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The investigations in Kedonkangas, Evijärvi Western Finland

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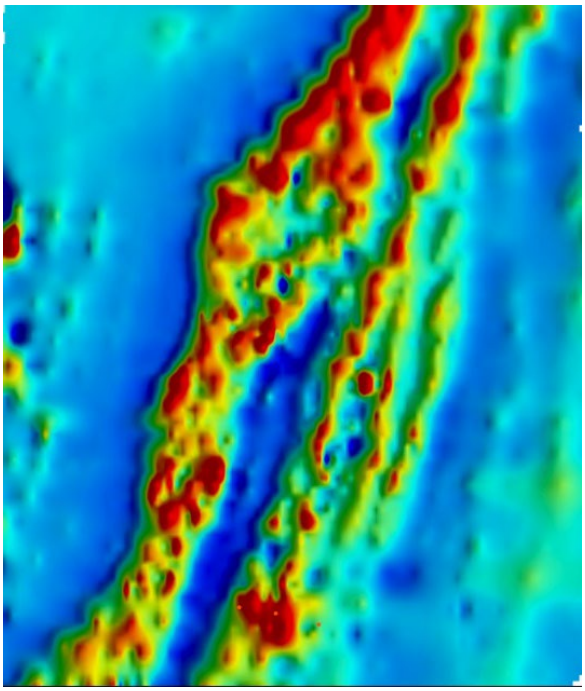

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GEOLOGICAL SURVEY OF FINLAND **DOCUMENTATION PAGE**

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Investigations in Kedonkangas, Evijärvi, Western Finland

Abstract
GTK investigated the metavolcanic sequence in Kedonkangas, Evijärvi to map the battery mineral potential. The aim of the investigation was to locate the source of previously found Co-Ni and scheelite rich boulders in the area. Three diamond drill holes tot. 460 m were drilled into a magnetic anomaly in proximal range from the glacial transportation range from a Ni – Co boulder. Assay results indicated in three sections in two drill holes of an elevated 100 ppm Co content, that may belong to a narrow steeply dipping Co zone. Additionally, scheelite was found in several sections with highest content of 1970 ppm W. Due to high silicification grade several sections were also analyzed for Au with 0.12 ppm Au in the best section.

Tiivistelmä

GTK teki Evijärven Kedonkankaalla akkumineraalitutkimuksia vuonna 2019. Päämääränä oli selvittää alueelta Ni-Co- sekä W-pitoisten kansannäytteiden alkuperä. Kolmella timanttikairareiällä kairattiin magneettiseen anomaliaan geologinen profiili, jonka keskeltä tavoitettiin kolmella lävistyksellä kahdessa kairareiässä kapea Co-pitoinen vyöhyke, jonka pitoisuus n. 100 ppm. Kairauksissa lävistettiin myös muutama scheeliitti-pitoinen vyöhyke, jossa W-pitoisuus parhaimmillaan 1970 ppm. Kivissä oli monin paikoin kvartsiutumista, jonka takia myös Au-analyysejä otettiin useasta kohdasta. Paras Au-pitoisuus analysoiduissa näytteissä oli 0,12 ppm.

Keywords
Battery mineral, Ni, Co, W, metavolcanic sequences, Evijärvi

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Contents

Documentation page

1 INTRODUCTION

Kedonkangas is located in the municipality of Evijärvi (Fig 1). Kedonkangas became one of the investigation targets along with Raisjoki (Kuusela & al. 2019, 2020), Kaitåsen (Nygård & al. 2021), Emas (Kuusela & al. 2022), Sammaloja (Hulkki 2022) and Dragbacken (Nygård & al. 2023) in the battery mineral project executed by GTK in 2019-2022 (Fig 2). Previous investigations in 1985 only covering geophysical ground measurements (magnetic, slingram) were performed when a scheelite rich diopside skarn boulder was found nearby the village of Ina (Västi 1988). The planned investigations in 1985 for till sampling to locate scheelite boulder was never executed due to other prioritisations. The ground geophysical data from 1985 combined with Co and scheelite rich boulders found in the area gave criteria to restart the investigations in 2019.

