

Figure S1. Simplified flow diagram of the sequential leaching procedure.

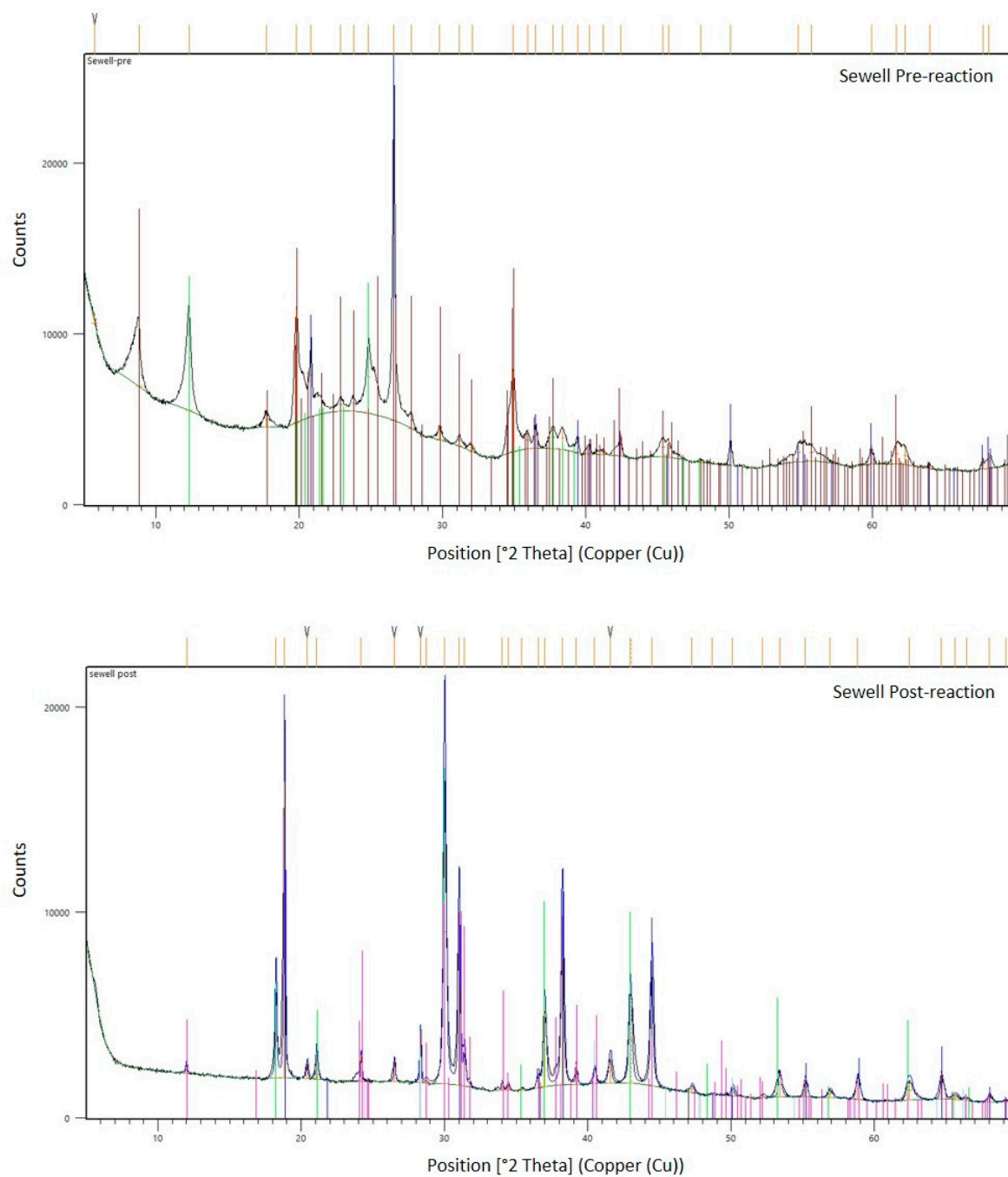


Figure S2A. X-ray diffraction patterns of the pre- and post-reaction samples (Sewell)

