Stratigraphy of the Nilsen Plateau, Western Escarpment, Antarctica

by

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Forward

Field work resulting in this report was conducted in 1963-64. Sixteen sections along approximately 35 miles of escarpment were measured to provide data for this report. About 500 rock samples have been archived at the U.S. Polar Rock Repository at The Ohio State University.

Rock sample descriptions and locations have been included with this report. Supporting details for statements made in this paper reside in files maintained by the author.

Abstract

About 2000 feet of sedimentary rocks and at least an equal thickness of diabase dikes and sills rest on an ancient erosion surface, and are divided into five formations. In ascending order these are; Scott Glacier Formation, Roaring Formation, Amundsen Formation, Queen Maud Formation and the Nilsen Formation

The formations are mostly flat–lying, have been altered by heat from numerous diabase intrusions, and are locally displaced by high–angle faults. Non-uniform injection of diabase dikes and sills irregularly displaces sedimentary strata.

Geologic Setting

Physiographically, structurally and stratigraphically the Nilsen Mountains are part of the Transantarctic Mountains. Nearly horizontal strata of later Paleozoic and early Mesozoic? age rest on an ancient erosion surface. These strata were intruded during Mesozoic by diabase. Recently the crust has been deformed into the fault—bounded blocks presently being eroded by glaciers

The stratigraphy discussed here would all be considered part of the Beacon rocks of older publications and the very obvious nonconformity beneath the sedimentary rocks is part of the very extensive ancient erosion surface called the Kukri Peneplain by Warren (1962)

Acknowledgements

The National Science Foundation, Office of Antarctic Programs funded this Nilsen Mountains investigation; and The Ohio State University Research Foundation, Institute of Polar Studies administered the operation. The U.S. Navy provided logistic support and transportation. Air Development Squadron 6 supported the fieldwork with critically important air transportation. Courtney Skinner, geological field assistant, Larry M. Rychener, laboratory assistant, and Warren Brussee, draftsman, have greatly aided this report. Dr. J. M. Schopf, of the U.S. Geological Survey, provided paleobotanical and stratigraphic advice, and critically read the manuscript. Dr. A Mirsky provided editing and critical evaluation of the early manuscript.

Most recently, Dr. David Elliot graciously requested a submission of this manuscript to The Ohio State University Byrd Polar Research Center.

Physiographic Setting

The highest elevations in the area of investigation, at the northern end of the plateau, were measured at about 13,000 feet elevation by altimetry and theodolite angles. Maximum relief in the northern end of the escarpment is about 9000 feet. In the southern part of the escarpment the summits are about 11,000–12,000 feet elevation and relief ranges from 2000 to 5000 feet.

The Nilsen Plateau obviously is located in a polar climate, with a mean annual air temperature of –36°F at about 6000 feet elevation (Base Camp). Air temperature during the field season ranges from +20° to –18°F. Dark rock surfaces warmed by the sun become warm enough to melt water so the frozen and partly frozen pools are present during midsummer. Wind in the area can be severe but much of the escarpment is located to the lee of the plateau block so is protected. The southern escarpment is windier than the northern parts as evidenced by snow free blue ice in the south and deep accumulation of snow in the north. Highest wind recorded by hand anemometer was 53 knots. During a season of 78 days, 15 days (19%) were considered too stormy to do field work, very good weather for an Antarctic area.

Previous Investigations

This investigation was the first to be fielded in the Nilsen Mountains. An earlier expedition from Ohio State University conducted geologic exploration of the Robert Scott Glacier area (Doumani and Minshew, 1965) especially around Mt. Weaver located 60 miles to the south–southeast. In 1934 Quinn Blackburn made the first ascent and geological investigation of Mt. Weaver (Blackburn, 1937). Mt. Weaver and the Thorvald Nilsen Mountains appear to be in the same structural block, and the geology of the two areas is similar. About 40 to 60 miles to the northwest, a New Zealand party conducted reconnaissance investigations of the geology between Axel Heiberg and Shackleton Glaciers (Barrett, 1965, McGregor, 1965).

Fig. 1. Nilsen Plateau, Western Escarpment(looking to North)

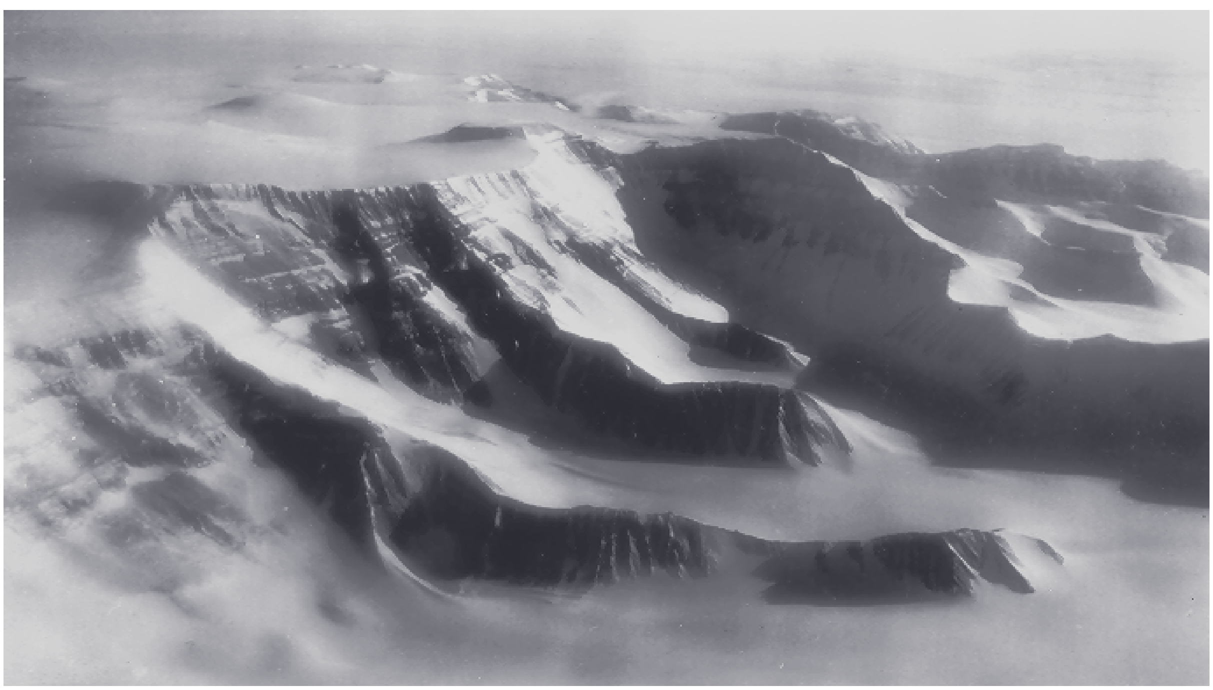


Fig. 2. Nilsen Plateau, Western Escarpment
(Northern end, Sections 14 & 16)

Fig. 3. Nilsen Plateau Base Camp
(Cougar Canyon & Section 2 in distance)

STRATIGRAPHY

Basement Rocks

Basement rocks of the Thorvald Nilsen Mountains include several types of granitic rocks, metamorphosed volcanic, and metamorphosed sedimentary rocks. The latter are highly folded and intruded by granitic rocks. Studies of the basement geology have been carried out by D. McLelland, Mackay School of Mines, University of Nevada, and are discussed in a separate paper.

The Scott Glacier Formation

The Scott Glacier Formation, the lowermost sedimentary unit of the stratigraphic succession of the Nilsen Mountains, crops out in all sections of the Nilsen Mountains. Domani and Minshew (1965) originally defined and described the type-section of the Scott Glacier Formation on Mt. Weaver.

The Scott Glacier Formation in the Nilsen Mountains ranges from 10 to 110 feet thick, and is present in all of the sections measured along the escarpment (Fig. 1). Outcrops of the more erosion-resistant lithologies (tillite, conglomerate, and sandstone) of the formation form ledges and steps that are easily seen when near the outcrop but less obvious when viewed from a distance.