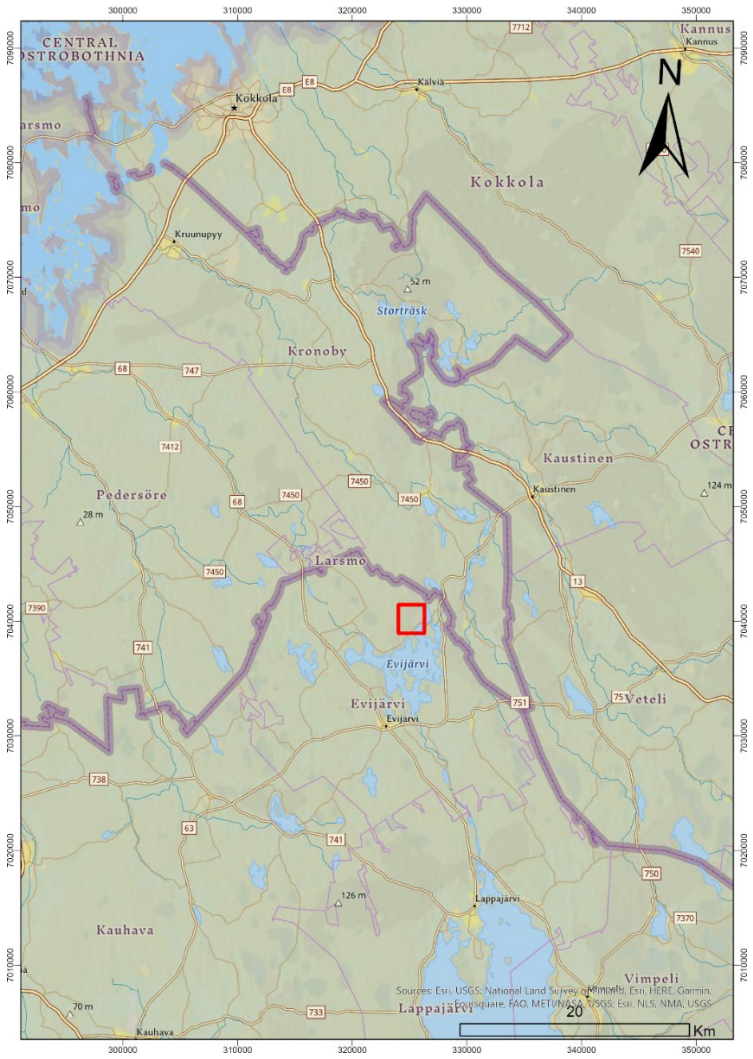

Fig. 1. Location of the Kedonkangas target in Evijärvi marked with red box.

2 REGIONAL GEOLOGY

Kedonkangas is a part of the Aho Belt in the Ostrobothnian schist belt (Fig 2). These rocks where originally deposited on the oceanic floor. The volcanic belt is thought to represent a mid-oceanridge basalt (MORB) or within-plate lava (WPL) environment (Vaarma & Pipping 1997). The bedrock was strongly deformed during the 1860 Ma orogenesis of the Svecofennian bedrock being thrusted into the Central Finland Granitoid Complex (CFGC). The rocks are composed of a wide array of metavolcanic rocks including basalts, volcanic tuff, black schists with surrounding rocks being mica schists and metagreywacke schists. The investigation area lies in the Aho belt which is a part of the outer rim of Vaasa migmatite complex and a border zone between the Lappfors and Pirttikoski metasedimentary suites. Towards the NE is the oval shaped Veteli granodiorite, and further to the NE, bordering the CFGC, are batholites of pegmatitic granites belonging to the Seinäjoki granitic pegmatites.

