

Nephrite (Jade) Deposits, Mount Ogden Area, Central British Columbia (NTS 093N 13W)

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KEYWORDS: *Nephrite, jade, gemstones, industrial minerals, garnetite, serpentinite, economic potential, tile-making grade.*

INTRODUCTION

Jade

Jade is a commercial term encompassing green, white, black or yellow-brown jadeitite or nephrite. Jadeitite is a rock that consists essentially of jadeite (Na-rich pyroxene), whereas nephrite consists of prismatic to acicular amphiboles of the tremolite-actinolite series forming bundles that are randomly oriented and interlocked. The density of British Columbia nephrite varies from 2.95 to 3.01 g/cm³ (Leaming, 1978). Jadeitite is slightly denser and harder than nephrite (7 compared to 6.5 on the Mohs scale). Nephrite is tougher (harder to break) than jadeitite. Its fracture strength is about 200 MN/m² whereas that of jadeitite is about 100 MN/m².

Nephrite and jadeitite are used in jewellery as gemstones and as carving and ornamental stones. The world market for jade, both nephrite and jadeitite is estimated at 300 tonnes per year, and three quarters of this originates in British Columbia (Scott, 1996). Nephrite accounts for

all of the current British Columbia production. The price of raw jade varies from less than Can \$10.00 to \$100.00 per kilogram on the retail scale, depending on the quality and importance of the transaction. In general, jadeitite commands a higher price than nephrite.

The Mount Ogden occurrences are located in central British Columbia (Figure 1) on the southwestern slopes of Mount Ogden, approximately 40 kilometres north-northeast of Takla Landing (MINFILE No. 093N 165). The main objective of this paper is to document two of these deposits which were examined during a two-day visit in 1999. The main aspects covered are geological setting, deposit controls, lithological relationships, petrology and mineralogy. The nephrite and nephrite schist samples that are described in this study are low grade. The best material, which has been described as 99% nephrite was previously extracted from the pits. The potential use of industrial grade nephrite which was stockpiled on the site for tile-making is also of interest.

Jade in British Columbia

In western North America, a belt favourable for jade exploration extends intermittently from Alaska through British Columbia and California to Mexico (Leaming, 1995). In British Columbia, the nephrite occurs as individual blocks, boulder fields, talus blocks and in situ occurrences. There are over 50 known nephrite deposits and occurrences in British Columbia.

The in situ deposits of nephrite occur at, or near the contact of ultramafic/mafic rocks (mainly serpentinites) with cherts, and other metasedimentary rocks of Mississippian to Jurassic oceanic terranes such as Cache Creek and Slide Mountain. There are at least 17 occurrences located in southern British Columbia along the Coquihalla River, Fraser River, Hozameen and Bridge River areas, in Shulaps and Cadwalder Range. Important commercial activity took place in Central British Columbia in the Mount Ogden camp (Figure 1), where at least 9 occurrences were located and to a lesser extent, in the Mount Sidney Williams area. Cry Lake and Dease Lake areas, where 22 nephrite occurrences were reported, and the



Figure 1. Location of the nephrite (Jade) camp in the Mount Ogden area, central British Columbia.

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Cassiar Mine are the most productive camps of northern British Columbia. Most of the known occurrences are described by Leaming (1978), and all of these are contained in "BC MINFILE" (www.em.gov.bc.ca/mining/geosurv/MINFILE).

British Columbia deposits occur mainly along tectonic inclusions of country rocks, dikes and mafic rock layers within serpentinites, or at the contact of serpentinite with the country rock, as described in other parts of the world by Coleman (1967). Tectonic and lithological contacts seem to be predominant ore controls. Where the nephrite is found in situ, it may be separated from the country rocks by a "white rock" or it may contain irregular zones of such a rock. In the literature, the "white rock" is commonly described as rodingite or calcsilicate rock containing hydrogarnet, diopside, wollastonite and tremolite (Coleman, 1967 and Leaming, 1978). In the field, the British Columbia prospectors also use this term to describe white-colored post-nephrite selvages and alteration zones which are fabric-controlled.

Good quality nephrite is a nearly monomineralic rock consisting of very fine and interlocked bundles of acicular tremolite crystals. It commonly contains small concentrations of spinel group minerals (chromite, magnetite, picotite), diopside, uvarovite, titanite, chlorite and talc. Bright green specs of chrome diopside are characteristic, but not restricted to Cassiar nephrite.

GEOLOGICAL SETTING OF MOUNT OGDEN DEPOSITS

The Mount Ogden nephrite camp is located near Fort St. James, in the northwest corner of the area described by Armstrong (1949). The area was also studied by Paterson (1974), and more recently by Schiarizza and Payie (1997) and Schiarizza *et al.* (1997). It is situated within the Cache Creek Terrane of the central Intermontane Belt. At this latitude the Cache Creek Terrane includes the Sitlika assemblage in the west and the Cache Creek Complex to the east. The Sitlika assemblage consists of Permo-Triassic bimodal volcanic rocks overlain by Upper Triassic to Lower Jurassic clastic sedimentary rocks. This assemblage is in fault contact with a poorly dated, but partially age-equivalent ophiolitic sequence that forms the western part of the Cache Creek Complex. Eastern elements of the Cache Creek Complex include a Permian to Lower Jurassic succession of predominantly pelagic metasedimentary rocks and thick Pennsylvanian - Permian carbonate sequences associated with ocean island basalts.

