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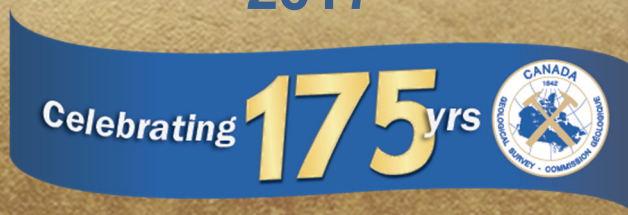


**Geological Survey of Canada
Scientific Presentation 75**

**Characterization of smelter dust from the
mineral fraction of humus**

R.D. Knight and P.J. Henderson

2017



Presented at: 6th International Symposium on Environmental Geochemistry

Date presented: September 2003

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Recommended citation

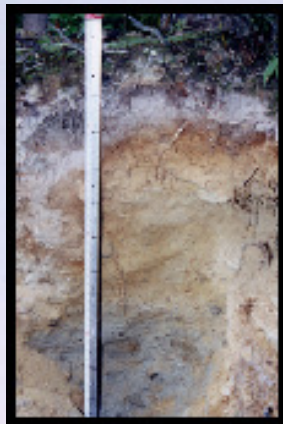
Knight, R.D. and Henderson P.J., 2017. Characterization of smelter dust from the mineral fraction of humus; Geological Survey of Canada, Scientific Presentation 75, 1 .zip file. <https://doi.org/10.4095/306043>

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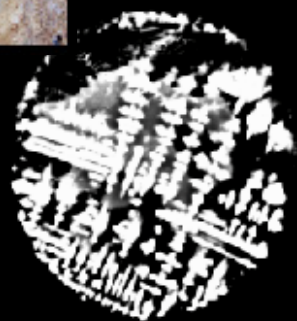


Characterization of Smelter Dust from the Mineral Fraction of Humus

R.D. Knight and P.J. Henderson



Exp. 14 mm 1000 x 1.25 E. P. 1000 x 1.25



Setting the Stage

Metals in the Environment Point Source Project

To determine:

- **Extent of metal loading**
- **Characteristics of emitted metals**
- **Processes and factors controlling metal distribution**
- **Criteria for differentiating geogenic and anthropogenic metal loading**
- **Mass balance of emissions to metal concentrations**

Setting the Stage

Part II

Metals in the Environment - GSC

Lake Sediments

Dendrochemical

Snow

Peat

Humus and soil

Smelter Dust

Metals in the Environment - RN

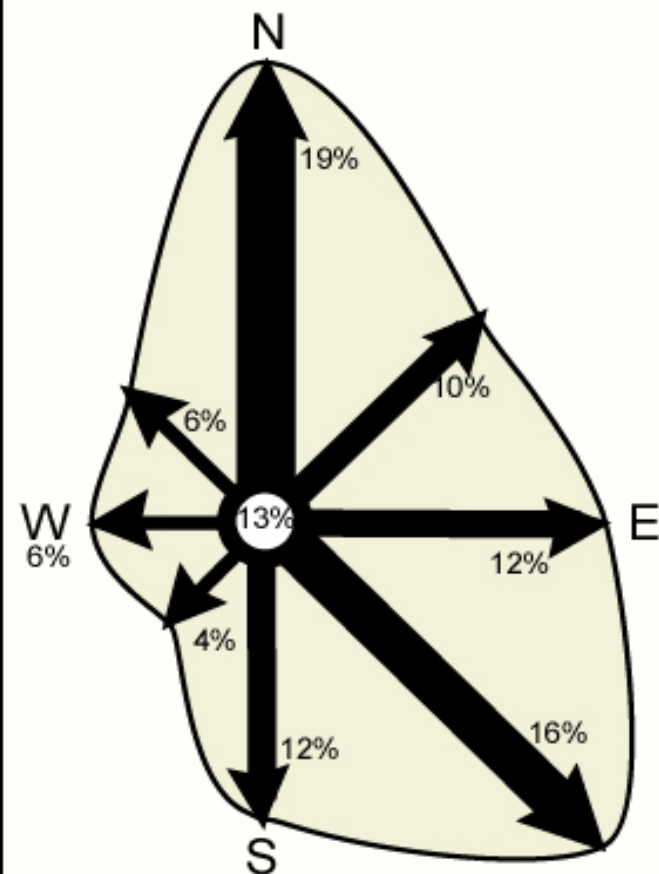
**Sources / Processes
/ Impacts**

**Cascade Impactors – St. Mary's
Atmospheric Studies –
Meteorological Service of
Canada**

**Stack chemistry
Slag chemistry**

Factors affecting the distribution of metal in soil

- **Wind**



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Factors affecting the distribution of metal in soil

- **Wind**
- **Soil Type**



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Factors affecting the distribution of metal in soil

- **Wind**
- **Soil Type**

Luvisol



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Factors affecting the distribution of metal in soil

- **Wind**
- **Soil Type**
- **Humus** (thickness/type)



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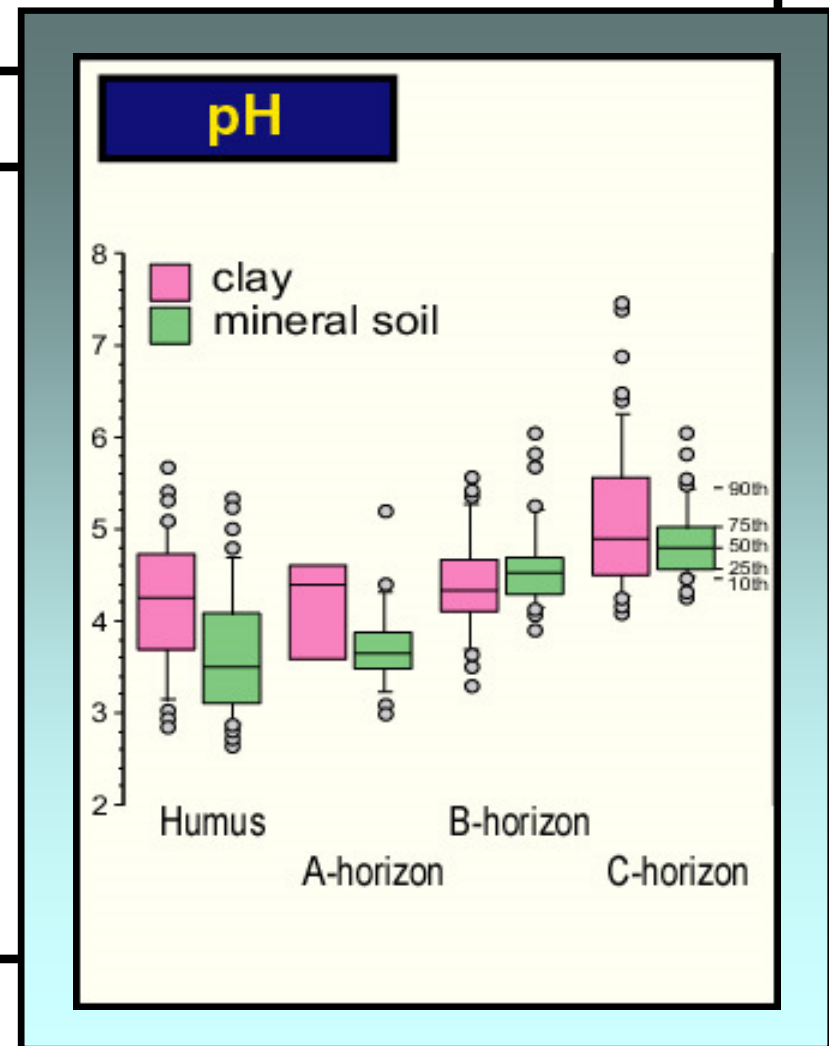
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Factors affecting the distribution of metal in soil

- **Wind**
- **Soil Type**
- **Humus** (thickness/type)
- **pH**



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Factors affecting the distribution of metal in soil

- **Wind**
- **Soil Type**
- **Humus** (thickness/type)
- **pH**
- **Geology** (bedrock & surficial)



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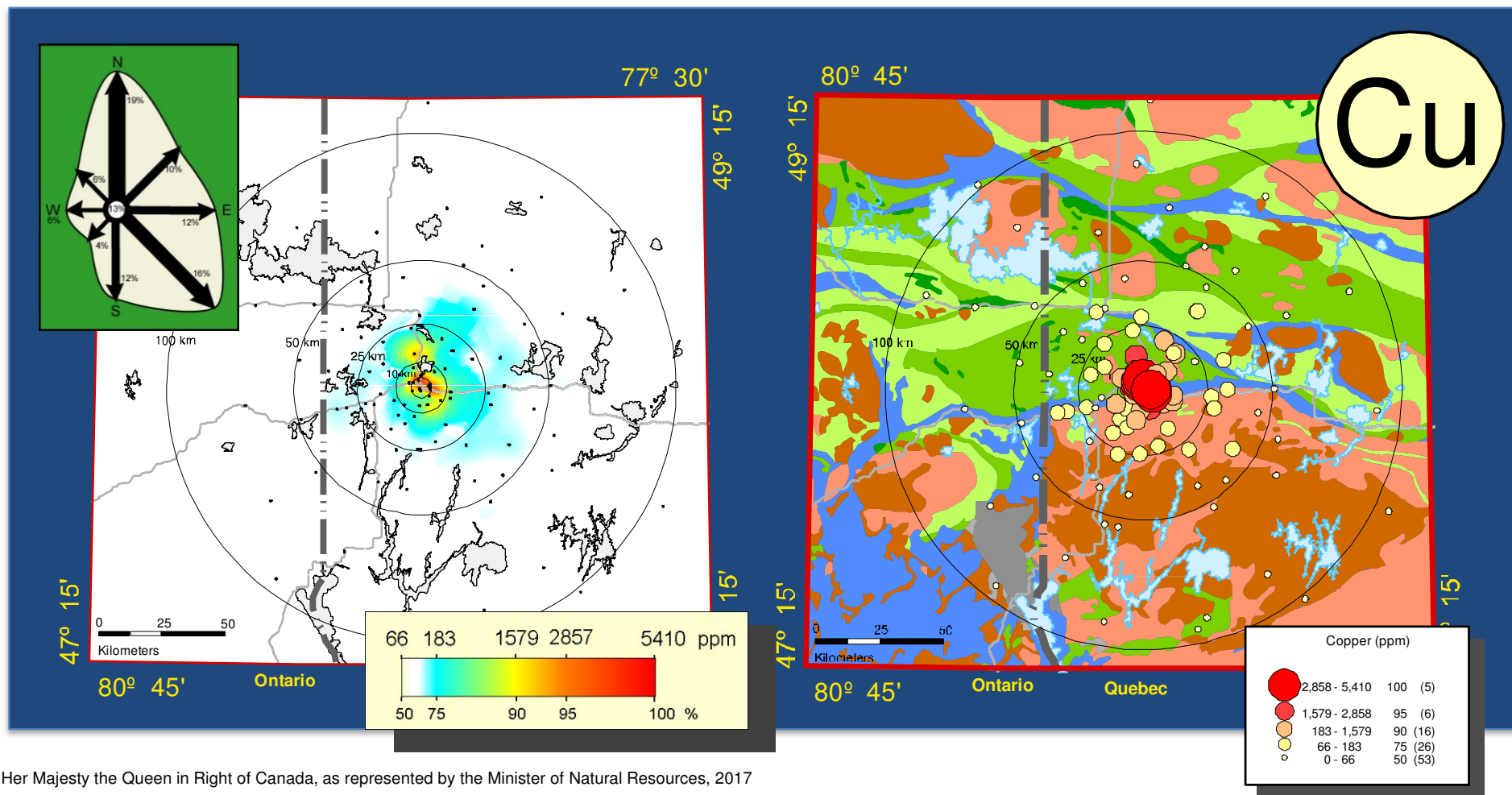


