# Critical minerals in Greenland and their geological potential to supply European Union markets

**Radomir Pachytel**[1]

*A b s t r a c t. The European Union needs a steady supply of raw materials critical to the development of its economy and security. To monitor and boost critical raw materials (CRMs) resilience, the EU has published a list of CRMs and the Critical Raw Materials Act. However, the EU's demand for most CRMs is growing steadily, while the national exploration programs being launched do not guarantee future coverage of internal supplies. In the face of global geopolitical instability, options are being sought to diversify the supply of each CRM. Greenland has many known mineral deposits and occurrences and good potential for the discovery of new resources. It is geographically close to the EU, as one of the thirteen Overseas Countries and Territories (OCTs) associated with the Union and linked with the Danish Realm. The geological makeup of the island could allow the implementation of world-class mining projects that could support the European economy. The EU expresses an urgent need for raw materials such as molybdenum, rare earth elements, platinum group metals, niobium, tantalum, titanium, vanadium, zirconium and graphite, and Greenland has the potential to supply the whole or part of the EU's needs. This article focuses only on the geological potential to supply EU markets, leaving aside issues related to legislation, economics and geopolitics, which may be more critical to future Greenland mining activities.*

**Keywords:** *Greenland, Critical Raw Materials, EU raw materials supply chains*

Greenland, an island covering >2.166 million square kilometres, located between the Arctic and Atlantic oceans, has become the scene of international competition for deposits of critical raw materials (CRM). Twenty five out of 34 raw materials (Rosa *et al*., 2023) considered critical by the European Commission (European Commission, 2024) may be found on the island. The Greenlandic government has been continuously cooperating with the European Union, trying to find the right balance between the protection of the environment, the safety of the local population and the potential extraction of raw materials. The first Letter of Intent between the EU and Greenland on cooperation in the area of mineral resources was signed in 2012 (European Commission, 2012). To strengthen the partnership, a new Memorandum of Understanding to develop sustainable raw materials value chains was established in 2023 (European Commission, 2023). Interest in Greenland's mineral commodities has grown annually, but a storm over the island's resource potential was unleashed by US President Donald Trump in January 2025. The newly appointed president stated that the US would gain control of Greenland (BBC, 2025). Greenland has been an integral part of Denmark since 1953 and has remained an autonomous territory of Denmark since 1979, when Greenland achieved Home Rule and considerable autonomy from Denmark. In 1984, largely to preserve its autonomy from EU regulations of its fisheries, Greenland elected to leave the EU, but remaining an EU OCT, securing an ongoing close relationship. In 2009, Greenland achieved Self Rule, a further step toward full autonomy and future independence, which is widely supported by Greenlanders. The desire to explore Greenland's mineral wealth, in the form of CRM deposits, is reported as the main reason for the US President's decision. Greenland's mineral resources have been explored and recognized mainly by a research institute under the Danish Ministry of Climate and Energy, the Geological Survey of Denmark and Greenland (GEUS), as well as by many mineral exploration companies. Based on GEUS reports, years of geological research, and analysis by companies interested in exploring the island, a great deal of information about the resource potential of the ice-free part of the island has been obtained, information that allows an analysis of the potential of Greenland to supply the European Union with CRM.

## GEOLOGY

The Greenland Ice Sheet covers nearly 79% of the island (MacGregor *et al*., 2024), the remaining 21% being the exposed bedrock (Fig. 1). As there are no forests on the island, rock exposures are easily accessible for analysis. The ice-free zone reveals rocks ranging from the Archean, dated at 3.9 billion years (Ga) (Moorbath *et al*., 1972; Nutman *et al*., 1993, 1996; Nutman, Friend, 2009; Wittig *et al*., 2010), to Quaternary sediments. The oldest are the remnants of Archean terranes merged into the North Atlantic Craton (2.7–2.5 Ga) (Friend *et al*., 1996; Nutman, Friend, 2007; Gardiner *et al*., 2020), extending from Canadian Labrador through southern Greenland to northwestern Scotland (Wittig *et al*., 2010). The unit is bounded by the Nagssugtoqidian Orogen (1.91–1.77 Ga) (Mayborn, Lesher, 2006) to the north and the Ketilidan Orogen (1.85–1.72 Ga) (Garde *et al*., 2002) to the south. The Ketilidan Orogen occupies South Greenland (Ghisler, 1990), bordered by the Labrador Sea and the Atlantic Ocean. To the north of the Nagssugtoqidian Orogen, a large part of the island is underlined by the tectonically complex Rae Craton (2.7–1.7 Ga) (Berman *et al*., 2000; Skulski *et al*., 2003; Pehrsson *et al*., 2013; Peterson *et al*., 2015; Liu *et al*., 2016). In western Greenland, from near Nuugaatsiaq to Nuussuaq, outcrops of supracrustal rocks from the Rinkian Orogen (1.9–1.85) (Guarnieri *et al*., 2024) can be found. Located in the central-western part of the country, a belt of islands from Upernivik to Disko is made up of younger strata of the Nuussuaq Basin (113–60 Ma), the only exposed Cretaceous–Paleocene sedimentary basin in West Greenland and one of a complex of linked rift basins (Dam *et al*., 2009). The remaining Precambrian basement is represented in north-west-

[1] Polish Geological Institute – National Research Institute, Rakowiecka 4, 00-975, Warsaw, Poland; e-mail: rpac@pgi.gov.pl;
ORCID ID: 0000-0001-9407-7233

