Gipsy (Gypsy) Lane Brick Pit, Leicestershire

[SK 619 071]

Introduction

Gipsy Lane Brick Pit (see (Figure 4.9)) is located north-east of Leicester, in the Rushey Mead district. Works at the site have focused on quarrying the calcareous mudstones of the Mercia Mudstone Group for clay extraction (Faithfull and Hubbard, 1988). Brick and tile manufacture has dominated the works at this site and other local quarries for many years, with production peaking during the turn of the last century (Fox-Strangeways, 1903). Faithfull and Hubbard (1988) reported the pit was still being worked at the time of their study at the site. Gypsum has also been quarried from Gipsy Lane predominantly for use in plaster and construction materials, and gypsum beds and nodules are well exposed at this site. The site is of particular interest to mineralogists as it exposes an upper stratigraphical section of the Mercia Mudstone Group containing carbonate, evaporite, sulphide and silicate minerals (King, 1967), and also the basal shale beds of the Westbury Formation (Warrington *et al.,* 1980). At least three iron-rich gypsum beds interbedded with the marls are exposed (Faithfull and Hubbard, 1988). Sections of these beds have been stockpiled, as they are of little commercial value due to the extensive oxidation of sulphide minerals which has resulted in iron-staining. Secondary copper carbonates (malachite and occasionally azurite) are also present. Siltstone and sandstone lenses within the calcareous mudstones are commonly dolomite-rich (Faithfull and Hubbard, 1988), and show striking halite pseudomorphs within them. Faithfull and Hubbard (1988) provided evidence for the existence of the uranium silicate coffinite exposed during opencast mining works at the site, and this is detailed in their comprehensive study. Other rare or unusual minerals observed at the site include celestine, erythrite, lavendulan and djurleite (Faithfull and Hubbard, 1988).

Description

Gipsy Lane Brick Pit (see (Figure 4.10)) exposes lower and upper sections of the Upper Triassic Mercia Mudstone Group (previously known as the 'Keuper Marl'). The lower exposed beds of the Mercia Mudstone Group comprise brown gypsiferous mudstones (Bosworth, 1912) of the Glen Parva Formation (Warrington *et al.,* 1980), interbedded with thin lenses or irregular masses of dolomitized sandstone and siltstone towards the top of the unit. Celestine has been found in one such dolomite-rich siltstone layer within the mudstones towards the top of the unit, in the form of coarsely crystalline pink masses (Faithfull and Hubbard, 1988). Sedimentary structures within the siltstone and sandstone lenses are common and include current-bedding structures such as ripple marks and halite pseudomorphs. Conformably overlying the gypsiferous mudstones are marls of the Blue Anchor Formation (formerly known as the 'Tea Green and Grey Marls'), which is the highest stratigraphical unit of the Mercia Mudstone Group and which is gypsum-free. Sulphides such as pyrite and galena are common in these beds and especially when associated with the abundant sandstone and siltstone lenses ('skerry bands'). An erosive base and abrupt change in colour and lithology marks the unconformable boundary between the Mercia Mudstone Group units and the thinly bedded black shales of the Westbury Formation, which is the basal unit of the Penarth Group. An intermittent sandy fish bone bed marks the base of the Westbury Formation.

At least three substantial gypsum beds are exposed (approximately 0.2–1 m in thickness). The gypsum is nodular and forms irregular upper and lower contacts with the marl. Green staining can be observed on the upper surfaces of exposed gypsum beds within the pit, which is attributed to the presence of the copper carbonate mineral malachite (Faithfull and Hubbard, 1988). Bornite and djurleite ($Cu_{31}S_{16}$) have also been observed as metallic lustrous films overlying the upper surfaces of gypsum beds (Anon, 1973), although these have not been observed in subsequent studies. The principal gypsum beds show considerable lateral continuity where exposed; however thinner discontinuous beds of nodular gypsum are present elsewhere at the locality (Faithfull and Hubbard, 1988).

