Chapter 7. Mineral Resource Assessment of the Tlogotsho Plateau, Nahanni Karst, Ragged Ranges and Adjacent Areas Under Consideration for Expansion of Nahanni National Park Reserve, N.W.T.

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7.1. Resource Assessments - Past and Present

Two previous mineral and fuel resource assessments have been completed in adjacent Yukon Territory (Geological Survey of Canada, 1981a; Sinclair et al., 1981). Some of the conclusions from the Yukon work are applicable to the western part of the study area, even though the original (Yukon) assessment domains were not extended into the Nahanni region of the District of Mackenzie. Dawson et al. (1992) have provided a broad metallogenic overview of metallogeny in the Canadian Cordillera that sets the regional context for the South Nahanni River region. The following broad tectonic classes of deposits are applicable to the South Nahanni River region:

Table 7.1. Some tectonic classes of mineral deposits in South Nahanni River region. Updated from Dawson et al. (1992) for consistency with Eckstrand et al. (1995) and gemstone research reported here.

Tectonic Setting of Host Rocks (youngest at top)	**Deposit Types**
Cretaceous and younger Laramide alpine and foreland tectonics, alpine and continental glaciation.	Cretaceous coal; minor copper veins; kimberlite-hosted diamonds; placer gold.
Middle Devonian to Mississippian Clastic wedge	Sedimentary exhalative (Sedex) barite-zinc-lead-silver-cadmium; MVT lead-zinc; sedimentary nickel-platinum; silver-lead-zinc veins
Cambrian to Middle Devonian Passive Margin - post-accretionary deposits (dominantly Jurassic to Cretaceous with minor younger mineralization related to brittle faulting)	Skarn tungsten, copper-zinc-molybdenum, zinc-lead-silver; rare element pegmatites; granite-related gemstones; disseminated and vein gold; vein silver-lead-zinc.
Cambrian to Middle Devonian Passive Margin - pre-accretionary deposits	MVT zinc-lead-silver; Sedex zinc-lead-silver-cadmium; sedimentary nickel-platinum
Mackenzie Mountains & Windermere Supergroups – pre-accretionary deposits	Iron-formation; stratabound sediment-hosted copper; carbonate-hosted zinc-lead-silver

7.2. Qualitative Assessments of Mineral Potential by Deposit Models in Domains

The background knowledge summarized in Chapter 6 is applied here to criteria for each potential deposit type, taken mainly from Eckstrand et al. (1995), with specific criteria added or emphasized based on the style of those deposit types as they occur in the South Nahanni River region.

Assessments of individual deposit types are tabulated below by deposit type and domain, in the same order as they appear in Eckstrand et al.: according to approximate increasing temperature and/or depth of emplacement. Only deposit types and host domains rated as Low to Moderate (5) through Very High (1) are presented in these tables. Notable absences are explained briefly in Section 7.3.

Resource potential ratings are summarized by domain and deposit type in Table 1.1 of the Executive Summary. Numerical ratings are explained in Table 1.2. Only the highest ratings are shown on Figure 1

Domains are outlined in the Executive Summary (Fig. 1.1), explained in Chapter 3 (Geology; Fig. 3.16), and reproduced in Fig. 6.1B. Host-Rock-Units are listed in Table 3.1 and also described in Chapter 3.

*7.2.1. Placer **gold*** (possible tourist interest) (McLeod and Morison, 1995).

Ideal Criteria \ Domain: Rating #s		**Ragged: 3 (Moderate)**	**Mattson-McDonald-Horn: 5 (Low to Moderate)**
Host Rocks	Stream sands and gravels	Reworked alpine tills	Reworked Laurentide tills
Associated rocks	Lode gold deposits and other gold-bearing source rocks	Gold in skarns and base-precious metal veins	Minor gold in copper-silver veins; and in silver-lead-zinc veins e.g. Prairie Ck. Likely gold from Canadian Shield
Geochem.	Gold-silver	Mainly gold in this study; elevated mercury, arsenic, tin, silver and copper at Selena Creek south of study area.	Gold only.
Structure	Gold concentrated in variety of sites in fluvial systems	Gold in both silt and gravel HMCs represent different stream environments as do deep excavations at Selena Ck.	Gold in HMCs from silts and sands reworked from Laurentide tills. Appear to be greatest in creeks aligned with 145° structures transecting Ram Plateau
Showings	Known placer mining operations	Placer exploration short-lived at Bennet Creek, Selena Creek and other sites.	No previous history of placer gold exploration except along Liard River.

