UAS-based hyperspectral and magnetic mineral exploration targeting Ni-PGE mineralization on Northern Disko Island, West Greenland.

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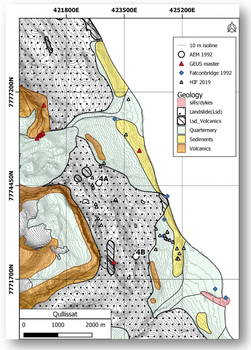
Introduction

Geologic mapping in arctic regions faces demanding challenges, from accessibility to weather, light and infrastructure conditions. In this study, we conducted UAS-based (unmanned aerial system) photogrammetric outcrop modelling, interpretation of orthoimages, multi- and hyperspectral based lithological classification and analysis of magnetic data. While magnetics give the location, orientation and subsurface extension of basaltic intrusion (sills/dykes) spectral imaging, in particular with focus on the iron absorption feature, reveals mineral proxies caused by sulphide weathering

Test area

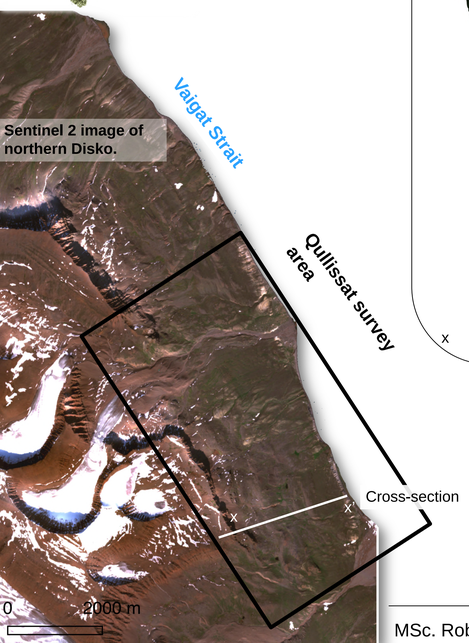
Fieldwork within the frame of the EIT project MULSEDRO focused on the Palaeocene flood basalt province of Disko Island (West Greenland). The Qullisat survey area at the Vaigat (Sullorsuaq) Strait, connecting with the Baffin bay, lies on the north coast of Disko Island.

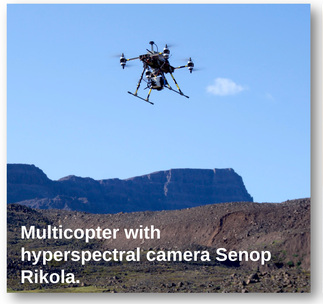


Regional setting

Location of Disko Island situated at West Greenland.

On the example of the Qullissat area, we demonstrate how UAS can bring new insights into strategies for magmatic Ni-PGE exploration in the area. Mineralization is associated to Palaeocene basalt sills of the Asuk and Ordlingassoq members, emplaced locally in coal-bearing Cretaceous sandstones.





Multicopter with hyperspectral camera Senop Rikola.

Fixed-wing with multispectral camera Parrot Sequoia.

Mineralization as iron alteration discovered during ground sampling. Length of hammer head 18 cm.

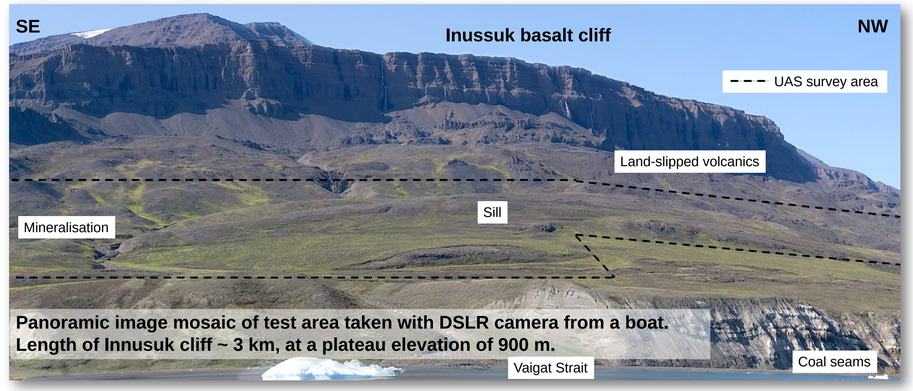
Methodology

UAS-based magnetic survey was conducted with custom-build Radai fixed wing drones. Multispectral UAS survey was flown with the Parrot eBee fixed-wings and detailed hyperspectral mapping was conducted with a Tholeg octocopter. Ground truthing was comprised of handheld spectroscopy, magnetic susceptibility and traditional geologic mapping.

