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Geology of the Central Portion of the Queen Maud Range, Transantarctic Mountains

Abstract. *The geologic section consists of a folded and metamorphosed basement complex of geosynclinal and nearshore sediments and intrusives, a thick sequence of nearshore and terrestrial sediments of middle to late Paleozoic age, and thick diabase sheets and basalt flows of Jurassic age. Block faulting, probably during the Miocene age, produced the range, which has been carved into its present form by glaciers.*

The portion of the Queen Maud Range, Transantarctic Mountains, between the meridians 174°W and 176°E and the parallels 84°10′S and 86°S was surveyed by field parties from Texas Technological College during the austral summers of 1962–63 and 1964–65.

Outlet glaciers transect the range in a nearly north-south direction. These and their tributaries form a trellis pattern which may be fault-controlled in part. Near the central north-south line of the area the Shackleton Glacier descends at the rate of about 16.5 m/km through the range from the polar plateau (elevation 2200 m) to the Ross Shelf Ice (elevation about 150 m). The rocks are best exposed for study along the confining walls of this glacier and its tributaries. Fewer outcrops are present along the glaciers to the east and west. The most prominent landmark in the area is Mount Wade (elevation 4750 m), which crests at the northern end of the Wade-Finley ridge at latitude 84°2′S, longitude 174°15′W.

The central portion of the Queen Maud Range has had a geologic history similar to that of the Transantarctic Mountains as a whole (*1, 2*) (Fig. 1). In late Precambrian-Cambrian time there was deposited in a geosynclinal environment a thick sequence of graywackes which may have been deformed by orogenic processes prior to the deposition of a thick series of quartzites, conglomerates, calcareous arenites, and limestones. An orogeny in late Cambrian or early Ordovician time produced fold mountains, the axes of which trend generally east-west. Calc-alkalic plutons were intruded into the cores of these mountains. Erosion leveled these mountains, and during Devonian to Triassic time a sequence of nearshore and terrestrial sediments was deposited. These sediments are the Beacon rocks, which have widespread distribution in East Antarctica. During the Jurassic period diabase was intruded in great quantities into these sediments and to a lesser extent into the basement complex in sheets, dikes, and irregular masses. Extrusions of similar material in great flows occurred simultaneously along the southern margin of the area. Block faulting during the Mid-Cenozoic age produced the Queen Maud Range, which in this central section appears to be a major tilted block dipping gently to the south. Late Cenozoic and recent glaciations have produced the present geomorphic features.

Two distinct sequences of metasediments are present in the basement complex. In the Ramsey Glacier area there is a minimum of 3500 m of metagraywackes and slates. This unit is very similar lithologically to the type Goldie formation, Beardmore Group (*3*), and is tentatively correlated with it. The second sequence crops out along both sides of the Shackleton Glacier. It is a thick unit comprised of quartzites, conglomerates, calcareous quartzites, and marbles. The type locality is Taylor Nunatak, latitude 84°55′S, longitude 176°W; the formation is here named the Taylor. No contacts between the two sequences of metasediments were observed and their age relationships are not known.

The intrusives associated with the metasediments are mostly calc-alkaline. Granodiorites and adamellites are common and are the principal constituents of a major pluton centered in the northern portion of the Shackleton Glacier. Smaller bodies of granite are distributed about the periphery of the pluton. These intrusives are tentatively correlated with the Granite Harbour Intrusives of Victoria Land (*4*), which have been dated radiometrically as Upper Cambrian to Ordovician (*6*).

The Beacon sequence is divided into five units. The oldest rests on the erosion surface on the basement complex. It is 61.5 m thick and is comprised of a basal portion of 47.5 m of gray to yellow conglomerate and quartzite sandstone topped by thin layers of siltstone. Above the basal portion is a cliff-forming, light yellow, fine-grained, massive, partly conglomeratic quartzite, which is 14 m thick. In age it may be the equivalent of the Alexandra formation, Lower Carboniferous, or the Pagoda Tillite, Upper Carboniferous (*4*). Tentatively we have named it the Butters formation. The type locality is Mount Butters, 84°53′S, 177°30′W.

