

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

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http://en.wikipedia.org/wiki/File:McMurdo_sound_USGS_map.jpg

http://lima.usgs.gov/documents/LIMA_overview_map.pdf

Taylor Valley



3.5km

Taylor Valley

Ross Sea

Commonwealth Gl.

Lake Fryxel

Lake Hoare

Canada Glacier

Blood Falls

Lake Bonney

Taylor Glacier

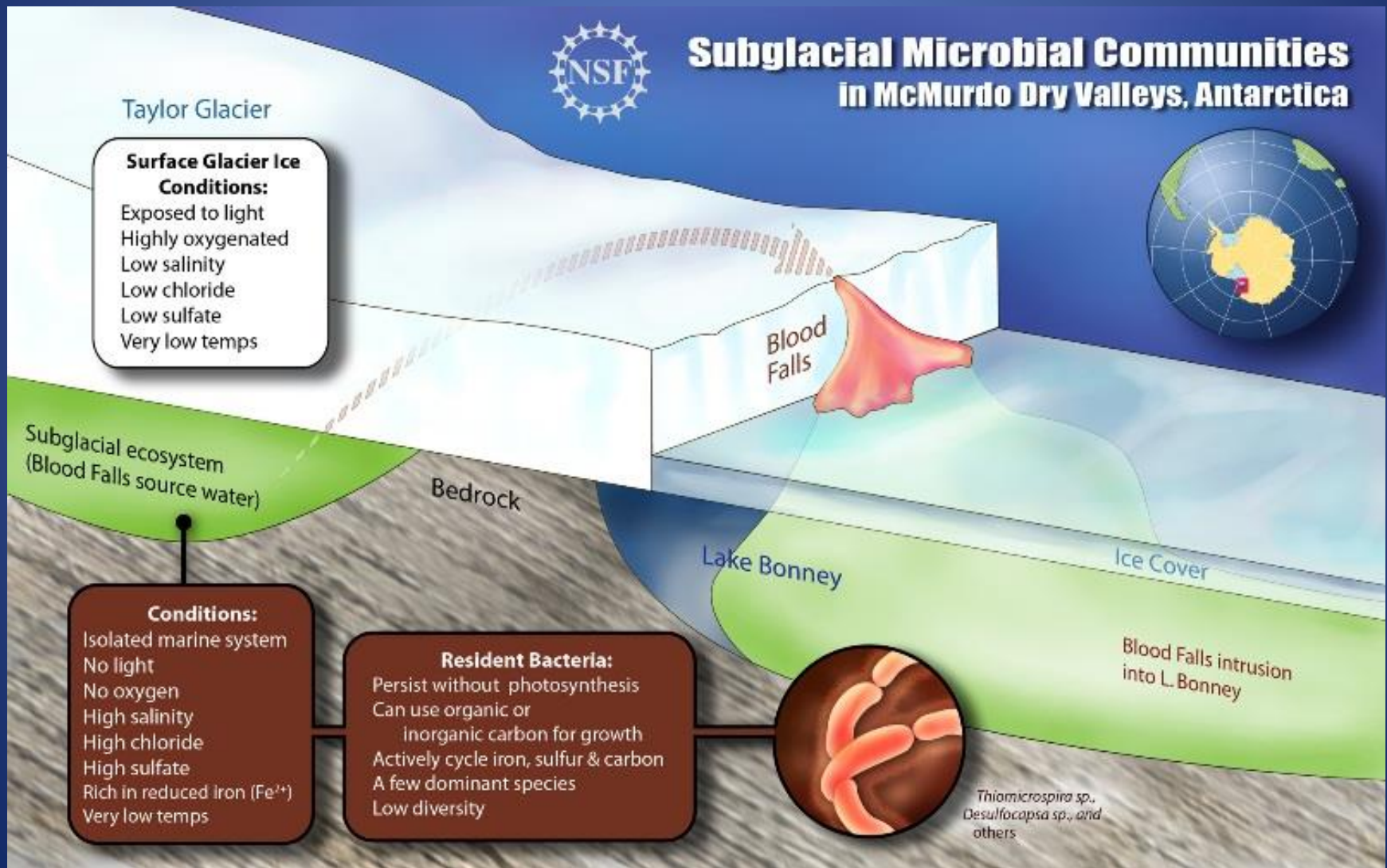
3.5km



Blood Falls



Conceptual Sketch of Blood Falls

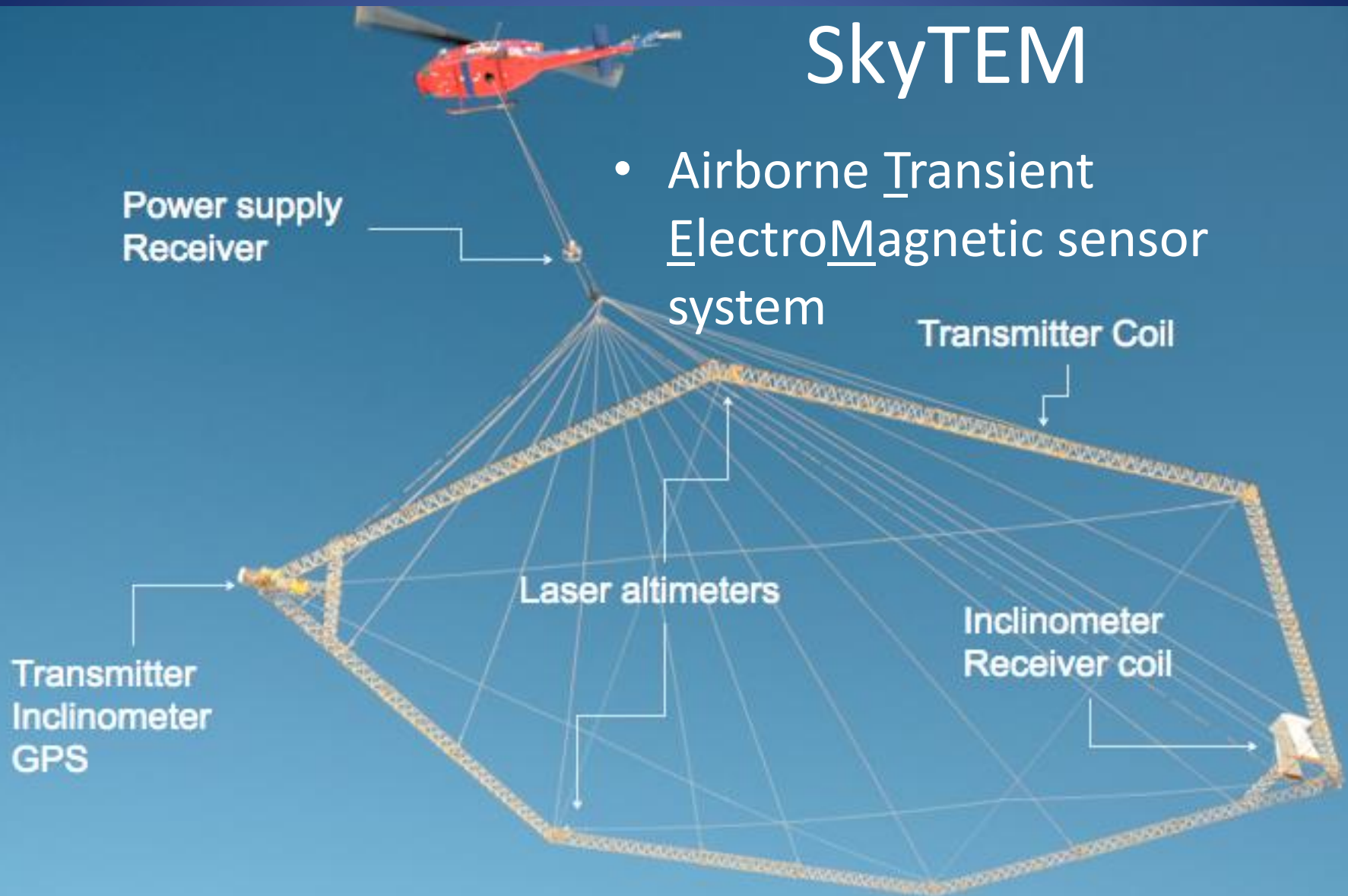


Takeaway Points

- 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?

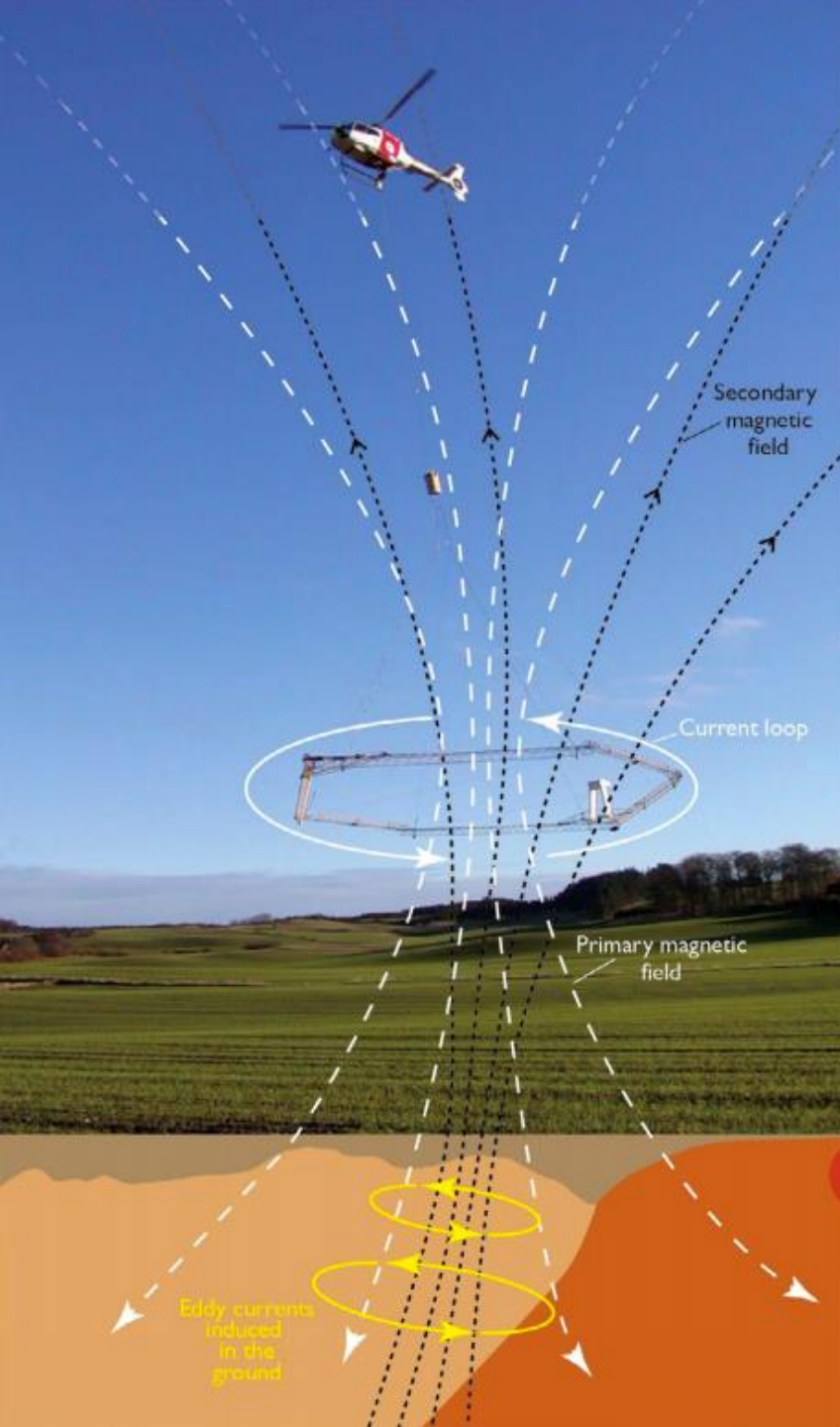
SkyTEM

- Airborne Transient ElectroMagnetic sensor system



SkyTEM

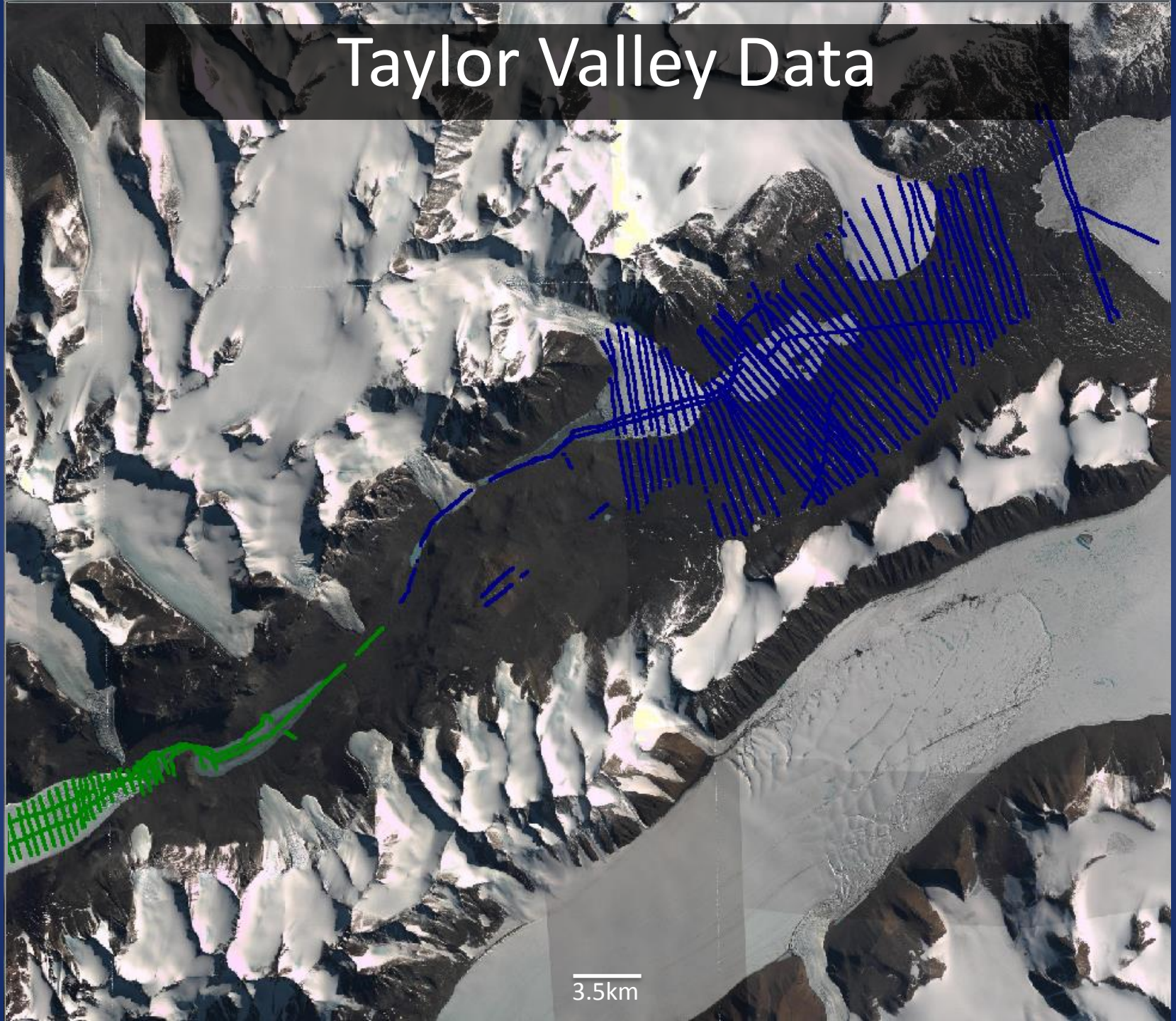
- Airborne Transient ElectroMagnetic sensor system
- Sensitive to good conductors
- I work with data reported as resistivity (ρ):
 - $\rho = 1/C$
 - Units: ohm-meters
 - $\rho_{\text{seawater}} = 0.34 @ 0^{\circ}\text{C}$
 - Generally reported on a log scale



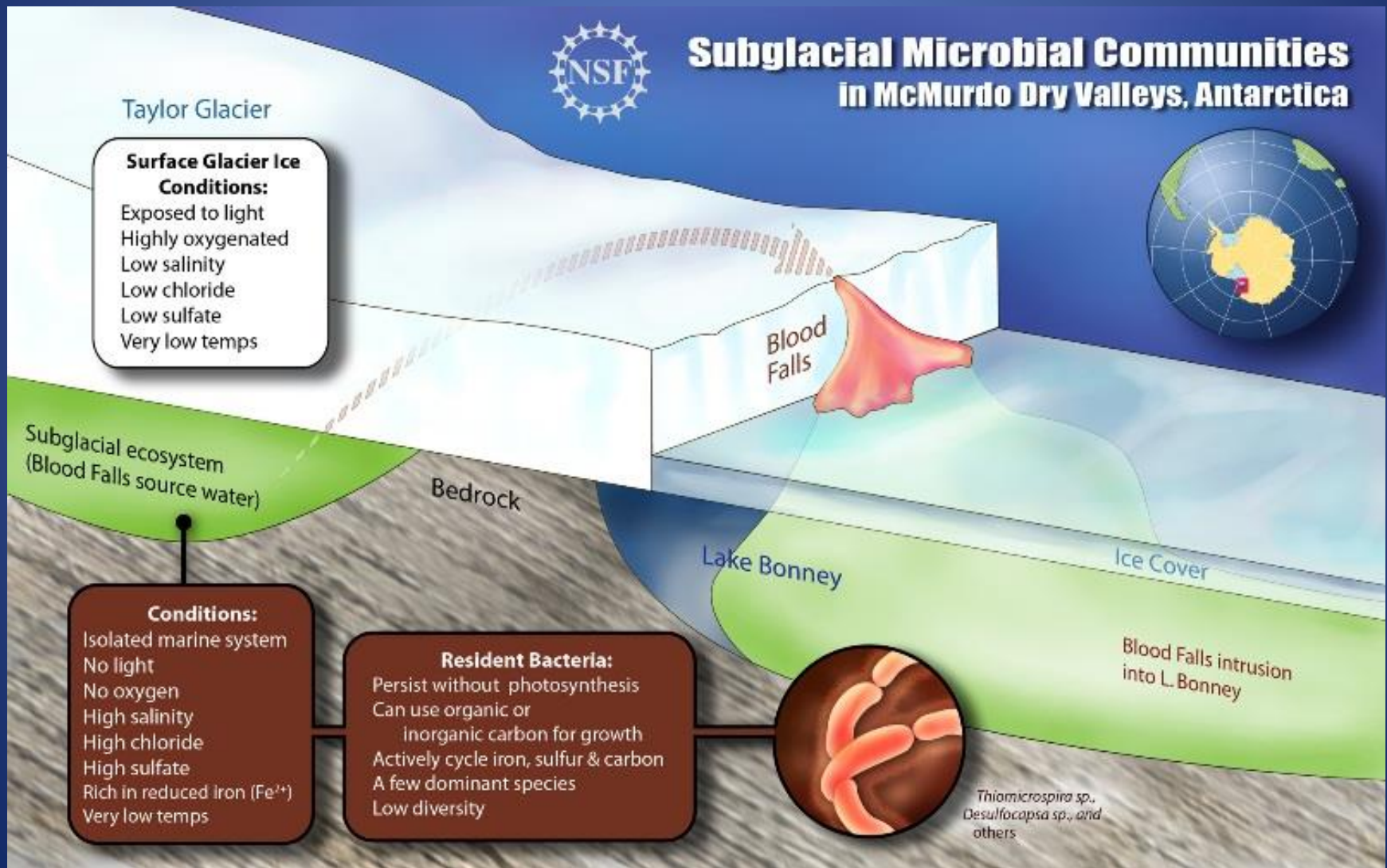
Dry Valleys Data



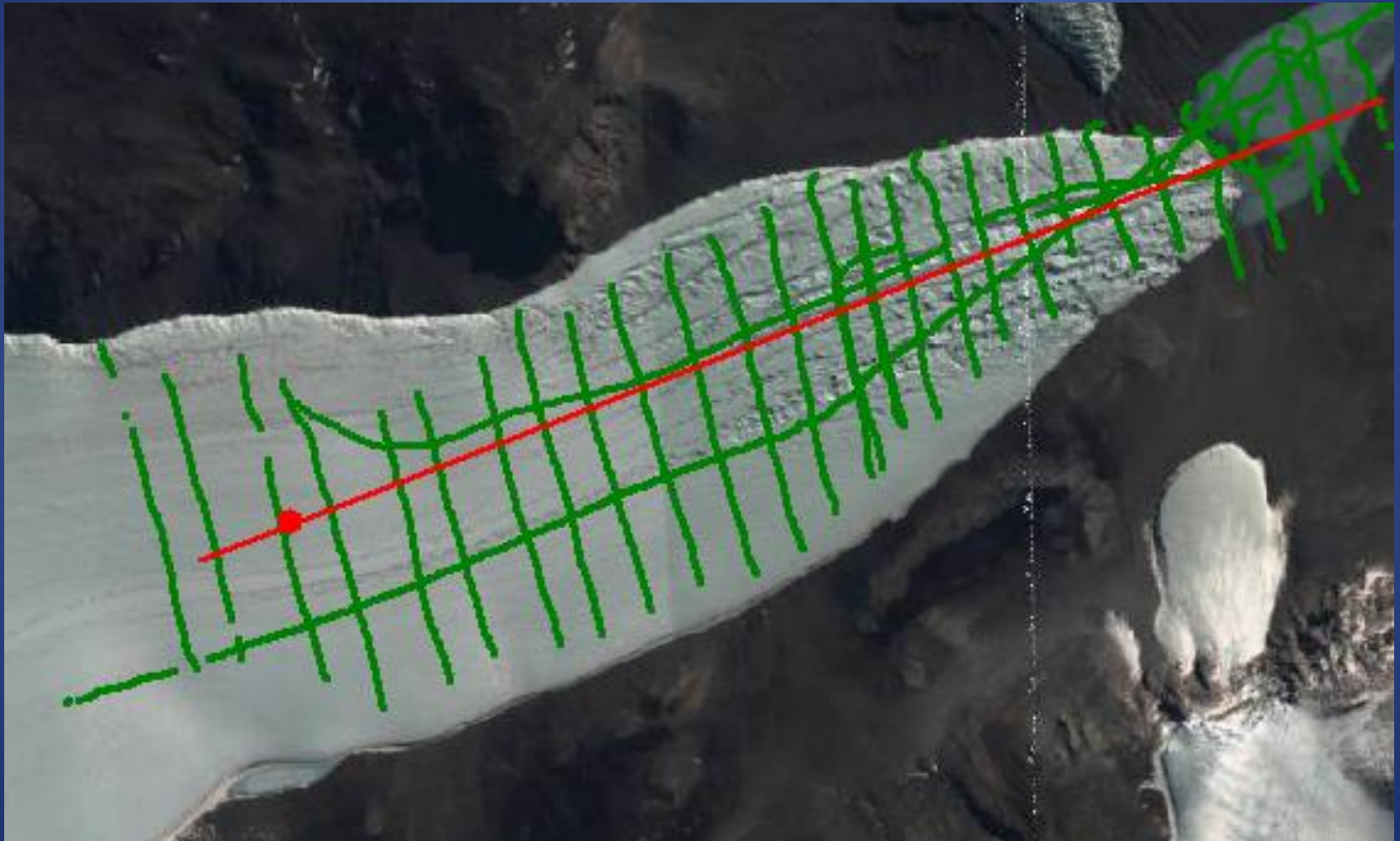
Taylor Valley Data



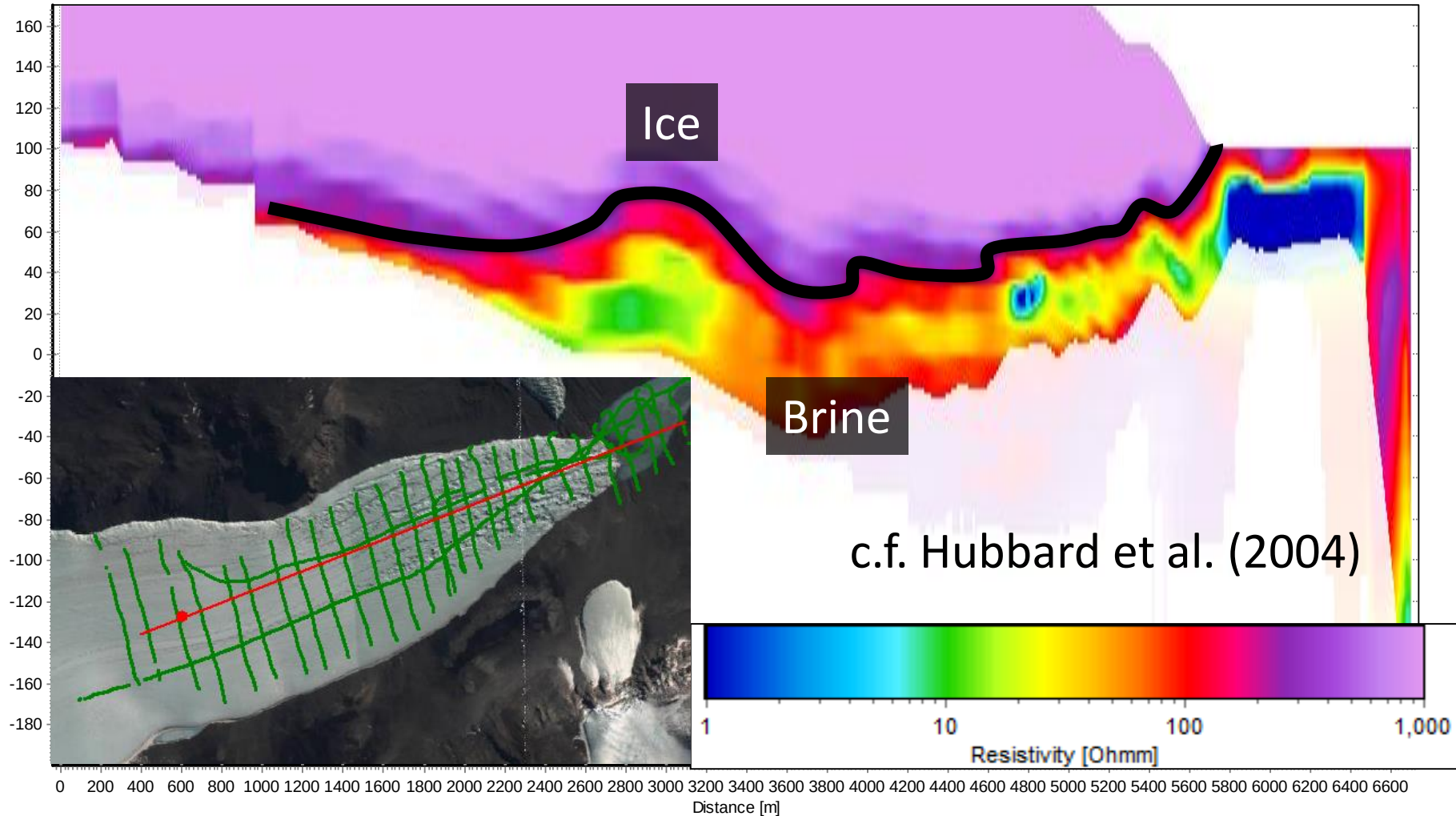
Conceptual Sketch of Blood Falls



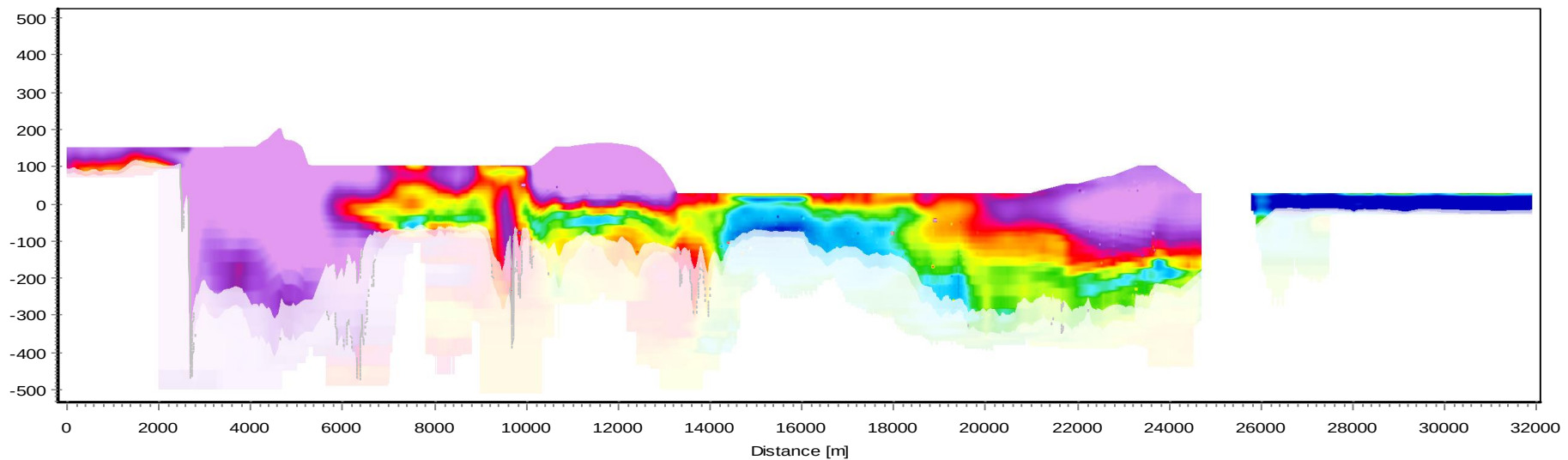
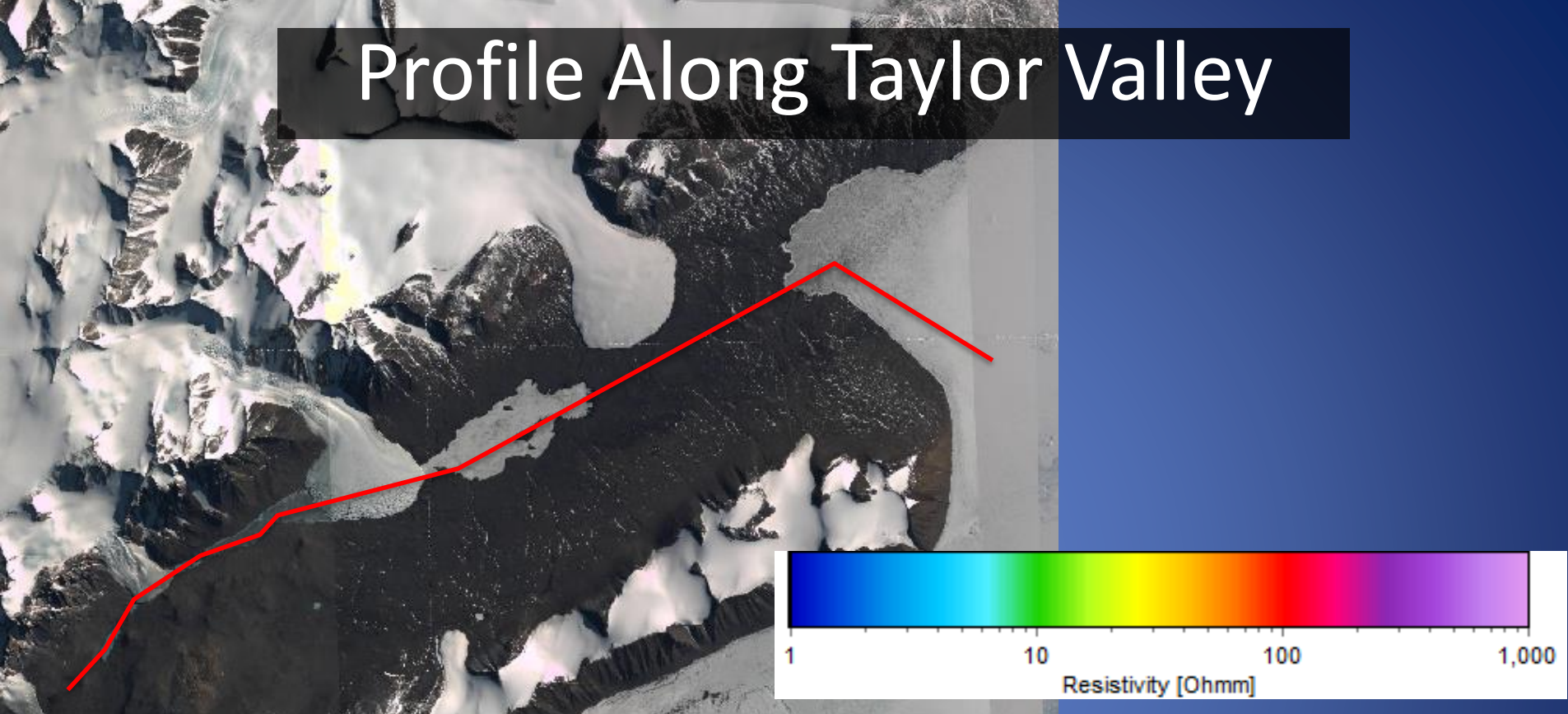
Real Data for Blood Falls



