

Figure S1. Schematic diagrams illustrating approximate sampling locations for RCMD samples in (a) continuous miner, and (b) longwall mine operations (Modified from Keles et al., [49]).

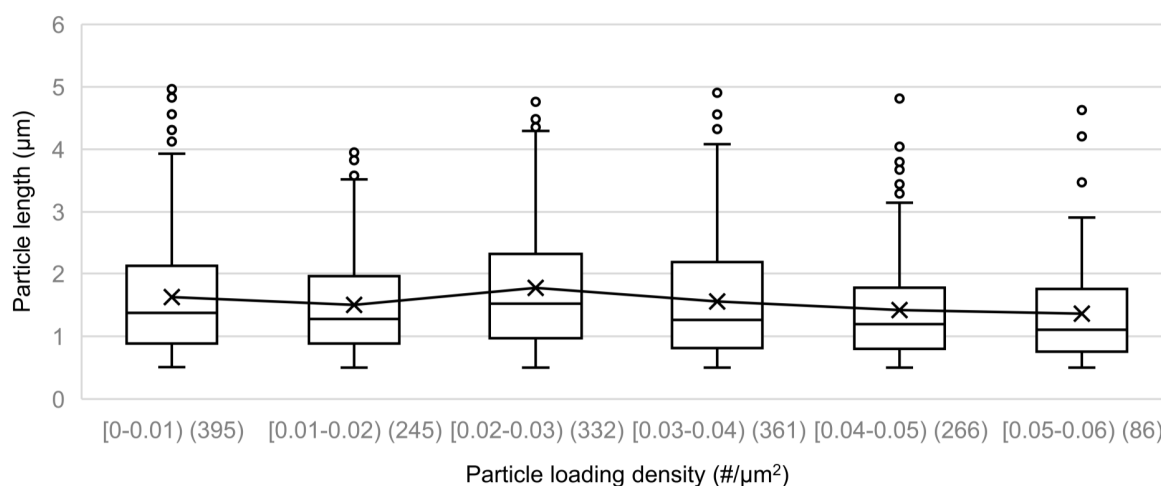


Figure S2. Distribution of silica particle size estimated from SEM-EDX data for the RCMD samples for various particle loading density ranges. Number of silica particles analyzed for each PLD bin is given in parentheses.

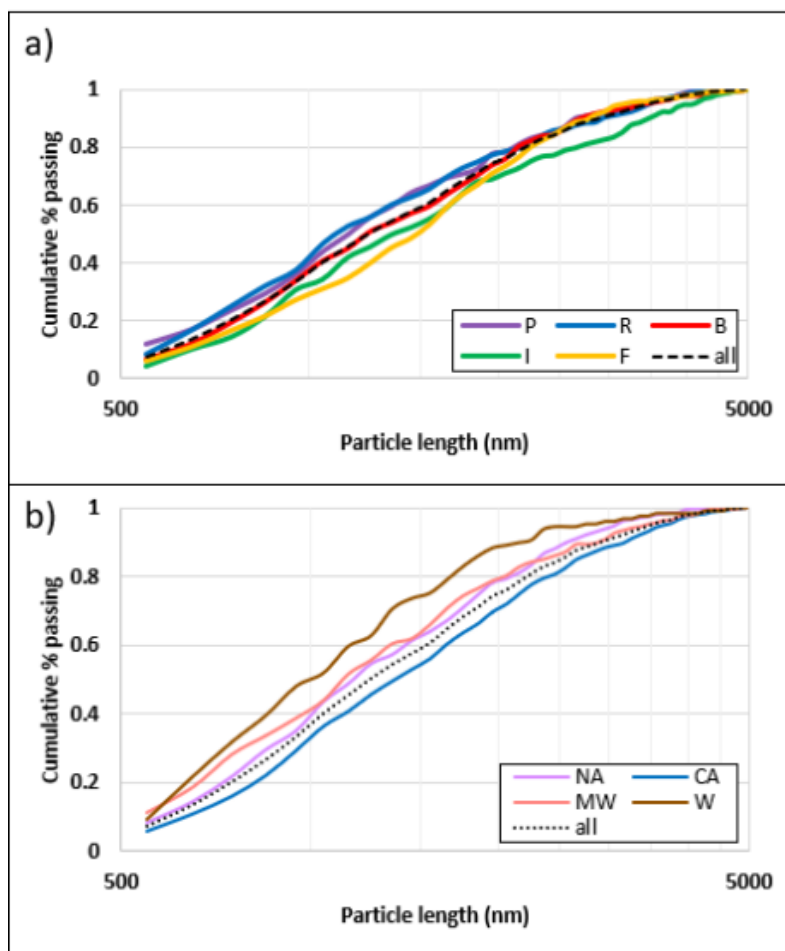


Figure S3. Overall size distributions for silica particles using data collected from the CC SEM-EDX routine established for silica particle identification for this study. Results are shown by (a) specific sampling location (P=production, R=return, B=bolter, I=intake, F=feeder breaker); and (b) mine regions (NA=northern Appalachia, CA=central Appalachia, MW=mid-west, W=west).