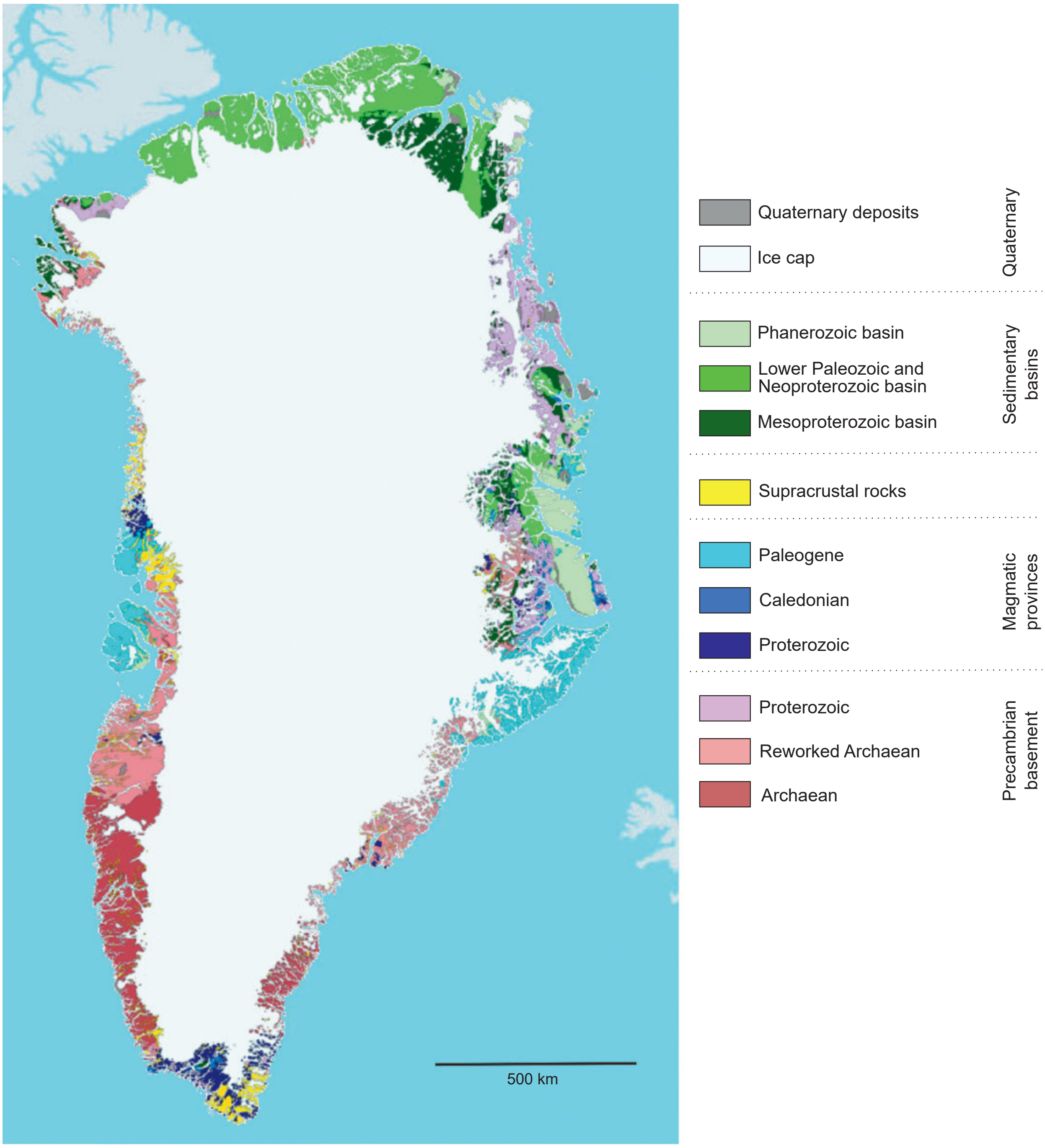


**Fig. 1.** Simplified geological map of Greenland, based on the Greenland Mineral Resources Portal (source: greenmin.gl; based on Henriksen *et al*., 2008)

ern Greenland by the Paleoproterozoic metal-rich Inglefield Mobile Belt (1.92–1.79 Ga), and in the north by the small Victoria Fjord Terrane, dominated by weakly foliated granodioritic orthogneisses, with lesser amounts of migmatite (<2.71 Ga) (Nutman *et al*., 2019). On the small islands to the west of the Inglefield Mobile Belt, near the Canadian Ellesmere Island, little-deformed and unmetamorphosed strata belonging to the Thule Basin (1.27–0.65 Ga) (Dawes, 1997) have been found. In the northern part of the island, the Franklinian Basin (640–380 Ma) (Surlyk, 1991) is exposed, bordering the Arctic Ocean and accumulating up to 8 km of strata (Henriksen, Higgins, 1998). Adjacent to these are the Middle Proterozoic Independence Fjord Basin rocks (1.38 Ga) (Henriksen, Higgins, 1998) and smaller areas of the Wandel Sea Basin (315–270 Ma) (Hàkansson, Stemmerik, 1989). East Greenland consists of N-S aligned rock formations classified within the tectonically formed Caledonian Orogen (490–390 Ma) (Surlyk, 1991), comprising strata >15 km thick and metasedimentary rocks of the Eleonore Bay Supergroup (950–850 Ma) (Caby, Bertrand-Sarfati, 1988) and the hydrocarbon-rich East Greenland Rift Basin (360–260 Ma) (Surlyk, 1991), bordered to the south by volcanic and intrusive rocks of the North Atlantic Igneous Province (62–54 Ma) (Jolley, Bell, 2022). In South-East Greenland, surveys have identified the presence of the Skjuldungen Complex, an alkaline province showing a major positive aeromagnetic anomaly (Nielsen, Rosing, 1990).

The area covered by the ice cap has not been significantly penetrated by exploratory drilling, and conclusions about the lithology hidden beneath the melting ice sheet are drawn mainly from geophysical analyses. A map of Greenland's subglacial geology was compiled by Dawes (2009) and, based on several new geophysical surveys, updated by MacGregor *et al*. (2024). With several new studies, additional analyses and modelling, the melting ice cap revealing more of the bedrock and exploration projects moving forward, the coming years will certainly bring a more accurate understanding of Greenland's geology.

## RESOURCES

Greenland has enormous raw material potential. According to the Geological Survey of Denmark and Greenland (Rosa *et al*., 2023), the island is home to 25 of the 34 CRMs listed on the EU's CRM list (Fig. 2). To date, 55 CRM deposits have been described, of which only one is being produced at the only CRM-related mine currently in operation [Feldspar (anorthosite) at Qaqortorsuaq/White Mountain] (Fig. 3). Among the raw materials with high estimated potential, the GEUS defines (1) graphite, (2) heavy rare earth elements (REE), (3) light REE, (4) molybdenum, (5) niobium, (6) tantalum, (7) platinum group metals (PGM), (8) strontium, (9) titanium, (10) hafnium and (11) zirconium. Greenland's currently identified potential for each of these critical raw materials is described separately below.

(1) Antimony, (2) baryte, (3) beryllium, (4) chromium, (5) cobalt, (6) copper, (7) feldspar, (8) fluorspar, (9) lithium, (10) nickel, (11) phosphate rock, (12) phosphorus, (13) silicon metal, (14) tin, (15) tungsten and (16) vanadium were distinguished as having medium estimated potential. Antimony, beryllium, lithium, phosphorus, and vanadium were analysed below, as EU countries provide <10% of annual internal supplies of these CRMs, which is lower than required by the Critical Raw Materials Act (European Commission, 2024). According to EU data (European Commission, 2025), baryte is mined in Bulgaria, which provides 11% of the EU's demand. Finland acts as a top EU producer of primary (91% of demand) and refined (34%) chromium, supported by Swedish refined products (9%). In the case of chromium, which is not currently on the EU list of critical raw materials, the projected accession to the Alliance by Albania, which has significant chromium resources on a European scale, may be of significant importance. Cobalt meeting EU demand is mined in Finland, the only EU primary cobalt producer. Refined cobalt is provided also by Belgium. 19% of the EU's annual copper demand is mined in Poland, which along with Germany and Spain ensures


**Fig. 2.** Greenland strategic and critical raw material resource potential according to the Geological Survey of Denmark and Greenland (Rosa *et al*., 2023)

