

Mesozoic volcanic rocks in the Queen Alexandra Range

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The primary objectives for the field program in the Queen Alexandra Range, central Transantarctic Mountains (figure), were to investigate the paleovolcanology of the silicic and basaltic pyroclastic rocks and lavas in the upper Falla Formation, the Prebble Formation, and the Kirkpatrick Basalt; to establish the tectonic setting in which these volcanic rocks were erupted; and to collect samples of basalts and associated secondary minerals for chemical and isotopic analysis.

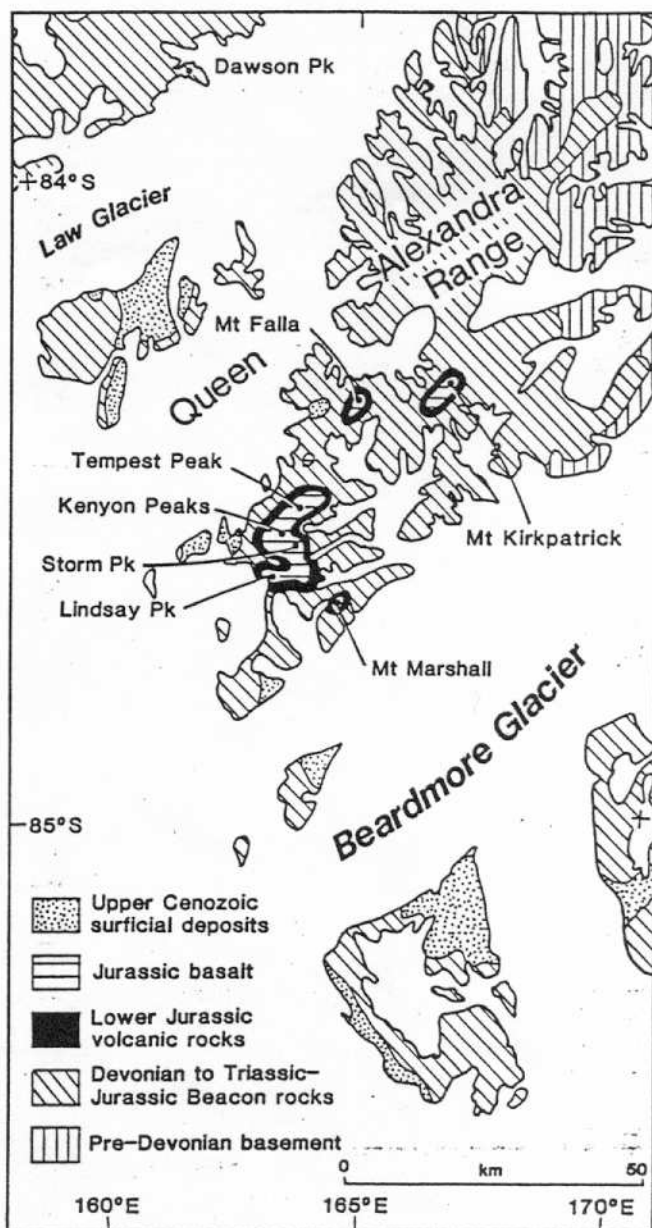
The type section of the Falla Formation, at Mount Falla (Barrett, Elliot, and Lindsay 1986), consists of a lower 282-meter-thick sandstone-carbonaceous shale sequence overlain by a 248-meter-thick dominantly volcanoclastic unit that can be divided into three lithofacies (Larsen 1988). The basic subdivision into nonvolcanic and volcanic units is clear at all other visited localities, but the total stratigraphic thickness is considerably less elsewhere.

Sections were studied and collected at Mount Kirkpatrick, Mount Falla, Lindsay Peak, and on a ridge northeast of Tempest Peak. On the ridge northeast of Tempest Peak, the section is disturbed by diabase intrusion and the upper tuff sequence is truncated by a fault. At Mount Kirkpatrick, the Falla sequence on the north-facing lower slope of spot height 4,020 is cut by faults that preclude establishing either a true stratigraphic thickness or a complete stratigraphic section. The only other localities where complete sections might be present could not be reached this season.

Regionally, the Falla varies greatly in thickness and lithology. Furthermore, the threefold subdivision of the upper volcanoclastic part of the type section is not typical of the formation as a whole. Tuffaceous beds occur in sections dominated by fluvial deposition, and massive quartzose sandstone beds occur within dominantly volcanic parts of the sequence. The quartzose sandstones include coarse quartz-rich beds that show petrologic and textural evidence of local derivation.

Vertebrate remains were found in the upper volcanoclastic part of the Falla at Mount Kirkpatrick; the fossil bones were identified by William Hammer as dinosaur remains.