The earliest deformation documented within the Cache Creek Terrane in central British Columbia is related to subduction, probably beneath adjacent magmatic arc rocks of the Quesnel Terrane, as indicated by local exposures of blueschist facies rocks that yield Late Triassic K-Ar and Ar-Ar cooling dates (Paterson and Harakal, 1974; Paterson, 1977; Ghent *et al.*, 1996). Subsequent uplift of Cache Creek Terrane is recorded by chert-rich clastic detritus that was shed westward into the basal part

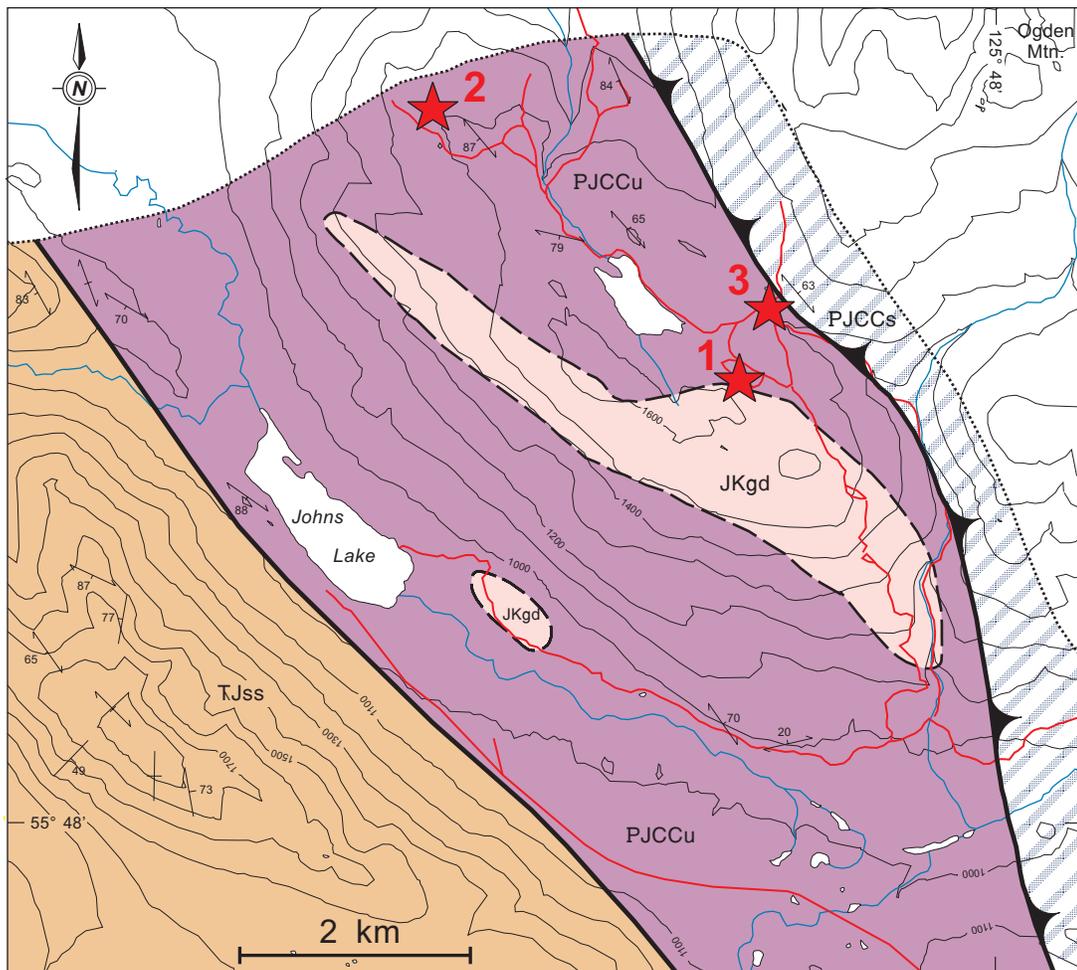
of the Bowser Lake Group in late Middle Jurassic to Late Jurassic time. This uplift may be related to a deformational episode that generated greenschist facies metamorphism and penetrative deformation within the Cache Creek Terrane and the Sitlika assemblage, and ultimately resulted in Cache Creek Terrane being thrust westward over Stikine Terrane (Monger *et al.*, 1978). Younger deformation in the region involved Late Cretaceous(?) to early Tertiary dextral strike-slip and related extension, in part, along major structures such as the Pinchi and Takla faults (Gabrielse, 1985; Struik, 1993; Wetherup and Struik, 1996).

The nephrite occurrences in the Mount Ogden area occur within a belt of ultramafic rocks and serpentinite melange (Figure 2) that was informally referred to as the Cache Creek ultramafic unit by Schiarizza and Payie (1997). These rocks are part of an extensive belt of ultramafic and related rocks that were referred to as Trembleur intrusions by Armstrong (1949), who interpreted them as intrusive bodies cutting Cache Creek volcanic and sedimentary rocks. More recently, these rocks have been interpreted to be tectonically emplaced upper mantle and lower crustal portions of dismembered ophiolite sequences (Whittaker, 1983; Ash and Macdonald, 1993; Schiarizza and MacIntyre, 1999). In the Mount Ogden area, the ultramafic unit is characterized by serpentinite melange comprising serpentinite and serpentine-carbonate-talc schists containing abundant knockers and fault-bounded lenses of greenstone, amphibolite and metasedimentary rocks. Greenstone was in part derived from mafic volcanic rocks, but also includes a large proportion of diabasic to gabbroic rocks, locally grading to weakly to moderately foliated amphibolite. Metasedimentary rocks include bedded chert, quartz phyllite and limestone.