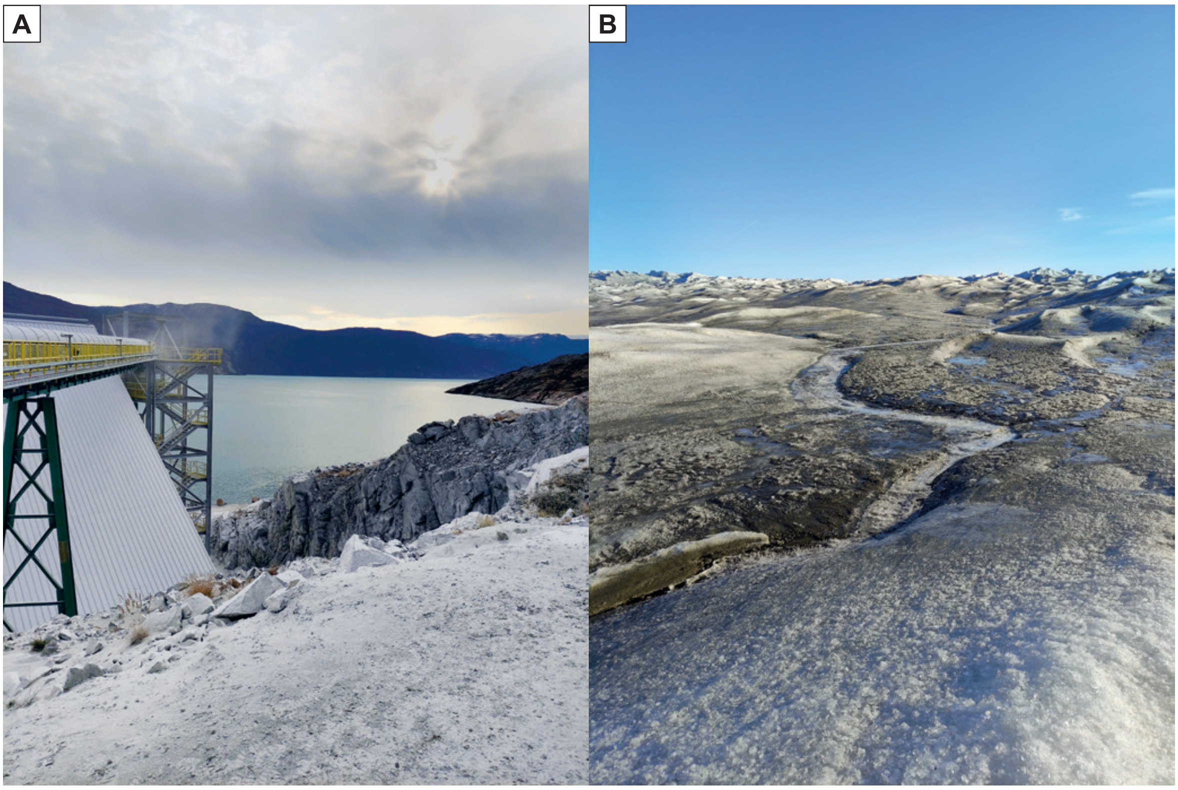


**Fig. 3. A** – Lumina's Qaqortorsuaq anorthosite mine; **B** – Greenland's ice cap seen from Point 660, NE of Kangerlussuaq

sufficient refined metal for market needs. Feldspar is supplied by Italy (22%), Spain (7%), and the EU's neighbour Turkey (51%). EU primary producers of fluorspar are Spain (71.7%) and Germany (28.3%), with Spain possessing more than 5% of global reserves. Finland is responsible for the EU sourcing of primary nickel (38%) and phosphate rock (17%). France (29%) leads EU production of silicon metal, supported by Germany (8%), and Spain (1.5%). The major supplier of silicon metal, Norway (34%), works closely with the EU. Spain and Portugal are the only producers of primary tin, but EU demand is met by large-scale processing operations, mostly in Belgium (10 kt) and Poland (4.6 kt). Although tungsten primary production in Austria, Spain and Portugal makes up about 2 kt of tungsten concentrates, the refining processes led by Austria supply the EU with 13.7 kt of W, about 30% of the Union's demand.

## Graphite

Graphite is a key raw material for the energy transition, which must be almost fully imported by the European Union. World graphite production in 2023 reached 1.6 Mt (U.S. Geological Survey, 2024), with the largest EU producer, Germany, mining just 160 tonnes (<0.01% of world production). Among the top-producing countries with the largest deposits are China (reserves – 78 Mt), Brazil (74 Mt), Mozambique (25 Mt), Madagascar (24 Mt), Tanzania (18 Mt) and Russia (14 Mt).

Previous geological analyses and assumptions have identified 9 significant graphite deposits and occurrences, with 6 Mt of known resources (Rosa *et al*., 2023; Fig. 4). The most well-characterized deposit is the Amitsoq deposit, located in South Greenland (Nanortalik region). When previously in operation in 1915–1924, the mine produced 6,000 t of graphite ore averaging >20% graphite carbon (Cg) content. GreenRoc Strategic Materials are currently re-developing the Amitsoq graphite project. It includes two deposits within the Paleoproterozoic Ketilidian Orogen, with an in-place graphite content of >20% Cg (compared to a global average of 8.45% Cg). The project is planned as an underground mine, with construction starting in 2026 and graphite production starting in 2028, with 4.71 Mt of ore to be extracted. The genesis of the ore is related to the formation of massive volcanogenic sulphides (VMS) as a result of syngenetic deposition of organic material from bacteria that developed in hot sulphide exhalations (Rosa *et al*., 2023). Subsequent processes of deformation and metamorphism have enabled the organic material to be transformed into flaky graphite (Rosa *et al.,* 2023), which will be processed at the planned GreenRoc plant. The other two graphite deposits recognized in Greenland are Eqalussiut/Akuliaruseq (West Greenland) and Kangikajik (East Greenland). In Eqalussiut, Graphite Field Resources estimated a graphite resource of 12.6 Mt grading 6.3 wt.% Cg (Thrane, Kalvig, 2018), while the potential graphite resource in Kangikajik is assessed as 500 kt of Cg (Rosa *et al*., 2023). In addition, graphite occurrences have been reported in at least six other locations – Aappaluttoq (South-East Greenland), Niaqornat/Qaarsut (central West Greenland), Langø/Qanaq (North-West Greenland), Utoqqaat/Maligiaq (southern West Greenland), Graenseland (South-West Greenland) and Sissarissoq (South Greenland).

The world could face a major graphite shortage by the end of the decade, mainly due to its use in EV battery production, so graphite-related projects could be an important component of Greenland's mining sector. The Amitsoq project received positive validation in a preliminary economic assessment by SLR Consulting. The study emphasized a four-year payback period, a 22-year mine life, a CAPEX of US$131m and a potential to produce 77,000 tonnes of concentrate with 94% feedstock (GreenRoc Strategic Materials, 2024).

