



# Contamination Knowledge Report

## GAKMAP particles investigation

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**May 15, 2015**

### Summary

One Si-wafer each from the first two sets of deployed GAKMAPS was examined. CK1 was deployed ~March 12-April 12 and CK2 was deployed ~April 12-May 12. Particles on CK 1 were mostly Al-rich particles plus four C-bearing particles. The majority of particles on CK 2 were also Al-rich but there was a wider range of particles with other compositions also collected. Notably, one particle containing minor Pb was identified. Overall, no significant concerns are identified in CK1 or CK2. However given the special importance and low desired contamination level for Pb, it may be prudent to examine a second mount from CK2 to see if additional particles of this type are present.

### Procedures

One randomly selected Si-wafer mount each was removed from CK1 and CK2 and placed in pre-cleaned Al cans with glass lids. Each mount was first briefly examined by optical microscopy in a class 1000 clean room. The mounts were then examined over a 2 day period by SEM. An SEM - image mosaic was first obtained from each mount and then all particles  $>2 \mu\text{m}$  in size were examined. EDX spectra were obtained for 100 s at 15 keV. Mosaic SE images of both mounts and representative EDX spectra are included at the end of this report.

### Observations

CK1: Optical: Many large metallic particles and several white (plastic?) particles were observed.

SEM: A total of 33 particles ranging in size from 3 to  $100 \times 45 \mu\text{m}$ . Particle compositions fell into several groups according to the elements present. The particle composition groups are listed as follows in order of decreasing element abundance with key diagnostic elements in bold: Al ( $\pm$  O) 26 particles; CNOS ( $\pm$ Cl, Mg, **K**) 3 particles. 1 particle each: ONaMgCaAl, ONaMgCl, SiOAl, ZnO.

CK2: Optical: Many large particles were present, mostly appearing to be metallic.

SEM: A total of 41 particles ranging in size from 1-50  $\mu\text{m}$ . Particle compositions: Al ( $\pm$ O, Mg) 26 particles; Fe $\pm$ Ni $\pm$ Cr $\pm$ Zn 4 particles – these are on the edge and may be from

handling tweezers; + one particle each of: FeOSAlCuCaMgP, FeNi+minor AlOC; ONaCaMgAl; CCaOSNaNaK; CuZnOPb – on wafer edge; OCaNaMgAl; ZnO; CONaClCaK; MgFOCCa; CaO; FeCrNi.

