

1987a), but more detailed examination showed that the least deformed portions have a granoblastic texture (Van Berkel and Currie, 1988, Fig.3) characteristic of statically recrystallized gneisses formed during medium to high grade metamorphism. An elongated hill north of Cormacks Lake consists of two-pyroxene granulite (unit PC1d) only slightly retrograded. Early tight folding is commonly obliterated by a gneissose banding which is itself folded to give the macroscopic map pattern. The metasedimentary rocks (unit PC2) can be subdivided into

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DESCRIPTIVE NOTES

480) which connects the town of Burgeo on the south coast of Newfoundland with the Trans Canada Highway (Route 1), and some privately owned logging roads, as well as Grand Lake and Little Grand Lake, provide access to portions of the western and central part of the map area. The greater portion of the map area is The map area is dominated by the Long Range uplands. gently rolling surface with an elevation between 300 and 650 meters, which is deeply dissected by rivers and streams. Much of 300 to 350 meters, except a more or less dense growth of stunted spruce ("tuckamore") and is characterized by bogs between barren peaks and ridges. The degree of bedrock exposure is high in the barren uplands except in areas underlain by undeformed granite where only the top of large rounded hills have exposed bedrock. Except in streams exposure is poor to non-existent in the wooded

Large portions in the south of the map area (12B/1 and 12A/4) are covered by bouldery till. All of the map area has been glaciated, with ice movements dominantly to the northwest in the western portion and to the southeast in the central and

This region was initially covered by 1:2,0,000 reconnaisance geological mapping by Riley (1957,1962). Kean (1983) mapped the King George IV sheet (12A/4) on a 1:50,000 3cale and Herd and Dunning (1979) and Dunning (1984) covered parts of the Puddle Pond sheet (12A/5). Whalen and Currie (1983 a,b), Knapp (1982) (12A/12). Several reports and preliminary maps dealing with portions of this region have been published by the authors (Van Berkel and Currie, 1986; Van berkel et al., 1986; Currie, 1986,1987; Van Berkel, 1987a,b,c; Van Berkel and Currie, 1988;

The mapped area falls into five diverse geological terranes that are separated by major faults (Van Berkel et al., 1986) Northwest of the Long Range fault, late Precambrian metasedimentary rocks and underlying Grenvillian gneisses of the Steel Mountain terrane (SMT, Van Berkel et al., 1986) have been thrust to the northwest. This region fits well into the Humber tectono-stratigraphic zone of Williams (1979). Between the Long Range fault and Victoria River fault, the rocks consist primarily of quartzofeldspathic gneisses with minor semi-pelitic and quartzitic rocks invaded by mafic and granitoid intrusions. This Central Gneiss terrane (CGT, Van Berkel et al., 1986) does not resemble either the Humber or Dunnage zones of Williams (1979) but has some similarities to the Gander zone. The narrow region consists principally of very low metamorphic grade mafic and felsic volcanic rocks of the Victoria Lake Group, a typical Dunnage zone assemblage. North of the Little Grand Lake fault, the Topsails terrane comprises very low grade metamorphic mafic and felsic volcanic rocks of the Glover Formation, typical of the Dunnage zone, and massive, often peralkaline, high-level granitic rocks which define the unique character of this terrane. Southeast of the Victoria River fault (Rocky Ridge Pond terrane) the rocks consist of medium-grained granoblastic quartzofeldspathic gneisses intruded by large plutons of late or post-tectonic granites, many of them megacrystic (Kean, 1983). To the west Carboniferous sedimentary rocks unconformably overlie or are in fault contact with the igneous and metamorphic rocks

Steel Mountain terrane Anorthosite of the Steel Mountain complex (unit I

dominates the Grenvillian rocks. Much of the anorthosite has massive, partly recrystallized, medium grained (up to 10 cm long) feldspar and even larger (up to 3 m) pyroxene crystals. Pyroxene is altered to hornblende and may have a rim of biotite. Relict layered igneous textures occur rarely. Most anorthositic rocks have colour indexes less than 5 (unit P2a) but locally gabbroic anorthosite (CI = 10-30) (unit P2b) and norite (CI= 50%) or pyroxenite (unit P2c) are present. Pockets and layers of titaniferous magnetite locally up to a few hundred metres long are common (Baird, 1943, 1954). Brittle faults and fracture zones are widespread. Narrow ductile shear zones have been observed in a few outcrops but probably have a limited extent. Epidotization has been observed in many exposures along the Burgeo Road (Route 480). Amphibolite dykes (unit P5) are uncommon, generally 0.25 to 3 m thick and trand between northwest and northeast. They may be correlative to the 600 Ma Long Range dyke swarm (Stukas and Reynolds, 1974) of the Great Northern Peninsula (Long Range Inlier). The Steel Mountain anorthosite is a massif-type anorthosite (Simmons and Hanson, 1978; Emslie, 978) and can be correlated with the Grenvillian Indian Head anorthosite (Walthier, 1949; Heyl and Ronan, 1954; Colman-Sadd, 1974) located some 15 km to the west, east of Stephenville.

