DANMARKS OG GRØNLANDS GEOLOGISKE UNDERSØGELSE RAPPORT 2018/26

Assessment of the dimension stone potential in South Greenland

Part 1 – Desk top study

Per Kalvig & Christian Knudsen

GEOLOGICAL SURVEY OF DENMARK AND GREENLAND
DANISH MINISTRY OF ENERGY, UTILITIES AND CLIMATE

GEUS

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Introduction

Worldwide, the use and production of dimension stones is a substantial sector measured in turnover and tonnages, although comprehensive market figures for the global business have not been found. Ideally, the dimension stone production concept, seems well suited for Greenland, given the relatively small scale of operation in terms of manpower and size of land, small environmental impact and easy access to navigable fjords for shipping the blocks. In combination with attractive – and outcropping – geology, encompassing a wide range of rock-types and colours, justifies a survey of the dimension stone business potential in South Greenland.

The Ministry of Mineral Resources in Greenland (MMR) and the Geological Survey of Denmark and Greenland (GEUS) agreed (2017) to reinitiate investigations on the potential for commercial dimension stone projects in South Greenland. Previous surveys were carried out in the 80's and 90's (Larsen, 1985; Gothenborg *et al.* 1994) and again in 2002 & 2003 (Kalvig *et al.* 2002; Rasmussen 2003, Rasmussen & Olsen 2003). The present campaign encompasses three phases: (i) Survey centred to gain knowledge about the dimension stone market and its dynamics, establishing contacts to the industry/potential investors, and identification of commercially interesting rock types/-colours; (ii) Fieldwork/target seek-out August 2018; (iii) Excursion for potential investors to selected sites, summer 2019. Stage (i) is reported in the following.

Definitions

Dimension stone is here understood as natural rock material quarried for the purpose of obtaining blocks or slabs that meet specifications as to size and shape. Colour, grain texture and pattern, and surface finish of the stone are normal requirements. Frequently the terms ornamental stones or building blocks are used as synonyms.

Dimension stones are commonly divided into three groups: (i) 'marbles' covering all calcareous materials from marbles, travertine and limestones; (ii) 'siliceous' covering all intrusive rocks, commonly named 'granites' and quartzite's and sandstone; and (iii) slate. Of these the first group is estimated to account for more than 50% of the market, and slates for roofing tiles and floors make up the smallest share.

Previous dimension stone operations in Greenland

Quarries, producing aggregate products, are present in almost all towns/townships in Greenland. Building blocks have been produced locally since the norse period (Figure 1), and have been used extensively in buildings in Greenland in the 19th and 20th century (Figure 2, 3 and 4).

Figure 1 *Church of sandstone belonging to the Eriksfjord Formation built during the norse period, Igaliku, South Greenland.*

Figure 2 *The church in Maaniitsoq, built in 1864.*

Figure 3 *The Igaliko sandstone from the Eriksfjord Formation used in farm houses in South Greenland.*

Figure 4 *The church in Uummannaq built of local grano-dioritic gneiss in 1935.*

Industrial scale dimension stone productions are, however, recorded from the Uummannaq district only. A state-owned marble block quarry was established on the Agpat Island in the Uummannaq district, in the period 1933-36 (Figure 5). In 1936 this operation was shifted to the Kamarujuk Fjord, to a site then named Marmorilik, where the operation continued up to 1940, and was then abandoned due to exporting constraints during the 2nd World War. In this period about 4,500 ton of marble blocks were produced.

Figure 5 *The abandoned marble quarry at Agpat, Uummannaq District.*

The quarry produced 10 x 2 x 0.8 m blocks, which prior to shipment were split into 4 - 6 ton size blocks. The quarry was re-opened in 1967 by Greenland Stone A/S and stayed in operation up to 1971; during this period about 5,000 ton blocks were produced[1]. Maarmorilik marble are used in several structures in Copenhagen (e.g. Overformynderiet, and the townhall structures in Lyngby[2]). Marble for the ongoing renovation of these and other structures, are in high demand. A research project is initiated by Aarhus School of Architecture (J. Foote/ R.B.Trempe), with the aim to identify potential dimension stones which can replace the Greenlandic marble.

[1] Secher: geoviden, nr. 1 , 2005.

[2] Steenfos & Taagholt: Grønlands teknologihistorie

Figure 6 *The piers at Marmorilik, Uummannaq District, used by the vessels shipping the zinc-lead mineral concentrate.*

Quarrying of dimension stones was carried out by traditional techniques. However, modern operations require inputs from a wide range of experts within the fields of e.g. geology, mining engineering, blasting, rock-breaking, rock mechanics, mine design and reserve evaluations, in order to deliver according to specs and time. Development of site specific methods are required, considering not only the technical aspects, but as well logistics, financial and market aspects.

Figure 7 *Lyngby Rådhus, build during 1939-41 and covered with marble from Maarmorilik*. *Renovation project scheduled to start 2019.*

2018 activities

Target seek-out criteria

The dimension stone market is dynamic and demanding a wide range of stones in terms of colour, texture, structure, mineralogy etc. and there is a very large variety on the market. However, some standard types like grey 'granites' dominate the market, mainly supplied by low-cost producers, and it appears challenging for Greenland-products to compete in this segment. However, several dimension stone market specialists expressed, that there is indeed room in the market for less common rocks with respect to colour and texture, providing produced in big blocks (preferable block size about 1.3 x 1.3 x 2.5-2.7 m).

