

Subsurface Resistivity Measurements of Hypersaline Brines from the McMurdo Dry Valleys, Antarctica

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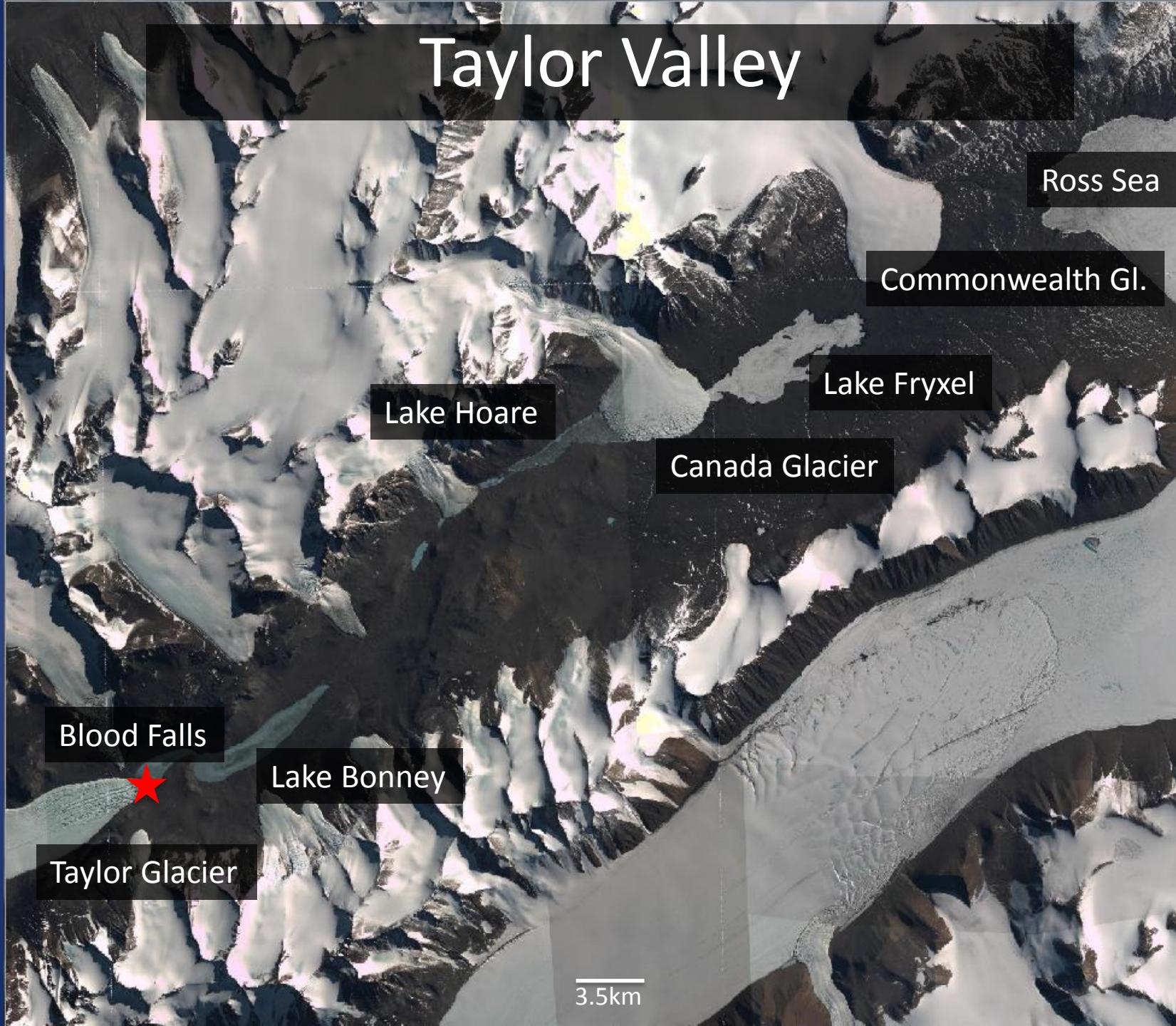


Taylor Valley

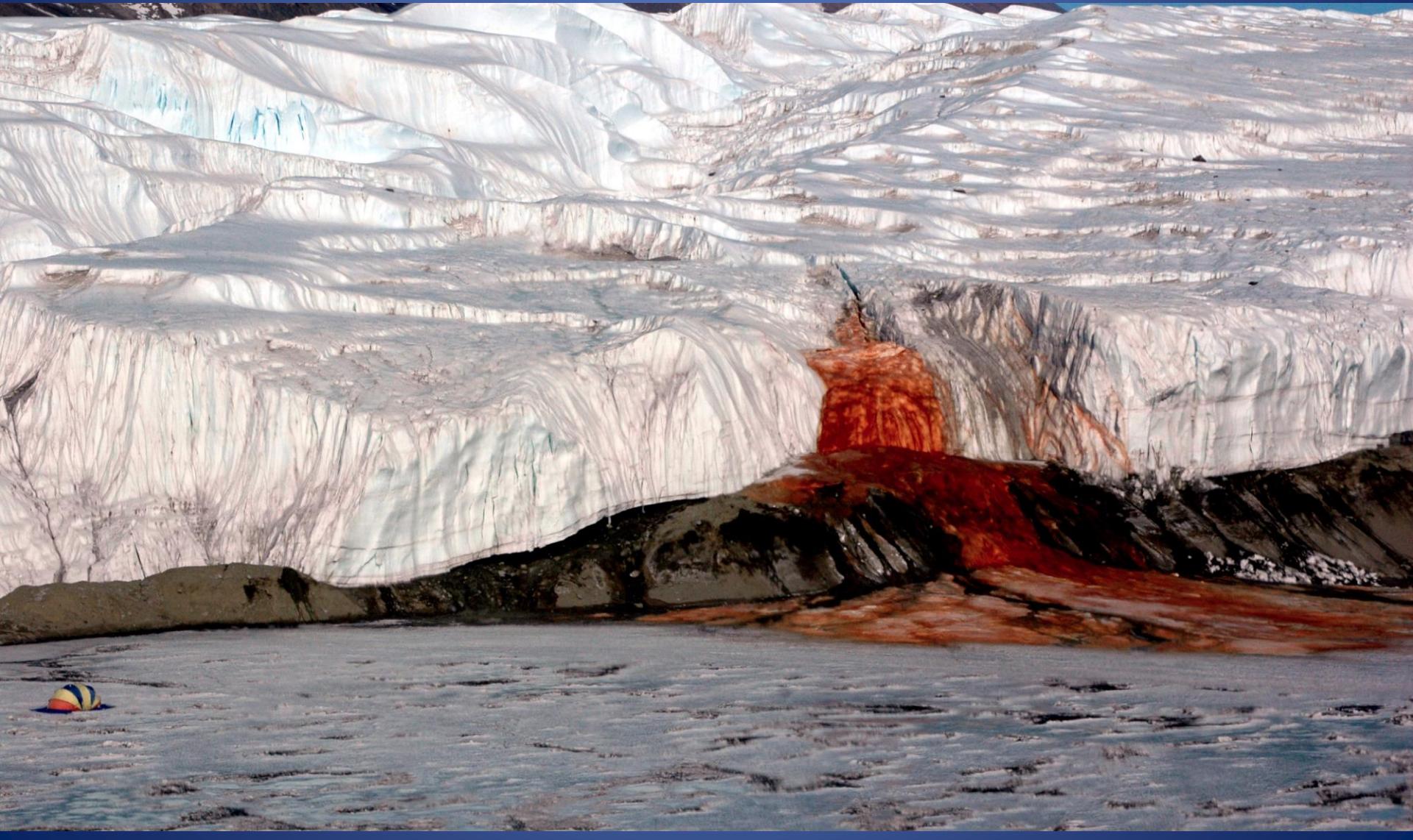


3.5km

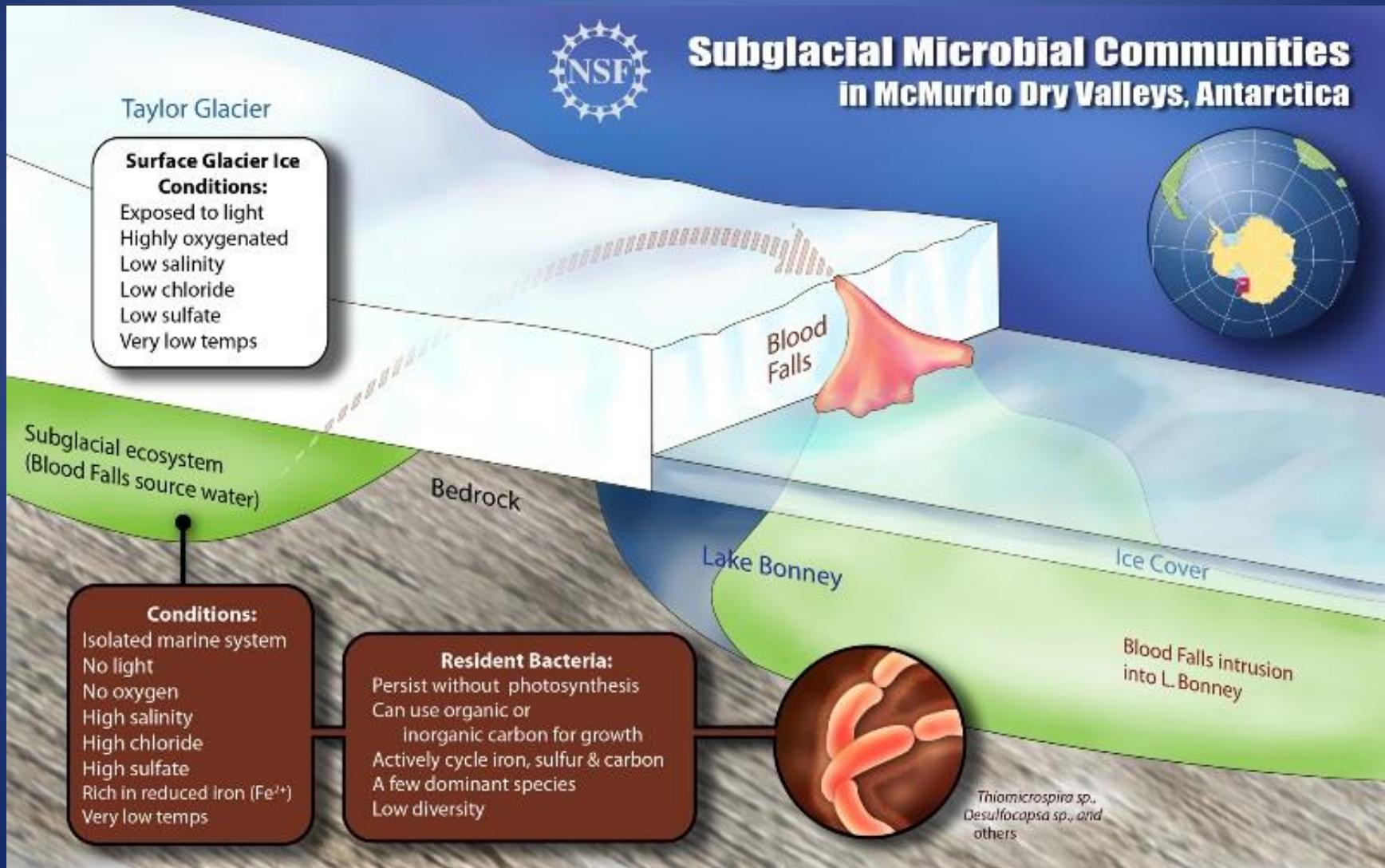
Taylor Valley



Blood Falls



Conceptual Sketch of Blood Falls

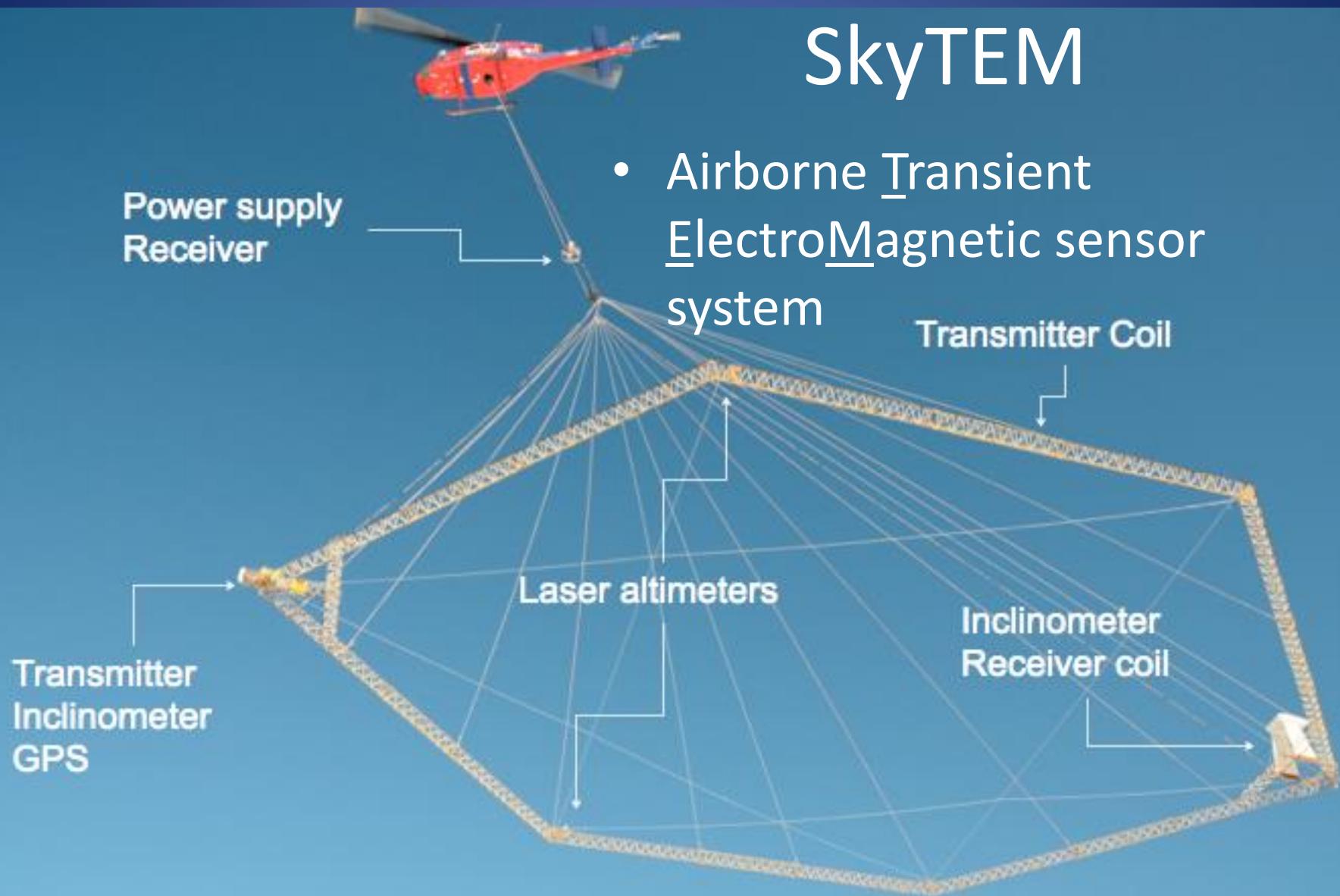


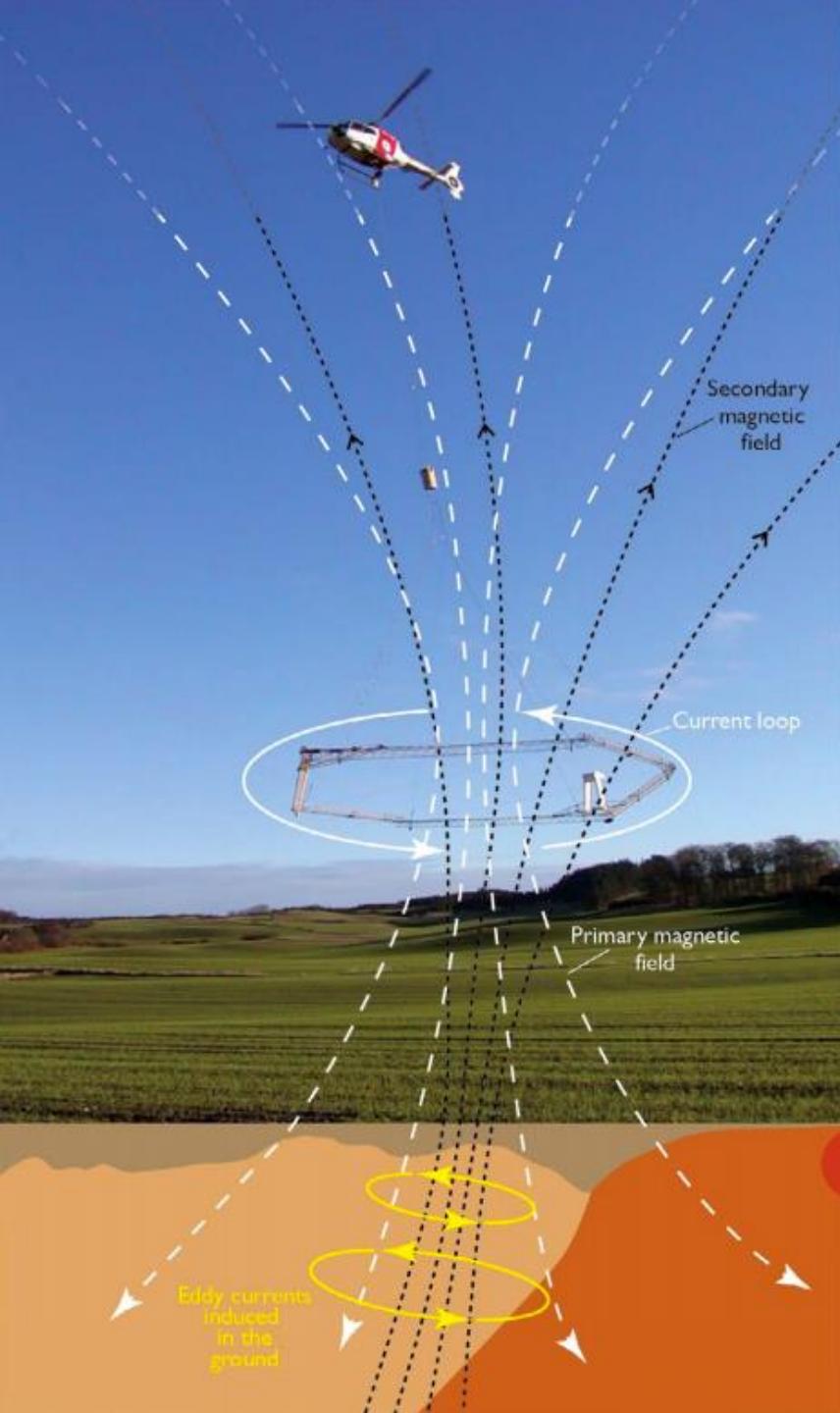
Takeaway Points

- The Dry Valleys in Antarctica contain large areas of shallow brines beneath glaciers and permafrost.
- These brines are a potential habitat for life and an analogue for likely extraterrestrial habitats.
- Taylor Glacier has brine underneath
 - Do other coastal glaciers?
 - AEM elsewhere?

SkyTEM

- Airborne Transient
ElectroMagnetic sensor
system

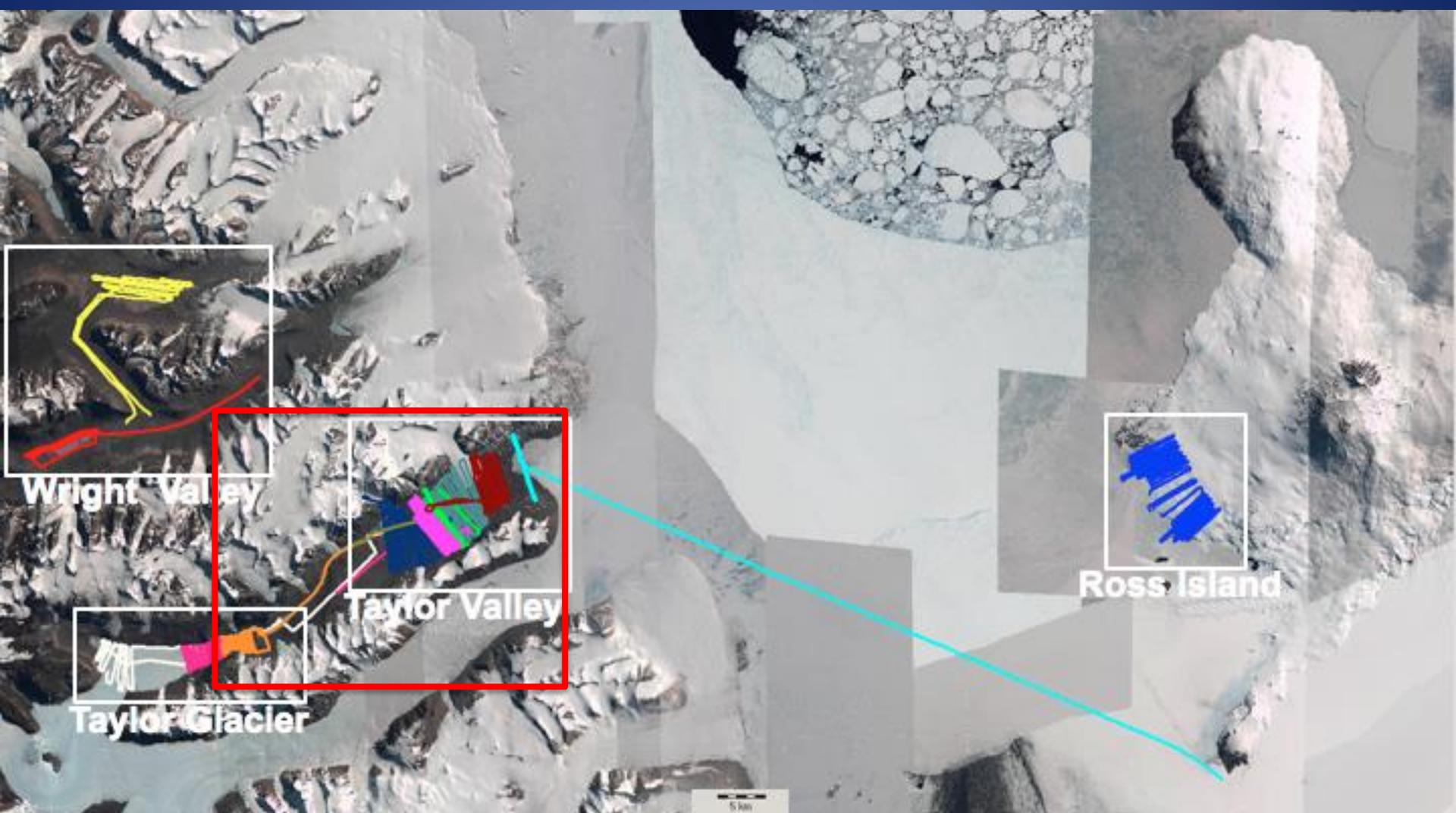




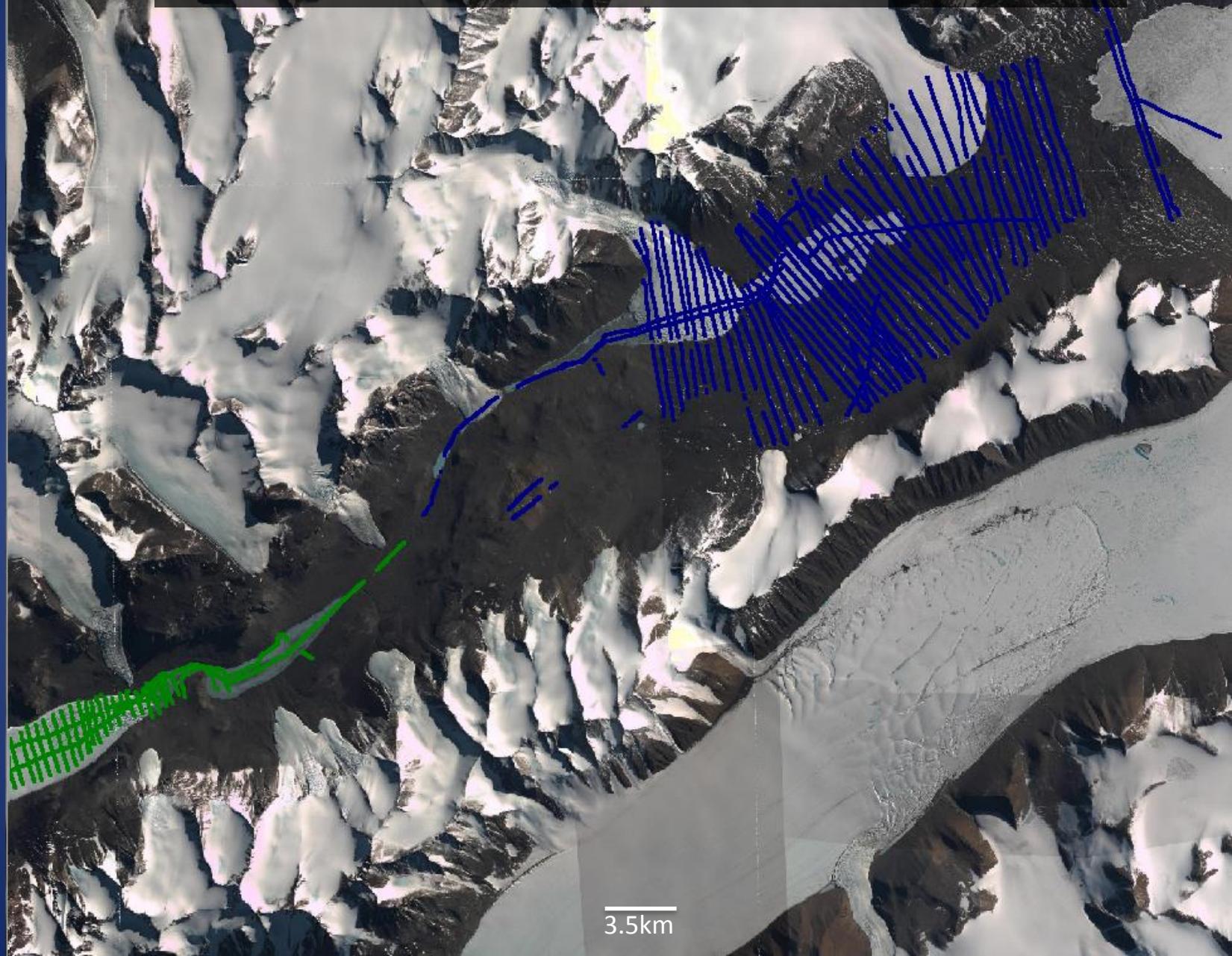
SkyTEM

- Airborne Transient ElectroMagnetic sensor system
- Sensitive to good conductors
- I work with data reported as resistivity (ρ):
 - $\rho=1/C$
 - Units: ohm-meters
 - $\rho_{\text{seawater}} = 0.34 @ 0^\circ\text{C}$
 - Generally reported on a log scale

