ARCHEAN SUPRACRUSTAL-BASEMENT ROCK RELATIONSHIPS IN THE KESKARRAH BAY MAP-AREA, SLAVE STRUCTURAL PROVINCE, DISTRICT OF MACKENZIE

Project 760024

Introduction

Granitic rocks unconformably below the Archean volcanic and sedimentary rocks of the Yellowknife Supergroup are preserved and particularly well exposed at Point Lake, District of Mackenzie. A 1:50 000 scale mapping project in the Keskarrah Bay map-area (parts of 86 H/2, 3, 6, 7) was undertaken in order to better appreciate the extent and significance of this granitic basement, the interrelationships of the various supracrustal facies at an apparent Archean basin margin, and ultimately to achieve a better understanding of the evolution of an Archean basin in the Slave Province. The region is currently an area of considerable interest for base metal exploration and recently for gold as well.

The existence of granitic basement at Point Lake was first recognized by Stockwell (1933) in an early reconnaissance expedition into the central part of the Slave Structural Province. The region of which this area is a part has been mapped at 1:250 000 scale by Bostock (1976).

The area is situated on the western margin of an extensive basin of supracrustal rocks that is bounded on the west by a heterogeneous assemblage of granitic gneisses and schists Basin is used in the sense of an outcrop area of supracrustal rocks. However, as has previously been suggested (McGlynn and Henderson, 1970) and as will become apparent later, the present outcrop basin margin may in part approximate the original depositional basin margin. The basin is open to the north, east and southeast beyond the borders of the map-area. The supracrustal rocks are part of the Yellowknife Supergroup and the formational nomenclature was established by Bostock (1976). All rocks in the area are Archean except for one small outlier of Goulburn (Aphebian) dolomite that occurs at the contact between the Itchen and Contwoyto formations about 2.5 km north of Point Lake.

General Geology

Point Lake Formation

Mafic volcanic rocks of the Point Lake Formation occur along the western margin of the basin and consist of a relatively thin member of thin bedded mafic tuffs and a thick sequence of dominantly pillowed and massive mafic flows with minor medium to fine grained fragmental units of similar composition. Very minor and small dacite bodies also occur locally with the mafic flows. Thick coarse grained gabbro sills that are probably contemporaneous with the mafic volcanism are abundant within the volcanics in the southwestern and north-central part of the map-area. The mafic volcanic flows are similar to the mafic volcanic sequence in the Yellowknife area. The volcanic strata east of Keskarrah Bay locally contain mudstone units that are commonly carbonaceous, and in some cases sulphide-bearing. Some of these mudstone units contain thick, massive, very coarse grained (centimetre scale) turbidites of exclusively granitic provenance. These coarse, still porous, beds commonly contain sulphides (mainly pyrite) derived from the enclosing sulphide-rich mudstones.

The major felsic volcanic unit of the Point Lake Formation occurs in the central part of the area. Thin bedded tuffs and locally volcanic conglomerate of intermediate composition occur on the west side and generally massive but locally coarsely fragmental rhyolite on the east. Volcanic lenses of varied composition also occur within the sandstones and conglomerates of the Keskarrah Formation

Contwoyto and Itchen Formations

The areally most extensive sedimentary units are the greywacke-mudstone turbidites that are characteristic of Yellowknife sediments throughout the Slave Province.

The Contwoyto Formation occurs in the north-central part of the map-area. Sedimentary structures characteristic of turbidity current deposition are well preserved. Composition of the greywackes is locally variable with more volcanogenic quartz-poor varieties commonly occurring near the volcanic rocks. In general, the sediments are more thinly bedded, more fine grained and have a greater mudstone component than similar sediments east of Yellowknife. The formation commonly contains units of thin bedded iron-formation of all facies. Oxide and carbonate facies occur in the west half of the outcrop area of the formation, and silicate iron-formation with locally associated sulphide iron-formation dominates in the east. Carbonate beds (both dolomite and limestone) also occur within the greywacke sequences and are commonly associated with iron-formation.

The Itchen Formation, another greywacke mudstone turbidite, differs from the Contwoyto in that iron-formation does not occur. Within the map-area the rocks are everywhere in medium metamorphic grade with assemblages of quartz-biotite-muscovite-cordierite-andalusite-sillimanite and garnet. In the southern half of its outcrop area the formation contains abundant pegmatites, locally tourmaline-bearing, and several very small, medium grained adamellite bodies.

