Koivuniemi (Vaajasalmi) — Flake Graphite

Technical Review — a drilled, met-tested coarse-flake graphite camp on an under-tested ∼8 km conductor system, Savo Schist Belt, Central Finland

Rautalampi–Suonenjoki, North Savo · reservation VA2026:0039 (2,156.55 ha, granted 2026-06-17, valid through 2027-05-31) · holder Geomorphic AI Finland Oy · prepared by Geomorphic AI, M. Sumner

Conceptual and preliminary. No Mineral Resource is defined on the property and no tonnage or grade target is stated for Koivuniemi; all endowment figures cited are third-party disclosures on other properties.

Location	Rautalampi–Suonenjoki, North Savo, Central Finland — ∼75 km NE of Jyväskylä, ∼50 km SW of Kuopio, ∼7 km N of Rautalampi
Tenure	Reservation VA2026:0039 (2,156.55 ha), granted 17 Jun 2026; 12-month term, valid through 31 May 2027
Holder	Geomorphic AI Finland Oy (100%)
Deposit model	Metamorphic-hosted coarse flake graphite; stacked horizons, 50–60° SW dip, upper-amphibolite to granulite facies
Drilled camp	Four sub-areas over ∼4.5 km — Koivuniemi, Käpysuo, Pukkiharju, Saareke; 44 holes / ∼7,081 m
Best intercepts	96.95 m @ 10.68% Cg · 37.55 m @ 7.47% · 33.55 m @ 10.86% · 23.55 m @ 10.6% · 19.25 m @ 19.3%
Flake & met	Coarse 500–1,000 µm plate population (flakes 50–1,000 µm); 90.7% C concentrate @ 81.9% recovery; 98.3–99.1% C after purification (GTK Mintec, C/MT/2021/1)
Conductor system	∼8 km of strong airborne-EM conductor on two axes (Geomorphic estimate from GTK imagery); under 2.5 km effectively drilled; ground EM on both
Scarcity	One of the few modern-drilled coarse-flake camps in Finland; EU natural-graphite mine supply effectively zero
Access / infrastructure	Public and forest roads through the area; 5–60 m glacial cover; GTK core, incl. re-logged Outokumpu PH core, at the Loppi national archive
Status	Held (12-month reservation); no Mineral Resource defined; drilled camp with multiple untested targets

Opportunity in brief

- **A drilled, met-tested camp — wholly owned, no competing title.** Forty-four holes across four contiguous sub-areas define stacked graphite horizons at 8–19% Cg over 13–97 m downhole — above every major international graphite development project (Matawinie 4.26%, Molo ∼6.1%, Mahenge 7.8%, Aitolampi 4.8%) — and GTK has already floated a 90.7% C concentrate at 81.9% recovery and purified it past 98% C. No third-party mineral title exists within 10 km (register snapshot 2026-07-20).
- **Coarse flake — the product the market is short of.** A coarse 500–1,000 µm plate population, 97.1–98.9 wt% in-flake carbon (SEM-EDS). Coarse +80-mesh flake prices at $1,132–1,150/t with jumbo spot to $2,400/t against ∼$350–470/t fines — and the two European deposits that out-grade Koivuniemi (Vittangi, Trælen) are both fine/microcrystalline and cannot serve this market.
- **Less than a third of the system is tested.** The camp sits on ∼8 km of strong airborne-EM conductor across two axes tied to assayed graphite by 20+ holes; the drilled segments cover under 2.5 km (Geomorphic estimates from GTK imagery). The best single target — the ∼3 km northern conductor — has been tested by one ∼5.6 m graphite-rich section in one drillhole, whose best 1.3 m sample assayed 15.3% Cg.
- **The scale question is open, not answered.** No tonnage estimate has ever been made: the historic operator never determined graphite grades, and GTK stopped short of a resource on drill density alone — while citing USGS criteria that place producing flake-graphite deposits at 8–12 wt% Cg and better, an envelope the camp's drilled grades sit comfortably inside.