The Prebble Formation (Barrett, Elliot, and Lindsay 1986; Larsen 1988) was studied at Mount Falla, Kenyon Peaks, Lindsay Peak, and Mount Kirkpatrick. The deposits show abundant evidence of a phreatomagmatic origin, involving interaction between rising basalt magma and groundwater at shallow levels beneath the surface. Much of the unit consists of lahars that were produced directly from "wet" eruptions. In addition to



Location and simplified geologic map of the southern Queen Alexandra Range.

the pyroclastic deposits, intrusive breccias were identified at Mount Falla, Mount Marshall, and at the ridge northeast of Tempest Peak where the Falla section was measured.

The volcanic neck at Kenyon Peaks was examined in detail and additional data were acquired on the nature of the vent-filling breccia and the relations with the bedded pyroclastic rocks in the vicinity. At this locality, three separate pyroclastic sequences were identified that show evidence of a combined phreatomagmatic and Strombolian origin; none of these appears to be related directly to the volcanic neck.

The Kirkpatrick Basalt was examined at Mount Falla, Storm Peak, Kenyon Peaks, Mount Marshall, and Mount Kirkpatrick. Thick flows near the base of the sequence show lateral transitions to massive accumulations of flow lobes and local devel-

opment of basal hyaloclastite. Hyaloclastite is also present at the top of two flows, possibly due to rafting. Data on cooling directions, based on "blind tips" on fracture surfaces (DeGraff, Long, and Aydin 1989), suggest that the very thick (as much as 135 meters) glassy flows primarily cooled from the upper surface downward, in some cases to within 1 to 3 meters of the base. The effects of shallow-level emplacement of diabase are well displayed at Lindsay Peak, Mount Kirkpatrick, and Mount Marshall. Evidence of interaction with water or water-saturated sediment is quite widespread. Samples were collected for investigation of low-temperature alteration of primary iron oxides, for isotopic analyses of secondary minerals, and for geochemical and isotopic analyses of the basalt lavas themselves. A new conchostracan-bearing locality was discovered in the upper interbed in the basalt sequence at Storm Peak. Sills were examined and collected at Mount Falla, Mount Marshall, Tempest Peak, and Dawson Peak.

In the course of these investigations, data were also gathered that support the hypothesis (Elliot 1991) that the volcanic rocks were erupted in a rift setting. Monoclinical warping was associated with the volcanic activity at Mount Falla and Lindsay Peak. In addition, at Lindsay Peak evidence also exists for large-scale slumping of upper Falla and Prebble rocks onto a surface cut across Falla sandstones.

Despite problems caused by adverse weather conditions, which curtailed the scope of the program, progress has been made in understanding the paleovolcanology of the extrusive rocks and their tectono-magmatic setting.

After the termination of helicopter operations at Beardmore, a few days were spent at Carapace Nunatak examining the Carapace Sandstone and the Mawson Formation, which are the equivalents of the Prebble Formation. The overlying Kirkpatrick Basalt was also examined. Broad similarities with the Beard-

more succession are obvious, but, of course, many differences exist in detail. We interpret the dipping sequence of lavas on the north face as a toreva block, and in fact, other toreva blocks were identified in the Queen Alexandra Range. The Basement Sill of the Ferrar Dolerite near Pearse Valley was examined and sampled and a brief visit was made to Coombs Hills to examine the Mawson Formation.

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References

- Barrett, P.J., D.H. Elliot, and J.F. Lindsay. 1986. The Beacon Supergroup (Devonian-Triassic) and Ferrar Group (Jurassic) in the Beardmore Glacier area, Antarctica. In M.D. Turner and J.F. Spletstoeser (Eds.), *Geology of the central Transantarctic Mountains*, (Antarctic Research Series, Vol. 36). Washington, D.C.: American Geophysical Union.
- DeGraff, J.J., P.E. Long, and A. Aydin. 1989. Use of joint-growth directions and rock textures to infer thermal regimes during solidification of basaltic lava flows. *Journal of Volcanology and Geothermal Research*, 38, 309-324.
- Elliot, D.H. 1991. Triassic-Early Cretaceous evolution of Antarctica. In M.R.A. Thomson, J.A. Crame, and J.W. Thomson (Eds.), *Geological Evolution of Antarctica*. Cambridge: Cambridge University Press.
- Larsen, D. 1988. The petrology and geochemistry of the volcanoclastic upper part of the Falla Formation and Prebble Formation, Beardmore Glacier area, Antarctica. (Unpublished master of science thesis, Ohio State University, Columbus, Ohio.)