Niter and Sylvite from Jenolan Caves, New South Wales, Australia

D. M. COLCHESTER 1**; R. E. POGSON** 1 **& R. A. L. OSBORNE** 2
1 - Austratian Museum - 6 College Street - Sydney, N.S.W. 2000. AUSTRALIA
2 - School of Professional Studies, A35 - University of Sydney, N.S.W 2006. AUSTRALIA

Niter deposits occur in two large natural bridges, the Grand Archway and the Devil's Coach House at Jenolan Caves, New South Wales. The likely source is urine from colonies of brush-tailed rock wallabies (*Petrogale penicillata*) that lived in the bridges until the late 1960s. Niter associated with sylvite is found in the "Dust Cave", an extremely dry section of the Grand Archway. The Grand Archway has an east-west orientation and strong dry cold wind flows though it in the winter, bringing temperatures below zero. Evaporation at low temperature is proposed to account for the deposition of sylvite, but not halite, in the Archway.

Introduction

Jenolan Caves in eastern New South Wales, Australia (Fig. 1) are developed in a narrow outcrop of steeply dipping Silurian Limestone.

The limestone is breached by two, adjacent, large bridges, the Devil's Coach House (oriented north-south) and the Grand Archway (oriented east-west) (Fig. 2).

MINGAYE (1898) described niter from the Devil's Coach House. HILL & FORTI (1997) cited this report. It has not proved possible to relocate the niter deposit described by MINGAYE, however, niter deposits have been found to be abundant in the Grand Archway.

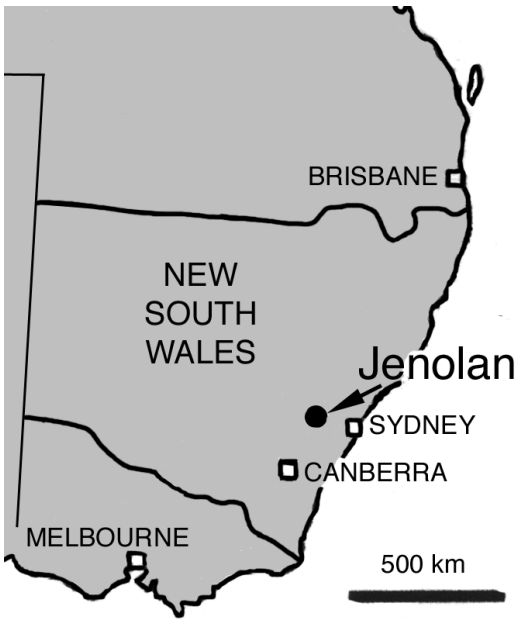

Figure 1 Location

The Grand Archway

The Grand Archway (Fig 2) is approximately 140 long. It is narrowest at its western end (15 m) and reaches a maximum width of 70 m about 90 m from its western entrance. At its western end the Archway has a flat paragenetic ceiling, 10m high, while at the eastern end the ceiling is modified by breakdown and slopes to the north at about 45 degrees.

Breakdown piles cover a terrace on the southern side, and occur in the eastern part of the northern side of the Archway. The breakdown is mantled by extensive deposits of fine grey-brown dust.

The interior of the Archway is dry. During the winter months (June, July, August), dry westerly winds blow straight through it. Snow and below zero temperatures are not uncommon at Jenolan in winter and icicles often grow from the ceiling at the western end of the Archway.

When the dust deposits in the Archway are moistened, efflorescences of niter grow. J.M. James (pers. comm.) reported the presence of niter and sylvite crystals in dust collected from the southwestern side of the Archway. White crusts of niter occur in crevices in breakdown and bedrock on the south side of the Archway.