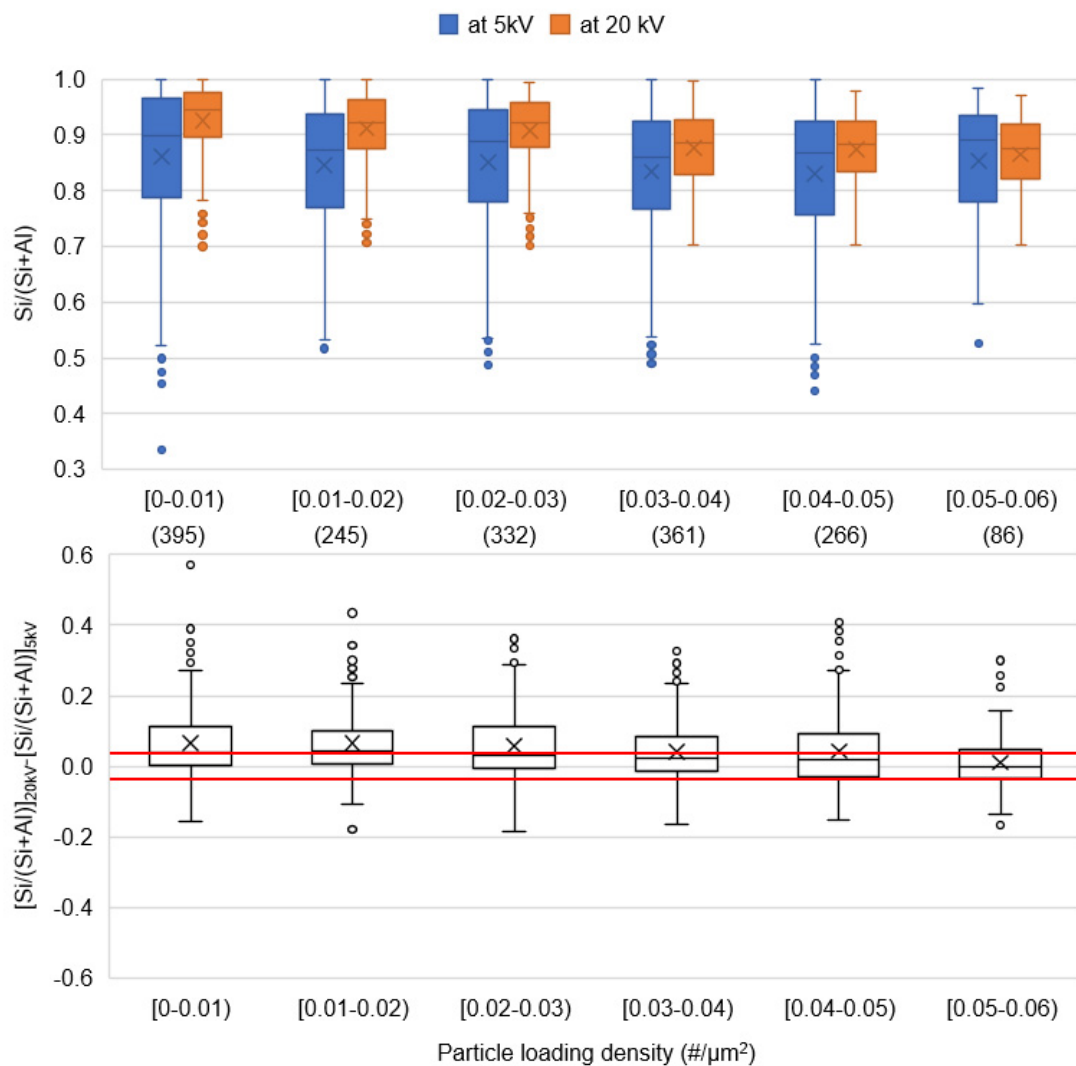


Figure S4. (a) Distribution of the $\text{Si}/(\text{Si}+\text{Al})$ ratio at 20 and 5kV as a function of PLD across all samples, (b) distribution of the *change* in $\text{Si}/(\text{Si}+\text{Al})$ ratio between measurements at 20 and 5 kV as a function of PLD across all samples. Number of analyzed silica particles are given in parentheses.

