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THE TECTONIC STRUCTURE OF GERLACHE STRAIT, WEST ANTARCTICA

STRUKTURA TEKTONICZNA CIEŚNINY GERLACHE'A – ANTARKTYKA ZACHODNIA

ABSTRACT

Four major fault-bounded blocks are recognized in the Gerlache Strait area, West Antarctica: the Danco Coast Block; the Brabant Island Block; the Neumayer Channel Block; and the Anvers-Melchior Islands Block. The blocks differ from each other in the succession and age of rocks. The faults bounding the blocks are mainly strike-slip ones and of Tertiary age.

INTRODUCTION

Geological investigations in the area of Gerlache Strait, West Antarctica, were carried out by the present author during the Polish Geodynamic Expeditions of 1984–1985 and 1987–1988 organized by the Polish Academy of Sciences and led by Prof. A. Guterch (Birkenmajer 1987, 1988). The present paper summarises main tectonic features of the area as recognized by the author in the field, and gives a reinterpretation of some geological data published earlier by other authors (for more geological information – see Birkenmajer 1995, 1998).

FAULT SYSTEMS

Two systems of Tertiary strike-slip faults are recognizable in the area of Gerlache Strait between Danco Coast and Anvers Island (Fig. 1): the longitudinal faults and the transversal ones (Birkenmajer 1985, 1988). They bound major tectonic blocks of the area which differ in age, composition and succession of predominantly magmatic rocks (Fig. 2).

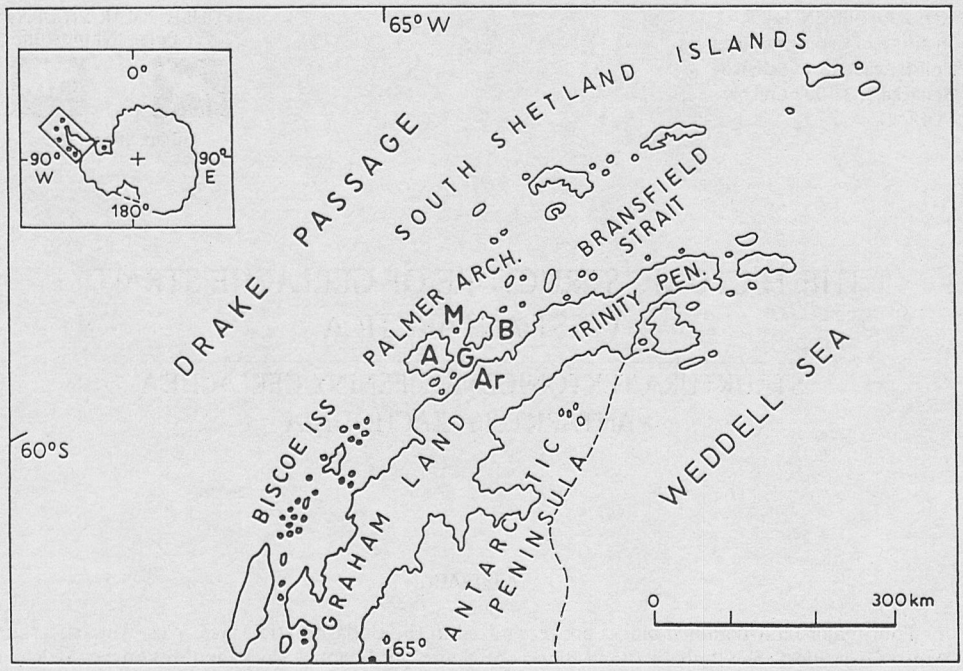

Fig. 1. Location of Gerlache Strait and surroundings in West Antarctica. A – Anvers Island; Ar – Arctowski Peninsula; B – Brabant Island; G – Gerlache Strait; M – Melchior Islands

Longitudinal faults. The SW-NE-trending strike-slip right-lateral Neumayer Fault runs from Peltier Channel to the northern part of Neumayer Channel cutting across the westernmost part of Wiencke Island (Scott 1965; Hooper 1962; Fleming and Thomson 1979). It probably continues offshore Anvers and Brabant islands as the Gerlache Fault.

Another SW–NE-trending, possibly also strike-slip fault – the Fournier Fault, runs subparallel with the Gerlache Fault, dividing Anvers Island in two (cf. Parada et al. 1992). The Fournier Fault probably continues north-west in Dallmann Bay offshore Brabant Island.