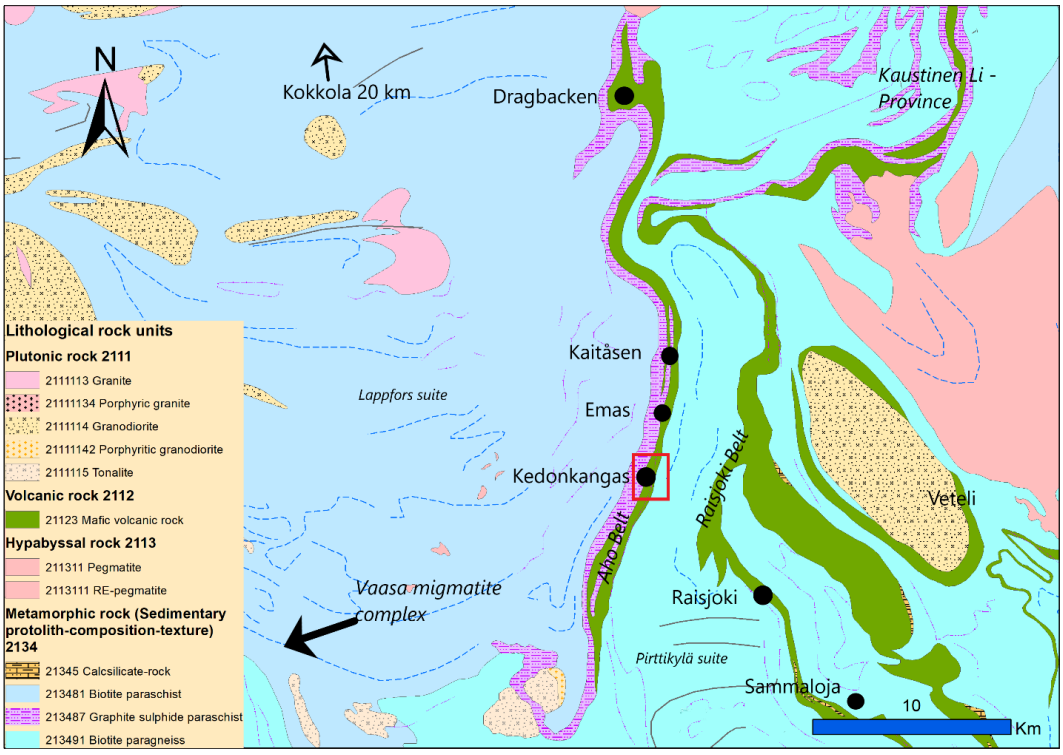

Fig. 2. Geology of Raisjoki investigation area with the investigation targets Dragbacken, Kaitåsen, Emas, Raisjoki, Kedonkangas and Sammaloja as black dots. The Kedonkangas area is highlighted by the red box (Bedrock of Finland scale-free © Geological Survey of Finland 2022).

3 GEOPHYSICS

Electromagnetic (slingram) and magnetic ground measurements were performed in the area in 1985 (Västi 1988). This previously acquired geophysical data was used in the new investigations started by GTK in 2019. Presented in (Fig. 3) as the NW anomaly and the SE anomaly, two round magnetic anomalies are visible in glacial transportation range to a Ni-Co rich (1800 ppm Co) layman sample (Fig. 3) as possible source areas for the boulder. Structural features, especially when observed inside geophysical anomalies are the most potential siting's for mineralization. The NW anomaly that appears to be "faulted apart" was unreachable for diamond drill sampling in the new 2019 investigations since the landowners did not give permission to do the sampling.

