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FLIN FLON-MANDY AREA,

MANITOBA AND SASKATCHEWAN

(Descriptive Notes)

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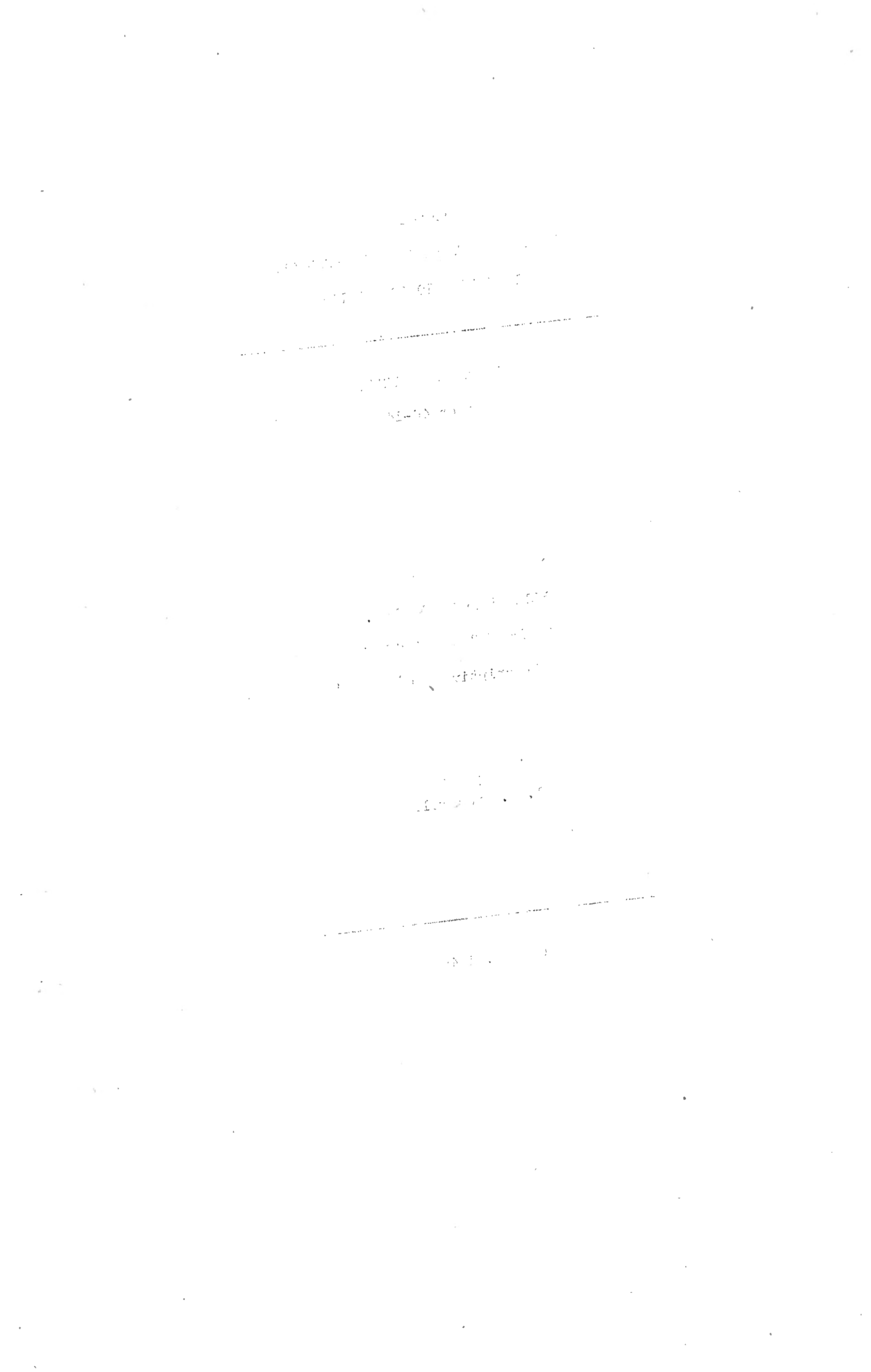

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Illustration

GENERAL GEOLOGY

Amisk Group

The oldest rocks of the area, the Amisk group, are lava flows with associated pyroclastic breccias, tuffs, and related minor intrusions. The seven mapped subdivisions of the group are interbedded with one another. Non-porphyritic andesite, basalt, dacite, and flow breccia (1)[1] predominate.

