GEOLOGY OF THE LETITIA LAKE AREA, LABRADOR*

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Introduction

A narrow belt of quartz feldspar porphyries flanks the south margin of the Seal Lake syncline in the Letitia Lake area (25 kms WSW of Seal Lake). The porphyries were named the Letitia Lake Group by Mann (1959) and are intruded by agpaitic alkaline complexes that host beryllium, colombium, thorium, rare earth, lead and zinc mineralization (Brummer 1960; Evans and Dujardin, 1961). Despite the economic significance of the area many important geological relationships have remained unclear. The relationship between the porphyries and a large granite buttress bordering the Seal Lake syncline on the south was not resolved by Brummer and Mann (1961). However, Currie (1973) states that the granite represents deformed and recrystallized Letitia Lake Group rocks. The Seal Lake Group was originally considered to unconformably overlie the Letitia Lake Group (Brummer and Mann, 1961), but Currie (1973) has suggested that the contact is conformable. In addition a correlation of the Letitia Lake Group with the upper part of the Croteau Group has been suggested by Brummer and Mann (1961) and Roscoe and Emslie (1973). Some 40 square kms centered on north Letitia Lake were mapped by the writer in an attempt to resolve some of these problems.

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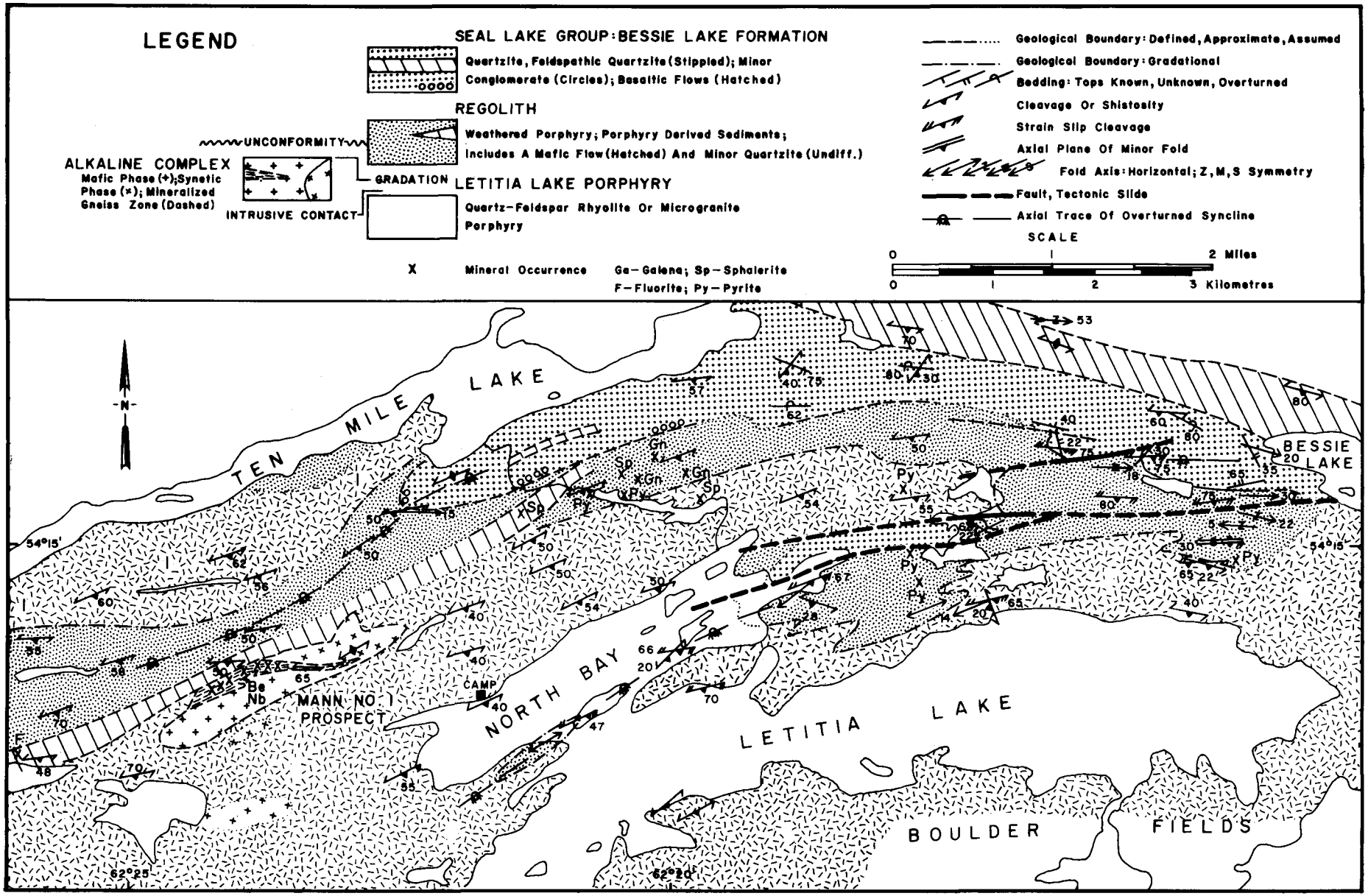

Fig. 1 Geology of the Letitia Lake area. For the regional setting see Fig. 1 in Marten and Smyth, this volume.

