Corrosion of Specimens and Equipment in a Mineral Store

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40,000 minerals

The store

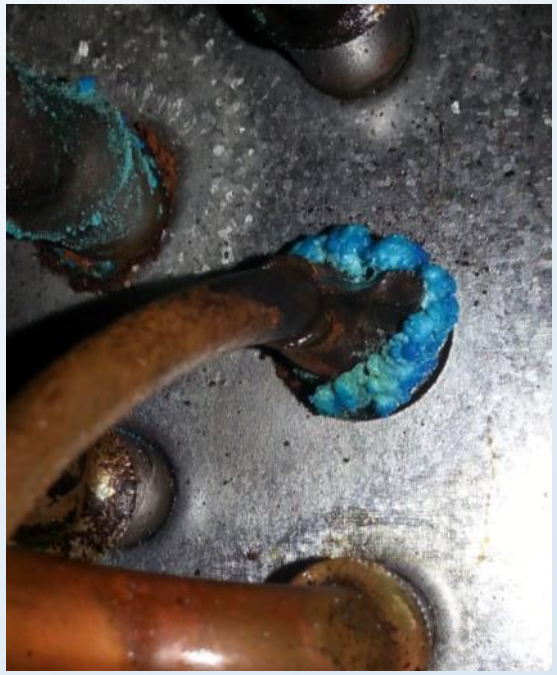
Minerals

Mineral Decay

Collections Care

Store environment

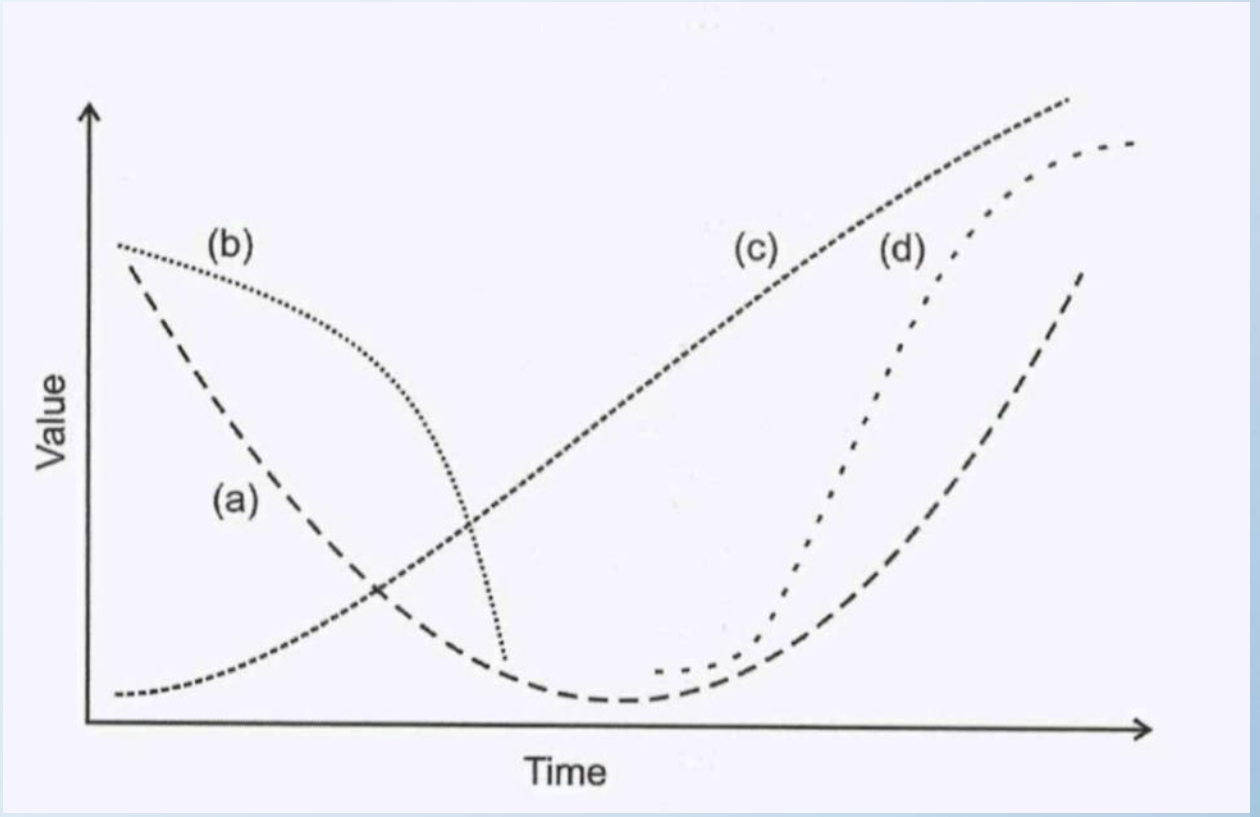
Damage to equipment



Definition of damage

$$f_D = f_V(f_C(p))$$

f_D – damage function
f_V - transformation function (value)
f_C - dose-response function (change)
p - parameter (stressor)