- **A national-scarcity asset in an EU supply vacuum.** EU natural-graphite mine production is effectively zero against a CRMA benchmark of 10% domestic extraction by 2030, and Nordic anode plants are being financed with no committed Finnish natural feed.
- **The technical foundation is already paid for.** ∼7,081 m of drilling, ground EM on both axes, bench metallurgy and petrography were funded by the Finnish state and Outokumpu; a partner builds directly on assayed grade, tested metallurgy and a mapped conductor system.

Property, location & access

The property lies between Rautalampi and Suonenjoki in North Savo, interior Central Finland — a low-relief landscape of boreal forest, fields and peatland with 5–60 m of glacial cover (GTK 24/2024). Access is by public and forest roads through the property area; deep domestic drilling and assay capacity are commodity services, and the GTK drill core — including the re-logged Outokumpu PH core — is preserved at the national core archive at Loppi. The position is a single granted reservation under the Finnish Mining Act 621/2011 — VA2026:0039, 2,156.55 ha, granted 17 June 2026 for a 12-month term — conferring priority to apply for an exploration permit (malminetsintälupa). Natura 2000 overlap is nil and there are no cultural-heritage intersections. Graphite is an EU Critical and Strategic Raw Material.

The reservation encloses the drilled camp, and the subsequent exploration-permit geometry will consolidate the full 44-hole pattern, including the roadside Pukkiharju collars.

History. Outokumpu staked and drilled Pukkiharju–Käpysuo under claim in 1977–82 chasing base metals; it logged the thick graphite intervals but did not determine graphite grades, found the Zn–Cu target "very modest", and walked away. GTK returned in 2016–19 under its national battery-minerals program, re-assayed the Outokumpu core for graphitic carbon, drilled 27 new holes across Käpysuo, Koivuniemi and Saareke, ran modern ground EM over both axes, and bench-tested the metallurgy. A Kingsrose Exploration Oy reservation (Kerkonkoski Etelä, VA2023:0059) covered the broader camp in 2023–25 — one of four belt-scale reservations over the Kotalahti nickel belt under its BHP-backed Ni–Cu programme. The camp failed the nickel screen, as it had for Outokumpu forty years earlier, and the reservation lapsed without a permit application; its karenssi cleared in May 2026 and Geomorphic's reservation was granted on 17 June 2026. The pattern is the thesis: the camp has been repeatedly assessed for the wrong commodity — the one party that assayed it for graphite (GTK) produced the best results in its history. No third-party mineral title exists within 10 km in the 2026-07-20 register snapshot.

Geological setting & deposit model

The camp lies in the Palaeoproterozoic Savo schist belt at upper-amphibolite to granulite facies: felsic gneisses with intermediate–mafic metavolcanic horizons carrying thick graphite-rich layers. Graphite occurs in graphitic paragneiss and black schist as syngenetic carbonaceous metasediments recrystallised to coarse flake at peak conditions of ∼560–740 °C — the metamorphic grade that produces large, well-ordered flakes. Mineralised zones form en-echelon lenses along the main fold structures: at Käpysuo–Pukkiharju the graphite-bearing zones are 20–150 m wide, running E–W in the north and folding open to the NW in the south, with consistently graphite-bearing layers from tens of centimetres to tens of metres thick. At Koivuniemi three stacked graphite-rich layers dip 50–60° SW and correlate hole-to-hole across the drilled fence. A sinistral strike-slip fault has offset the Vaajasalmi block from Käpysuo; the airborne-EM response resumes on the offset block (Geomorphic reading of the GTK imagery).

Why it was missed. Graphite weathers recessively, so outcrop over mineralisation is absent — the reason a camp of this grade drew no graphite-directed industry follow-up after GTK's program, and the reason the exploration story is read almost entirely in electromagnetics, where graphite is an exceptional conductor.