Several very coarse grained norite bodies (unit P2c) up to one kilometre across are more mafic facies of the Steel Mountain anorthosite. Poorly foliated quartz diorite-tonalite (unit P3) s present within the eastern margin of the Steel Mountain anorthosite and field relations suggest intrusive contacts with anorthositic rocks (unit P2), whereas the intermediate and granitic gneisses (unit P4) have tectonic contacts with the anorthositic rocks (unit P2). North of the Steel Mountain complex rocks of the Disappointment Hill complex (unit P1) consist of granulitic gneisses in various stages of retrogression intruded by

orthopyroxene-bearing granitoid rocks (Currie, 1986,1987). Intermediate and granitic gneisses (unit P4) containing inclusions and large bodies of amphibolite occur within and between the Long Range fault zone and the Steel Mountain anorthosite. A low-grade metamorphic overprint often forms an incipient mica-rich foliation in these gneisses and the strike of the foliation is parallel to the trace of the Long Range fault. Locally, spectacular platy schists are produced in shear zones. The intermediate and granitic gneisses (unit P4) are assumed to be Grenvillian on the basis of composition, structural style and high grade metamorphic textures. The age of the low-grade

Foliated granitoids (unit P6a) occur south of Grand Lake and comprise heterogeneous but generally pale pink granitoid rocks characterized by L-S fabric (Currie, 1986,1987) They consistently contain 5-15% of mafic schlieren and transposed mafic dykes, most of which have been converted to biotite schists. Foliated conglomerate, quartzite and garniteferous quartznica schist (unit P7) can be traced in a narrow belt for nearly 20 kilometres. The age of this rock unit is highly uncertain but is certainly younger than the foliated granitoids (unit P6a) because it contains clasts of and directly overlies this unit. The conglomerate may represent the basal conglomerate of the metasedimentary cover cover rocks (unit P€3). Currie (1987) has shown that west of the Little Grand Lake area the gneisses of unit P4 are younger than the Steel Mountain anorthosite (unit P2) and two-pyroxene granulites of the Disappointment Hill complex (unit P1). A post-tectonic

peralkaline granite (unit P6b) at Hare Hill gave a Pb-U date on zircon of 617+/-8 Ma. Given these constraints it seems reasonable to identify the metamorphism of the gneisses of units P1 to P4 as Grenvillian in age, that is about 1000 Ma. Around the southwestern arm of Grand Lake Grenvillian gneisses are unconformably overlain by metasedimentary cover rocks (unit PC3) consisting of actinolite +/- garnet schist, marble, calcareous phyllite, pelitic quartzite (with staurolite + garnet assemblages) and quartzite. Some details of the stratigraphy and petrography of this sequence are given by Currie (1986,1987), who followed earlier workers in correlating it with the Late Precambrian-Early Paleozoic Fleur de Lys Supergroup (Knapp et al., 1979; Kennedy, 1981; Hibbard, 1983a,b; The gneissic basement and its metasedimentary cover have

been thrust to the northwest, forming spectacular duplexes in which the basement-cover unconformity is repeated several times (Currie, 1987). The thrusting has variably overprinted the fabric of the gneisses, producing new growth of oriented micas (Currie, 1987, Fig.2), and grain size reduction in feldspar, quartz and amphibole. The degree of overprint is generally low, but locally high enough to produce fissile schists in which the older gneissosity is wiped out. Sheets of very fissile, two-mica granitoid schists often found in the thrust zones may be produced by such overprinting, combined with alkali loss, rather than by synkinematic intrusion as suggested by Currie (1987). Cambro-Ordovician rocks northwest of the Grand Lake fault (units €01 to €03) have been described in detail by Williams (1985) and Currie (1986,1987) and the Carboniferous sediments of the Bay St. George Subbasin (units C1 to C3) by Knight (1983).

