QUATERNARY MAPPING AND DRIFT EXPLORATION IN THE STRANGE LAKE AREA, LABRADOR

by

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ABSTRACT

Situated approximately 145 km west of Nain, the recently discovered Zr-Nb-Ta-Be-REE Strange Lake deposit has provided a rare opportunity for studying the patterns of glacial dispersal, both geochemical and lithological, from a deposit of known extent. The area was affected by a continental glacial regime advancing towards 070. The sampling program in 1984 was designed to supplement and enhance the lake and stream waters and sediment plus reconnaissance till sampling undertaken in 1983. The current project focused on systematic sampling of tills across map sheets 14D/5 and 24A/8 with the aim of characterizing the geochemical signature of the deposit. Further, lithologic analyses of both intra-till clasts and surface boulders were also undertaken. Data analyses are still in preliminary stages, but suggest a well defined dispersal train with Be and Pb being particularly good indicators. Similarly, lithological analyses suggest the boulder train may reflect geological differentiations related to specific parts of the deposit.

INTRODUCTION

The recent discovery of a Zr-Nb-Ta-Be-REE deposit by the Iron Ore Company of Canada at Strange Lake has generated considerable interest, both in terms of its economic potential and in terms of characterising geochemical dispersal trains. From the Quaternary viewpoint, the discovery offers an excellent opportunity to study the effects of dispersal from a deposit of known (or almost known) extent affected by a continental glacial regime. Indeed, detailed till geochemistry has been completed by R. Dilabio of the Geological Survey of Canada. Further, analysis and discernment of the geochemical signature from the mineralisation may be applied to other areas where the origin of geochemical anomalies or mineralised boulders is unknown.

REGIONAL SETTING

The Strange Lake deposit is situated approximately 145 km west of Nain, on the Labrador-Quebec border. The study area comprised N.T.S. map sheets 14D/5 and the Labrador portion of 24A/8, a total area of approximately 1010 km^2.

The study area has been included in several small-scale terrain classification programmes (Lopoukhine et al., 1977; Douglas and Drummond, 1955). Both have characterized the area as 'high plateau', although this may be refined to one of a 'dissected upland'. The area is a peneplain surface which was elevated above sea level during the Pliocene (Cooke, 1929). This surface has been named the Nain plateau (Ives, 1960), and attains a maximum elevation of 700 m above sea level near the coast, decreasing inland to around 550 m above sea level in the study area. Climatically, the Strange Lake area falls within the zone of discontinuous permafrost.

GLACIAL HISTORY

Evidence from numerous sources, both terrestrial and marine, suggests a complex series of glaciations during the Quaternary for most of northeastern North America. However, the Strange Lake area reveals evidence of only the Late Wisconsin glaciation, the last major phase of glacial activity in northern Labrador.

Little is understood of the development of the Laurentide ice sheet, although Ives (1957) postulates that climatic deterioration led to 'instantaneous glacierization' of the high plateau areas. Subsequent ice flow patterns relate to an ice centre to the east of Hudson Bay (Shilts, 1980; Dyke et al., 1982 and others). Flow was not topographically controlled.

Deglaciation was probably by downwasting rather than a recessional process (Ives, 1960). The lack of recessional moraines and the widespread presence of glaciofluvial features and deposits both in the field area and elsewhere may be cited as supporting evidence. Deglaciation probably started about 10,500 years B.P. (Short, 1978) around the coast, with the Strange Lake area probably becoming ice free sometime after 9000 years B.P. (Short, 1978; Ives et al., 1976). A major pro-