## **Discussion**

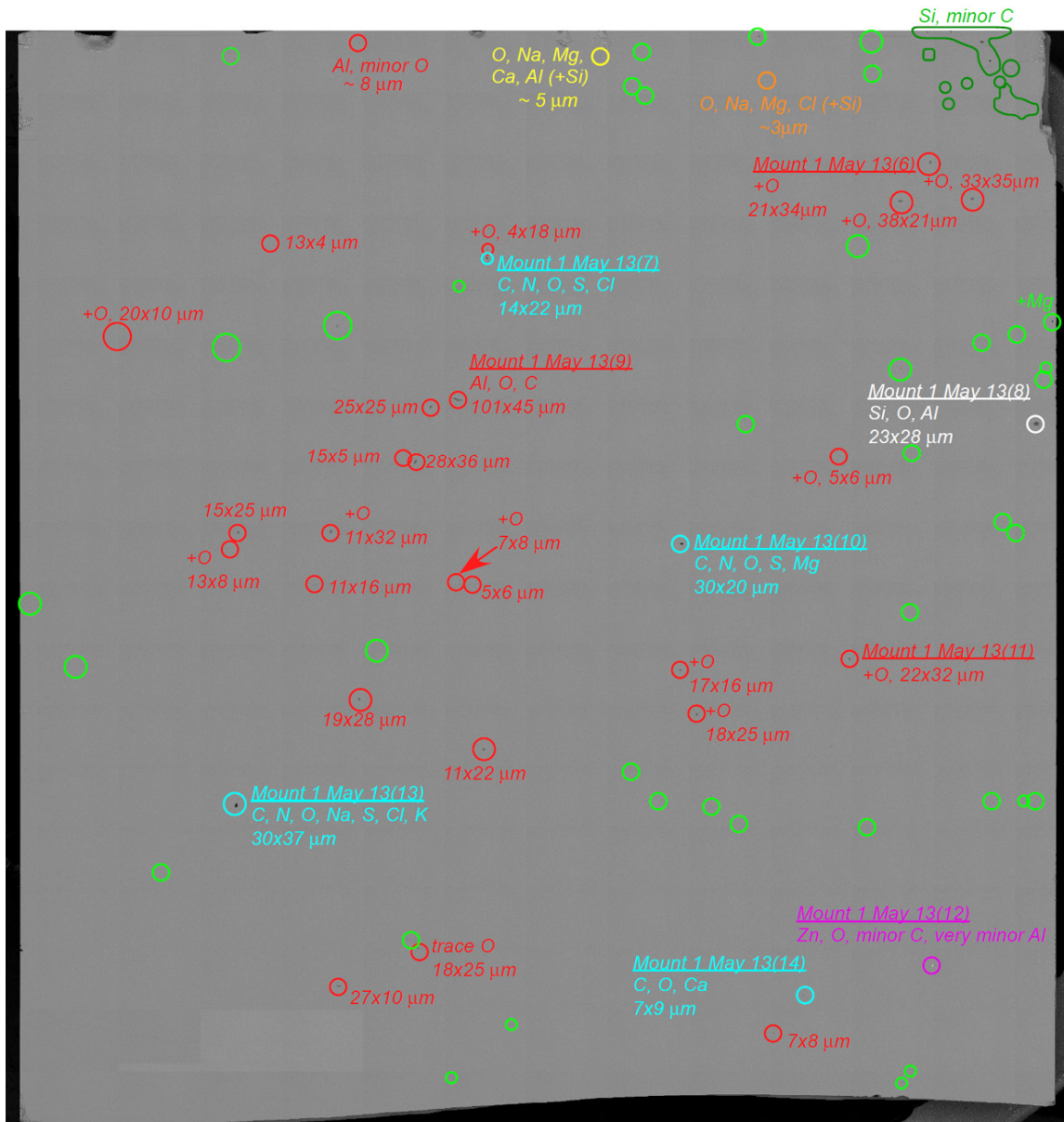
Key diagnostic elements: The Contamination Knowledge effort is monitoring the abundances of the following diagnostic elements in collected particles: C, K, Ni, Sn, Nd, and Pb. So long as the cleaning standard of 100A/2 is met for the TAGSAM surface, the abundance limits of C, K, and Ni will be satisfied. On the other hand, this cleaning standard may not be sufficient to protect certain types of scientific studies if highly unusual abundances of Sn, Nd, and Pb are found. Below is a summary for each of these elements:

- C: On the order of 10% of collected particles were C-rich. A few of these had typical elemental signatures of biological contaminants such as skin flakes or perspiration. Other C-bearing particles included a probable calcite and inorganic particles.
- K: Trace K was observed in several particles. The one particle showing a significant K peak was probably a skin flake.
- Ni: Trace Ni was observed in several Fe-rich particles. Given the locations of these particles near the edge of the wafers, these may have been introduced by handling with stainless steel tweezers.
- Sn: Not observed
- Nd: Not observed
- Pb: Minor Pb (1-few wt. %) was observed in one particle. This particle was mainly composed of Cu and Zn. This 6x8 µm particle was found near the edge of the wafer and could be handling debris, but the composition is unusual.

