

# Supplementary materials: Enabling high throughput quantitative metallography for complex microstructures with deep semantic segmentation models: a case study in ultrahigh carbon steel

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### Abstract

This supplementary document contains data visualizations and microstructure maps for each validation in the main paper. For each cross-validation run, there is are figures showing the predicted segmentation maps for the validation set, in addition to derived quantities such as particle size distribution and denuded zone width distribution.

## 1 uhcs

### 1.1 validation set 0

Figure S1.1 shows the class predictions for validation set 0.

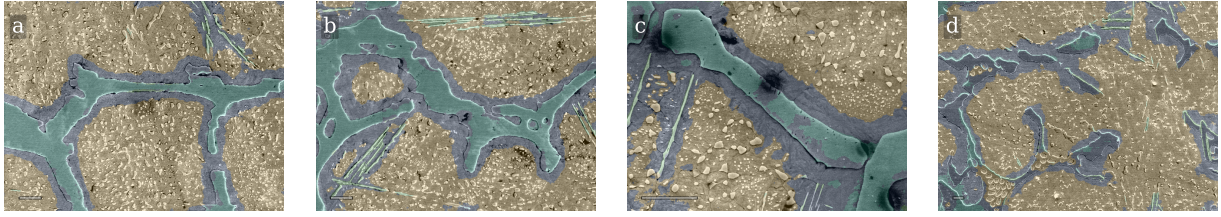


Figure S1.1: The uhcs class predictions for validation set 0. Scale bars indicate  $10\mu m$ . Best viewed electronically.

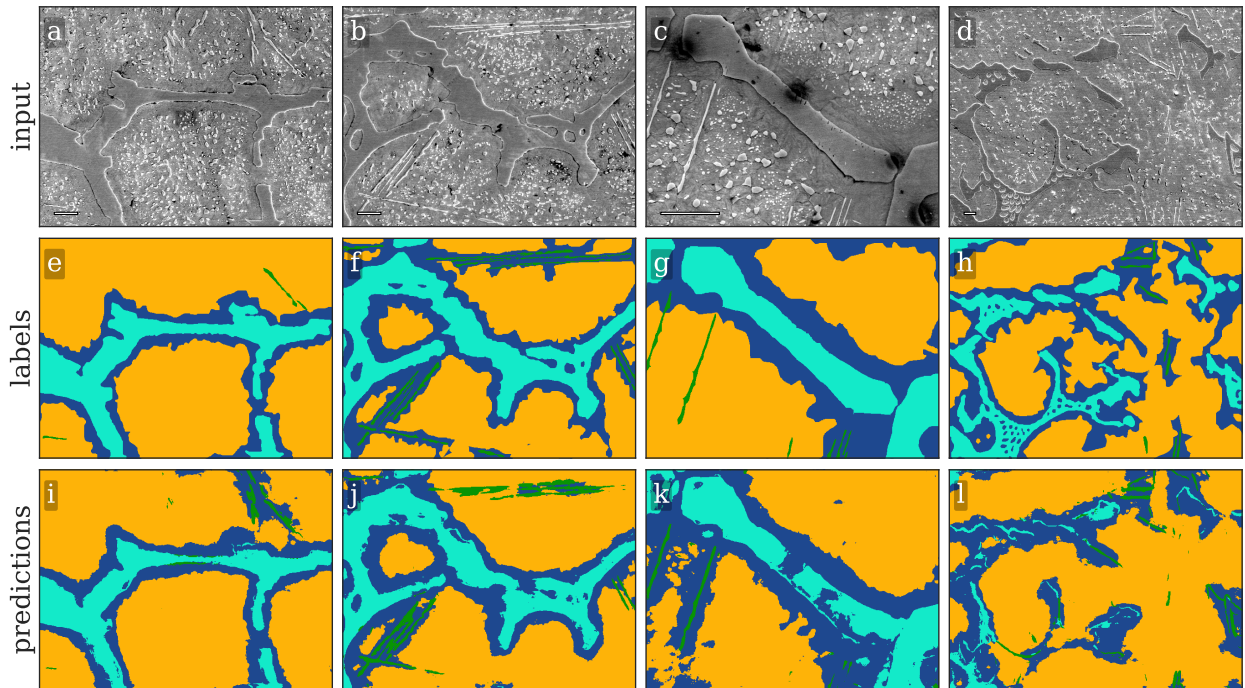


Figure S1.2: The uhcs class predictions and annotations for validation set 0. Scale bars indicate  $10\mu m$ . Best viewed electronically.

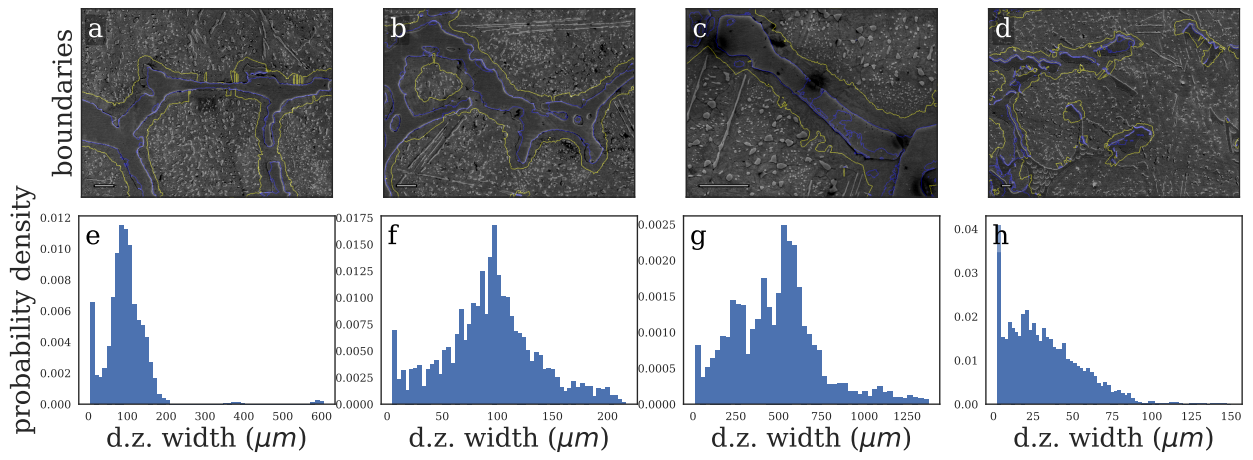


Figure S1.3: Predicted denuded zone and width distribution. Scale bars indicate  $10\mu m$ . Best viewed electronically.

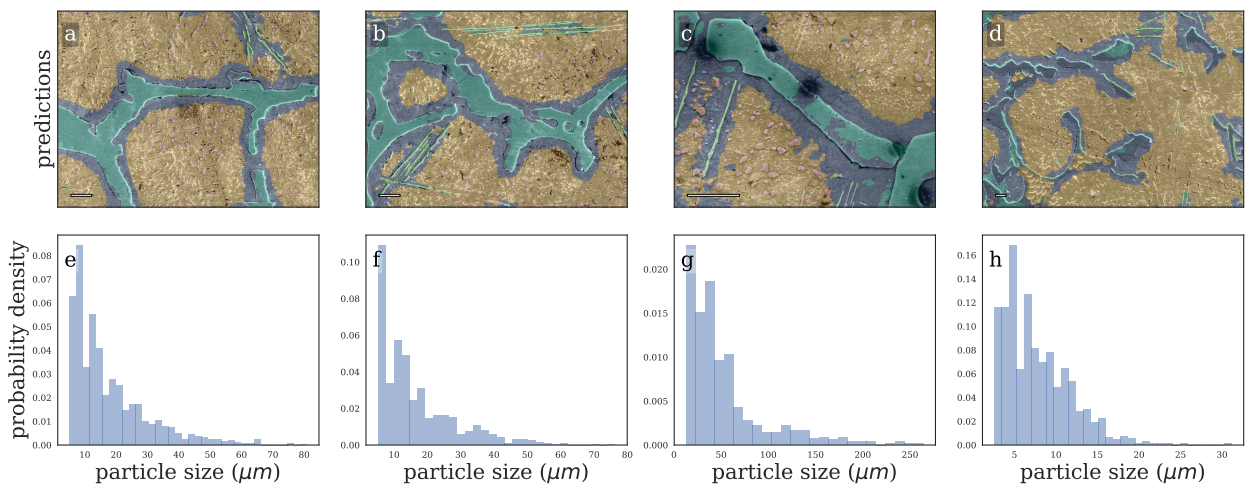


Figure S1.4: Joint microstructure segmentation predictions and derived particle size distributions. Scale bars indicate  $10\mu m$ . Best viewed electronically.

## 1.2 validation set 1

Figure S1.5 shows the class predictions for validation set 1.

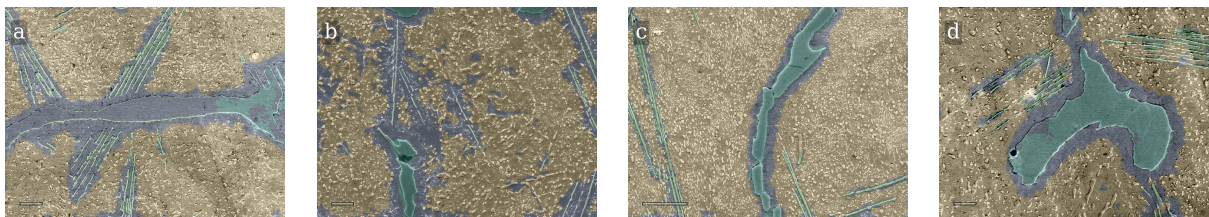


Figure S1.5: The uhcs class predictions for validation set 1. Scale bars indicate  $10\mu m$ . Best viewed electronically.