After Strlic et al. 2013

1. Physical damage

A. Cracking

B. Crazing

C. Spalling

2. Chemical damage

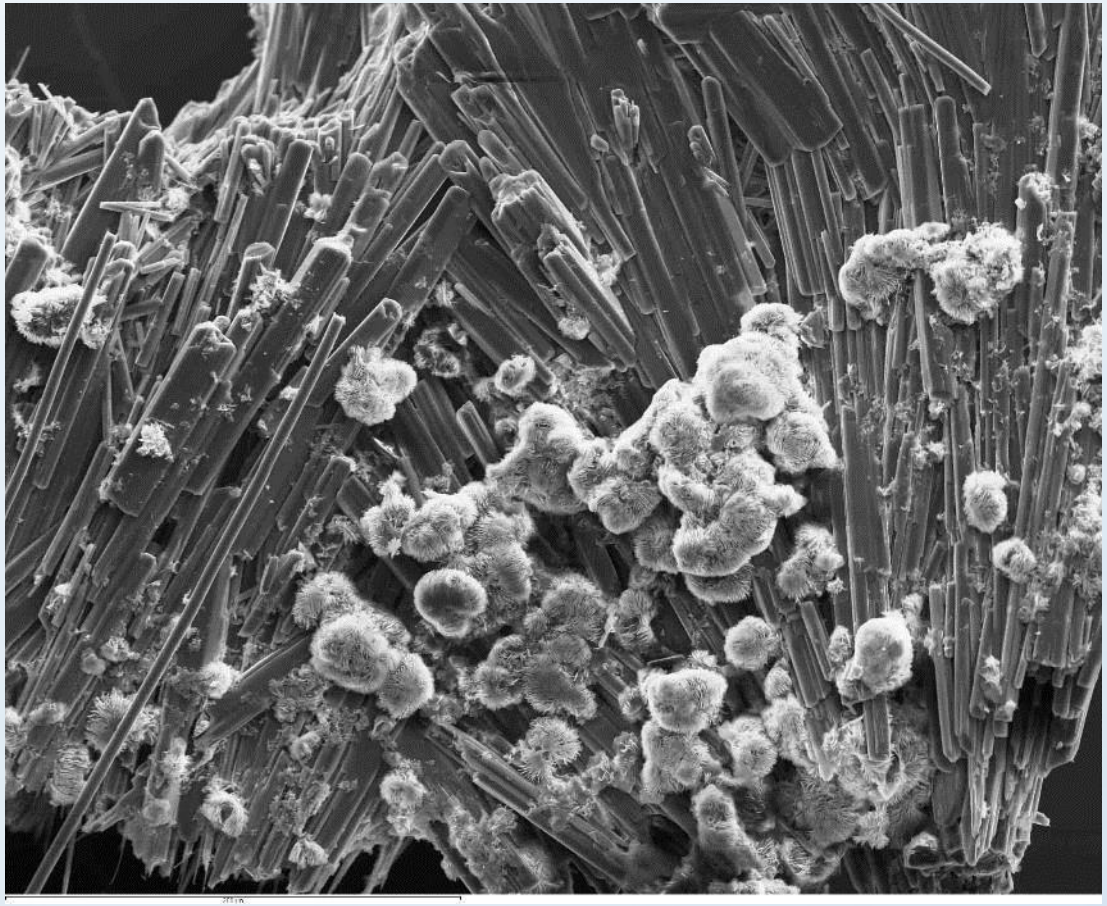
A. Corrosion

B. Efflorescence

C. Tarnish

3. Combination of 1 and 2

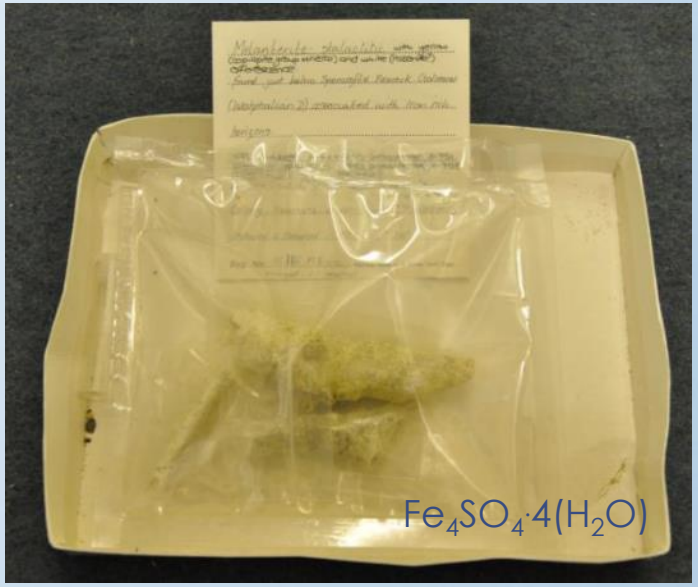
