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GEOCHRONOLOGY AND PETROGENESIS OF TOPLEY INTRUSIONS

ENDAKO-BABINE LAKE AREA

by

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INTRODUCTION

The first slide shows the regional distribution of Topley Intrusions in central British Columbia. For orientation purposes, Babine Lake, Stuart Lake and Francois Lake are shown in relation to Prince George. Endako Village is situated more or less in the center of the Topley Batholith that extends approximately 180 miles from Quesnel northwesterly to middle of Babine Lake.

The topic of our discussion will be centered within the rectangular boundary on this map. More specifically, we will focus various phases of Topley Intrusions from east of Francois Lake to east end of Babine Lake.

GENERAL GEOLOGY

The next slide illustrates the general geology of this region that covers about 3500 square miles. The Topley Intrusions shown in red intrude older Cache Creek Group rocks that are shown in blue and centered more to the northeast sector of the map area. Also older Hazelton-Takla Group volcanic rocks coloured dark green are recognized locally in southwesterly or lower portion of map.

A very distinctive metamorphic aureole shown in pink bounds part of the Topley Intrusions that are in contact with Cache Creek rocks in the center of the map. The belt of metamorphic rocks is referred to as the Quartz Diorite Complex.

A body of older serpentinized ultrabasic rocks shown in brown and probably related to the Trembleur Intrusions occurs in an area north of Cunningham Lake.

An extensive cover of Upper Cretaceous and Tertiary volcanic rocks shown in yellow occupies approximately 30% of the map area. To a large degree the younger volcanic rocks obscure and mask much of the petrologic and structural relationships of the older rocks. The remainder of this discussion will be devoted primarily to the Topley rocks that are shown in red and most of the next few illustrations will show the broad limits of the Topley as seen on this map. On the subject of younger rocks, there are several small intrusive stocks that are much younger than Topley and these are not shown on this map. It should be pointed out that two small outliers of Topley rocks will be included in this broader picture.

TOPLEY ROCKS UNITS

The Topley is a composite batholith in which various intrusive phasescan be recognized by their distinct textural and compositional changes. The next slide shows a total of eighteen rock units of the Topley that have been mapped in the Endako-Babine Lake area. Some of rock unit nomenclature is after Mike Carr's report; the Endako Mines geologists have chosen appropriate local names to the other units on this map. As can be seen, several of the rock units are quite extensive and can be recognized in both principal bodies of Topley. Some of the smaller units make up the small pieces of a rather complicated jig-saw puzzle. Boundaries of the various units are all inferred mostly from detailed geologic information but locally in part from magnetic data.

The eighteen Topley units can be categorized into five separate groups based on composition and texture. The next few slides will show the

separate groups and the distribution of the individual units within the Topley Batholith outline. Basically we will be progressing downward through the Topley units as listed on the left column; essentially beginning with acid rocks, progressing into intermediate rocks and finishing up with basic units.

The first of these slides shows spatial distrbution of Casey ALASKITE in orange, Francois granite in mauve, Limit quartz monzonite in bright red in lower right, Pinkut granite is the small center red and Butterfield granite is the red upper left corner body. These acid rocks, with exception of Francois granite, show regional compositional variations from granite to quartz monzonite. The first slide on the second screen shows the textural and to some extent the compositional differences between these five units.

Casey alaskite is typically leucocratic fine to medium sugary textured with miarolitic cavities, but can vary with some coarse-grained and porphyritic varieties being encountered. Compositionally the coarse-grained and sometimes subpegmatitic varieties can range down to quartz monzonite.

Francois granite is typically red, equigranular with a uniform granite composition. Frequently a unique rapakivi texture is exhibited by the feldspars.

Limit quartz monzonite is also variable from pink fine-grained granite to a grey biotite quartz monzonite; the coarse equigranular quartz monzonite variety predominating.

The Pinkut and Butterfield granites are similar and both vary from a muscovite-biotite granite to a biotite quartz monzonite. Due to their similarities it is possible that these two widely-spaced units are related.

The next slides on both screens illustrate the distribution and rock samples for Tintagel granite in bright orangy red, Glenannan quartz monzonite in mauve, the horse-shoe-shaped Nithi quartz monzonite in red, the Endako quartz monzonite in dark maroon and Stellako quartz monzonite in orange. This acidic group of rock units are all inequigranular with only slight compositional variations.

