THE PLUTONIC ROCKS OF THE SOUTHERN GERLACHE STRAIT, ANTARCTICA: GEOCHRONOLOGY, GEOCHEMISTRY AND MINERALOGY

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Resumen

Las rocas plutónicas estudiadas se caracterizan por una disminución hacia el oeste de las edades (Cretácico inferior-Mioceno). Geoquímicamente son similares aunque en los granitoides Cretácicos se detecta una tendencia de aumentar el SiO_2 hacia el este. Estimaciones de la profundidad de la fuente y de emplazamiento sugiere un aumento hacia el oeste.

Key words: Plutonism, Antarctica, geochronology, geochemistry.

Introduction

The intrusive rocks of the Gerlache Strait include gabbros, diorites, tonalites, granodiorites and granites (Alarcón et al. 1976), which form part of the extensive plutonism developed in the Antarctic Peninsula as a product of a continuous subduction since Early Mesozoic to Late Tertiary (cf. Pankhurst, 1982). Previous studies distinguished pre- and post-volcanic rocks plutons (West, 1974) and reported radiometric ages that indicate Cretaceous ages for the Danco Coast rocks and Tertiary ages for the Wienke Is. and Southern Anvers Is. (Scott, 1965; Pankhurst, 1982; British Antarctic Survey, 1984). Thus a westward decreasing ages of the plutonic rocks is insinuated.

The aim of this study is to get a better understanding of the poorly known plutonic history of the Gerlache Strait, based on geochronological, geochemical and mineralogical data of a limited number of samples. This study was financed by the INACH grant e.17, and is a contribution to the IGCP Project 249 "Andean Magmatism".

Geochronology

Three previous K-Ar ages of plutonic rocks of the Danco Coast range from 117 to 94 Ma (cf. Scott, 1965; British Antarctic Survey, 1984) and two Rb-Sr isochron ages gave of 131 ±4 and 114 ±11 Ma (Pankhurst, 1982). A new biotite K-Ar age of 113 ±3 Ma was obtained in a hornblende - biotite granodiorite of the SE extreme of the Anvord bay (fig. 1).

Mineral and whole rock K-Ar ages in the 54-49 Ma range reported by the British Antarctic Survey (1984) geological map in the Doumer Island were confirmed by two new biotite K-Ar ages of 50.2 ±1.4 and 55.7 ±1.6 obtained at SE Doumer Island and Lockroy Port in the Wiencke Island respectively (fig. 1). Early Tertiary biotite K-Ar ages of 68 ±2 and 54.2 ±1.4 Ma were obtained at the NE extreme of Anvers Island. A tonalite collected at the Palmer base gave a biotite K-Ar age of 20.4 ±1 Ma, which is similar to the previous K-Ar ages obtained in the surrounding areas.

With the exception of a Late Cretaceous Rb-Sr age of the Cape Monaco granites (cf. Pankhurst, 1982) on the extreme SW of Anvers Island, a westward migration of the plutonism with time is confirmed. The limit between the Mesozoic and Cenozoic plutonic rocks was roughly defined in fig. 1.

Geochemistry

Both, the Mesozoic and Cenozoic intrusive rocks exhibit a wide SiO_2 range, fall in the VAG field of Pearce et al. (1984), and have calc-alkaline characteristics. The Cretaceous Danco Coast granitoids show and overall increase in SiO_2 to the east, and the intermediate Cenozoic rocks have the highest REE abundances and the lowest La/Yb ratios.

Taken together the Mesozoic and Cenozoic samples, the Y contents exhibit a maximum at the intermediate compositions whereas Nb and Zr show, respectively, a well and poorly defined positive correlation with SiO_2. The behaviour of Y, Nb and Zr, and the presence of negative Eu anomalies in the intermediate and felsic rocks, suggest a derivation from a more basic magma by clinopyroxene + plagioclase removal.

Mafic Mineralogy

Most of the analyzed pyroxenes are Ca-rich clinopyroxene; orthopyroxene was only found in a Cretaceous granitoid sample. Using the geobarometer based on the mole fraction Tschermaks of clinopyroxene in equilibrium with plagioclase and quartz (Ellis, 1980), the pressure conditions of the Tertiary magma source, or pause region, increase to the west from 4 to 8 kbar.