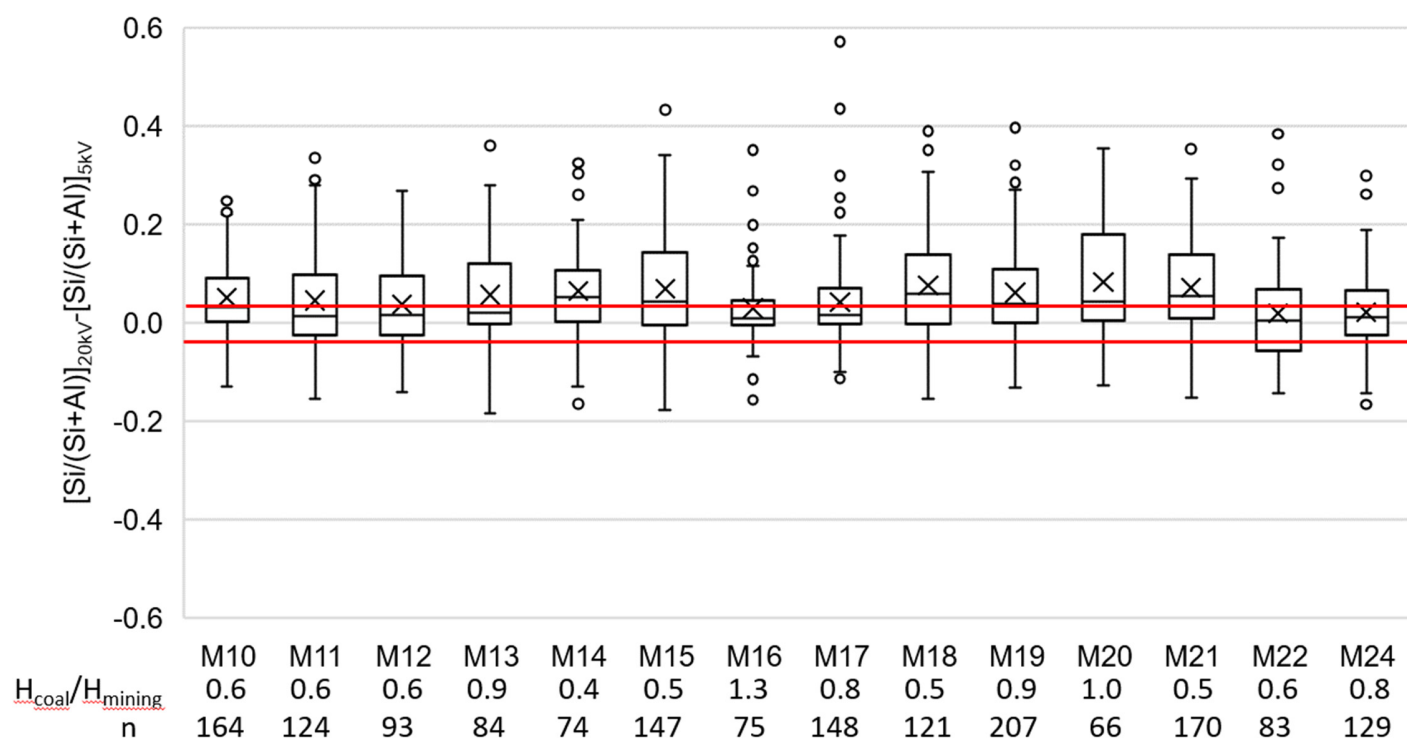


Figure S5. Distribution of the *change* in Si/(Si+Al) ratio between measurements at 20 and 5 kV per mine across all samples. Coal height to total mining height and number of analyzed silica particles are given per mine.