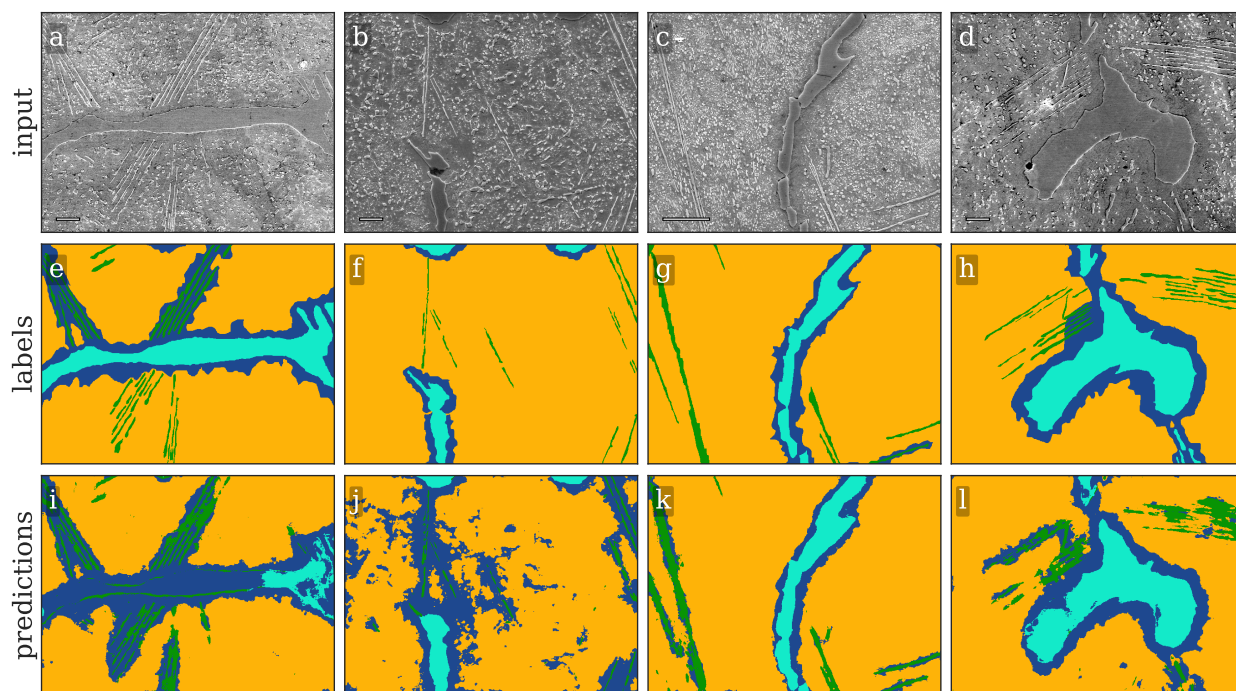


Figure S1.6: The uhcs class predictions and annotations for validation set 1. Scale bars indicate  $10\mu m$ . Best viewed electronically.

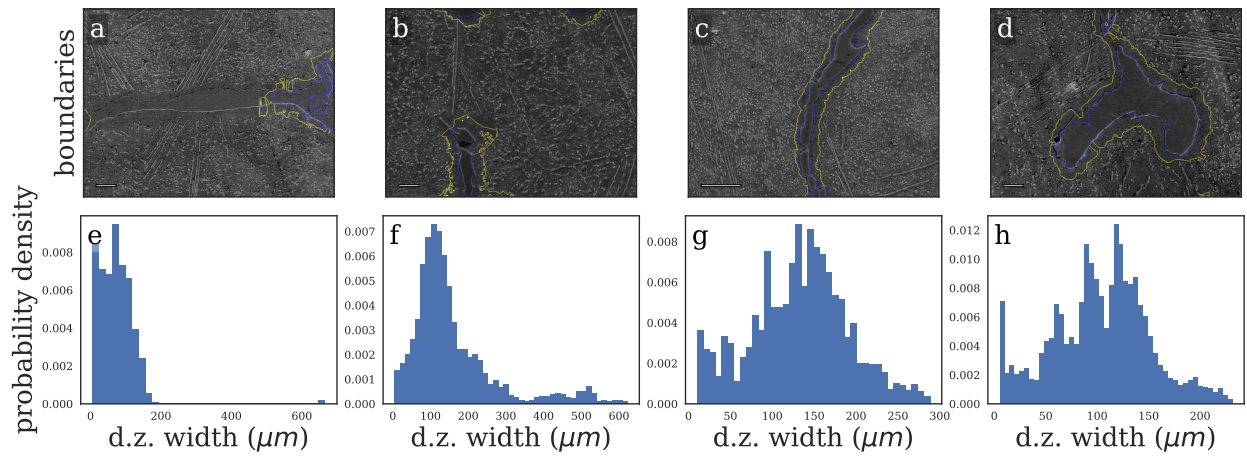


Figure S1.7: Predicted denuded zone and width distribution. Scale bars indicate  $10\mu m$ . Best viewed electronically.

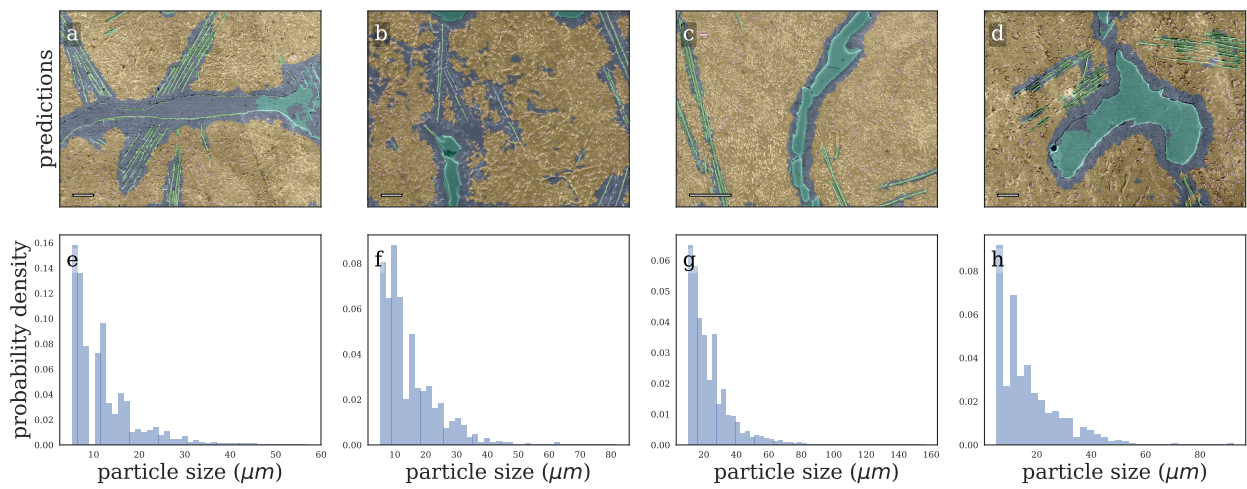


Figure S1.8: Joint microstructure segmentation predictions and derived particle size distributions. Scale bars indicate  $10\mu m$ . Best viewed electronically.

### 1.3 validation set 2

Figure S1.9 shows the class predictions for validation set 2.

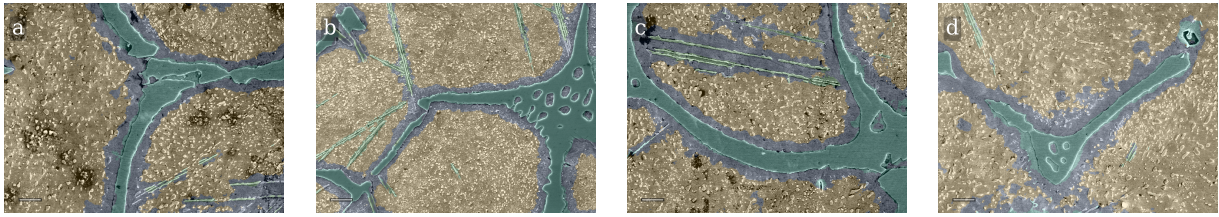


Figure S1.9: The uhcs class predictions for validation set 2. Scale bars indicate  $10\mu m$ . Best viewed electronically.

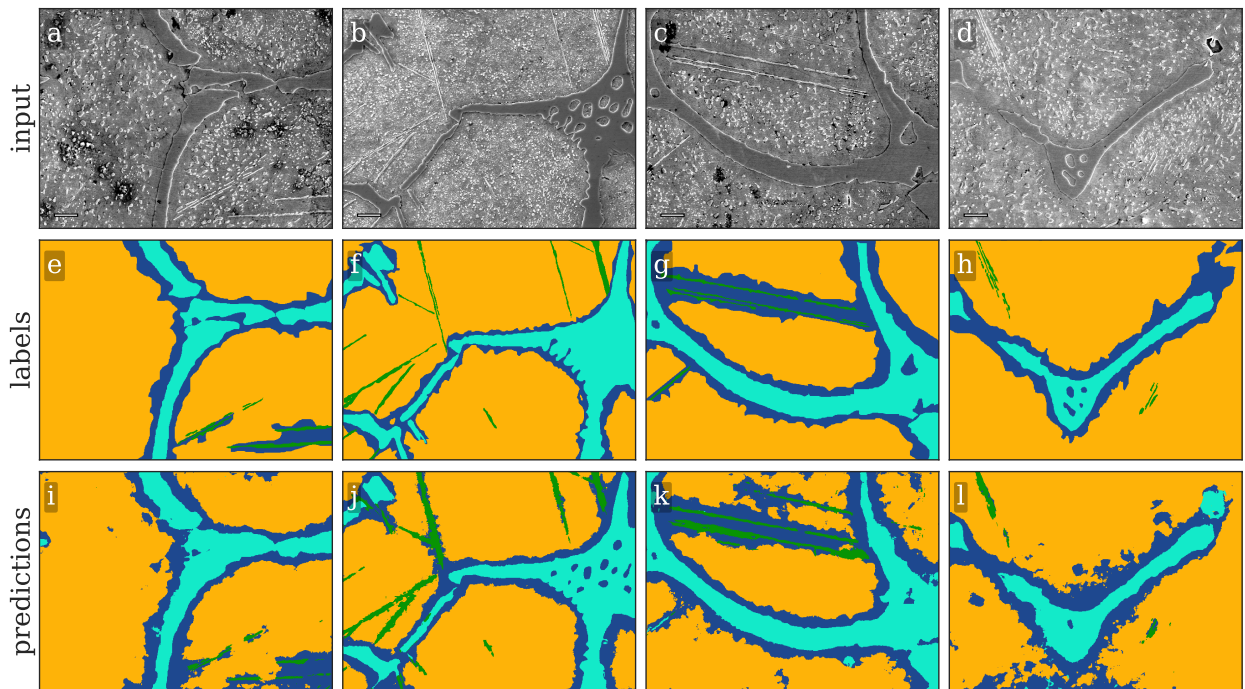


Figure S1.10: The uhcs class predictions and annotations for validation set 2. Scale bars indicate  $10\mu m$ . Best viewed electronically.

