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12. A Sampling Scheme for Geochronological Investigations on Devonian-Carboniferous Admiralty Intrusives and Their Country Rocks in North Victoria Land, Antarctica

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INTRODUCTION

Isotopic dating projects carried out in the past decade on rocks of North Victoria Land have significantly improved our understanding of the pre-Mesozoic basement geology of this area. From the geochronological data we learnt that the three fault-bounded lithological units of North Victoria Land (i.e. from E to W, the Robertson Bay, Bowers and Wilson Terranes; Fig. 1), despite major differences in their structural and metamorphic evolutions, were all affected by the Ross Orogeny in late Cambrian to early Ordovician times. K-Ar and Rb-Sr data on minerals of high-grade metamorphic rocks from the northern Wilson Terrane (ADAMS & KREUZER 1984, KREUZER et al. 1987) indicate a final cooling about 480 to 470 Ma ago. K-Ar data on very low to low-grade metasediments of the Bowers and Robertson Bay Terranes (ADAMS ET AL. 1982, ADAMS & KREUZER 1984) suggest that metamorphism and deformation in these terranes took place at about the same time.

In addition to the Ross-age metamorphics, two suites of Paleozoic granitoids were recognized in North Victoria Land (Fig. 1). The Granite Harbour Intrusives which are restricted to the Wilson Terrane are of Cambrian to early Ordovician age (KREUZER et al. 1987) and include both late- and post-tectonic granitoids (see FENN & HENJES-KUNST this vol.). The Granite Harbour Intrusives magmatism, therefore, is closely related to the Ross Orogeny. The second suite of granitoids is formed by the Admiralty Intrusives which yield Devonian to early Carboniferous cooling ages (KREUZER et al. 1987) and generally lack deformation. Admiralty Intrusives are mostly found in the Robertson Bay Terrane but there are also some granitoids of this suite within the Bowers and Wilson Terranes (Fig. 1). Especially the field relations of the Admiralty Intrusives within the Wilson Terrane are still a matter of debate and there has been a controversy in the recent literature on whether the Admiralty Intrusives granitoids represent „terrain-stitching" plutons or not (KLEINSCHMIDT & TESSENSOHN 1987; BORG et al. 1987).

This report presents the results of a sampling project on Admiralty Intrusives granitoids and their country rocks from the northern part of North Victoria Land carried out during GANOVEX VI in the austral summer of 1990/91. Rock samples were mainly collected for geochronological investigations the aims of which are twofold: (i) to get a better estimate of the crystallization ages and, therewith, the intrusion ages of the Admiralty Intrusives plutons, and (ii) to date more precisely the Ross related metamorphism and deformation of the low-grade metasediments in the three terranes.

ADMIRALTY INTRUSIVES

The Admiralty Intrusives granitoids in the northern part of North Victoria Land consist of two large intrusions, the Yule Bay Batholith and the Everett Granite, both located within the Robertson Bay Terrane and several smaller isolated intrusives most of which do also occur within this terrane (Fig. 1). Only two Admiralty Intrusives plutons are exposed in the other two terranes. The granitoid of Znamenskiy Island is located in the northern extension of

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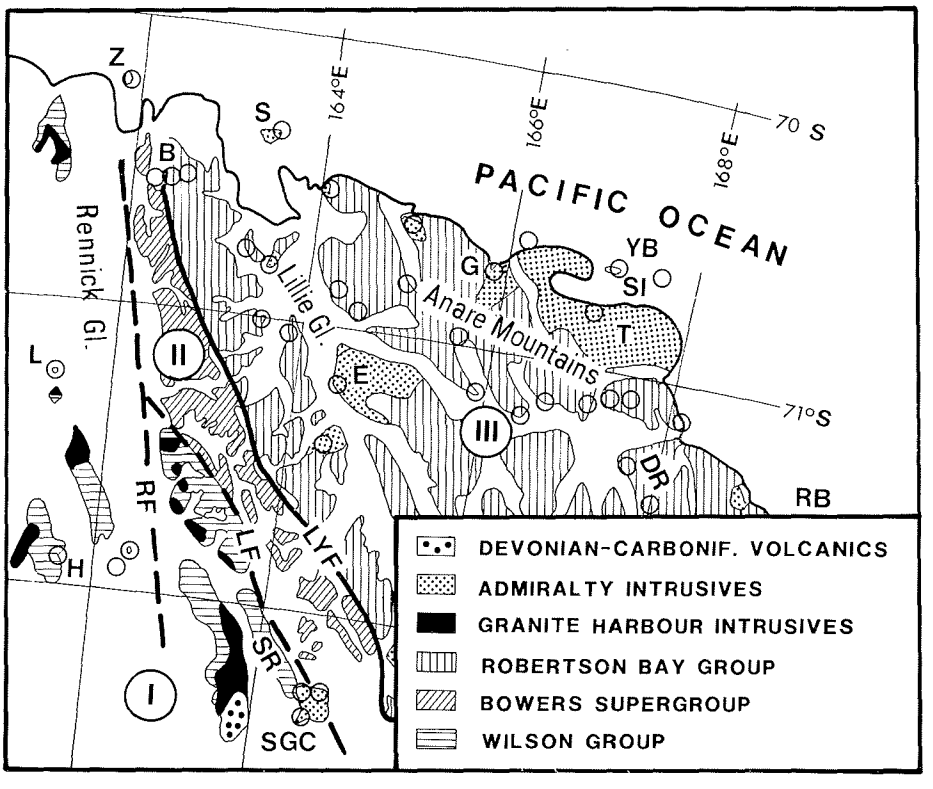

