TUFF-LAVA FROM SOUTHEAST QUEENSLAND, AUSTRALIA

J.A. ROSS
G. P. O. Box 151, Canberra City, A. C. T 2601, Australia.

ABSTRACT

This paper describes a rhyolitic rock type which has the textures of both lava and tuff. It is interpreted here as a tuff-lava. It does not represent a mode of volcanic eruption additional to those represented by lavas and ash fall and ash flow tuffs but rather the "frozen" transition of conduit lava being converted to tuff.

INTRODUCTION

An extinct shield volcano, named the Focal Peak Shield Volcano, occurs in southeast Queensland and northeast New South Wales, Australia. The volcanics and associated intrusives of the shield volcano are late Oligocene in age. Eruptives include the Albert Basalt and the Mt Gillies Rhyolite on the volcano's eastern flank[1,2].

The Mt Gillies Rhyolite is composed largely of rhyolites and includes pitchstones and non-glassy rhyolites. Dykes and eruptives are numerous and are composed largely of conduit lavas and lavas and uncommon ash flow tuffs, ash fall tuffs and tuff-lava.

THE TUFF-LAVA CONCEPT

In the 1960s many workers described textures within eruptives and, the occasional, intrusive igneous rock, largely of rhyolitic composition, which they believed displayed characteristics of both lava and tuff origin [3-6]. These rocks were called by names such as "froth-flow" and "tuff-lava". These terms can be considered to be synonymous.

Locardi and Mittempergher[3] stated that some eruptives in Italy were froth-flows in which transitions from lava to tuff could be traced. They concluded that a moderately to a highly viscous magma was converted partially into pumiceous material by gas expansion and exsolution. Shearing between flow laminae within the parental lavas led to patchy vesiculation and the formation of vesiculation bands. Shearing along, and the fragmentation of, these bands resulted in the formation of lenses or fiammes of glass set within the matrices of pumiceous matter which were consequently, in part, brecciated by friction to ash.

Feeders for the ignimbritic and supposed tuff-lava complexes of the northern Caucasus region of the Soviet Union have been described by Koronovsky[4]. Vertical sections of these feeders are exposed and consist of complex interfingering of zones, bands and patches of lava, breccia and supposed tuff-lava within individual dykes. The reported tuff-lavas become increasingly more voluminous upwards within the feeders and are composed of patches and bands of pumiceous material intercalated with conduit lava from which the pumiceous material was believed to be derived. Fiammes occur within the tuff-lavas. Extrusive tuff-lavas were reported to be present although greatly subordinate in volume to ignimbrites (ash flow tuffs). Koronovsky[4] attributed the formation of his tuff-lavas to unequal gas separation and brecciation along the flow bands.

Other supposed tuff-lavas are described by Cook[5] and will not be discussed here.

A WARNING

The concept of tuff-lava is now discredited. The supposed tuff-lavas described in the literature[3-6] are now believed generally to be tuffs including those in which rheomorphism or secondary post-eruptive flow has occurred during cooling.

An attempt will be made in this paper to show that intrusives (and rare extrusives) with co-existing conduit lava (or lava) and tuff can exist. Before pointing out a fundamental fact in support of such a transitional or intermediate type of rock, I would ask the reader to have an open mind and not let it be clouded by the past dismissals of such rock types. The fact is: many tuffs are derived from parental sources which were once magma within magma chambers and/or conduits and consequently it is reasonable to assume that the geological record will sometimes preserve the zones in which tuffaceous materials were being generated from parental magmas; to assume otherwise would be geologically unrealistic.

In this paper then, in relation to the uncommon tuff-lavas in the Mt Gillies Rhyolite, we will be discussing a

rock type which represents such frozen transitional zones and not a mode of eruption deserving to be considered as additional to the three modes of lava, ash fall and ash flow tuff. This paper should not be read as implying that the supposed tuff-lavas discussed in the previous section are in fact tuff-lavas – perhaps a few are, especially those supposed tuff-lavas described by Koronovsky[4], but more field and thin section study would be required to ascertain this.

TUFF-LAVA FROM SOUTHEAST QUEENSLAND

Samples of uncommon tuff-lava have been recognised in the dykes and eruptives of the Mt Gillies Rhyolite. The tuff-lava samples consist of the two components glassy lava and ash, which generally coexist as thin intercalated bands and patches. Subsequently, these tuff-lava samples are here called two component tuff-lavas in order to emphasise the coexistence of the above two components.

Because there are two separate components and one component, the ash, is believed to be derived from the lava component, the volumetric ratio of the two can be expected to vary considerably as is borne out by field work. At some field outcrops the volumetric percentage of the ash component constitutes around 50 % of the outcrop and at others can range down to around 1 % and less. For a rock outcrop with a very low volumetric percentage of ash, the term tuff-lava is probably not to be preferred. Perhaps a preferred term or rather description would be a lava or conduit lava with minor ash. The cut-off point between the use of this description and the term tuff-lava cannot readily be defined objectively. A suggested subjective cut-off point would be a volumetric percentage of 10 % ash.

At one locality of special interest (Cashell's Gap) well defined lava and ash bands and patches occur within a tuff-lava in a dyke over an area of about 120 by 50 metres. Because of the presence of nearby non-glassy rhyolitic eruptives at altitudes slightly lower than the dyke outcrops, it is suspected that the dyke outcrops were within a few tens of metres of the surface eruptive orifice of the dyke. The lava and ash bands within this dyke average around 1 cm in width. The lava component is a black porphyritic glass (equivalent to pitchstone) and the other component is a pink and very porous ash. Both components are present in approximately equal volumetric proportions in some outcrops of the dyke. At other dyke outcrops a pitchstone auto-agglomerate occurs and contains less than 5 % ash.

