

THE GEOLOGY OF BASE GABRIEL GONZALEZ VIDELA, ANTARCTICA

Introduction

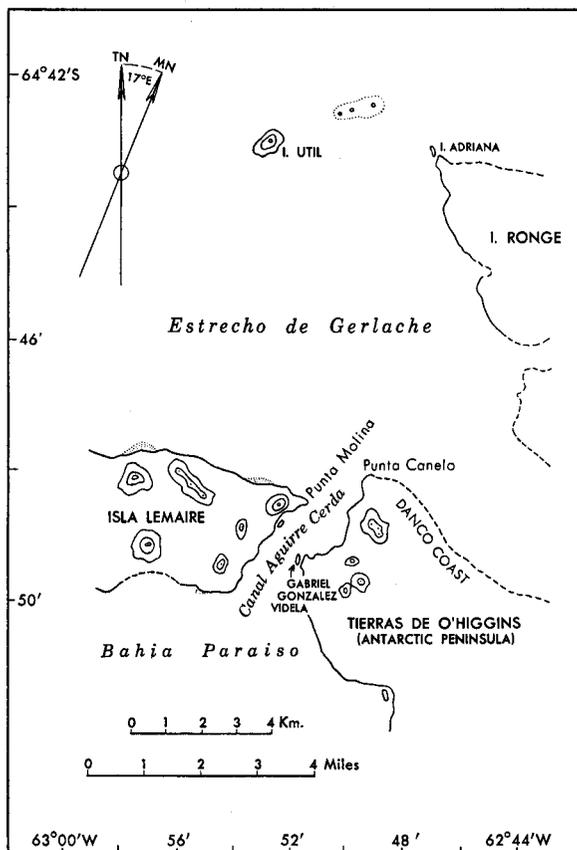
The Chilean scientific base, Gabriel Gonzalez Videla, is located on the Danco Coast at the north end of the "Antarctic" Peninsula (Fig. 1). Isla Util, a small island in the Gerlache Strait, lies 7 miles north of the base. Field work was done during the 1960-61 austral summer, and 70 thin sections of the rocks collected were studied subsequently at the University of Wisconsin.

The chief features of the geology of the area are shown in Fig. 6. The base is situated on two small islands (approx.

port the northern island is named Isla "Lomnitz" and the southern island, Isla "Dott". Between the islands and the mainland is a 90-metre channel, which is dry at low tide (Fig. 2). This channel and the eastern shores of the islands are covered by till.

Isla "Lomnitz" is composed of stratified andesite sills or flows intruded by a quartz diorite pluton. Thin aplite dykes and veins cut the andesite and quartz diorite everywhere on the island, but are most abundant along the north-eastern shore. Along the central part of the western shoreline, a 6-metre section of metamorphosed, interlaminated siltstone and shale lies between andesite sills or flows.

Fig. 1. Location map of base Gabriel Gonzalez Videla and Isla Util.



18,000 square metres), which are separated by a very narrow channel partly filled with morainal material. In this re-

The andesite sheets extend southward and occupy the northern half of Isla "Dott". Approximately 5 metres below

the uppermost sill or flow is a bed of metaconglomerate, 4 metres thick. An intrusive body of porphyritic andesite occupies the southern half of Isla "Dott" where it is intruded by the andesite sill rock.

suritized feldspar. Pale green chlorite and amphibole total 7 per cent of the rock, and lesser accessory minerals include epidote, apatite, zircon, magnetite, and ilmenite. The matrix has a pronounced flow structure and is composed

