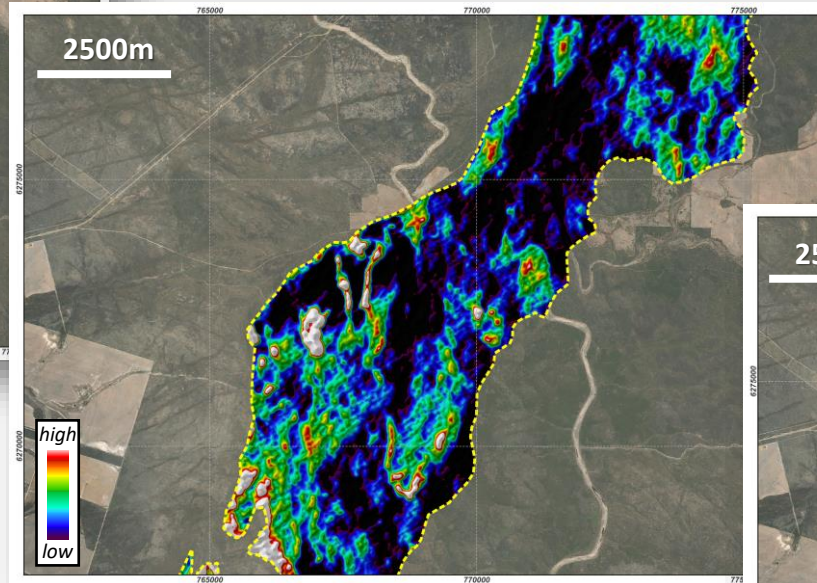


2005 survey, EW, 400m line spacing, **60m** flying height



- A lower sensor height minimises dilution of the pegmatite K response.

2007 survey, EW, 50m line spacing, **30m** flying height



2007 survey, local maxima processing

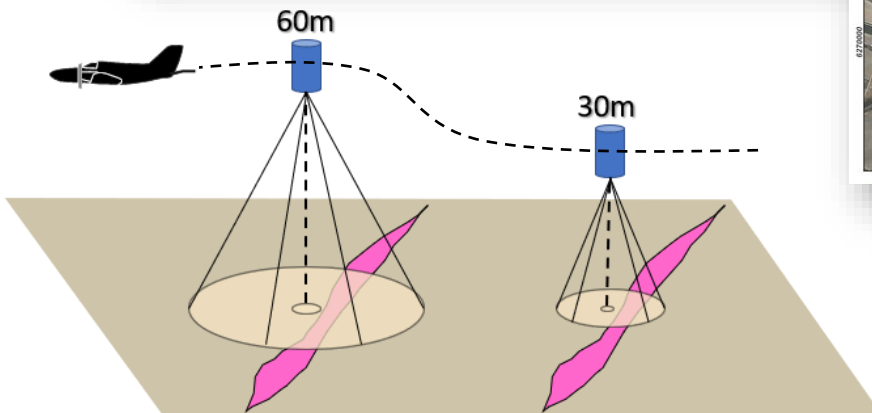
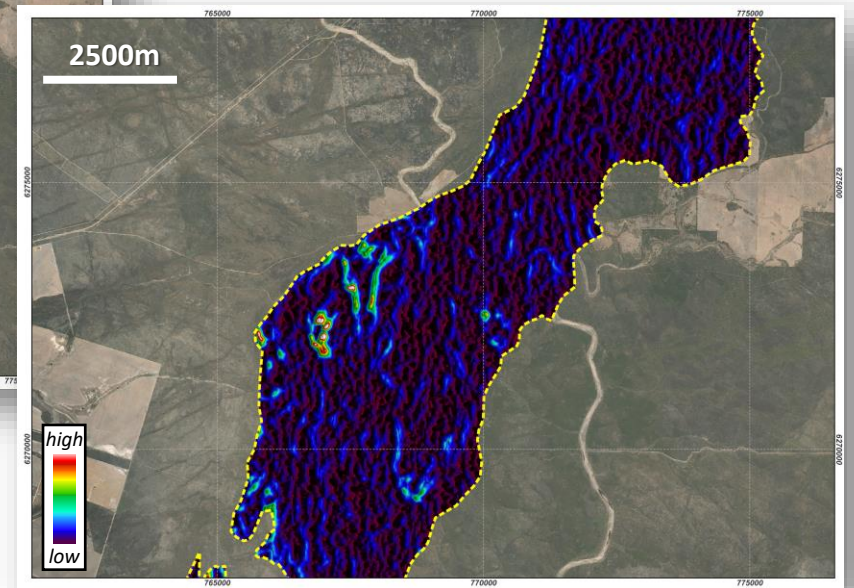