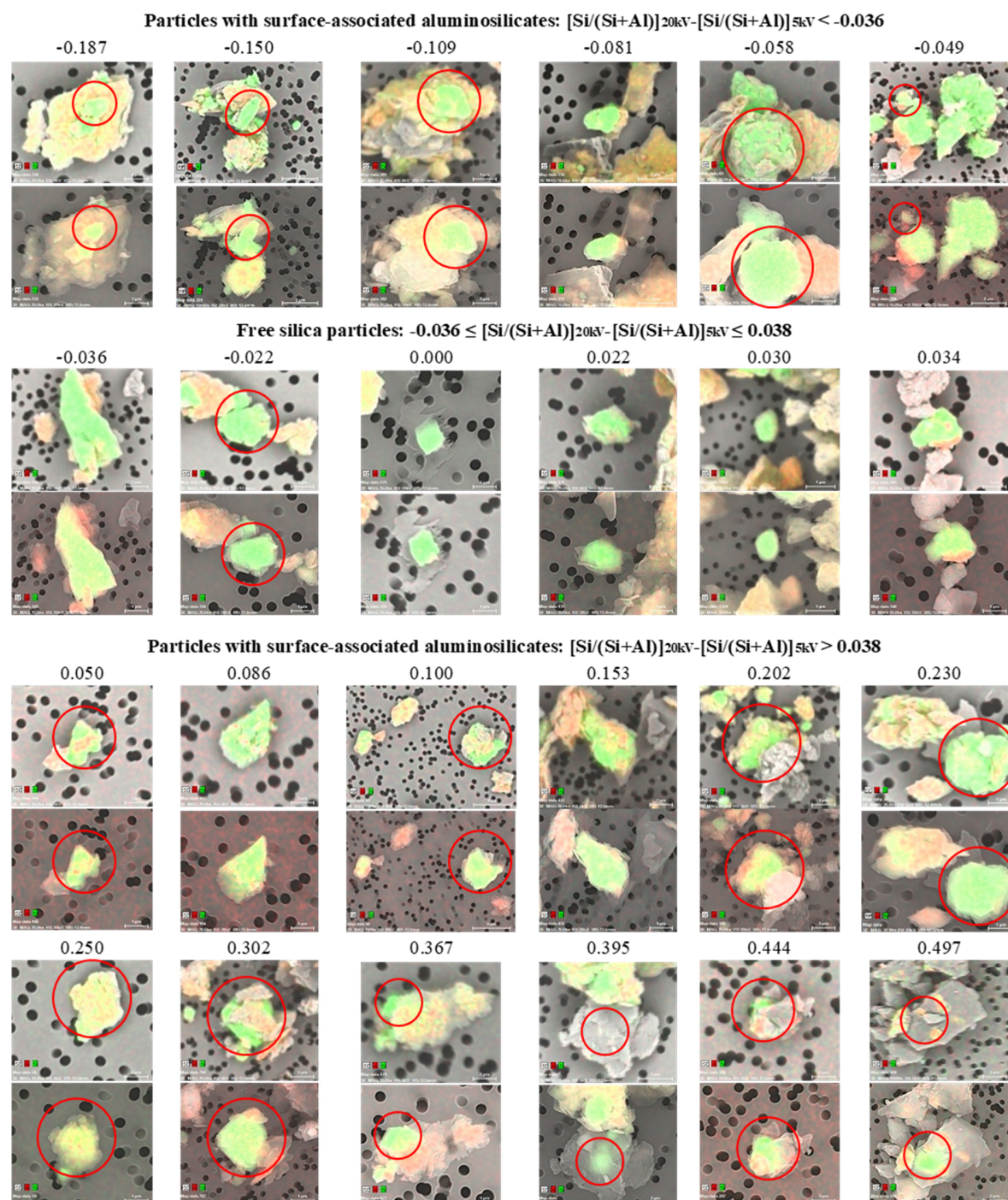


Figure S6. Example silica particles observed in some of the 58 RCMD samples analyzed for this study. Images are organized by the *change* in Si/(Si+Al) ratio at 5 and 20kV. The first group demonstrates silica particles with surface-associated aluminosilicates (clay) that exhibit a negative change in ratio. Such particles tend to be finer and have larger aluminosilicate particles under them. Moving from left to right, the silica particles increase in size relative to the clay particles sitting under or around them. The second group of particles

are classified as free silica (based on their change in ratio being within the thresholds set by the VCAS160 reference particles). Notable, some of these particles do have clay particles in close proximity and/or possibly forming a partial occluding layer on the particle. The third group shown are silica particles with surface-associated clay that exhibit a positive change in ratio. For these particles, the first-row of image pairs show silica particles with relatively minor influence from the associated clay, which are generally small or only forming a partial occlusion layer on the silica. The second-row of image pairs illustrate silica particles with more significant influence from the associated aluminosilicates. These silica particles appear to have more substantial occlusion layers or be part of agglomerates; interestingly, two of the particles appear to be ingrained within another particle (likely coal).