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EXPEDITION TO SERMILIGAARSUK FJORD, SW GREENLAND

Preliminary Field Report

1 INTRODUCTION

This fieldwork was undertaken as part of my MSci thesis, "Chemical Mass Transfer during Alteration and Au Mineralization of Tartoq Group Greenstones, Sermiligaarsuk Fjord, SW Greenland", in partial fulfillment of the requirements for the degree of MSci Geology at Imperial College London and the Associateship of the Royal School of Mines.

Exploration of the Tartoq Group Greenstone Belt, southwest Greenland, has revealed extensive carbonate alteration zones and associated gold mineralization. There has been consistent interest in the region from mining companies since the 1970s. Despite the region's potential, no economic gold deposits have been found.

The Bureau of Minerals and Petroleum (BMP) for Greenland and The Geological Survey of Denmark and Greenland (GEUS) set up a co-financed, 3-year project from 2008-2010 in order to re-evaluate the economic potential of Archaean rocks in parts of Southwest Greenland. The focus of the 2010 field season was a project called "Structurally controlled hydrothermal alteration and mineralization on a regional scale and detailed studies of selected greenstone belts, southern West Greenland, 61°30'-64°".

My undergraduate MSci thesis is being undertaken in collaboration with GEUS under the umbrella of that project. The aim of the project is to complete a detailed study of the mineralogical changes and geochemical transfers associated with the hydrothermal alteration and mineralization in the Tartoq Group greenstones, by quantifying the elemental transfers into, out of and across alteration zones during metasomatism. In quantifying the dispersion patterns of pathfinder elements and qualititatively evaluating their relationship with the alteration mineral assemblage, it should be possible to provide information that will be useful in locating exploration targets in this region in the future.

The preliminary work for the project was this expedition. The aim was to investigate previously mapped areas that have recognised Au potential, update the maps as necessary and examine transects across hydrothermal alteration zones, collecting rock samples for mineralogical and geochemical analysis.

1.1 LOCATION

The Sermiligaarsuk Fjord area is located in southwest Greenland, approximately 70km SW of Paamiut and 170km WNW of Narsarsuaq. It is roughly centred at 61°30'N 48°30'W.

1.2 TERRAIN AND CLIMATE

Situated on the rugged West Greenland coast, steep-sided cliffs rise to 500-900m elevation alongside the deep fjord and run for 30km to the inland ice. The landscape consists of barren plateaus and ridges and lightly vegetated valleys, with frequent ribbon-like lakes in between. There is around 75% exposure, weathered bedrock and light scrub forming the only cover.

The climate is alpine and the weather typically very variable, however we were fortunate enough to have clear blue skies and temperatures up to 22°C throughout the field season.