The eastern margin of the ultramafic unit is an east-dipping thrust fault. An assemblage of mainly metasedimentary rocks forms the hangingwall of the fault (Figure 2). This sedimentary unit is dominated by light to dark-grey, platy quartz phyllites, but also includes metachert, cherty argillite, slate, limestone, metabasalt and metasandstone. Farther to the east, this unit includes thick bodies of light-grey weathered limestone that contain fusulinids of early Late Permian age (Paterson, 1974).

To the west of the ultramafic unit is an extensive belt of metasedimentary rocks dominated by slate, siltstone and sandstone, with local conglomerate (Figure 2). These rocks belong to the Upper Triassic to Lower Jurassic clastic sedimentary unit of the Sitlika assemblage (Paterson, 1974; Schiarizza and MacIntyre, 1999). The contact between the two units is not exposed in this area. Regionally, it is an east-dipping thrust fault (Schiarizza and MacIntyre, 1999), but where observed about 10 kilometres south of the present study area it is marked by a younger dextral strike-slip fault (Schiarizza and Payie, 1997).

An elongate stock of coarse grained, biotite±muscovite granodiorite cuts through the eastern to central part of



Source: Schiarizza, et al., 1997.

Jurassic or Cretaceous(?)

JKgd Medium to coarse grained biotite granodiorite

SITLIKA ASSEMBLAGE

Triassic to Jurassic(?)

T.Jss Eastern clastic unit: variably foliated siltstone, sandstone and conglomerate containing felsic volcanic clasts; medium to dark grey slate and phyllite; locally includes foliated limestone, limestone conglomerate and green chloritic phyllite.

CACHE CREEK COMPLEX

Pennsylvanian to Lower Jurassic

PJCCs Sedimentary unit: light to medium grey quartz phyllite, platy quartzite and metachert; lesser amounts of recrystallized limestone, dark grey phyllite, massive to pillowed greenstone and chlorite schist; minor amounts of metasandstone.

PJCCu Ultramafic unit: serpentinite, serpentinitized ultramafite and serpentine-magnesite-talc schist; serpentinite melange containing knockers of greenstone, diabase, amphibolite, chert and limestone; locally includes mariposite-quartz-magnesite-altered rock (listwanite), rodingite and nephrite.

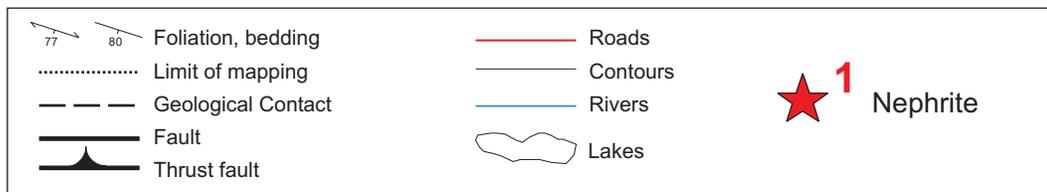


Fig 2 Mtogden Map.cdr

Figure 2. General geology of the Mount Ogden area (modified from Schiarizza *et al.*, 1997).

the ultramafic unit (Figure 2). Similar granodiorite forms a small plug 2 kilometres southwest of the main stock, and occurs as dikes and pods elsewhere in the ultramafic unit. These rocks are undated, but are suspected to be Early Cretaceous in age, based on their lithologic similarity to parts of the Early Cretaceous Mitchell batholith, which cuts the Cache Creek Complex and Sitlika assemblage 50 kilometres to the south (Schiarizza and MacIntyre, 1999).

GEOLOGY OF THE NEPHRITE DEPOSITS

The three in situ, past producing deposits located within the study area (Figure 2) are identified as (1), (2) and (3). Deposit 1 is located at the contact of a granodiorite pluton which forms a prominent knob with a low relief ultramafic unit. The ultramafic unit consists of serpentinites, serpentine-carbonate-talc schists and melange containing knockers of greenstone, diabase, amphibolite, chert and limestone. Deposit 2 is located approximately 3.5 kilometres northwest of deposit 1. At the scale of figure 2, deposit 2 seems to be located entirely within the same ultramafic unit as deposit 1. Deposit 3 is located about 800 metres northeast of deposit 1, along a fault contact between the ultramafic unit and the sedimentary unit. The sedimentary unit consists mainly of

phyllites, quartzites, metacherts, marble, and chlorite schists. Deposit 3, also referred to as “main showing” by Leaming (1978), was not studied because of flooding of the pit and lack of good exposure. The cross section of this deposit was published and described by Leaming (1978). The nephrite lens in deposit 3 was 50 metres long, 3 metres wide and 5 metres high, with the total estimated tonnage of 2250 tonnes (Leaming, 1978). Most of the material was probably industrial grade. Deposits 1 and 2 are described below in more detail.