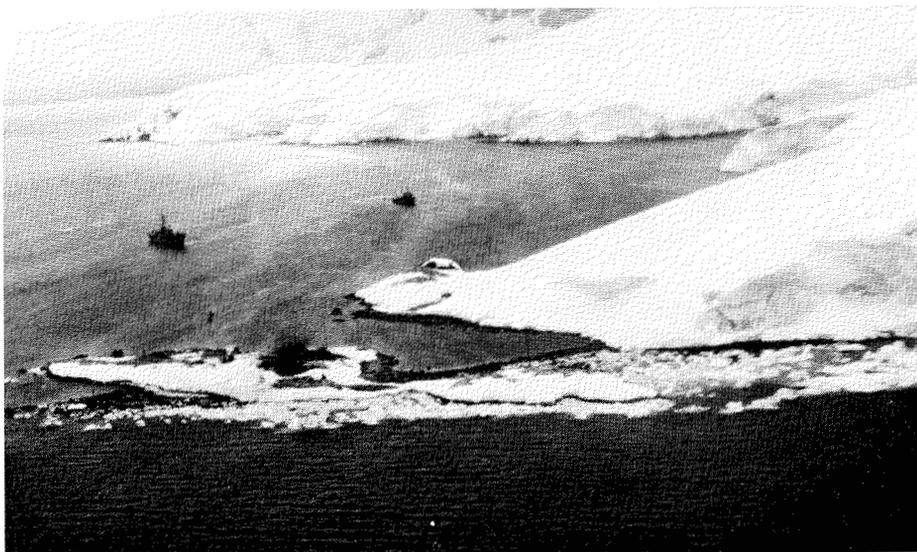


Fig. 2. Aerial view of base Gabriel Gonzales and neighboring Danco Coast.

The Igneous Complex

1. *Porphyritic Andesite*

The porphyritic andesite occupies the southern half of Isla "Dott" whereas the southern tip of the island is cut by irregular dikes of fine-grained andesite less than 0.5 metre thick.

In hand specimen, about 45 per cent of the rock is composed of light grey plagioclase feldspar phenocrysts as long as 2 mm. in a fine-grained, dark grey matrix. The fine-grained andesite has a chilled zone 2 to 3 mm. wide against porphyritic andesite, and the fine-grained andesite penetrates micro-fractures in the porphyry (Fig. 3).

The phenocrysts are of calcic andesine (as determined by the Michel-Lévy method) and exhibit albite and Carlsbad-and-albite twinning. Rare crystals are zoned. The fine-grained ground mass includes 2 per cent of quartz myrmekitically intergrown with saus-

mainly of microlites and altered micro-crystalline feldspar.

2. *Andesite*

The multiple andesite sills or flows of Islas "Lomnitz" and "Dott" are about 200 metres thick. Thickness of individual sheets is extremely difficult to determine because of intense fracturing and poor exposures due to snow and guano cover. Where measurable sheets are 4 to 7 metres thick and dip steeply south.

Conclusive evidence in favour of the andesite being a series of multiple sills rather than a series of flows is not present. However, intrusion of the fine-grained andesite into the porphyritic andesite and the absence of rounded inclusions of the underlying rock in the overlying andesite rock suggests that they may be multiple sills.

The non-porphyritic andesite is a dark grey, fine-grained rock. Calcic andesine comprises at least 75 per cent

of the rock, and exhibits albite and to a less degree Carlsbad-and-albite twinning. Zoning is rare. The alteration of the plagioclase ranges from negligible to complete saussuritization. About 5 per cent quartz is present, and some is intergrown myrmekitically with sodic

Isla "Lomnitz" and crops out as a large intrusive body on the mainland east of the islands. The quartz diorite is coarse and even-grained, and is mottled green and light to medium grey. It is separable into three facies on the basis of colour, composition, and grain size.

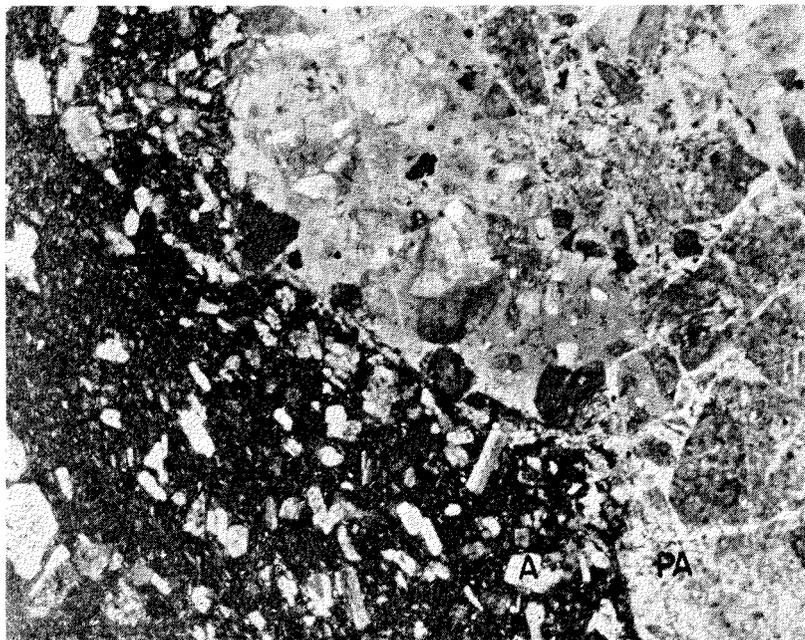


Fig. 3. Contact between fine-grained andesite sill or flow rock intruding porphyritic andesite. PA—porphyritic andesite; A—andesite sill or flow rock. X 8, diffused light.

oligoclase. Green to brownish-green chlorite comprises 10 per cent of the rock. Accessory minerals are zircon and apatite; sphene and biotite are rare. The biotite is present as minute flakes, which are commonly altered to pale green chlorite and clinozoisite. Opaque minerals (2 per cent) are ilmenite and magnetite.