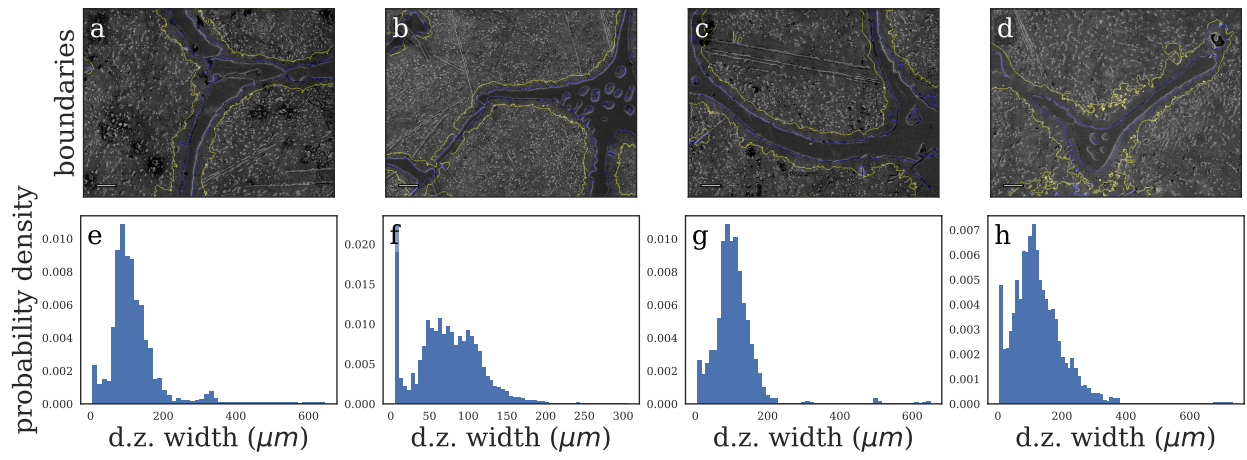


Figure S1.11: Predicted denuded zone and width distribution. Scale bars indicate  $10\mu m$ . Best viewed electronically.

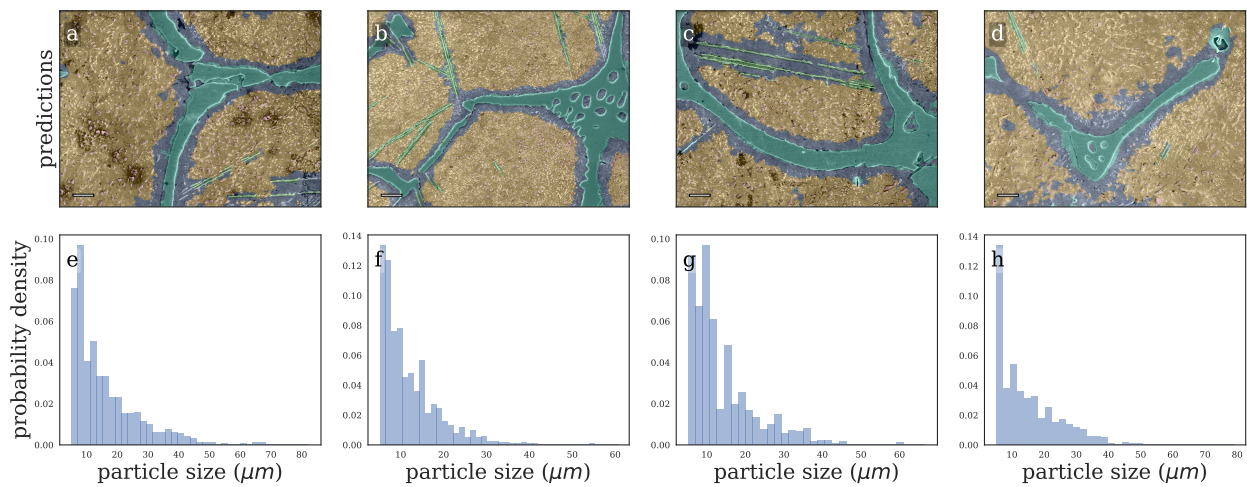


Figure S1.12: Joint microstructure segmentation predictions and derived particle size distributions. Scale bars indicate  $10\mu m$ . Best viewed electronically.

### 1.4 validation set 3

Figure S1.13 shows the class predictions for validation set 3.

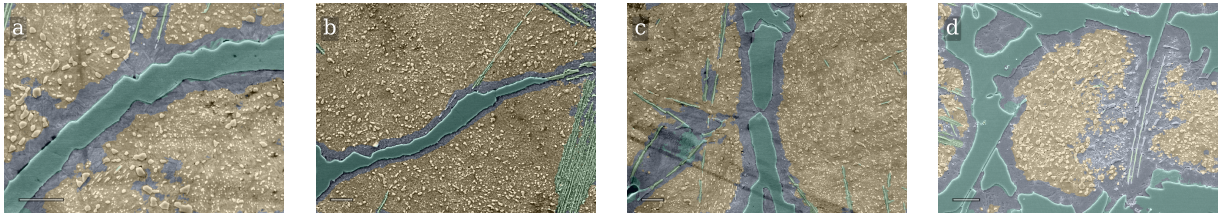


Figure S1.13: The uhcs class predictions for validation set 3. Scale bars indicate  $10\mu m$ . Best viewed electronically.

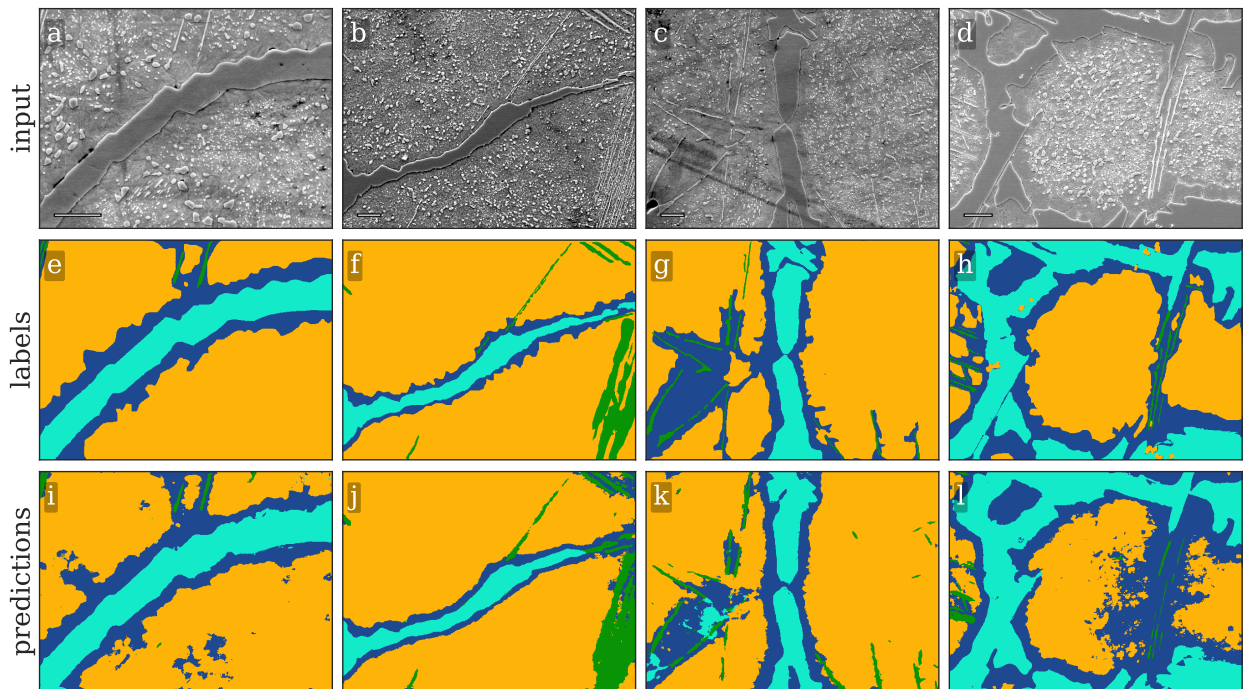


Figure S1.14: The uhcs class predictions and annotations for validation set 3. Scale bars indicate  $10\mu m$ . Best viewed electronically.



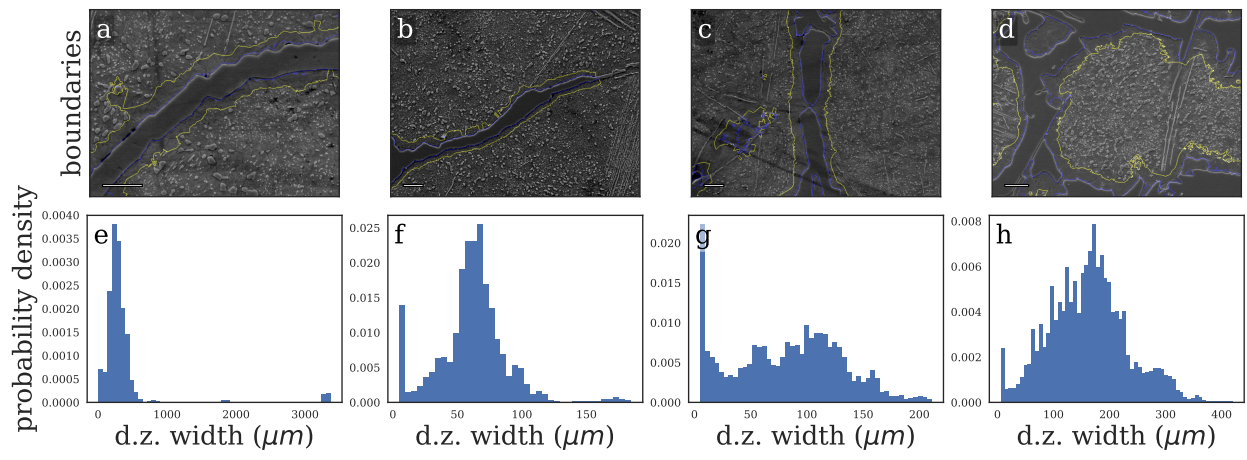


Figure S1.15: Predicted denuded zone and width distribution. Scale bars indicate  $10\mu m$ . Best viewed electronically.