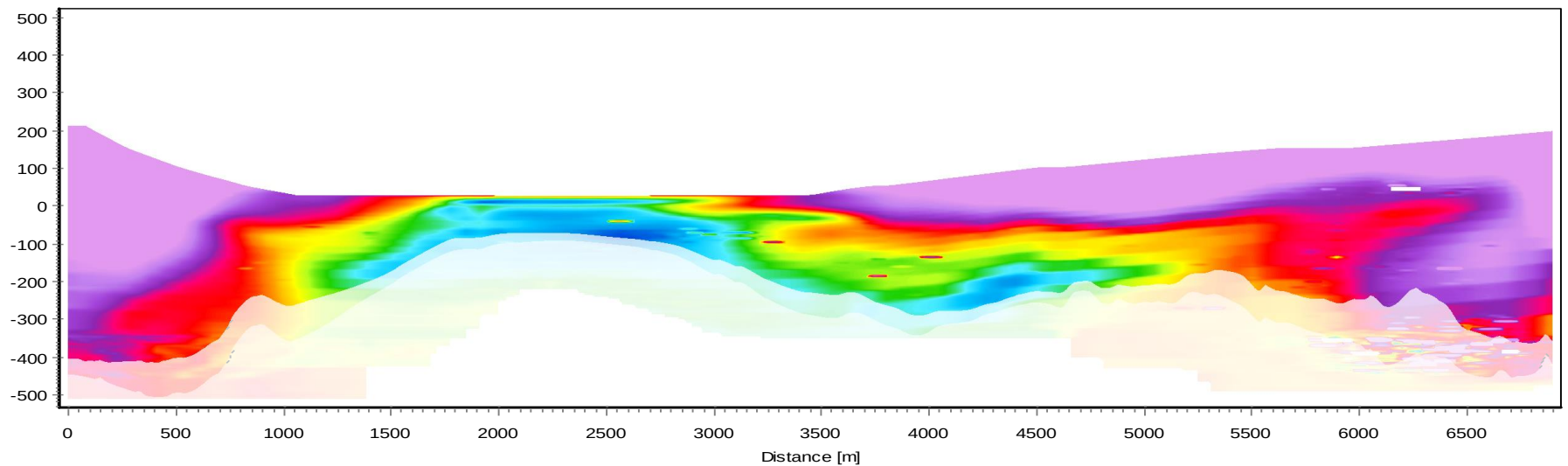
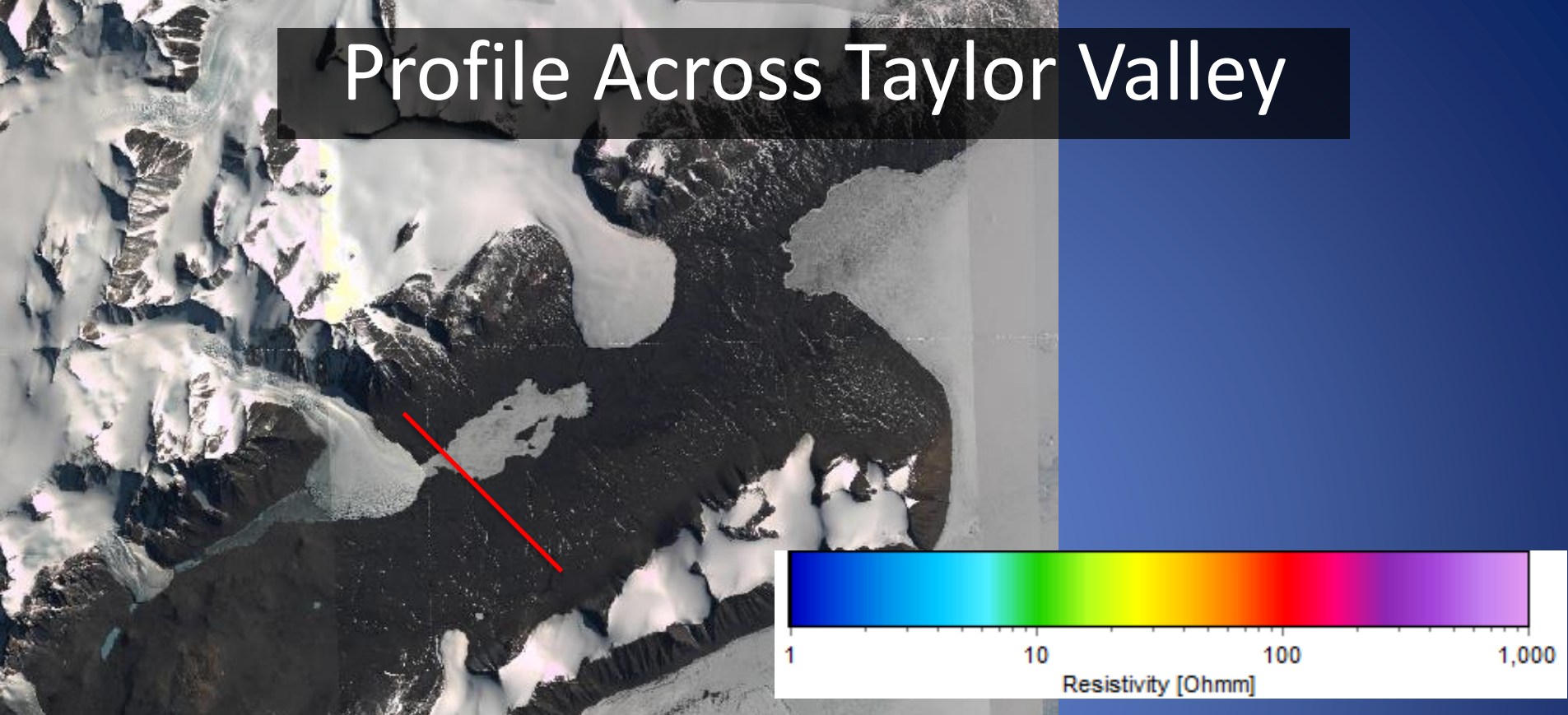
Real Data for Blood Falls



Profile Along Taylor Valley

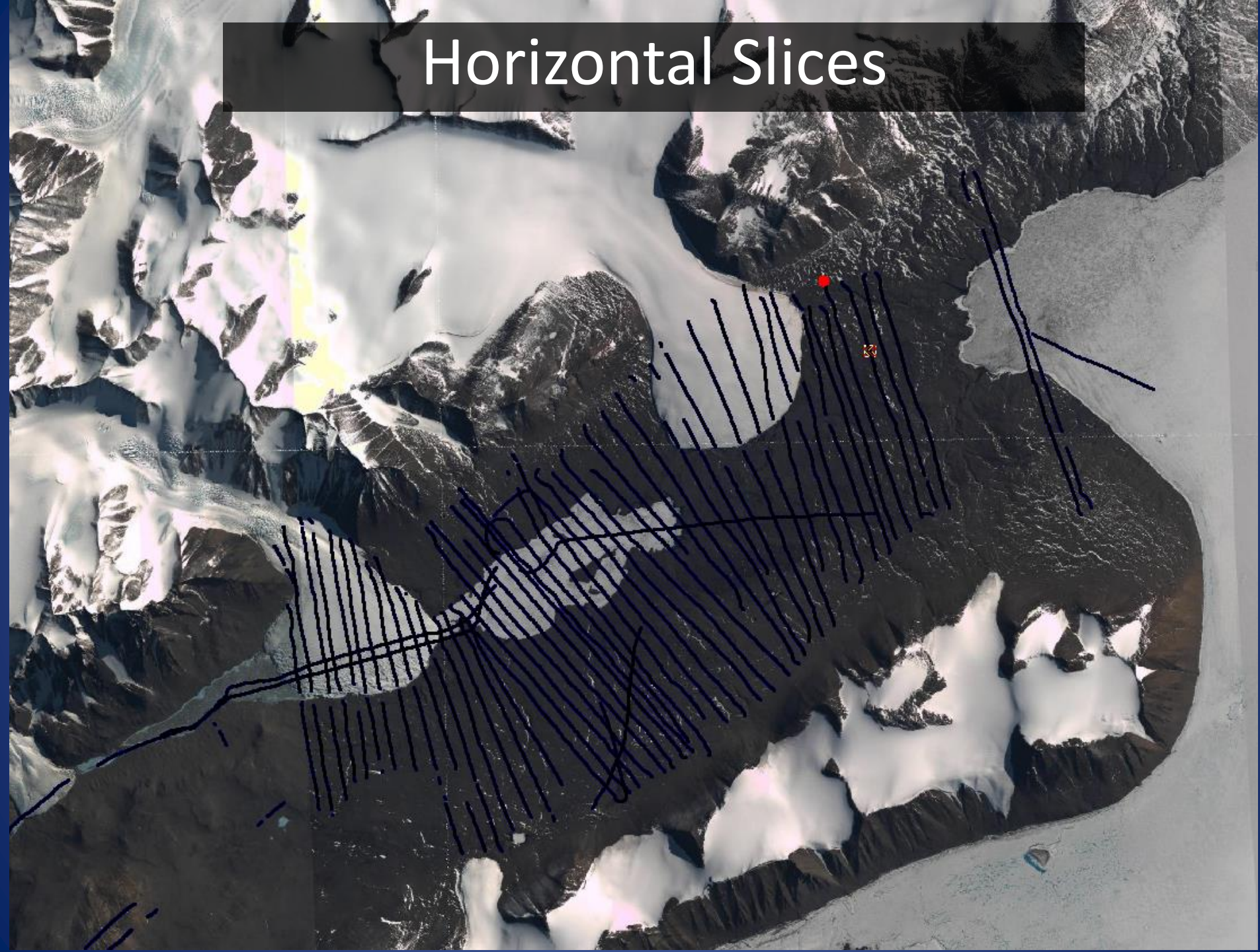


Profile Across Taylor Valley

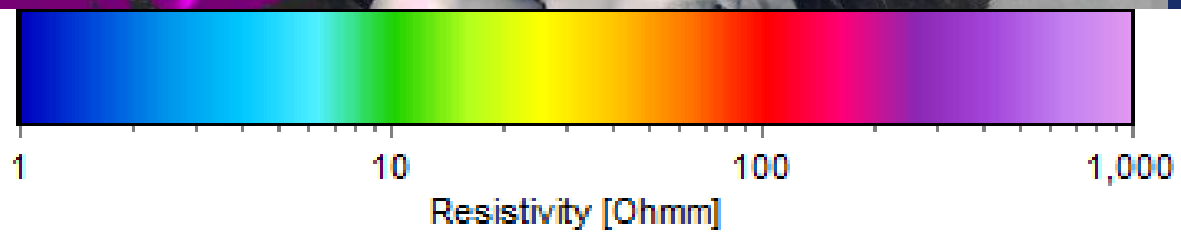
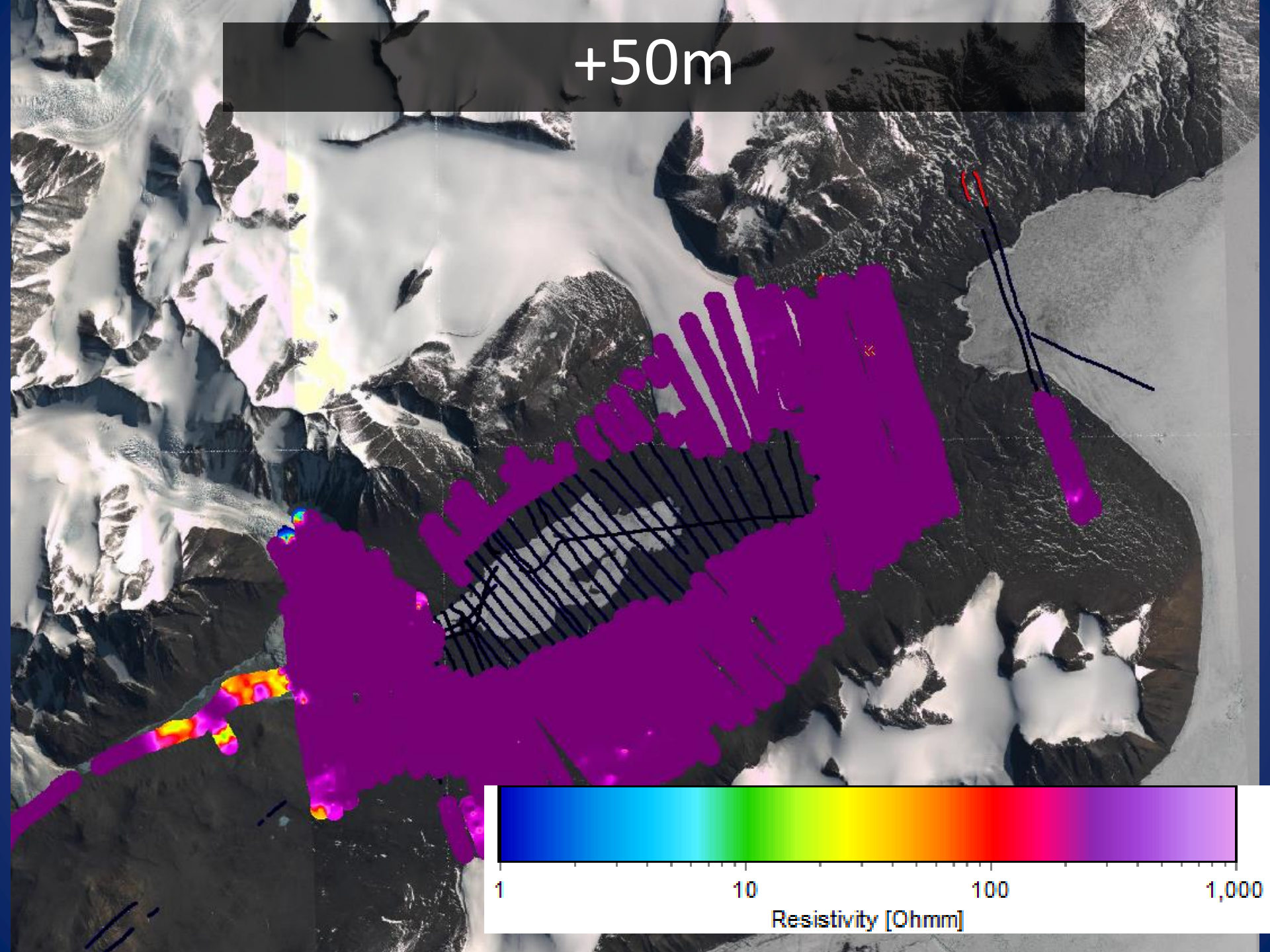




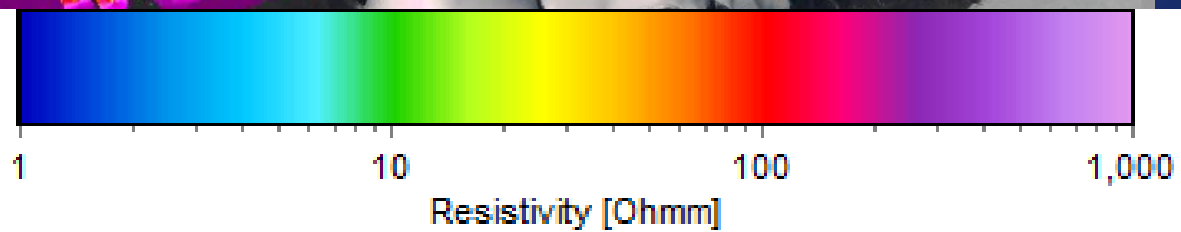
Horizontal Slices



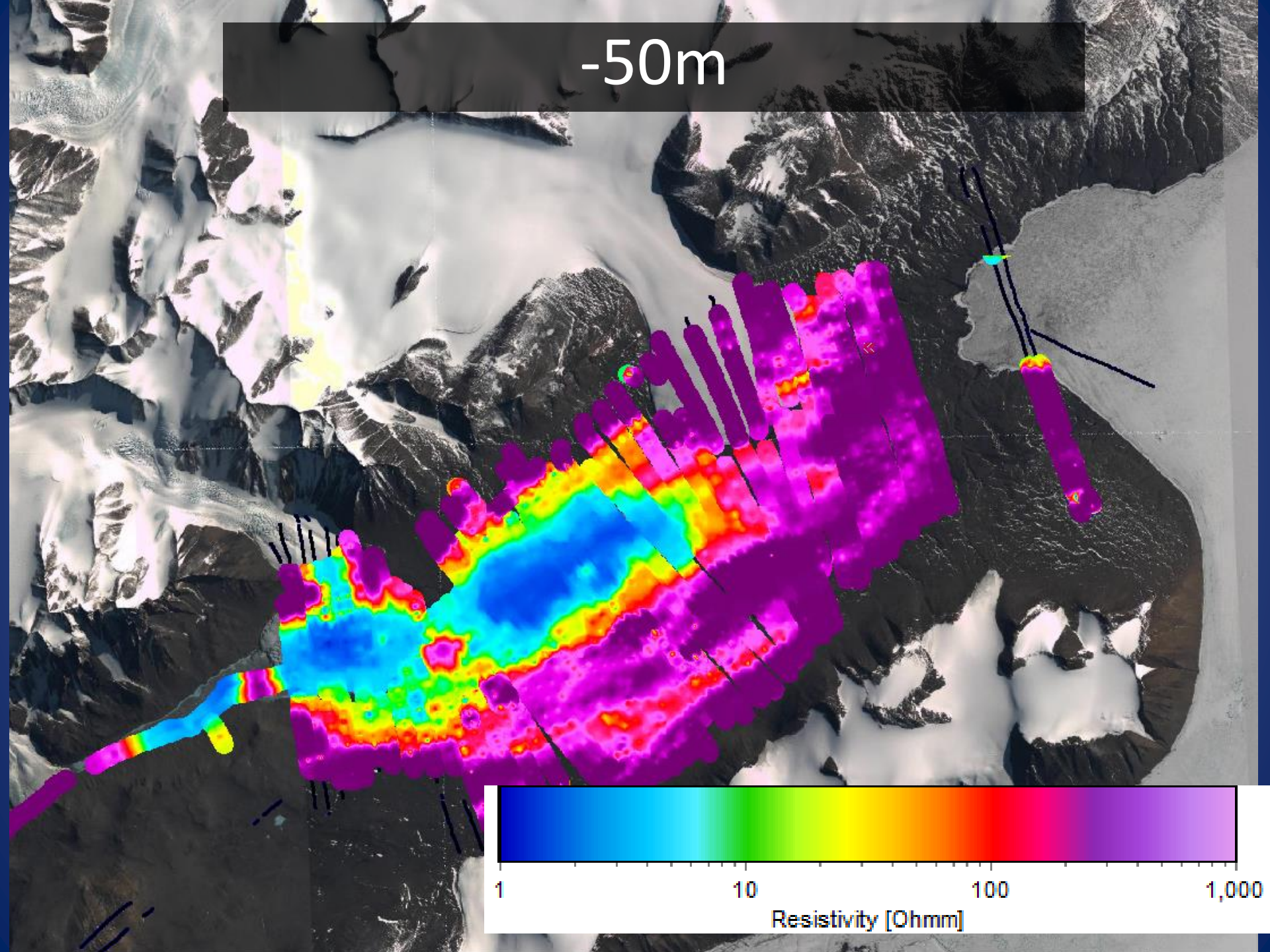
+50m



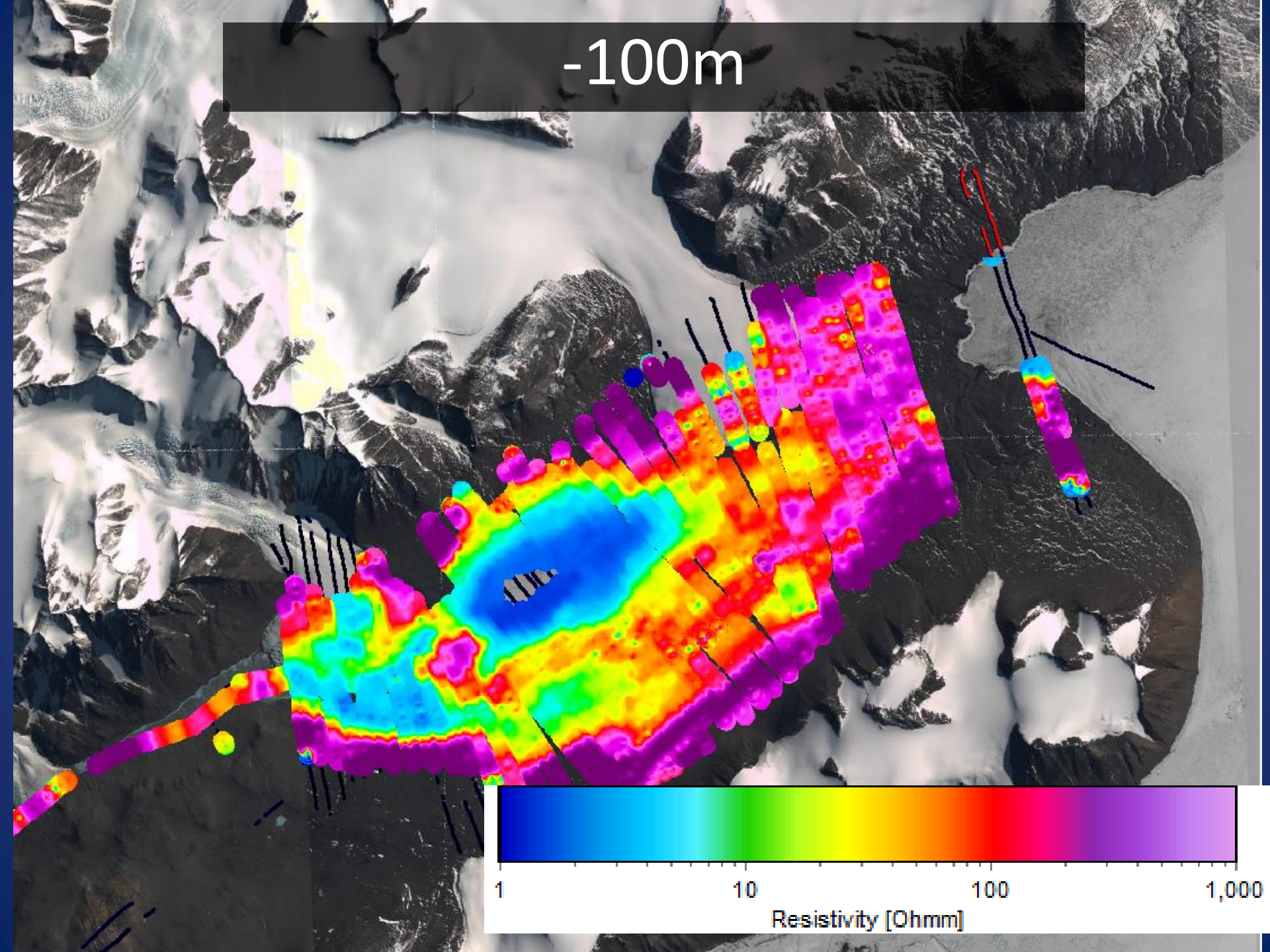
0m



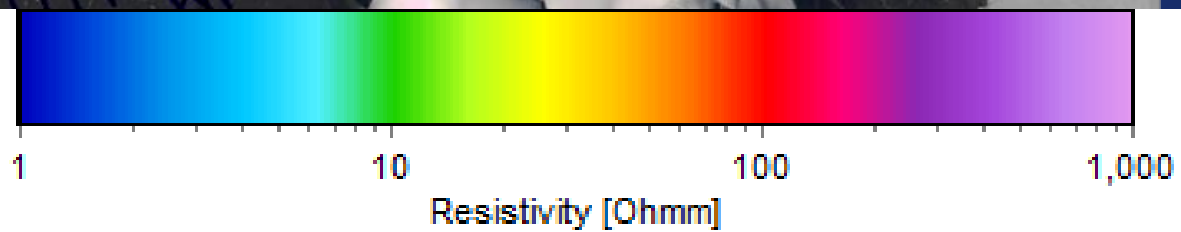
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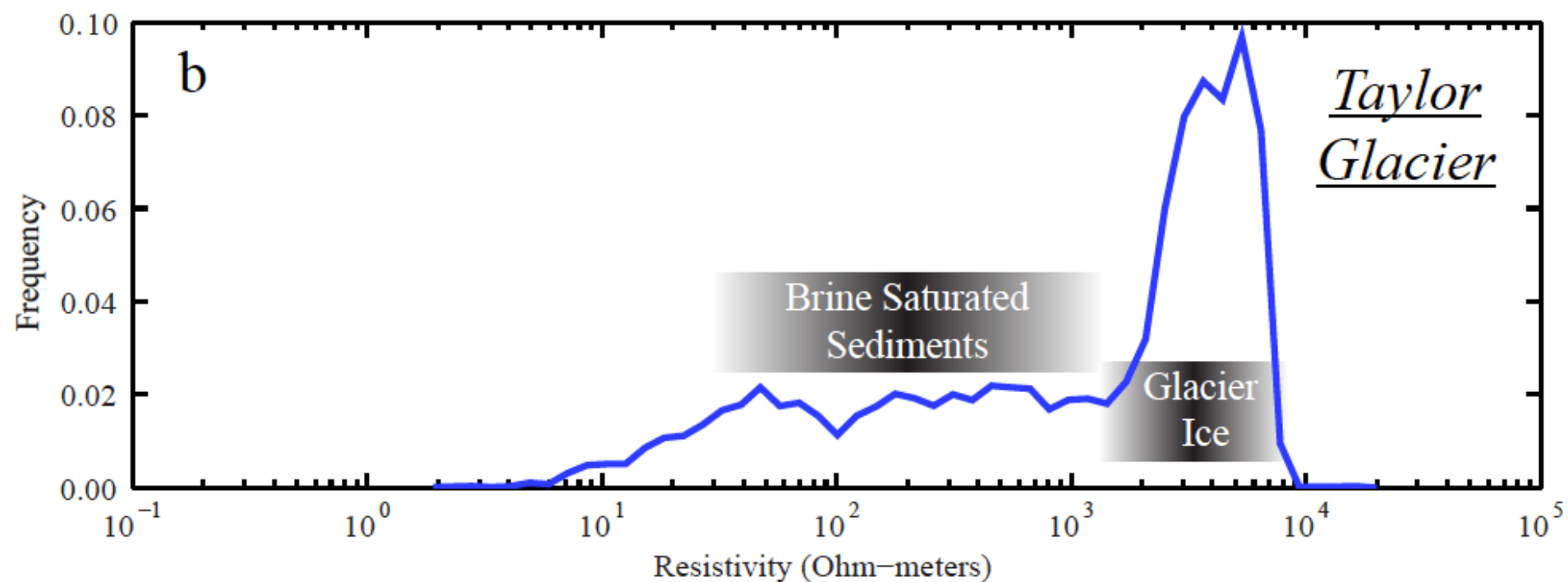
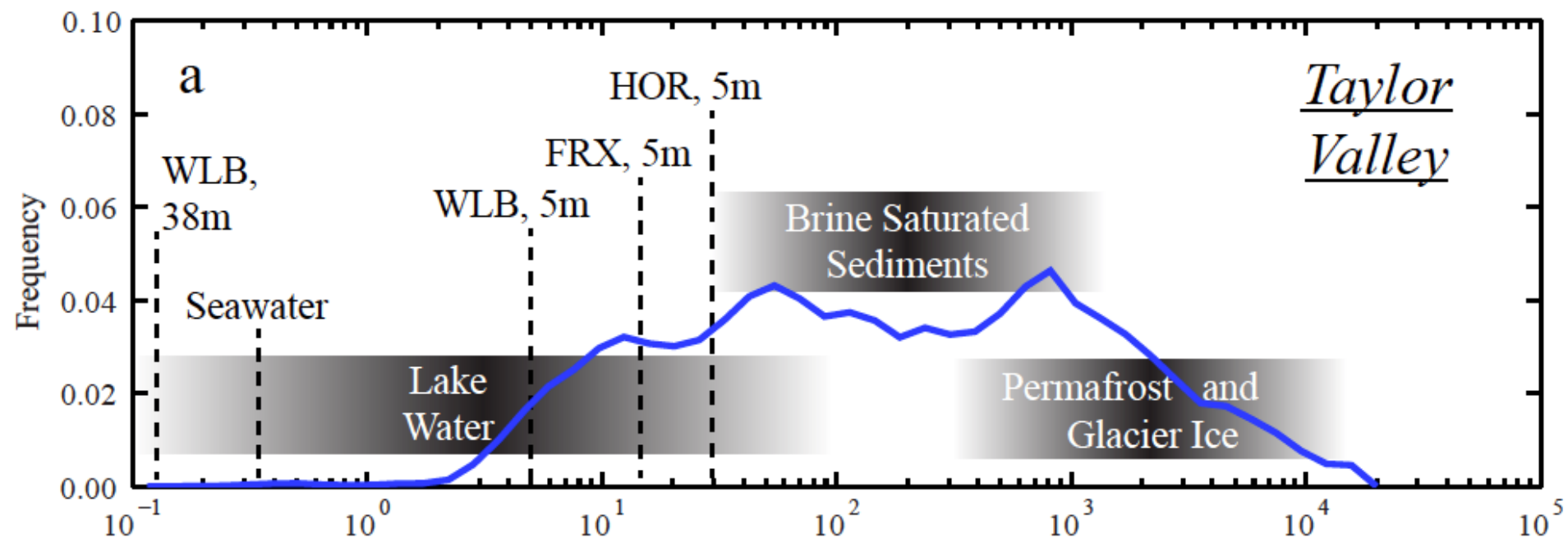