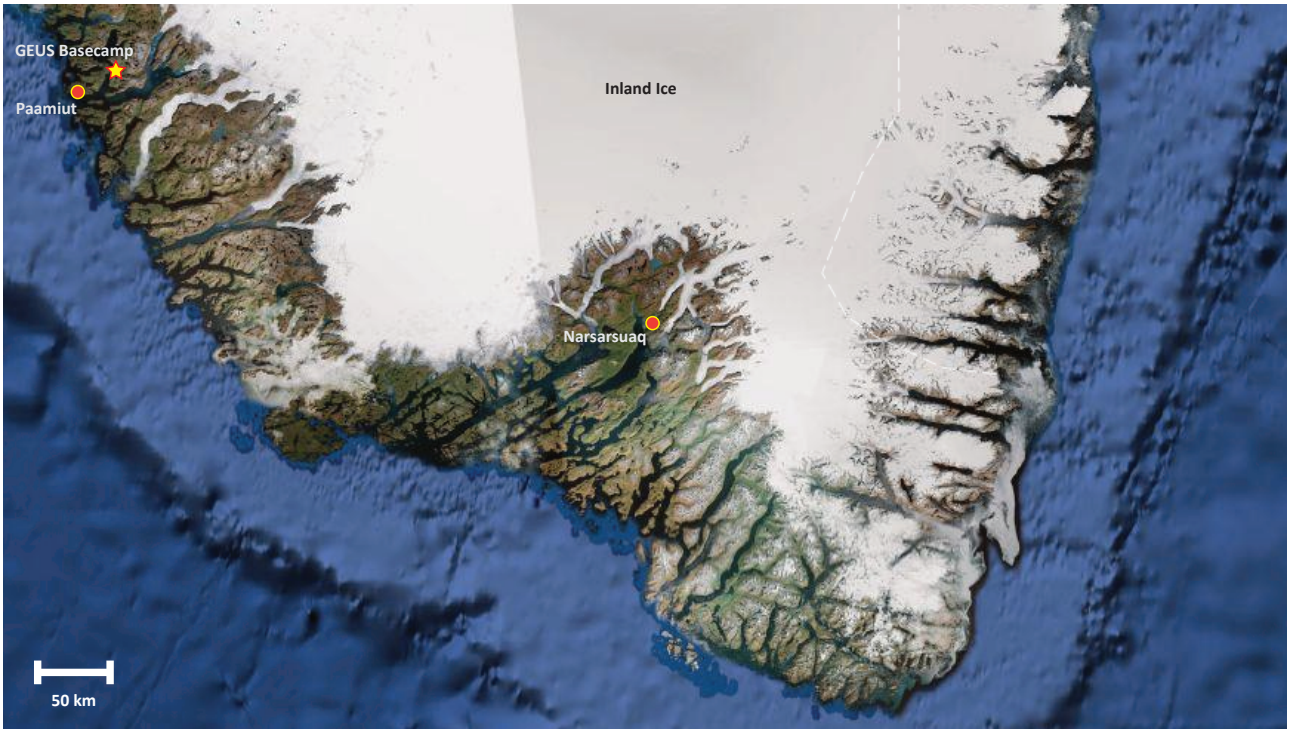


Figure 1. Map of South Greenland

1.3 GEOLOGICAL SETTING

The Sermiligaarsuk Fjord area is situated at the southernmost end of the Archaean craton in West Greenland. This region is comprised of remnant greenstone supracrustals, the Tartoq Group, which lie unconformably on a gneissose Archaean basement (Higgins & Bondesen 1966). In this study I focus on four main greenstone outliers, named Nuluk, Iterlak, North Midternaes and Midternaes. No original contacts have been observed between the supracrustals and the basement; the boundaries may be gradational, migmatitic-agmatitic (for example, eastern Nuluk) or sharp, for example, high angle thrust zones or faults in west Iterlak and north Midternaes (Appel & Secher 1984; Evans & King 1993). It is thought that the Tartoq Group is the remains of a once-continuous belt of supracrustals that was downfolded into the underlying basement and then eroded, leaving behind isolated outliers of greenstone (Appel & Secher 1984). In the Midternaes area, east of Sermiligaarsuk Fjord, underformed rocks from the Proterozoic Ketilidian Mobile Belt unconformably overlie the Tartoq Group (Steenfelt 2000).

1.4 FIELD AREA

Fieldwork was split into four camps, each one based at one of the four main greenstone outliers situated to the north and south of Sermiligaarsuk Fjord; Nuluk, Iterlak, North Midternaes and Midternaes. Most previous work by mining companies in the area has focused on the Nuluk and Iterlak outliers, which show the strongest alteration and the highest and most consistent anomalous gold grades. I also focused on these two areas during this field season, so the stays at Camps 1 and 2 were significantly longer than 3 and 4.

