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KYANITE AND RELATED MINERALS IN WESTERN NEWFOUNDLAND

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ABSTRACT

An assessment of nonmetallic mineral deposits on Newfoundland's west and southwest coast continued in 1992. The survey focussed on minerals that have an economic potential in the refractory and abrasive industries. A reconnaissance assessment was carried out on promising occurrences of coarse kyanite, garnet, and staurolite northeast of Corner Brook Lake. In the observed showings, these minerals comprise a high percentage of the host-rock's constituent minerals. The deposits, which occur along thrust faults, are best exposed in streams that crosscut metamorphic rock formations east of Corner Brook Lake. Showings of kyanite-rich schist in the Port aux Basques Complex were sampled for tests to determine the degree of purity of the kyanite to see whether it and other minerals of economic interest can be efficiently separated from their host rocks.

INTRODUCTION

Some nonmetallic mineral showings on Newfoundland's west and southwest coasts are being assessed to determine their potential commercial value in the refractory and abrasive industries. Initial work in 1991 focussed on occurrences of kyanite, sillimanite and garnet in the Port aux Basques region (Howse, 1992). Field activities in 1992, consisted of follow-up and sampling of promising kyanite occurrences northeast of Grand Bay and also included a preliminary investigation of newly identified occurrences of coarse garnet and kyanite northeast of Corner Brook Lake (Figure 1). The Corner Brook Lake showings were identified by Cawood and van Gool (1992) during the course of detailed mapping of schists and gneisses along the eastern margin of the Humber Zone.

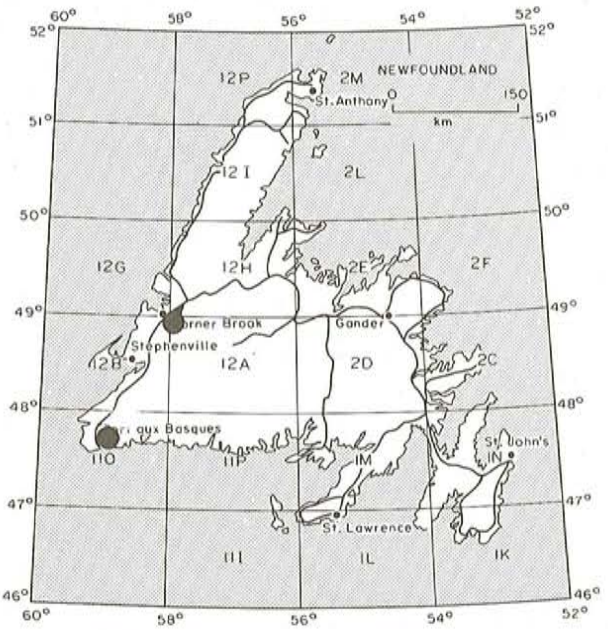


Figure 1. *Location of study areas.*

Sillimanite, kyanite, and andalusite, sometimes collectively referred to as the sillimanite group of minerals, share the common chemical composition Al_2SiO_5, and on heating to a specific temperature for each mineral, converts to the important refractory commodity, mullite ($Al_6Si_2O_{13}$). Mullite refractories, in the form of bricks and shapes, are used in the metallurgical and glass industries. It is used in refractory cements, mortars, plastics and ramming mixes.

Thus the main, although not exclusive, commercial value of the sillimanite minerals lies in their potential exploitation as a source of mullite. Kyanite, for example, the most widely used of the three, with 95 percent of production used in refractories, is also utilized as an additive in a wide variety of products such as ceramic linings, precision castings, brake shoes and discs, and for insulating functions in the aerospace industry.

Staurolite, an iron–aluminum silicate, with a hardness of 7 and a specific gravity of 3.6, is used as a sandblasting agent and as premium quality foundry sand. A newly developed staurolite product marketed under the name 'biasill filler', is used in coatings and polymers. Staurolite is suited for filler applications because of its resistance to physical and chemical attack (Collings and Andrews, 1990).

PREVIOUS WORK

In the Corner Brook region, Hibbard (1983), after a geological reconnaissance, described float occurrences of quartz–muscovite schist containing spectacularly coarse garnet and kyanite in the valley north of Corner Brook Lake. Cawood and van Gool (1992), through detailed mapping, identified the source of these minerals along a series of parallel thrust faults directly east and northeast of Corner Brook Lake.