In principle the seek-out will consider the following technical/geological/market aspects:

- *Homogeneity*: colour, texture, discontinuities (veins, dykes, inclusions, foliation, metamorphic structures and layering)
- *Rock quality*: deteriorating minerals, minerals causing staining in the rock, and porosity of the rock
- *Dimensioning:* Thickness of productive units, resource volume, spatial disposition
- *Fracturing:* preferential directions; frequency, density, intensity and type
- *Site logistics:* proximity to navigable fjord and settlements

In addition to the above criteria, a number of technical specifications of relevance to the dimension-stone product have to be met. We will identify preliminary targets based on desktop studies (geological maps, photo-geology, previous campaign reports, samples, and gathering of local knowledge/information) – considering the market input on the most common rock-types in demand. Existing license areas will be excluded from the desktop survey. Geophysics (GPR; Geo-el; etc.), detailed mapping, bulk sampling and drilling are not part of the field-work activities, due to time limitations.

Larsen (1985) visited the area aiming at evaluating the possibility to find granite with a quality that could be used for production of dimension stone. The field-localities visited are shown on Figure 8.

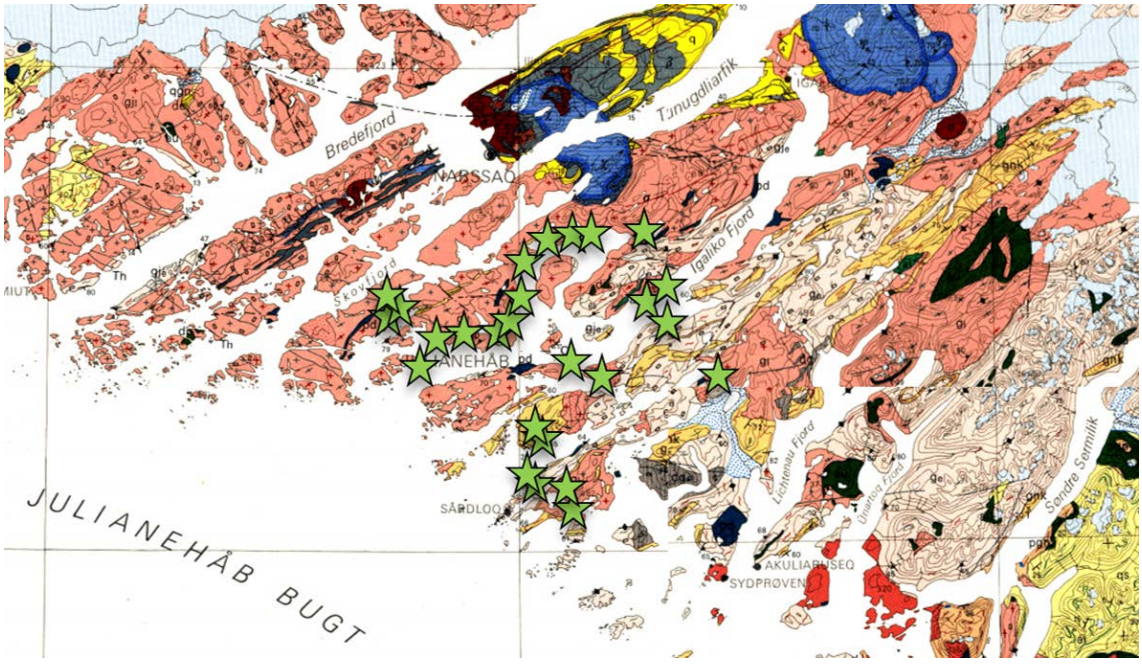

Figure 8 *Field localities visited by Larsen (1985) on the geological map of South Greenland.*

2018 fieldwork

The second step is to study the formation of the rocks in order to ascertain the possibility of producing blocks of a commercial size, attractive colour and adjacent to the cost, allowing easy shipment of the blocks.

The fieldwork will be conducted by two GEUS geologists (Per Kalvig; Christian Knudsen) and one MMR-geologist (Arent Heilman) in the period August 21 – September 4th. The fieldwork will be boat based (Jonstrup) and will be travelling out of Narsarussuaq and restricted to Arsuk to the North and Alluitsup Paa to the South (Figure 9).

Samples will be collected where colour appear acceptable and the outcrops follow the set criterias. Handspecimens – or samples of approximately 30 cm will be extracted. These samples can be used as examples of colour/texture variations. Polished samples can be compared against existing products on the market, and used to obtain feedback from potential investors, and will as well indicate if the sample can fulfill technical tests and be polished to acceptable finish. Thus the samples are essential for the second stage target seek-out, aimed for the investor-trip in 2019.

Samples will be collected during the fieldwork and selected samples will be tested, according to the criteria's above, during the second half of 2018.