Keskarrah Formation

The Keskarrah Formation consists of a conglomerate and a sandstone member. The conglomerate is composed of mafic volcanic and granitic clasts in relative proportions that reflect the local source. Granitic clasts predominate where the conglomerate occurs above the granitic basement, particularly in the eastern exposures. Within or adjacent to volcanic tuffs, the conglomerate cobbles are dominantly volcanic lithologies largely derived from the adjacent volcanic strata and reflect the local volcanic variation. The sandstone member locally interbedded with the conglomerate consists of fine to medium grained commonly cross-bedded lithic sandstone of predominantly felsic volcanic provenance. The medium to locally large scale cross-bedding in the sandstone and its close association with the thick massive conglomerates, suggests a subaerial environment of deposition for the formation. Intermediate and mafic volcanic rocks occur as lenses in both members of the Keskarrah Formation

Granitic Basement

A massive, medium to locally coarse grained granodiorite characterized by abundant, commonly irridescent, quartz and by the presence of chlorite as its dominant mafic mineral, occurs in the southern and northwestern part of the map-area and as a small body between the two arms of Point Lake. The granodiorite is basement to the supracrustal succession. At many localities the unconformity is clearly exposed and is usually marked with a basal conglomerate derived in part from the underlying granodiorite (Henderson, 1975a, Fig. 4). Contact metamorphic effects suggesting an intrusive relationship with adjacent supracrustal rocks were not observed. In general, the granodiorite is massive, although in the northwestern body it becomes increasingly foliated towards the gneisses that lie to the west. In the southern body the granodiorite is locally gneissic in places west of Keskarrah Bay and it becomes increasingly cataclastically deformed to the south. Almost everywhere the granodiorite is cut by altered but undeformed diabase dykes. Similar dykes are present in the overlying supracrustal rocks, but are less numerous. In addition to these undeformed dykes, older, severely sheared mafic dykes occur locally that may have been feeders to the overlying Point Lake volcanic rocks.

At several localities where the unconformity is exposed, a weathered horizon can be seen in the underlying granodiorite. The weathered material is characterized by the extremely altered feldspar, although the original texture of the rock is preserved. At one locality a 15 cm layer of coarse quartz and sand presumably derived from this regolith occurs between the weathered granite and the succeeding conglomerate. Cobbles of granodiorite regolith are commonly found in the conglomerates, along with fresh granodiorite cobbles.

Gneisses and Schists

Along the west margin of the area is a heterogeneous assemblage of gneisses and schists. The rocks vary from orthogneisses, most common in the southwest corner of the map-area, to paragneisses, biotite schists and minor amphibolite, that commonly contain varied proportions of granitic to pegmatitic dykes and sills to the north. Adjacent to the contact with the Yellowknife supracrustal rocks the rocks of this unit are highly cataclastic to mylonitic. The degree of cataclasis of the gneisses declines to the west over a distance of 1 km from the supracrustal rocks. The extreme structural and metamorphic contrast between these gneisses and the adjacent supracrustal rocks suggest that this gneissic unit may be in part older than the Yellowknife rocks. However, no direct evidence of an unconformable relationship between these units was observed. Wherever it was exposed the contact was faulted.

Intrusive Granitic Rocks

Three small plutons that postdate the deposition of the Yellowknife rocks occur within the area. South of the west part of Point Lake a medium grained biotite adamellite, massive in the centre and strongly foliated at its margins, occurs between the Point Lake mafic tuffs and cataclastic gneisses to the west. Near the southeast corner of the map-area is a weakly foliated, medium grained biotite-muscovite adamellite with minor pegmatite. Abundant pegmatitic and granitic sills related to this pluton are present in the enclosing sediments. The edge of a third pluton composed of a massive, medium grained, coarsely porphyritic, biotite adamellite occurs at the southeast corner.