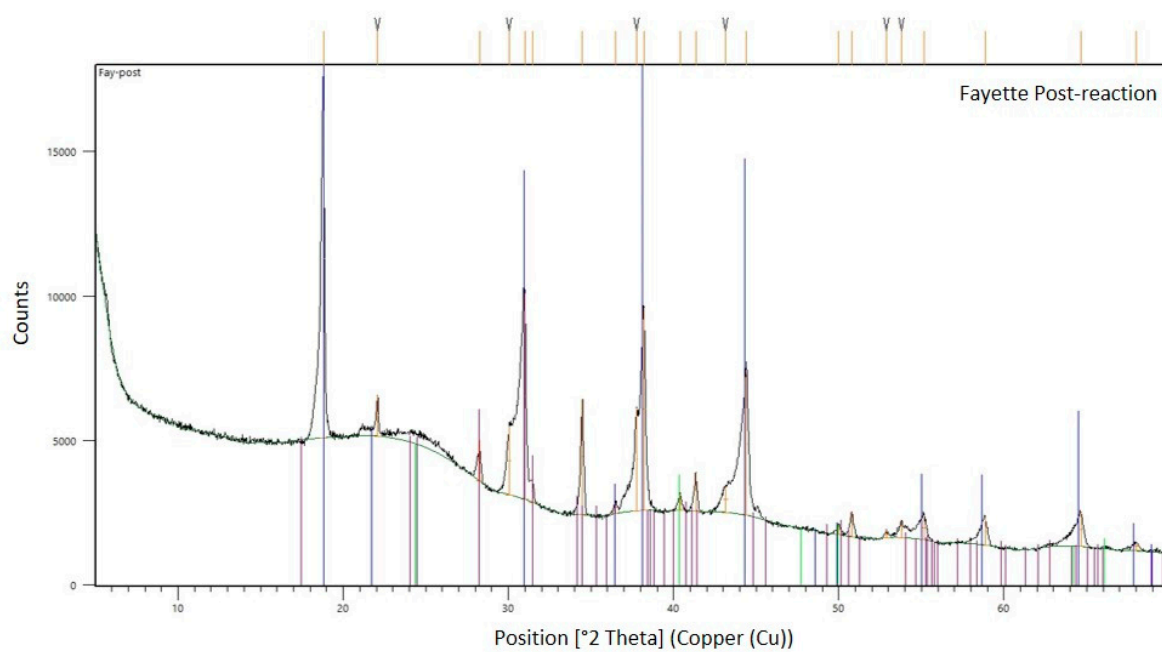
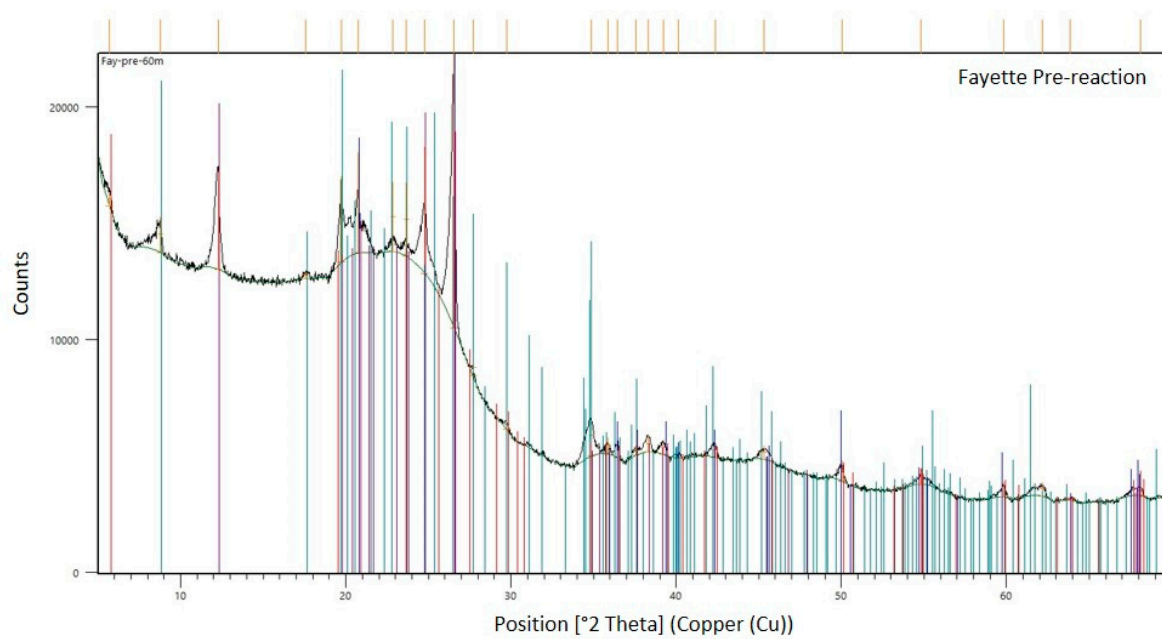