Dry Valleys Data

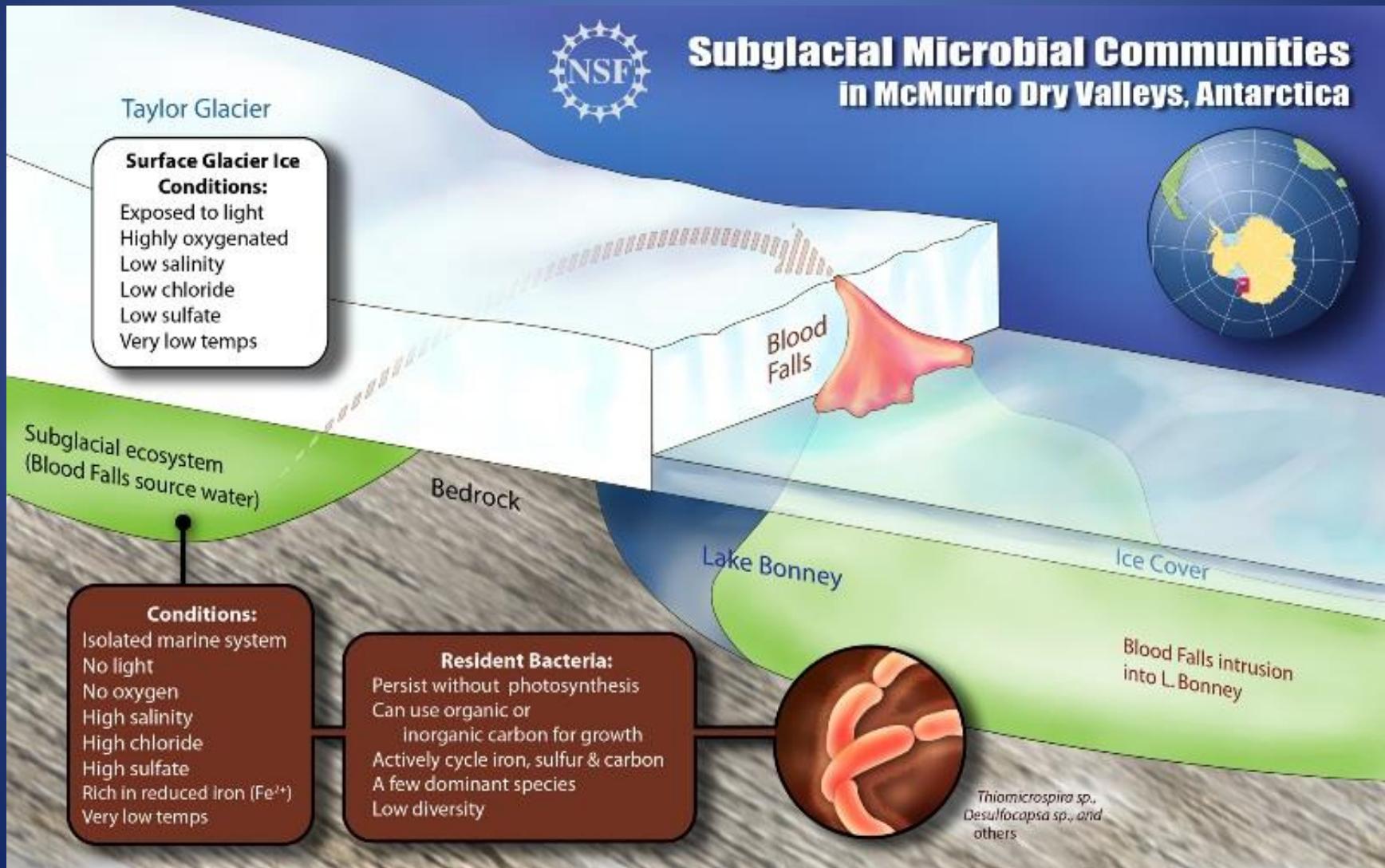


Taylor Valley Data

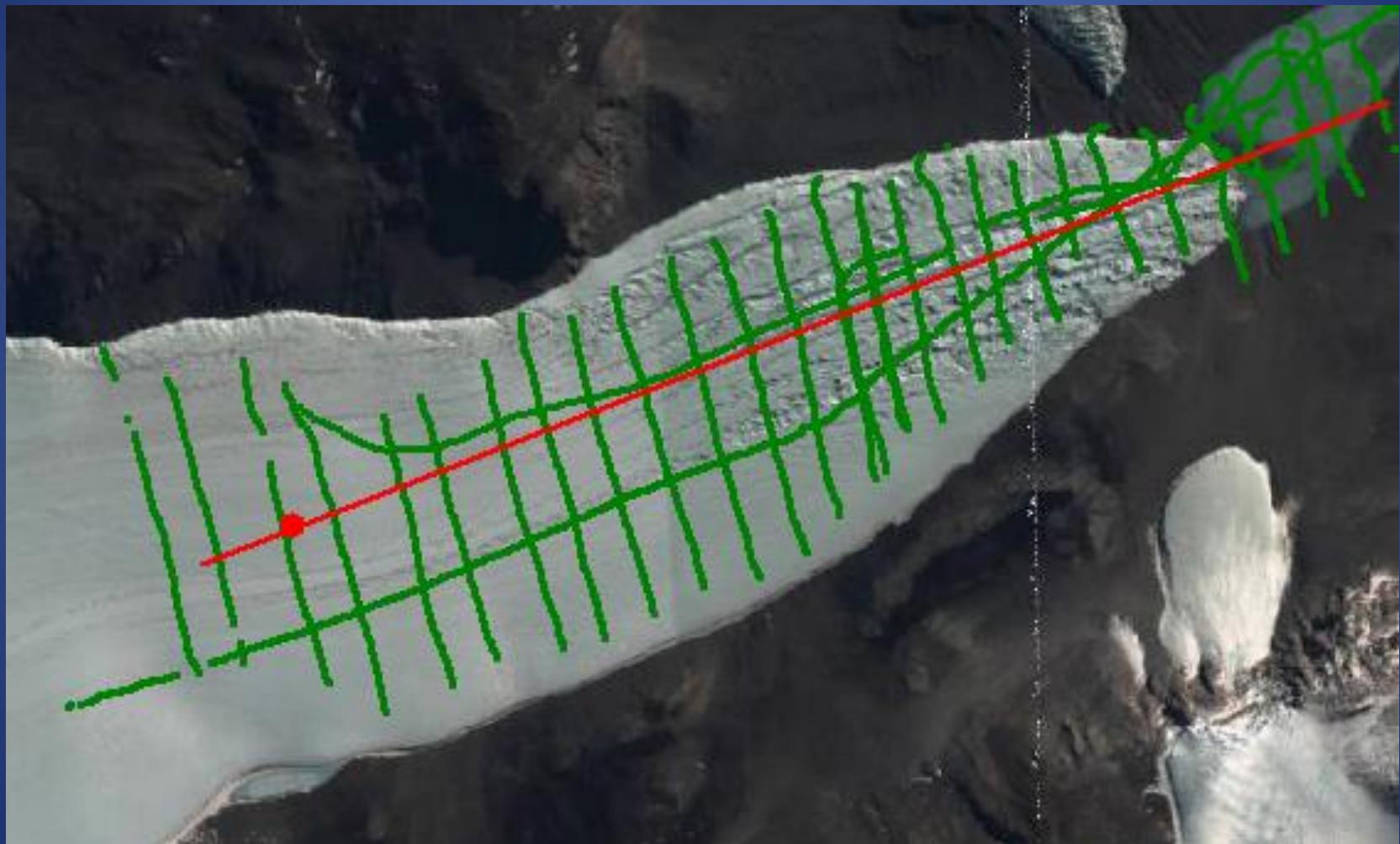


3.5km

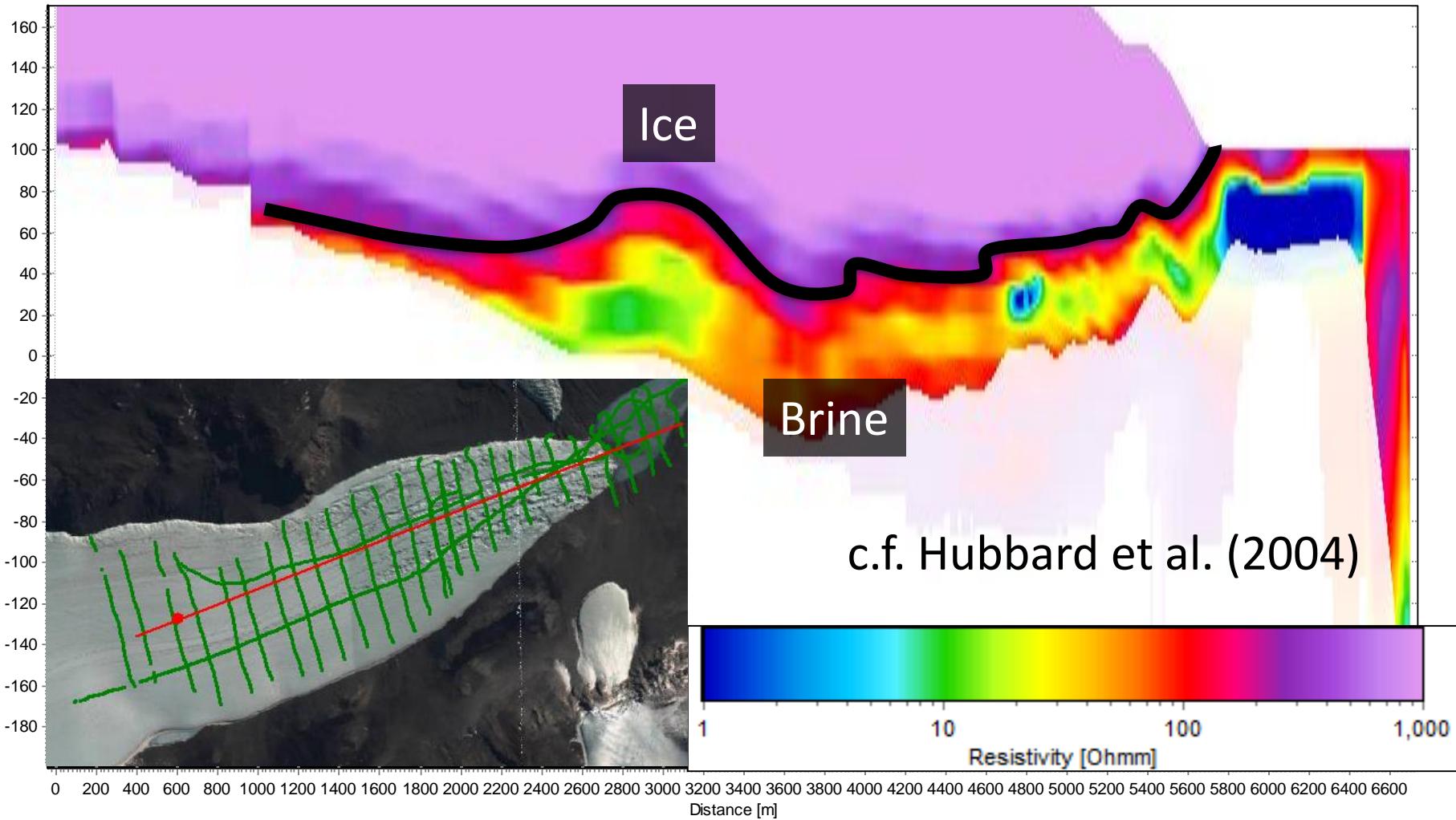
Conceptual Sketch of Blood Falls



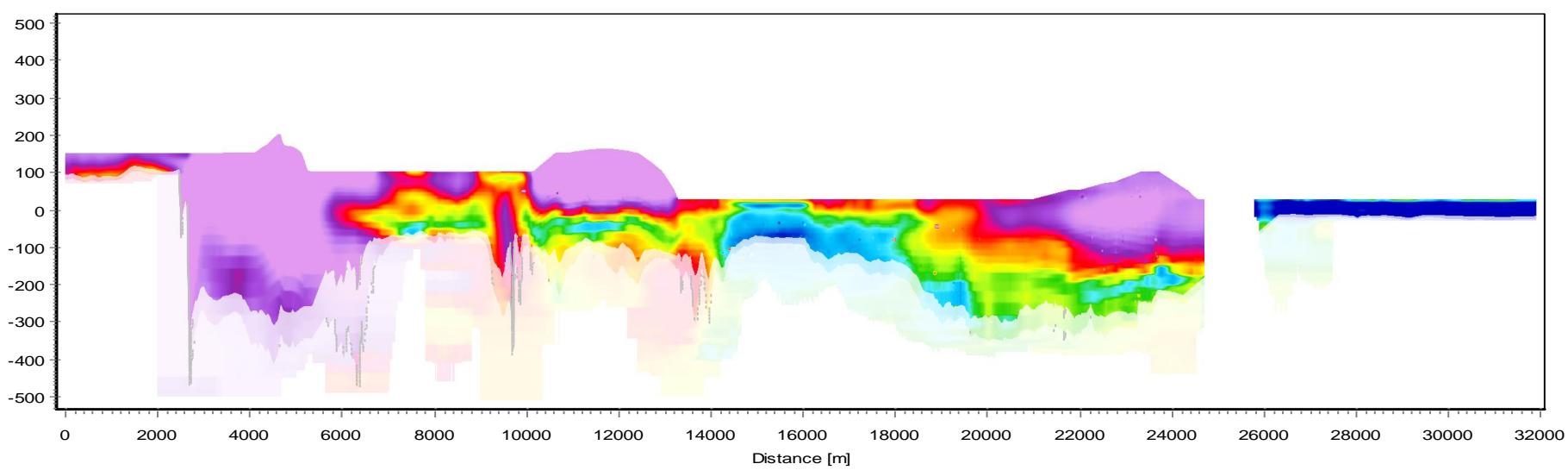
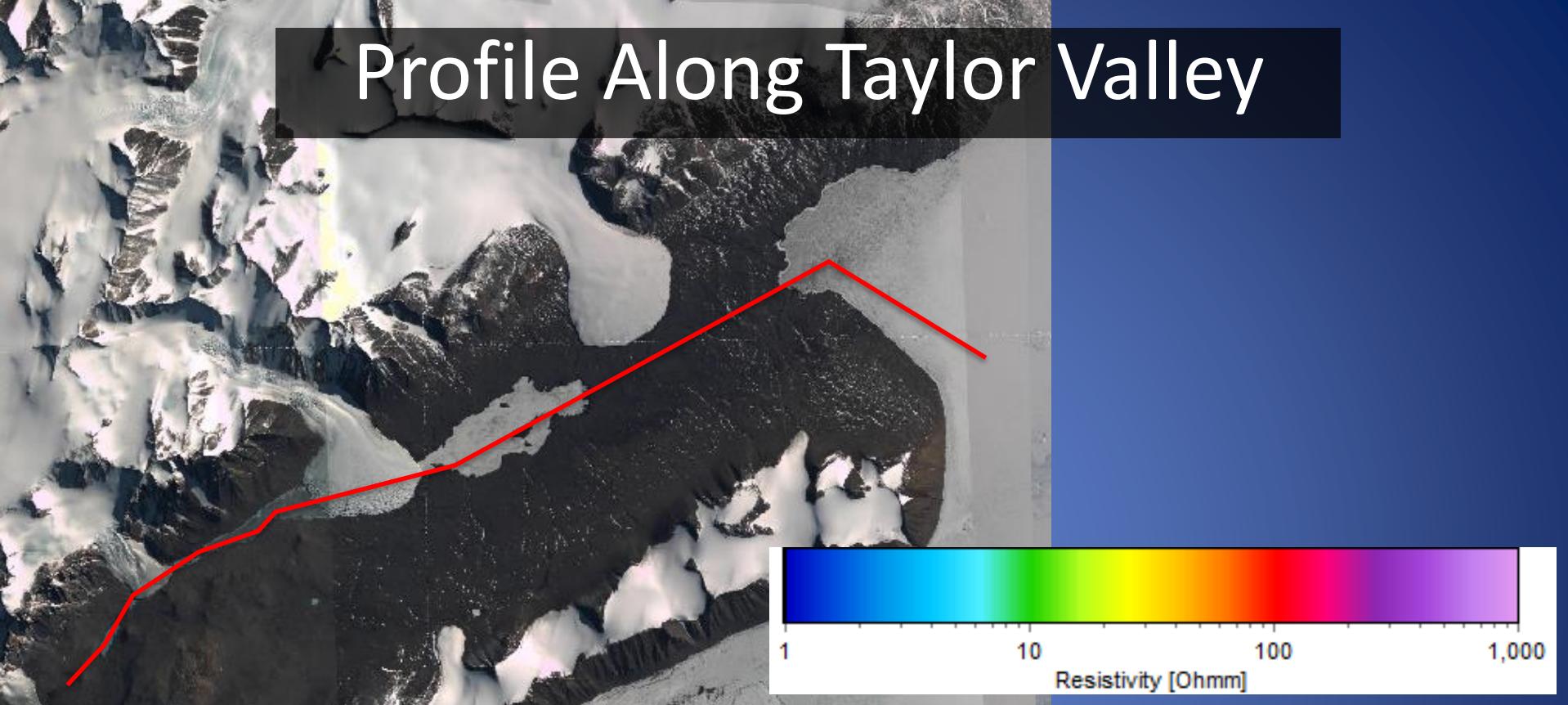
Real Data for Blood Falls



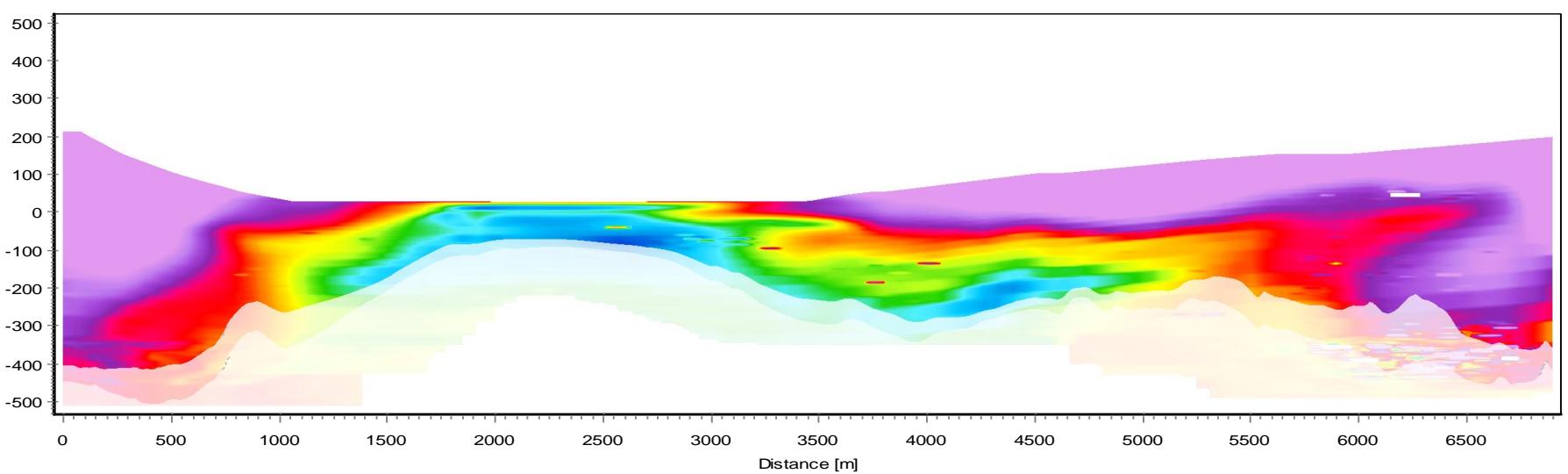
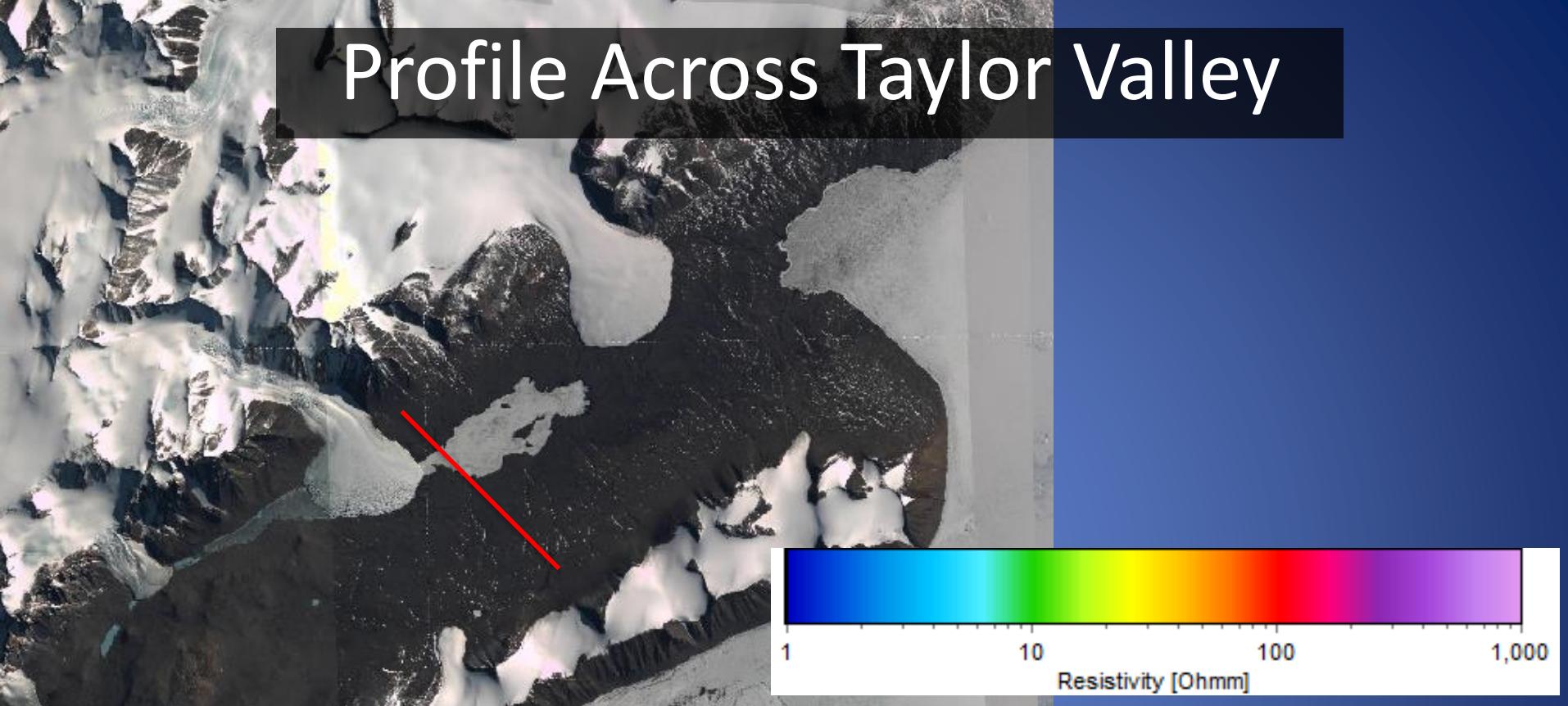
Real Data for Blood Falls



Profile Along Taylor Valley

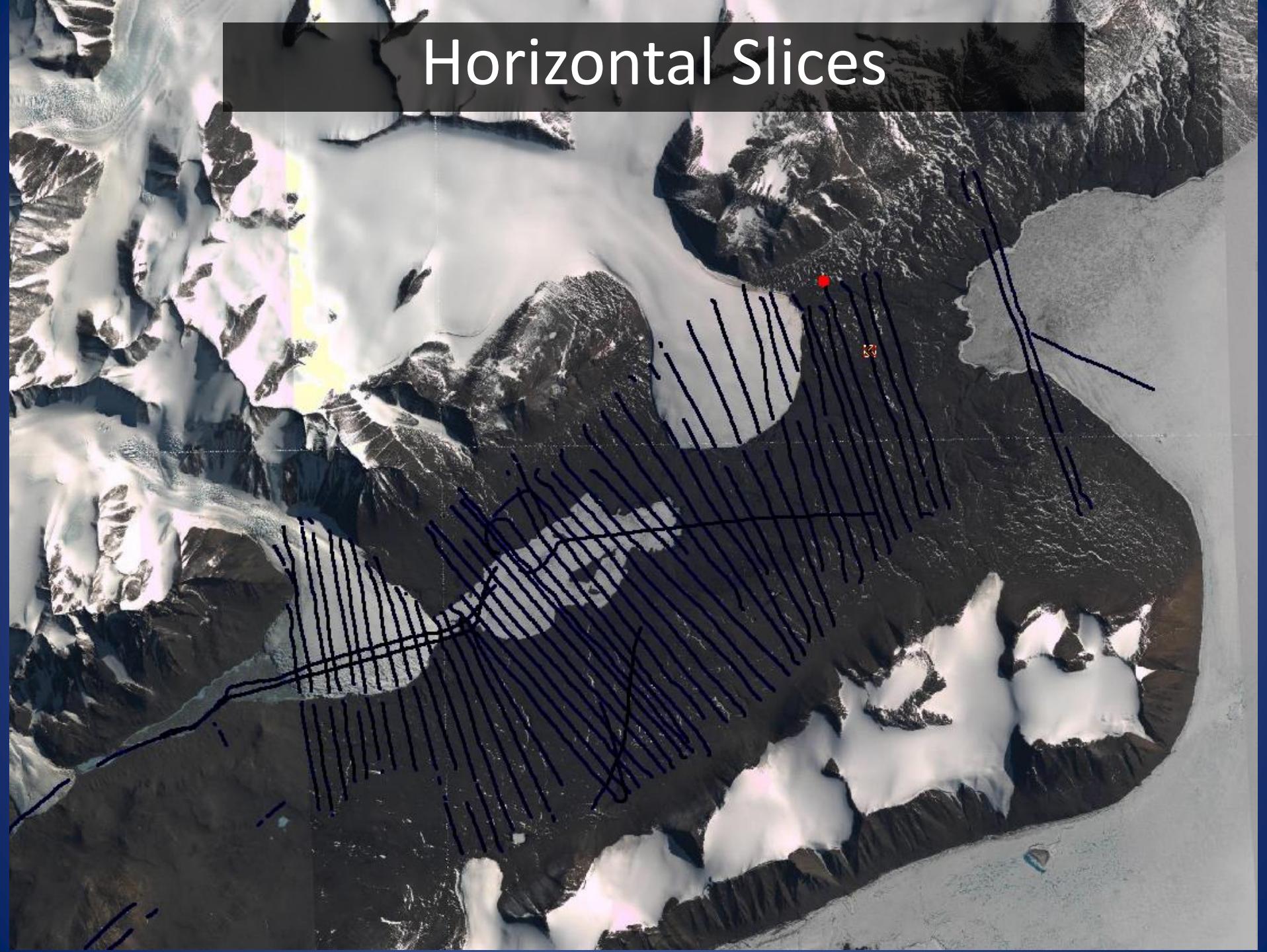


Profile Across Taylor Valley

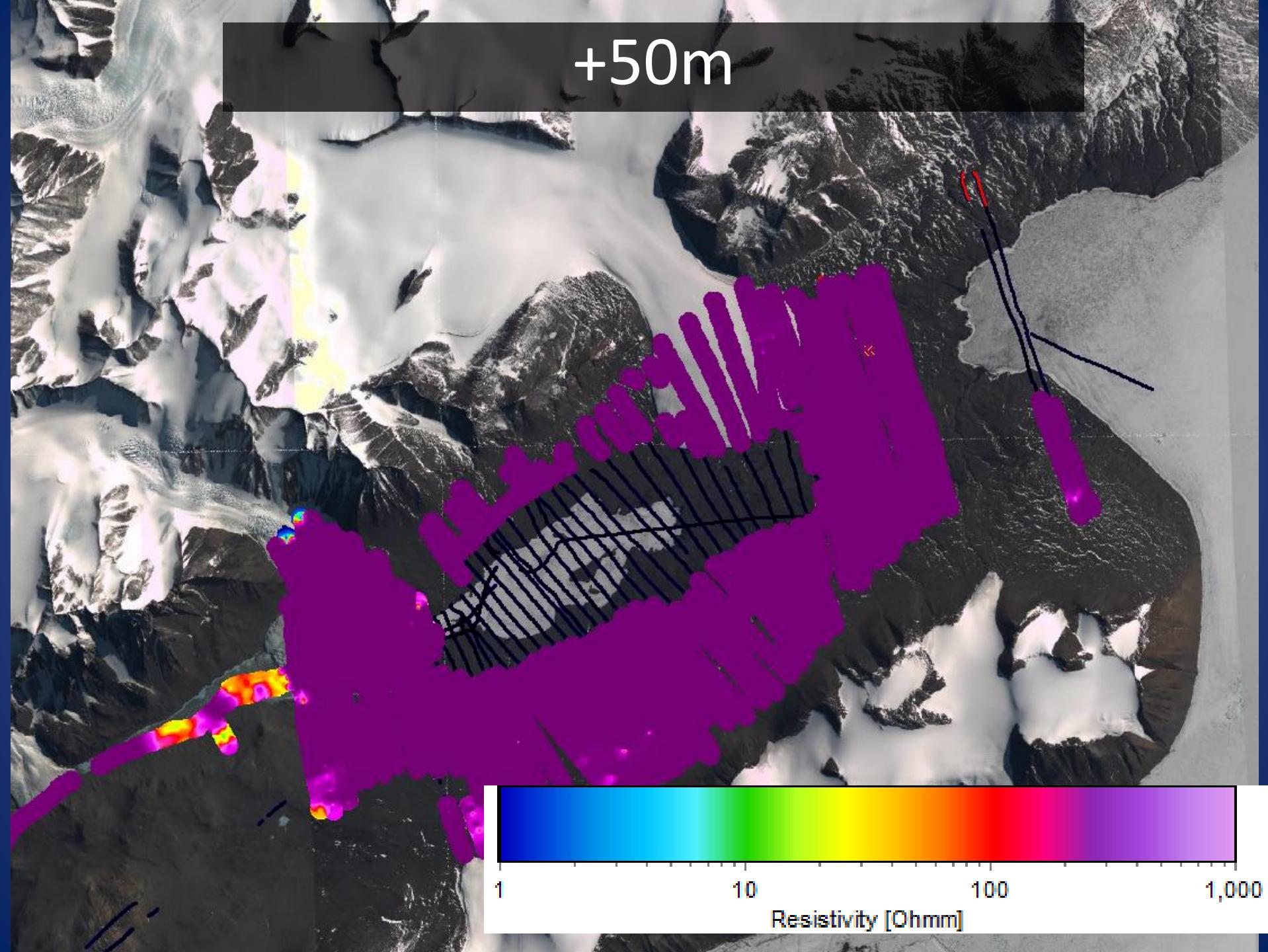




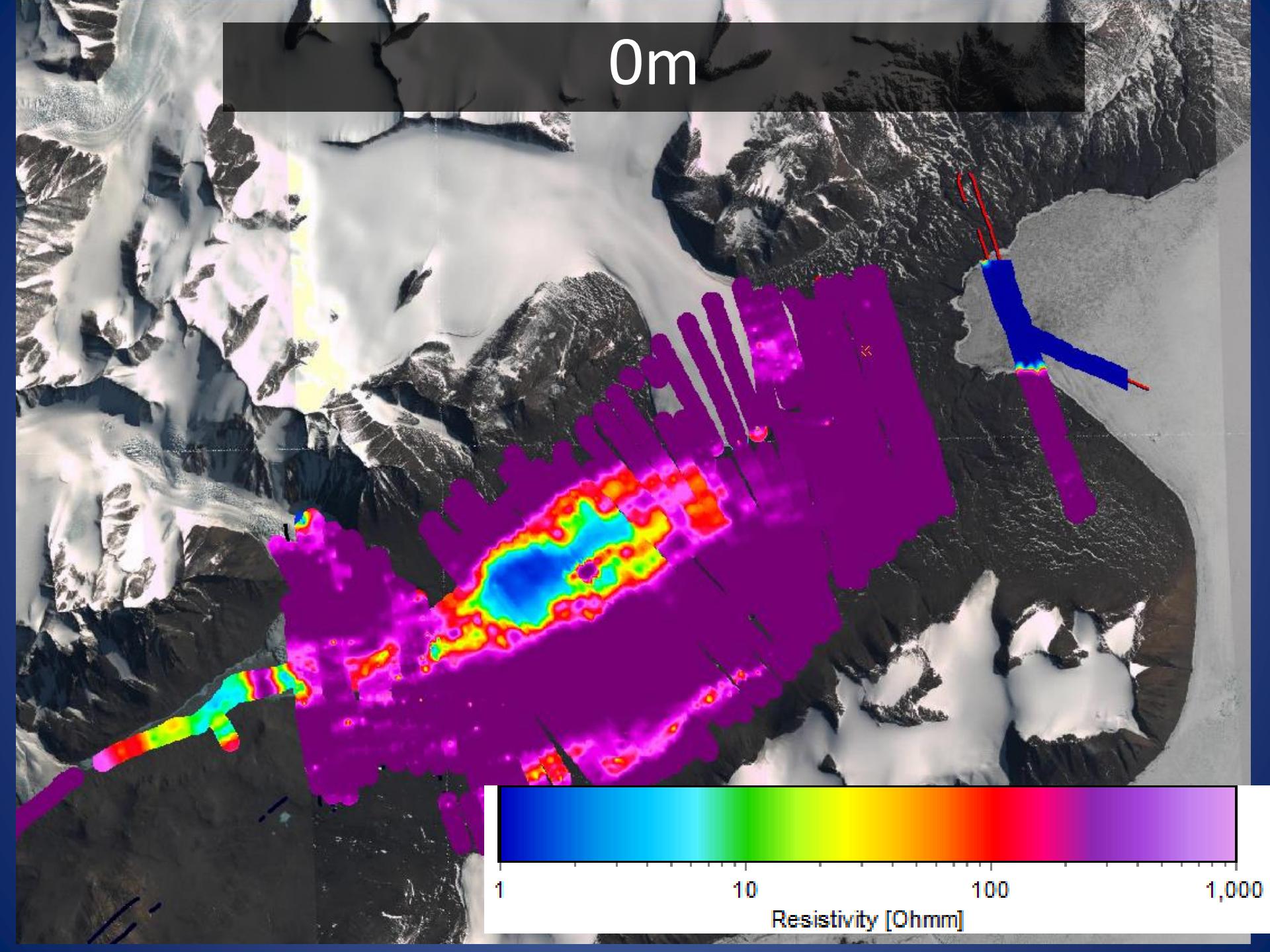
Horizontal Slices



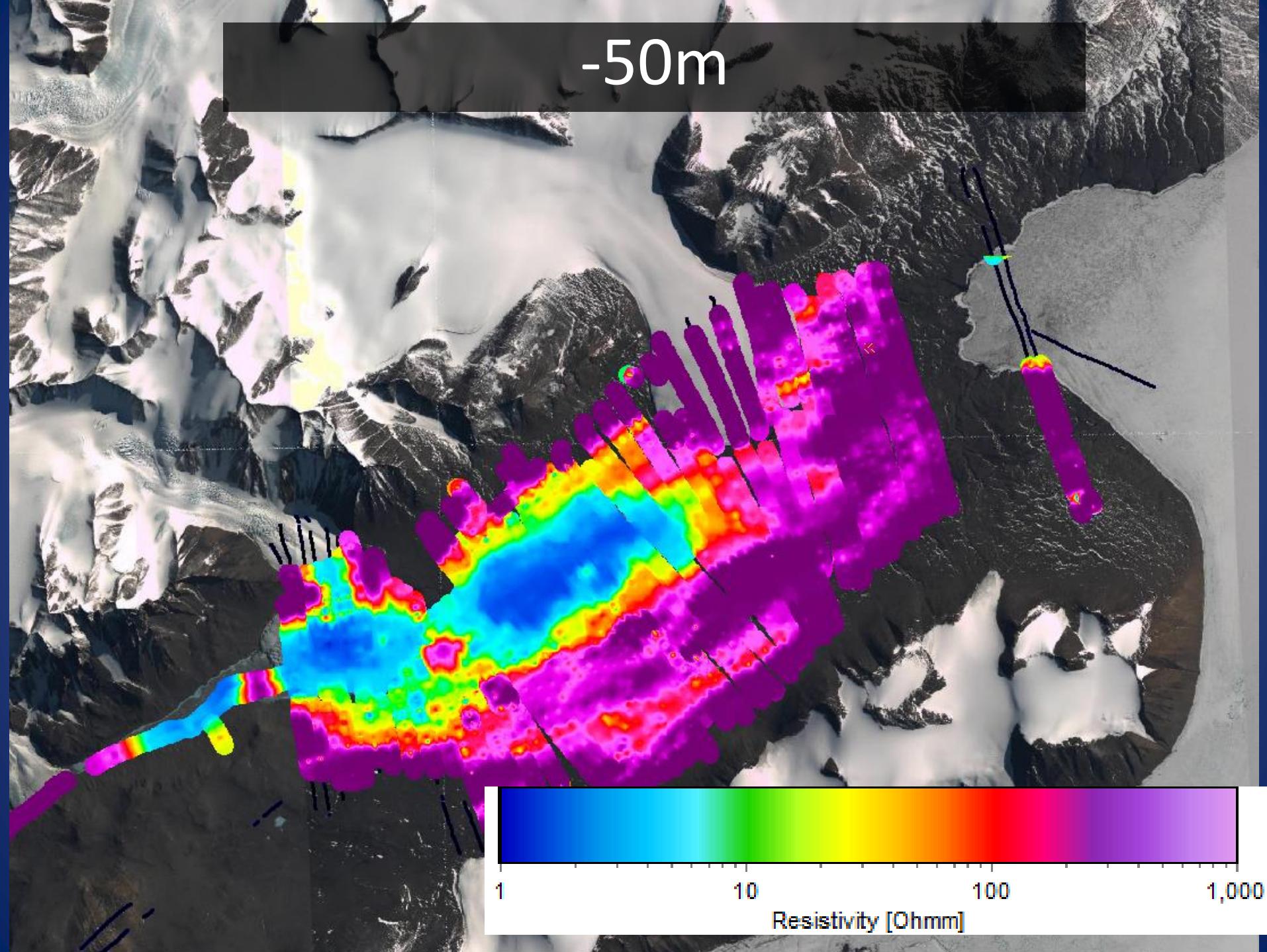
+50m



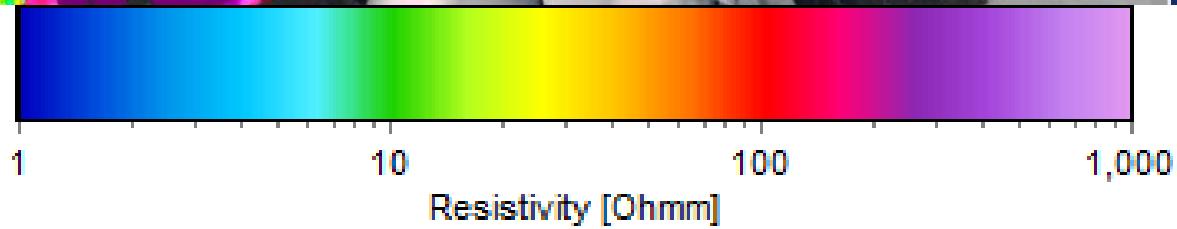
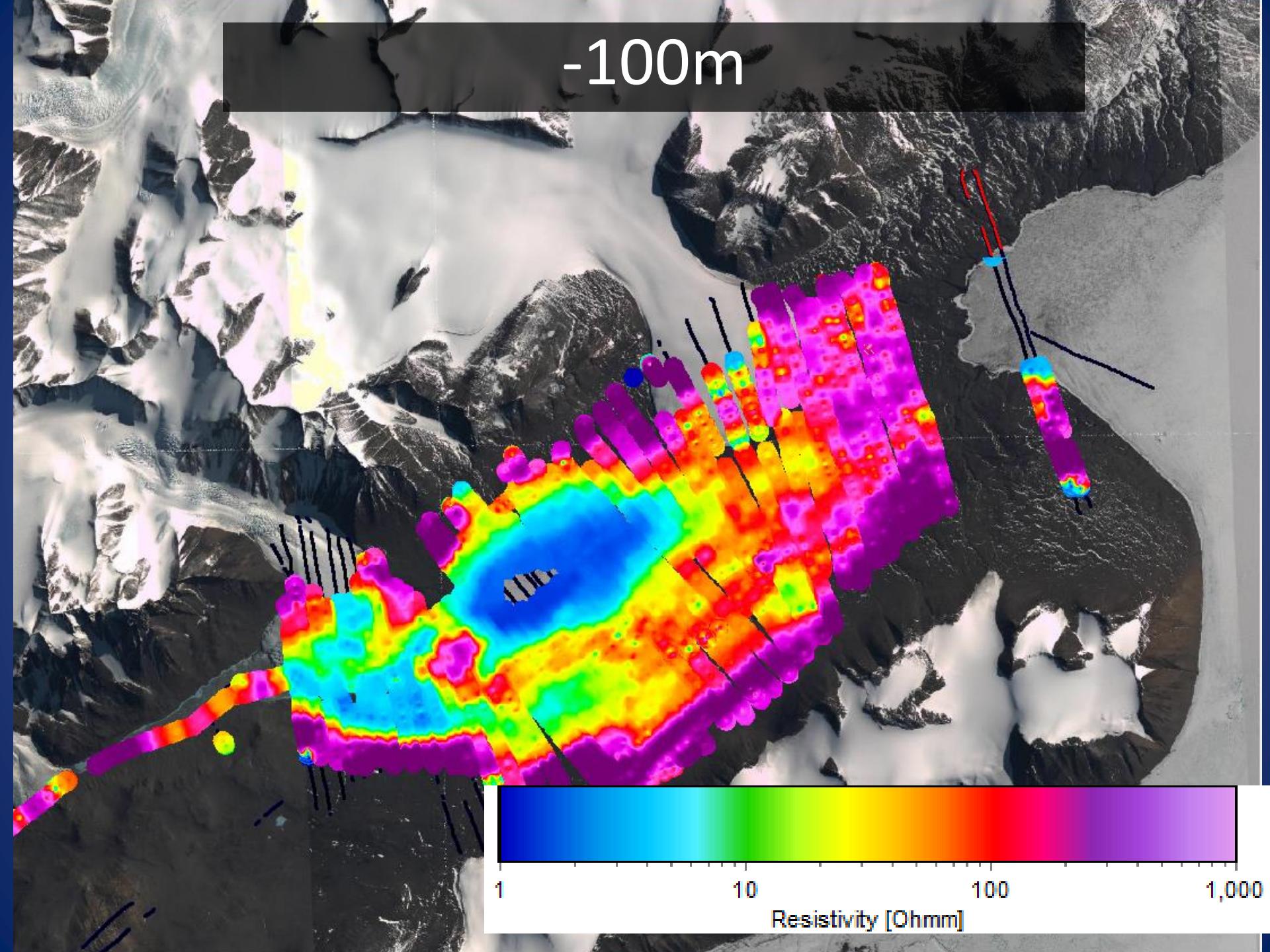
0m