Lithologies within the formation include ledge–forming tillite, poorly sorted conglomerate-sandstone, and interbedded siltstone, shale, and varvite (Figs. 6-9). A tillite unit is usually in contact with basement rock and in turn covered by siltstone, varvite and a few thin layers of tillite.

Basal tillite units are composed of medium to dark gray silty mudstone matrix with numerous randomly scattered pebbles, cobbles and boulders (Fig. 6). Large clasts are fragments of metavolcanic and metasedimentary rocks, apparently derived from the basement complex of the Nilsen Plateau area. Most boulders show features of glacial transportation and deposition (faceted and angular, and a few are striated).

Fig. 4. Striated Glacial Polish on basement rock, and under basal Scott Glacier Formation

Fig. 5. Striated pavement on basement rock
pavement extends under basal Scott Glacier Formation

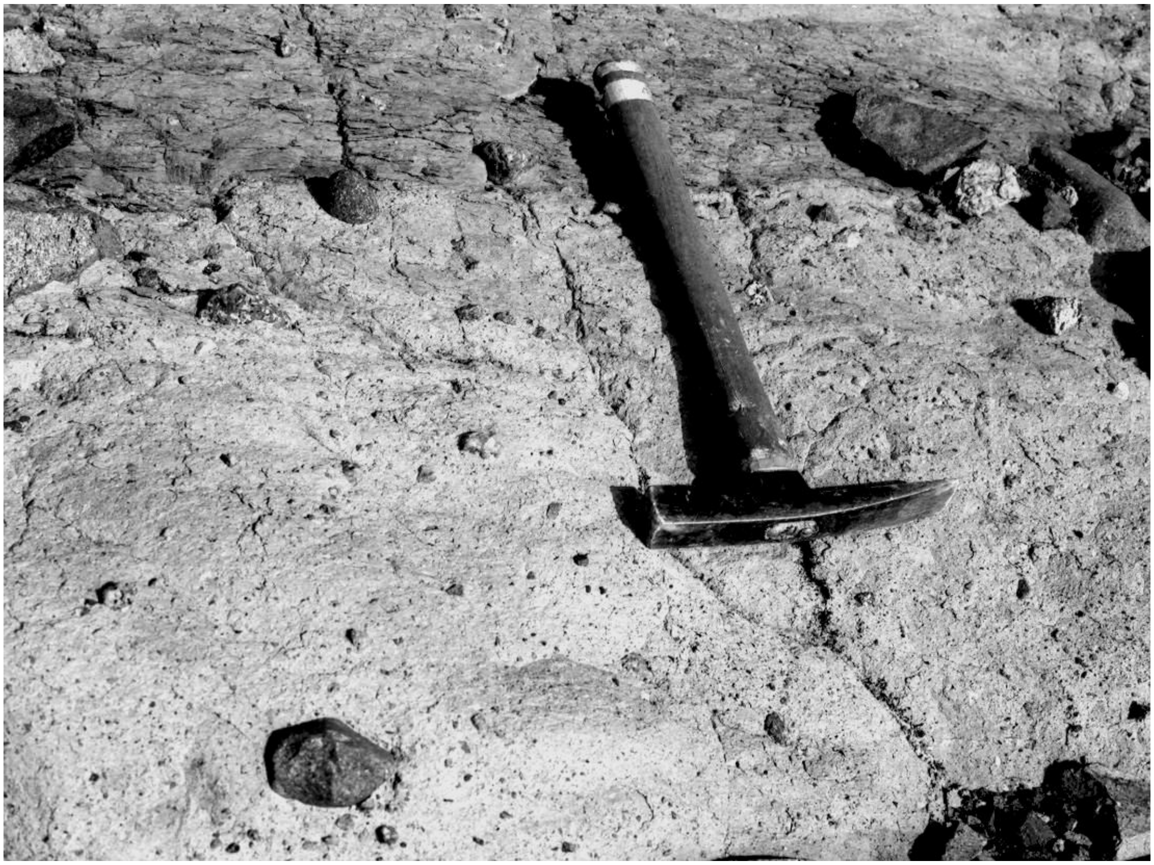


Fig. 6. Tillite of Scott Glacier Formation

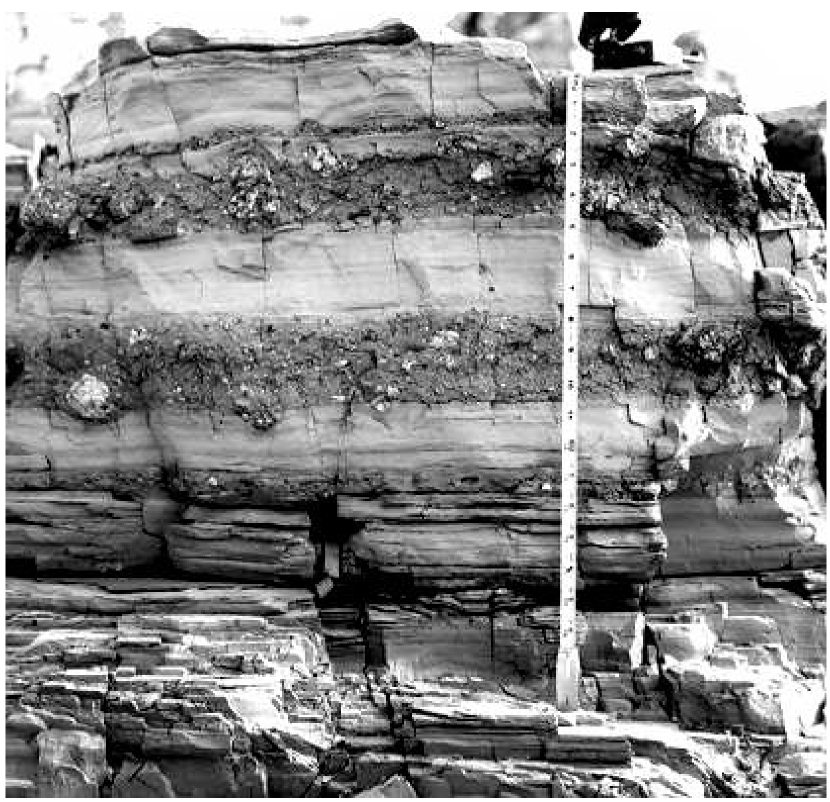


Fig. 7. Tillite & varvite interbedded
Scott Glacier Formation

A light yellowish-gray–weathering siltstone or mudstone (locally varved) commonly rests on the boulder beds. Varved beds are locally deformed into small folds (Fig. 11) and thin tillite units interbed with mudstones at some outcrops.

The uppermost part of the formation is composed of a medium dark gray siltstone or mudstone containing a few randomly scattered pebbles and cobbles.

One of the best exposures of the Scott Glacier Formation is located on the northeast corner of Lonely Ridge (see map) at Wildcat Pass.

Boulder counts made at Wildcat Pass, Lonely Ridge and at Sections 1 and 6 along the escarpment are shown in Table 2 in appendix.

Dominant boulder lithology at each location, (Table 2) matches the local basement lithology, and less abundant boulder lithologies like more distant rocks.

Thin sections of the tillite matrix show angular, fresh fragments of quartz, feldspar, metamorphic and igneous rocks set in siltstone and clay. Thin sections of the boulder beds show 50 to 65 percent matrix with sorting typical for that of a till.

Thin sections of conglomerate beds within the Scott Glacier Formation show a composition of poorly sorted, angular fragments of quartz and feldspar grains, as well as granitic and metamorphic rock fragments in a poorly sorted matrix of mudstone and siltstone.

Sandstone in the upper part of the Scott Glacier Formation is poorly sorted, arkosic, and mostly fine–grained. A single count shows 40% grains of quartz, 20% feldspar grains, 1% trace minerals, and 39% argillaceous and silty matrix. Trace minerals included tourmaline, biotite, leucoxene, apatite, epidote, rutile (?), andalusite (?), and kyanite (?).