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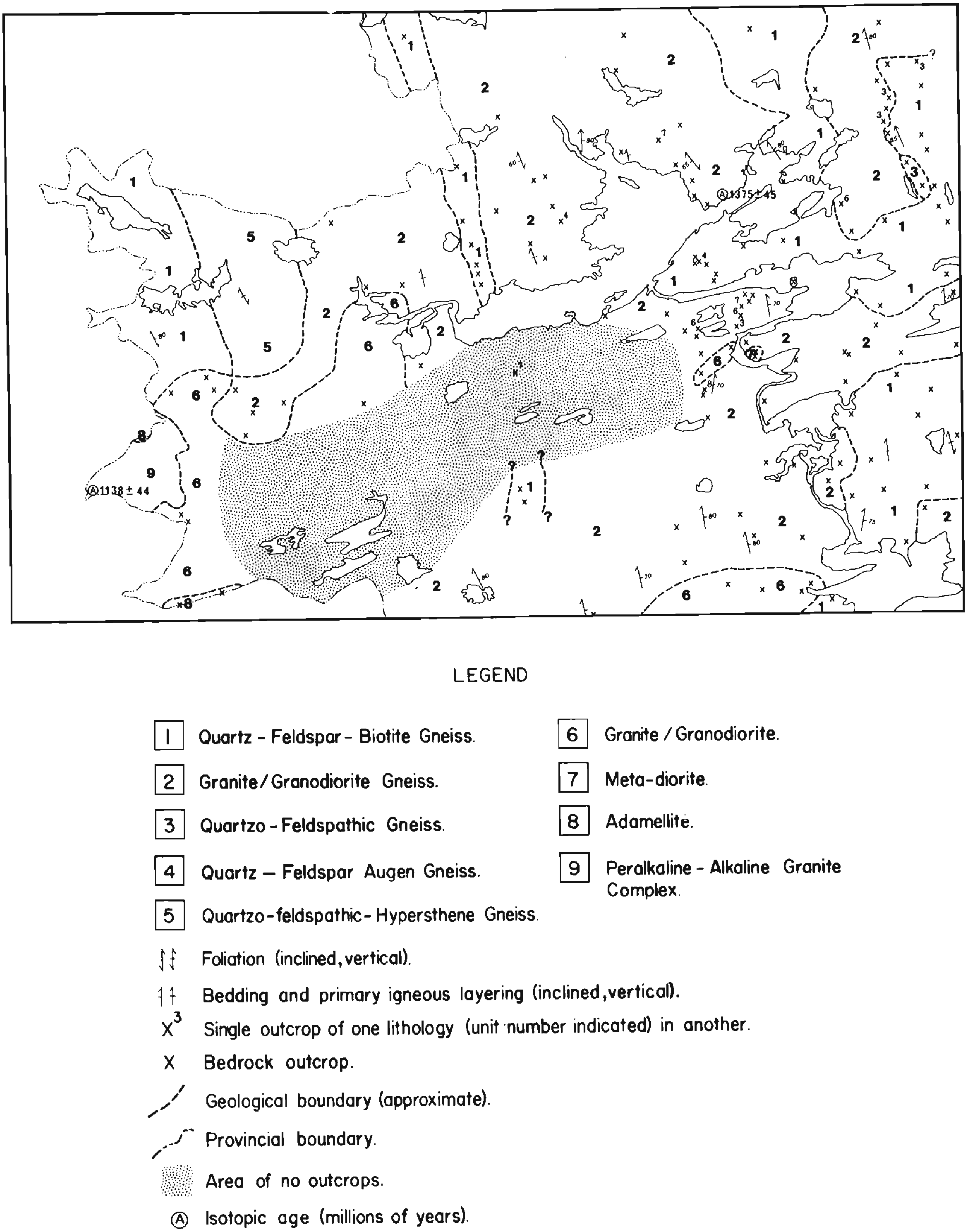

Figure 1: *Geological map of the Strange Lake area.*

glacial lake developed to the west of the study area, between ice inland and the highlands to the east. Glacial Lake Naskaupi existed for about 1000 years, until final retreat of the inland ice led to its decline. A major outflow channel was through the Kogaluk River system (Barnett and Peterson, 1964), 20 km to the south of Strange Lake. The study area was probably unaffected by major drainage from Lake Naskaupi.