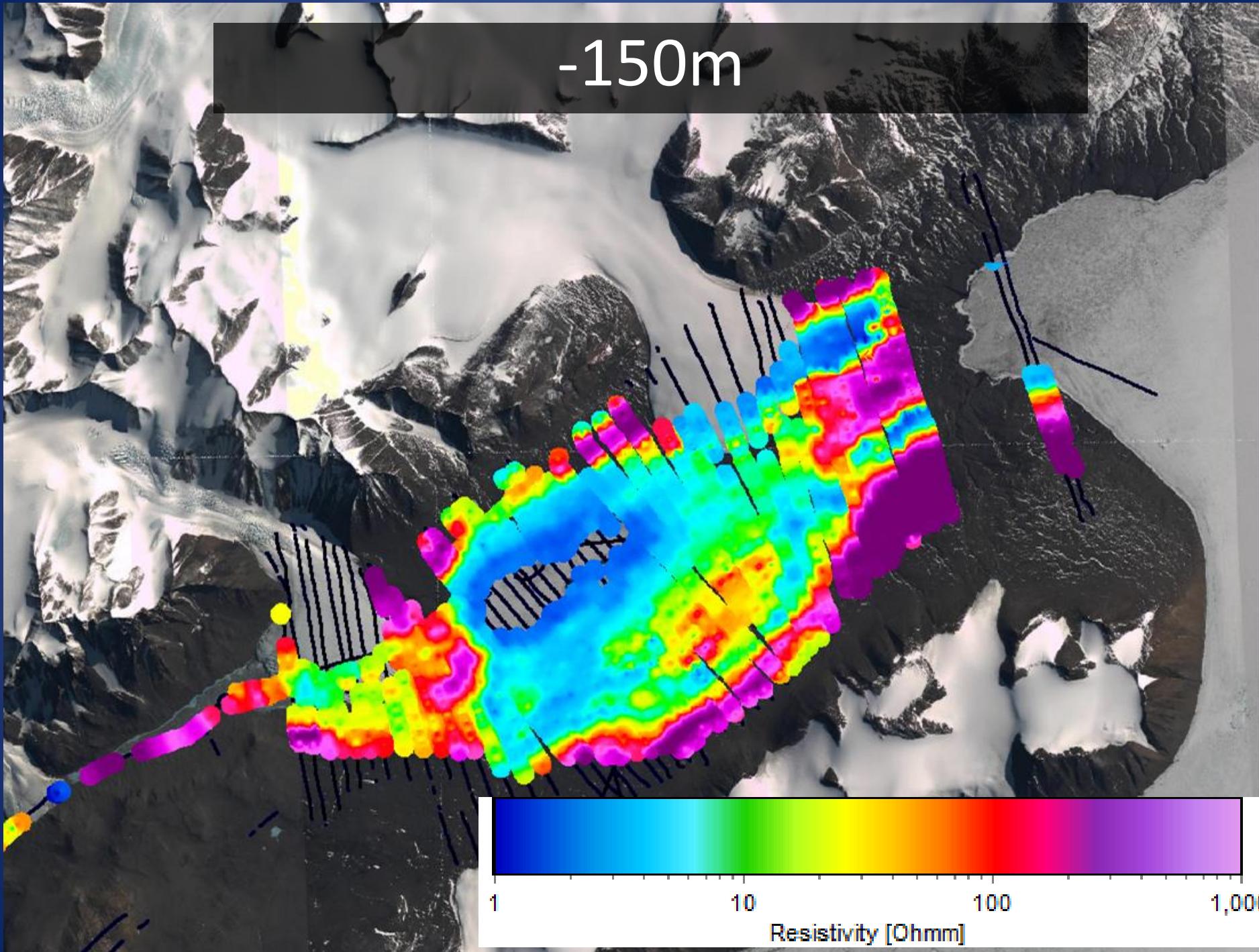
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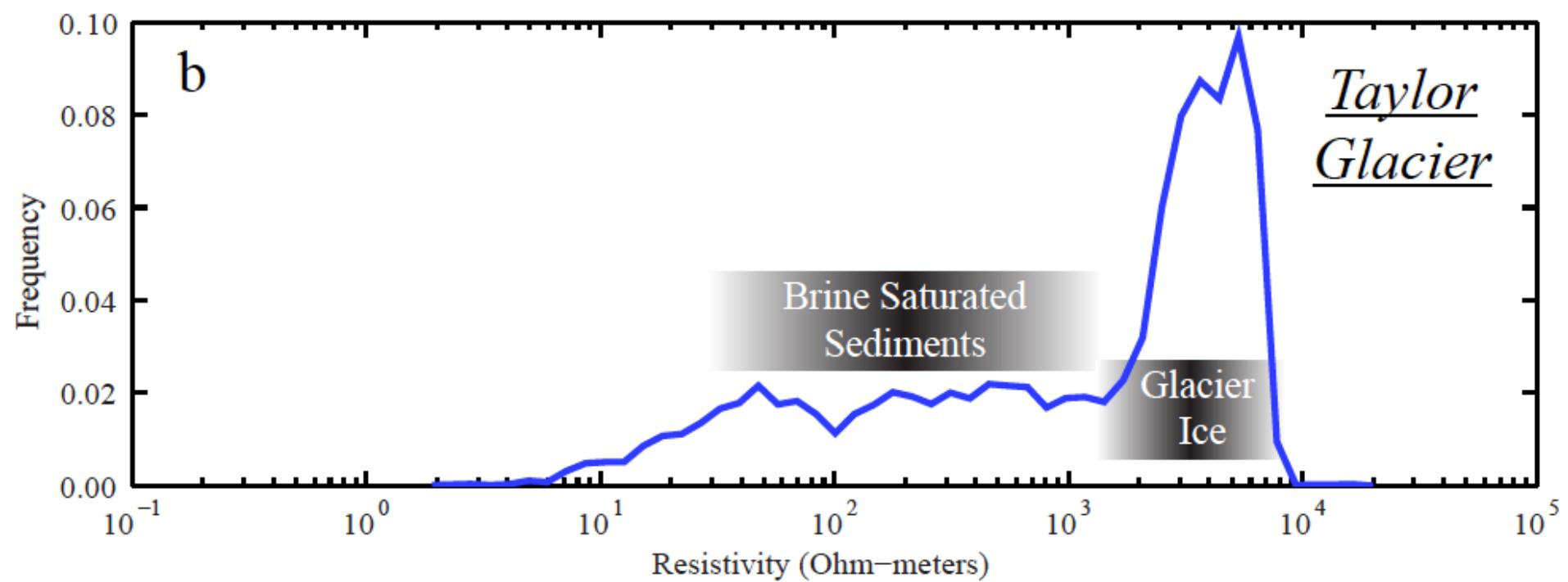
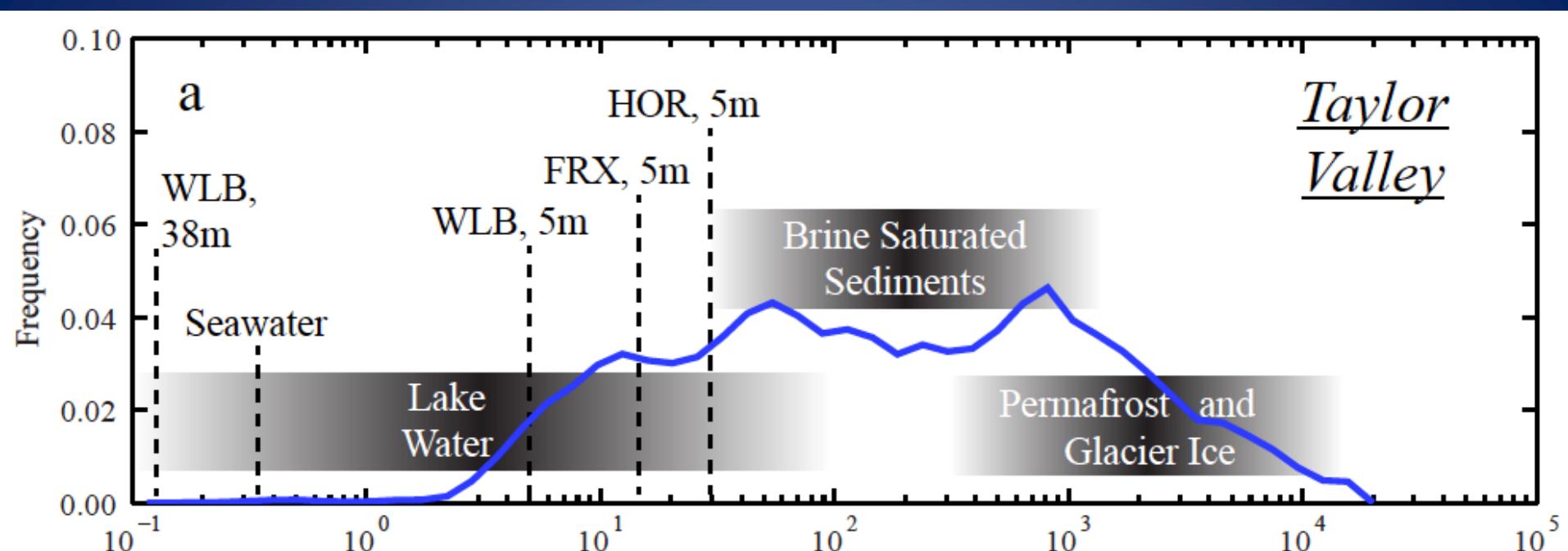


-100m

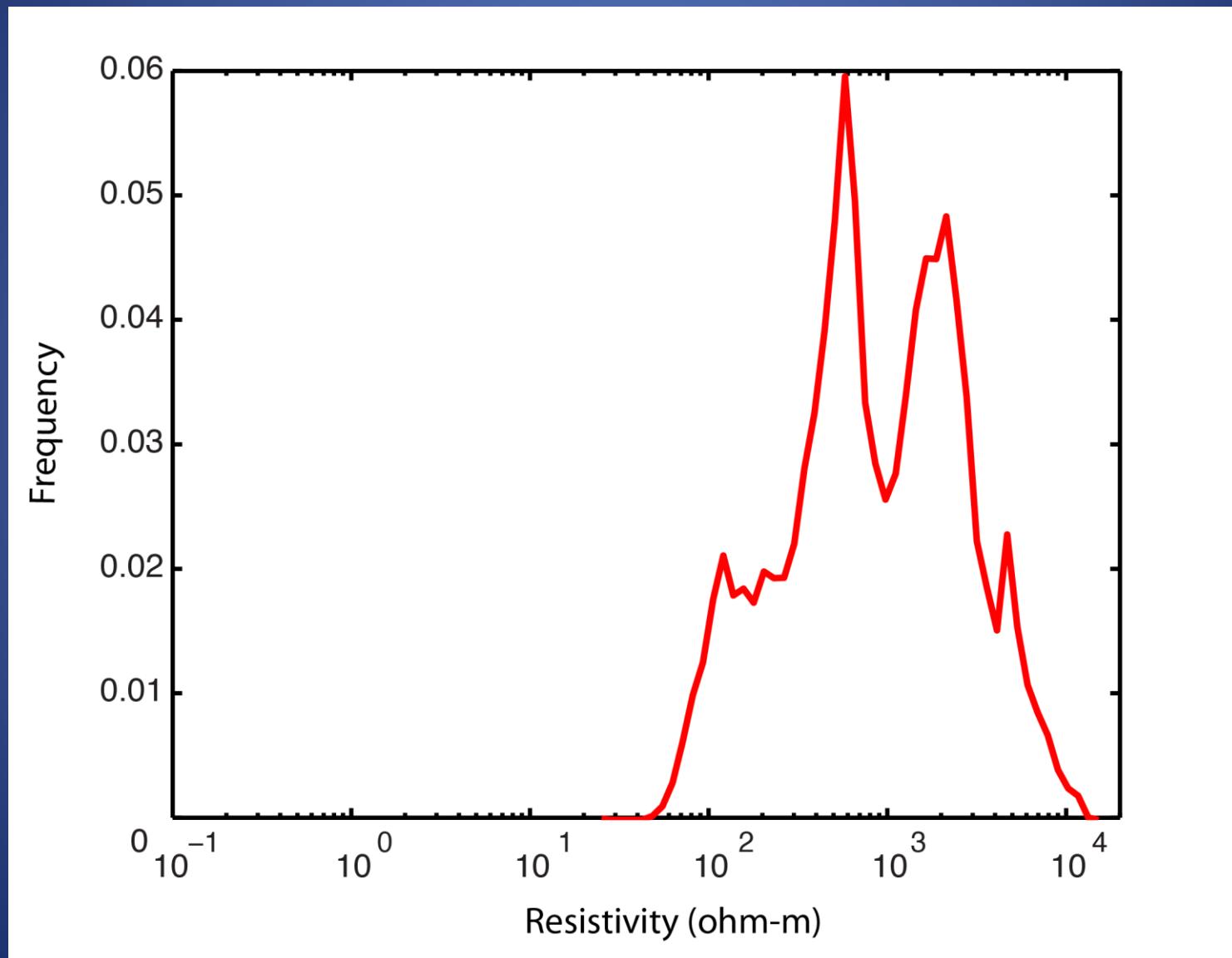


-150m

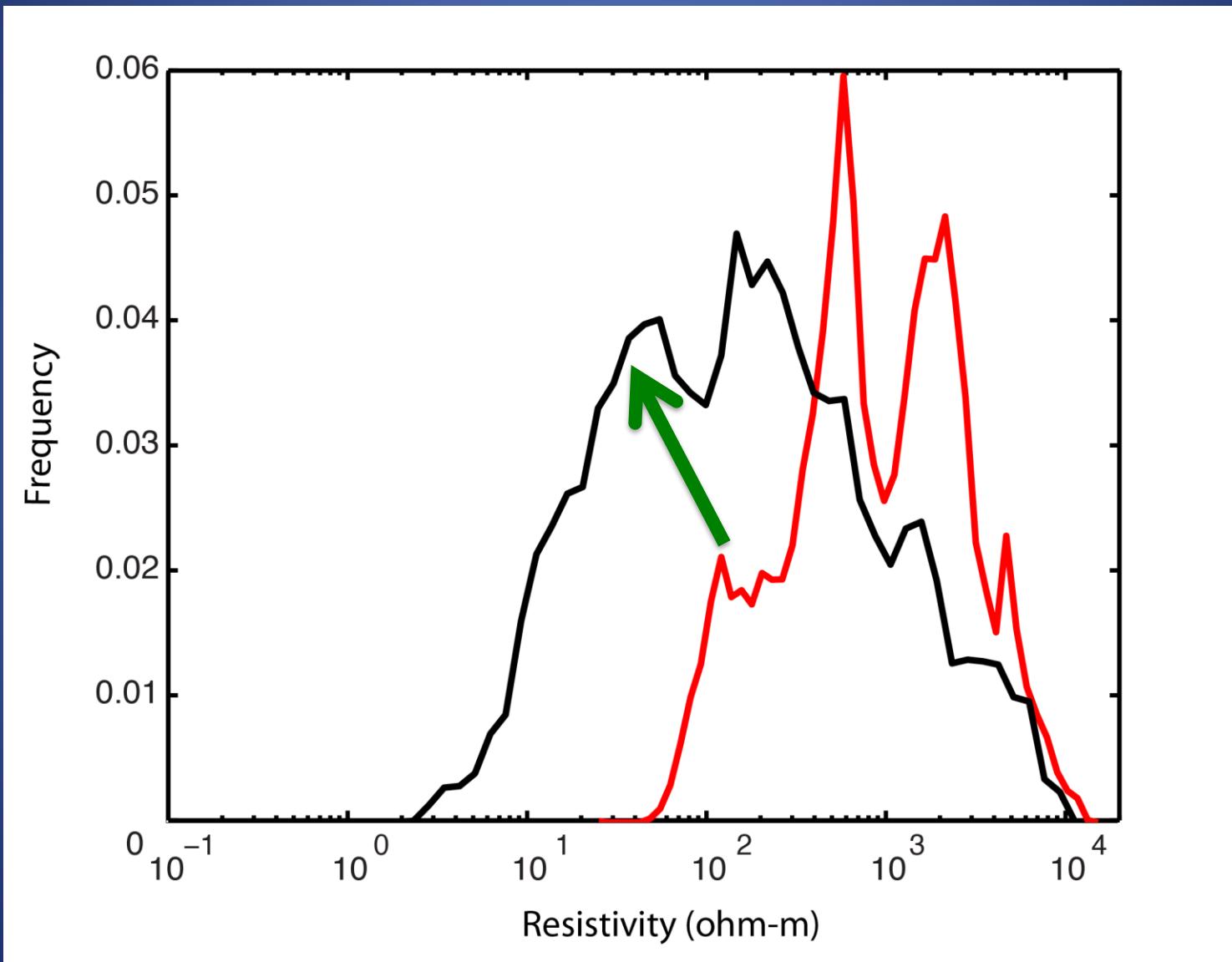




Permafrost, 3m Below Surface



Permafrost, 150m Below Surface



Results

- Much of Taylor Valley is underlain by shallow brines, *contra* previous research
- The source for Blood Falls is mapable
- SkyTEM is a feasible method for widespread, no impact subsurface mapping in polar enviros

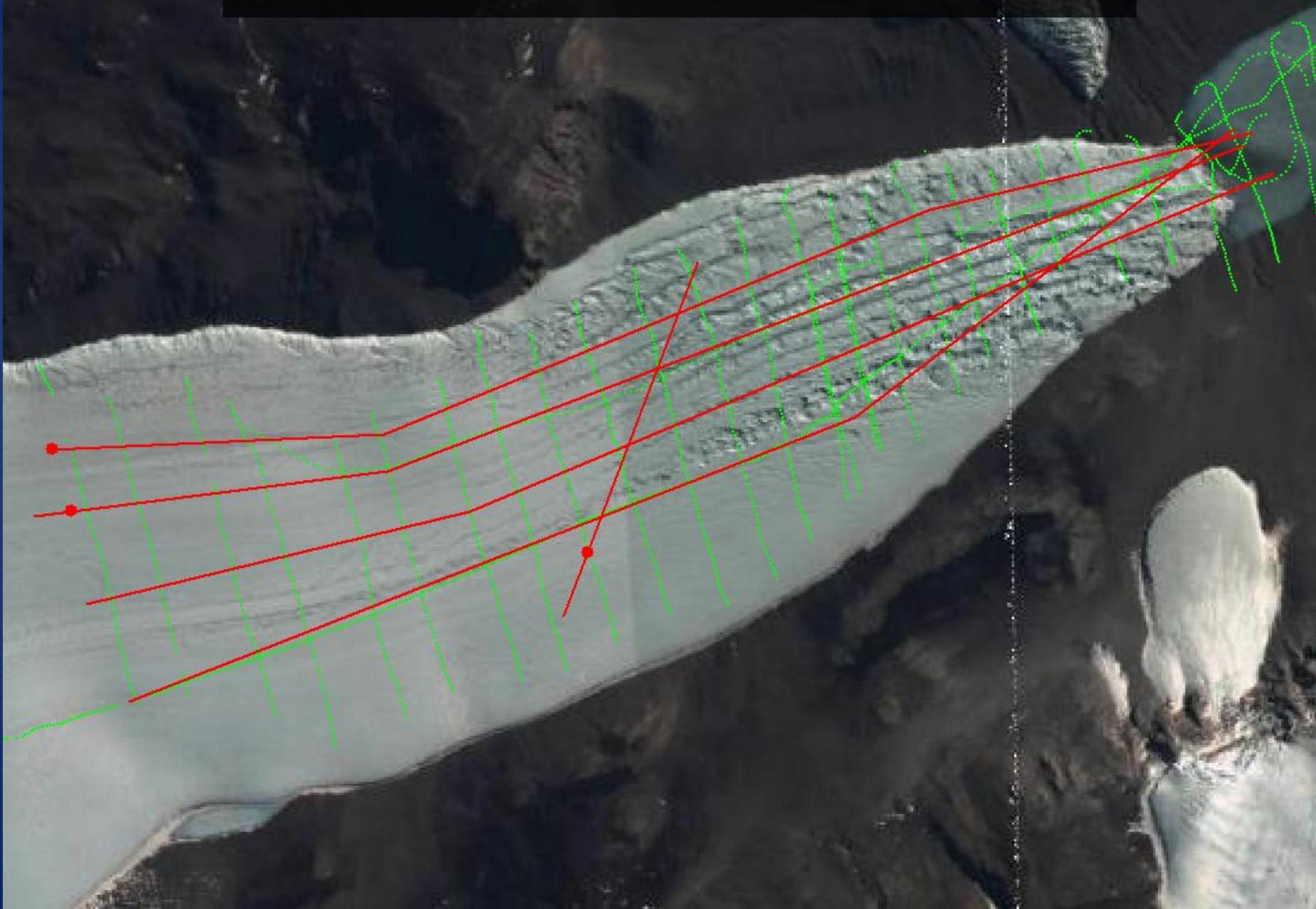
Next Steps

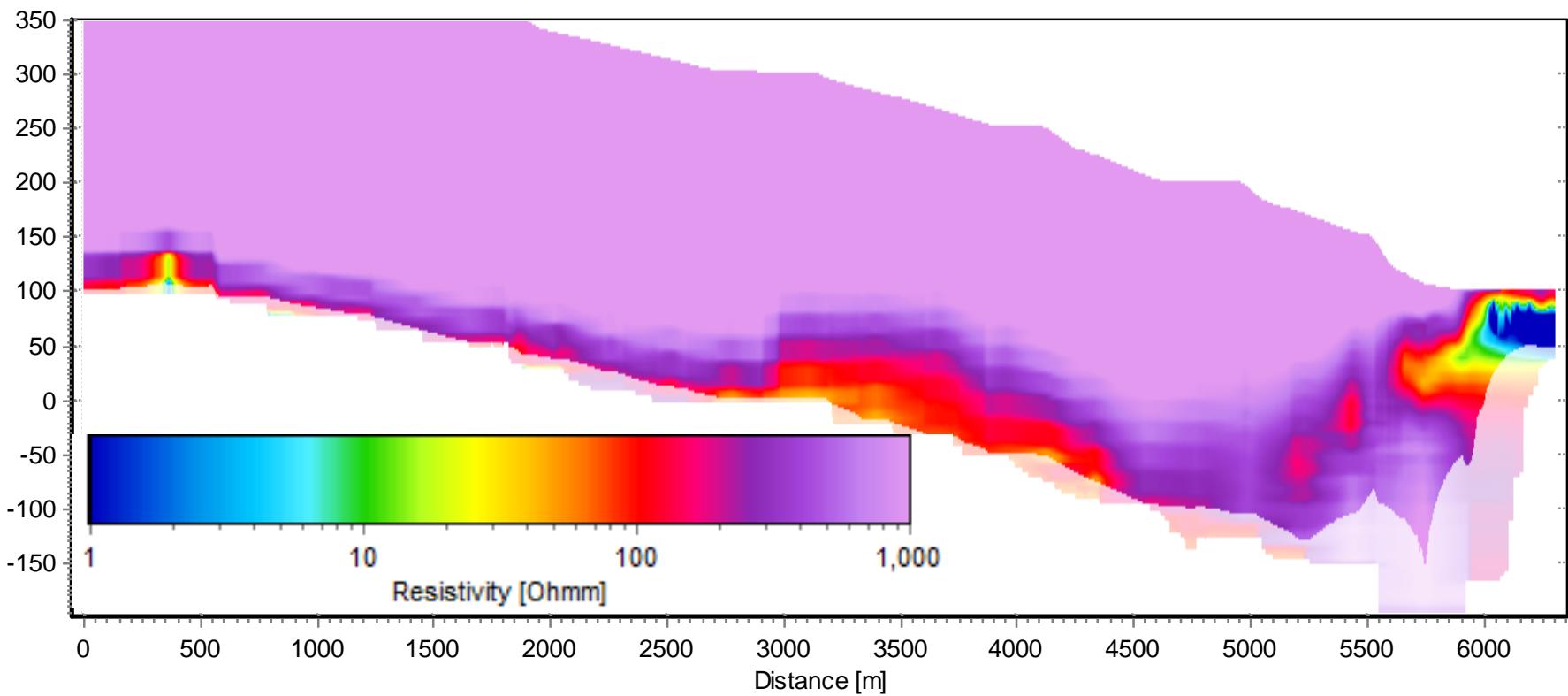
- Quantify volume of brines
- Hydrologic history and balance of the Dry Valleys
- Delivery of nutrients to the coastal ocean?
- Is this typical of lots of Antarctic coasts?
- Implications for life in Dry Valleys and off-planet?
- Use TEM off-planet?

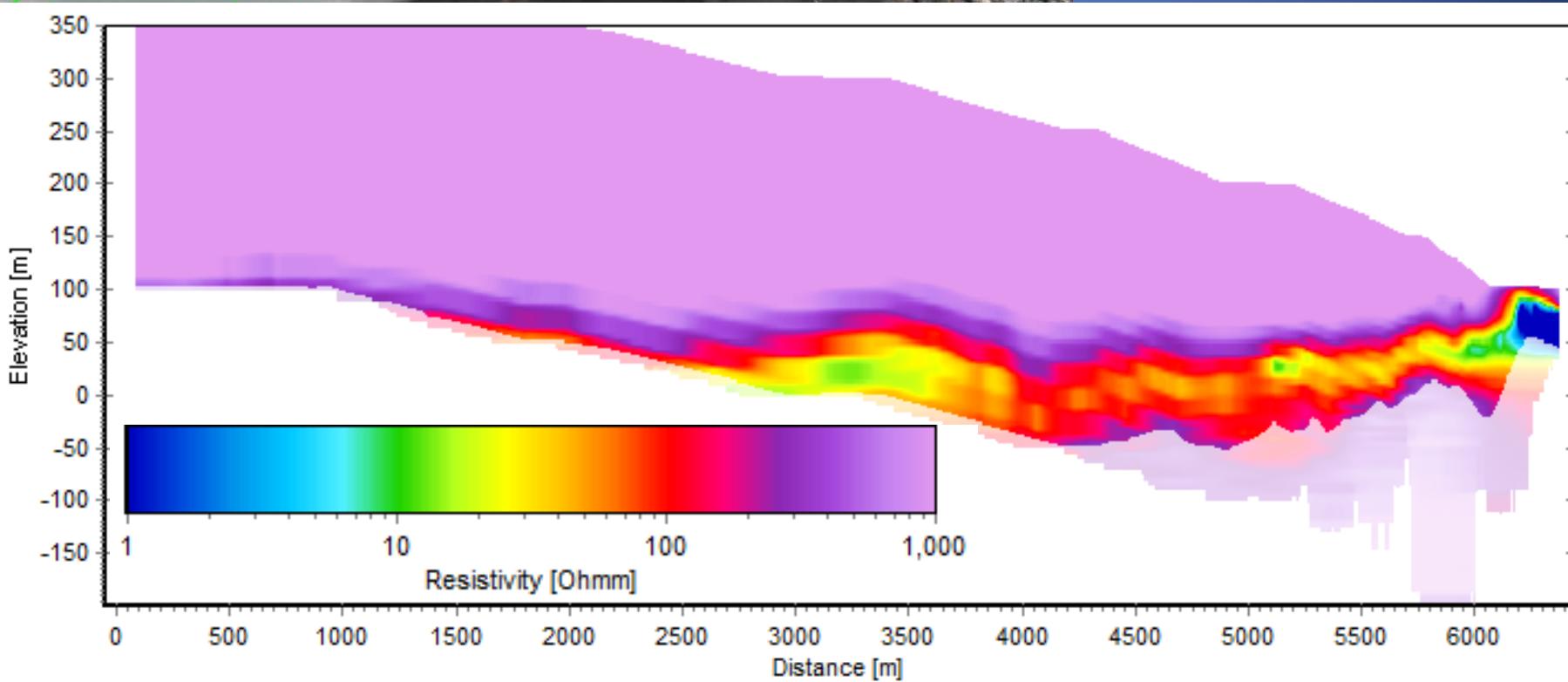
A seal is lying on a field of white, textured ice. It is facing towards the right of the frame. A large, thin-lined speech bubble originates from its mouth, containing the text "Questions?"

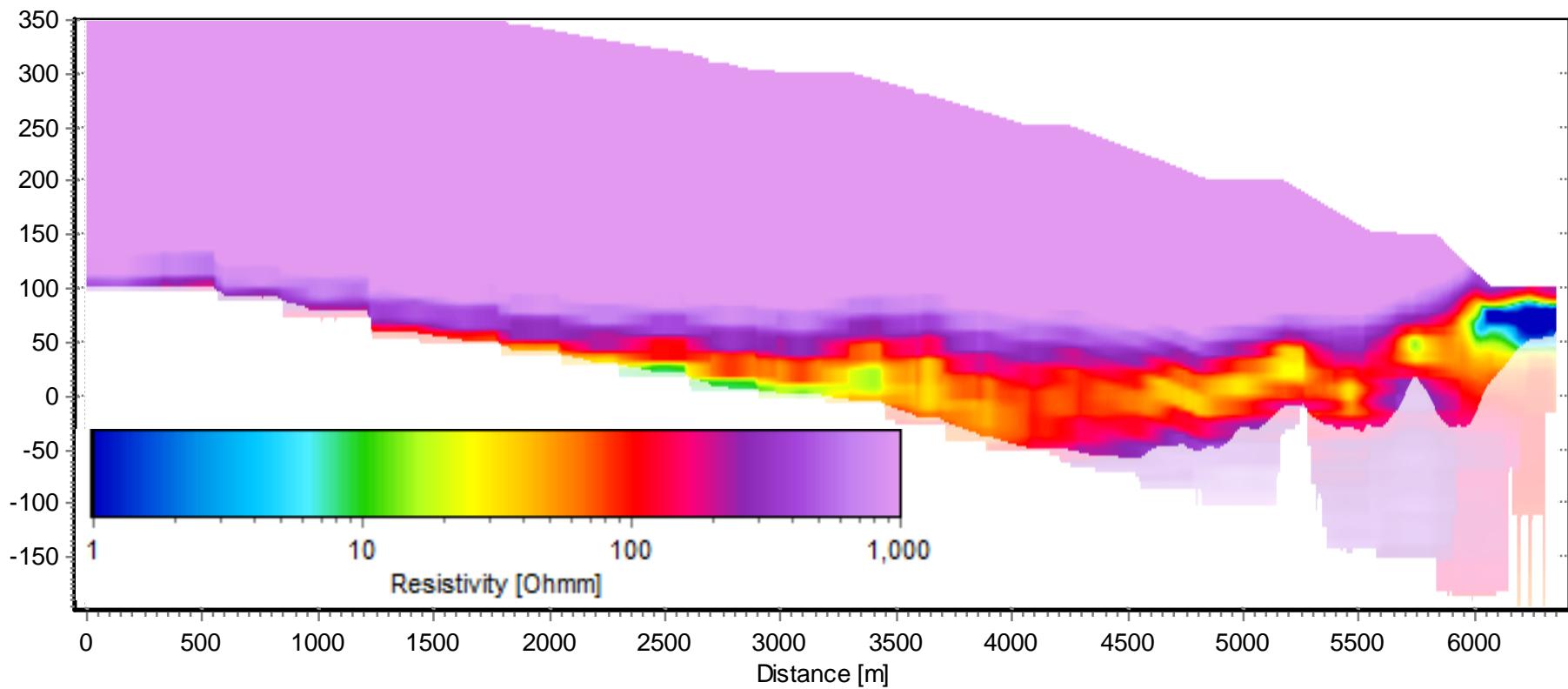
Questions?