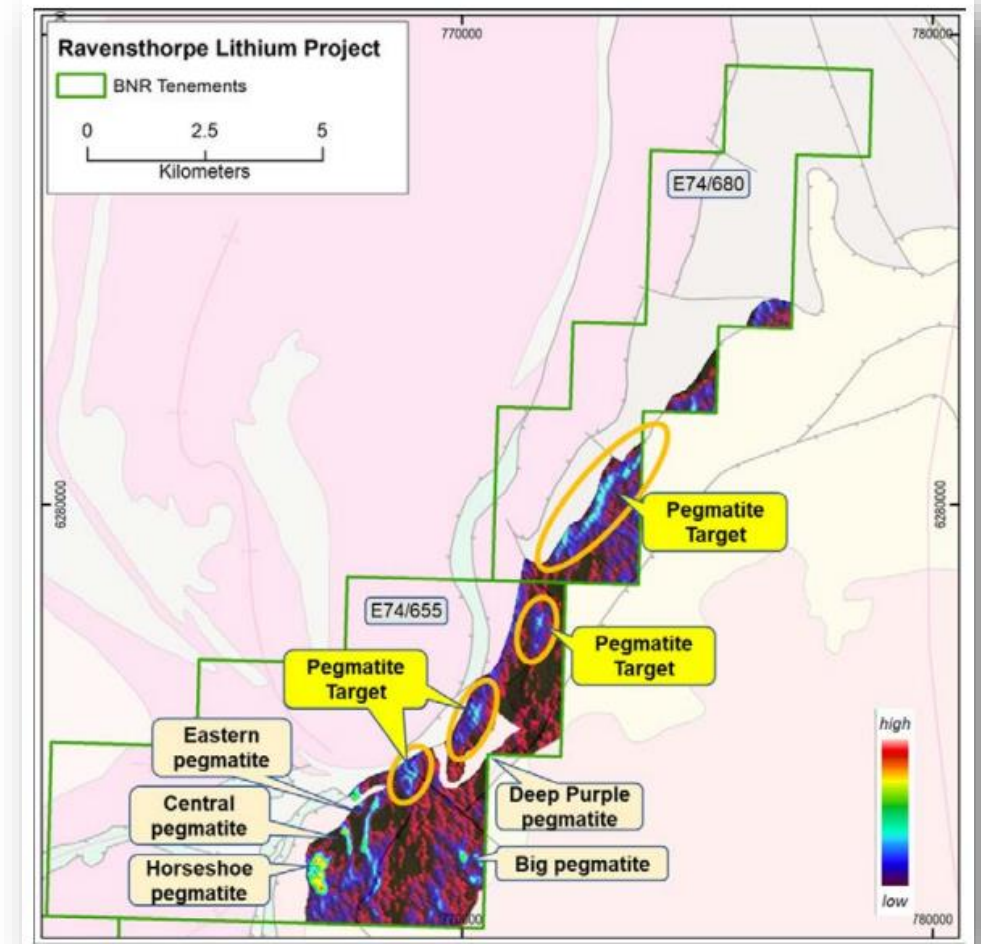
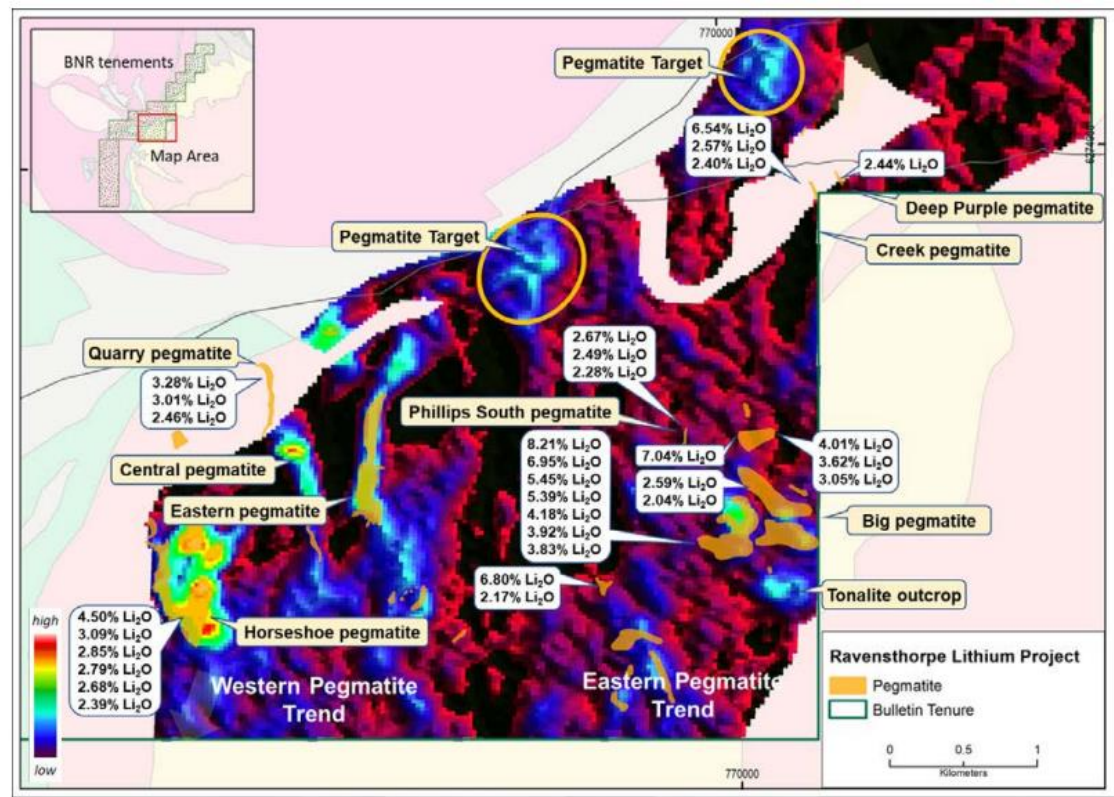
Illustration of the notion of “field of view”

K concentration distribution within the Annabelle Volcanics over satellite imagery

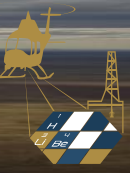
Exploration results



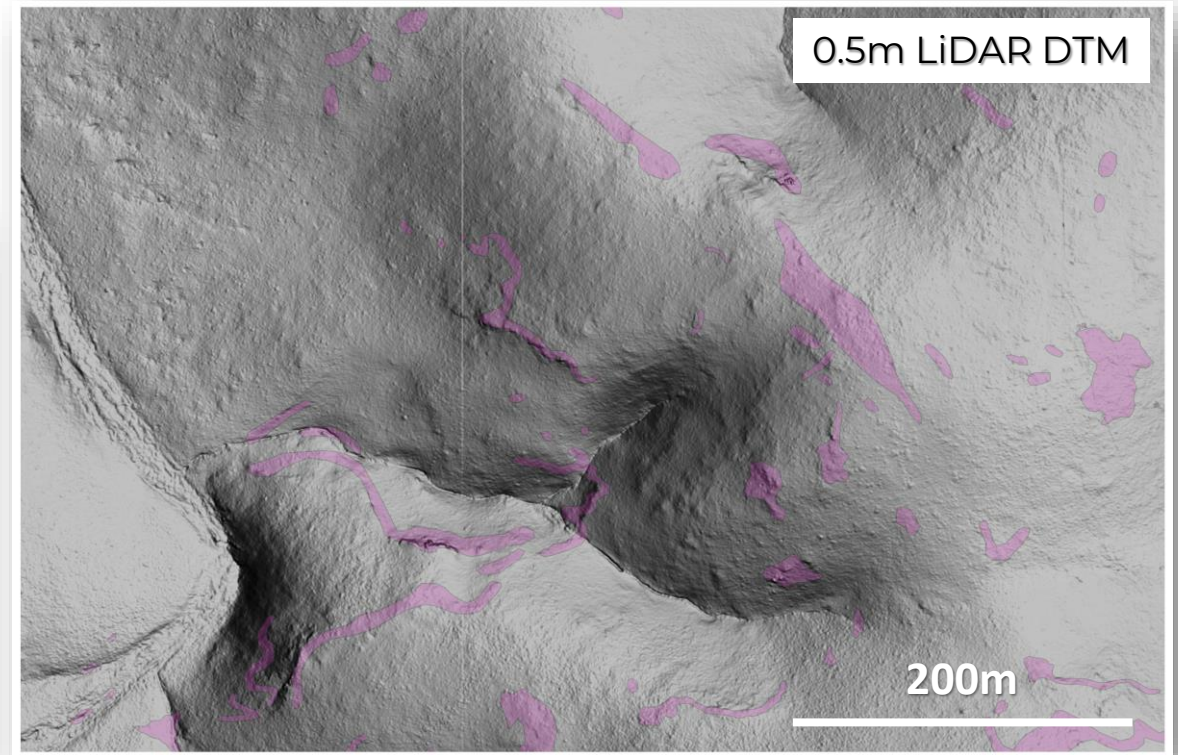
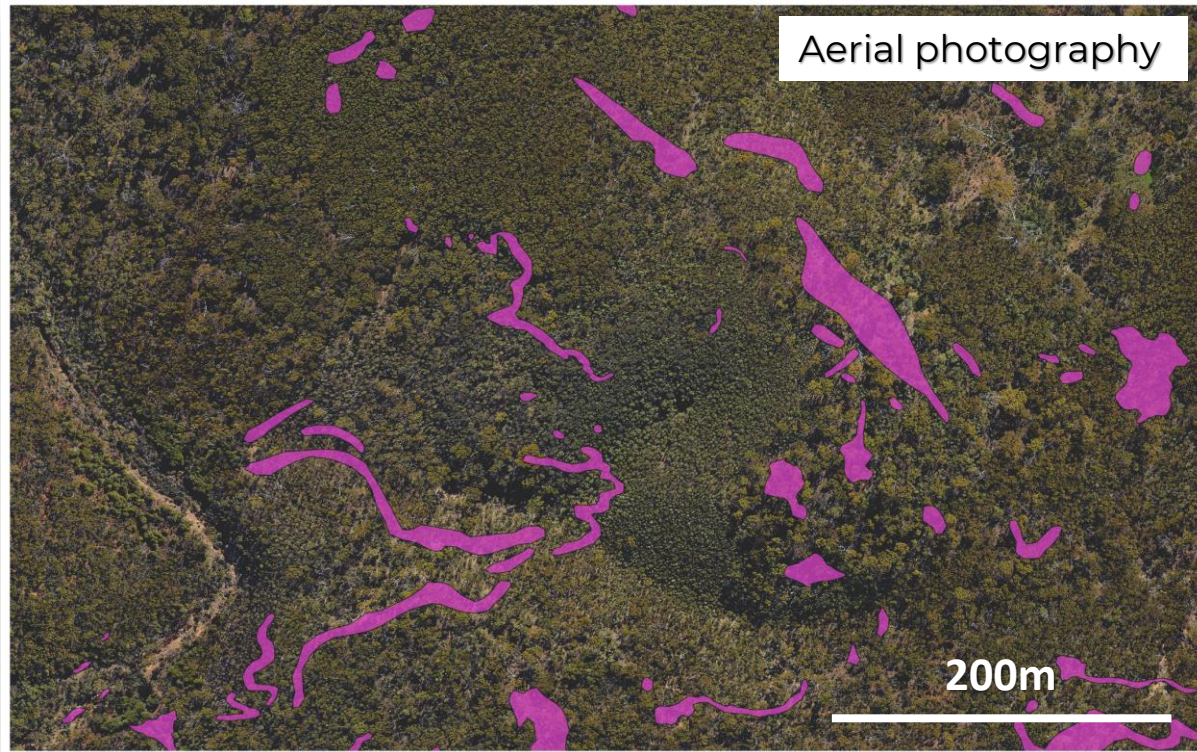
- Most mapped pegmatites coincide with apparent K anomalism and new targets are generated.

