GEOLOGICAL SURVEY OF CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

PAPER 63-26

ARSENO LAKE MAP-AREA, DISTRICT OF MACKENZIE 86 B/12

(Report and Map 41-1963)

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Price 75 cents

1963

The average elevation of the area is about 1,100 feet above sea-level and maximum relief is about 600 feet. Topographically high areas are underlain by volcanic rocks (1) and granitic rocks (5 and 10), the belt of volcanic rocks (1) along the eastern margin of the map-area in particular is marked by a very prominent ridge. Areas underlain by rocks of the Snare Group (6-8) are topographically lower than other areas and are characterised by a series of long ridges that strike roughly parallel with the axial traces of folds. Rock exposures are fairly numerous and reasonably well distributed. The area is sparsely timbered with rather small trees; black spruce and jack pine are the common varieties.

The oldest rocks in the area are metamorphosed basalts or andesites (1) of the Yellowknife Group. Typically these rocks are dark grey or dark green, fine grained, and finely foliated and banded. In thin section they are seen to consist of blue green hornblende, and locally actinolite, and plagioclase, with minor amounts of quartz, sphene, sulphides, and locally epidote or biotite. The amphiboles are oriented parallel with the foliation and occur in rude bands that alternate with plagioclase-rich bands. Locally chlorite is developed from some amphiboles. Plagioclase commonly appears to be crushed and to occur in elongate masses of very fine grains oriented parallel with the foliation and banding, suggesting that the texture was formed by shearing. Pillows are commonly stretched parallel with the foliation, which is roughly parallel with the strike of bands of pillow lava. Pillow lavas and pillow breccia are found throughout the sequence but are most common in the central part of the thickest section in the southeast corner of the map-area. All determinations indicate that tops face west or southwest. This being so and assuming no repetition by faulting, for which there is little evidence, the exposed thickness of lavas varies from about 18,000 feet in the southeast part of the area to about 1,500 feet farther north along the east boundary of the map-area. Included with the lavas are narrow tuff bands and volcanic breccia, narrow dykes and small irregularly shaped masses of rhyolite porphyry, and small bodies of fine- to medium-grained diorite. Some of the finely banded rock that contains no pillow lavas may represent metamorphosed basic tuffs. Along most of the western and southwestern contact of the lavas the rocks are intensely sheared over a width of from 100 to about 500 feet. Dark green chlorite-carbonate schists are developed in this zone of shearing.

Paraconglomerate (2) conformably overlies the volcanic rocks in the southeast part of the area. This rock is limited in extent and its thickness varies from a few feet to a maximum in the order of 1,500 feet. Directly over the volcanic rocks the paraconglomerate consists of a variety of pebbles varying in maximum dimension from 1 inch to about 1 foot in a matrix that consists of rude bands of aligned hornblende crystals alternating with quartz-plagioclase rich bands. Biotite, minor epidote, and sulphides are also present. In places the chief mafic mineral is chlorite but normally hornblende forms as much as 30 per cent of the matrix. This rock type grades up into one in which the matrix is greywacke, consisting of quartz and plagioclase grains in a felt of chlorite and muscovite that forms about 30 per cent of the matrix. The micas or hornblende in these rocks tend to be oriented parallel with a northwest striking cleavage. Quartz, plagioclase, and pebbles are partly crushed and the crush zones are roughly parallel with the above-mentioned cleavage. Pebbles, which vary in size from 1 inch to 1 foot, are not closely packed; in fact, they are rarely in contact with one another. They vary in amount from 1 to 25 per cent of the rock. Near the volcanic rocks the pebbles are mostly rather angular volcanic fragments, but higher in the sequence the diversity is greater and includes rounded cobbles of granitic rock, diorite, quartz, fine-grained felsitic rocks, and angular pebbles of greywacke and shale. Pebbles are commonly stretched along the dominant northwest striking cleavage direction.

Interbedded with the top of the paraconglomerate (2), and overlying it, and overlying with apparent conformity the volcanic rocks (1), are feldspathic greywacke and shales (3) of the Yellowknife Group. These rocks consist of a monotonous succession of interbedded and commonly graded units of dark grey, buff, or rusty weathering feldspathic greywacke and shale that have been converted by metamorphism to biotite, and more commonly knotted biotite schists. The proportion of feldspathic greywacke to shale and the thickness of the beds vary throughout the sequence. The thickness is difficult to determine because of the complex structure but it is probably between 1,000 and 2,000 feet. Overlying these rocks conformably is a sequence of fine-grained, finely banded, dark green hornblende gneisses (4) the exposed thickness of which is less than 1,000 feet. These rocks consist of hornblende and locally actinolite in rude bands that alternate with bands of plagioclase and quartz. Epidote, biotite, and sulphides are minor constituents. The origin of these rocks is uncertain as primary structures were rarely observed. The appearance locally of bedding structures and calc-silicate bands suggests that the rocks may be metamorphosed limy sediments or tuffaceous rocks.