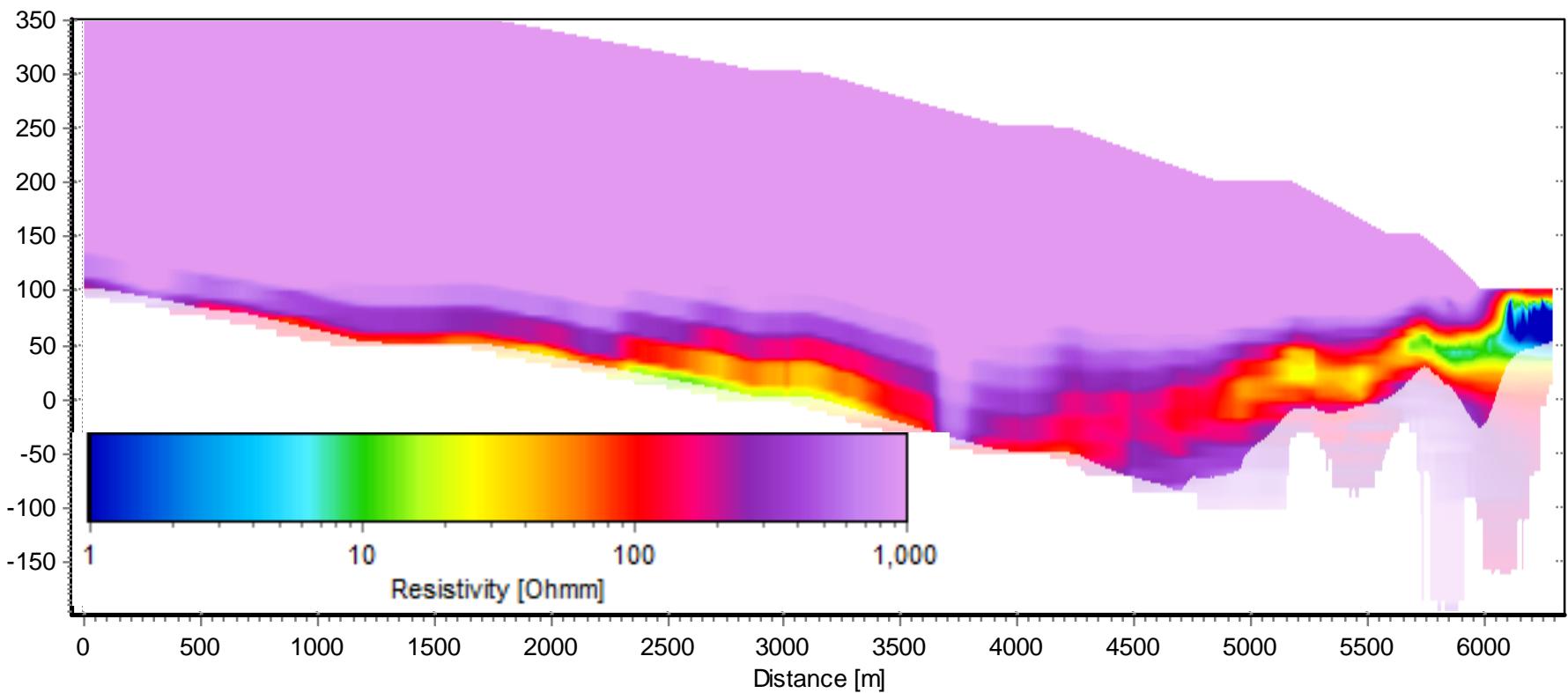
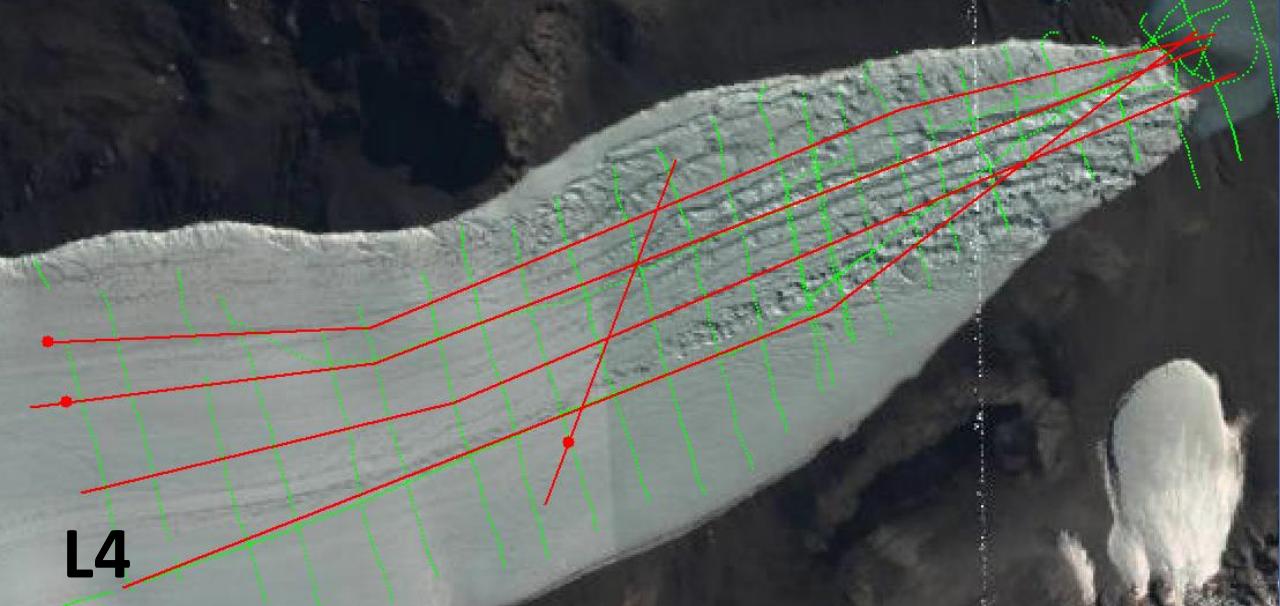
Along the Glacier

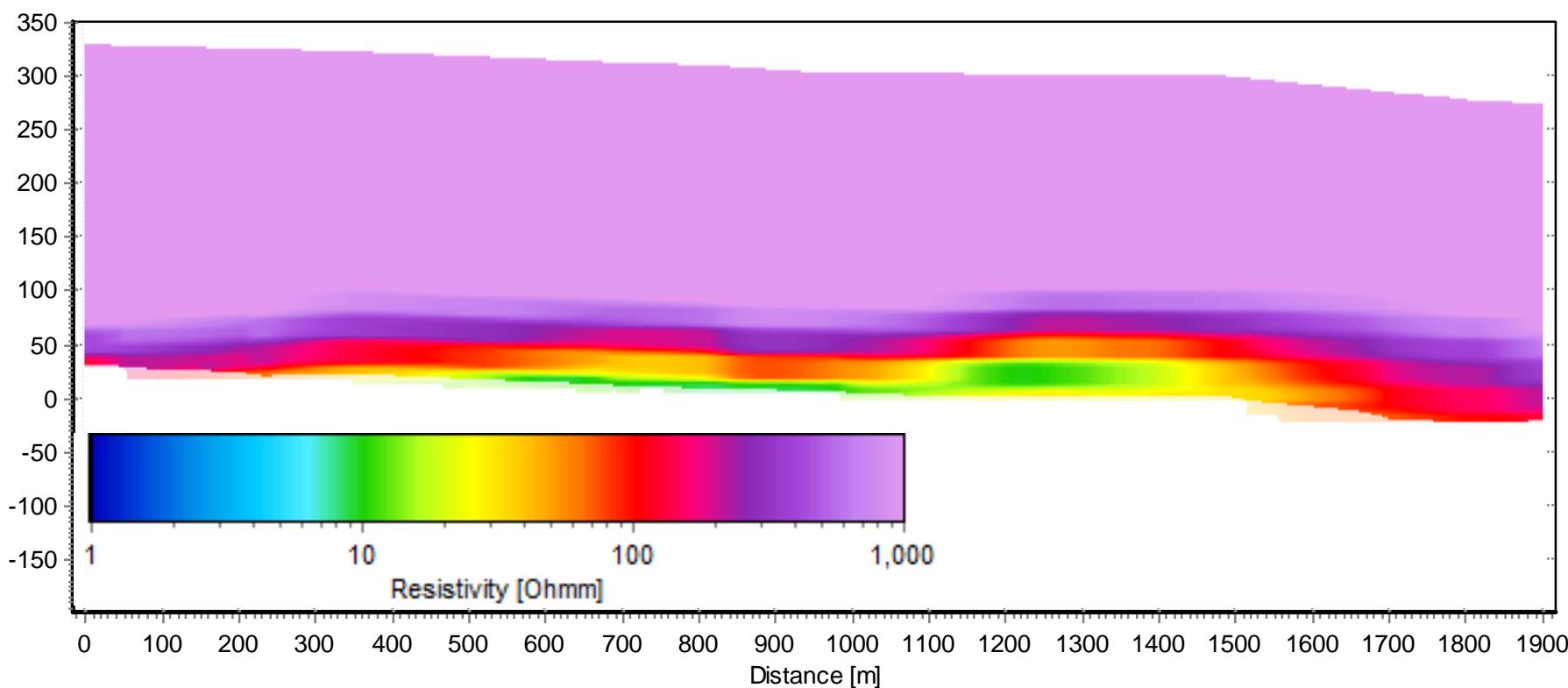
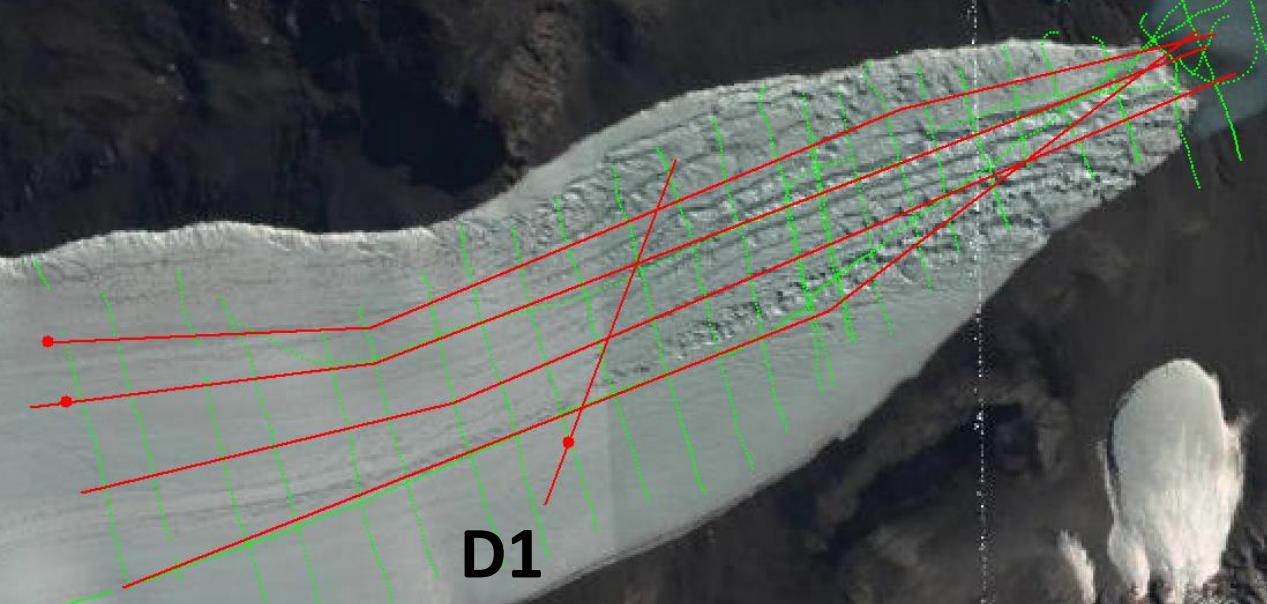




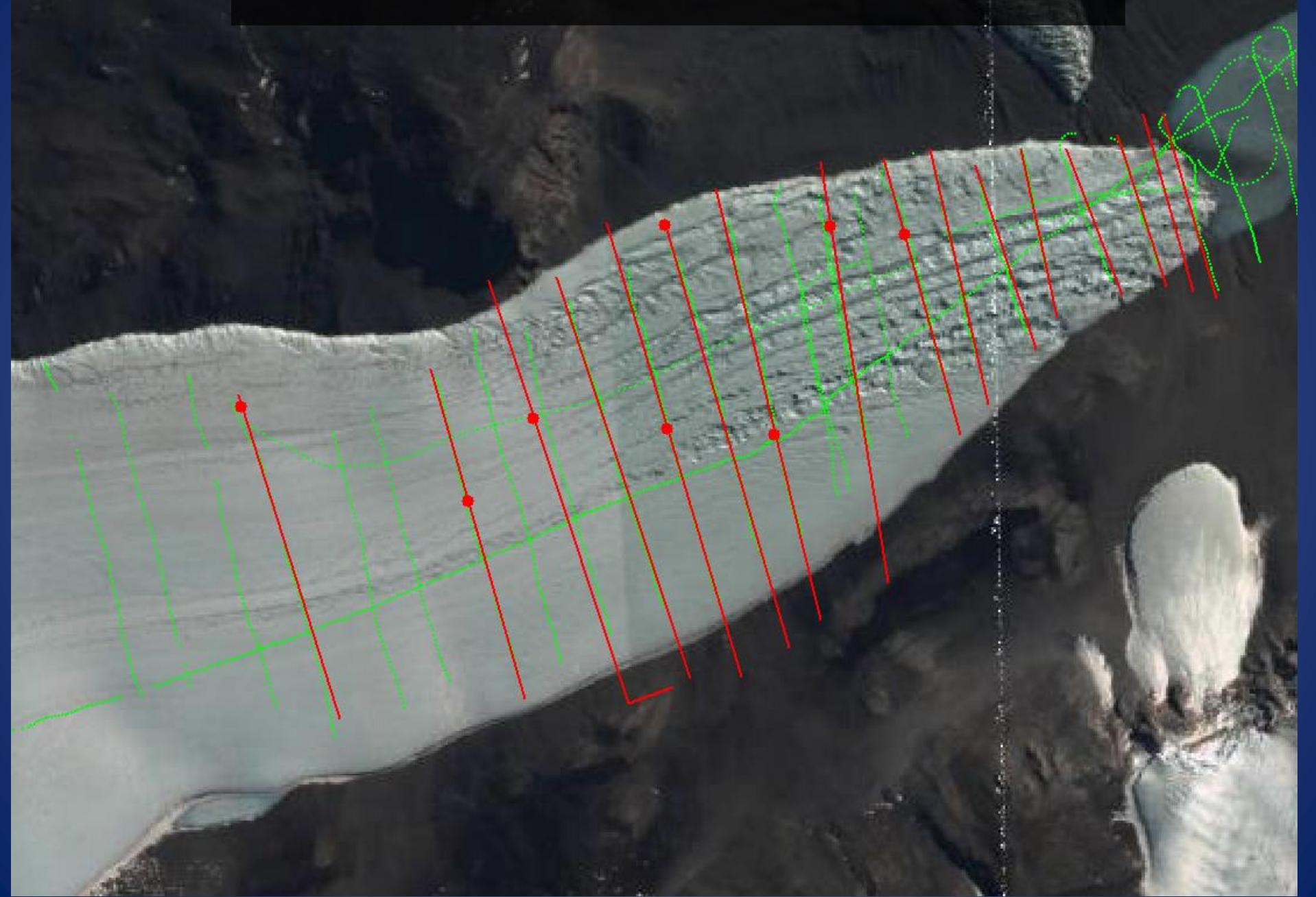


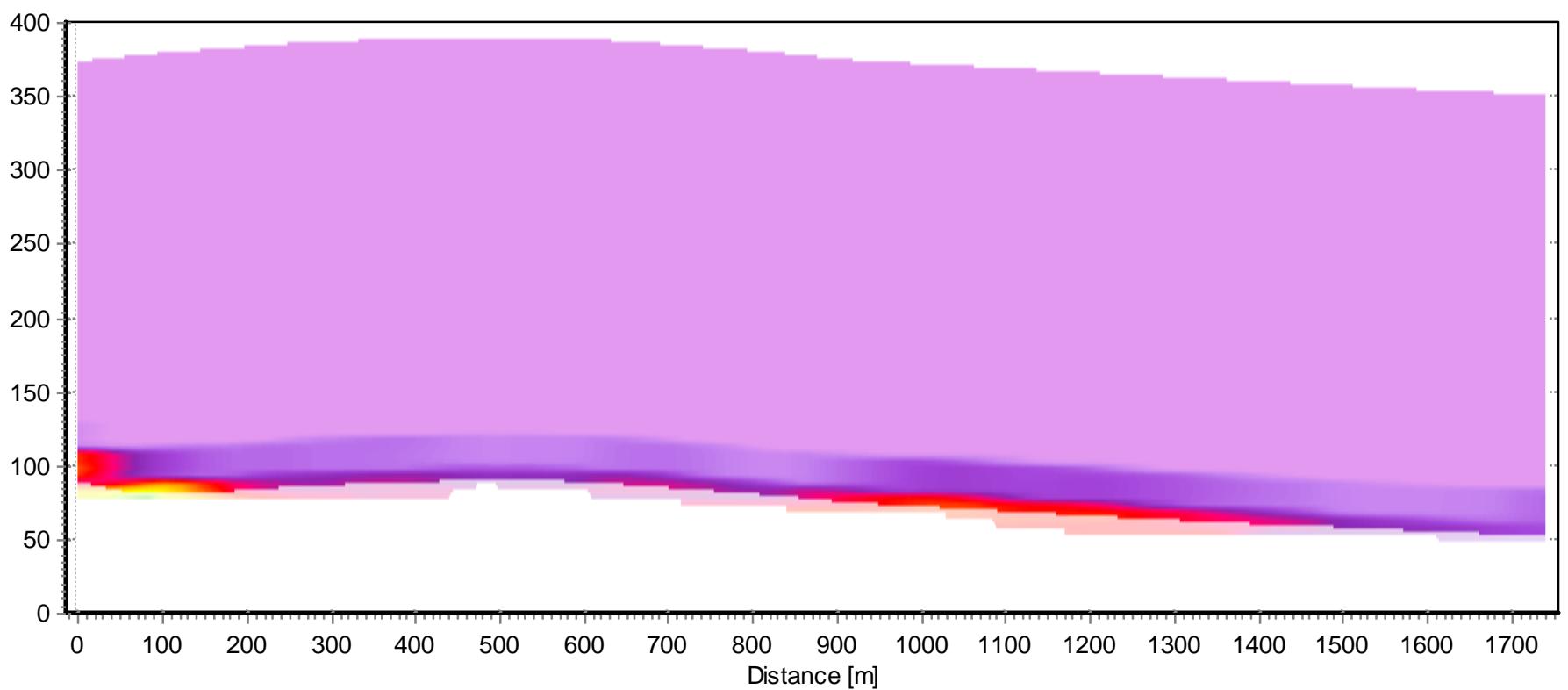
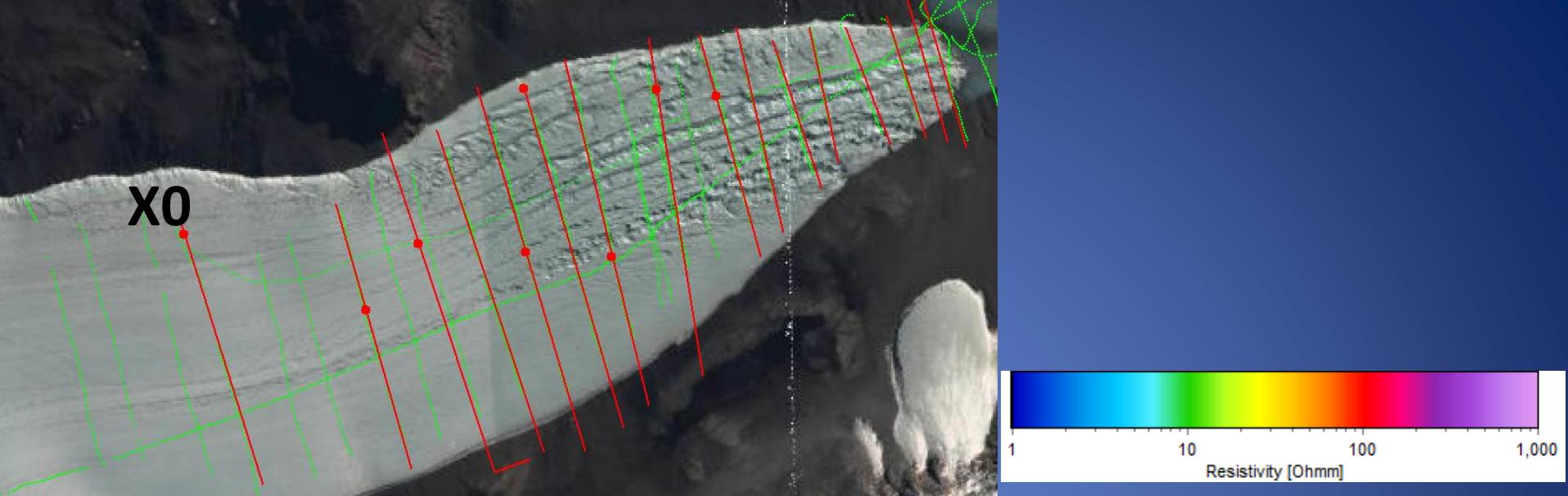


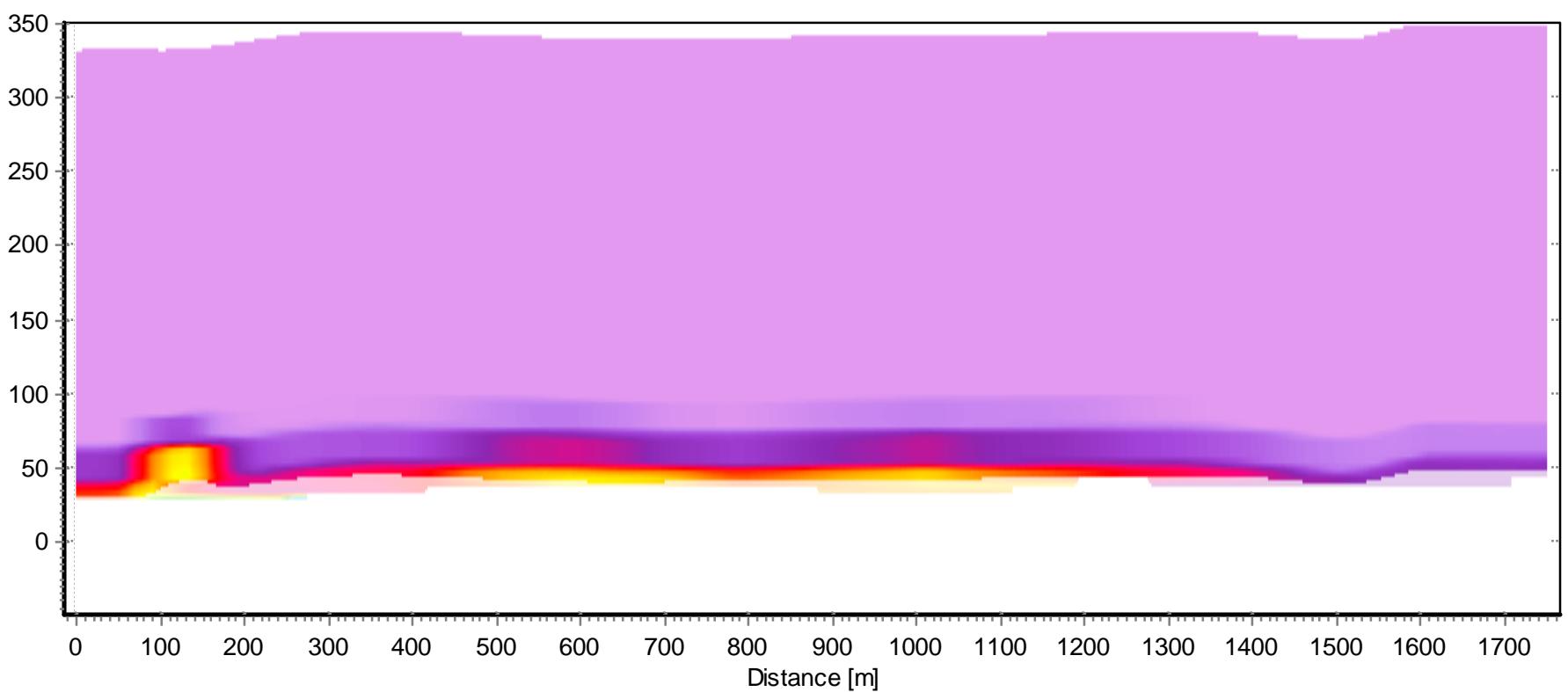
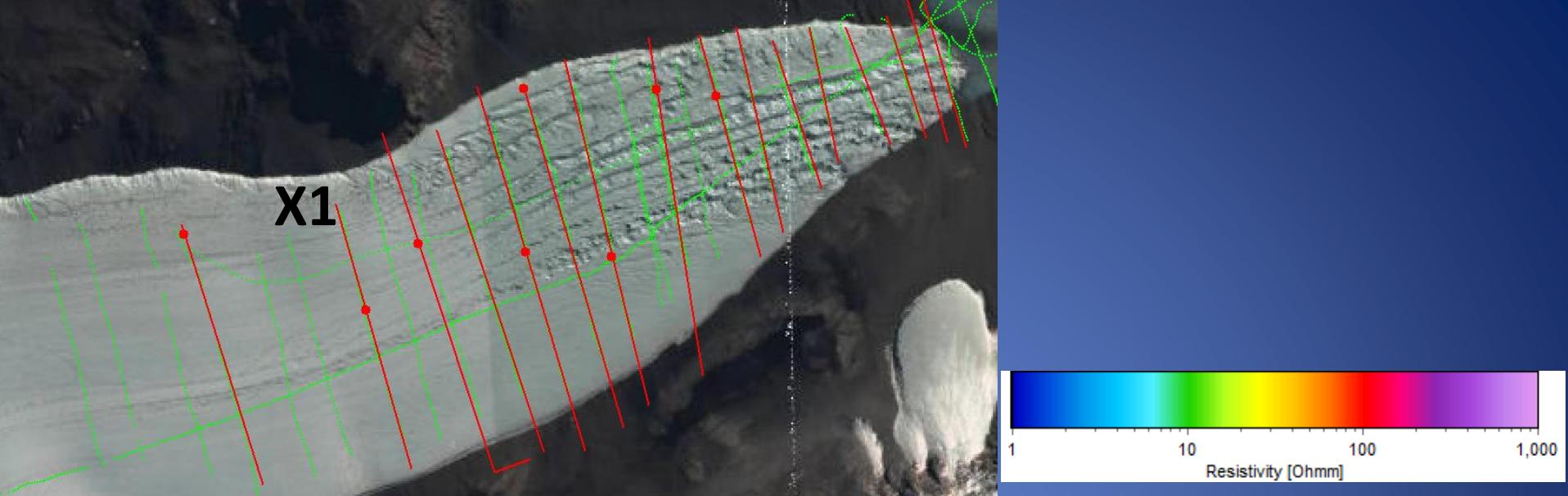


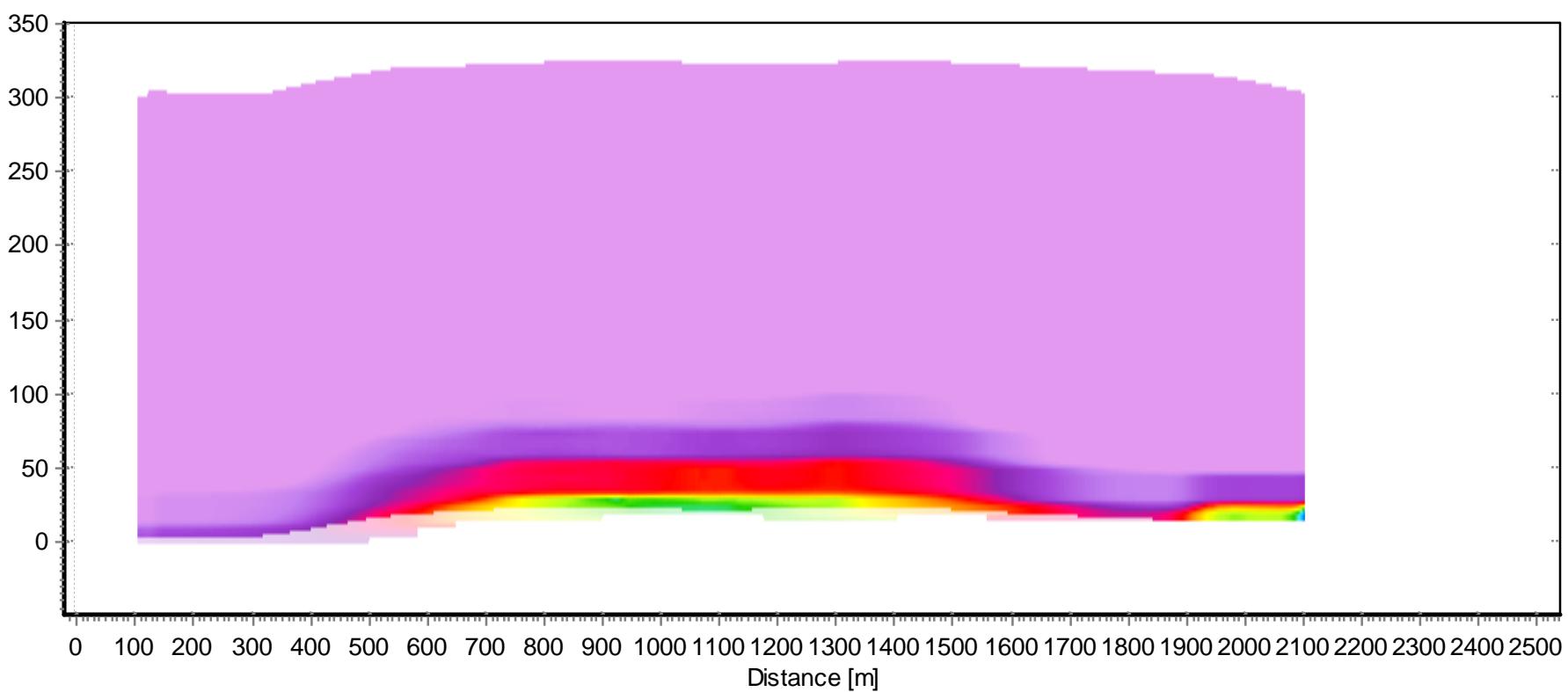
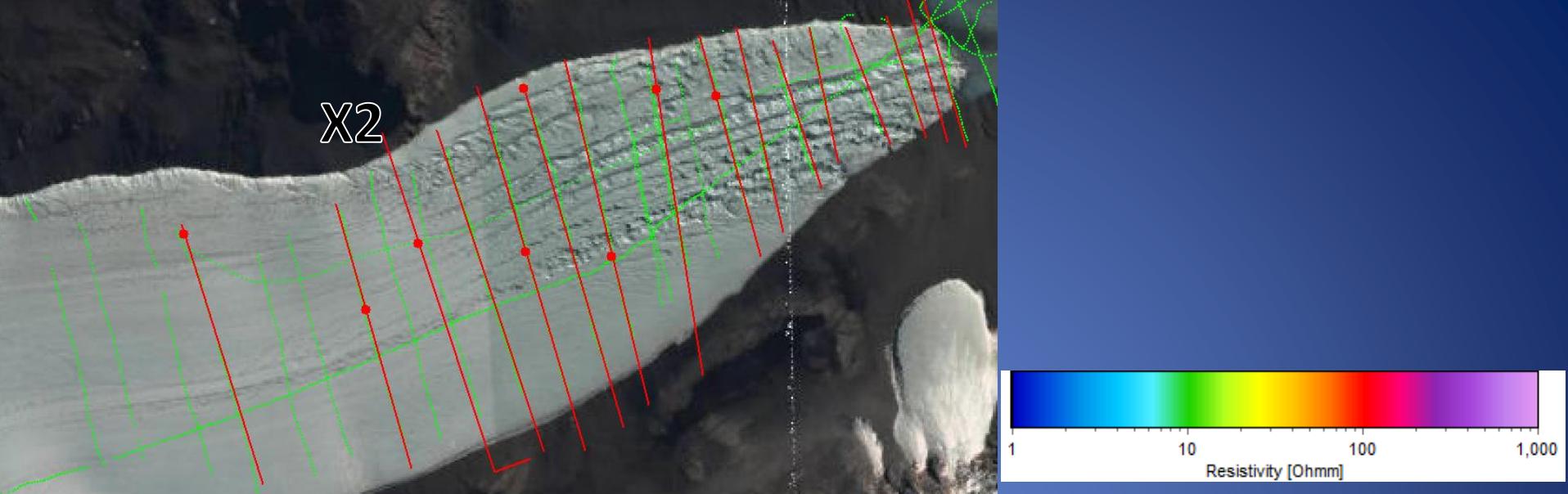


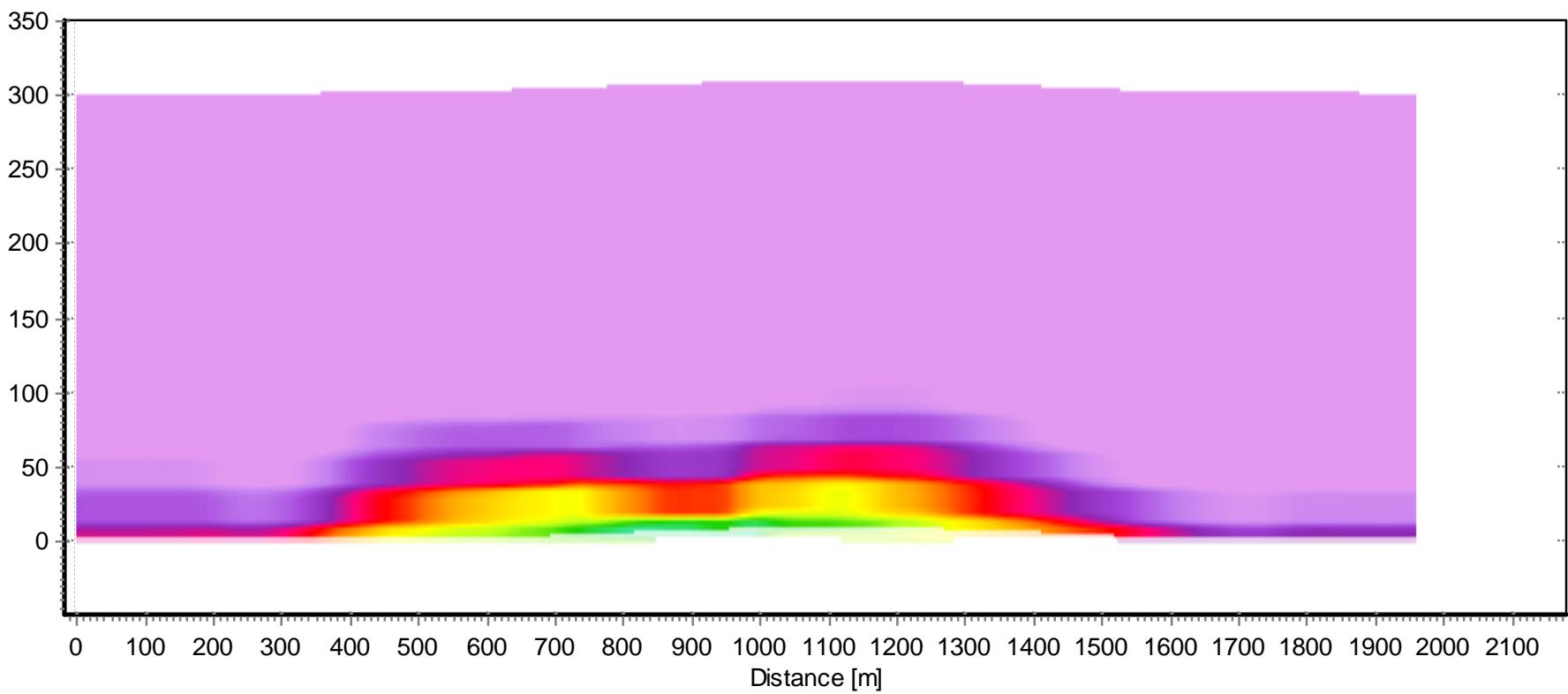
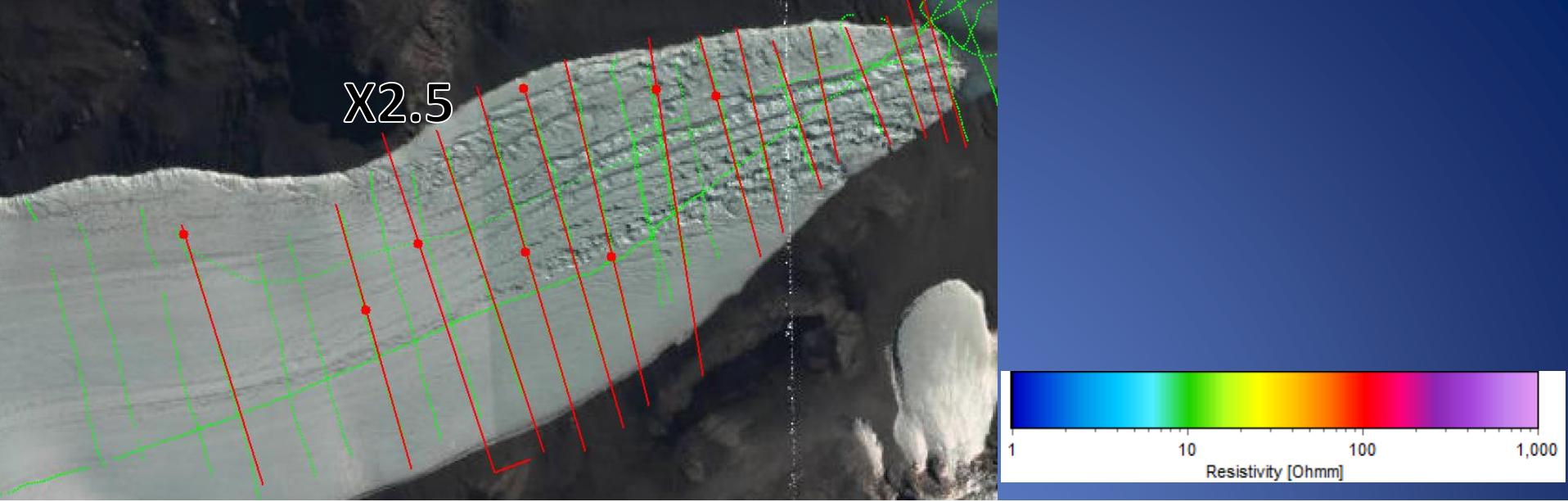
Across the Glacier