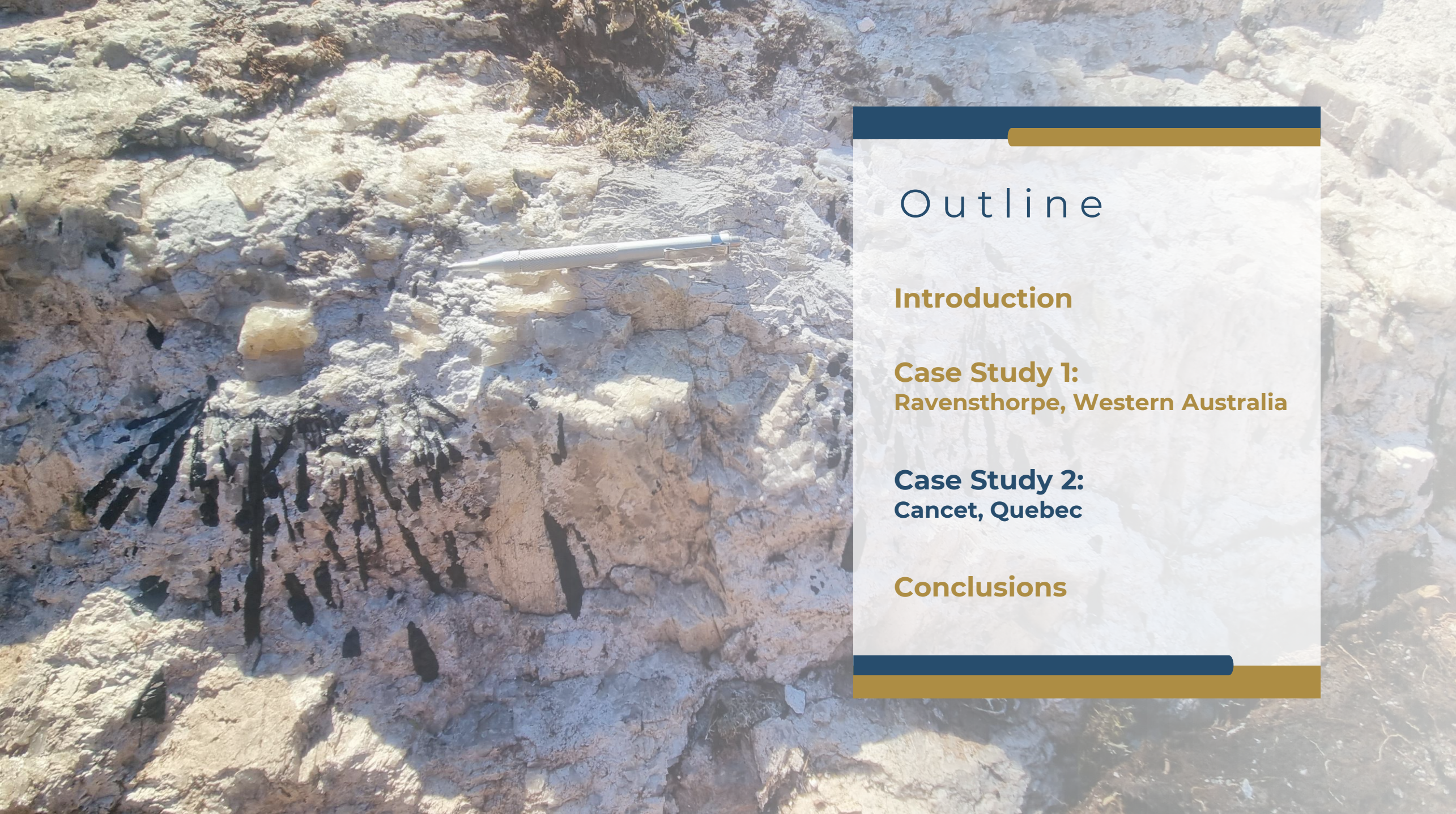


LiDAR surveying to pinpoint outcrops



- Small pegmatite outcrops can be identified in detailed LiDAR DTM data even under thick vegetation.