GEOLOGY

Apart from the alkaline-peralkaline granite complex that hosts the Strange Lake mineral deposit, the area has only been the focus of reconnaissance level geological mapping (Taylor, 1970, 1979), which has characterized it as comprising Aphebian migmatites and associated lithologies, intruded by younger Paleohelikian adamellitic rocks in the central-eastern part. Subsequent bedrock mapping has redefined the intrusive body as housing the Strange Lake complex (see Miller, this volume), and an attempt has been made to subdivide the migmatitic group into discrete units, the latter as part of the 1984 Quaternary mapping project. On this basis, a compilation map has been produced (Figure 1). Clearly, however, more detailed bedrock mapping is required. The Strange Lake deposit occurs within a suite of peralkaline granites, which are composed of K-feldspar, quartz, albite and riebeckite with or without aegirine, together with accessory zircon, gittinsite, fluorite, hematite, pyrochlore and allanite (Hlava and Krishnan, 1980).

TERRAIN ANALYSIS

A detailed aerial photograph interpretation of the Strange Lake area was undertaken before the field season. Subsequent fieldwork resulted in a refinement of the initial picture, a compilation of which is presented (Figure 2). In general terms, four major terrain units are identifiable. The most widespread unit can be described as till, which covers approximately 45% of the field area. The till ranges from a veneer (<1 m) in areas of high relief to extensive thicknesses (>10 m) in subdued relief areas. In many cases, the till has a lineated appearance, reflecting regional glacial movements. Within the lowlands, along well defined paleo-valleys, glaciofluvial terrain is exposed. This covers 30%

Figure 2: *Surficial terrain map of the Strange Lake area.*

of the area and is either exposed as a veneer of well-sorted sand or gravel overlying till, or as a distinct esker ridge, the latter reflecting subglacial drainage channels. Areas of subdued relief within the till terrain are often the site of poor postglacial drainage, reflected by organics (15% of area), which often are a veneer (<1 m). The final major terrain unit is bedrock (10% of area). These areas are most often found in the uplands, but are also exposed as discrete crags across the map area or within the outwash channels.

SAMPLING PROGRAM

Detailed sampling of lake and stream waters and sediments was undertaken as part of a field study in 1983 (McConnell et al., 1984). In association with this, a reconnaissance level till sampling program was completed. Detailed till sampling was also undertaken in the vicinity of the deposit by R. Dilabio of the Geological Survey of Canada. The 1984 project was designed to enhance and complement these previous investigations, and focused on two specific sampling media.

Quaternary deposits, predominantly till, were sampled during foot and helicopter traverses from over 350 sites. Soil profile sampling of B, BC and C horizons was completed where possible to determine the geochemical profile and the horizon most characteristic of the parent material. Similarly, vertical sampling was also undertaken within the C horizon to determine grain-size distribution changes as well as geochemical variations. Glaciofluvial outwash deposits were also sampled, but since their genesis entails both greater distances of transport and transport along less well defined flow lines compared to fill deposits, only a limited number of samples were collected. Surface sampling was carried out on a regional 2 x 2 km grid, with more detailed sampling (0.5 x 0.5 km grid) being done around and down-ice of the Strange Lake complex. In total, 757 samples were collected in 1984.

In addition to overburden sampling, lithological analyses were made of clasts from within till samples and of boulders on the till surface. The aim was to determine both glacial transport directions and distances within the study area. Strict bedrock control is required, but a review of the available geological data reveals that the gneissic terrane is unsuitable for use as indicator lithologies. Indicators may, however, be revealed from within the mineralized complex. Apart from these, adamellites are considered a suitable lithology due to their discrete occurrence in the western part of the study area and their distinct (highly weathered) character.

INITIAL RESULTS

Analysis of ice flow indicators reveals a remarkably consistent regional pattern across the study area. Ice flow directions are between 060 to 075 with a mean of 070. At individual sites, however, some variation is noted as ice is deformed around bedrock obstructions. These facts indicate that, firstly, topography did not determine ice flow in the Strange Lake area and, secondly, that ice was at or above the pressure melting point during the development of erosional features, most likely during the onset of glaciation.