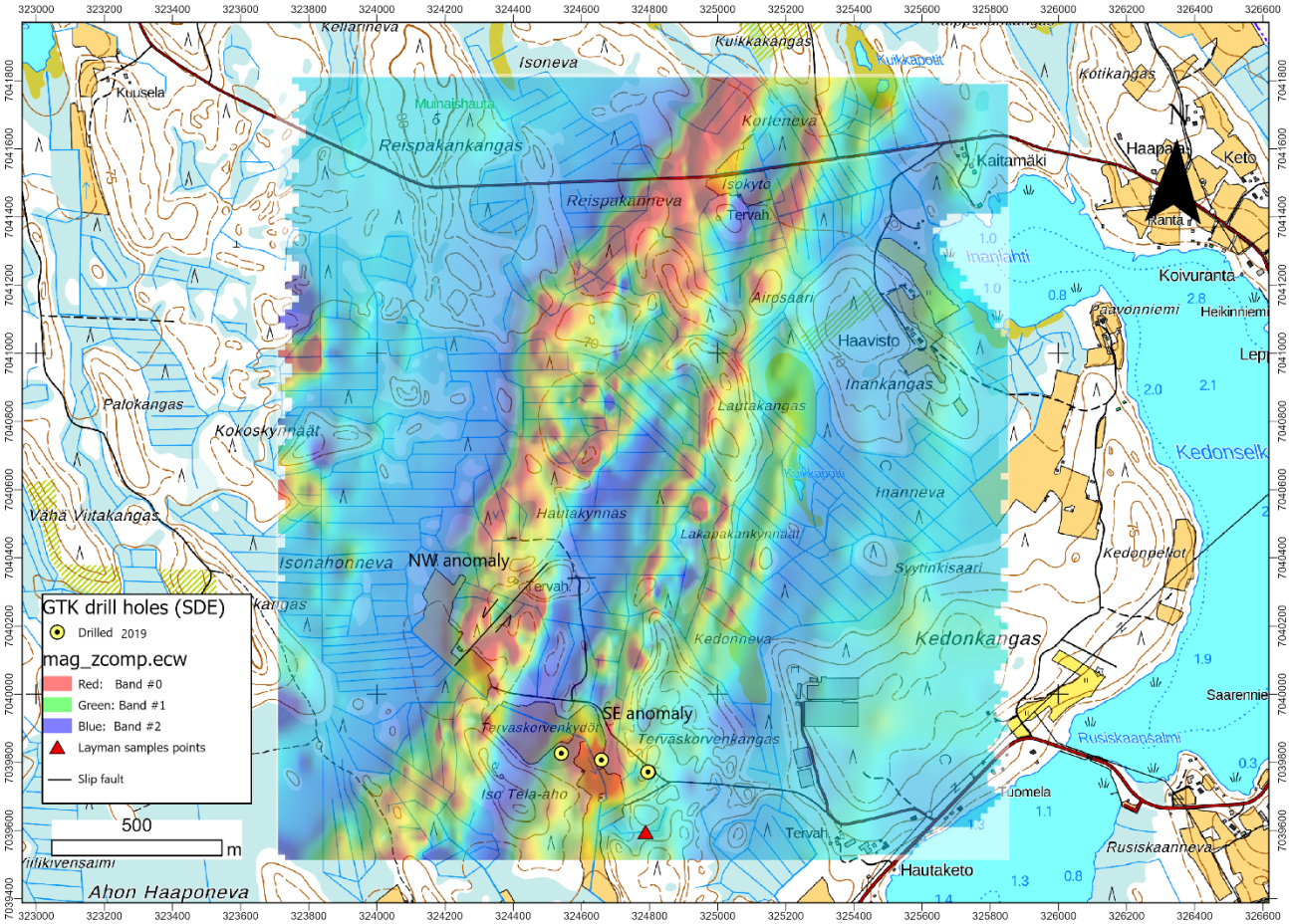

Fig. 3. *Ground magnetic map of the Kedonkangas investigation area with the locations of GTK 2019 drill holes and Ni-Co boulder in Kedonkangas.*

4 DIAMOND DRILLING

Four drill holes, of which three were successful, were drilled in the magnetic SE anomaly in 2019 (Table 1). Diamond drill hole P4222019R18 had to be aborted due to technical problems.

Table 1. Diamond drill holes drilled in 2019 in Kedonkangas with collar data.

HOLE_ID	N-TM35FIN	E-TM35FIN	Z-N2005N00	Length m	Azimuth	Dip
P4222019R16	7039806.763	324658.7256	66.2429	188.9	100.48	44.5026
P4222019R17	7039826.551	324541.1582	66.5161	173.6	103.92	46.7104
P4222019R18	7039771.586	324797.2044	68.6656	17	NA	NA
P4222019R19	7039771.84	324795.4776	68.7076	80.5	102.05	43.6891
				tot 460		

4.1 Assay methods

95 samples were analyzed from three drill holes in Eurofinns Labtium with method 306PM (ICP-OES, ICP-MS). Compared to Emas, Kaitåsen and Raisjoki targets the rock in all drill holes is in several places more silicified and was therefore also analyzed for Au. Additional Au analyses were taken from 42 samples method 705P and graphite analysis for 23 samples for total non-carbon analysis with method 811L.

