Coast sector between longitudes 109°W. and 119°W., south to 77°S. For various reasons, only the first of the two sectors was surveyed. A Jamesway camp (75°45′S., 135°W.) was established at a location central to the area and transportation to and from outcrops was by helicopters operated and maintained by Antarctic Development Squadron Six (VXE-6). The camp was erected and maintained by Holmes and Narver personnel. The camp was ready for occupancy on 1 November as scheduled. The scientists were in residence and ready for operations on 15 November.

To maximize the use of the facilities and support units, the scientific investigations included five programs:

1. Detailed geologic survey of the Hobbs Coast sector, Marie Byrd Land (Principal investigator: F. A. Wade, Texas Tech University; co-principal investigator: John R. Wilbanks, University of Nevada-Las Vegas).
2. Study of volcanic history of Marie Byrd Land, West Antarctica (Principal investigator: W. E. Le Masurier, University of Colorado-Denver).
3. Study to determine if the West Antarctic Ice Sheet is disintegrating (Principal investigator: George H. Denton, University of Maine-Orono).
4. Resource and radioactivity survey in Antarctica by airborne gamma ray spectrometry (Principal investigator: E. J. Zeller, University of Kansas).
5. Study of terrestrial orthropods of Marie Byrd Land, Antarctica (Principal investigator: R. W. Strandtmann, Texas Tech University).

George W. Grindley, New Zealand Geological Survey, was a guest member of the staff. Three helicopters were stationed at the camp. Operations were curtailed somewhat by a regulation that prohibits more than two being flown at any one time; at no one time could all 13 scientists be in the field. Frequent blizzards and whiteouts were responsible for many nonflying days. Field operations were carried out on only 14 days between 14 November and 22 December.

The geology of Marie Byrd Land has been and still is enigmatic to investigators. West Antarctica is composed of four large island units and an unknown number of small ones. All are segments of continental crust. The large islands are the geographic units known as the Antarctic Peninsula, Ellsworth Mountains, Eights Coast, and Marie Byrd Land. Relationships between the four have not been satisfactorily determined. This is so because relative and absolute ages of most rock units have not been established. In all of Marie Byrd Land the only sedimentary formation that has been assigned a relative age is the Swanson Formation, which crops out in the Ford Ranges. On the basis of an assemblage of microfossils, Iltchenko (1972) placed it in the late Precambrian/early Paleozoic.

In the two areas scheduled for investigation in 1977-78, exclusive of Tertiary vulcanism, the only events that had been dated with some confidence were a Cretaceous orogeny in both areas and a late Paleozoic orogeny in the Walgreen Coast sector. Low-grade metasediments occur in both areas, but no fossils had been noted in any of the units. Radiometric dating has yielded few acceptable dates. It was hoped that careful resurveys of both areas might produce information that would make possible the development of an acceptable geologic history of all of Marie Byrd Land.

The most exciting event of the field season was the discovery on 11 December 1977 of plant fossils. Although they were present only in erratics of carbonaceous argillite that rested on the granite surface of Milan Rock (approximately 76°1′S. 140°42′W.) in considerable numbers, they could not have been transported more than 1 or 2 kilometers. From the characteristics and bearings of the glacial striations on the granite outcrop, it appears that they were plucked from a subice outcrop located to the southeast of Milan Rock. The discovery was made by George Grindley. Other geologists present were John Wilbanks, John Brand, James Reilly, and Oley Melander. The Wilbanks collection was submitted to James M. Schopf for study and fossil identifications. His preliminary results indicate the age of the formation to be Middle Devonian. The Grindley collection was studied by D. C. Mildenhall, whose preliminary report suggests a relative age of Upper Devonian.

James Reilly selected specimens for radiometric dating by M. Halpern, University of Texas-Dallas, and Carl Cathey collected oriented specimens for fabric analyses.

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Plutonic rocks from the Ruppert Coast, West Antarctica

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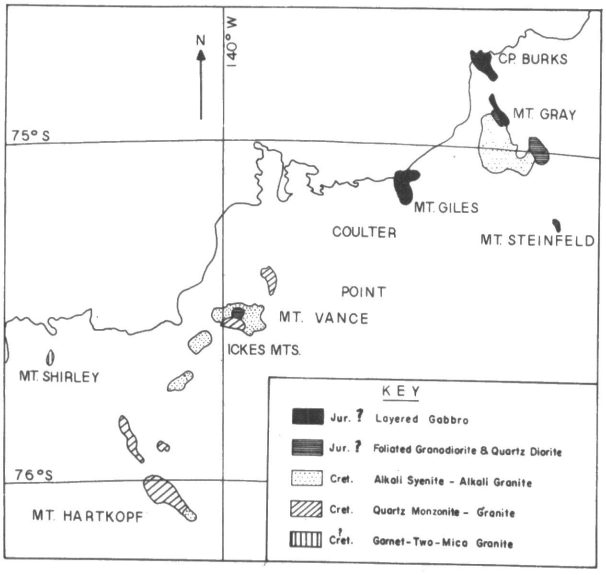
This paper summarizes studies of a collection of plutonic rocks from the Ruppert Coast, West Antarctica (see figure). The rock specimens were collected during the 1967-68 field season by C. Craddock and K. B. Spörli, who carried out a preliminary study and constructed a geologic map (Spörli and Craddock, 1967, 1968).