The main interest is directed towards the following rock-types/geological formations:

- Quartzite from the Eriksfjord Formation with priority on the greenish, well cemented sandstone.
- Labradorite in anorthosites related to the Gardar intrusions
- Syenite and nepheline syenite related to the Gardar intrusions
- Rapakivi granites in the Sothern Ketilidian Orogen

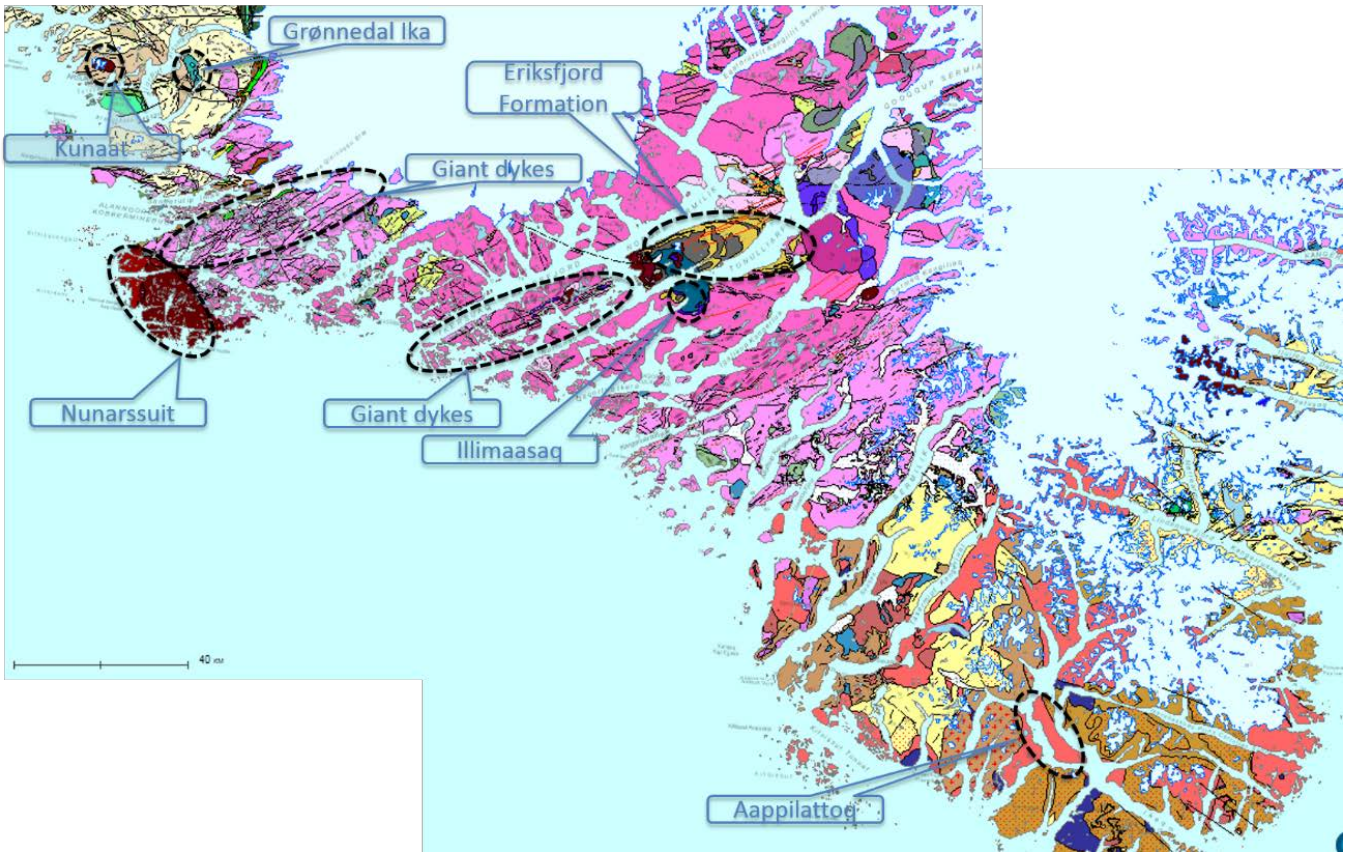

Figure 9 *Map of the field area*

Quartzite

Various samples of sandstones/quartzites of the Eriksfjord Formation were collected by Rasmussen and Olsen (1993) aiming at getting a representative collection of colours and textures. The greenish variant (Figure 10), collected during that campaign appears to attract interest in the market. Thus known localities will be visited, with the aim to get a better understanding of volume of the deposits, homogeneities, evaluate potential block size and quality, as well as data related to the logistic challenges.

Figure 10 *Green quartzite from the Eriksfjord Formation. Length of horizontal side 25 cm.*

Labradorite

Labradorite has its name from Labrador where it has been known to occur since the 18th century and the geological type area for Labradorite is Paul's Island near the town of Nain in Labrador, Canada. Labradorite display an iridescent optical effect (or schiller) known as labradorescence caused by alternating exsolution lamellae of albite and anorthite plagioclase.

There is an evolution in anorthosite composition during earth history with Ca-rich compositions dominating the early history, demonstrated by the Ca-rich nature of the Archean anorthosite in Greenland (*c.* 75–90 % An; Knudsen *et al.* 2012). Younger anorthosite contains less Ca and anorthosite formed as part of the *c.* 1.3 Ga old Mesoproterozoic Nain Plutonic suite (Emslie et al 1994) has an anorthite or Ca component percentage *c.* 50 – 70 % An (An_{50-70}).