The rounded blocks (or clasts) in the pitchstone auto-agglomerates at this and other localities show no evidence of rheomorphism or secondary flow. There is no sign of elongation or strong or even moderate welding together of any of the blocks. Additionally, the lengthy bands of black porphyritic glass, alternating with the ash component in the two component tuff-lava, show no signs of internal welding together of glass or internal lengthy flow textures, either to the naked eye or in thin sections, Rheomorphism can, therefore, be dismissed as an explanation for the observed textures.

In thin sections of the Cashell's Gap tuff-lava the black porphyritic glassy bands are very similar in texture to definite pitchstone lavas occurring elsewhere in the Mt Gillies Rhyolite although the following differences occur. Within the Cashell's Gap tuff-lava numerous minute lens-shaped vesicles occur: such vesicles are rare in the pitchstone lavas. In the glassy component of the tuff-lava all pyroxene and fayalite phenocrysts are altered presumably due to oxidation by volatiles: unaltered pyroxene and fayalite phenocrysts commonly occur within the pitchstone lavas.

In thin sections the pink porous ash component is distinctly fragmental and has an ignimbritic appearance. Moderate welding (sintering) of the fragments has occurred while some flow of the ash is evident. Semi-randomly distributed small brecciated fragments of phenocrysts and partially vesiculated elongated glassy lenticles are common.

At another locality occurring 20 kms due east of Cashell's Gap a pitchstone auto-agglomeratic eruptive contains blocks of pitchstone which generally contain only minor ash bands and patches. However, some blocks contain much ash and can be considered to be tuff-lava samples. The eruptive itself should not be called a tuff-lava as the tuff-lava blocks are less numerous than blocks containing little or no ash. The lenticles in the blocks of tuff-lavas resemble those of classical ignimbrites. More evidence is required before stating that this eruptive is derived from the above dyke at Cashell's Gap especially since the history of rhyolitic eruptions in the Cashell's Gap area is complex.

The lenticles from the southeast Queensland tuff-lava samples sometimes display traces of lava-flow. Some lenticles possess rounded indented edges which may represent the remains of fractured vesicular walls. Many of the preserved vesicles within the lenticles are associated with phenocrysts and occur along the margins and within fractures of these crystals.

The mineralogy of the tuff-lava samples is consid-

ered to be the same as the pitchstones occurring within the Mt Gillies Rhyolite *i.e.* sanidine (and minor anorthoclase) +/− quartz + ferrohedenbergite (and minor ferroaugite) + fayalite + ilmenite +/− ferrohypersthene + zircon + chevkinite +/− ferropigeonite +/− partially resorbed plagioclase in approximate order of decreasing abundance[2]. Based upon the Shand classification of igneous rocks, the rhyolites of the Mt Gillies Rhyolite are metaluminous[7].

ORIGIN OF TUFF-LAVA

The formation of ash in the southeast Queensland tuff-lava samples is attributed to gas vesiculation occurring preferentially along flow bands and in patches thus disrupting the conduit lavas (c.f. Koronovsky[4]). The degrees of violence of this vesiculation are probably insufficient, however, to convert all of the disrupted conduit lavas to ash. Such disruptions probably occurred within the conduits near their surface orifices. In passing it would seem useful for a re-examination of the ignimbritic and once supposed tuff-lava complexes of the northern Caucasus region of the Soviet Union to be undertaken as the rock textures and geology described by Koronovsky[4] are similar to those of southeast Queensland.

23 January 1984; Revised 16 October 1984

1. Ross, J. A., *Proc. R. Soc. Qld.*, 1974, **85**, 111.
2. Ross, J. A., "The Tertiary Focal Peak Shield Volcano, South-East Queensland – a Geological Study of its Eastern Flank", Unpublished Ph. D. Thesis, University of Queensland, Australia, 1977.
3. Locardi, E. and Mittempergher, M., *Bull. Volcan.*, 1967, **31**, 131.
4. Koronovsky, N. V., *Bull. Volcan.*, 1971, **34**, 639.
5. Cook, E. F. (ed), *Tufflavas and Ignimbrites; A survey of Soviet Studies*, Elsevier Book Company, 1966.
6. McCall, G. J. H., *Geol. Rundschau.*, 1964, **54**, 1148.
7. Carmichael, I. S. E., Turner, F. J. and Verhoogen, J., *Igneous Petrology*, McGraw-Hill Book Company, 1974.

ANNOUNCEMENT

INTERNATIONAL CONFERENCE ON PESTICIDES: TOXICITY SAFETY AND RISK ASSESSMENT

An International Conference will be held on *October 27–31, 1985* at Industrial Toxicology Research Centre (CSIR), Lucknow, India. The conference comprise plenary sessions key note addresses, poster sessions and expert panel deliberations on the following topics:

1. Pesticides: Interaction with animals, humans and environment. 2. Model systems to study pesticide intoxication in animals and humans. 3. Residues of pesticides with special reference to human health and rist. 4. Extrapolation of animal data to humans. 5. Education, safety measures in occupational workers exposed to pesticides. 6. Pesticides: Special problems in the geoclimatic regions of the developing countries. 7. Pesticides in the context of phytotoxicology and ecotoxicology. 8. Safety evaluation and risk assessment of pesticides – Future perspectives.

Further particulars may be had from: Dr T. S. S. Dikshith, General Secretary, Industrial Toxicology Research Centre, Lucknow 226 001, India. **Last date for receipt of abstracts/papers is July 15, 1985.**