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1982/10. Preliminary review of Eocambrian-Cambrian basaltic associations and tectonic setting within western and north-western Tasmania

A.V. Brown
*H.M. Waldron**

Abstract

This report summarises the basaltic events and tectonic setting during Eocambrian-Cambrian times in parts of western and north-western Tasmania.

INTRODUCTION

The following has been submitted as a paper to the International Association of Vulcanology and Chemistry of the Earth's Interior/International Association of Geochemistry and Cosmochemistry (IAVCEI/IAGC) meeting 'Generation of Major Basalt Types' to be held in Reykjavik, Iceland from 15-22 August 1982.

REPORT ABSTRACT

HIGH-MAGNESIAN ANDESITES WITHIN A CAMBRIAN CONTINENTAL RIFT ENVIRONMENT, WESTERN TASMANIA

A.V. Brown
Geological Survey of Tasmania, G.P.O. Box 124B, Hobart Tasmania, 7001, Australia

H.M. Waldron
Department of Geology, University of Melbourne, Parkville, Victoria, 3052, Australia

Chemically distinct basaltic lava associations found within volcano-sedimentary troughs of western Tasmania have been considered by Varne and Foden to be the result of progressive melting within part of an upwelling mantle diapir beneath a system of *en echelon* intracontinental rifts formed during Eocambrian-Cambrian times in part of eastern Gondwanaland.

High-magnesian andesite found within western Tasmania is characterised by pyroxene and minor chrome spinel phyric lavas with SiO_2 contents of 54-58 wt%; TiO_2 <0.1 wt%; MgO 15-20 wt%; Zr ∿10ppm; Y ∿5ppm; and concave REE pattern, similar to present day boninitic lavas. The phenocrystic pyroxenes in these lavas are highly altered but the chrome spinel has a Cr/(Cr+Al) = 0.89-0.94. These lavas are probably primary. Extrusive flows form interbedded pillow, breccia and massive flows. In one location, high-magnesian andesite flows overlie Precambrian basement, demonstrating that such lavas are not restricted to Island Arc environments. This phase of volcanism is considered to have coincided with the early cessation of rifting. Ultramafic cumulates, derived from these lavas in crustal magma chambers, contain basal orthopyroxene bearing dunite with the orthopyroxene having a clinoenstatite composition (En_{94}, and CaO contents of <0.25 wt%). The olivine present is $Fo_{93.5}$ and chrome spinel has Cr/(Cr+Al) = 0.90-0.92.

An earlier phase of melting produced highly enriched olivine tholeiite lavas. These lavas were erupted through continental crust and are interbedded with terrigene clastic sedimentary rocks. Low-Ti (0.7-1.0 wt%) basal flows are olivine phyric but the majority of the flows are clino-

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* Department of Geology, University of Melbourne

pyroxene and/or plagioclase phyric. Chemically the lavas are characterised by SiO_2 contents of 45-51 wt%; TiO_2 >0.7 wt%; MgO 5-11 wt%; Zr 70-220ppm; Y 20-40ppm; and high total REE content with LREE enrichment, $(La/Yb)_N$ = 1.5-3.5.

Highly depleted, low-Ti quartz tholeiite lavas were the product of a third melt phase. Flows of this basaltic episode were extruded just after the onset of a compressive tectonic phase approximately 30ma after cessation of rifting. In places, lavas from this third basaltic phase are interdigitated with mass flow conglomerate units at the base of a middle-Middle Cambrian sequence. The Middle Cambrian sedimentary rocks are mainly a continentally derived, clastic turbidite succession. Chemically the low-Ti quartz tholeiite contains SiO_2 contents of 50-56 wt%; TiO_2 0.2-0.6 wt%; Zr ∿15ppm; Y ∿10ppm; and severe LREE depletion, $(La/Yb)_N$ <0.5.