-100m

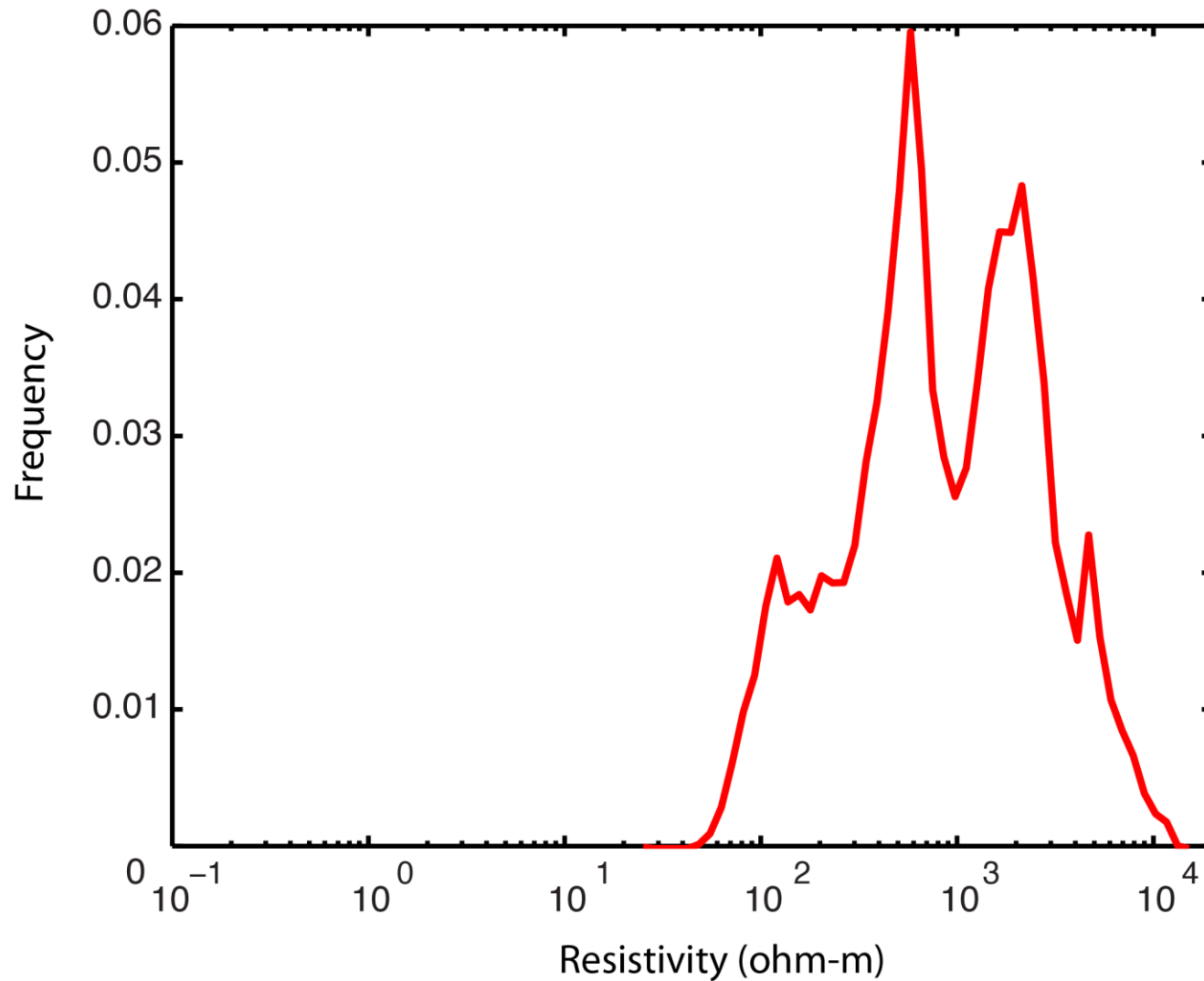


-150m

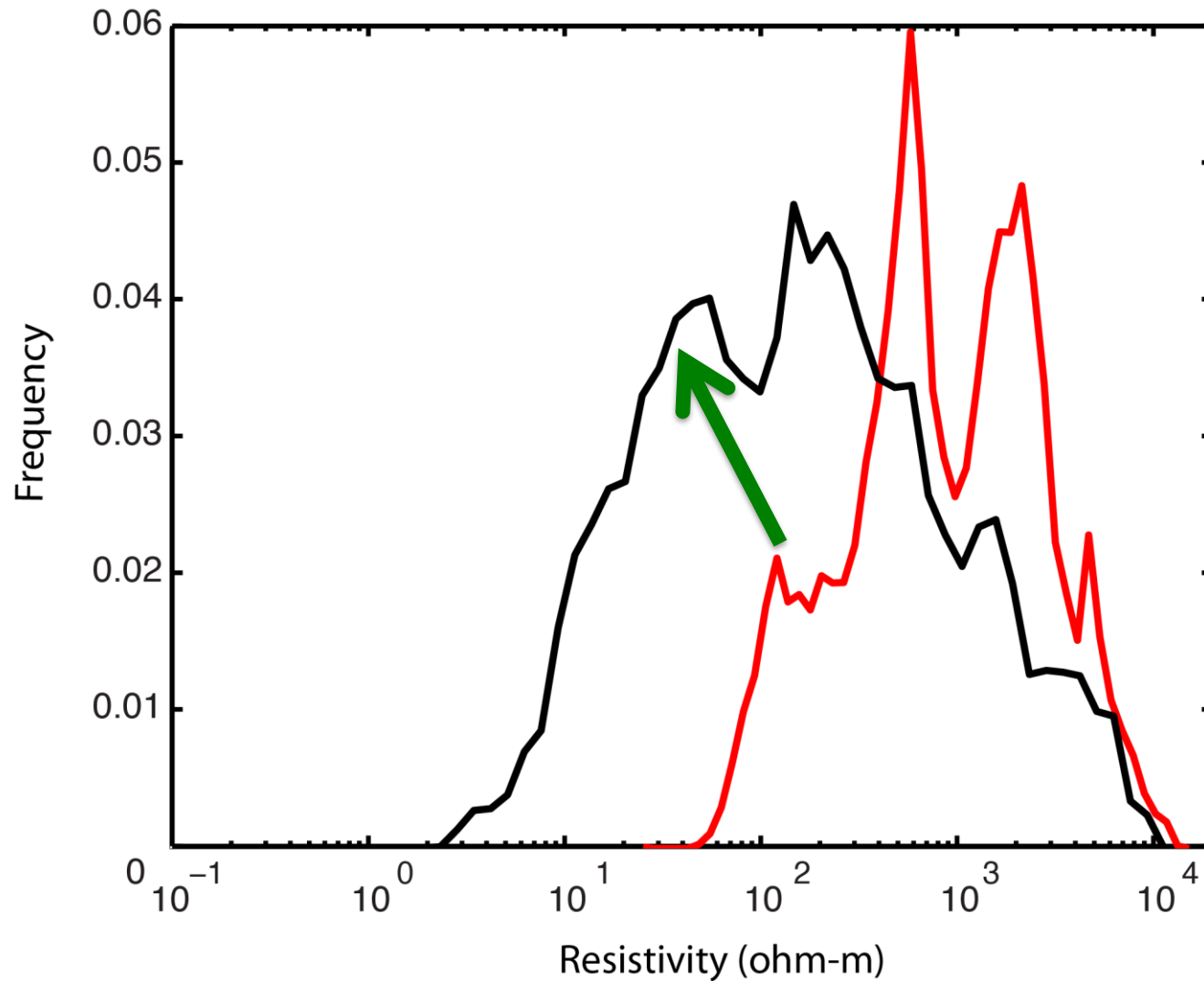




Permafrost, 3m Below Surface



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

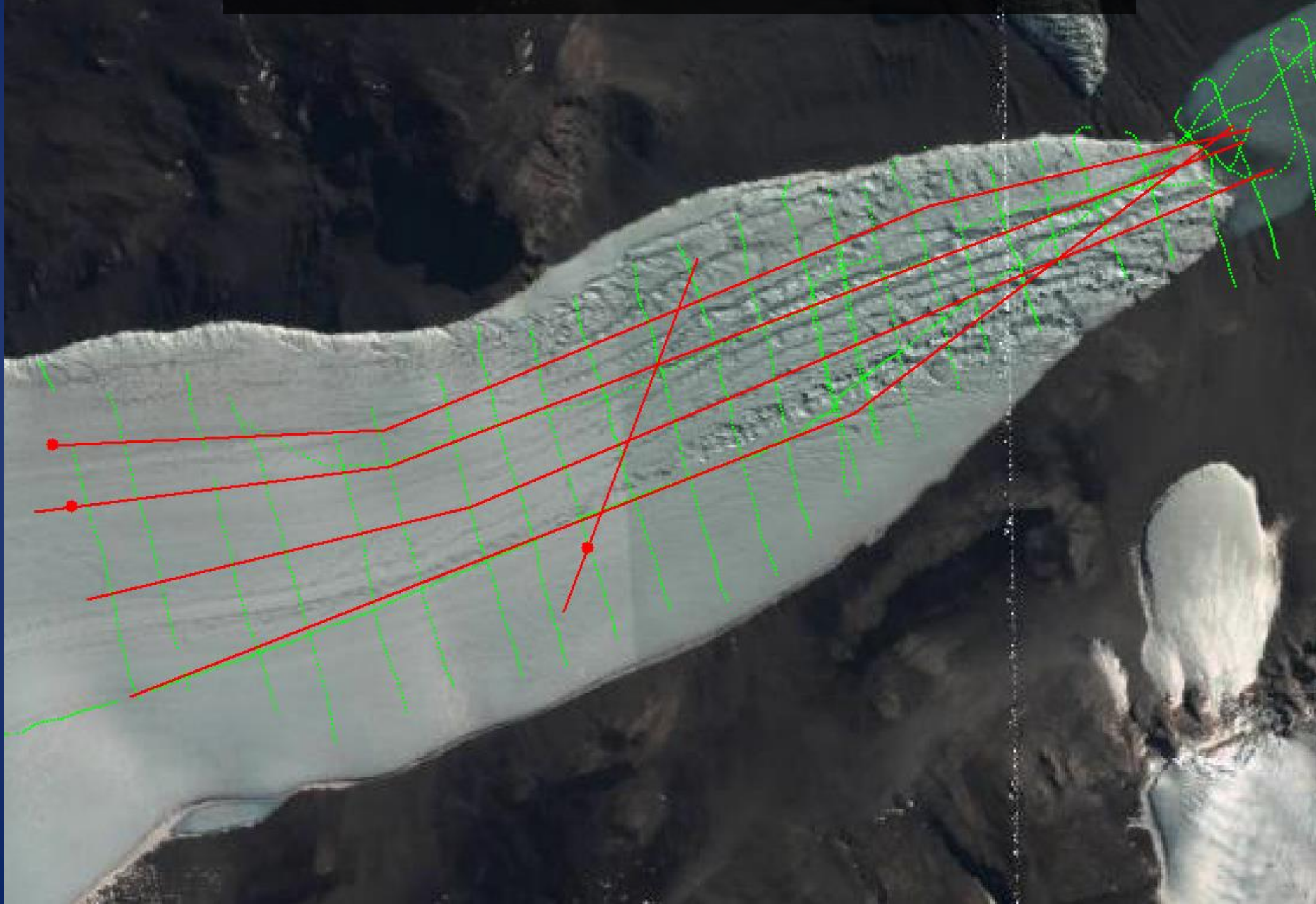
Next Steps

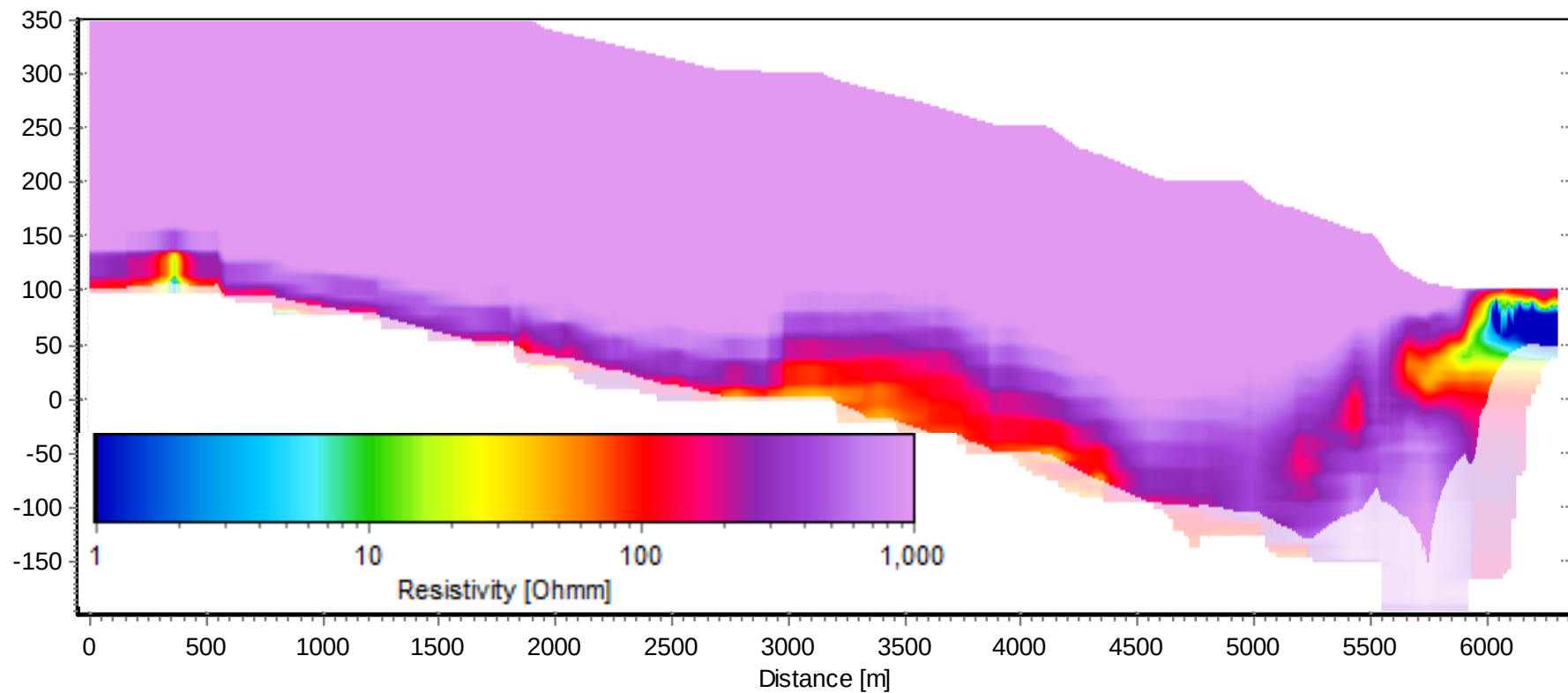
- Quantify volume of brines
- Hydrologic history and balance of the Dry Valleys
- Delivery of nutrients to the coastal ocean?
- Is this typical of lots of Antarctic coasts?
- Implications for life in Dry Valleys and off-planet?
- Use TEM off-planet?

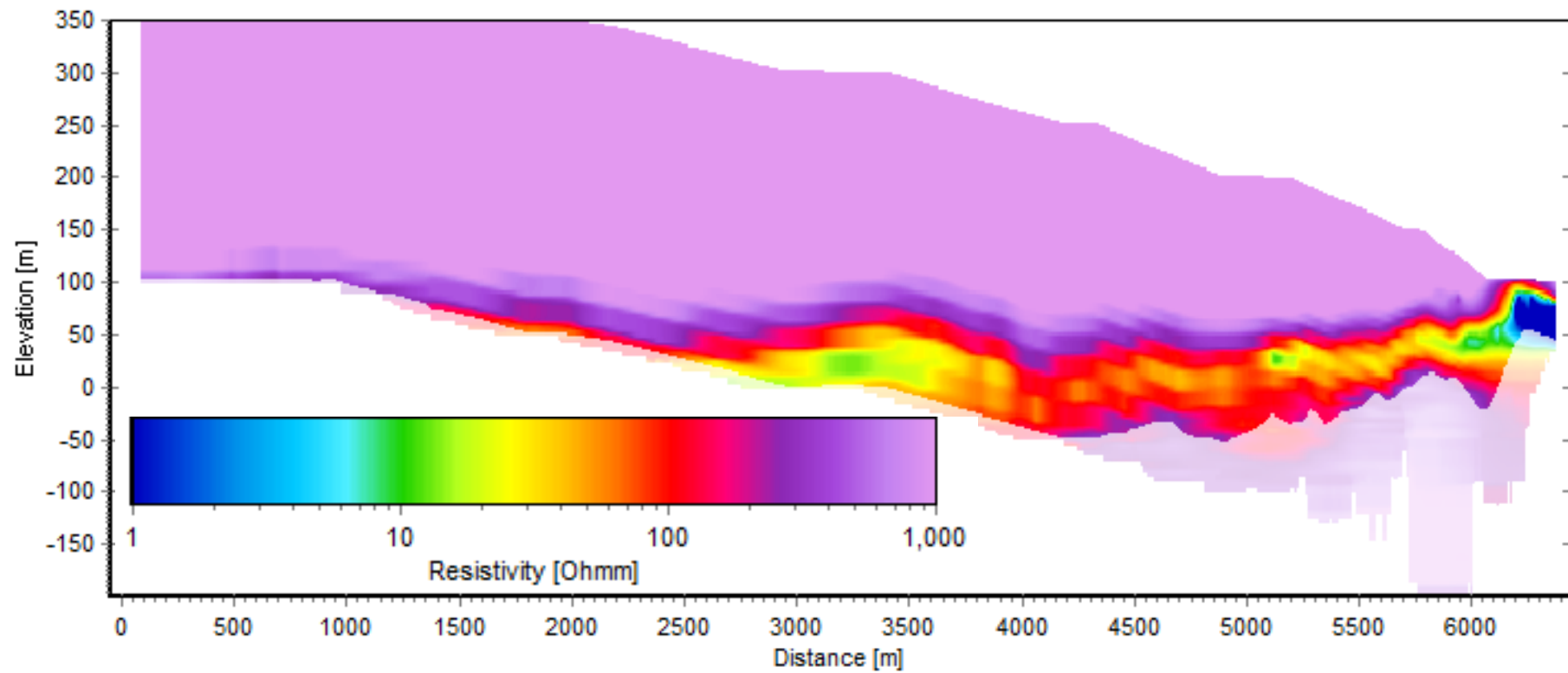
A large elephant seal is resting on a snowy, icy surface. The seal is positioned in the lower-left to center of the frame, facing towards the right. It has a thick, wrinkled, greyish-brown body with some lighter, mottled patches. Its head is slightly raised, and it has a small, dark eye and a small, light-colored mouth. A speech bubble is positioned above the seal's head, containing the text "Questions?". The background is a vast, flat, white expanse of snow and ice, with some subtle textures and shadows. The overall scene is bright and cold.

Questions?

Along the Glacier

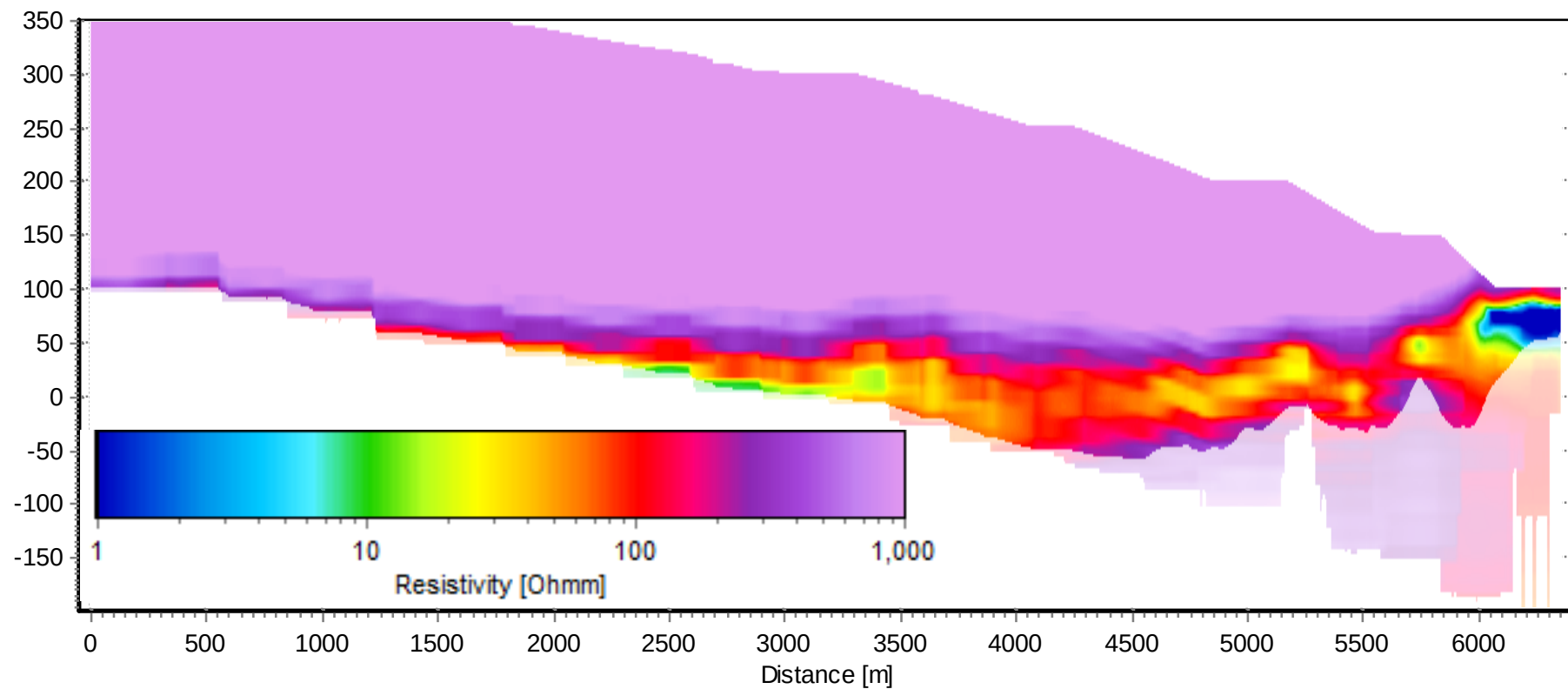






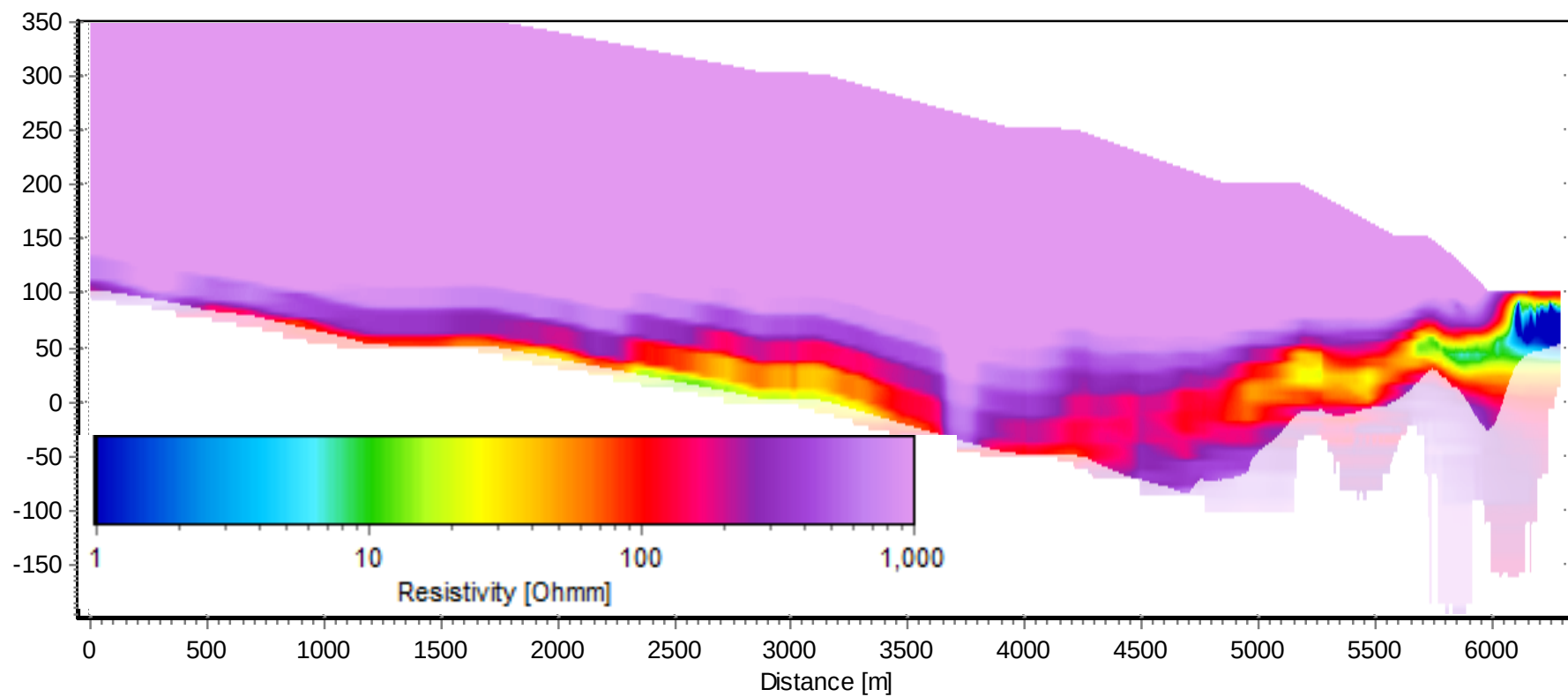


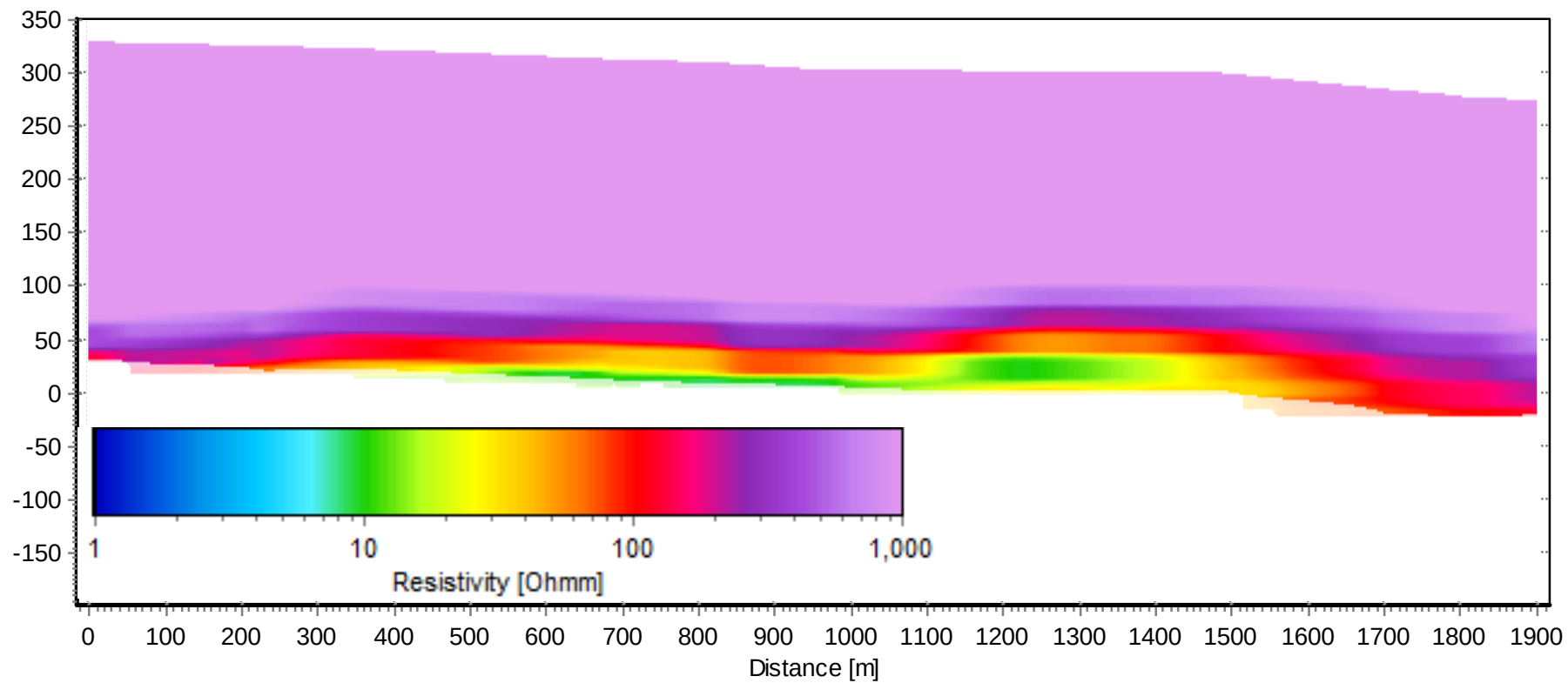
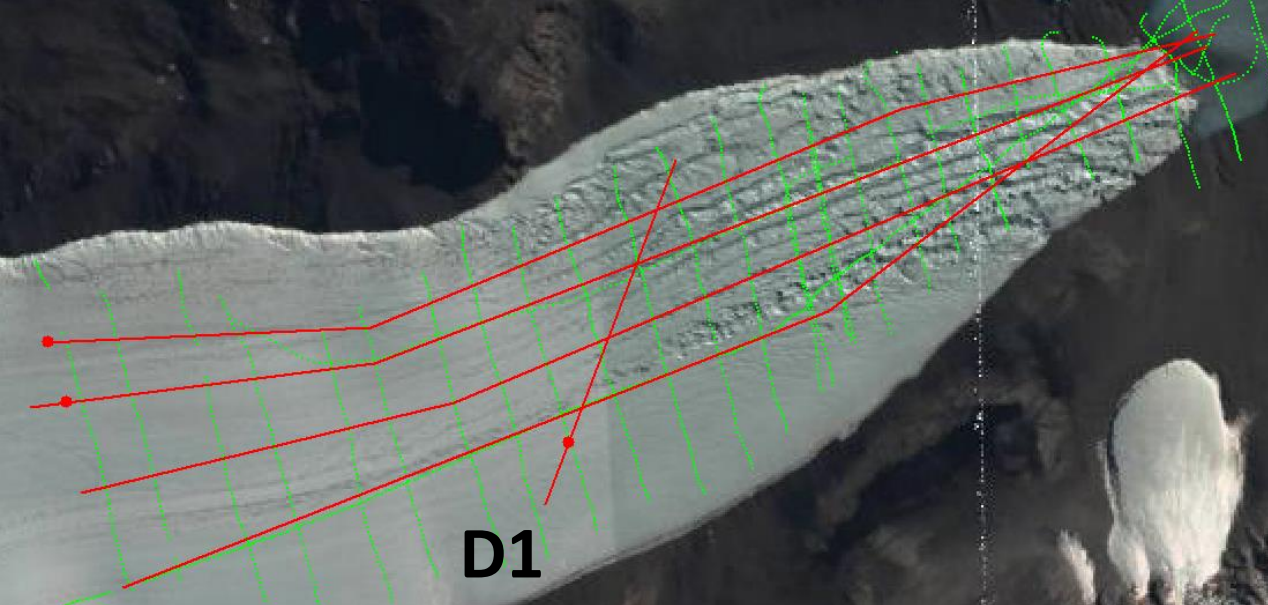
L3