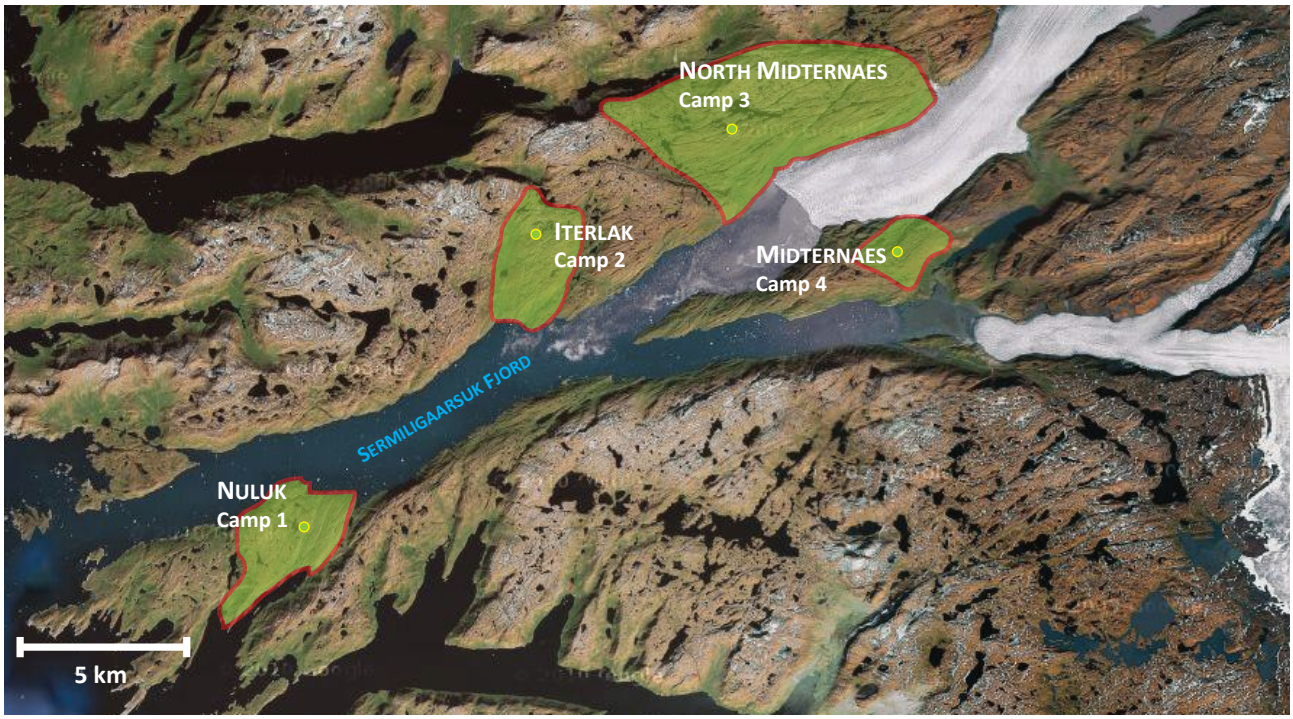


Figure 2. Map of Sermiligaarsuk Fjord area, showing boundaries of the four main Tartoq Group greenstone outliers and the locations of the field camps.

2 FIELDWORK

At each camp, one or more days were spent in reconnaissance, understanding the mineralization styles and identifying alteration zones. Previous company reports from Rezny Mines Ltd, NunaOil, and Greenex were made available through GEUS. Using these and the accompanying maps, previous drill sites and mineralization targets were explored and documented. Once suitable profile targets had been identified, detailed transects were made across alteration zones and samples were taken for whole rock geochemical analysis. A total of 96 samples were taken in all 4 areas.

2.1 PROFILES

Two detailed profiles were made in the Iterlak region and one in each of North Midternaes and Midternaes. See Appendix for details.

2.2 TIMELINE

19th June: Flight from Copenhagen to Narsarsuaq, then local flight to Paamiut followed by transfer by chartered boat to GEUS Basecamp.
20th June: Helicopter transfer to first camp, Nuluk.

20th-23rd June: Camp 1, Nuluk.
24th-28th June: Fieldwork days lost due to illness. The expedition leader, my field partner, Denis Schlatter continued the work in the Nuluk area during this time.
29th June – 5th July: Camp 2, Iterlak.
6th-10th July: Camp 3, North Midternaes.
11th-13th July: Camp 4, Midternaes.
14th July: Return to basecamp.
16th July: Helicopter flight from basecamp to Narsarsuaq.
17th July: Return flight to Copenhagen.