Mechanical analysis of a sandstone from the Scott Glacier Formation shows that the Inclusive Graphic Standard Deviation (Folk, 1961) is 1.11, a poorly sorted sandstone. The Inclusive Graphic Skewness is - 0.17 showing a fine–skewed sandstone. The Graphic kurtosis is 1.57, very leptokurtic, (meaning the fine and coarse parts of the sandstone are more poorly sorted than the middle sizes.)

Varvite (varved siltstone) beds typical of the Scott Glacier Formation are shown in Fig. 8 & 9. Varvite from the northeast corner of Lonely Ridge contains silt–sized and smaller particles. One varvite is overlain by a tillite bed containing 4-foot diameter boulders (Fig. 8). A siltstone and very fine-grained sandstone contact the varvite at its base.

Individual varves range in thickness from 0.7 to 1.6 inches. A single varve (unit) grades from light gray, silt–sized grains at the base to medium dark gray, clay–sized material at the top. Varve boundaries are sharp along the contact with coarser material above the clay-sized fraction of the subjacent varve.

One unusual varve contains numerous angular sand-sized grains scattered in the medium dark gray argillaceous, fine lithology of the varve. These scattered clasts are larger than the silt at the base of the varve and were likely deposited independently (perhaps floating ice) and simultaneously with the silt and clay fraction of the specimen. Varved and regular mudstone occur in contorted beds (Fig.7) between non-disturbed rocks suggesting deformation prior to lithification, perhaps caused by moving glacier ice or gravity-driven slumping.

The Scott Glacier Formation overlies the basement with a sharp, well—defined nonconformity, easily seen from great distances and readily observed in aerial photographs. The old erosion surface on which the formation rests shows low relief with local channels 10 to 30 feet deep. At Wildcat Pass, and also at the base of Section 7, the tillite matrix, which lies directly on the basement, has been locally forced into old fractures in the basement rock surface. Also basement boulders from the old erosion surface have been displaced a few inches from their original location. In most localities the ancient erosion surface is clean and gives the impression of a pavement and is polished and grooved occasionally (Fig. 4 & 5).

The upper contact of the Scott Glacier Formation is not clear at many locations due to diabase sill intrusions along the contact.

Fig. 8. Varvite with tillite (boulder depresses upper varve layer.)

Fig. 9. Contorted varvite (penecontemporaneous deformation)

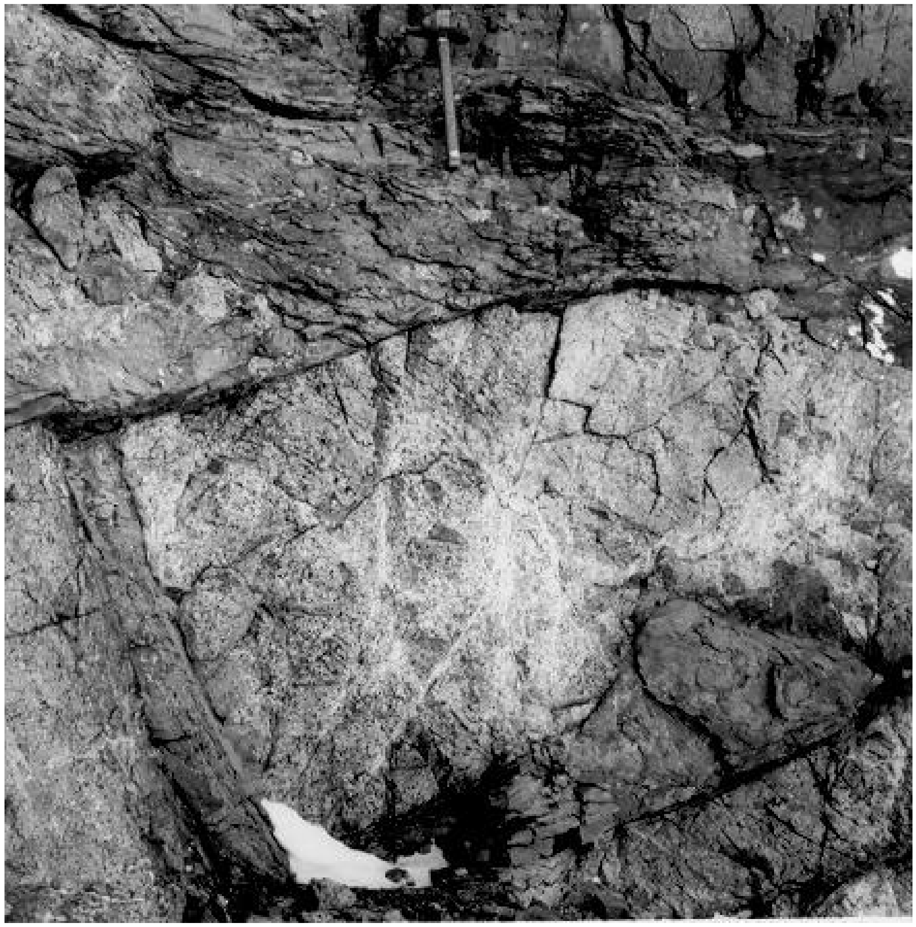


Fig. 10. Tillite injected into basement rock fractures


Fig. 11. Tillite-Sandstone unit contact
(near top of Scott Glacier Formation)

Origin of the Scott Glacier Formation

The Scott Glacier Formation was formed by glacial, glacio–fluvial, and glacio–lacustrine processes. Tillites were deposited directly by glacial ice. Evidence for glacial deposition includes:

(1) unsorted tillite with scattered large, faceted clasts,
(2) striated and faceted pebbles, boulders, and cobbles,
(3)the intrusion of tillite into open joints and cracks of the basement rock suggesting the application of pressure from over-riding ice,
(4) presence of varvites in associated beds,
(5) locally striated and polished pavement directly below the boulder beds.

The siltstone, sandstone, conglomerate and varvite in the formation were transported only short distances, sorted and deposited by water.

The Scott Glacier Formation fits tillite properties as described by Pettijohn (1949), Crowell (1957), Dott (1961), and Schwartzbach (1936).

Direction of glacier-ice-flow responsible for deposition of the tillite appears to have been from the northwest. Striae and groove directions on the glacial pavement at the base of Section 12 range from N15°W to N30°W (true). Possible grooves near the base of Section 5 are oriented N65°W, and questionable striae on the basement at Section 13 strike N70°W.

Long axes of 13 elongate cobbles and boulders$_1$ in the ti11ite at the base of Section 16, show a preferred orientation about N50°W, with a secondary preference at about 90° to the dominant direction, in agreement with the striae directions above.

Crescentic marks on the striated pavement at Section 12 suggest that ice motion was from N30°W to S30°E (true) In the same area, a polished surface is preserved on the NW side of a small roche moutonée.

Listed indicators indicate that ice flowed from northwest to southeast during deposition of the Scott Glacier Formation. Cross-bedding observed in overlying formations show corresponding orientation of the paleoslope.

The age of the Scott Glacier Formation has not been directly determined; however, stratigraphic position and lithology are similar units of the Buckeye Tillite in the Ohio Range (Long, 1962). Spores in the upper part of the Buckeye Tillite suggest an Early Permian age. Other tillite formations of the Transantarctic Mountains are considered of Permian age (Lindsay, 1959, 1970). The Scott Glacier Formation is most likely of Permian age.

The Roaring Formation

The Roaring Formation is exposed in nearly all measured sections along the western escarpment of the Nilsen Mountains. Outcrops of the formation are less resistant to erosion than formations above and below, and commonly form gentle, uniform slopes. In many places diabase sills are present at the top of the formation, separating the Roaring Formation from the other sedimentary rock units. The formation is well exposed on several ridges in Roaring Valley (provisional name) and measured Sections 4 & 6 are considered type sections.

The dominant lithology of the Roaring Formation is very dark gray carbonaceous and micaceous shale. Minor lithologies include a dark greenish-gray siltstone, mudstone, and very fine sandstone. Other lithologic types include medium gray, well–bedded, silty shale, medium light greenish–gray mudstone, with a blocky fracture, and lenticular light gray, silty calcareous beds. Several beds of calcareous rocks measured in Section 5 range from light to dark gray and contain variable amounts of clay, silt, and fine sand with calcite fracture fillings.

