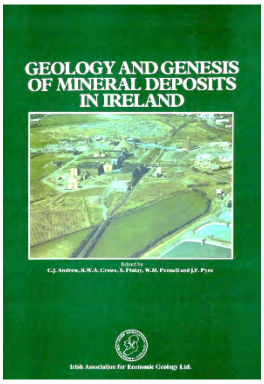


Irish Association for Economic Geology

(founded 1973)

Home Page: https://www.iaeg.ie

Field evidence for ignimbrites in the Avoca Belt.

W.B. Jones

To cite this article: Jones, W.B. (1986) Field evidence for ignimbrites in the Avoca Belt. *In:* Andrew, C.J., Crowe, R.W.A., Finlay, S., Pennell, W.M., and Pyne, J.F. '*Geology and Genesis of Mineral Deposits in Ireland*', Irish Association for Economic Geology, Dublin. 83-88. DOI:

To link to this article: https://

Field evidence for ignimbrites in the Avoca volcanic belt.

W. B. Jones

Phillips Petroleum Co. Europe-Africa
The Adelphi,
John Adam St.,
London WC2N 6BW.

Abstract

Evidence for the presence of ignimbrites among the volcanic rocks at Avoca is interpreted from gradational contacts between lava-like and tuff-like rock, the arrangement of massive outcrops in parallel lines, the persistence of these alignments for distances of about 5km along strike, and the presence of columnar jointing. It is proposed that the Avoca Hills consist of a conformable succession containing four or more ignimbrites overlain by the orebody, with a steep inverted dip to the SE.

Introduction

The genetic relationship between the Avoca orebodies and associated volcanic rocks is now well established (Wheatley, 1971 a, b), the general consensus being that the deposits are of Kuroko type (Platt, 1977). Sheppard et al. (this volume) provide an overall review of the Avoca district and readers are referred to this paper for details of the regional geology, mineralization and discussion of ore genesis. This paper presents evidence for the volcanics being in large part ignimbrites and considers the structure of the volcanic belt.

The ignimbrites

Good exposures of volcanic rocks occur along the Avoca River valley on the western side of Tigroney hill and form a series of small crags to the south, the most impressive of which is the 150m long and 50m high crag west of the river known as Bell Rock (Figs. 1 and 2). These massive exposures are composed of fine-grained pale-grey igneous rock best described by the field term "felsite" and tend to occur on the steep flanks of elliptical hillocks. The low ground between the hillocks has sparse outcrops of rocks with a similar colour, but showing a foliation and sometimes an augen-like texture which are more suggestive of tuffs. Consequently the volcanics have tended to be regarded as a succession of acid tuffs containing pods of rhyolite, either as dome-like flows or intrusions (Lampard, 1960; Wheatley, 1971a; Downes and Platt, 1978). There are, however, three reasons for believing that these volcanics may be interpreted as ignimbrites.

The first of these reasons is that it is very difficult to identify boundaries between the "felsite" and the "tuffs"; the lithologies seem to grade into each other as if the massive exposures represent the more resistant parts of larger bodies, the rest of which are more strongly foliated, and hence easily eroded. This is observed both along the Avoca valley and on the ridge between Cronebane and Kilmacrea (Fig. 1). Ignimbrites would fit these observations as they commonly have hard welded centres grading to softer unwelded tops and bottoms.

Secondly, the felsite hillocks are approximately arranged in lines parallel to the northeasterly trend of the hills. Bell Rock faces a similar crag on the opposite side of the river. East of this are three smaller crags making a line of small hills up the side of Tigroney (Plate1). All of these outcrops are made of similar looking felsite and may be regarded as parts of the same resistant horizon, separated from each other by faults with displacements of a few tens of metres (Fig. 2). Altogether there seem to be four resistant horizons exposed along the valley, the one just described being the third in stratigraphic order. The first, separated from the others by a shale horizon, forms the south-pointing spur about 1km north of Avoca village. The second is another line of hills crossing the valley about 500m south of, and parallel to, the third, while the fourth is marked by a hillock 300m to the north.