Forty-six specimens of granitic and gabbroic rocks recently have been analyzed for 10 major elements by X-ray fluorescence and atomic absorption spectrometry techniques. Additional optical work has been carried out using a five-axis



Distribution of plutonic rocks along the Eights Coast. (Cape Burks is about 175 kilometers from Mount Shirley.)

Universal stage. Five main plutonic rock suites have been distinguished on the basis of field and laboratory data. These suites are described below, in their inferred chronological order.

Layered gabbro crops out at Cape Burks, Mount Giles, and northern Mount Gray. Major minerals are plagioclase (andesine/labradorite-bytownite), clinopyroxene (salite-hedenbergite), olivine (in the more basic members to the northeast), opaque minerals commonly associated with apatite, and subophitic kaersutite and titaniferous biotite. These rocks are quartz-free.

To the south of the gabbros, foliated granodiorites and quartz diorites are exposed at Mount Gray, Mount Steinfeld, and Mount Vance. These rocks clearly are igneous in character. Typically they contain multiply zoned plagioclase, quartz, olive-green hornblende, biotite, and rare perthitic alkali feldspar, microcline, and sphene. Specimens from the south of Mount Gray and Mount Steinfeld show evidence of hydrothermal alteration and alkali metasomatism. Three whole-rock Rb-Sr (rubidium-strontium) isotope analyses on a gabbro and a quartz monzonite (parallel to the layering gabbro) from Mount Giles and a quartz diorite from Mount Gray suggest that these rocks are 154±35 million years old.

An alkali syenite-alkali granite intrusion crops out in the southern and western regions of Mount Gray. At least three phases of this pluton have been observed from a helicopter, but only two phases have been recognized in the laboratory. All specimens from this pluton have similar felsic mineralogy. Anorthoclase occurs in various stages of exsolution with minor quartz and albite; granophyric intergrowth between quartz and anorthoclase is common. The mafic mineralogy of the lighter, more abundant phase includes mainly bluish-green hornblende, commonly with cores of ragged clinopyroxene, and some biotite. The darker-weathering phase contains grains of aegirine-augite with sodic augite cores mantled by olive-green hornblende, and rare aenigmatite grains. Similar alkalic granites from the Ickes Mountains contain rare grains of riebeckite-arfvedsonite. The alkaline granitic rocks of Mount Vance contain little biotite and actinolite (?) as major mafic phases. The presence of actinolite, together with the abundance of volcanic inclusions seen in the outcrop, and the comparatively low iron-magnesium ratios, suggest that the initial melt was modified by the assimilation of basic material. An inclusion of the gabbro has been identified in a specimen from Mount Gray. Amphibole from an alkali granite from the Ickes Mountains yields a K-Ar (potassium-argon) apparent age of 96 million years.

Biotite- and hornblende-bearing quartz monzonite and granitic rocks crop out west of Coulter Point. These rocks are calcalkaline in character (Peacock index = 59.5) and are typical of the type found in cordilleran batholiths. However, when compared to similar rocks from the Sierra Nevada batholith (Bateman *et al.*, 1963), they have lower modal quartz (10-25%) and are unusual in containing exclusively perthitic alkali feldspar. A specimen of granite from Landry Peak has yielded a Rb-Sr apparent age of 92 million years. Compared with the alkaline rocks, these rocks are poorer in manganese and richer in magnesium.

Two specimens of a garnet-two-mica granite were collected from Mount Shirley. Similar rocks have been described elsewhere in West Antarctica from the southern Ford Ranges (Warner, 1945) and from small islands west of Thurston Island (Lopatin and Polkov, 1976).

To the west of Coulter Point the intrusives are associated with a contorted pile of calcalkaline volcanic rocks (Peacock index = 59), metamorphosed in the greenschist facies. The age of these volcanic rocks is not clear, but they may correlate with other calcalkaline suites from West Antarctica, which are probably Jurassic in age (Dewar, 1970; Fuenzalida *et al.*, 1972; Lopatin and Polkov, 1976; Thomson, 1972a; White, 1970).

It is interesting to note that the apparent ages obtained from these plutonic rocks correspond to two of the magmatic "pulses" statistically determined from dates of plutonic rocks from the Antarctic Peninsula (Saunders *et al.*, in press).