Animal trails along the bedding are present in the uppermost layers of the formation in Sections 10, 13 and 16. Animal burrows perpendicular to bedding are present in the upper half of the formation at Sections 2 and 7.

The Amundsen Formation

The Amundsen Formation crops out in prominent cliffs (Fig. 12) along the entire escarpment bordering the Amundsen Glacier and Sections 6 and 7 in Roaring Valley are designated the type section.

The Amundsen Formation is dominantly feldspathic graywacke and arkose (Pettijohn 1954). Arkosic sandstone structures vary from thin-bedded to massive; with cross–bedding (Fig. 14) and current ripples common. Outcrops are very light gray, light yellowish–gray, reddish–brown, or dark gray. In the northern part of the escarpment rounded limonitic spots make a distinctive pattern on the outcrop (Fig. 12). Small yellow spots (about 0.25-0.50 inch) and amoeboid-shaped carbonaceous bodies about 1 to 2 inches across also are distinctive properties of the sandstone at northern exposures. Fossils in the formation include poorly–preserved stems**,** animal (worm-like) burrows and trails.

Minor beds of carbonaceous and micaceous shale, siltstone, and mudstone are interbedded with arkosic rocks of the Amundsen Formation. The fine clastic rocks locally may be ripple-marked (Fig. 15) and weather to medium or light gray.

In hand specimen the arkose or feldapathic graywacke is very fine to medium–grained with fair size sorting. Mechanical analyses show the inclusive standard deviation (Folk**,** 1961) ranges from 0.4 phi to 0.9 phi, indicating well sorted to moderately sorted sand; symmetrical to strongly fine skewed (Folk, 1961) with most samples fine skewed; and most samples are platykurtic.

Thin section analyses of specimens from the Amundsen Formation show clasts of quartz, feldspar, and minor amounts of other minerals in an argillaceous siliceous, micaceous or limonitic matrix.

In type section the Amundsen Fomation is 700 to 900 feet thick, thinning in the southern sections to about 400 feet (Section 13), while to the north formation thickness ranges from 330 feet (Section 14) to 625 feet (Section 16).

The Amundsen Formation was probably deposited under lacustrine and fluvial conditions. Cross–bedding and overall shape of the arkosic bodies suggest deposition in an area of reduced relief with meandering streams and lakes, Even-bedded and siltstone layers with oscillation ripple marks interbedded with cross–bedded sandstone suggest lacustrine or lagoon deposition. In general, the Amundsen deposits seem to represent a flood plain with a series of lakes and shifting stream channels

Feldspar grains (mostly orthoclase, from 10% to 25%) indicate a granitic source rock for the formation. Trace amounts of metamorphic minerals such as cordierite, kyanite, and scapolite indicate minor metamorphic rock sources; Lower beds of the Amundsen Formation are better sorted with grains slightly more rounded than the sandstone beds of the upper layers

Paleoslope was determined from large cross–beds (up to 3 feet thick) with steep slopes, as well as small current–ripple marks at many of the measured sections. Directions from the whole area of study indicate a paleoslope trending from north–northwest to south–southeast(true) (Appendices).

In most measured sections the Amundsen Formation contacts the under-lying Roaring Valley Formation with a disconformity. Local erosion under basal sandstone beds is visible. Contact with overlying Queen Maud Formation occurs at the base of the shale and mudstone sequence containing Glossopteris.

Amundsen Formation

Fig. 12. Spotted arkosic ss
Amundsen Formation ss cliff

Fig. 13. Calcareous nodular sandstone bed
within Amundsen Formation

Fig. 14. Cross-bedded sandstone
Amundsen Formation

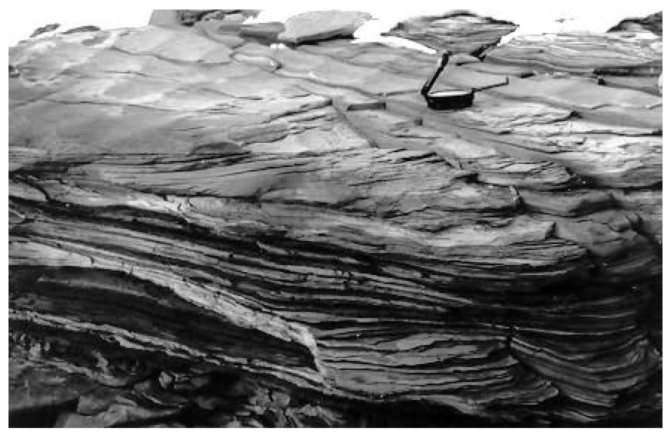


Fig. 15. Ripple marks in siltstone/sandstone
Amundsen Formation

The Queen Maud Formation

The Queen Maud Formation type section is exposed on Mt. Weaver, (Doumani and Minshew, 1965) at the head of the Robert Scott Glacier, where the unit is composed of a cyclic sequence of sandstone, siltstone, shale, mudstone, and coal with a Glossopteris flora.

In the Nilsen Mountains the Queen Maud Formation was measured in all of the sections except Section 16, where it is present, but higher than the top of the measured section, The fine clastic rocks of the formation do not resist erosion as well as the arkosic sandstones and siltstones of the underlying Amundsen Formation or the overlying Nilsen Formation. Nevertheless, fossil plant collections can be made from the excellent outcrops.

Lithologies of the Queen Maud Formation include sandstone, siltstone, mudstone or shale, and coal. The dominant rock type is carbonaceous, blocky, mudstone or shale which weathers very light powdery gray. Many such beds contain Glossopteris and related fossils.

Mudstone units in the formation are composed of a sub–microcrystalline matrix with a few scattered silt grains of quartz and feldspar. The matrix appears to have been recrystallized from heat of sills that commonly are present within a few hundred feet of any location in the formation. Coaly fragments are present along bedding surfaces, and the percentage of carbonaceous material ranges from less than 5 percent in gray shale to over 90 percent in better quality coal.

Coal and coaly shale, present only locally in the Queen Maud Formation, were observed in Sections 6, 8, 10, 11, 12 and 13. Coal beds are all less than 6 feet thick and most are less than 3 feet thick, appearing to be lenticular, and are best developed in the southern part of the area.

Rank of all samples as calculated from the Parr formula for Dry, Mineral–matter-free Fixed Carbon (ASTM Standards on Coal and Coke, 1959), is low volatile bituminous. The dry, Mm–free F.C. values increase with each higher coal bed, and this rank increase probably was caused by the intrusion of a 950 feet-thick sill located about 85 feet above the highest of the three coal beds. Thermal metamorphic effects on Antarctic coal from sills have been discussed by Schapiro and Gray and by Schopf and Long (1964), who conclude that much of the coal in Antarctica had attained at least bituminous rank prior to intrusion of diabase bodies. Subsequent heating by intrusions has caused increase in rank to as high as meta-anthracite, and some of the coal has been coked and yet retains a banded appearance.

Cyclic Deposition

A cyclic depositional pattern is present, particularly in Section 13, where coal beds were observed. Common lithologies within a cycle include sandstone, siltstone, carbonaceous shale, coal, carbonaceous shale, siltstone and then sandstone of the next cycle. The thickness of the Queen Maud Formation is inaccurately known, because measured sections do not include the upper contact of the formation.

Only section 12 showed both the top and bottom contact in connected succession and there the Queen Maud Formation is about 315 feet thick. The lower formational boundary is placed just above a sandstone bed with conglomeratic, quartz pebble lenses in the vicinity of Section 13. In Section 5 the formational thickness is at least 620 feet although the upper contact is missing, and in Section 14 a thickness of 640 feet was measured. Variable thickness of the Queen Maud Formation appears to be the result of differential, post-depositional erosion before deposition of the overlying Nilsen Formation. However, thickness of units within the formation also varies.