A massive resistant horizon forms the crest of the ridge between Cronebane and Kilmacrea, while a second massive horizon forms a lower ridge on the NW side (Plate 2). Further NW a third horizon and a small part of a fourth exposure is seen before the volcanics disappear below the glacial overburden of the valley bottom. This is probably the same succession of four massive horizons as is seen along the Avoca valley. The spacing of the ridges is about the same, although the two areas are about 5km apart. The constant thickness of the bodies over this order of distance is characteristic of ignimbrites but not of rhyolite flows.

The third line of evidence is the occurrence of columnar jointing. This may be seen at the southern end of Bell Rock and also at an outcrop at the southwestern end of the second ignimbrite east of the Kilmacoo Fault (Plate 4). Columnar jointing is also characteristic of ignimbrites but not of rhyolite domes.

Structure

The arrangement of the ignimbrite outcrops in approximately parallel linear ridges suggests that they are steeply dipping. This is confirmed by the columnar jointing at both localities where the columns dip gently to the NW (Plate 4). The jointing would originally have been perpendicular to the depositional surface, so the ignimbrites must now be dipping steeply to the SE.

Shale outcrops on the hillside east of Avoca village show a southeasterly dipping cleavage intersecting more steeply dipping bedding planes. The same relationship is apparent in Cronebane open pit on the other side of the ignimbrite belt. Plate 3 illustrates an outcrop near the deepest part of the pit, close to the footwall, showing this bedding/cleavage intersection. The outcrop also shows graded bedding indicating younging to the NW and parasitic folds appropriate to the SE limb of a syncline.

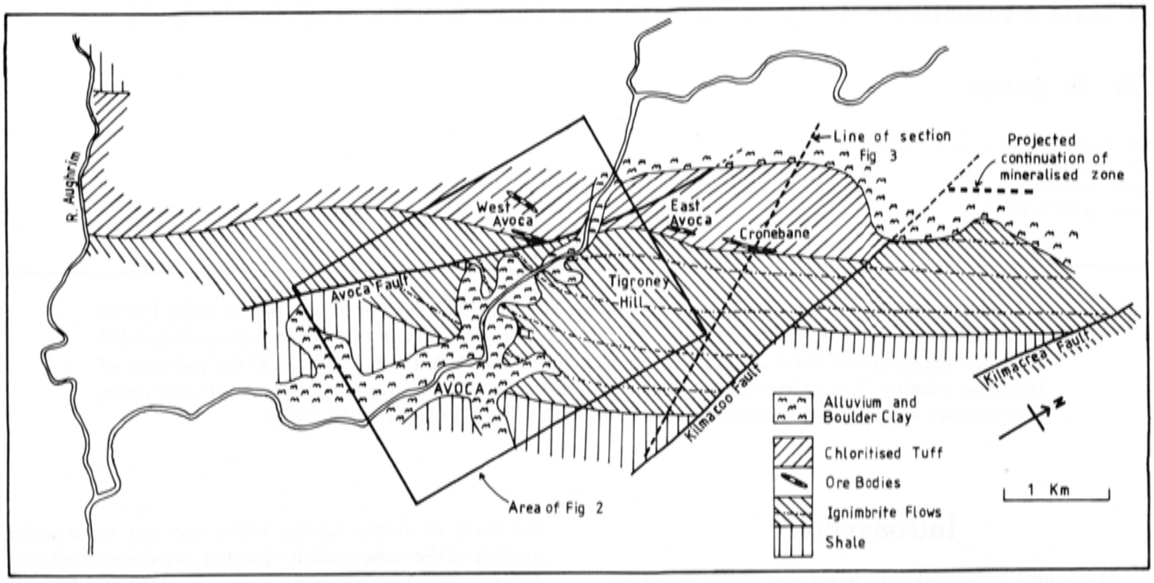


Figure 1. Geological map of the Avoca Hills.

The structural evidence thus points to the Avoca Hills being an inverted conformable succession younging to the NW and lying on the SE side of a major syncline.

Discussion

The field evidence for ignimbrites presented here is supported by the petrographic work of Wheatley (1971 a, b) who described welded glass shards and fiammé in the felsites and suggested that ignimbrites might be present among the volcanics. Also, ignimbrites have been reported in stratigraphically equivalent Ordovician volcanics near Bunmahon Co. Waterford (Stillman et al., 1974). The association of the Avoca ignimbrites with shales, and particularly the discovery of graptolites in black shales in West Avoca open pit (Badham, 1978), demonstrates that the ignimbrites were emplaced under water. Even this is not unprecedented, since Francis and Howells (1973) described subaqueously deposited ignimbrites in the Ordovician of Snowdonia.