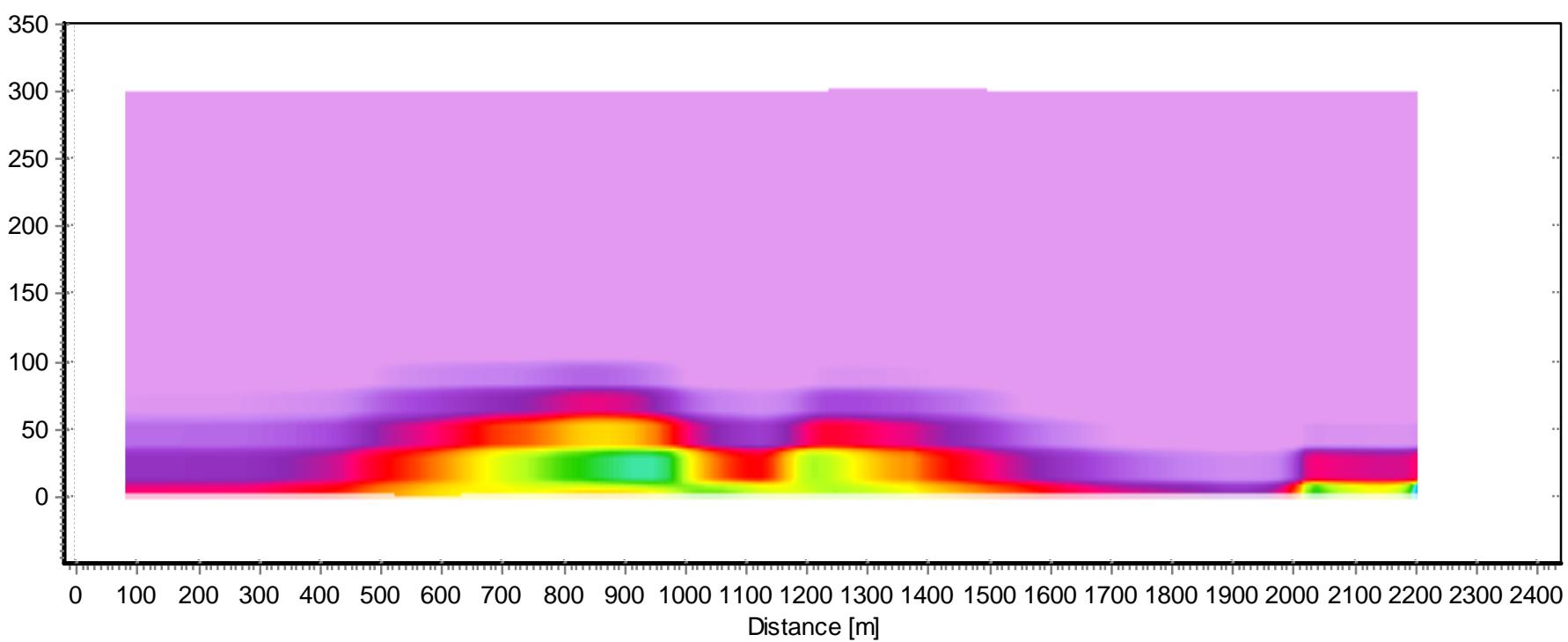
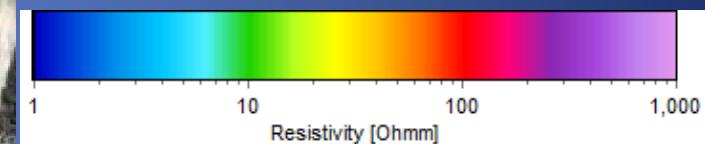
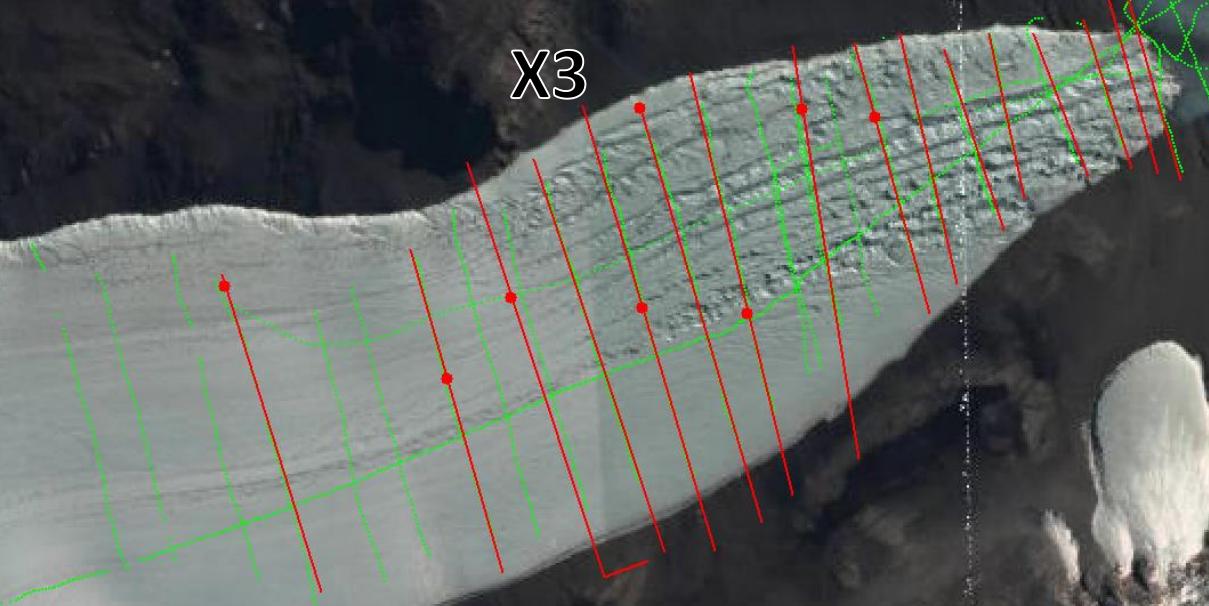


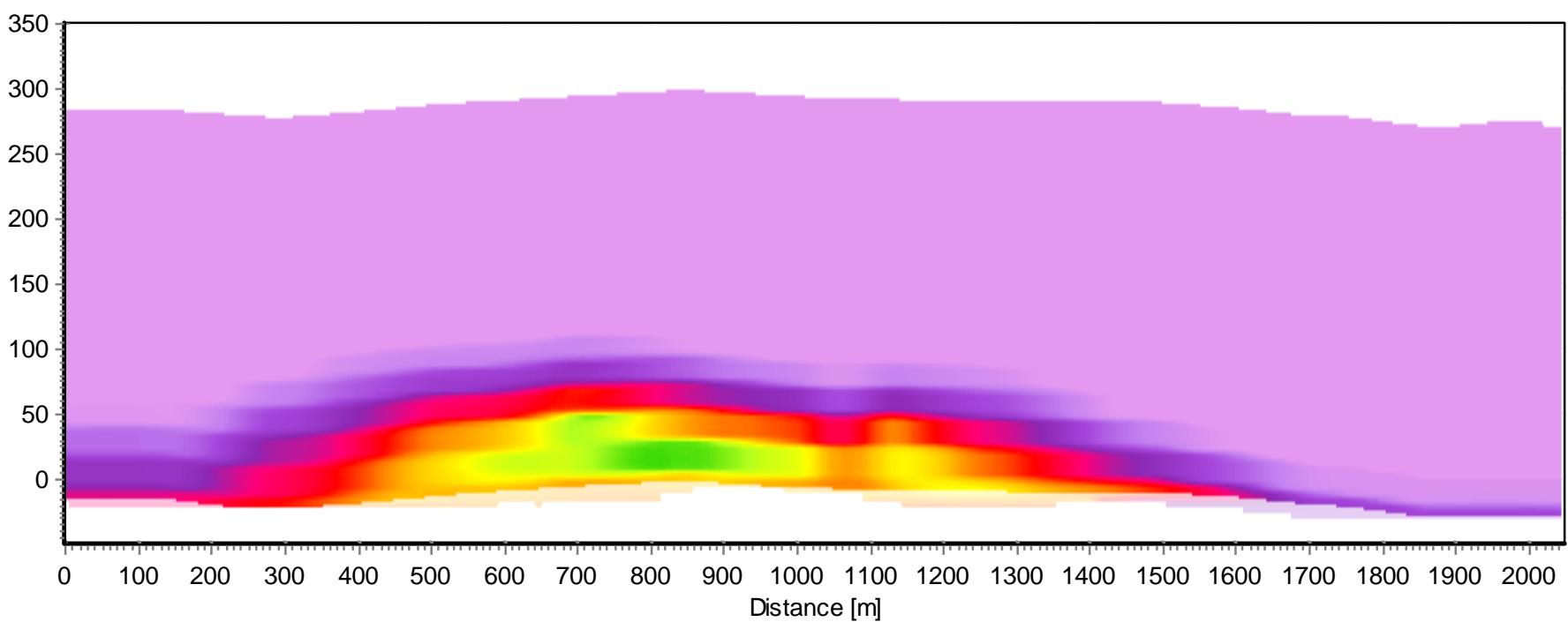
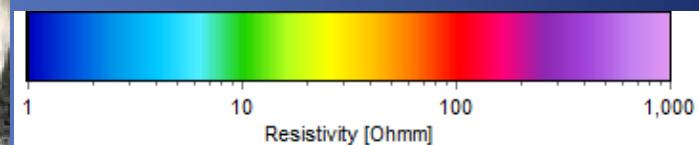
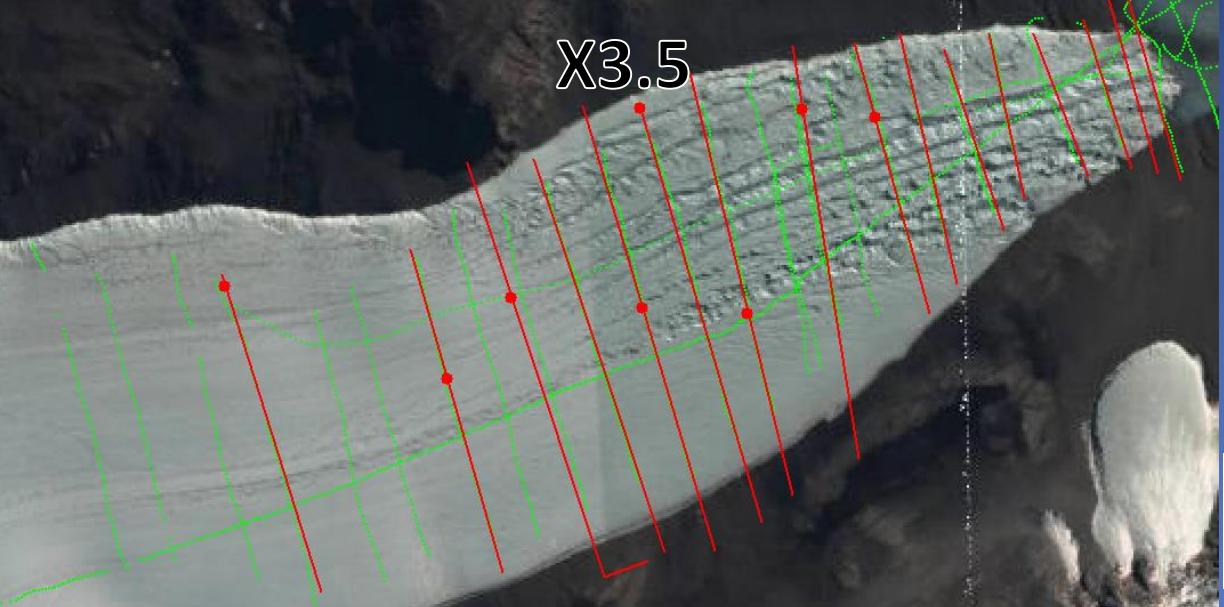


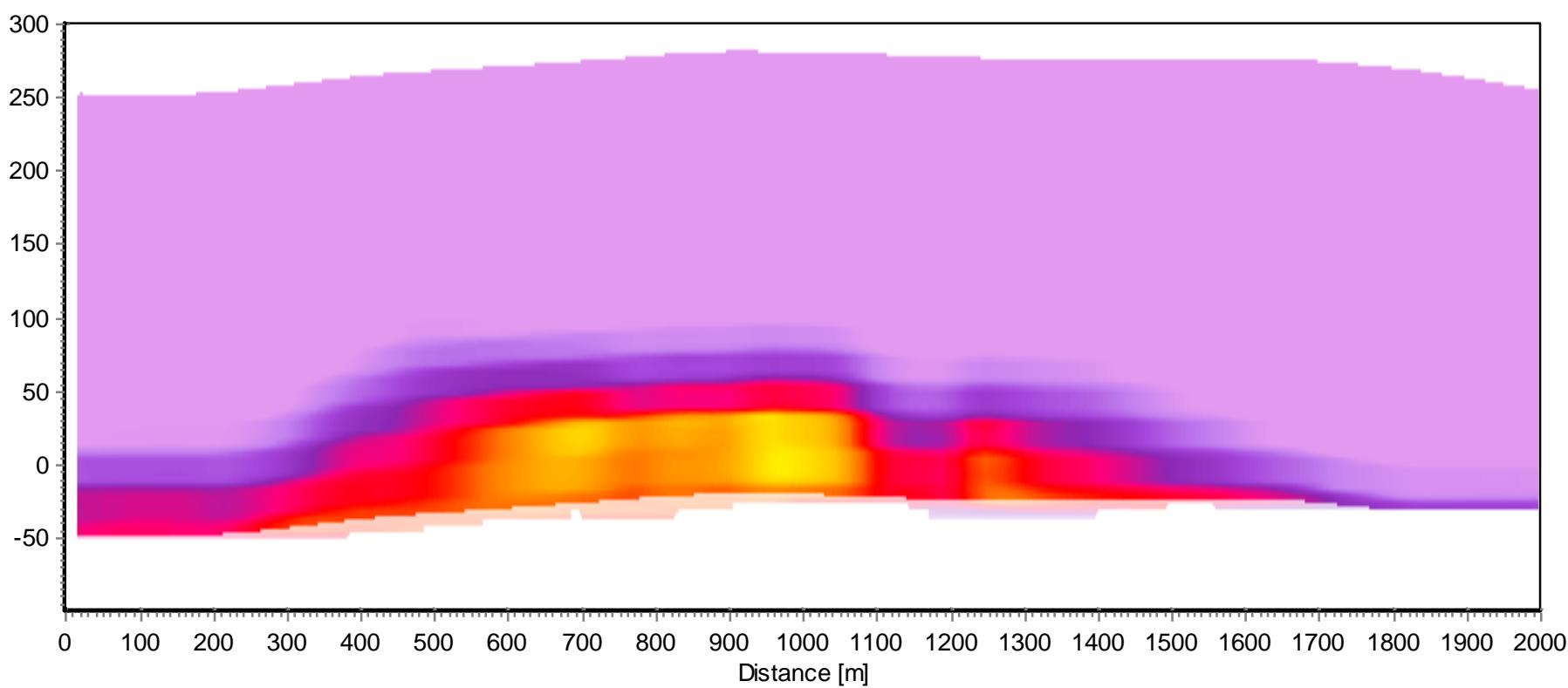
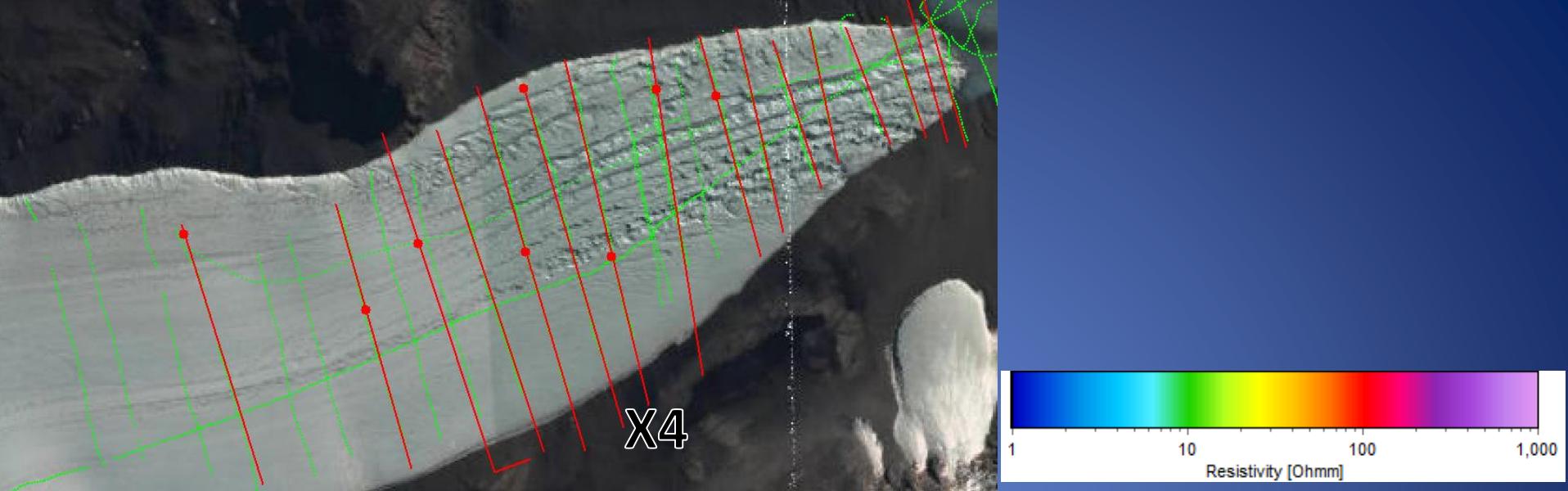


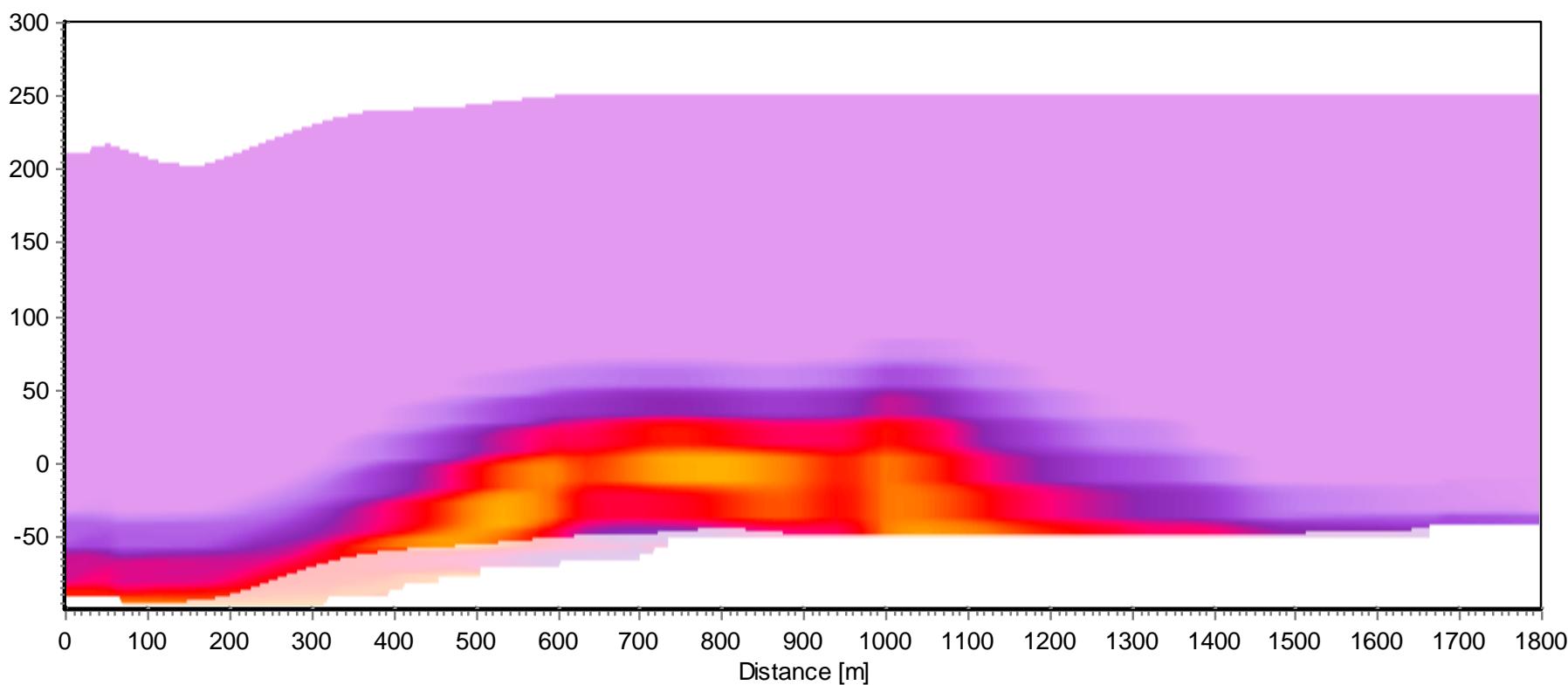
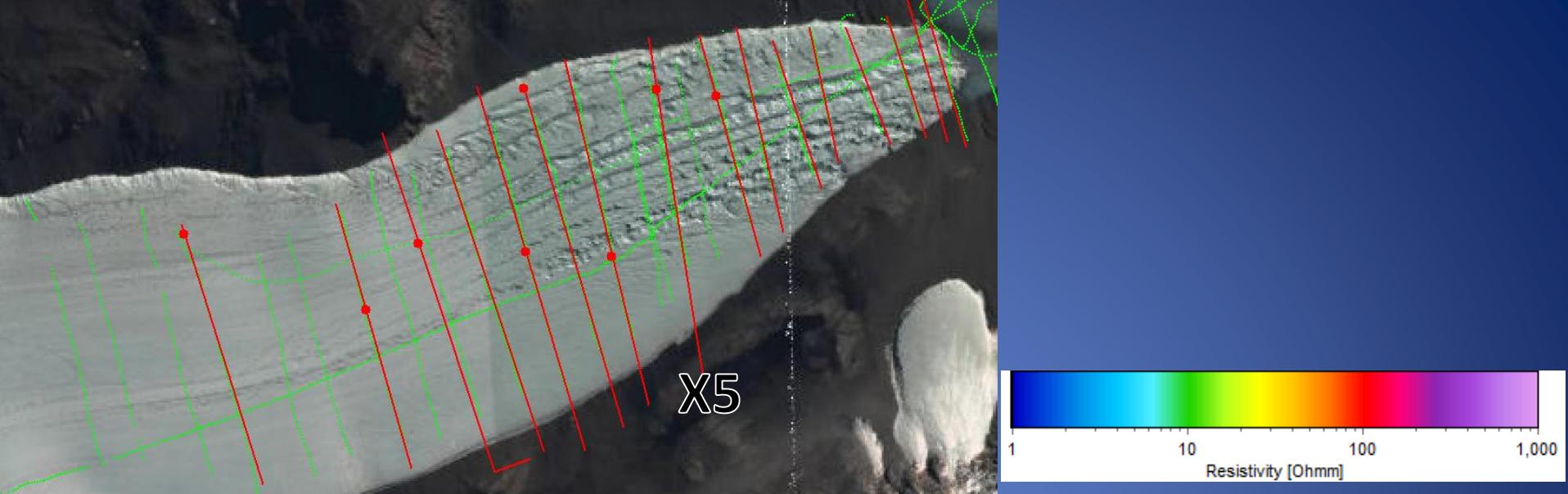


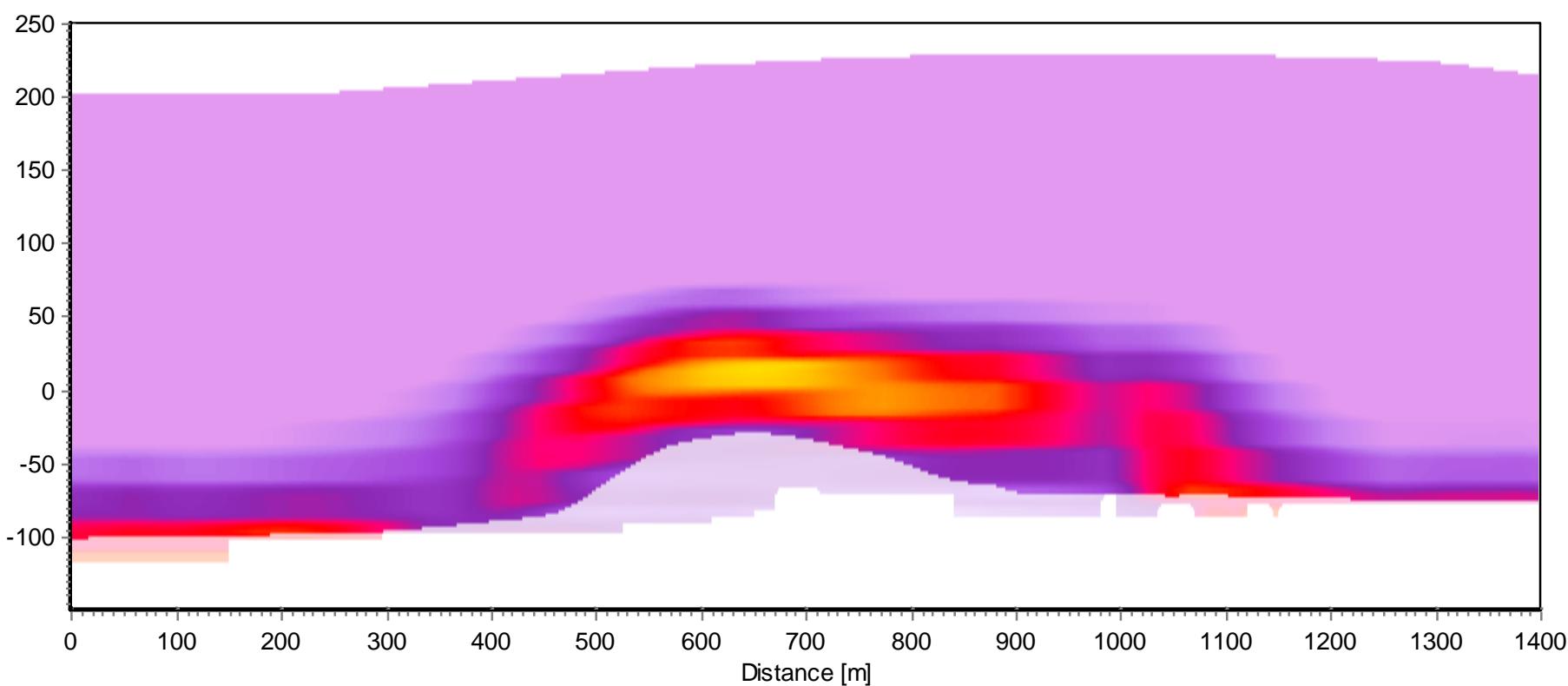
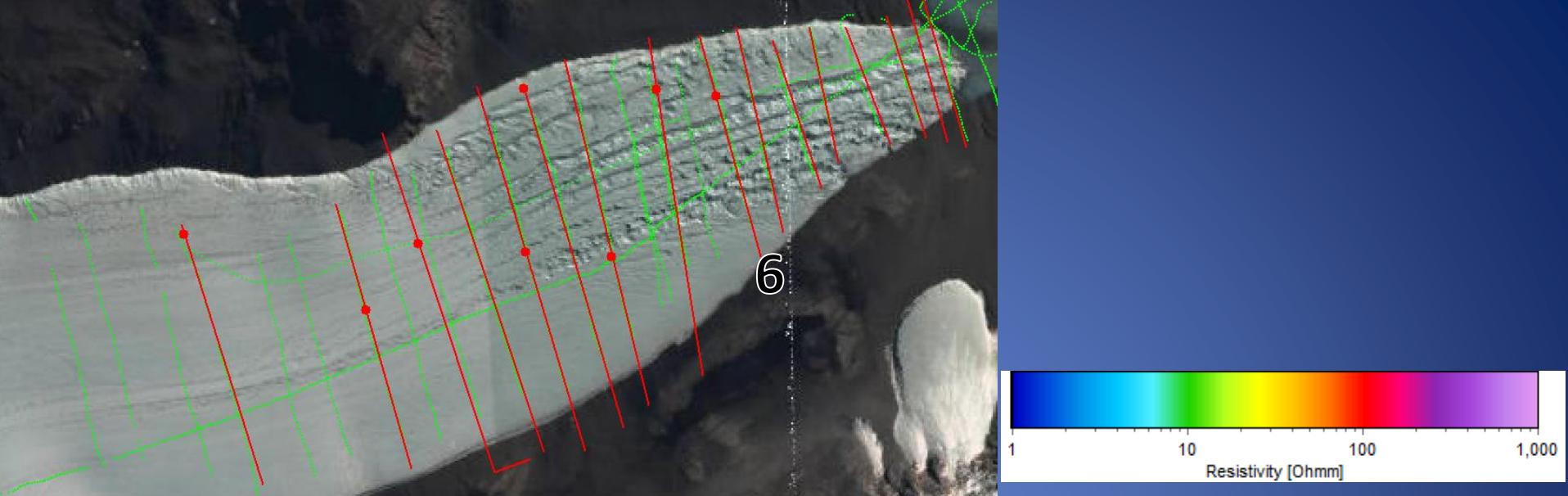


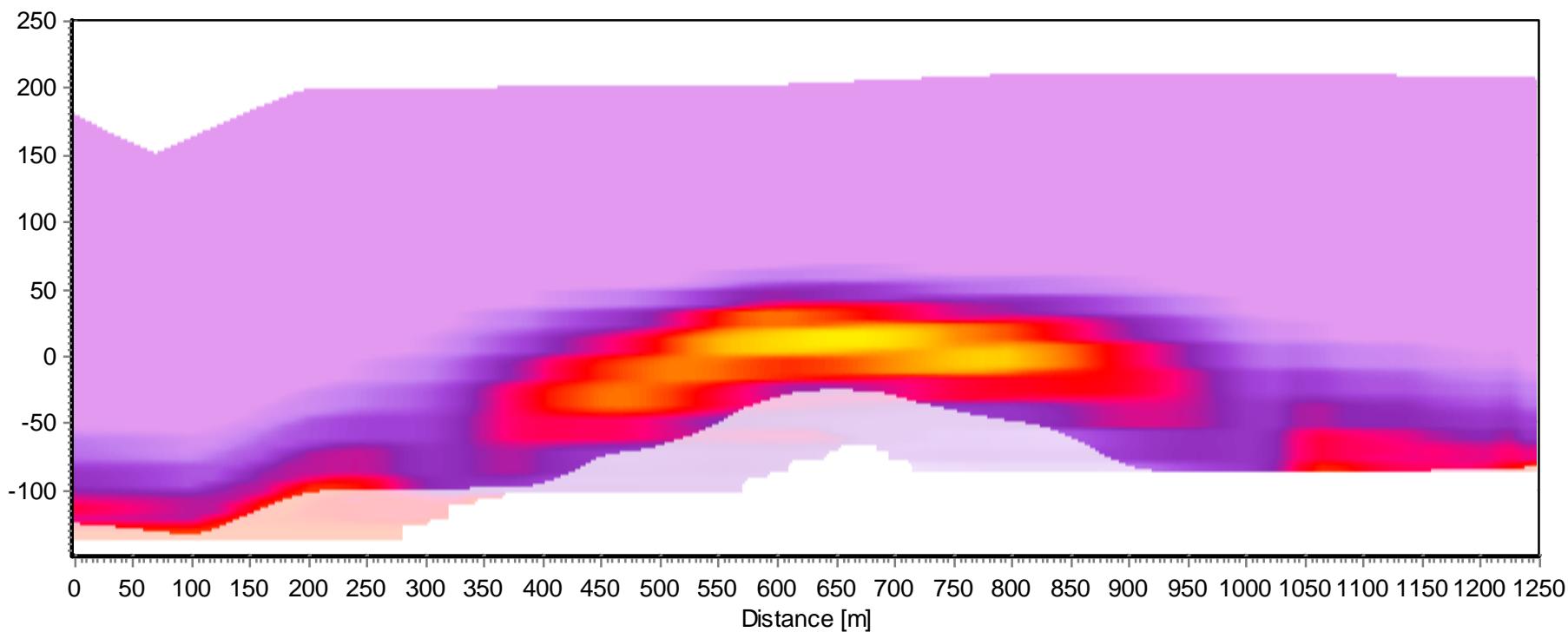
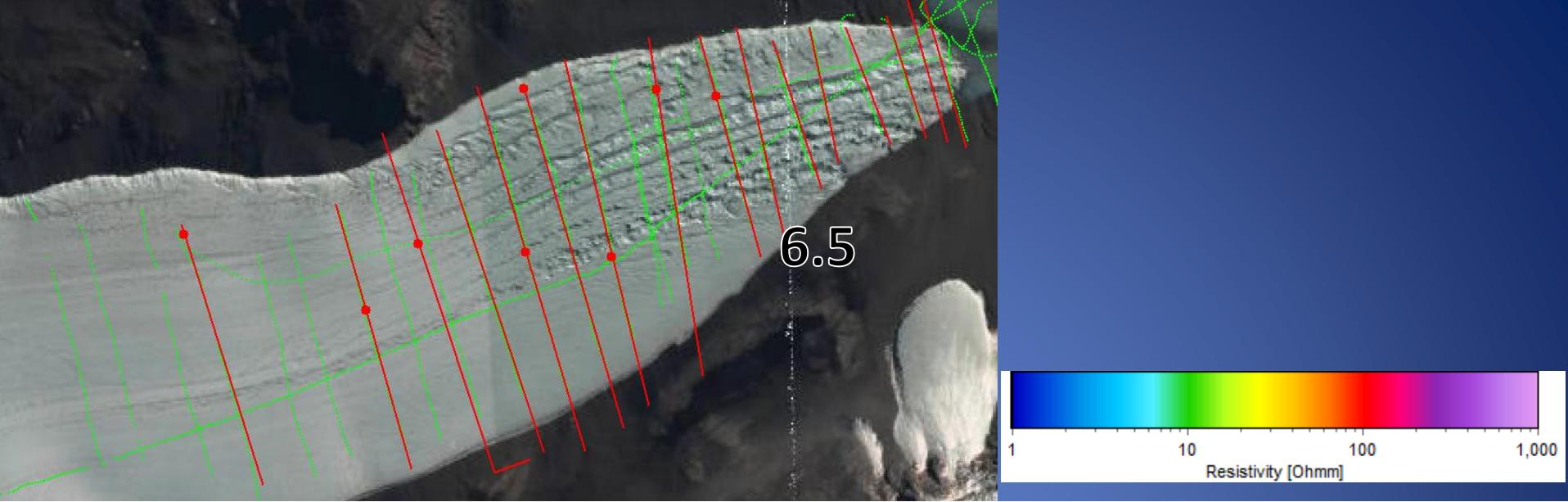