*7.2.2. **Coal*** (Ricketts, 1985, 1988; Normin.DB showings 095BNW0002, 0003, 0004)

Ideal Criteria \ Domain: Rating #s		**Mattson: 5 (Low to Moderate)**
Host Rocks	Sandstone with wide paleo-swamps	Mattson Formation
Thickness	Thick seams 2-4 m	Two seams, 0.9 and 1.8 m thick
Breadth	Laterally extensive	Laterally extensive
Rank	Bituminous	High volatile Bituminous A or B
Quality	Low-sulphur	High sulphur, good thermal coal with possible coalbed methane potential; may be suitable for metallurgy but sulphur would require scrubbing
Structure	Relatively flat lying, shallow, conducive to mining	Folded and thrusted. Assessment report states “outcrop on dangerous cliff, seam not readily accessible to measurement” for Yohin occur.
Showings	Mineable thicknesses of coal in domain	Many occurrences documented.

*7.2.3. Sedex **lead-zinc-silver*** (Sedimentary exhalative; Lydon, 1995)

Ideal Criteria \ Domain: Rating #s		Ragged & Broken: 1 (Very High)	Meilleur: 3 (Mod to High)
Host Rocks	Euxinic carbonaceous shaley rocks that accumulated in a tectonically active oxygen-free environment	Selwyn Basin (Road River Group) and overlying Earn Group (thinning to ESE).	Meilleur River and Prairie Creek embayments of Selwyn Basin (Road River Group). Earn Group thin or absent.
Associated Rocks	Evaporites, fault breccias and local conglomerates, local radiolarian cherts	Evaporites known in cratonic equivalents; minor subtle breccias and facies changes known but poorly understood.	Evaporites in cratonic equivalents; significant breccias, e.g. Cadillac Megabreccia Member.
Geochem.	Pathfinder hydrothermal elements, e.g. Ba, Cd, V, P_2O_5 (also silica but may be sedimentary).	Stream sediments and spring waters highly anomalous in these as well as primary Pb, Zn exploration elements.	Stream sediments and spring waters highly anomalous in pathfinder as well as primary Pb, Zn exploration elements.
Structure	Faults associated with facies changes suggest growth faults	Subtly present; suggested by facies change along upper South Nahanni River, from Broken to (more carbonate) to Ragged (more shale) domains.	Strongly present in Prairie Creek Embayments as documented by Morrow (1987).
Accessories	Epigenetic veins with similar mineralogy	Not known.	Prairie Creek silver-lead-zinc vein may be example, but more likely manto.
Showings	Exposed or drilled Sedex deposits	Vulcan; also highly anomalous springs are proxies with elevated Zn-Cd-Ni-As.	No known showings. Prairie Creek stratabound drill intersections are more likely to be Manto. Highly anomalous springs in Meilleur River area may be proxy with elevated Zn-Cd-Ni-As.

*7.2.4. Sedimentary **nickel** sulphides* (Nick type; Hulbert, 1995; Goodfellow, 2002)

Ideal Criteria \ Domain: Rating #s		Ragged, Broken:4 (moderate)	Meilleur: 5 (low to moderate)
Host Rocks	Bituminous, phosphatic shales of Phanerozoic age (Cambrian and Devonian examples by Hulbert; Devonian widespread according to Goodfellow)	Cambro-Ordovician and Devonian Earn Group have abundant bituminous and phosphatic shale members. Earn Group is in belts along SW side of South Nahanni River, and NE side of Broken Skull R.	Cambrian not exposed in Meilleur River Basin. Earn Group is absent, only Besa River shale in mid-late Devonian. Uncertain where geochemical anomalies originate (see below).

