Ancient Monuments Laboratory
Report 1/90

ANALYSIS OF PLASTER SAMPLES FROM CLEEVE ABBEY, SOMERSET.

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Summary

Degrading wall plaster was analysed by Scanning Electron Microscopy. This showed that NaCl crystal growth was present in the plaster and was probably responsible for the degradation.

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Analysis of Plaster Samples from Cleeve Abbey, Somerset

Dr Gerry McDonnell

1 Introduction

Cleeve Abbey has some well preserved medieval wall paintings on the plastered walls of the Church. In some areas the plaster is erupting, and blistering, which if it continues will lead to the loss of some paintings. The Conservation Studio requested that the cause of the plaster degradation be investigated. This report is one part of that investigation and covers the chemical/mineral analysis of the plaster.

2 Methods of Analysis

Two samples of mortar from the affected areas were examined by X-Ray Powder Diffraction (XRD) to determine the major mineral components of the plaster and by Scanning Electron Microscope (SEM) to examine the inclusions present in the mortar.

3 Results

3.1 XRD Analysis

The XRD pattern produced by both mortar samples showed the presence of silica (sand) and calcite. There was no evidence for the presence of other major minerals. The technique cannot identify the presence of organic components in the plaster. The sand/calcite mix is typical of a lime mortar or plaster.

3.2 SEM Analysis

A sample of each mortar and a sample of local slate were mounted on stubs, coated with carbon (to make them conducting) and examined in the SEM. Energy dispersive X-ray analysis was used to qualitatively examine the chemical composition of the slate sample and the inclusions in the mortar. The texture of the mortar was also investigated. Analysis of the inclusions showed them to be similar to the local slate sample, but there was considerable variation in composition (Figure 1), particularly in the presence/absence of iron and manganese. Analysis of the local slate detected the presence of titanium, which was absent from the inclusions in the mortar, but given the variation already observed between inclusions, small variations in all elements must be expected. Therefore, no firm conclusion can be drawn about the source of the inclusions without further detailed analysis.

Examination of the inclusions and the mortar/inclusion interface showed that there was no evidence for chemical reactions, eg the growth of sulphides etc, that might cause the eruptions on the mortar surface.

Further examination of the mortar showed the presence of cubic crystals (Plates 1-3). Spot analysis of the crystals identified them as sodium chloride (Figure 2).

4 Discussion

XRD analysis gave no indication as to the cause of the blistering, the mortar being a typical sand/calcite mix. SEM analysis showed that there was no reaction between the slate inclusions and the mortar, but crystals of sodium chloride were identified.

5 Conclusions

The blistering of the mortar surface is probably due to the growth of sodium chloride crystals in the mortar, caused by fluctuating Relative Humidity (RH), and/or rising damp.

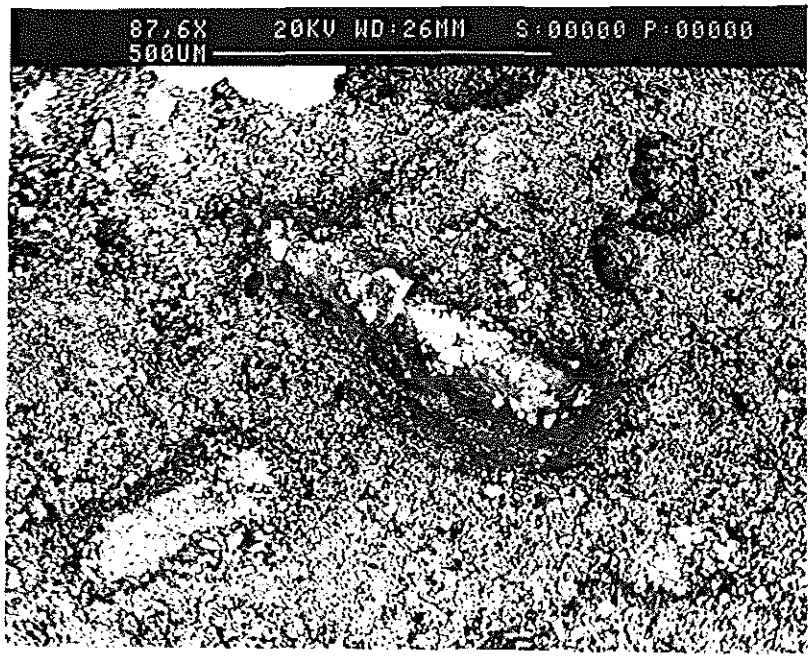

Plate 1
SEM micrograph of mortar showing growth of crystals (white) in centre and lower left of field of view (x87.6).

Plate 2
Centre of plate 1 at increased magnification (x360)