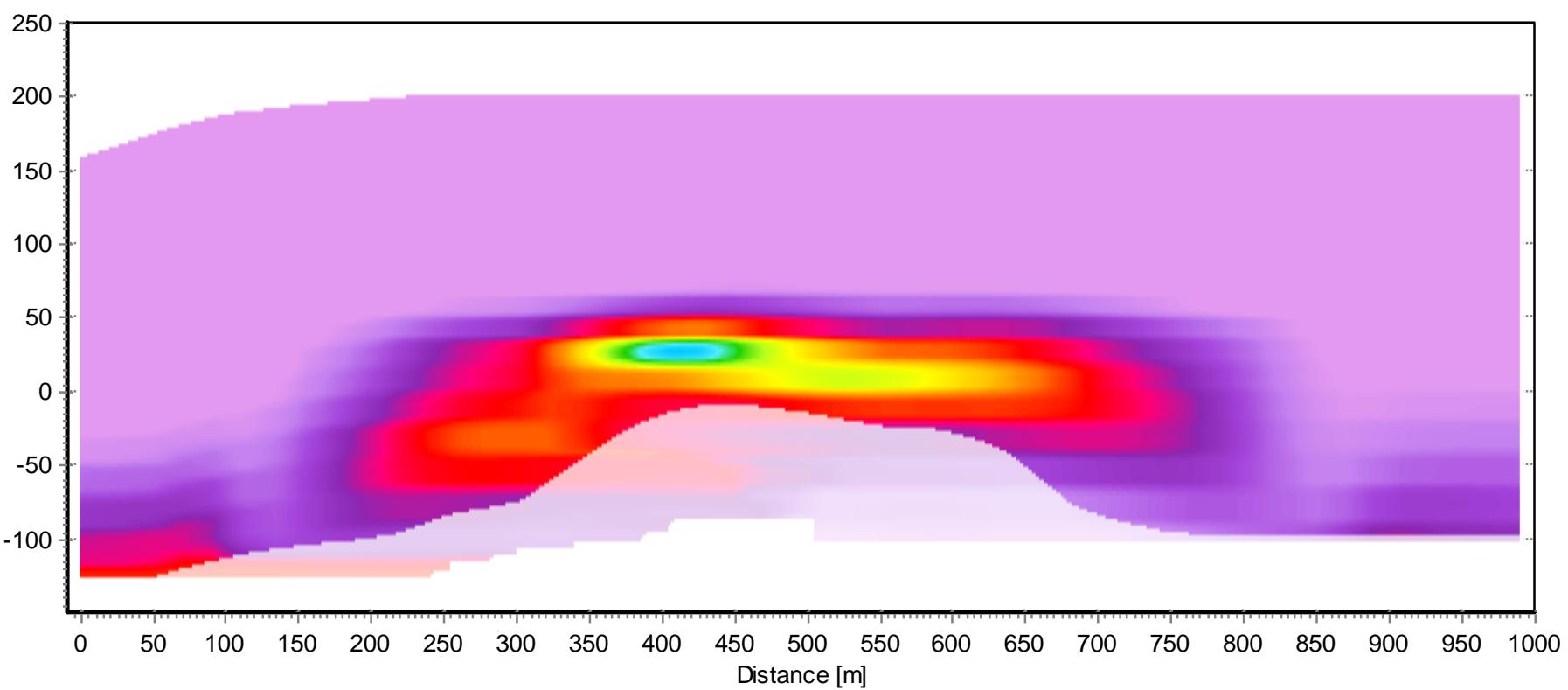
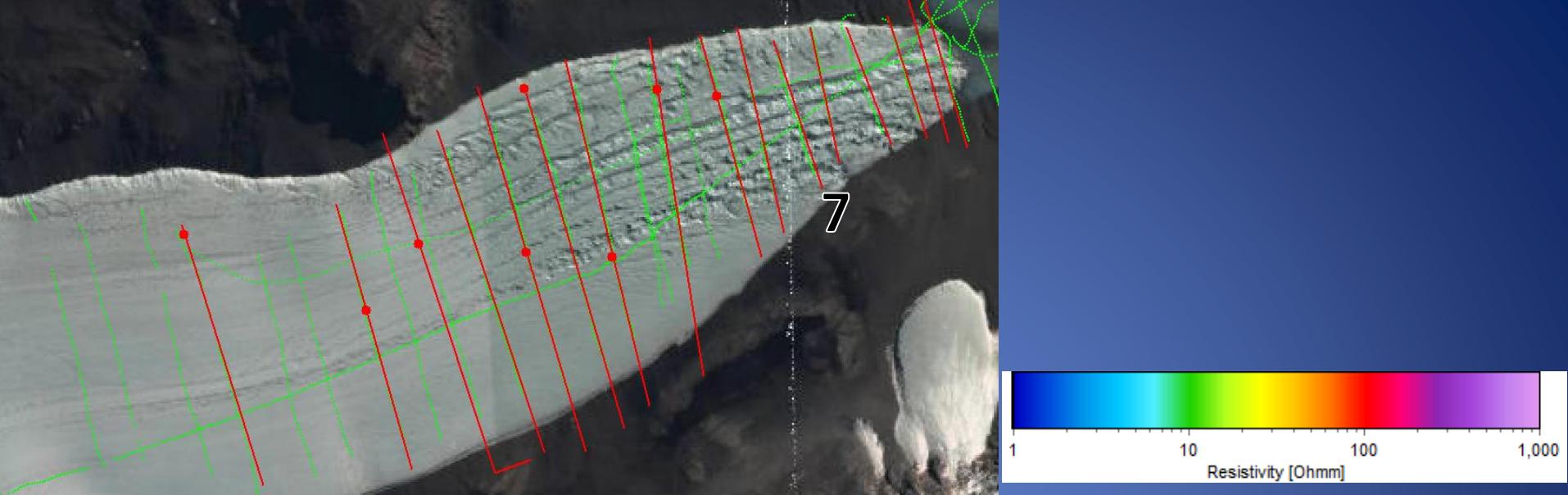


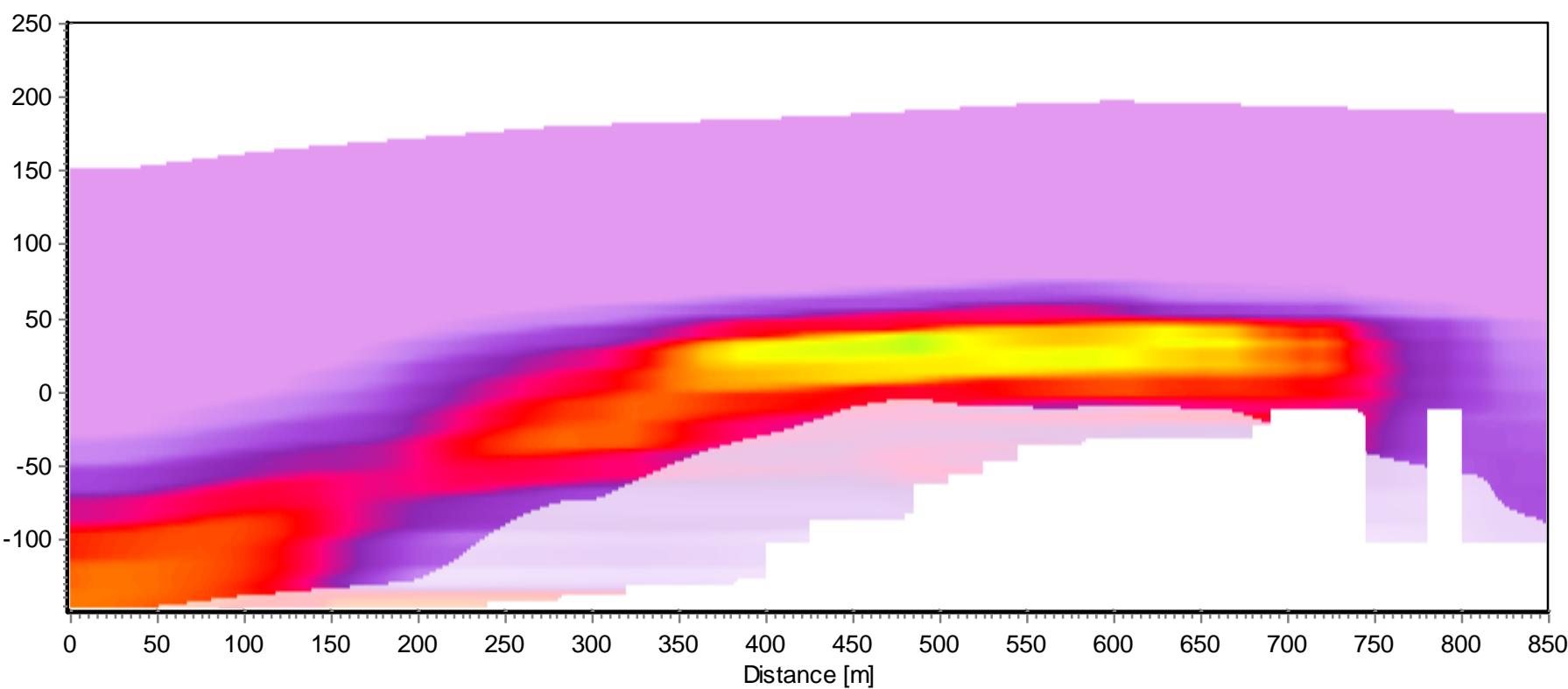
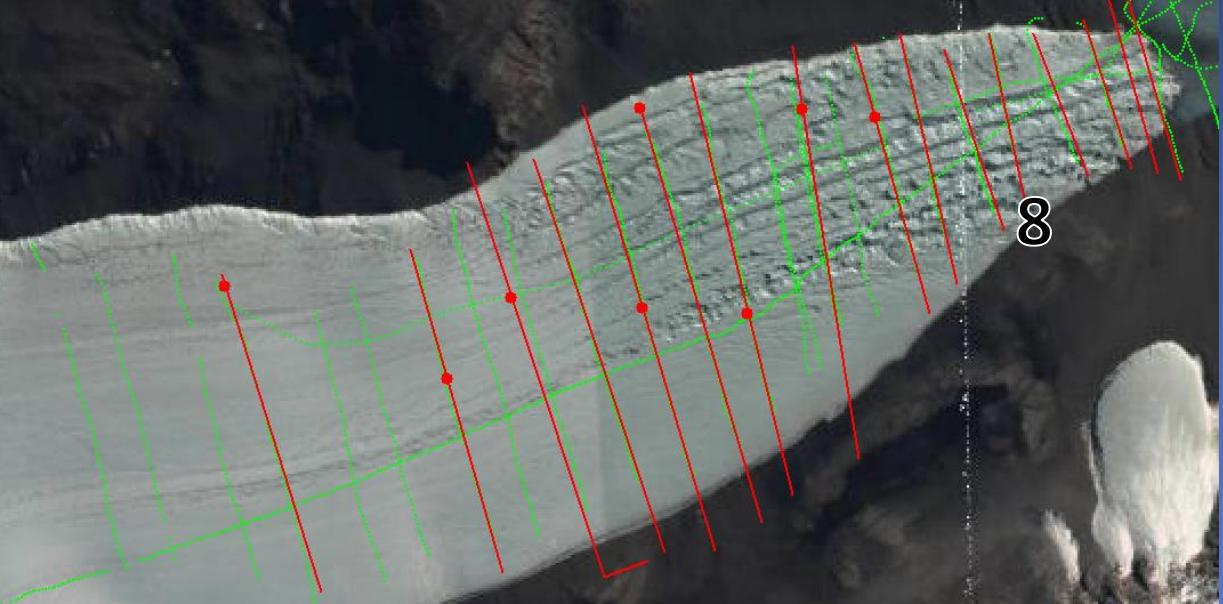


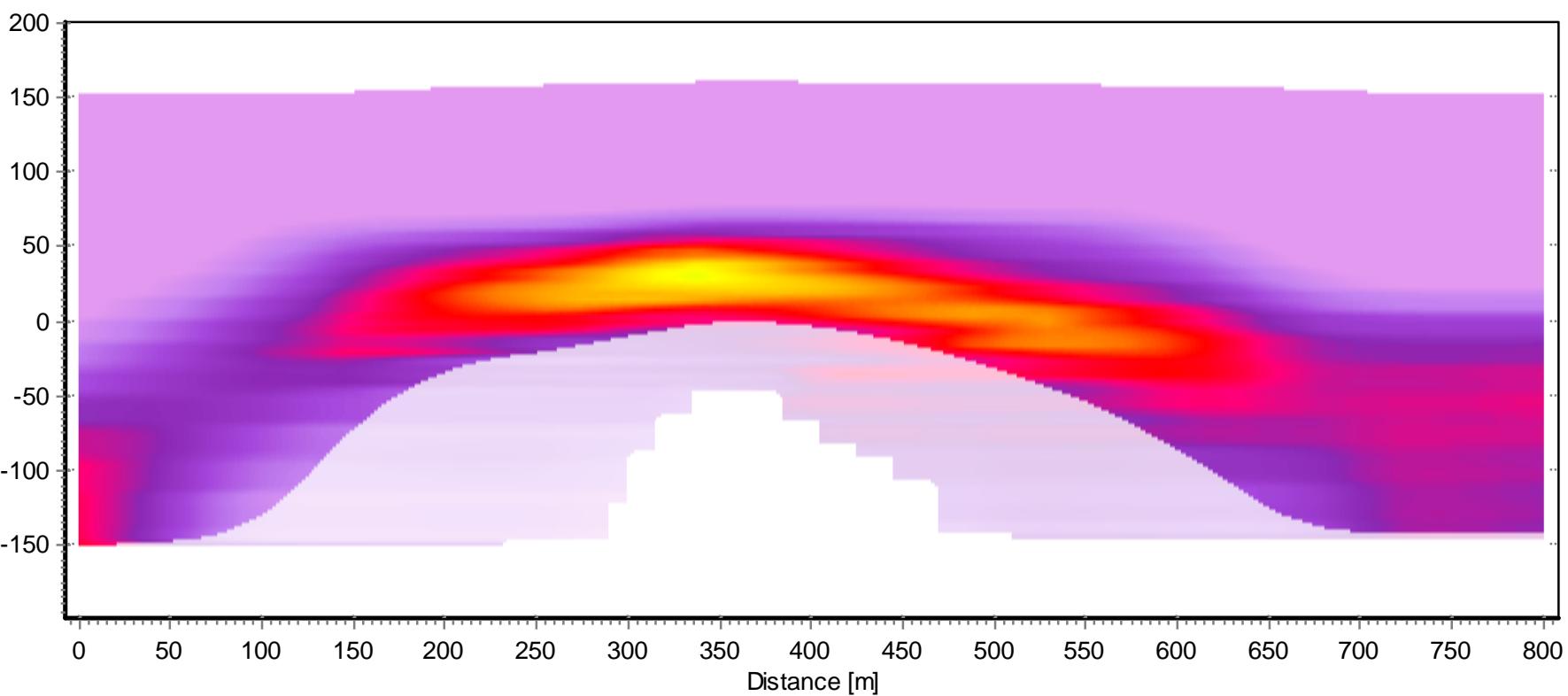
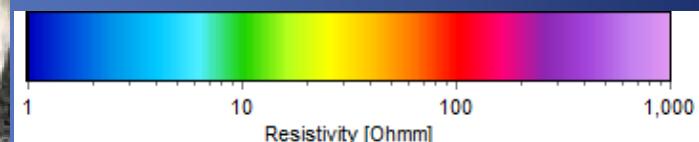
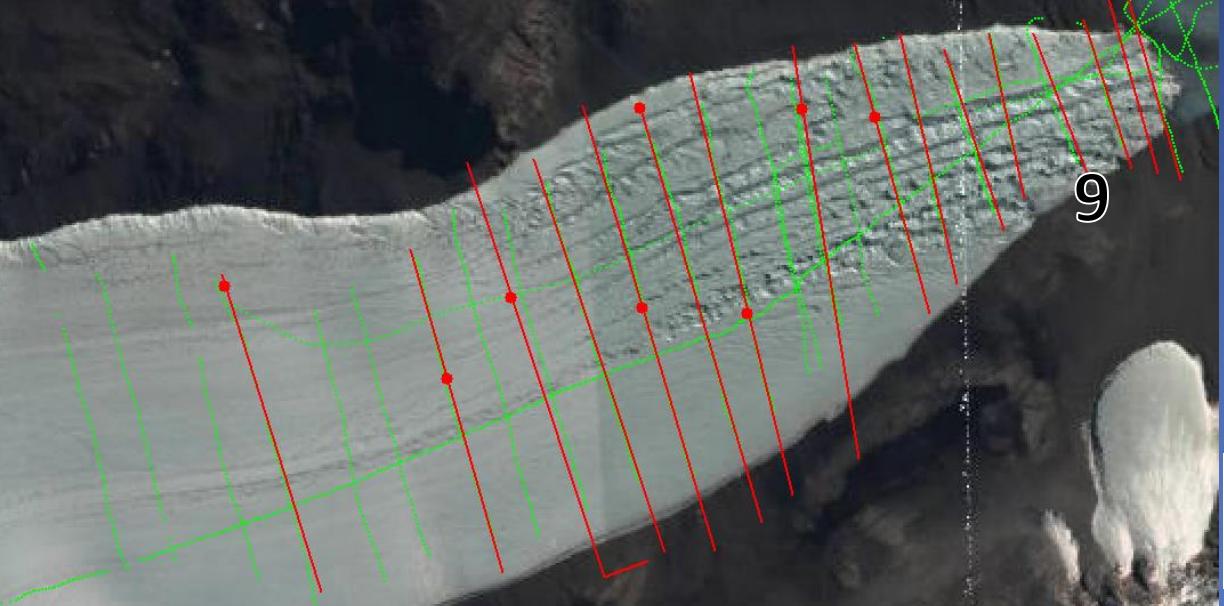


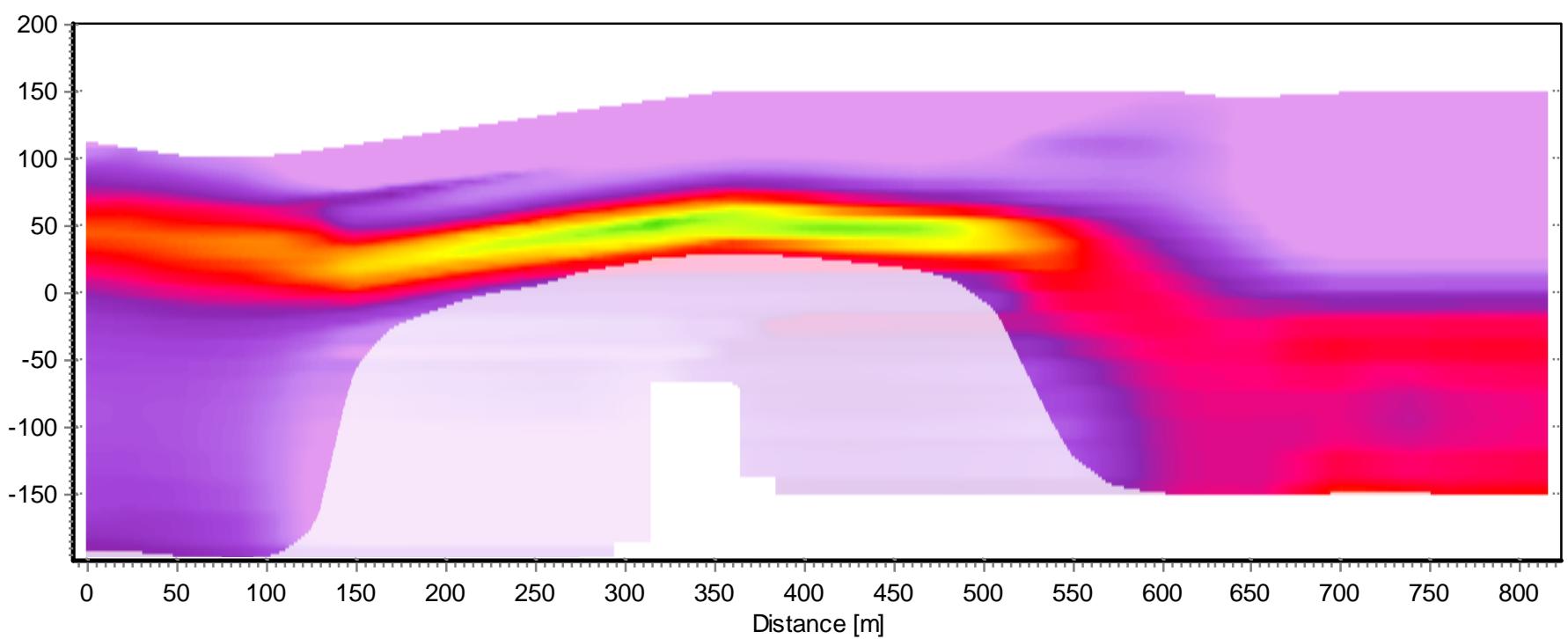
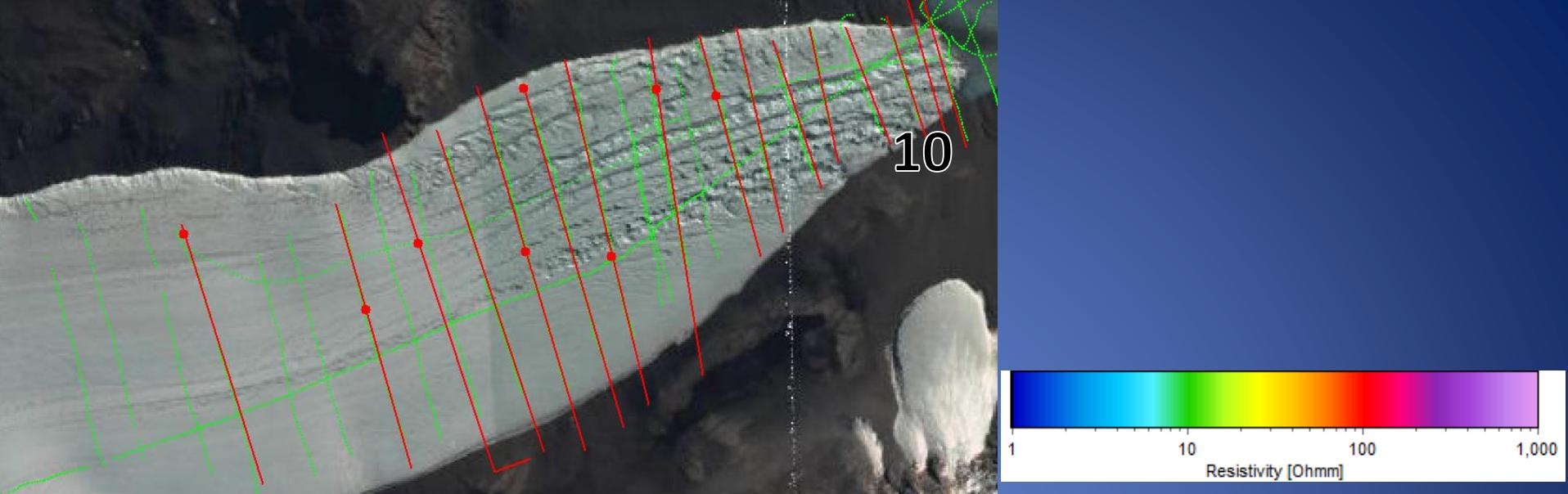


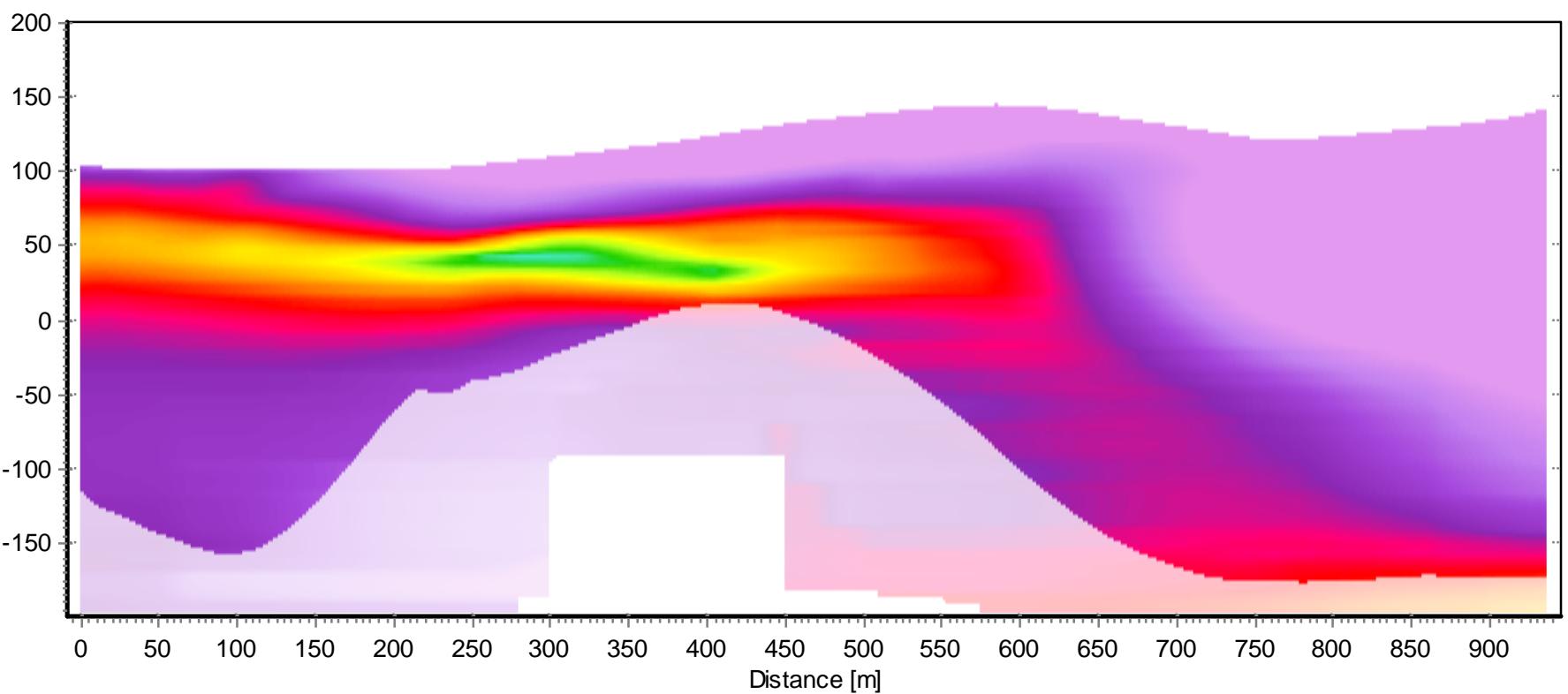
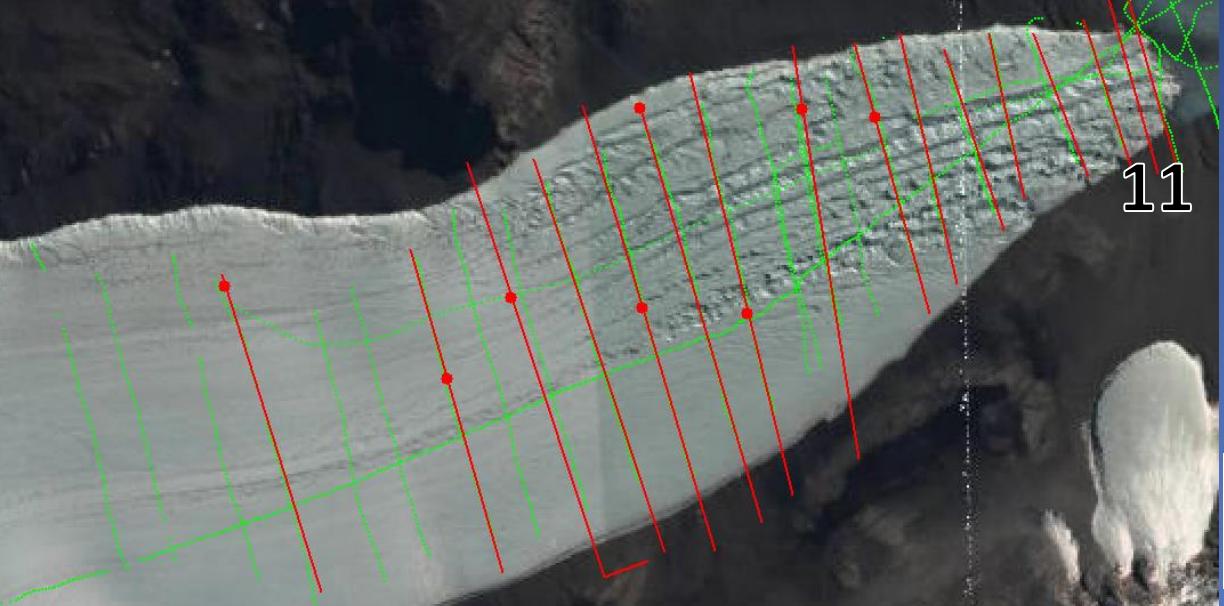


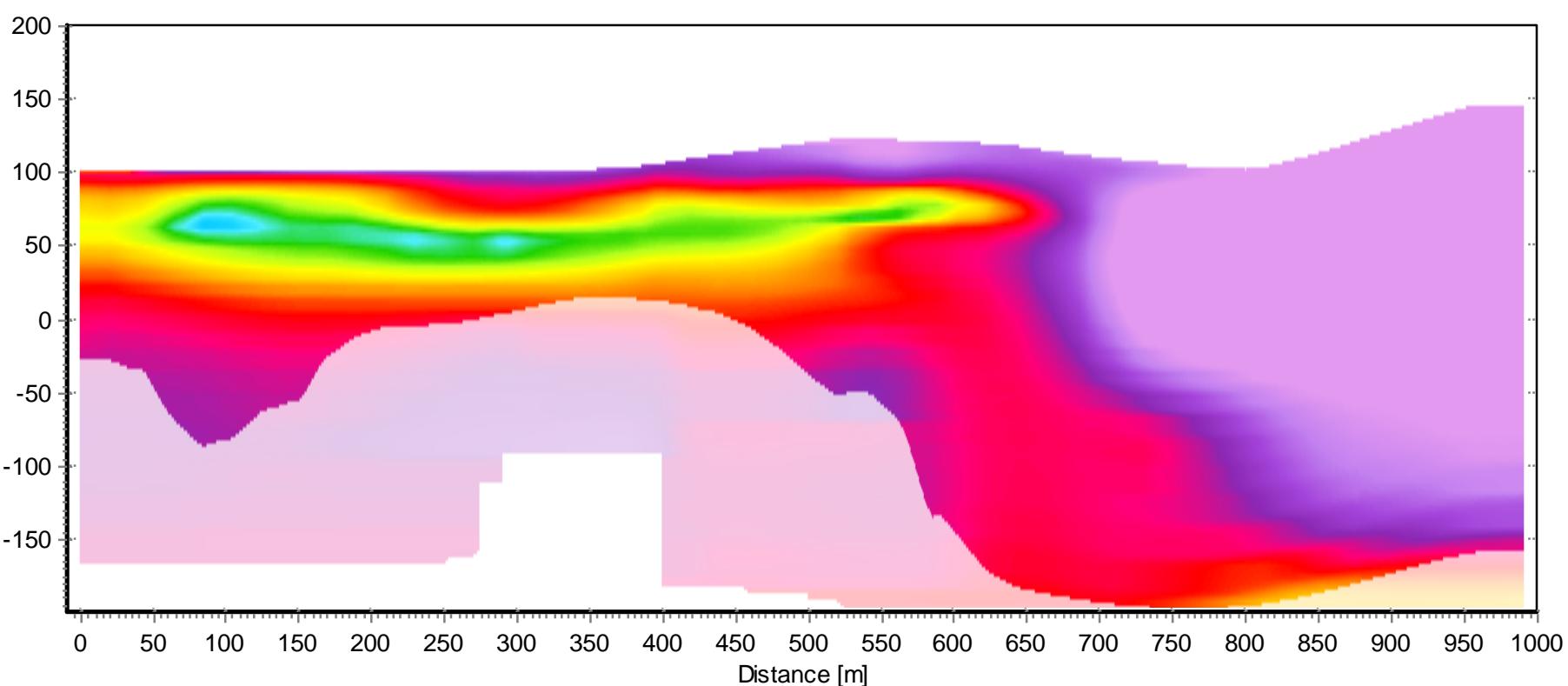
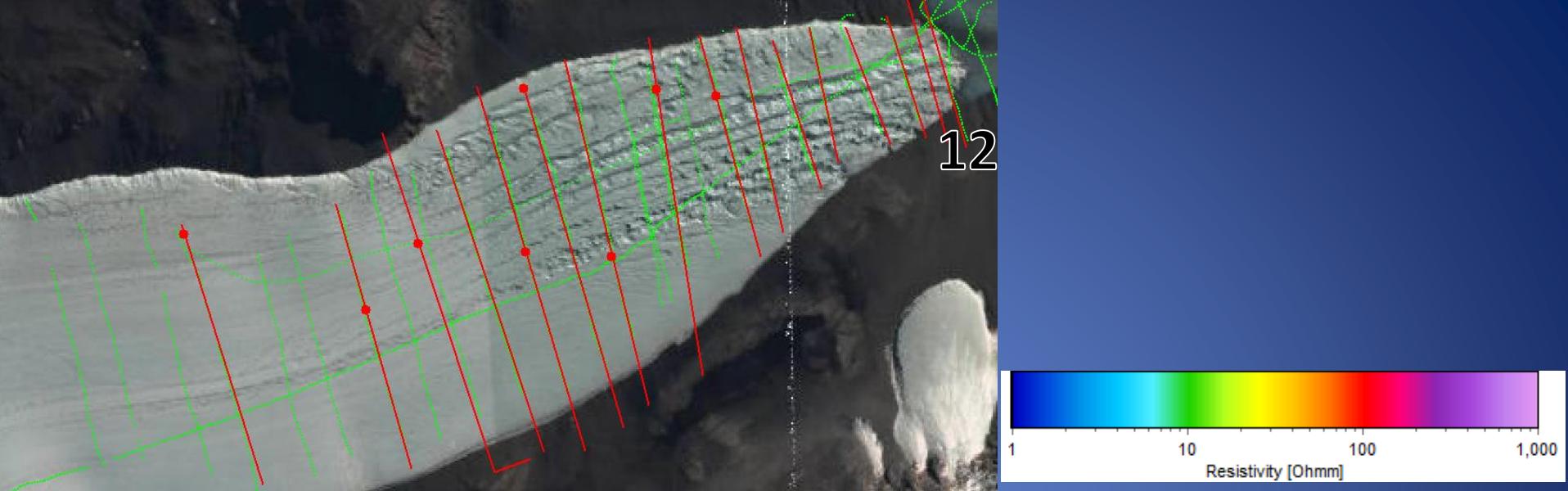