The oldest rocks east of the Long Range fault form two north-south trending belts, one with generally leucocratic quartzofeldspathic rocks of the Cormacks Lake complex (unit PC1) f unknown origin and one with metasedimentary rocks (unit $P \in 2$). The belts are separated by late-tectonic granodiorite-tonalite (unit 01) and granite (unit 02). The Cormacks Lake complex (unit P£1; Herd and Dunning 1979; Van Berkel, 1987a) contains horizons with pyrite+gedrite+/-

garnet and minor pelitic and quartzitic rocks (unit PC1b), and 48°00 thick layers and lenses, and inclusions of amphibolite (Van Berkel and Currie, 1988, Fig. 2) and coarse-grained meta-gabbro (unit P€1c). Some of the amphibolite exhibits relict igneous texture which may indicate that it forms a remnant of ophiolite complexes (unit 03). The predominant quartzofeldspathic gneiss was formerly interpreted as deformed biotite granite (Van Berkel,

a western portion dominated by quartzofeldspathic rocks and a much smaller eastern portion of more quartzitic and semipelitic rocks. All were deformed and metamorphosed during medium to high-grade metamorphism. The quartzofeldspathic rocks (unit PC2a) exhibit a medium grained granoblastic texture with abundant feldspar porphyroblasts (Van Berkel et al., 1986, Fig. 19.5) that obliterated primary sedimentary features. Amphibolite (unit PC2c) inclusions are common and locally large bodies of amphibolite are present but no recognizable ultramafic bodies were observed. Trains of amphibolite inclusions may be highly deformed and disrupted dykes.

Lithologically monotonous more quartzitic and semipelitic

metasediments (unit PC2b) form a narrow zone along the eastern edge of the metasedimentary belt (unit P€2), have undergone severe deformation, and contain strips and inclusions of tectonized serpentinized dunite and other metamorphosed ultramafic rocks (unit 03a,b), and gabbro (unit 03c)(Fox and Van Berkel. 1988). Microstructural evidence for strong deformation is obliterated by recrystallization but numerous foliation-parallel quartz veins and lenses (Van Berkel, 1987a, Fig. 41.3) are preserved in certain zones and probably formed in shear zones by tectonic segregation (Piasecki, 1980). The origin of the ultramafic slivers is uncertain. They could be fragments of ophiolites and mark the traces of major thrust faults (Van Berkel et al. 1986; Fox and Van Berkel, 1988). Alternatively, severe deformation of a sedimentary ophiolite mélange (cf. Williams, 1977) could give similar field relations. The contact between the two metasedimentary units (PC2a and b) appears to be a strain gradient over a distance of a few hundred metres. South of Little Grand Lake the metasedimentary rocks (unit PC2) form stromatic to nebulitic migmatites and locally have recognizable quartzitic and calcareous beds (unit PC2d; compare Herd. 1978). Unlike the Cormacks Lake complex (unit PC1) these migmatites are openly folded on a mesoscopic scale. Numerous small veins of biotite granite (Van Berkel and Currie, 1988 Fig. 4) form a characteristic feature of these migmatites. East of

North Pond a thin layer and an inclusion of serpentinite were The metasedimentary rocks (unit PC2) appear to be possibly correlative with the metasedimentary rocks northwest of the Long Range fault which have been correlated with the Fleur de Lys Supergroup (Knapp et al., 1979; Kennedy, 1981; Hibbard, 1983 a, b; Williams, 1985).

Late-tectonic, massive to weakly foliated plutons composed of a variety of granitic rocks (unit 01, 02) invade the previously described rock units. Dominant rock types are medium to coarse grained hornblende-biotite granodiorite and tonalite (unit 01) and biotite granite and leucogranite (unit 02). Their regional distribution is confirmed by radio-element mapping techniques (Broome et al., 1987). Hornblende-biotite granodiorite and tonalite (unit 01) often contain amphibolite inclusions, expecially in the region south and southeast of Grey Pond where inclusions form 5 to 30% of individual exposures. The region from Padille Pond to Battle and Silver Pond contains various granitoid rocks ranging from a distinctive, mafic enclave-rich, foliated granodiorite-tonalite (unit 01) to medium to coarsegrained, foliated biotite granite and leucogranite (unit 02) This large region probably includes several plutons of very

Mafic and ultramafic rocks of possible ophiolitic affinities (unit 01) not only occur in the metasediments (unit PC2) but also as inclusions and layers in the Cormacks Lake complex (unit PC1). Metagabbro (unit 03c) is generally altered to amphibolite and variably epidotized, but locally, moderately strained, coarse grained original textures are preserved, e.g. south of Portage Lake (Van Berkel, 1987a, Fig. 41.4) and north of Cross Pond. Dunite and harzburgite (unit 03a) and pyroxenite (unit 03b) are well preserved in a large outcrop south of Portage Lake where moderately to highly strained metagabbro (unit 03c) encloses a large (300 by 200 m) tectonic sliver of partially serpentinized dunite, harzburgite and pyroxenite. From southeast to northwest dunite with minor harzburgite passes abruptly into pyroxenite veined by harzburgite. Other tectonic slivers enclosed by metagabbro (unit 03c) in this region contain harzburgite and pyroxenite. Small amounts of chromite are found as dispersed euhedral crystals in dunite south of Portage Lake, and also as thin seams in serpentinite inclusions and layers in the metasedimentary rocks (unit PC2; see Van Berkel et al., 1986,