In southern Norway larvikite is mined, characterized by bright optical interference colour (iridescence) seen in certain varieties due to optical refraction in the exsolution pattern of alternating orthoclase (K-feldspar) and anorthite (plagioclase) lamellae. The age of the intrusions

is Permian and is part of the initial stages of rifting in the Oslo Graben. Therefore similar to the tectonic setting of the Gardar, which is also tied to the initial stages of (failed) rifting. The bulk of the feldspar in the larvikite is ternary, with compositions in the range $An_{4–30,}$ $Ab_{58–82}$ and $Or_{3–35}$ (Heldal *et al.* 2008).

The larvikite is the most valuable dimension stone in Norway responsible for an export of raw blocks of approximately 600 Mio. NOK/year. If we can find something similar in Greenland it would be really interesting.

The Gardar intrusions are Mesoproterozoic (1,35 – 1,13 Ga) and proposed to be equivalent to the Nain Plutonic Suit in Labrador even the main part is slightly younger c. 1.2 Ga old. Accordingly, the Gardar Igneous province is an obvious place to look for labradorite in Greenland.

Geological mapping in South Greenland was at its height in the late 50'ties and early 60'ties and there are quite a few publications describing anorthosites as part of the plutonic suite, e.g. Bridgewater (1967) state: "The anorthosite inclusions represent a top accumulate of labradorite, which crystallized at a relatively early stage from the developing Gardar magmas at depth". Upton et al. (1985) state that Tugtutôq older giant dyke complex contains plagioclase with labradorite composition. Further Upton (1964) write: "Inclusions of labradorite anorthosite material are common in a number of the intrusions in the Tugtutôq-Narssaq area just as they are in other parts of the Gardar province".

The plagioclase compositions are generally in the range An_{45-60}. Which is close to that of the Nain Plutonic suite, and the anorthosite tied to the Giant dykes (Figure 11) are obvious target for exploration for labradorite.

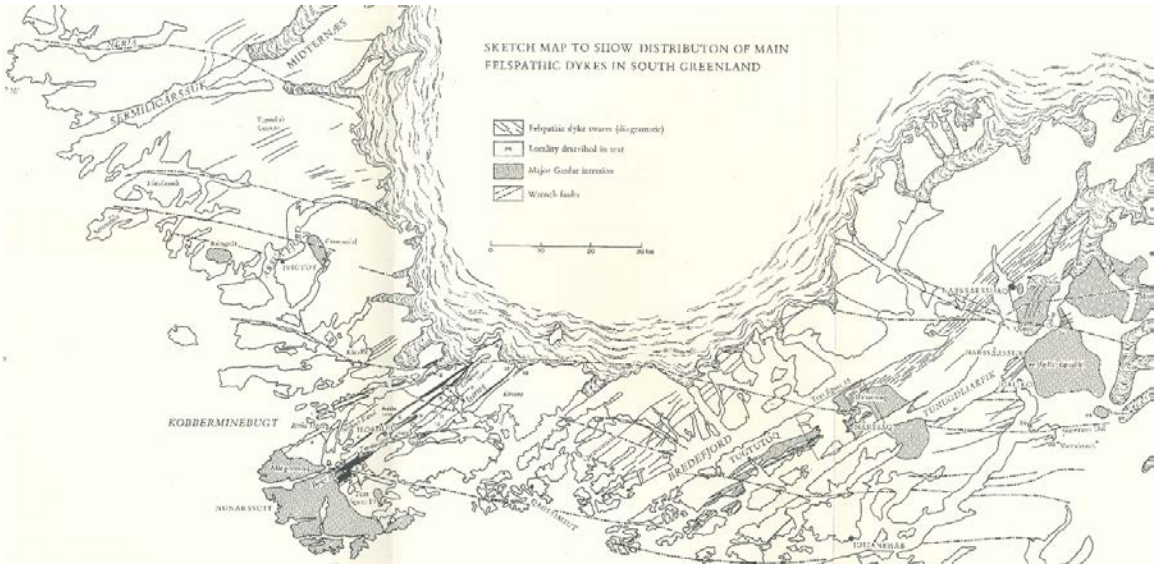

Figure 11 *Map of the distribution of feldspatic dykes in the Gardar Province. (Bridgwater & Harry 1968).*

Moonstone

Moonstone is another variety of exsolved feldspar-group minerals with an iridescent optical effect (or schiller). During cooling, orthoclase and albite separate into alternating lamellae (just as albite and anorthite in the case of labradorite). When light falls between these thin layers it is scattered producing the phenomenon in this case called adularescence. Upton found feldspar with adularescence in the Kûngnât intrusion (Figure 12). Upton (1960) note that the feldspars of the Ring-Dyke (Figure 12) display strong zonation from An_{62} in the most calcic cores to rims of cryptoperthitic alkali feldspar with an average composition of $An_{48,}$ Ab_{46} $Or_{6.}$ Accordingly, the Kûngnât intrusion is also an obvious target for exploration.

