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6. The Johnnie Walker Formation: A Pre-Granite Harbour Subvolcanic Unit in the Wilson Terrane, Lower Mawson Glacier, Victoria Land, Antarctica

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INTRODUCTION

Regional mapping was carried out in the area of the Prince Albert Mountains between Reeves and Mawson Glaciers, central Victoria Land, during GANOVEX VI, 1990/91. This has led to the discovery of an apparently non-metamorphosed sub-volcanic unit in the medium to high-grade Wilson Terrane. The unit is exposed at Walker Rocks which had not been visited previously but were mapped as Granite Harbour Intrusives (SKINNER & RICKER 1968) or Ferrar Group (WARREN 1969) on older maps.

DEFINITON, TYPE LOCALITY AND TYPE SECTION

The name „Johnnie Walker Formation" is proposed here for the unit of non-metamorphic andesitic and rhyolitic rocks which occur north of the Convoy Range in the Transantarctic Mountains. Investigated outcrops are located in the southern extension of the medium to high-grade metamorphic Wilson Terrane of the Paleozoic Ross foldbelt.

The name is taken from Walker Rocks, a group of nunataks in the lower Mawson Glacier, 25 km from the Ross Sea coast. Walker Rocks consist of three nunataks, only two of which are represented on the 1 : 250,000 map, sheet „Convoy Range". The new formation is exposed on the largest and southernmost of these nunataks (Fig. 1).

A type section is chosen through the outcrop of the southernmost Walker Rock from NW to SE (Fig. 1). The base of the new formation is formed by an unconformable, non-tectonic contact with folded and metamorphosed Priestley schists (Fig. 2). As the top of the formation is not exposed, only a minimum thickness can be estimated in the order of several 100 m. The formation is bordered on its southern and western flanks along an intrusive contact by different granitoids of the Granite Harbour Intrusive suite (grey Larsen and red Irizar-type granites). Younger granitic dikes cut through the contact into the Johnnie Walker Formation. Thus, the Johnnie Walker Formation is stratigraphically younger than Priestley schists and older than Granite Harbour Intrusives.

DESCRIPTION AND LITHOLOGY

The Johnnie Walker Formation consists of two units: (i) The basal andesite member, which morphologically forms the upper part of the outcrop, has a thickness of about 200-300 m, and is mostly massive. Irregular portions of brecciated andesite are also observed. The holocrystalline andesite is rather uniform with mm-sized placioclase

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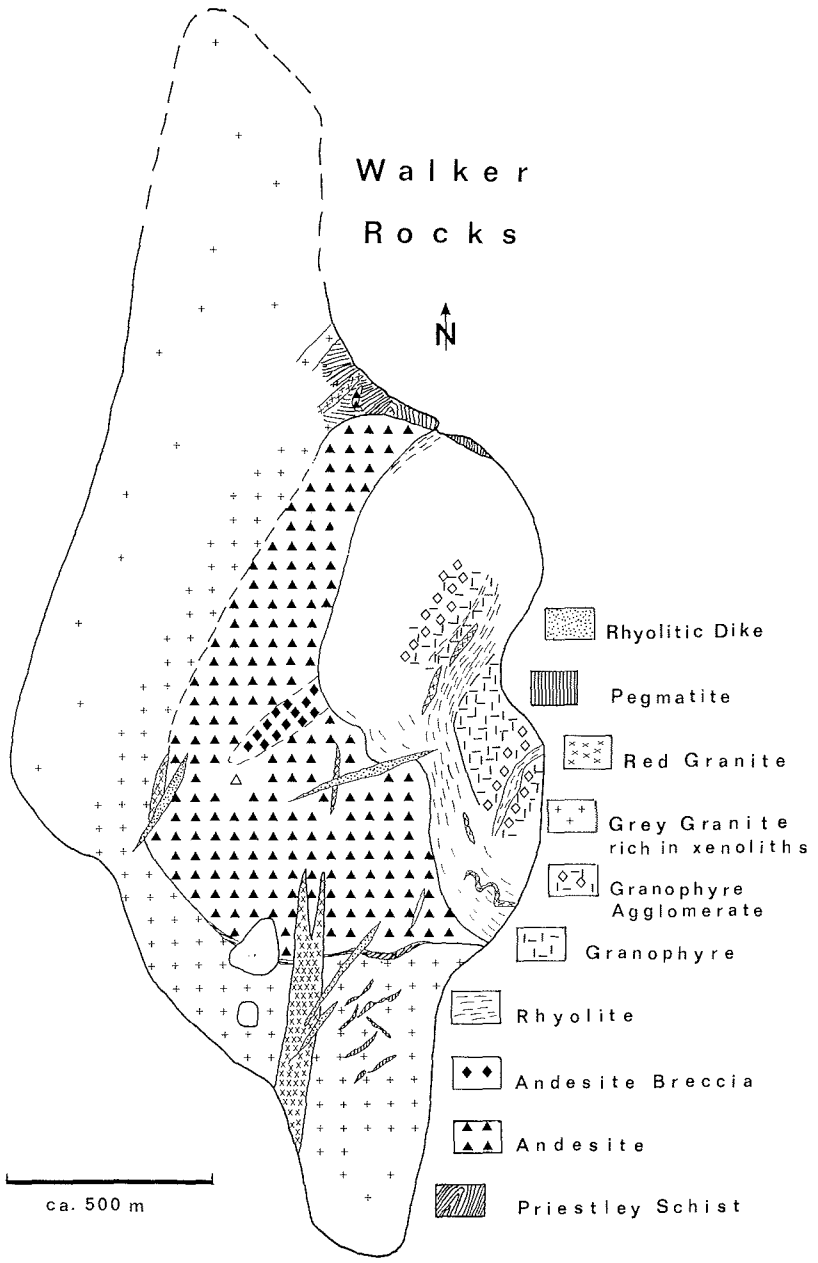