4.2 Results

Analysis results are summarized in Table 2. The best analyzed section contained 0.12 ppm Au in drill hole P4222019R16 section 84 - 85 m. In drill hole P4222019R19 the highest scheelite content was 1970 ppm W in section 59 – 60 m, located close to heavily silicified rocks (Fig 4) and 111 - 163 ppm W for the section at 43 – 45 m. Anomalous Co (> 100 ppm) is present in drill hole R16 in two analyzed sections and in one section in R17 Fig. 5. It is possible the R16 and R17 intersection may relate to the same narrow steep dipping metasomatized horizons (Fig 5) alike the ones intersected in Emas (Kuusela et. al 2022) and Kaitåsen (Nygård et. al 2021). The morphology of the magnetic SE anomaly and the silicified nature of the rocks suggests the presence of N - S trending shear planes that could be mineralized (Fig.5). In contrast to Emas and Kaitåsen these three anomalous Co intersections in Kedonkangas do not correlate with Cr. The graphite content in the analyzed black schists stays generally below 4 %. Co and U content are displayed according to rock type for drill holes R16 and R19 in Figures 6 and 7.

Table 2. Significant sections in Kedonkangas.

Drill hole	From	To	section/m	Element	Content	Rocktype
P4222019R16	9.7	11	1.3	Co	104 ppm	Graphite schist
P4222019R16	14	16	2	Co	95 ppm	Graphite schist
P4222019R17	155	156	1	Co	93.7 ppm	Graphite schist
P4222019R16	84	85	1	Au	0.12 ppm	Graphite schist
P4222019R17	14	15	1	C	3.81%	Graphite schist
P4222019R19	59	60	1	W	1970 ppm	Silicified volcanic rock
P4222019R19	43	46	2	W	137 ppm	Silicified volcanic rock

Fig. 4. Kedonkangas drill hole R19 with silicified black schists and volcanic rocks. The section 59 – 60 m contains nearly 0.2 % W.