The Tintagel granite is a bright red coarse-grained rock in which K-spar appears to be quite highly hematized; additionally the rock is often highly crackled or fractured and as a result is difficult to identify.

The Glenannan quartz monzonite is usually very coarse-grained but can become porphyritic and locally almost pegmatitic. Compositionally the mafic constituents and content may vary from biotite to hornblende. Very closely resembling the Glenannan both in texture and composition is the Nithi quartz monzonite. Possibly the only recognizable difference is that Nithi generally has less mafics and K-spar grains usually have a more pale to dull pink colouration as compared to bright pink K-spar in Glenannan. Separating these two rock units is a grey subporphyritic Stellako quartz monzonite body. This rock unit is easily identified by the odd 1/4 to 1/2 inch purple feldspar phenocryst in a medium-grained matrix.

The comparatively dark grey Endako quartz monzonite is distinguished by the larger bright orange-tinged K-spar grains in a grey matrix.

The next two slides show the Caledonia quartz monzonite in orange on the map and Sugarloaf granodiorite in mauve.

The Caledonia unit is porphyritic quartz monzonite in which large 3/4 to 1-1/2 inch euhedral zoned feldspar phenocrysts are very abundant. Occasionally these purplish and dark pink phenocrysts can be up to five inches in length. The distribution of Caledonia extends from the east end

of Fraser Lake and along the southern periphery of Topley exposures to a point just south of Burns Lake.

The Sugarloaf unit is adjacent to Caledonia and it is also porphyritic but the purplish phenocrysts only occur sporadically and rarely attain a size over one inch. The Sugarloaf is easily recognized by overall reddish colour and large black book biotite grains.

The next two slides show spatial distribution of Sheraton quartz monzonite in orange on the map, the Taltapin quartz diorite in mauve and McKnab quartz diorite in brown. These units are all coarse-grained and generally equigranular.

The Sheraton quartz monzonite which is usually coarse-grained but occasionally subporphyritic is spatially bounded by Taltapin quartz diorite. Field evidence has shown that the Taltapin grades into the Sheraton over a transition zone 1000 feet wide. The foliated McKnab quartz diorite has also been evidenced to be the foliated marginal phase of the Taltapin quartz diorite. Therefore to summarize this group of three rocks there is petrologic evidence to indicate definite inter-relationship from a foliated quartz diorite to an equigranular quartz monzonite.

The next two slides show spatial distribution of the basic rock of Topley. Smith Creek diorite in red at lower right corner of map is coarse-grained and seriate. The Boer diorite in orange on the map is scattered as small bodies over the western half of the Topley outline. The Stag Lake gabbro is a coarse equigranular rock that resembles Smith Creek diorite in texture and composition near its margins. The basic rocks as might be expected show a rather haphazard distribution. There is some evidence to possibly suggest that basic rocks near Cunningham Lake are related and transitional into quartz diorite units.

The next slide is a broader compilation or grouping map to show the relative distribution of first of all the acid rocks, namely granites and quartz monzonites in orange, which are, in turn, crudely bordered or mantled by the intermediate to more basic rocks such as granodiorite and quartz diorite in dark pink. The dark basic rocks do not show any preferred distribution and as a result cannot be grouped into any sort of belt or zone.

PETROGENESIS

Based on field evidence on contact relationships and petrology, it is proposed that the Topley Intrusions for the Endako-Babine Lake area were sequentially emplaced during three distinct intrusive stages. To illustrate this three-fold evolution we have, as seen on the next slide, subdivided the Topley into three intrusive levels as Upper or epizonal intrusions in orange, the Middle or mesozonal in dark pink and Lower level or hypozonal in dark red. These divisions have been made from categorizing or grouping rock units based on similar compositional and textural features.

The next slide on the second screen shows the grouping of the various rock units with corresponding diagnostic features for the three intrusive levels. It should be pointed out that not all rock units within a certain level exhibit or satisfy all the diagnostic features.

With reference to the Table the Upper level rock units are all acidic rocks in which composition may vary slightly from granite to quartz monzonite but are predominantly in the granite range. These rock units usually exhibit textural variations and most have associated dykes that exhibit or inherit some host rock features. The leucocratic Casey alaskite has the best characteristics of an upper-level intrusion as it is typically mafic deficient fine sugary textured with miarolitic cavities. On the

map it can be seen that the Upper level rocks appear to form irregular stock-like and dyke-like bodies within older or Middle-level intrusive rocks.