Fig. 1: Geological sketch map of the southernmost Walker Rock.

Abb. 1: Geologische Kartenskizze des südlichen Aufschlusses des Walker Rock.

phenocrysts set in a dark groundmass. Vesicles have not been observed. While alteration is generally limited to greenish discolorations there are patches of stronger (hydrothermal?) alteration.

(ii) The overlying rhyolite-granophyre member, by contrast, is more inhomogeneous. Morphologically, it forms the lower part of the outcrop and consists of bodies of granophyres and sparsely porphyritic rhyolites which appear to be sandwiched in discrete layers. Over a total thickness of about 200 m the granophyres become more abundant upwards. Two types of granophyre exist. A massive type with up to 60 % phenocrysts (quartz, plagioclase, alkalifeldspar, biotite) in a fine-grained felsic matrix. A second type is a nodular granophyre with cm to dm-sized rounded clasts set in a fine-grained fluidal rhyolitic matrix. This texture probably formed by some process of autobrecciation during flowage and intrusion of a highly viscous crystal mush.

While in the upper parts the rhyolites and granophyres appear to be horizontally interlayered we found one rhyolite dike cutting through a thick nodular type granophyre. The dike contacts show evidence of rhyolite-granophyre mixing resulting in a hybrid zone up to 1 m wide. Apparently, the granophyre was still partially liquid at the time of dike injection. These field observations, in particular size and texture of the rock bodies suggest a formation in a subvolcanic environment.

Contact relations

The lower contact between the Johnnie Walker Formation and Priestly schists is unconformable and forms an E-dipping inclined surface. Contact relations can best be observed on the northern cliff of the outcrop (Fig. 1). The lower and steeper part of the cliff is formed by folded and generally N-S striking and steeply W-dipping Priestley schists (Fig. 2). In the upper part these schists are unconformably overlain by the andesitic and the rhyolitic member of the formation. Because of the blocky nature of the outcrop the unconformable contact could nowhere be directly observed but mapping within 2 m is possible in many places.

The boundary of the two volcanic units is sharp and generally steep. It has been mapped across the whole outcrop for about 2 km in a north-south direction.

The upper contact is more critical to the interpretation of the Johnnie Walker Formation. Larsen-type granite (FENN & HENJES-KUNST this vol.) forms a wide arch enveloping the Johnnie Walker andesites. The intrusive contact is steep in the south and flat-lying in the center of the nunatak (Fig. 1). Highly deformed Priestley schists in beds between a few cm and 1 m wide are observed at and parallel to the boundary. Cm-thin flakes of schists also occur within the granite near the contact. Internal magmatic deformation of the granite suggests that the granite was nearly solidified near its contacts when intruding the andesites. Additional internal deformation postdating the intrusion occurs along discrete, mostly NW-SE oriented, dextral ductile shear zones and small-scale brittle strike-slip faults offsetting aplitic dikes.

This contact between Johnnie Walker andesite and Larsen-type granite is cut by undeformed coarser-grained Irizar-type granite with its typical red alkalifeldspars. Similar granite also intrudes the Johnnie Walker rhyolite/granophyre sandwich in flat-lying bodies up to 2 m thick (Fig. 3). The youngest rocks exposed at Walker rocks are represented by aphyric dikes of suspected rhyolitic composition. These are similar to acidic dike rocks cutting the basement rocks elsewhere in the area (FENN & HENJES-KUNST this vol.)

Age

Contact relations of the Johnnie Walker Formation clearly indicate that it formed between Ross-age metamorphism of the Priestley schists and the intrusion of the Granite Harbour magmas. Thus it is clearly a part of the Cambro/Ordovician Ross Orogen.