The ignimbrites would be 300m-500m thick if they are in contact with each other. This is thicker than average, but certainly within the known range for ignimbrites (Macdonald, 1972). It may be that the succession also contains other, nonwelded ignimbrites which, being less resistant, do not give rise to distinguishable topographical features.

Some previous authors have described a major syncline running along the Cronebane open pit. However, the volcanics NW of the pit consist of foliated green chloritic andesitic tuffs (Wheatley, 1971a; Badham, 1978) and do not form a mirror image of the ignimbrite succession to the SE. It may be that the idea that the Avoca Hills form the core of a syncline results from the Cronebane pit lying approximately along the axis of the Hills. This is a coincidence since the Kilmacoo Fault to the NE would displace the mineralized zone to lie under the boulder clay plain to the NW of the Hills (Fig. 1). Gardiner (1970, Fig. 1) portrayed the axial trace of the Wicklow Syncline, one of the major structures in the Lower Palaeozoic of SE Ireland, as passing NW of the mountain of Croghan Kinshelagh and then running along the axis of the Avoca Hills. Croghan

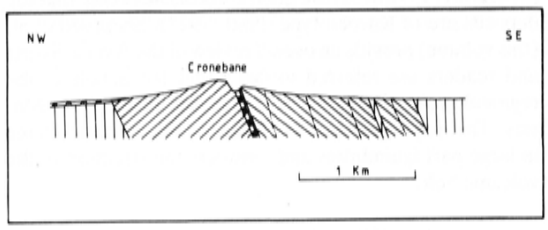


Figure 3. Sketch cross section through the Avoca Hills at Cronebane. Vertical scale equal to horizontal scale. Legend as in Figure 1.

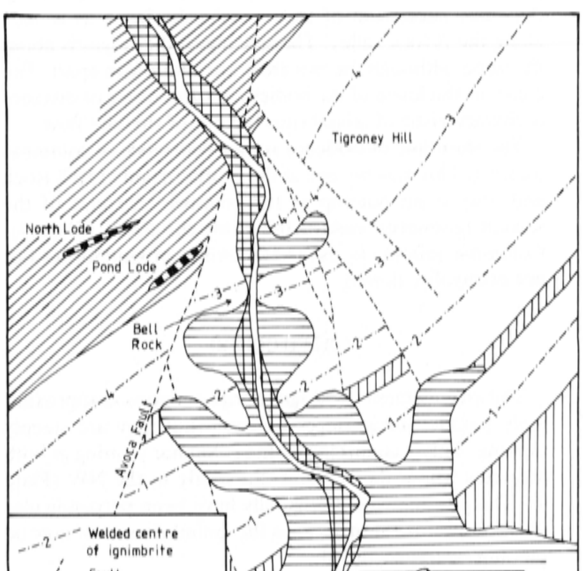
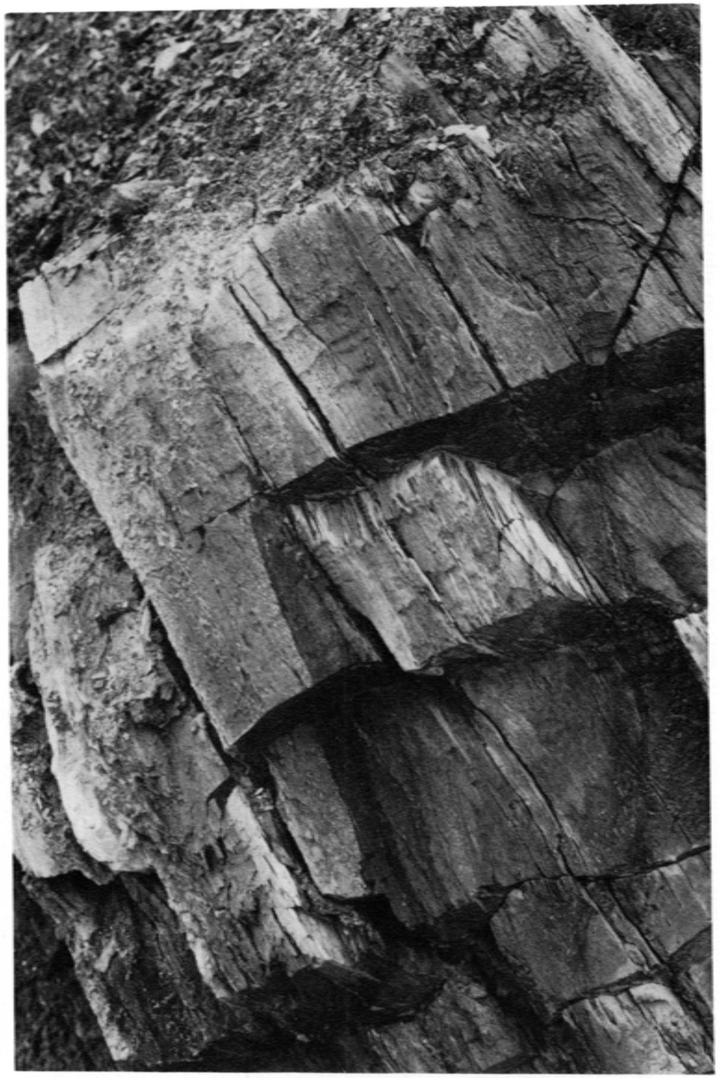