Deposit 1

Deposit 1, which was referred to as the “new showing” by Leaming (1978) is now almost completely mined out (Photo 1), but a large quantity of industrial grade nephrite is stockpiled at the site. The pit that contained the deposit is oriented approximately 120° and is over 250 metres along strike. Along the nearly vertical wall, the excavation is in places more than 18 metres high and 5 metres wide. The exposed footwall is arcuate and follows roughly topographic contours and the contact of granodioritic pluton with the ultramafic unit (Photo 1). The possible reserves before mining were estimated at 500 to 1000 tonnes. Probable reserves were estimated at 50 tonnes (Leaming, 1978). At this stage it is impossible to determine what was the total tonnage extracted from

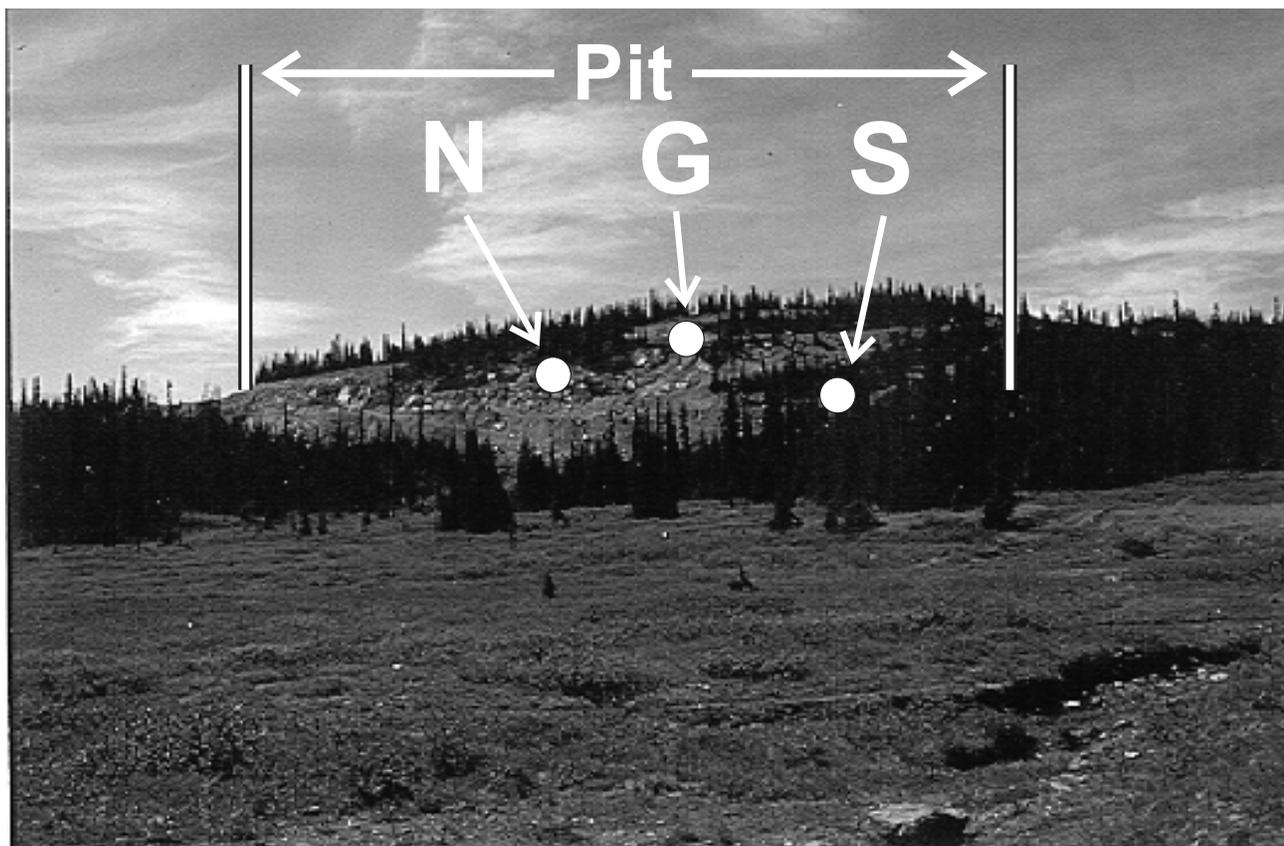


Photo 1. Deposit 1, Mount Ogden area: granodiorite-diorite (G), nephrite (N) and serpentinite (S). The excavation is approximately 250 metres along strike.

this deposit and if any metasediments were originally present within the pit limits.

Granodiorite Pluton

The granodiorite-diorite pluton is about 6.5 kilometres in length and more than one kilometre in width. It is a gray, pink or beige, medium-grained, equigranular rock consisting of 29.6 % quartz, 20.4 % orthoclase, 41.1% oligoclase-andesine, 6.7 % chlorite and minor titanite and apatite (Armstrong, 1949). A sample of the pluton near its southwest extremity collected during earlier mapping, shows relatively fresh biotite and muscovite instead of chlorite. The plutonic rock, exposed less than 10 metres from the pit, is strongly altered and cross-cut by closely spaced sets of centimetre-scale thick fractures, in-filled by a fine grained siliceous phase containing quartz (65-70%), feldspar (15-20%), epidote group minerals (10-15%), sericite (15%) and chlorite (3%). The altered pluton consists of feldspar (75%), epidote (12-15%), zoisite (3-5%), chlorite (6-7%), limonite (<1%), and carbonate and titanite in trace amounts.