The lowermost 30 metres of andesite, near the northern shore of Isla "Lomnitz", is brecciated and consists of fragments 0.2 mm. to 15 mm. in diameter in a finely crystalline matrix. The cause of brecciation was not determined.

3. Quartz Diorite

Quartz diorite intrudes the andesite sills or flows along the eastern coast of

Facies 1. The quartz diorite of the Danco Coast is medium grey with a greenish tinge and has a high mafic content (15 per cent). Cores of many of the plagioclase crystals in this facies are saussuritized. Isla Util, which lies to the north of the base, is composed of quartz diorite identical to that of the Danco Coast facies. Three xenoliths of porphyritic andesite were found on the south-central coast of the island in the quartz diorite. This andesite is quite different from that of Gonzalez Videla, but may be related to the same period of igneous activity.

Facies 2. Along the east-central coast of Isla "Lomnitz", where the quartz diorite is near the andesites, it is pink and green. A decrease in the amount of

mafics to 8 per cent and a small increase in alkali feldspar accounts for this colour change. Plagioclase is much less altered than that of Facies 1.

Facies 3. Immediately south of the scientific office building, the quartz diorite changes to a fine-grained facies. Orthoclase and plagioclase each comprise 30 per cent of the rock, with quartz also comprising about 30 per cent of the rock. Because of the increase in alkali feldspar, this small area (approx. 45 metres x 20 metres) can be considered a microadamellite.

zircon, dark brownish-green hornblende, which is slightly pleochroic, and rare flakes of dark brown biotite. The opaque minerals (2 per cent) are magnetite and ilmenite commonly altered to leucoxene.

All facies contain xenoliths (0.1 to 1 metre in diameter) of the finely crystalline andesite rock and are intruded by veinlets of aplite.

A minor fault cuts the quartz diorite at the northern end of the Danco Coast crop. Slickensides are horizontal.

The quartz diorite of base Gabriel

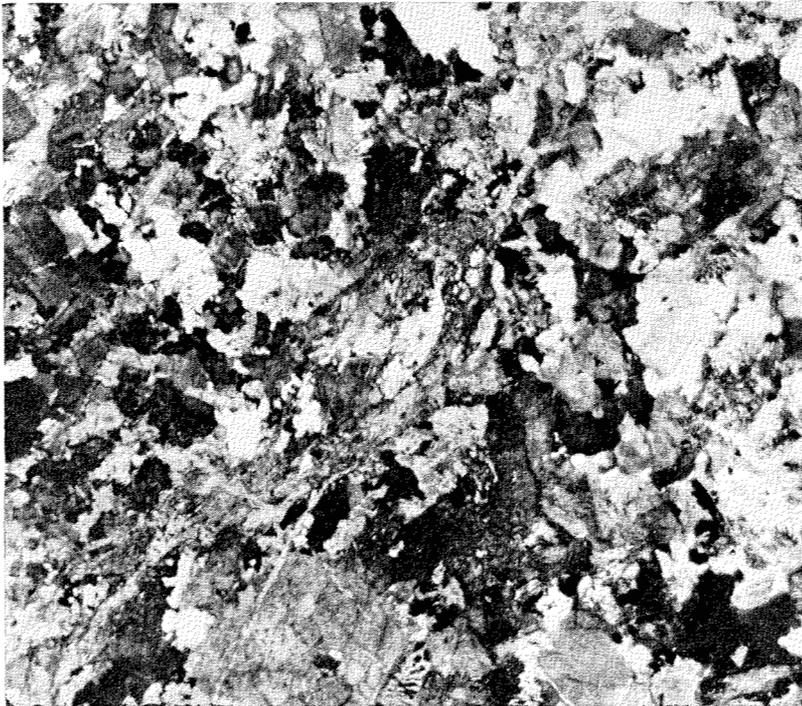


Fig. 4. Quartz diorite of base Gabriel Gonzales Videla (facies 1). Note altered plagioclase feldspar and characteristic myrmekitic texture. X 8, polarized light.

