On a local scale, vitrinite reflectance decreases with increasing distance from intrusive bodies (Horner and Krissek 1989). This pattern is consistent with the effects on organic carbon distributions that were discussed above.

Vitrinite reflectance values also exhibit a regional pattern (table). The northern sections consistently have lower average vitrinite reflectance values, and the vitrinite reflectance values increase progressively toward the central sections. The southern section has intermediate vitrinite reflectance values. This pattern is visible in the "lower," "middle," and "upper" Mackellar Formation.

Conclusions. Analysis of 105 samples from the Mackellar Formation yields an average organic carbon content of 0.40 percent. Localized reductions in this value are due to the presence of intrusive bodies. Organic carbon contents are relatively uniform within most sections, and organic carbon contents show little regional variation with the exception of the southernmost section. The southern section was probably influenced by a different sediment source, which is also supported by a difference in paleocurrents between the northern and southern measured sections.

Vitrinite reflectance values help to identify altered samples within the Mackellar Formation, and also establish regional heating patterns in the Beardmore Glacier area. Within the Mackellar Formation, the northern section has the lowest vitrinite reflectance values. The average vitrinite reflectance is highest in the center of the study area and decreases slightly in the southernmost section. This pattern of heating may have implications that extend beyond the Mackellar Formation. The pattern described in the Mackellar Formation would be consistent with an intrusive event that was located along the continental margin of Antarctica during Jurassic time.

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Studies of granites and metamorphic rocks, Byrd Glacier area

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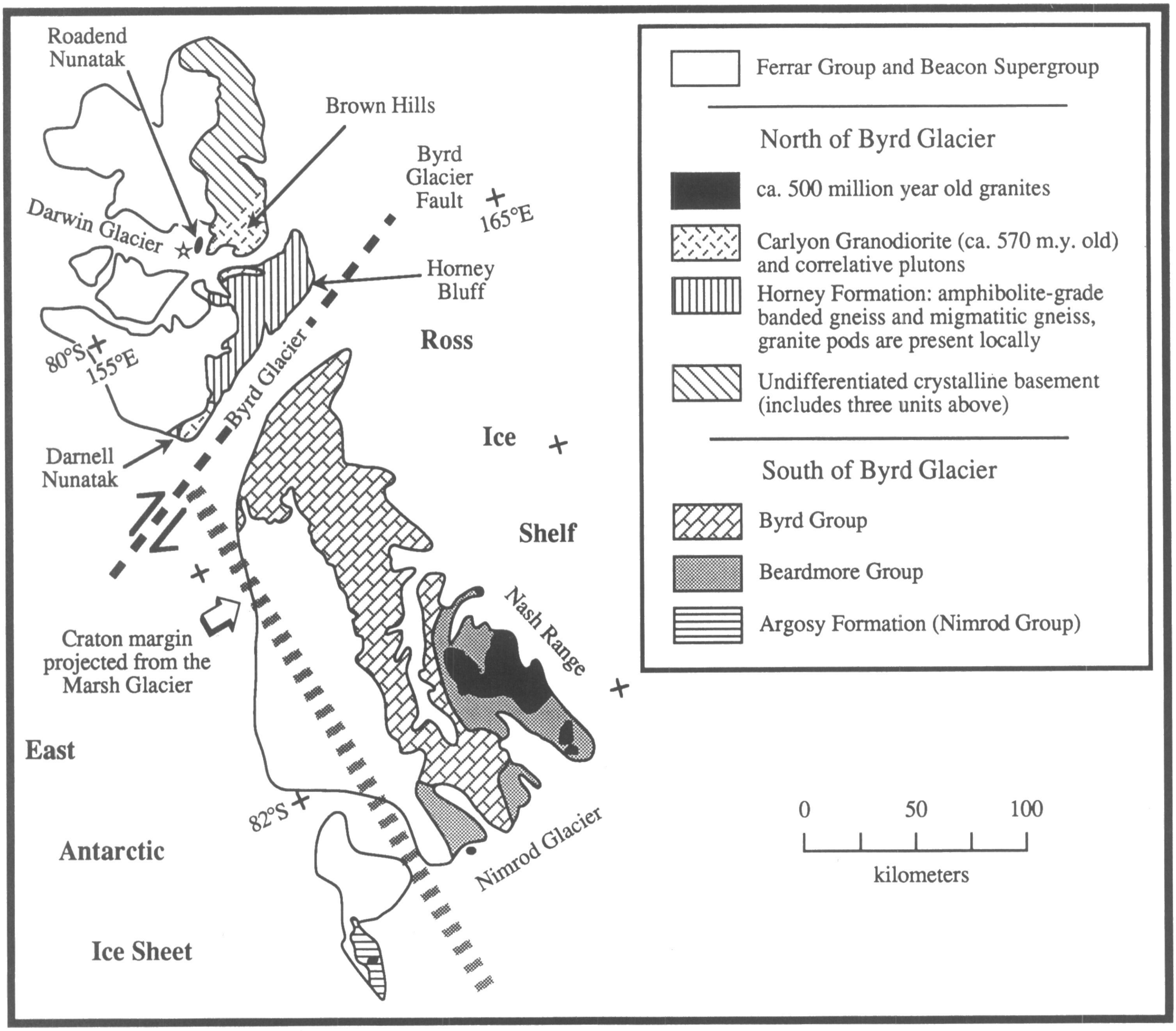
This paper summarizes work on the late Precambrian to early Paleozoic basement of the Transantarctic Mountains from 1 June 1988 through 1 June 1989. It supplements previous reports in the *Antarctic Journal* (see Borg, DePaolo, and Smith 1988).