3 FURTHER WORK

Rock samples were sent to Activation Laboratories Ltd, Ontario, Canada for wholerock geochemical analysis. Selected samples along profiles were also chosen to be made into polished thin sections and sent to the Natural History Museum, London. I have received the results from Actlabs and am awaiting the remainder of the polished thin sections. Work is currently being undertaken to analyse the results from Actlabs and quantify the elemental transfers across alteration zones.

4 REFERENCES

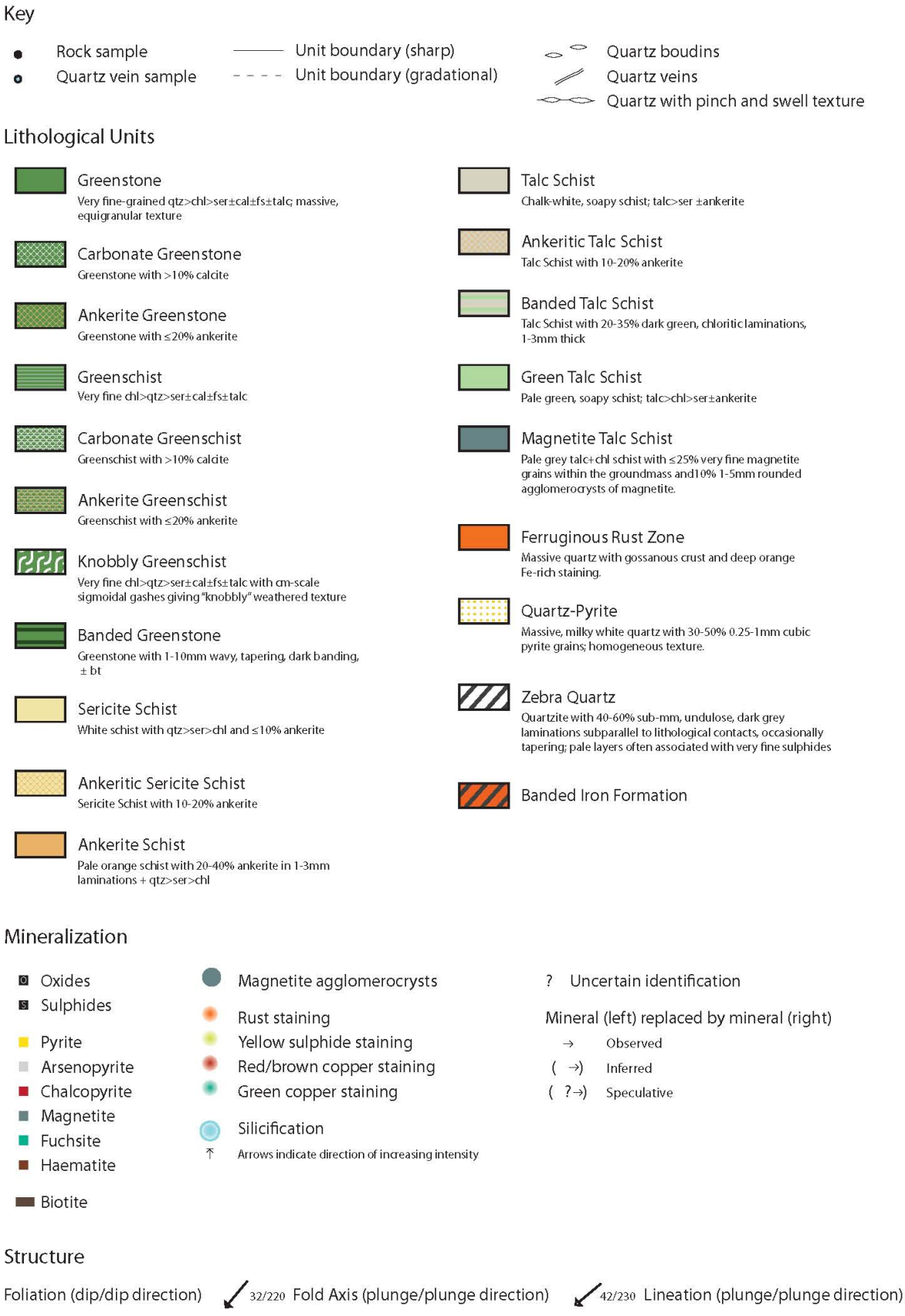
Appel, P. W. U. & Secher, K. 1984. On a gold mineralization in the Precambrian Tartoq Group, SW Greenland. *Journal of the Geological Society of London,* **141,** 273-278.