Associated Rocks	Limestone concretion zone (tsunami interpretation by Goodfellow) beneath Nick occurrence	Outcrop studies were not sufficiently detailed to map concretion or tsunami limestone ball member.	
Geochem.	Anomalous Ni, Zn, PGE, P, U, V and Ba.	Anomalous in stream sediments and spring waters, particularly along southwest side of South Nahanni River.	Commonly anomalous in stream sediments and springs in tributary to Prairie Creek and in Meilleur R. valley.
Structure	Local depositional basins with proximal growth faults	Local depositional structures suggested by facies changes	Local depositional structures suggested by facies changes
Showings	Nick-type Devonian stratiform pyrite, vaesite (NiS2), melnikovite, sphalerite and wurtzite, with phosphatic carbonaceous chert.	No showings present, but the degree of anomalies (Table 6.1) in springs and stream sediments strongly suggests outcrops of this type should be exposed.	No showings present, but the degree of anomalies (Table 6.2) in springs and stream sediments suggests outcrops of this type should be exposed.

7.2.5. Mississippi Valley-type ***lead-zinc*** (Sangster, 1995). 3 (Moderate) to 6 (low)

Ideal Criteria \ Domain: Rating #s		**Broken & Sombre: 5**	**MacDonald: 3**	**Mackenzie: 6**
Host Rocks	Carbonate rocks with dolomitized facies	Sombre and Sunblood dolostones	Arnica-Natla-Landry-Headless formations	Lower Little Dal Group not in study area
Associated Rocks	Minor platformal sandstones and laterally equivalent evaporites	Common interbedded sandstones and laterally extensive grey shales. Evaporite laterally equivalent include Keg River Formation (Paleozoic Broken, Sombre & MacDonald) and Little Dal evaporites (Mackenzie)		
Paragenesis	Vuggy dolomitization	Zebra dolostone	Zebra dolostone and vuggy Manetoe Facies	Pinnacle reefs in Gayna River area
Geochem.	Bitumens and zinc-lead geochemical anomalies	Positive response to zinc zap; stream sediment and spring waters locally anomalous.		
Structure / Tectonics	Platformal carbonates adjacent to basinal rocks; unconformities in platformal carbonate succession; transecting regional fault zones that likely were reactivated repeatedly through time are all present in examples and study area.			
Showings	MVT mineralization style present	Numerous small showings of Manetoe facies and zebra dolostone with positive response to zinc zap.		

*7.2.6. Lode **gold**: disseminated replacement (sediment-hosted, Carlin-like; Poulsen, 1995b, 1996; Poulsen et al. 2000) **

Ideal Criteria \ Domain: Rating #s		Ragged: 4 (Moderate)*
Host Rocks	Cambrian to Triassic calcareous siltstone to dolomitic limestone; thinly bedded best host; rarely sandstone, conglomerate, greenstone or felsic dykes and sills.	Favourable units include carbonate members of Yusezyu, Rabbitkettle and Steel formations. Steel (AKA Silurian Siltstone) with disseminated pyrite is direct analogue to highly productive Roberts Mountain Formation of Nevada.
Associated Rocks	Mesozoic granitoid intrusions, associated skarn and calc-silicate hornfels	Selwyn Plutonic Suite; skarn W and local calc-silicate hornfels (mainly aluminosilicate hornfels).
Alteration	Visually subtle: bleached to tan "sanded" to gritty decalcified carbonates, local disseminated carbon gives grey to black colour, silicified jasperoid (from carbonate) resembles chert; discordant hydrothermal breccias; argillic alteration along fault zones.	Very little of this type of alteration has been reported
Structure	Spatial association with thrusts (ductile shear zones at low angles to bedding), upright anticlines of 10 to 100m amplitude; and high-angle normal faults reflecting (reactivated from?) Proterozoic structures.	Jurassic to recent folds and thrust faults are analogous, however a regional low-angle thrust such as the Roberts Mountain Thrust has not been documented in Ragged Ranges. Nearest analogue would be the Plateau Thrust, NE of area.
Geochem.	Enriched in arsenic (As in arsenopyrite and orpiment/realgar in coarse calcite), antimony (Sb in stibnite) and mercury (Hg). Local W and Ba may reflect host rocks. Low Cu, Pb, Zn and Ag.	As and Sb are commonly anomalous in streams of Ragged Ranges study area; much less so in Tlogotsho Plateau. Hg was not analyzed for this study, however high Hg was reported for Selena Creek placer environment. Cu, Pb, Zn and Ag are high in springs and stream sediments and ascribed to Sedex.
Showings	Documented showings of lode disseminated gold in carbonates	Not known in Ragged Ranges; Yukon example of intrusion-related disseminated gold in Kootenay Arc include Ketza River and Brewery Creek; in northern BC e.g. Midway and Cariboo.