Primarily on the basis of morphological evidence, three till types can be distinguished in the field area. The first unit was identified at only one locality. A trench on the Strange Lake deposit reveals a thin (50-60 cm), massive, overconsolidated unit with a silty to fine sandy matrix, comprising clasts of local origin. It is expected that the geochemical profile will be compatible with the underlying mineralized lithologies. These characteristics are similar to those expected for a lodgement till, and the unit is tentatively assigned this origin.

Overlying the lodgement till unit in the trench and ubiquitous over the rest of the study area is a sandy to silty-sandy matrixed unit. This unit is normally-consolidated, has micro-sorting evidenced in terms of small lenses of sand or silt and contains clasts of more distal origin compared to the underlying unit. Geochemically, it is expected to reveal a signature different from the lodgement till; this would be more evidence for further transport of this unit. Thicknesses of the melt-out till unit exceed 5 m in places in the field area, although more extensive thicknesses may be expected. On the basis of its characteristics and stratigraphic position relative to the underlying lodgement till, this unit is tentatively assigned a subglacial melt-out origin. An identifiable subunit has similar morphological characteristics to the melt-out till unit, but since it is found in the lee of large crags, forming till 'tails', the term lee-side till may be applicable. This subunit was formed as debris melted out and dropped into a cavity formed as ice moved over a bedrock obstruction. This differs from the melt-out tills, which formed as debris-rich ice stagnated and downwasted.

The third till is predominantly a boulder unit. Clasts are angular to subangular and show no evidence of basal transport. In all cases, this unit directly overlies the subglacial melt-out/lee-side till element. It is possible that this unit is a supraglacial melt-out, although it is realized that the morphological evidence also corresponds to a subglacial melt-out till origin. More analyses should help us to determine the origin of this unit.

The finer than 4ø (63 microns) fractions of till samples were analyzed for Cu, Pb, Zn, Co, Cd, Ni, Mn, Fe, Be, F, Li and U. In addition, Th, Rb, Sr, Y, Zr, Nb, Ga, La, Ba, V, Ce and Cr were analyzed by X-ray fluorescence. Data analysis and manipulation are ongoing, and some elements have been examined in terms of their aerial distribution (Figure 3). The Be and Pb data show a strong correlation to the peralkaline complex and are good indicators of the mineralization. The dispersal train is well developed and tails off in a downglacier direction; it declines sharply north and south of the dispersal train. This profile is similar to that found by McConnell et al. (1984). However, control in terms of consistent regional sampling will only be achieved with the addition of the 1984 data so further conclusions at this time are difficult.

Similarly, the character of the boulder shadow from the mineralization is still under investigation and awaiting more comprehensive data on the nature of the deposit. However, the boulder train exhibits well defined lithologic alignments parallel to flow, which may be related to discrete units within the Strange Lake Alkalic Complex.

Evidence from boulder and till geochemistry indicates at least 30 km of transport from the deposit. A lag from the edge of the complex to its expression in either boulder or surface geochemistry is evident. The length of this so-called 'k' value (Drake, 1983) is dependent upon a series of variables, primarily overburden thickness (Miller, 1984). However, the nature of the overburden deposits has already revealed two tills, possibly a lodgement and melt-out facies, which exhibit contrasting transport distances and characteristics. Clearly then, in an exploration program, the nature of the