Figure 12 *Feldspar with iridescence/adularescence in the Kûngnât (photo C. Knudsen).*

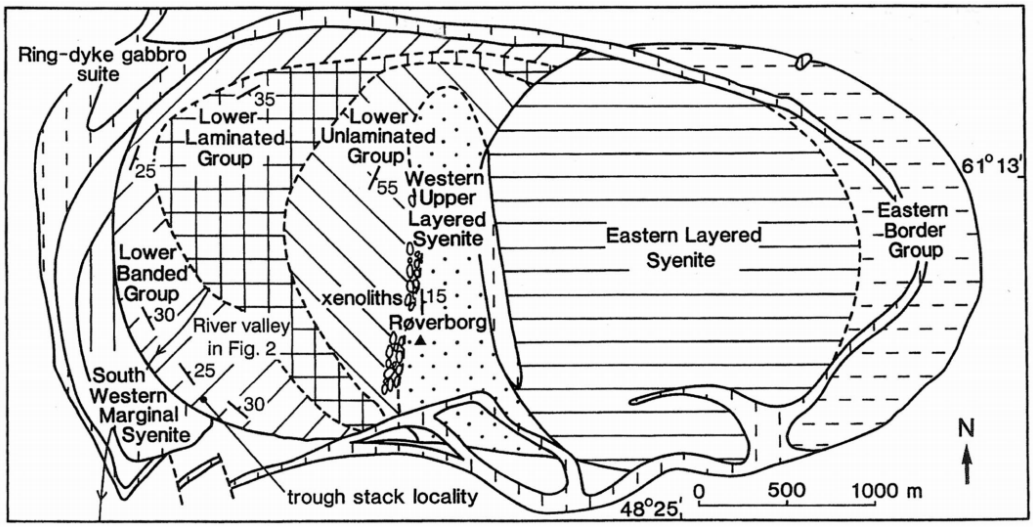

Figure 13 *Geological map of the Kûngnât intrusion (Upton et al 1985).*

Rapakivi

One of the more spectacular rocks in South Greenland is the rapakivi granite. It is reported to occur with very few fractures and likely to have good technical properties (Gothenborg 1994, Rasmussen 2003, Kalvig *et al.* 2002). The best locality sampled during this work is the island Angnikitsoq where the fracture density is low and the colour is good.

2019 activities

Given positive results of the 2018 field activities, it is anticipated that an excursion during the summer 2019, to selected sites, could attract potential investors/stakeholders. The excursion could as well be considered to include localities outside South Greenland, e.g. the light coloured anorthosite in the Søndre Strømfjord area, and the marbles around Agpat and Maarmorilik.

Further details on the 2019 activities will be included in the 2018-activity report.

The industry and contacts

Per Kalvig and Christian Knudsen visited the MARMO+MAC Tecnology Trade Fair exhibition September 27-29th, 2017, and a meetings were held with eleven organisations/groups (see Appendix 1). Based on the meetings we made the following conclusions:

- The present supply of blocks is more than sufficient to satisfy the market, and from that perspective there is no need for new quarries. However, the market is continuously looking for new products.
- For the same reason, most contacts emphasized that new quarries producing mainstream products are not likely to become viable.
- Quarry owners are divided into two groups: (i) Companies controlling the value chain from quarrying blocks to polishing of slabs and selling own products; (ii) Quarry owners exporting the blocks with no additional value added. It appears that the industry is very fragmented, although there is a trend towards consolidation and vertical integration. Several contacts reckoned the concept-(ii) to be the most suitable business concept regarding Greenland.
- Majority of the contacts have no clue about Greenland and consequently dimension stone quarry operations have at no time been considered. A PR-campaign on the favourable logistic, infrastructure and geological potential is required in order to catch the attention of this sector.
- That said, it was expressed several times, that products from Greenland could possess and 'additional' value to the products ('fair-trade; 'clean environment').
- Among the sample photos presented in the meetings, the majority of the contacts found that the greenish quartzite from Igaliko could be attractive for the market.
- One contacts were interested to learn more about the slates/phyllites potential.; follow-up on this request is in progress.
- Further there was interest in rocks with labradorite.

Concept budget

A concept budget has been developed in order to provide a first-hand indication of the financial implications and the viability a potential dimension stone operation in Greenland. The input figures for the concept are kindly provided by and discussed with Mr. O. Grage, E. Nielsen, Mekaniske Stenhuggeri, Copenhagen (personal comm. Dec, 2017).

The concept budget is considering the following assumptions:

- A workforce of nine workers and one supervisor/manager
- No permanent accommodation structures on site, given the proximity to local townships and settlements;
- Operational period: eight months per year (no production during winter)
- Production capacity: 600 meter cubic/month (full operational in year 3), which will classify this operation in the group of small producers
- Running costs increments: salaries: 2% pa; consumables and transport: 10% pa
- Four classes of saleable products (1. Low value; 2. Defected blocks; 3. Ordinary blocks; and 4. 1st Choice blocks. Obviously, the production will aim for production of high price classes. It is assumed that the latter will account for 10 %
- All blocks are shipped to Denmark/Europe for further treatment/export, by RAL. No considerations given to local transports from quarry to RAL-loading facility.

The concept budget is considered as conservative (attached in Appendix B). Indeed, a wide range of key parameters may have major influence on the viability of the operation, and a detailed project assessment is premature. However, the sensitivity of the concept budget to variations in some of the parameters is tested and their impacts on the Internal Rate of Return (IRR) and break-even is illustrated in the Figure 14 a, b, c, d. providing preliminary indications of the sustainability of this type of operations in Greenland.

