Mineral Instability: More common than you'd think

Kathryn Royce — School of Geography & the Environment, University of Oxford

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'.

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

Vulnerability & Instability

Approximately 10% of all known mineral species are vulnerable in museum conditions. Some examples include:

- Calcite (Fig. 1)
- Cinnabar
- Fluorite
- Halite
- Pyrite (Fig. 2) & Marcasite
- Quartz varieties

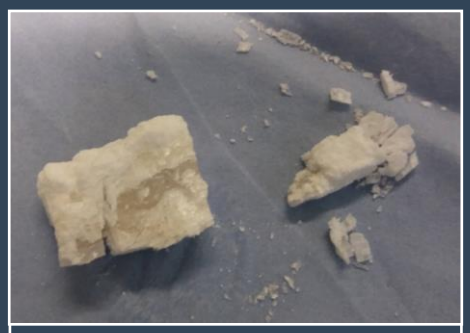

Fig. 1: Severe calcite efflorescence from exposure to acetic acid. The specimen also depicts extensive fracturing which led to decrepitation.

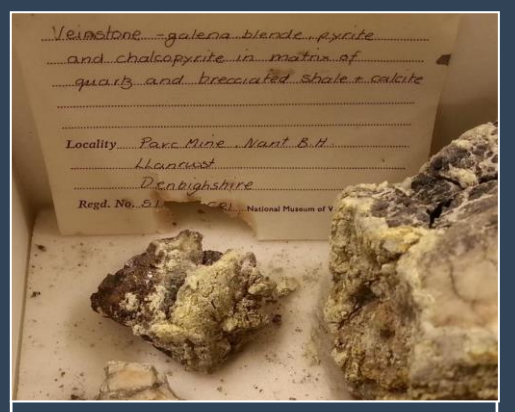

Fig. 2: Spalled veinstone affected by pyrite oxidation, which has 'scorched' the label & defaced the accession number, resulting in potential dissociation of specimen & contextual information. (© ACNMW)

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 scientific research, education, display, or 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.

D.Phil. 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, the project aims to begin the endeavor by:

1. raising awareness that minerals are indeed subject to change and most forms of change can be mitigated or managed, and
2. beginning to address the lack of accessible information on mineral instability within the heritage sector.

References:
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2. Howie, F.M.P., 1992. *The Care and Conservation of Geological Material: minerals, rocks, meteorites, and lunar finds*. Butterworth-Heinemann.

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