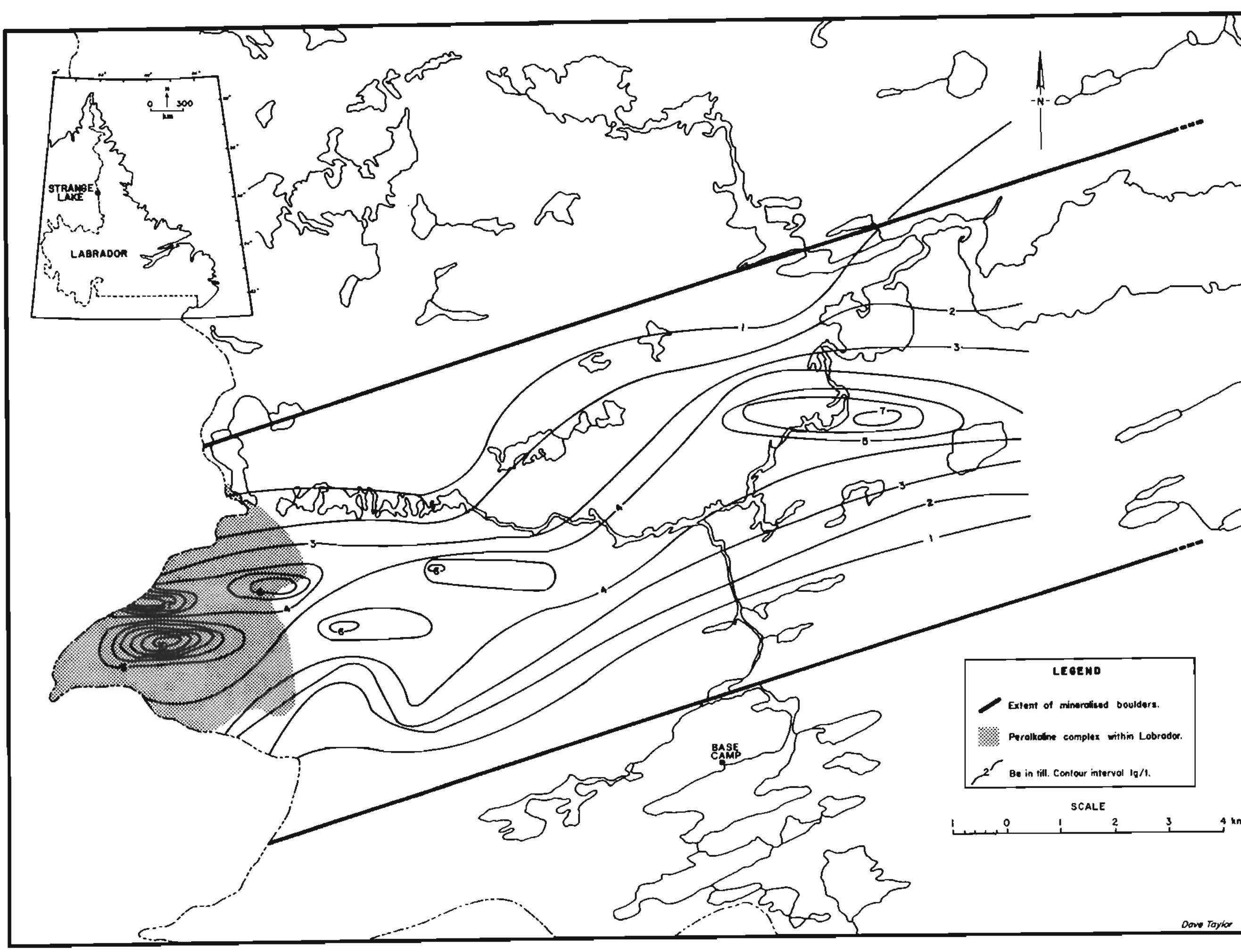

Figure 3: *Geochemical/boulder dispersal from the Strange Lake deposit.*

facies being sampled is critical and, if ignored, could lead to erroneous conclusions regarding the location of areas of potential mineralization.

FUTURE RESEARCH

Determinations of the chemistry and grain sizes of the samples is ongoing. These data will be added to the data collected in 1983 to produce an overall picture of the geochemical signature of the deposit and provide an evaluation of the most useful parameters for characterizing this type of deposit. Similarly, the nature of overburden units will be assessed, in terms of their grain size and geochemistry, and other distinguishing characteristics for mineral exploration.

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