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Geologic studies in Orville Coast and eastern Ellsworth Land, Antarctic Peninsula

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Reconnaissance geologic mapping of about 30,000 square kilometers was completed during the 1977-78 austral summer in the Orville Coast, the last large remaining area of unexplored mountains in Antarctica (see figure 1). The U.S. Geological Survey field party also visited parts of eastern Ellsworth Land to map some areas that had not been explored before and to conduct more detailed studies in some previously mapped areas. The geology of the Orville Coast has many similarities to the geology of the Lassiter Coast (Rowley and Williams, in press; Williams *et al.*, 1972) and eastern Ellsworth Land (Laudon, 1972; Laudon *et al.*, 1969).

The oldest exposed rocks in the area are the predominantly sedimentary Latady Formation (Williams *et al.*, 1972), which is locally interbedded with volcanic rocks. The formation, of Late Jurassic and perhaps partly Middle Jurassic age, comprises all the Hauberg and Wilkins Mountains and part of the southern Sweeney Mountains. The clastic fraction of the Latady is rich in volcanic rock fragments derived from a contemporaneous magmatic arc that formerly occupied the present interior of the Antarctic Peninsula. The Latady Formation becomes generally finer grained as it passes southward and southeastward off the edge of the magmatic arc. Depositional environments simultaneously change from swamps and possible continental settings on the flank of the arc (present southern Sweeney Mountains and Sky-Hi Nunataks) to deltas and other nearshore marine environments farther south (present Hauberg and Wilkins Mountains), to an open shallow-water marine environment farthest south (present Cape Zumberge, which is the southernmost rock outcrop on the Orville Coast, see figure 2), and the nunataks east of the Wilkins Mountains.

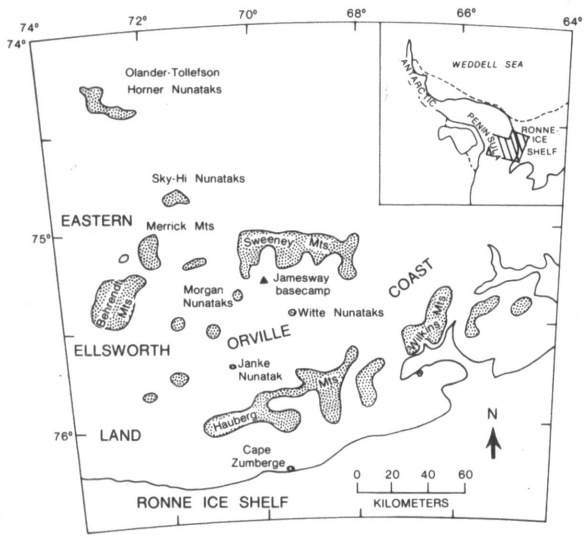

Figure 1. Sketch map of major topographic features in Orville Coast and eastern Ellsworth Land.

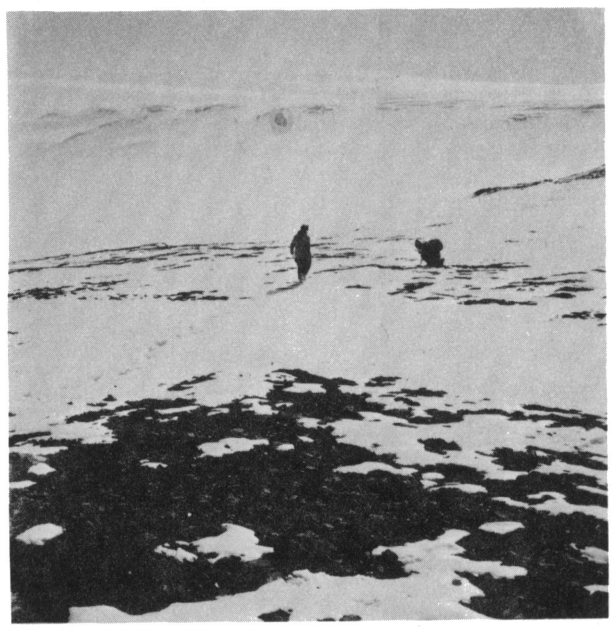

Figure 2. Cape Zumberge, where ice cliffs (seen in the background) rise more than 150 meters above the surface of the Ronne Ice Shelf, to the south (left).

The volcanic rocks that locally are interbedded with the Latady Formation consist of calc-alkaline silicic to intermediate composition ash-flow tuffs, lava flows, air-fall tuffs. Most appear to have been deposited subaerially. In the northern Sweeney Mountains, Sky-Hi Nunataks, and Olander-Tollefson-Horner Nunataks these rocks represent the interior and southern flank of the magmatic arc. They intertongue with the Latady Formation in the southern Sweeney Mountains and much of eastern Ellsworth Land. They are generally correlative with volcanic rocks of similar lithology found throughout the interior of the Antarctic Peninsula.

The Latady Formation and the volcanic rocks have been folded along west-northwest- to east-northeast-trending axes; most rocks display a well-developed axial-plane cleavage (figures 3 and 4). Generally east-striking thrust faults were observed in several places; the direction of thrusting probably was toward the south, based on the predominant sense of fold asymmetry and overturning.