Evans, D. M. & King, A. R. 1993. Sediment and shear-hosted mineralization of the Tartoq Group supracrustals, southwest Greenland. *Precambrian Research,* **62**, 61-82.

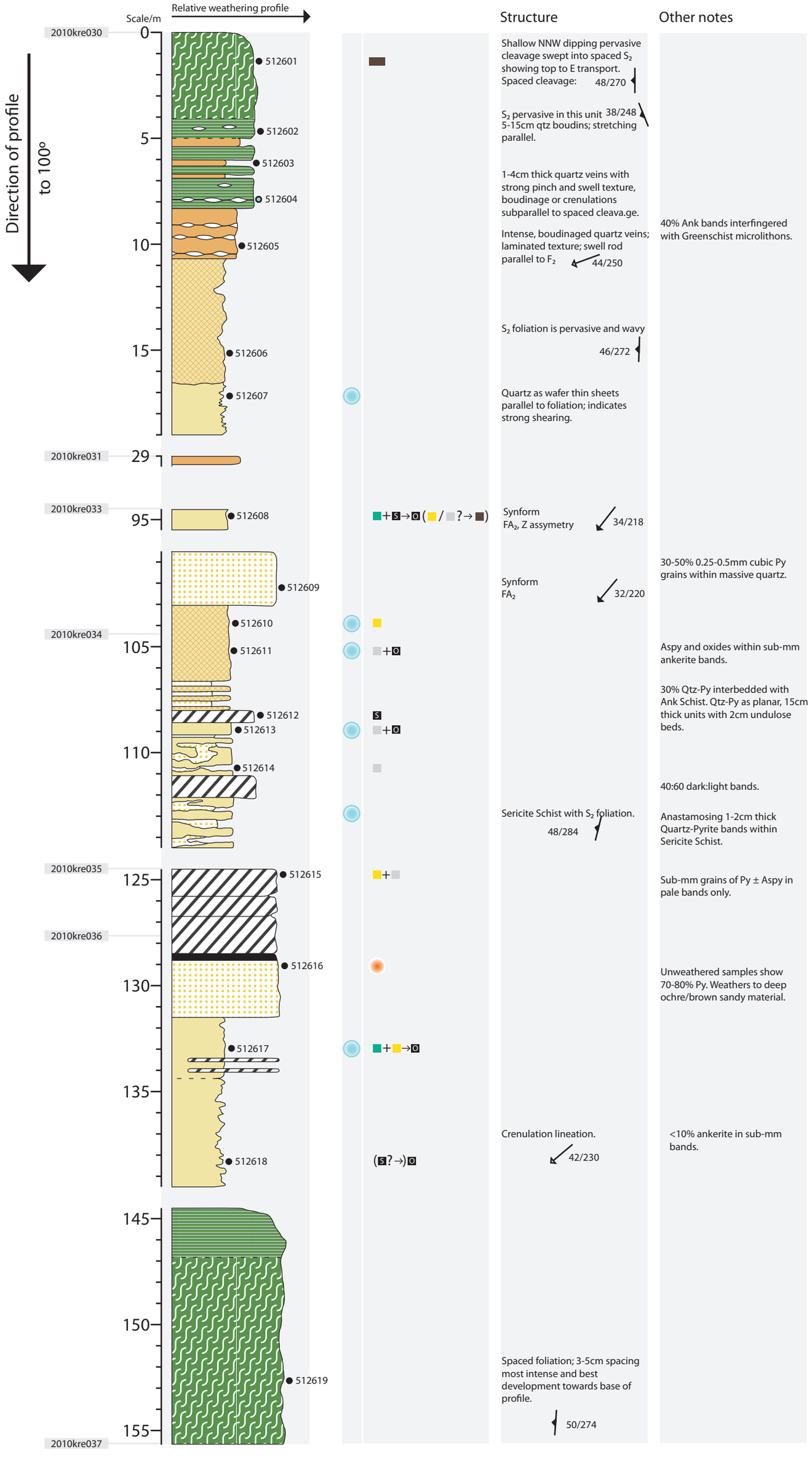
Higgins, A. K. & Bondesen, E. 1966. Supracrustals of pre-Ketilidian age (the Tartoq Group) and their relationships with Ketilidian supracrustals in the Ivigtut region, South-West Greenland. *Rapport Grønlands Geologiske Undersøgelse,* **8,** 21pp.

