PHYSICAL VOLCANOLOGY OF THE EARLY PROTEROZOIC BEAR LAKE MAFIC METAVOLCANIC SUCCESSION, FLIN FLON, MANITOBA

by

© Michael B. Dolozi

A Thesis submitted to the Faculty of Graduate Studies
of the University of Manitoba
in partial fulfillment of the requirements for the degree
of
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ABSTRACT

The 3.3-km thick, Early Proterozoic, Bear Lake mafic metavolcanic succession near Flin Flon, Manitoba, is a vertically dipping, homoclinal sequence within a fault block. The base of the mafic succession is a fault, and the mafic units are overlain by 1.8 km of felsic to intermediate metavolcanic rocks. Six formations have been defined within the mafic sequence: formation 1, 3 and 5 are dominantly pillowed flows, formation 2 comprise equal abundances of pillowed and massive flows, and formations 4 and 6 are dominantly bedded breccias and tuff-breccias with intercalated pillowed flows. These formations show an increase in amygdule abundances with stratigraphic height; amygdule abundance increases from 0 to 25% in the lower part to 10 to 75% in the upper part, the formations thus record the evolution of an upward shoaling, flank section through a mafic sheild volcano. High amygdule abundances and the possible presence of a flow-foot breccias in formation 5 indicate that the volcano may have become locally emergent.

The main focus of this study was the bedded fragmental units of formation 4. This 416-m thick formation is lens-shaped, and has been traced laterally for 11.2 km. The dominant lithology is breccias and tuff-breccias that are commonly matrix-supported but are occasionally clast-supported. Bed thicknesses are 0.5 to 15 m, and beds are

ungraded, normally graded or reversely graded with non-erosive bed contacts. Fragments are commonly amygdaloidal (range 5-55%; mean 31%), angular to subangular, and 0.5 to 100 cm in size with partial or complete chilled rims; the matrix is microlitic and weakly microlitic, blocky, vesicular and non-vesicular lapilli and ash. A few tuff-breccia beds contain irregular, plastically deformed particles and an unusually high proportion of vesicular matrix particles. Medium- to thinly-bedded lapilli-tuffs and tuffs that are dominantly normally graded with sharp bed contacts and occasional scour-and-fill and flame structures form a small proportion of the formation. The enclosing and intercalated pillowed flows have a lower amygdule content (range 5 to 35%, mean 21%) with amygdules concentrated near pillow margins.

Breccias and tuff-breccias were apparently deposited by a series of debris flows generated by slumping of preexisting fragmental material that was explosively erupted in shallow water by a combination of magmatic and contact steam explosions. During the eruptions, the fragmental material was periodically transported to deeper water depositional environments and locally incorporated some fragments derived from pillowed flows. Tuff-breccias with plastically deformed particles and more vesicular matrix probably indicate hot emplacement, possibly by block-and-ash flows. These hot units are stratigraphically restricted and thus indicate temporal variations in the types of explosive activity. The medium- to thinly-bedded tuffs at the top of the formation were probably

deposited by turbidity currents during the wanig stages of explosive activity.

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Chapter 1

INTRODUCTION

Statement of the Problem.

In Precambrian greenstone belts the predominant mafic metavolcanic successions are composed of lava flows and various types of fragmental deposits (Henderson, 1953; Dimroth et al., 1978; Bailes and Syme, 1979, 1980; Ayres, 1981; Ferreira, 1984). Of these fragmental rocks, subaqueous deposits are the most difficult to recognize and interpret because of the varied processes which lead to their formation (Fisher, 1984; Kokelaar, 1986). However, this is an important group of rocks to study because it is fairly common and contains measurable parameters which are useful in interpreting volcanic processes (Ayres, 1977a).

The Bear Lake mafic metavolcanic succession near Flin Flon, Manitoba, consists of lava flows as well as abundant, bedded fragmental deposits (Bailes and Syme, 1979, 1980). The mechanisms of formation of some of the bedded fragmental rocks in this area, and hence the evolution of the volcano represented by this succession are poorly understood. This study uses primary structures and textures of these rocks in order to decipher their mode of formation.

Understanding Precambrian volcanic processes from physical volcanology requires comparisons with younger volcanoes where primary structures and volcanic environments are relatively well understood. The problems of reconstructing