The drilled camp

Two campaigns define four sub-areas over ∼4.5 km: GTK diamond drilling 2017–18 (27 holes) and Outokumpu 1977–82 (17 holes, graphite re-assayed by GTK), totalling 44 holes for ∼7,081 m. Orientations differ by sub-area: the GTK Koivuniemi holes were collared at 045°/–45° against the 50–60° SW dip, so downhole widths there approximate true widths (Geomorphic-derived); the Käpysuo GTK holes were drilled at 360°/180° at –45° across the E–W conductors, and the Outokumpu PH holes are variably oriented (e.g. 090°/–51°) — Käpysuo and Pukkiharju intercepts are therefore quoted as drilled, true widths unknown.

Koivuniemi (NE anchor)

Nine GTK holes (R16–R24, 763 m). Flake-graphite layers were intersected in every hole that reached bedrock. Three stacked horizons correlate across the R16–R17–R22 fence: R17 carries the best composite (23.55 m @ 10.6% Cg from 62.5 m), R16 the same layer up-dip (source-stated 11.0 m @ 10.88%; the printed 36.40–53.30 m section is the correlation envelope, not the composite endpoints) plus a 26.6% Cg single sample. The drill pattern was laid out before the ground geophysics existed; the surveys later showed a larger, more intact conductor immediately north (see below).

Käpysuo

Fourteen GTK holes (R1–R8, R25–R30; 2,117 m) into strong E–W conductors. Seven holes carry composites of 12.85–20.20 m at 8.06–19.3% Cg — including R27's 19.25 m @ 19.3% Cg, the highest-grade wide intercept in the camp. The graphite-bearing sample population (554 samples ≥∼5% Cg across 34 camp holes; GTK 13/2024) averages 12.0% Cg with 2.54% S; the raw campaign means are 7.5% Cg (GTK core) and 9.7% Cg (re-assayed Outokumpu core). GTK confirms the eastern along-strike continuation, and its ERT sections image deep-reaching conductors to the survey's ∼120 m depth of investigation.

Pukkiharju

Seventeen Outokumpu holes (RTL/PH-1–17; 3,701 m), thirteen in graphite — Pukkiharju is the Outokumpu-era claim name for the Käpysuo target, and the PH holes cluster on its SW side. The re-assayed core delivered the camp's thickest intercepts — PH-7's 96.95 m @ 10.68% Cg from 16 m downhole, PH-11's 33.55 m @ 10.86%, PH-9's 37.55 m @ 7.47% from 210 m — plus the camp-maximum single sample of 38.0% Cg (PH-7).

Saareke

Four GTK holes (500 m) into a satellite conductor SE of Koivuniemi; graphite ran below 5% Cg (best 6 m @ 3.6% in R33) with the response partly explained by hornblende-rich volcanics. Saareke calibrates the discrimination method — and its NE-corner anomaly remains undrilled.

Hole	Sub-area	Interval (m)	Width (m)	Grade (% Cg)
RTL/PH-7	Pukkiharju	16.00–112.95	96.95	10.68
RTL/PH-9	Pukkiharju	210.45–248.00	37.55	7.47
RTL/PH-11	Pukkiharju	90.75–124.30	33.55	10.86
R17	Koivuniemi	62.50–86.05	23.55	10.6
RTL/PH-6	Pukkiharju	60.30–81.20	20.90	11.80
R26	Käpysuo	106.00–126.20	20.20	12.1
R27	Käpysuo	108.30–127.55	19.25	19.3
R6	Käpysuo	73.85–93.20	19.35	8.1
RTL/PH-17	Pukkiharju	174.25–191.55	17.30	9.03
R29	Käpysuo	37.80–52.50	14.70	9.9
R30	Käpysuo	28.90–42.35	13.45	8.06
R3	Käpysuo	90.25–103.30	13.05	11.1
R2	Käpysuo	62.85–75.70	12.85	12.5
R16	Koivuniemi	36.40–53.30 (sect.)	11.00	10.88

Significant graphite intercepts, downhole widths (GTK OFR 60/2021; OFR 24/2024). Cg = graphitic (non-carbonate) carbon, assayed at accredited Eurofins Labtium Oy, Kuopio; single-sample maxima reach 26.6–38.0% Cg. Cu–Ni medians ∼0.01–0.02%, Zn medians 0.02–0.05% with isolated maxima to 0.91% — a clean graphite system. R16: the composite sits within the printed correlation section; exact endpoints unpublished.

