5 General Background to Greenland and Project

Location of Nalunaq Gold Mine

Illustrated in Figure 5.1, Greenland, (Kalaallit Nunaat in Greenlandic, Grønland

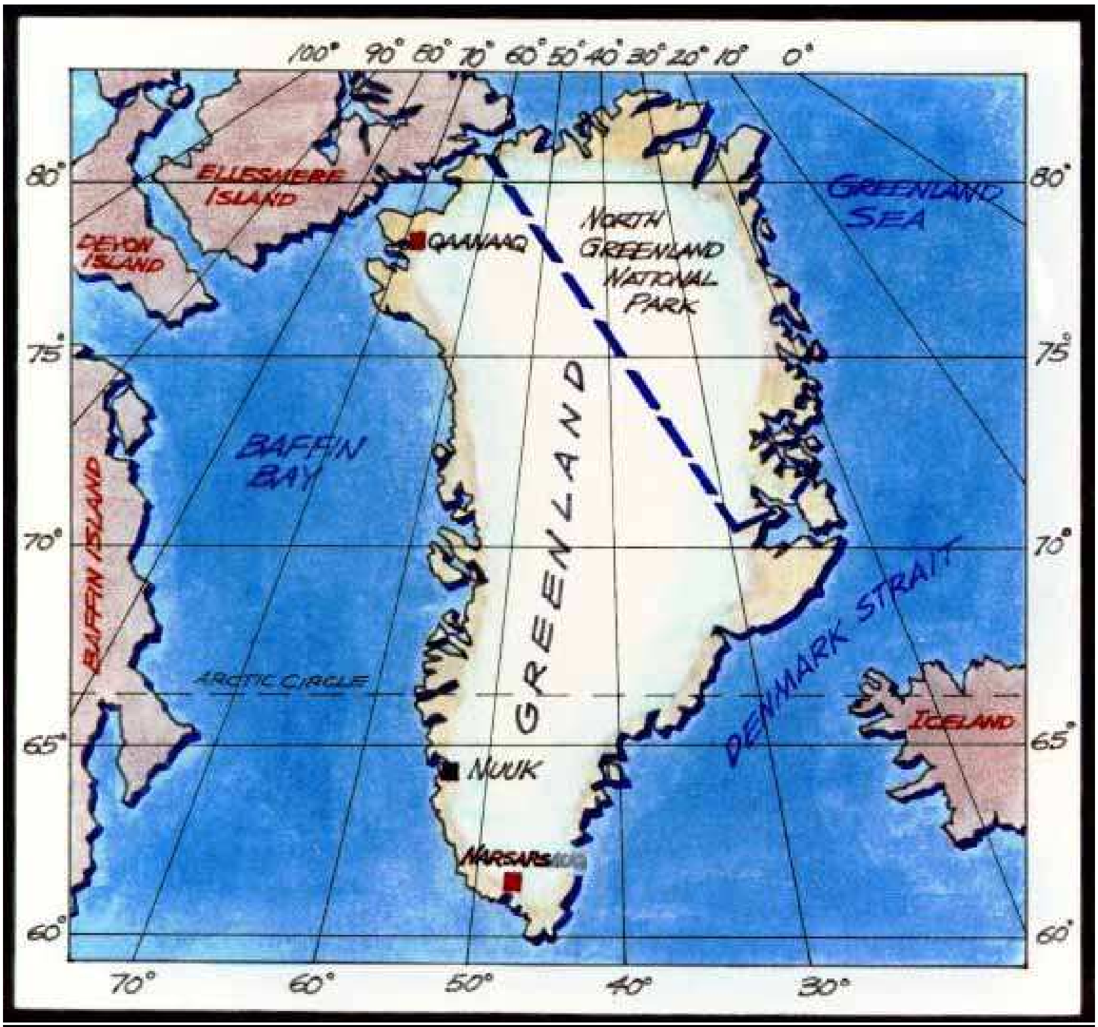

Figure 5.1 – Generalised Sketch-Map of Greenland

in Danish), is an internally self-governing part of Denmark, being a vast island situated between the North Atlantic and Arctic Oceans. Although geographically and ethnically an Arctic island nation associated with the continent of North America, politically and historically Greenland is closely tied to Europe, specifically Denmark and Norway. Greenland lies mostly north of the Arctic Circle and is separated from the Canadian Arctic Archipelago, to the west, primarily by the Davis Strait and Baffin Bay, and from Iceland, to the east, by the Strait of Denmark. The largest island in the world that is not also considered a continent, Greenland has a maximum length, from its northernmost point on Cape Morris Jesup to Cape Farewell in the extreme south, of about 2,655 km (1,650 mi). The maximum distance from east to west is about 1,290 km (800 mi). The length of Greenland's coast, which is deeply indented with fiords, is estimated at 5,800 km (3,600 mi). The total area of Greenland is approximately 2,175,600 sq km (840,000 sq mi), of which about 84 per cent, or some 1,834,000 sq km (708,000 sq mi), is ice cap which can be up to 3kms in thickness. Approximately one-twentieth of the world's ice and one-quarter of the earth's surface ice is found in Greenland. The weight of the massive Greenlandic ice cap has depressed the central land area to form a basin lying more than 300 m [1,000 ft] below sea level. It also contains The North Greenland National Park - the world's largest national park. The capital is Nuuk, formerly called Godthab.

As shown in Figure 5.2, the Nalunaq gold mine is located at latitude 60°21′ N,

Figure 5.2 - Mine Location Plan

and longitude 44°50′ W about 32km NE of Nanortalik in southern Greenland and to the west of the permanent ice-cap. The mine lies in the municipality of Nanortalik, in Kirkespirdalen, a broad glacial valley, about 8 km from the tidal, ice-free, Saqqaa Fjord. The Saqqaa Fjord joins the Søndre Sermilik Fjord, which together with Tasermiut Fjord form two deep 60-80 km NE trending fjords that extend from the ocean of the Davis Strait (in the southwest) to the Greenland ice cap (in the northeast). Figure 5.3 shows a

Figure 5.3 – General View of the Nalunaq Mine

general view of the existing facilities and the mine area including the mine camp, the access road to the portals and the portals themselves.