The depositional environment of the Queen Maud Formation was non-marine and included sand deposition in both quiet and moving mud and silt deposition under reducing conditions. Swamps or peat bogs provided reducing, anaerobic conditions allowing accumulation of plant parts, which, eventually, coalified; perhaps on a coastal plain or delta of low relief over which streams meandered and on which Glossopteris leaves collected in abundance.

Most of the coal-forming basin lay to the southeast of the Nilsen Mountains, down the regional slope toward the Mt. Weaver area where Doumani and Minshew (1965) report abundant coal beds and more complete cyclical development.

Sediment source existed somewhere northwest of the Amundsen Plateau. The once highland sources providing arkosic sediments for the Amundsen Formation were likely reduced to lower-relief landscapes. The basins of accumulation supported fluvial flats with flood plains, abundant plant growth and peat accumulation.

Fig. 16. Fossil wood and leaves from the Queen Maud Formation

Fig. 17. Cyclic sandstone, shale & coal, Queen Maud Formation

Fig. 18. Coal, shale & sandstone
Queen Maud Formation

Fig. 19. Fossil tree stem in place
Queen Maud Formation

The Nilsen Formation

The Nilsen Formation, the highest and youngest of the sedimentary rock units observed on the Nilsen Plateau, is dominantly sandstone with minor beds of conglomerate, mudstone, and siltstone. The formation was measured only in Sections 11, 12, and 9, (Appendices) at the southern reaches of the escarpment. At the northern end of the study area the formation likely outcrops on the slopes above Section 16 not reached by the field party. Thin erosional remnants of the Nilsen Formation may cap several of the high peaks in the area. The type section is designated at Section 11 where the formation is thicker, not withstanding complicating faults and talus cover. Section 9, which can be considered an upward extension of Section 12 provides the best outcrops of the formation.

Nilsen Formation outcrops are light yellowish–gray and moderately resistant to erosion forming moderately steep, nearly uniform slopes with occasional ledges of basal coarse-grained sandstone or fine conglomerate

The fine-grained conglomerate contains a clayey and sandy light-yellowish matrix between angular to rounded pebbles and boulders of shale, sandstone, pegmatite and vein quartz, chert, volcanic rocks, and metamorphic rocks. The rounded clasts probably represent second or third cycle deposits while the angular boulders and cobbles were produced by erosion just prior to deposition. A few of the cobbles are water–worn Glossopteris shales from the Queen Maud Formation. Boulders of sandstone as much as 2 feet long were observed. Much of the conglomerate is steeply crossbedded.

Sandstone units, as much as 150 feet thick, are light yellowish–gray, and composed of fine-grained to coarse–grained fragments of quartz, feldspar, chert volcanic rocks and sedimentary rocks in a clayey and silty matrix with only fair cementation allowing partial disaggradation by hand.

Mechanical analyses of the sandstone show it to be mostly poorly sorted with a few specimens being moderately sorted with an inclusive graphic standard deviation (Folk) ranging from 0.7801 to 1.770. The inclusive graphic skewdness (Folk) of the sandstone ranges from -1,8 to 0.74 but most samples are between 0.1 and 0.5 (fine–skewed to strongly fine–skewed) and most samples are the mesokurtic or leptokurtic.

Bedding of the sandstone ranges from a few inches to massive units as thick as 30 feet with cross–bedding common. The direction of cross–bedding is nearly opposite that of the underlying formations based on three measurements of cross–bed dip from torrential type cross–beds made (Appendices) at locations well separated stratigraphically within the formation. Other cross-bed slopes in Section 9 and Section 12 show similar direction of depositional currents from southeast to northwest.

Fine clastic rocks of the Nilsen Formation include light to medium greenish–gray, blocky to shaly mudstone, which weathers yellowish-gray. Siltstone and shale are present also, and form units up to 135 feet thick, which contain a few beds of sandstone. Fossil wood and a few unidentified grass–like fossils were found in mudstone in Section 9.

Thickness of the Nilsen Formation in Section 11 is about 615 feet and in Section 9 it is 550 feet, but the true thickness of the formation is not known as the upper contact was not seen. Cliffs to the north of Section 16 appear to include about 1500 feet of the Nilsen Formation and the cirque there is an ideal location for further investigation of the formation. The source area for Nilsen Formation must have been of varied lithology; volcanically and orogenically active. Cross–bedded sandstone and the conglomerate contain pebbles, cobbles, and boulders of sedimentary, metamorphic, volcanic, pegmatitic, and vein quartz from younger and older lithologies of the area. Some of the cobbles were derived from the underlying Queen Maud

Formation and contained plant fossils. Sediment probably accumulated in alluvial fans, stream channels, flood plains, and lakes.

The source area of the sediment, as indicated by cross–bedding, lay to the southeast, a direction which was down-slope prior to time of deposition of the Nilsen Formation. The change in regional slope and the coarse clastic texture of the rocks of the formation indicate relatively high energy stream-transport from the southeast.

The Nilsen Formation disconformably overlies the Queen Maud Formation and the erosional surface under the basal conglomerate is distinct. Formations superjacent to the Nilsen Formation are not present in the area, so upper contact is unknown.

The Nilsen Formation most likely can be correlated with the Falla and Fremouw Formations (McGregor 1965; Wade et al.1965; (Barrett,1969; Elliot,1970) of the Beardmore Glacier part of the Queen Maud Mountains. Lithology, stratigraphic position, and paleocurrent data compare closely those of the Falla and Fremouw Formations.

The Fremouw Formation in the Shackleton Glacier area contains Lower Triassic vertebrate fossils (Elliot, et al., 1970). As noted above, large sections of the Nilsen Formation are present in the northern reaches of the Nilsen Plateau's western escarpment. Further investigation of Antarctic Triassic strata should include a detailed study of these rocks.

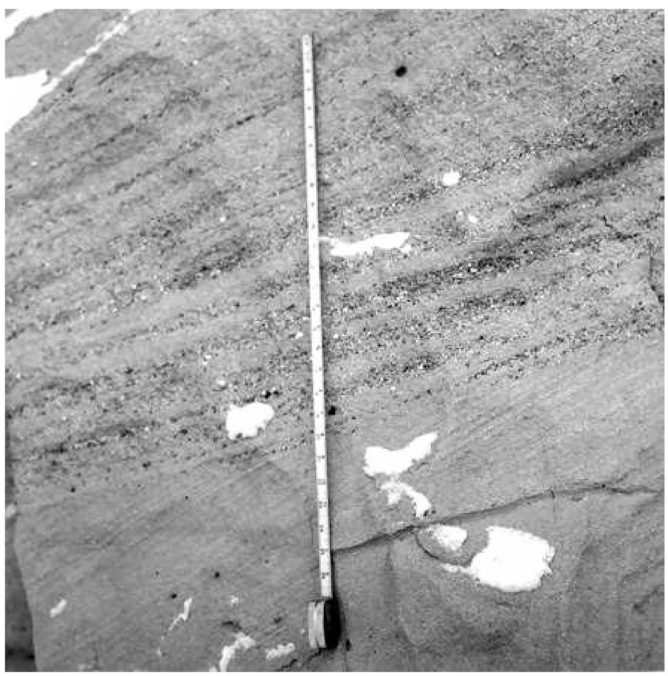


Fig. 20. Coarse-grained sandstone, cross-bedded
Nilsen Formation

Fig. 21. Fossil wood in Nilsen Formation

Diabase Intrusives (Ferrar Dolerite?)

Diabase sills and dikes on the western escarpment of the Nilsen Plateau make up about half the thickness of measured sections (Figs. 2, 3 ,22); cutting basement rock and sedimentary strata. Outcrops of diabase are resistant to erosion and form steep cliffs and ledges (Fig. 22) that can be traced along the escarpment with relative ease.

Sills are fine to medium grained diabase with a network of plagioclase lathes and pyroxene. The margins of the sills are very finely crystalline and the interiors are medium to coarsely crystalline. Darker minerals are more abundant in the base of a sill while feldspar increases in upper levels.

