SEAHA
EPSRC CENTRE FOR DOCTORAL TRAINING
SCIENCE AND ENGINEERING IN
ARTS HERITAGE AND ARCHAEOLOGY

Mineral Instability: More common than you'd think

K. Royce [1,3 *], C. Baars [2], H. Viles [3]

1. UCL Institute for Sustainable Heritage, University College London, London, UK | * kathryn.schronk.18@ucl.ac.uk
2. National Museum Cardiff, Cardiff, Wales, UK
3. School of Geography and the Environment, University of Oxford, Oxford, UK

Introduction

It is widely believed that minerals are stable under museum conditions. But not all specimens are. Each mineral species is a unique combination of composition and crystalline structure.

Both composition and structure determine stability under environmental conditions. When these conditions are inappropriate for the specimen, change is likely, be it physical or chemical (Table 1). When these changes are unwanted or unacceptable, they are considered 'damage'.

Fig 1: Severe calcite efflorescence from exposure to acetic acid. The specimen also depicts extensive fracturing which led to decrepitation.

Vulnerability & Instability

Approximately 10% of the 4,400 known mineral species [2] are vulnerable in museum conditions. Some examples include:

- Calcite (Fig. 1)
- Cinnabar
- Fluorite
- Gypsum & Selenite
- Halite
- Jade
- Natron
- Pyrite (Fig. 2) & Marcasite
- Quartz variations

Table 1. Critical agents of deterioration & their negative effects on minerals [1, 2]

AGENT OF DETERIORATION	EFFECTS ON SPECIMENS
Temperature	• Decrepitation • Dissociation • Fracture • Increase reaction rate • Polymorphism • Pseudomorphism • Sublimation • Volatization
Relative Humidity (RH)	• Corrosion/Oxidation • Cracking • Dehydration • Deliquescence • Efflorescence • Hydration • Swelling • Water film formation
Pollutants	• Corrosion • Efflorescence (Fig. 2) • Moisture retention
Light	• Fading • Loss of colour / fluorescence • Other heat-related effects

Why does it matter?

Some undesirable outcomes from damage include loss of specimens, information, and value (Fig. 2). When this occurs, a museum is unable to use damaged specimens for some of the following activities:

- Scientific research
- Education
- Display
- Reference

In order to prevent such losses, research into mineral stability is necessary to determine and provide ideal storage and display conditions.

While such research may have been performed in other sectors, little has crossed over into museum literature.

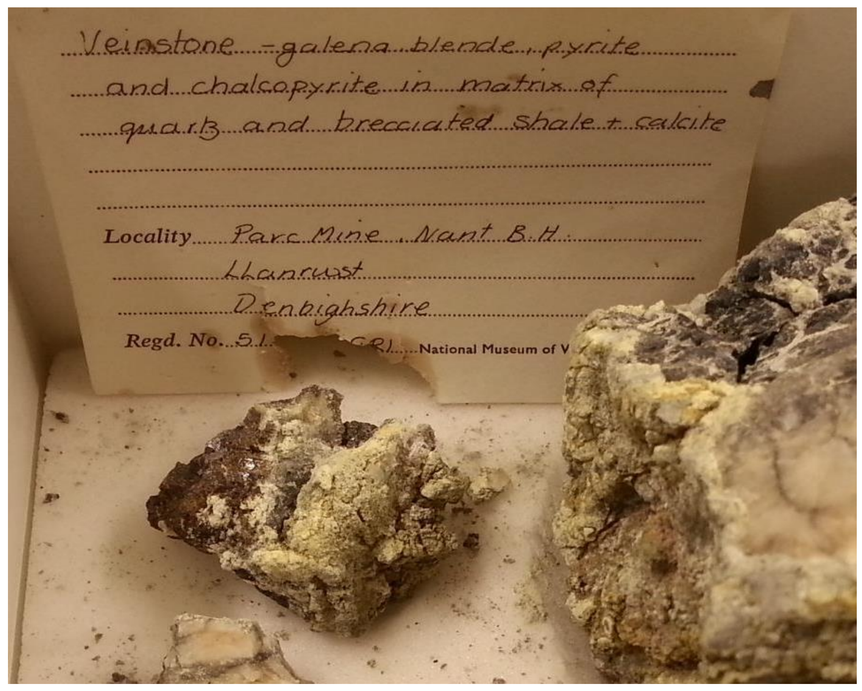

Fig 2: Spalled veinstone affected by pyrite decay, which has 'scorched' the label & defaced the accession number, resulting in potential dissociation of specimen & contextual information. (© ACNMW)

Research Aims

To rectify poor environmental conditions, comprehensive guidelines and standards need to be introduced. Yet to do so, rigorous research into the stability parameters for each mineral species under museum conditions is required. While such is an enormous undertaking, my research aims to begin the endeavor by:

- Identifying the most susceptible minerals that experience damage in ideal museum conditions (45-65%RH, 20° C) through a collection assessment
- Exposing samples of said minerals to varying exposures of temperature, RH, light, and/or common indoor pollutants to identify when damage occurs
- Analyzing reaction products to better understand how a mineral reacts to specific environmental variables

1. Child, R.E., ed., 1994. *Conservation of Geological Collections*. London: Archetype Publications.
2. Howie, F.M.P., 1992. *The Care and Conservation of Geological Material: minerals, rocks, meteorites, and lunar finds*. Butterworth-Heinemann.

national museum cardiff
amgueddfa genedlaethol caerdydd

UNIVERSITY OF OXFORD

SCHOOL OF GEOGRAPHY AND THE ENVIRONMENT

UCL