White Rock

The main lithology exposed within the wall is a white, hard, massive, granular, macroscopically homogeneous rock. Microscopically, this rock is quite heterogeneous consisting mainly of zoisite/clinozoisite (15-50%), serpentine (1-40%), epidote (1-60%), and other minerals which are locally important such as tremolite, wollastonite(?), carbonate and minor constituents such as talc, chlorite, titanite, apatite and pyrite.

Nephrite

There is currently no in situ nephrite exposed, with the exception of three small remnants of nephrite, probably less than 30 centimetres thick and 2 metres along the wall of the pit. Good quality nephrite from one of the remnants is very hard, dark green semitranslucent, and consists mainly of actinolite-tremolite microfibers (>90%), serpentine (<10%), talc (6%), spinel group minerals (<1%), and traces of titanite, ilmenite and hematite. Lower quality nephrite is dark green, greenish-grey, schistose and consists of larger proportions of serpentine or talc and opaques. Leaming (1978) indicates that chlorite was also present. Backfill or debris covers the bottom of the pit, and no in situ rocks that formed the hangingwall of the deposit are observed within the excavation.

Nephrite-Host Rock Relationship

Several of the fresh and angular blocks near the excavations were examined. Two representative examples that show the relation of lower quality nephrite and country rock are shown below. The first example shows irregular contacts of nephrite (N) with the country "white rock" (Photo 2). Nephrite (N) is aphanitic, compact, deep green, vitreous and moderately schistose, comprised

mainly of tremolite (48-52%), serpentine (48-50%), and less amounts of limonite, chromite and locally uvarovite (1.5-2%) which forms bright green rims around chromite. The country rock is pale greenish-pinkish white, equigranular, very hard and massive. The coarse grained "white rock" (CW) contains mainly epidote group minerals (74-80%), serpentine (13-15%) and titanite (7-9%). The fine grained "white rock" (FW) also consists mainly of epidote group minerals (84-90%), in addition to carbonates (13-15%), titanite (1-3%) and serpentine (1.5-2%). Microscopic observations show that both the coarse grained (CW) and fine grained "white rock" (FW) are generally fine grained (less than 1 mm), however, interlocking aggregates of epidote group minerals in combination with the serpentine content results in a coarser and more granular texture on the weathered surface.

The inferred lithologies that probably formed the footwall of the pit are strongly serpentinized ultramafic rocks that are now exposed in the southern part of the excavation. These rocks are almost black to yellow green, aphanitic and consist mainly of serpentine (30-85%), talc (<15%) and opaques (<30%, locally <18% magnetite).

The second example shows the nephrite-serpentine contact (Photo 3). Good quality, massive, deep green, semitranslucent nephrite, comprised of tremolite-actinolite (90-95%), serpentine (5-10%) and chromite (1-1.5%), grades sharply into schistose, dark greenish-greyish-white and mottled semi-nephrite (SN). Semi-nephrite contains fine grained tremolite (50-52%), serpentine (28-30%), talc (16-18%) and traces of limonite, and grades progressively into serpentinite (S). Serpentinite (S) comprises a dark green, fissile rock, of mainly fine grained serpentine (88-90%), tremolite (8-10%), magnetite (1.5-2%), ilmenite (1%) and traces of titanite. Centimetre thick, anastomosing, fibrous white to pale green tremolite veins cut, and are most abundant in, the semi-nephrite, but extend into serpentinite, where they pinch out gradually. These veins are thickest at the semi-nephrite - nephrite contact, where they terminate abruptly at high angles to the contact (Photo 3).

Deposit 2 (Far North)

On the regional scale, deposit 2, also referred to as the "Far North deposit" is located entirely within the ultramafics (Figure 2), however detailed investigation (Figure 3) indicates that the nephrite follows the north-west-trending contact of ultramafic rocks (in this case serpentinite) with garnetite. The excavation trends 125° and is approximately 100 metres long by 5-15 metres wide, and less than 5 metres deep (Figure 3). It contained approximately 500 tonnes of high quality nephrite (Kirk Maakepeace, Jade West).

The excavation area consists of a steeply north-east-dipping lithological sequence comprising serpentinite, nephrite, nephrite schist, chlorite schist, garnetite, blue marble and metavolcanics / metasediments (in geographic order from south to north). No lithological contacts between nephrite or nephrite schist with serpentinite