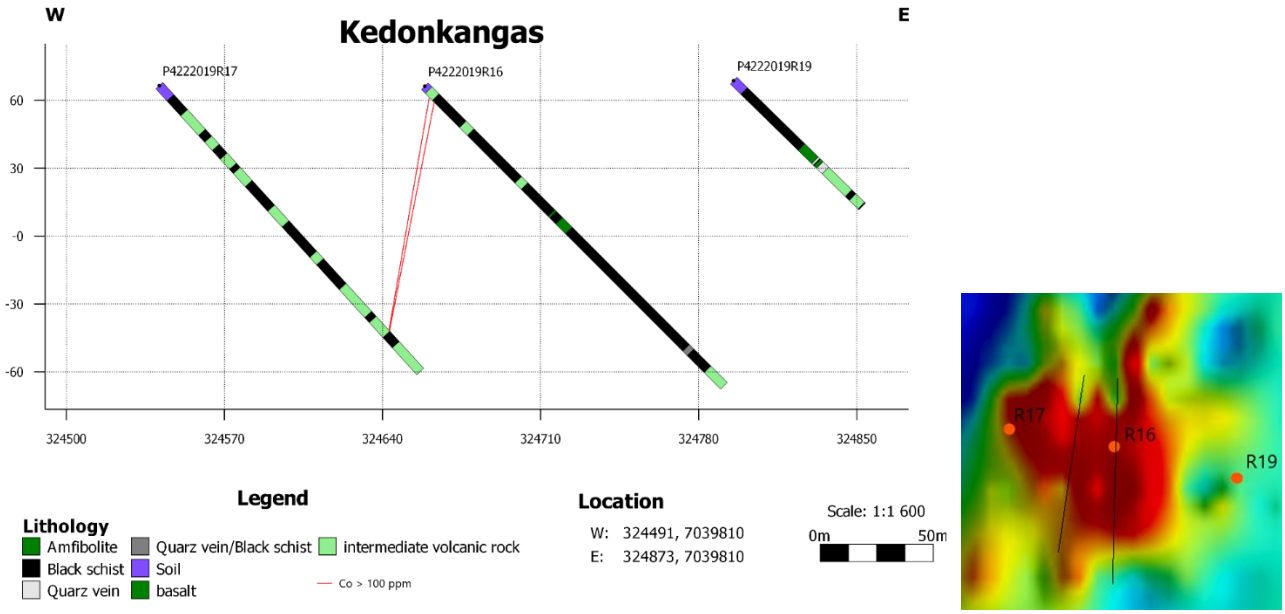

Fig. 5. A geological cross section of the Kedonkangas area with three diamond drill holes. It is possible the Co intersections in R16 and R17 represent the same narrow steep dipping metasomatized horizon. The morphology of the ground magnetic anomaly suggests N - S trending shear planes as possible conduits for the anomalous Co intersections in R16 and R17.

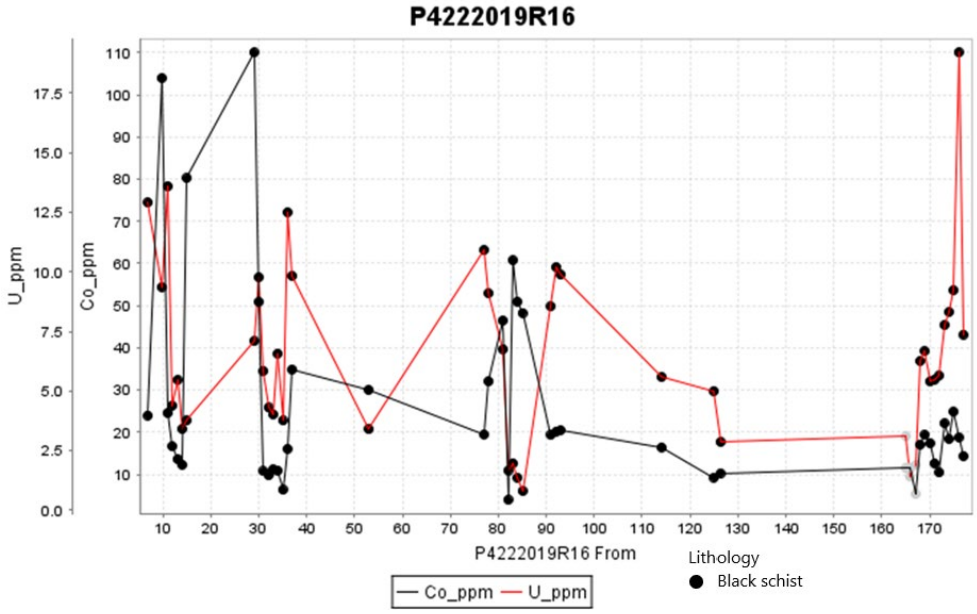

Fig. 6. Co and U content in analyzed sections in drill hole R16. Uranium content tend to be higher in black schists than other rock types. All mineralized sections are reported as black schists in R16.