Fig. 1: Geological sketch map of northern North Victoria Land, Antarctica.
(I) = Wilson Terrane; H = Helliwell Hills, L = Lonely One Nunatak, O = Onlooker Nunatak, SGC = Salamander Granite Complex, SR = Salamander Range;
(II) = Bowers Terrane; Z = Znamenskiy Island;
(III) Robertson Bay Terrane; B = Mt. Bruce, DR = Dunedin Range, E = Everett Range, G = Gregory Bluffs, RB = Robertson Bay, S = Sputnik Island, SI = Surgeon Island, T = Tapsell Foreland, YB = Yule Bay;
Faults; LF = Lanterman Fault, RF = Rennick Fault, LYF = Leap Year Fault. Circles indicate sample sites.

Abb. 1: Geologische Kartenskizze der Helliwell Hills im Gebiet des Rennick-Gletschers, Nordvictorialand, Antarktis. Kreise bezeichnen Probenpunkte.
Im Wilson Terrane (I) ist H = Helliwell Hills, L = Lonely One Nunatak, O = Onlooker Nunatak, S = Salamander-Granit-Komplex.
Im Bowers Terrane (II) ist Z = Znamenskiy Island.
Im Robertson Bay Terrane (III) ist B = Mt. Bruce, DR = Dunedin Range, E = Everett Range, G = Gregory Bluffs, RB = Robertson Bay, S = Sputnik Island, T = Tapsell Foreland und YB = Yule Bay.
Bei den Störungen bedeutet LF = Lanterman-Störung, RF = Rennick-Störung und LYF = Leap-Year-Störung.

the Bowers Terrane and, therefore, is thought to form part of this terrane. There are, however, no rocks of the Bowers Super Group (see GANOVEX-TEAM 1987) exposed on this island. The Salamander Granite complex, located within the northern Wilson Terrane, is of special importance as it forms the only granitoid which yielded a Carboniferous age (BORG et al 1987). At the northwestern end of the Salamander Granite Complex, we found an intrusive contact to poly-metamorphic rocks of the Salamander Range which form part of the Wilson Group.

Most Admiralty Intrusives plutons are typical I-type granitoids in that they contain biotite, ± amphibole but lack muscovite. Primary muscovite has only been observed in some granitic rocks of the Gregory and Tapsell plutons which form part of the Yule Bay Batholith. Granitoids of the Yule Bay Batholith may thus be regarded as transitional between I- and S-type characteristics. A detailed petrographical and geochemical description of the Admiralty Intrusives granitoids was given by VETTER & TESSENSOHN (1987).

For geochronological investigations sample material was collected from nearly all intrusions (Fig. 1). Different rock types of the individual plutons, e.g. contrasting varieties of granitic rocks, aplites, or mafic inclusions were

sampled whenever possible. Different sample sites within individual intrusions were only considered for the Yule Bay Batholith and the Salamander Granite Complex both of which are thought to form composite igneous intrusions. In the Yule Bay area WYBORN (1981) distinguished at least four different Admiralty Intrusives plutons. Three of those plutons were sampled in the course of GANOVEX VI. The Salamander Granite Complex is a stratified intrusion (BORG et al. 1987). Rock samples were collected from both the upper monzo-syeno granite and the lower monzonite.