Previous nonmetallic commodity assessments in the Port aux Basques–Rose Blanche region (Figure 1) have focussed mainly on silica. Gale (1967), who carried out an assessment of pegmatites in the region, collected chip samples from the quartz vein at Diamond Cove. The analyses revealed a high silica content and prompted further assessments of the vein as a potential source of flux-grade silica (Butler, 1967; Fleming, 1968). Gale (*op. cit.*) also noted that some of the larger pegmatite veins were a potential source of commercial feldspar, and that metamorphic rocks of the western part of the region contained abundant kyanite. Prior to Gale's work (*op. cit.*), Tater (1964) carried out a reconnaissance survey of pegmatite in the region.

Brown (1977), in a report, based on his regional mapping of the Port aux Basques Complex, noted that schist bands in the Port aux Basques gneiss contained up to 20 percent kyanite. O'Neill (1985) in a M.Sc. thesis study of the Isle aux Morts River zinc prospect described quartz–muscovite schist units containing a high percentage of kyanite.

1992 FIELD PROGRAM

The 1992 field program had two objectives: to investigate and sample occurrences of garnet, kyanite, and staurolite near Corner Brook Lake (Plate 1), and to carry out follow-up on kyanite showings northeast of Grand Bay, Port aux Basques (Figure 1).

Plate 1. *Northern tip of Corner Brook Lake looking east. Background and adjacent areas host a wide variety of industrial minerals including garnet, kyanite, staurolite, silica and marble.*

In the area northeast of Corner Brook Lake, outcrops of muscovite–quartz schist containing a high content of coarse garnet, kyanite, and staurolite were examined and sampled. These showings, which occur along thrust faults, are best exposed in streams that crosscut the generally north-striking rock formations (Figure 2). Representative samples of the best occurrences were collected for testing.

Fieldwork in the Port aux Basques area in 1992 was aimed at identifying the most promising occurrences of kyanite-rich schist northeast of Grand Bay. Using an ATV and some helicopter support, an area as far inland as the Isle aux Morts River zinc prospect was covered in a reconaissance manner. Four areas were selected for representative bulk sampling (Figure 3). These samples will be tested to determine the purity of the kyanite, and to see if it and other mineral of commercial interest can be removed from the host rock.

CORNER BROOK LAKE SHOWINGS

Geological Setting

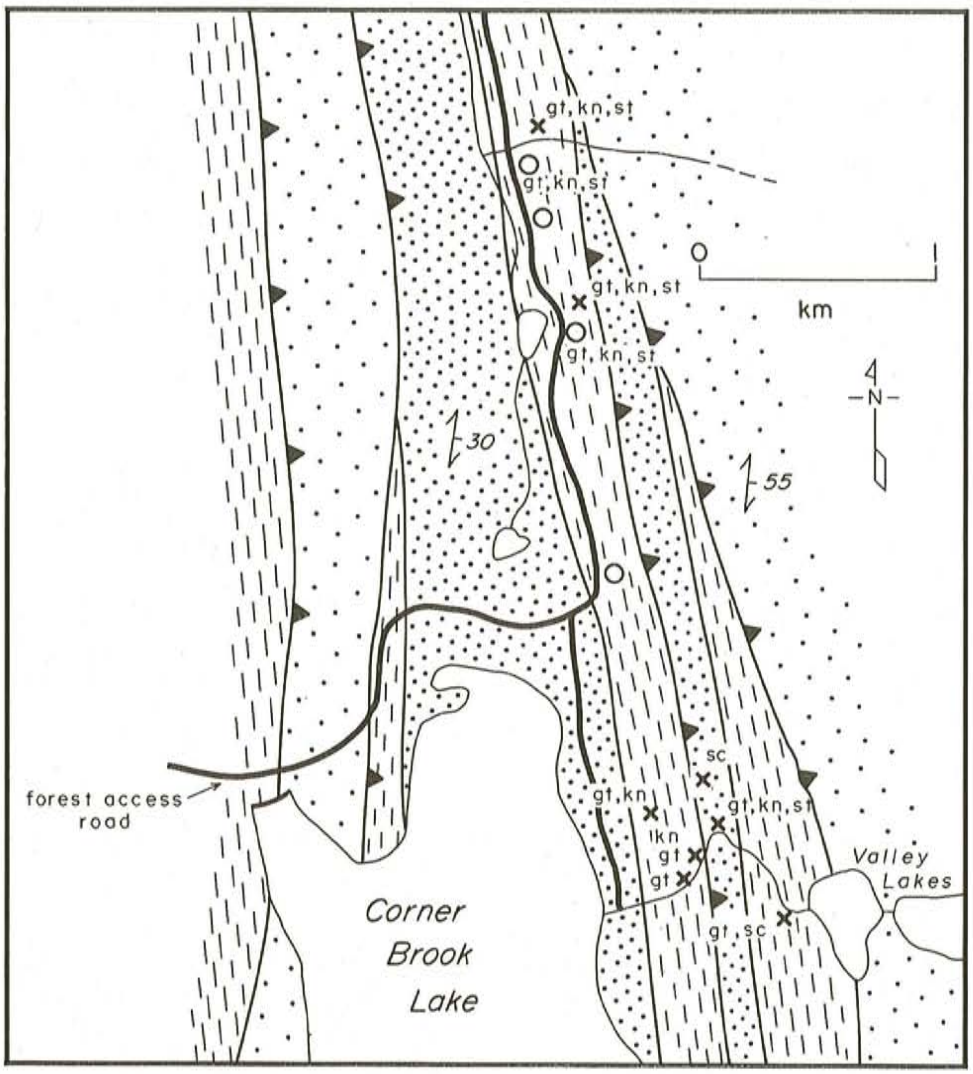
The Corner Brook Lake occurrences of coarse garnet and kyanite, are located within the eastern margin of the Humber Zone near its boundary with the Dunnage Zone. This region has been the subject of a number of theses and reconnaissance studies (Kennedy, 1982; Knapp, 1982; Knapp *et al.*, 1979; Hibbard, 1983), however, the first detailed mapping of the area's gneisses and schists was published by Cawood and van Gool (1992). Their work describes the geology in the Corner Brook–Grand Lake region and includes a detailed account of the thrust belt along the northeast side of Corner Brook Lake, the site of the showings (Figure 2). Thus, their description of garnet–kyanite–staurolite-rich rock units draws attention to the potential of this region for hosting commercial concentrations of high-alumina refractory and abrasive minerals.