SUMMARY OF TECTONIC SETTING

The following summary of the tectonic setting of western and north-western Tasmania is based on Williams (1978), Varne and Foden (submitted for publication), Brown *et al.* (1980), and unpublished work done by A.V. Brown (1976-1982) in the Corinna, Zeehan, and Smithton Quadrangles during mapping programs for the Geological Survey Branch of the Tasmania Department of Mines.

During Eocambrian-Cambrian times a series of *en echelon* rift troughs formed within that part of eastern Gondwanaland now represented by Victoria Land, Antarctica; the island of Tasmania; and the State of Victoria in south-eastern Australia. Remnants of this *en echelon* rift system are considered to include the Staveley, Heathcote and Mt Wellington Belts of Victoria; south-eastern King Island; the Bowers Trough in Victoria Land; as well as numerous elongate areas of Eocambrian-Cambrian rocks in Tasmania.

The intracontinental rifting, accompanied by diapiric upwelling of fertile mantle, is considered to have started with the onset of a tensional tectonic phase during Eocambrian times (∿650-630 Ma). Basaltic volcanic events within different troughs are considered to have been interrelated, with chemical variations between troughs due to inhomogeneities within localised parts of the diapir. Progressive tappings of the diapiric reservoir of original fertile mantle also produced variations in magma type.

The Dundas and Smithton Troughs of western Tasmania were formed within the relatively unmetamorphosed Precambrian sedimentary rock successions of the Rocky Cape region. In the Dundas Trough, initial sedimentary infilling of the rift basins was by shallow-water siliceous sediments. These sediments were derived from basement rocks, and deposited in a rapidly subsiding shelf environment. Initial infilling was followed by the onset of basaltic volcanism. Olivine tholeiite lavas from the first melt phase are interbedded with turbidite sequences of mixed continental and volcaniclastic material.

The high-magnesian andesite is considered to belong to the second phase of basaltic volcanism that coincided with the early cessation of rifting. Extrusive flows consist of pyroxene phyric high magnesian andesite and form interbedded pillow, breccia and massive flows, in one location overlying Precambrian basement. Due to cessation of rifting, most of the second phase melt was trapped within the rift basement rocks and formed localised magma chambers along the length of the rift. Cessation of rifting was then followed by a period of tectonic quiescence throughout

most of the Lower Cambrian, during which erosion of the volcano-sedimentary infilling of the trough and crystallisation of layered cumulate ultramafic-mafic bodies in the crustal magma chambers took place.

Early in the Middle Cambrian (∿550 Ma), a compressive tectonic phase developed, causing deformation of the crustal magma chambers and the emplacement of ultramafic-mafic bodies along pre-existing lines of weakness into the eroded troughs of deposition. This emplacement was followed by extrusion of a third, highly depleted, phase of basaltic lavas in the middle of the Middle Cambrian. These lavas were also extruded along the pre-existing lines of weakness, and in places interdigitated with mass-flow deposits containing ultramafic detritus. The mass-flow units are part of a fossiliferous middle-Middle to Upper Cambrian continentally derived turbidite succession.

Along the eastern side of the Dundas Trough is a 10-15 km wide elongate zone of acid volcanic rock, the Mt Read Volcanics. This acid volcanic pile is considered to have been the result of crustal melting due to high heat flow associated with the upwelled mantle. The earliest record of acid volcanic detritus within sedimentary rock sequences of the Dundas Trough is in the upper-Middle Cambrian.

Biostratigraphic correlates of the Dundas Trough sequences are found within the Mt Read Volcanic successions but the only known contact between the Dundas Trough and Mt Read Volcanic successions so far mapped are faults extending between areas of relatively unmetamorphosed Precambrian rocks (at Mt Bischoff, Ramsay River-Coldstream River and Mt Dundas areas).

To the east of the Mt Read Volcanics lies the Tyennan region, which consists of deformed Precambrian metamorphic rock successions. Litho-structural correlates of Tyennan region successions occur to the west of Rock Cape region rocks on the west coast of Tasmania at Cape Sorell. These metamorphosed Precambrian rocks are considered to be basement for the younger, relatively unmetamorphosed Precambrian sequences of the Rocky Cape region.

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