Steenfelt, A. 2000. Geochemical signatures of gold provinces in South Greenland. *Transactions of the Institute of Mining and Metallurgy (Section B: Applied Earth Science),* **109**.

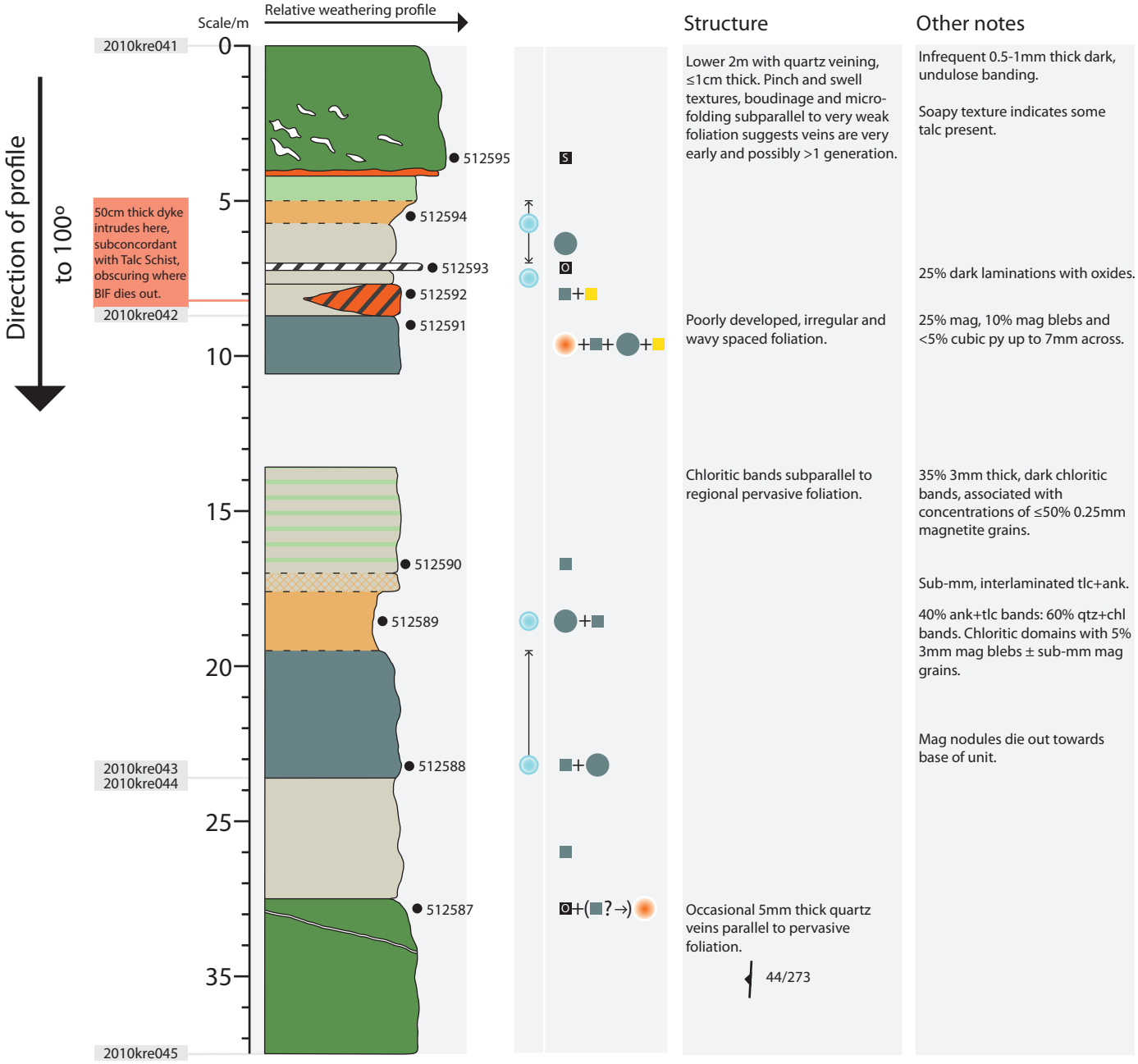
5 APPENDIX


Key
Rock sample
Quartz vein sample
Unit boundary (sharp)
Unit boundary (gradational)
Quartz boudins
Quartz veins
Quartz with pinch and swell texture
Lithological Units
Greenstone
Very fine-grained qtz>chl>ser±cal±fs±talc; massive, equigranular texture
Carbonate Greenstone
Greenstone with >10% calcite
Ankerite Greenstone
Greenstone with ≤20% ankerite
Greenschist
Very fine chl>qtz>ser±cal±fs±talc
Carbonate Greenschist
Greenschist with >10% calcite
Ankerite Greenschist
Greenschist with ≤20% ankerite
Knobbly Greenschist
Very fine chl>qtz>ser±cal±fs±talc with cm-scale sigmoidal gashes giving "knobbly" weathered texture
Banded Greenstone
Greenstone with 1-10mm wavy, tapering, dark banding, ± bt
Sericite Schist
White schist with qtz>ser>chl and ≤10% ankerite
Ankeritic Sericite Schist
Sericite Schist with 10-20% ankerite
Ankerite Schist
Pale orange schist with 20-40% ankerite in 1-3mm laminations + qtz>ser>chl
Talc Schist
Chalk-white, soapy schist; talc>ser ±ankerite
Ankeritic Talc Schist
Talc Schist with 10-20% ankerite