*A broad family of vein-related gold-bearing ores that are spatially and genetically linked to magmatic (volcanic and/or plutonic) systems at shallow crustal levels may be invoked to explain the many small veins in this Domain that have minor gold and other precious metal contents. Nonetheless, for the purpose of gold assessment, the rating of 4 (Moderate) is the same as that represented here by the disseminated replacement type. Other gold-bearing deposit types include a range of VMS, epithermal, porphyry, skarn and intrusion-related styles of mineralization with metal endowments that include variable amounts of Au, Ag, Cu, Pb, Zn, As, Sb, Bi, Hg, Te, Mo, W and Sn. Such deposits are recognized elsewhere in the Yukon, Alaska and BC and appear to be associated with intrusions that may be the same age as some in the study area.

*7.2.7. Vein **silver-lead-zinc*** (Sangster and Beaudoin, 1995)

Ideal Criteria \ Domain: Rating #s		**Meilleur: 1 (Very High)**	**Ragged+MacDonald: 5 (Low to Mod)**
Host Rocks	Sedimentary, volcanic or plutonic rocks of Proterozoic to Eocene age. Most common in clastic metasedimentary rocks with graphite and pyrite.	Mainly carbonate rocks with minor siliciclastic strata, mainly Paleozoic.	
Associated	Granites no longer thought to be directly related; structure more NB. Sedex Pb-Zn deposits are common metallogenic province associations.	Mackenzie Mountains fold and thrust belt with high angle normal and transcurrent faults (Cook 1977) and precursor growth faults affecting sedimentation (Fig. 3.1).	
Geochem.	Keno Hill: Ag, Pb, Zn, Sb, As and Mn	Similar, strong at Prairie Creek; + Hg.	Local , minor
Structure	related to faults – major, extensional, related to transfer between shear zones. Ore shoots are commonly on subsidiaries to major faults	Prairie Creek vein appears to be extensional feature on back of thrust fault. Very extensive vein system	No major vein systems noted
Alteration	Generally minor, related to immediate vicinity of ore.	Local alteration	No major alteration known
Showings	Tend to occur in districts with many veins in swarms.	Prairie Creek Mine is a large vein system with local offshoots and stratabound zones, possible veins in Meilleur River valley. Dawson (1995) listed this as a manto deposit.	No major vein systems known. Several small Pb-Zn-Ag skarns and mantos to the east.

*7.2.8. Skarn **tungsten*** (DNAG 20.5, Dawson, 1995) 8,1,3; carbonates in shales near plutons

Ideal Criteria \ Domain: Rating #s	**Ragged: 1 (Very High)**
Host Rocks	Metamorphosed equivalents of relatively thick limestone and calcareous to carbonaceous pelites: skarn, calc-silicate hornfels, schist and marble of Neoproterozoic to Cretaceous age	Cambro-Ordovician Seqwi and Rabbitkettle Formations. The Cambrian carbonate-shale facies change is located at about the position of CanTung, and trends sub-parallel to the Flat River Valley. The Ordovician to Devonian facies change lies northeast of the zone of intrusion of the Selwyn Plutonic Suite (i.e. east of Ragged Ranges)