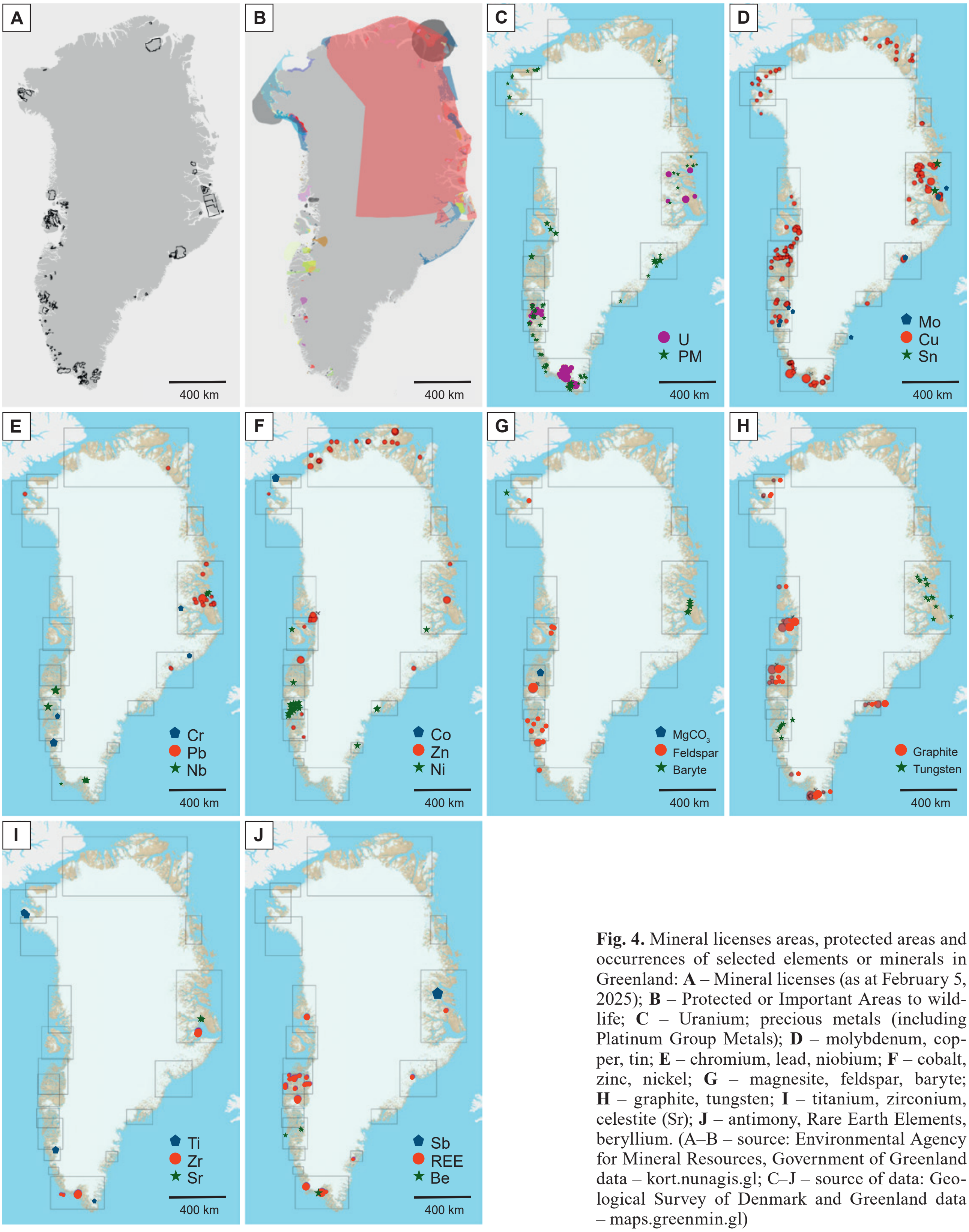


**Fig. 4.** Mineral licenses areas, protected areas and occurrences of selected elements or minerals in Greenland: **A** – Mineral licenses (as at February 5, 2025); **B** – Protected or Important Areas to wildlife; **C** – Uranium; precious metals (including Platinum Group Metals); **D** – molybdenum, copper, tin; **E** – chromium, lead, niobium; **F** – cobalt, zinc, nickel; **G** – magnesite, feldspar, baryte; **H** – graphite, tungsten; **I** – titanium, zirconium, celestite (Sr); **J** – antimony, Rare Earth Elements, beryllium. (A–B – source: Environmental Agency for Mineral Resources, Government of Greenland data – kort.nunagis.gl; C–J – source of data: Geological Survey of Denmark and Greenland data – maps.greenmin.gl)

## Rare Earth Elements (REE)

Both light rare earth metals – cerium, lanthanum, praseodymium, neodymium, promethium, europium, gadolinium, samarium – and heavy rare earth metals – dysprosium, yttrium, terbium, holmium, erbium, thulium, ytterbium, lutetium – may become the subject of detailed geological exploration and extraction in Greenland. In 2023, at least 68% of REE production took place in China (U.S. Geological Survey, 2024), overtaking the United States, Myanmar, Australia and India. EU supplies are solely dependent on China, which provides 100% of heavy rare earth elements to the Union (European Commission, 2025). Although China, Vietnam and Brazil are described as the countries with the largest recognized reserves, foreign companies may intensify their attention on Greenland, where the USGS estimated REE reserves at 1.5 million tonnes (U.S. Geological Survey, 2024).

The Proterozoic alkaline magmatic province, including the Ilimaussaq Complex in South Greenland, is a globally significant geological region (Fig. 4). The complex includes several large REE deposits – Kvanefjeld/Kuannersuit, Kringlerne/Killavaat Alannguat, Motzfeldt and Appat. The Kvanefjeld/Kuannersuit deposit of REE-U-Zn-F type is a large-scale project developed by Energy Transition Minerals Ltd. Data collected by the company (Energy Transition Minerals Ltd, 2025) suggests that the total rare earth oxides content exceeds 11 Mt, including 0.4 Mt of heavy REE and 0.9 Mt of $Y_2O_3$ (cut-off of 150 ppm U). Extremely important for the extraction and processing of additional components is the $U_3O_8$ content of 592.84 Mt. The Government of Greenland has legislated against uranium mining in the Mining Act, and at this point it is prohibited (Lund, 2024). The Kringlerne/Killavaat Alannguat, operated by Tanbreez Mining Greenland (bought in 2025 by Critical Metals), contains a Zr-REE-Nb-Ta deposit of at least 4.7 billion tonnes (Tanbreez, 2025). The eudialyte component of the rock is about 20% (940 Mt), with a head grade of 2% $ZrO_2$, 0.6% of REO, 0.2% of $Nb_2O_5$, 0.03% of $Ta_2O_5$ and 0.03% of $HfO_2$. Among the rare earth oxides, 72.81% are light REE while 27.19% heavy REE (Tanbreez, 2025). According to Tanbreez (2004), the mine can provide 86% of the world's demand for dysprosium. Gallium, on which China has imposed export restrictions, can also be extracted from the project. As of early September 2024, a drilling program was underway, including 14 holes with a total length of about 2,200 metres (Tanbreez, 2024). The results are expected to enable more accurate estimates of the mine's resources and lifetime. The area of the future planned mine is located in South Greenland and is characterized by year-round direct shipping access through deep-water fjords leading directly into the North Atlantic Ocean. Other known deposits include Appat (3.2 Mt of Zr-Y-REE ore; South Greenland), Motzfeldt (340 Mt of Zr-Nb-Ta-REE-U-Th ore; South Greenland), the Sarfartoq carbonatite complex (5.9 Mt indicated REO of P-Nb-REE ore; southern West Greenland) and Milne Land (4 Mt REO from Zr-U-Th-REE-Ti ore; central East Greenland). Occurrences of REE were also found in Niaqornakassak and Umiammakku Nunaa (central West Greenland), the Tikiussaq carbonatite complex (southern West Greenland), Qeqertaasaq/Qaqarssuk the carbonatite complex (southern West Greenland) and Kap Simpson (North-East Greenland).

### Molybdenum

The world's recognized molybdenum reserves exceed 15 million tonnes, of which nearly 40% is in China (U.S. Geological Survey, 2024). China accounts for more than 42% of the global output, ahead of Chile (17.7%), Peru (14.2%), the USA (13.1%) and Mexico (5.8%). The list of molybdenum producers does not contain countries from the European Union, while the EU remains the largest importer of Mo, importing almost twice as much as second-placed South Korea. 59% of the raw material purchased by the EU comes from the US (European Commission, 2025), and Greenland could become an important source of supply diversification.

The most developed molybdenum advanced project in Greenland is the Climax-type molybdenum-porphyry Malmbjerg deposit in central East Greenland (Fig. 4), about 30 km from the coast. Malmbjerg is licenced to Canadian company Greenland Resources. The planned mine will extract molybdenum from an open pit mine that is planned to begin operation in 2029. The company is targeting a 20-year plant life, with average annual production in the first 10 years of 14,900 tonnes, grading an average content of 0.23% $MoS_2$ (Greenland Resources, 2025). Reserves are currently estimated at 245 million tonnes of ore, with an average content of 0.176% $MoS_2$. Greenland Resources will have the opportunity to supply the EU with 20–30% of its current Mo needs. The plant will produce molybdenite concentrate, with salt water as the main processing element. The high quality of the Malmbjerg ore deposit, with its low impurity content, makes it an ideal source of molybdenum for the European steel industry. During geological analysis, two other molybdenum sites were identified in Greenland – Kap Simpson (Mo from fluorite and quartz veins; across the fjord from Malmbjerg) and Flammefjeld (Climax-type Mo mineralization; southern East Greenland). However, the potential for Mo occurrences is wider, especially within the Paleogene igneous province in the east of the island.

### Niobium and tantalum

World niobium mining is dominated by Brazil (>90%), with a small contribution from Canada (8.4%) and marginal from African countries such as the Democratic Republic of Congo and Rwanda (U.S. Geological Survey, 2024). Tantalum production is divided among the Democratic Republic of Congo (40.8%), Rwanda (21.7%), Brazil (15%), Nigeria (4.6%), China (3.3%), Australia (1.8%) and Burundi (1.5%), but the largest reserves identified to date are located in China (240,000 t) (U.S. Geological Survey, 2024).