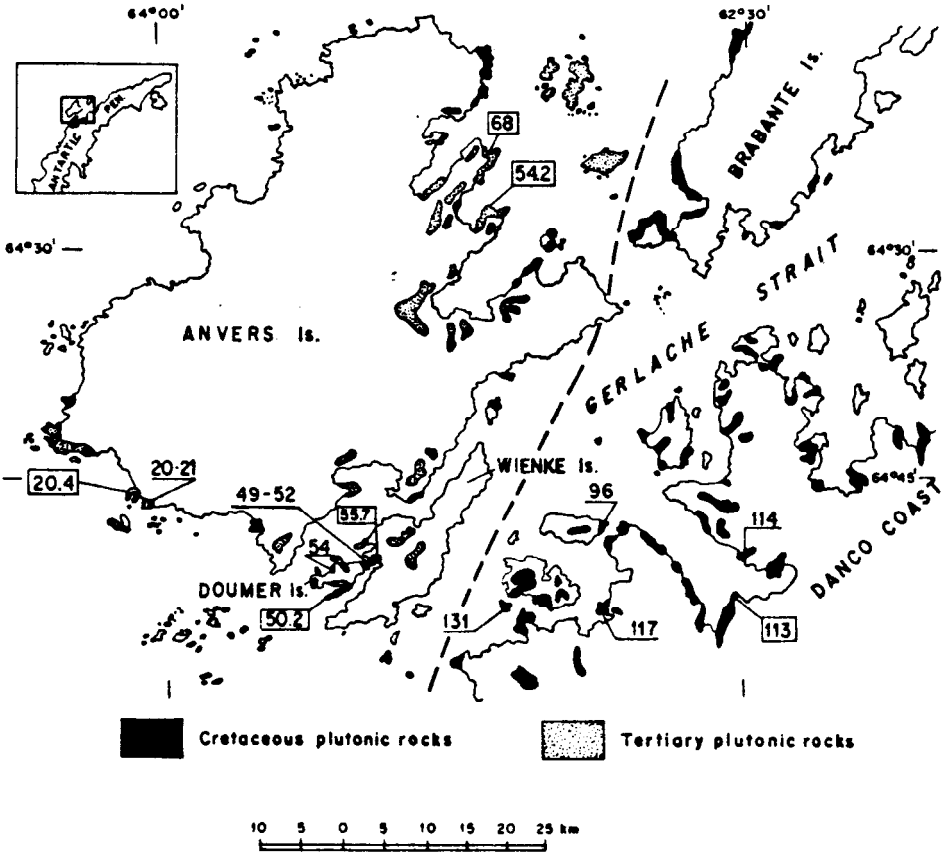

Fig. 1. Distribution of the plutonic rocks in the Gerlache Strait, modified after Alarcón et al. (1976). Numbers indicate radiometric ages; enclosed numbers are the ages obtained in this study.

Most of the analyzed amphiboles are magnesio-hornblende. The remainder ones correspond to ferro-hornblende and actinolitic hornblende. The pressure conditions of the hornblende crystallization, using the Hammarstrom and Zen's (1986) geobarometer, roughly increase to the west from 1 to 2.7 kbar.

No variations have been detected in the biotite compositions. The analyzed biotites have mole fraction annite (X_{ann}) of 0.4 - 0.5 with the exceptions of an Early Tertiary sample that has X_{ann} equal to 0.6. In addition, no variations have been found in the oxygen fugacity conditions ($10^{-14.5}$) for the biotite crystallization.

Conclusions

The plutonic development of the Gerlache Strait is characterized by:
1) A westward decreasing ages from Early Cretaceous to Miocene. Two non plutonic intervals 96-68 and 50-20 Ma emerge from the available geochronological data.
2) Calc-alkaline products exhibiting a wide compositional range, and on overall eastward SiO_2 in the Cretaceous Danco Coast granitoids. The geochemical similarities between rocks with similar SiO_2 but different ages, suggest a common source and similar magmatic evolution.

3) Similarities in the composition of the mafic phases of the studied rocks. However, a westward increase in both source (or pause region) and emplacement depths is envisaged.

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