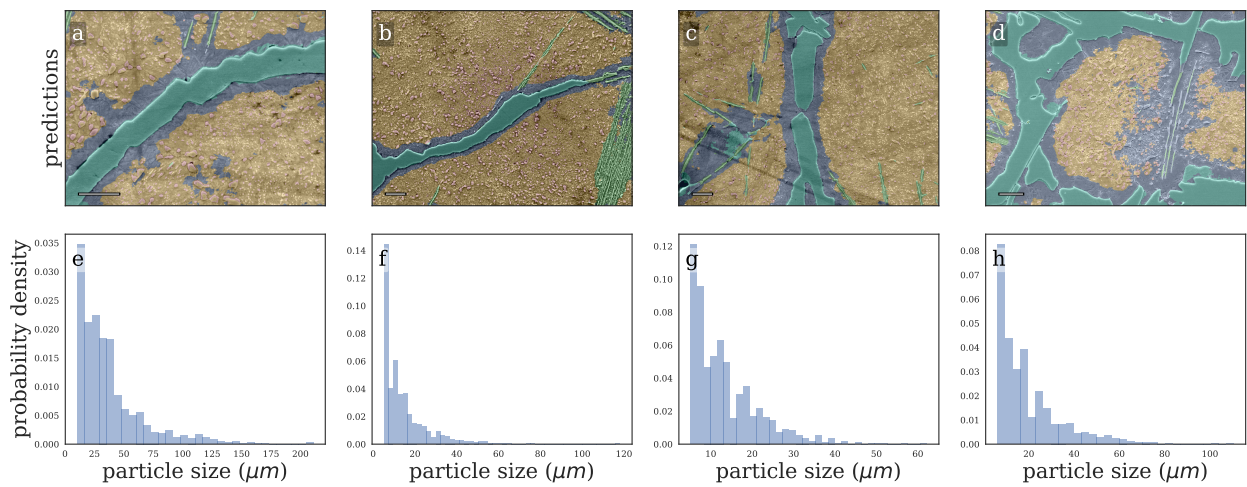


Figure S1.16: Joint microstructure segmentation predictions and derived particle size distributions. Scale bars indicate  $10\mu m$ . Best viewed electronically.

## 1.5 validation set 4

Figure S1.17 shows the class predictions for validation set 4.

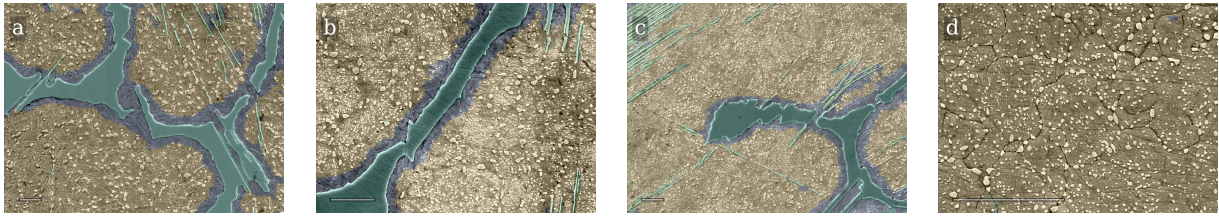


Figure S1.17: The uhcs class predictions for validation set 4. Scale bars indicate  $10\mu m$ . Best viewed electronically.

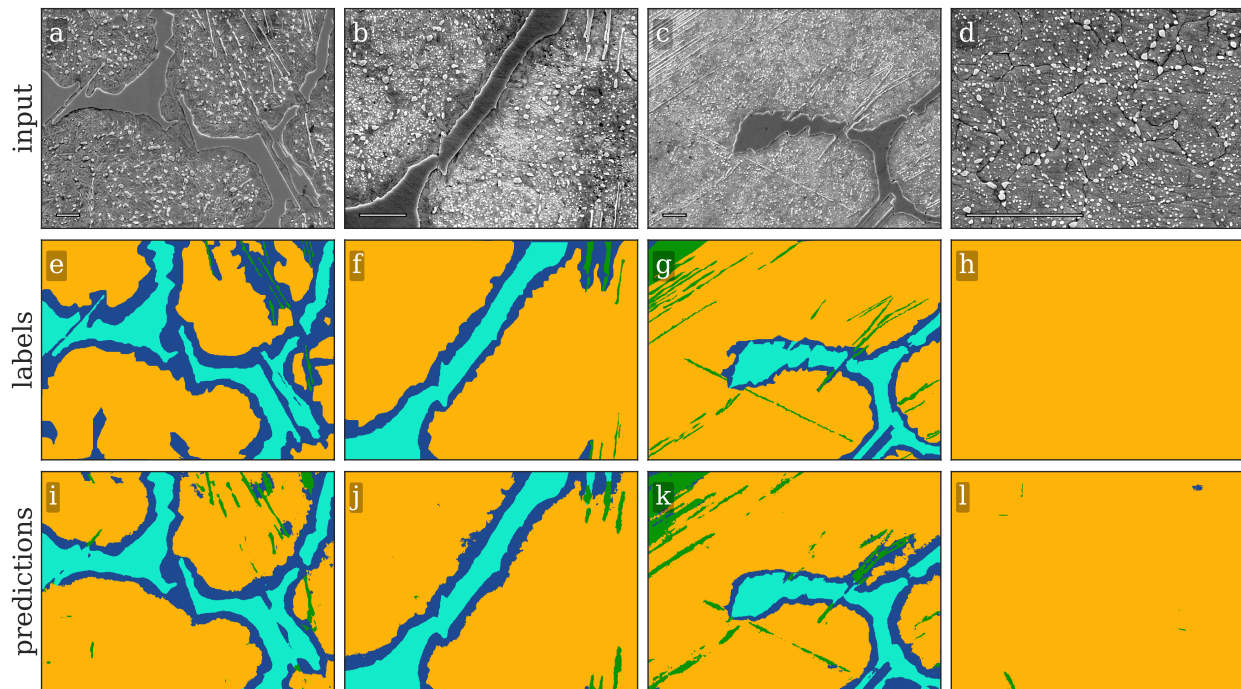


Figure S1.18: The uhcs class predictions and annotations for validation set 4. Scale bars indicate  $10\mu m$ . Best viewed electronically.

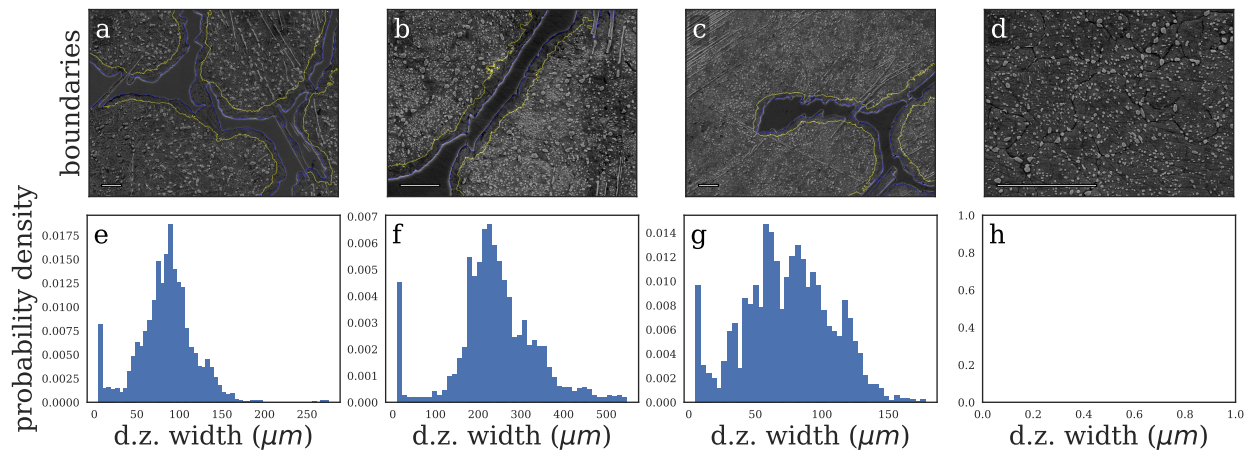


Figure S1.19: Predicted denuded zone and width distribution. Scale bars indicate  $10\mu m$ . Best viewed electronically.

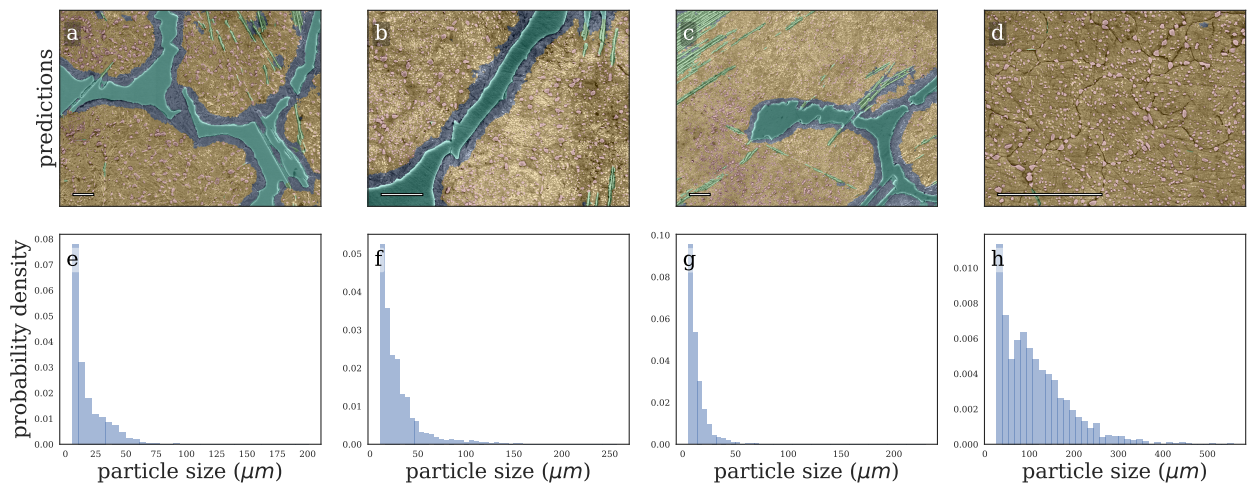


Figure S1.20: Joint microstructure segmentation predictions and derived particle size distributions. Scale bars indicate  $10\mu m$ . Best viewed electronically.

## 1.6 validation set 5

Figure S1.21 shows the class predictions for validation set 5.

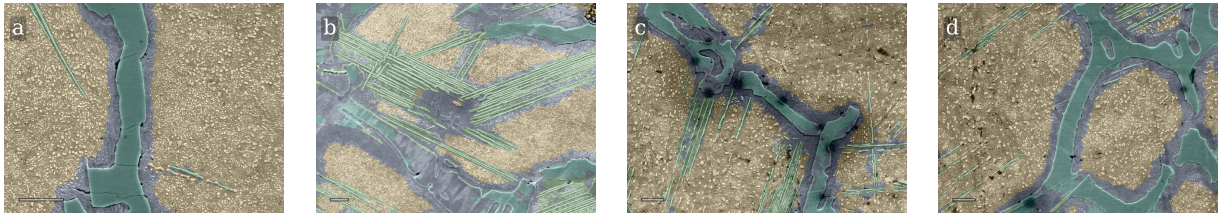


Figure S1.21: The uhcs class predictions for validation set 5. Scale bars indicate  $10\mu m$ . Best viewed electronically.