Outline

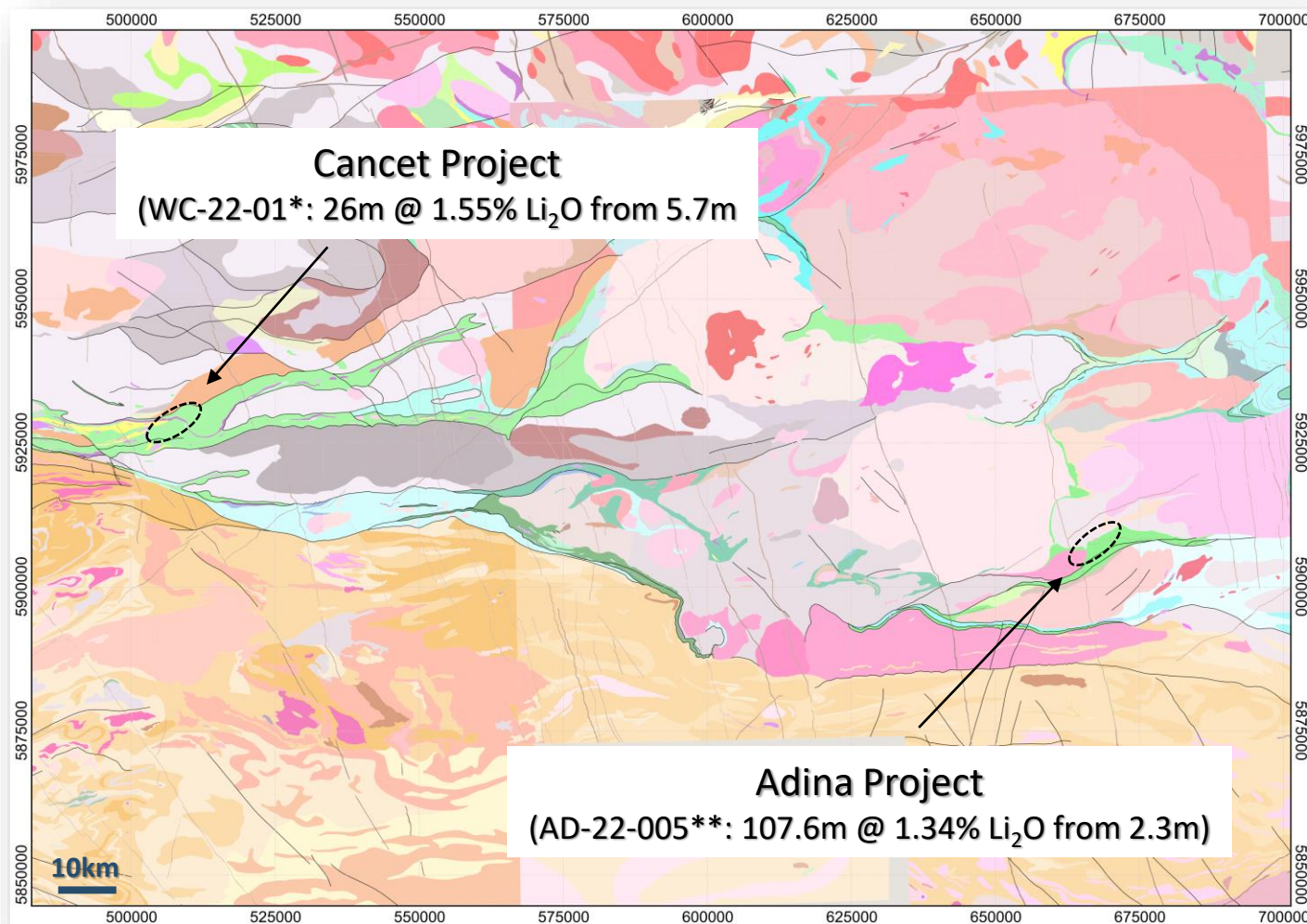
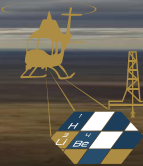
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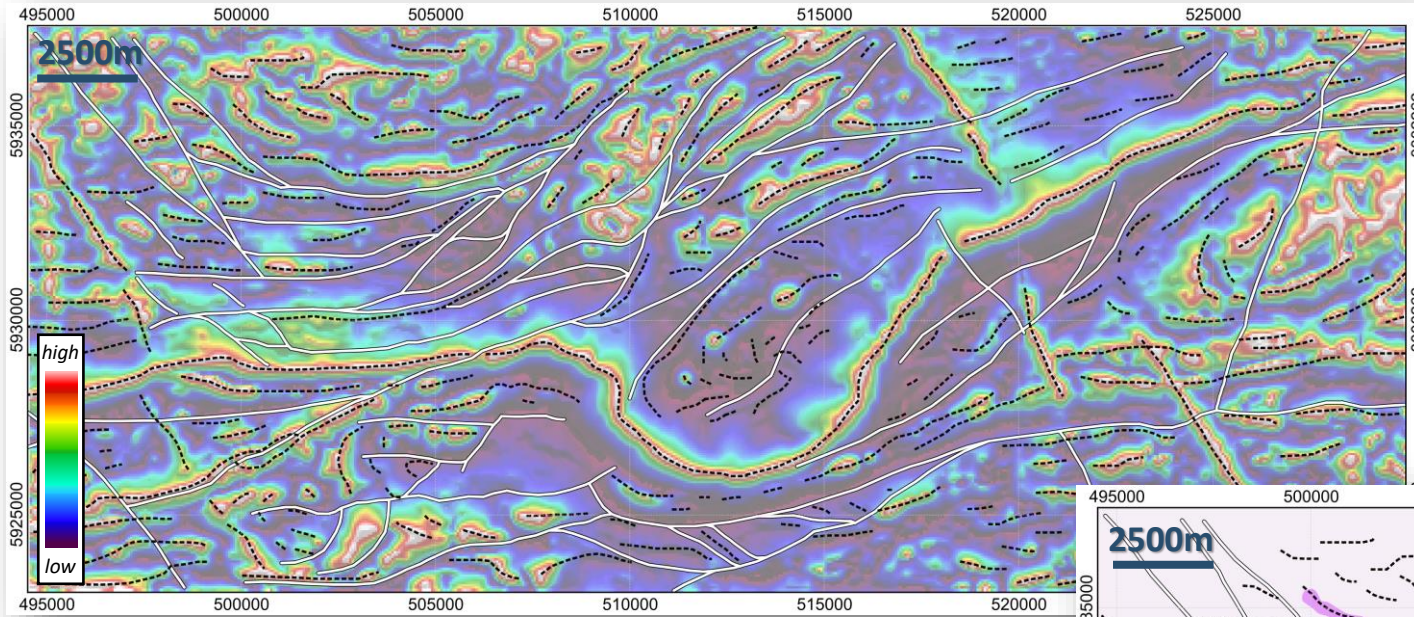
Cancet Project - Regional Geology