The northeast side of Corner Brook Lake is underlain by three units. These consist of basement gneiss (Corner Brook Lake Complex) overlain by a series of easterly dipping thrust slices made up mainly of psammite, pelite, and carbonate (Breeches Pond Formation). Psammite, pelite, and quartzite of the Mount Musgrave Group underlie the higher ground to the east.

The Breeches Pond Formation is particularly rich in industrial minerals. Of particular interest are the showings of remarkably coarse garnet, kyanite, and staurolite (Plate 2). Bands of white marble, although narrow, are noteworthy, as are associated quartzites. Descriptions of showings that were investigated and sampled are given below.

Valley Lakes Brook Occurrences

Some of the more significant occurrences are found along a small brook that flows from Valley Lakes into Corner Brook Lake (Figure 2). One showing is located about 140 m upstream from a woods access road, and its location is marked by an abrupt change in the direction of the stream. This exposes a significant strike length of zone in addition to a cross-section. Kyanite–garnet–staurolite-rich schist is associated with bands of white marble and carbonate schist. Garnet–kyanite schist structurally overlies the carbonate sequence. The garnets are generally quite large (ranging up to 3 cm in diameter), are commonly fractured and sometimes contain inclusions of quartz and pyrite. The proportion of garnet in the rock shows a wide variation, ranging from less



LEGEND

?LATEST PRECAMBRIAN–MID ORDOVICIAN

Breeches Pond Formation

?LATEST PRECAMBRIAN–EARLY ORDOVICIAN

Mount Musgrave Group

PRECAMBRIAN

Corner Brook Lake Complex

SYMBOLS

Stratigraphic contact

Thrust Fault

Cleavage

Mineral occurrence (in place, float)

Figure 2. *Northeast side of Corner Brook Lake showing location of industrial mineral occurrences described in text; geology after Cawood and van Gool (1992).*

than 10 percent to more than 50 percent. Kyanite and (or) staurolite is commonly associated with garnet, forming an interesting crisscross or random orientation in the host rock (Plate 3).

Other bedrock occurrences were noted farther upstream as well as some large boulders of schist containing spectacularly coarse crystals of garnet, kyanite, and staurolite. A second, abrupt southward turn in the direction of the stream, about 300 m upstream from the first, defines another fault zone, and hosts typically, coarse kyanite, garnet, and staurolite. In most outcrops, these constitute a high percentage of the rock's constituent minerals.