Associated Rocks	Extensive hornfels zone adjacent to an exposed two-mica pluton, or overlying a buried pluton.	Two-mica plutons of the Selwyn Suite are typically small, composite with mapped phases such as marginal granite to granodiorite and megacrystic alkali feldspar rich quartz monzonite to granite cores, and associated aplitic and pegmatitic dykes intruding both plutons and country rock.
Geochem.	Cu, Mo and Zn together with W in bulk stream sediments; F in waters.	Cu, Mo and Zn are common in stream sediment samples, but W is not commonly anomalous despite bulk samples and analysis of heavy mineral concentrates. F is anomalous in a number of spring waters.
Structure	Shallowly dipping pluton-limestone contacts overall. Irregularities in pluton-limestone contact, particularly re-entrants and troughs.	A number of the plutons have shallowly dipping contacts, i.e. pluton roof underlies sedimentary rocks, in a zone from Flat River Valley around Tungsten to Glacier Lake.
Accessories	Stockwork fracturing along pluton-limestone contact	Present
Showings	Aside from scheelite in exposed skarns, quartz-molybdenite-scheelite stockworks may be present in adjacent intrusion.	World class tungsten skarn deposit at CanTung is hosted in Seqwi Formation; less well developed tungsten skarns are in Rabbitkettle Formation around Tungsten and at Lened.

*7.2.9. Skarn **lead-zinc-silver*** (DNAG 20.1, Dawson, 1995) 8,1,3; carbonates in shales near plutons

Ideal Criteria \ Domain: Rating #s		**Ragged and Broken: 3 (Moderate to High)**
Host Rocks	Metamorphosed equivalents of relatively thick limestone and calcareous to carbonaceous pelites: skarn, calc-silicate hornfels, schist and marble of Neoproterozoic to Cretaceous age	Cambro-Ordovician Seqwi and Rabbitkettle Formations. The Cambrian carbonate-shale facies change is located at about the position of CanTung, and trends sub-parallel to the Flat River Valley. The Ordovician to Devonian facies change lies northeast of the zone of intrusion of the Selwyn Plutonic Suite (i.e. east of Ragged Ranges)
Associated Rocks	Intrusions of Paleozoic to Tertiary granitoid batholiths, stocks and dykes	Two-mica plutons of the Selwyn Suite are typically small, composite with mapped phases such as marginal granite to granodiorite and megacrystic alkali feldspar rich quartz monzonite to granite cores, and associated aplitic and pegmatitic dykes intruding both plutons and country rock.
Geochem.	Zoned with proximal skarns rich in Cu and W; distal skarns, mantos and veins rich in Mn, Ag and Pb.	Abundant small showings and stream-sediment anomalies in Ragged Ranges include all of these elements, as well as Mo, Ni, U, Zn, As, F. Some of these elements are part of the Sedex suite.

Structure	Structural traps in carbonate host rock, e.g. intersecting anticlines by dykes, faults and intersecting faults.	Many structurally favourable sites of these types are present in Ragged Ranges where the fold and thrust belt is intruded by Selwyn plutons
Accessories	Calc-silicate skarn minerals, especially garnet, pyroxene, amphibole together with base metal sulphides. Purplish-black Mn-rich gossan over skarn.	These elements have been observed and described in Ragged Ranges region, local angular garnets and pyroxenes are in point counts of Heavy Mineral suites from Ragged Ranges; Mn is part of geochemical suite in spring waters and stream sediments.
Showings	Small base-metal sulphide occurrences lacking obvious skarn affinity may be distal; include Ag-rich Pb-Zn veins and 'rootless' conformable and discordant Fe-Zn-Pb replacement bodies.	Griswold, Heather, Hooper and Lucky Lake occurrences are interpreted by Dawson (1995) to be Zn-Pb-Ag skarns, and Roy as a manto. Coincident Sedex are distinguished from rom skarn suite by ore textures and precious metals of the latter. F in Vulcan Sedex deposit is likely an overprint from granite-related alteration. Dawson (1995) considers Prairie Creek Vein (very distant from any exposed plutons) as vein component of distal skarn or manto deposit.