Banded Talc Schist
Talc Schist with 20-35% dark green, chloritic laminations, 1-3mm thick
Green Talc Schist
Pale green, soapy schist; talc>chl>ser±ankerite
Magnetite Talc Schist
Pale grey talc+chl schist with ≤25% very fine magnetite grains within the groundmass and10% 1-5mm rounded agglomerocrysts of magnetite.
Ferruginous Rust Zone
Massive quartz with gossanous crust and deep orange Fe-rich staining.
Quartz-Pyrite
Massive, milky white quartz with 30-50% 0.25-1mm cubic pyrite grains; homogeneous texture.
Zebra Quartz
Quartzite with 40-60% sub-mm, undulose, dark grey laminations subparallel to lithological contacts, occasionally tapering; pale layers often associated with very fine sulphides
Banded Iron Formation
Mineralization
O Oxides
S Sulphides
Pyrite
Arsenopyrite
Chalcopyrite
Magnetite
Fuchsite
Haematite
Biotite
Magnetite agglomerocrysts
Rust staining
Yellow sulphide staining
Red/brown copper staining
Green copper staining
Silicification
Arrows indicate direction of increasing intensity
? Uncertain identification
Mineral (left) replaced by mineral (right)
→ Observed
(→) Inferred
(?→) Speculative
Structure
28/086 Foliation (dip/dip direction)
32/220 Fold Axis (plunge/plunge direction)
42/230 Lineation (plunge/plunge direction)