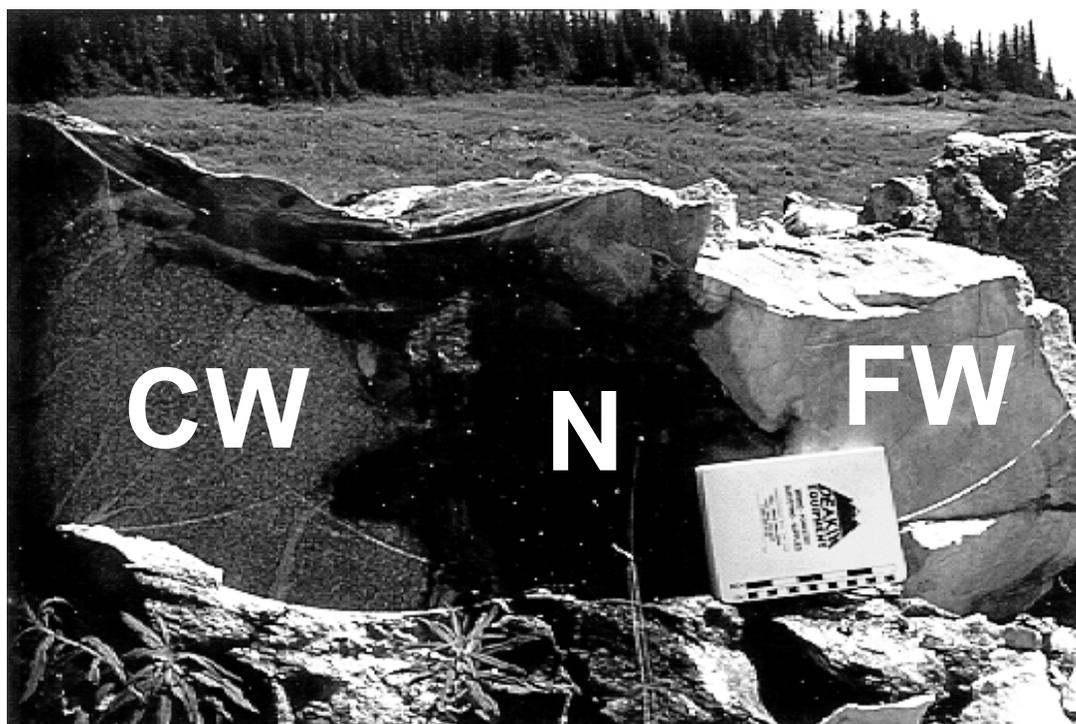


Photo 2. Nephrite in sharp contacts with fine grained “white rock” and coarse grained “white rock”; deposit number 1, Mount Ogden area. Nephrite (N) contains mainly tremolite and serpentine and less amounts of limonite, chromite and uvarovite. The fine grained “white rock” (FW) consists mainly of clinozoisite, carbonate and some titanite; the coarse grained “white rock” (CW) consists mainly of zoisite and epidote and less amounts of serpentinite, titanite and clinozoisite.

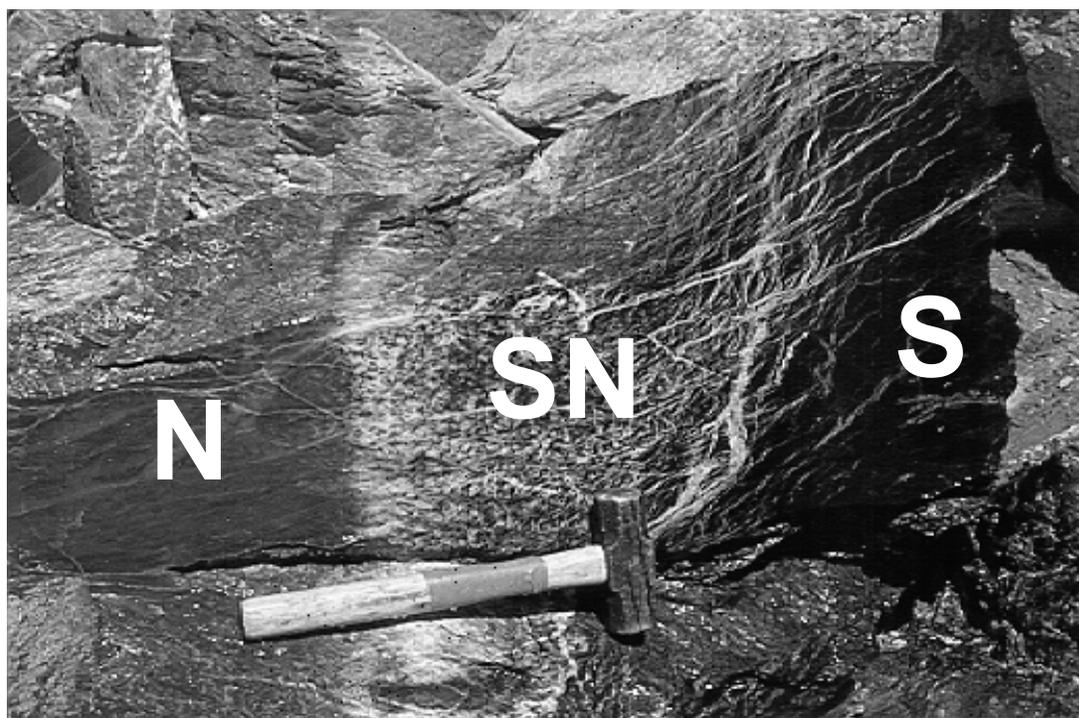


Photo 3. Nephrite - serpentinite contact, Jade West stockpile, Mount Ogden area (hammer handle is 25 cm in length). Coarse, anastomosing, white to pale green tremolite veins cross cut the semi-nephrite (SN) and serpentinite (S). Nephrite (N) is massive and comprised mainly of tremolite and less amounts of serpentine and chromite; semi-nephrite (SN) contains mainly tremolite, serpentine and talc and traces of limonite; serpentinite (S) contains mainly serpentine and less amounts of tremolite, magnetite, ilmenite and titanite.