Figure S2B. X-ray diffraction patterns of the pre- and post-reaction samples (Fayette)

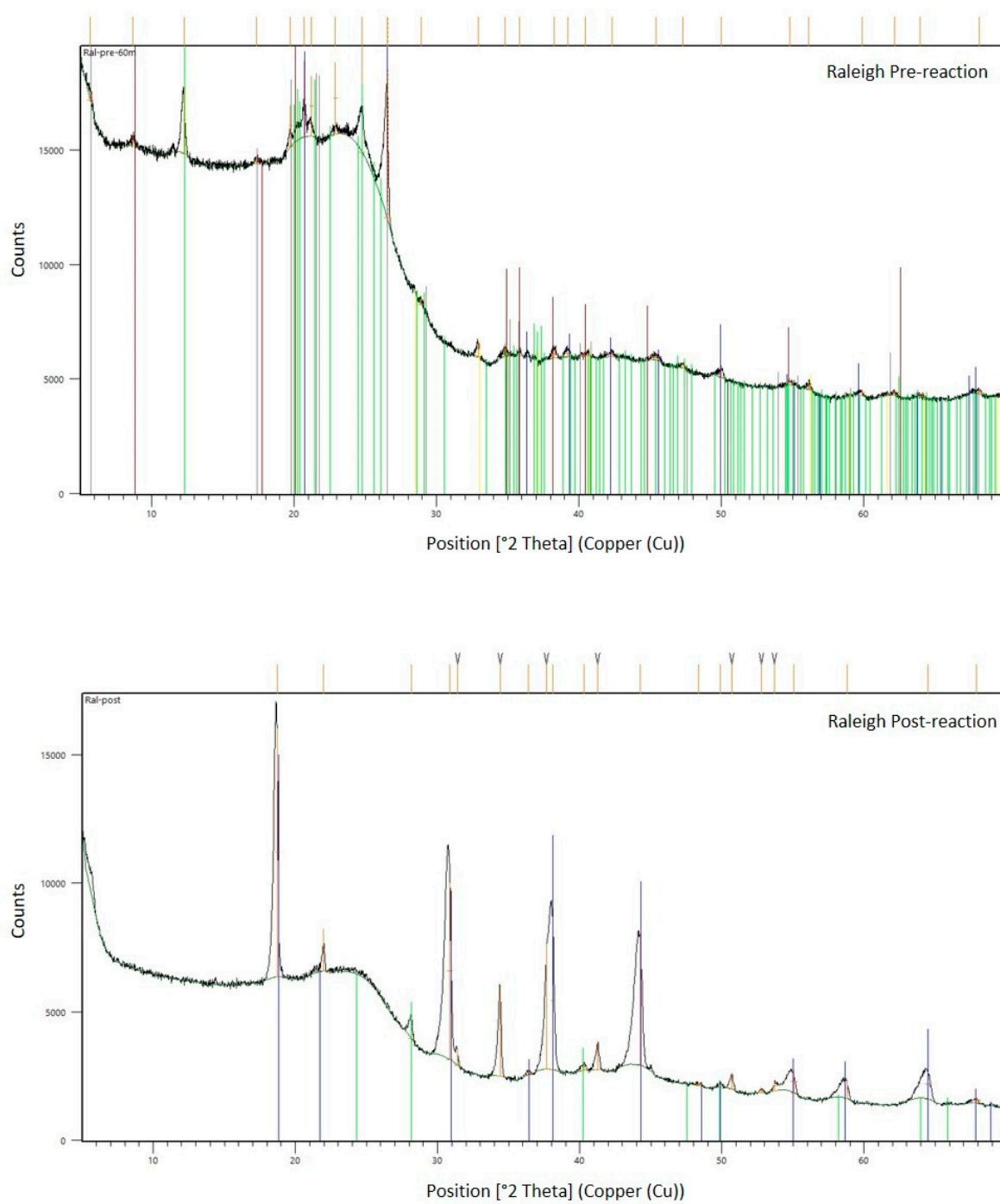


Figure S2C. X-ray diffraction patterns of the pre- and post-reaction samples (Raleigh)