Extent of Metal Loading

Humus

<2mm

ICP-AES Aqua regia



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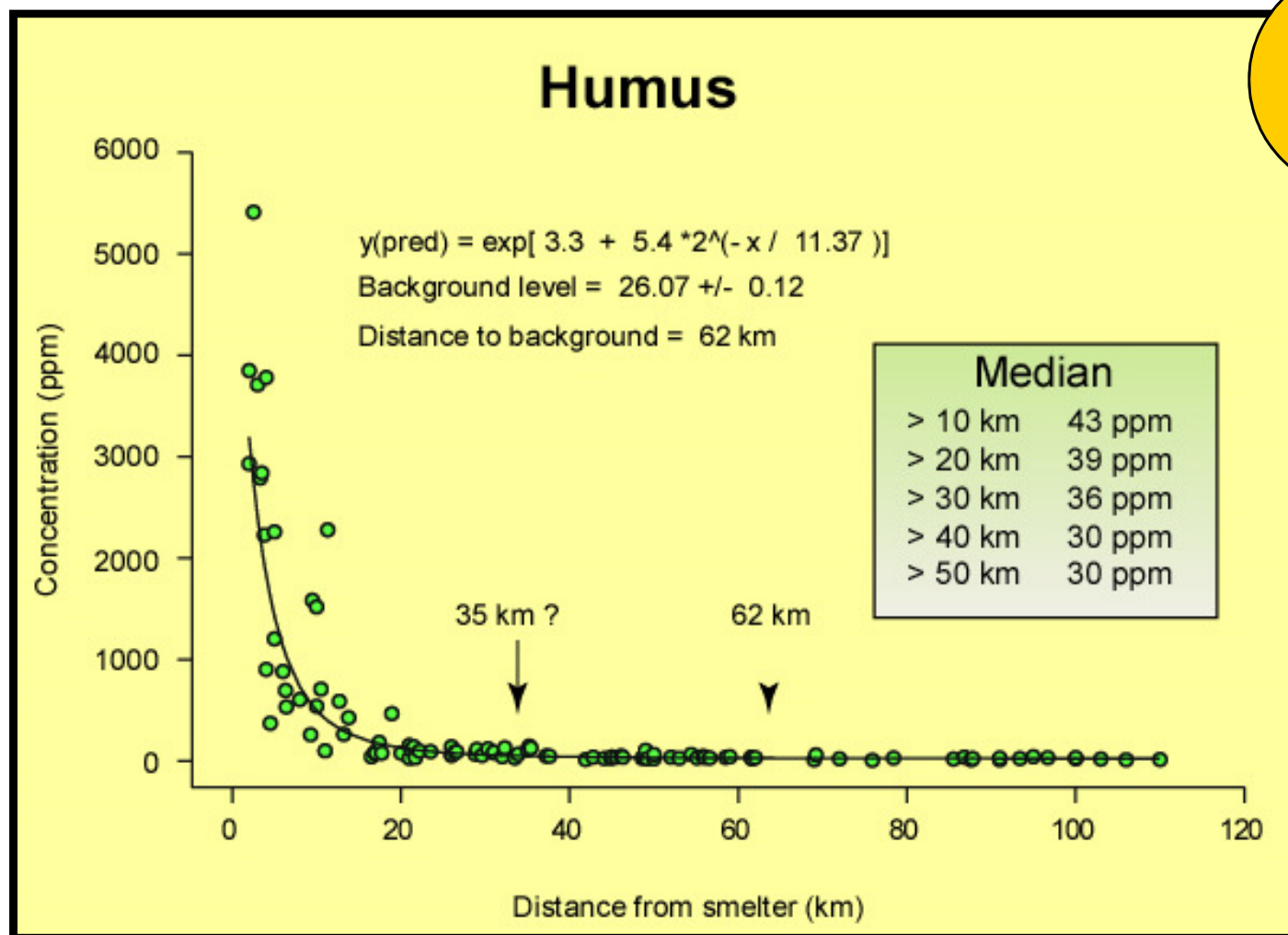


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Extent of Metal Loading



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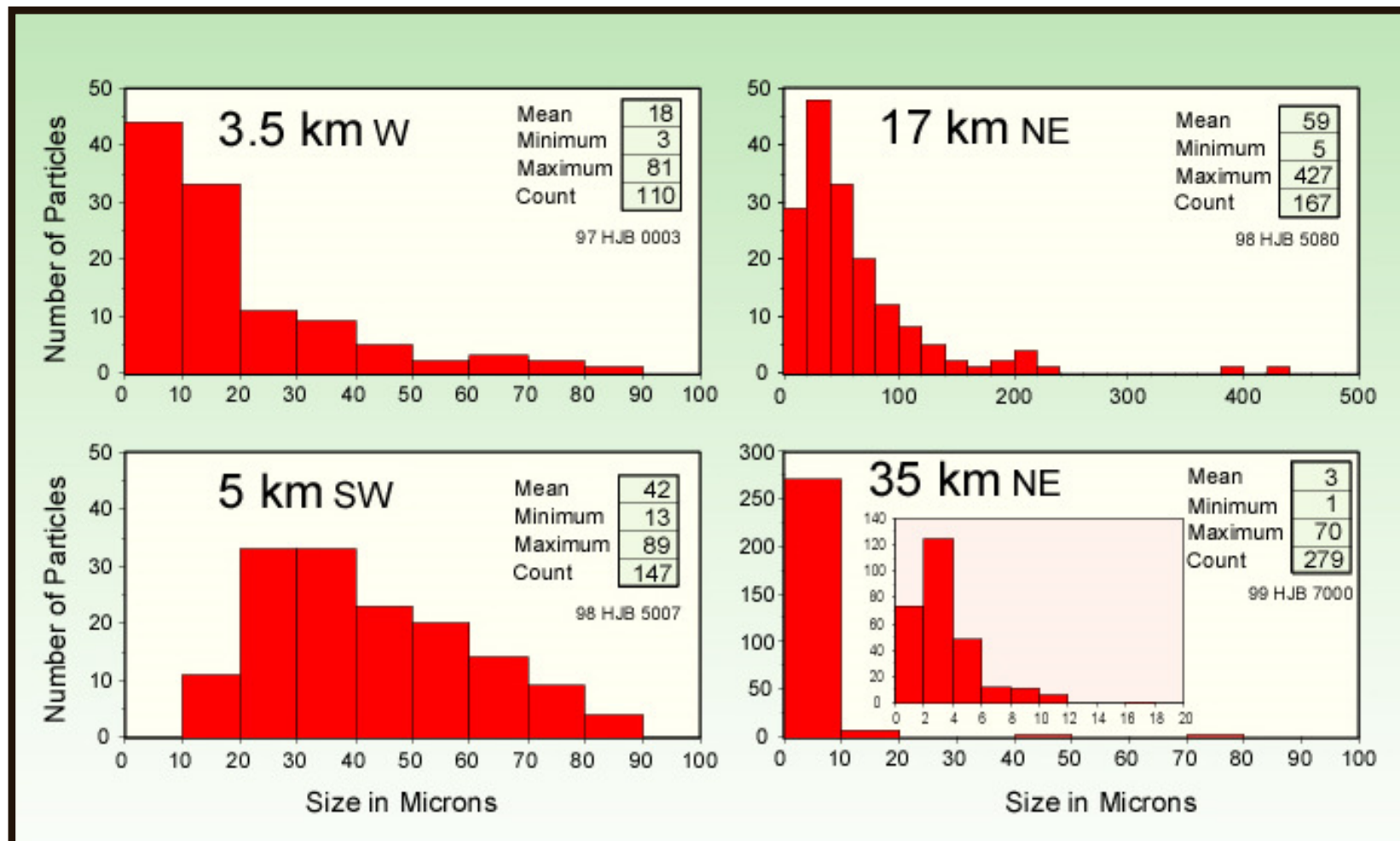
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Characteristics of Emitted Particles

Size and abundance with distance



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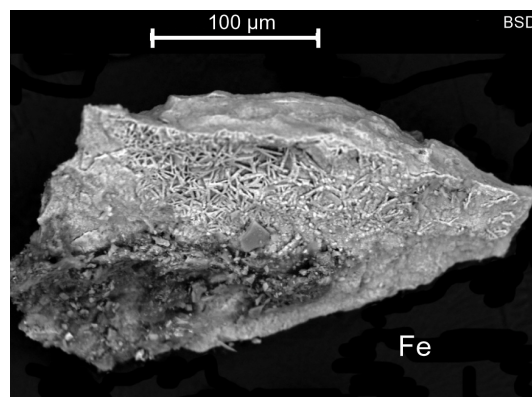
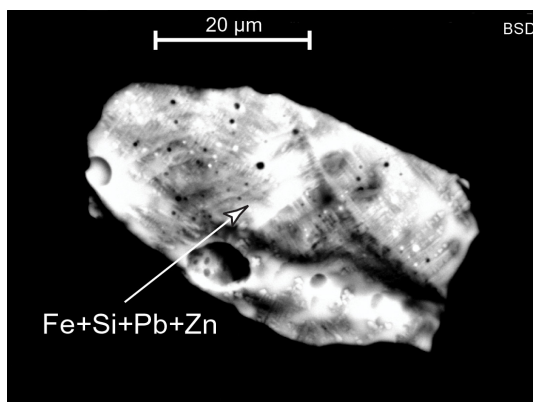
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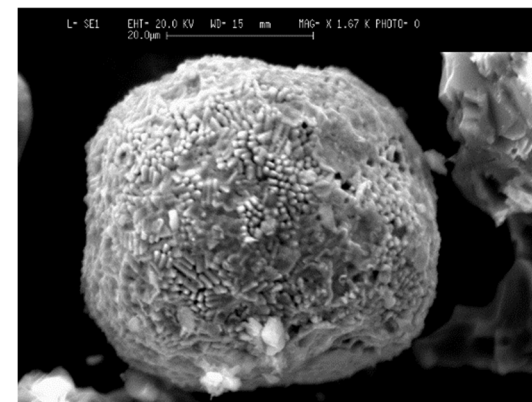
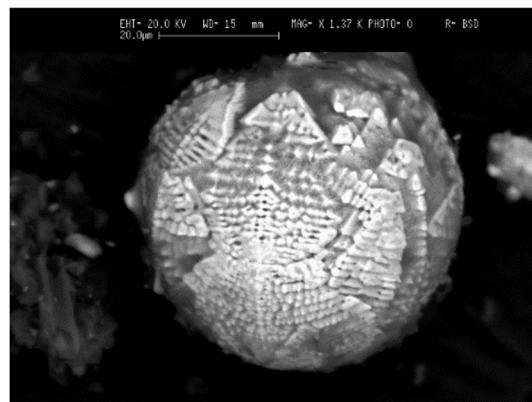
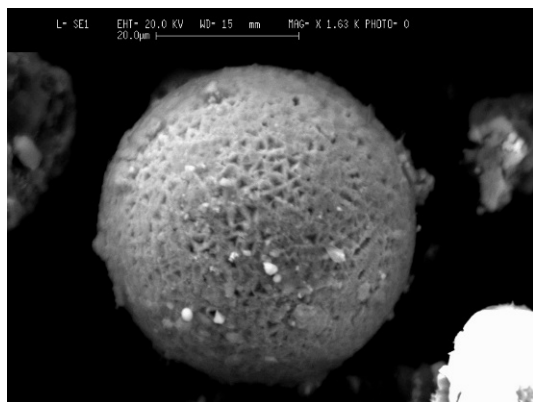
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Characterization of Particles in Humus