Intrusions of massive to mildly foliated medium-grained diabasic gabbro and coarse-grained leucocratic gabbro (unit 07; Van Berkel and Currie, 1988, Fig. 5) are cut by fine grained diabase dykes (Van Berkel and Currie, 1988, Fig. 6), tend to trend northeast-southwest or east-west, and be bounded by faults. Although these bodies locally contain enclaves of dunite (Van Berkel and Currie, 1988, Fig. 7), harzburgite, pyroxenite or from remnants of ophiolites (unit 03) by lack of deformation and associated ophiolitic units (deformed ultramafics, sheeted dykes, pillow lavas), common presence of minor amounts of biotite and local presence of lamprophyric texture. Mapping of the large body around Bottle and Southwest Brook Pond is hampered by poor exposure, but road and hydro line cuttings suggest a complex mixture of mafic phases including many dykes, with granitoid enclaves (units 01, 02) and granite intrusions (unit 09), all generally trending northeast. H. Miller (personal communication, 1986) found a large positive Bouguer anomaly in this region which can be modelled by assuming about 70 percent of mafic rocks of density 2.9 to a depth of 8 km (M.D.Thomas, personal The large Annieopsquotch complex (unit 07) has generall

been interpreted as a large ophiolite fragment (Dunning and Herd, 1980; Dunning, 1984; Dunning and Chorlton, 1985). However our reexamination shows that the ultramafic portions form small pods in a gabbroic matrix, that the dykes of the complex cut a gabbroic matrix, and that other lithologies typical of complete ophiolite complexes are notably absent. We therefore suggest that the Annieopsquotch complex is not ophiolitic but a post-obduction mafic complex (unit 07) emplaced under a sinistral shear regime, thus explaining the N160E-N200E orientation of the dykes. Another large mafic complex (unit 07b) with many mafic dykes

occurs west of Dashwoods Pond. The mafic rocks consist of rather leucocratic (CI=40) medium grained rocks composed of plagioclase with minor orthopyroxene and even less hornblende. They are cut by more mafic hornblende-rich dykes (CI=60) which generally trend between northeast and southwest, and comprise between 5 to 30% of individual exposures. Large rusty enclaves of quartzofeldspathic rocks of unit PC2 are locally present and prove the intrusive nature of this complex. A large intrusion of mafic rocks is transected by the Burgeo Road (Route 480), close to the Long Range fault, consists of fine and medium grained diabase (unit 07b) with minor coarse grained

gabbro. Along the eastern edge of the body at the Burgeo Road Route 480) coarse grained gabbro locally exhibits an igneous layering defined by magnetite-rich layers. Zircon dating unning, personal communications, 1985) and K-Ar determinations (R.K. Herd, in Stevens et al., 1982, p. 46 and 47) indicates a lowermost Upper Ordovician age for this body. A large intrusion of quartz diorite and tonalite (unit 08 outcrops along the Burgeo Road. The rocks contain inclusions of diabase and gabbro thought to be derived from unit 07, and are cut by granite veins. A faint mineral banding and alignment of inclusions in the margin of the intrusion may be due to flow processes. Small, massive diorite plutons (unit 08) occur roughout the map area. Around Crabbes River a diorite intrusion contains numerous mafic inclusions. The youngest intrusive rocks (unit 09) comprise massive medium grained biotite granite and leucogranite, locally with porphyritic feldspar, which commonly veins the previous units. Large intrusions of this type occur south and northwest of Southwest Brook Pond, north of Lloyds Lake and in the southwestern part of the area.

Silurian red sandstone, conglomerate (unit S1a) and rhyolite unit S1b) unconformably overlie mafic intrusive rocks (unit 07) and basalt of the Victoria Lake Group (unit 05a) south of the Annieopsquotch complex (Chandler, 1982; Chandler and Dunning, 1983). Devonian sedimentary rocks with minor volcanic rocks of the Windsor Point Group (unit D1) unconformably overlie this unit and the massive biotite granite of unit 09. Victoria Lake terrane The Victoria Lake terrane lies between the Annieopsquotch