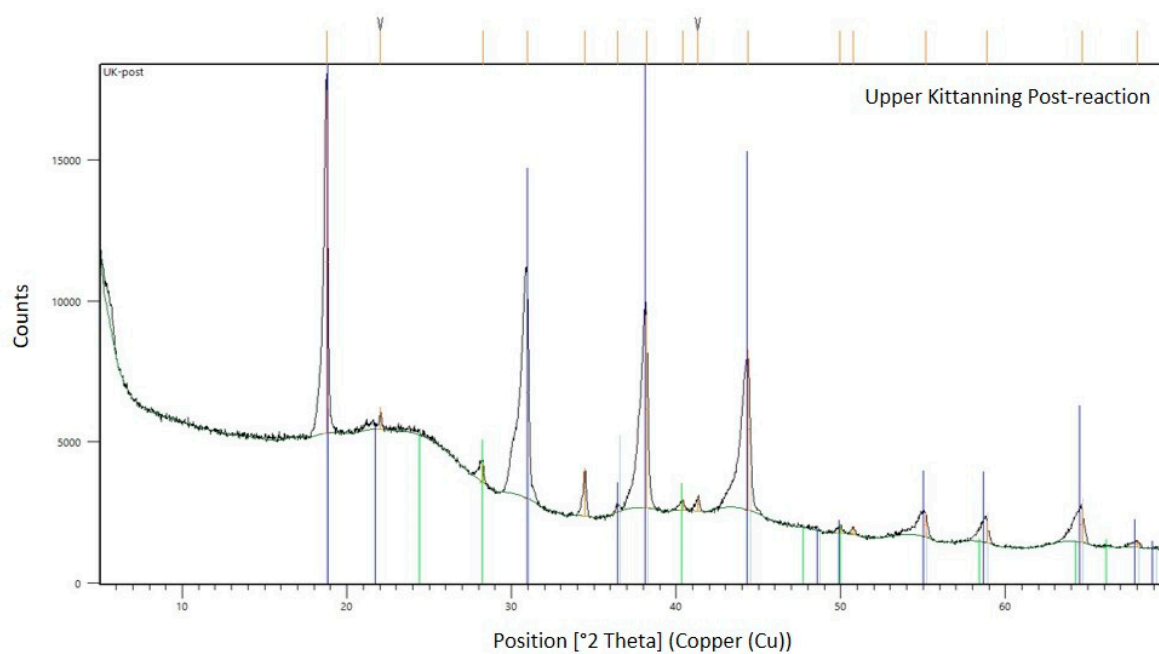
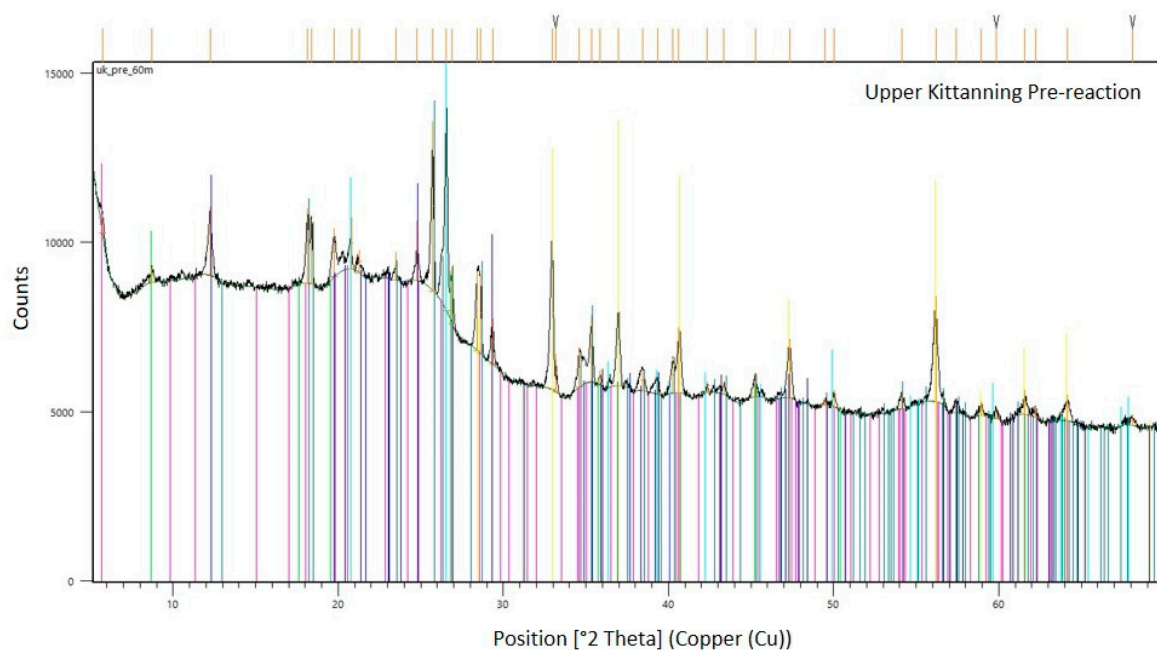