The conductor system

GTK low-altitude airborne EM defines two principal strong-conductor axes striking roughly E–W, ∼1.8–1.9 km apart, within one coherent stacked-horizon package. Axis lengths and widths below are Geomorphic estimates measured from the GTK airborne imagery — no digitized conductor axis exists yet, and producing one from the raw data is the first technical task. The A1 axis (Käpysuo–Pukkiharju; Geomorphic working label) runs ∼5 km at 0.4–0.7 km width, with all 31 holes there clustered in the central ∼2 km. The A2 axis — the Koivuniemi northern conductor — runs ∼3 km immediately north of the Koivuniemi pattern: a larger, more intact anomaly than the drilled conductor, open east and west (GTK 60/2021), effectively untested down-dip, into which hole R18 penetrated a ∼5.6 m graphite-rich section at its edge; the best 1.3 m sample assayed 15.3% Cg (no composite grade published). Ground EM covers both axes: the 2017 Vaajasalmi slingram survey (100 m coils, 0.4–3.5 kHz) and the 2018–19 Käpysuo MaxMin/GEM-2

survey (0.8–28 kHz), plus magnetics, ERT and legacy Outokumpu slingram/gravity/magnetics. The exploration signature is diagnostic: graphite conductors here are non-magnetic — strong negative EM outside magnetic anomalies (GTK 60/2021) — and more than 20 drillholes tie the axes directly to assayed flake graphite, while the more magnetic, sulphide-interpreted responses (including the documented Pukkiharju Zn–Cu occurrence) are discriminated by magnetics and excluded from the graphite case.

