



# the Mineral Susceptibility Database

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A new tool for communicating research outputs with  
the heritage sector and beyond

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*Goldschmidt 2021, Session 14b: Science Communication in Geochemistry & Geosciences*



National Museums Liverpool  
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National Museums Liverpool

SoGE

School of Geography  
and the Environment



national  
museum  
cardiff  
amgueddfa  
genedlaethol  
caerdydd





# Geological Material...

## in Heritage

- Jewelry
- Pigments
- Ceramics
- Glass
- Sculpture
- Metals

## as Heritage

- Planetary formation & evolution
- Beginning & evolution of life
- Climate on Earth throughout time

Hetjens Museum, Düsseldorf

the Petrie Museum, London





Melanterite (OUNHM MIN.26443)

# Susceptibility

All things are susceptible to change!

- governed by:
  1. ambient conditions
  2. physical & chemical properties
    - conditions favourable for stability
    - response / change to unfavourable conditions
- inherent, secondary property
- expression dependent on likelihood of exposure to an agent
- degree = likelihood x effect

*“The state or fact of being likely or liable to be influenced or harmed by a particular thing”*  
– Oxford University Press 2021





# Susceptibility in Heritage Contexts

- determines which hazards pose deterioration risks
- informs storage & display conditions

## 10 Agents of Change\*

- Incorrect Humidity
- Incorrect Temperature
- Light (vis & UV)
- Pollutants
- Physical Forces
- Water
- Fire
- Pests
- Criminals
- Dissociation

\* ICCROM (Pedersoli et al.) 2016  
*A Guide to Risk Management of Cultural Heritage*, p. 27



*the Field Museum, Chicago*

# the Indoor Environment

## Parameters:

- ~1 bar
- -20-50°C
- 0-100% RH
- visible light & UV
- indoor pollutants: particulates, aerosols

## Covers 'extremes' that could occur during:

- equipment & infrastructure failure
- unusual weather
- flooding
- localised heating by spotlights

as well as buildings without insulation or HVAC



# Mineral Susceptibility Database

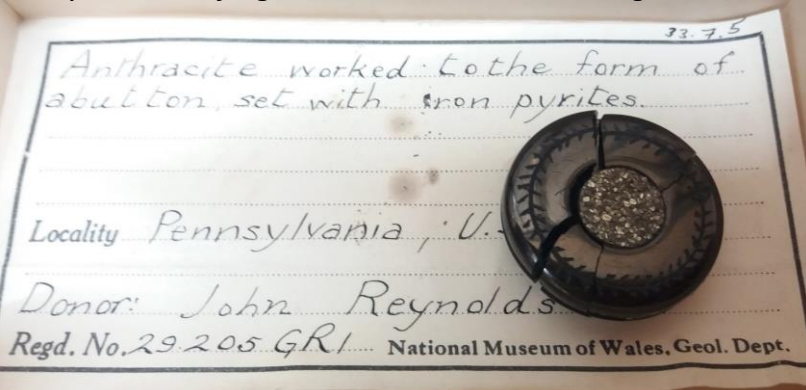
- Comprehensive resource for assessing conditions required by mineral objects & collections
- Consolidates current research from various scientific fields
- One freely accessible location
  - Improve access to reliable information

By being a repository of interdisciplinary research, the Database:

1. encourages informed decision making,
2. increases awareness of which disciplines & institutions are performing relevant research,
3. exposes additional research applications & opportunities,
4. advocates cross-disciplinary research & communication.