The second unit is the Mackeller (*4*). The basal section consists of 136.5 m of dark gray to black, hard, silty shale which weathers to a reddish color. Thin, gray to white beds of siltstone are interbedded with shale. The upper portion of this unit consists of 167 m of buff-colored, fine- to coarse-grained sandstone interbed-

	Quaternary		Moraines
	?Miocene		Block faulting
	Jurassic	Ferrar dolerites Kirkpatrick basalts	Diabase intrusives, mostly sheets Basalt flows, amygdaloidal
BEACON SEQUENCE	Triassic	Dominion Coal Measures	Cross-bedded sandstone, carbonaceous shale mudstone. Plant fossils
BEACON SEQUENCE	Permian	Falla formation	565 m. Massive cross-bedded sandstone and thin dark gray shale beds. Plant fossils
BEACON SEQUENCE	Permian	Buckley formation	Upper member, 421 m. Alternating sandstone and carbonaceous shale. Coal. Plant fossils. Lower member, 52 m. Fine- to medium-grained sandstone with zones of conglomerate
BEACON SEQUENCE	Unconformity		
BEACON SEQUENCE	?Permian	Mackeller formation	Upper member, 167 m. Buff, fine to course sandstone and thin beds of shale Lower member, 136.5 m. Dark gray to black shale and thin beds of gray to white sandstone
BEACON SEQUENCE	Devonian or ?Carboniferous	Butters formation	Upper member, 14 m. Massive, conglomeratic quartzite Lower member, 47.5 m. Basal conglomerate, sandstone siltstone
	Erosion surface		
	Cambrian-Ordovician	Granite Harbour Intrusives	Granodiorites, adamellites, granites Folding and low-grade metamorphism
	Cambrian-Late Precambrian	Taylor formation	Phyllites quartzites, calc-arenites, marbles
	Probable orogeny		
	?Late Precambrian	Goldie formation	~3300 m. Metagraywackes

Fig. 1. Generalized geologic section, Central Queen Maud Range.

ded with shaly sandstone and black shale. Total thickness is 303.5 m.

The Buckley unit (*4*) rests unconformably on the Mackeller. The basal 52 m are principally light gray, fine- to medium-grained sandstone in which there are zones and lenses of pebble conglomerate; particularly prominent zones occur at 6 and 43 m above the base. The upper portion of the Buckley unit is a sequence, 421 m thick, of alternating sandstones and carbonaceous shales, some of which may be classified as coal. The cyclic repetition of sandstones and shales occurs at least 15 times in this unit. The total thickness of the Buckley formation is 473 m.

The Falla unit (*4*) consists of massive cross-bedded sandstones interbedded with gray to dark gray, silty shale. The amplitude of the cross-bedding increases upward and the grain size decreases from coarse to fine upward. Petrified logs are present in both the upper and lower portions of the unit. Some of these appeared to be in original positions of growth. Plant fossils, probably Permain (*6*), were abundant in a zone in the upper portion. Total thickness of the Falla formation to the present surface is 565 m.

In the southernmost portion of Roberts Massif there is exposed a sedimentary section which is correlated with the Dominion Coal Measures, which conformably overlies the Falla formation in the Dominion Range located at the junction of the Beardmore and Mill glaciers. A small portion of the Roberts Massif section was accessible for study at Fluted Peak. The lower portion consists of carbonaceous shales interbedded with sandstones. Above these are siltstones and mudstones with some lenses of what is probably fresh-water limestone. At least one of the mudstone layers is highly fossiliferous. Overlying the siltstones and mudstones is a thick section of cross-bedded, coarse-grained sandstone. There is no exposed contact with the underlying Falla formation.

The basis for correlation of this section with the Dominion Coal Measures is its age as indicated by the fossil assemblage. The corystosperm *Dicroidium* is present, verifying a Triassic age.

The Jurassic diabase is present for the most part in sheets which commonly cut across the bedding planes in the Beacon sequence yet remain essentially parallel to the regional strike and dip. Feeder dikes are common. The sheets dominate the landscape and form vertical cliffs wherever they crop out. These sheets constitute nearly one-half of the post-peneplane portion of the section, totaling approximately 1225 m. These diabase intrusives are the equivalent of the Ferrar dolerite in the adjacent area (*4*). Chilled margins of the intrusives have calcic plagioclase phenocrysts in a finely crystalline groundmass of plagioclase and pyroxene. In sheets thicker than 60 m the central portion is a coarse to very coarse gabbro which includes crystals of pyroxene up to 7.5 cm long.

The extrusive flows in the southern portion of the area have been named the Kirkpatrick basalts by Grindley (*2*). They are tentatively correlated in age with the Ferrar dolerites. The upper portion of each flow is vesicular and often amygdaloidal. The amygdules are primarily quartz, calcite, zeolites, and celadonite.

Till deposits are distributed along the walls of the glaciers and on extensive flat and gently sloping deglaciated areas, particularly in the southern half of the region. The evidence for greater glacierizations in the past is considerable. Remnants of marginal moraines are present on the walls bounding the larger glaciers at elevations of 25 to 100 m above the present ice level. In the southern half of the area at several places are exposures of till deposits which may represent an earlier Pleistocene glacial stage. These till deposits are well indurated. One has been cut by the present glacier through a thickness of 330 m.

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