Angular morphology



Spherical morphology



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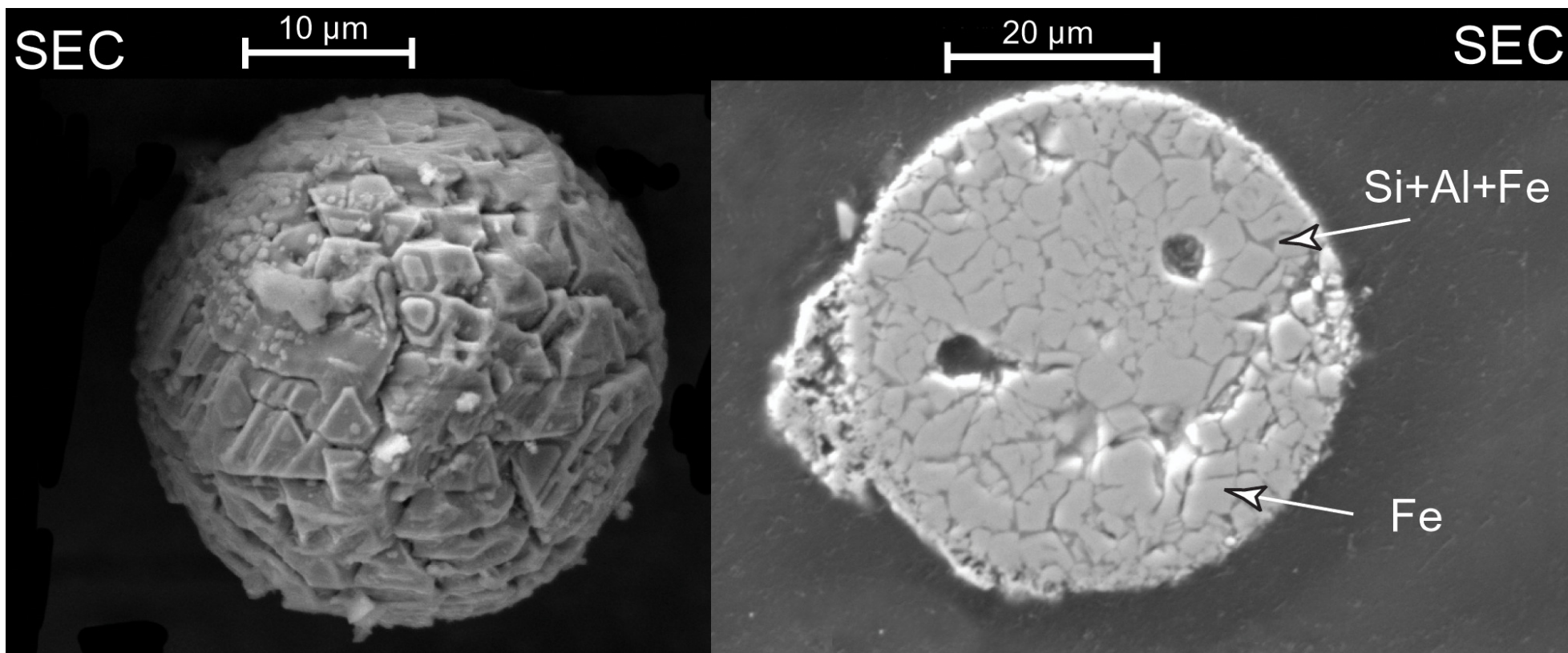


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Class 1: Plated



Fe and Fe+Si

-agglomeration and partial fusing of flux

-complete melting and slow re-crystallization

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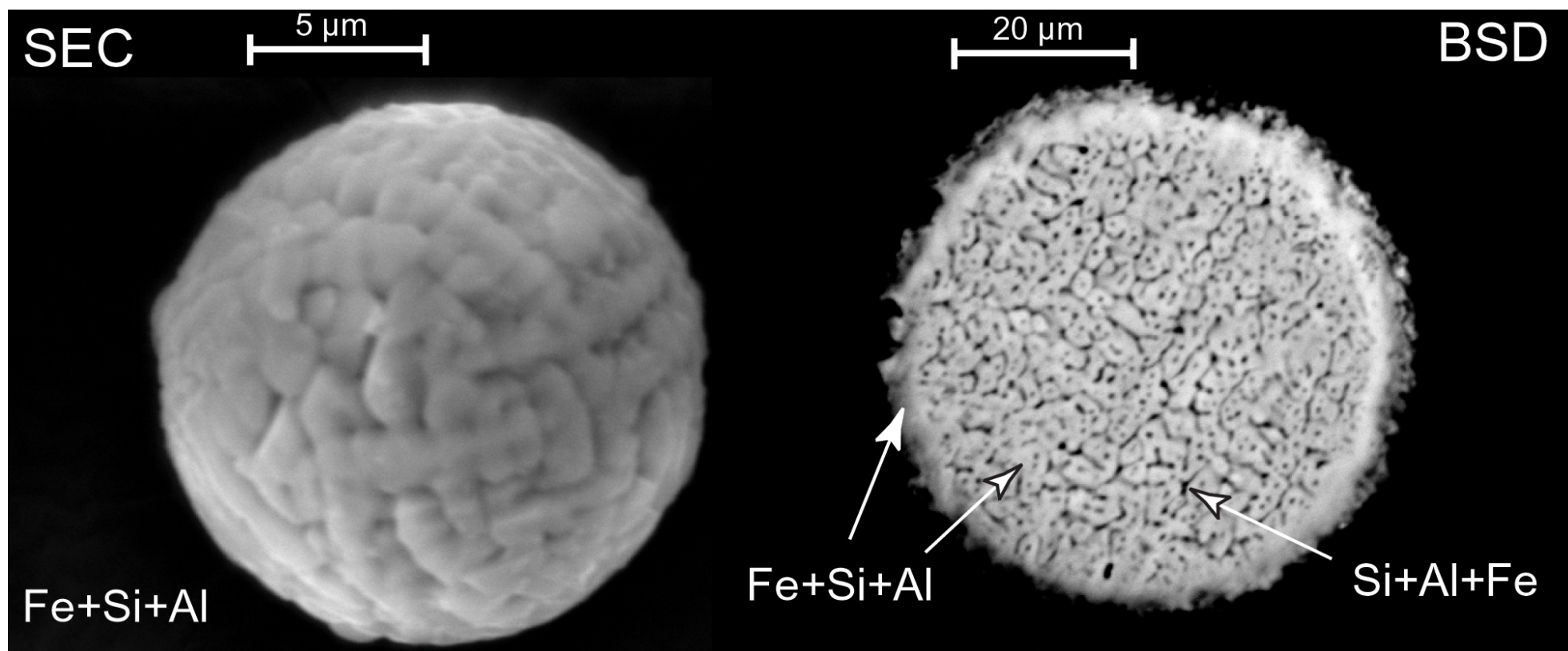


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Class 2: Tubular



Fe and Fe+Si+Al

greater amount of agglomeration and partial fusing than Class 1

complete melting and faster re-crystallization than Class 1

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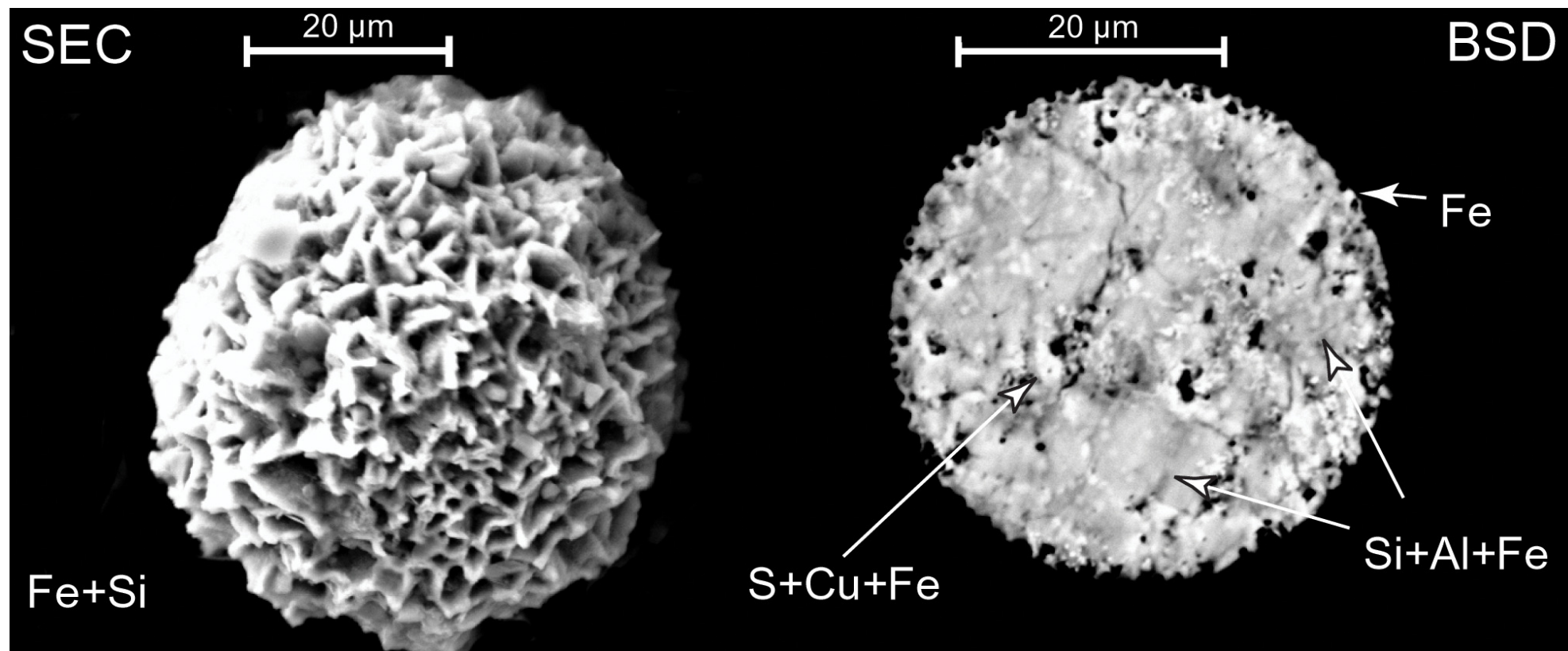


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Class 3: Etched



Fe, S+Cu+Fe
matrix of Si+Al+Fe

- molds of chalcopyrite
- poorly differentiated phases

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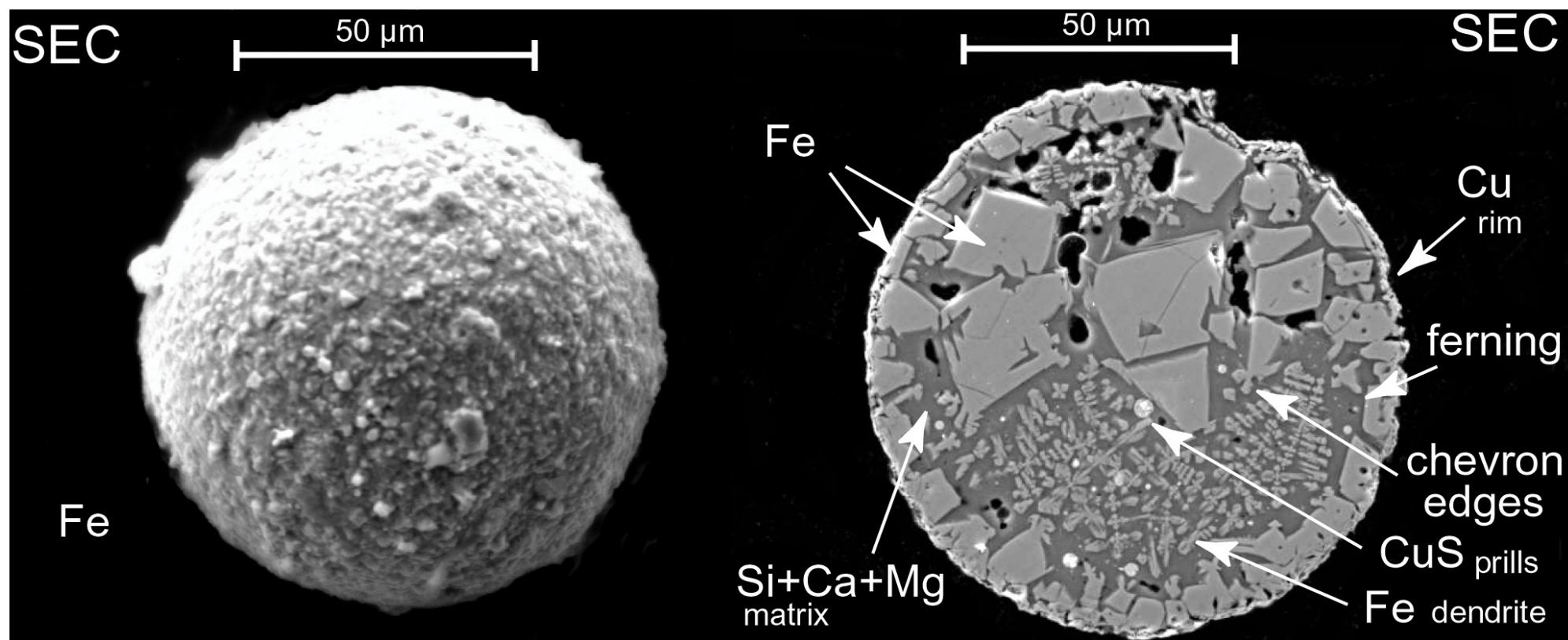