## **Recommendations**

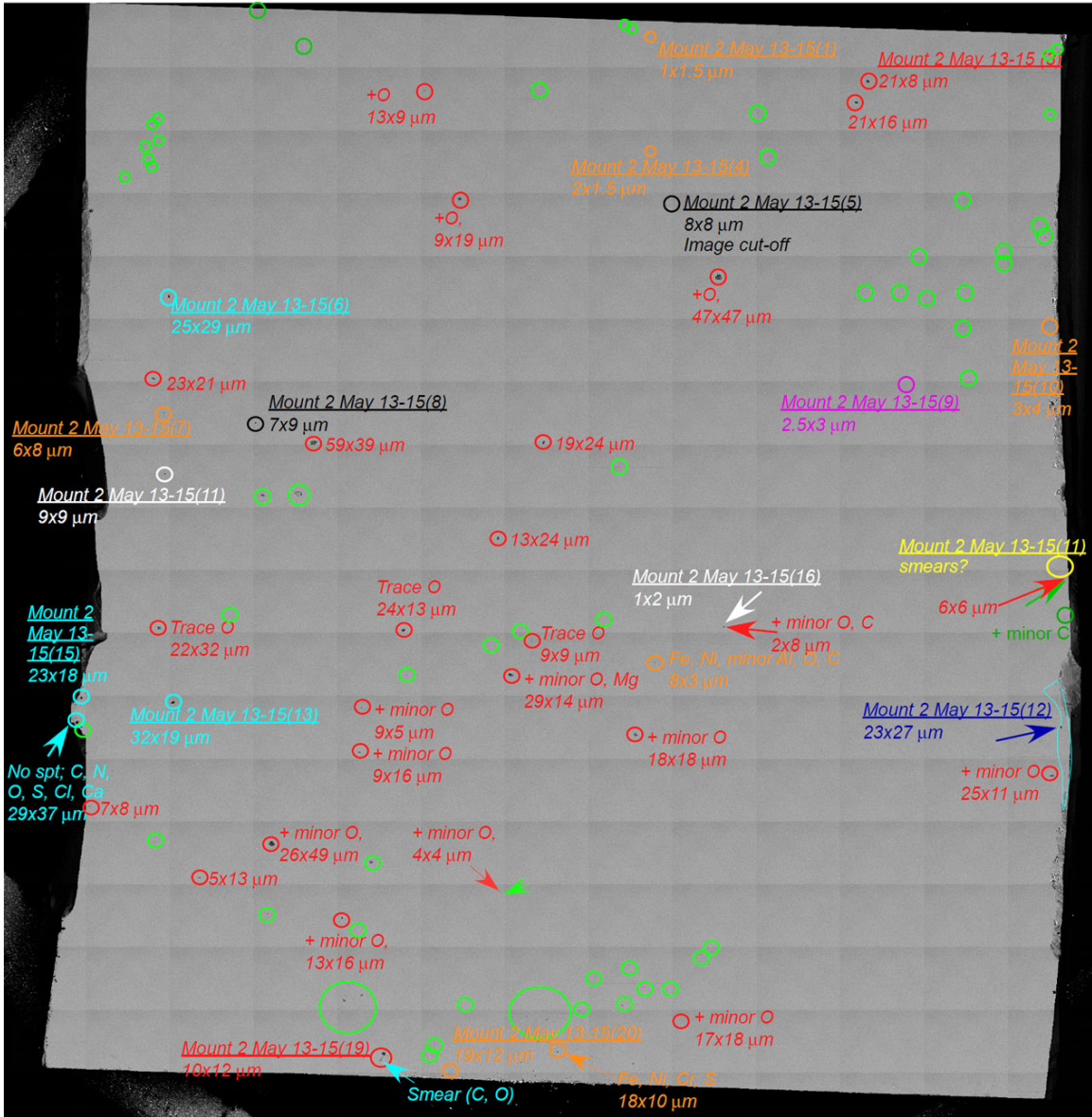
Continue to monitor as planned. No further recommendations at this time.