In Greenland, 3 deposits and 2 important occurrences of Nb and Ta have been described so far (Rosa *et al*., 2023; Fig. 4). The Sarfartoq carbonatite complex, in southern West Greenland, hosts pyrochlore veins (Nb-Ta-REE-Nd-Th-U), which are estimated to contain 64 kt (avg. 5.56 wt.% $Nb_2O_5$) of ore, with the maximum recorded values of 58% of $Nb_2O_5$ and 0.58% of $Ta_2O_5$ (Woodbury, 2003; Stendal *et al*., 2004; Kolb *et al*., 2016). The Motzfeldt deposit (South Greenland) contains 340 Mt mineral resources at 120 ppm $Ta_2O_5$, 1850 ppm $Nb_2O_5$, 4600 ppm $ZrO_2$ and 2600 ppm REO, as well as significant amounts of U and Th (RAM Resources, 2012). Within the Illimausaq Complex in South Greenland, the Kringlerne/Killavaat Alunnguat deposit, showing high Zr-REE-Nb-Ta enrichment, is operated by Critical Metals (see: Rare Earth Elements). Other Nb/Ta occurrences in Greenland were recorded within the Qeqertaasaq/Qaqarssuk carbonatite complex (southern West Greenland) and Kap Simpson (North-East Greenland). Considering the growing demand for niobium and tantalum, and the unstable geopolitical situation in the Lake Kivu area, Greenland could become a source of these raw materials for the EU.

### Platinum Group Metals (Pt, Pd, Rh, Ru, Ir, Os)

The world's leading producer of PGMs, South Africa, is responsible for the extraction of 67% of the world's platinum and 34% of palladium (U.S. Geological Survey, 2024). South Africa is home to 89% of the world's estimated PGM reserves to date, with the largest resource in the Bushveld Complex. The European Union has so far failed to demonstrate significant deposits of PGMs, which makes it entirely dependent on imports (European Commission, 2025). In addition to African countries (South Africa and Zimbabwe), supplies of PGMs exist in Russia (13% world production), Canada (3%) and the US (1.6%). This potential could be expanded to include Greenland.

Greenland's PGM-identified deposit is associated with the tholeitic layered gabbroic Skaergaard Intrusion (East Greenland; Fig. 4) (Nielsen *et al*., 2015). It contains stratiform PGM-Au mineralization, with enriched concentrations of Ti, Cu, Ga and V. The license is held by Platina Resources, who reported 203 Mt of resources at 0.88 g/t Au and 1.33 g/t Pd (Platina Resources, 2025). Greenland's coast near the Denmark Strait is rich in precious metal occurrences. Nearby Skaergaard, occurrences of these metals were found in the Kap Edvard Holm Complex (Pt-Pd-Au), Miki Fjord Macrodyke (Cu-Ni-Pd-Au), and Ammassalik intrusive suite (Ni-Cu-PGM). In southern West Greenland PGMs were found in the Amikoq layered complex (Pt-Pd-Rh), the Maniitsoq Norite Belt (Ni-Co-Cu-PGM) and the Fiskenaesset anorthosite-gabbro complex (Cr-Ni-Cu-PGM), while in South Greenland increased PGM contents were noted in Sarqaa and Amitsoq ultramafic plugs/dykes (Pt-Pd-Au-Cu). Estimates indicate many sites in Greenland could represent potential accumulations of PGMs, particularly palladium and platinum.

## Strontium

Strontium is industrially mined as strontianite ($SrCO_3$) and celestite ($SrSO_4$). Global resources are estimated to surpass 1,000 Mt (U.S. Geological Survey, 2024), with Spain (200 kt) and Iran (200 kt) being the largest producers, followed by China (80 kt) and Mexico (35 kt). 99% of the strontium used in the EU comes from Spain (European Commission, 2025), hence the need for imports from outside the alliance is currently negligible.

Karstryggen celestite mineralization in upper Permian carbonates of Central East Greenland (Fig. 4) has the potential for 25–50 Mt of $SrSO_4$ (avg. 50–60 wt.%) (Scholle *et al*., 1990). This estimate makes Karstryggen one of the largest strontium deposits in the world. However, EU demand for strontium is not high, due to the fully developed production industry in Spain. For this reason, Sr mining projects will not be crucial for EU-Greenland raw material cooperation in the coming years.

## Titanium and Vanadium

Ilmenite remains the main source of titanium (93.5%), well ahead of rutile (6.5%). The global resources of ilmenite, rutile and anatase surpass 2,000 Mt (U.S. Geological Survey, 2024). While the largest producers are China (3.1 Mt), Mozambique (1.6 Mt) and South Africa (1.1 Mt), the largest reported reserves are in Australia (215 Mt), China (210 Mt) and India (92.4 Mt). Import sources of primary titanium for the EU are mainly Norway (23%), South Africa (15%) and Canada (14%), while refined titanium comes mainly from Germany (European Commission, 2025). Titanium, used primarily in pigment production and the steel industry, is in high demand in EU countries. Vanadium is mined in China (68 kt), Russia (20 kt), South Africa (9.1 kt) and Brazil (6.4 kt), while the largest reserves were recorded in Australia (8.5 Mt) (U.S. Geological Survey, 2024). There is no extraction of this resource within the European Union (European Commission, 2025).

Five important titanium deposits have been recorded in Greenland (Fig. 4). Moriusaq and the Thule Black Sands (north-west Greenland) are ilmenite-rich placers of the Thule Black Sand province (Dawes, 1989). Bluejay Mining and GreenRoc Mining, involved in the reconnaissance of these deposits, have documented respectively at 117.3 Mt avg. 1.7% Ti at Moriusaq and 19 Mt avg. 2.8% Ti at Thule Black Sands (Rosa *et al*., 2023). The Isortoq deposit is located in the southern part of the island in the Paleoproterozoic Ketilidian Orogen, where Ti-V-Fe mineralization is associated with troctolite-bearing dikes. West Melville Metals defined total resources of 70.3 Mt grading 29.6 wt.% Fe, 10.9 wt.% $TiO_2$ and 0.144 wt.% $V_2O_5$ (cut-off of 15 wt.% Fe) (Turner, Nicholls, 2013). In East Greenland, geologists found Ti-enriched Jurassic palaeoplacers in Milne Land (see section Rare Earth Elements) and Ti-V titanomagnetite in the Skaergaard Intrusion (see section Platinum Group Metals). The Skaergaard Intrusion could be particularly significant, where resources of 104 Mt with 4.68% Ti and 0.12% V were estimated (Sorensen *et al*., 2016). Other occurrences of titanium and vanadium enrichment were recorded in Sinarsuk (southern West Greenland) and Stendalen (South Greenland).

## Hafnium and Zirconium

Global mine production of zirconium mineral concentrates comes mostly from zircon, but also eudialyte and baddeleyite, while hafnium is a byproduct of hafnium-free zirconium metal. The production of zirconium mineral concentrates reached 1.6 Mt. The industry leaders were Australia (31%), South Africa (25%) and China (9%) (U.S. Geological Survey, 2024). The largest known reserves are described in Australia (55 Mt), South Africa (5.6 Mt), Senegal (2.6 Mt), Madagascar (2.3 Mt) and Mozambique (1.5 Mt). The European Union relies completely on external supplies of zirconium, while having a well-developed processing sector producing hafnium (European Commission, 2025).

Calculations based on data from Greenland's three zirconium deposits – Kringlerne/Killavaat Alunnguat (see section Rare Earth Elements), Motzfeldt (see section Niobium and Tantalum) and Milne Land (see section Rare Earth Elements) – suggest that the island may have the largest reserves of the raw material in the world, about 57.1 Mt (Rosa *et al*., 2023; Fig. 4). Along with these are associated hafnium deposits estimated at 107 kt. Since hafnium occurs in the zircon- and eudialyte-rich rocks of the Gardar Province, additional reconnaissance work in South Greenland may yield further information on Hf deposits.