major structure which may be part of the Cape Ray fault system. The dominant rock unit in this area is the Victoria Lake Group (unit 05) which consists of basalt, felsic volcanics, and intercalated sediments, and especially around Victoria Lake contains numerous diabase dykes and sills (H.Williams, personal communication, 1987). Zircons from rhyolite of the Victoria Lake Group gave an age of 462 + 2/-4 Ma (Dunning et al., 1987). Rocky Ridge Pond terrane Southeast of the Victoria River fault the dominant rock

types are medium to coarse grained granoblastic

complex - King George IV Lake and the Victoria River fault, a

quartzofeldspathic gneisses (unit P4?) and migmatitic quartzofeldspathic paragneisses with minor pelitic schist and quartzite (unit PC4). They are invaded by small to large plutons f medium to coarse-grained, foliated biotite granite or leucogranite (unit 02?) and a Devonian megacrystic granite (unit D2). The medium to coarse grained granoblastic quartzofeldspathic gneisses (unit P4?) have a very distinct appearance and their metamophic age could be Grenvillian (age dating in progress). The grain size of these gneisses is so coarse (up to 10 mm) due to static recrystallization during high-grade metamorphism that they can easily be confused with felsic intrusive rocks. Veins and sheets of granite, granodiorite and tonalite (not shown as a separate unit) are very common (Kean, 1983) in the medium to coarse-grained granoblastic quartzofeldspathic gneisses (unit P4). A diabase body (unit 07b) (Kean, 1983), locally with igneous layering, was found in Rocky Ridge Pond. The Devonian megacrystic biotite granite (unit D2) contains numerous enclaves of Bay du Nord clastic sediments and volcanics (unit 06). All the rocks contain narrow, late, biotite-rich shear zones. These shear zones parallel the Victoria River fault.

Much of the Topsails terrane (Whalen and Currie, 1983a,b) in the Little Grand Lake map area is underlain by well-preserved, locally pillowed (Van Berkel and Currie, 1988, Fig.8) basalt of the Glover Group (unit 04). Several layers of felsic volcanics

and sediments, and a few layers rich in hematite were observed in

the basalt. Intrusions of gabbro/diabase (unit 07b,c) and granite

(units S2 and S3) are common. A late phase of east-west striking

mafic dykes cuts the granites (unit S2) east of Little Grand The transition from the Topsails terrane to the Steel Mountain terrane on Glover Island occupies a zone 0.5 to 1 km wide comprised of highly deformed felsic volcanics and sediments of the Glover Group (unit 04b) and two mafic intrusions (unit 07b), including north-trending diabase dykes which cut the ophiolitic (Knapp, 1982) serpentinite of unit 03a. This transition lies in a roughly north-south striking deformation zone overprinting and folding all earlier fabrics, foliating the mafic intrusions (unit 07b) and cross-cutting geologic boundaries. The origin of this zone is not presently understood. The sinuous character of the metasedimentary and volcanic rocks of unit 04b suggest a dextral component of shear in this region.

The Steel Mountain anorthosite contains numerous small pockets of titaniferous magnetite. Baird (1943 and 1954) described large lenses of magnetite north of Flat Bay Brook, which contained about 7 percent TiO2. Rusty quartzofeldspathic rocks of the Cormacks Lake complex (unit PC1) contain a few percent pyrite and magnetite, resulting in a distinctive rusty weathering surface, but have no detectable

Au. Pt or Pd, even not in large shear zones. Serpentine layers and inclusions (unit 03a) enclosed by the quartzofeldspathic and more quartzitic and semipelitic rocks of unit PC2, locally contain up to 10 percent chromite and magnetite in the form of thin seams (Van Berkel et al., 1986, Fig. 7) or as dispersed euhedral crystals. Au-Pt-Pd analyses (Van Berkel et al., 1986, Table 1 and unpublished data) of various serpentinite layers and inclusions (unit 03a) yield up to 40 ppb Au, up to 54 ppb Pt and up to 36 ppb Pd. Ultramafic and mafic rocks of unit 07 contain up to 9 ppb Au, 10 ppb Pt and 9 ppb Pd. Fissile zones with macroscopically visible pyrite contain up to 50 ppm Au. One outcrop of layered gabbro (unit 07b) on the Burgeo Road (Route 480), 7.5 km east of the Long Range Fault, contains layers rich in magnetite. A brittle fault cutting diabase (unit 07) with minor granite offshoots (unit 09) in the northeast corner of the Main Gut map area (12B/8) is exposed in a stream and contains quartz veins with minor pyrite. A quartz vein sample

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(6VMGPTS4) with about 2% pyrite has a content of 190 ppb Au. Another

quartz vein sample (6VM 413) of the same exposure contains about 30%

pyrite and gave 646 ppb Au (Van Berkel, 1987b).

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