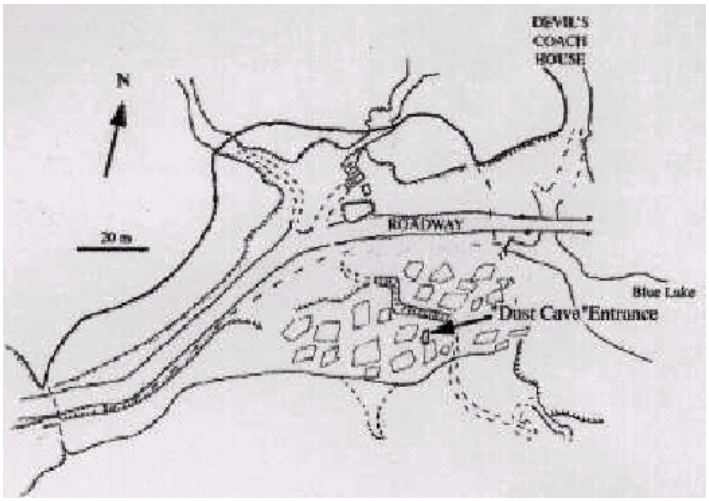

Figure 2 The GrandArchway

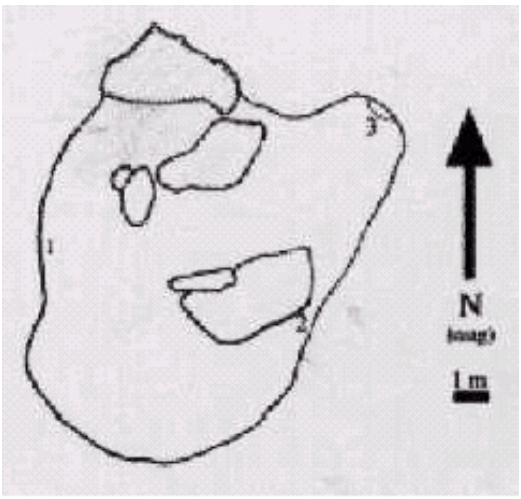

Figure 3. Dust Cave

"Dust Cave" Deposits

The "Dust Cave" is a cavity within the breakdown pile, high on the southern side of the Grand Archway. The cavity is approximately 9 m (NE-SW) by 7 m (NW-SE) (Fig. 3). The floor consists of fine dry dust. The walls consist of breakdown blocks, bedrock (limestone and lithified palaeokarst deposits) and poorly consolidated conglomerate cave fill.

Three significant white crusty deposits occur in the cave. Deposit #1, located on the eastern wall consists of white crusts with stalactitic projections growing along the beds of a laminated palaeokarst deposit (Fig 4). Deposits # 2 and 3 consist of crusts growing from the cave floor and from porous conglomeratic cave fills exposed in the cave walls.

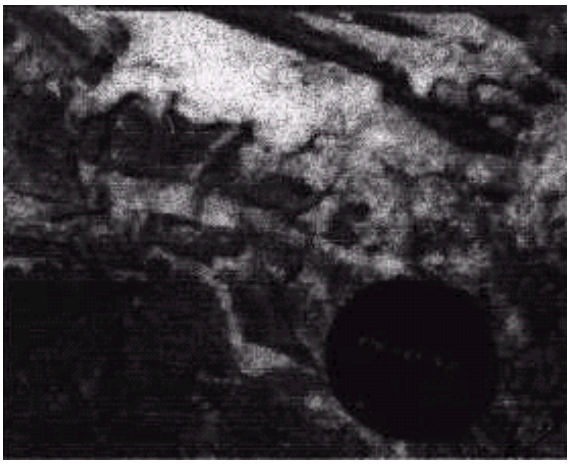

Figure 4

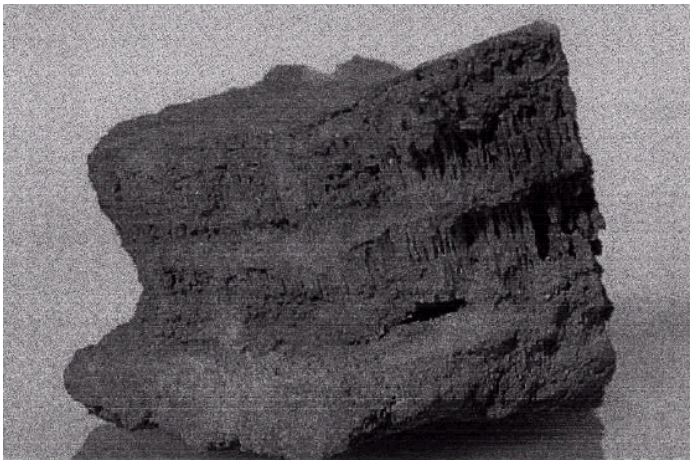

Figure 5

Figure 4. "Dust Cave " Deposit # Note stalactitic form of nitre (white) in top, left field. Lens cap is 55 mm in diameter.
Figure 5. Specimen D 52263 - Specimen is 50 mm high and 70 mm wide. The two distinct layers of columnar crystals that form upper 30 mm of ,the sample are separated by a fine grain crust. Note how the columnar niter crystals are separated by vertical

Mineralogy

Small samples of the deposits in “Dust Cave” were collected and examined using X-ray diffraction. Niter was identified in all three deposits and sylvite associated with the nitre in deposits 1 and 2.

Specimen D 52263

A sample of evaporitic crust (Australian Museum Mineralogy Collection # D 52263) was collected from the floor of Dust Cave at location # 2. The specimen was excavated from below a mound of fine dust. In form the specimen resembles “wedding cake” gypsum found in salt lakes. The specimen (Figure 5) is approximately 50 mm thick. The bottom 20mm is composed of cemented grey dust. Two layers of columnar niter crystals form the upper 30mm of the specimen; these are separated and capped by finer grained crust. As in “wedding cake” gypsum, significant open cavities occur between the columnar crystals.