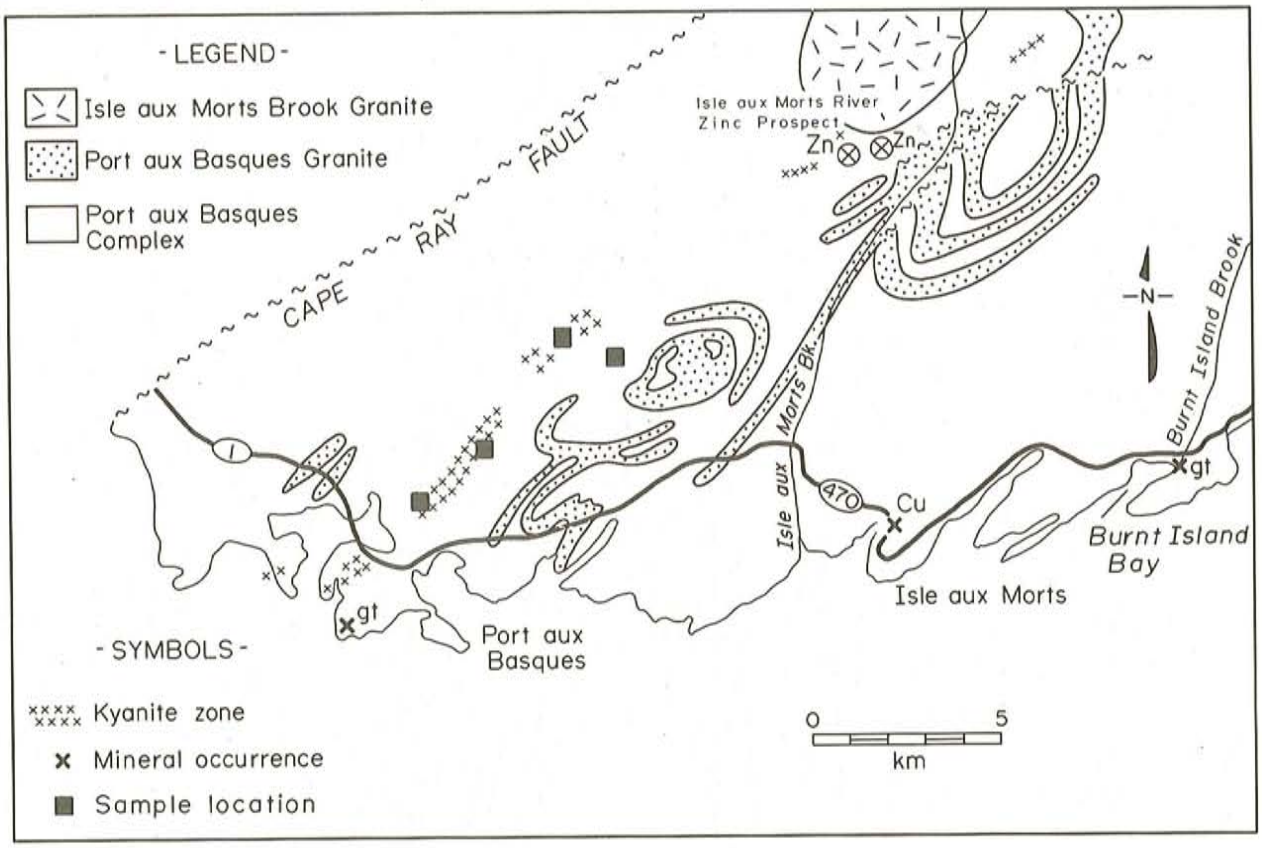


Figure 3. *Sketch map of the Port aux Basques region showing field area and sample site locations.*

Plate 2. *Typical example of coarse garnet, staurolite and kyanite in muscovite–quartz schist near Corner Brook Lake.*

Plate 3. *One of the main showings of garnet, kyanite and staurolite is exposed along a stream bed about 350 metres from the shore of Corner Brook lake.*

A smaller zone of mainly garnetiferous quartz–mica schist was noted at the base of a small waterfall about 100 m west of the westernmost Valley Lake. The north-striking unit is about 4 m thick and dips steeply (70°) eastward. Also, at this site are outcrops of quartzite that indicate a formation several metres thick spatially associated with the garnetiferous schist.

North Brook Showings

A similar zone of garnet–kyanite–staurolite schist associated with bands of white marble and carbonate–mica schist was noted in a stream about 2.4 km north of the occurrences described above. Outcrops of the same rock unit

along with extensive float were observed in the intervening ridges and valleys. The stream showings are found in a north-striking eastward-dipping (58°) sequence of psammitic and pelitic schists with interbedded marble. In the best exposure, 60 m upstream from the road, quartz–muscovite–schist-rich in garnet, kyanite, and staurolite, directly overlies a band of white calcitic marble and carbonate-mica schist. The crystals of garnet, kyanite, and staurolite are extremely coarse and collectively constitute a high percentage of the rock. Although difficult to estimate accurately because of lack of outcrop, this zone is probably no more than 5 m thick.