Surgeon Island, located in Yule Bay, is formed by granitic rocks which, because of their structural (see KLEINSCHMIDT et al. this volume), geochemical (VETTER & TESSENSOHN 1987) and isotopical characteristics (VETTER et al. 1984), strongly contrast with the Admiralty Intrusives granitoids of the Yule Bay area. In order to gain more insight into the geological evolution of this „huge raft of older basement carried up by the Yule Bay intrusion" (GANOVEX-TEAM 1987) samples were collected from Surgeon Island, too.

COUNTRY ROCKS

The country rocks of the Admiralty Intrusives granitoids in the Robertson Bay Terrane are formed by a monotonous sequence of turbidites of early Paleozoic sedimentation age, i.e. the Robertson Bay Group (GANOVEX-TEAM 1987). Lithologically, the Robertson Bay Group turbidites vary between greywackes and silty mudstones. For the purpose of this study rock samples of predominantly pelitic composition were collected within a broad cross section which runs roughly parallel to the northern Pacific coast of North Victoria Land and which extends from the Robertson Bay coast to the western terrane boundary (Fig. 1). Care was taken to avoid sample sites which are located within the thermal aureoles of intrusions of the Admiralty Intrusives.

From east to west, the structural and metamorphic habit of the Robertson Bay Group meta-mudstones changes in a regular manner. In the Dunedin Range and the eastern Anare Mountains finely crystalline slates of mostly pale-grey colour are found which were affected by a single-phase deformation resulting in a well-developed penetrative cleavage. Only those slates were sampled which showed a slaty cleavage oriented at a high angle to the bedding planes. This was done in order to gain sample materials with a high degree of metamorphic recrystallization. Slates of the central Anare Mountains and further to the west are distinguished from those of the eastern Robertson Bay Terrane in that they show kink bands and a crenulation cleavage indicative of a two-phase deformation. To the west of the Lillie Glacier the slates grade into variably coloured phyllites. Locally, the phyllites and slates are intercalated with schistose rocks which consist of folded quartz-feldspar and mica-rich layers alternating on a mm-scale. This type of schist bears close resemblance to the Millen Schists (GANOVEX-TEAM 1987). Typical Millen Schists with an at least three-phase deformation were only found in the Mt. Bruce area in a narrow zone next to the western boundary of the Robertson Bay Terrane. It should be mentioned, however, that schistose rock types transitional between Millen Schists and phyllites are present in the Mt. Bruce area as well.

The field data summarized above suggest a slight increase in both, deformation and metamorphism across the Robertson Bay Terrane. Metasediments of the eastern areas are of very low grade and show a single-phase deformation whereas those of the westernmost Robertson Bay Terrane can be classified as low-grade and poly-phase with respect to their metamorphic and structural evolutions, respectively. These field results match those of earlier studies (see GANOVEX-TEAM 1987).

Metasedimentary sequences well comparable to the Robertson Bay Group turbidites in their sedimentological features as well as in their structural evolution and metamorphic grade are also known from the Wilson and Bowers Terranes (GANOVEX-TEAM 1987). For comparative geochronological investigations, very low to low-grade slates and phyllites were sampled from three sites within the Wilson Terrane (Lonely One and Onlooker Nunataks, Helliwell Hills, Fig. 1) and from one site located at the eastern boundary of the Bowers Terrane (spur W of Mt. Bruce).

FUTURE ANALYTICAL INVESTIGATIONS

Two different approaches are planned for geochronological investigations on the rock samples. The Admiralty Intrusives granitoids and the metagranitoids from Surgeon Island will be dated by the U-Pb zircon method. Applied to igneous rocks which did not suffer from later overprints this method will yield crystallization ages rather than cooling ages. Furthermore, zircons of I- and S-type granitoids often contain an U-Pb component inherited from the crustal source rocks of the intrusives. Dating of zircons of the Admiralty Intrusives can thus constrain the crystallization age of these granitoids as well as yield informations about the age of the deeper crust of North Victoria Land. The very low to low-grade metasediments will be dated by the K-Ar method on total rock-splits in continuation of the work of ADAMS et al. (1982) and ADAMS & KREUZER (1984). These studies revealed in part highly variable apparent ages which point to local post-Ross disturbances of the K-Ar systematics. The K-Ar dates on slates and phyllites which will be obtained in the course of the present study will therefore be subsequently verified by Ar-Ar analyses. Combined K-Ar and Ar-Ar dating is regarded as a powerful tool to unravel the timing of Ross-related and younger processes which affected the very low to low-grade metasediments of North Victoria Land.

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