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Class 4: Granular to Smooth



Fe

matrix Si+Al+Mg

- multiple stages of formation

- molten droplets and un-melted mineral dust

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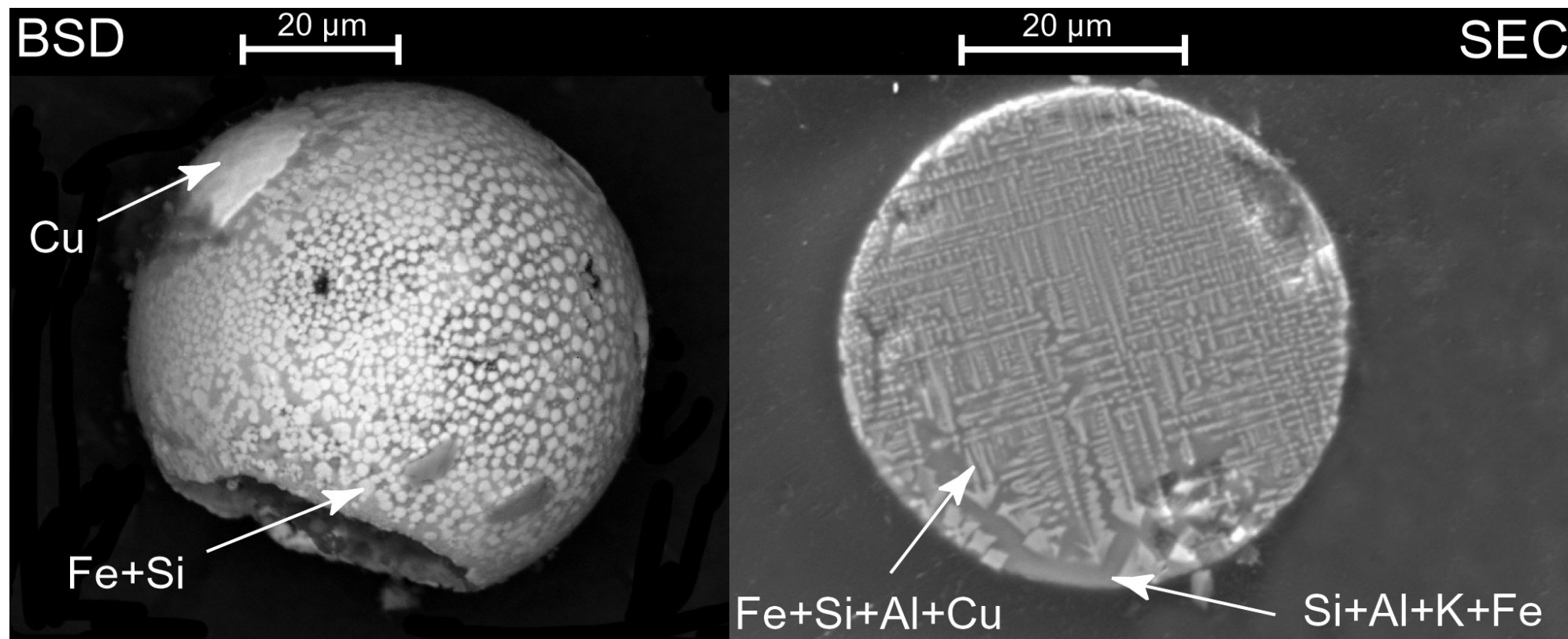


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Class 4: Granular to Smooth



crystalline Fe

matrix Si+Al+Mg

- dendritic to trellis quench textures

- note the outer cap of Cu on the left image

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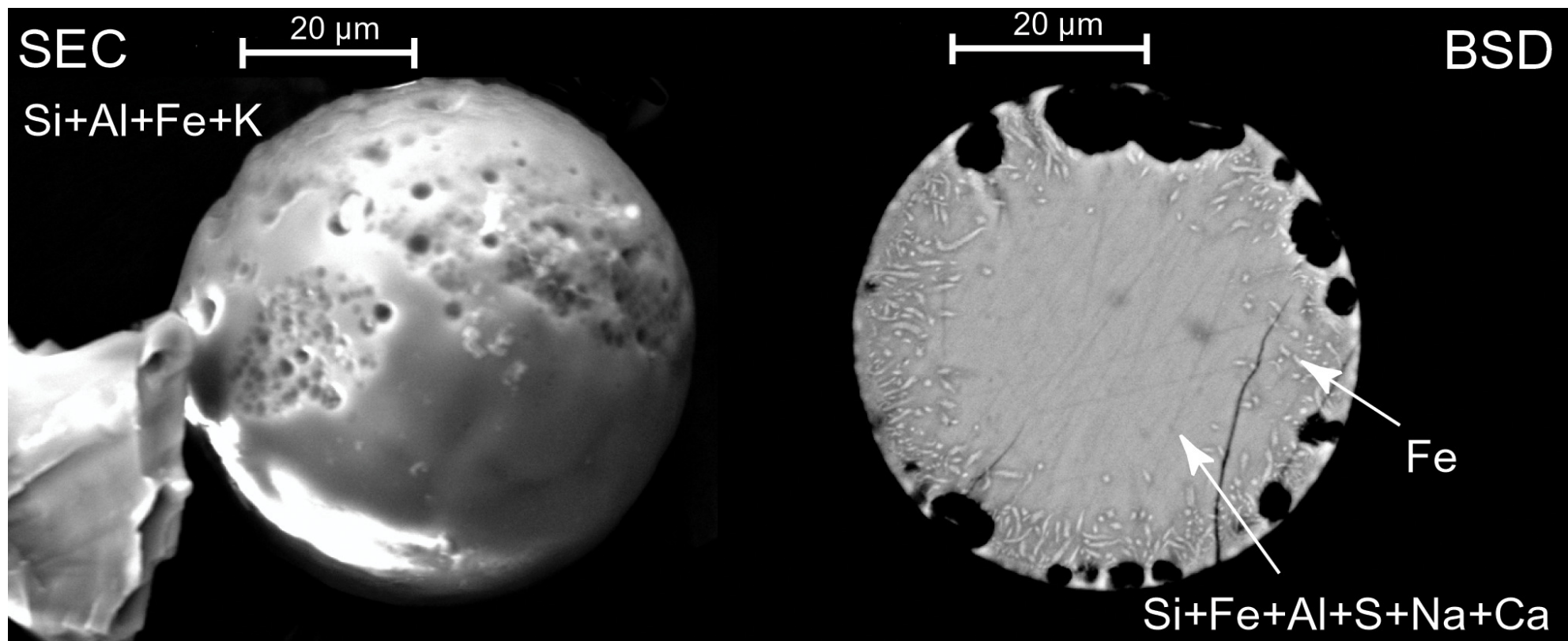


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Class 5: Lunar



**Si+Al+Na with
minor Fe**

- almost complete release of metals
- last remnants of Fe near dust edge

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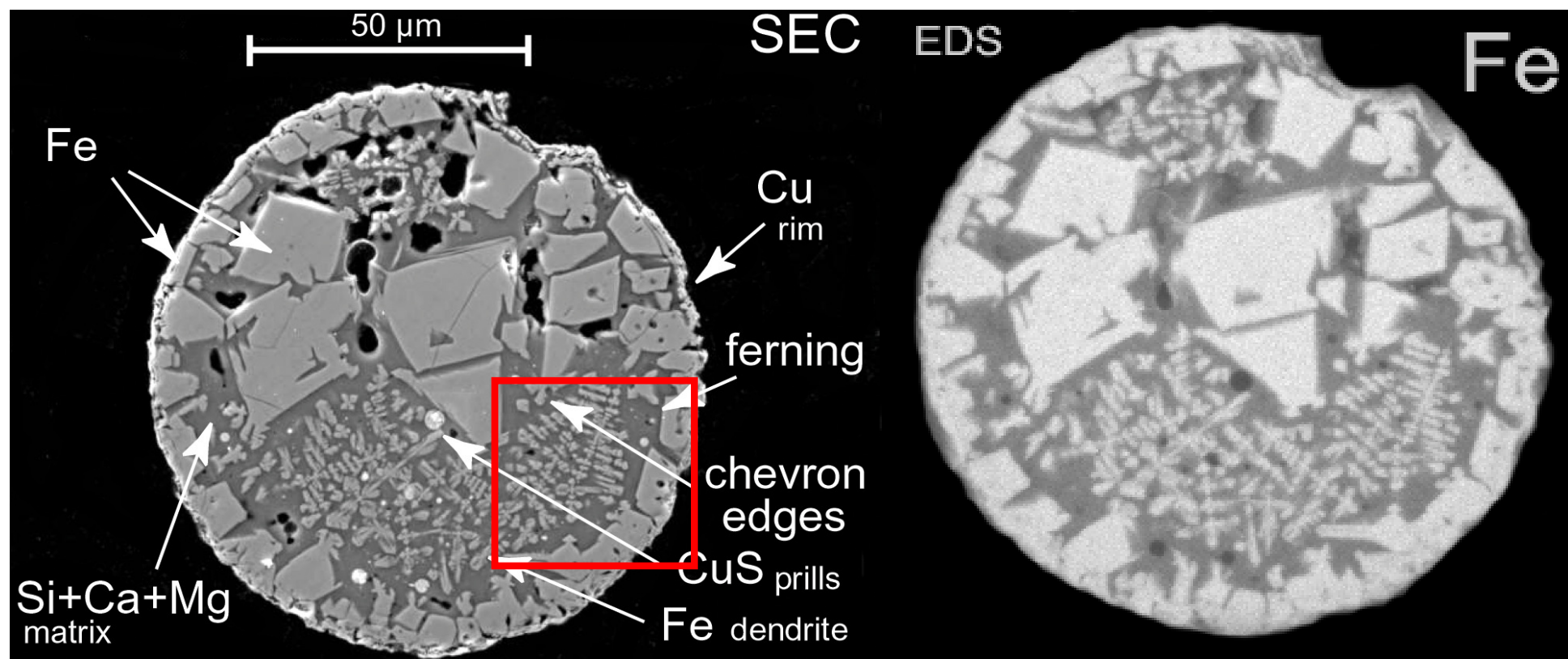