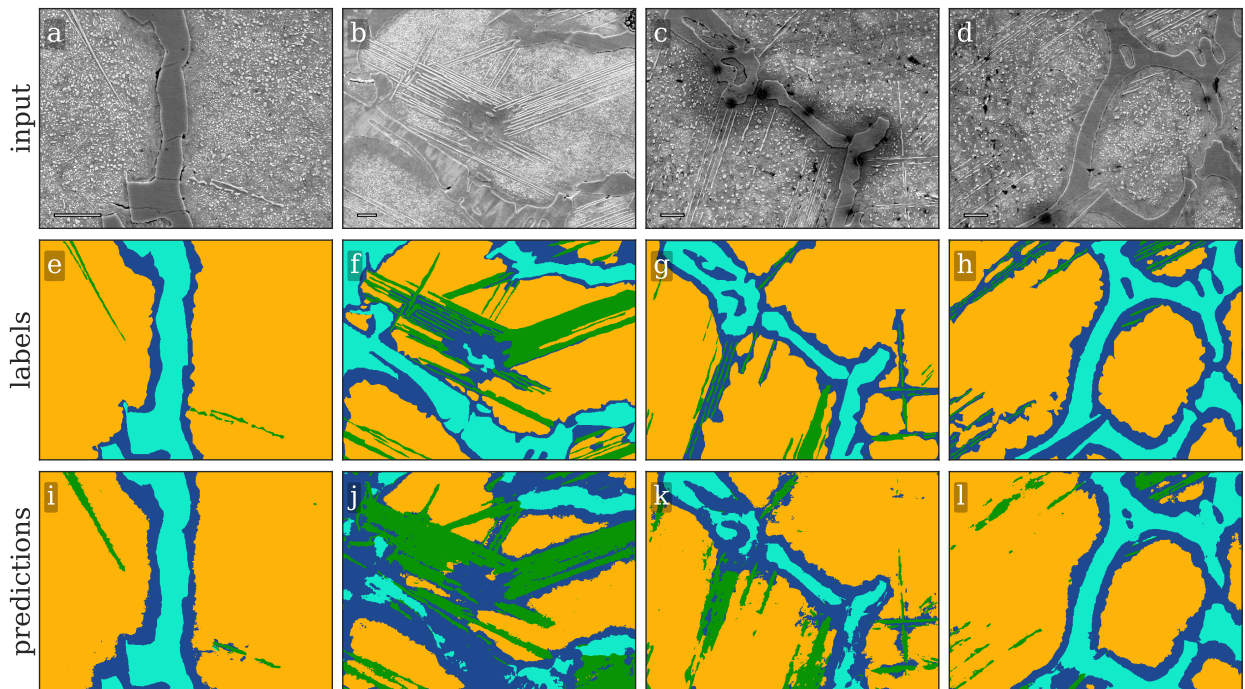


Figure S1.22: The uhcs class predictions and annotations for validation set 5. Scale bars indicate  $10\mu m$ . Best viewed electronically.

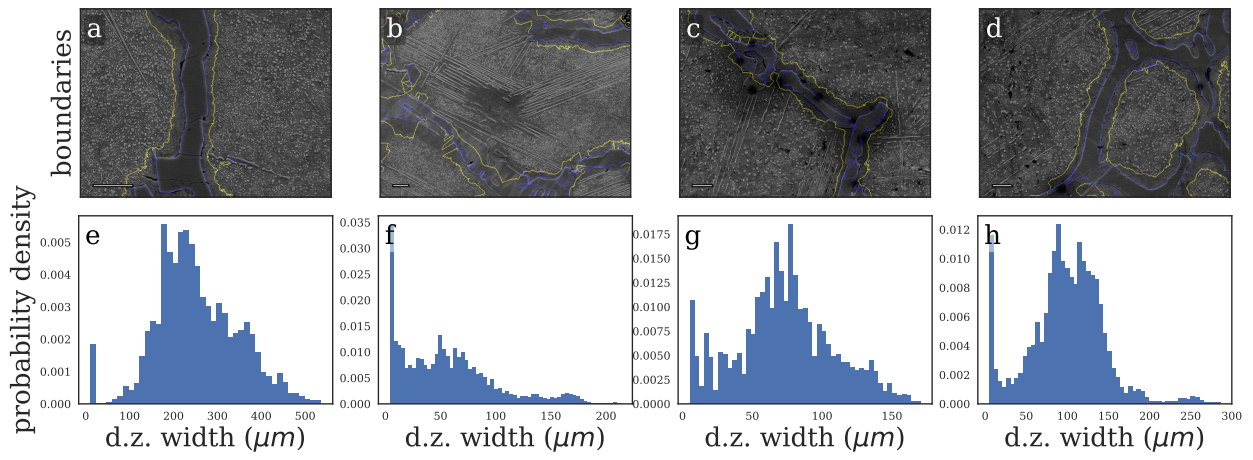


Figure S1.23: Predicted denuded zone and width distribution. Scale bars indicate  $10\mu m$ . Best viewed electronically.

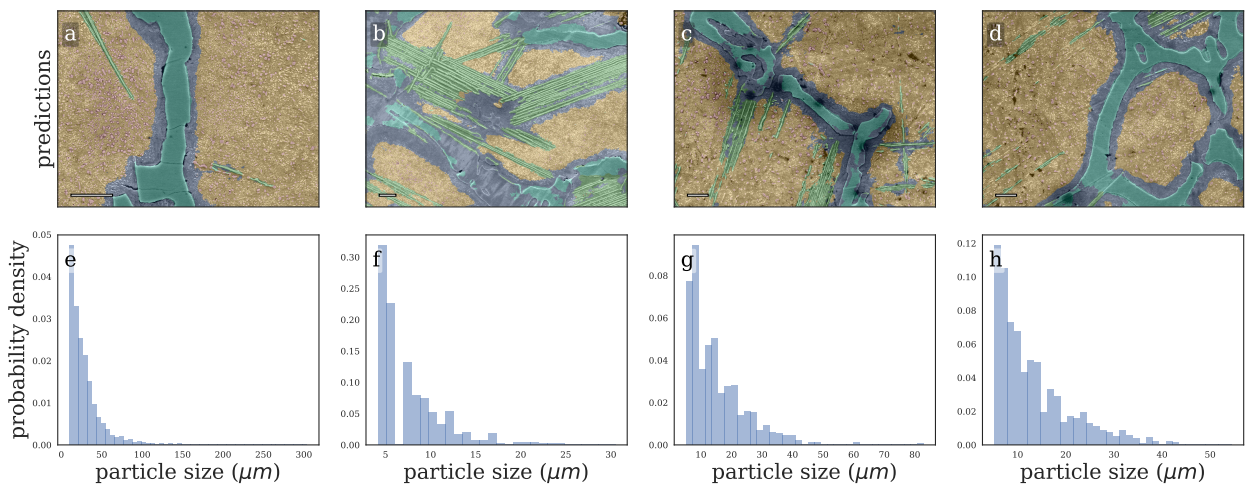


Figure S1.24: Joint microstructure segmentation predictions and derived particle size distributions. Scale bars indicate  $10\mu m$ . Best viewed electronically.

## 2 spheroidite

### 2.1 validation set 0

Figure S2.25 shows the class predictions for validation set 0.

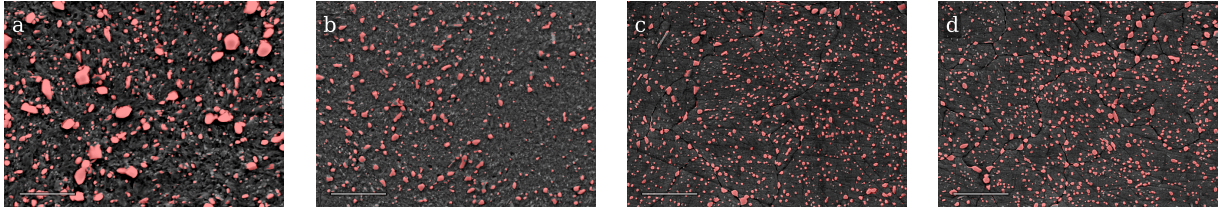


Figure S2.25: The spheroidite class predictions for validation set 0. Scale bars indicate  $5\mu m$ . Best viewed electronically.

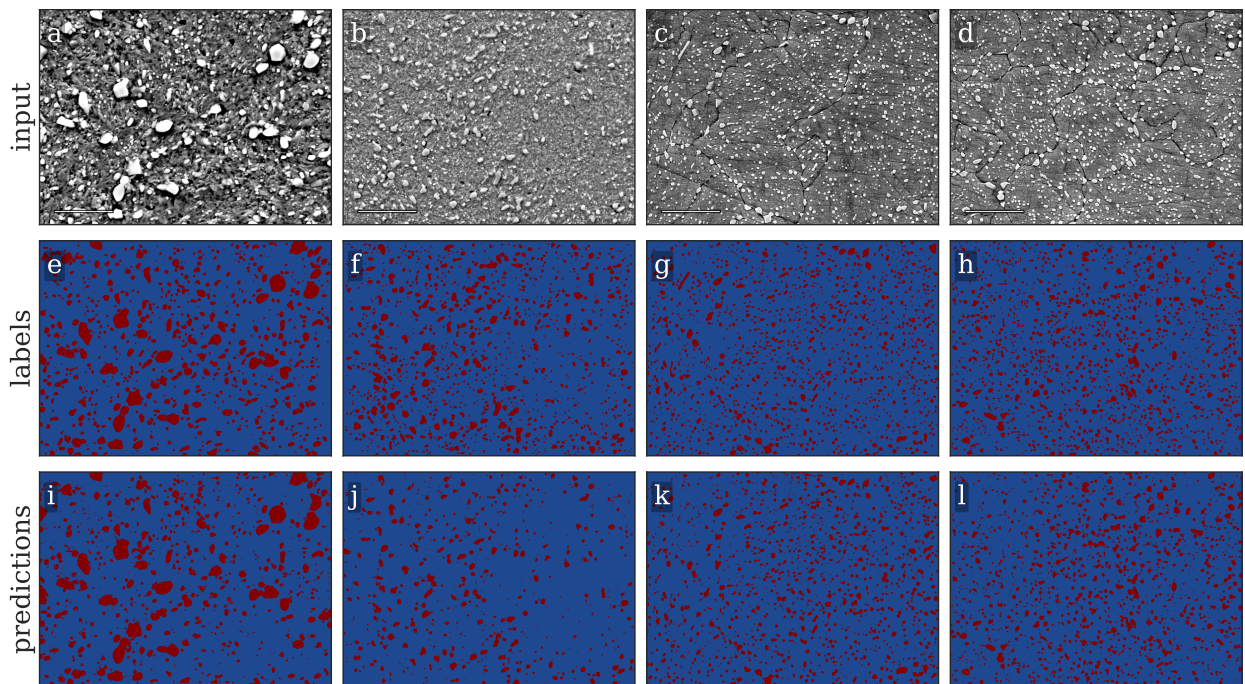


Figure S2.26: The spheroidite class predictions and annotations for validation set 0. Scale bars indicate  $5\mu m$ . Best viewed electronically.