The area lies in the Municipality of Nanortalik in the region of South Greenland, which is part of the province of West Greenland for administrative purposes. The main towns of the Municipality are Nanortalik itself together with the smaller communities of Tasiusaq, Alluitsup Paa, Ammassivik, Narsarmijit and Aappilattoq. A 4m wide gravel road connects the mine site with the harbour facility at Sarqa Fjord 10km distant. There are no communities situated within a 15km radius from the mine.

Political and Economic Background

Vikings reached the island in the 10th century from Iceland. Norse Greenlanders submitted to Norwegian rule in the 13th century and in 1536 it became a Danish dependency, along with Norway under the Kalmar Union which existed until 1814. At that time, the kingdom of Denmark-Norway found itself on the losing side of the Napoleonic Wars. In gratitude to Sweden for assistance in defeating Napoleon (and as a consolation for the recent loss of Finland to Russia), mainland Norway and certain Norwegian territories were transferred to Sweden — thus, the personal union of Norway and Denmark ended. The dependencies of Greenland, Iceland and the Faroe Islands, however, remained part of the re-organised "Kingdom of Denmark" and Danish colonization began.

In the early 20th century, the United States was believed to have claims made possible by the discoveries and exploration of the Peary expeditions.

In 1933, Norway attempted to claim eastern Greenland. The Permanent Court of Arbitration decided that the entire island belonged to Denmark and Greenland was made an integral part of the Kingdom of Denmark in 1953. Greenland was granted self-government in 1978 by the Danish parliament and the law went into effect on May 1st 1979. Denmark continues to exercise control of Greenland's foreign affairs in consultation with Greenland's Home Rule Government. Greenland joined the European Community (now the EU) with Denmark in 1973, but Greenlandic voters subsequently chose to leave the European Economic Community upon achieving self-rule and withdrew in 1985 over a dispute centred on stringent fishing quotas. The Queen of Denmark remains Greenland's Head of State. The Queen's government in Denmark appoints a High Commissioner (Rigsombudsmand) representing the Danish government and monarchy. Greenland is a parliamentary democracy within a constitutional monarchy and has an elected parliament of thirty-one members operating over 4 year terms. The head of government is the Prime

Minister, who is usually the leader of the majority party in Parliament. Two representatives are elected to the Danish Parliament. Foreign affairs are Denmark’s responsibility, but Greenland actively participates in international agreements relating to Greenland. Defence is the responsibility of Denmark. The laws of Denmark, where applicable, apply.

Fishing, sealing, and fur trapping are the principal economic activities in Greenland, which must rely on large amounts of financial support from Denmark. The fish catch is primarily cod, shrimp, and salmon; fish processing is the major manufacturing industry. Agriculture is only possible on one percent of Greenland's total area. Cattle, sheep, and goats are raised in small numbers in some portions of the south-western coast, and hardy vegetables are grown. Denmark is Greenland's largest trading partner, and its main exports are fish, hides and skins, and fish oil. Thule Air Base in the north supports a community of American and Danish civilian and military personnel.

The economy remains critically dependent on fishing and exports of fish, with the shrimp fishing industry being the largest income earner. There has been a increase of interest in hydrocarbon and mineral exploration opportunities and these sectors will provide an increasing contribution to the Greenlandic economy. The increased interest in tourism offers potential for growth but is limited by the short season and high costs. The public sector, including publicly owned enterprises and the municipalities, plays the dominant role in the economy. Around half of Government revenue is provided by grants from the Danish Government and this forms an important supplement to the Gross Domestic Product (GDP). Greenland’s per capita GDP (at US$20K in 2001 – latest available figure) is roughly equivalent to that of the weaker economies of Europe.

Greenland suffered economic contraction in the early 1990; but since 1993 the economy has improved. The Greenland Home Rule Government has pursued a tight fiscal policy since the late 1980s which has helped create surpluses in the public budget coupled with low inflation. The present period of world economic recession is adversely affecting Greenland in common with most other world economies.

Recent Political Progress Towards Independence

In a move following a referendum on greater autonomy in November 2008, Greenland is assuming self-rule, in the latest step towards independence from Denmark, which will see the nation take a greater share of revenues from its natural resources. The Home Rule Government is taking control of the police and the courts and Kalaallisut (Greenlandic) becomes the official language. Denmark however retains the final say in defence and foreign-policy matters. This new self-rule system will take the nation to full independence and Greenlanders will be treated as a separate people under international law. The new coalition government hopes the anticipated increase in revenues from minerals from mines such as Nalunaq and Black Angel will help to fund a final breakaway from Copenhagen. Many political analysts, however, feel that any move towards full independence is likely to be put on the backburner by the government as the new Prime Minister Kuupik Kleist, pictured in Figure 5.4, has vowed to first concentrate on tackling the major social problems, such as alcoholism, domestic violence and a high suicide rate. As noted above, Greenland currently relies heavily on subsidies from the Danish government and this subsidy system is likely to remain in the longer term.

Figure 5.4 – Greenland Prime Minister – Kuupik Kleist

Greenland was formerly the world's main source of natural cryolite, a mineral used in the manufacture of aluminium, but by the late 1980s, reserves at the Ivittuut mine were exhausted. Deposits of coal, iron ore, lead, zinc, silver, molybdenum, diamonds, gold, platinum, niobium, tantalite, olivine, graphite and uranium are known to exist and there are prospects for hydrocarbon resources. Lead, zinc, silver, gold, coal, graphite, olivine and others minerals have been exploited in the past. In addition to the Nalunaq Mine, Angus & Ross plc have obtained a mining licence to exploit the Black Angel Mine at Maarmorilik in West Greenland and plan to reopen the mine in 2010. These two mining operations will make a major contribution to Greenland economy for a number of years. Apart from the obvious direct financial contributions to the country's revenues, the project will provide direct employment together with subsequent knock-on economic opportunities for the people and country both locally and nationally.

Greenland has a favourable economic environment for mining companies which includes the following attractive features:

- No royalties to pay;
- Corporation Tax of 30%;
- Free depreciation;
- Indefinite loss carry forward;
- Dividends declared before tax;
- National Insurance charge of 0.8% of wages and salaries;
- Extendable exclusive mineral licences given for 5 year periods;
- Mining licences given for 30 years;
- Straight forward accounting rules; and
- Greenland levies no Value Added Tax (VAT).