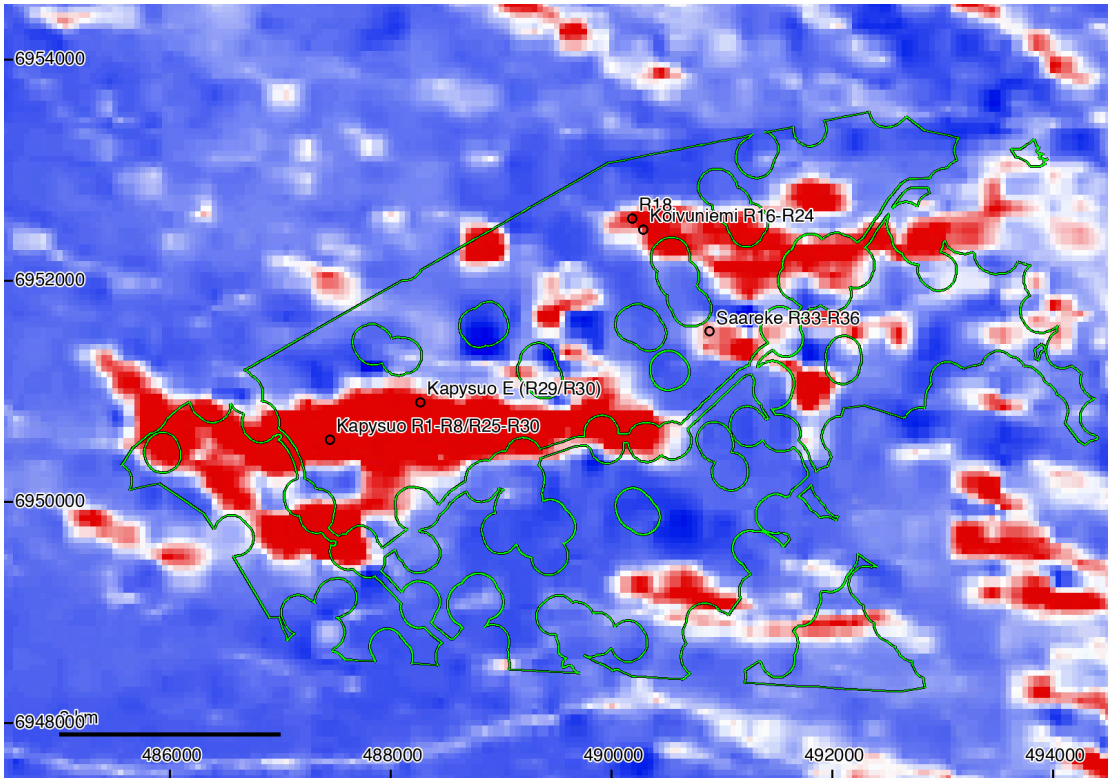

Figure 1 — Airborne EM in-phase response (red = strong conductor) over the camp (ETRS-TM35FIN), reservation outline (green), drill collars marked. A1 (left) hosts the 31 Käpysuo/Pukkiharju holes; A2 (upper right) is tested by one short section of one hole. Source: GTK airborne geophysics (CC BY 4.0); compiled Geomorphic AI, July 2026.

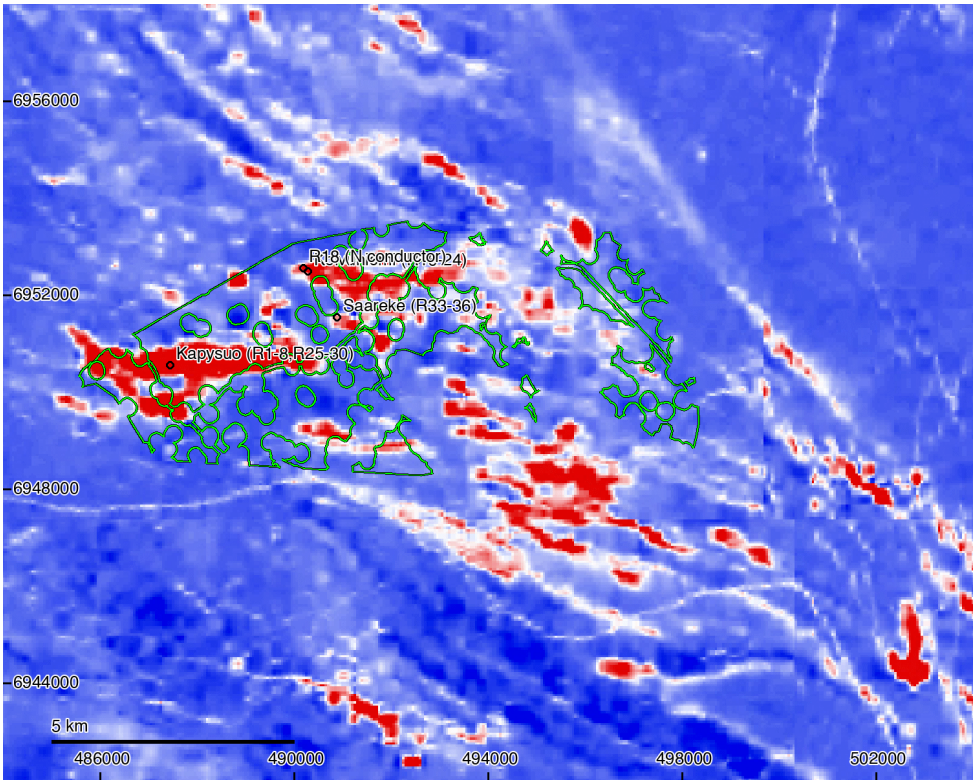

Figure 2 — Regional EM view. A2's strong response continues east of the reservation's NE lobe with pods trending ENE on open ground; the discrete magnetic conductor belt to the SSE is interpreted as sulphidic and excluded from the graphite case. Source: GTK airborne geophysics (CC BY 4.0); compiled Geomorphic AI, July 2026.

A repeatable target signature. Geomorphic's visual estimate from the GTK imagery puts ~6 km^2 of strong-conductor response in the camp window, over half of it inside the reservation — including essentially every drilled conductor — with the A2 eastern continuation and A1 western tip extending the same signature onto open ground beyond it. Digitized conductor polygons to firm these figures are a stated near-term task.