Thickness of individual sills ranges from a few feet to about 950 feet but composite sills are up to 1100 feet thick. The total thickness of sills in the measured sections (Appendices) in the south was about 800 feet while the total of the sill thicknesses in the northern measured sections is about 2000 feet, suggesting more diabase was intruded in the northern part of the area.

The age of the diabase is assumed to be similar to intrusive diabase rocks described from other areas in the Transantarctic Mountains. Ten specimens from near Beardmore and Skelton Glaciers have been dated by McDougall (1963) using the potassium—argon method and the ages range from 147 to 163 million years Evernden and Richards (1962) report an age of 162 million years for a dolerite in Victoria Valley. Diabase of the Nilsen Plateau likely was emplaced at a similar time and is, therefore, of Middle Jurassic age.

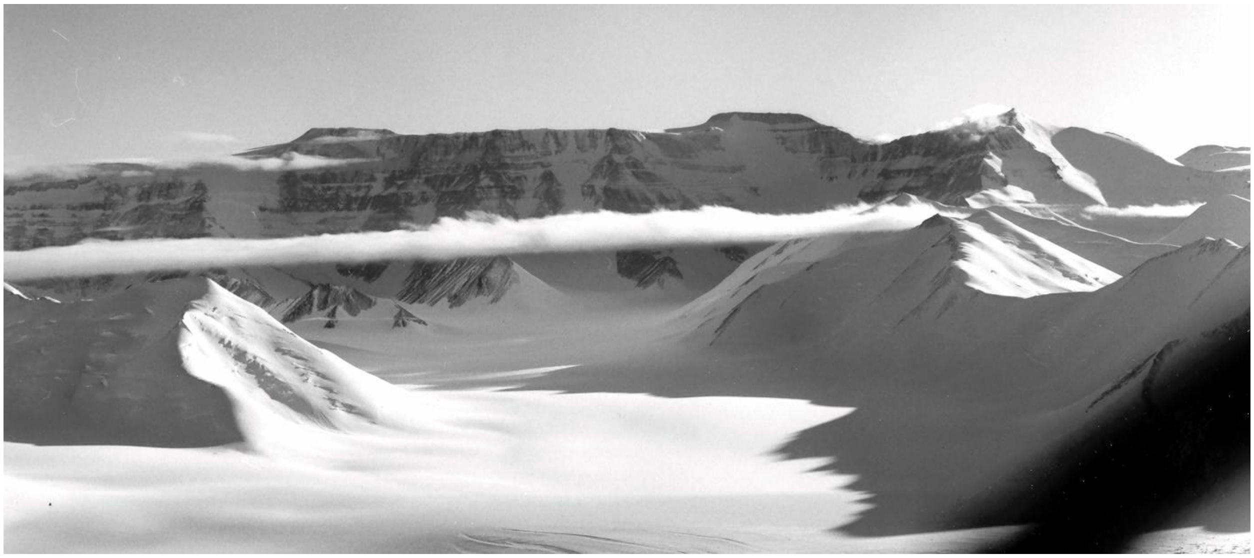


Fig. 22. Diabase sills form dark cliffs of the Nilsen Plateau

GEOLOGIC STRUCTURE

General Structural Setting

The Nilsen Plateau appears to be a large down-faulted block with large boundary faults paralleling the Amundsen and Robert Scott Glaciers. Several thousand feet of sedimentary strata are present above the prominent nonconformity. The same nonconformity is several thousand feet higher in mountains to the northwest and possibly the southeast.

Most of the strata within the main block are nearly horizontal, with only slight dip to the south. Locally, small tilted blocks are present a minor fault blocks within the major downfaulted block. The down–dropped fault block has protected the sedimentary rocks from removal by erosion and, therefore. is properly called an obsequent fault block mountain (Johnson 1929).

Major Faults

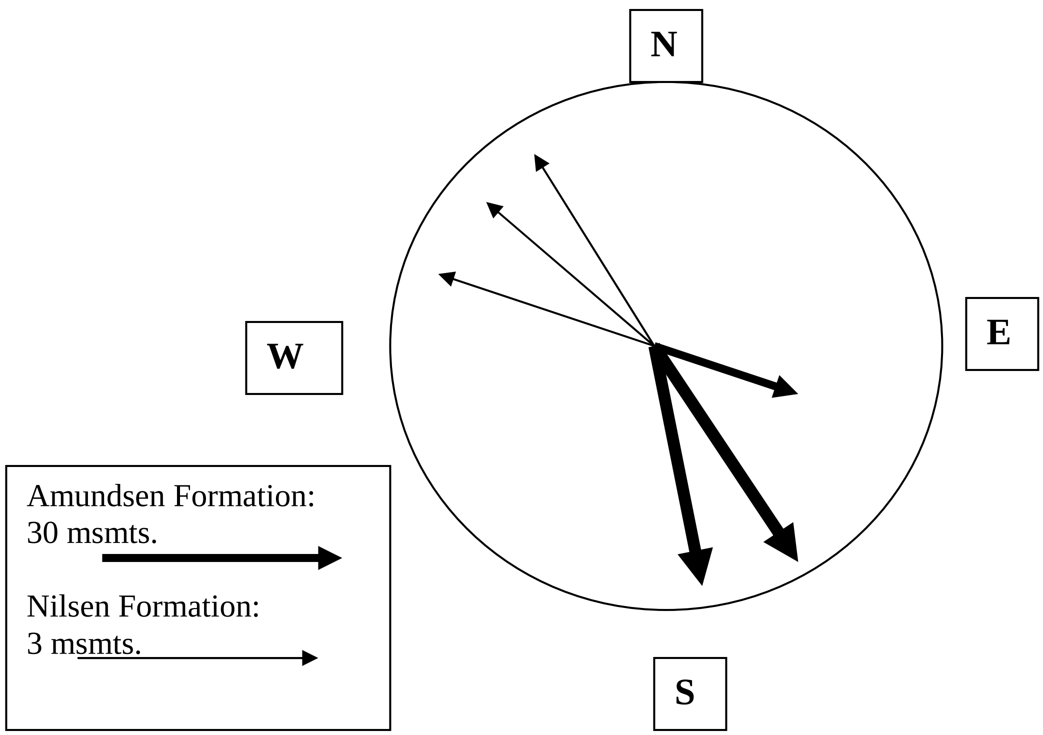
Large faults are assumed to be present near the base of the western Nilsen Plateau escarpment. A reverse fault, locally a thrust fault, forms the western escarpment and remnants of the fault plane are visible along the cliffs of the southern part of the escarpment. Strata, adjacent the fault, are locally overturned as shown in Fig. 23. The plane of the thrust and reverse fault strikes N50°E and dips to the northwest indicating a compressive force from the northwest and suggesting the Nilsen block has been forced down rather than “dropped” by normal faulting and tensional force.

Fig. 23. Thrust fault, Western Escarpment,
Nilsen Plateau, southern end

Appendices

Measured Sill and Sedimentary Thickness

	Section Number	**Total Measured**	**Sed. Rocks**	**Sills**	**Sills above measmt.**	**Sills below measmt.**	**Comments**
North	**16**	1600	820	780	+	+	
end	**14**	2600	1005	1590	+	-	
	1	1510	1000	510	+	-	
	2	1720	545	1175	-	-	
	3	1800	1030	790	+	+	
	4	1900	1280	620	+	-	
	5	2700	1700	1000	+	+	
	6	2080	1070	1010	-	-	
	7	2050	1230	820	+	-	
	8	2480	725	1755	-	-	faulted
	10	885	610	275	+	-	
	11	3030	1475	1555	+	+	fault,2X
South	**12 & 9**	2480	1420	990	+	-	
End	**13**	1780	920	800	-	-	



Current-bed and ripple mark directional data; (generalized)
Amundsen & Nilsen Formations

Boulder Counts

Location	Granitic	Gneiss	Meta-volc.	Meta-sed.	Total
Section 6	1	0	64	35	100
Wildcat Pass NE side low	47	21	17	15	100
Wildcat Pass SW side	78	0	10	20	108
Lonely Ridge SE corner	82	8	6	11	107
Lonely Ridge	90	3	44	3	100
Lonely Ridge NW corner	60	12	21	7	100
Section 1	56	6	31	7	100