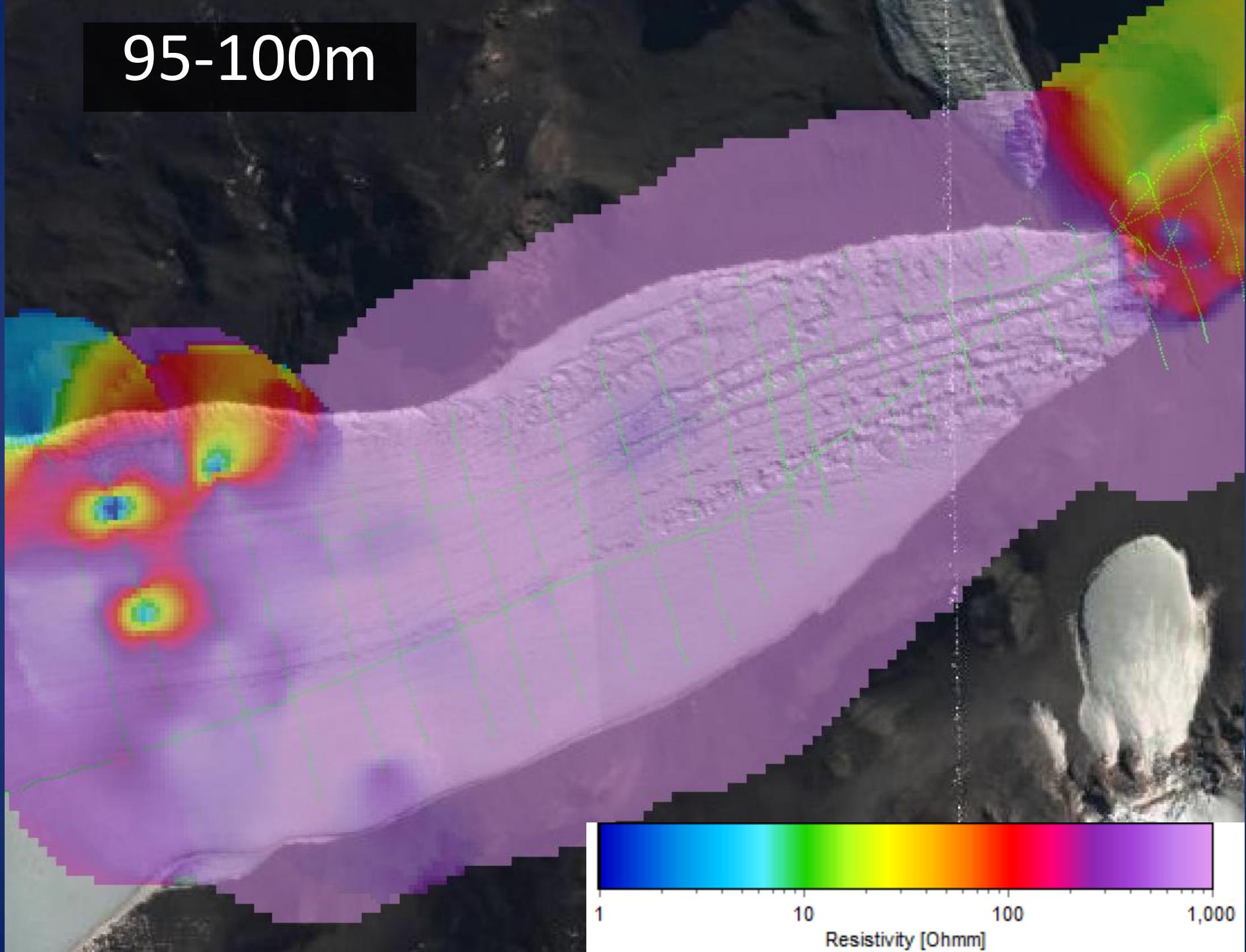




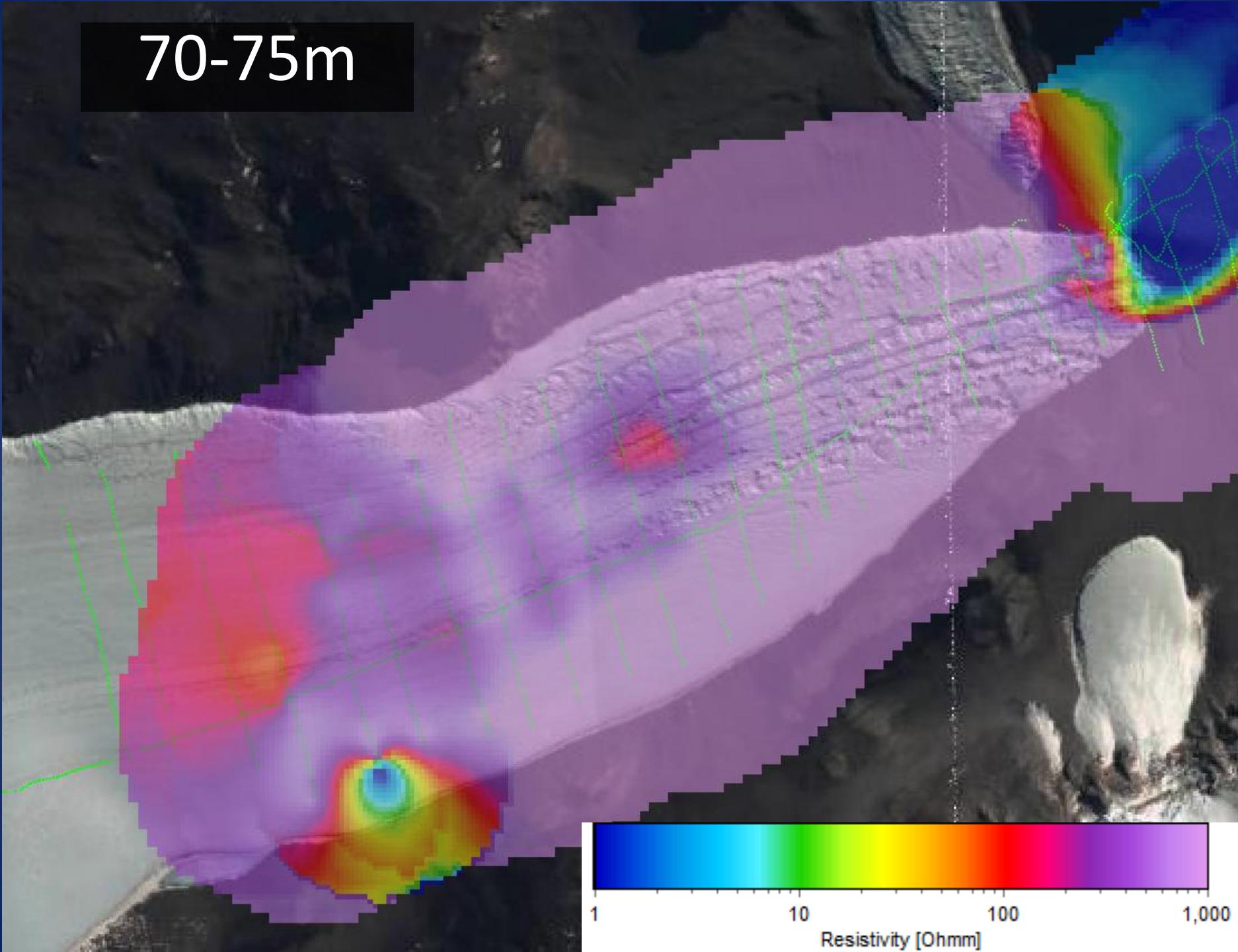
Through the Glacier

An aerial photograph of a glacier. The upper portion of the image shows dark, rugged mountain slopes. Below them, the glacier's surface is a pale blue-grey color, marked by numerous parallel crevasses and ridges. The transition between the land and the ice is a sharp, dark edge.

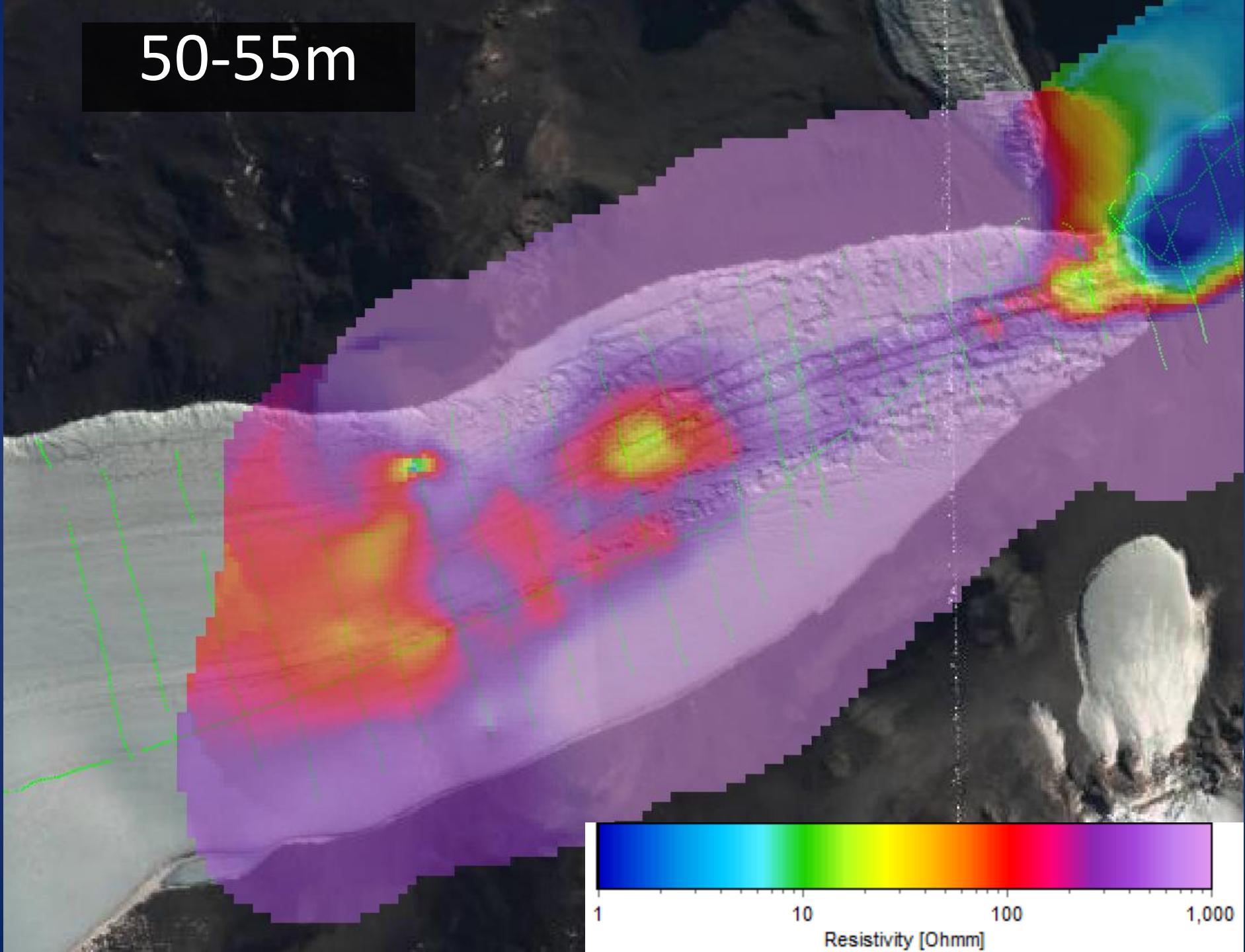
95-100m



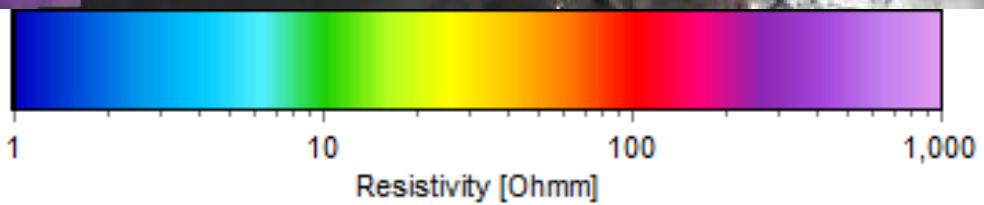
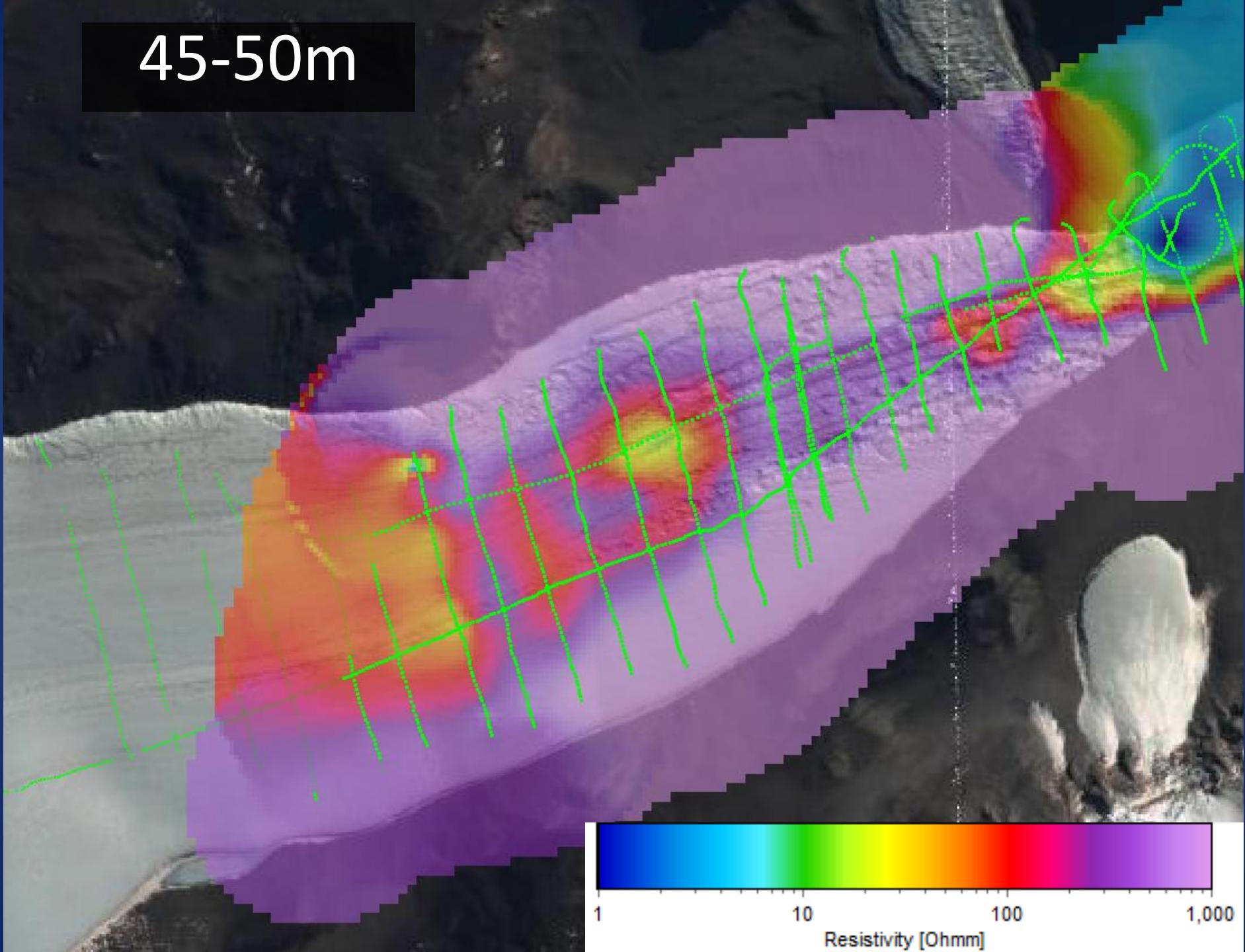
70-75m



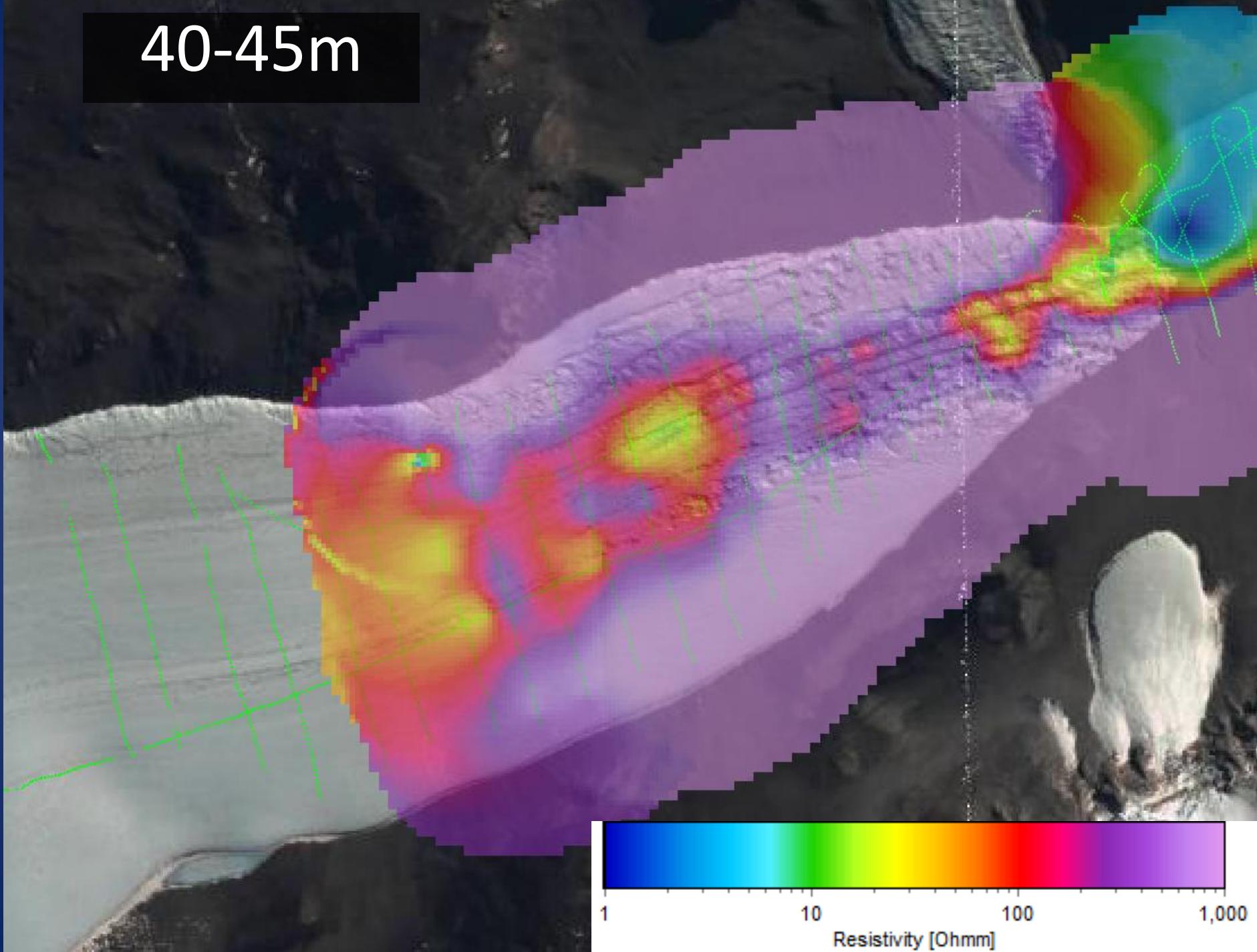
50-55m



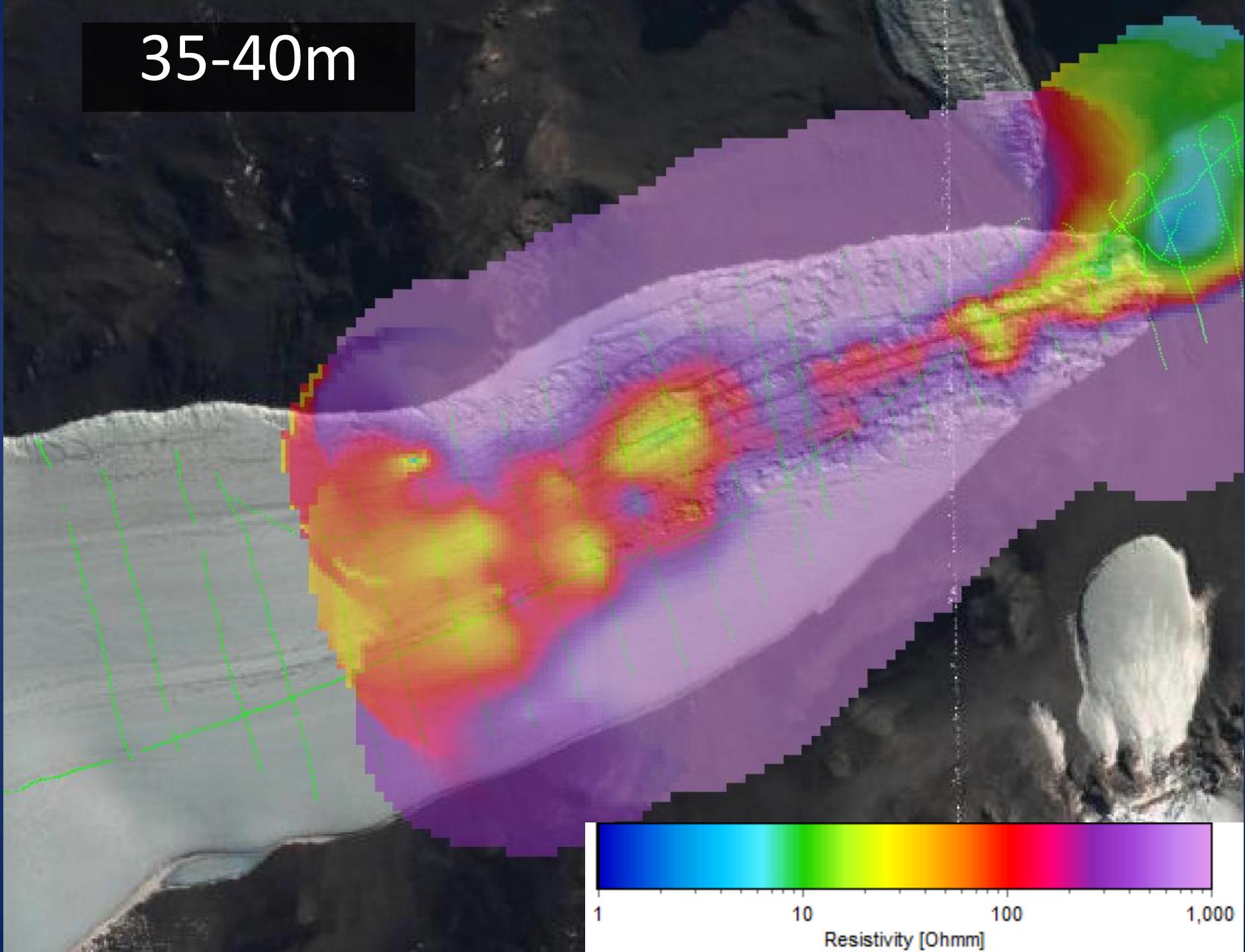
45-50m



40-45m



35-40m



1

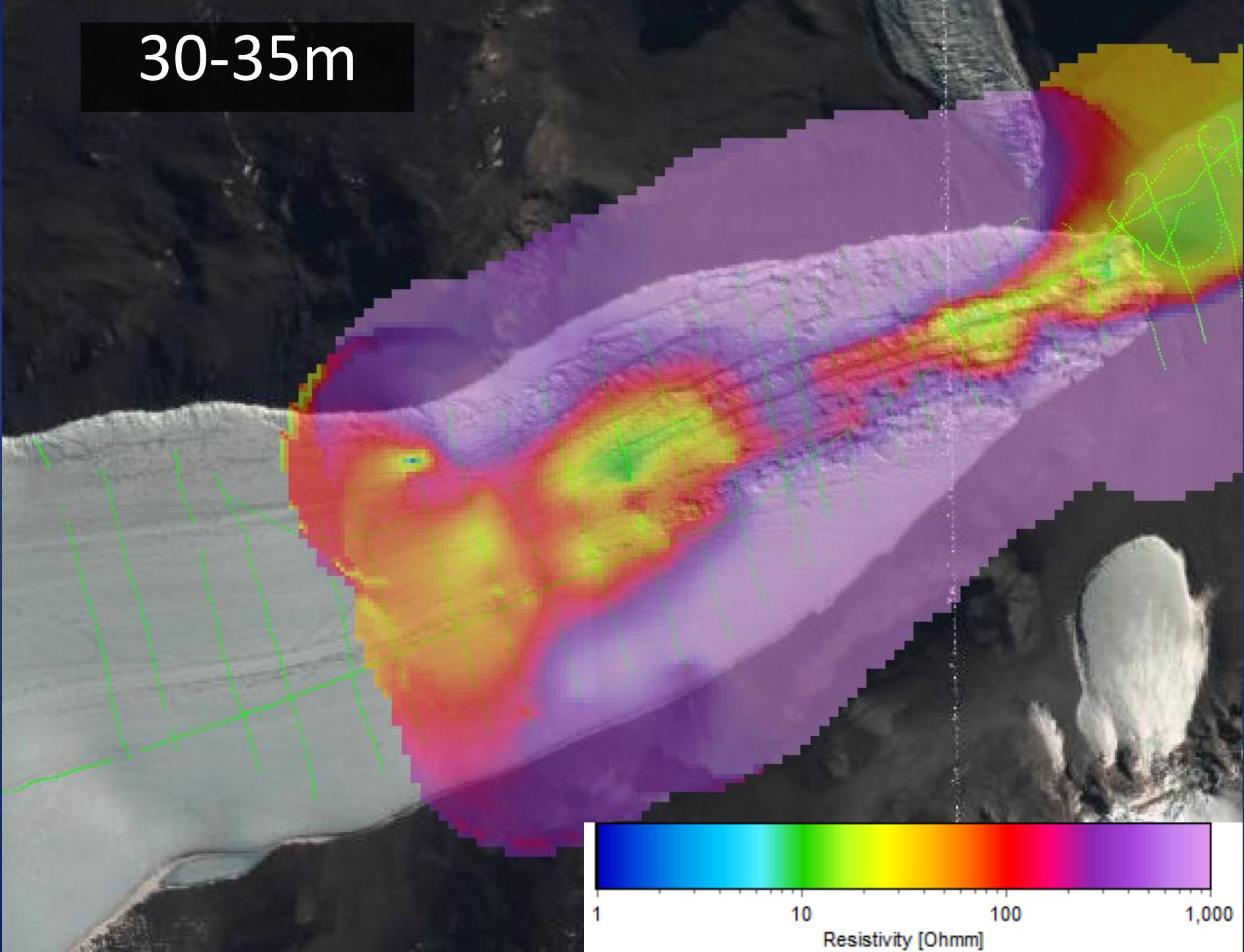
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100

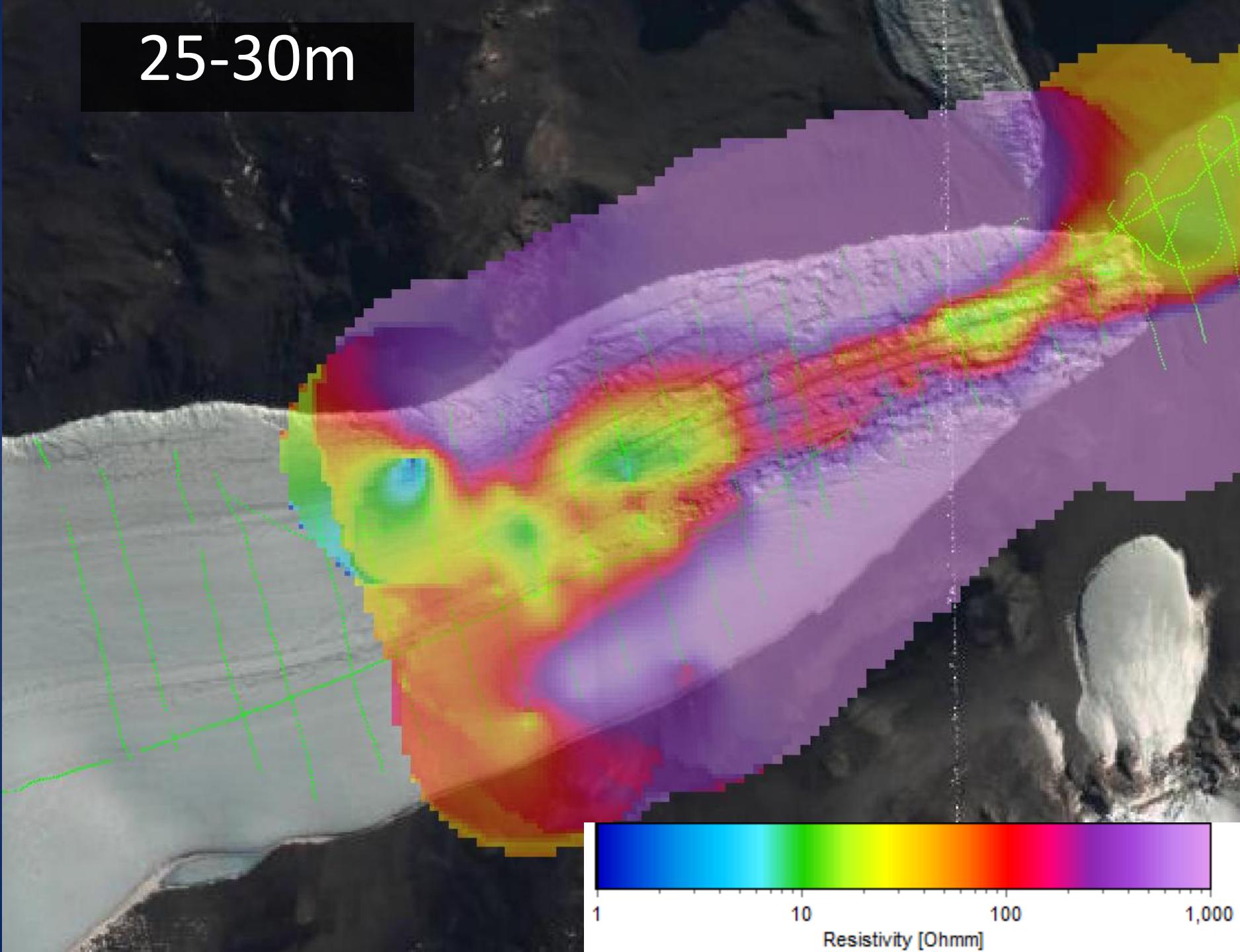
1,000

Resistivity [Ohmm]