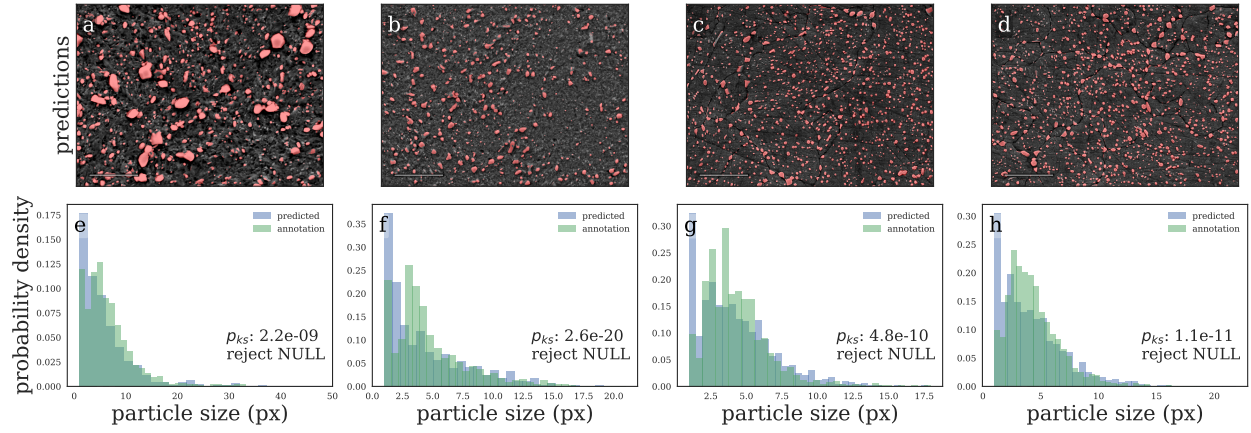


Figure S2.27: Joint microstructure segmentation predictions and derived particle size distributions. Scale bars indicate  $5\mu m$ . Best viewed electronically.

## 2.2 validation set 1

Figure S2.28 shows the class predictions for validation set 1.

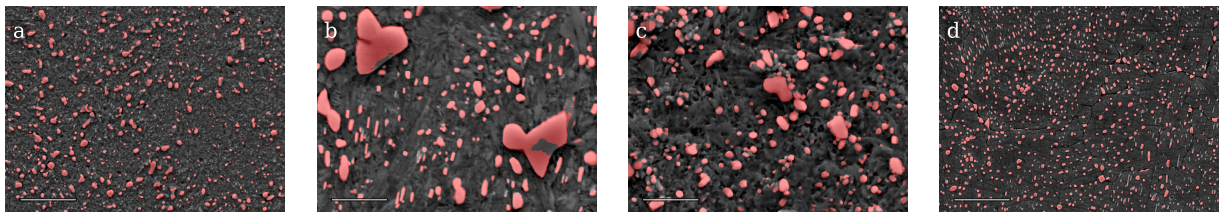


Figure S2.28: The spheroidite class predictions for validation set 1. Scale bars indicate  $5\mu m$ . Best viewed electronically.

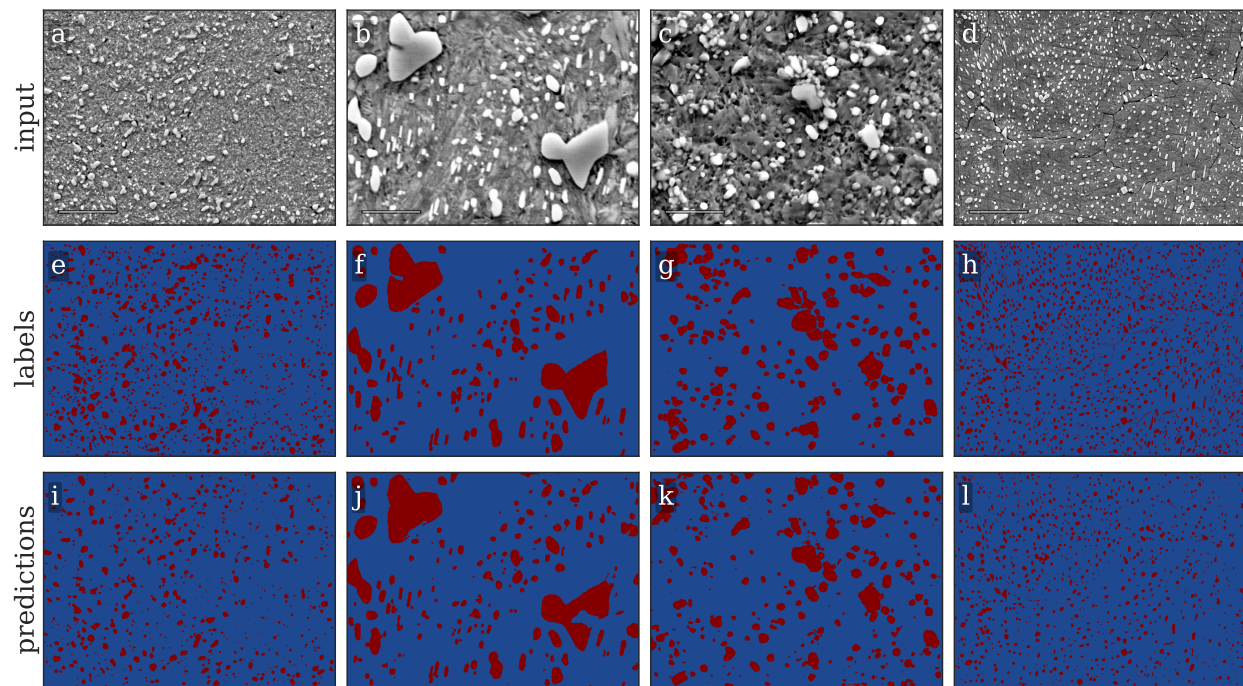


Figure S2.29: The spheroidite class predictions and annotations for validation set 1. Scale bars indicate  $5\mu\text{m}$ . Best viewed electronically.

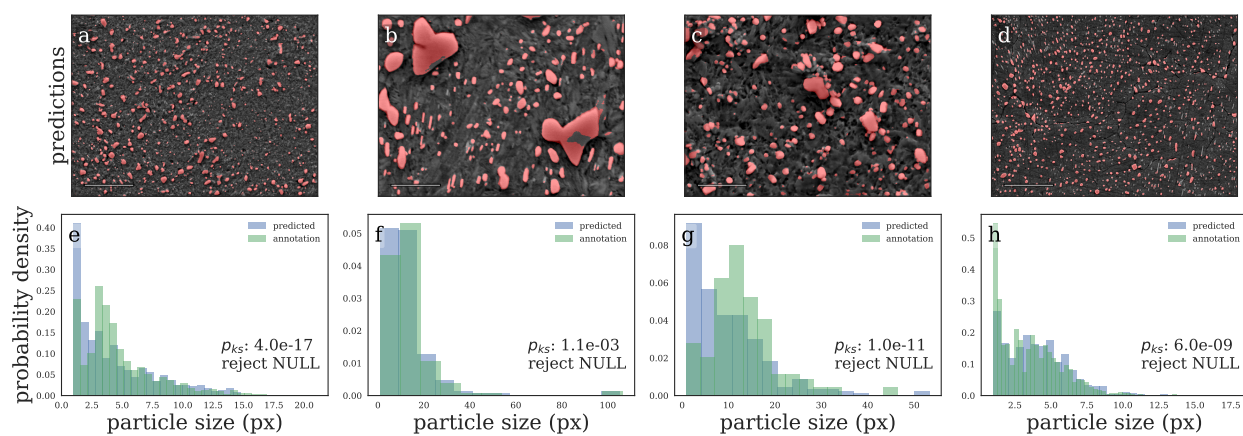


Figure S2.30: Joint microstructure segmentation predictions and derived particle size distributions. Scale bars indicate  $5\mu\text{m}$ . Best viewed electronically.



### 2.3 validation set 2

Figure S2.31 shows the class predictions for validation set 2.

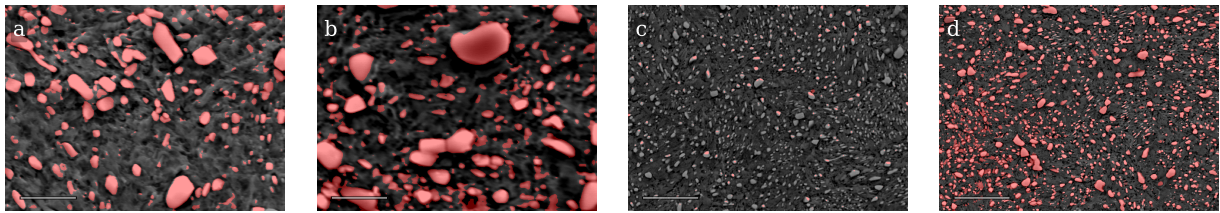


Figure S2.31: The spheroidite class predictions for validation set 2. Scale bars indicate  $5\mu\text{m}$ . Best viewed electronically.