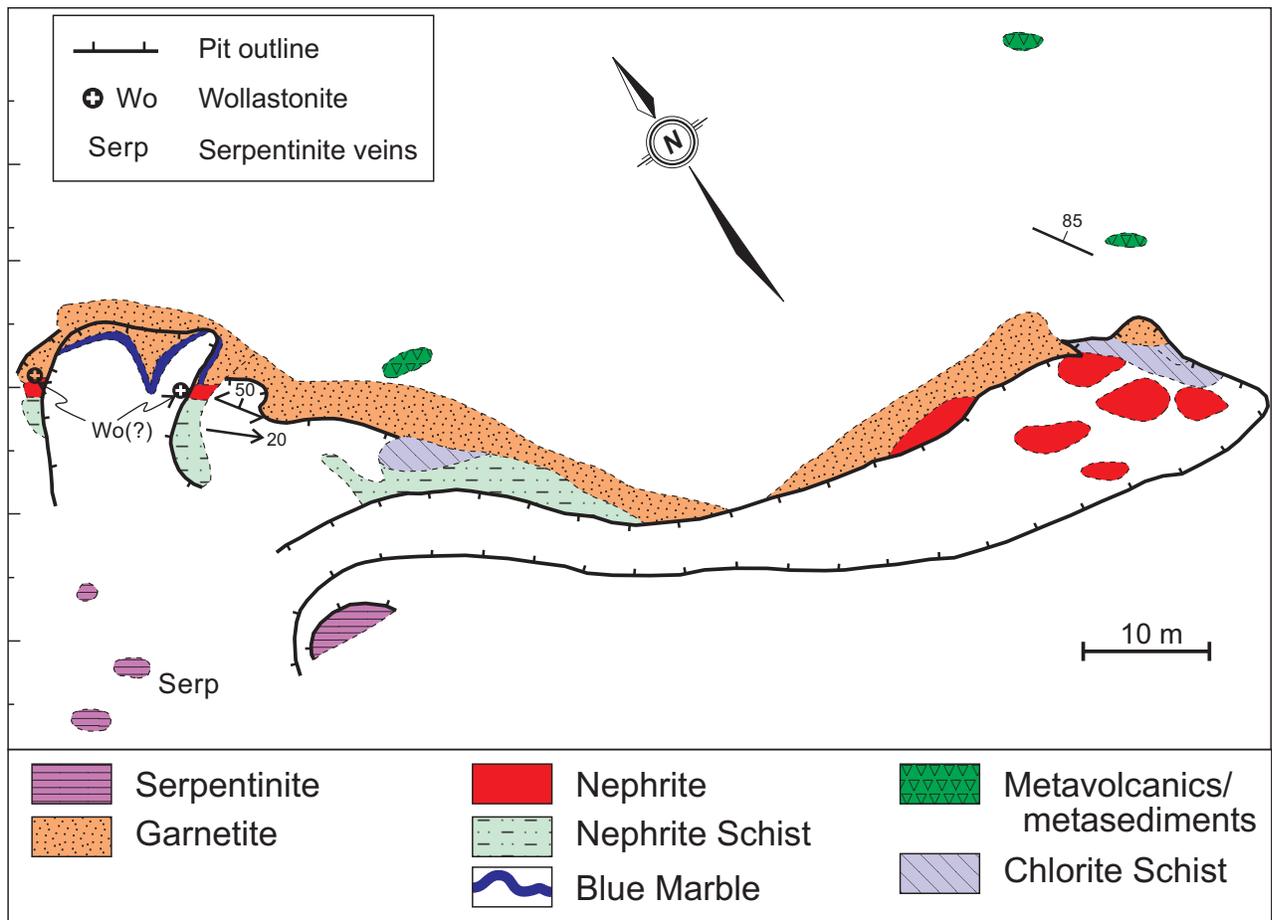


Figure 3. Geology of deposit number 2, Mount Ogden area.

are observed because of the backfill and grading of the pit floor. In the western portion of the pit, a less than 20 centimetre thick vein of fibrous mineral, tentatively identified as wollastonite, separates nephrite schist from the garnetite. All other lithological contacts are sub-parallel or parallel to the regional fabric (Figure 2), to the schistosity within the pit, and to the pit outline (Figure 3). The contact between marble and garnetite is sharp and irregular, and appears to be folded in the western portion of the excavation. The orientation of the axis of this partially exposed decametre-scale fold is expected to be collinear with minor fold axes observed within the pit, which plunge 20° towards 125°.

Nephrite/Nephrite Schist

No gem quality, and little good quality ornamental grade nephrite remains in the pit. Most of the nephritic rock exposed in the pit is a nephrite schist, characterized by a green-grey colour and foliation parallel to lithological contacts. Nephrite schist is generally aphanitic, comprising mainly of 50-55% interlocking subhedral tremolite-actinolite fibres (0.03 mm), acicular prisms (up to 0.4 mm long) and blades, and 35-40% fibrous and prismatic serpentine aggregates. The rock also contains

actinolite (3-5%), carbonate (5-7%), limonite (8-10%), hematite (1.5-2%), pyrite (trace-0.5%), traces of chalcopyrite and spinel, and 0.5% of an unknown mineral. Carbonate forms in veins and pods parallel to the schistosity.

Chlorite Schist

Aphanitic, greyish-green chlorite schist is softer and more fissile than the nephrite schist. It contains chlorite (40-45%), serpentine (40-45%), clinozoisite (10-12%), limonite (10-12%) and traces of magnetite and apatite. The schist lenses are cut by folded carbonate veins and are in contact with garnetite, which forms the northern wall of the excavation.