The gypsum beds contain small sub-spherical black masses, up to 8 mm in diameter, particularly in the upper gypsum beds. These sub-spheroids can be observed in a variety of environments, namely: (a) on the top surfaces of beds; (b) in green-stained clay films within nodular gypsum (sometimes partially enclosed in gypsum); (c) enclosed entirely within massive gypsum in the outer sections of nodules; and (d) occasionally in green-stained clay proximal (several millimetres) to gypsum nodules (Faithfull and Hubbard, 1988). Commonly malachite, erythrite and occasionally lavendulan ($NaCaCu_5(AsO_4)_4Cl.5H_2O$), form encrustations around, or associations with, the sub-spheroids, while a rare deep-blue efflorescence may be due to the presence of azurite (Faithfull and Hubbard, 1988), although only one of these minerals is usually observed on any one spheroid.

In the Blue Anchor Formation, sulphides are present and include pyrite in the form of aggregates of cubes dispersed among the grey-coloured mudstones, and galena in association with small plates of barite in the skerry bands. Black vanadium-rich spots also occur scattered sporadically throughout the marl, but never associated with, and having a different appearance and mode of occurrence to, the black spheroids in the gypsum beds. The spots are up to 1 cm in diameter, with diffuse outer boundaries encircled with green reduction zones; these are the result of ferric iron (contained in the marl) reduction by the organic-rich vanadium deposits (Faithfull and Hubbard, 1988).