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Class 4: Granular to Smooth



Fe

matrix Si+Al+Mg

- multiple stages of formation

- molten droplets and un-melted mineral dust

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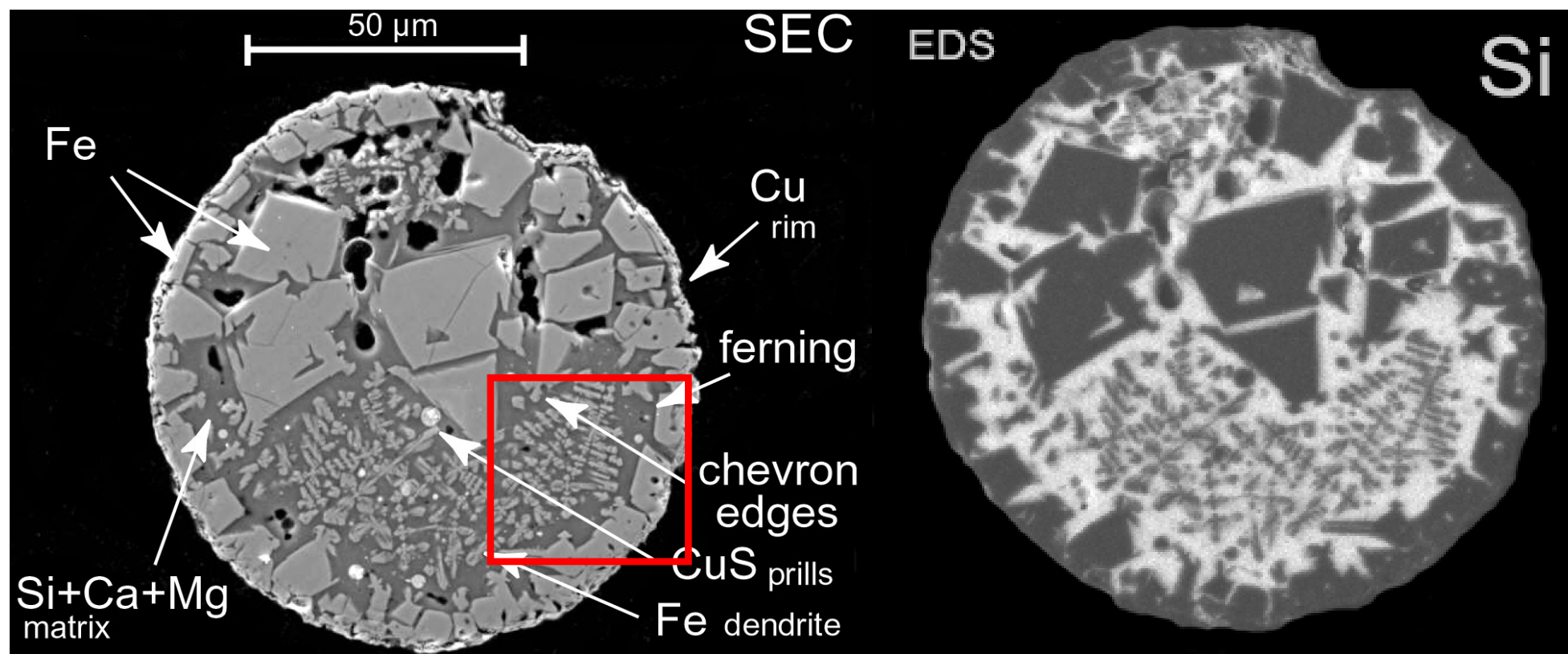


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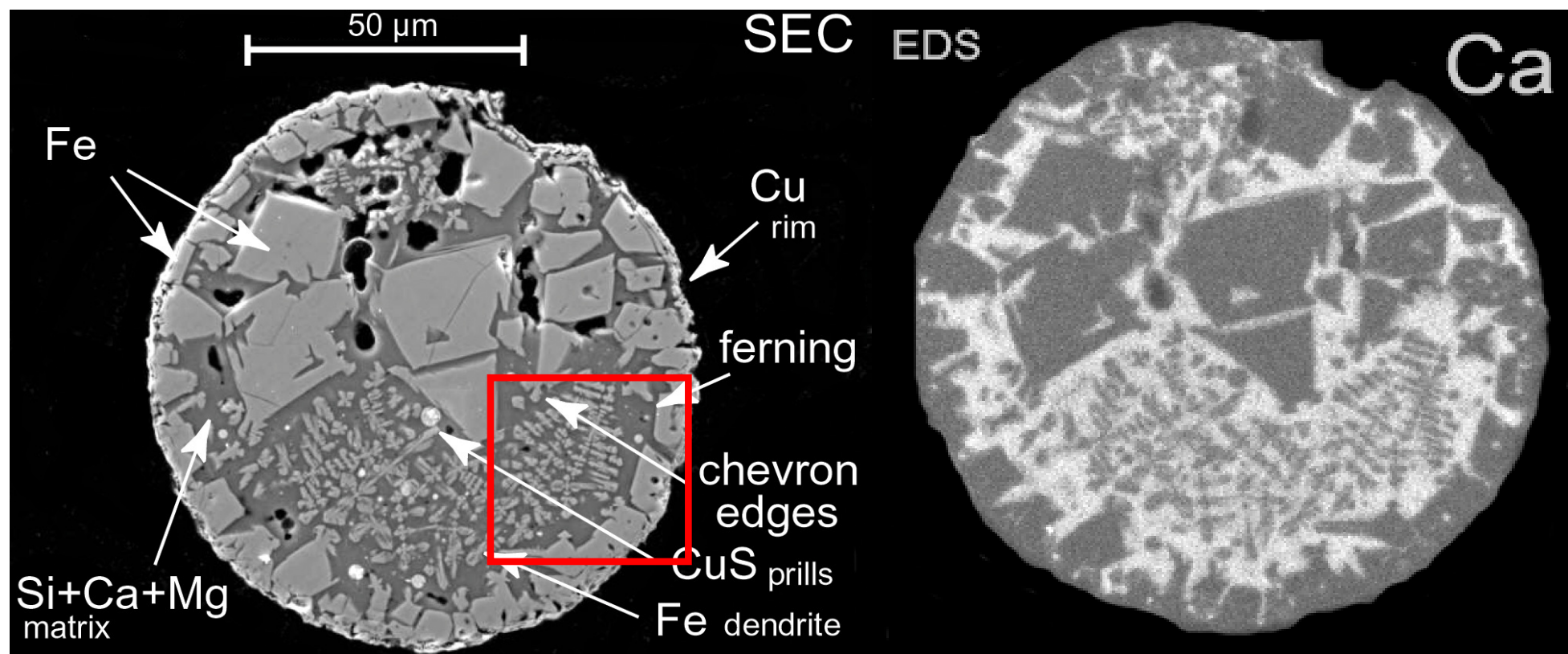


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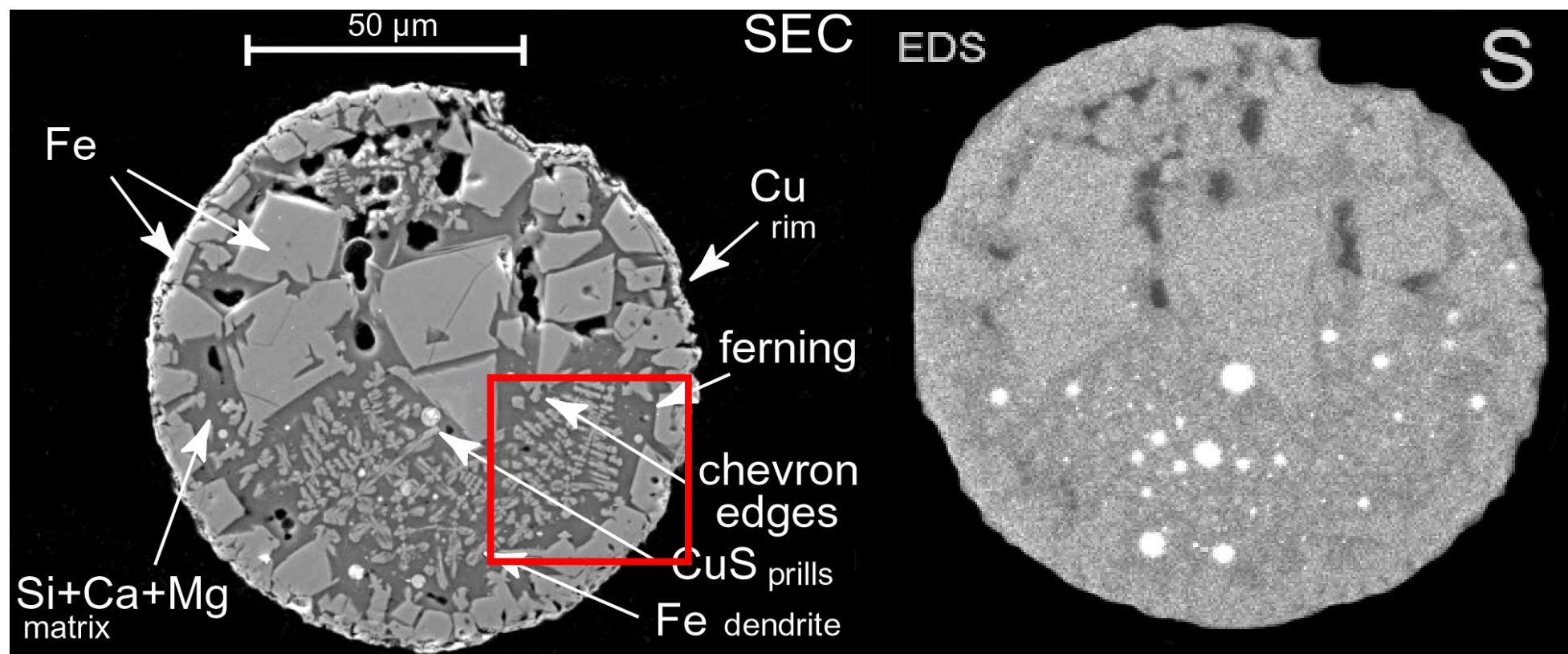


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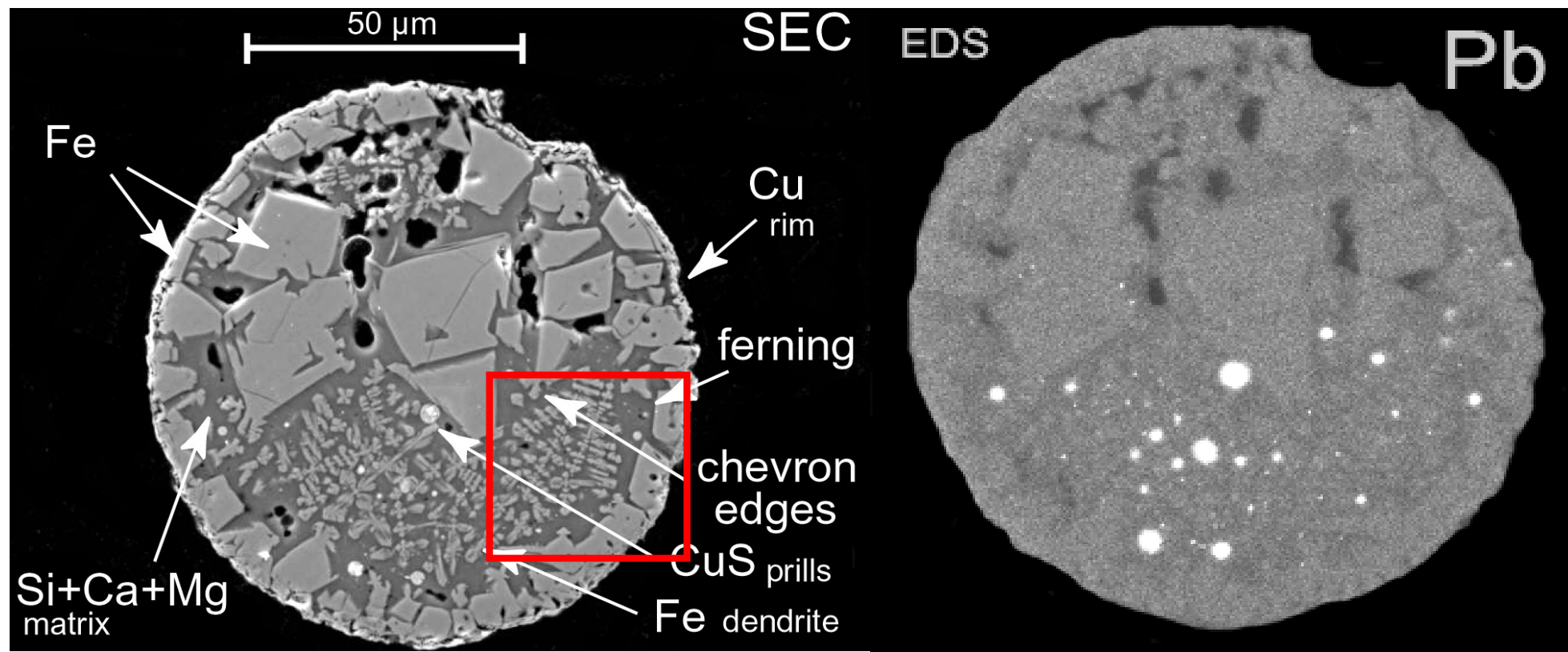