# Mount 1 May 13, 2015

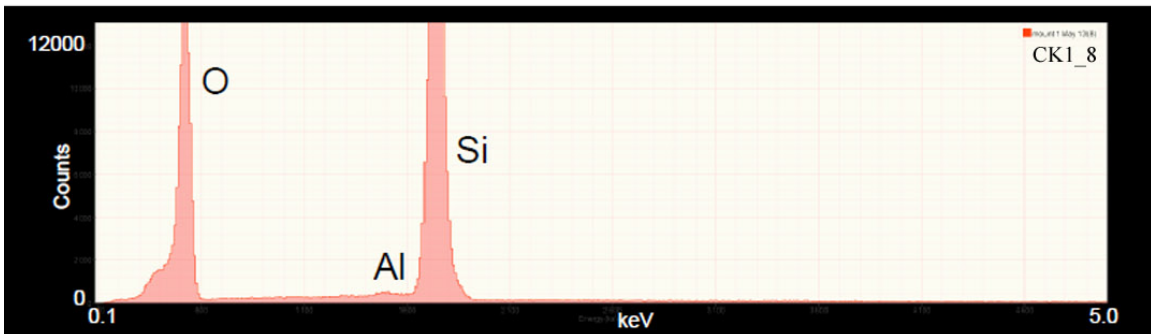
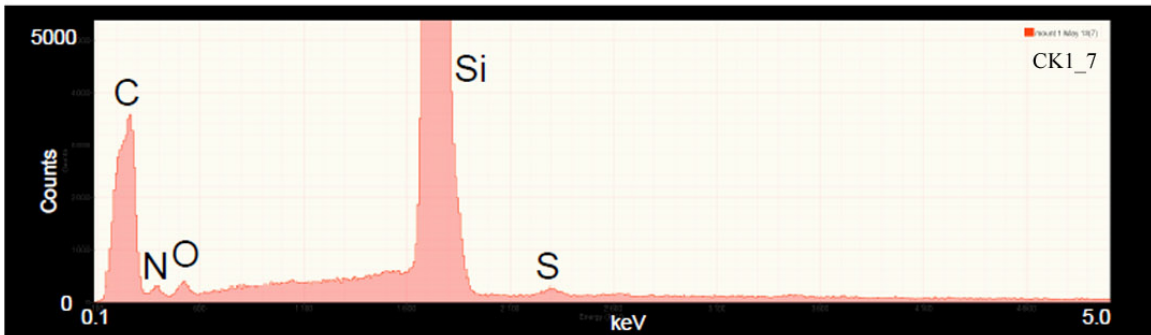
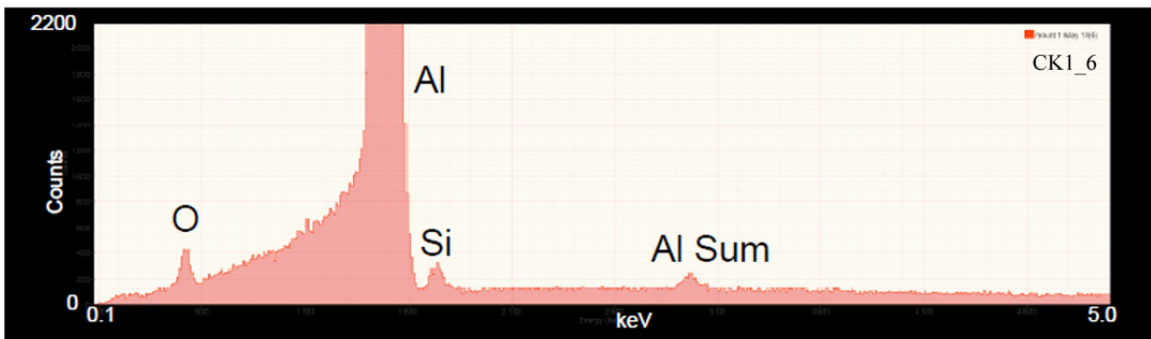
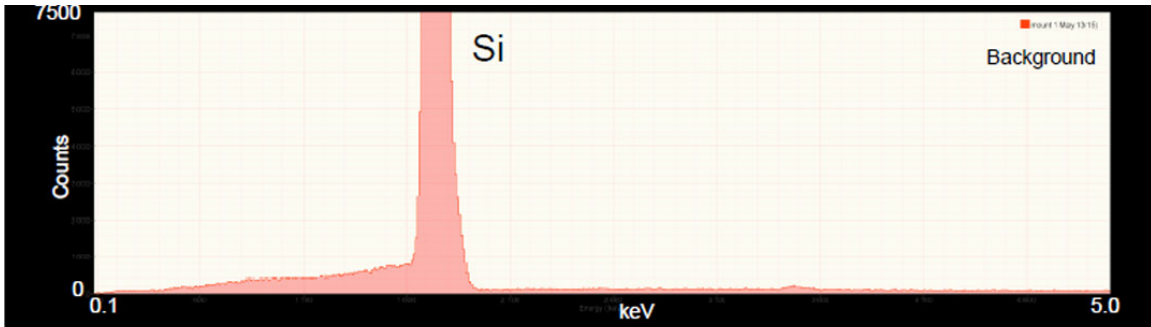