7.2.10. ***Emeralds*** *associated with bituminous sedimentary rocks* (Groat et al., 1995, 2002; Colombian type of Walton, 1996)

Ideal Criteria \ Domain: Rating #s		**Ragged Ranges Area: 5 (low to moderate)**
Host Rocks and Associated Rocks	Thick, intensely folded and faulted bituminous shales, sandstones and limestones	Only moderately thick and moderately folded and faulted bituminous strata
	Evaporites, briny hot springs	Not present
	Bituminous rocks enriched in Na, Mg, Mn, S, depleted in K, Al, Si, Li, Mo, Ba, Zn, Cr and V	Stream-sediment geochemistry indicates opposite regionally
	Host rock Na/K ratio of less than 1:1	No detailed data
Stream Geochem.	Na best single pathfinder. Low Li, Mo and Pb may help to indicate leaching of an area.	No indications at the level of detail obtained in Ragged Ranges survey
Structure	Regional faults bounding areas of Na metasomatism	Not apparent in data
Accessory Minerals	Calcite-albite-dolomite vein networks, hematite bands, H2S smell, native sulphur, fluorite, apatite, pale green opaque beryl	Fluorite in Vulcan showing inferred to be added to Sedex deposit area as part of contact metamorphism
Showings	Other emeralds of this type known in area	Not known in this domain; Regal Ridge in Yukon (Groat et al. 2002) is closest known example.

7.2.11. ***Emeralds*** *associated with skarns in calcareous & bituminous sedimentary rocks*
(Groat et al., 1995; Norway type of Walton, 1996; Marshall et al. 2003; Falck et al. 2003)

Ideal Criteria \ Domain: Rating #s		**Ragged Ranges Area: 1 (Very High)**
Host Rocks	Pegmatites or quartz veins intruding and skarns invading bituminous aluminum-rich sedimentary rocks with carbonate interbeds	Moderately thick aluminous Cambrian to Devonian black shales overlying Rabbitkettle Limestone intruded by Cretaceous plutons with associated pegmatites
Associated Rocks	Pre-existing skarn as competent unit to host quartz veins; permit development of thick veins with miarolitic cavities	Limestones e.g. Rabbitkettle host skarn at interface with shales
Trace Elements	Host rocks and/or granites enriched in lithophile elements and trace elements V, Be, Cr, Ni, Al	Two-mica plutons provide Be & Al, shales provide Al, V, Cr.
Showings	Other emeralds of this type known in area	Gem quality at Lened

7.2.12. Other gems associated with granitoid rocks intruding calcareous & bituminous sedimentary rocks
(Groat et al., 1995, 2003; Scott et al. 2003; Walton, 1996; Appendix 1.7. O'Grady)

Ideal Criteria \ Domain: Rating #s		**Ragged Ranges Area: 2 (High)**
Host Rocks	Pegmatites in marginal phases of high-level composite stock of hornblende quartz-syenite and marginal hornblende-quartz diorite	Both hornblende and transitional hornblende-two-mica high-level granitoid plutons are widespread
Associated Rocks	Sedimentary rocks rich in Ni, V, Al	Selwyn Basin and Earn Group shales
Trace Elements	Host rocks and/or granites enriched in lithophile and trace elements Li,Rb,Cs,Be, B, Al,V.	Granitoid intrusions and requisite host rocks are widespread in Ragged Ranges
Showings	Gem-quality minerals present in region	Gem quality elbaite in western pegmatite-aplite zone of the hornblende-bearing O'Grady batholith, part of Selwyn Plutonic Suite that transects Ragged Ranges. Little Nahanni Pegmatite hosts spodumene, elbaite, beryl and niobium – tantalum minerals.