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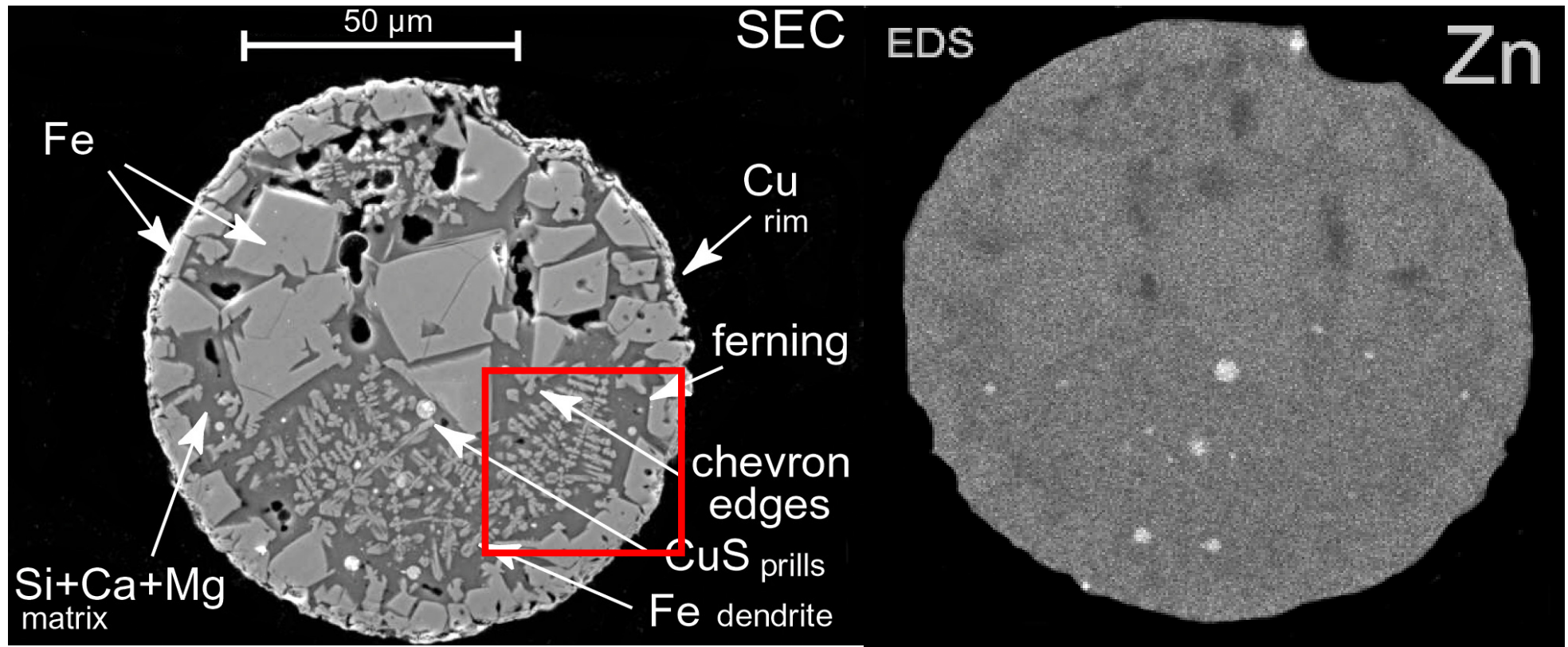


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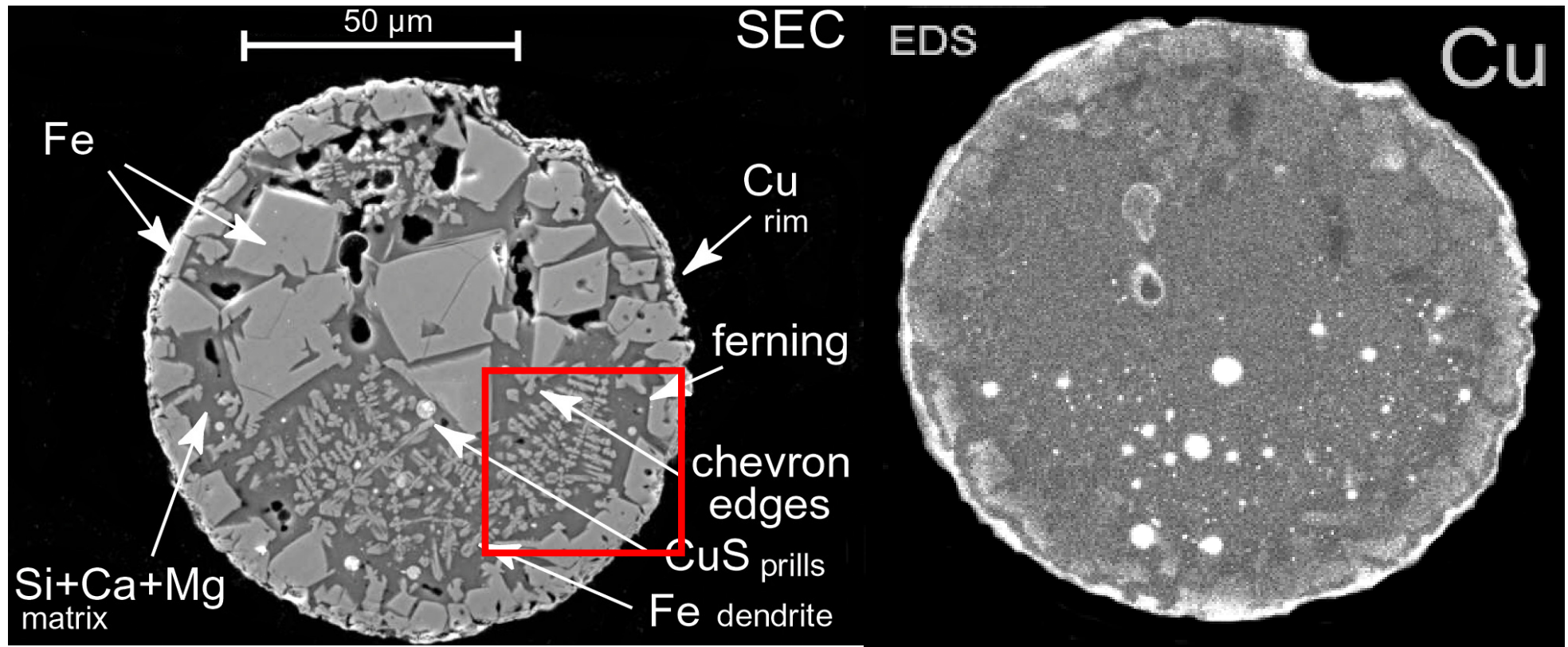


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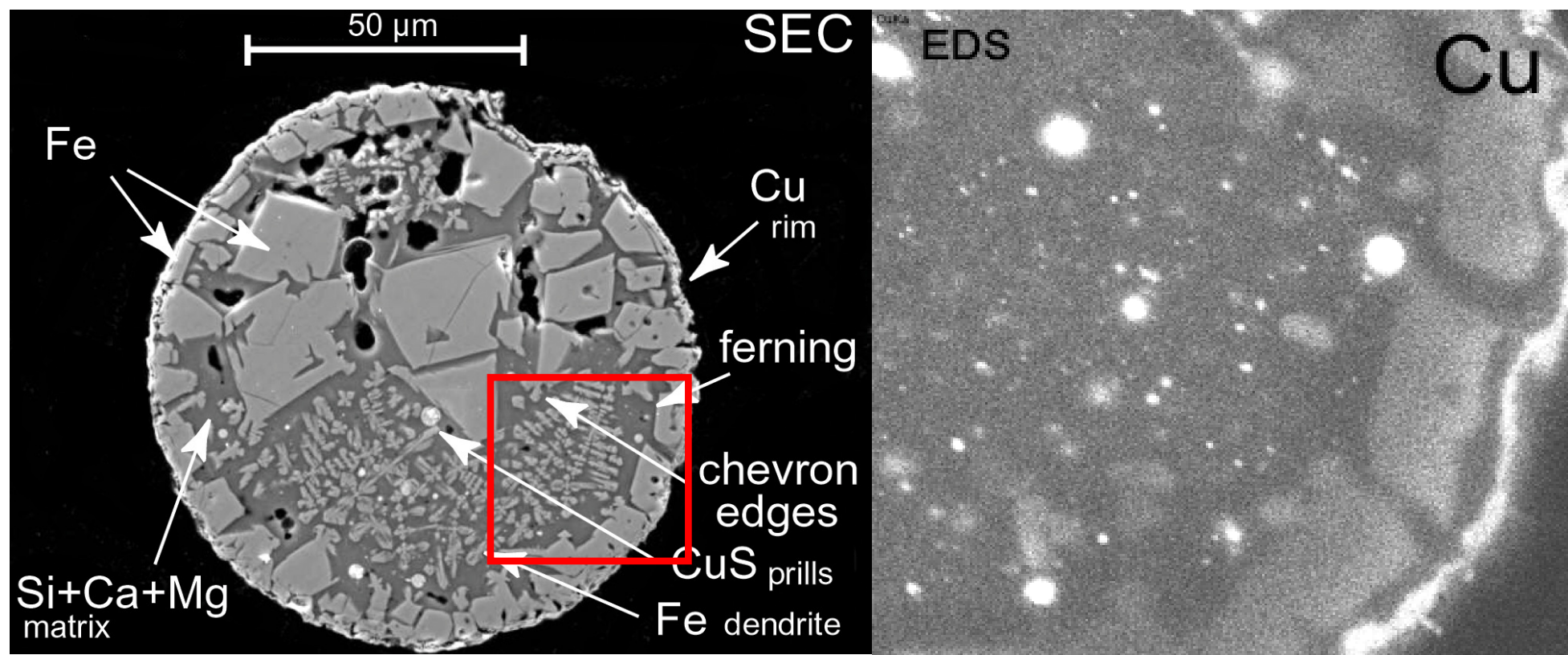


