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Conodont colour alteration adjacent to a volcanic plug, Canning Basin, Western Australia

Robert S. Nicoll

The colour change of conodonts adjacent to a small volcanic plug in the Canning Basin, Western Australia suggests that the temperature of the liquid melt exceeded 600°C. The limit of the thermal effects of the intrusion appears to be about one metre into the surrounding carbonate sediments.

The change of colour in conodonts from their normal amber to black or white in areas adjacent to igneous intrusions, has long been known (Ellison, 1944; Sweet & Bergstrom, 1966), but until the 1977 study of Epstein & others this phenomenon had not been explained and quantified. Their study recognised nine levels of distinct, but gradational, colour change and defined the conodont colour alteration index (CAI), which they related to temperature levels by experimental studies.

In the Canning Basin of Western Australia the Fitzroy Lamproite, consisting of a number of plugs, dykes, and sills of leucite lamproite or kimberlite composition, intrudes sediments that range in age from Precambrian to Triassic. The age of intrusion is disputed, but may be Jurassic, Oligocene, or Miocene (Playford & others, 1975). One plug is known to be in contact with carbonate rocks in outcrop (Fig. 1). This is located in the Oscar Range, where it is surrounded by gently dipping limestones of the early Late Devonian Napier Formation.

The carbonate rocks immediately surrounding the plug are dark grey to black. This coloration could be the result of baking of disseminated petroleum at the time of intrusion. When the samples were processed for conodonts in the laboratory, a thin film of petroleum usually accumulated on the surface of the container.

In this project a series of sample sets was collected from limestone at the margin of the leucite lamproite plug in order to study conodont colour variation adjacent to a small intrusive body. Twenty samples were collected, five from each of four sections (Fig. 1). The maximum distance of each section from the lamproite-carbonate contact was just over one metre.

Table 1 shows the number of conodonts recovered from each sample and the CAI values. The non-recovery of conodonts from samples in sections 802 and 803 probably reflects the absence of conodonts at the time of deposition of the sediment and not destruction from the heat of the intrusion. Preservation of conodont elements in samples 801/01 and 804/01 is poor and some of the specimens are only just recognisable as conodonts.

Section 801 shows that within one metre of the lamproite-carbonate contact the CAI value changes from 8 to 1 (Fig. 2). In contrast, sample 804/05, which is 1.05 m from the contact, has a CAI value of 5. This difference probably results from an irregular contact between the plug and the limestone, and sample