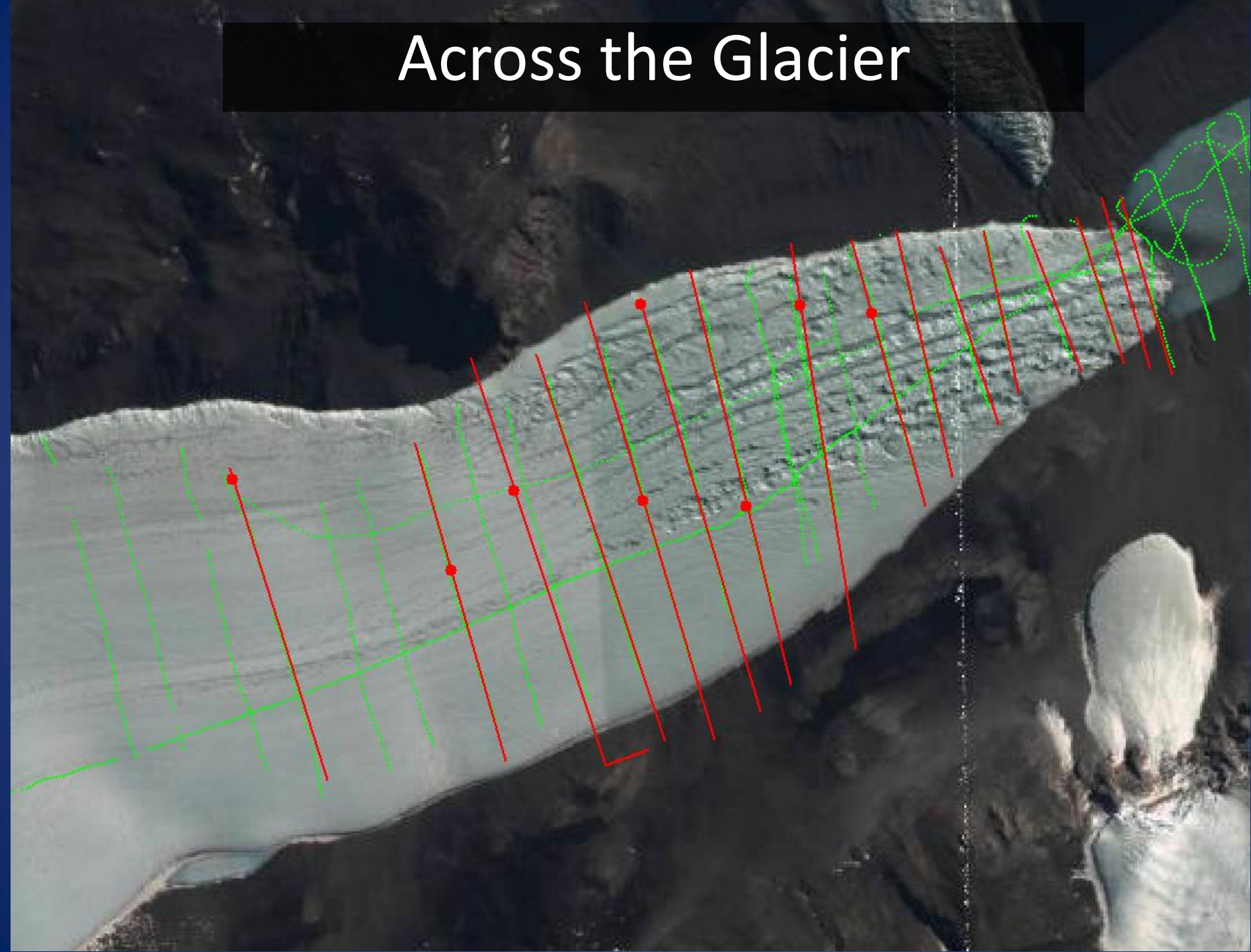


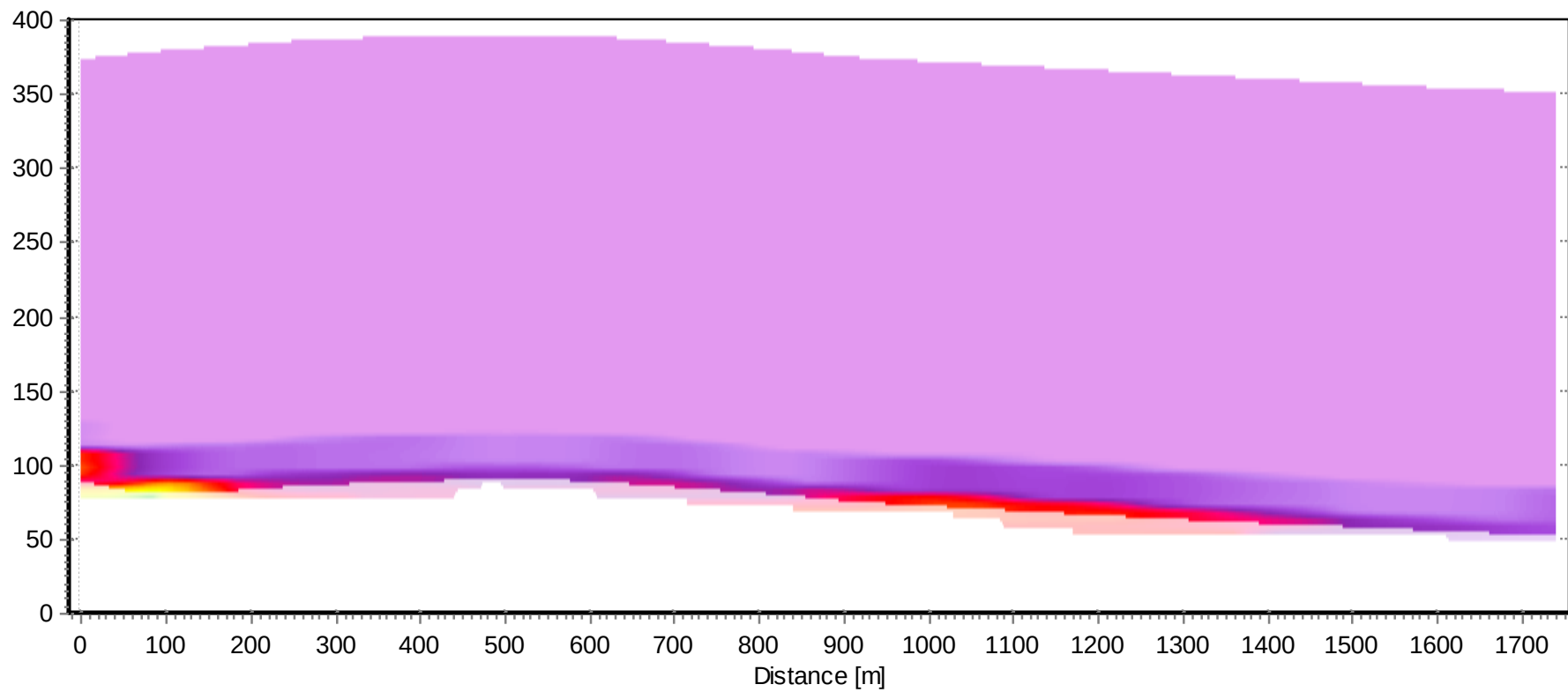
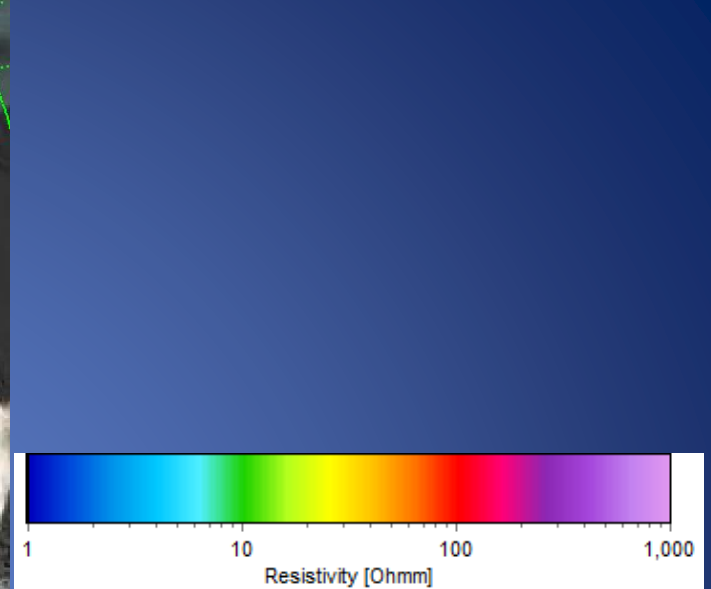
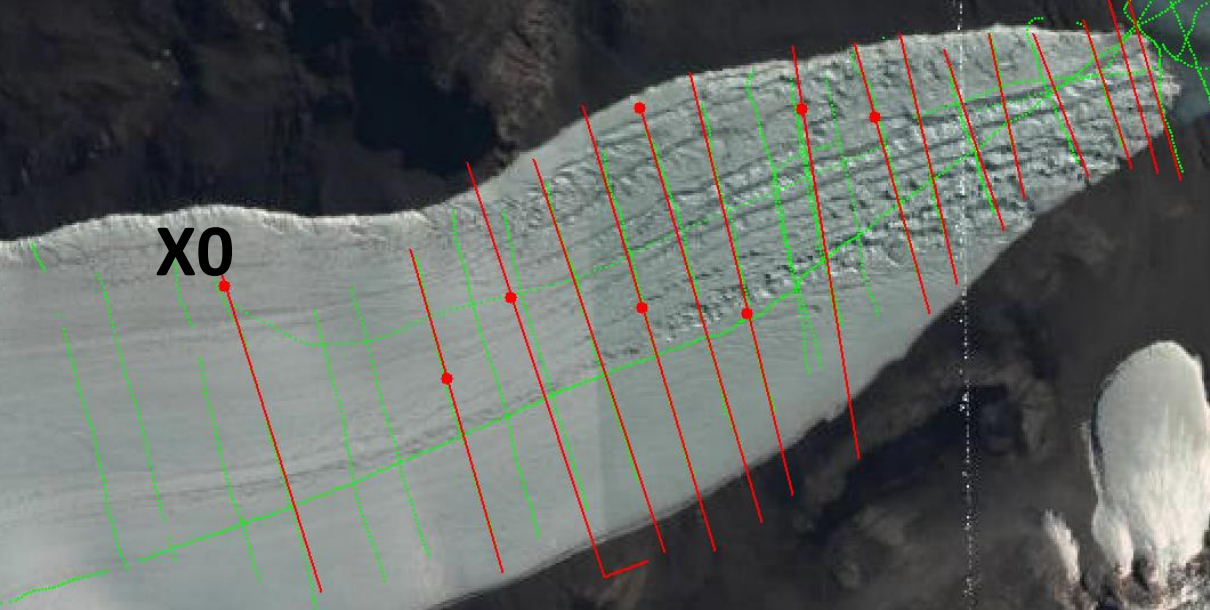
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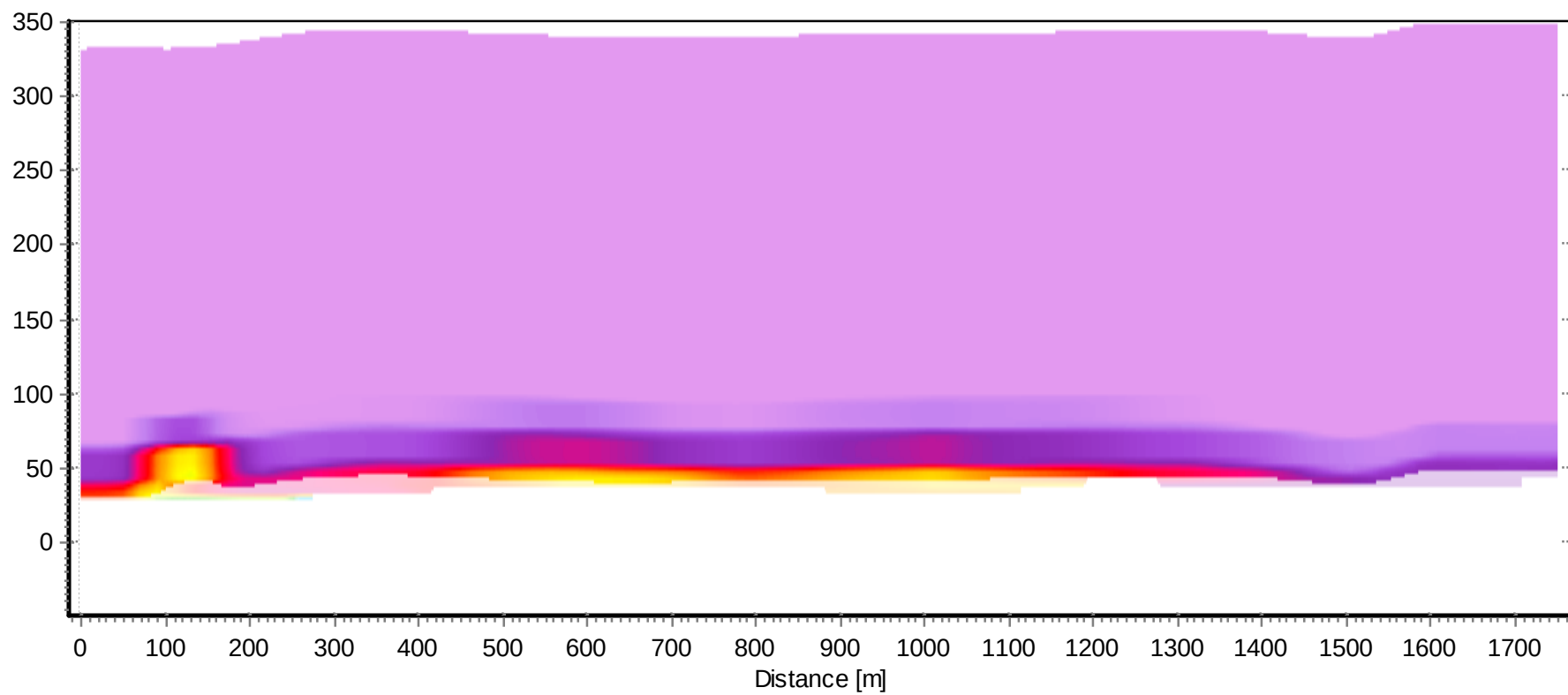
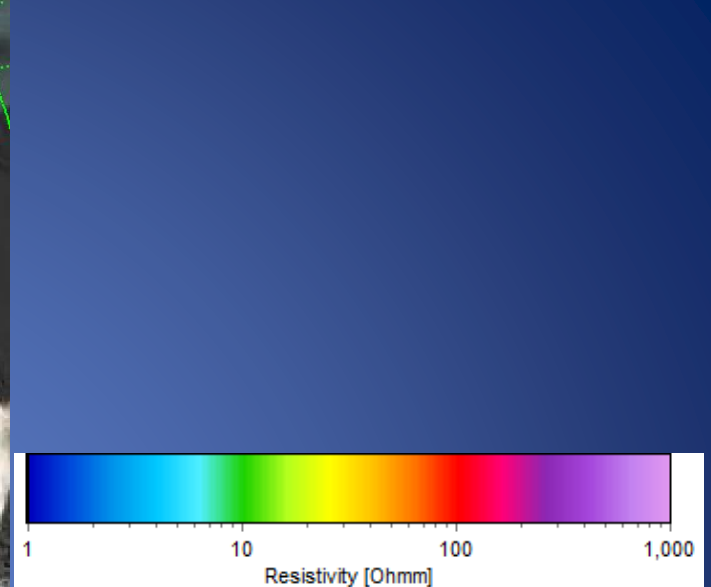
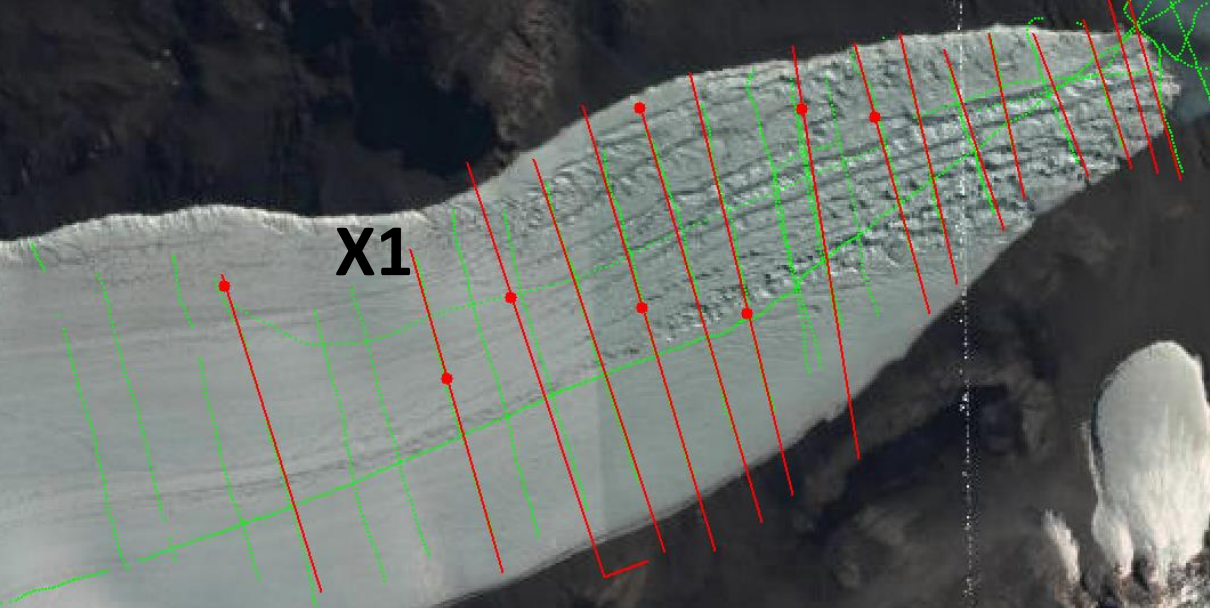


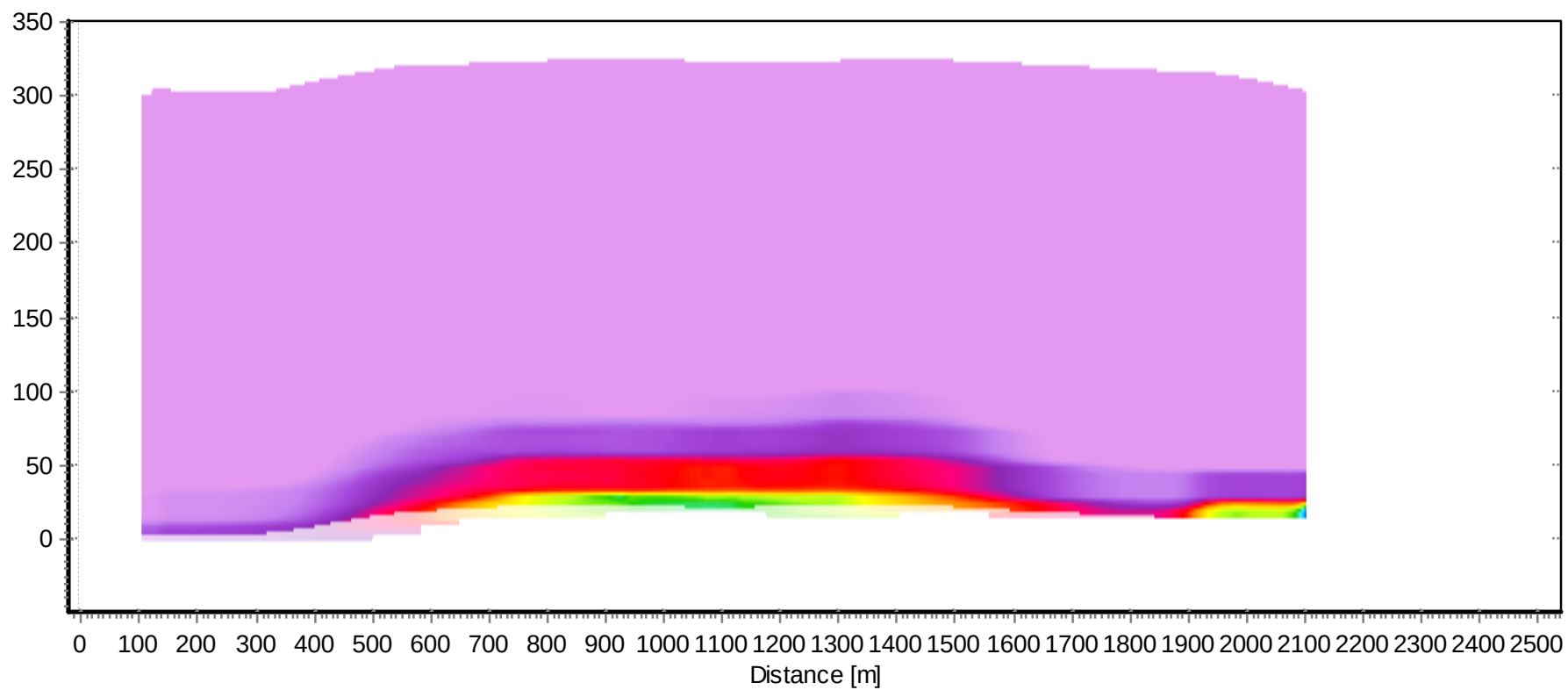
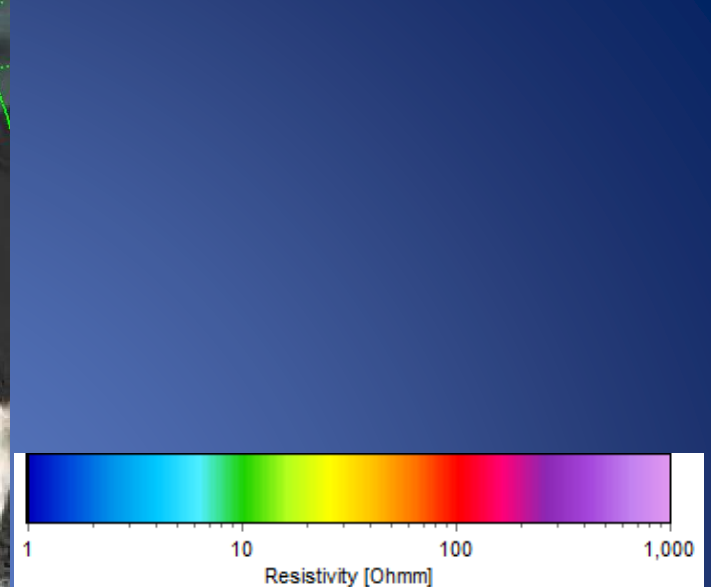
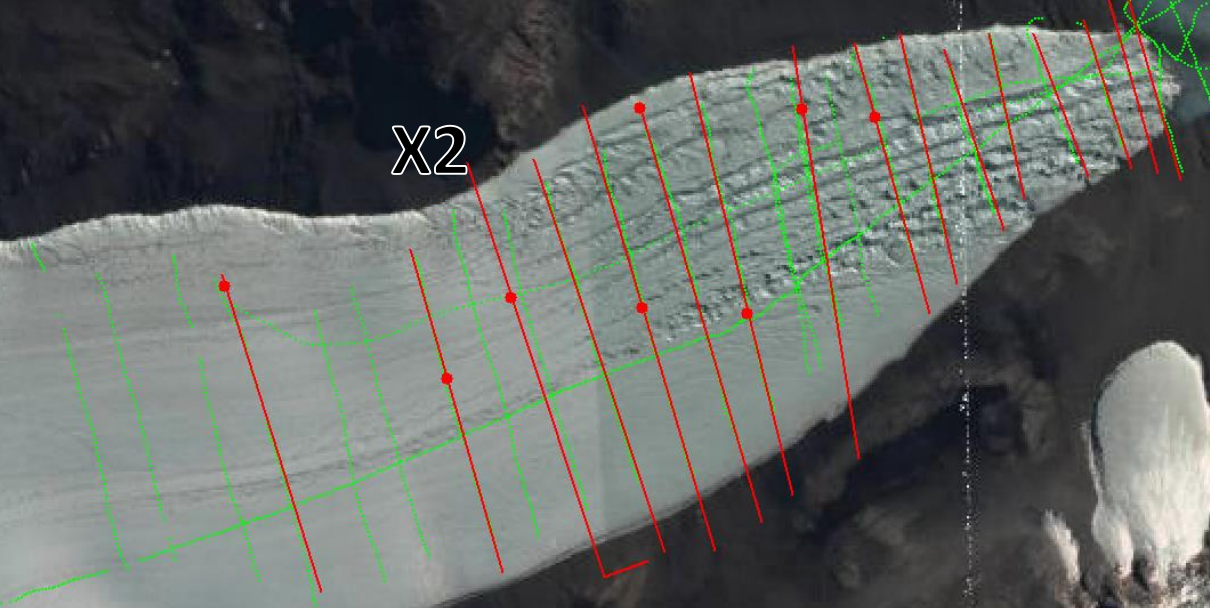


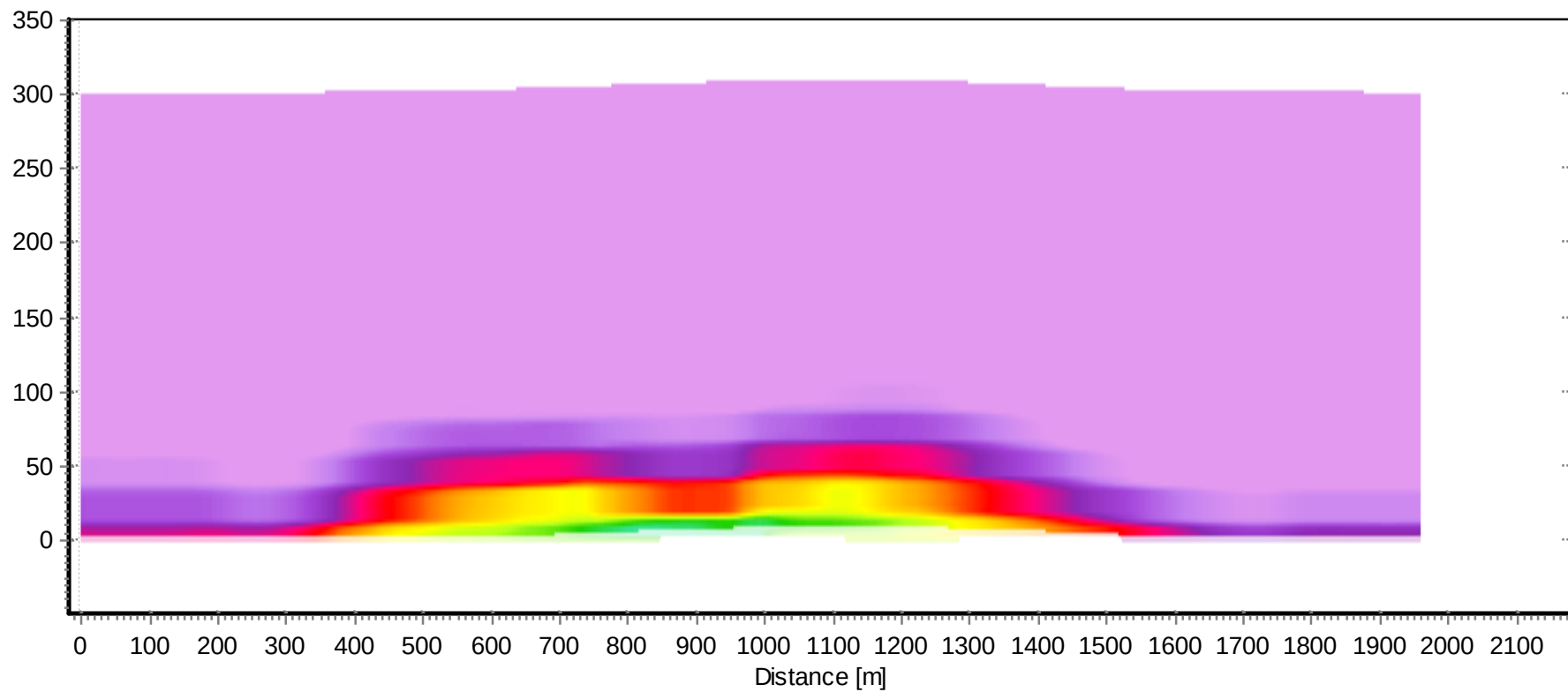
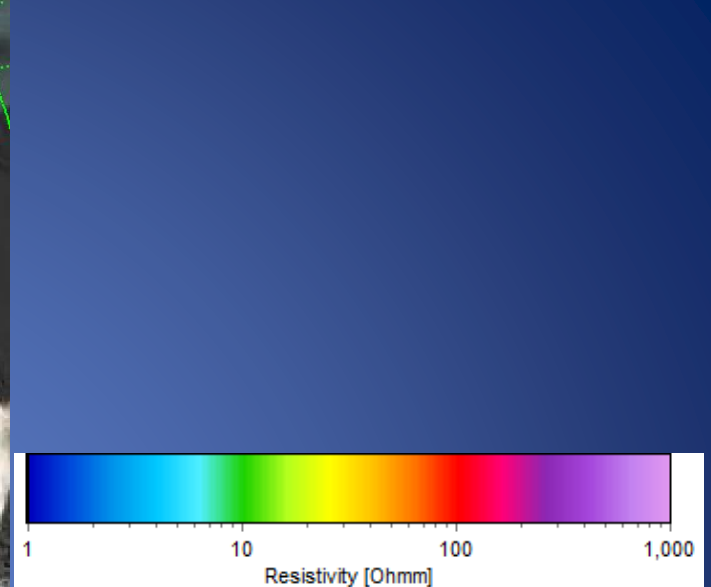
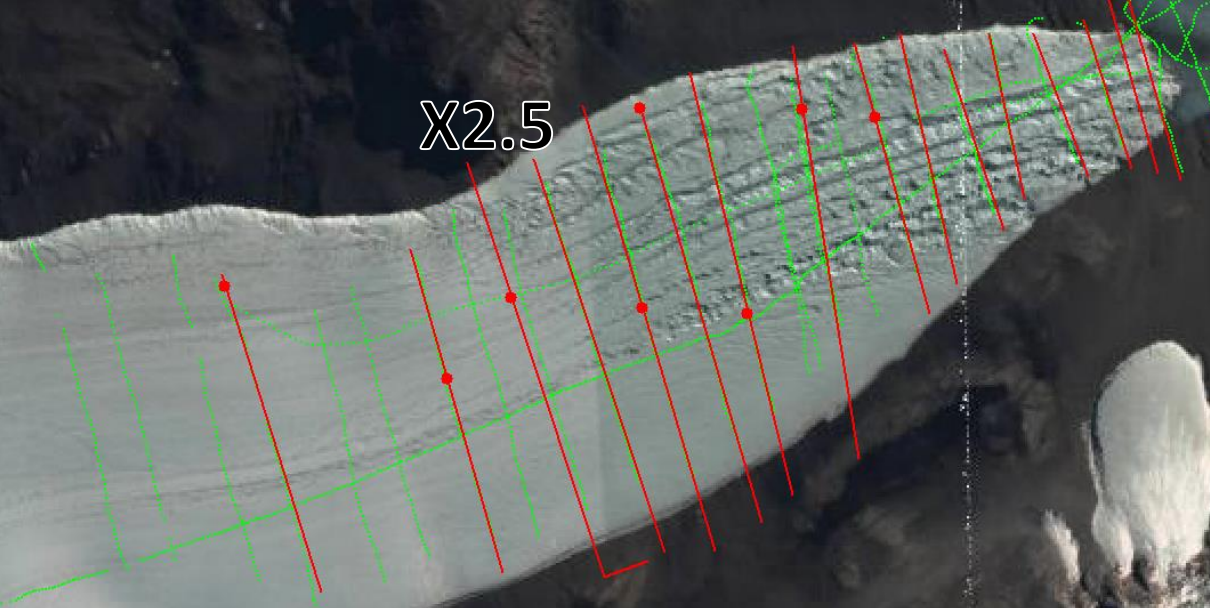
Across the Glacier

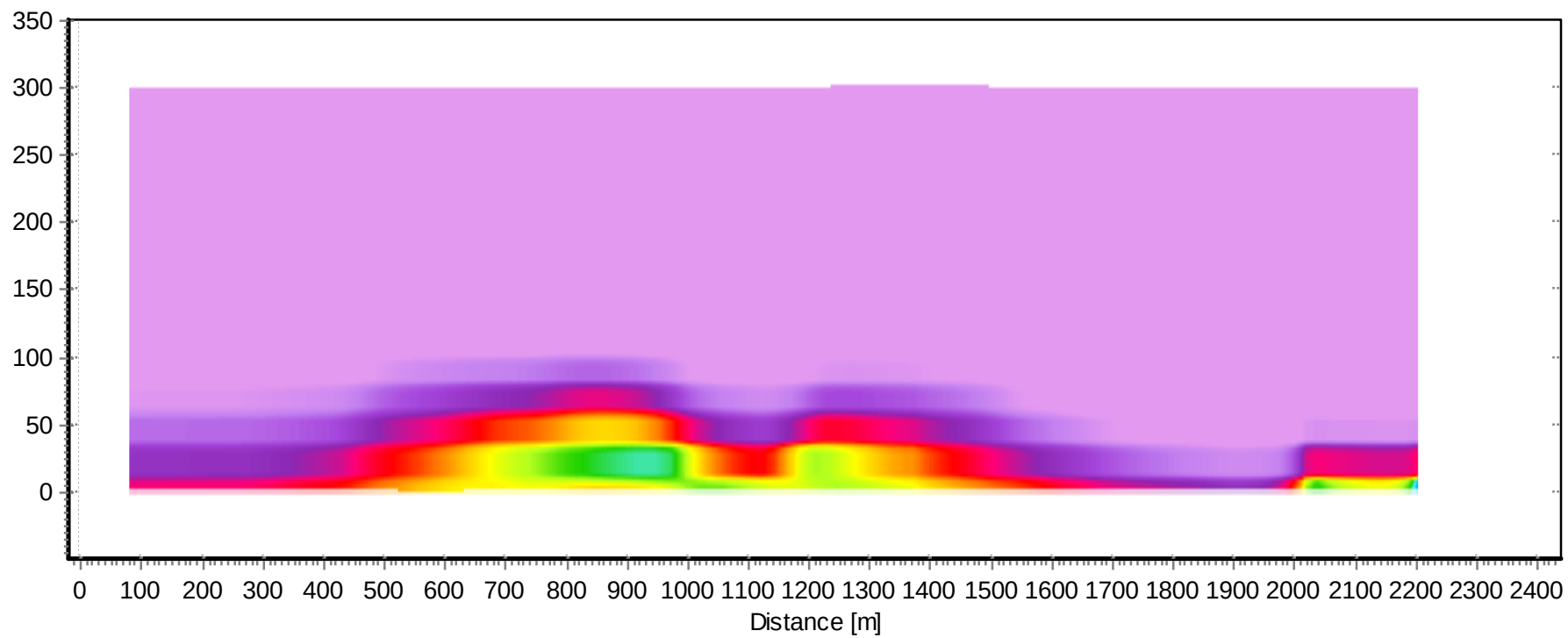
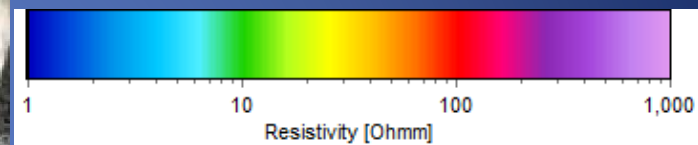
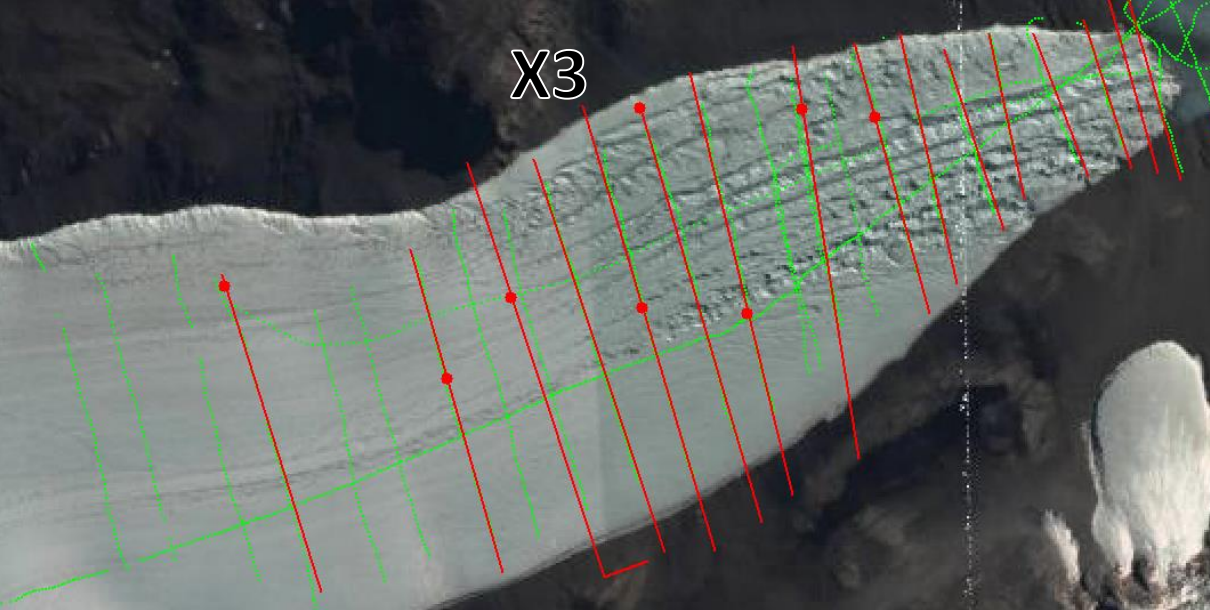