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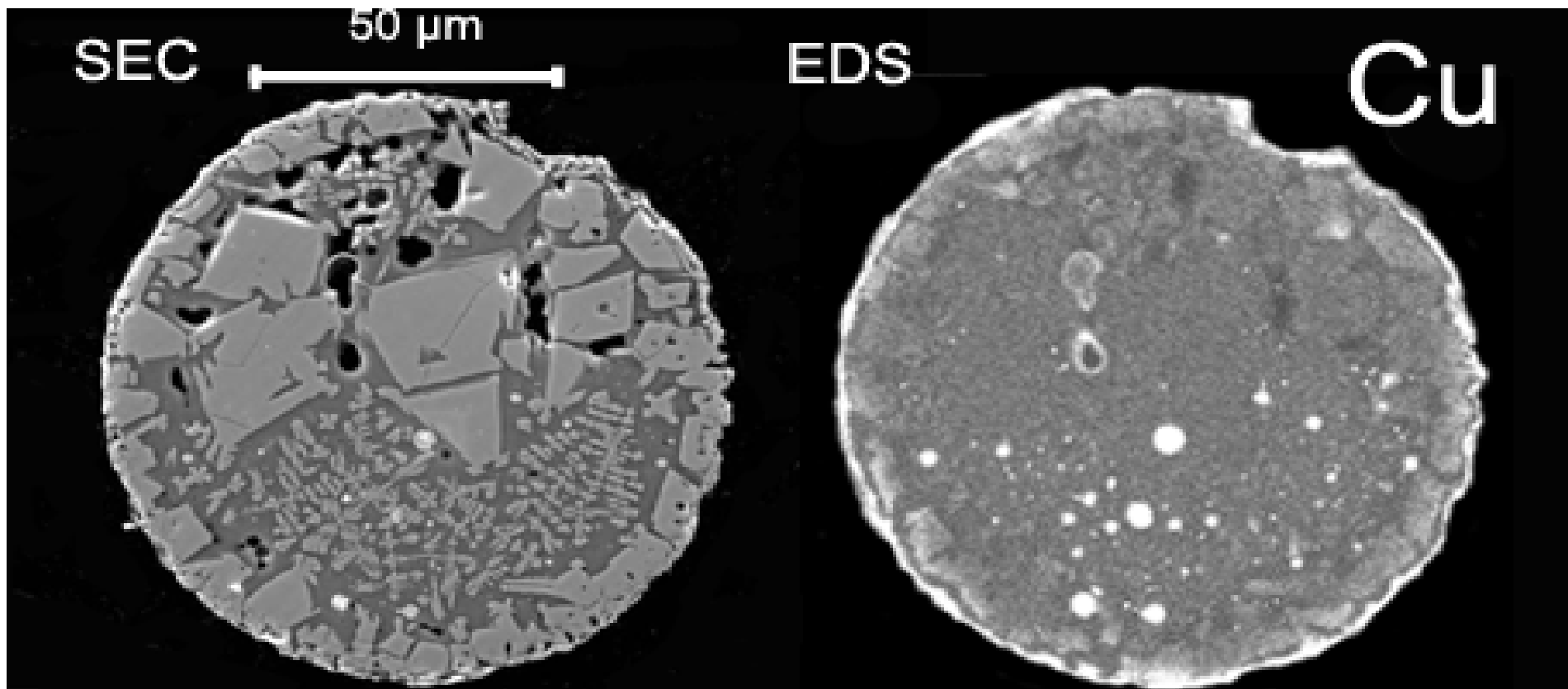


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Cu content by EDS image analyses



Class 4: Granular to Smooth
Fe, matrix Si+Al+Mg

Cu = 6% of area

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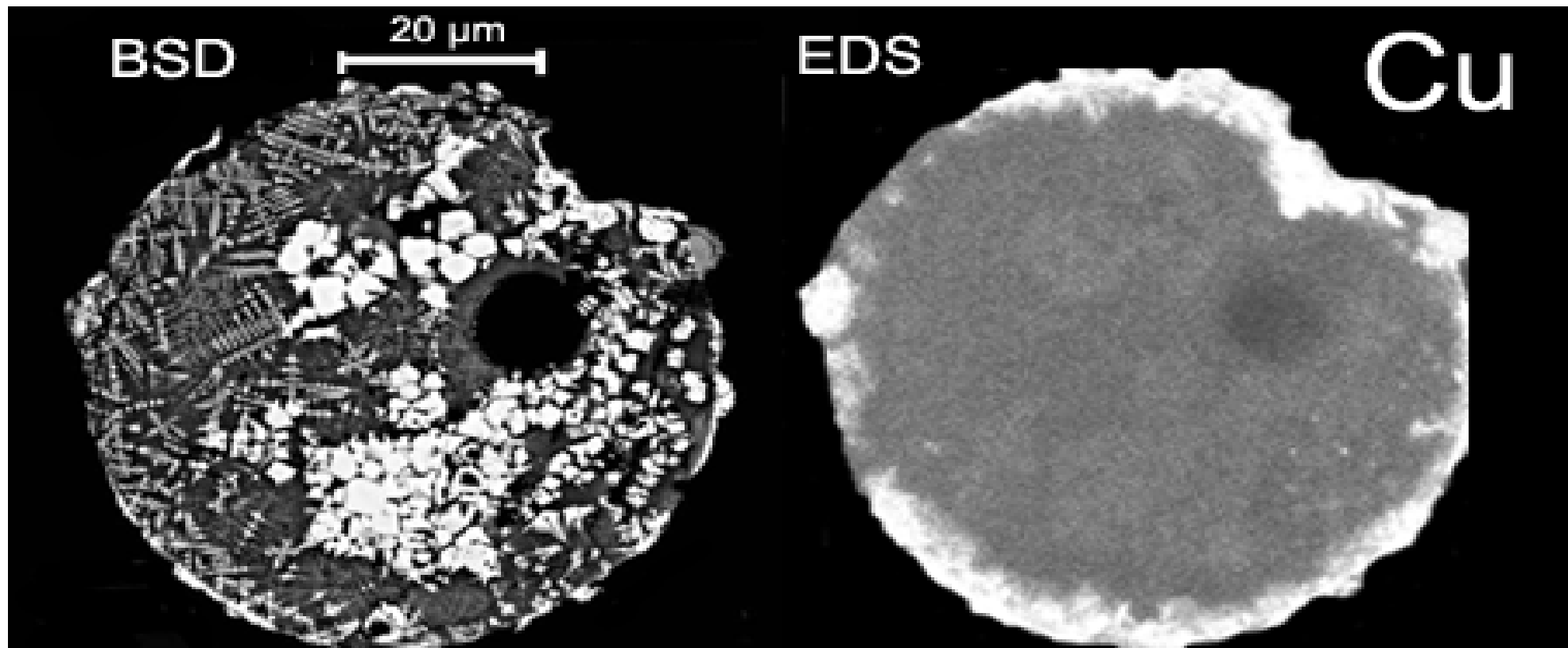


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Cu content by EDS image analyses



Class 4: Granular to Smooth
Fe, matrix Si+Al+Mg

Cu = 17% of area

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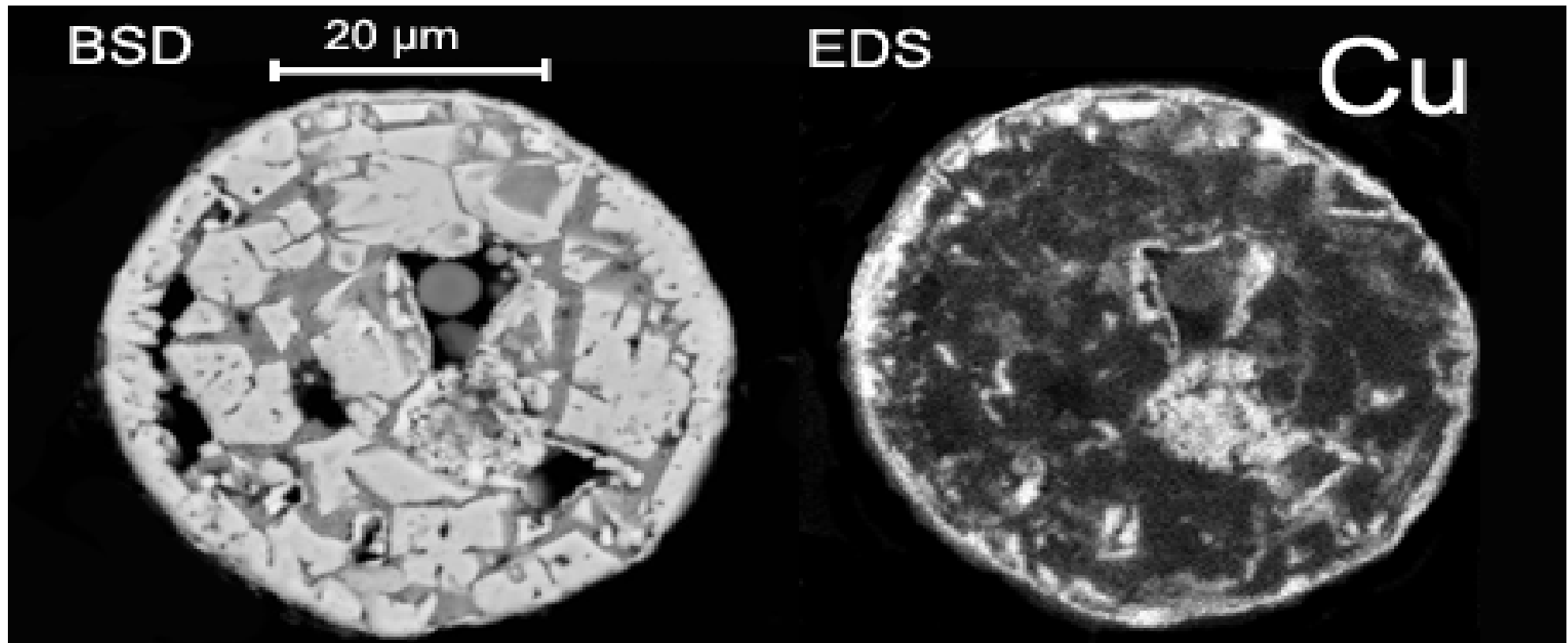


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Cu content by EDS image analyses



Class 4: Granular to Smooth
Fe, matrix Si+Al+Mg

Cu = 19% of area

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Does the Cu add up

How many particles are there?

How many contain Cu?

How many Cu bearing particles are there per gram?