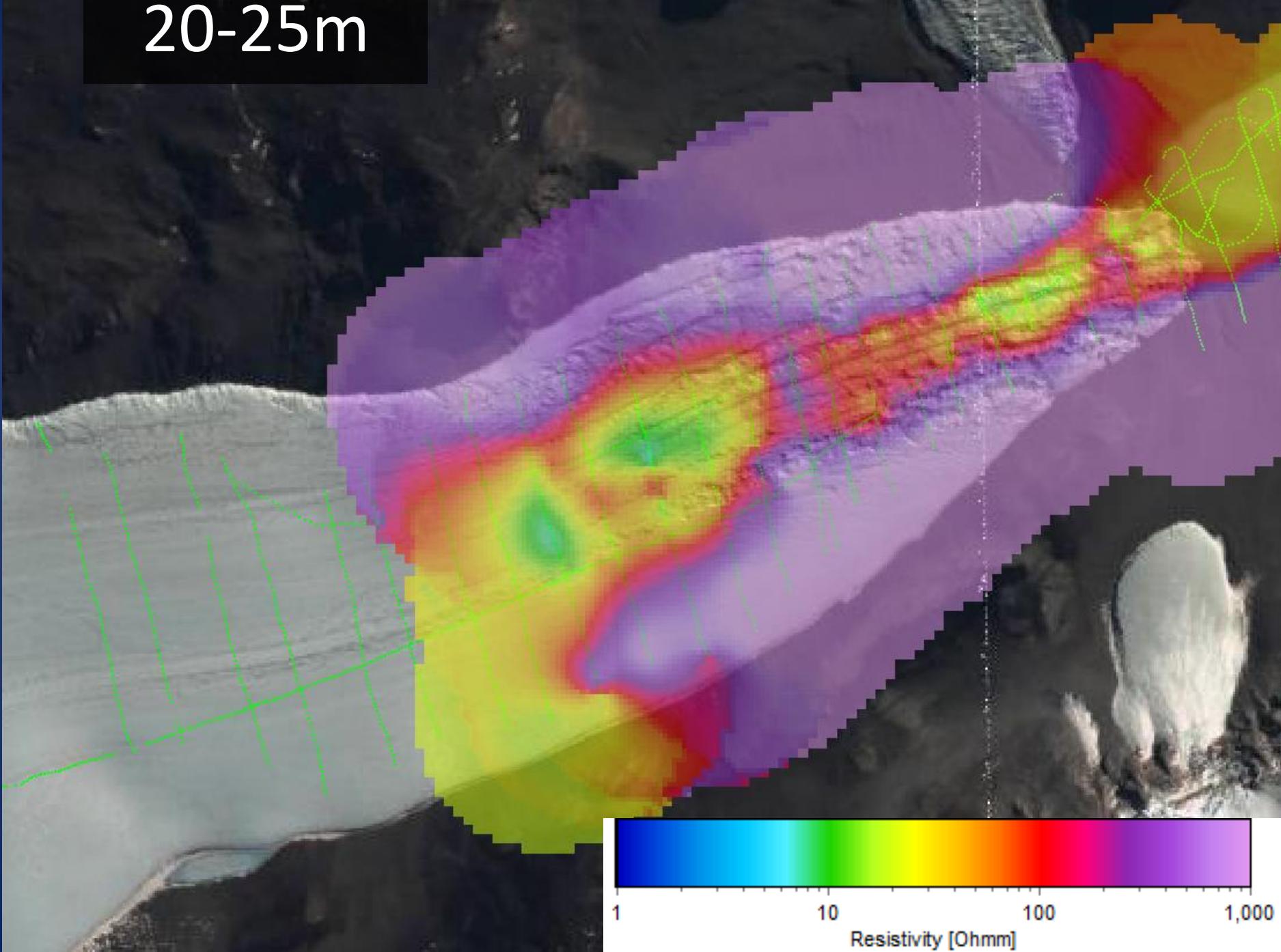
30-35m



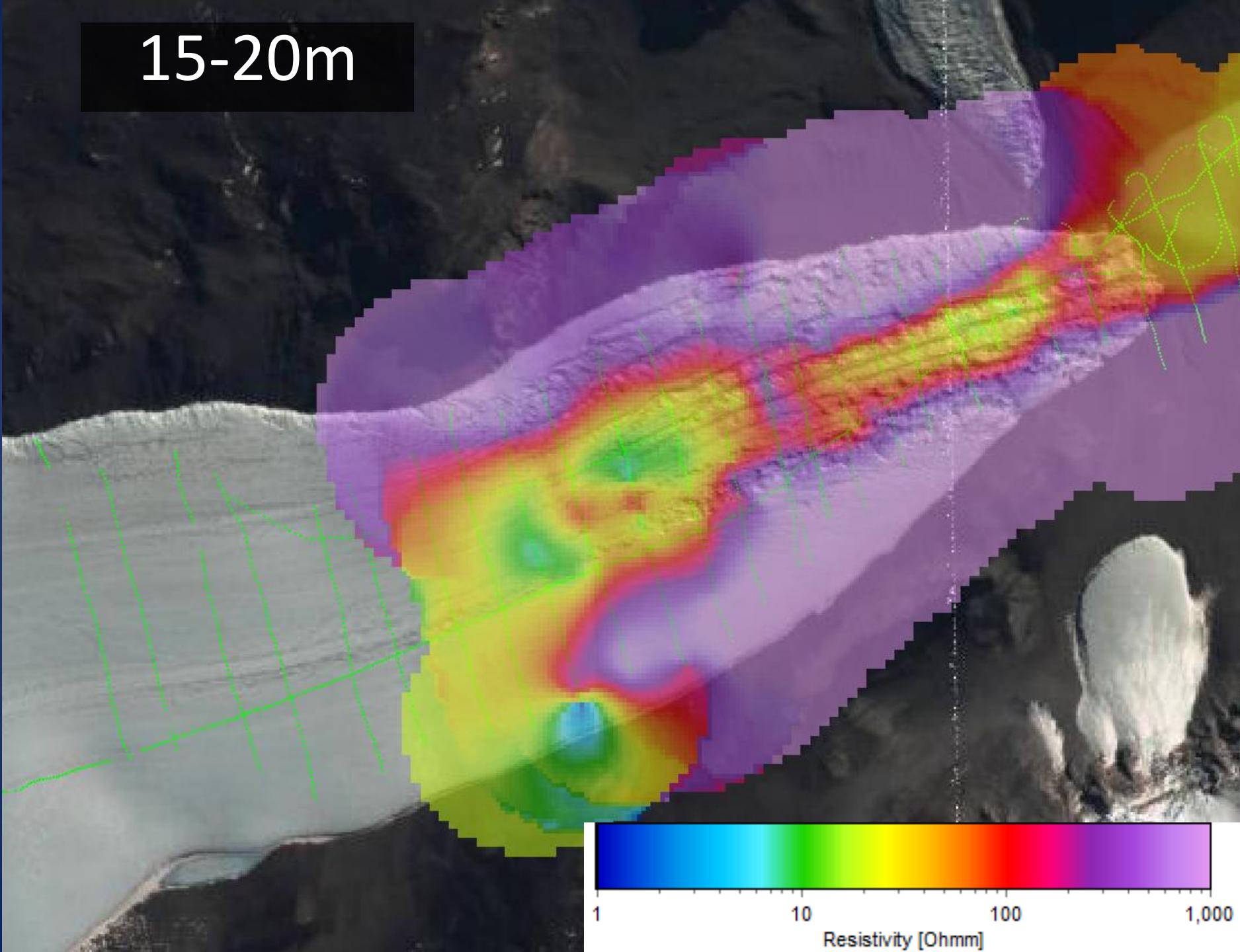
25-30m



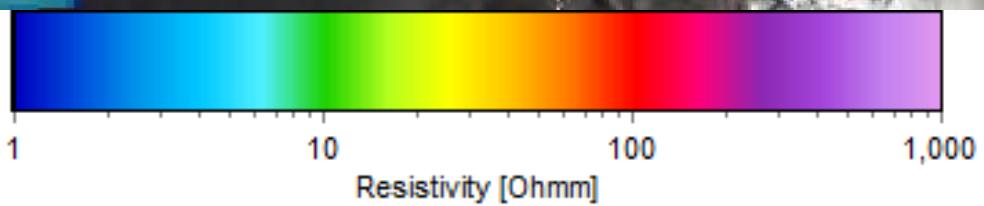
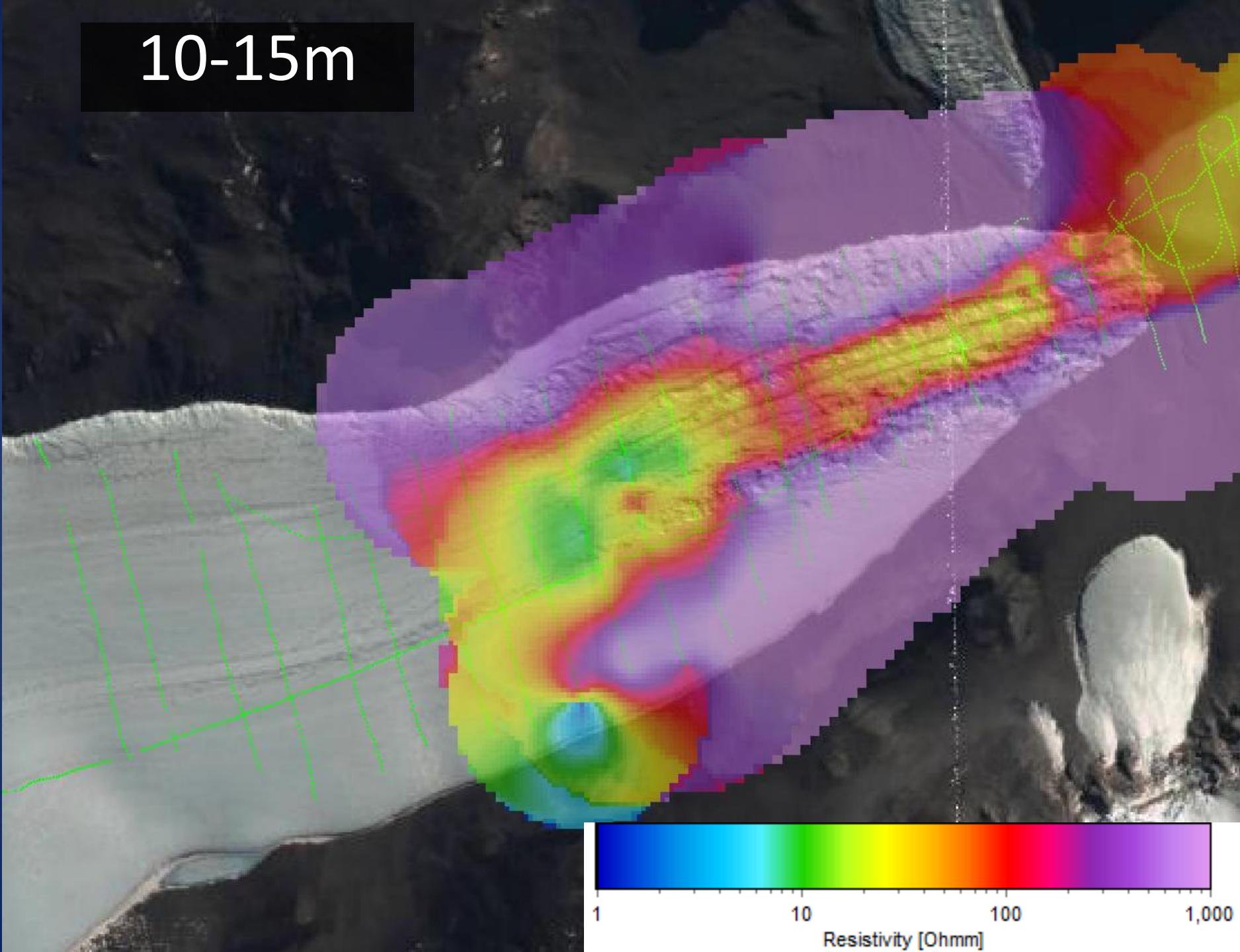
20-25m



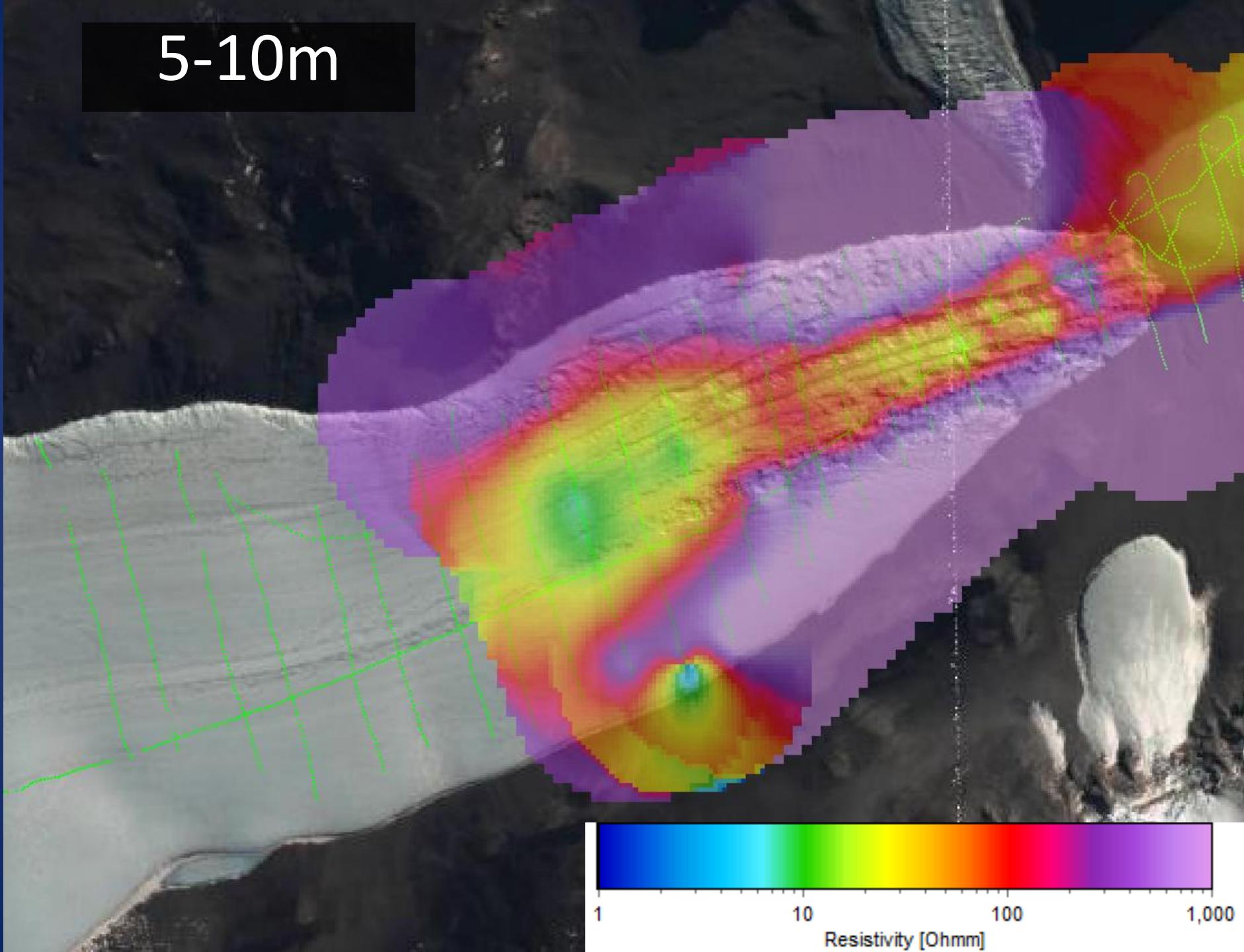
15-20m



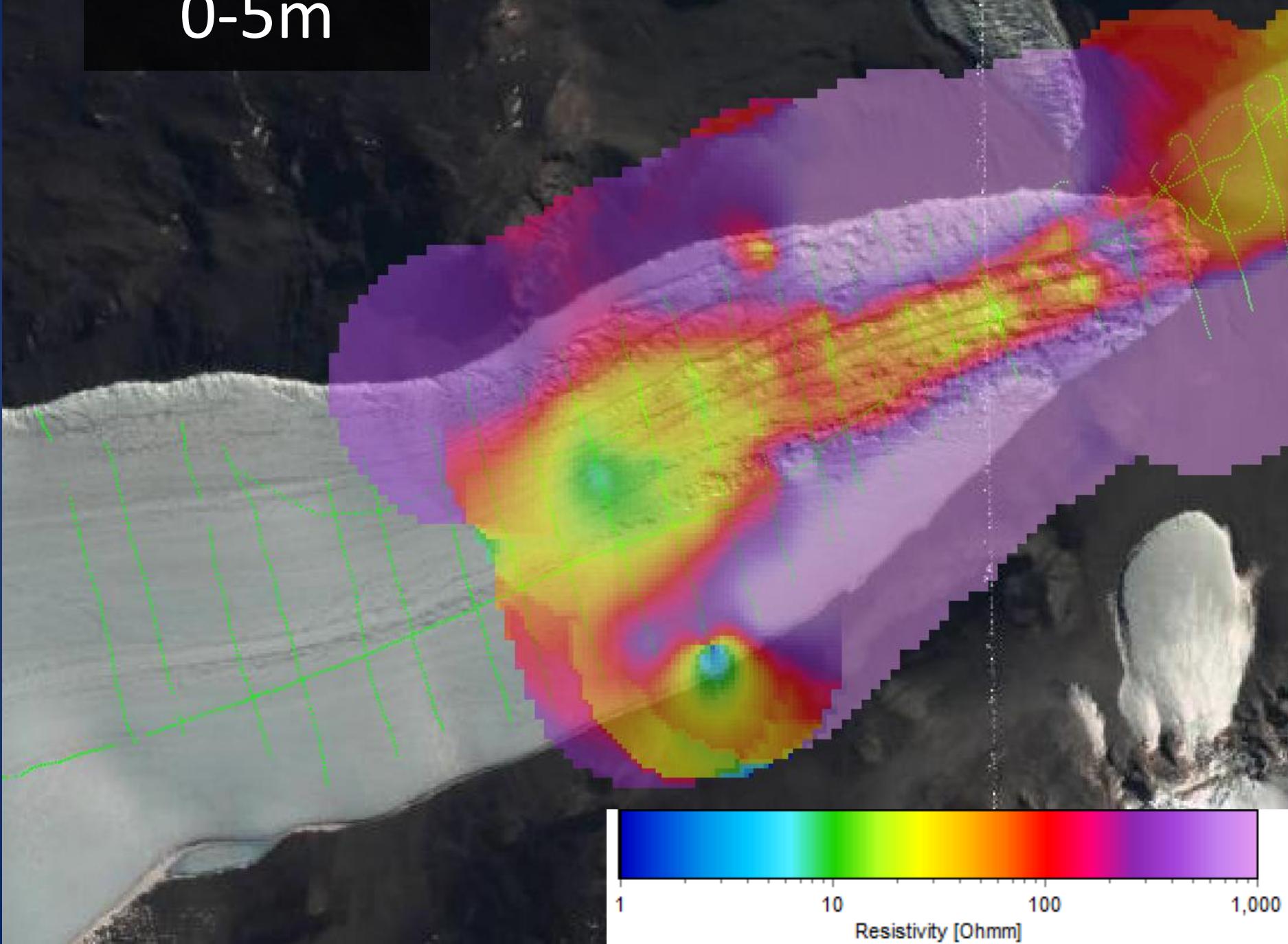
10-15m



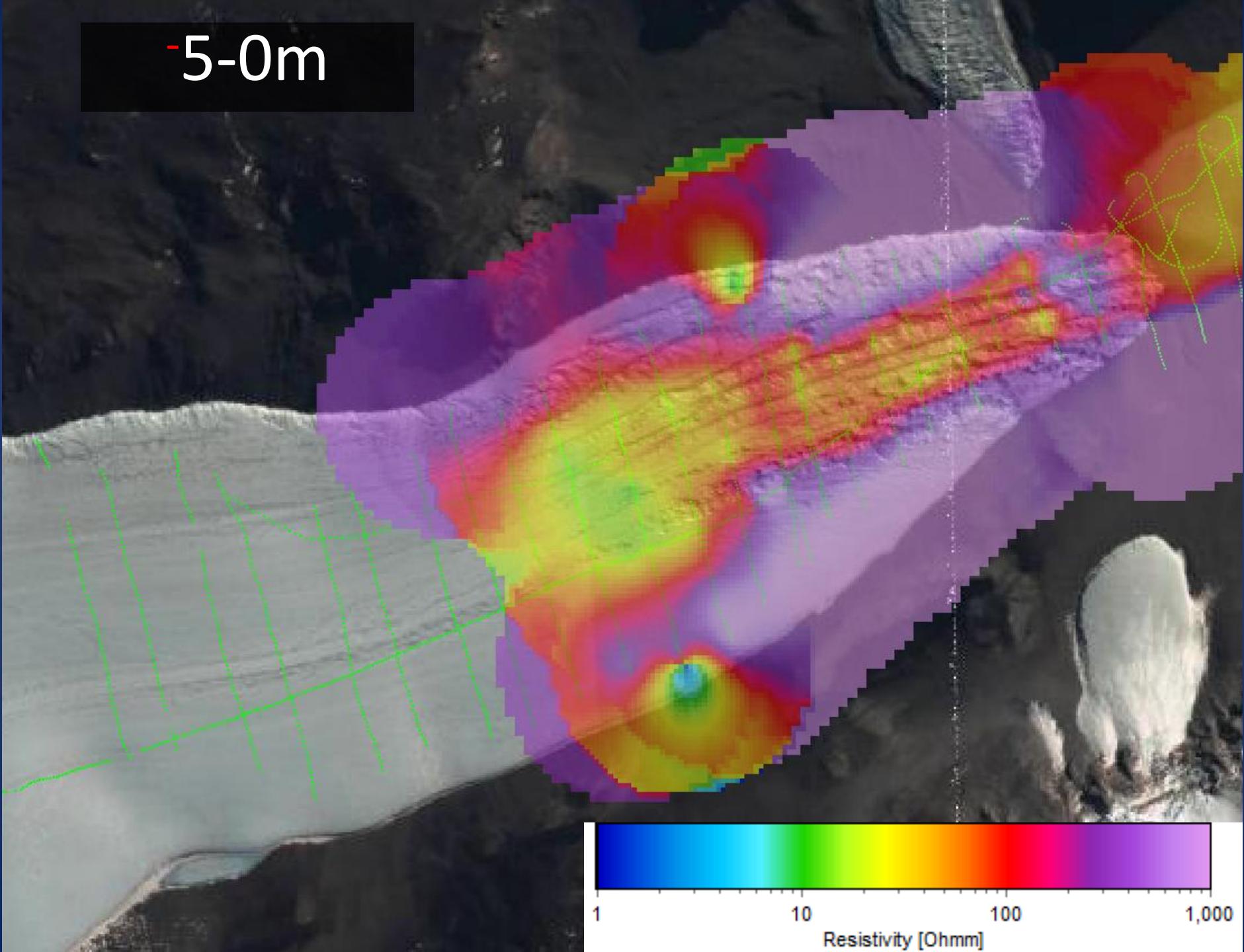
5-10m



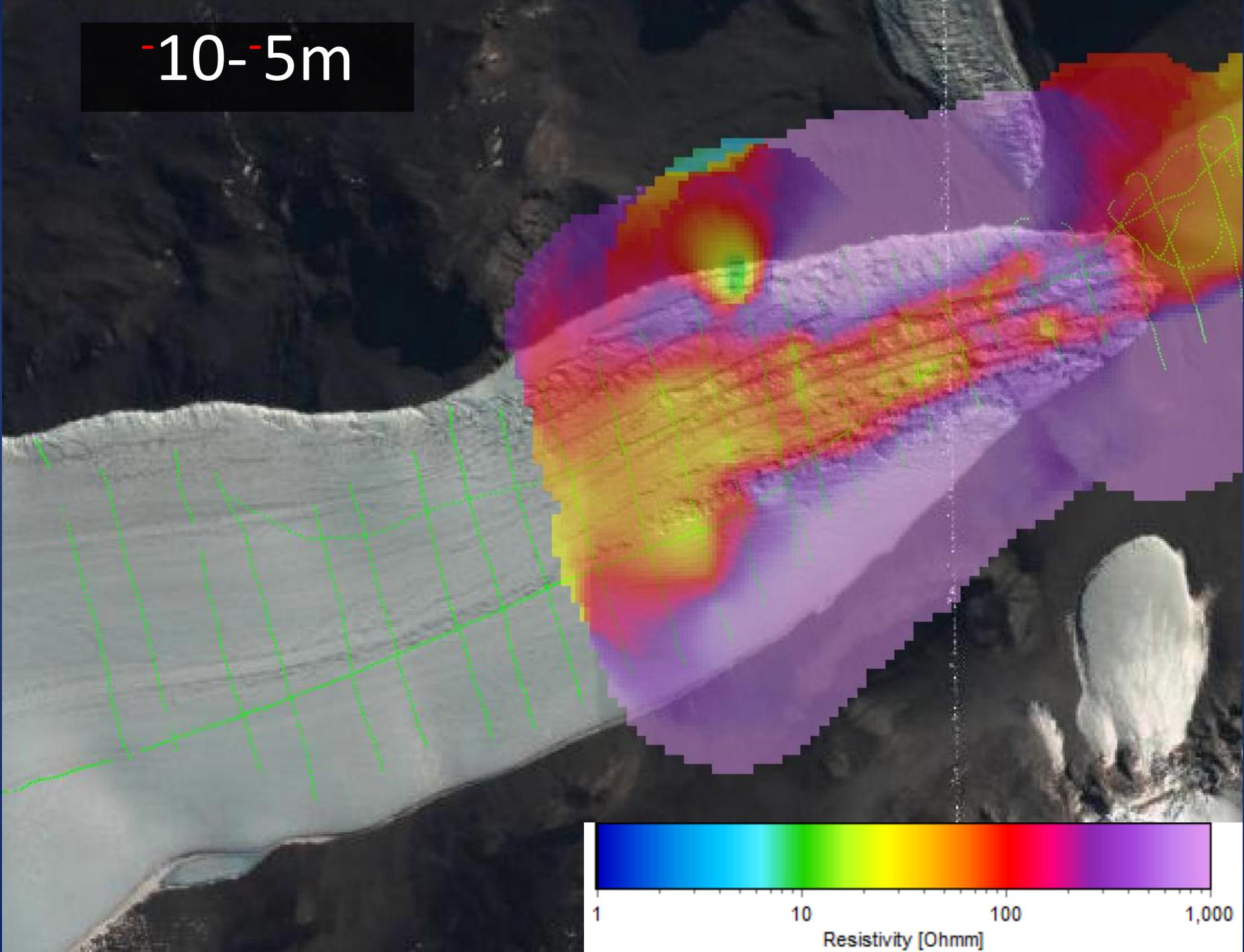
0-5m



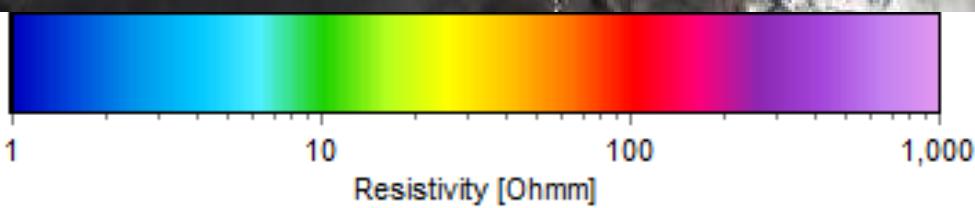
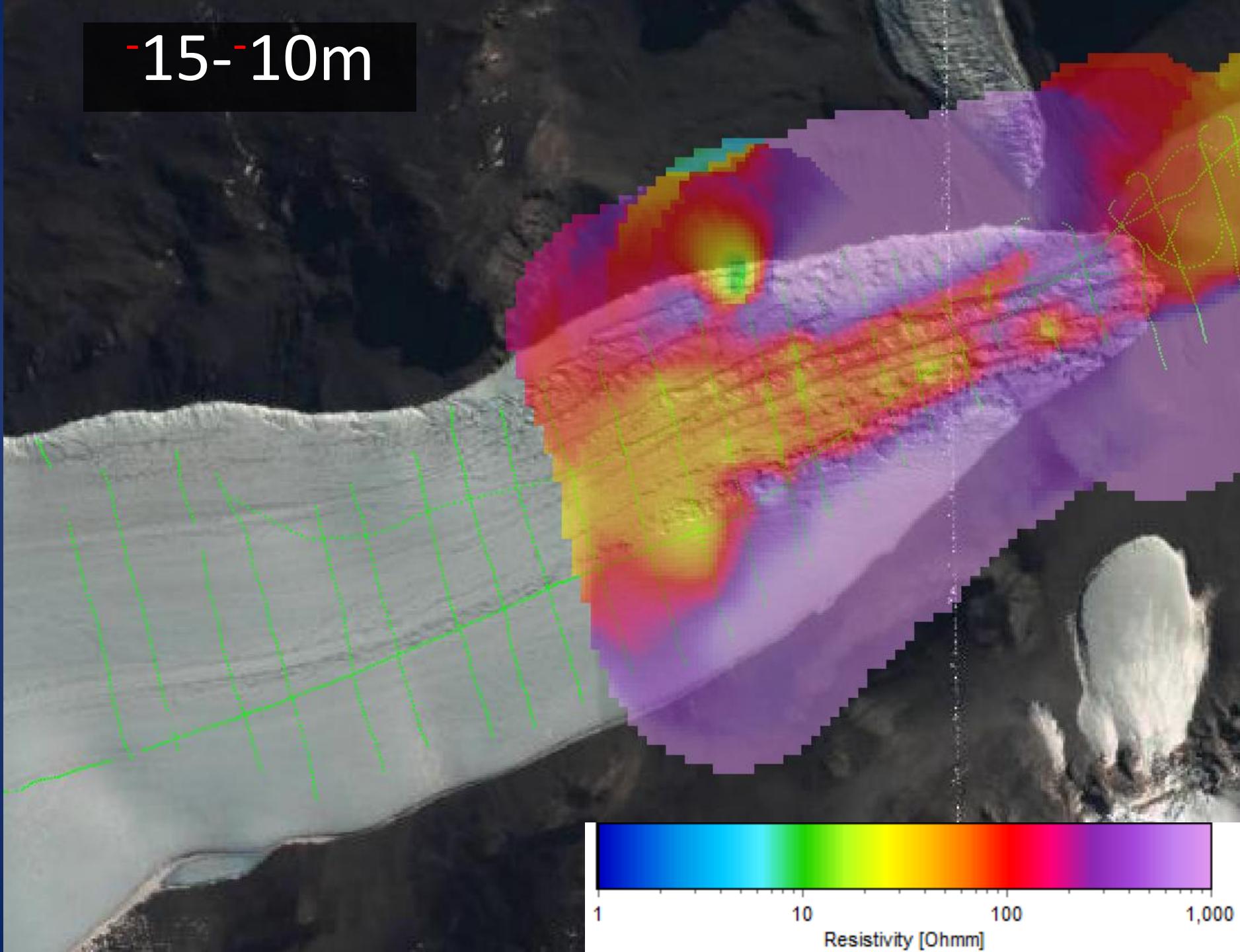
-5-0m



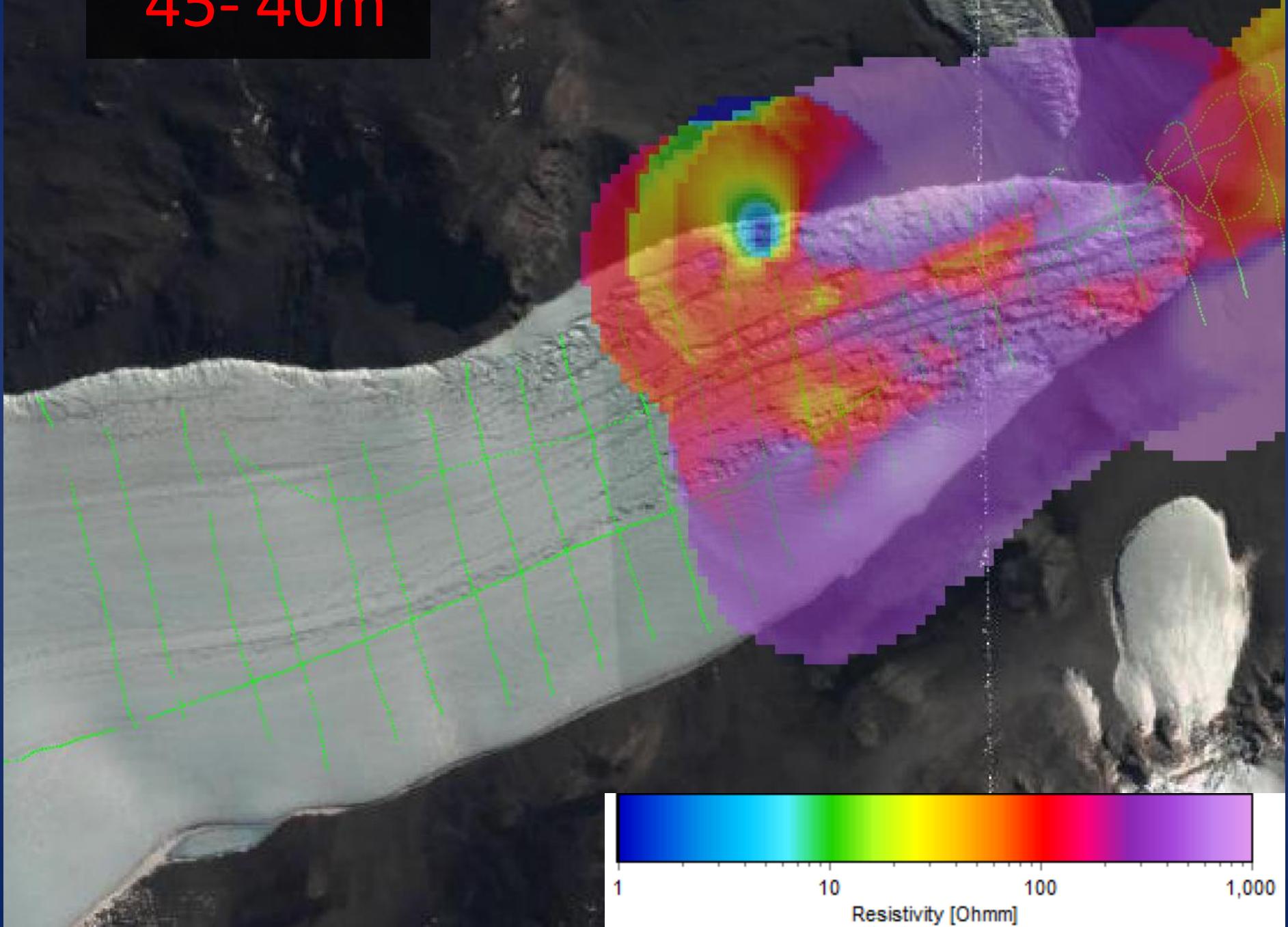
-10-5m



-15-10m



-45--40m



Conclusions

- Best places to look:
 - Near Blood Falls
 - Midway back on glacier
- Need to compare to Jessica's GPR data
 - Resistivity matches GPR?
 - Add in depth to basal ice
- Blood Falls as a pressure relief valve