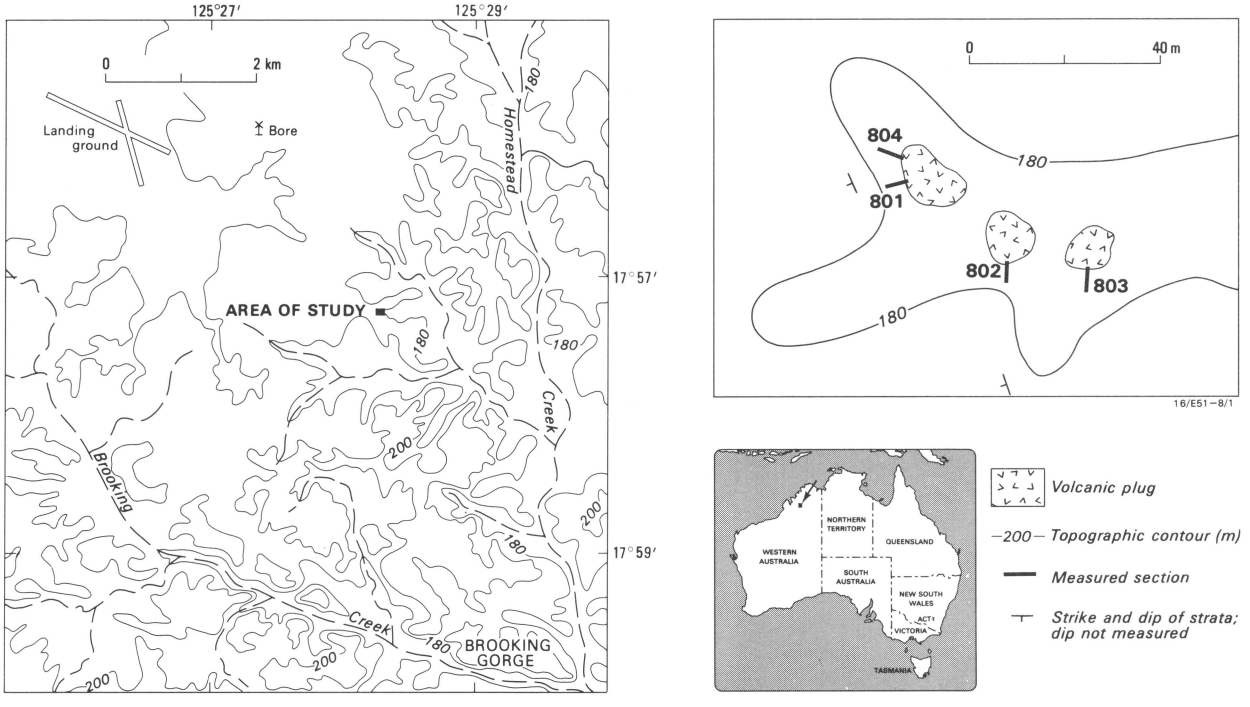

Figure 1. A. Locality map, showing the study locality about 4 km north of Brooking Creek, near the eastern end of the Oscar Range; Leopold Downs 1:100 000 topographic map, grid reference 3962-618132.
B. Sketch map, showing irregular outline of volcanic plug and location of the measured sections.

