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EPIGENETIC COMMON OPAL FROM THE HAWKESBURY SANDSTONE FORMATION OF THE SYDNEY BASIN

By J. F. Lovering, B.Sc.

Assistant Curator of Minerals and Rocks, The Australian Museum, Sydney.

(Plate IV.)

Abstract.

An unusual occurrence of epigenetic common opal, apparently derived from the normal ground-waters of the Hawkesbury sandstone formation of the Sydney Basin, is described. The opal forms simple and botryoidal incrustations, simple and coralloidal stalactitic structures and also is deposited on stalactites of lamellar limonite. Refractive index values vary widely and haphazardly between 1.414 and 1.443.

In the Hawkesbury sandstone formation of the Sydney Basin small caves and ledges often show groups of stalactites and, more rarely, stalagmites up to 3 cm. in length. An immediate reaction was to class them as being calcereous and derived from the several calcereous members of this formation. Closer study, however, showed they were composed of common opal and as such were of considerably greater interest.

The common opal probably occurs wherever the Hawkesbury sandstones outcrop as, when looked for, they have always been found. The best occurrences yet seen, and the ones described here, were in small caves along the banks of Galna Creek which is west of the main northern railway line between Mount Colah and Mount Kuring-gai stations.

Typically the common opal structures are found on the roofs and floors of small caves but often they are found growing horizontally at 90 degrees to the walls of almost vertical cracks. Often, and particularly where the caves are formed by ledges in a creek bed, the stalactites are wet and apparently still growing. Elsewhere they are quite dry and "dead".

At least four different modes of occurrence can be differentiated :—

I. Simple and botryoidal incrustations.
II. Simple stalactitic structures.
III. Coralloidal stalactitic structures.
IV. Incrustation on lamellar limonitic stalactites.

I. Simple and Botryoidal Incrustations.

Simple (*i.e.*, smooth) incrustations are usually about 1 mm. thick. The botryoida type incrustation is slightly thicker and represents a further stage in deposition as the botryoidal surface is formed by the accentuation of irregularities in the surface by further deposition of material. Both incrustations may grow immediately on the surface of the normal sandstone or else a second zone may develop between the normal sandstone and the common opal. This central zone shows residual quartz grains in white, opaque common opal which has replaced or rather infiltrated and included the clay cement. The process is rather one of infiltration as crushed fragments of the opal are almost opaque due to included clay material. In some cases this central zone is represented by infiltration of limonitic material.

The central zone rapidly gives way to the outer layer of the white, opaque common opal with a resinous lustre and normally hard and homogeneous. Inside any of the larger botryoidal protuberances the centre is composed of dark, earthy material which is much softer than the outer opal. This is paralleled in the description of opal stalactites by Anderson (1930) from a lava tunnel. He noted that the opal is often only a coating on rather earthy, porous, concentric material. This material was considered by Anderson to represent a more hydrated siliceous material which forms the normal hard outer type by surface dehydration. Similarly this interpretation can be applied to the occurrence in point for, although the circumstances of formation are quite different, the manner of deposition is comparable.

Because of the clean white colour of the outer surface it was thought the material would be reasonably pure and suitable for refractive index studies. Crushed fragments were examined and were found to be contaminated by a considerable amount of extraneous matter (mostly opaque clay-like substances) which had been included by the opaline material as it grew, most likely as settled dust particles.

Clear and comparatively uncontaminated fragments of common opal were used in refractive index determinations. Values obtained from the samples chosen were very variable, ranging from 1.414 to 1.443. This would indicate that the water content of the common opal was also very variable. As the variation in refractive index values is apparently haphazard, so the variable water content would be haphazard and any chemical determination of water would serve no useful purpose.

II. Simple Stalactitic Structures.

A natural development of the botryoidal type of incrustation is the formation of simple stalactites and then stalagmites arising from preferred deposition from the protuberances of the incrustation. As such they show similar structures—a central soft, earthy core with a hard exterior of white, opaque common opal. These simple stalactites are conical, 1.0–1.5 cm. long and 0·2–0·8 cm. diameter at the base.