Details of analytical results are given in recent abstracts (Borg, DePaolo, and Smith 1989; Borg and DePaolo 1989) and in a manuscript submitted to the *Journal of Geophysical Research* (Borg, DePaolo, and Smith in preparation).

Geologic mapping and sampling of granitic and metamorphic rocks were carried out along the north side of the Byrd Glacier, along the lower Darwin Glacier, and in the Brown Hills during January 1989. This was accomplished with a combination of helicopter support and ground traverses. In early January, a tent camp and fuel bladder (for helicopter operations) were placed by an LC-130 about 4 kilometers west of Roadend Nunatak on Darwin Glacier near the Darwin Glacier Camp of 1978–1979 (figure). UH-1N helicopters provided support from McMurdo, commuting about 300 kilometers each way on each day of support—an arrangement that was subject to disruption by the unpredictable weather but was necessary because the north side of the Byrd Glacier is inaccessible by ground traverse. About 1,800 kilograms of rock were collected representing 40 localities.

The basement in the region is composed of granitic and metamorphic rocks (figure). The metamorphic rocks include both metasedimentary and metaigneous lithologies. The metasedimentary rocks are represented by complexly folded amphibolite-grade banded gneisses and schists and are best exposed



Geologic sketch map of the Byrd Glacier region. Compiled from Grindley and Laird (1969), Felder (1980), and our mapping. A star marks the location of our camp.

at Horney Bluff along Byrd Glacier. This unit is very distinctive, and we propose the term "Horney Formation" to describe it. The metaigneous rocks are represented by deformed and metamorphosed granites which have intruded the Horney Formation and were themselves intruded by younger granites about 500 million years ago. The metagranites are exemplified by the Carlyon Granodiorite in the Brown Hills [568 ± 10 million years old as dated by Felder (1980)] but they are extensively exposed in the cliffs on the north side of the upper Byrd Glacier in the vicinity of Darnell Nunatak. The Carlyon Granodiorite contains a large amount of included metamorphic material ranging from pendants several hundred meters across in outcrop to xenoliths (and presumably xenocrysts) less than 1 centimeter across. The contact of the metagranite with Horney Formation is complex and has been obscured somewhat by deformation. Clearly discordant contacts are present in places but most contacts are migmatitic. A deep level of emplacement is inferred for these "older" granites. Granites emplaced about 500 million years ago, during the Ross Orogeny, are unequivocally exposed only at Roadend Nunatak and in regions north of the Brown Hills along the Ross Ice Shelf. These are identified in the field by their lack of deformational fabrics (cf., Felder 1980).