[1] Numbers in brackets refer to map-unit numbers on the accompanying map and map legend.

Many of these dark green, andesitic and basaltic flows show amygdaloidal or pillow structures, whereas others are wholly or in part quite massive. The lava flows pass gradationally into flow breccias composed of irregular, rounded masses of andesite in a matrix of andesite. Dacite is uncommon, and is not readily distinguishable from the associated andesite. The porphyritic andesite (2) carries phenocrysts of altered feldspar that are either quite large and numerous or small and widely scattered. It varies from massive to amygdaloidal or pillowed and, on the whole, is somewhat lighter green than the non-porphyritic flows.

The andesite breccia (3) is considered to be a pyroclastic rock. The fragments are commonly angular, and comprise a variety of types such as andesite, amygdaloidal andesite, and more acidic volcanic rocks, all lying in an andesitic matrix. Bodies of the breccia vary greatly in thickness within short distances along their strike. The porphyritic andesite breccia (4) is similar, except that either the fragments or the matrix, or both, carry phenocrysts of altered feldspar. Bedded tuff and breccia (5) occur as thin but persistent layers. They differ from the other breccias (3,4) only in that they exhibit layers of alternating coarse and fine fragmental materials. The tuffs are still finer grained, and are commonly thinly laminated.

The rhyolite (6) weathers light grey, is amygdaloidal, and contains rather poorly shaped pillows. The quartz porphyry (7) is a fine-grained, grey, light weathering rock with phenocrysts of quartz and commonly, also, of feldspar. It forms short lenses and long continuous layers, considerable parts of which may be breccias, with fragments very similar to the matrix, although some of the breccia contains fragments of quartz porphyry and andesite in a matrix of andesite. The quartz porphyry and breccias are probably largely flows, but some of the mapped bodies may be intrusive equivalents of the lavas. Sericite-carbonate schist (7a) on Stitt Island and vicinity carries remnants of quartz phenocrysts in sufficient number to suggest that the whole was originally quartz porphyry.

Older Intrusive Rocks

Intrusive equivalents of the volcanic rocks of the Amisk group comprise numerous, unmapped dykes and sills of andesite, porphyritic andesite, and quartz porphyry. In places the andesitic types are abundant, and are intimately mixed with the flows. Possibly also closely related to the flows are dykes, sills, and irregular bodies of meta-diorite and meta-gabbro (8). These are similar in appearance to some of the massive flows, but show chilled contacts and crosscutting relationships. Numerous small bodies of these rocks have not been mapped separately from the extrusive rocks.

The Cliff Lake granite porphyry (9) is an oligoclase granite characterized by abundant, large eyes of bluish quartz. It is placed below the Missi series in the map legend chiefly because boulders, exactly like this unusual rock, are found in the Missi conglomerate. In addition, the

Missi conglomerate appears to overlie the sheared granite (9a), which is probably a schistose equivalent of the Cliff Lake granite porphyry. A few small dykes of quartz porphyry cut volcanic rocks near the borders of the granite porphyry, and are no doubt offshoots from it.

Missi Series.

The Missi series lies with marked unconformity on the Amisk group and its related intrusions. Conglomerate (10) occurs at the base and at several other horizons within the series. The basal conglomerate and other beds near Little Cliff and Grant Lakes are of coarse material comprising a variety of boulders and pebbles many of which were evidently derived from the underlying volcanic formations. The other beds of conglomerate shown on the map contain no boulders, but consist of pebbles, chiefly of quartz, lying in a matrix of quartzite. The boulder conglomerate passes rather abruptly into greywacke and arkose (11) with scattered pebble beds and lenses. No sharp line can be drawn between such rocks and the greywacke and arkose (12), which is without pebble-bearing beds. Crossbedding is characteristic of the three subdivisions of the Missi series.

Younger Intrusive Rocks

Diorite and gabbro (13) in the vicinity of Bootleg Lake is a phase of the granite, granodiorite, and quartz diorite (14) of the same locality, and no sharp contact exists between them. The age relationship between bodies of granitic rocks (14) and the Missi series is uncertain.

The Boundary intrusions (15) comprise a great variety of rock types ranging from fairly acidic to ultrabasic. At places one type grades into another, but more commonly dykes of one type cut another type, or angular fragments of one or more phases are included in another phase. The emplacement of this group of rocks was accompanied by much brecciation both of the country rock and of earlier crystallized phases of the intrusive rock itself.