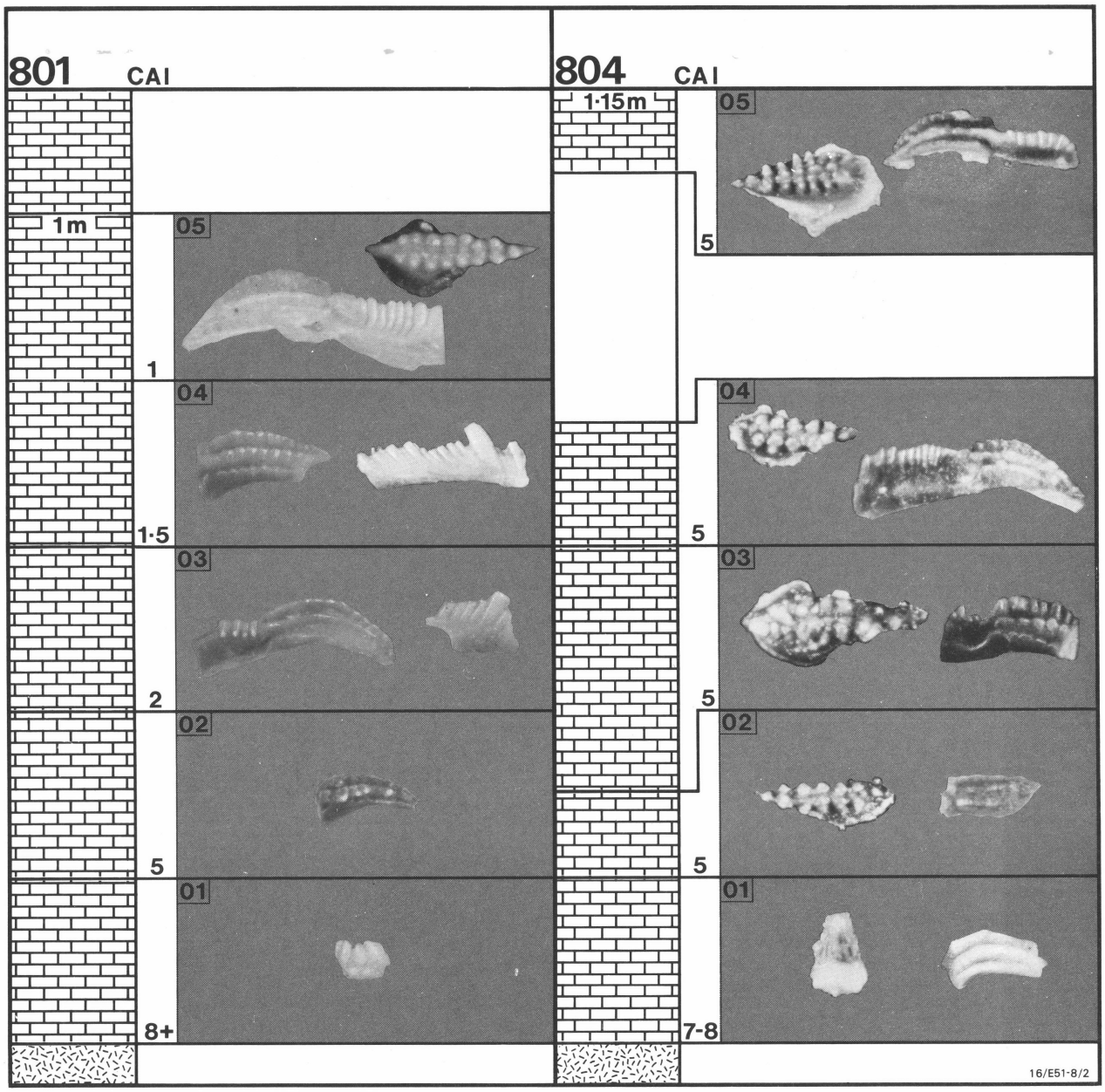

Figure 2. Chart showing colour change of specimens in sections 801 and 804.
801/01—S element, indt. fragment, CPC 21159, CAI 8+; 801/02—Pa element, *Polygnathus xylus* Stauffer, 1940, CPC 21160, CAI 5; 801/03—Pa element, *P. xylus,* CPC 21161, CAI 2; 801/03—Pb element, *P. xylus,* CPC 21162, CAI 2; 801/04—Pa element, *P. xylus,* CPC 21163, CAI 1.5; 801/04—Sc element, ? *P. xylus,* CPC 21164, CAI 1.5; 801/05—Pa element, *P. xylus,* CPC 21165, CAI 1; 801/05—I element, *Icriodus expansus* Branson & Mehl, 1938, CPC 21166, CAI 1; 804/01—S element, *I. expansus,* CPC 21167, CAI 7-8; 804/01—Pa element, *P. xylus,* CPC 21168, CAI 7-8; 804/02—I element, *I. expansus,* CPC 21169, CAI 5; 804/02—Pa element, *P. xylus,* CPC 21170, CAI 5; 804/03—I element, *I. expansus,* CPC 21171, CAI 5; 804/03—Pa element, *P. xylus,* CPC 21172, CAI 5; 804/04—I element, *I. expansus,* CPC 21173, CAI 5; 804/04—Pa element, *P. xylus,* CPC 21174, CAI 5; 804/05—I element, *I. expansus,* CPC 21175, CAI 5; 804/05—Pa element, *P. xylus,* CPC 21176, CAI 5. All specimens are X 40.

Section/ Sample	Sample weight (kg)	Distance of base from igneous contact (mm)	Cono-donts recovered	CAI
801				
/01	3.6	0	3	8+
/02	3.7	200	8	5
/03	3.9	400	6	2
/04	3.8	600	6	1.5
/05	3.2	800	79	1
802				
/01	3.5	0	0	—
/02	4.1	200	0	—
/03	3.4	400	0	—
/04	3.5	600	0	—
/05	3.5	800	0	—
803				
/01	3.2	0	0	—
/02	3.5	200	0	—
/03	3.9	400	1	2
/04	3.3	600	0	—
/05	2.8	800	0	—
804				
/01	4.1	0	5	7-8
/02	4.1	200	5	5
/03	3.7	300	18	5
/04	3.8	600	50+	5
/05	4.2	1050	100+	5

Table 1. Recovery of conodonts and CAI values.

804/05 probably being closer to the plug than the outcrop measurement indicates.

The conodonts from samples 801/01 and 804/01, having CAI values of 7 to 8+, indicate temperature levels in excess of 600°C (Epstein & others, 1977). This conforms well with a temperature of about 750°C for the melt at the time of intrusion, estimated from an examination of thin-sections (Dr John Ferguson, BMR, personal communication, 1979).

This study suggests that the temperature effect on sediments surrounding small intrusive bodies is limited to a narrow zone, in this case about one metre. It also indicates that conodonts may be useful in determining the melt temperature of adjacent small igneous bodies.

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The early geological history of the Proterozoic Mount Isa Inlier, northwestern Queensland: an alternative interpretation: Discussion

G. M. Derrick[1] *& I. H. Wilson*[2]

Introduction

In this discussion of Blake (1980) we focus on three major points:

(1) Relations between the Tewinga Group, Bottletree Formation, and Haslingden Group.
(2) Incorporation of some Corella Formation carbonates in 1860 m.y. old basement rocks of the Tewinga Group.
(3) Unconformities.

Relations between the Tewinga Group, Bottletree Formation, and Haslingden Group

Significant differences exist between ourselves and Blake concerning relations between the Argylla Formation and Magna Lynn Metabasalt (Tewinga Group), Bottletree Formation, and Haslingden Group. The differences are illustrated in Figure 3 of Blake.

Bottletree Formation/Haslingden Group contact relations

Blake states that contemporaneity of the Yappo Member of the Haslingden Group and the Bottletree Formation is indicated by 'interfingering' of the two units along strike. An alternative interpretation of these same outcrops is that the upper Bottletree Formation contains lenses of sediments very similar to those at the base of the overlying Yappo Member, which locally cuts across the strike of the Bottletree Formation and fills broad depressions on the Bottletree land surface. We suggest that the contact is a disconformity or unconformity, and conclude there is good evidence to exclude the Bottletree Formation (containing acid volcanics) from the Haslingden Group (acid volcanics absent).

1. Formerly BMR; present address—Houston Oil & Minerals, AMP House, 10 Eagle Street, Brisbane, Queensland 4000.
2. Geological Survey of Queensland, GPO Box 194, Brisbane, Queensland 4001.