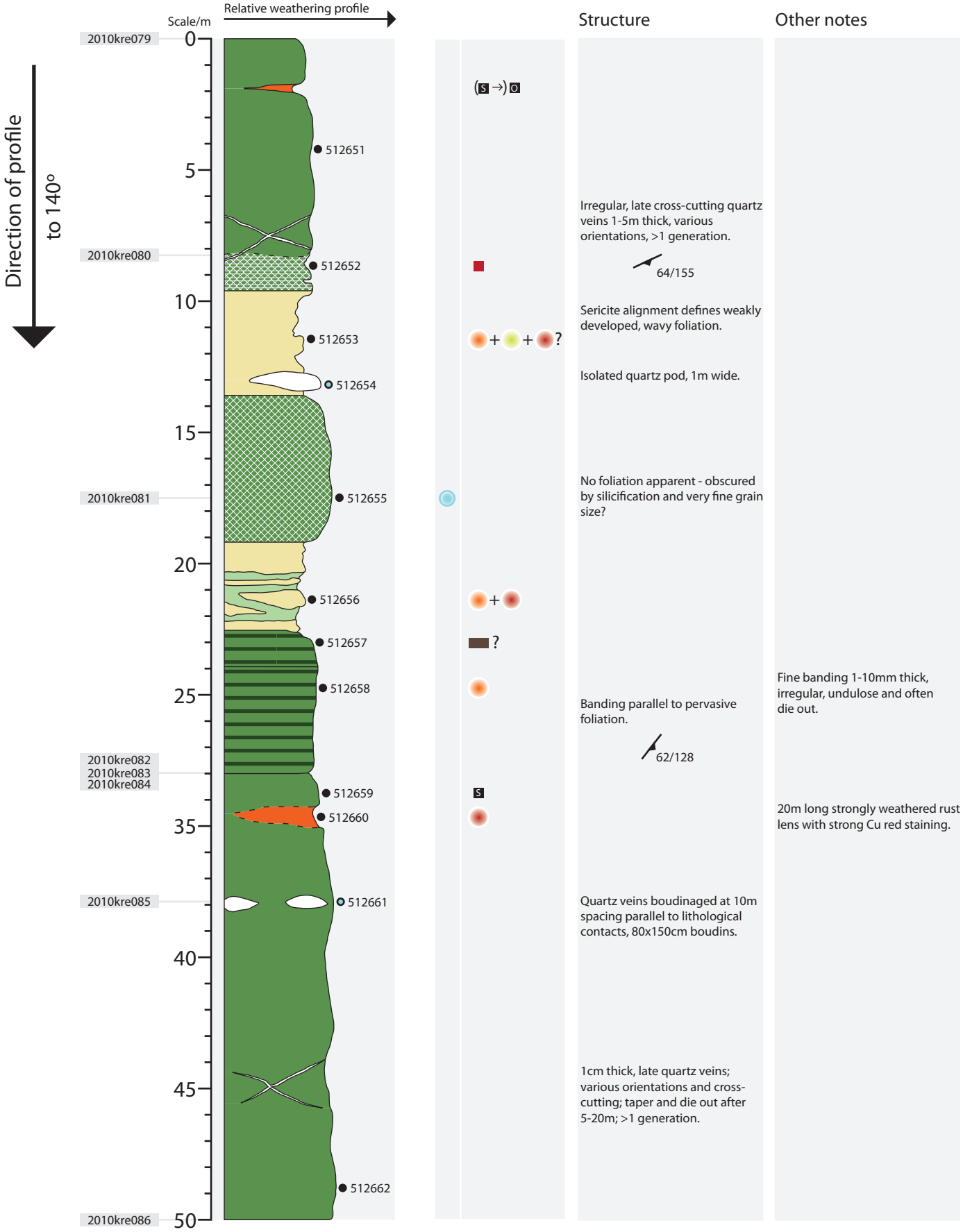
Profile through Western Valley Sulphide Showing alteration zone, Iterlak



Profile through Appel Showing alteration zone, Eastern Valley, Iterlak



Profile through Kidney Bean Lake alteration zone, Midternaes



Profile through alteration zone, Northern Midternaes