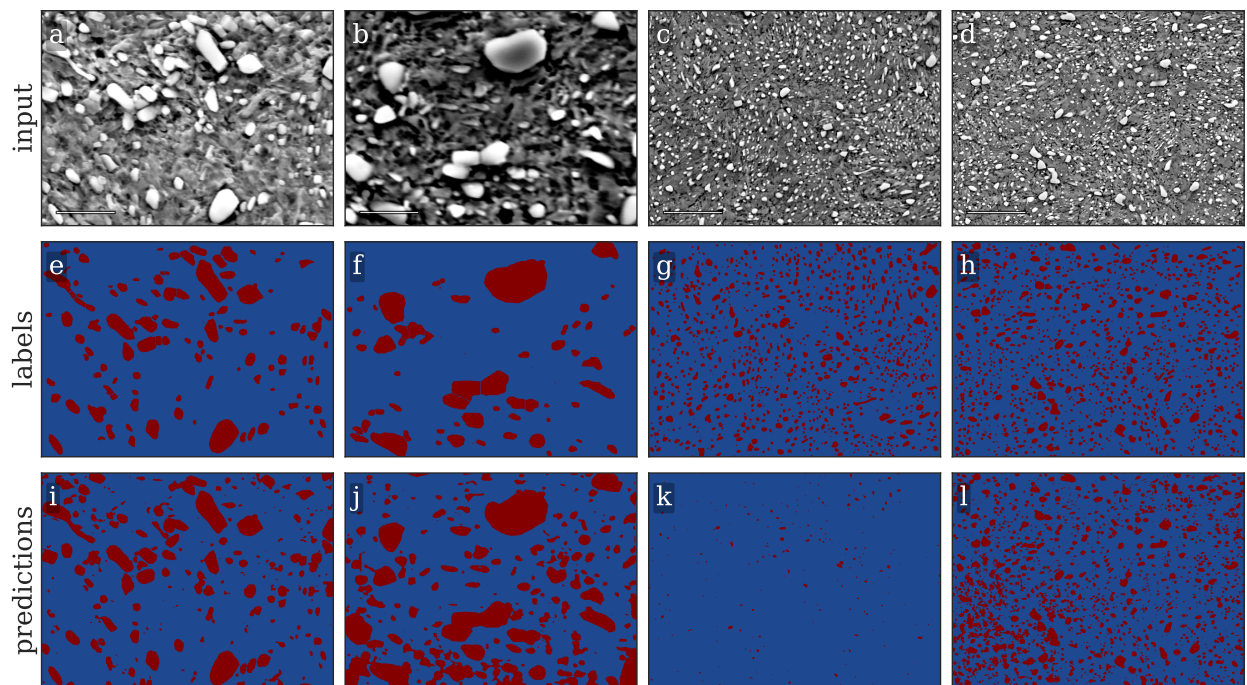


Figure S2.32: The spheroidite class predictions and annotations for validation set 2. Scale bars indicate  $5\mu\text{m}$ . Best viewed electronically.

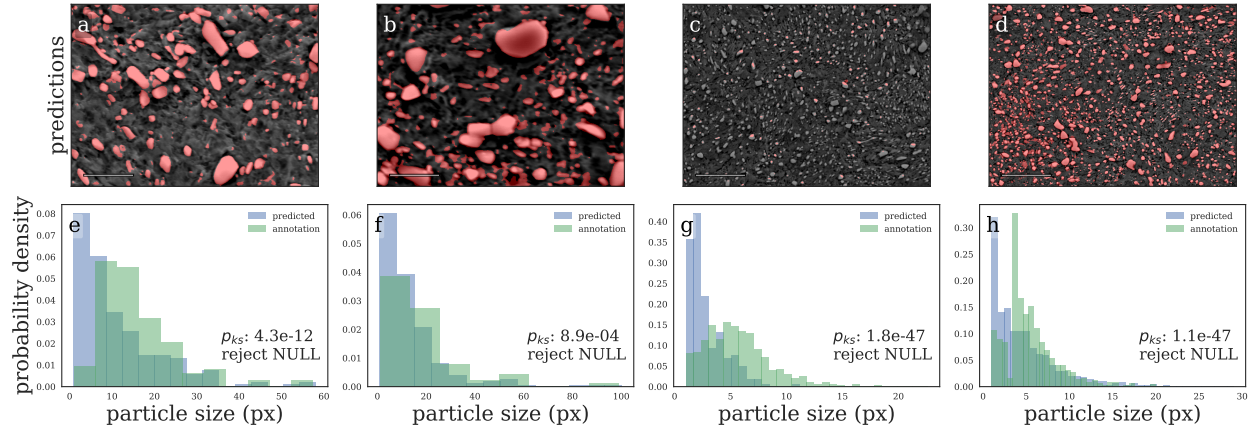


Figure S2.33: Joint microstructure segmentation predictions and derived particle size distributions. Scale bars indicate  $5\mu m$ . Best viewed electronically.

## 2.4 validation set 3

Figure S2.34 shows the class predictions for validation set 3.

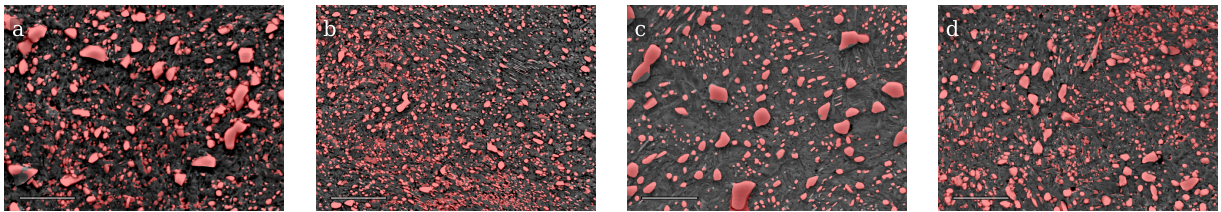


Figure S2.34: The spheroidite class predictions for validation set 3. Scale bars indicate  $5\mu m$ . Best viewed electronically.

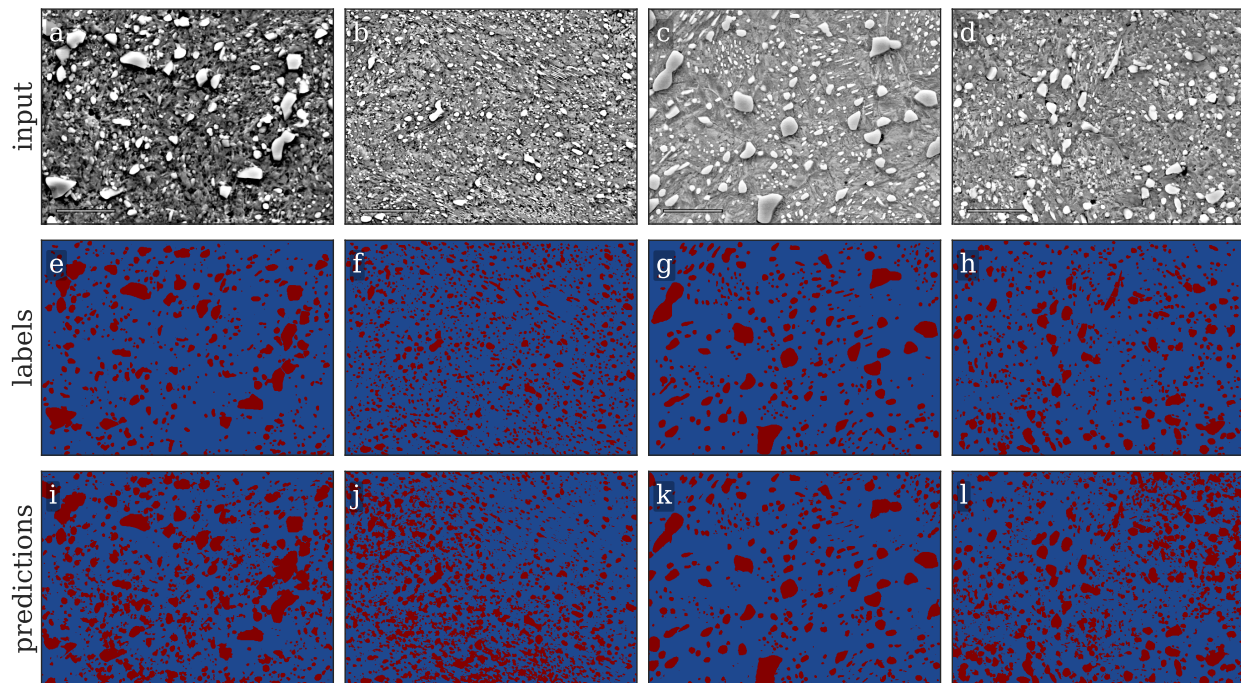


Figure S2.35: The spheroidite class predictions and annotations for validation set 3. Scale bars indicate  $5\mu\text{m}$ . Best viewed electronically.

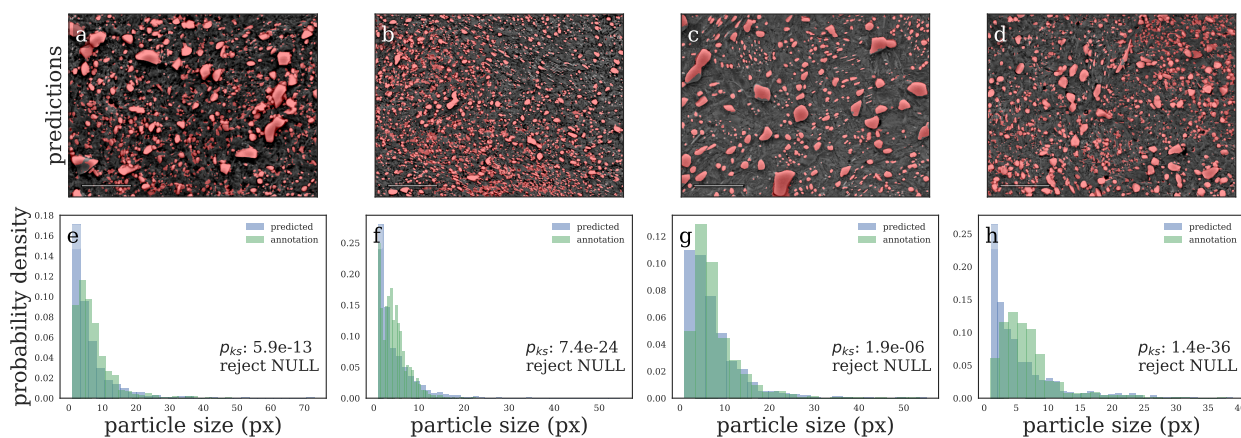


Figure S2.36: Joint microstructure segmentation predictions and derived particle size distributions. Scale bars indicate  $5\mu\text{m}$ . Best viewed electronically.

## 2.5 validation set 4

Figure S2.37 shows the class predictions for validation set 4.

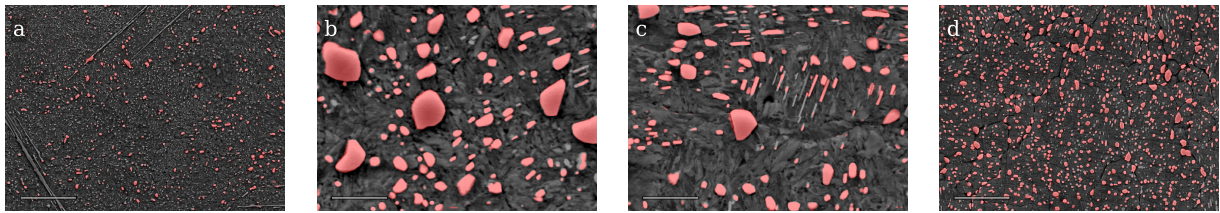


Figure S2.37: The spheroidite class predictions for validation set 4. Scale bars indicate  $5\mu\text{m}$ . Best viewed electronically.