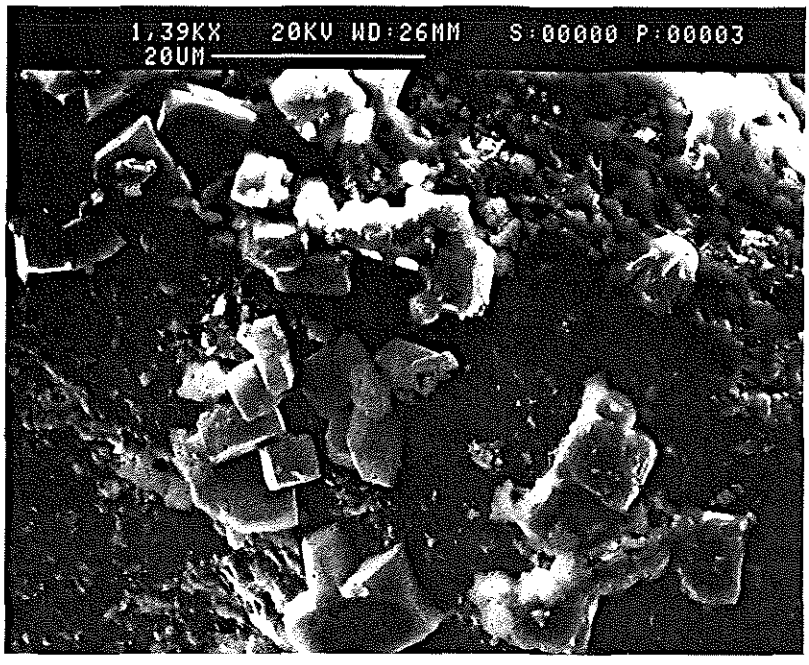

Plate 3
Detail of crystals, note cubic form (x1390)

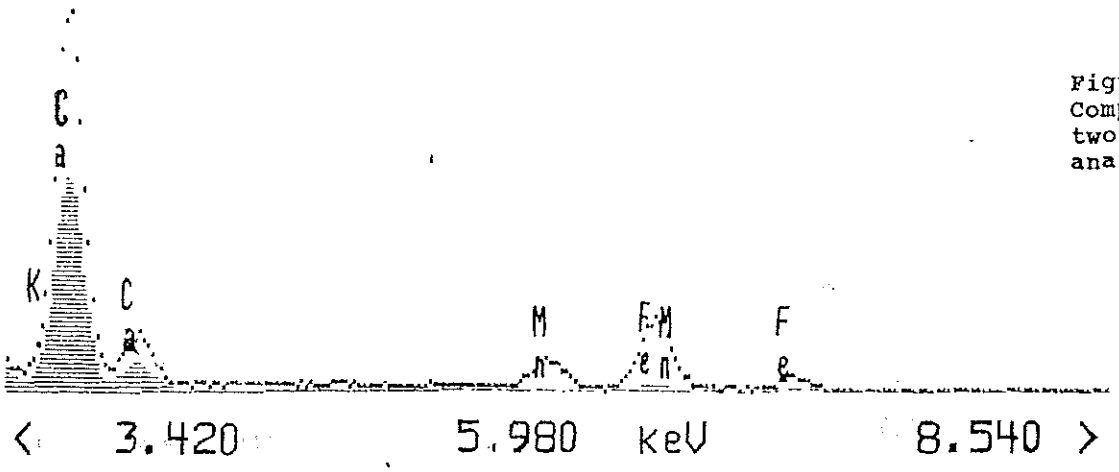

Figure 1
Comparison of two inclusion analyses

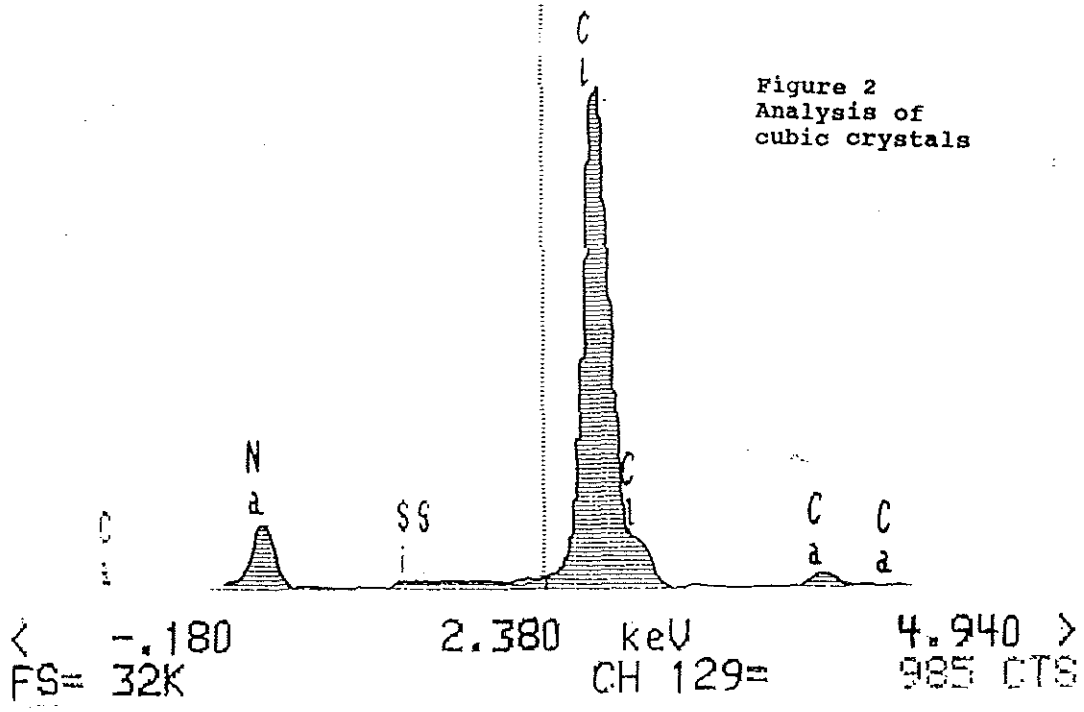

Figure 2
Analysis of cubic crystals