In overall character, the metamorphic rocks of the Byrd Glacier area, especially the Horney Formation, resemble the Miller Formation in the Miller Range to the south. The Miller Formation is constrained to be greater than about 1.7 billion years old and has samarium/neodymium model ages of about 2.8 billion years (Borg, DePaolo, and Smith in preparation). It is part of the East Antarctic Craton. Isotopic data on granites from the Miller Range and areas to the east suggest that the edge of the Miller Range-type crust is at the Marsh Glacier, immediately east of the Miller Range, and that this type of crust does not extend beneath the region characterized by the Shackleton Limestone. If correlation of the Horney Formation with the Miller Formation is corroborated, and if the edge of the East Antarctic Craton (as represented by Miller Range-type crust) is projected northward parallel to the average structural grain in the Transantarctic Mountains, then a strike-slip fault can be postulated beneath the Byrd Glacier with a minimum of about 125 kilometers of right-lateral offset (figure). The concept of a strike-slip fault in the Byrd Glacier had been proposed by Grindley and Laird (1969) to explain the lack of continuity between the basement rocks on each side on the glacier. The idea was discussed further by Grindley (1981) in relation to geophysical studies by Davey (1981) which suggested that a series of rifting centers and transform faults was responsible for opening of the Ross Sea. Comparison of the neodymium-isotopic compositions of the Horney Formation and associated granites with those of the Miller Formation and associated granites, however, will be the first quantative test for this hypothetical fault.

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The Skelton Group, southern Victoria Land

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During the 1988–1989 austral season, we observed, mapped, and collected rocks from the geologically complex Skelton Group and from younger, cross-cutting diabase sills and biotite granite plutons in the vicinity of the Skelton Glacier, central Transantarctic Mountains (figure 1). Regrettably, weather conditions and logistical problems significantly reduced our field days to only eight. Our field party consisted of Margaret N. Rees, Ernest M. Duebendorfer, and Albert J. Rowell as well as Peter Braddock, a New Zealand mountaineer and scientific illustrator. We used four snowmobiles and eight Nansen sledges to traverse the 400 kilometers from McMurdo Station to the field area. We returned along the same route, which followed approximately that of the 1958–1959 Victoria Land traverse across the Ross Ice Shelf to Teall Island and up the Skelton Glacier. Because of weather delays, our journey took about 4 days each way. Prior to departure, we flagged the first 100 kilometers of the route and deposited 55-gallon drums of fuel using a hovercraft. Subsequently, the hovercraft pilots, Sarah Jones and Lou Czarniecki, deployed more fuel along the route to 220 kilometers out and retrieved our empty drums from along that leg. While in the field, we collected granitic rocks from Teall Island and metasedimentary rocks from the lower part of Ant Hill and mapped and sampled primarily at the confluence of the Cocks and Skelton glaciers. We also had helicopter-supported fieldwork during which we examined outcrops at the top of Teall Island, a ridge near the head of Cocks Glacier, and near Lake Vida in the McMurdo Dry Valleys.

Lower-greenschist facies metasedimentary and metavolcanic rocks dominate the map area which had been visited previously by three other parties (Murphy et al. 1970; Flory et al. 1971; Skinner et al. 1976). Initially, Skinner (1982) suggested an Early Paleozoic age for these rocks and for the Anthill and Cocks formations but subsequently argued for a pre-Vendian age (Skinner 1983). We regard the age and the stratigraphic relationships between and within the Anthill and Cocks formations as still uncertain, primarily for four reasons. In our opinion:

- the lack of fossils could be attributed to the deformation and metamorphism rather than the age of the rocks;
- the contact between the Cocks Formation and Anthill Limestone appears to be tectonic not depositional;
- obscure sedimentary structures do not provide reliable regional younging information as a result of the multiple phases of deformation; and
- we could not detect a different structural history between the Cocks and Anthill formations.

Our mapping documents at least three phases of deformation in the map area (figure 1); the structures produced by the three events, D_1, D_2, and D_3, from oldest to youngest, are only in part comparable to those described by Skinner (1982). Our data indicate that, within the map area, the diabase sills post-