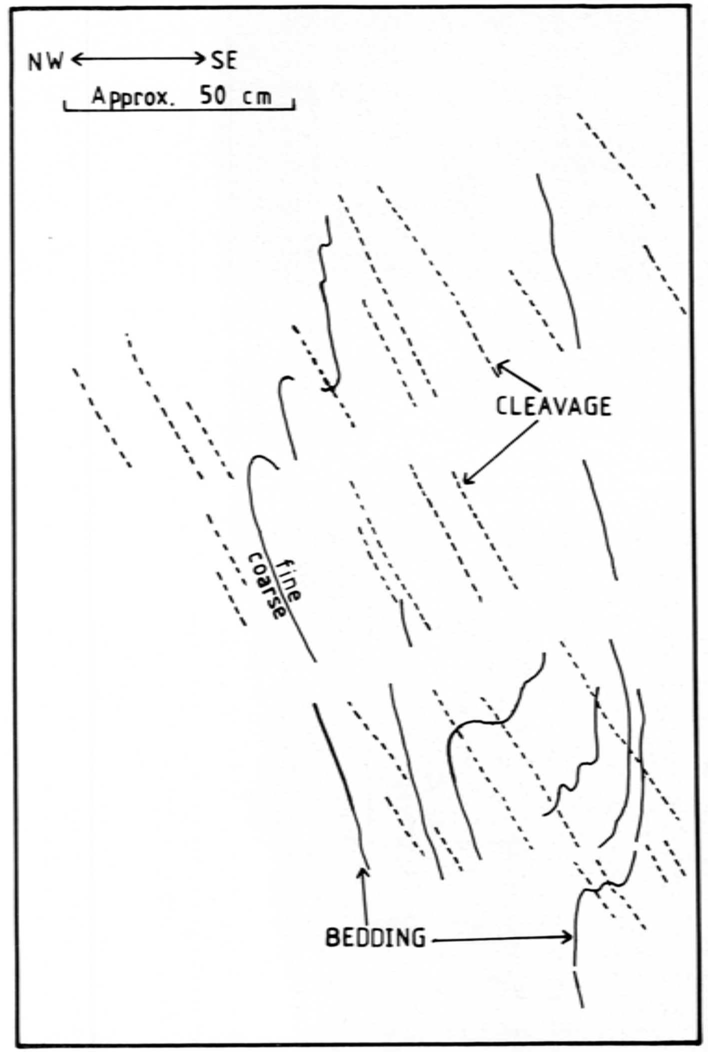
Figure 2. Geological map of the Vale of Avoca.

Plate 1. View of South Tigroney from West Avoca. The massive outcrop on the right, the line of wooded outcrops beyond, and the Bell Rock on this side of the river are the welded centre of an ignimbrite.