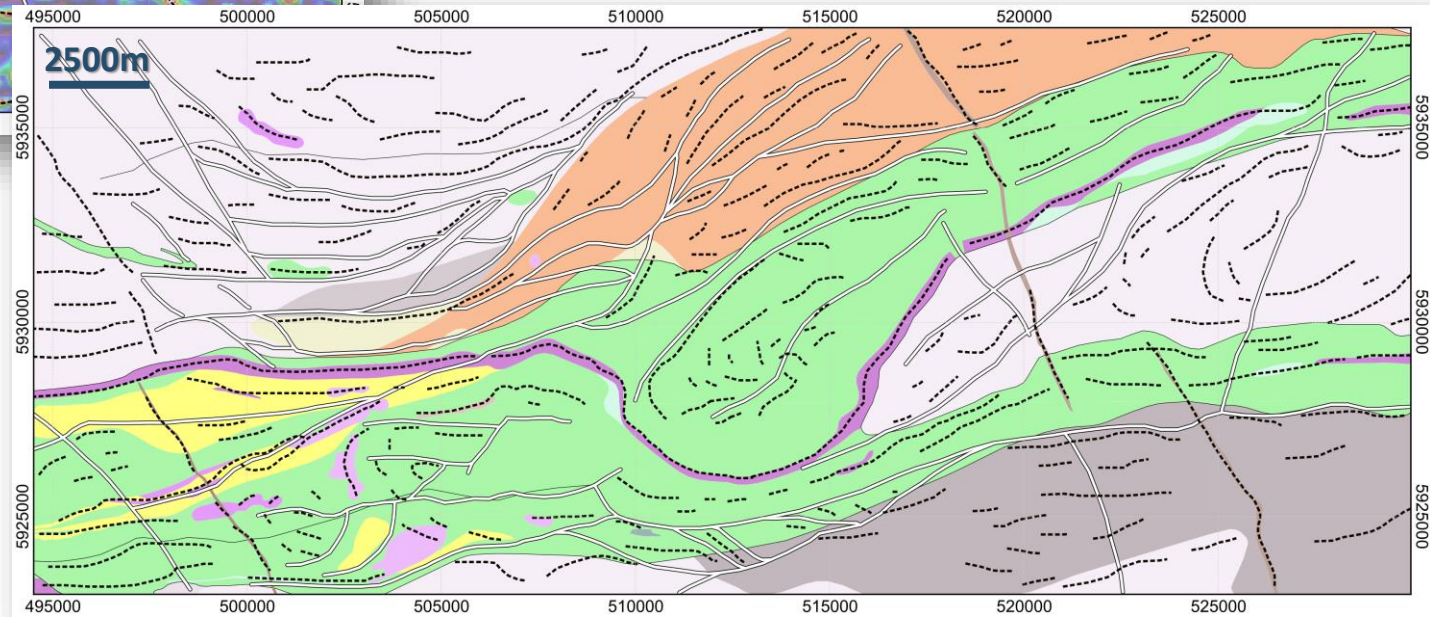
- Pegmatites are hosted in amphibolised basalts of the Mesoarchean Guyer Group within the eastern Superior geological Province of Canada.



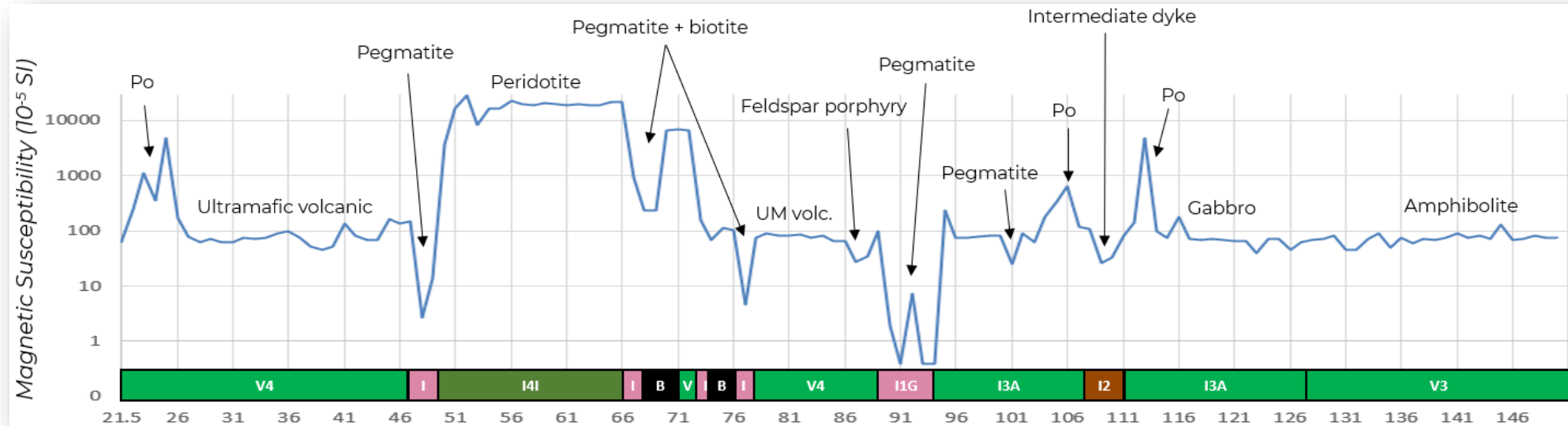
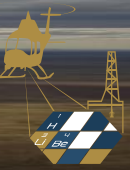
Aera selection from regional airborne magnetic



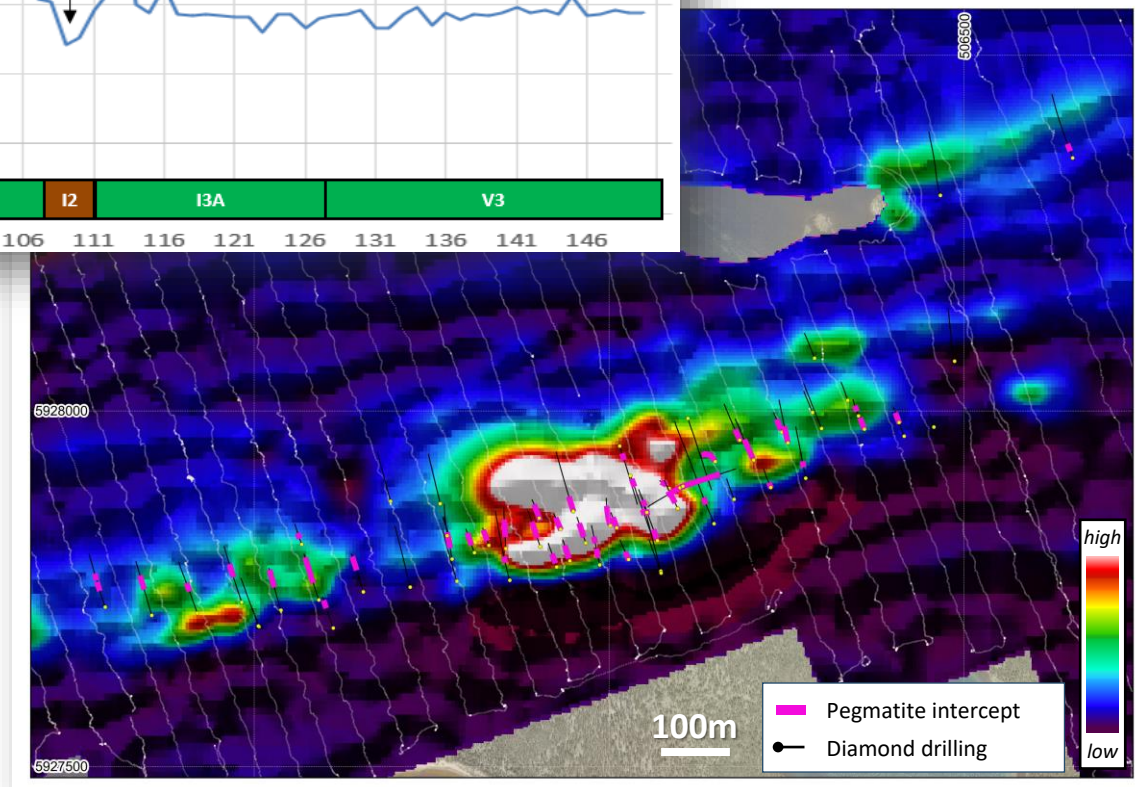
- Regional airborne magnetic datasets can be used to select areas of favourable geo-tectonic setting for pegmatite emplacement.