Structure

Throughout the area mapped the structural trend is generally northerly The Point Lake mafic volcanics in the northern part of the area occur in an east-facing, steeply dipping, homocline, but become increasingly more folded toward the south. The belt of mafic volcanic rocks east of Keskarrah Bay is also a steeply dipping, east-facing homoclinal succession. The Contwoyto and Itchen formations in contrast are commonly tightly folded into steep, often closely spaced, isoclines. In its main outcrop area the Keskarrah Formation occurs in a synclinal structure complicated by smaller-scale folds. Throughout the area all units have a northerly-trending cleavage of varied intensity. The major faults are also northerly trending. An older fault set with an easterly trend and relatively small displacement locally offsets the north-striking units.

Metamorphism

Isograds also trend northerly. The lowest metamorphic grade rocks are near the west margin of the basin. The grade rises both to the east and to the west. The cordierite isograd to the east occurs in the central part of the Contwoyto outcrop area and passes through the Point Lake felsic volcanics south of the northerly part of Point Lake. The assemblage biotite-muscovite-cordierite-andalusite, with or without garnet, is common. Staurolite is rare. Garnet and amphibolite are spectacularly developed in the silicate iron-formation. Coarse sillimanite is common in parts of the Itchen Formation to the east. To the west there is a narrow zone of medium grade metamorphic rocks east of the gneisses, south of the north arm of Point Lake. The metamorphic as well as structural contrast between the relatively low grade supracrustal rocks and the cataclastic granitic gneisses adjacent to them, is striking.

Economic Geology

The area and surrounding region has been of considerable economic interest in recent years. The Izok Lake deposit of Texas Gulf, among the largest deposits in the Slave Province, occurs about 12 miles north of the northeast corner of the map-area. Within the map-area Zn-Cu mineralization occurs on the peninsula on the south shore of Point Lake west of Keskarrah Bay (Henderson, 1975a) in mafic volcanics within the Keskarrah Formation. Minor copper mineralization is locally present in black mudstone units of the Contwoyto Formation and also in the Point Lake mafic volcanics south of Point Lake. The silicate-sulphide facies iron-formations of the Contwoyto Formation have been actively prospected for gold. A more detailed discussion of the economic geology of the area is presented by Bostock (1976).

Intraformational Relationships

A major problem in dealing with the stratigraphy of Archean rocks is the difficulty of determining the intraformational relationships, even within a small area. The rocks are commonly structurally complex and in most parts of the Canadian Shield the typically steeply-dipping strata outcrop on an essentially horizontal plane. Without a reference horizon of some sort, it is difficult to relate one part of a basin with another, particularly across the structural trend of the various rock units.

In the Keskarrah Bay map-area, the unconformity surface between the granitic basement rocks and the overlying Yellowknife supracrustal rocks is such a reference horizon. South of Point Lake there is what amounts to a series of four northerly-trending "cross-sections" through the upper part of the Archean crust

The bottom of each "section" is fault bounded with the sections facing east. The first section starts in the gneiss terrain (basement?) west of the map-area, passes eastward up through the mafic tuffs and flows of the Point Lake Formation and into the Keskarrah Formation, where it ends at the synclinal axial plane. The second section starts at the fault between the Point Lake volcanics and the basement granite west of Keskarrah Bay, and again extends eastward up through the Point Lake Formation, the Keskarrah Formation and into the Contwoyto Formation, where it ends against the fault. The third section is in the small triangular fault block and consists of basement granite, Keskarrah conglomerate, Point Lake volcanic rocks, more conglomerate, and finally, the Contwoyto greywacke-mudstone turbidites. The last section starts with the basement granite, passes into conglomerate which is followed by the Contwoyto Formation, with no volcanic rocks present in the section.

These four sections show the transition from the volcanic rocks that outcrop along the basin margin to the sediments that occur in the central part of the basin. The basement granodiorite lies unconformably below both the volcanics and sediments of the Yellowknife Supergroup. The granodiorite contributed detritus while both volcanism and sedimentation were taking place, as conglomerate and detritus of granitic provenance are found in both the volcanic and sedimentary units in the vicinity of the granitoid basement. All the formations of the Yellowknife Supergroup are essentially contemporaneous; the volcanic rocks are interbedded with the Keskarrah sediments and the contact between the Keskarrah and the Contwoyto formations, where exposed, is abruptly gradational. Thus, there are no significant internal unconformities within the Yellowknife Supergroup. In the westernmost section the mafic volcanics are thickest and no Contwoyto sediments are present. To the east into the basin the volcanic section becomes progressively thinner, until in the easternmost section no volcanics are present. Apparently, the mafic volcanism is restricted to what is the present-day margin of the basin and does not underlie the basinal turbidites of the Contwoyto and Itchen formations. This further supports the suggestion that the Archean supracrustal basins in the Slave Province were ensialic (McGlynn and Henderson, 1970).