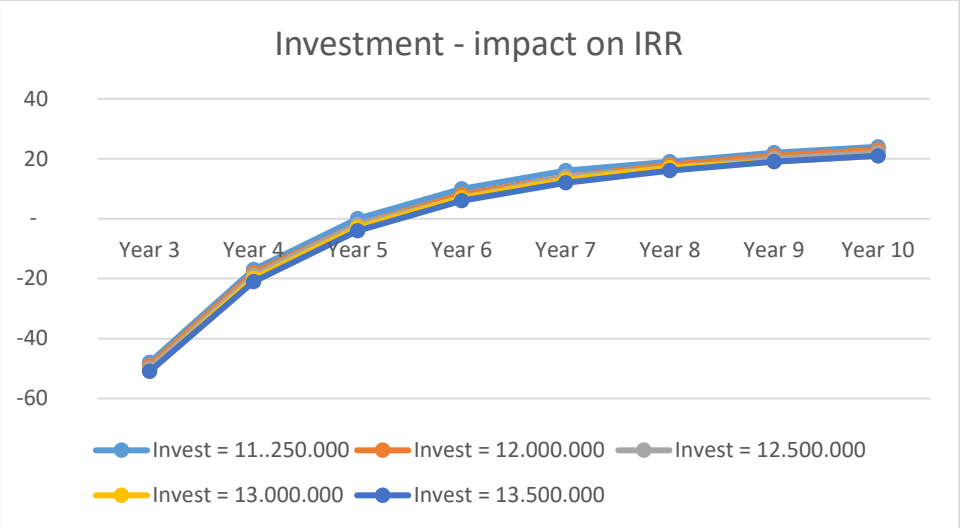

***Figure 13 a**: Variation in capital costs, varying from 11.25 – 13.50 Mio. Kr, results in break-even between four to five years, and marginal impact only on the IRR.*

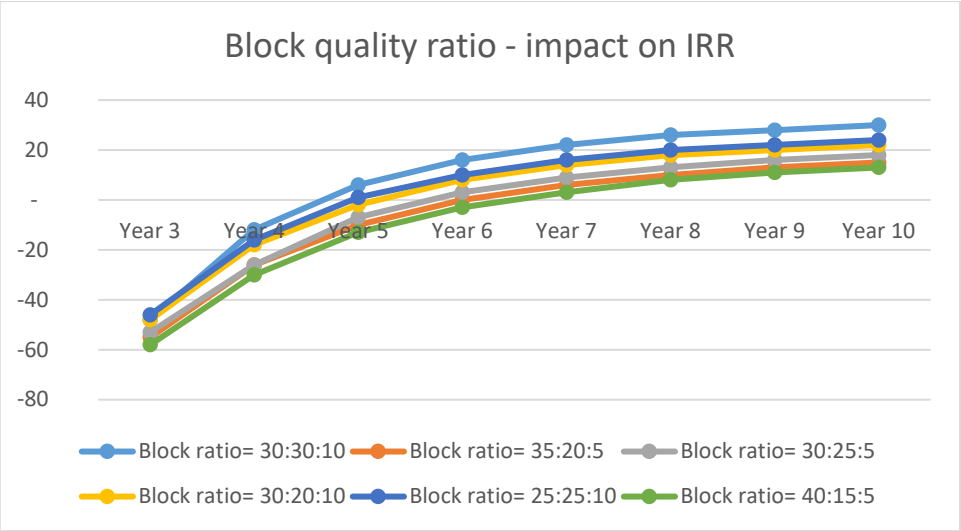

Figure 13b. *The percentage share of the three block classes are varied, and illustrates that low ratio of the high-quality blocks delay the break-even from with at least two years. As well the IRR(10 years), drops from about 30% to 10%.*

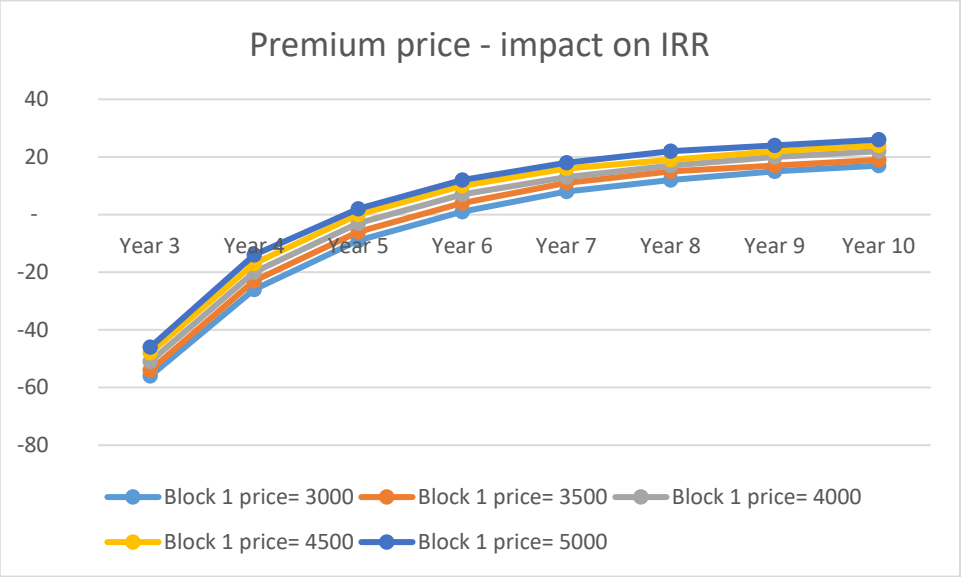

Figure 13c: *Variation in the premium price (1st Choice blocs) in the range from 3,000 kr/ton to 5,000 kr/ton reduces the break-even period with one year from about six years to five years, as well as a significant drop in the IRRR (from about 26% to 17%).*