Brummer and Mann (1961) divided the Letitia Lake Group into a lower unit of quartz feldspar porphyry, grading into an upper unit of banded rhyolite, tuff and quartz-sericite schist. This study has found that the lower unit is the peripheral fine grained phase of an epizonal pluton - the largest granitic buttress occurring to the south and east. The "upper unit" therefore marks the pre-Seal Lake Group erosion surface and forms the basal part of the Seal Lake Group. In this account the name Letitia Lake Group is abandoned, and what was the "lower unit" is referred to as the Letitia Lake Porphyry. This reinterpretation means that correlation of the porphyry with the Croteau Group can no longer be considered. It has also been found that the alkaline complex pre-dates and is unconformably overlain by the Seal Lake Group.

Letitia Lake Porphyry

The Letitia Lake Porphyry is homogeneous on outcrop scale and consists of subhedral K-feldspar phenocysts (2-5 mm) and rounded blue quartz phenocysts (16 mm) in a fine grained dark grey groundmass. Despite the overall dark colour of the rock, on weathered surfaces the groundmass is seen to be essentially quartzo-feldspathic with finely divided flakes of chlorite and some biotite, rarely up to 1 mm in grain size. The porphyry shows some lithological variation, chiefly in the relative proportions of phenocrysts, and in the colour of the groundmass which is locally mauve-grey or pinkish. A few outcrops along the south shore of Letitia Lake are coarser in texture, with phenocrysts up to 1 cm in size, and have a more

granular groundmass. Extensive boulder fields of angular frost-heaved porphyry boulders blanket the southern part of the area where most previous maps indicate the presence of granite. Smyth (personal communication), working 20 kms to the east, reports that the granite there locally grades into porphyry. It is considered therefore that the Letitia Lake Porphyry grades into granite south of Letitia Lake, and essentially represents a marginal microgranitic phrase of the pluton. This is supported by the presence of granophyric texture in the porphyry, reported by Mann (1959).

Alkaline Complex

The body at Letitia Lake forms part of the Red Wine Alkaline Province (Currie, 1973; Curtis et al., 1974). It was only briefly examined by the writer, due to its complexity and a lack of time. It includes syenitic and mafic phases, and much of the mineralization appears to be confined to a median zone of albite-soda amphibole-soda pyroxene gneiss. The contacts of the complex were not observed.

Seal Lake Group

The Regolith

The regolith at the base of the Seal Lake Group is divided into two units. The lower unit represents weathered bedrock and grades downwards into unaltered porphyry. The upper unit consists of oxidized sediments derived from underlying weathered porphyry and is notably enriched in

haematite and specularite; it locally includes units of cleaved feldspathic quartzite and a mafic lava flow, precursors of the overlying Bessie Lake Formation sedimentation.

Lower Unit

An intersecting net of irregular dark mauve-grey zones, 2-4 cm thick, appear in the porphyry approximately 200-650 m from the basal contact of the Bessie Lake Formation, and they outline triangular, polygonal and irregularly shaped bodies of pale porphyry (20-80 cm in diameter). In hand specimen there appears to be no difference in lithology between the porphyry and these zones except for haematite content. At the base of the unit the zones are erratically distributed and poorly defined, but become more prominent upwards and in places contain seams of haematite bordering median fractures. The zones are believed to be the product of pre-Seal Lake Group oxidation and weathering that followed joints and fractures in the porphyry. The upper part of the lower unit has been strongly deformed and the net of alteration zones has been transposed to form a streakily banded rock that could be mistaken for a banded rhyolite.

Upper Unit

The sediments of the upper unit appear to be thin and discontinuous; in places they are difficult to distinguish from the tectonically derived, banded rock of the lower unit. The sediments consist of cleaved and slaty grey siltstone and psammite with scattered quartz eyes. Bedding is defined by alternating grey and dark grey bands 2-5 cm in thickness. Haematite

and specularite are common in disseminated fine grains, and massive haematite also occurs in veins and concordant lenses up to 1.7 m long and 25 cm thick.

A fine grained mafic-intermediate horizon up to 50 m thick occurs in the upper unit and is believed to be a flow related to those in the Bessie Lake Formation. Lenses of white-weathering feldspathic quartzite, largely transformed to quartz-sericite schist are locally intercalated with the grey sediments and are typical of the immediately overlying Bessie Lake Formation.

A band of the regolith occupying a horizontal fold core appears to truncate the north border of the alkaline complex, and clasts of medium grained syenitic rock occur at two localities in the regolith close by. It is therefore probable that the Seal Lake Group unconformably overlies the alkaline body.