On microscopic examination, all facies generally display myrmekitic texture as an intergrowth of andesine (50 per cent), orthoclase (15 per cent) and quartz (15 per cent) (Fig. 4). Chlorite and amphibole, up to 20 per cent, are present as light green, tabular crystals. The accessory minerals include: apatite,

Gonzalez Videla is possibly correlative with the post-Jurassic "Andean intrusives" of the Trinity Peninsula.

4. Aplitic Dykes

Throughout Isla "Lomnitz" and along the eastern shoreline of Islas "Lomnitz" and "Dott" aplitic dykes ranging in

width from a few mm. to 0.5 metre intrude the andesite sheets, porphyritic andesite, and quartz diorite. The dykes are offset slightly along minor normal and reverse faults. The aplite is pink and contains 55 per cent of microcline feldspar and 40 per cent of quartz. Zircon is the main accessory mineral. Apatite, rutile and magnetite are rare.

Contact Metamorphic Rocks

1. *Argillite*

On the central western shoreline of Isla "Lomnitz" a 6-metre section of metamorphosed, finely interlaminated siltstone and shale crops out. The beds are near vertical and tops, as indicated by fine-scale cross-laminae, are to the south. Laminae are 1 mm. to 1.5 cm. thick and have very sharp contacts. Micrograded bedding is present in the darker laminae (Fig. 5). The contact between the metasediments and the overlying and underlying andesite

sheets is very sharp and irregular. Load casts, microfaulting, and delicate cross laminae are preserved. The rare cross lamination demonstrates a paleaocurrent direction from the east-northeast. Quartz grains are recrystallized and form a mosaic around chlorite and sericite flakes.

2. *Argillaceous Metaconglomerate*

On Isla "Dott", approximately 5 metres below the uppermost andesite sheet, a 4-metre bed of metaconglomerate crops out. The metaconglomerate is composed of rounded granules and pebbles of quartz and subordinate sandstone and quartz diorite in a metamorphosed silty matrix. The matrix is carbonaceous and has flowed around the rock fragments. In places, where the ratio of matrix to clasts is very high, the rock is a phyllite.

Accessory minerals include garnet (?) occurring as idiomorphs in the matrix; magnetite occurring in the matrix



Fig. 5. Interlaminated siltstone and shale showing micrograded bedding in the dark laminae. X 8, diffused light.

and as inclusions in the quartz; minor amounts of dark brown biotite; and zircon.

Geologic Evolution

Adie (ref. 1, p. 1) states that: "Rocks of Graham Land are all crystalline-differentiation products of a common parental magma and form a normal calc-alkaline series". Examination of the composition of the feldspar of the Gonzalez Videla dominant rock types and their intrusive relations tends to support Adie's thesis. A continual decrease in Ca content with a corresponding increase in alkaline content, through time, tends to suggest a common parent magma (Table 1).

Peninsula region to provide the pebbles found in the metaconglomerate of base Gabriel Gonzalez Videla. It is possible that Adie's "basement complex" served as the source for these pebbles.

Preceding the folding of the sediments and intrusion of the quartz diorite, the andesite sheets were emplaced. Adie² points out that the Jurassic period was one of extensive extrusion of andesite flows in the Antarctic Peninsula. It is possible that during this period the porphyrite andesite and fine grained andesite sheets were emplaced. Following the intrusion of the quartz diorite body, aplite dykes and veinlets marking the most acid phase of the possible common parental magma, intruded the igneous and metamorphic complex.

Table 1. Composition of feldspar suggesting magmatic differentiation.

<i>Rock type</i>	<i>Feldspar</i>	<i>Relative age</i>
Aplite	Microline	youngest
Quartz diorite	Ab70An30 to Ab55An45	
Andesite	Ab60An40 to Ab50An50	
Porphyritic andesite	Ab60An40 to Ab50An50	oldest

From the observed field relationships, the geologic history was as follows:

- Youngest 3) Intrusion of the quartz diorite pluton and aplite dykes coupled with tectonic disturbances in the Antarctic Peninsula.
- 2) Intrusion and/or extrusion of the andesite sills and/or flows.
- Oldest 1) Deposition of the arenaceous and conglomeratic sediments.

Adie² believes that old, possibly Precambrian or early Paleozoic, granitic crystalline rocks crop out along the west-central coast of the Antarctic Peninsula (in the vicinity of Adelaide Island and northeastern Alexander I Land). Clearly, older (than the "Andean" intrusives) granitic rocks must have been exposed in the Antarctic

Though generally referred to a Cretaceous-early Tertiary age, the dating of Antarctic Peninsula diorites remains uncertain. A sample from Gabriel Gonzalez Videla is now being analysed for absolute age.