Figure S2 D. X-ray diffraction patterns of the pre- and post-reaction samples (Upper Kittanning)

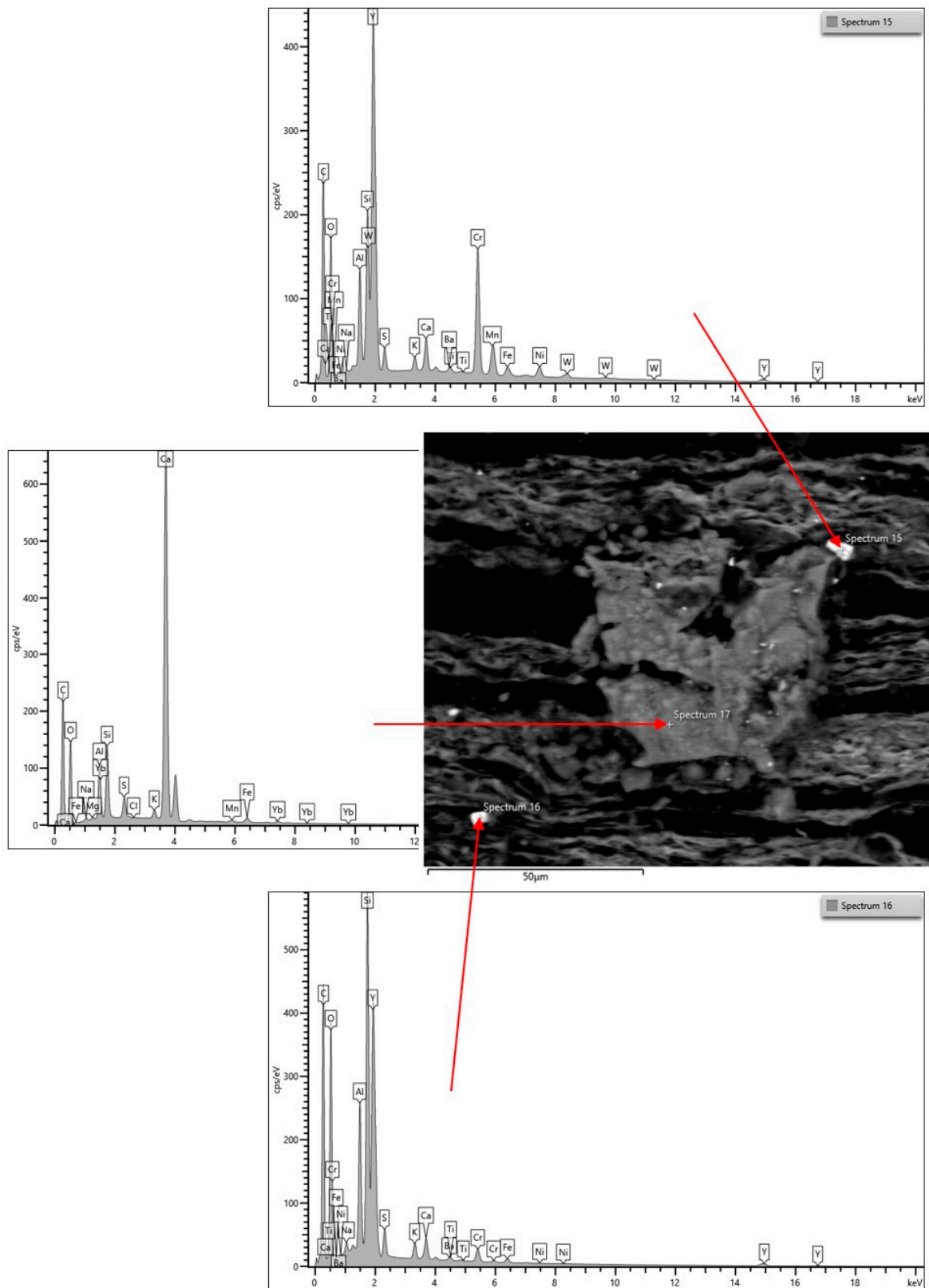


Figure S3B. EDS peaks for some