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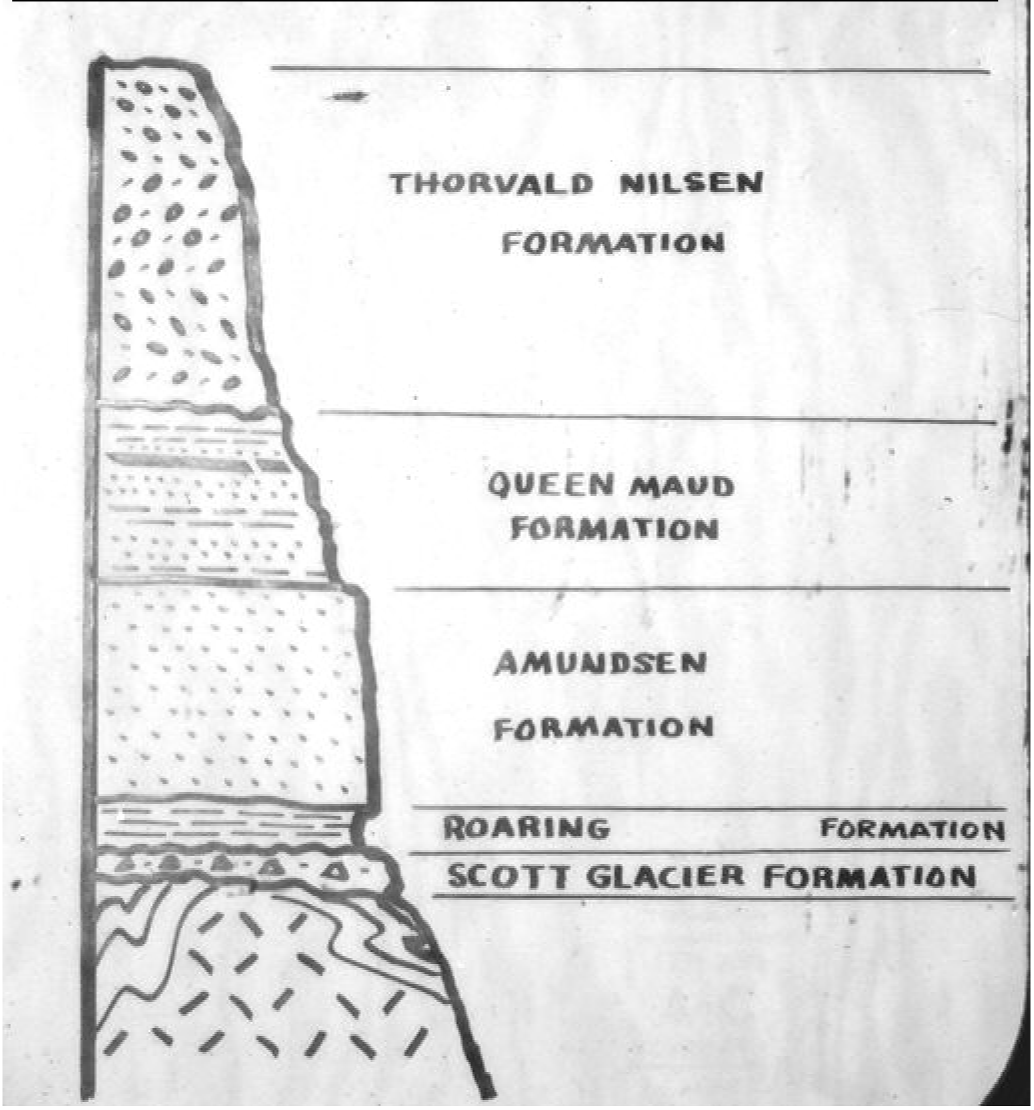
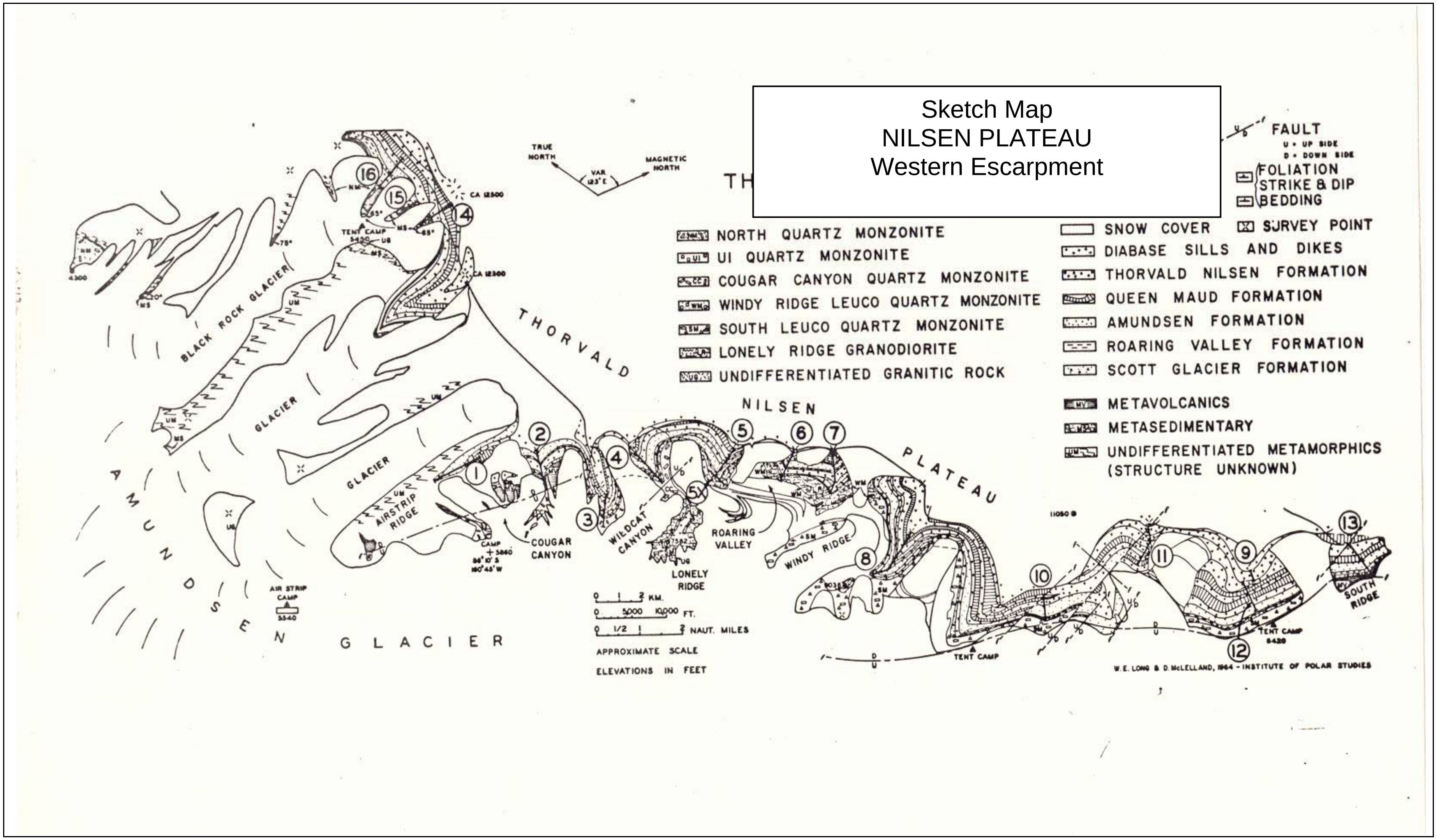
Generalized Stratigraphic Section