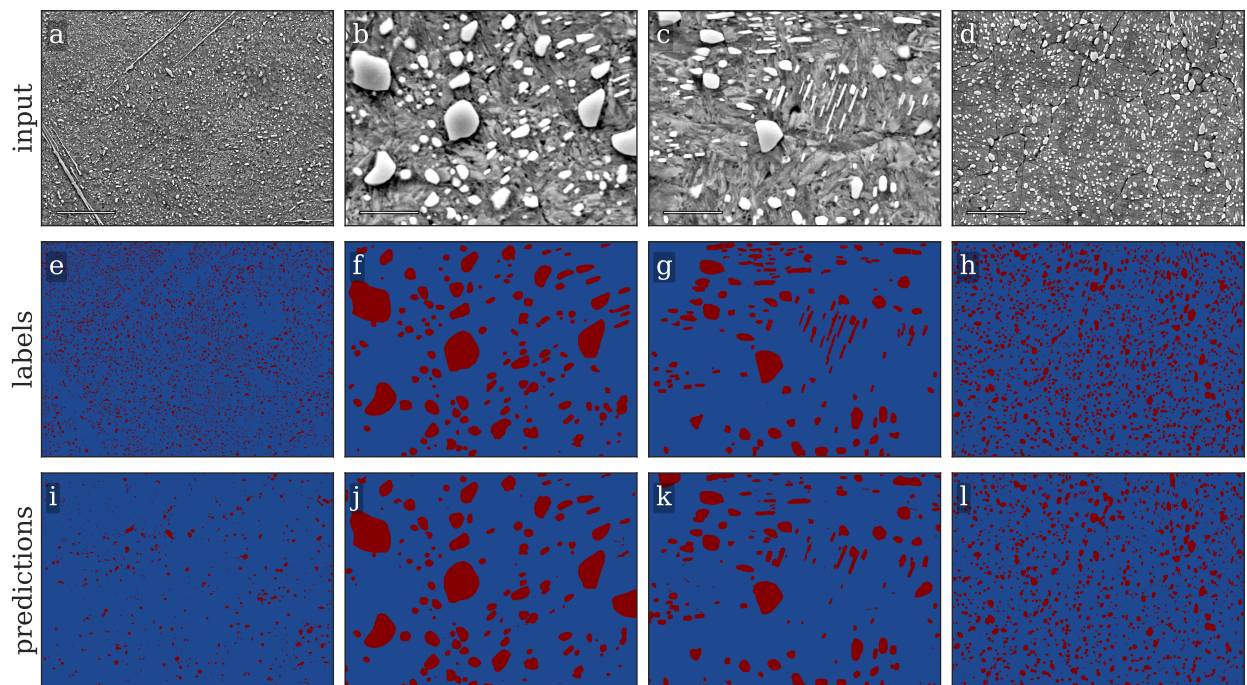


Figure S2.38: The spheroidite class predictions and annotations for validation set 4. Scale bars indicate  $5\mu\text{m}$ . Best viewed electronically.

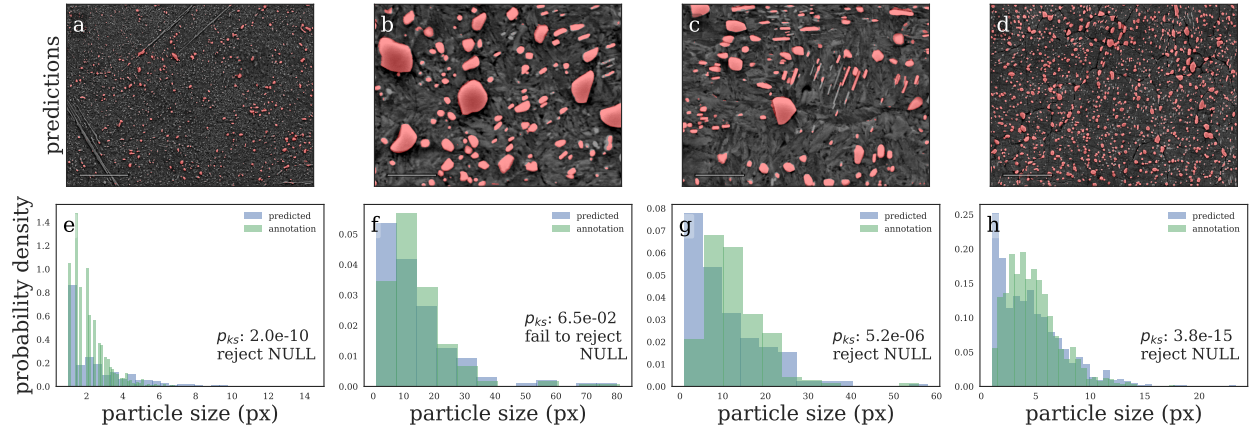


Figure S2.39: Joint microstructure segmentation predictions and derived particle size distributions. Scale bars indicate  $5\mu m$ . Best viewed electronically.

## 2.6 validation set 5

Figure S2.40 shows the class predictions for validation set 5.

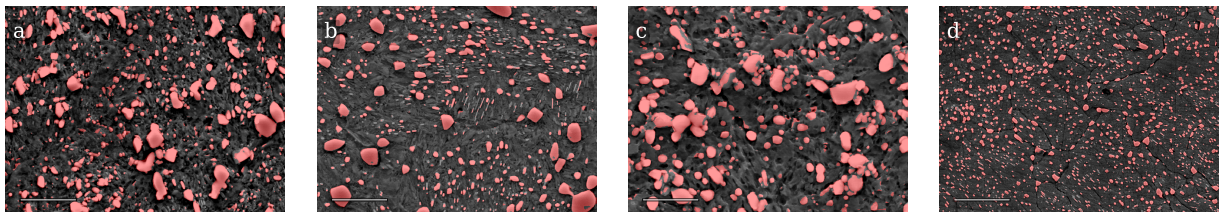


Figure S2.40: The spheroidite class predictions for validation set 5. Scale bars indicate  $5\mu m$ . Best viewed electronically.

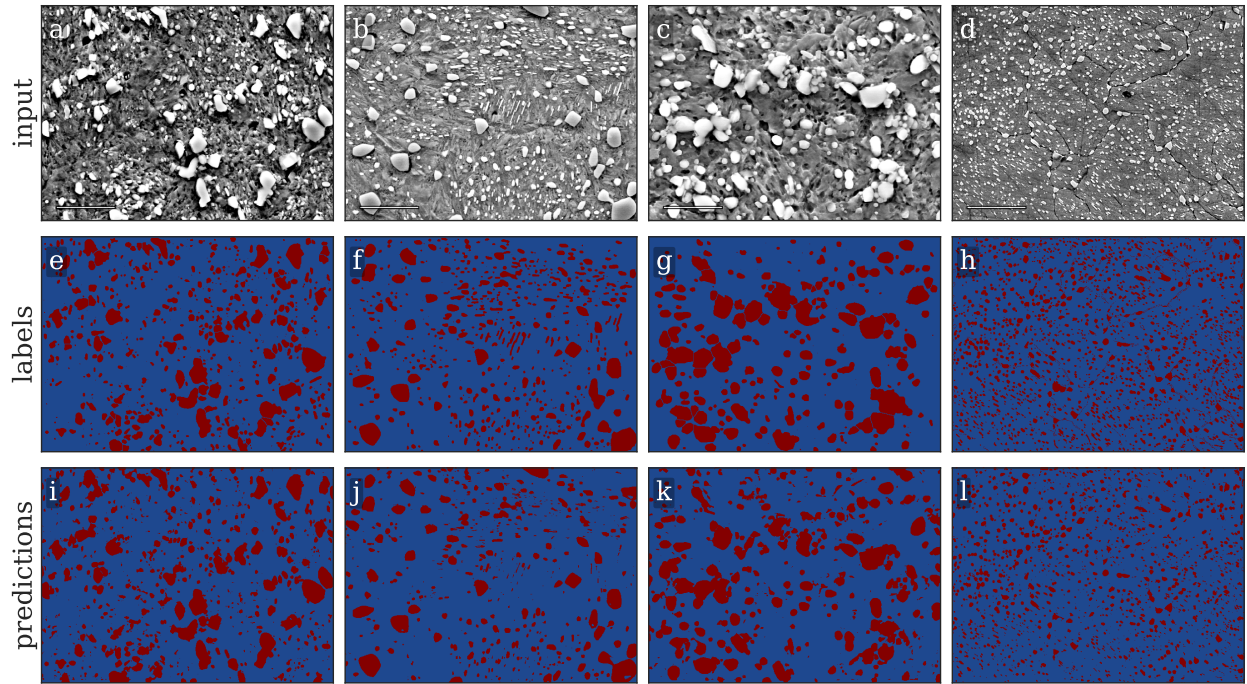


Figure S2.41: The spheroidite class predictions and annotations for validation set 5. Scale bars indicate  $5\mu\text{m}$ . Best viewed electronically.

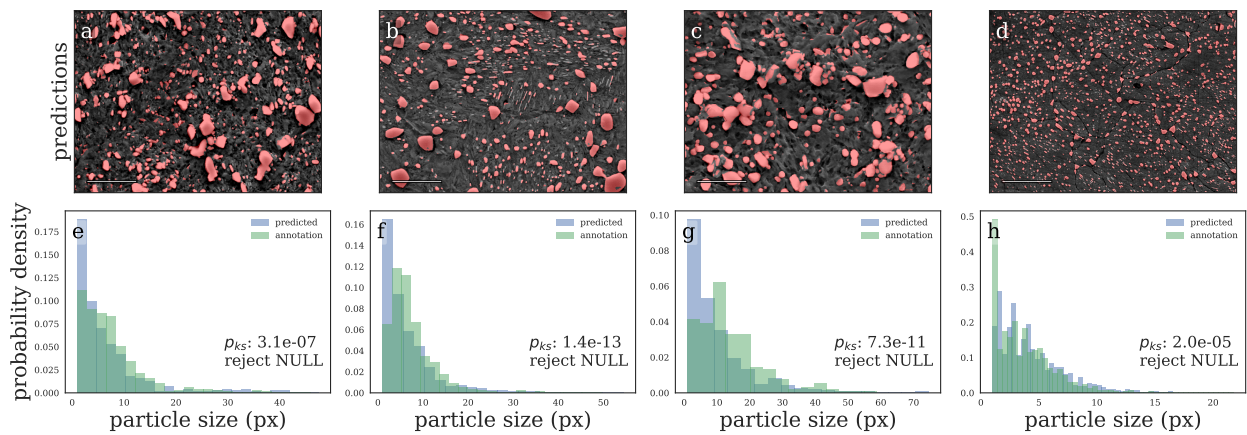


Figure S2.42: Joint microstructure segmentation predictions and derived particle size distributions. Scale bars indicate  $5\mu\text{m}$ . Best viewed electronically.