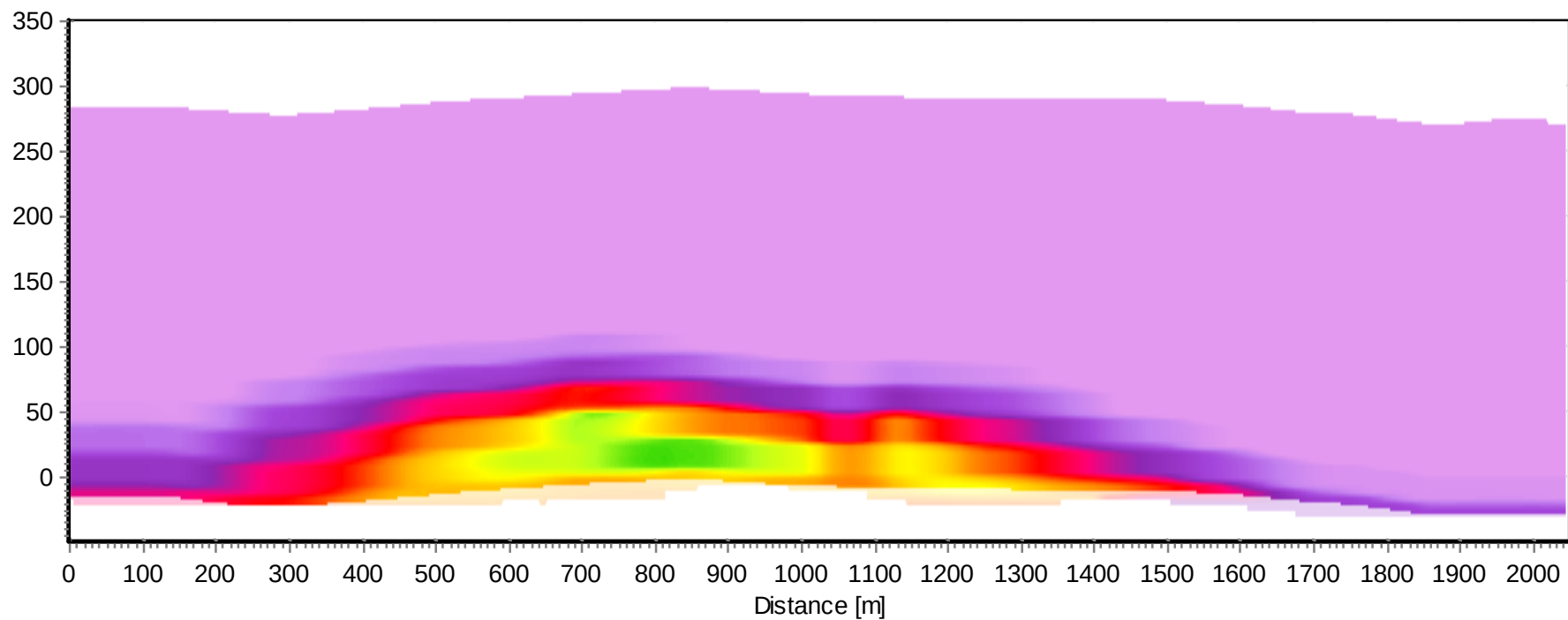
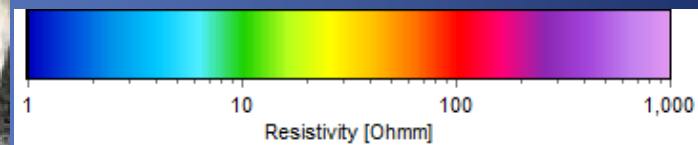
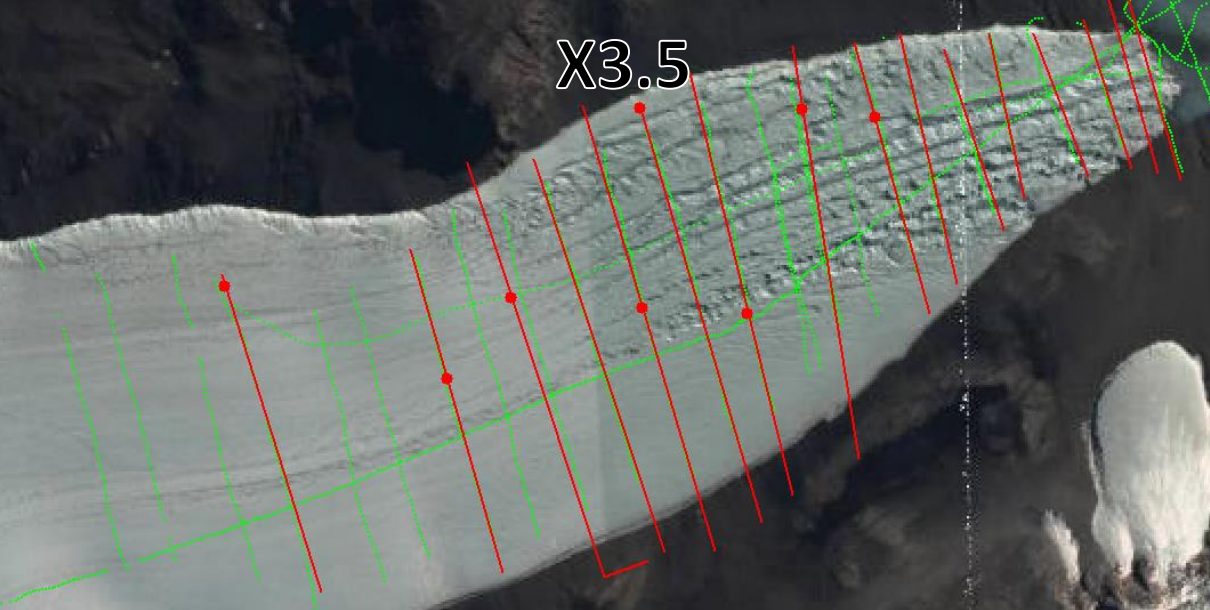


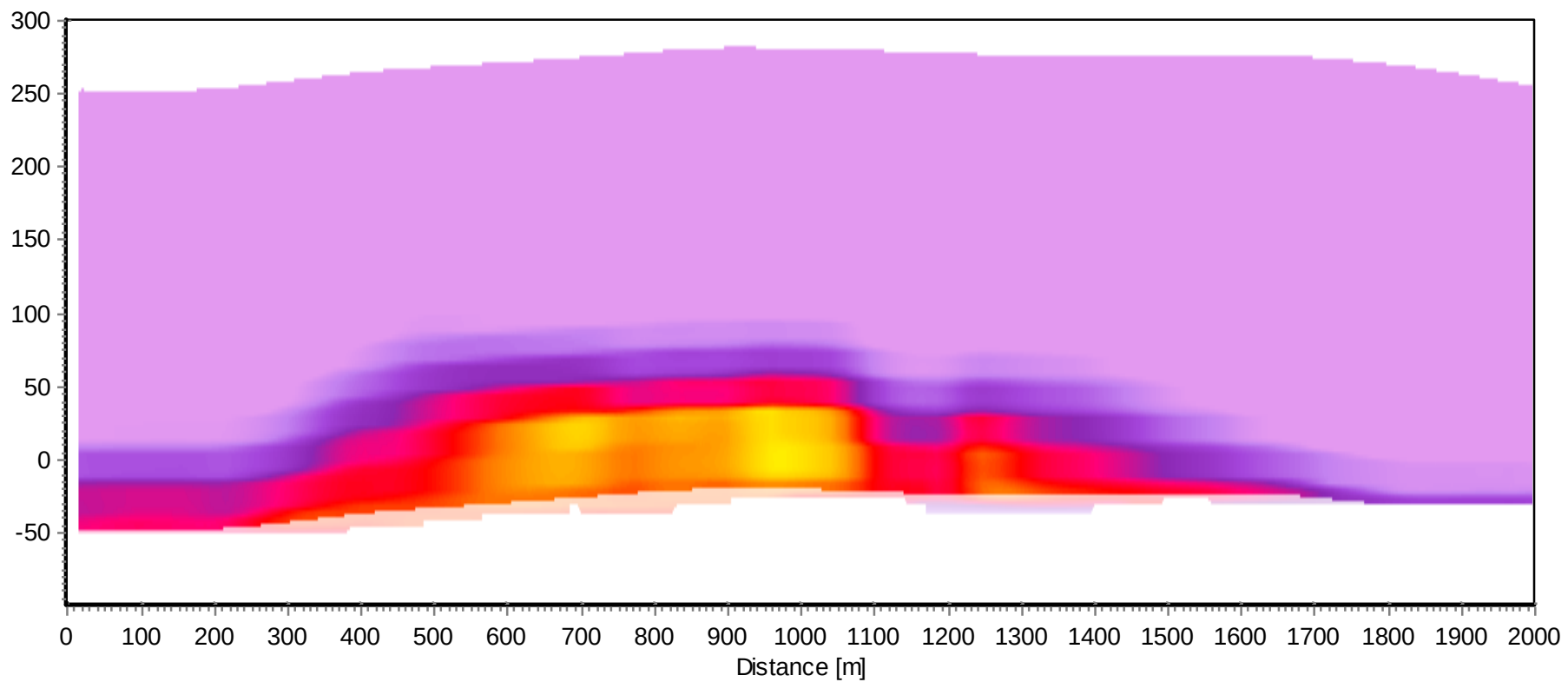
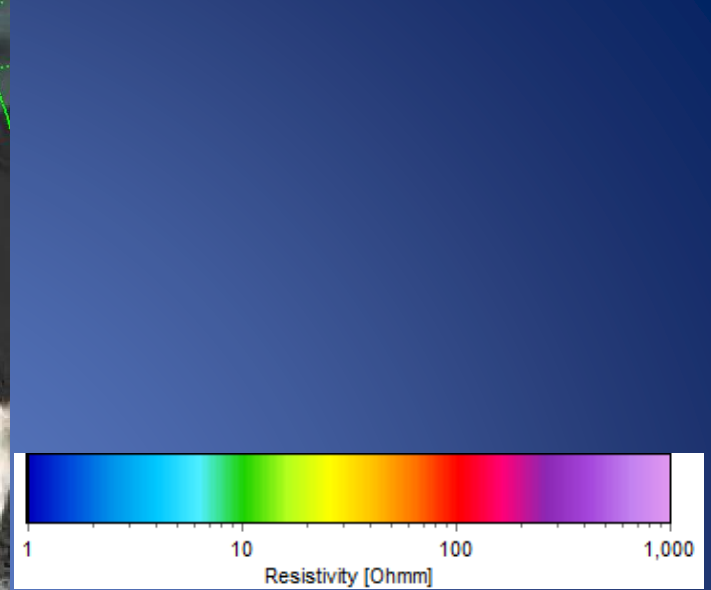
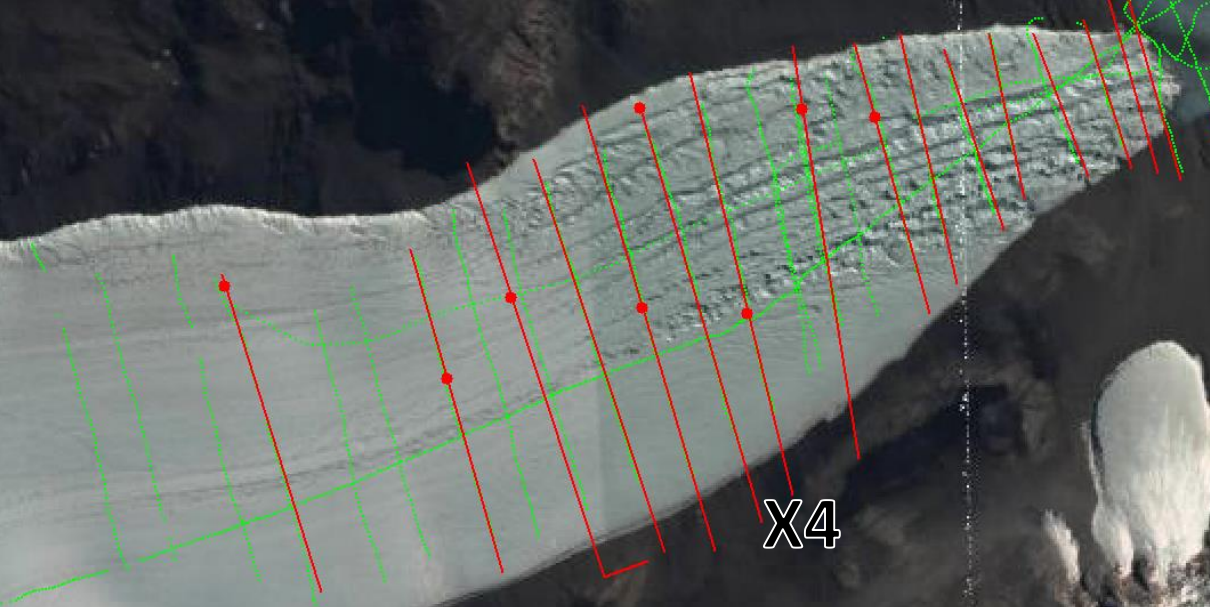


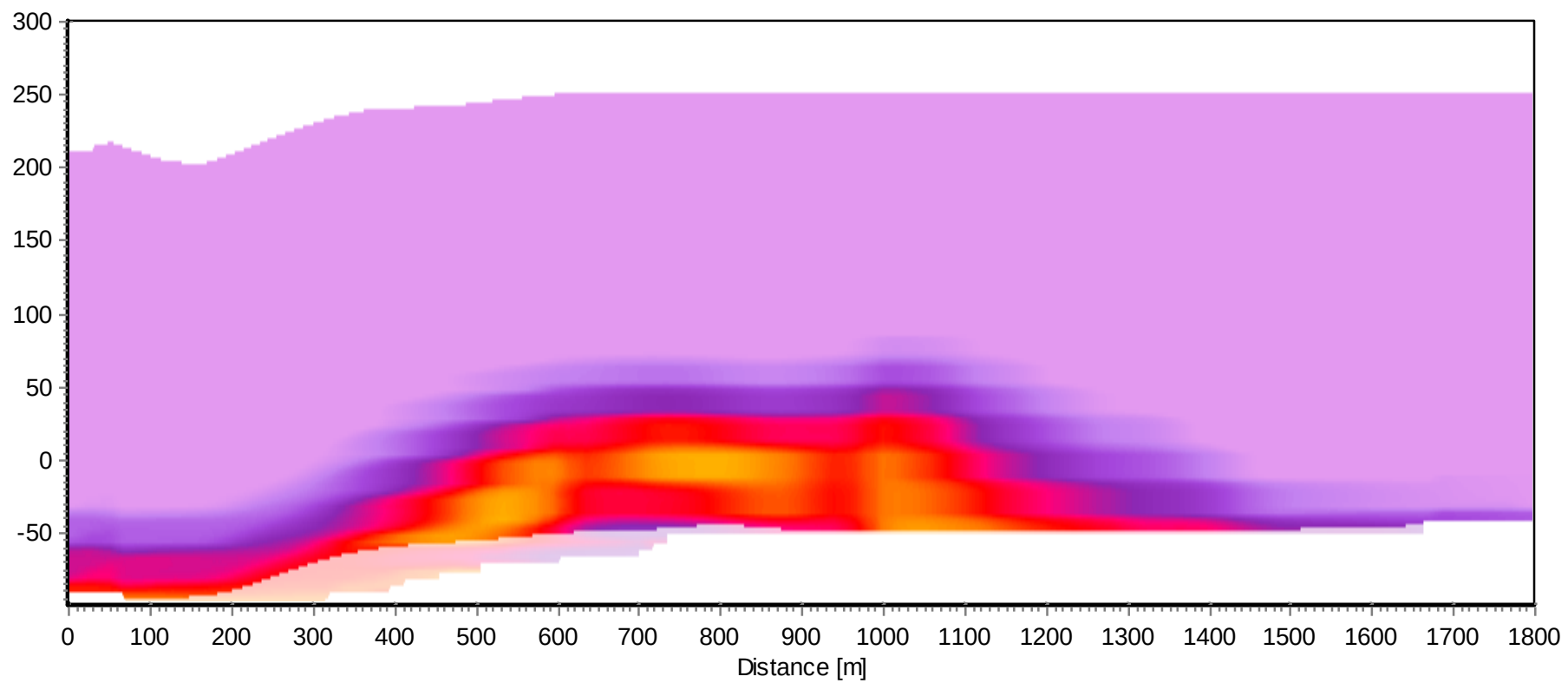
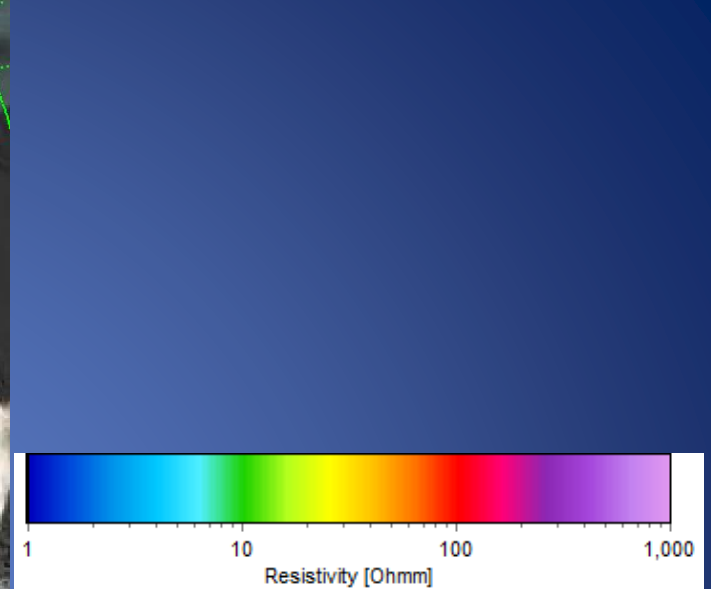
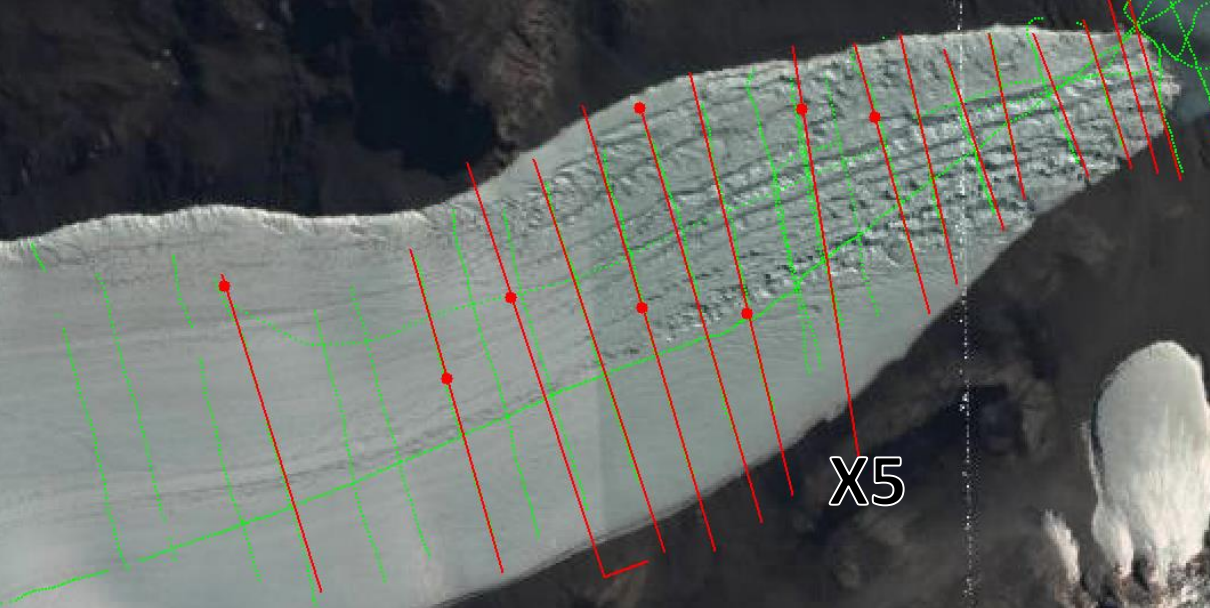


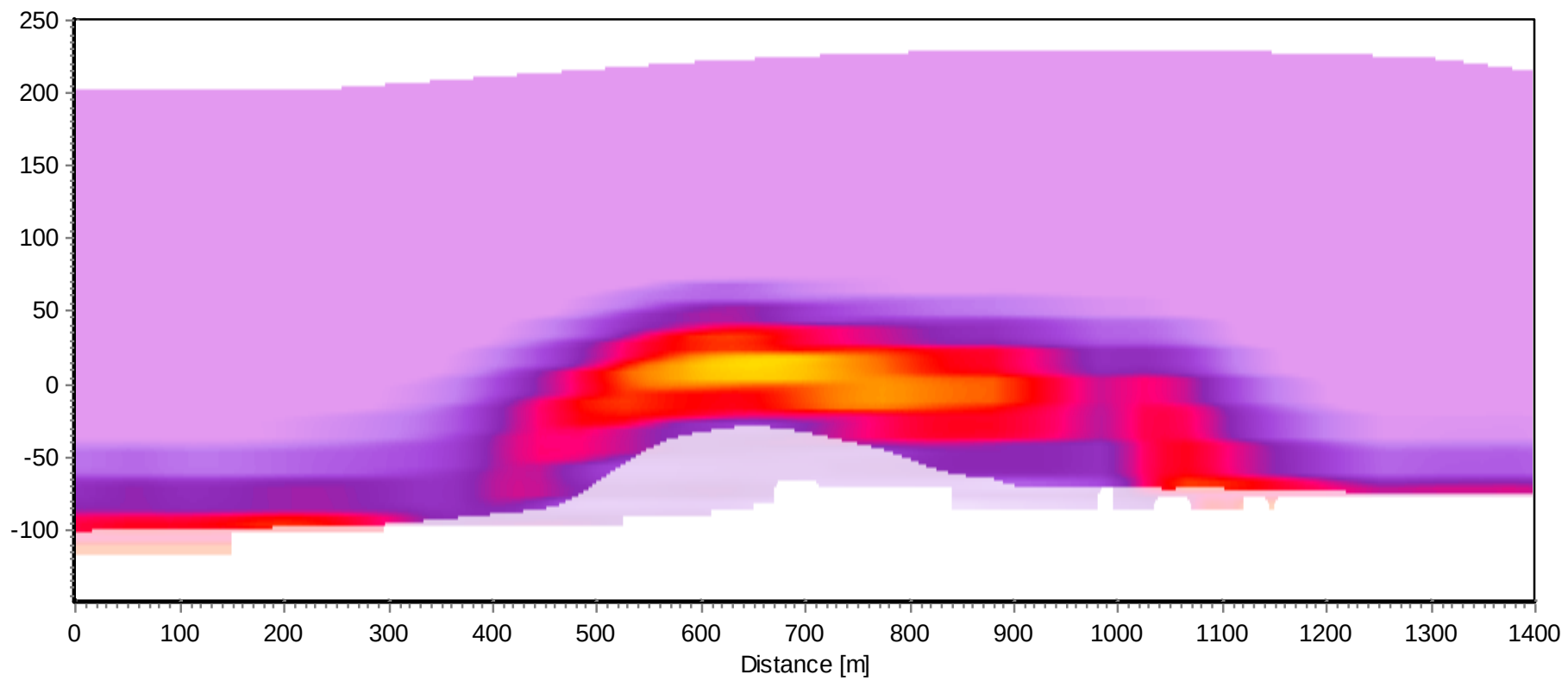
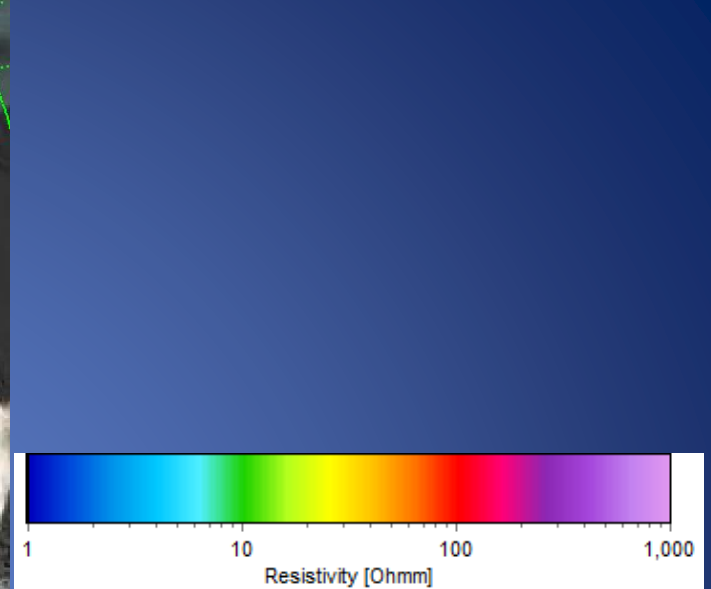
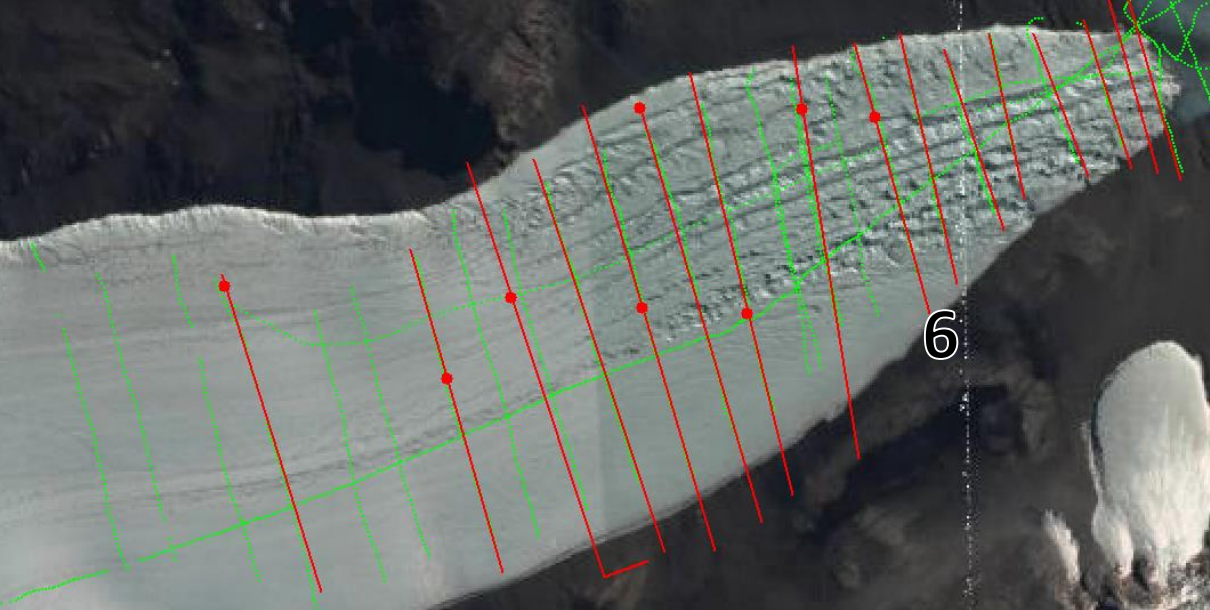


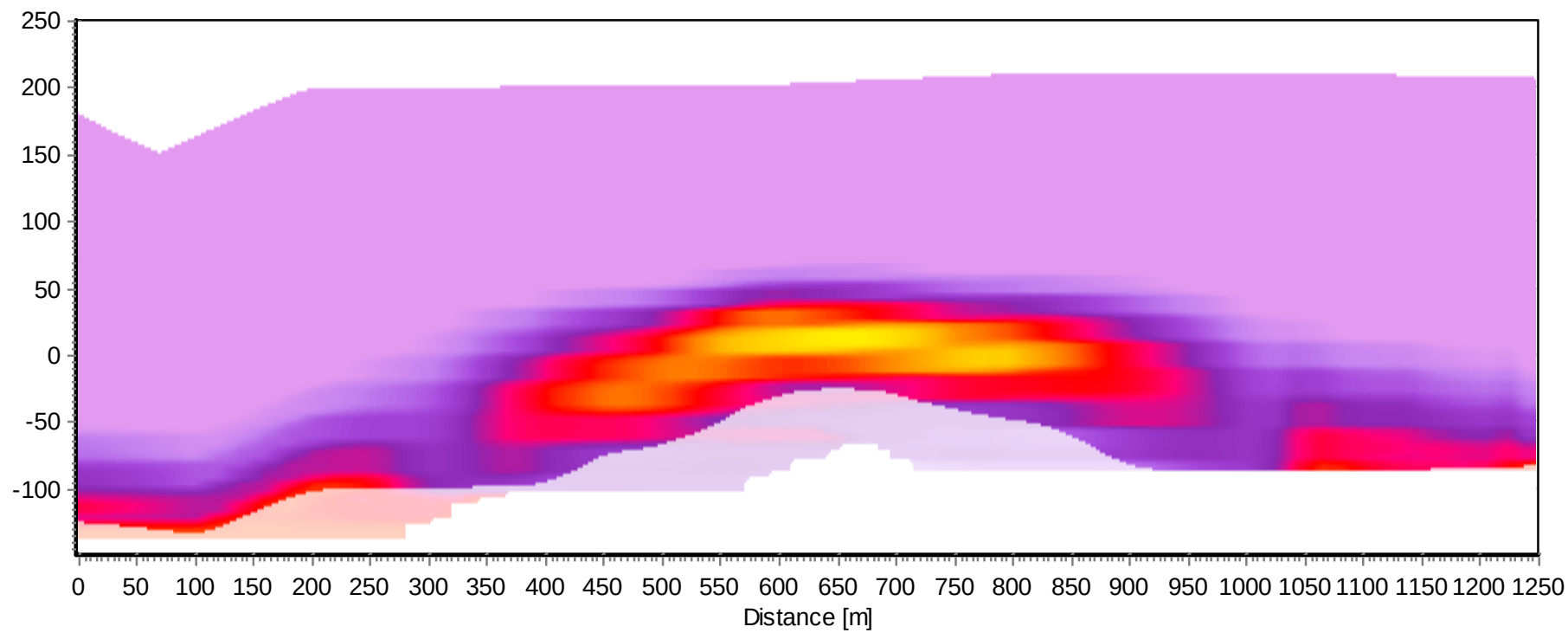
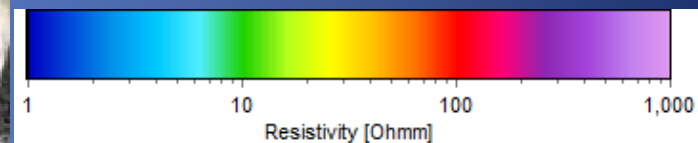
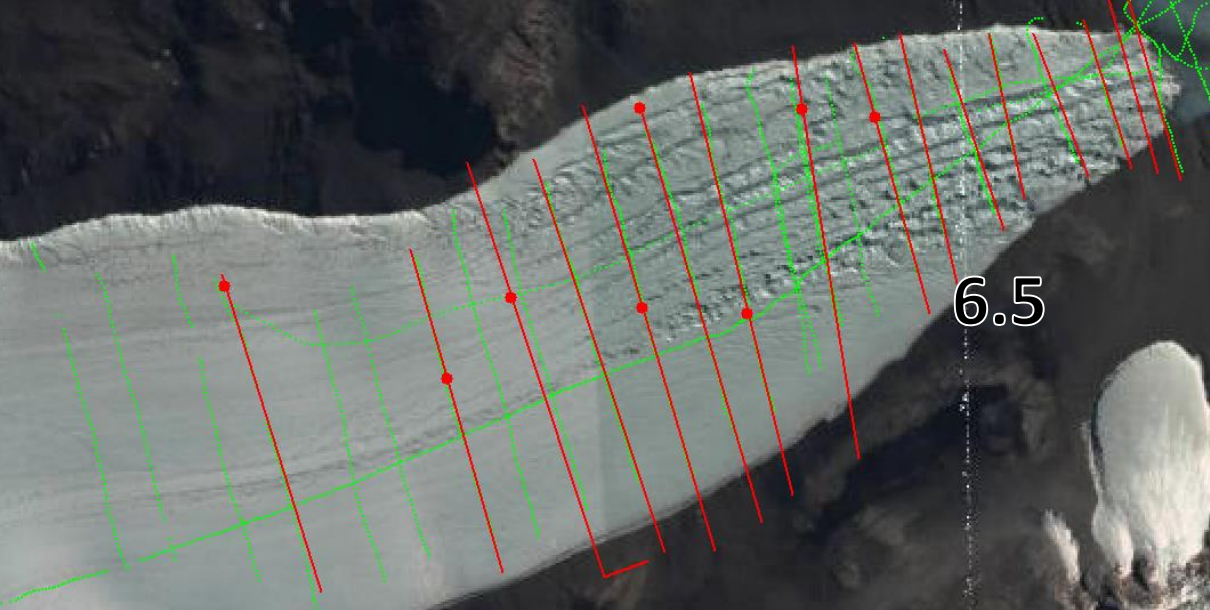