# Mount 2 May 13-14, 2015

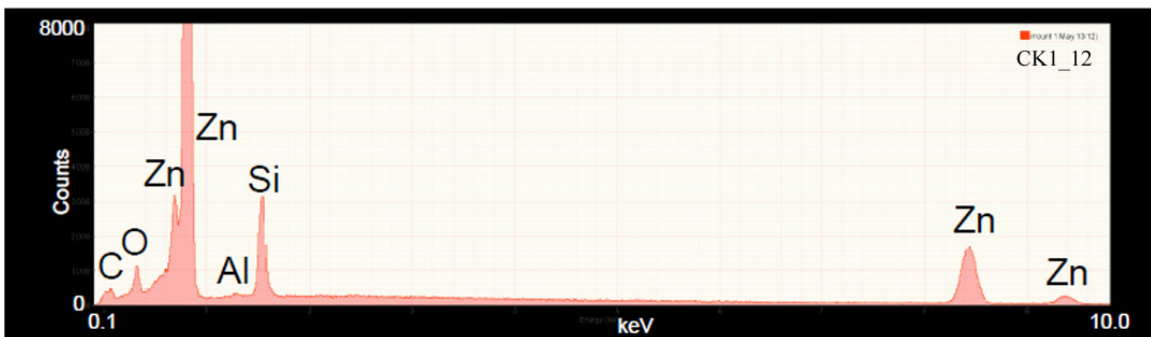
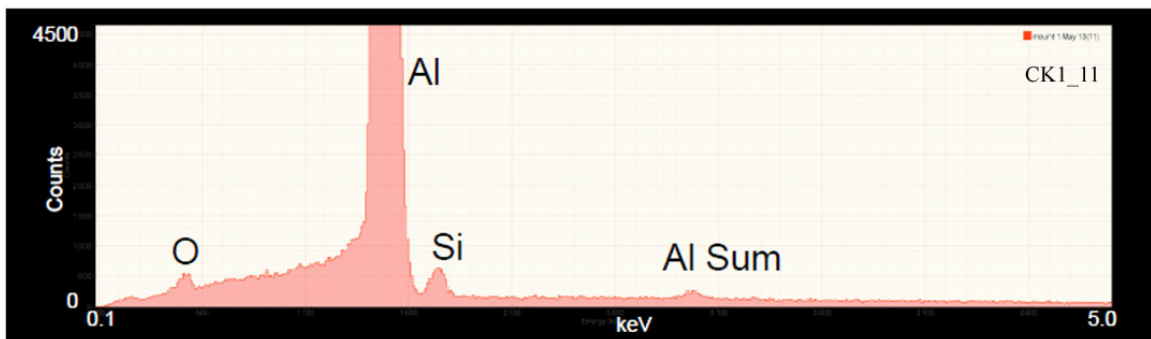
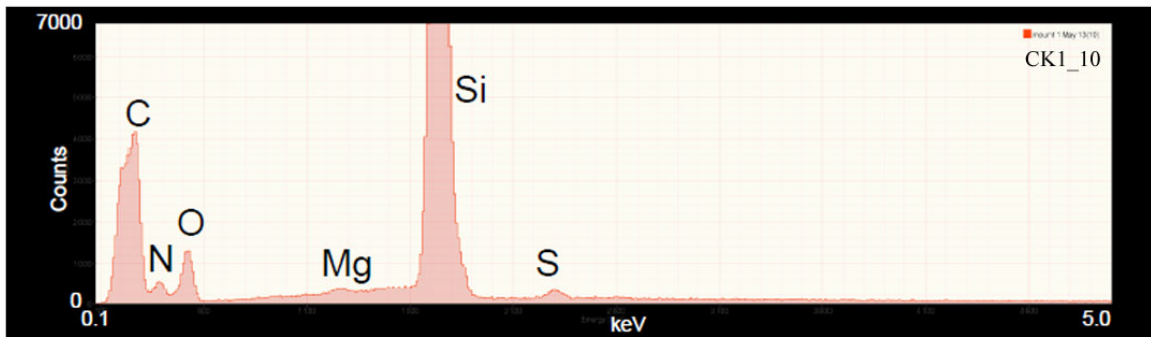
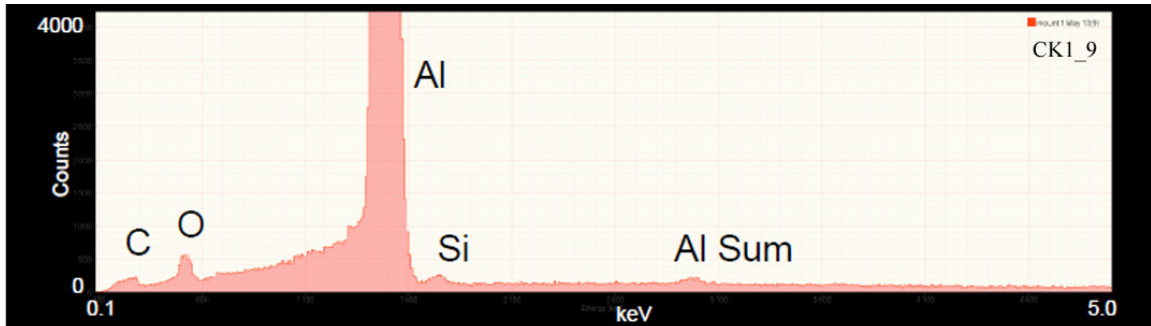
- C-bearing
- Si
- Al +/- O
- Contains Zn, Cu, Fe &/or Ni



