

SOURCE AREAS AND GEOCHEMISTRY
OF
LOWER CARBONIFEROUS IGNIMBRITES,
SOUTHERN NEW ENGLAND OROGEN,
N.S.W., AUSTRALIA

By

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*To
my
family*

*Sue
Richard, 3 yrs
Christopher, 17 mths*

ABSTRACT

A number of extensive silicic ignimbrites crop out along the western edge of the southern part of the New England Orogen, in the Hunter Valley from north of Scone to Port Stephens on the central east coast of New South Wales. The Early Carboniferous ignimbrites occur closest to the western margin of the Orogen and six of them, by partially overlapping each other, outcrop along almost the entire length of Hunter Valley. These six ignimbrites were analysed for primary flow-induced lineations of crystals and pumice clasts, using a slightly modified method used by previous workers, by measuring the lineated objects on sawn slabs of the ignimbrite rather than thin sections. The flow lineation vector strengths determined average 53% overall and they are statistically much stronger any previous study using thin sections whose average vector strengths are 24%.

By projecting the determined flow lineations until they intersected, clusters of intersection points enabled source areas of the ignimbrites to be defined. Three source areas were determined and they lie on the western side of the Hunter Fault, that forms the western margin of the New England Orogen, beneath the Permian Sydney Basin succession.

In the region of each of the three determined source areas are significant circular, mostly negative, gravity anomalies which are best explained by there being calderas infilled with low density lavas and pyroclastics now buried below the Permian succession.

The calderas are a part of volcanic centres that each consist of several vents. The Curra Keith, Oakfields and McCullys Gap ignimbrites (named herein) are determined to have originated from different vents within the Muswellbrook caldera which is located just west of the township of Muswellbrook. The Port Stephens and Nelson Bay ignimbrites (named herein) originated from the Port Stephens caldera located approximately 5 km south of Port Stephens, and the Martins Creek ignimbrite originated from the Maitland caldera located between the townships of Maitland and Branxton. The three calderas form a

chain which is named the Kuttung Volcanic Chain, and this chain was sited within an ensialic back-arc basin, the same as 'modern' large-scale ignimbrite-producing calderas are.

The Maitland caldera is the closest to the surface as three inliers of Early Carboniferous lavas and a granodiorite intrusion crop out within the confines of the gravity anomaly. The granodiorite is assumed to be the exposed root of the caldera and the comagmatic source of the ignimbrites derived from it.

The ignimbrites were petrographically and, geochemically analysed for both major and trace elements so that Curra Keith, Oakfields and Port Stephens ignimbrites plot as high-K rhyolites and the Nelson Bay and Martins Creek ignimbrites are both high-K dacites. The McCullys Gap ignimbrite is best called a sodic trachyte. A plot of V versus Sr distinguishes each of the ignimbrites from each other, Ni+Cr versus SiO₂ discriminates the rhyolites from the dacites, and Zr versus SiO₂ differentiates the Muswellbrook Volcanic Centre from the Maitland and Port Stephens Centres'.

A new geology map of the Port Stephens District is presented containing new structural data. Bedding in the massive Port Stephens ignimbrite which outcrops over much of the district was determined in the laboratory from collected orientated samples of the ignimbrite. Once plotted the bedding data shows that the Port Stephens District is criss-crossed by two sets of faults that form many fault blocks, and by repeatedly stepping up to the north they bring the southerly dipping Port Stephens ignimbrite back to the surface. The two main fault directions of the fault sets are NNW-SSE, and WNW-ESE and they are consistent with other fault directions in the rest of the southern part of the New England Orogen. An orthogonal joint set N-S and E-W is related to the Girvan Anticline which closes in the Port Stephens District and they are intruded by some sixty Tertiary basalt dykes. A co-ignimbrite lag-fall breccia at the base of the Port Stephens ignimbrite confirms the proximal nature of the ignimbrites in the Port Stephens District.

CERTIFICATE
OF
ORIGINALITY

I

MALCOLM DAVID BUCK

hereby declare that this
thesis has not been
submitted for a higher
degree elsewhere and all
work contained herein
is original except where
references are cited

Signed *Malcolm D. Buck, M.Sc., J.P.*

12 August 1988

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