

1 This figure illustrates that the comparison between the original spectra and the downsampled spectra for the remaining six rock types.

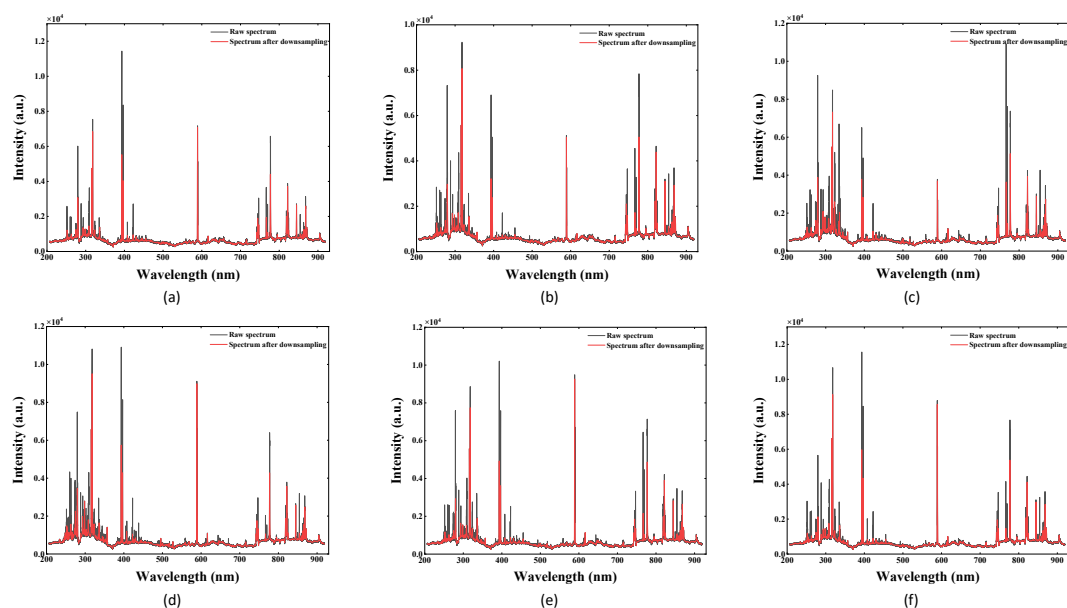


Fig S1 (a)-(f) Comparison of results before and after downsampling of six rock types:(a) Granodiorite, (b) Pyroxenite diorite, (c) Biotite amphibole diorite, (d) Biotite diorite, (e) Diorite, and (f) Quartz diorite.

2 SVM model specific parameters

Table S1 Parameters of the SVM module

| | Detail parameters |
|--------------------|-------------------|
| Input data | 1024×1 |
| Kernel | RBF kernel |
| Feature scaling | StandardScaler |
| Kernel coefficient | Scale |
| Class weighting | Balanced |

3 1D-CNN model specific parameters

Table S2 Parameters of the 1D-CNN module

| | Detail parameters |
|-------------|----------------------|
| Input layer | 1024×1 |
| CNN module | Numbers of layers: 3 |
| | Size of kernels: 3×1 |

| | |
|---------------------|-----------------------|
| | Number of kernels: 64 |
| Pooling layer | Max Pooling |
| | Pool size: 2×1 |
| Activation function | ReLU |
| Optimizer | Adam |
| Learning rate | 0.001 |
| Weight decay | 1e-4 |
| Loss function | Cross-entropy loss |
| Batch size | 8 |
| Epochs | 300 |

4□ 2D-CNN model specific parameters

Table S3 Parameters of the 2D-CNN module

| | Detail parameters |
|---------------------|-----------------------|
| Input layer | (1, 224, 224) |
| CNN module | Numbers of layers: 3 |
| | Size of kernels: 3×1 |
| | Number of kernels: 64 |
| Pooling layer | Max Pooling |
| | Pool size: 2×1 |
| Activation function | ReLU |
| Optimizer | AdamW |
| Learning rate | 0.001 |
| Loss function | Cross-entropy loss |
| Batch size | 8 |
| Epochs | 300 |

5□ DenseNet121 model specific parameters

Table S4 Parameters of the DenseNet121 module

| | Detail parameters |
|-------------------------|---|
| Input layer | (1, 224, 224) |
| First convolution | Kernel size =7 Padding = 3 Stride = 2 |
| Optimizer | AdamW |
| Learning rate | 0.001 |
| Weight decay | 1e-4 |
| Loss function | Cross-entropy loss |
| Learning-rate scheduler | CosineAnnealingLR |
| Batch size | 8 |
| Epochs | 300 |

6 GoogLeNet model specific parameters

Table S5 Parameters of the GoogLeNet module

| | Detail parameters |
|-------------------------|---|
| Input layer | (1, 224, 224) |
| Auxiliary classifiers | Disable |
| First convolution | Kernel size =7 Padding = 3 Stride = 2 |
| Classifier dropout | 0.2 |
| Optimizer | AdamW |
| Learning rate | 0.001 |
| Weight decay | 1e-4 |
| Loss function | Cross-entropy loss |
| Learning-rate scheduler | CosineAnnealingLR |
| Batch size | 8 |

Epochs 300

7□ MSCNN model specific parameters

Table S6 Parameters of the MSCNN module

| | Detail parameters |
|-------------------------|--|
| Input layer | (1, 224, 224) |
| Invalid value handling | NaN/Inf replaced with 0 |
| Multi-scale branches | Parallel Conv2d branches with kernel sizes 3, 5, and 7 |
| Classifier dropout | 0.2 |
| Base channels | 16 |
| Block 1 | 16 |
| Block 2 | 32 |
| Block 3 | 64 |
| Block 4 | 128 |
| Pooling layer | Max Pooling |
| Dropout | 0.3 |
| Optimizer | AdamW |
| Learning rate | 0.001 |
| Weight decay | 1e-4 |
| Loss function | Cross-entropy loss |
| Learning-rate scheduler | CosineAnnealingLR |
| Batch size | 8 |
| Epochs | 300 |