Geographical

Greenland consists of an interior ice-covered plateau surrounded by a mountainous, generally ice-free, rim. The interior ice cap varies in thickness, measuring 3,000 m (9,800 ft) in the centre of the island. Underneath the ice cover are the ancient rocks of the Greenland Shield, which is geologically related to the Canadian Shield. The greatest heights of land are along the eastern coast, where the extreme elevation is Gunnbjørn Fjeld (about 3,700 m/12,000 ft). Drainage is afforded mainly by the so-called ice fjords, in which glaciers from the ice caps pass through valleys to the sea, where they form thousands of icebergs each year. The climate is extremely cold, but during the short summer in the south the mean temperature is 9° C (48° F). The mammals of Greenland are more American than European, and include the musk-ox, wolf, lemming, and reindeer.

The continental ice sheet which occupies most of the centre of Greenland retreated from the Kirkespir Valley several thousand years ago. Consequently the terrain is dominated by geologically young glacial landforms. These have been augmented by immediate postglacial processes such as the formation of talus (scree). Modification by processes of the present sub-arctic climatic regime is taking place, predominantly fluvial and mass wasting. The valley floor now contains a braided river whose alluvium gives a flat base to the valley. There are numerous active slope processes such as debris flows and probable continued movement of rock glaciers. Frost shattering is continuing but probably at a lower rate than in the immediate post glacial period.

Climate

The Greenlandic climate is arctic to sub-arctic with cool summers and very cold winters. Mean temperatures do not exceed 10° C (50° F) in the warmest summer months. In the southern part of the country and the innermost parts of the long fjords, the temperature can, however, rise to more than 20° C (68° F) in June, July or August. The sea around Greenland affects the climate on the land. The stretches of coastline close to the open sea, in particular, are cooled by the sea. Therefore during the summer months it is warmest and driest in the middle of the country, which lies closest to the ice sheet. In all parts of the country the weather is locally changeable and can vary from fjord to fjord and from one valley to the next. The air is generally very dry in Greenland in relation to many other countries, and because of this low humidity the low temperatures do not feel as cold as might be expected. Many days are completely calm with calm seas and glassy fjords and lakes. However, the wind can pick up and certain areas can experience so-called föhn winds, which are often preceded by lens-shaped clouds and are usually warm from the southeast which can be very strong with gusts of more than 50 m/s (111 mph), usually followed by precipitation. During the winter the wind can increase the effect of the cold with a high wind chill factor. Greenland is not completely devoid of rain, but heavy rain is rare. Rainfall levels are generally a little higher in the south than in the north. For example, Nanortalik in the south has 900 mm (35 inches) of rain a year, whilst Upernavik in the north averages just 200 mm (8 inches) of rain a year. In fact there is less rainfall in Northeast Greenland than in the Sahara, and thus the expression "the Arctic desert" has arisen. Quantities of snow also vary locally, but it is not unusual to see large amounts of snow in many towns from December to March.

Temperatures in Greenland

The temperature in Greenland is highly dependent on location and season. The mean temperature remains below +10° C (50° F) in June, July and August in just about every town in Greenland, whilst all places are below freezing from November through to April. Conversely, the winter is particularly cold in the very north of Greenland, for example in Upernavik, where the thermometer shows an average of -20° C (-4° F) in February.

Greenlandic Mean Temperatures

There can be large fluctuations in mean temperatures from day to day; for example in the summer months there are several places in Greenland where day temperatures can exceed 20°C. In Qaqortoq in South Greenland the winter is mild with -5.5°C as the coldest mean temperature, whilst the mean temperature remains above freezing from May to October. In Kangerlussuaq on the Arctic Circle it is cold during winter with a mean temperature as low as -22°C, yet during the summer it is the warmest place in Greenland with mean temperatures of around +11°C in July.

Climate at Nalunaq

The climate at Nalunaq tends to show an average annual temperature just above 1°C, with July the warmest month at 10°C and February the coldest at -9°C. Daily maxima and minima may be considerably higher or lower than this respectively. The two dominant wind directions are north and south each representing around 20 -25% of the time. This is due to the funnelling effect of the north-south orientated Kirkespir Valley. Calm conditions occurred abound 20% of the time. A mountain valley phenomenon whereby differential warming of air masses causes winds to blow down the valley sides so that strong gusts may occur from all directions. The dominant persistent local wind system is the katabatic system generated by the Greenland icecap, in which the density difference between cold, dense air at the top of the icecap and the warmer, lighter air at sea level drives a downward flow of air through the fjords. The temperature of this air will increase as it descends to sea level because of the greater pressure there under the Föhn effect. If the incoming air has warmed to the temperature of the air already present, then minimal outflow occurs. However, if the air coming off the icecap is still cooler and denser than that over the fjord, strong outflows can develop. The mine site is generally windier than Nanortalik, although the wind direction at Nanortalik is more variable. Precipitation at the mine is almost double that of the town, with slightly lower air temperatures.

Conditions at the Harbour Facility

Saqqaa Fjord is physically similar to many coastal fjords in Greenland and other parts of Northern Europe. It varies between 2.5 and 4 km wide, and is about 45 km long, covering an area of some 160 km^2. The average depth of the fjord is some 140 m. The fjord is subject to strong winds, which originate in the open ocean or from the katabatic system associated with the Greenland ice-cap. In general, winds are strongest in the winter and are strongly directional, north and south, blowing up or down the fjord. The offshore winds can significantly affect the movement of sea ice and polar ice, carried to the mouth of the fjord by the cold East Greenland Current. This can create ice-bound conditions around the mouth of the fjord at Nanortalik and the winds can also drive larger ice-bergs up the fjord as far as the mouth of Kirkespir River. Tidal flows within the fjord are strongly diurnal and relatively large with a tidal range of about 3.6 m. The sea is usually ice free so that the year-round shipments of supplies and consumables is possible.

Population and Demographics

The CIA World Factbook gives the following information.