Interpretation

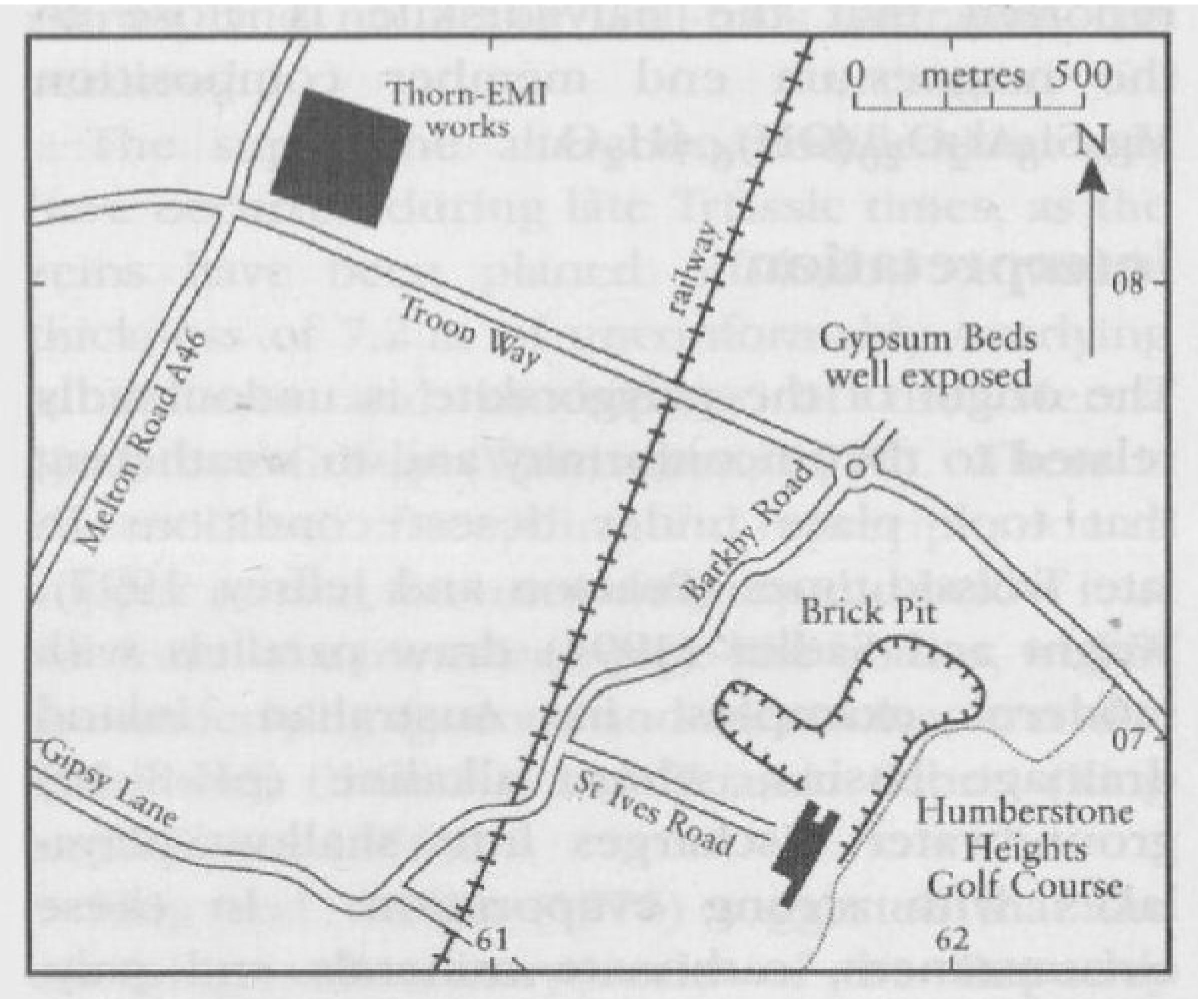
The black sub-spherical masses in the gypsum were first identified as djurleite ($Cu_{31}S_{16}$) and later as chernovite ($YAsO_4$) (Embrey, 1978) on the basis of X-ray diffraction (XRD) and chemical analysis using spectrographic methods. However, following further XRD and energy dispersive analysis, the likely constituent of the spheroids was identified as being similar to the mineral coffinite ($U(SiO_4)_{1-x}(OH)_{4x}$) (Faithfull and Hubbard, 1988). This conclusion was backed up by X-ray fluorescence analysis. Yttrium forms a minor component of the coffinite, and also detected during analysis were lead and/or sulphur, and aluminium as minor constituents. The spheroids are only moderately radioactive which implies that they are not pure coffinite, and based on the results of combustion experiments and polished thin-section analysis it seems likely that the coffinite is homogeneously dispersed on a fine-scale within an organic matrix. Three other mineral phases which constitute the spheroids have not been conclusively identified, but include a grey copper sulphide, a pink nickel arsenide and a grey/white cobalt-nickel-copper-arsenide-sulphide, which may constitute up to 50% volume. The enclosure of the coffinite and arsenide spheroids within massive nodular gypsum suggests that the spheroids are an early feature. The gypsum is thought to have precipitated in the sediment interstices in inter-and supratidal sabkha flats around the Triassic shoreline. If diagenetic oxidation was occurring simultaneously with gypsum formation, it is possible that organic material present (e.g. disaggregated algal mats) would scavenge elements such as U, Co, Ni, Cu and As prior to envelopment by the growing gypsum nodules.

Other occurrences of coffinite together with Cu-Co-Ni-As mineralization have been reported from the Triassic at Budleigh Salterton in Devon (Harrison, 1975). Pb-Cu-Co-Ni-As-V mineralization without uranium is recognized in the Triassic sandstones at the Alderley Edge District GCR site in Cheshire (Ixer, and Vaughan, 1982).

Conclusions

The Triassic succession exposed at Gipsy Lane contains a suite of uranium and vanadium minerals associated with organic matter within gypsum. It demonstrates an unusual association of elements that reflect specific circumstances at the time of origin, in which U, V and other elements entered an evaporitic environment, were scavenged by organic matter and subsequently preserved within gypsum.

References



(Figure 4.9) Location map of Gipsy Lane Brick Pit.

(Figure 4.10) Gipsy Lane Brick Pit. (Photo: M.L. White.)