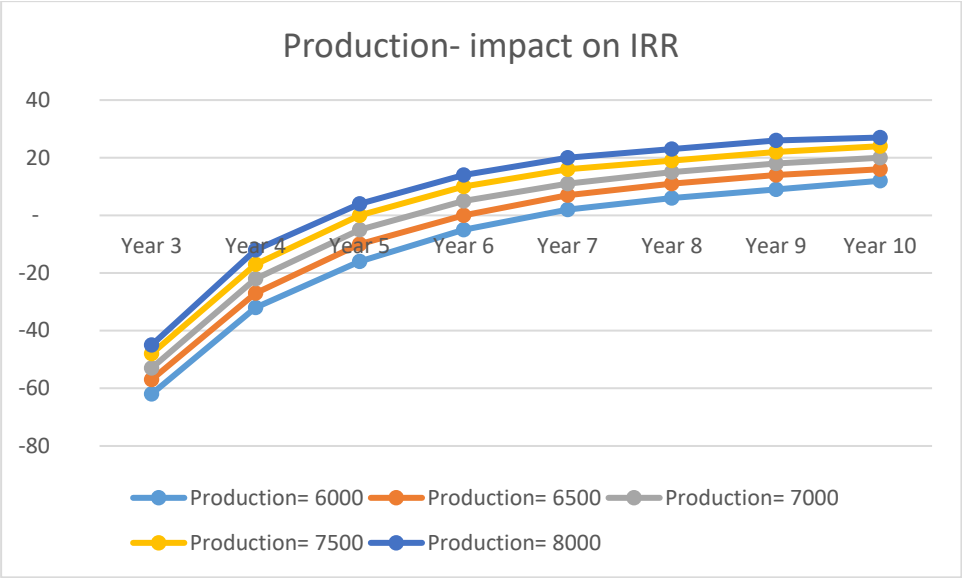

Figure 13d: *Improved production capacity from 6,000 ton/year to 8,000 ton/year reduces the break-even period from seven to 4.5 years, and significant improved IRR as well.*

This rather conservative concept budget indicates the viability for a dimension stone production in Greenland, with break-even period in the range of four to seven years, and the IRR over tone years in the range of 12 to 30 years. It should however be stressed, that the supreme condition for all estimates is based on the assumption that the blocks are attractive in the market.

References

Bridgwater, D. 1967: Feldspathic inclusions in the Gardar igneous rocks of South Greenland and their relevance to the formation of major anorthosites in the Canadian Shield. Canadian Journal of Earth Sciences, 4, 995-1014.

Bridgwater, D. & Harry, W.T., 1968. Anorthosite xenoliths and plagioclase megacrysts in Precambrian intrusions in South Greenland. Bull. - Grønl. Geol. Unders. 77 (also Medd. Grønl. 185 (2), 243 pp.).

Emeleus, C.H. & Upton B.G.J. 1976: The Gardar period in South Greenland. In A. Escher, W.S. Watt (Eds.), Geology of Greenland, Grønlands Geologiske Undersøgelse, Copenhagen 152-181.

Emslie, R. F., Hamilton, M. A., & Thériault, R. J. 1994: Petrogenesis of a mid-Proterozoic anorthosite-mangerite-charnockite-granite (AMCG) complex: Isotopic and chemical evidence from the Nain Plutonic Suite. *The Journal of Geology*, *102*, 539-558.

Gothenborg, J., Garde, A.A. & Bugnon, C.: 1994. Greenland ornamental stone resources. Open File Series. Grønlands Geologiske Undersøgelse 94/2 143 pp.

Heldal, T., Kjølle, I., Meyer, G. B., & Dahlgren, S. 2008: National treasure of global significance. Dimension-stone deposits in larvikite, Oslo igneous province, Norway. *Geology for society*, *11*, 5-18.

Kalvig, P., Knudsen, C. & Rasmussen, T.V. 2002: Potentialer for fa**c**adesten og skærver i Grønland. Danmarks og Grønlands Geologiske Undersøgelse Rapport 2002/11, 105 pp.

Knudsen, C., Wanvik, J., & Svahnberg, H. 2012: Anorthosites in Greenland: a possible raw material for aluminium? Geological Survey of Denmark and Greenland Bulletin, 26, 53-56.

Larsen, J.G. 1985: Dagbog over geologiske feltundersøgelser af granitter til facadesten I den sydlige del af Qaqortoq kommune. 8 pp.

Parsons, I., & Butterfield, A. W. (1981). Sedimentary features of the Nunarssuit and Klokken syenites, S Greenland. *Journal of the Geological Society*, *138*(3), 289-305.

Rasmussen, T. V. 2003: Dimension stone prospecting in West, South and East Greenland. Danmarks og Grønlands Geologiske Undersøgelse Rapport 2003/8, 60 pp.

Rasmussen, T. V. & Olsen, H. K. 2003: Dimension stone prospecting in West and South Greenland. Danmarks og Grønlands Geologiske Undersøgelse Rapport 2003/107, 67 pp.