The Kaminis granite (16) carries phenocrysts of feldspar. On the east shore of Phantom Lake it is clearly seen to invade the Boundary intrusions. Only the larger dykes of feldspar porphyry and quartz-feldspar porphyry (16A) are shown on the map. Those in the south part of the map-area west of Burley Lake are evidently offshoots from the Kaminis granite and of the same age as this granite. They cut the granitic rocks (14) and an arsenopyrite vein at the Newcor mine. Some porphyry dykes as far north as Flin Flon may also be of this age, for they cut the Boundary intrusions and appear also to cut the copper-zinc ore at the Flin Flon mine. West and north from Flin Flon Lake, however, some of the porphyry dykes are cut by the Boundary intrusions. These dykes cut a body of granitic rock (14), but may, nevertheless, be related in origin to it.

STRUCTURAL GEOLOGY

Folds

The structural geology of the area is complex. The rocks of the Amisk group were closely folded and deeply eroded before the deposition of the Missi series, which lies with marked angular unconformity against the older volcanic rocks. The Missi series itself was then folded, and the pressures active at this time no doubt further complicated structures already existing in the Amisk group. As a rule, fold axes in both the older volcanic formations and the younger sedimentary series trend a few degrees west of north. In the Missi series the limbs of the folds are commonly overturned toward the west, but in the volcanic rocks similar structures are present only locally. Main synclines include the Grant Lake syncline in the Missi series and the Hidden Lake-Burley Lake syncline in the Amisk group. On either side of the latter fold the volcanic rocks form the Mandy Road anticline on the east and the Beaver Road anticline on

the west. The Beaver Road anticlinal axis is exposed for only a short distance to where the fold is cut off by a fault, but the fold is, nevertheless, a major one, for all the volcanic rocks in the southwest part of the map-area and southwest of the fault zone lie on its southwest limb. An exception to the rule that fold axes trend a few degrees west of north is found in the Missi series where the Flin Flon Creek syncline trends easterly and its south limb is steep or sharply overturned against a buttress of volcanic rocks.

Faults

Faults are numerous, both large and small. Some of the larger, such as the Cliff Lake, Channing, and Ross Lake faults, trend a few degrees west of north. What is probably the most important fault zone in the area is not evident on the map except in places where its various sections have been given local names, as Club Lake, Creighton Creek, Flin Flon Lake, and Green Lake faults. All are believed to be parts of a single fault zone, complicated by cross faults and cut out for considerable distances by the Boundary intrusions. The movement along this fault zone must have been great for, as mentioned above, almost the whole of the axial part of the Beaver Road anticline has been cut off. Along the Creighton Creek and Club Lake sections of the fault zone Amisk volcanic rocks to the east have been thrust over Missi sedimentary rocks on the west. The fault zone has not been traced beyond an outcrop at the railway 2,000 feet northeast of Club Lake. Beyond this point it appears probable that the fault movement was taken up by compression within the Missi sediments. This compression caused the development of the anomalous Flin Flon Creek syncline as a result of a northerly and upward push from the more competent lavas to the south. Within the volcanic rocks south of the contact the same forces found expression in the curved Railway fault and in a similar fault immediately south of it, along both of which there appears to have been overthrusting to the north. Another fault that shows evidence of considerable displacement is the Reo fault in the southwest part of the map-area.

Schistosity

Schistosity is developed throughout much of the area and, in general, is more pronounced in the north than in the south. In the northwest part the schistosity commonly strikes northeast and dips gently southeast, but in places it trends slightly west of north and dips steeply east. In the east and southeast parts of the map-area this northerly strike and steep easterly dip prevails, whereas in the southwest part of the area the trend is northwest and dips are steeply southwest. On some outcrops two or more sets of schistosity cross one another.

Lineation

In addition to the schistosity, which causes the rocks to break along planes, there is also a secondary, linear structure. This is especially noticeable in the northern part of the area where schistosity is also most pronounced. The lineation finds expression in several ways. Most evident is an elongation of boulders and pebbles into cigar-shaped bodies, and similar elongation may be seen in volcanic fragments, pillows, amygdules, and phenocrysts. Lineation also appears as lines at the intersection of planes of schistosity or fracture, as pencil structure, and as striations on small joint or slip planes. The lineation is represented on the map by an arrow drawn in a vertical plane passing through the long axis of the linear feature; the tip of the arrow points in the direction of plunge of the elongation, and in some places the angle of plunge, namely the vertical angle between the long axis and the horizontal plane, is shown in degrees. A close relationship exists between the linear structures and the schistosity, for, where the two occur together, as is common, the lineation lies in the plane of the schistosity. At such places the two symbols are joined, and it is unnecessary to give the angle of plunge for this can be calculated. A noteworthy feature is that, regardless of the strike of

schistosity or the attitude of folds, the lineation constantly plunges southeast. The angle of plunge is commonly from 20 to 40 degrees.