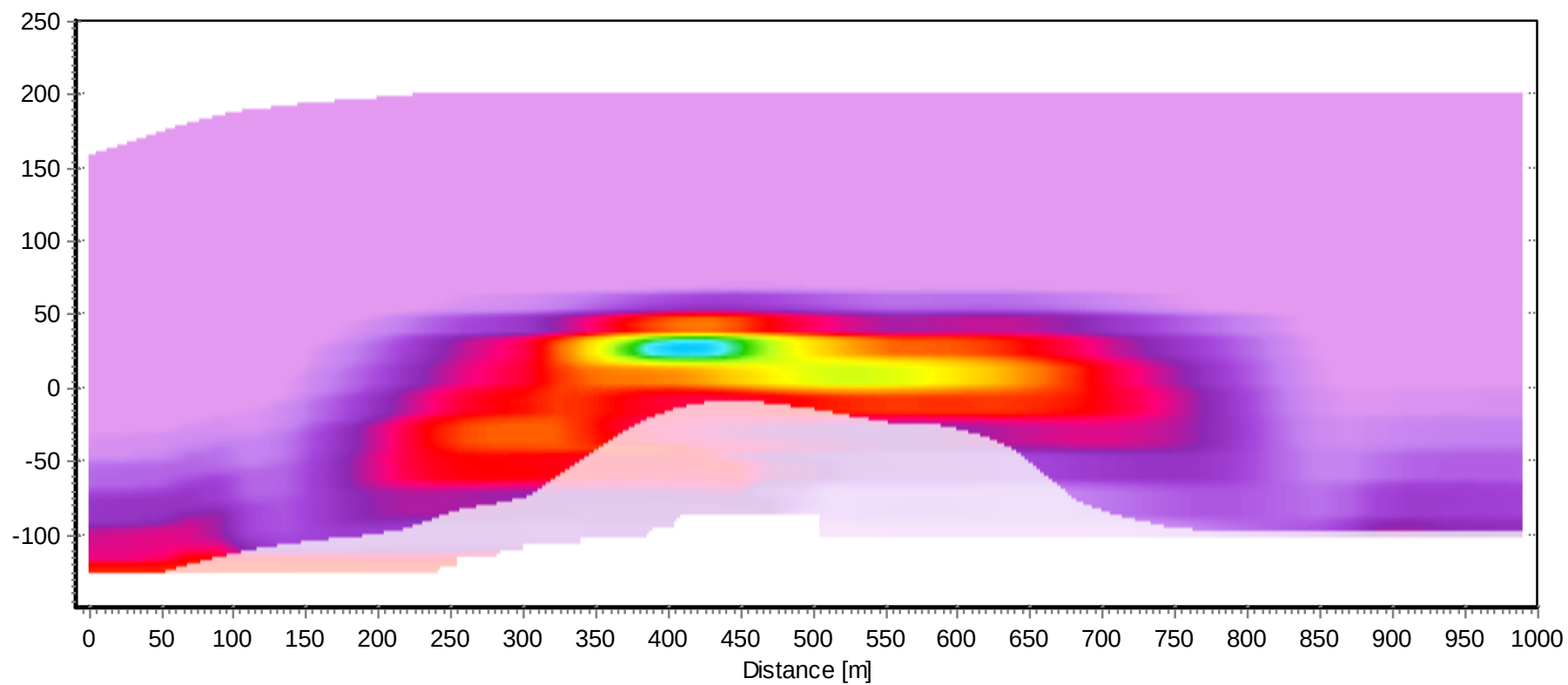
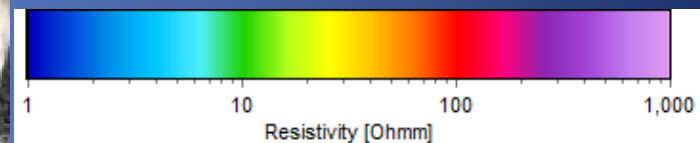
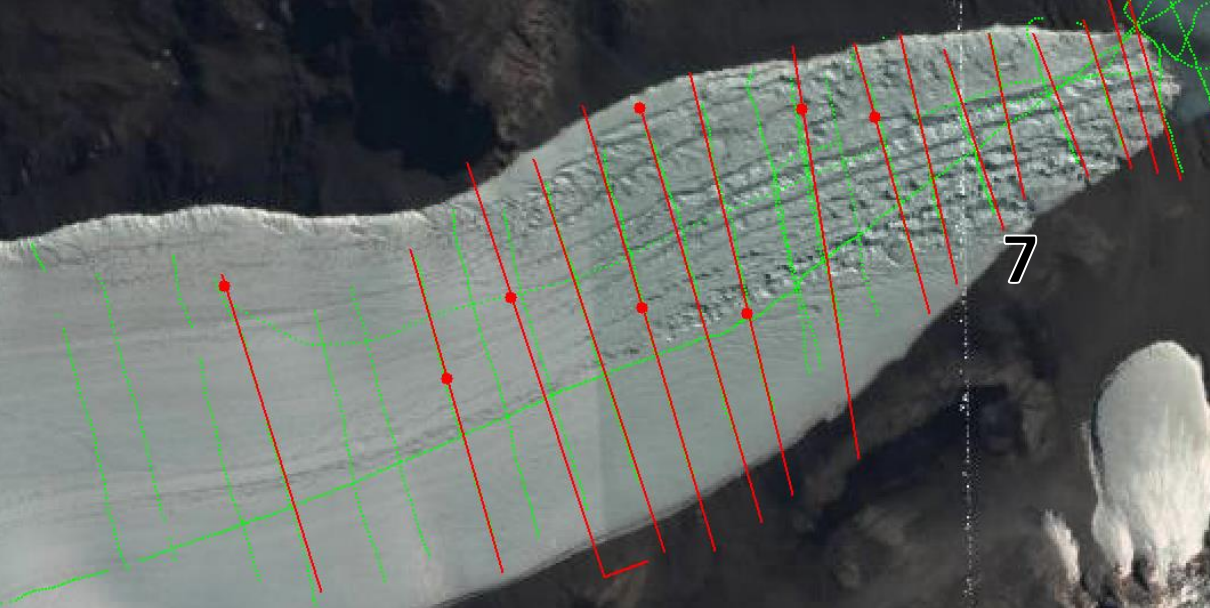


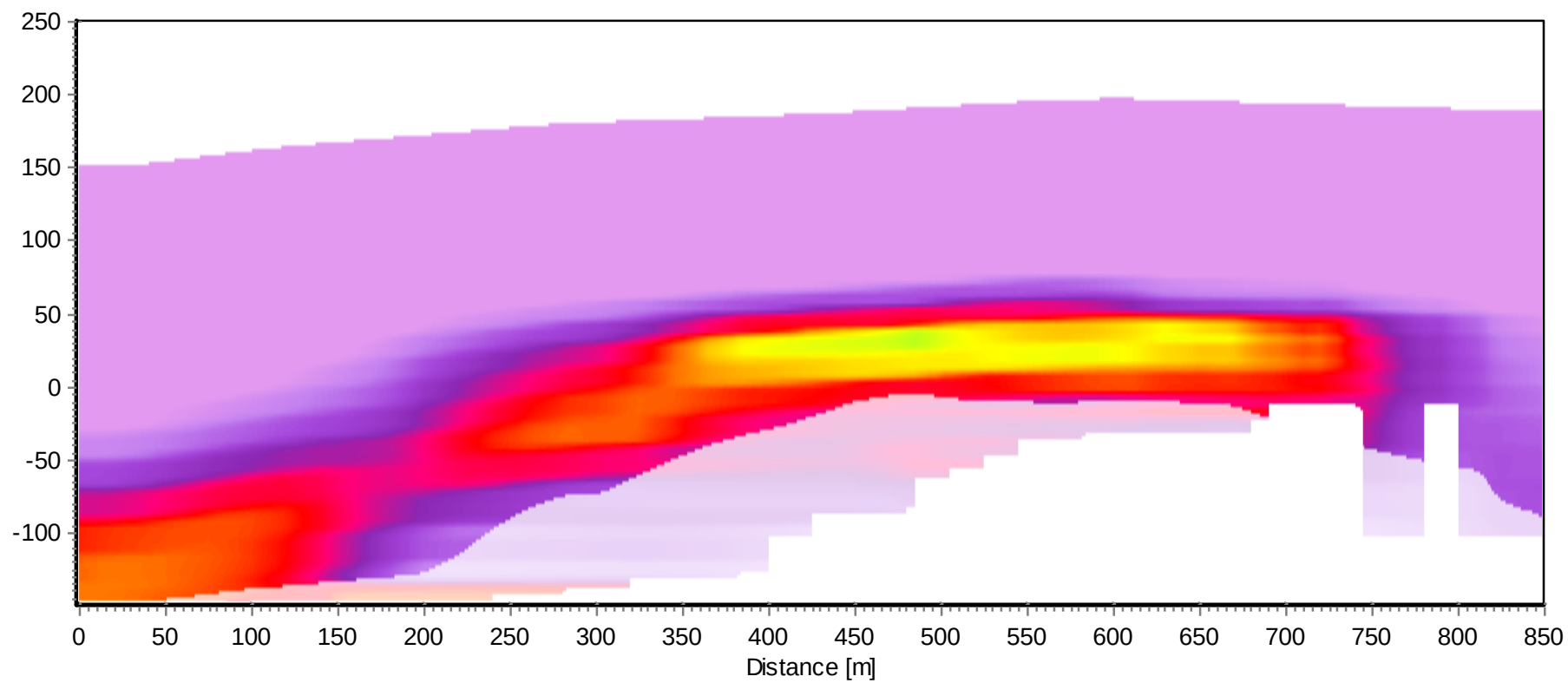
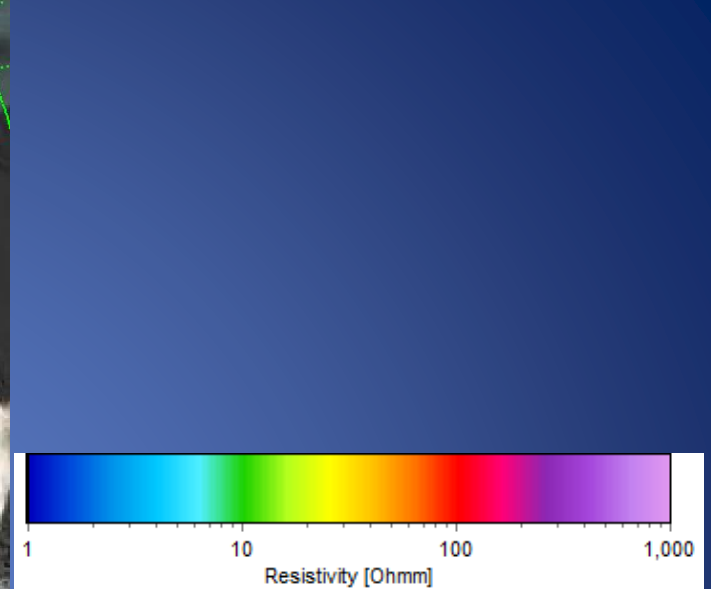
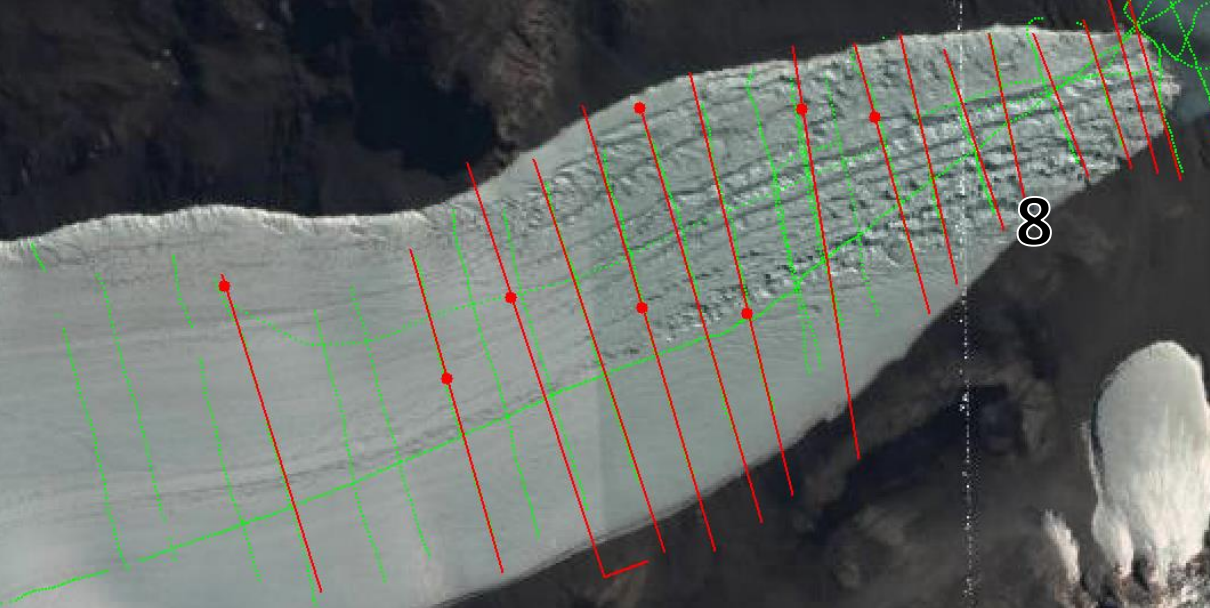


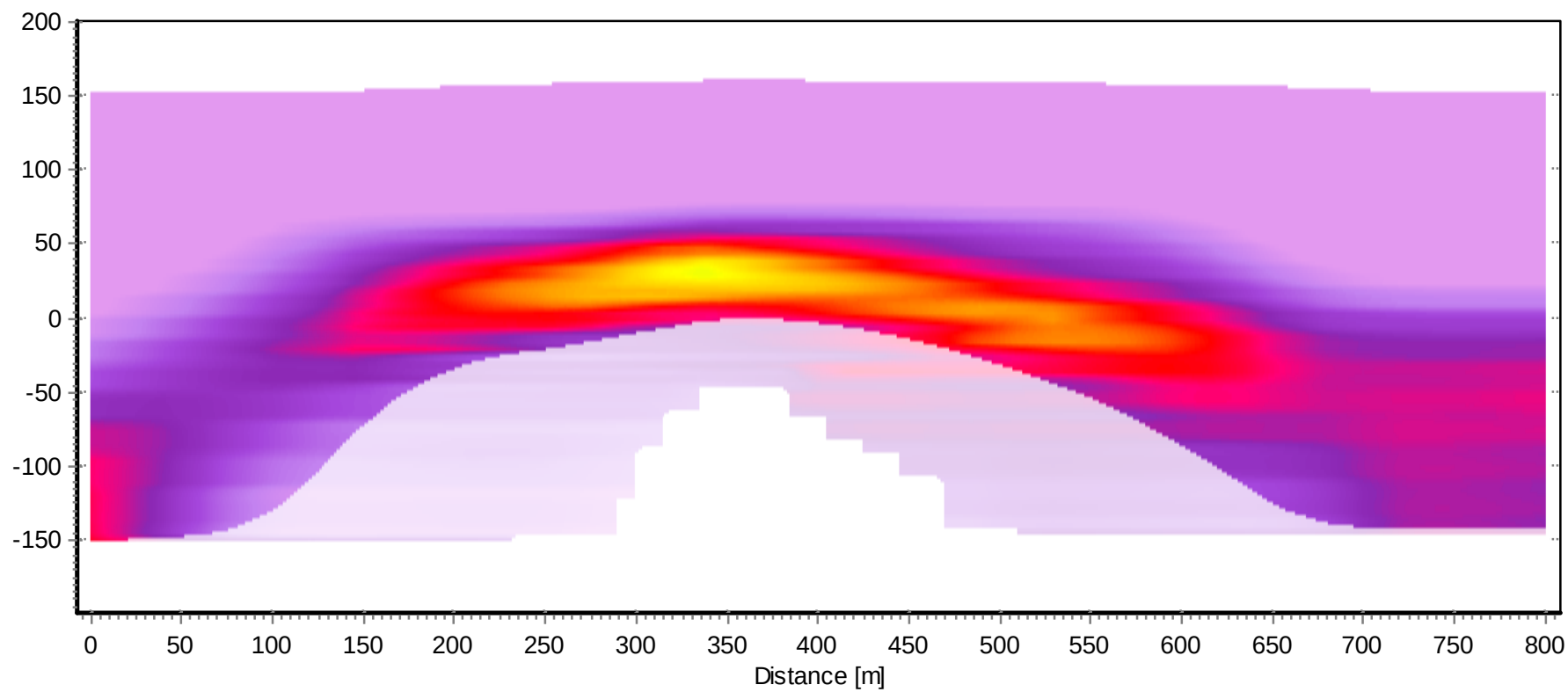
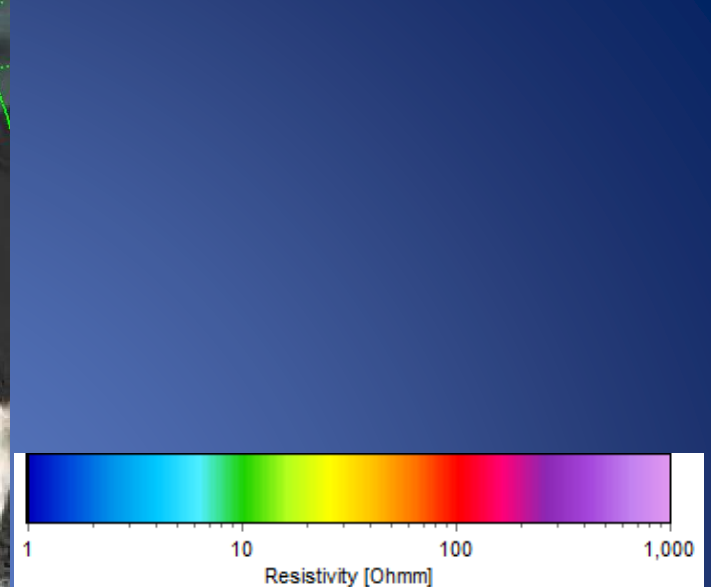
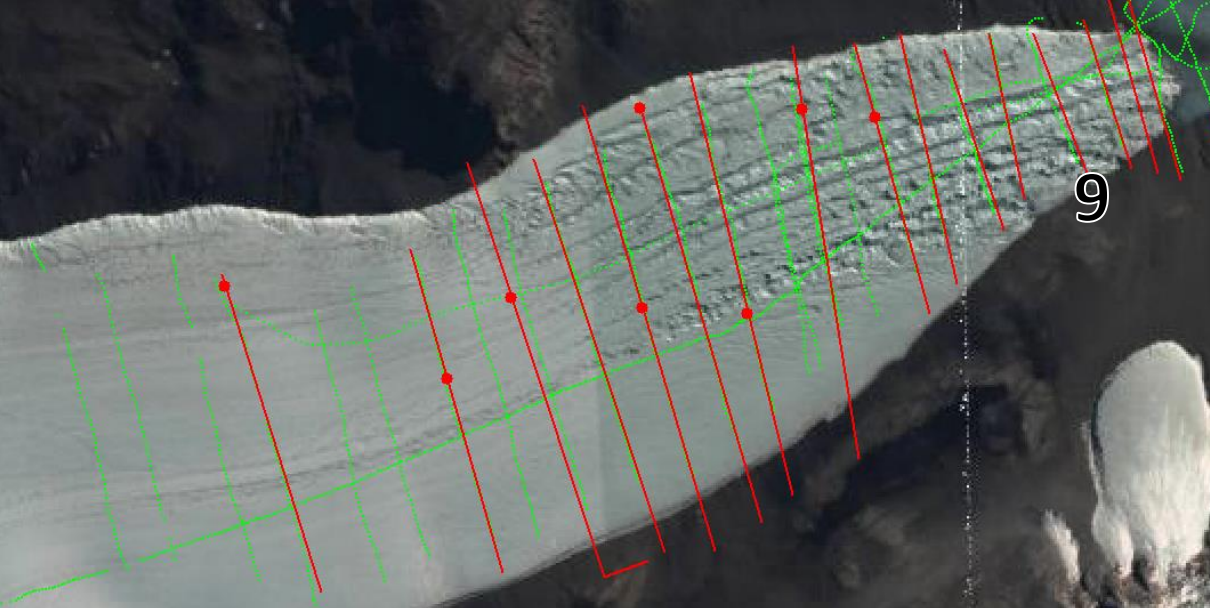


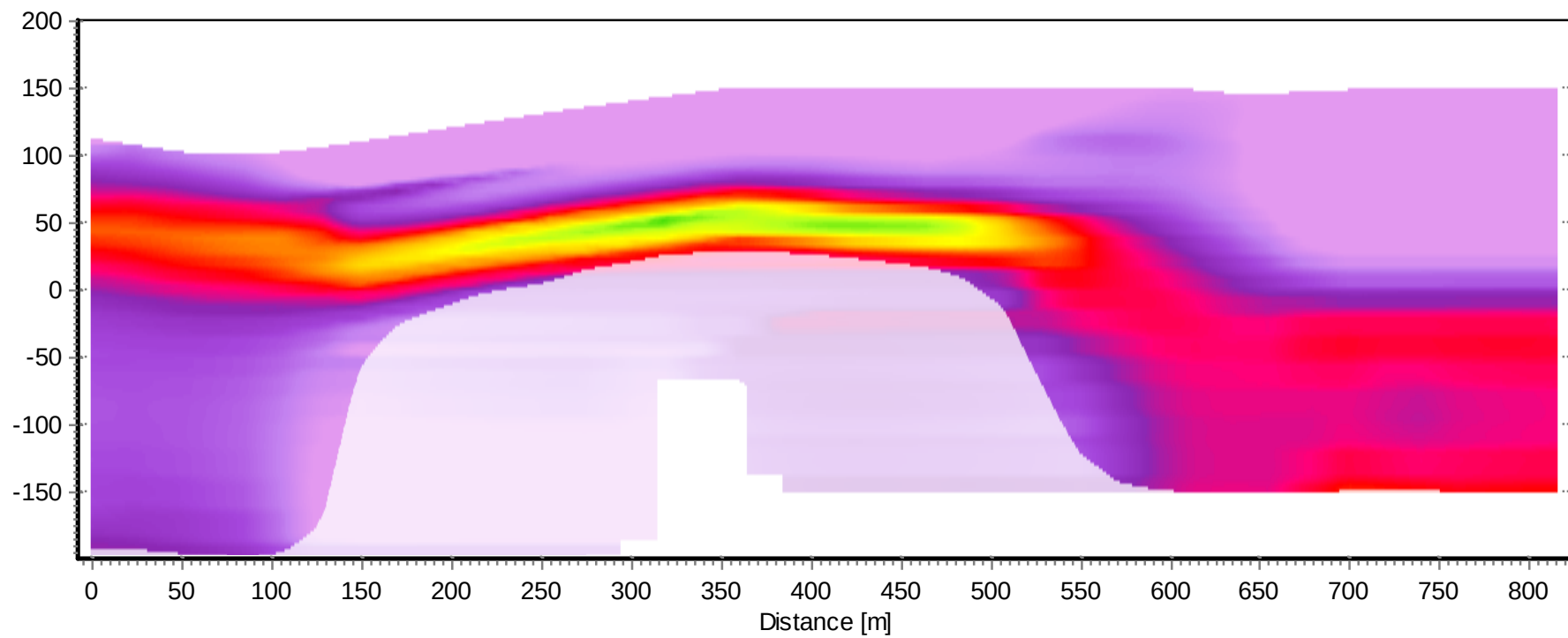
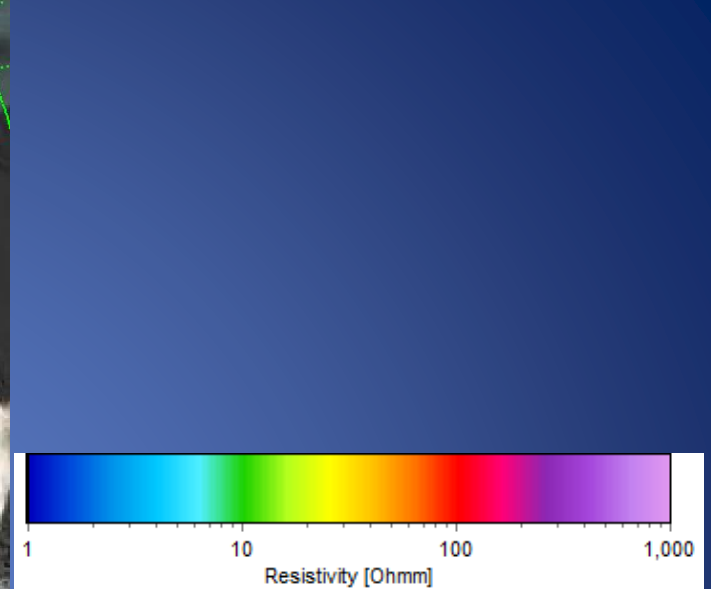
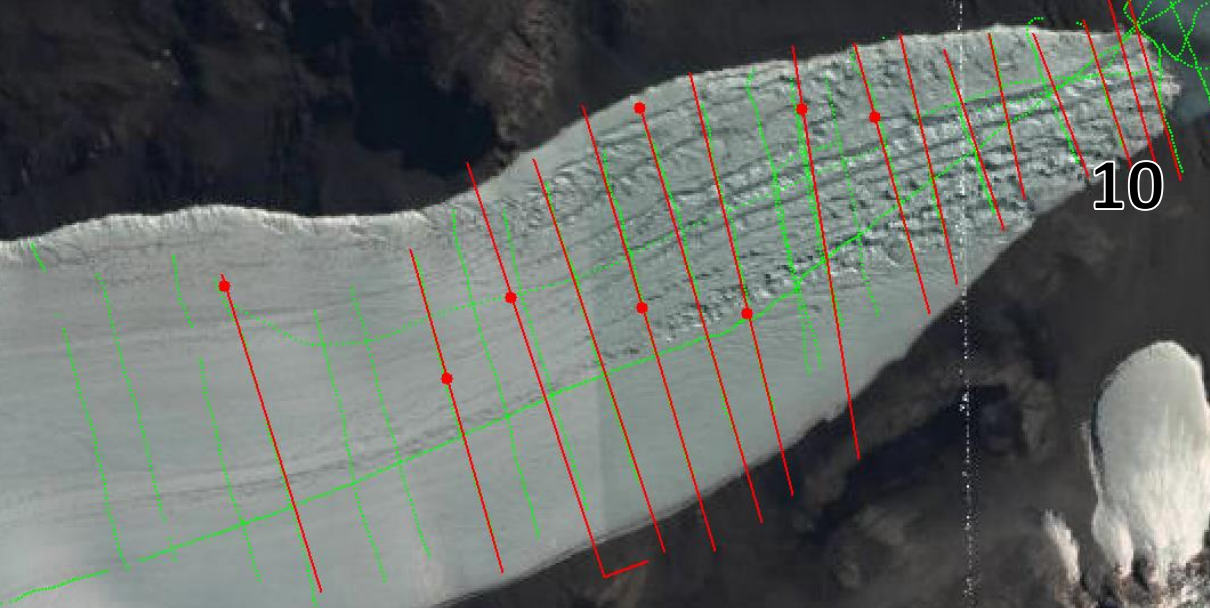


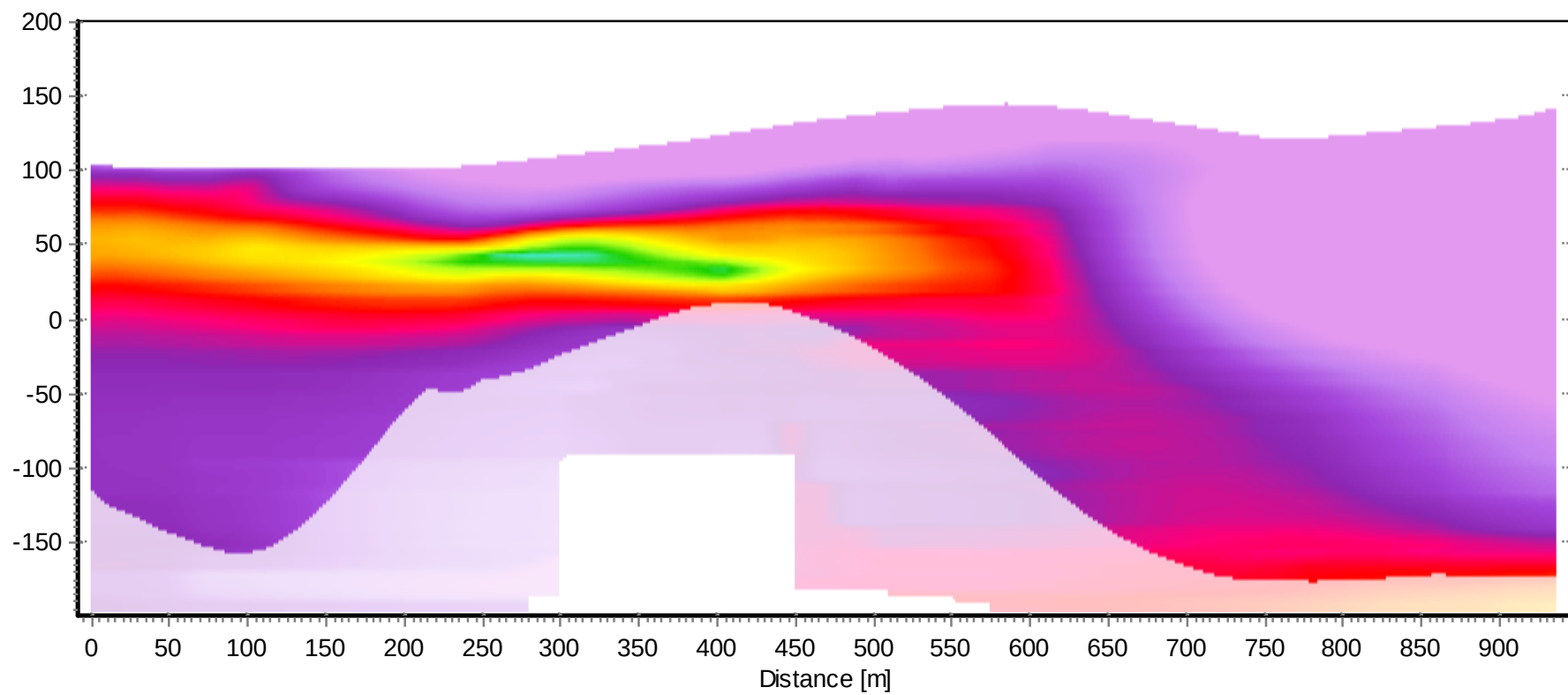
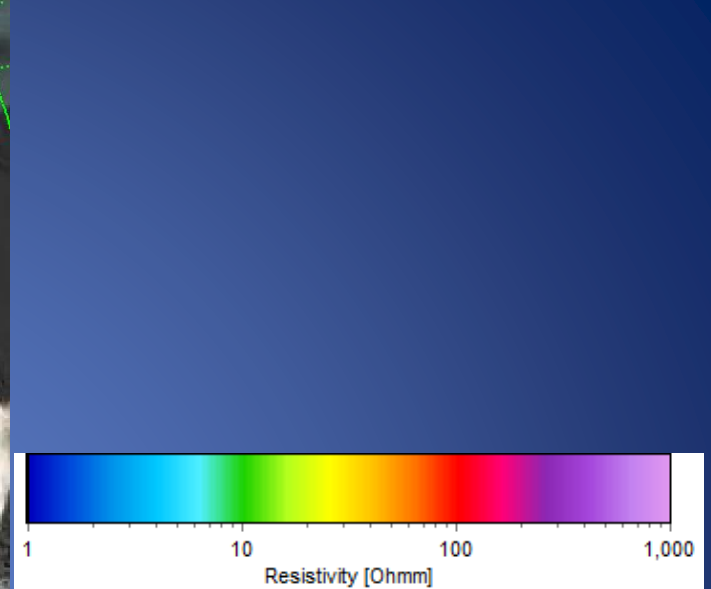
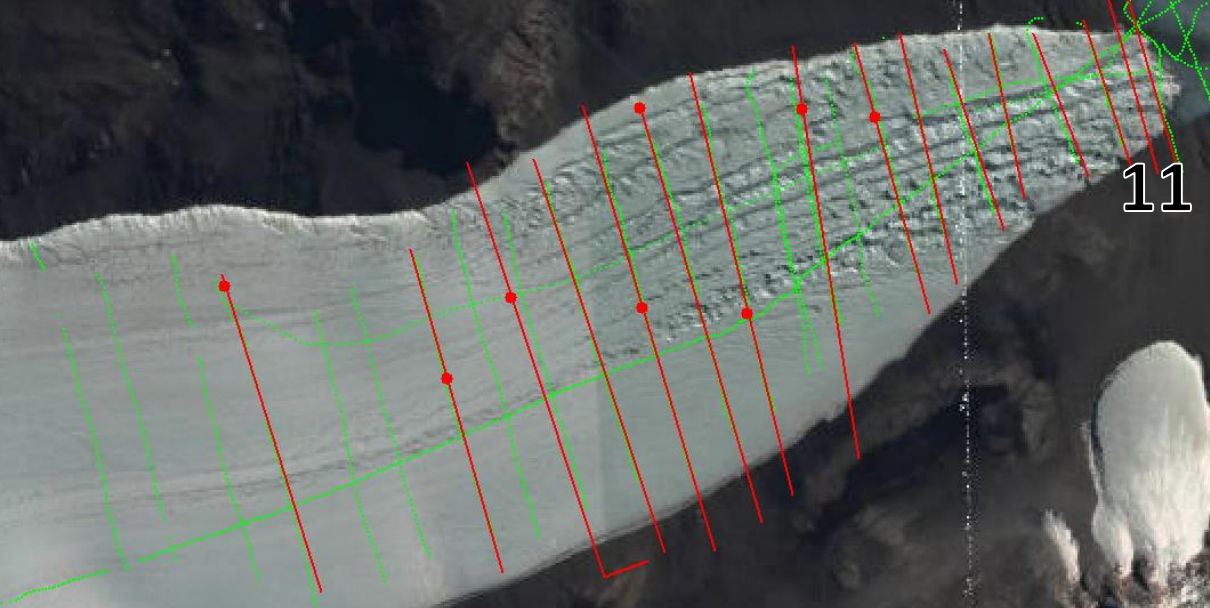