REY-bearing minerals in the Sewell sample.

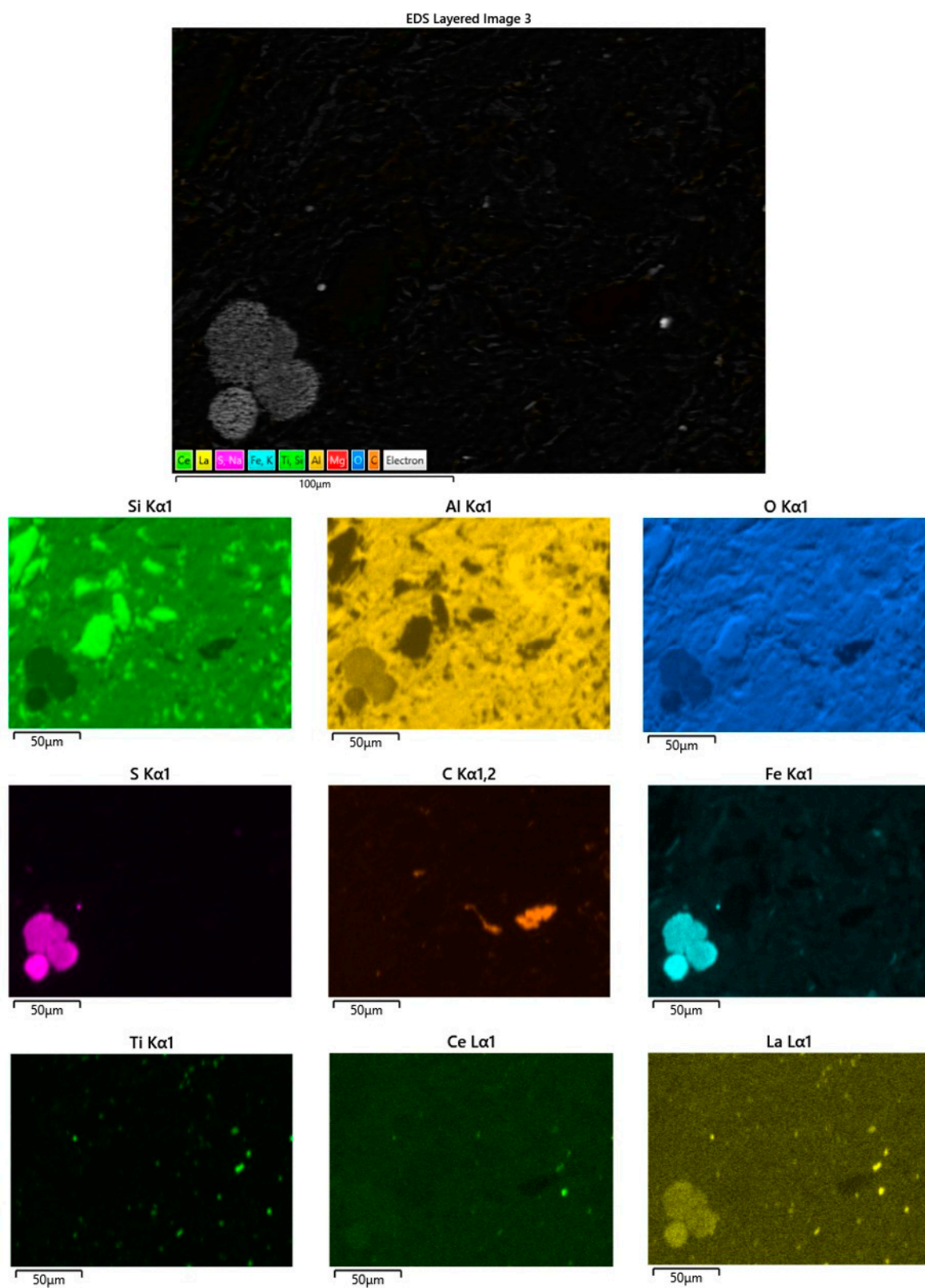


Figure S4A. EDS maps of some REY-bearing minerals in the Upper Kittanning sample.