## Antimony

About 83 thousand tonnes of antimony are mined worldwide annually (U.S. Geological Survey, 2024). The production leaders are China (48%), Tajikistan (25%) and Turkey (7%), while the largest documented reserves are held by China (640 kt), Russia (350 kt), Bolivia (310 kt), Kyrgyzstan (260 kt), Burma (140 kt) and Australia (140 kt). There is no antimony mining in the European Union, while the refined sourcing is led by China (30%), Belgium (21%) and France (14%). The EU's import reliance on refined antimony is about 47% (European Commission, 2025).

Two potential antimony deposits have been identified in central East Greenland (Rosa *et al*., 2023; Fig. 4). The North Margeries Dal and Broget Dal deposits are estimated to contain 3.78 kt of Sb. North Margeries Dal is characterized by stibnite ($Sb_2S_3$) vein mineralization within Precambrian shales and dolomites, which may also be a source of gold and tungsten, widely present in the area (Rosa *et al*., 2023). Broget Dal has Sb-potential within upper Devonian faults with copper-antimony mineralization (Rosa *et al*., 2023). The whole region near North Margeries Dal and Broget Dal has potential for antimony mineralization, mainly in veins cutting through the Precambrian upper Eleonore Bay Supergroup dolomitic shales. Based on GEUS-defined tracts of mineral resource potential (Rosa *et al*., 2023), the granites of the Ilua plutonic suite (South Greenland) have potential for hydrothermal antimony mineralization and hold possibilities for further Sb studies.

**Beryllium**

The highest annual production of beryllium is provided by the United States, responsible for 190 t out of 330 t worldwide (U.S. Geological Survey, 2024). Other significant suppliers are China (74 t), Brazil (40 t) and Mozambique (24 t). The identified resources of Be have been estimated to be more than 100 kt. EU Import reliance is 100%, based mainly on supplies from the US, Kazakhstan and Japan (European Commission, 2025).

Greenland's known beryllium deposit, Taseq, is located in South Greenland, within the Ilimaussaq intrusion of the Gardar Province (Rosa *et al*., 2023; Fig. 4). Be-bearing rocks of <0.1 % BeO in most of the mineralized area were found in hydrothermal veins and metasomatic zones (Engell *et al*., 1971). The other occurrences were described in the Nuuk (southern West Greenland) and Kobberminebugt (South Greenland) pegmatites, as well as the Kap Simpson felsic intrusive complex. All currently recognized resource estimates of beryllium in Greenland constitute about one-third of the Be annual production in the United States.

**Lithium**

In recent years, lithium has become one of the most important raw materials for the energy transition, due to the huge increase in demand for the production of batteries. The world leaders in annual lithium production are Australia (86 kt), Chile (44 kt), China (33 kt), Argentina (9.6 kt) and Brazil (4.9 kt) (U.S. Geological Survey, 2024). The biggest resources are held by Bolivia (23 Mt), Argentina (22 Mt), the United States (14 Mt) and Chile (11 Mt). Among the European Union countries, the largest reported resources are in Germany (3.8 Mt) and Czechia (1.3 Mt), with 1.2 Mt in EU candidate country Serbia, where the Li extraction project has been suspended due to social protests (BBC, 2024). The EU supplies are mainly provided by Chile (79%), Switzerland (7%) and Argentina (6%), with Portugal being the sole primary lithium producer in the Union (European Commission, 2025).

The potential for developing lithium mining projects in Greenland is low. The Kvanefjeld/Kuannersuit deposit (see section Rare Earth Elements) is the only known Li occurrence (Rosa *et al*., 2023); nevertheless, the mining of dispersed lithium will not be part of the developing mining project (Energy Transition Minerals Ltd, 2025). There is a potential for testing lithium content in the Nuuk region and of the Caledonian granites in the eastern territory, but no significant occurrences of this metal have been recorded so far.

**Phosphorus**

Phosphorus is produced by processing phosphate rock, the reserves of which are abundant and distributed globally (U.S. Geological Survey, 2024). The smallest mining operations are conducted in Europe, and only undertaken in Finland. Phosphorus is supplied to the EU mainly by Kazakhstan (62%), Vietnam (22%) and China (13%) (European Commission, 2025).

The phosphorus resources in Greenland were estimated at 11.5 Mt (Rosa *et al*., 2023). They are disseminated within the Southern West Greenland carbonatites, from the Sarfartoq complex through the Qeqertaasaq/Qaqarssuk complex to the Tikiusaaq complex. The entire area was analysed during research for the occurrence of rare earth elements. Two additional occurrences were recorded in the Grønnedal-Ika complex of the Gardar intrusive suite (south Greenland) and the the Gardiner ultramafic complex (southern East Greenland). Analyses conducted so far indicate that in sites described as potential phosphorus deposits, other raw materials will become the main mining target.

## POTENTIAL TO SUPPLY EXTERNAL MARKETS

Based on information on Greenland's current reconnaissance of CRM occurrences, the highest potential is in the sectors of graphite, REE, molybdenum, niobium, tantalum, PGMs, titanium, vanadium and zirconium supply. For these raw materials, EU import reliance on primary sources amounts to 100% (except for graphite, where IR = 99%) (European Commission, 2025).

To promote the development of the sector and provide an update on the status of individual raw materials projects, the Government of Greenland, in cooperation with the European Commission, organized the seminar 'Advancing EU-Greenland Collaboration: Investments and Innovation in Sustainable Raw Materials and Renewable Energy' in October 2024. The event is aimed to promote and facilitate dialogue between businesses and government institutions to identify investment, research and innovation opportunities, and to fulfill the tasks of the EU-Greenland Strategic Partnership on raw materials and clean energy cooperation within the EU Global Gateway strategy. It targeted companies related to the exploration, production and export of graphite, molybdenum, anorthosite, rare earth elements, and Greenland's hydropower potential. The seminar was attended by Greenlandic Ministers who promoted investments in the country. The event identified opportunities for international companies, showed the openness of the local community, and encouraged the implementation of mining projects.

The Government of Greenland has defined the raw material industry as the third pillar of the island's economy. Currently, it depends on two backbones: fishery and an annual block grant from the Danish government. The European Union proposed several paths for financing exploration projects in Greenland, including the European Raw Materials Alliance and the European Investment Bank. New mining projects in Greenland could enable diversification of EU supply routes. Disputed territories or state-controlled straits do not restrict maritime transport to continental Europe. The development of air transport is facilitating industrial development. A major expansion of Nuuk's International Airport opened in November 2024 (Sermitsiaq, 2025), allowing direct flights between the island's capital and European Union countries. The constituted mining law and the clarity of the process of obtaining exploration or mining licenses, with the need to contact just one administrative entity (one-door system), is well-established and attractive. The lack of land ownership makes the possibility of operations entirely dependent on government approval.

Despite its known and growing potential over the years, Greenland has not attracted any large mining companies. Due to the harsh environment, dispersed, small population and lack of infrastructure, the costs of exploration and extraction projects are high. Practically all pieces of equipment have to be imported, and any equipment problems make it necessary to wait for costly deliveries from Europe or North America. Environmental issues are also worth raising. There are plenty of protected areas or areas of importance to wildlife throughout the island, which should be considered when setting mining targets. Many areas are inaccessible year-round due to the freezing sea ice, which prevents or can delay work. The mines operating in Greenland must usually build adequate storage facilities to store the raw material when it cannot be taken from the plant, which incurs significant costs. Legislative issues related to the uranium mining ban have affected extraction projects for other commodities, the remoteness of potential mining sites skews their economic viability, and geopolitical issues do not ensure long-term project stability, but these extremely important issues do not affect Greenland's high geological potential.