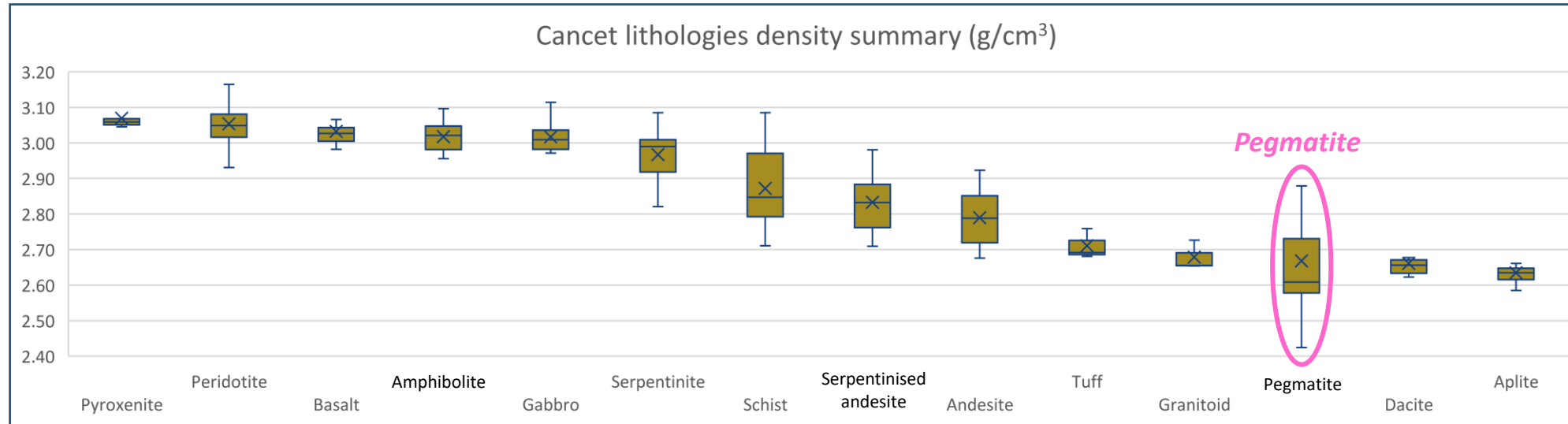
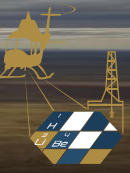
Magnetic susceptibility of pegmatites



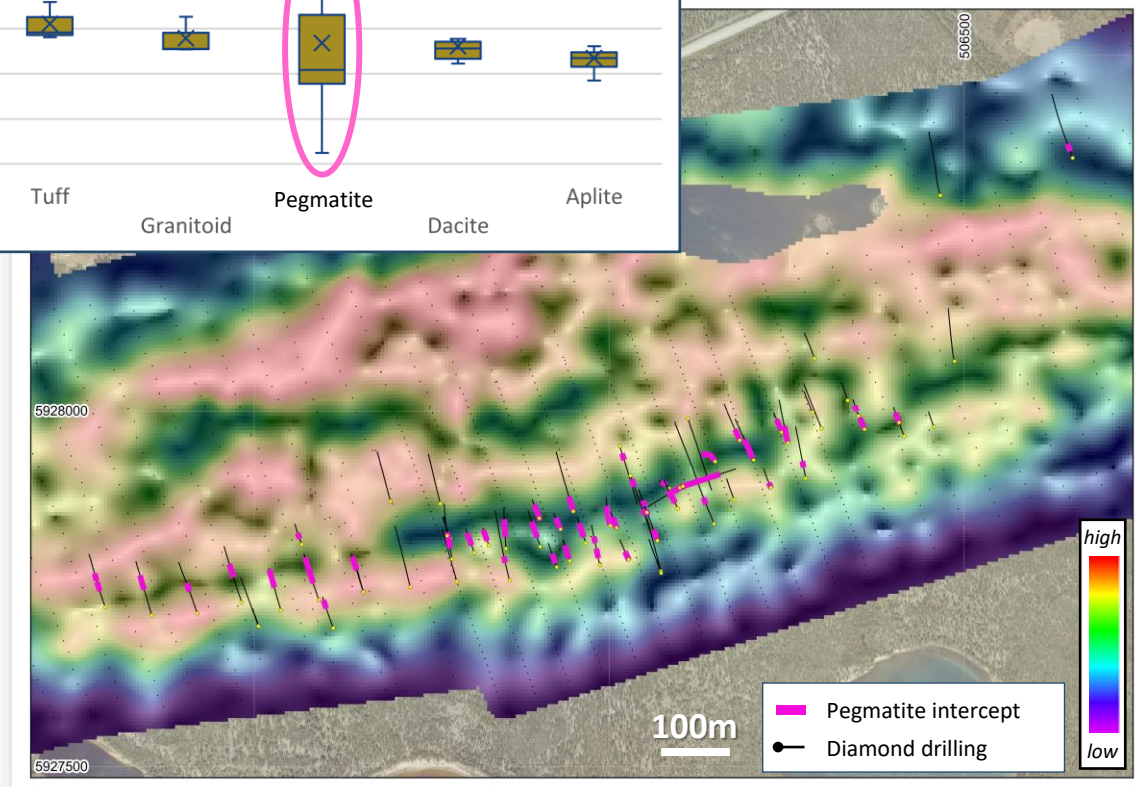
- Non-magnetic pegmatites intrude preferentially along the contact of ultramafic volcanics, gabbro and highly magnetic peridotite.
- Magnetism is not a reliable tool to directly or indirectly map pegmatites.



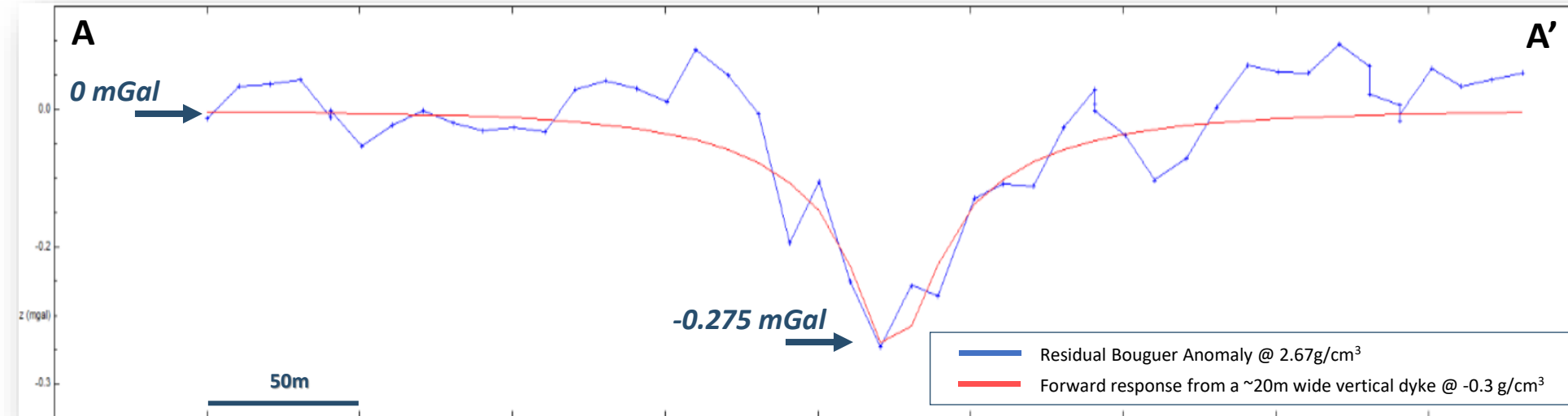
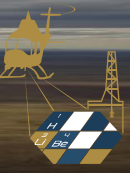
Density of pegmatites