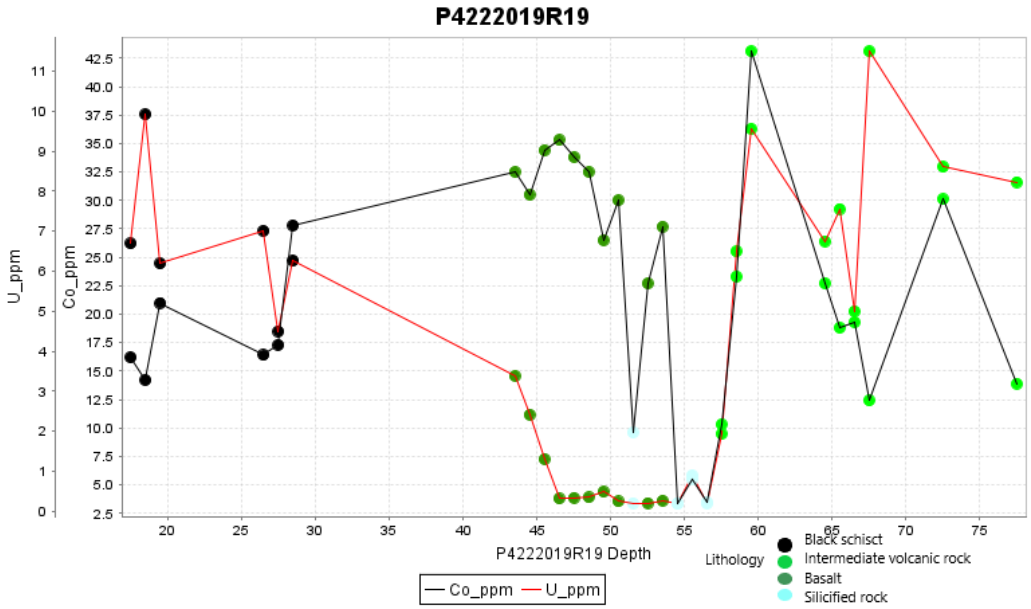

Fig. 7. Co and U content according to rock type. The sections with light blue dots are heavily silicified quartz rock.

5 STEREOGRAPHIC PROJECTION OF MAIN SCHISTOSITY

Oriented drill core measurements were taken from the core wherever possible after every drill run of 3 meters. The measurements show and average dip azimuth of 293 degrees with a dip angle of 62 degrees. In the thrusted volcanic belts, the bedding S0 in most cases follow the main S1 direction (Vaarma & Pipping 1997). The average strike direction of S1 is therefore 202 degrees.

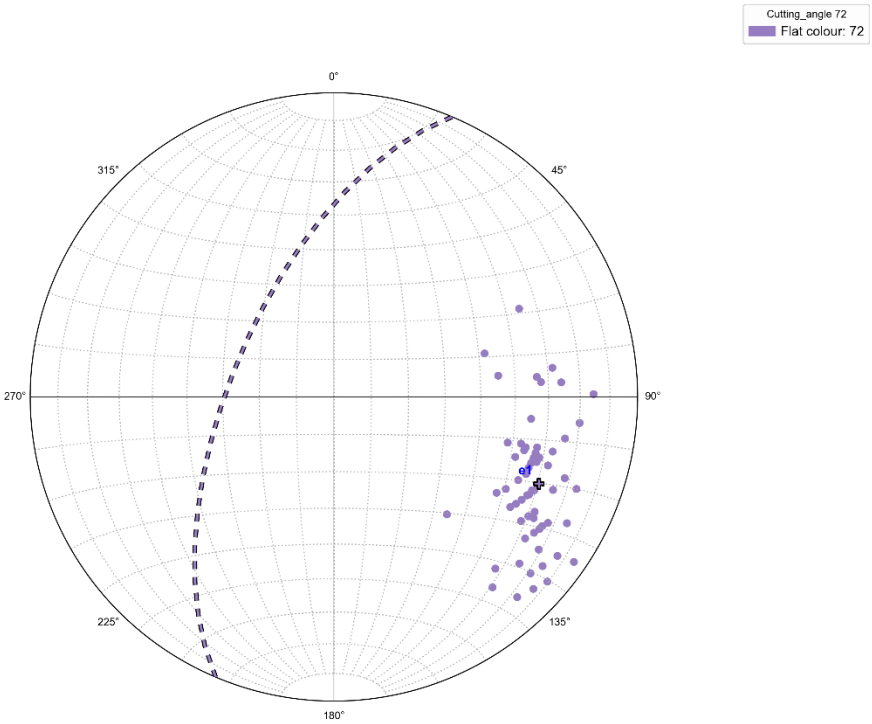

Fig. 8. Stereographic projection of main schistosity S1 in Kedonkangas.

6 DISCUSSION AND SUGGESTION FOR FURTHER WORK

According to the magnetic anomalies the metavolcanic sequences in Kedonkangas are divided in two metavolcanic horizons with associated black schists. The eastern horizon was investigated with three diamond drill holes. The rocks were in several places silicified especially in the rock contacts probably relating to the presence of small local mineralization of W and Au. Anomalous Co was analyzed in three sections that could possibly be combined to a narrow-mineralized horizon penetrated by drill holes R17 and R16. A preliminary suggestion for further work would be to investigate the NW anomaly and with surficial till sampling across the assumed slip faulted area and explore the continuation of the possible Co horizon towards north and south.

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