Greenland has a population of 57,600 (estimated at July 2009), of whom 88% (2000 est.) are Greenlandic, (a mixture of Kalaallit Inuit and Greenland born Europeans). The remaining 12% are mainly Danish Nationals. The majority of the population is Evangelical Lutheran. Nearly all Greenlanders live along the fjords in the south-west of the main island, which has a relatively mild climate.

The Age structure of the population is (2009 est.):

- 0-14 years: 23% (male 6,926; female 6,597)
- 5-64 years: 70% (male 21,696; female 18,699)
- 65 years and over: 7% (male 2000; female 1975)

Median Age (2009 est.)

- Total: 33.5 years
- Male: 34.9 years
- Female: 31.9 years

Population growth rate: 0.062% (2009 est.)

- Birth rate: 14.79 births/1,000 population (2009 est.)
- Death rate: 8.23 deaths/1,000 population (2009 est.)
- Net migration rate: -5.99 migrant(s)/1,000 population (2009 est.)

Sex ratio (2009 est.):

- at birth: 1.05 male(s)/female
- under 15 years: 1.03 male(s)/female
- 15-64 years: 1.16 male(s)/female
- 65 years and over: 1.01 male(s)/female
- total population: 1.12 male(s)/female (2009 est.)
- Infant mortality rate: 10.72 deaths/1,000 live births

Life expectancy at birth (2009 est.):

- total population: 70.07 years
- male: 67.44 years
- female: 72.85 years

Total fertility rate: 2.19 children born/woman (2009 est.)

Nationality:

- noun: Greenlander(s)
- adjective: Greenlandic

Languages: Greenlandic (Kalaallisut - East Inuit language), Danish, English

Employment
- Labour Force 32120 (2004)
- Unemployment Rate 9.3% (2005 est)

Literacy
- Definition: Age 15 and over can read and write
- Total Population: 100%
- Male: 100%
- Female: 100%

Settlement and Occupations

Over 15,000 of Greenland population live in the capital Nuuk.
The other main Greenland towns are:

- Sisimiut Pop. 5,350
- Ilulissat Pop. 4,533
- Qaqortoq Pop. 3,144
- Aasiaat Pop. 3,100
- Maniitsoq Pop. 2,859
- Tasiilaq Pop. 1,848
- Paamiut Pop. 1,817
- Narsaq Pop. 1,764
- Nanortalik Pop. 1,509
- Uummannaq Pop. 1,366
- Qasigiannguit Pop. 1,320
- Upernavik Pop. 1,178

Nalunaq lies within the Municipality of Nanortalik. Nanortalik is Greenland's most southerly town and is located in a scenic area consisting of picturesque fjords, small woodlands and steep mountainsides. The Municipality of Nanortalik runs from the island of Qeqertarsuaq over Cape Farewell to the 60km long Lindenow Fjord on the east coast, giving a total area of approximately 15,000 km^2. Nanortalik is the tenth largest town in Greenland located about 100 km north of Uummannarsuaq, the southern tip of Greenland. Nearby settlements are Narsaq Kujalleq, Alluitsup Paa, Tasiusaq, Aappilattoq, Ammassivik as well as the following settlements with no more than 20 inhabitants each: Saputit, Nalasut, Nuugaarsuk, Akuliaruseq, Qallimiut, Qorlortorsuaq, Alluitsoq, and the weather station Ikerasassuaq. The primary occupations are seal hunting, fishing, service and administration. The district around Nanortalik is home to 2,200 people distributed between the town itself, five settlements and a number of sheep-holding stations. In addition to the well-preserved old quarter, Nanortalik boasts a characteristic wooden church from 1916 and an open-air museum consisting of several buildings (Figure 5.5). The name Nanortalik means *"place of polar bears"*.

Figure 5.5 Nanortalik

Nanortalik has little productive trade. There are no factories and no large-scale fishing activities as sea ice prevents fishing for several months a year. Small-scale fishing, crab fishing, seal and seabird hunting and tourism provide most of the locally produced revenue. The Nalunaq Gold Mine has been a major employer since it opened. Many years, a graphite mine operated some 20 km from the town.

6 Geological Setting

The geology of SW Greenland is dominated by the Ketilidian Mobile Belt, which forms a Paleoproterozoic continental accretion to the Achaean core of south Greenland. The Julianehaab granite forms a Cordillera-type marginal batholith complex to the north, whereas the south is composed of flat-lying migmatitic metasediments termed the Psammite Zone. The gold mineralisation is hosted in the Psammite Zone, which include enclaves of epiclastic molasse sediments from the Cordilleran Mobile Belt, found in graben-like structures in the Nanortalik peninsula, and large areas of high-grade micaceous migmatites, with several generations of late and post orogenic granites. Gold mineralisation occurred after the peak regional metamorphism (between 1850-1750 million years ago), which transformed the host metabasic rocks, mostly pillow lavas and dolerite sills, into black amphibolites with a well-developed foliation fabric. This metamorphism clearly predates the gold mineralisation as its associated alteration fabric crosscuts the amphibolite fabric. The gold mineralisation is spatially associated with a pronounced calc-silicate alteration selvage and clearly developed in equilibrium with the calc-silicate alteration within the rest of the metabasic package. Several generations of aplite dykes, which cross cut and offset the mineralisation, provide good constraints on the timing of the gold mineralising event. The metabasic nappes in the Nanortalik district were invaded by granite batholiths towards the end of this metamorphic event, which separated the possibly once inter-connected nappe sheets. A pronounced marker horizon, consisting of a thick massive-sulphide graphite-chert sequence at the base of the metabasic package, is found at Nalunaq and also in Ippatit, Lake-410 as well as at the Kangerluluk occurrence on the SE Coast of Greenland, suggesting that this stratigraphy has a wide lateral extent.

Geology of the Nalunaq Area

The gold mineralisation at Nalunaq is hosted in a package of metabasic rocks including metadolerites and fine-grained amphibolites, and is often spatially related to the contact between these. The metabasic complex is underlain and partially intruded by granites to the south, whereas to the north it is underlain by meta-arkoses (molasse sediments). The granites comprise several generations of medium-grained calc-alkaline granite to porphyritic alkali feldspar granite, which intruded the metabasic rock package during the waning stages of the orogeny. Aplite dykes cross cut the metabasic rocks in several major directions. These dykes are believed to be associated with and derived from the granites.