Plate 2. The NW side of the Avoca hills at Kilmacoo. The ridge at the top and the line of crags below are the resistant welded centres of ignimbrites.



(a)



(b)

Plate 3. **a**: Outcrop in Cronebane pit showing graded bedding, bedding/cleavage intersections and parasitic folding indicative of a major syncline to the NW. **b**: Sketch of Plate 3a to illustrate structural features.

Plate 4. Subhorizontal columnar jointing in an ignimbrite outcrop on Kilmacoo.

Kinshelagh lies on the SW extension of the Avoca Hills, and it is proposed here that the axial trace continues along the low ground NW of the hills. It may be that the Rathdrum volcanics mark the reappearance of the Avoca volcanics on the other side of the Wicklow Syncline.

The Kuroko-type mineral deposits of Japan are believed to have formed by the debouchment of hydrothermal fluids from rhyolite domes into a marine environment (Sato, 1977). An exposure at the eastern end of Cronebane pit showing sulphides infilling the interstices of a brecciated felsite has been quoted as an example of such a hydrothermal vent area within a rhyolite dome (Platt, 1977; Badham, 1978). It is suggested here that this outcrop shows a fumarolic vent on the surface of the uppermost ignimbrite, and it is possible that such vents occur along this top surface rather than being restricted to localized domes. The author has proposed elsewhere that the massive sulphide deposits were formed by the transfer of metallic elements from within the ignimbrites to the surface of the accumulating volcanic pile by escaping volatiles and circulating seawater (Jones, 1983).

Acknowledgement

This contribution is largely based on a paper published in the Journal of Earth Sciences of the Royal Dublin Society.

References

BADHAM, J. P. N. 1978. Slumped sulphide deposits at Avoca, Ireland and their significance. *Trans. Inst. Min. Metall.* B87, 21-26.

DOWNES, K. M. D. and PLATT, J. W. 1978. The Avoca-Ballard mineralized belt, County Wicklow. *J. Earth Sci. R. Dublin Soc.* 1, 121-133.

FRANCIS, E. H. and HOWELLS, M. F. 1973. Transgressive ash flow tuffs among Ordovician sediments of N.E. Snowdonia, N. Wales. *J. Geol. Soc. London* 129, 621-641.

GARDINER, P. R. R. 1970. Regional fold structures in the Lower Palaeozoic of south-east Ireland. Bull. *Geol. Surv. Ireland* 1, 47-51.

JONES, W. B. 1983. The geological association of sulphide mineralization at Avoca, Co. Wicklow — a new interpretation based on field evidence. *J. Earth Sci. R. Dubl. Soc.*, 5, 145-152.

LAMPARD, W. J. 1960. Mineralisation at West Avoca, Co. Wicklow, Ireland. Unpub. PhD thesis, Univ. London.

MACDONALD, G. A. 1972. *Volcanoes.* Prentice-Hall, New Jersey, 510 pp.

PLATT, J. W. 1977. Volcanogenic mineralization at Avoca, Co. Wicklow, Ireland, and its regional implications. *In: Volcanic processes in ore genesis.* Inst. Min. Metall. and Geol. Soc. London, 163-170.

SATO, T. 1977. Kuroko deposits; their geology, geochemistry and origin. *In: Volcanic processes in ore genesis.* Inst. Min. Metall. and Geol. Soc. London, 153-161.

SHEPPARD, W. A. 1980. The geological setting and the nature of copper mineralization at Avoca Mines, Co. Wicklow, Ireland. *In: European copper deposits,* Belgrade, 286-294.

STILLMAN, C. J., DOWNES, K. and SCHIENER, E. J. 1974. Caradocian volcanic activity in east and southeast Ireland. *Sci. Proc. R. Dubl. Soc.* 5A, 87-98.

WHEATLEY, C. J. V. 1971a. Economic geology of the Avoca mineralized belt, S. E. Ireland and Parys Mountain, Anglesey. Unpub. PhD thesis, Univ. London.

WHEATLEY, C. J. V. 1971b. Aspects of metallogenesis within the southern Caledonides of Great Britain and Ireland. *Trans. Inst. Min. Metall.* B80, 211-223.