The regional schistosity and the lineation extend without change in attitude across contacts between the Amisk group and the Missi series and were developed, for the most part at least, in post-Missi time. They may have been formed before the Boundary intrusions were emplaced, for they were not seen in these intrusions nor in the Kaminis granite or related porphyry dykes.

A still later deformation of the area is evidenced by numerous small faults with displacements of only a few inches or a few feet. These small faults strike from northeast to north and show right-hand offsets. Although individual offsets are small, they may add up to as much as 200 feet in a distance of 1,000 feet along the strike of a bed.

MINERAL DEPOSITS

At the Flin Flon base-metal mine, operated by Hudson Bay Mining and Smelting Company, Limited, approximately 25,000,000 tons of ore have been mined during the period from 1930 to 1945. As of January 1, 1946, reserves were estimated to be 26,000,000 tons, averaging 2.99 per cent copper, 4.24 per cent zinc, and 0.089 ounce of gold and 1.25 ounces of silver a ton. In addition to the four metals named, other elements recovered from the ore include cadmium, selenium, and tellurium. Mine workings extend to the 3,750-foot level, but only a little development work has yet been carried on below 3,250 feet. The ore is associated with quartz porphyry along a contact between competent lava flows on the northeast side and more easily sheared pyroclastic and flow breccias on the southwest. In the mine area these formations form a large, southeast-pitching drag-fold on the southwest limb of the Hidden Lake-Burley Lake syncline. The drag apparently formed as a result of movement of the beds on the northeast side up and to the south with respect to those on the southwest side. Subsidiary, southeast-pitching drag-folds occur on the northeast limb of the anticlinal part of the main drag-fold, and crumpling occurs on the crests of the main and subsidiary drag-folds. The ore zone as a whole is localized along or near the northeast limb of the anticlinal part of the main drag-fold, and ends against its crest. The ore plunges southeast with the pitch of the fold and with the plunge of the lineation. Several large orebodies lie near one another in the ore zone, which is up to 400 feet wide and has been followed down the plunge for 6,500 feet. Some of these occur en échelon beneath the subsidiary drag-folds, with right-hand offset along strike, and northeast offset down the dip. The orebodies vary from lenticular to irregular, and some are hook-shaped along parts of their crests. The hook-shaped structures are open downwards and to the northwest, as if either reflecting the shapes of the crests of drag-folds or the intersections of two sets of cleavage. The orebodies lie with their longest axes along the direction of plunge, and dip steeply northeast or are locally vertical. The ore is of two distinct types, solid sulphide and disseminated sulphide. Metallic minerals include pyrite and smaller amounts of sphalerite, chalcopyrite, galena, tetrahedrite, arsenopyrite, pyrrhotite, magnetite, and gold. The gold occurs in the solid sulphide ore, but is not present in the disseminated ore. The rocks within the ore zone and on the foot-wall side are altered to chlorite schist and lesser amounts of sericite schist across widths of as much as 1,000 feet. In addition they are partly silicified and carbonatized. The alteration has obscured the original character of the rock in many places and has made the determination of details of folding difficult.

The Mandy mine was a base-metal producer from 1917 to 1920 and again in 1943 and 1944. Altogether some 137,700 tons of ore were mined. The ore was similar to that at Flin Flon, but higher in grade, averaging about 7.3 per cent copper, 12.9 per cent zinc, and 0.09 ounce

of gold and 1.8 ounces of silver a ton. Mine workings extend to the 1,025-foot level. Most of the ore was obtained from a lens that extended from the surface to a depth of 230 feet, but some was found at horizons down to 625 feet. The ore lenses were in schistose andesite breccia, they followed the strike of the formation, and plunged steeply south.

In addition to the two base-metal mines the area includes several base-metal and gold occurrences. Two of the gold deposits, the Newcor and the Henning-Maloney, have been explored by underground work. Several quartz veins in the vicinity of Phantom Lake carry scheelite.