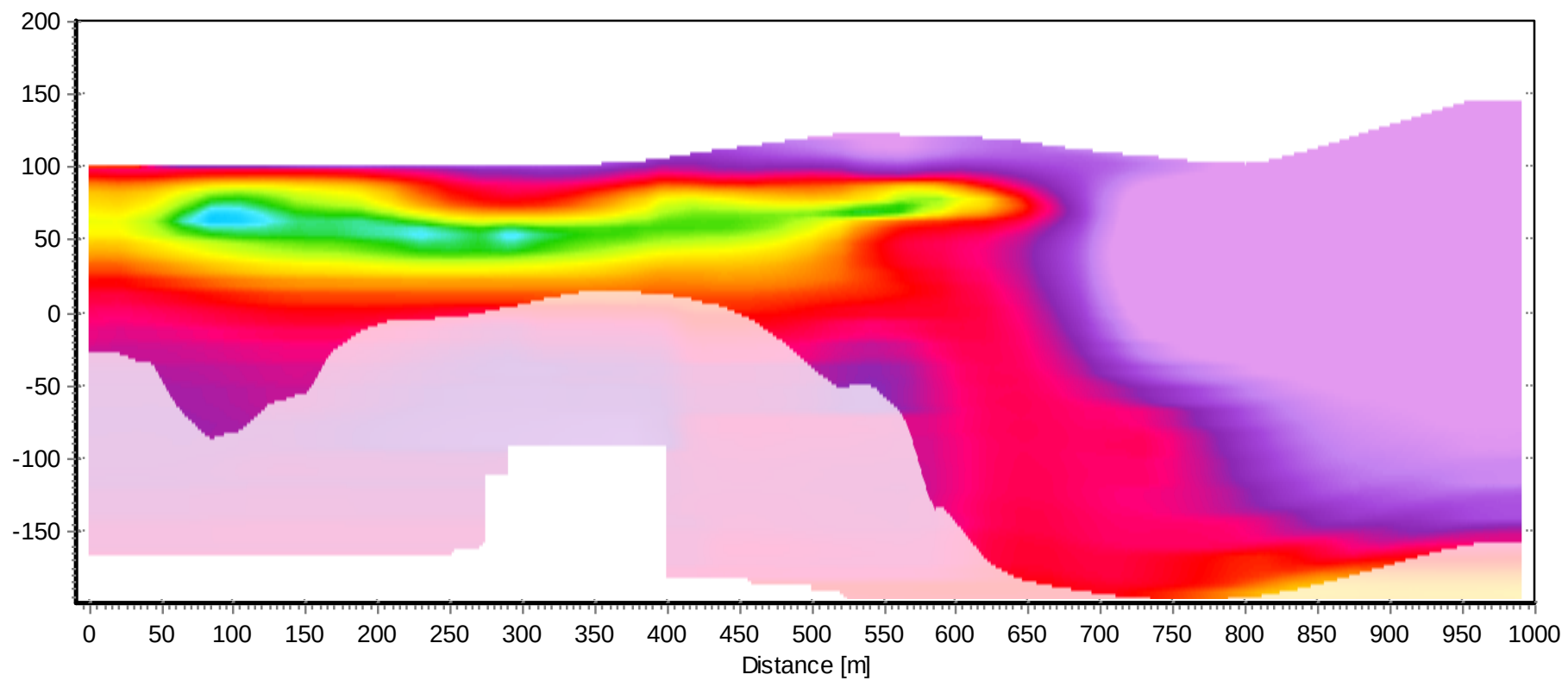
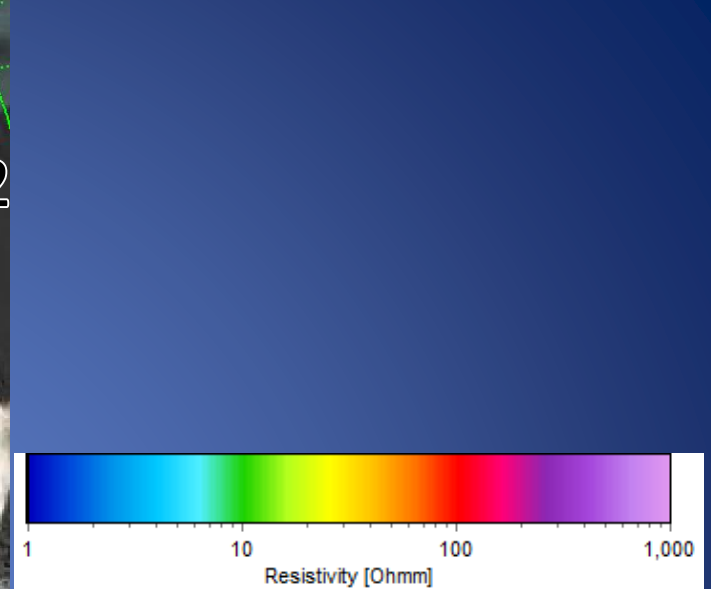
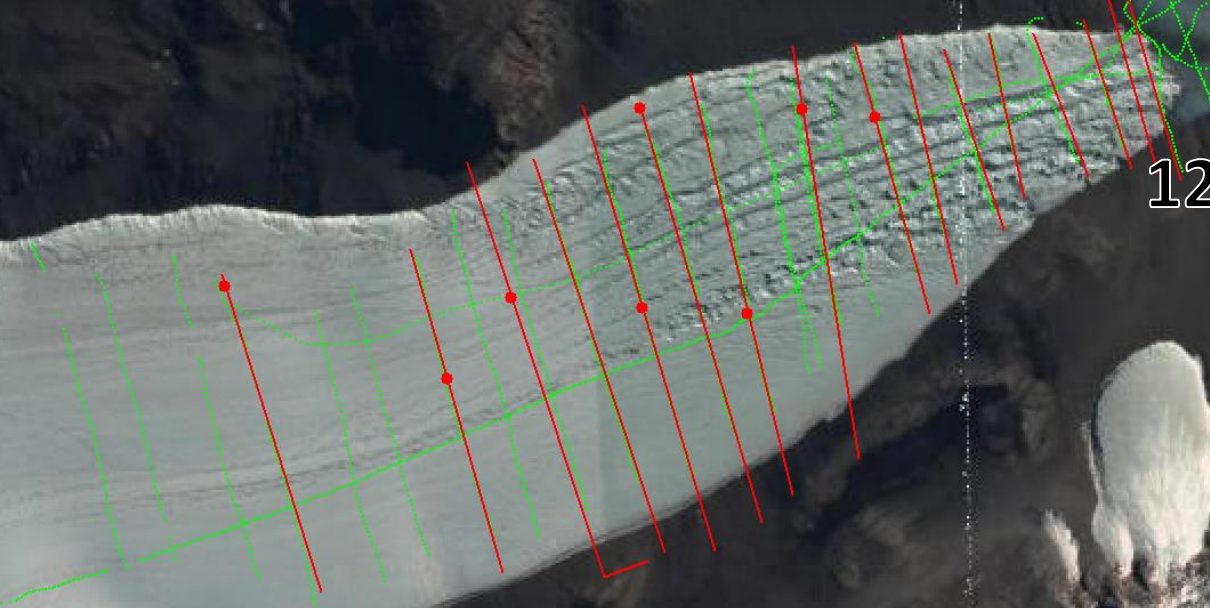








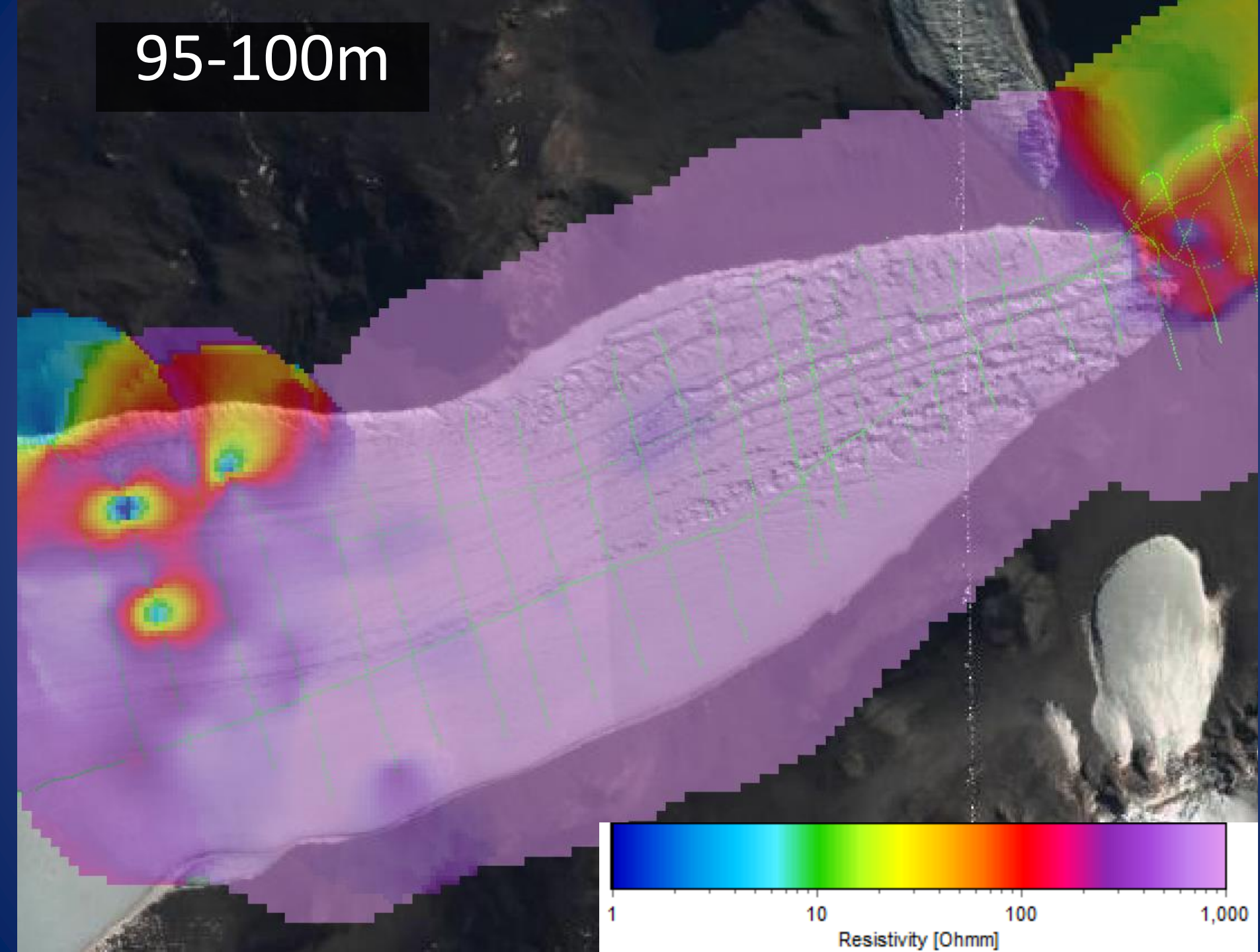




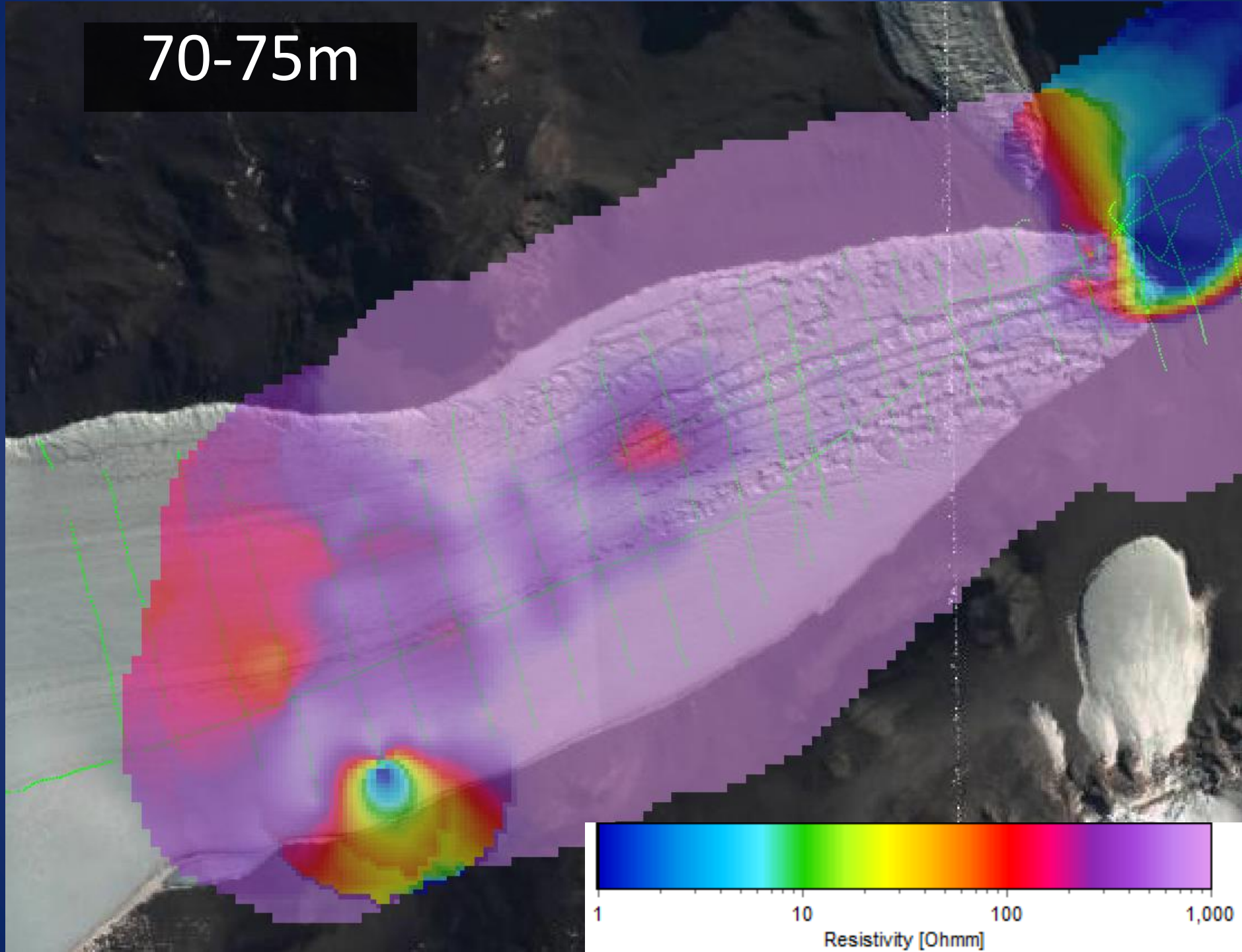
Through the Glacier



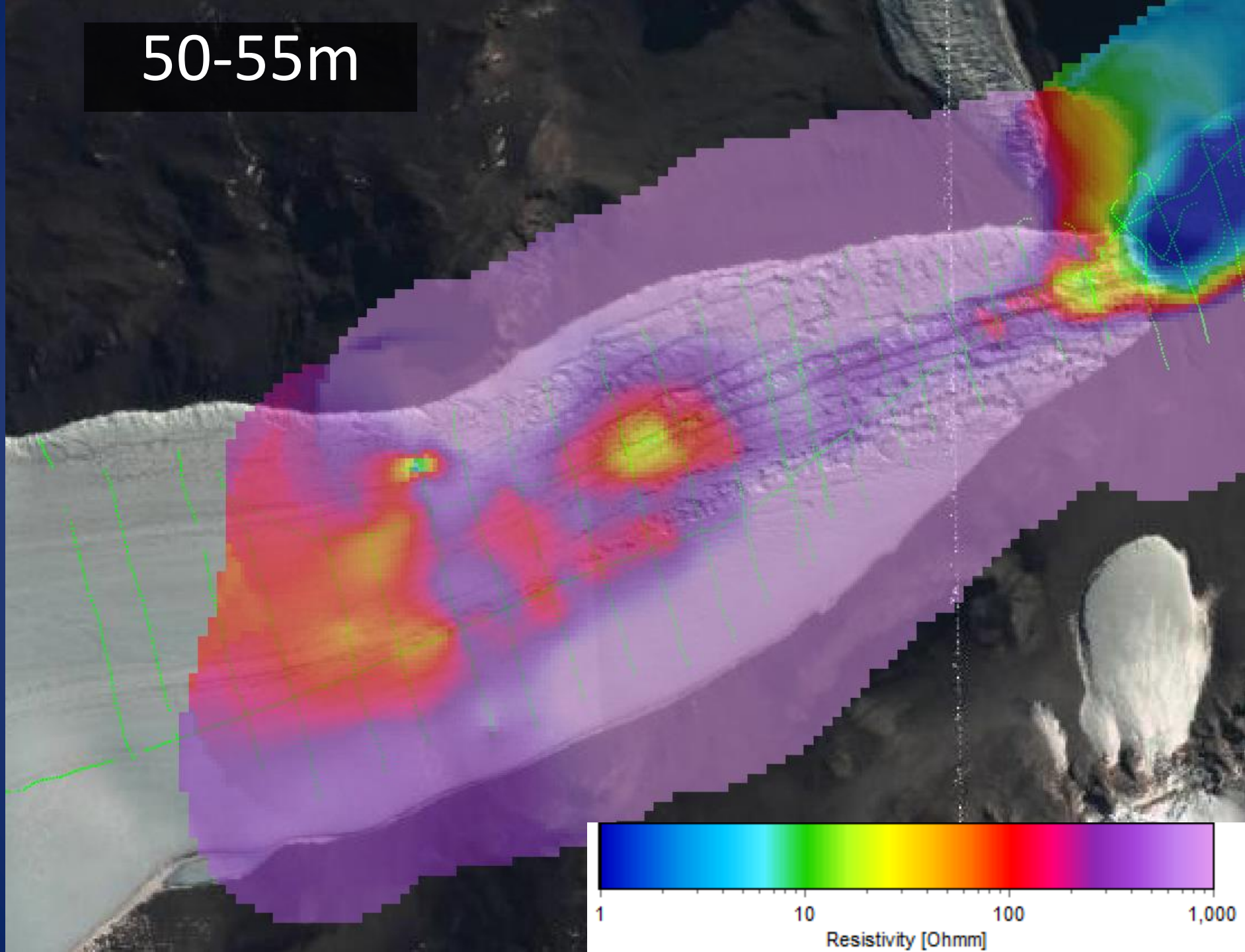
95-100m



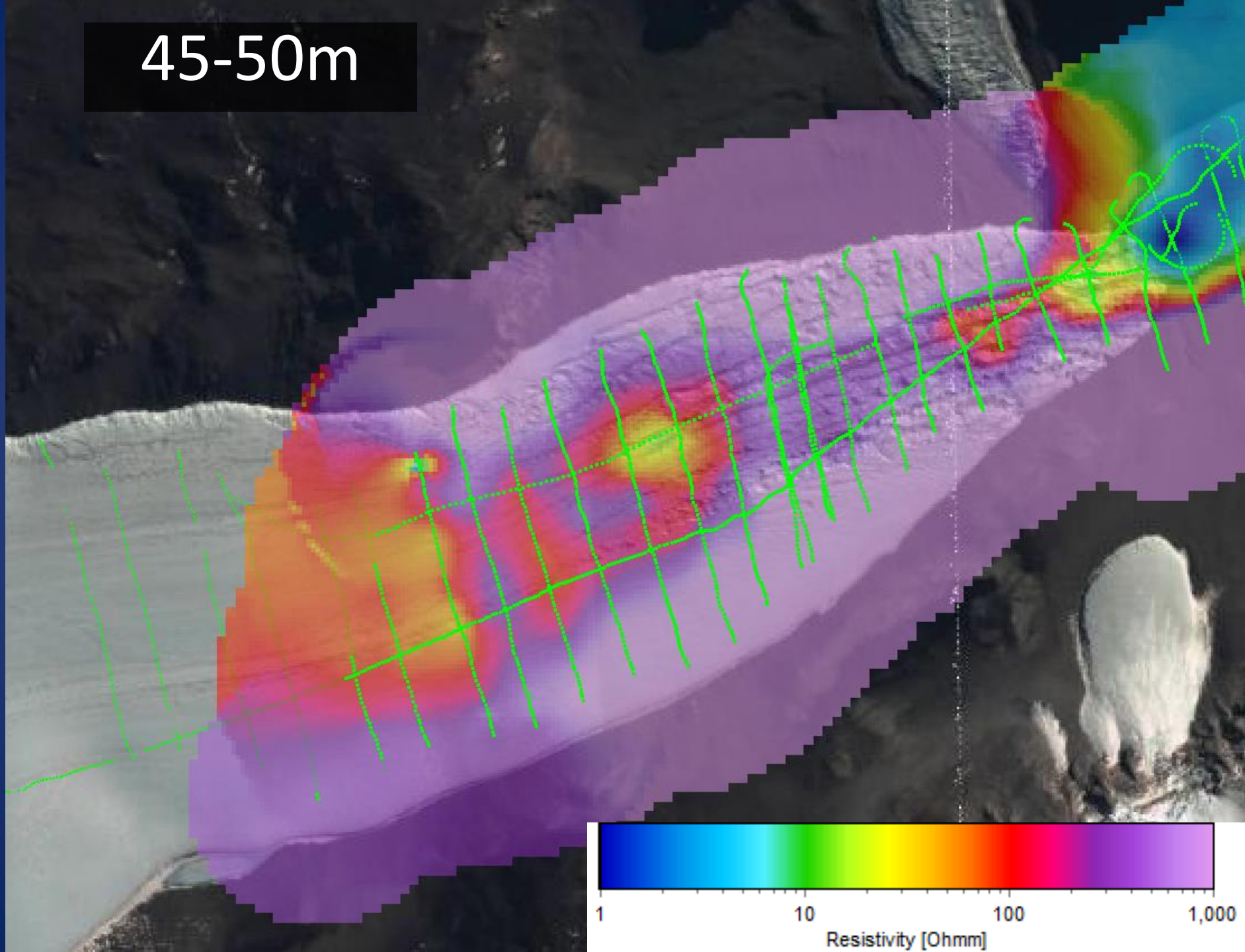
70-75m



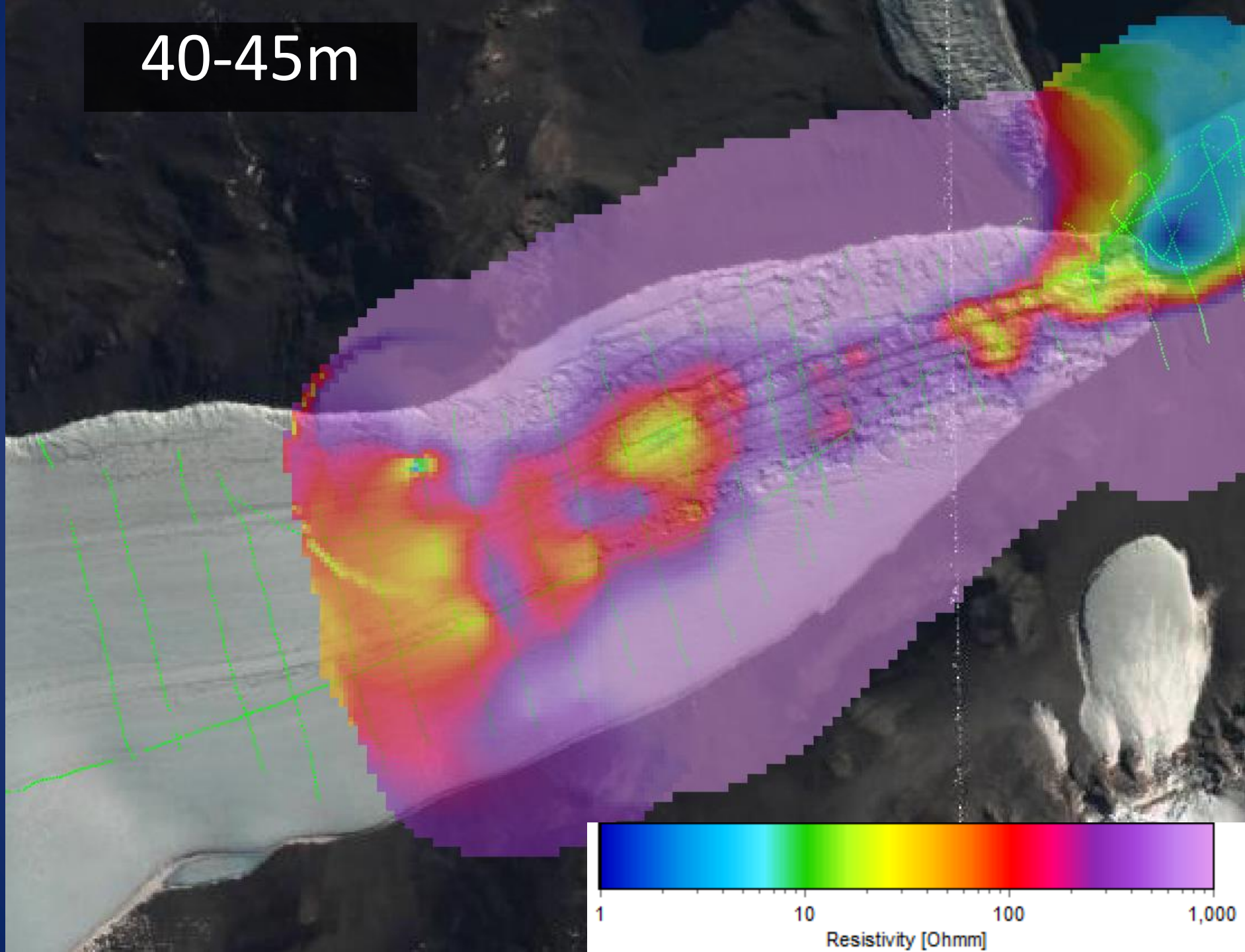
50-55m



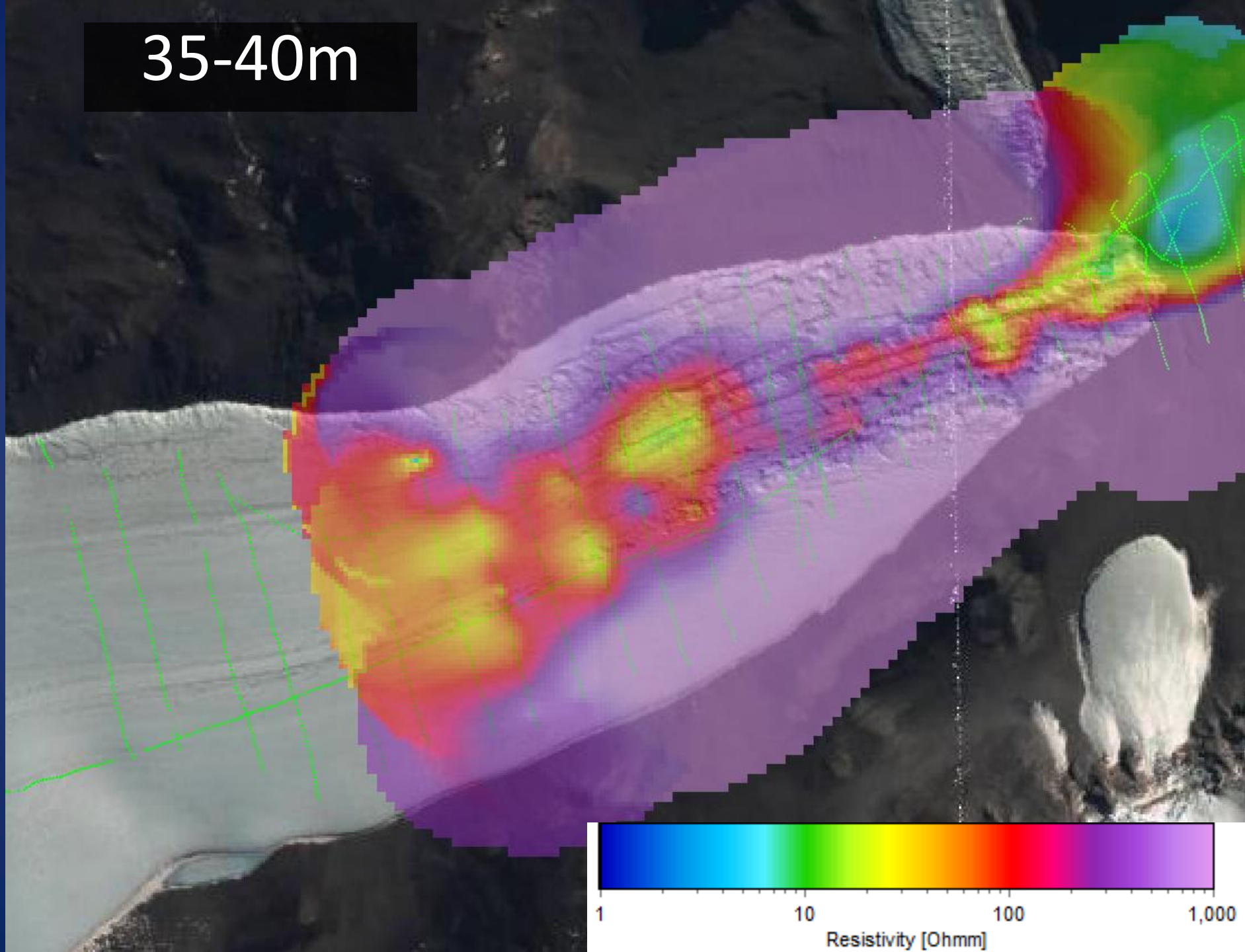
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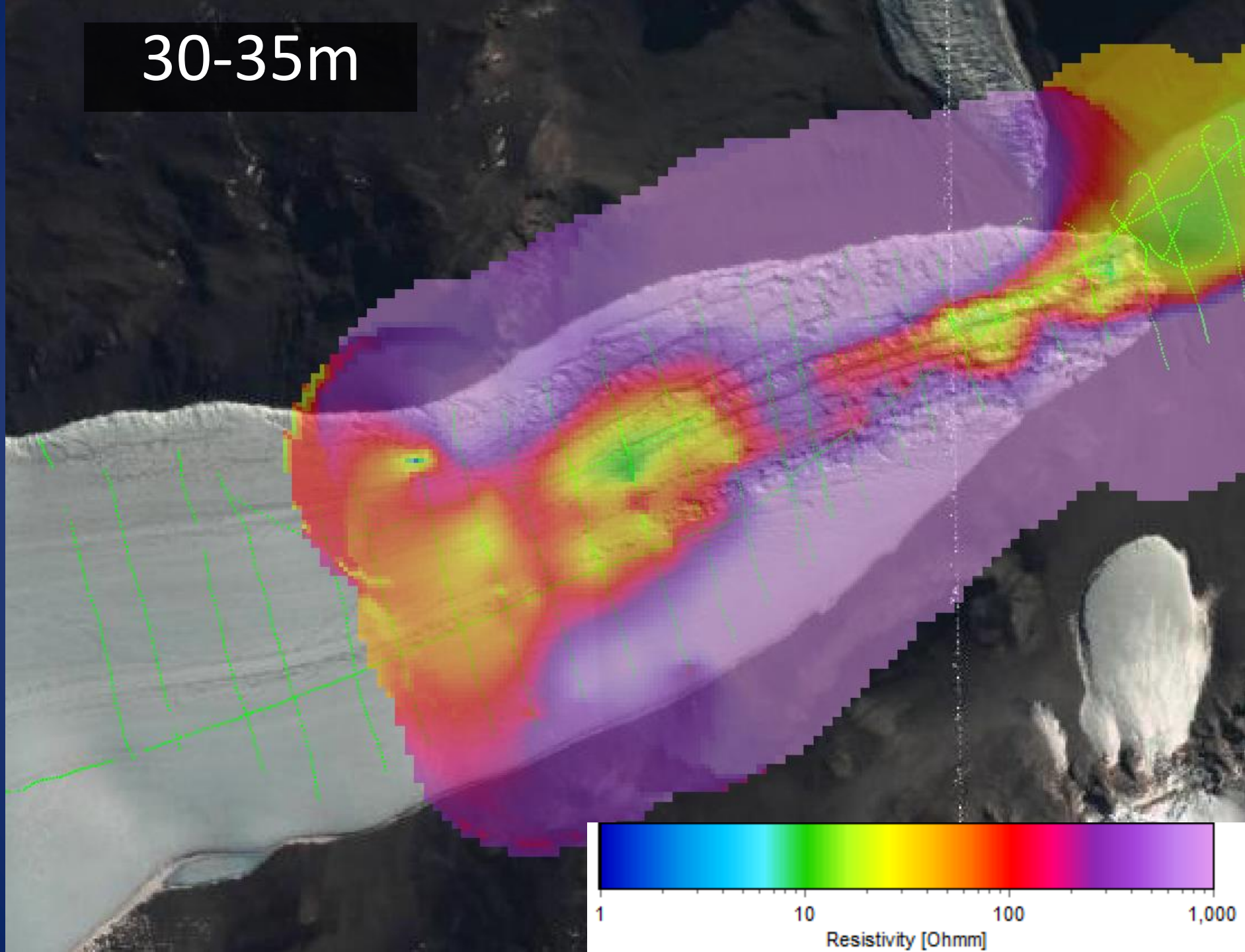
40-45m