Bessie Lake Formation

This formation consists of clean, white quartzite and feldspathic quartzite with interbedded mafic flows. Conglomerate (up to 7 m exposed thickness) was observed at three localities at the base of the formation in contact with the regolith. The conglomerate contains clasts of Letitia Lake Porphyry, vein quartz and fine grained grey psammitic or felsitic rock. It rests conformably on the sediments forming the upper unit of the regolith, and is thus not a true basal conglomerate; locally, however, it may rest directly on weathered bedrock.

Structural History

Two phases of deformation have effected both the Seal Lake Group and the Letitia Lake Porphyry. The porphyry had not suffered any major tectonic deformation before deposition of the Seal Lake Group.

The first deformation was largely restricted to the contact between the Seal Lake Group and its basement, the homogeneous porphyry. The upper part of the regolith is intensely deformed and the schistosity, which is parallel to bedding, dies out upwards and downwards. Translation between the porphyry and the Seal Lake Group may have occurred along this zone, but there is no direct evidence of relative movement.

The second deformation produced a regionally pervasive cleavage dipping south at 55^{o}, and subhorizontal to gently east-plunging synclines fold the S_1 schistosity and bedding. The complementary anticlines are missing, and are replaced by shear zones (tectonic slides) related to the second phase cleavage. The subhorizontal plunge of the F_2 folds has caused an intertonguing map pattern of regolith and porphyry; this appears to have been interpreted by earlier workers as primary interbedding of lithologies.

Most previous publications show the Grenville Front passing through the Letitia Lake area (e.g. Tectonic Map of Canada). This study and that of Marten and Smyth (this volume) shows that there is no discrete zone marking a dramatic increase in deformation and metamorphism along the south margin of the Seal Lake basin. The Grenville Front does not appear to

persist as such into central Labrador. This would explain the difficulties experienced by previous workers in attempting to trace its continuation eastwards to the coast of Labrador (e.g., Taylor, 1971).

Mineralization

Alkaline Complex

Complex mineralization related to the alkaline bodies has been described by Brummer and Mann (1961) and Evans and Dujardin (1961). The deposit (Fig. 1) includes 11,000 tons per vertical foot of material averaging 0.35-0.40% beryllium oxide, continuing to a depth of at least 200 feet. A zone of gneiss, 2,400 feet long and 144 feet wide, is reported to average 0.24% niobium oxide. Lead and zinc assayed well below 0.5%. The mineralized zone is radioactive, and assays of 0.2% thorium oxide and 0.06% uranium oxide have been reported, though the presence of uranium was not confirmed by subsequent assays. Problems in the beneficiation and treatment of the ore have deterred any further work on the prospect.

It should be noted that discovery of the deposit resulted from a geochemical programme planned to evaluate the Seal Lake copper district (Brummer, 1960); since the mineralization is not visible in outcrop, the remainder of the Red Wine Alkaline Province has potential for similar occurrences.

The alkaline rocks of the Red Wine Province appear to be very similar to a mineralized portion of the Ilmaussaq alkaline intrusion

(1020 ± 24 m.y.) forming part of the Gardar magmatic province (3000-1000 m.y.) of south Greenland (Sorensen et al. 1974). The mineralization to the Ilimaussaq intrusion appears identical in type to that at Letitia Lake, but there the main interest lies in uranium rather than the beryllium or niobium. A low grade body totalling 18.6 million metric tons containing 5,800 metric tons of uranium has been outlined, and a method of beneficiating the uranium has been evolved; in addition, a spatial and probable genetic connection between the mineralization and lujavrite has been noted (Sorensen et al., 1974). The Red Wine alkaline rocks on average are of lujavrite composition (Curtis et al., 1974).

These relationships suggest that the Gardar magmatic province extends through southern Labrador (Bridgewater et al., 1973), and that the Red Wine alkaline bodies must be considered as exploration targets for uranium. Other occurrences of the economically interesting Gardar gabbroic-alkaline association may be expected in southern Labrador; for example, areas of 'amphibolite' and gabbro of unknown affinities shown on reconnaissance maps are worth attention.

Sulphides

The Letitia Lake Porphyry locally contains disseminated fine grained pyrite, giving rise to rusty or heavily gossaned outcrops, and quartz veins carrying galena and sphalerite were reported by Brummer (1960). This mineralization, occurring in the peripheral phrase of an epizonal

pluton, can be compared to porphyry type deposits. However, there is nothing to suggest that this comparison has any economic significance in the Letitia Lake area.

Uranium

Background radioactivity in the regolith is at least 50% greater than background values in the Letitia Lake Porphyry, and in many places, is double. Discrimination by the McPhar TV-1 scintillometer used indicates that the source is uranium. A thin (1 cm) zone with readings of up to 5 times background was located in a shear zone related to the second deformation. The anomalous uranium is believed to be genetically related to the basal unconformity of the Seal Lake Group (see Marten and Smyth, this volume).

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