In an era of geopolitical struggle for raw materials, high costs and harsh weather conditions are becoming progressively less important while raw material security and a steady supply of key components for the industry are present on the other side of the scale. Despite the challenges, the Greenland's geological potential to provide all of the EU's annual demand for molybdenum, REEs, PGMs and zirconium is significant.

## CONCLUSIONS

Greenland's geological history spans nearly four billion years. Precambrian bedrock make up most of the island, with magmatic and metamorphic rocks being the source of many valuable raw materials deposits and occurrences. Twenty five of the thirty four EU CRMs are known in Greenland. Among them, graphite (Amitsoq deposit), molybdenum (Malmbjerg deposit) and rare earth elements (Kringlerne/Killavaat Alannguat deposit) extraction projects are closest to starting operation. The potential is also high for niobium, tantalum, PGMs, titanium, vanadium and zirconium. Geological reconnaissance of the ~21% of the island not covered by the ice cap has enabled the identification of several locations with high CRM potential.

The European Union's demand for CRM supplies is substantial and will grow during the energy transition. Many products cannot be sourced within the Alliance's borders, hence the need to develop supply chains for ensuring raw materials and energy security. EU import reliance on numerous primary CRM sources amounts to 100%, hence it is important to acquire strategic, reliable partners, ideally located close to EU borders. Greenland may soon prove to be a source of valuable raw materials for the European Union. On the other hand, mining development could bring economic development to Greenland, along with diversification of its fishery-based economy. Greenland has significant geological potential to emerge as a major mining hub on the global stage. However, for this potential to be realized, it is imperative that various economic, legislative, and geopolitical factors be addressed, independent of the island's mineral resource endowment.

**Acknowledgements.** The author thanks Dr. Julie Hollis for her valuable comments and suggestions that enabled the improvement of the manuscript.

## REFERENCES

BBC, 2024/8/11 – Thousands protest against lithium mining in Serbia; https://www.bbc.com/news/articles/cged9qgwrvyo

BBC, 2025/01/26 – BBC News. https://www.bbc.com/news/articles/crkezj07rzro

BERMAN R., RYAN J., TELLA S., SANBORN-BARRIE M., STERN R., ASPLER L., HANMER S., DAVIS W. 2000 – The case of multiple metamorphic events in the Western Churchill Province: evidence from linked thermobarometric and in-situ SHRIMP data, and jury deliberations. Geological Association of Canada Abstracts, Abstract 83.

CABY R., BERTRAND-SARFATI J. 1988 – The Eleonore Bay Group (central East Greenland). [In:] Winchester J. (ed.), Later Proterozoic Stratigraphy of the Northern Atlantic Regions. Blackie and Son Ltd: 212236.

DAM G., PEDERSEN G., SØNDERHOLM M., MIDTGAARD H., LARSEN L., NØHR-HANSEN H., PEDERSEN A. 2009 – Lithostratigraphy of the Cretaceous–Paleocene Nuussuaq Group, Nuussuaq Basin, West Greenland. Geological Survey of Denmark and Greenland Bulletin: 171.

DAWES P. 1989 – The Thule black sand province, North-West Greenland: investigation status and potential. Open File Series Grønlands Geologiske Undersøgelse, 89 (4): 17.

DAWES P. 1997 – The Proterozoic Thule Supergroup, Greenland and Canada: history, lithostratigraphy and development. Geology of Greenland Survey Bulletin, 174: 149.

DAWES P. 2009 – The bedrock geology under the inland ice: the next major challenge for Greenland mapping. GEUS Bulletin, 17: 57–60; https://doi.org/10.34194/geusb.v17.5014

ENERGY TRANSITION MINERALS LTD. 2025/2/10 – Energy Transition Minerals; https://etransmin.com/

ENGELL J., HANSEN J., JENSEN M., KUNZENDORF H., LOVBORG L. 1971 – Beryllium mineralization in the Ilímaussaq intrusion, South Greenland. Rapport Grønlands Geologiske Undersøgelse, 33: 1–40; https://doi.org/10.34194/rapggu.v33.7247

EUROPEAN COMMISSION, 2012 – Commission Decision of 8.6.2012 on the signature of a Letter of Intent between the European Union and Greenland on cooperation in the area of mineral resources. Brussels, Lex-EU.

EUROPEAN COMMISSION, 2023/11/30 – EU and Greenland sign strategic partnership. : European Commission webpage; https://ec.europa.eu/commission/presscorner/detail/en/ip_23_6166

EUROPEAN COMMISSION, 2024 – Regulation of the European Parliament and of the Council of 11 April 2024 establishing a framework for ensuring a secure and sustainable supply of critical raw materials and amending. Regulations (EU) 168/2013, (EU) 2018/858, 2018/1724 and (EU) 2019/1020. Official Journal of the European Union. Brussels, EUR-lex.

EUROPEAN COMMISSION, 2025/2/10 – European Commission Raw Materials; https://rmis.jrc.ec.europa.eu/

FRIEND C., NUTMAN A., BAADSGAARD H., KINNY P., MCGREGOR V. 1996 – Timing of the late Archaean terrane assembly, crustal thickening and granite emplacement in the Nuuk region, southern West Greenland. Earth and Planetary Science Letters, 142: 353–365.

GARDE A., HAMILTON M., CHADWICK B., GROCOTT J., MCCAFFREY K. 2002 – The Ketilidian orogen of South Greenland: geochrono-logy, tectonics, magmatism, and fore-arc accretion during Palaeoproterozoic oblique convergence. Canadian Journal of Earth Sciences, 39 (5): 765–793; https://doi.org/10.1016/j.lithos.2020.105384

GARDINER N., KIRKLAND C., HOLLIS J., CAWOOD P., NEBEL O., SZILAS K., YAKYMCHUK C. 2020 – North Atlantic Craton architecture revealed by kimberlite-hosted crustal zircons. Earth and Planetary Science Letters, 534, 116091; https://doi.org/10.1016/j.epsl.2020.116091

GHISLER M. 1990 – Geographical subdivision of Greenland. Rapport Grønlands Geologiske Undersøgelse, 148: 8–10.

GREENLAND RESOURCES, 2025/2/10 – Greenland Resources. https://greenlandresources.ca/