A. Conversion to different mineral.



$MgCO_3 \cdot 5H_2O$

↓

$MgCO_3 \cdot 3H_2O$



Analysis of corrosion products

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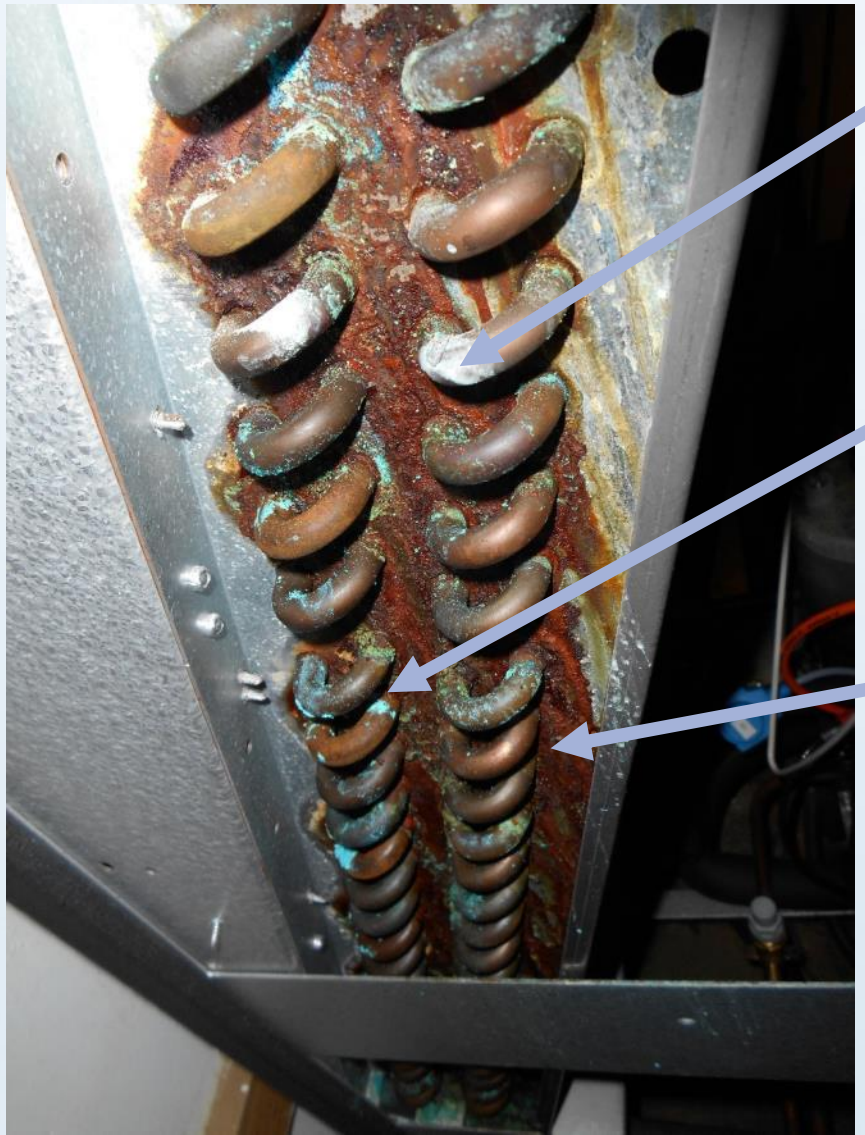


1.