Transversal faults. A system of transverse faults, striking predominantly E–W to SE–NW, was recognized on Wiencke Island and Brabant Island (Scott 1965; Hooper 1962; Alarcón et al. 1976; Fleming and Thomson 1979). These are also mainly strike-slip faults. To this system belong faults of Schollaert Channel (Fig. 2).

GEOLOGICAL STRUCTURE OF TECTONIC BLOCKS

Four major fault-bounded tectonic blocks have been distinguished in the Gerlache Strait area (Birkenmajer 1998): (A) the Danco Coast Block; (B) the Brabant

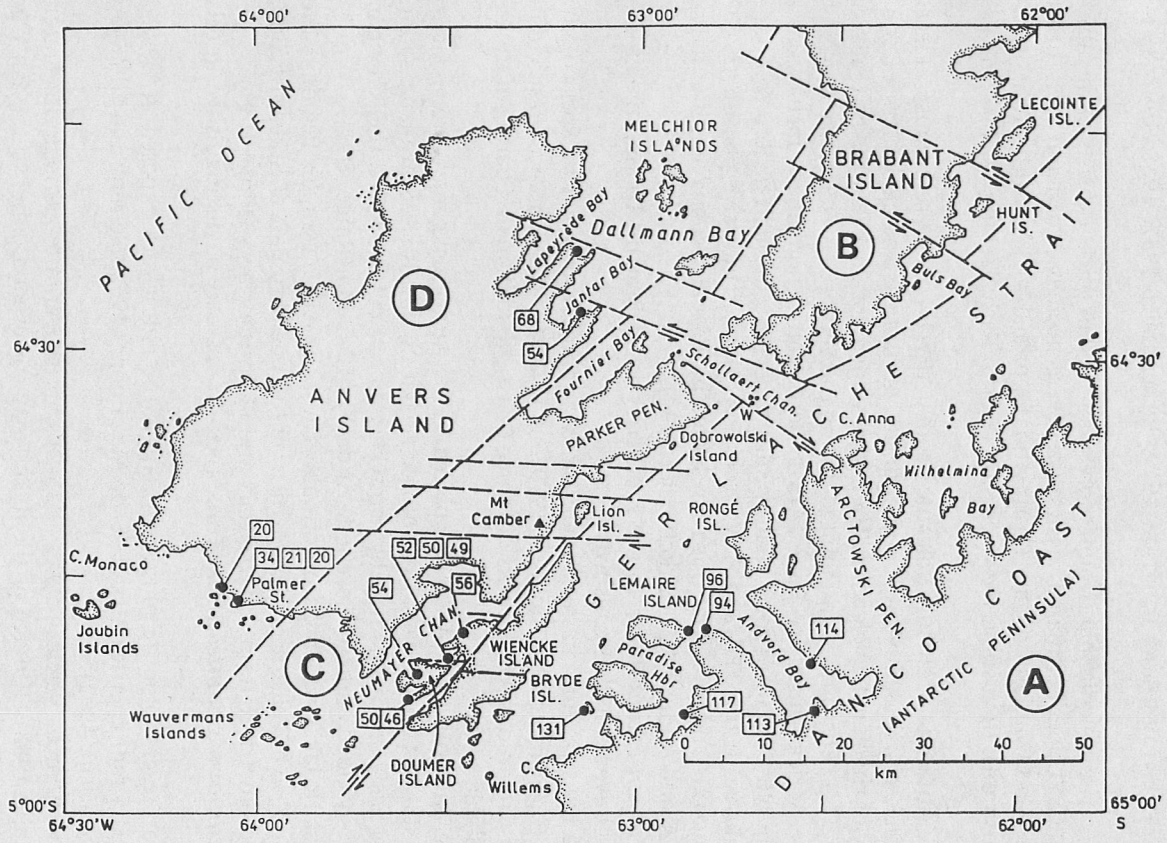

Fig. 2. Major tectonic blocks of Gerlache Strait and its surroundings. A – Danco Coast Block; B – Brabant Island Block; C – Neumayer Channel Block; D – Anvers-Melchior Islands Block. Major strike-slip faults marked by dashed lines; W – The Waifs. Numbers in boxes denote radiometric ages (after Fleming and Thomson 1979; and Parada *et al.* 1992), in Ma

Island Block; (C) the Neumayer Channel Block; (D) the Anvers-Melchior Islands Block (Fig. 2).