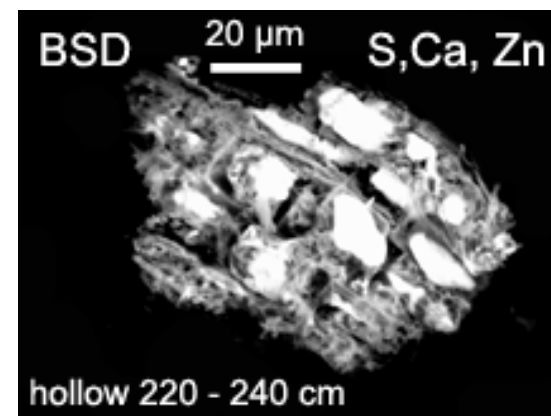
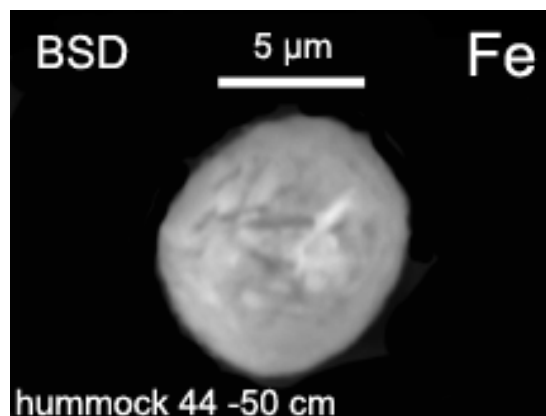
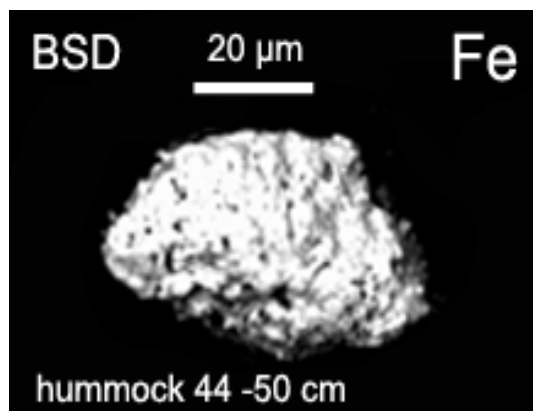
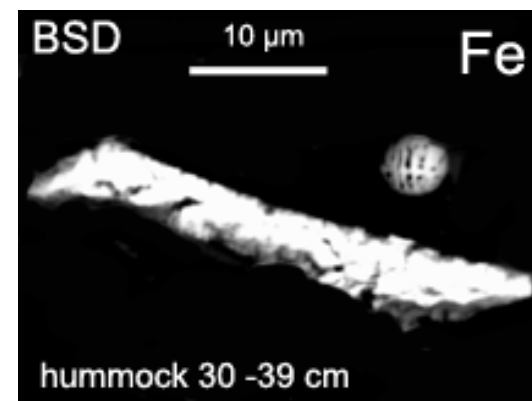
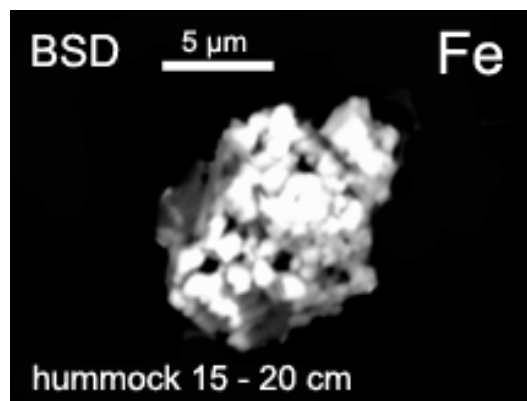
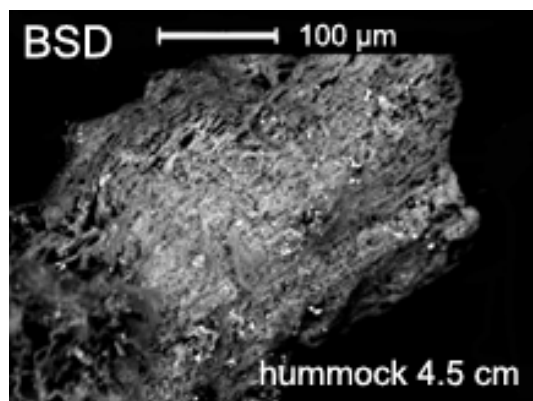
How much Cu is in a Cu-bearing particle?

What is the weight of Cu in one particle?

How much Cu comes from Cu-bearing particles?

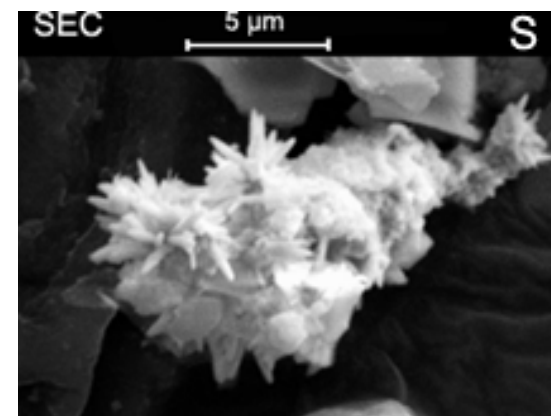
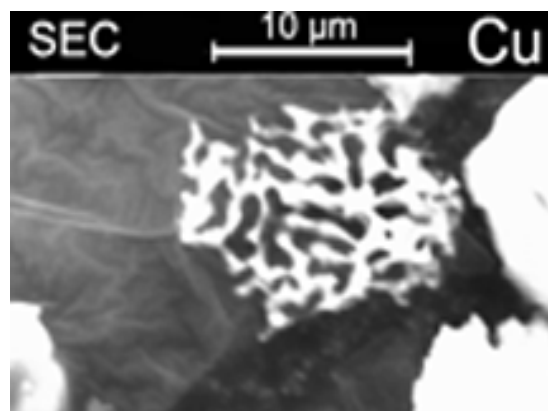
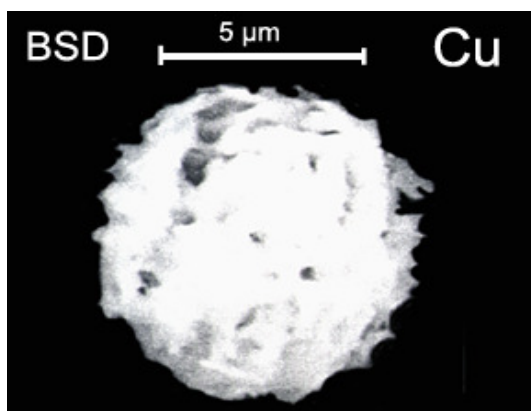
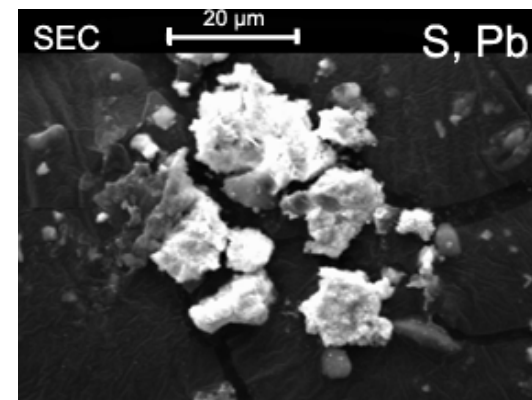
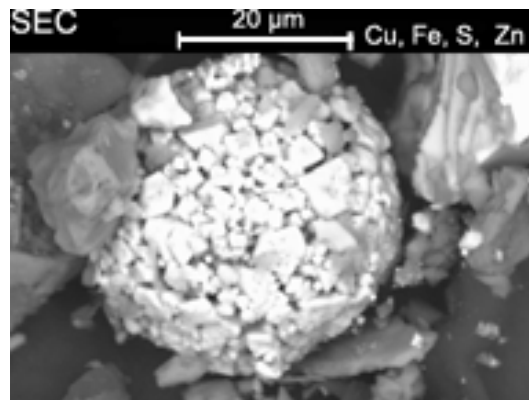
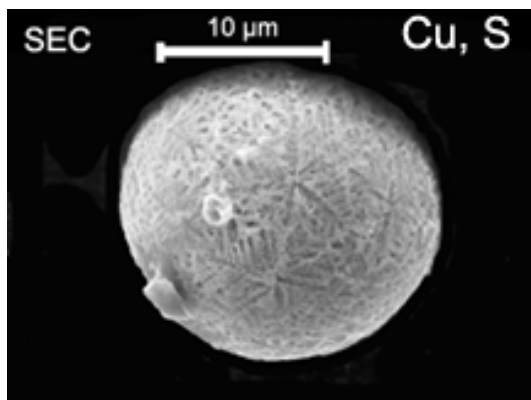
~ 1 ppm

Particles in Peat



**From: Inez Kettles
GSC Bulletin 584**

Particles in Snow



**From: Kliza, Telmer, Bonham-Carter, Hall,
GSC Open File 3869, Sept. 2000**

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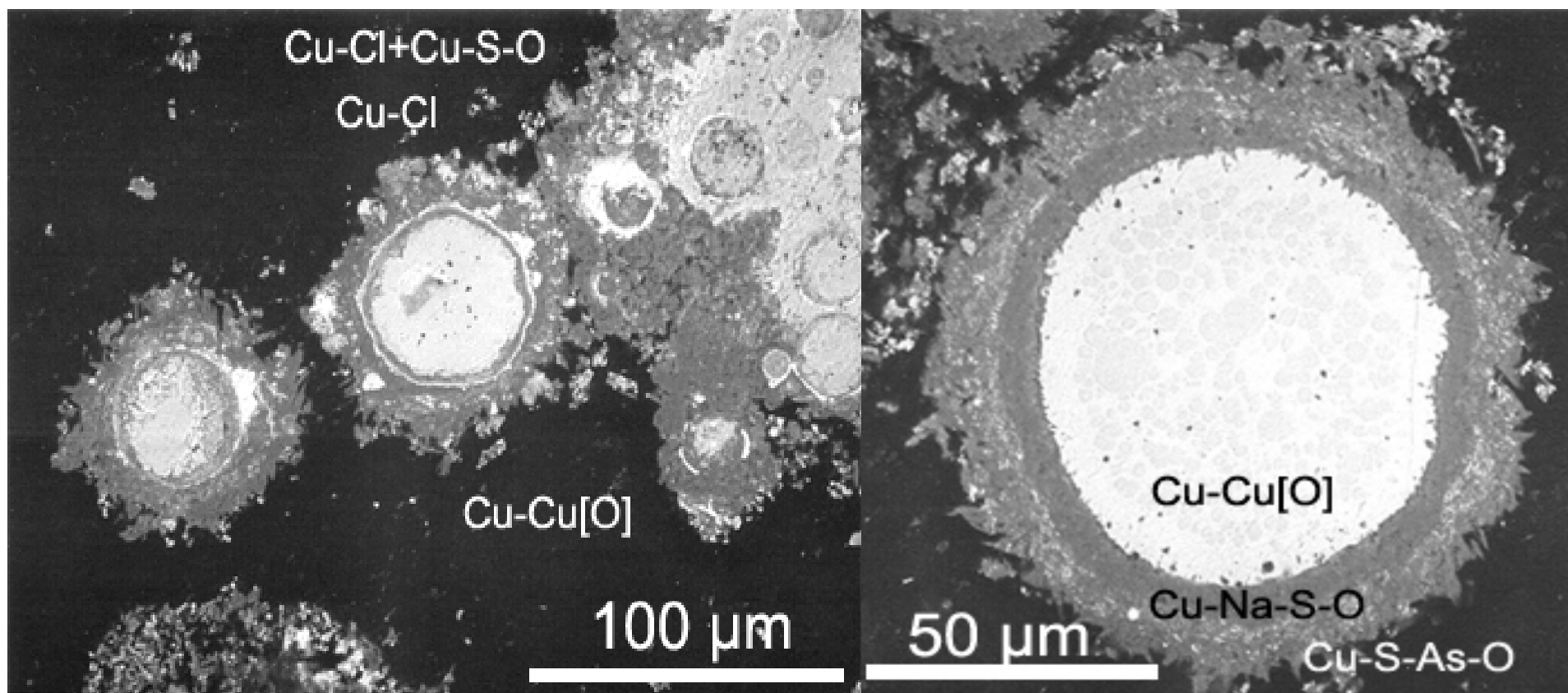
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Particles from the Stack and Plume

Speciation and chemical characterization: Jim Skeaff. Dogan Paktunc, Jim McGeer



Kröhnkite $\text{Na}_2\text{SO}_4 \cdot \text{CuSO}_4 \cdot 2\text{H}_2\text{O}$ 37%

As_2O_3 12% Na_2SO_4 9% ZnSO_4 7%

Anglesite PbSO_4 20%

= 85%

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Yearly Summary

Year 1 – Reconnaissance

Limited data collection and processing (transects – Rouyn and Trail)

Year 2 – Data Collection

Primary data collection and sample analyses

Year 3 – Data Analyses

Completed data analyses and compilation; initial plotting

Year 4 – Compilation and Interpretation

Re-analyses based on poor QA/QC results for selective leaches;
development of access database; preparation of open file;
LINKAGES with other point-source data sets. Publications, in
house and journals

Year 5 – Publications and Presentations

GSC Open file; GSC Bulletin linking point source sub-projects;
Joint and individual Journal papers; Conference special sessions.

Thank you for your attention

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