*7.2.13. Granitic pegmatite-hosted **rare metals**, e.g. **Lithium*** (Sinclair, 1995)

Ideal Criteria \ Domain: Rating #s		Ragged: 3 (Moderate to High)
Host Rocks	Highly differentiated granitoid pegmatites	Selwyn Suite includes highly differentiated phases
Associated Rocks	Plutons and associated pegmatites and aplites intruding medium grade metamorphic terranes.	Regional metamorphism is very low grade (too low?)
Geochem.	Primary dispersion aureoles in host rocks (Li, Rb, Cs, Be, B) and related mineralogy help ID local to regional targets.	The elements listed at left are locally anomalous in standard stream sediment and heavy mineral samples in Ragged Ranges. See Table 6.1.
Structure	Along fault systems and lithologic boundaries.	Abundant fault zones and significant lithological boundary variations are mapped in Ragged Ranges.
Related Deposits	Transition between granites and quartz veins. Peraluminous to subalkaline rare metal granites are associated with Li, Be, Nb, Ta, W and Sn deposits.	Skarn W deposits known, skarn Pb-Zn inferred in region.
Showings	Mineral assemblages include beryl, spodumene, tourmaline, columbite-tantalite.	Little Nahanni Pegmatite example is west of study area, but pegmatite showings are also within study area, e.g. Eudyalite

7.3. Mineral deposit types of low to very low potential in the South Nahanni River region.

- Primary in-situ **diamond** deposits are considered of **low potential (6)** due to the lack of ancient crust beneath the study area (Snyder et al. 2002), a fundamental criterion for diamond-bearing kimberlites or lamproites (Kjarsgaard, 1995a, b). Minor potential is suggested by microdiamonds in the Ordovician (McArthur et al. 1980) Mountain Diatreme that intrudes identical strata north of the study area (Godwin and Price, 1987).
- Stratiform **iron** (Gross, 1995) is in the Rapitan Formation near Coates Lake and the Redstone copper deposit, but is considered of **low potential (6**), too deep and remote to be considered here.
- Stratiform **phosphate** (Chandler and Christie, 1995) is of **low to moderate potential (5)**, having been noted by Cecile (1982) in Misty Creek Embayment, a northwestern analogue to Meilleur River embayment. Such occurrences are too thin to be considered even remotely economic in this location.
- Sandstone **uranium** (Bell, 1995) and unconformity uranium (Ruzicka, 1995) are of **very low potential (7)**; the former because the only conceivable host, the Mattson Formation, was deposited under a wet climate and such deposits are very uneconomic; the latter because all of the rocks are too young.
- Volcanic Redbed **Copper** (Kirkham, 1995a) is of **very low potential (7)** for the same reasons as iron – only traces of copper are found near Coates Lake in thin exposures of Little Dal basalts (Gabrielse et al. 1973).
- Peralkaline rock-associated **rare metals** (Richardson and Birkett, 1995) are of **low potential (6)** because none of these rock types are present in the study area. Potentially prospective intrusions are located in Map Sheet 95C in the Yukon, where the

`Ting Creek' alkalic intrusion has been documented by Harrison (1982).

- Vein **copper-silver-gold** as a deposit type is not included in Eckstrand et al., and is rated as of **low potential (6)**. This "type" used to refer here to the many small showings of tetrahedrite with associated malachite and vuggy quartz veins that are found along fractures and in vuggy spaces in dolomites of MacDonald Domain. One example is the Nahanni Butte showing. None of these is large enough to be considered more than a curiosity, however the gold content of such showings may be a source for minor local placer gold deposits.
- Porphyry **Copper, Molybdenum, Tungsten** (Kirkham and Sinclair, 1995) are considered of **low potential (6)** because large alteration zones such as pyritic haloes are absent, there is however little evidence of high fluid phases in exposed granitoid complexes, and there is no surficial geochemical evidence of large alteration zones or elevated copper and associated elements. Furthermore the area has been well explored by major companies and no significant showings reported. Mesozonal plutons of Selwyn Plutonic Suite do intrude a wide range of supracrustal rocks, and include feldspar megacrystic porphyritic phases.

7.4. Mineral deposit types of highly uncertain potential in the South Nahanni River region.

- Falck (pers. comm., 2003) recommended consideration of sapphires as another potential gemstone type that could be present in the Ragged Ranges. The Yugo Sapphires are hosted in a lamprophyre in Montana and as placers in that area. Lamprophyre dykes are common in Ragged Ranges (one is exposed in the pit at CanTung) and this potential has not been evaluated in the north any more than the emerald deposits were 5 years ago.