The Middle Level rock units include those that are generally of variable intermediate composition ranging from granite to granodiorite with quartz monzonite predominant. Most of these rocks are coarse-grained with porphyritic textures being common, particularly for Caledonia, Sugarloaf and Stellako units and to a lesser extent Glenannan and Nithi units. Based on composition the Smith Creek diorite should rightfully fit into the Lower level but texturally this unit appears better fitted to the Middle Level.

The Lower Level rock units with exception of Sheraton quartz monzonite, are more basic rocks that feature deep-seated instrusive characteristics. Texturally these rocks are coarse grained and equigranular and composition within itself is fairly uniform. The Sheraton quartz monzonite is classified with this level due to its known relationship to Taltapin quartz diorite.

To summarize the intrusive level model for Topley Intrusions in Endako-Babine Lake area the Upper Level acidic rocks occur as stocks or dyke-like bodies in a larger zone of Middle Level quartz monzonites and granodiorites. These in turn are partly mantled by Lower Level quartz diorite and gabbro. Actually the Stag Lake gabbro may be interpreted as a remnant block of older lower-level basic rocks. Field evidence has shown that it is older that the Stellako quartz monzonite and Sugarloaf granodiorite.

GEOCHRONOLOGY

A number of the Topley rock units for this area have been dated by the K-Ar method. The next slide shows a number of age-dates that have been obtained for rock units of Topley. Several of these ages, especially those that are grouped near the east end of Francois Lake, are taken from a paper

by White, Sinclair, Harakel and Dawson. The dates as shown are averages of usually two or more age dates for each rock unit.

With reference to the age dates across the map, the Francois granite is youngest at 137 m.y. and Boer diorite is oldest at 184 m.y. In examining the age dates it can be seen that the ages can be roughly grouped into several time periods or spans. For instance, there is a population of age-dates at 137 to 144 m.y., another group at 151 to 152 m.y., a third group at 164 to 166 m.y. and a last entry at 184 m.y. In analyzing these groups in more detail the respective age dates of rock units can be correlated into the Intrusive Level model for Topley Intrusions.

In this manner the Francois granite at 137 m.y., Casey alaskite at 138 m.y. and Butterfield granite at 139 m.y. can be conveniently grouped as Upper Level intrusives. The Limit quartz monzonite is also classified as Upper Level and it is age-dated at 142 m.y. This age date is certainly within the experimental error range of the other Upper Level rocks.

The Middle Level intrusives apparently span a longer time period ranging from 139 to 162 m.y. At the top of this level the Glenannan granite at 139 m.y., Nithi quartz monzonite at 140 m.y. and Endako quartz monzonite at 142 m.y. are closely grouped. At an intermediate range the Caledonia quartz monzonite at 151 m.y. and Sugarloaf graodiorite at 152 m.y. can be grouped. At the bottom of the Middle Level is Stellako quartz monzonite at 162 m.y. This last date is, by the way, somewhat older than the age-date that White and Dawson obtained. However we feel that the 162 m.y. which was obtained from two separate samples is representative.

The Smith Creek diorite age-date appears somewhat anomalous. The rock unit has petrologic features that fit both the Middle and Lower Levels.

The age-date at 144 m.y. suggests that the unit should correspond to Middle Level. However with reference to the next slide on second screen it is seen that the Ar ratios and %K for Smith Creek age date is quite low. As a result, the age-date does not confirm the justification for placing Smith Creek as Middle Level; instead, possibly the unit would be better correlated to a lower level environment.

The Sheraton quartz monzonite, Taltapin quartz diorite and McKnab quartz diorite are neatly grouped at 164 to 166 m.y. Then there is an apparent and definite gap in time and possibly in intrusive event down to older Boer diorite at 184 m.y.

With reference to the Table the age-date for Amphibolite is 236 m.y. This amphibolite is part of the metamorphic aureole that bounds the Topley Intrusions. This age-date then possibly represents the age of metamorphism for Cache Creek rocks.

In summary, the age-dates are indicating that emplacement of Topley Intrusions for Endako-Babine Lake area spanned a 50 m.y. period from Early to Late Jurassic. Field evidence on contact relationships between rock units in turn indicates that the batholith probably sequentially evolved by a process of magmatic differentiation from the more basic and deep-seated intrusive phases to the final stages of upper level granitic stock and dyke-like bodies.