No other outcrops of the Johnnie Walker Formation are known so far, but many rhyolitic and porphyritic non-metamorphic dikes occur in the basement between the Nansen Plateau and the Mawson Glacier (SKINNER & RICKER 1968, FENN & HENJES-KUNST this vol.). On Anderson Ridge these rocks yielded a Rb/Sr whole

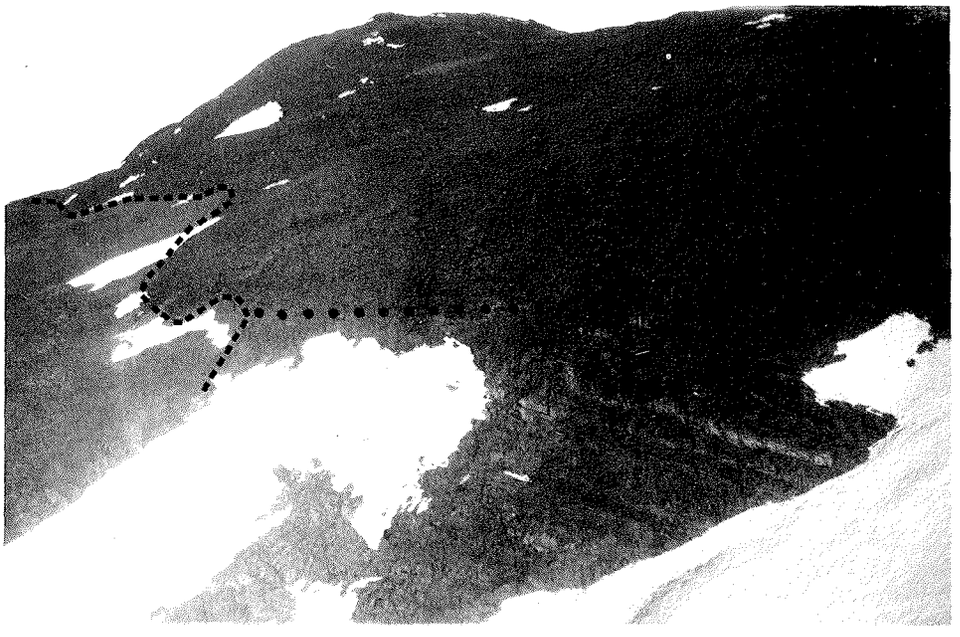

Fig. 2: Contact relations between Priestley Schists and new Johnnie Walker Formation, NE flank of outcrop (Fig. 1), view to the SW. Layered Priestley Schists in the foreground dip to the right (W). Dark andesites overly schists (top right and hill in the centre). Light colored rhyolites (left) overly andesites stratigraphically.
Dotted line = unconformable contact between Priestley Schists and andesites. Dashed line = stratigraphic contact between andesites and rhyolites.

Abb. 2: Kontakt zwischen Priestley Schists und neuer Johnnie Walker Formation an der NE-Flanke des Aufschlusses von Abb. 1 mit dem Blick nach SW. Gebankte Priestley Schists im Vordergrund fallen nach W ein. Dunkle Andesite überlagern die kristallinen Schiefer (oben rechts und Hügel im Zentrum). Helle Rhyolite (links) überlagern die Andesite in stratigraphischem Verband.
Gepunktete Linie = Diskordanter Kontakt zwischen Priestley Schists und Andesiten. Gestrichelte Linie = Stratigraphischer Kontakt zwischen Andesiten und Rhyoliten.

rock isochrone age of 480 m.y. (DUPHORN et al. in press). These dikes, however, are younger than the Granite Harbour Intrusives, whereas the lithologically similar rocks of the Johnnie Walker Formation are older.

Of a comparable lithological nature are also the andesitic- rhyolitic associations of the Gallipoli Volcanics in North Victoria Land (GANOVEX Team 1987). However, these are clearly unrelated to the rocks described here, because they are of Devonian/Carboniferous age and related to the younger Admiralty Intrusives.

Metavolcanic rocks of the Cocks Formation in the Skelton Glacier area, South Victoria Land (SKINNER 1982), may be compatible in age and composition, but the metamorphic degree seems to be higher.

The closest analogon seems to be the Wyatt Formation in the Central Transantarctic Mountains (STUMP et al. 1986), which is not only similar in lithology but occurs also in a comparable structural position.

CONCLUSIONS

The Johnnie Walker Formation is unusual in two aspects: (i) Rocks of such type and age have not been observed previously in Victoria Land and (ii) they pose a problem for the geological evolution of the Wilson Terrane.

Non-metamorphic sub-volcanic rocks are difficult to explain in a position between Ross-age metamorphics and deep-seated post-tectonic Granite Harbour Intrusives. These relations require a rapid and short-lived uplift event between metamorphism and post-tectonic granite intrusion.

Fig. 3: Granitic dike of Granite Harbour Suite (right) intruding Johnnie Walker rhyolites. The chilled margin of the granite is clearly recognizable.

Abb. 3: Granitischer Gang der Granite Harbour Suite (rechts) intrudiert Johnnie Walker Rhyolite unter Ausbildung eines feinkörnigen Kontaktsaums.

In order to address this problem we plan to investigate the geochemical relations between the various igneous rocks described. Geochemical provenance studies will help to place the Johnnie Walker volcanism into the proper tectonic framework. In addition, isotopic dating will serve as a crucial test to the field relations observed here. A comprehensive interpretation of the new Johnnie Walker Formation within the context of the Ross Orogeny can be given only after these laboratory data have been obtained.

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