(A) Danco Coast Block. This block includes the area of Danco Coast between Cape Willems (SW) and Wilhelmina Bay (NE). It consists of four major rock-units (West 1974; Fleming and Thomson 1979; Birkenmajer 1987, 1988, 1992, 1994, 1995):

(1) The Trinity Peninsula Group, more than 1000 m thick, consists of metaturbidites (TPG: ?Upper Permian-Triassic). They were strongly folded and even thrust during the Gondwanian orogeny (Trinity phase, probably close to the Triassic/Jurassic transition), then subjected to erosion prior to Early Cretaceous (Birkenmajer 1992);

(2) The Antarctic Peninsula Volcanic Group (APVG: Lower Cretaceous), at least 2000 m thick, consists of basaltic and andesitic lavas, tuffs and agglomerates, subordinately of rhyodacitic volcanics. They were folded, locally event thrust together with their TPG substratum, and faulted during the Tertiary (Birkenmajer 1994);

(3) The Andean Intrusive Suite (AIS-1: Berriasian-Cenomanian) includes medium-scale plutonic intrusions, mainly sills, of granite through gabbro composition, emplaced in the TPG and APVG rocks. A younger intrusive phase (AIS-2:? Late Cretaceous and/or Tertiary) is represented by several systems of minor hypabyssal basic and acidic dykes (Birkenmajer 1994).

(B) Brabant Island Block. In the southern part of Brabant Island, three rock-complexes have been distinguished:

(1) Altered stratiform basaltic-andesitic lavas and volcaniclastics („rocks of unknown age": Fleming and Thomson 1979), up to 2000 m thick, may correspond to the Lower Cretaceous APVG rocks of Danco Coast. No radiometric dating of the lavas is available so far;

(2) A granodiorite sill (AIS-1) emplaced in the APVG rocks may correspond to granitoid sills of Danco Coast. No radiometric dating of this sill is available so far. Numerous basic and acidic hypabyssal dykes (AIS-2) cut the APVG rocks. One of these dykes yielded an Early Eocene K-Ar date of 52±2 Ma (Ringe 1991);

(3) Basaltic lavas which unconformably cover the APVG complex belong to the youngest phase of volcanic activity which, in the northern part of Brabant Island, yielded radiometric dates of Late Tertiary and Pleistocene ages (Ringe 1991).

(C) Neumayer Channel Block. Three rock-groups may be distinguished in this block:

(1) Granite-granodiorite pluton (AIS-1) is the oldest rock exposed. It yielded Early Tertiary radiometric dates of 56–46 Ma (Hooper 1962; Fleming and Thomson 1979; Parada *et al.* 1992);

(2) A system of vertical dykes (AIS-2) cuts the granite-granodiorite pluton (Birkenmajer 1988). The age of the dykes may correspond either to the Early or the Late Tertiary;

(3) Basaltic-trachyandesitic lavas and tuffs (Hooper 1962; Alarcón *et al.* 1976; Fleming and Thomson 1979; Birkenmajer 1988) are the youngest magmatic rocks of the block in question. They may correspond in age to Late Tertiary-Pleistocene

volcanics of Brabant Island (cf. Ringe 1991). On Parker Peninsula, Anvers Island, these volcanics unconformably cover eroded/planated and weathered plutonic rocks (1) and the dykes (2) – Birkenmajer (1988 1998).

(D) Anvers-Melchior Islands Block. This tectonic block includes NW part of Anvers Island and its offshore islands, and Melchior Islands. The rock-succession there is poorly known (Fleming and Thomson 1979). Three rock-groups may be distinguished:

(1) A volcanic suite which occurs in the coastal area of Palmer Station-Cape Monaco and further north-eastwards (Fleming and Thomson 1979: Mv) may correspond to the APVG;

(2) Granite, diorite and tonalite plutons (Hooper 1962; Fleming & Thomson 1979; Parada *et al.* 1992), represent three intrusive phases (AIS-1): 68–54 Ma (Maastrichtian-Late Paleocene); 34 Ma (Eocene/Oligocene transition); 21–20 Ma (Early Miocene) – see Fig. 2;

(3) Two main groups of dykes (AIS-2) have been distinguished (Hooper 1966): the older group is represented by dominant hornblende-bearing basic dykes; the younger group consisting of less frequent, usually propylitized pyroxene-bearing dykes, might be of Tertiary age.

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STRESZCZENIE

W obszarze Cieśniny Gerlache'a (Antarktyka Zachodnia) wyróżniono cztery główne bloki tektoniczne ograniczone uskokami: blok Wybrzeża Danco, blok Wyspy Brabant, blok Cieśniny Neumayera i blok Wyspy Anvers–Wysp Melchiora. Bloki te różnią się sukcesją i wiekiem kompleksów skalnych. Uskoki ograniczające poszczególne bloki tektoniczne to głównie uskoki przesuwcze o wieku trzeciorzędowym.