Metallurgy & flake quality

- **Flotation (GTK Mintec, C/MT/2021/1).** A 16 kg Koivuniemi core composite (calculated head 11.3% C, 3.4% S, 7.5% Fe; measured flotation feed 10.7% C) gave 98.9% rougher carbon recovery and a final four-stage cleaner concentrate of **90.7% C at 81.9% overall recovery** (SiO_2 3.9%, Fe 1.0%, S 0.3%) on a simple kerosene/MIBC flowsheet. Magnetic separation was not required for grade (GTK notes it may still be included industrially for management of Fe/S minerals).
- **Purification.** Alkaline roast + acid leach delivered **98.3–99.1% C** with residual S of 0.006–0.007% and Fe of 0.01%. The 99.1% result (K-PT2) was achieved on a separate 72.5% C concentrate feed; purifying the 90.7% flotation concentrate gave 98.3% C. Koivuniemi was the only sample of the three in the C/MT/2021/1 program to meet GTK's >99% C target (GTK 13/2024 later purified Raisjoki fines past 99% with a different flowsheet); companion Käpysuo work on the same camp reached 99.4% C in the <50 µm fraction.
- **Flake.** Koivuniemi flakes measure 50–1,000 µm with a coarse 500–1,000 µm plate population associated with recrystallised quartz clusters (GTK 60/2021); SEM-EDS in-flake carbon runs 97.1–98.9 wt% (semi-quantitative). At neighbouring Käpysuo, flakes reach 1.2 mm with ~70% at 100–500 µm, and GTK describes them as mostly perfectly crystallised (Raman; Al-Ani et al. 2020); the Vaajasalmi thin-section Raman study (Nurkkala 2022) rates crystallinity as moderate, with a stated thin-section-preparation caveat. The Koivuniemi concentrate floated at d80 = 90 µm from conservative fine grinds — 2–4× coarser than the comparison deposits at the same grind — and Käpysuo's +125 µm concentrate fraction ran 96.9% C (camp analogue; no Koivuniemi fraction assays exist yet).
- **Headroom (Geomorphic interpretation).** The bench grinds (d80 44–66 µm against a crushed feed d80 of 884 µm) under-utilise the native flake size; flake-preserving flowsheets (staged grind, flash flotation) are the standard route to lift recovery and grow the coarse-mesh share, where every recovered tonne roughly triples in price. Concentrate flake-size-by-mesh has not been measured and is the highest-value confirmatory test.

Blue sky — five growth vectors

Each vector is anchored to a specific observation in the drilling or geophysics — mapped upside, not conjecture. Together they define the growth case beyond the drilled camp.

- **Vector 1 — the northern conductor (A2): ~3 km, effectively virgin.** A larger, more intact conductor than the one that yielded the camp's best GTK intercepts, tested by one ~5.6 m graphite-rich section in one hole (best 1.3 m sample 15.3% Cg), open both ends along strike and untested down-dip — the single largest untested conductor in the camp.
- **Vector 2 — along-strike extensions of the drilled axis (A1).** ~5 km of conductor with drilling confined to the central ~2 km; the eastern continuation is a GTK-recommended drill target and the western tip crosses the reservation boundary with outboard pods beyond.
- **Vector 3 — depth.** The systematic MaxMin window reaches only ~30–50 m; ERT images deep-reaching conductors to its ~120 m depth of investigation, and the deepest reported mineralised intercept (37.55 m @ 7.47% from 210 m downhole, PH-9) shows the system persists well below the drilled shell.
- **Vector 4 — the district.** GTK 24/2024 recommends drilling to confirm continuation of the graphite layers into the eastern part of its study area, indicated by the airborne EM anomaly; Geomorphic's reading of the regional imagery adds ~0.9 km of strong conductor plus ENE-trending pods east of the reservation's NE lobe, on open ground.
- **Vector 5 — the product.** Bench recovery of 81.9% came from grinds far finer than the native flake; a flake-preserving flowsheet converts the same grade into the jumbo/large mesh classes carrying the 40–80% price premium (Geomorphic interpretation of the C/MT/2021/1 grind data).