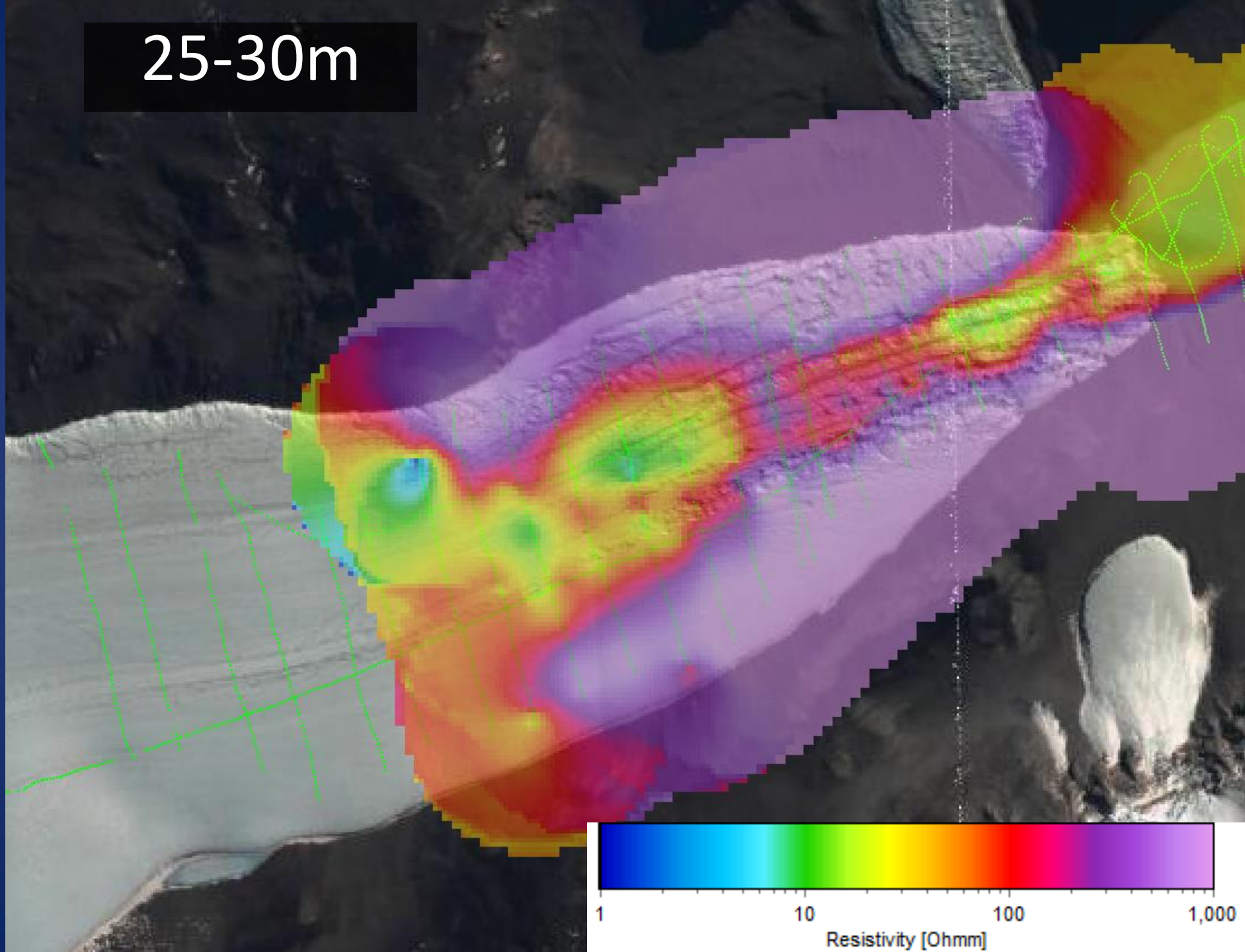
35-40m



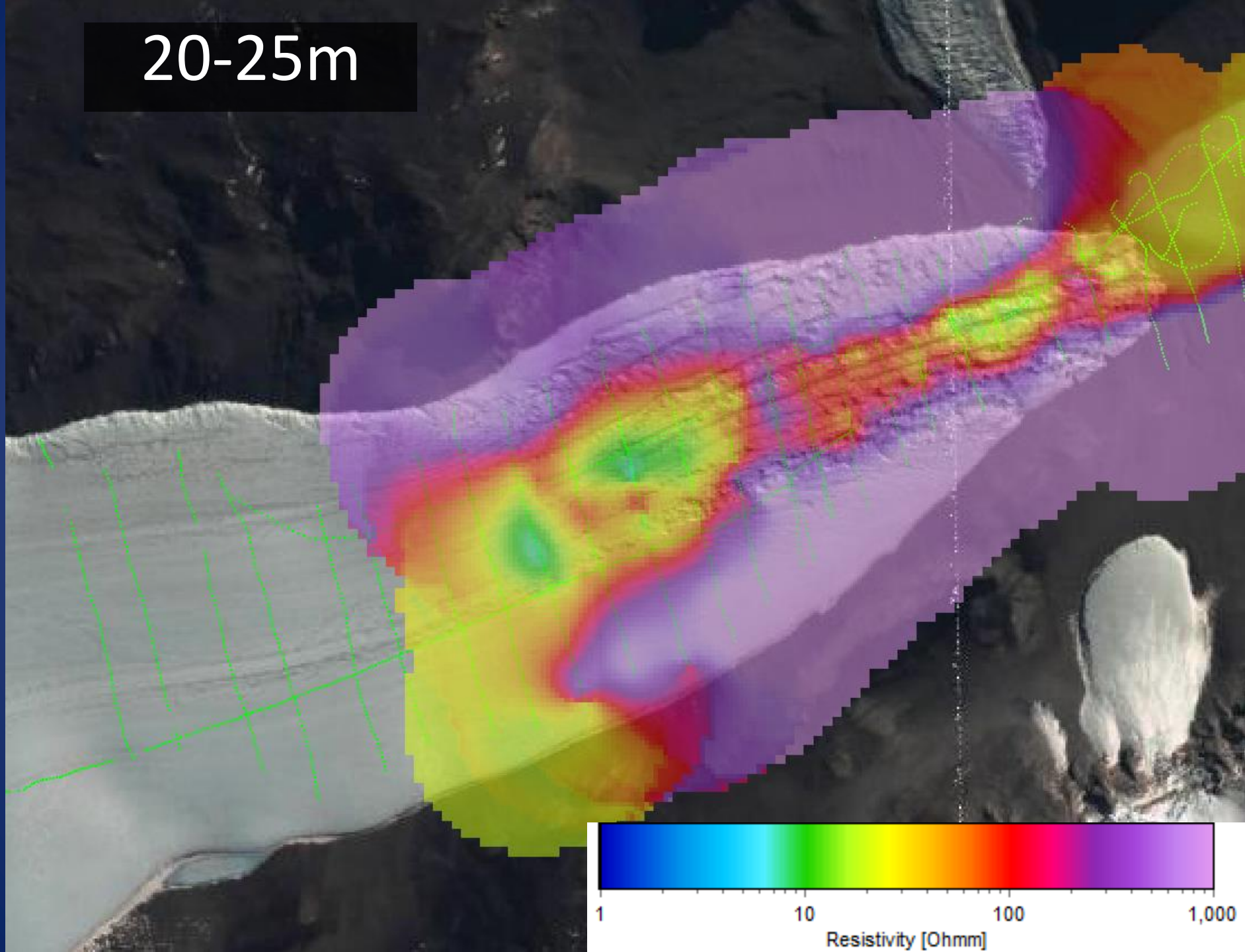
30-35m



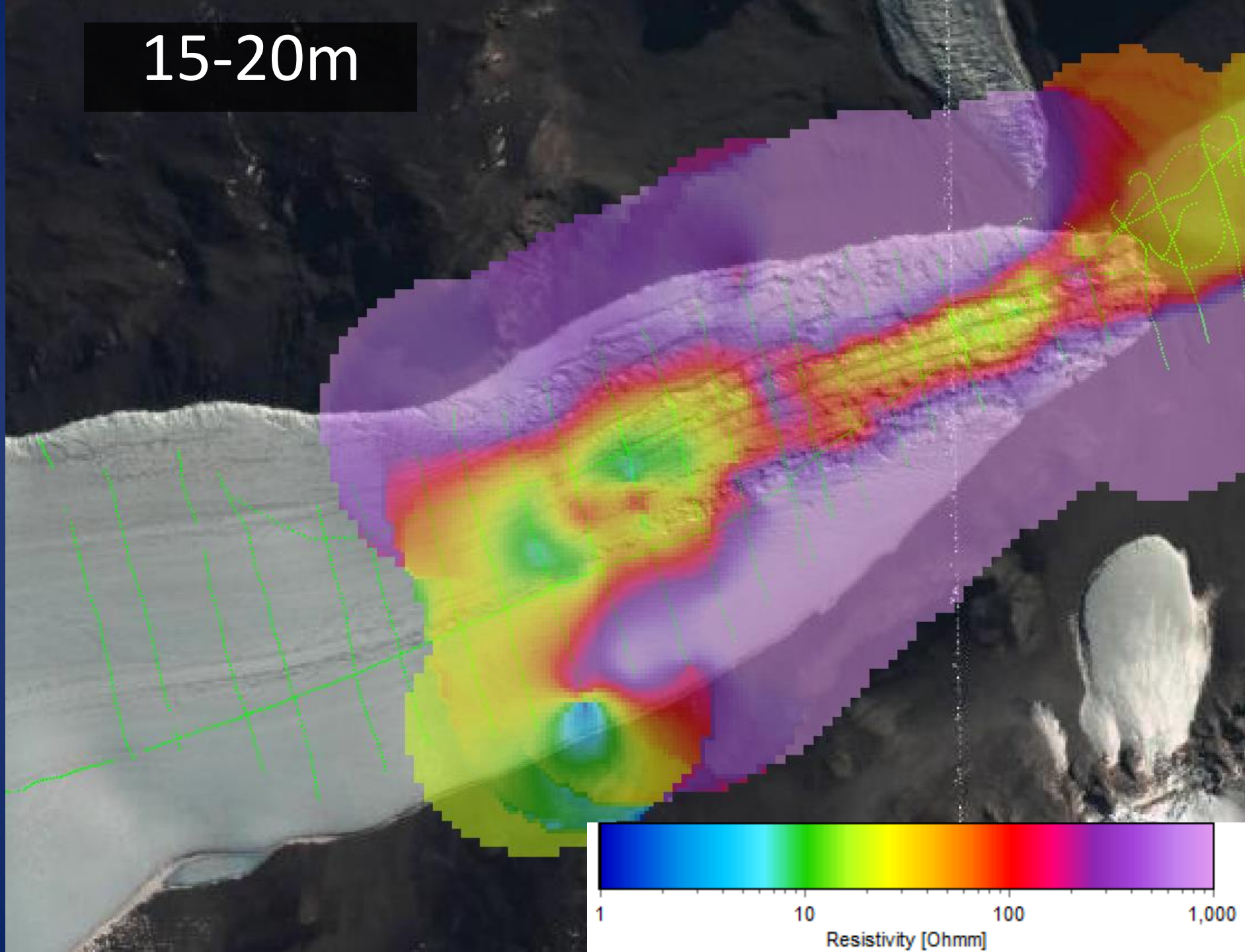
25-30m



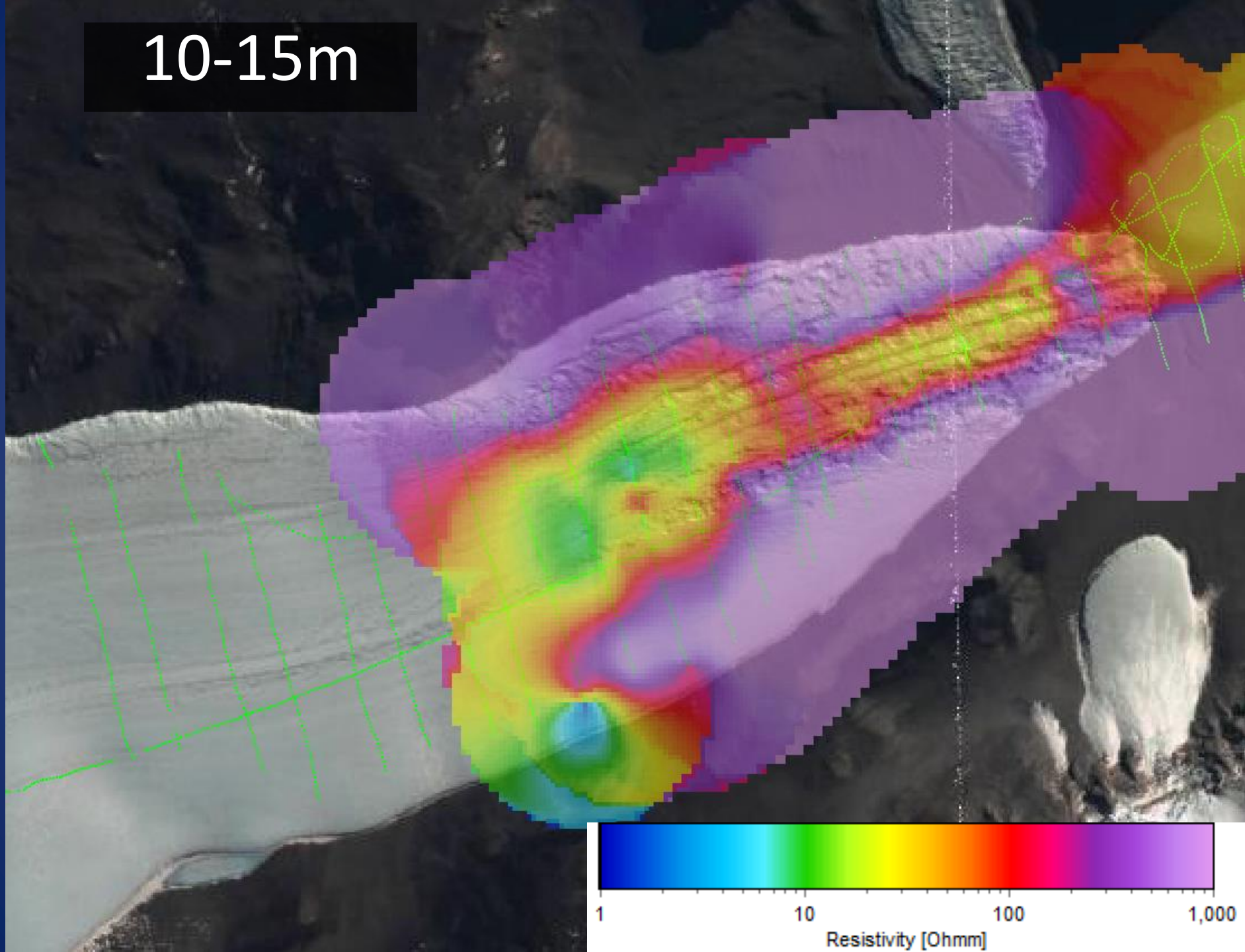
20-25m



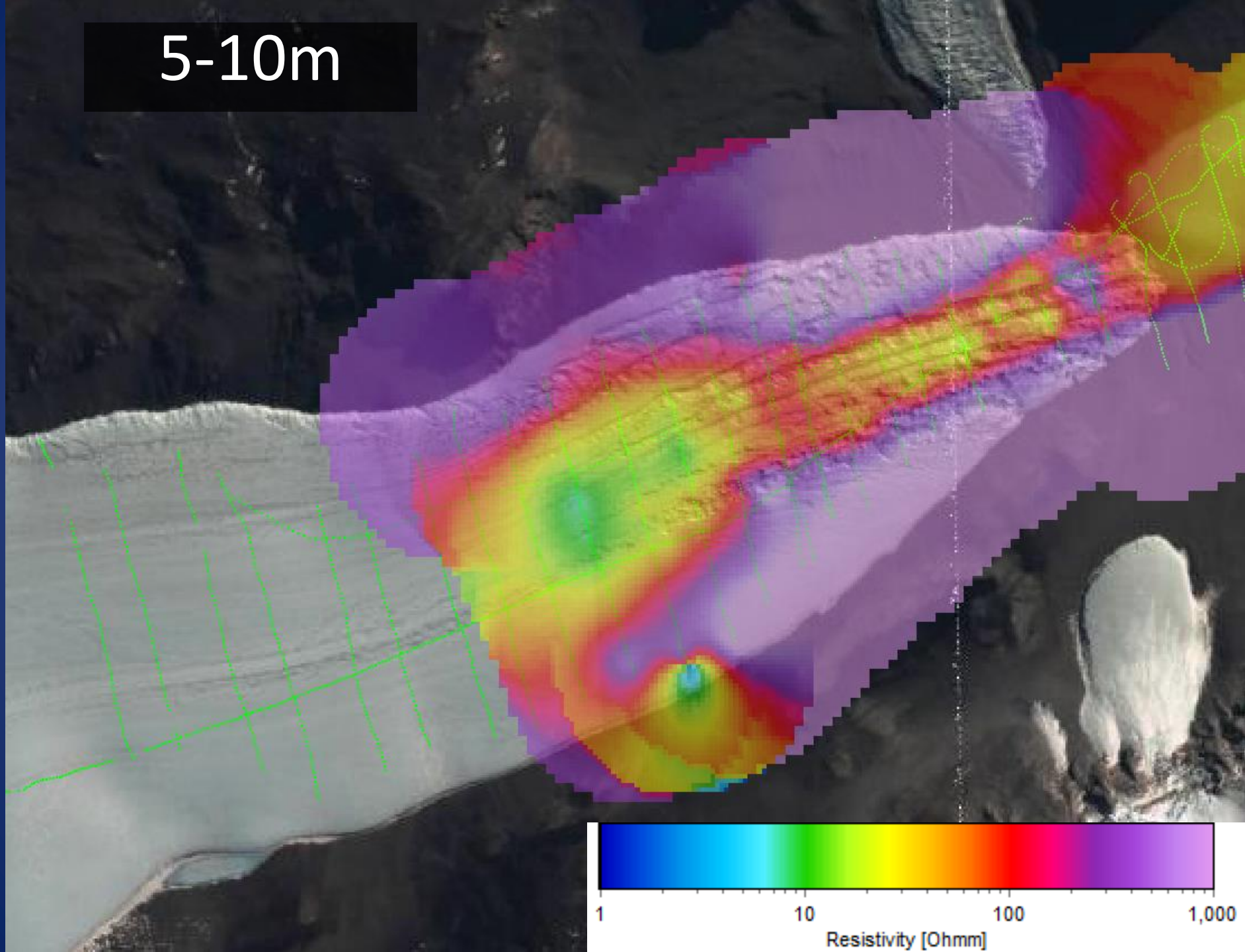
15-20m



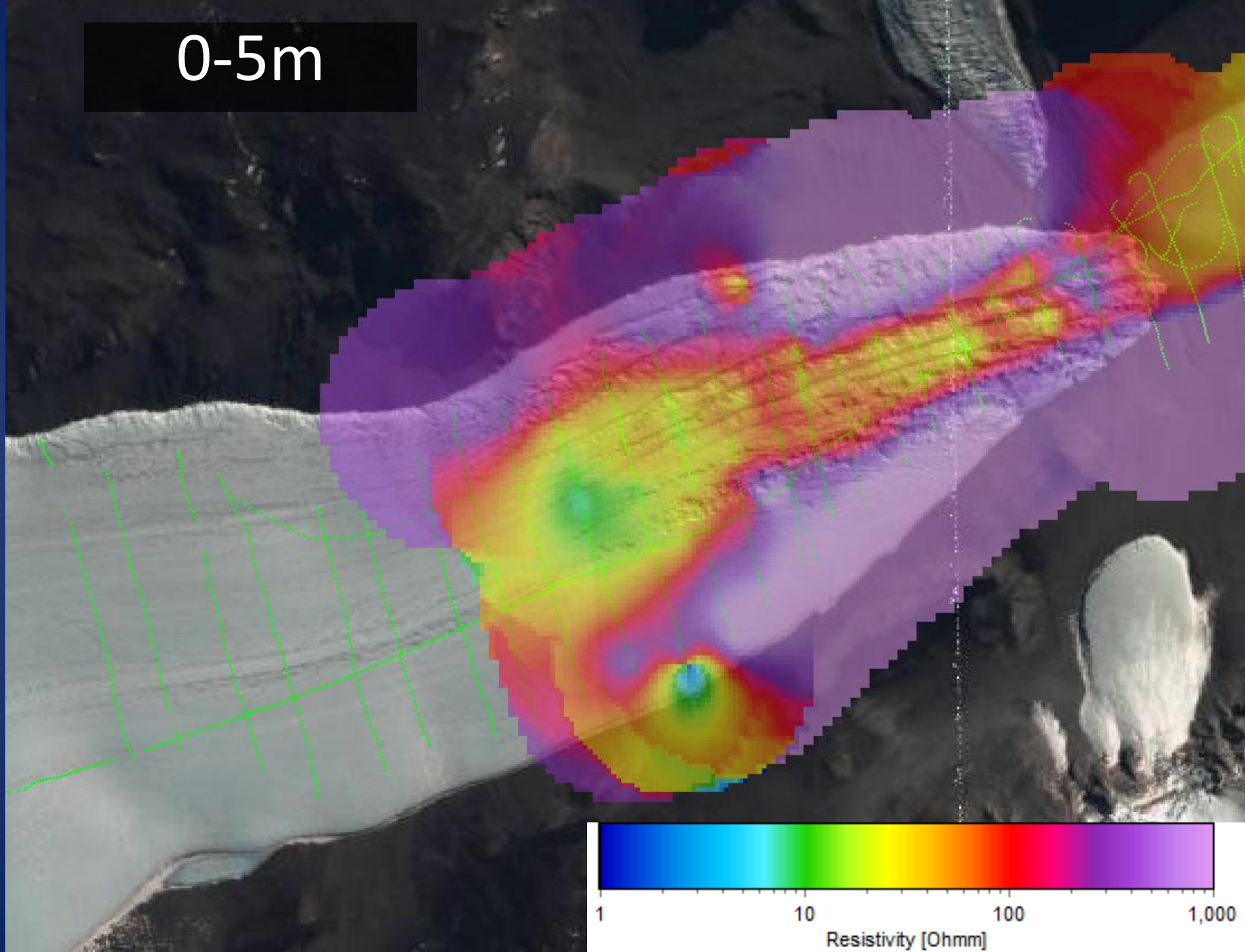
10-15m



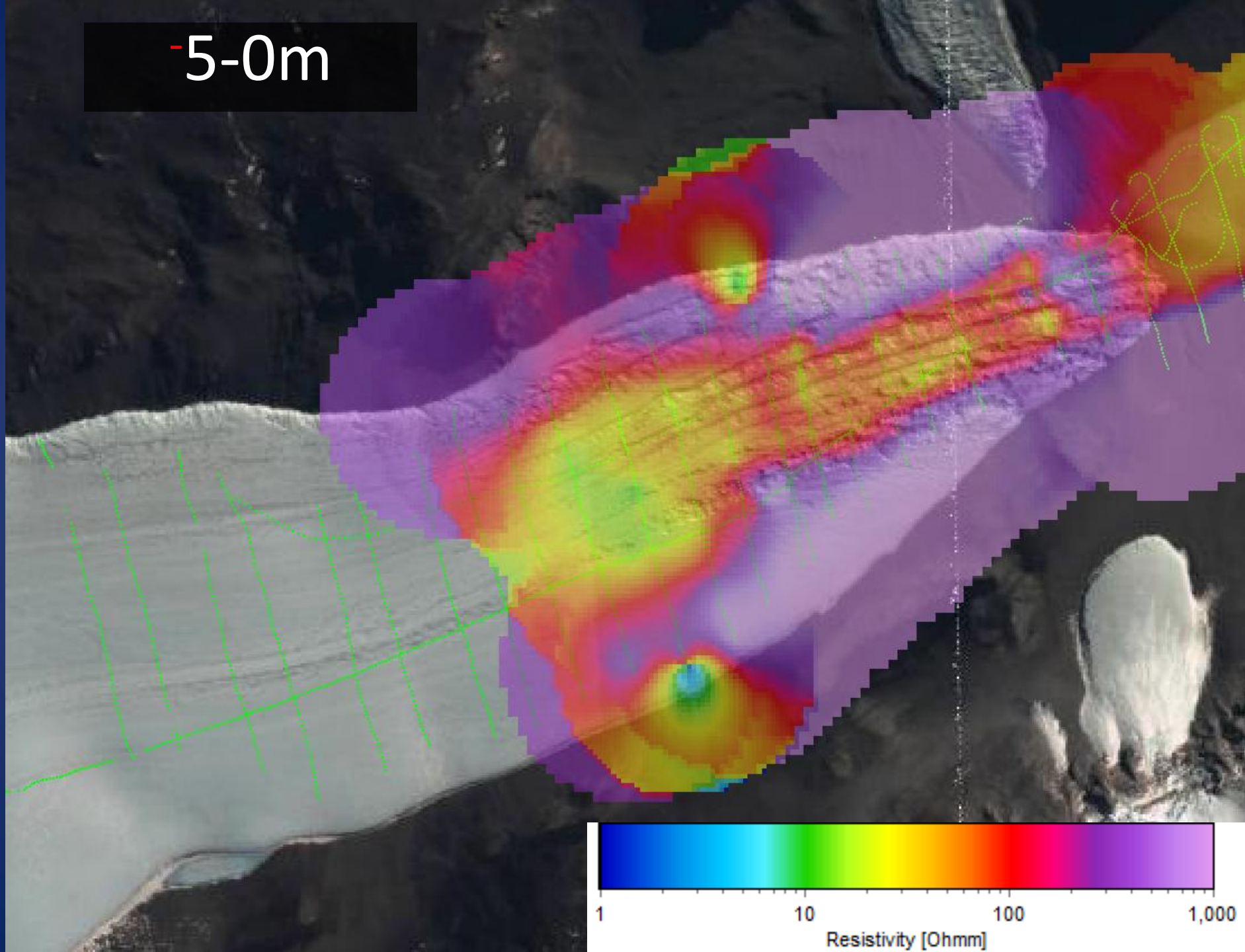
5-10m



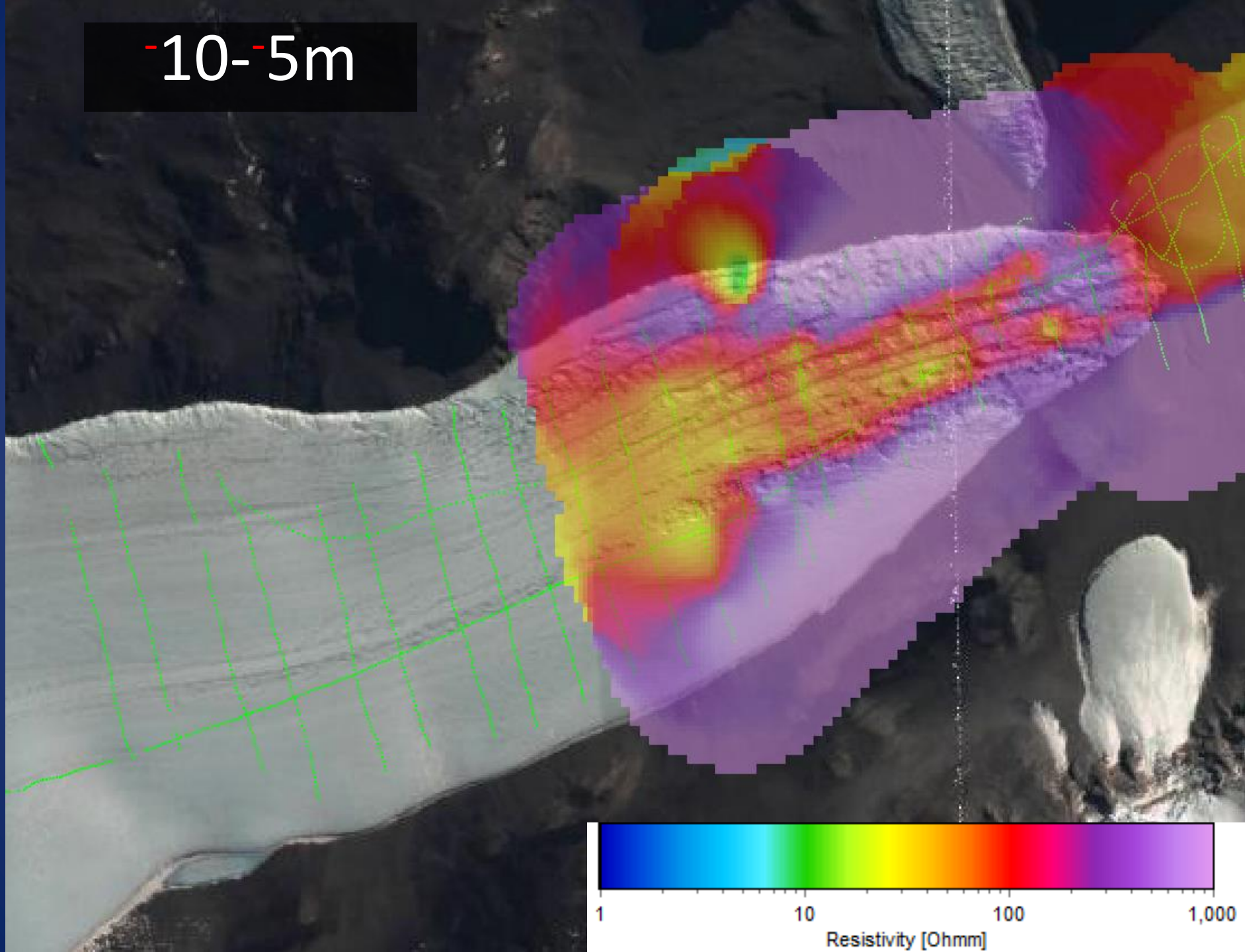
0-5m



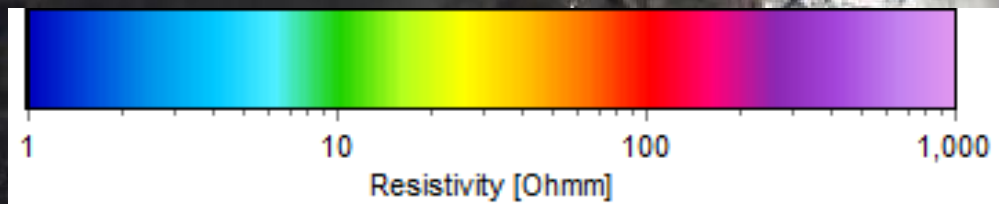
-5-0m



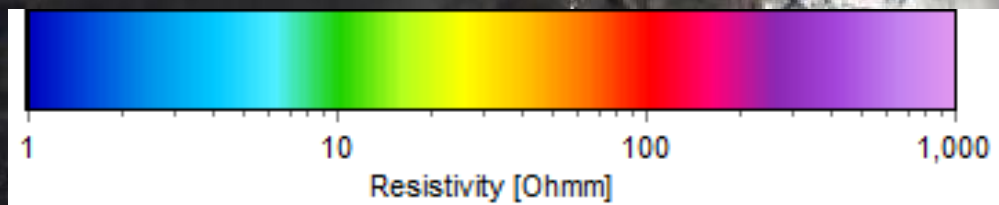
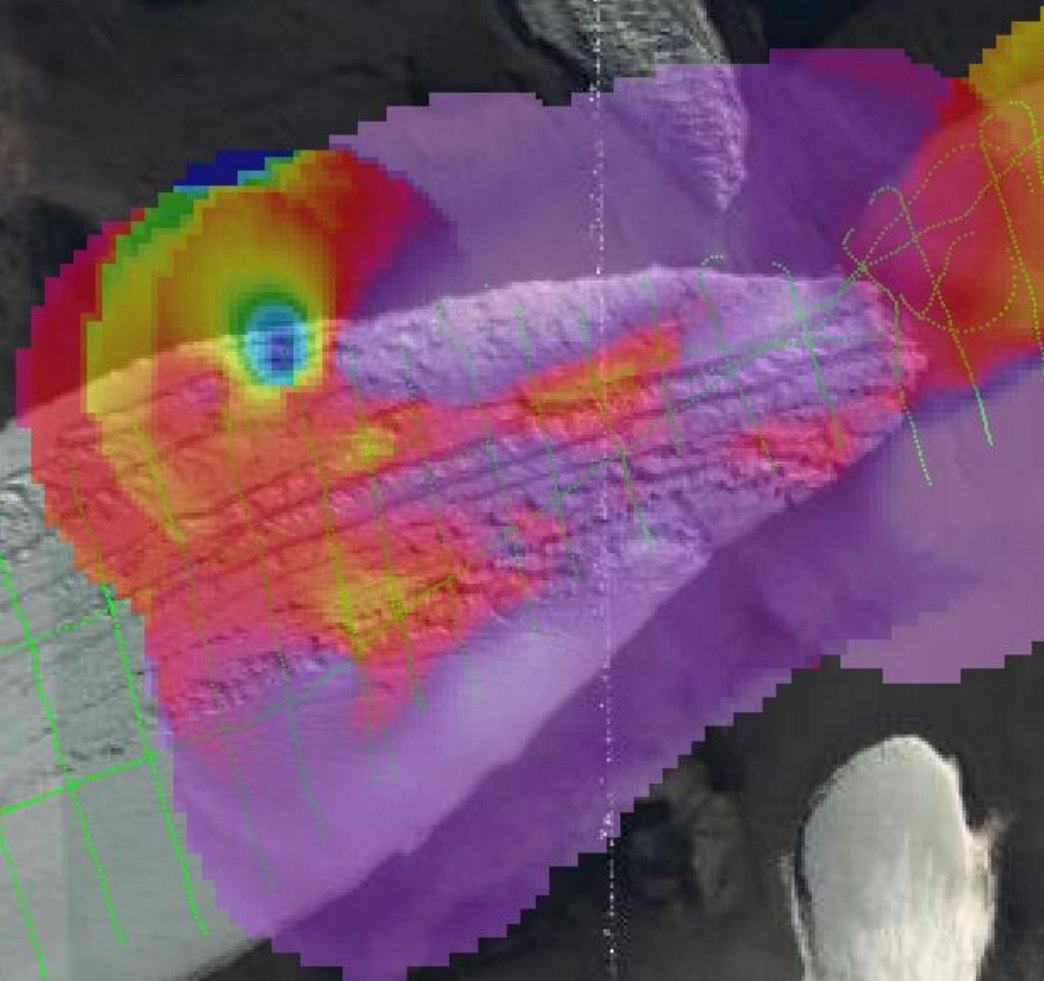
-10-5m



-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