Ruby on zoisite frogs – the Field Museum, Chicago

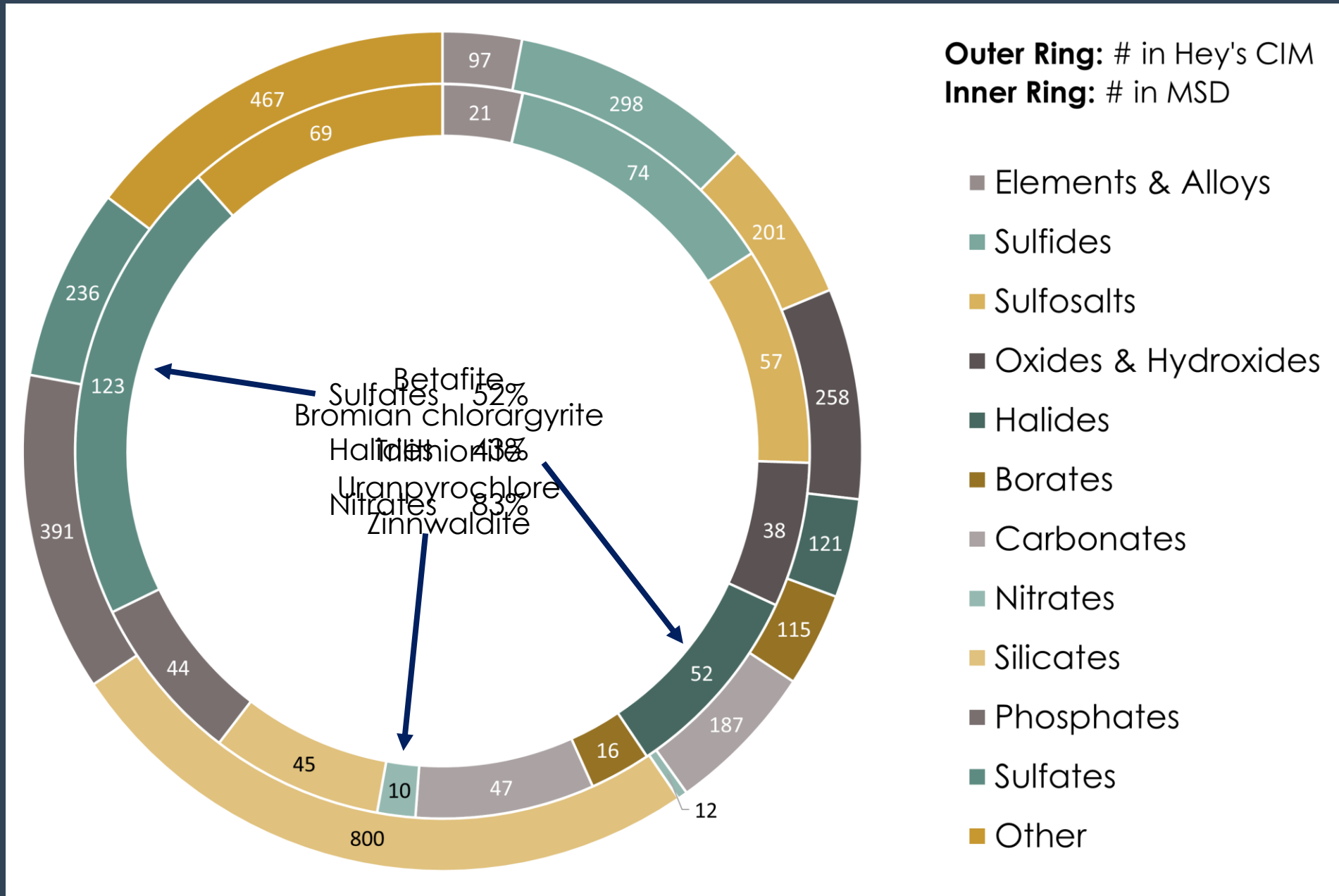


Marble specimen centre table – Ashmolean, Oxford



# Facts & Figures

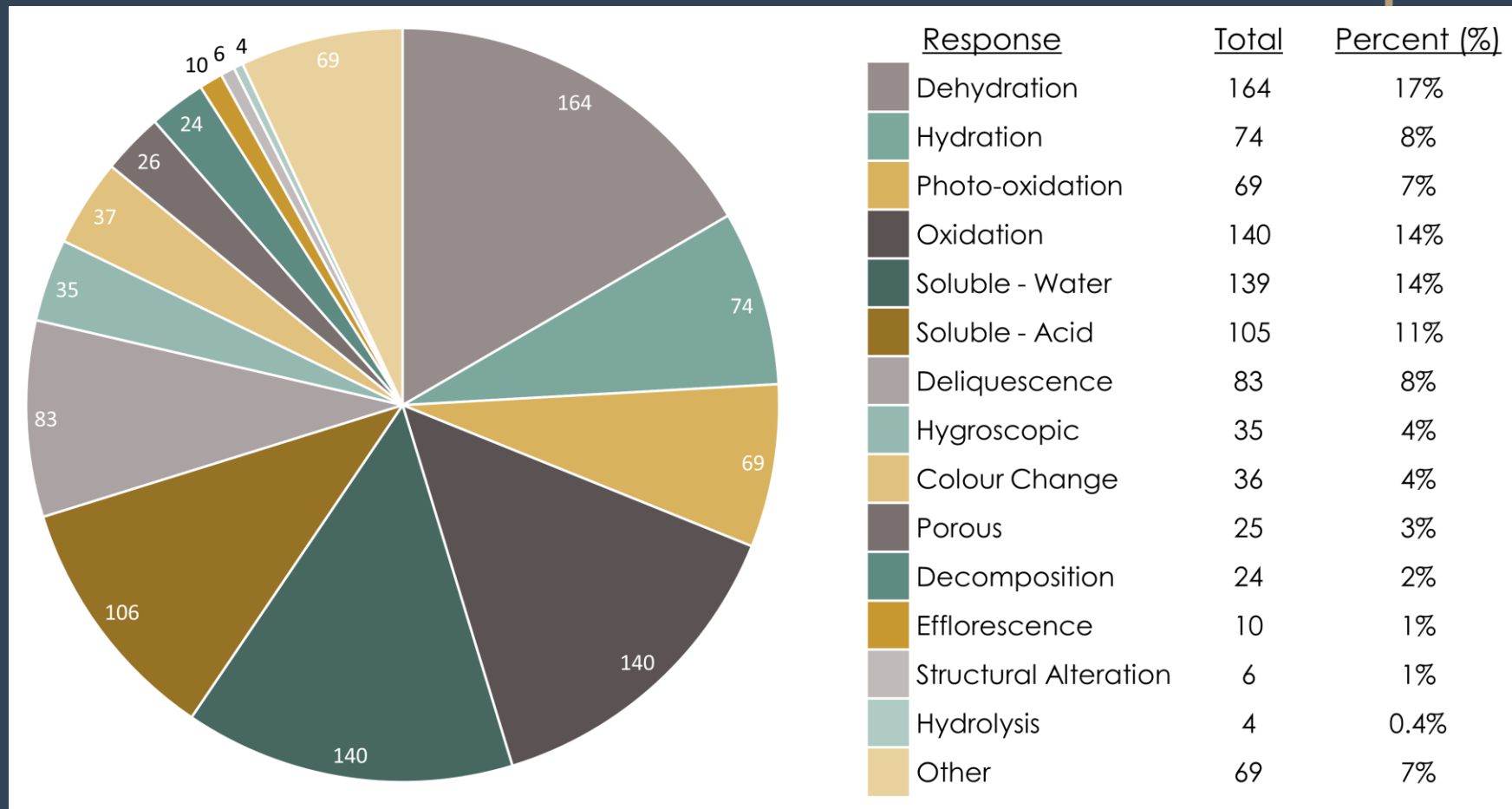
- 596 minerals
- 987 entries
- 10% of total mineral species
- 17% of species in Hey's CIM
- Some mineral groups better represented than others



# Water Predominance

Entries: Agent of Change

Agent	#	%