Acknowledgements

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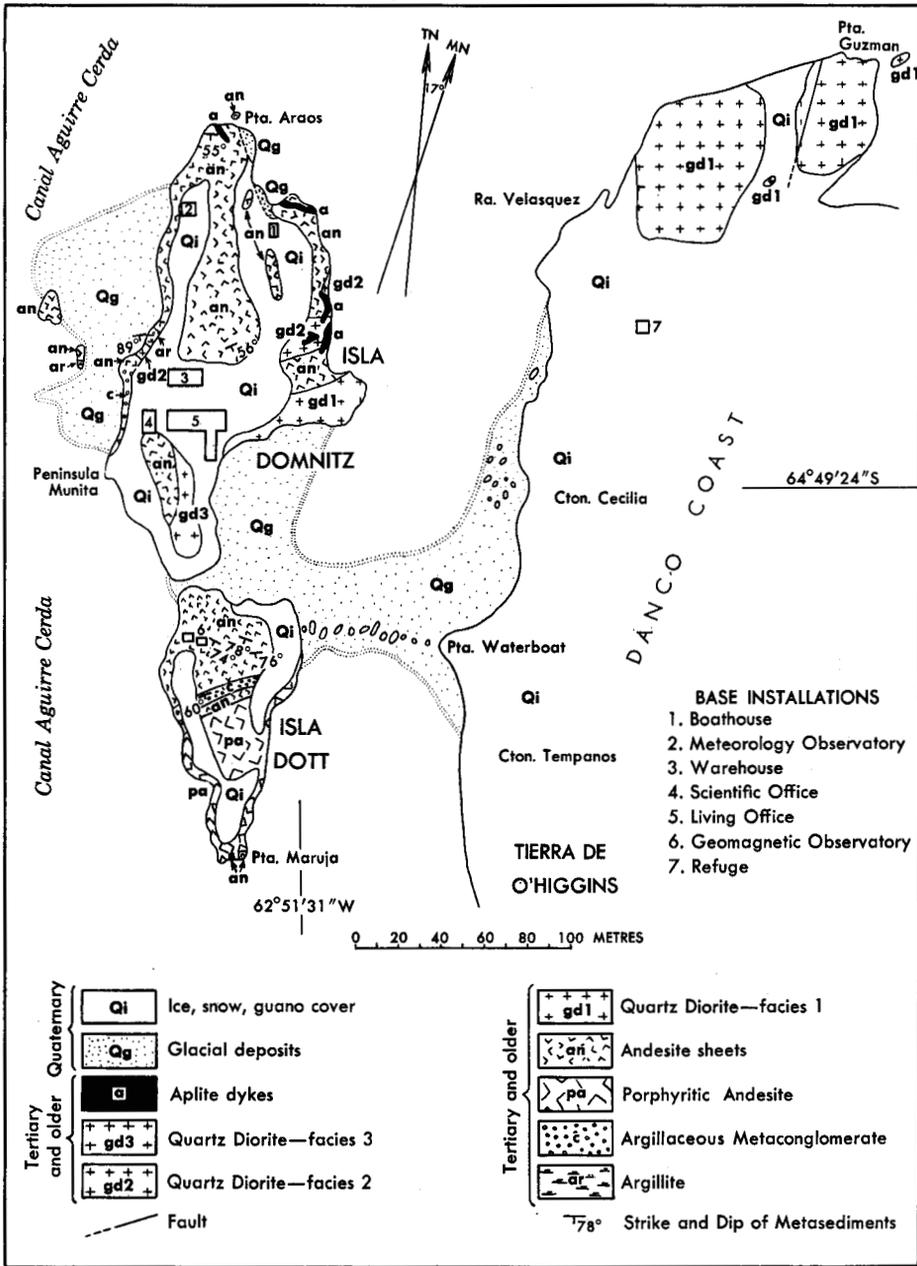


Fig. 6. Geological map of base Gabriel Gonzales Videla, Antarctica.

¹Adie, R. J. 1955. The petrology of Graham Land. II. The Andean granite-gabbro intrusive suite. Falkland Islands Dependencies Surv. Sci. Rept. No. 12, 39 pp.

²Adie, R. J. 1954. The petrology of Graham Land. I. The basement complex; early Palaeozoic plutonic, and volcanic rocks. Falkland Islands Dependencies Surv. Sci. Rept., No. 11, 22 pp.