A PRELIMINARY NOTE ON THE BLACK SPELEOTHEMS AT JERSEY CAVE, YARRANGOBILLY, N.S.W.

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Abstract

Black to grey flowstones and other speleothems occur commonly in Jersey Cave and, to a lesser extent, in other tourist caves at Yarrangobilly. Preliminary investigations indicate a carbonaceous nature for the material that produces the dark coloration. The deposits occur both as a surface layer and deep within the calcite masses. An account is given of the investigations into the nature of these deposits and hypotheses are advanced for the mode of formation.

The black speleothems of Jersey Cave, Yarrangobilly, N.S.W. have been of interest to visitors since the original description of the cave in 1891. The deposits are regarded as part of the attraction of the cave:

> The beauty of the caves is undoubtedly enhanced by the great variety of colours possessed by the various formations. This is particularly the case with the black surfaces, which set off to perfection the many beautifully white isolated forms, . . . which relieves to a wonderful extent the monotony there would otherwise be if the entire chambers were coated with pure white calcareous growths (Anderson & Leigh, 1891).

The origin of black deposits has been attributed by local hearsay, apparently based on little evidence or indeed examination of evidence within the cave, to manganese, carbon or the 'exuviae of bats'. The deposits occur as a layer on upper surfaces, becoming thicker as the surface becomes more horizontal. Small patches of black material may be found on stalactites but only where upwards-facing surfaces occur or where material has been washed from above. Restriction of the deposit to upper surfaces of flowstone and stalagmite is consistent with the hypothesis that the material has an aerial origin. Broken formation or breakdown often has a black upper surface with a normal coloured underside. The surface on which such pieces lie also have normal coloration suggesting that protection from airborne particles occurs under these circumstances.

Deveson (1969) observed that the material occurs only in the upper 3 mm of flowstone cross sections. Our observations indicate a surface layer and up to three layers of similar thickness deeper in the flowstone (to a maximum depth of approximately 30 cm). Examination of the surface layer under a microscope reveals a thin black line (≃ 0.1 mm) overlying an apparent grey staining in and between the calcite crystals with decreasing greyness until the next layer of colourless or red-brown calcite occurs. The black material gives the impression of encouraging 2-4 mm thick layers within the (more usually) massive flowstone.

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Extraction of the black material by solution in hydrochloric acid was attempted by Deveson (1969) for the surface layer and by the present authors for both the surface and subsurface layers. In both sets of analyses the resultant solution contained negligible quantities of iron, manganese or other cations considered likely to produce dark discoloration. The acid-insoluble residue was a dark grey flaky material with fine grains of sand-like material; the entire residue was insoluble in boiling aqua regia. Deveson (1969) heated the residue in an ignition tube until a white ash identified as silica remained. Carbon was qualitatively identified from another sample of the residue.

Our samples of acid-insoluble material were boiled in hydrofluoric acid and then digested in hydrochloric acid. The resultant solution was then subjected to atomic absorption spectrophotometry for a number of cations. No manganese was found but relatively high percentages of iron (expected), potassium and sodium (unexpected) were determined. A possible source for these latter two ions is the basalts which overlie the limestone.

Organic carbon was determined at 7.7% by a modified Walkley and Black method in a surface sample. We suggest that the hypothesis that the black speleothems of Jersey Cave are produced by carbon originating in bushfire smoke settling out in the cave environment, seems reasonable in view of the above evidence. The presence of silica in bushfire smoke is to be expected. Evans, King, MacArthur, Packham & Stephens (1976) report levels of "mineral ash" at up to 60% of the particulate content of smoke; the mode of deposition and its episodic nature all tend to favour such an explanation.

The whole investigation has provoked rather more questions than it has answered and further investigations are being pursued.

REFERENCES

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NOTE ADDED AFTER CONFERENCE

Similar deposits were observed in Drovers Cave, near Jurien Bay, on a post-WACCON field trip and A. Goede (pers. comm.) reports occurrences in Exit Cave, Tasmania. Examination of some small caves on the Upper Murray (Indi) River, N.S.W., has revealed surface deposits exactly analagous to those at Yarrangobilly. In Drovers Cave the layering of both dark and "white" calcite is much thinner than at Yarrangobilly in all stalagmite cross-sections examined, perhaps reflecting the stronger seasonal rainfall in Western Australia.