Upton, B.G.J. 1960: The alkaline complex of Kûngnât Fjeld, South Greenland. Bulletin Grønlands Geologiske Undersøgelse, 27, 145 pp (also Meddelelser om Grønland, 123, Nr. 4, 145 pp).

Upton, B.G.J. 1964: The geology of Tugtutôq and neighbouring islands South Greenland. Pt. II. Nordmarkitic syenites and related alkaline rocks. Meddelelser om Grønland, 169, No 2. 62 pp.

Upton, B. G. J. 1964: The Geology of Tugtutôq and Neighbouring Islands, South Greenland: Part III: Olivine Gabbros, Syeno-gabbros and Anorthosites. Meddelelser om Grønland, 169, 1-47

Upton, B. G. J., Stephenson, D., & Martin, A. R. 1985: The Tugtutôq older giant dyke complex: mineralogy and geochemistry of an alkali-gabbro-augite-syenite-foyaite association in the Gardar province of South Greenland. Mineralogical Magazine, 49(354), 623-642.

Appendix A: Contacts

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Grupimar
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Email: mpacheco@grupimar.es
Grupimar is a trading company and directed us to their sources such as Lundhs, M+Q; Souther Quarries & Red Quarries.

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Larvik Granit produces c. 40% of the larvikite exported from Norway. Expressed their interests for dimension stone in Greenland.

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www.levantina.com
Production of dimension stone blocks from own quarries located in several countries.

Lundhs
Thor-Anders Lundh Håkestad, CEO,
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Mob: +47 913 15991
Email: *talh@lunds.no* web: *http://lundhs.no/*

Line Møller Mærsk, geologist (*line.moller.maersk@Lundhs.no*): Lundhs is the dominant producer of larvikite in Norway and have as well a production of labradorizing anorthosite from Sirevåd, and six types of granites and rappakivies from Finland. Rather keen to learn more about dimension stone projects in Greenland. Recommends to search for light coloured rocks.

M + Q Italia Spa
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M&Q is the mother company of Finstone, and therefore shared the booth.

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FI-23200 Vinkkilä, Finland
One of the largest producers. Over the last couple of years the company strategy has changes from block producers to vertical integrated producers producing a wide range of final products. Keen to learn more about Greenlandic dimension stone projects.

Southern Quarries/ SQ Group
Jose Luis Esteve (development)
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Keen interest in Greenlandic projects.

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www.ssqgroup.com
This group is specialised in producing roof-tiles. Keen interest to learn about Greenlandic phyllite potentials.

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www.segemar.gov.ar

Appendix B: Concept budget

Concept budget	Item	Unit	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Capital costs												
	Excavator 40 t	DKK (Mio.)	1.80									
	Loader 25 t	DKK (Mio.)	1.20									
	Generator 150 KW	DKK (Mio.)	0.25									
	Misc	DKK (Mio.)	2.00	1.00	0.50	0.50	0.50	0.30	0.30	0.30	0.30	-
	Quarrying equipm.	DKK (Mio.)	4.00									
Start-up costs		DKK (Mio.)	2,000									
Running costs	Labour	DKK (Mio.)	3.20	3.26	3.33	3.40	3.46	3.53	3.60	3.68	3.75	3.82
	Fuel + maintenance	DKK (Mio.)	0.50	0.55	0.61	0.67	0.73	0.81	0.89	0.97	1.07	1.18
	Consumables	DKK (Mio.)	0.50	0.55	0.61	0.67	0.73	0.81	0.89	0.97	1.07	1.18
	Transport											
	Grl- EU (Kr/ton)	DKK/t	400	440	484	532	586	644	709	779	857	943
	Block transport	DKK	0.16	0.88	3.63	3.99	4.39	4.83	5.31	5.85	6.43	7.07
	Marketing	DKK	0.50	1	1	1	1	1	1	1	1	1
Production	total	ton	400	2,000	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500
	Low value	%	50	40	40	40	40	40	40	40	40	40
	Defective blocks	%	35	30	25	25	25	25	25	25	25	25
	Ordinary Blocks	%	10	20	25	25	25	25	25	25	25	25
	Blocks 1 Choice	%	5	10	10	10	10	10	10	10	10	10
Product price	Low value	DKK/t	1,000	1,050	1,103	1,158	1,216	1,276	1,340	1,407	1,477	1,551
	Defective blocks	DKK/t	1,500	1,575	1,654	1,736	1,823	1,914	2,010	2,111	2,216	2,327
	Ordinary Blocks	DKK/t	2,500	2,625	2,756	2,894	3,039	3,191	3,350	3,518	3,694	3,878
	Blocks 1 Choice	DKK/t	4,500	4,725	4,961	5,209	5,470	5,743	6,030	6,332	6,649	6,981
Income		DKK (Mio.)	0.60	3.78	15.30	16.06	16.87	17.71	18.59	19.52	20.50	21.52
Result		DKK (Mio.)	**- 15.51**	**- 2.99**	**6.08**	**6.26**	**6.44**	**6.80**	**6.93**	**7.05**	**7.14**	**7.49**
Result sum.		DKK (Mio.)	**- 15.51**	**- 18.50**	**- 12.42**	**- 6.16**	**0.28**	**7.07**	**14.01**	**21.06**	**28.19**	**35.69**