Garnetite

Garnetite macroscopically resembles the “white rock” in deposit number 1. It is the most prominent, homogeneous and continuous lithology exposed within the pit wall, characterized by a white colour, rugous feel, massive appearance and reacts weakly with HCl. The rock is hard, fine to medium grained, equigranular, and comprised mainly of garnet (probably hydrogarnet; 65-80%), carbonate (probably calcite; 15-25%), quartz

(5%), and traces of talc, epidote, clinozoisite and apatite. Carbonate forms mainly in garnet interstices and in garnet fractures. Garnetite separates the nephrite from marble.

Blue Marble

Blue marble is distinctively dark bluish-grey, medium grained, equigranular and massive. It reacts moderately to strongly with HCl. The rock is a nearly monomineralic and consists mainly of carbonate (96-98%), limonite (2-3%), and traces of pyrite and hematite. Carbonate grains have folded twin lamellae and wavy to embayed contacts.

Serpentinite

The serpentinite forms the footwall of the excavation and is characterized by fine to medium grained, strongly schistose and fissile rocks ranging from dark greenish-grey serpentinite (94-97% serpentine), to banded pale greenish-greyish-white talc schist. The talc schist contains up to 55% talc, serpentine (30-35%) and chlorite (7%). Both serpentinite and talc schist contain traces to minor amounts of garnet, pyrite, chromite and oxidized magnetite. Serpentinite is cut by a hatch pattern of fibrous and prismatic serpentine veins. Talc schist is cut by anastomosing, fibrous talc and lesser serpentine veins that are parallel to the schistosity and make up to 45% of the rock.

Metavolcanics/Metasediments

Centimetrically banded dark grey to pale grey, medium grained and schistose metavolcanics / metasediments within the hangingwall of the excavation, were not observed in direct contact with nephrite. Metavolcanics / metasediments contain plagioclase (53-55%), serpentine (in veinlets 33-35%), biotite (5-6%), epidote group minerals (3-4%), and traces of garnet and apatite. The unit also contains an unknown mineral, tentatively identified as anthophyllite (5-6%). Fine grained plagioclase and epidote veinlets cut the serpentine-rich veinlets.

Origin

A variety of origins were proposed to explain nephrite deposits (Leaming, 1978). It is believed that most of the British Columbia nephrite occurrences formed by contact metasomatic exchange between serpentinized ultramafics and country rocks (commonly metasediments).

There is a wealth of published data on the stability field of tremolite in marbles and to lesser extent in ultramafic rocks. The common range of PT conditions where tremolite-actinolite amphiboles are reported extends from less than 1 kilobar at 300°C (contact metamorphism) to over 6 kilobars at 700°C (relatively high-grade regional metamorphic environments). These limits are reasonable for most geological situations where metamorphic fluids are internally buffered, and thermodynamic equilibrium

is attained within carbonate or other homogeneous protolith. The processes responsible for the formation of the British Columbian nephrite deposits were probably externally buffered, because of the association between nephrite and faults. The relative spatial distribution of the serpentinite, "white rocks", nephrite and metasediments is typical of metasomatic reaction zones, and in most cases, thermodynamic equilibrium at the scale of the deposit was probably not attained. Furthermore, good quality nephrite rocks are nearly monomineralic, therefore tremolite is expected to remain stable to higher temperatures. The granodiorite was traditionally considered as unrelated to the formation of nephrite (Leaming, 1978), but more work is required to validate this statement.

Exploration Potential

The Mount Ogden area still has good economic potential for the discovery of extensions to the existing deposits or new nephrite deposits, despite the extensive overburden and repeated coverage in past years by traditional prospecting. The three deposits within the study area trend approximately northwest and are parallel to the dominant regional fabric; potential new discoveries are expected to have the same orientation.

The main nephrite controls appear to be the contact between the granodiorite pluton and ultramafic unit and major tectonic contacts between metasedimentary / metavolcanic rocks and the ultramafic unit. It is possible that VLF would turn out to be an efficient geophysical tool to outline the controls described above. The "white rock" in outcrops or boulder trains is itself an indirect nephrite indicator.

Economic Potential

British Columbia is renowned for its nephrite production. The value-added processing, which resides mainly in carving and jewelry is also well established. To sustain this industry, new high quality nephrite discoveries are needed.

Nephrite tile making offers another opportunity. A number of the nephrite mining camps, such as those of the Mount Ogden area, were exploited by surface mining. As a result, important quantities of industrial grade nephrite, suitable for tile making, were left as stockpiles at the sites. While nephrite tiles would not be able to compete with the main-stream granite or marble tiles in terms of cost per unit, they will represent an upscale niche product. Furthermore, preliminary examination of the "white rock" samples adjacent to nephrite deposit number 2, in the Mount Ogden area, indicates that white garnetite or hydrogarnetite zones may occur in close proximity to the nephrite material and marble. Some applied research is justified to determine if this unusual (hydro-) garnet rich rock has any industrial applications.

ACKNOWLEDGEMENTS

We thank Jade West Group of Companies, for authorizing the access to their properties. We would like to thank K. Makepeace, president of the company, for sharing their experience and hands on approach. The paper was reviewed and improved by comments from Derek Brown from the British Columbia Geological Survey, Suzanne Paradis from Geological Survey of Canada, and Dan Marshall from Simon Fraser University. Drafting was done by Mike Fournier from the British Columbia Geological Survey.

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