X-ray diffraction showed that this specimen contained both niter and sylvite. In order to determine the location of the sylvite, a polished specimen was prepared and examined using SEM and Energy Dispersive X-ray Spectrometry. These showed (Figs 6 & 7) that the sylvite forms highly skeletal equant inclusions 0.3-3mm thick in the niter, sometimes as strings of separate inclusions aligned perpendicular to the horizontal surface of the crusts. Observed sylvite composition was variable, ranging from 5-15 % by volume.

The observations are consistent with the sylvite being deposited after the nitre and filling some of the vertical cavities between the columnar niter crystals.

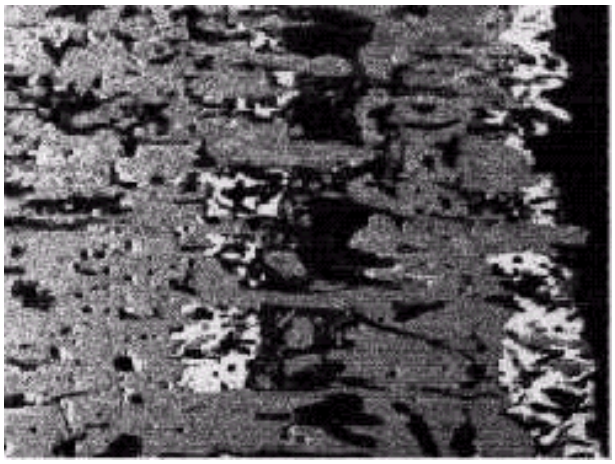

Figure 6

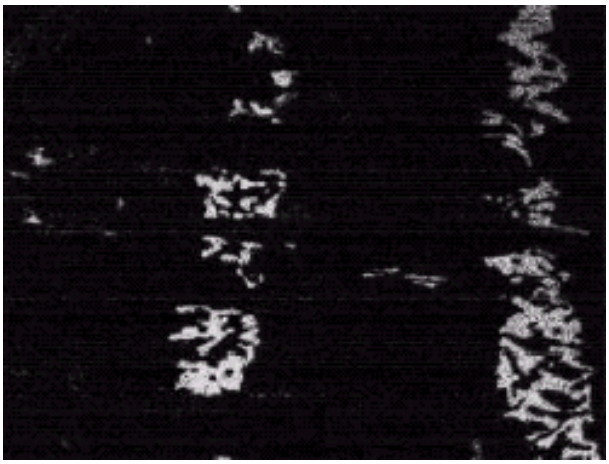

Figure 7

Figure 6. Backscatter Electron Image Specimen D 52263. Light grey = niter While = sylvite Image 4 mm high x 5mm wide.
Figure 7. Cl Ka- X ray Image Specimen D 52263 White = chlorine Image 4 mm high x 5mm wide

Paragenesis

Source of the Nitrate and Chloride

Niter deposits in caves have frequently been attributed to leaching from surface soils, volcanic ground water, bat guano piles and the action of nitrogen-fixing bacteria (HILL 1981a, 1981b, HILL & FORTI, 1997, LEWIS, 1992). These situations do not occur in the Grand Archway at Jenolan Caves. The Grand Archway was, however, until the late 1960s home to a breeding colony of the brush-tailed rock wallaby (*Petrogale penicillata*) and much of the dust in the cave is clearly derived from decaying rock wallaby faeces.

Deposition of Sylvite, but not Halite

In many of the occurrences of sylvite cited by HILL & FORTI (1997) sylvite occurs in association with the less soluble, and more common, chloride mineral halite. Since sodium is a common cation in organic waste, and sylvite is more soluble than halite, it might be anticipated that halite would occur in these deposits, with sylvite being deposited only in the final stages of the evaporative process.

Acknowledgments

The authors acknowledge financial and institutional support from the Australian Museum. The Jenolan Caves Reserve Trust permitted access and collecting from the caves and provided accommodation for fieldwork.

References

HILL, C.A., 1981a. Origin of cave saltpetre. National Speleological Society Bulletin 43: 110-126.

HILL, C.A., 1981b. Mineralogy of cave nitrates. National Speleological Society Bulletin 43: 127-132.

HILL, C.A. & FORTI, P., 1997. Cave Minerals of the World, Second Edition. National Speleological Society, Huntsville.463 p.

LEWIS, W.C., 1992. On the origin of cave saltpetre-a second opinion. National Speleological Society Bulletin 54: 28-30.

MINGAYE, J.H., 1898. On the occurrence of phosphate deposits in Jenolan Caves, New South Wales. Australasian Association for the Advancement of Science, Report 5: 423-425.