III. Coralloidal Stalactitic Structures.

A further development in the deposition process is the irregular growth of the stalactites forming "coralloidal" stalactites apparently very similar to those first described by Swartzlow and Keller (1937). This irregular growth in all directions leads to the formation of bulbous and grotesque growths which resemble coral heads. The internal structure is the same as described above.

IV. Incrustation on Lamella Limonitic Stalactites.

Stalactites of lamellar limonite up to 8 cm. long and of elongated section show a unique coating of the hard, white form of the common opal. The incrustation is rather thin but covers quite large areas on the stalactites. One stalactite showed a previously broken end into which the opal had been deposited forming over, but still following, the concentric lamellae of limonite.

ORIGIN.

The presence of wet and still growing stalactites indicates that the depositional processes are still active and the origin of the silica is not difficult to find. Ground-waters are commonly carriers of silica and the slow percolation of water through the typ cal orthoquartzites of the Hawkesbury sandstones would allow appreciable solution of the silica. The deposition of this silica as opal indicates that alkalies are absent from the waters otherwise quartz would have formed preferentially (Clarke 1916). Analyses of water from Hawkesbury sandstone generally show it as slightly acid with alkalies rare, so in that area opal is to be expected as the product of precipitation. Osborne (1948), in discussing the origin of certain silica cements in some members of the

Hawkesbury sandstone formation, also attributes their formation to ground-water action. This would suggest that such cements were formed at a time when the ground-waters were alkaline but present day conditions favour formation of common opal.

The simple incrustations are dry and " dead " and most likely have been so since the time of formation, but the coralloidal growths, which are a later development, together with some simple stalactites, are still forming. It would therefore appear that all types of deposition began about the same time.

The origin of the opaline material differs from that described by Anderson (1930) and Swartzlow and Keller (1937) in being undoubtedly entirely due to precipitation of silica from charged ground-water. These other writers have described the occurrences from lava tunnels in which the opal may have at least partly been formed by deuteric solutions although later ground-water solution and subsequent deposition is considered by Swartzlow and Keller to be still in progress.

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Explanation of Plate IV.

Fig. 1.—Common opal, simple stalactites. D38202 (Australian Museum Mineral Collection Registered Number). x 1⅓

Fig. 2.—Common opal, coralloidal stalactites. D38205. x 1.

Fig. 3.—Common opal, covering lamellar limonitic stalactites. D38203. x ½.

Photographs by Howard Hughes.

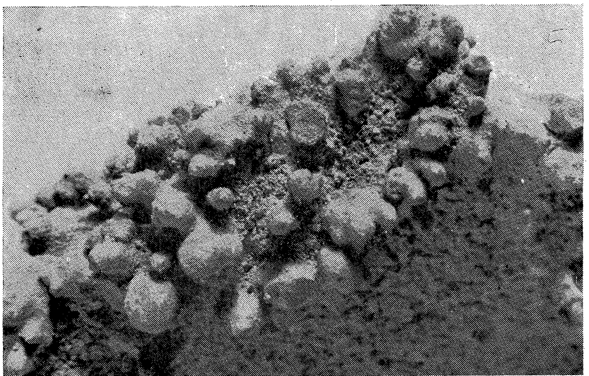
Fig. 1.

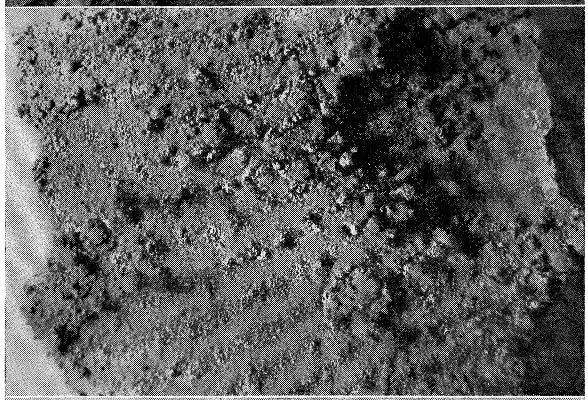
Fig. 2.


Fig. 3.