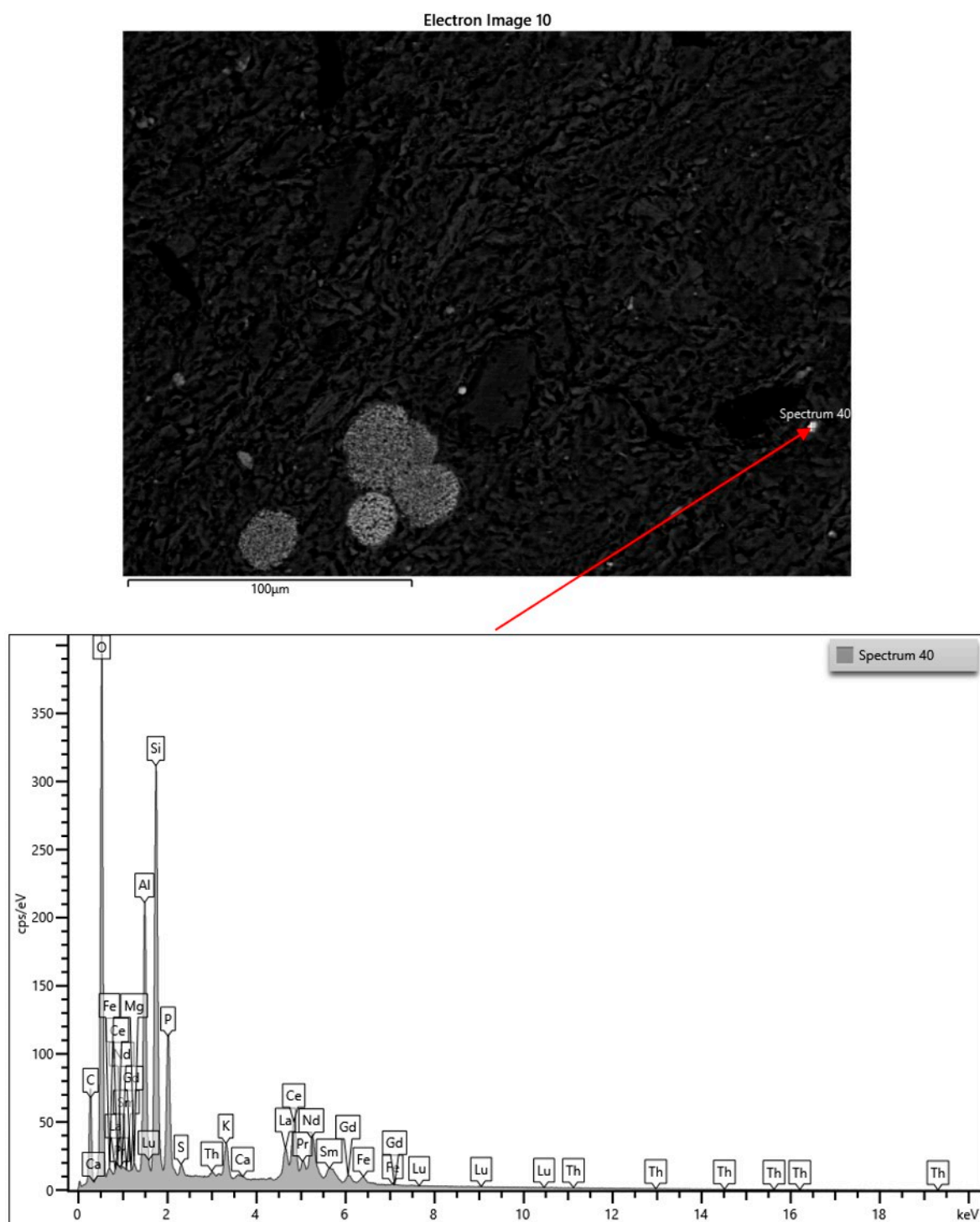


Figure S4B. EDS peaks for an REY-bearing mineral (monazite) in the Upper Kittanning sample.