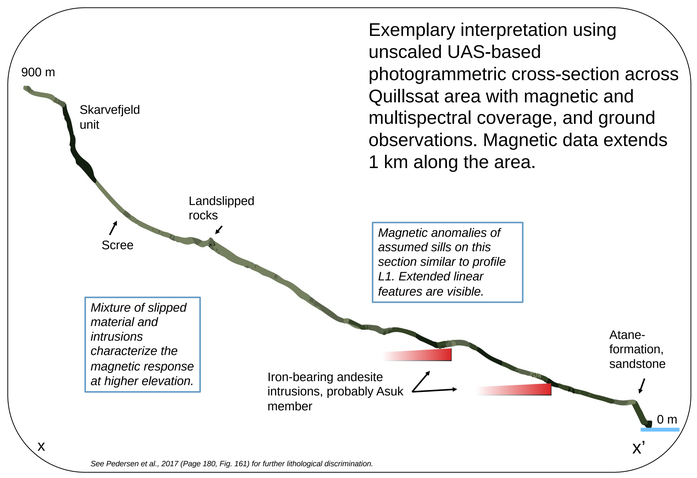
Transport of UAS equipment to starting points in challenging terrain

Fluxgate magnetometer

Fixed-wing UAS for magnetic survey. This UAS was assembled fro components on the field sites.



Panoramic image mosaic of test area taken with DSLR camera from a boat. Length of Innusuk cliff ~ 3 km, at a plateau elevation of 900 m.



Exemplary interpretation using unscaled UAS-based photogrammetric cross-section across Quillssat area with magnetic and multispectral coverage, and ground observations. Magnetic data extends 1 km along the area.

See Pedersen et al., 2017 (Page 180, Fig. 161) for further lithological discrimination.

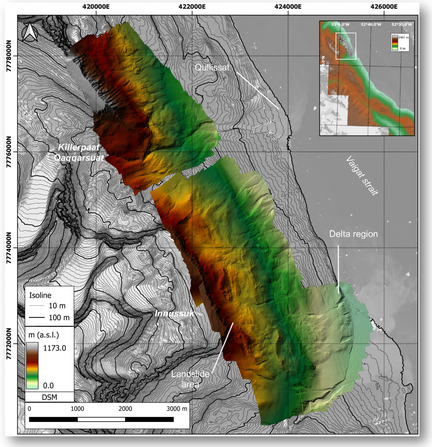
Additional Information

https://eitrawmaterials.eu/project/mulsedro
Project Overview

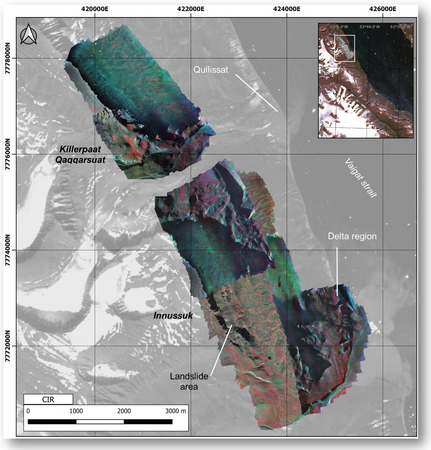
https://www.isaaffik.org/mulsedro-multi-sensor-drones
Field work details

Results

A total of 216 line-km for magnetics and 18.5 km² of multi- and hyperspectral data was covered during the expedition. First results show that integration of drone-borne spectroscopic and magnetic data highlights potential local mineralization. Based on our results, possible indications for mineralization are linear features and sharp contact boundaries in magnetic data products and specific iron absorptions in the spectral data. Resulting maps are validated using handheld spectroscopy, ground magnetics, susceptibility measurements, combined with geochemistry and mineralogy of rock samples examined in the laboratory.



UAS-based digital elevation model, fused from several flights.



UAS-based false-colour infrared multispectral mosaics (bands 735 nm, 660 nm, 550 nm).

Conclusion

Based on collective data interpretation of fixed-wing magnetics, multispectral imaging and high resolution digital surface models, we support a geologic interpretation having basaltic intrusions covered by sandstone formations and quaternary rock and soil. Observations of weathering and distinct magnetic anomalies leads geologist to new target areas for following ground sampling during subsequent field season. Conclusively, the study solidifies UAS as highly valuable tool for exploration.

References

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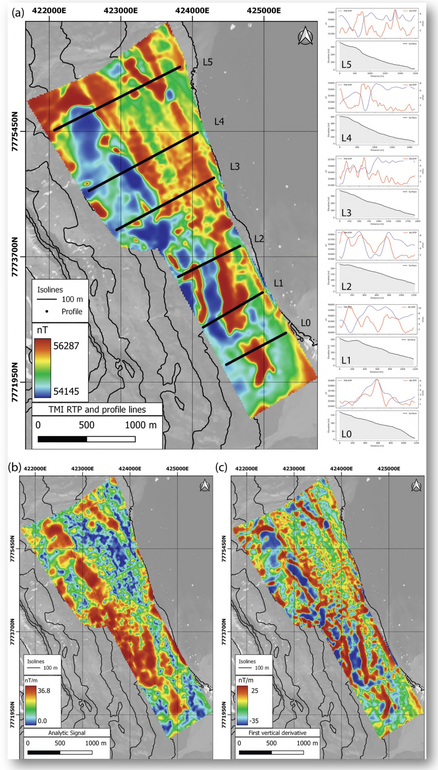

UAS-based magnetic data aides to interpret iron-rich volcanics and target detection. (a) Total magnetic intensity as reduced-to-pole with elevation profile lines and extracted magnetic profile lines (L0-L5). (b) Analytic signal of magnetics. (c) First vertical derivative enhances lithologic contacts.

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