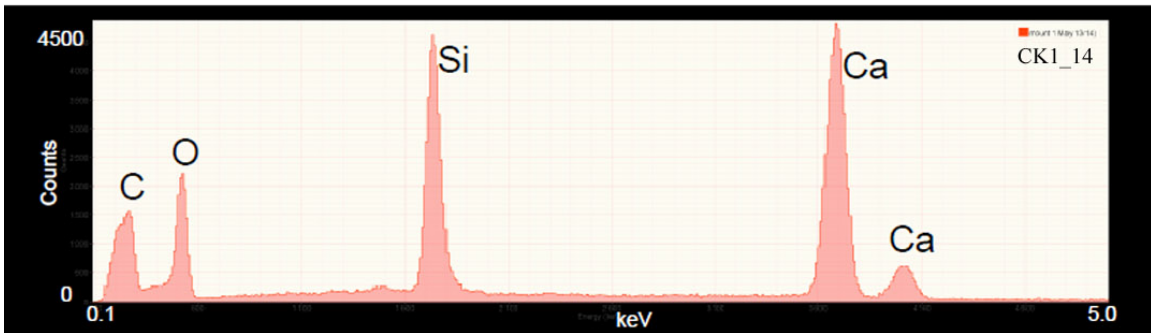
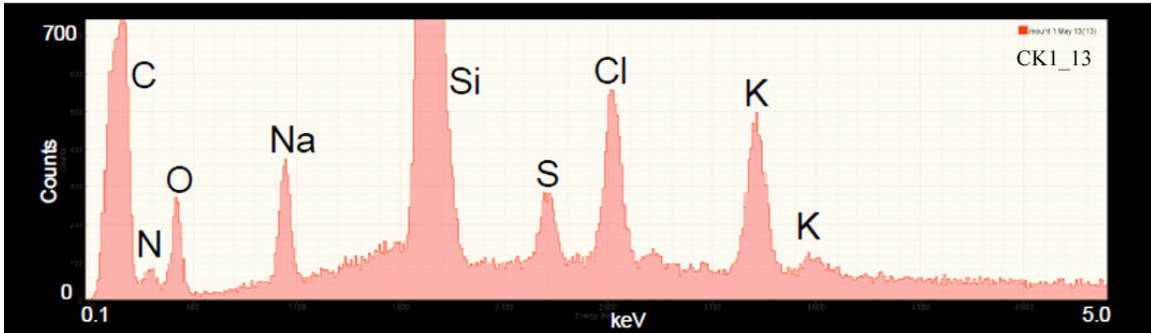
CK1 EDX spectra