The metabasic rock sequence consists of a lower unit of micaceous schists, presumably metapelites interbedded with calcareous units including thin marbles. The full thickness of this unit is unknown as it is tectonically bordered against the underlying meta-arkoses. This mica-schist sequence is overlain by a thick package of chemical sediments, most notably interbedded graphitic schists and thick pyritic cherts. Massive sulphide horizons up to 20-30 m thick occur at several horizons within this package.

Overlying the sulphidic graphite–chert sequence is a thick metabasic rock sequence, which forms the bulk of the Nalunaq sequence. This package is in excess of 400 m thick and includes fine-grained amphibolite, medium-grained tuffs and metadolerites. The metabasic rocks pass into a sequence of volcanoclastics and ash tuffs. These units occur in a thin slice on the Nalunaq Mountain and in the valley floor towards the east. The top of the sequence in the Nalunaq area is a series of volcanic agglomerates and conglomerates, which show clear evidence of being water lain. The conglomerates occur in the eastern slopes of the main valley, towards the Kirkespiret Mountain.

The main lithologies associated with the gold mineralisation at Nalunaq are as follows:

- Fine-Grained Amphibolite: Metabasalt

  This is the predominant rock at Nalunaq, and is a dark green to black, fine-grained amphibolite with occasional relict pillow structures. It has a grain size of <0.5 mm and consists of hornblende, (clino-pyroxene) and oligoclase, with minor amounts of quartz, biotite and calcite. Sulphides are mainly pyrrhotite and pyrite with minor chalcopyrite. Biotite-rich layers within these rocks are interpreted as inter-pillow sediments and the possible products of secondary potassic alteration.
- Medium-Grained Amphibolite: Metadolerite

This is a coarser grained dark green to black amphibolite with grain size varying from 1-3 mm, and is found interbedded with the fine-grained amphibolites. The major minerals are amphibole and plagioclase with minor pyroxene and sericite.

- Aplites

Aplite dykes occur abundantly on the surface, criss-crossing the mountain, following both flat-lying and steep orientations. The aplites are usually fine to medium grained and composed mainly of quartz and feldspar, with subordinate biotite, which gives a 'peppered' appearance.

- Pegmatites

These are coarser grained felsic dykes, which have a very similar mineralogy to the aplites.

Ore Deposit

The gold mineralisation at Nalunaq is a mesothermal vein-type gold deposit, hosted in amphibolite-facies metabasic rocks. The gold is associated with sheeted quartz veins, hosted in a large-scale shear structure, which appears to relate to regional thrusts. However, possibly due to extensive post-mineralisation deformation there is no direct relationship between gold grade and amount of quartz. The veins consist of equigranular, white to grey quartz with stripes and bands of diopside and anorthite. Locally in the lower portion of the developed area, garnet and calcite are also found along with pink k-feldspars. Sulphides are rare and only traces of pyrite and pyrrhotite are seen. Within the contact rock minor arsenopyrite (FeAsS2) and lollingite (FeAs2) are present.

The quartz is medium to fine grained and clearly shows several generations of crystallisation and recrystallisation. Gold often forms small isolated grains measuring from 3 mm to sub-micrometre (ìm) size. The typical gold grains measure 100-200 ìm and occur largely as separate grains. A particularly fine-grained gold is seen in many parts of the vein. This has a very fine spongy texture with a homogeneous distribution, and its very large surface area is amenable to leaching. Where the spongy gold appears it constitutes a significant portion of the available gold.

7 History of Mining at Nalunaq

Timeline of Mining at Nalunaq

The time-line of mining activity through the proposed restart of operations and shipment of the first doré and up to installation of the CiP process and full production from the mine is given below.

- Deposit discovered in 1992;
- Extensive geological investigations were carried out including a total of 4,600 m of tunnelling and 15 km of diamond drilling.
- Feasibility study and an Environmental Impact Assessment submitted.
- Mining commenced on July 1st 1994 by Nalunaq I/S, which was initially a joint venture between the state owned mining company Nuna Minerals and the Canadian mining company Crew Development Corporation but which became 100% owned by Crew Gold;
- Nalunaq placed on care and maintenance on September 30, 2008 on the basis of the uneconomic nature of the resource;
- Crew concluded the sale of Nalunaq Gold Mine including all the assets, infrastructure, inventories and goodwill to Angus and Ross plc, the effective date being 1st July 2009;
- *Completion of licensing and statutory requirements with BMP by Angus & Ross – October 2009;*
- *Reopening of the mine and refurbishment of the operation – October 2009;*
- *Production of gold doré bullion –December 2009;*
- *First shipment of gold doré bullion– December 2009; and*
- *Provision of CiP plant process – March 2010.*

Mining and Processing History

During the operations of Crew Gold, Nalunaq posed considerable challenges due to the simple, yet difficult, geometry of the Main vein. The most challenging factors included a narrow vein width of 0.7 meters and a 30° - 40° degree dip. The narrow width called for a high degree of drilling and blasting accuracy to prevent dilution and also required additional rock handling activities to ensure all the ore was successfully transferred to the bottom of the stope for mucking and cleaning. The preferred mining method was long-hole mining, which comprised drifting horizontally along the strike at 11m vertical spacing, resulting in ore blocks of about 14m - 16m length on dip. The ore drifts were either mined as a whole face or in two cuts separating the ore and the waste. This block was then subdivided into 14m wide stopes between 1.5m rib pillars. Each block was opened with a short raise along one pillar and then blasted using long blast holes drilled either from the top or the bottom. Following stoping and removal of the ore, the stope was cleaned of any residual fine ore, some of which was at high grade. Development waste from the ramp and the waste from the mining method was placed to external surface dump. Initially waste rock was used to build and expand the portal areas, as fill for laydown areas or as a base for ore stockpiles. A waste rock dump was created on the valley side from the 350 m level entry, extending up the valley.

Due to the review of resources during 2008 and because there was only a single ramp access area with limited strike length, the rate of mining was not expected to exceed 300 tonnes per day (tpd). With the cost structure and camp infrastructure in place, it was decided that the operation would not be profitable at current gold prices. This resulted in a decision to suspend operations and move to care and maintenance with a view to seeking a suitable buyer.