GREENROC STRATEGIC MATERIALS, 2024 – Amitsoq graphite mining project. Advancing EU-Greenland Collaboration: Investments and Innovation in Sustainable Raw Materials and Renewable Energy. European Commission, Nuuk.
GUARNIERI P., ROSA D., THRANE K., KOKFELT T., SØRENSEN E., DEWOLFE M., BAKER N. 2024 – Tectonics of the Paleoproterozoic Rinkian orogen, central West Greenland. GSA Bulletin, 136 (5–6): 2596–2615; https://doi.org/10.1130/B36930.1
HÀKANSSON E., STEMMERIK L. 1989 – Wandel Sea basin – a new synthesis of the late Paleozoic to Tertiary accumulation in North Greenland. Geology, 17 (8): 683–686.
HENRIKSEN N. 2008 – Geological History of Greenland – Four Billion Years of Earth Evolution. Geological Survey of Denmark and Greenland, Copenhagen.
HENRIKSEN N., HIGGINS A. 1998 – Early Palaeozoic Basin development of North Greenland part of the Franklinian Basin. Polarforschung, 68: 131–140.
JOLLEY D., BELL B. 2022 – The evolution of the North Atlantic Igneous Province and the opening of the NE Atlantic rift. Geological Society of London Special Publications: 1–13; https://doi.org/10.1144/gsl.sp.2002.197.01.01
KOLB J., KEIDING J., STEENFEL A., SECHER K., KEULEN N., ROSA N., STENSGAARD B. 2016 – Metallogeny of Greenland. Ore Geology Reviews, 78: 493–555.
LIU J., RICHES A., PEARSON G., LUO Y., KIENLEN B., KJARSGAARD B., STACHEL T., ARMSTRONG J. 2016 – Age and evolution of the deep continental root beneath the central Rae Craton, northern Canada. Precambrian Research, 272: 168–184; https://doi.org/10.1016/j.precamres.2015.11.001
LUND K. 2024/10/1 – Advancing EU-Greenland Collaboration: Investments and Innovation in Sustainable Raw Materials and Renewable Energy (C. Keldsen, Interviewer). European Commission.
MACGREGOR J., COLGAN W., PAXMAN G., TINTO K., CSATHÓ B., DARBYSHIRE F., FAHNESTOCK M.A., KOKFELT T.F., MACKIE E.J., MORLINGHEM M., SERGIENKO O. 2024 – Geologic provinces beneath the Greenland Ice Sheet constrained by geophysical data synthesis. Geophysical Research Letters, 51 8), e2023GL107357; https://doi.org/10.1029/2023GL107357
MAYBORN K., LESHER C. 2006 – Origin and evolution of the Kangâmiut mafic dyke swarm, West Greenland. [In:] Garde A., Kalsbeek F. (eds.), Precambrian Crustal Evolution and Cretaceous-Palaeogene Faulting in West Greenland. Geological Survey of Denmark and Greenland Bulletin: 61–86.
U.S. GEOLOGICAL SURVEY, 2024 – U.S. Geological Survey; https://doi.org/10.3133/mcs2024
MOORBATH S., O'NIONS R., PANKHURST R., GALE N., MCGREGOR V. 1972 – Further rubidium-strontium age determinations on the very early Precambrian rocks of the Godthab district: West Greenland. Nature, 240: 78–82.
NIELSEN T., ROSING M. 1990 – The Archaean Skjoldungen alkaline province, South-East Greenland. Geological Survey of Greenland Report, 148: 93–100.
NIELSEN T., ANDERSEN J., HOLNESS M., KEIDING J., RUDASHEVSKY N., RUDASHEVSKY V., SALMONSEN L.P., TEGNER C., VEKSLER I. 2015 – The Skaergaard PGM and gold deposit: the result of in situ fractionation, sulphide saturation, and magma chamber-scale precious metal redistribution by immiscible Fe-rich melt. Journal of Petrology, 56 (8): 1643–1676.
NUTMAN A., FRIEND C. 2007 – Adjacent terranes with ca. 2715 and 2650 Ma high-pressure metamorphic assemblages in the Nuuk region of the North Atlantic Craton, southern West Greenland: complexities of Neoarchaean collisional orogeny. Precambrian Research, 155: 159–203.
NUTMAN A., FRIEND C. 2009 – New 1:20,000 scale geological maps, synthesis and history of investigation of the Isua supracrustal belt and adjacent orthogneisses, southern West Greenland: a glimpse of Eoarchaean crust formation and orogeny. Precambrian Research, 172 (3–4): 189–211; https://doi.org/10.1016/j.precamres.2009.03.017
NUTMAN A., FRIEND C., KINNY P., MCGREGOR V. 1993 – Anatomy of an Early Archaean gneiss complex: 3900 to 3600 Ma crustal evolution in southern West Greenland. Geology, 21: 415–418.
NUTMAN A., MCGREGOR V., FRIEND C., BENNETT V., KINNY P. 1996 – The Itsaq Gneiss Complex of southern West Greenland; the world's most extensive record of early crustal evolution (3900–3600 Ma). Precambrian Research, 78: 1–39.
NUTMAN A., BENNETT V., HIDAKA H., HENRIKSEN N., ALI S. 2019 – The Archean Victoria Fjord terrane of northernmost Greenland and geodynamic interpretation of Precambrian crust in and surrounding the Arctic Ocean. Journal of Geodynamics, 129: 3-23; https://doi.org/10.1016/j.jog.2019.03.006
PEHRSSON S., BERMAN R., EGLINGTON B., RAINBIRD R. 2013 – Two Neoarchean supercontinents revisited: the case for a Rae family of cratons. Precambrian Research, 232: 27–43.
PETERSON T., SCOTT J., LECHEMINANT A., JEFFERSON C., PEHRSSON S. 2015 – The Kivalliq Igneous Suite: anorogenic bimodal magmatism at 1.75 Ga in the western Churchill Province, Canada. Precambrian Research, 262: 101–119.
PLATINA RESOURCES, 2025/2/10 – Platina Resources; https://platinaresources.com.au/
RAM RESOURCES, 2012/4/27 – RAM Resources webpage; https://cisp.cachefly.net/assets/articles/attachments/39109_20120427_-_maiden_inferred_resource_for_aries_project.pdf
ROSA D., KALVIG P., STENDAL H., KEIDING J. 2023 – Review of the critical raw material resource potential in Greenland. Geological Survey of Denmark and Greenland, Copenhagen.
SCHOLLE P., STEMMERIK L., HARPOTH O. 1990 – Origin of major karst-associated celestite mineralization in Karstryggen, central East Greenland. Journal of Sedimentary Research, 60 (3): 397–410.
SERMITSIAQ, 2025/2/10 – Sermitsiaq. Den store lufthavnsfest; www.sermitsiaq.ag
SKULSKI T., SANDEMAN H., MACHATTIE T., SANBORN-BARRIE M., RAYNER N., BYRNE D. 2003 – Tectonic setting of 2.73–2.7 Ga Prince Albert Group, Churchill Province, Nunavut. GAG-MAC Joint Annual Meeting Abstract, 28.
SORENSEN L., WEATHERLEY S., KOKFELT T., NIELSEN T. 2016 – Magmatic titanium-vanadium potential in Greenland. Geology and Ore, 27: 12
STENDAL H., NIELSEN B., SECHER K., STEENFELT A. 2004 – Mineral resources of the Precambrian shield of central West Greenland (66° to 70°15'). Part 2. Mineral occurrences. Geological Survey of Denmark and Greenland.
SURLYK F. 1991 – Tectonostratigraphy of North Greenland. Grønlands Geologiske Undersøgelse Bulletin, 160: 25–47.
TANBREEZ, 2024/10/1 – Business Mission Greenland Presentation. European Commission, Nuuk.
TANBREEZ, 2025/2/10 – Tanbreez Mining Greenland website; https://tanbreez.com/
THRANE K., KALVIG P. 2018 – Graphite potential in Greenland. Mineral Resource Assessment Workshop, November 2017. Geological Survey of Denmark and Greenland.
TURNER A., NICHOLLS S. 2013 – NI43-101 Technical Report On An Initial Resource Estimate For The Isortoq Fe-Ti-V Project, Qaqortoq District, South Greenland. West Melville Metals.
U.S. GEOLOGICAL SURVEY, 2024 – Mineral commodity summaries 2024: U.S. Geological Survey; https://doi.org/10.3133/mcs2024
WITTIG N., WEBB M., PEARSON D., DALE C., OTTLEY C., HUTCHINSON M., JENSEN S.M., LUGUET A. 2010 – Formation of the North Atlantic Craton: Timing and mechanisms constrained from Re-Os isotope and PGE data of peridotite xenoliths from SW Greenland. Chemical Geology, 276 (3): 166–187; https://doi.org/10.1016/j.chemgeo.2010.06.002
WOODBURY M. 2003 – Sarfartoq exploration licence, el2001/05. Annual report January–December 2002. New Millennium Resources internal report. Geological Survey of Denmark and Greenland.

The work was received by the editorial office on 19.02.2025
Accepted for printing on 7.03.2025