Rocks of the Yellowknife Group (1-4) are cut by two masses of granitic rocks (5). Granodiorite and quartz monzonite occur just east of Emile River, near the south boundary of the map-area. These rocks are fine to medium grained, equigranular, buff to grey weathering, and massive to weakly gneissic, and consist of about 20 per cent quartz, 7 per cent mica, and feldspar. The plagioclase-microcline ratio varies but plagioclase predominates. Muscovite and biotite occur in about equal amounts. Narrow zones of mixed gneisses and partly granitized sediments occur along the contacts. Where observed along the east boundary of the map-area, the quartz monzonite (5a) is buff weathering, pinkish grey, medium to coarse grained and slightly gneissic, and it consists of altered plagioclase, microcline, quartz, and biotite with minor epidote, sphene, and sulphides. The plagioclase grains are zoned and rectangular in shape, and the interstices are filled with microcline and quartz. The biotite is partly altered to chlorite. The quartz monzonite in many outcrops examined appears to be sheared or crushed in a northerly direction. In thin sections of these rocks, elongate crush zones were observed to cut across grains of feldspar and quartz and individual grains of these minerals were fractured and the pieces displaced slightly. As crushing increased, the mafic minerals disappeared but the crush zones and fractures contained chlorite and the occasional book of white mica.

Rocks of the Yellowknife Group (1-4) are overlain unconformably by rocks of the Snare Group (6-8). Wherever the unconformity is exposed or nearly exposed dolomite (6) lies at the base of the Snare Group. The band varies in thickness from a few tens of feet to about 200 feet. This dolomite band may extend along the whole length of contact in the area but poor exposures make it impossible to be certain of this. Around Boland Lake, two more thin bands of dolomite occur near the base of the Snare and other dolomite bands occur higher in the sequence. It is difficult to be certain of correlating these bands because in many places they are poorly exposed and because some bands are known to grade along strike into a siltstone-shale sequence with bands of calc-silicates. In thin section, these rocks are seen to vary considerably in mineral composition due to differences in original composition and degree of metamorphism. Granular or crystalline carbonate is the essential mineral together with various assemblages of minerals including epidote and zoisite, quartz, tremolite, phlogopite, biotite, sphene, and diopside.

The bulk of the Snare Group (7) consists of finely bedded, alternating units of siltstone and shale, graded units of these rocks, and rusty pyritic shales and their metamorphic equivalents. In many areas the beds are only fractions of an inch thick and the rock has a varved appearance, with buff silty bands alternating with medium grey shaly bands. Locally, however, the thickness of beds may range from 4-8 inches. In thin section, the grey bands are seen to consist of muscovite, chlorite, quartz, plagioclase, and biotite. The buff coloured bands consist of the same minerals but have less mica and chlorite. With increasing metamorphism, biotite and muscovite are the only micaceous minerals present, commonly in clots. Finally, in the more highly metamorphosed knotted schists, metacrysts of garnet and andalucite appear. Micas are oriented parallel with both bedding and cleavages. Metacrysts tend to occur along cleavages. In the southeast part of the area, near the base of the sequence, rusty black shale beds are common. To the north and northwest, higher up in the unit, this shale decreases in abundance and the rocks locally become more quartz-rich and originally were probably siltstones or fine-grained impure quartzites. The thickness of unit 7 is unknown but it is thought to be more than 4,000 feet and to thicken to the northwest and west from Boland Lake. Bands or beds of calc-silicates occur in this sequence and where they are numerous, the rocks have been mapped separately (7a). Individual bands vary in width from an inch to about 6 inches and some bands persist along strike for some hundreds of feet. These rocks vary in mineral composition, probably because of variations in original composition and certainly because of variation in degree of metamorphism. In places they consist of fine-grained biotite-quartz schists much like the host rocks with large randomly oriented porphyroblasts of poikilitic blue-green hornblende. Other bands contain combinations of hornblende, actinolite, cummingtonite, zoisite, epidote, quartz, pyroxene, garnet, biotite, and sphene.

Within siltstone-shale units are beds of thin to coarse bedded quartzites and feldspathic quartzites (8). These rocks are light grey and consist essentially of quartz and locally plagioclase, with minor amounts of muscovite and biotite or chlorite. Near or in dolomite bands some quartzite contains carbonate and/or tremolite in amounts up to 15 per cent. The quartzite bands commonly lie near dolomite beds within the sequence of sediments and none is more than 500 feet thick. They tend to pinch out along strike and grade into siltstones or argillites. At the south end of the very long lake just north of Arseno Lake, conglomerate (8a) is found at the base of a quartzite band. For the most part this consists of a quartz-pebble conglomerate in lenses and bands in a coarse feldspathic quartzite. In the band shown on the map, dolomite pebbles are also present and in places the matrix is limy. These rocks are in apparent conformity with underlying sediments.

Sediments of the Snare Group (6-8) are cut by dykes and possibly sills of rusty weathering, dark green, fine- to medium-grained, crudely foliated meta-gabbro (9). These rocks are found only in the Snare sediments and were introduced before or during the folding and before the metamorphism of the sediments. The rocks consist of blue-green hornblende, commonly collected into bands, and plagioclase in about equal amounts with minor amounts of quartz, biotite, and sulphides. In places porphyroblasts of poikilitic hornblende also occur.