Nilsen Plateau, Antarctica



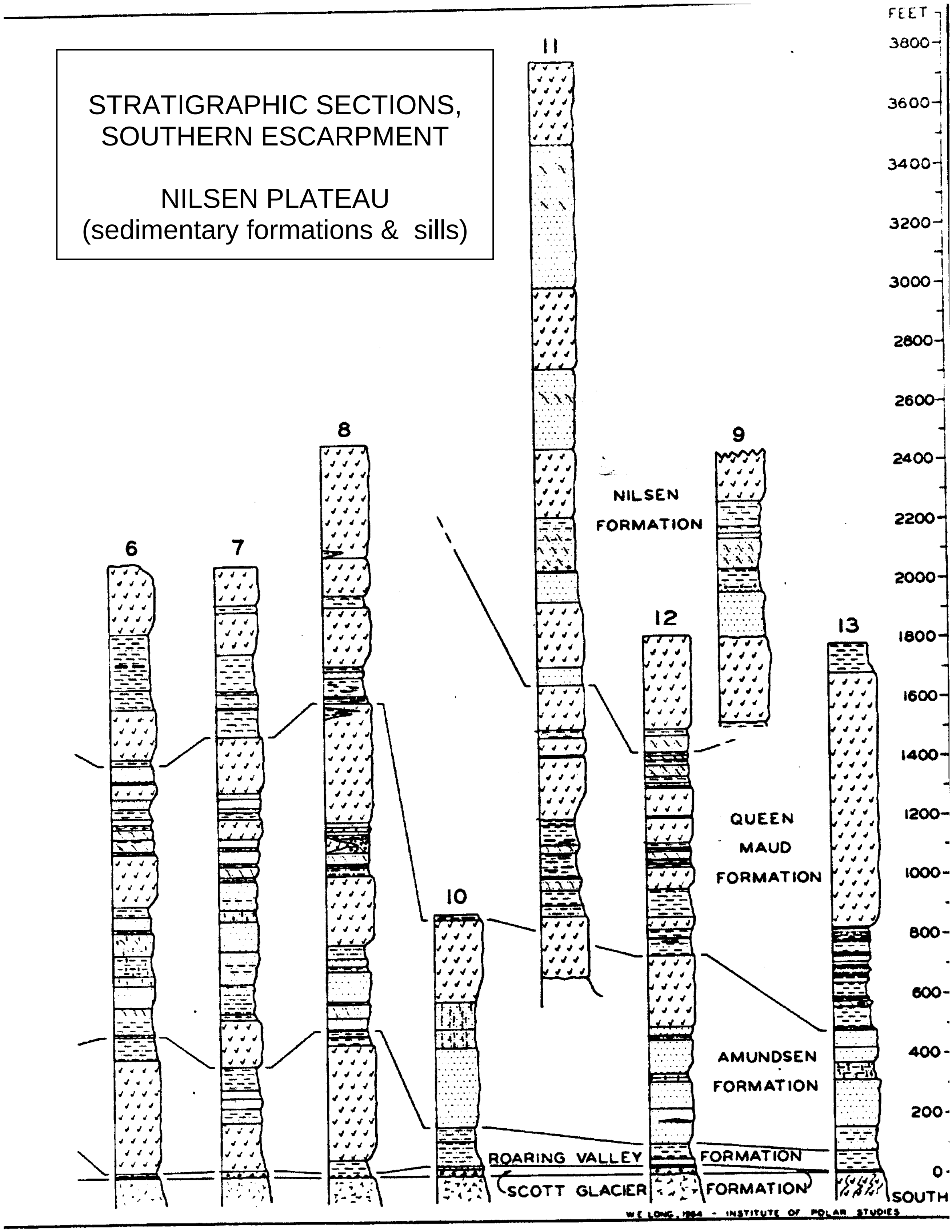
Nilsen Plateau, Western Escarpment
Amundsen Glacier flowing to North (top of photo)

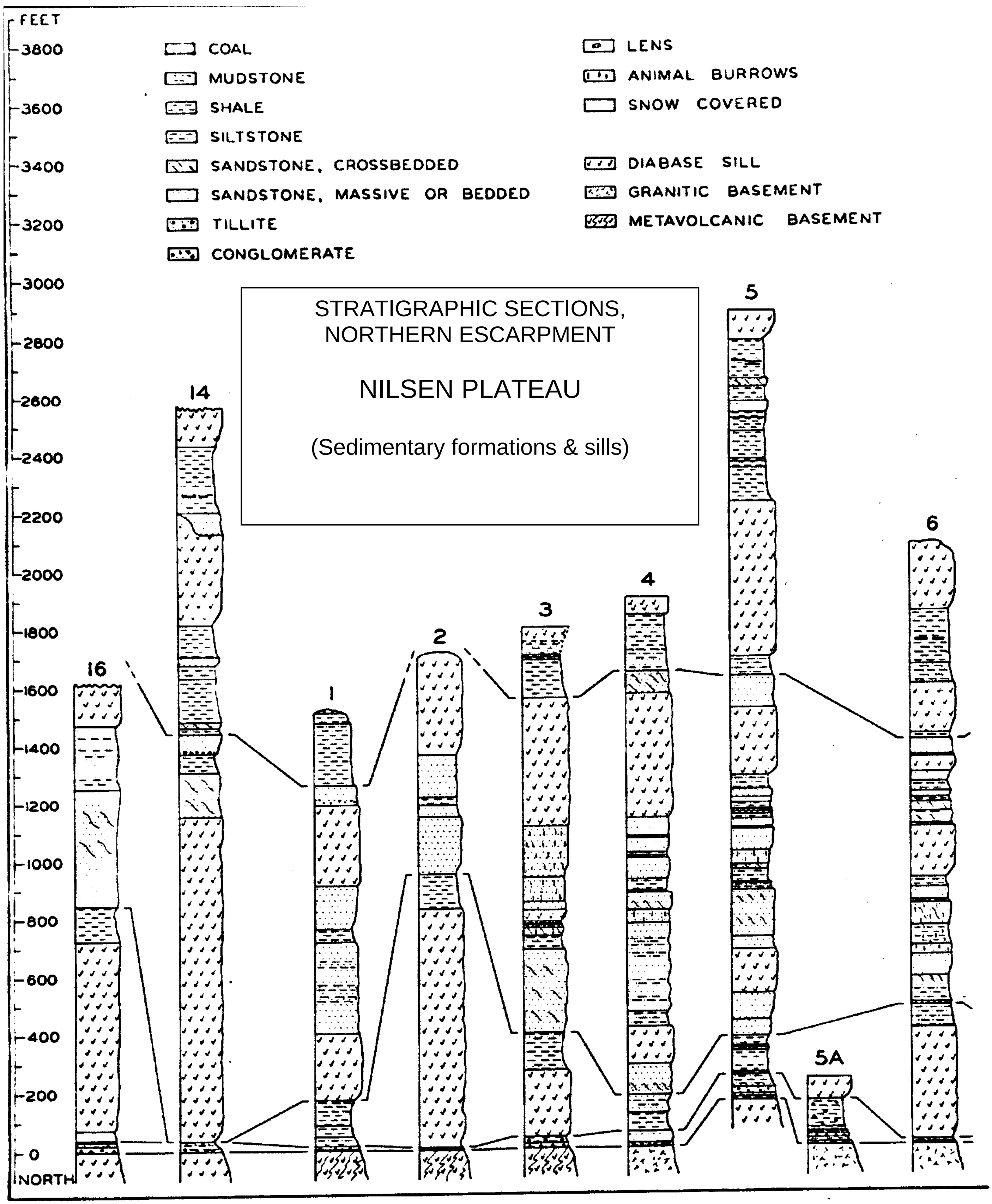
Sketch Map
NILSEN PLATEAU
Western Escarpment



STRATIGRAPHIC SECTIONS, SOUTHERN ESCARPMENT

NILSEN PLATEAU
(sedimentary formations & sills)

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SNOW COVERED
DIABASE SILL
GRANITIC BASEMENT
METAVOLCANIC BASEMENT
STRATIGRAPHIC SECTIONS, NORTHERN ESCARPMENT
NILSEN PLATEAU
(Sedimentary formations & sills)
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