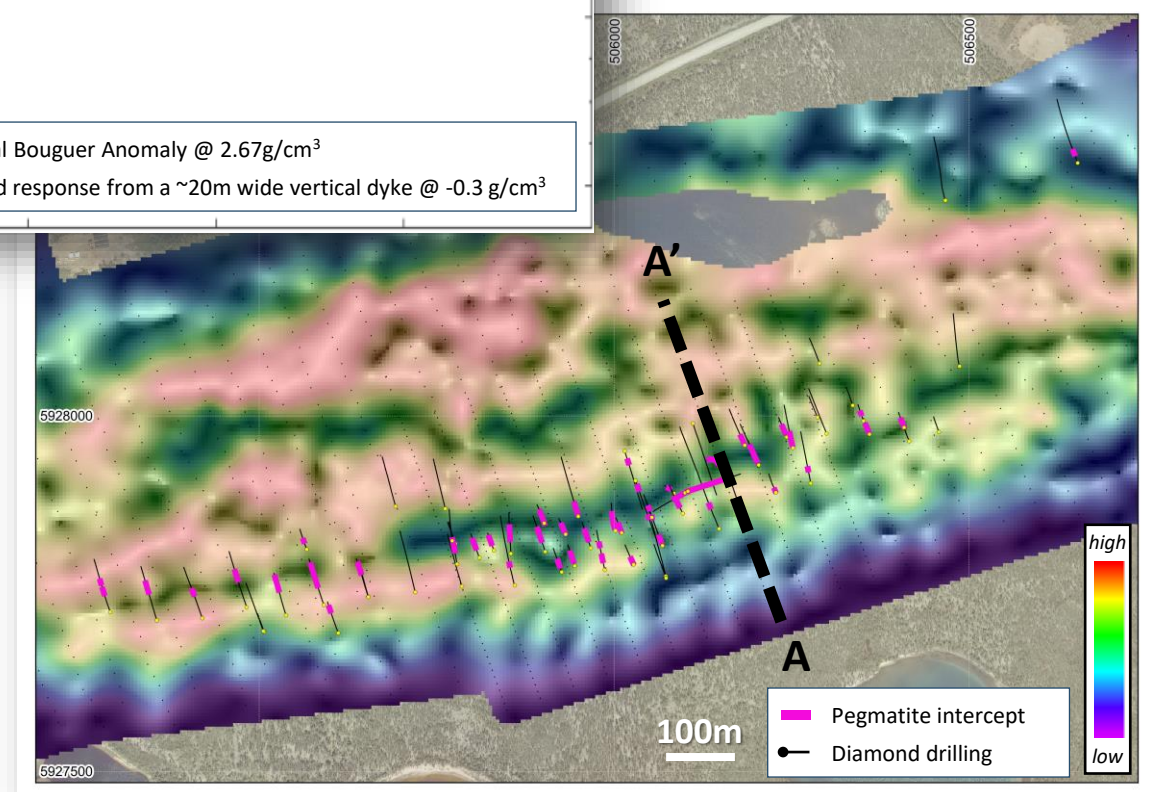
- Pegmatites (and other felsic intrusives) within mafic and ultramafic host rocks are clearly identifiable as narrow linear lows in detailed gravity imagery.