The Crew Nalunaq operation had no processing facility on site. During the first years of operation, ore from Nalunaq was processed at the El Valle plant of Rio Narcea Gold Mines Ltd in Spain. In October 2006, Crew acquired the Nugget Pond processing plant in Newfoundland, Canada. Following refurbishment of the plant, ore shipments to Nugget Pond commenced in February 2007. During the Crew period of operation from mid-2004 until the end of 2008, the mine produced about 308,000 ounces of gold.

Environmental and Compliance History

Four main instances of instances of non-compliance were highlighted during the various inspections taken by BMP during the period of Crew's ownership and operation of the site. The first noted is the most serious.

- Major spillage of diesel fuel and oils at the generator and compressor station at the 350m level surface portal;
- Equipment disposed of underground was found to still contain hydraulic oil which should have been drained before equipment disposal. Two of the equipment cores found underground contained 45 to 90 litres of hydraulic oil each. This oil must be removed. More care must be taken in the future;
- BMP noted on occasion that the bunding around fuel tanks contained a quantity of water, presumably from precipitation, which compromised the capacity of the bunding to contain any extreme release of fuel from the tanks; and
- There were some instances noted of the poor operation of the sewage treatment system which may have allowed some polluted discharge into the river.

Pollution from the Previous Operations

The first of these above can be seen as a serious incident which was highlighted on several occasions by BMP, the latest in late 2008 and resulted in written enforcement action being taken by BMP. However, the remaining visual evidence which is extremely noticeable at the 350m level compressor station of spilled fuel, and which has been identified in A&R's initial surveys, shows that the necessary and appropriate clean up action was never taken by the Crew management. It is A&R's intention that this area of polluted ground will be excavated and dealt with appropriately as part of their overall up-grade of the mine.

The NERI Environmental Monitoring Reports for the operation for 2006, 2007 and 2008 give a comprehensive picture of the effects of the operation.

In summary, elevated concentrations of copper, chromium, arsenic and cobalt above natural background levels have been identified found in lichens at the waste rock dump and in the camp area. All metal concentrations showed a significant decrease with increasing distance from the road with elevated concentrations found to a distance of about 1000 m from the road. No elevated concentrations were found in mussels and sculpins in the marine environment near the harbour, while seaweed had slightly elevated concentrations locally. The impact from the mine was primarily on the Kirkespir Valley and originated from dust dispersal. The impact in the marine environment was very low and appears to have stabilised around the baseline level. Arctic char livers showed no elevation in metal concentrations.

Other Mining in Greenland

The following have been the major mines in Greenland with their operational periods:

Ivittuut:	Cryolite	1854-1987
Mestersvig:	Lead, zinc	1956-1963
Maarmorilik:	Lead, zinc, silver	1973-1990 (Black Angel Mine)
Nalunaq:	Gold	2004-2008

There are also a number of other smaller former mining sites where various minerals including coal, marble, graphite and other materials have been mined or quarried.

The minerals sector is probably the sector that is showing the most tangible signs today of being a growth sector in the country. The present heightened interest levels in exploration for minerals in Greenland has resulted in the identification of potential economic mining opportunities at several locations.

There is currently one active mining operation in Greenland at the Seqi Olivine Mine at Maniitsoq Municipality.

Greenland might become home to up to five new mines over the next years. In addition to the re-opening of A&R's Black Angel Mine at Maarmorilik and the Nalunaq Gold Mine which is the subject of this study, these include a very large molybdenum mine in East Greenland, ruby mining at Fiskenæsset, south of Nuuk, a eudialyte mine at Narsaq, and a diamond mine in the region between Kangerlussuaq and Nuuk. In addition to these, there are potential new mining projects to extract gold, palladium, platinum, niobium, tantalum, zinc and coal.

8 Hours of Operation and Manpower

Manpower

It is anticipated that the mine will employ approximately 65 - 70 people. Because of the relative remoteness of the location, personnel will live at the Nalunaq mine camp base during their work period. A maximum of around 70 people will live on site at any time. The personnel will be employed on a rolling shift system including day and night shifts which will also make allowance for rotation away from the site and travel back home. The shift pattern and working periods and the rotation periods for on and off site have not yet been finalised. However, the on/off site rotation system is likely to be:

- Locally based personnel: 2 weeks on + 1 week off
- Expatriates: 6 weeks on + 3 weeks off

Employment in the underground mine itself is likely to be predominantly males. Employment on the surface will not be gender specific. Welfare facilities for both sexes will be equally available at the Nalunaq camp.

Hours of Operation

The mine will operate on a 24 hours per day and 7 days per week basis.

9 Background to the EIA

Background to the Environmental Impact Assessment (EIA)

As noted in Chapter 1, the Environmental Impact Assessment (EIA) is used to evaluate the potential impacts on the environment and the community, of proposed developments and its overall aim as part of a feasibility study is to minimise negative impacts. The EIA can also help the financial institutions and statutory government regulatory bodies to evaluate the environmental and social effects of a project.

The ESIA can be utilised by the developer to aid a feasibility study, by highlighting possible environmental or social problems or risks, which can then taken account of in the projects design. The EIA can be used to show that the mine has been designed in a sustainable manner, with appropriate control and mitigation measures incorporated from the outset.

Consultation with the local community is a major component of the EIA and separate SIA in order to ensure that the project design and plan of operation takes account of the views and wishes of the local community. Consultation with the relevant statutory authorities is also undertaken.

The EIA will consider both the positive and negative effects of the project, together with the residual effects, after proposed mitigation measures have been taken into account.

Summary of Previous Environmental Work

As noted seen in Chapter 9 there is a good deal of published data, analysis and research available dealing with the operations of Crew's operations at Nalunaq and the environmental and pollution impacts and effects consequential to the methods of operation and processing. NERI have carried out a great amount of testing and analysis of environmental conditions from 1973 until the present day and considerable data from the previous operation on the effects on the local flora, particularly the lichens, together with the marine environment at the harbour site has been gathered.

Agreements as to Work Required and not Required

No agreements have been reached with BMP as to work specifically required or not required.

Requirements for ESIA

BMP has prepared a paper setting out their requirements for the preparation of an Environmental Impact Assessment (EIA). The English translation of this paper is included in this report as Appendix 9.1. The requirements of this document form the basis of the layout and the content of this EIA.