The calcitic white marble band has a maximum thickness of 50 cm and has a smooth massive appearance (Plate 4). The fresh surface has a slight yellowish tint and its texture is medium grained. Its dry brightness is estimated to be somewhere between 92 and 95 percent. This band of marble has a sharp footwall contact with carbonate–mica schist, which also contains several small stringers and lenses of white marble.

Plate 4. *Massive, white, high calcium marble exposed in stream bed.*

A second garnet–kyanite-rich schist zone (010°/55°E) outcrops about 45 m upstream from the showing described above. Although low in the stream bed, it can be traced over a width of 10 m at low water. Much disseminated pyrite is present in the schist, which hosts coarse kyanite (6 to 8 cm), and garnets up to 2 cm. Disseminated pyrite was observed in individual garnet crystals.

Fifty metres farther upstream from the above occurrence, the presence of typically large angular schistose boulders marks the site of another zone. One particularly large block aligned 010° and dipping very steeply eastward, appears to have been moved just slightly out of place. The schist contains an increased biotite content, and is characterized by patches or zones of garnets, which are smaller than those in the downstream occurrences (1.5 cm maximum). Also kyanite, although present, is much finer grained.

SILICA

Quartzite of variable quality was observed in the streams and in the cliffs northwest of Valley Lakes. A cliff section, 7 m thick, was sampled for geochemical analyses. The rock is medium to coarse grained, and greyish brown to white (Plate 5). It is strongly cleaved (020°/40°E), and fractured normal to the cleavage. Flakes of mica were noted along fracture planes. The unit was traced for 40 m along strike. A huge angular boulder of extremely pure milky-white quartz lies just west of the sampled face and may represent an unexposed part of the sequence. The variety and quality of industrial minerals occurring in close proximity in this area enhances their commercial potential.

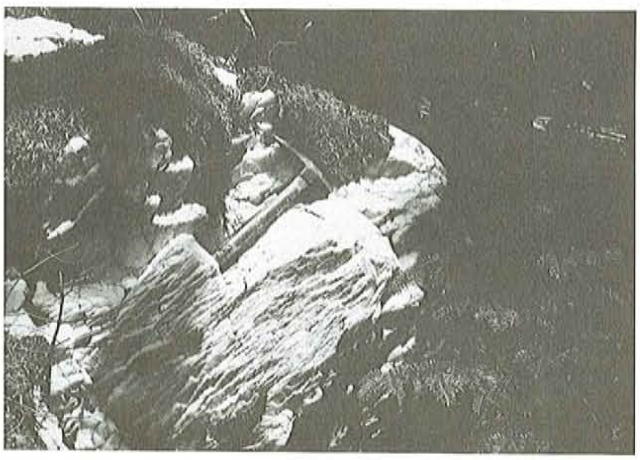


Plate 5. *Quartzite formations east of Corner Brook Lake is evidence that the area has good potential for industrial grade silica.*

GRAND BAY REGION–PORT AUX BASQUES

A linear zone extending from Grand Bay to the Isle aux Morts zinc prospect was examined in 1992 (Figure 3). The most extensive kyanite mineralization was observed in the Grand Bay part of the belt. Disseminated and coarse kyanite are present, although the former is much more common. It consist of flat blue-green bladed crystals up to 20 mm long and 4 mm thick in mica–garnet schist. Some of the schist bands are estimated to contain up to 20 percent kyanite. The coarse kyanite consists of fist-size aggregates of interlocking crystals associated with quartz pods. This type of occurrence, although uncommon, was noted in bedrock and in float. Individual outcrops containing disseminated blades of kyanite range up to several metres in width and can be traced along strike (northeast) for tens of metres.

A 30-kg representative sample of kyanite-rich schist was collected from four different showings (Figure 3). Plans are currently underway to have bench-scale processing tests carried out on the samples, subject to the availability of finances. Results will be released on open file when they become available.

SUMMARY

Newfoundland has excellent potential for hosting deposits of industrial minerals suitable for use in the refractory and abrasive industries. Newly identified showings of coarse garnet, kyanite, and staurolite near Corner Brook Lake suggest that some of the area's schists represent highly prospective targets for commercial deposits. These rocks are believed to correspond to similar units on Glover Island and south of Grand Lake, thus suggesting promising new areas for further exploration. In addition, the region has good potential for significant deposits of silica as evidenced by quartzite ridges of the Mount Musgrave Group. In the Port aux Basques region, zones of kyanite-rich gneiss and schist in the Port aux Basques Complex have been sampled. Plans are underway for mineralogical tests to determine the degree of purity of the kyanite, and bench-scale tests to determine whether or not it can be efficiently separated from the host rock.

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