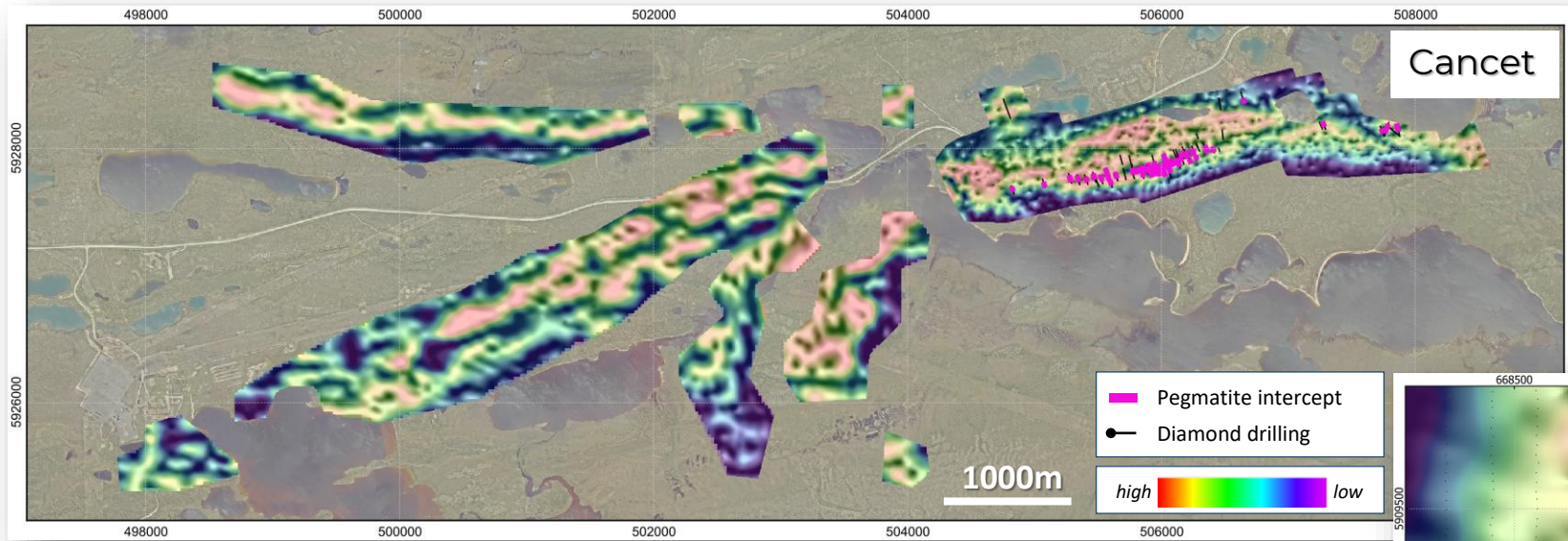
The need for good quality datasets



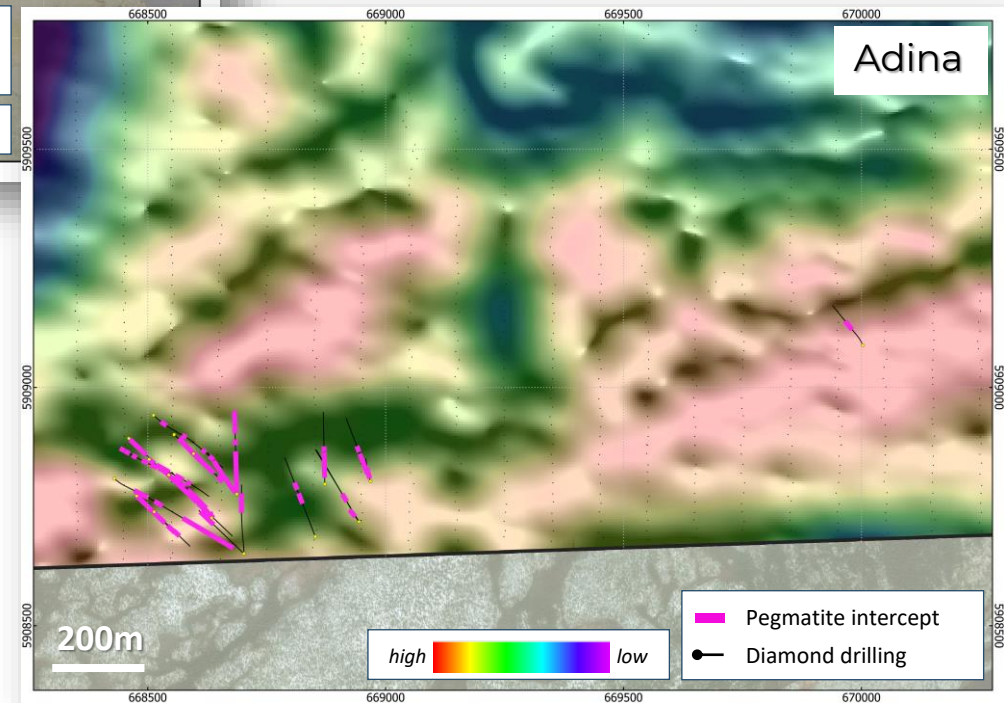
- Low amplitude and narrow anomalies require high quality microgravity datasets.
- Note the difficulty to interpret any apparent dip.

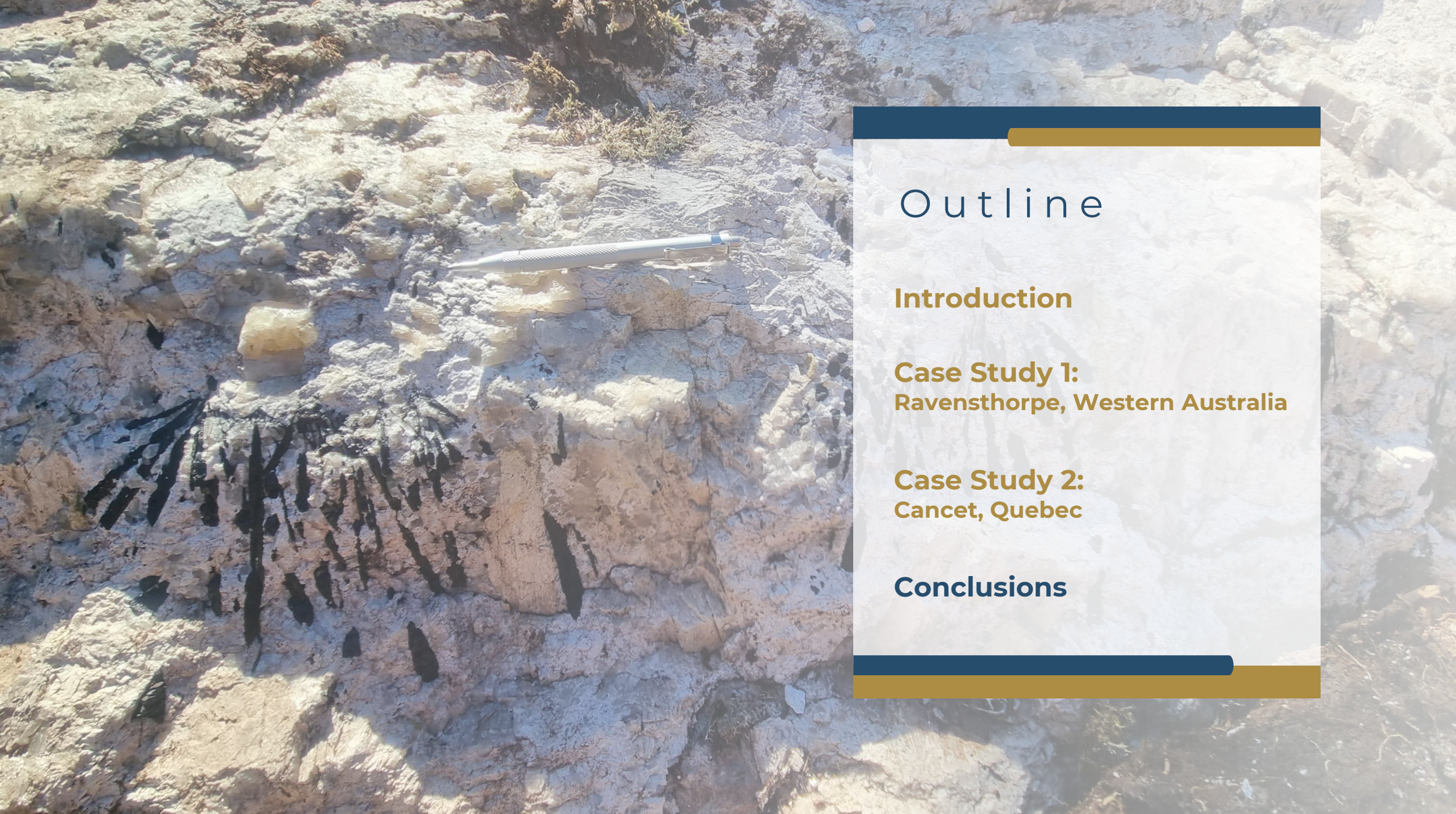


Drill targeting from microgravity



- Systematic microgravity surveys are effective at finding pegmatites buried under shallow glacial cover.





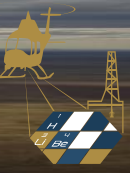
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Pegmatites are NOT geophysical non-responders.

The presence of pegmatites can be expressed directly or indirectly in high-resolution and high-quality geophysical and remote sensing datasets, in the right geological environment.

Gamma-ray spectrometry surveying can identify surficial pegmatites as discrete potassium anomalies when background levels are adequately considered.

High-resolution LiDAR digital terrain models can map small pegmatite outcrops even under thick vegetation cover.

Microgravity surveying can delineate pegmatites which intrude into denser lithologies as discrete and linear gravity lows.

Regional airborne magnetics can be used to select areas featuring appropriate geo-tectonic settings favourable for pegmatite emplacement.

Other geophysical methods are also used for pegmatite exploration with varying degrees of success.

References:

Ahtola, T., Kuusela, J., Käpyaho, A. and Kontoniemi, O. 2015: Overview of the lithium pegmatite exploration in the Kaustinen area in 2003-2012. Geological Survey of Finland, Report of Investigation 220.

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Thanks

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