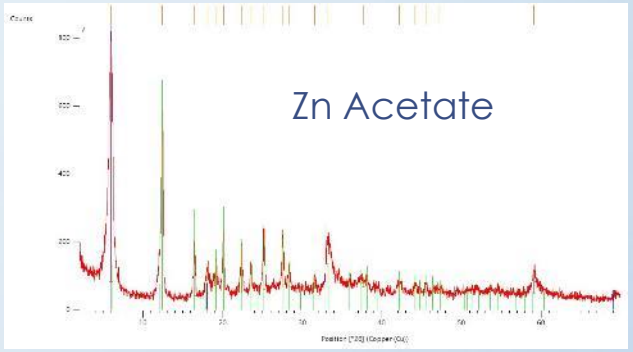
Element	Weight%	Atomic%
O K	30.22	63.33
Cu K	60.19	31.76
Zn K	9.58	4.92
Totals	100.00	

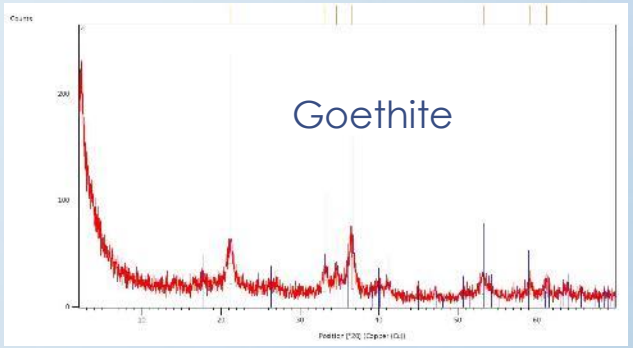
2.

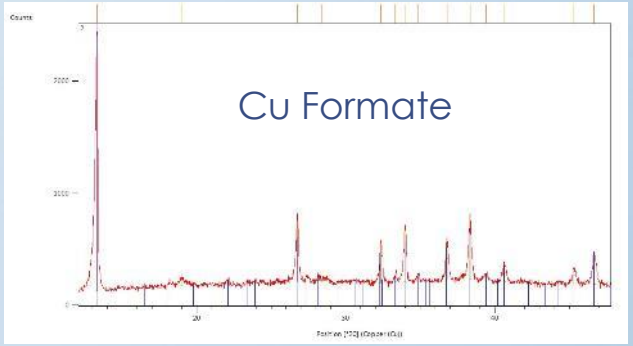
Element	Weight%	Atomic%
O K	16.54	44.04
Cu K	83.46	55.96
Totals	100.00	

3.

Element	Weight%	Atomic%
O K	21.06	48.64
Fe K	69.30	45.85
Cu K	3.82	2.22
Zn K	5.81	3.28
Totals	100.00	







Acetic acid concentrations

Draeger tubes 67 22 101

Number of strokes	3	T [deg C]	26.9
Time of measurement	30s	RH [%]	42.8
Colour change	blueviolet to yellow		
Correction factor	F=1013hPa/atm		

Sample number	Acetic Acid 01	Acetic Acid 02	Acetic Acid 03	Average
Date	11/08/2015	11/08/2015	11/08/2015	
Atmospheric pressure [hPa]	1027	1027	1027	
Location	Door	Alcove	AHU	
Measurement [ppm]	2	4	5	
Correction factor	0.986368062	0.986368062	0.986368062	
Standard deviation	10-15%	10-15%	10-15%	
Acetic Acid concentration [ppm]	1.97	3.95	4.93	
Acetic Acid concentration [mg/m3]	4.91	9.82	12.28	9.01
Acetic Acid concentration [microg/m3]	4912.11	9824.23	12280.28	9005.54

Sulphur dioxide concentrations

Draeger tubes 67 28 491

Number of strokes	10	T [deg C]	26.9
Time of measurement	3min	RH [%]	43
Colour change	greyish-blue to white		
Correction factor	F=1013hPa/atm		

Sample number	SO2 01	SO2 02	SO2 03	Average
Date	11/08/2015	11/08/2015	11/08/2015	
Atmospheric pressure [hPa]	1027	1027	1027	
Location	Door	Alcove	AHU	
Measurement [ppm]	0.1	0.1	0.1	
Correction factor	0.986368062	0.986368062	0.986368062	
Standard deviation	10-15%	10-15%	10-15%	
Sulfur dioxide concentration [ppm]	0.10	0.10	0.10	
Sulfur dioxide concentration [mg/m3]	0.26	0.26	0.26	0.26
Sulfur dioxide concentration [microg/m3]	263.36	263.36	263.36	263.36

Potential mechanisms

1. Temperature and RH fluctuations drive minerals close to transition limits – physical damage, e.g. lansfordite – nesquehonite, chalcocyanite - chalcanthite
2. Air pollution/RH cause corrosion – chemical damage, e.g. marcasite/pyrite

Next steps

1. Damage survey of specimens in the Mineral Store.
2. Analysis of corrosion products.
3. Evaluation of the roles of T, RH and air pollutants in relation to damage.
4. Outcome: recommendations/guidance for the safe storage of mineral collections.

Thank you

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