<i>Water</i>	662	67
<i>Pollutants</i>	158	16
<i>Light</i>	134	14
<i>Temperature</i>	23	2
<i>Oxygen</i>	10	1



- MSD = reflection of published knowledge
  - Hydration & oxidation state changes are common & important reactions that occur under atmospheric conditions
  
- Is this a true reflection of reality?





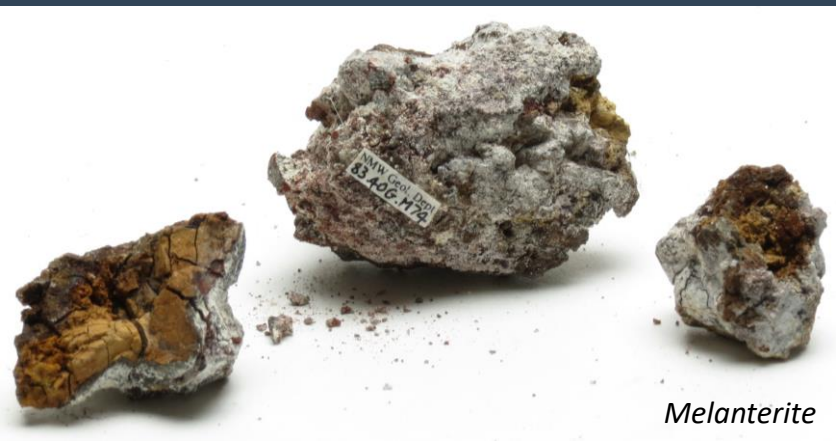
# MSD Aiding Geoscience Research

Existing entries & references evidence:

- Knowledge gaps → research opportunities
  - Reaction types & details (i.e., parameters & products)
- Current research hotspots (e.g., sulfates → Martian research)
  - Institutions & individuals performing research
- Data have practical applications within heritage sector

25.10.4	ferrohexahydrate	$\text{FeSO}_4 \cdot 6\text{H}_2\text{O}$		dehydration		to lower hydration states	Jambor et al. 2000; Hyc
			25C, > 61% RH	hydration		to higher hydration states	Waller 1992
			RT, 63-89% RH	oxidation		to fibroferrite (via copiapite a 63-80% RH)	Jerz & Rimstidt 2003
25.10.5	melanterite	$\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$	20C, > 95% RH	deliquescence			Chou et al. 2002; Jerz &
			20C, < 57% RH	dehydration	efflorescence	to siderotil, where Cu <	Chou et al. 2002
			20C, < 65% RH	dehydration	efflorescence	to rozenite, where Cu >	Jambor et al. 2000
			25C, > 58-60% RH	deliquescence		to solution $\text{Fe}_2(\text{SO})_3$	Xu et al. 2009
25.10.6	rhomboclase	$(\text{H}_5\text{O}_2)\text{Fe}^{3+}(\text{SO}_4)_2 \cdot 2\text{H}_2\text{O}$	22-25C, 33-53% RH	alteration		to kornelite & paracoquimbite	Xu et al. 2009
				dehydration	efflorescence	to lower hydration states	Waller 1992; King 1985
25.10.8	kornelite	$\text{Fe}^{3+}_2(\text{SO}_4)_3 \cdot 7\text{H}_2\text{O}$	22-25C, > 43% RH	hydration		to paracoquimbite	Xu et al. 2009
			20C, > 73% RH	deliquescence			Waller 1992
25.10.9	coquimbite	$\text{AlFe}^{3+}_3(\text{SO}_4)_6(\text{H}_2\text{O})_{12} \cdot 6\text{H}_2\text{O}$	moist air	hydration		to higher hydration states	Howie 1984
				dehydration	efflorescence	to lower hydration states	Waller 1992; King 1985
25.10.10	paracoquimbite	$\text{Fe}^{3+}_4(\text{SO}_4)_6(\text{H}_2\text{O})_{12} \cdot 6\text{H}_2\text{O}$	22-25C, < 43% RH	dehydration		to kornelite	Xu et al. 2009
25.10.11	quenstedtite	$\text{Fe}^{3+}_2(\text{SO}_4)_3 \cdot 11\text{H}_2\text{O}$		dehydration	efflorescence	to paracoquimbite	Waller 1992; King 1985
			22-25C, > 68% RH	deliquescence		to solution $\text{Fe}_2(\text{SO})_3$	Xu et al. 2009
25.10.12	ferricopiapite	$\text{Fe}^{3+}_{0.67}\text{Fe}^{3+}_4(\text{SO}_4)_6(\text{OH})_2 \cdot 20\text{H}_2\text{O}$	22-25C, 33-53% RH	alteration		to kornelite & paracoquimbite	Xu et al. 2009

Fe Sulfides



*Melanterite*



*Halite*



*Marcasite*

## Have any relevant research?

- MSD Submission Form @ <http://mineralcare.web.ox.ac.uk/database>  
or
- email: [kathryn.royce@ouce.ox.ac.uk](mailto:kathryn.royce@ouce.ox.ac.uk)

## Further Information:

- Reference for Mineral Care: <http://mineralcare.web.ox.ac.uk/>



# Thank you for listening!

The Mineral Stability Database is an output of a collaborative doctoral research project, supported by collaborators from the following institutions:

- University of Oxford, School of Geography & the Environment – Prof. Heather Viles
- National Museum Cardiff – Dr. Jana Horak, Tom Cotterell
- National Museums Liverpool – Dr. Christian Baars
- BSRIA Ltd. – Tom Gagarin
- OR3D – James Earl

The PhD project is part of the Science and Engineering in Arts, Heritage, and Archaeology Centre for Doctoral Training (SEAHA CDT).

Funding has been provided by:

- The Engineering and Physical Sciences Research Council (EPSRC)
- The Barbara Whatmore Trust
- The Pilgrim Trust
- The National Conservation Service



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