References

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McGlynn, J. C. and Henderson, J. B.
1970: Archean volcanism and sedimentation in the Slave Structural Province; *in* Symposium on Basins and Geosynclines of the Canadian Shield, A. J. Baer, ed.; Geol. Surv. Can., Paper 70-40, p. 31-44.

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LEGEND

Diabase, a north northwesterly set and a older slightly altered locally porphyritic east west set.

16. Adamellite, massive, medium grained, coarsely porphyritic with biotite.

15. Pegmatite, biotite, muscovite and locally tourmaline bearing, medium-grained adamellite present locally.

14. Adamellite, weakly foliated, medium grained with biotite and muscovite.

13. Adamellite, massive to foliated at margins, medium grained with biotite.

12. Gabbro

YELLOWKNIFE SUPERGROUP

Numbered sequence of units does not imply a stratigraphic sequence.

Itchen Formation

11. Psammitic and pelitic schists with no iron formation.

Contwoyto Formation

10. Meta-greywacke and mudstone with lenses of oxide, carbonate and silicate iron formation
10a meta-greywacke and mudstone (low metamorphic grade)
10b psammitic and pelitic schists (medium metamorphic grade)

Keskarrah Formation

9. Lithic sandstone, with local volcanic units (4)

8. Conglomerate with local volcanic units (4)

Point Lake Formation

7. Dolomite

6. Rhyolite, mainly fragmental

5. Dacite, mainly fragmental

4. Basalt, andesite, local minor dacite lenses, black shale lenses with rare quartz feldspar sandstone beds.

3. Mafic tuffs thin bedded

2. Granodiorite, adamellite, with abundant mafic dykes, older than Yellowknife supracrustal rocks.

1. Mixed gneisses, orthogneiss, paragneiss, granite and pegmatite, in part possibly older than Yellowknife supracrustal rocks.

SYMBOLS

- Geological boundary, defined, approximate assumed
- Bedding (tops known, overturned, not known)
- Pillowed volcanic flows, tops known, not known.
- Schistosity, gneissosity, cleavage, foliation (inclined, vertical, dips unknown)
- Isograd (cordierite)
- Generalized fold axis, anticline, syncline
- Fault
- Esker
- Barren area
- Wooded area

Geology by: John B. Henderson and R. Micheal Easton 1976

Compiled by: John B. Henderson 1977

This Open File Report is a preliminary map subject to revision before final publication.

KESKARRAH BAY

NORTHWEST TERRITORIES

Scale 1:50,000 Échelle

Miles 1 0 1 2 3 Miles

Metres 1000 0 1000 2000 3000 4000 Mètres

Yards 1000 0 1000 2000 3000 4000 Verges

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ELEVATIONS IN METRES ABOVE MEAN SEA LEVEL

CONTOUR INTERVAL ..... 10 METRES

NORTH AMERICAN DATUM 1927

TRANSVERSE MERCATOR PROJECTION

ÉLÉVATIONS EN MÈTRES AU-DESSUS DU NIVEAU MOYEN DE LA MER

ÉQUIDISTANCE DES COURBES ..... 10 MÈTRES

SYSTÈME DE RÉFÉRENCE GÉODÉSIQUE NORD-AMÉRICAIN 1927

PROJECTION TRANSVERSE DE MERCATOR

ÉTABLIE PAR LA DIRECTION DES LEVÉS ET DE LA CARTOGRAPHIE, MINISTÈRE DE L'ÉNERGIE, DES MINES ET DES RESSOURCES, OTTAWA. EN 1976. RENSEIGNEMENTS À JOUR EN 1954

CES CARTES SONT EN VENTE AU BUREAU DES CARTES DU CANADA, MINISTÈRE DE L'ÉNERGIE, DES MINES ET DES RESSOURCES, OTTAWA, OU CHEZ LE VENDEUR LE PLUS PRÈS.