Rocks of the Snare Group are cut by gneissic granodiorite and quartz monzonite (10). These granitic rocks are grey to pinkish grey, medium grained, and gneissic and contain about 50 to 60 per cent of slightly altered plagioclase, quartz, microcline, perthite, myrmekite, biotite, muscovite, and minor sulphides. The plagioclase-microcline ratio varies as does the amount of mica. Bands and irregularly shaped masses of pink pegmatitic material were common in the gneisses. Near the contacts with sediments bands of biotite-rich rock are common. A fairly large mass of pegmatitic granite or quartz monzonite (10a) intrudes sediments of the Snare Group. Tourmaline is a characteristic accessory mineral in this rock, which also contains variable amounts of microcline, plagioclase, and quartz and minor amounts of mica. Mixed gneisses, migmatites, and granitized sediments (10b) occur around the granitic masses (10) in the western part of the area.

The effects of metamorphism on the different rock units has been briefly described. Rocks of the Yellowknife Group have been metamorphosed during the intrusion of early granitic rocks (5) and then again when Snare rocks were being metamorphosed. In rocks of the Snare Group, the intensity of metamorphism increases to the north and to the west where granitic rocks are exposed.

The structure of the rocks of the Yellowknife Group is complex. The volcanic rocks are steep-dipping and, where observations on pillows are possible, consistently face west or southwest. The foliation in these rocks appears to be derived in part from shearing. The sediments of this group are folded about axial planes that strike north of west to west of north and dip steeply. These folds have been modified by northwest and then by northeast striking folds that were produced during Snare deformation. A zone of mylonites and crushed or sheared rocks, shown on the map where extensively developed, was formed during the later folding. Intense shearing along the contact of the main band of volcanic rocks that resulted in the development of chlorite-carbonate schists is a related structure. The rocks of the Snare Group are folded about axial planes that strike east of north and dip steeply west. The folds plunge gently to the north. In the western part of the map-area near the granitic rocks (10) a later direction of folding the axes of which strike northwest to west can be detected.

Steep-dipping tear faults with a north of east strike and small right hand displacement cut the sediments of the Snare Group and to a lesser extent the volcanic rocks of the Yellowknife Group. These faults are marked by zones of brecciation and fracturing.

Gold has been found in volcanic rocks of the Yellowknife Group. The showings have been described by Lord[1] and a brief summary of this report follows. Quartz veins, some gold-bearing, occur in steep-dipping shear zones that occur in the volcanic rocks, and in or along margins of rhyolite or porphyry dykes. The shear zones commonly strike parallel with the foliation in the lavas. The exposed widths of veins vary between 6 inches and 6 feet and some veins have been explored for lengths up to 850 feet. Metallic minerals, which on the average may constitute several per cent of the veins, consist of chalcopyrite, pyrrhotite, pyrite, galena, sphalerite, a fibrous soft grey bismuth bearing mineral, native copper, and gold. Bulk sampling of considerable lengths of several veins over mineable widths indicated a gold content in the order of 0.3-0.4 ounce per ton.

A zone of magnetite- and hematite-bearing hornblendic rock was found just east of Grizzly Lake. It is a type of iron-formation and outcrops over a length of about 1,000 feet along or in a band of hornblendic rock (4). Fine-grained magnetite and maroon, fine-grained hematite occur in lenses and bands of foliated hornblendic gneiss. Visual examination suggests a low overall iron content.

An aeromagnetic map of this area has recently been published[2] and a few comments on the relationship between geology as mapped and the magnetic data follow. The small anomaly in the south-east corner of the sheet corresponds approximately with the occurrence of magnetite and hematite shown on the geological map and mentioned in the above paragraph. The trend of the anomaly is parallel with the strike of the mineralized zone or iron-formation. The small north-east-trending anomaly just east of the central part of Arseno Lake corresponds roughly with a fault shown on the geological map. No significant mineralization was noted in this fault but it was not examined in detail everywhere along its length. The rocks of the Snare Group are non-ferromagnetic except along the eastern contact or unconformity. The magnetic variations in the contact area are thought to be due to effects of rocks of the Yellowknife Group that underlie the Snare sediments. As the Snare sediments thicken away from the contact such

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[1] Lord, C.S., 1951: Mineral Industry of District of Mackenzie, Northwest Territories; Geol. Surv., Canada, Mem. 261, p. 201.

[2] 1963: Arseno Lake, Northwest Territories; Geol. Surv., Canada, Geophysics Paper 2918.

effects are masked. But within the contact area magnetic depressions tend to occur along axes of synclinal folds where sediments of the Snare Group are thick. The easterly trending isomagnetic lines in the centre of the Arseno Lake aeromagnetic map correspond to an easterly striking belt of highly metamorphosed and partly granitized sediments of the Snare Group in the central part of the western margin of the geological map.

ROGER DUHAMEL, F. R. S. C.
QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1963
Price 75 cents Cat. No. M44-63/26