Peer context & market

Project (owner, country)	Resource	Graphite	Flake class	Status 2026
Balama (Syrah, MZ)	1,036 Mt @ 11.6%	120 Mt	Fines-dominant	Producing; restarted Jun 2025
Mahenge (Black Rock/POSCO, TZ)	213 Mt @ 7.8%	16.6 Mt	66% >180 µm	FID pending; ∼2028
Molo (NextSource, MG)	141 Mt @ ∼6.1%	∼8.6 Mt	46% large+jumbo	Producing Ph.1 (∼11 ktpa)
Vittangi (Talga, SE)	35 Mt @ 23.8%	8.3 Mt	Microcrystalline	Permitted; CRMA SP; mine ∼2029
Matawinie (NMG, CA)	120 Mt @ 4.26% M+I	∼5.1 Mt	Mixed	Under construction (May 2026)
Bissett Creek (Northern, CA)	70 Mt @ 1.74%	1.2 Mt	∼95% +80 mesh	FS; financing
Lac Knife (Focus, CA)	12 Mt @ 15.3%	1.7 Mt	Coarse-capable	FS 2023; unfinanced
Aitolampi (Grafintec, FI)	26.7 Mt @ 4.8%	1.3 Mt	Fine–medium	Pre-permit studies
Skaland/Trælen (Norge, NO)	1.84 Mt @ 23.6%	0.43 Mt	Flake	Europe's only producing mine (∼10.5 ktpa)
Woxna (Leading Edge, SE)	2.6 Mt @ 9.1%	∼0.27 Mt	>50% large	Built, on C&M
Koivuniemi (Geomorphic, FI)	No MRE defined	—	Coarse 500–1,000 µm class	Reservation; multiple untested targets

Company disclosures and technical reports as at 17 July 2026, not independently verified by Geomorphic. Contained graphite across stated categories; conventions differ between projects.

- **Pricing.** +80 mesh (>180 µm) 94% C flake: $1,132–1,150/t FOB China; jumbo/large spot $1,200–2,400/t; fines ∼$350–470/t. The coarse premium widened through the fines glut because coarse supply is structurally short. (Fastmarkets/SMM, as at 17 July 2026.)
- **Policy.** Chinese export licensing on natural flake (Dec 2023) and dual-use controls on anode materials (Nov 2025); ∼220% effective US duties on Chinese anode material (Feb 2026) with the FEOC graphite exemption expiring end-2026; the EU CRMA requires 10% domestic extraction by 2030 against effectively zero current EU mine output. Vittangi's CRMA Strategic Project designation is the template for Koivuniemi's next status gate.
- **Regional demand.** Vianode (Herøya), Talga Luleå (FID 2026–27) and the GigaVaasa anode cluster are advancing with no committed Finnish natural-graphite feed. A coarse-flake camp ∼300 km from Vaasa with demonstrated 98–99% C purification is the natural upstream fit — premium coarse flake as primary product, fines as anode-precursor by-product.

Sources

GTK Open File Research Reports 60/2021, 24/2024 (incl. beneficiation reports C/MT/2018/12, C/MT/2019/19, C/MT/2019/22), 24/2018, 13/2024, 72/2023 and 89/2023; GTK C/MT/2021/1 (Salvador, 2021); Outokumpu claim reports 2924/1 (1984) and OKU 826 (1981); Nurkkala, A. (2022), MSc thesis, University of Turku; Al-Ani et al. (2020), Minerals 10:680; GTK airborne and ground geophysical data services (CC BY 4.0); assays by Eurofins Labtium Oy (Kuopio, accredited); Tukes varauspäätös VA2026:0039 (17 June 2026); GeoPool Oy tenement advice (24 May 2026); peer and market data from company disclosures, Fastmarkets, SMM, CSIS, US ITC/Commerce and EU CRMA documentation as at 17 July 2026, not independently verified.