10 Consequences and Alternatives

Objectives of the Project

The main objective of the NGM project is the rehabilitation and re-opening of the existing Nalunaq mine and the profitable and environmentally sound exploitation of the remaining mineral resources available within the licence area. It is A&R's intention that the disturbed area will be restored and left in good order following the final closure of the operation at exhaustion. It is anticipated that the first gold doré bullion will be shipped from the mine in December 2009.

Longer Term Objectives

It is A&R's intention to maximise the recovery of the local mineral resource and, as part of this, further exploration will be undertaken in the vicinity of the deposit within the presently licensed area in order to discover any further economic mineralisations and deposits.

Limitations of this report

This EIA covers the initial stages of operation and the ongoing mining of the deposit through its life. It does, however, only deal with the gravity method section of the mineral process route which will be solely employed for the first six months. It is intended to submit an addendum to this EIA in October 2009 which will set out the methods and environmental issues involved with the complementary adoption of a carbon-in-pulp leaching process which is required to maximise gold recovery, particularly at the fines sizes, and maximise the overall exploitation of the resource. This CiP route will then be constructed following approval of the addendum for a planned start-up in March 2010.

Advantages and Disadvantages

Regional

Advantages:

- Continued exploitation of natural local mineral resource;
- Continued contribution to local economy;
- Continued local employment in full time, skilled, well paid, long term, non-seasonal work;
- Continued upturn in average personal economic activity;
- Continued use of an otherwise derelict brownfield site
- Widens local economic base;
- Improvement of local skills base through training and employment;
- Lowering of local unemployment levels;
- Increase in local population;
- Consequential increases in local services;
- Improved transport links;
- Induced and indirect employment and economic opportunities;
- Heightened impact of Nanortalik Municipality in National scene;
- Opportunity for improved tourism trade; and
- Commitment of A&R to promote and maintain traditional Kalaallit Inuit way of life.

Disadvantages:

- Depletion of natural local resource;
- Possibilities of adverse environmental impacts arising from the works;
- Possible polarisation of well paid and poorly paid inhabitants;
- Possible effects of influx of workers from other parts of Greenland or overseas;
- Increased sea traffic;
- Increased air traffic;

National

Advantages:

- Continued exploitation of natural mineral resource;
- Continued contribution to national economy;
- Continued contribution to GDP;
- Continued employment in full time, skilled, well paid, long term, non-seasonal work;
- Continued upturn in average personal economic activity;
- Continued use of a otherwise derelict brownfield site
- Widens national economic base;
- Improvement of national workforce skills base through training and employment;
- Lowering of national unemployment levels;
- Opportunity for improved tourism trade;
- Commitment of A&R to promote and maintain traditional Kalaallit Inuit way of life;
- Increased sea traffic;
- Increased air traffic;
- Improved national transport links;
- Politically valuable project

Disadvantages:

- Depletion of natural resource;
- Possibilities of adverse environmental impacts arising from the works;
- Possible polarisation of well paid and poorly paid inhabitants;
- Possible effects of influx of workers from overseas;
- Increased sea traffic;
- Increased air traffic;
- Possible perceived increase in pressure on traditional Kalaallit Inuit way of life;

International

Advantages:

- Increased awareness of Greenland as minerals source;
- Heightened profile and awareness of Greenland as a player in the international political and economic markets;
- Increase in international interest in Greenland;
- Continued use of otherwise derelict brownfield site, and commitment to eventual rehabilitation in a internationally spot-lit region;
- Opportunity for improved tourism trade;
- Highlights Greenland's commitment to maintain traditional values and Kalaallit Inuit way of life;
- Highlights Greenland's independence;
- Raise awareness of Greenland as good place to develop minerals interests;
- Heightened profile of Greenland in International mining scene;
- Home of a modern and innovative top-class mine project;

Disadvantages:

- May attract excessive minerals and petroleum/gas exploration;
- Possible pressure group criticism due to allowing continued development in Arctic;

Consequences of Project not taking place

If the project does not go ahead under Angus & Ross plc's proposals this gold resource will not be exploited in the short to medium term. In this case the mine site and the mine workings will be abandoned and will become either derelict or restored under the terms of Crew's rehabilitation bonding. In the latter case, very major investment will be required to redevelop and reopen the resource for exploitation in the future. In either case the economic and other benefits, which would otherwise accrue to the Nation of Greenland, and the Municipality of Nanortalik due to its exploitation, would not become available for some considerable time or may be lost completely. Thus the national and municipal economy will not be able to accrue the advantages provided by the exploitation of a major national resource. The Company's proposals are well founded and use modern, effective, efficient and environmentally sound methods and principles. If this project does not proceed, it is possible that another company might eventually consider attempting to progress alternative proposals in due course, although as noted above this would be at a much increased cost.

Alternative Opportunities

Whilst Angus & Ross plc have another mining interest in Greenland in the Black Angel lead and zinc mine at Maarmorilik, which is expected to start production in 2010. A&R consider that the operation and exploitation of Nalunaq gold mine, with its opportunity to resume early production in October 2009 and the financial benefits which this will provide to A&R, will be very beneficial to the start-up requirements of the large Black Angel Mine. The Black Angel Mine is Angus & Ross plc's main long term business opportunity at this time. Whilst A&R have ambitions to open minerals projects elsewhere in Greenland and in other parts of the world in addition to Black Angel and Nalunaq, there is no viable alternative opportunity available to A&R at the present time.

10 Exploration and Feasibility

Present Position

The greatest risk to the project comes from the low level of resource delineation which prevails. NGM concentrated on production of ore without carrying out any work to replace resources as reserves have been mined. This has resulted in no proven reserves with the postulated resource based on good geological evidence but not by firm drilling or exploration data. By reference to the NGM Resources/Reserves Report for the end of 2008 it can be seen that 570,000 tonnes of inferred resources are present at a cut-off grade of 15g/t (rather than the 11g/t proposed by A&R) together with 45,000 tonnes of indicated resources at 10g/t some of which have been depleted by subsequent NGM operations. Due to the nuggetty nature of the deposit and the form of the gold bearing reef, resource delineation by drilling is not a competent method, except to prove structure. Grade must be proved by underground development headings with regular sampling of the ore body. Grade can change markedly over short distances. The NGM geologists have identified three target areas with various pros and cons. A&R will develop the operation with reference to grades proven by their underground developments but will initially win ore from existing stopes and pillars while development drivages into fresh resources are under way. It is believed that advance development is crucial to the provision of resource delineation data and to maintain the overall resource. The greatest risk is that sufficient proven reserves are not timeously identified.

Historical Reserves Information

SRK Report 2002

The SRK report of 2002, written before initial development of the deposit, provided the following information.

The Mineral Deposit

The gold mineralization occurs in quartz veins which vary in thickness from 0.5m to 7.0m, in the Nalunaq Mountain on the north side of the Kirkespir Valley. The host rocks are calc-silicate altered meta-volcanics. The main gold mineralisation is associated with what is known as the Main Vein, which is a remarkably consistent shear zone extending for about 2,000m on the surface, and showing a well-defined orientation and exceptional continuity. The structure constitutes a regular sheet with overall strike of 45°-50° and overall dip of 36° that appears to continue through the mountain. On the local scale, the structure undulates somewhat, and dips measured in the face of the adits vary between 22° and 45°.

The Main Vein is separated from the subsidiary South Vein by the Pegmatite Fault, a normal fault with vertical offset of 60 m. Four minor faults have been recognised, cutting the Main Vein. They vary in orientation and dip and offset the Main Vein by tens of centimetres to tens of metres. Systematic drilling and outcrop sampling has confirmed the continuation of the mineralised sheet both towards depth, below the outcrops, and up to 600 m into the mountain along strike.

The mineralisation is spatially associated with quartz, which almost universally occupies the central portion of the shear zone. The presence of quartz veins is the single most important component of the gold mineralisation and occurs principally as sheeted veins with stripes and bands of included calc-silicates and feldspars. Despite the mineralised shear-zone being a well-defined and continuous feature, the veins within it are complex. The Main Vein is a composite structure with multiple quartz veins, tectonically introduced slivers of the host rock, pinched or boudinaged veins, and internal and external folds. The veins may occupy discrete shears, which coalesce to form stacked veins or die out along strike.

Gold distribution

Systematic sampling of the vein underground has shown the gold grade is subject to a high nugget effect. Despite this, a grade-zonation is clearly identifiable with high-grade segments running approximately E-W throughout the mine area. The high-grade sector is characterised by a well-developed Main Vein structure, with a thick or continuous quartz vein or multiple veins, and relatively abundant visible gold. There is a general trend towards lower grades in the lower sections of the workings. Exceptionally high-grade vein segments are found in a number of locations. The high-grade segments are characterised by abundant visible gold, often as small flakes and grains concentrated in narrow bands (of a few tens of millimetres) within the sheeted quartz vein and often, but not exclusively, associated with stripes of calc-silicates. The gold is predominantly "needle point" grains of 100-200 microns diameter, a size distribution which gives excellent recovery in gravity circuits. Studies have suggested that the gold precipitated at the solid contact of open fractures which now host the quartz veins, and that most quartz was filled in later. The sheeted appearance may have formed during subsequent contact-parallel crack-and-seal events in a discontinuous shear motion.

Crew Corporation Report 2007

A Crew report of 2007 provided the following information.

Historical information

In April 2007, Crew Gold released an updated ore reserve and resource statement for Nalunaq. The effective date for the data was December 31, 2006. The 2006 surface drilling program, combined with new underground development, provided the basis for updating of resources and the first reporting of ore reserves for this operation. The majority of resources at NGM are classified as inferred, due to the narrow vein, nuggetty nature of the deposit, where drilling on its own does not provide reliable grade estimation. Measured and indicated resources are only defined after underground drifting on structure and detailed sampling have been completed.

Total inferred resources were estimated at 1.5 million tonnes at approximately 17 g/t (diluted to 1.5 m assumed mining width and zero cut-off grade) containing approximately 823,000 ounces gold. Inferred resources are defined on the basis of a potentially mineralized area, defined by regular drilling intercepts, and excluding areas where more closely spaced sampling and underground development has allowed for classification of indicated resources. All inferred resources have been subject to reduction by assuming 40-50% payability within the areas defined by drilling intercepts and surface sampling. The grade is assumed to be similar to the average of previously recovered ore, within a range of 16-21 g/t, as the drill intercepts appear to show a similar level of variability as the earlier resources.

Indicated resources were estimated at 535,000 tonnes at 18 g/t for approximately 315,000 of ounces gold and are based on data derived from underground drifting and systematic sampling at 1-3 m intervals. Indicated resources have a payability factor of 80% recoverable, in line with previous production performance. A total of 5,000 meters of on-vein development has been completed in strike drives and raises within the Main Vein structure. A total of 2,440 channel and chip samples were collected during the exploration stages and a further 3,400 chip samples were taken in the faces of strike drives and slot raises after production commenced in 2004.

The most significant difference to previous estimates is that Indicated Resources are now included from the Upper Block. This is due to the fact that mining development has advanced into this area and therefore activated substantial indicated resources, which are based on continuous sampling along surface outcrops. In addition, a small contribution is added from underground development near the 500 m level. The South Block is slightly expanded due to new underground development while the Target Block shows a reduction of approximately 50,000 ounces, largely due to mining depletion.

<u>Reserves *(at 31.12.2006)*</u>

Probable reserves are a subset of indicated resources and are defined where stope layouts have been completed following sublevel drift and raise development. The design of stopes is based on closely spaced sampling and assignment of actual grades from at least three sides of individual blocks, using a cap of 300 g/t Au. Current probable ore reserves total 205,000 tonnes at 18.8 g/t Au for 124,000 ounces gold. \ A mining recovery factor of 84% has been applied for expected losses in pillars and other unrecoverable areas.

Crew Corporation Report 2008

A Crew review of 2008 provided the following information.

Ore resources at Nalunaq underwent review during 2008. It was found that the Mountain Block was the only mining area remaining where a reasonable degree of confidence could be had in the ore resource. The Mountain Block cannot be effectively drilled from the surface because of the difficult terrain.