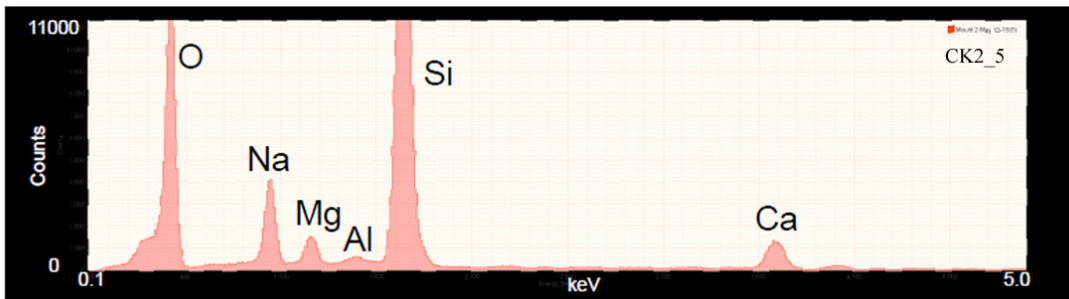
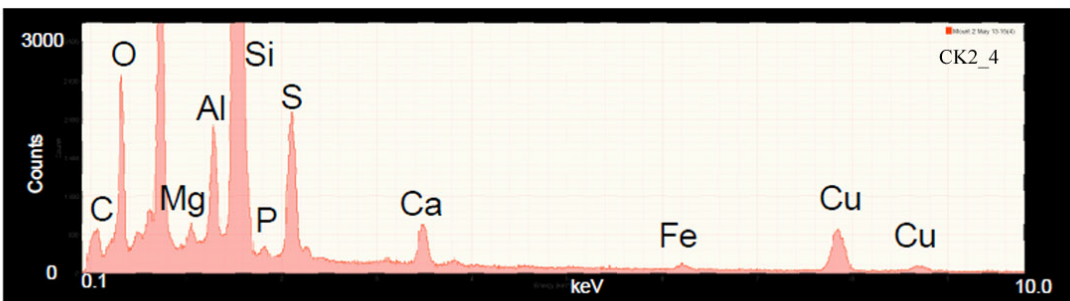
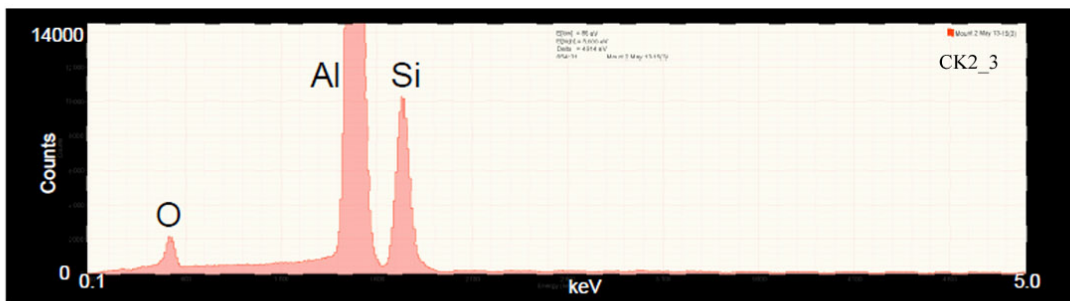
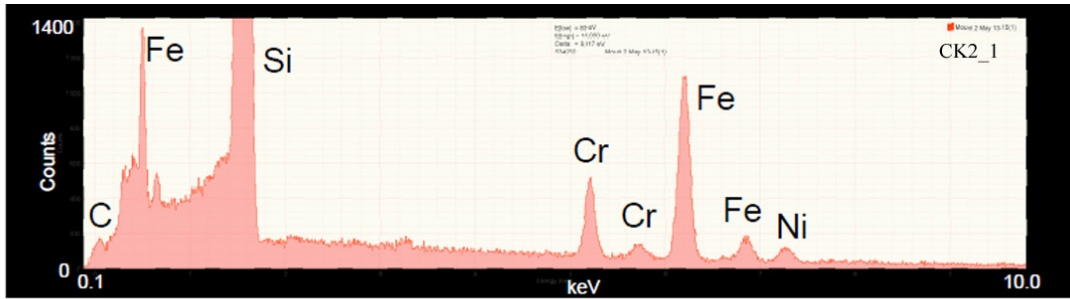
CK1 EDX spectra



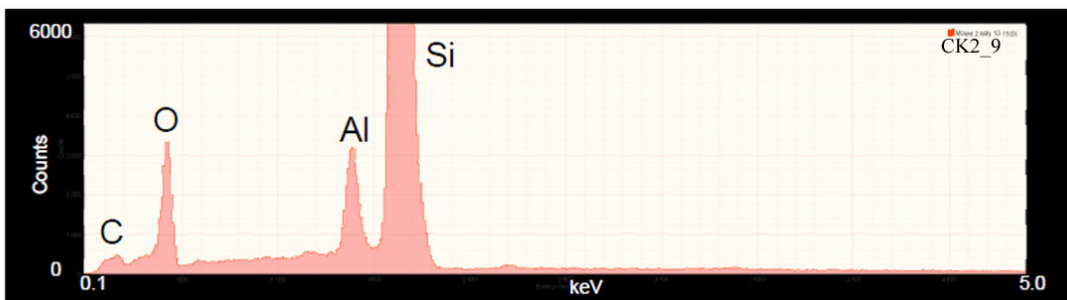
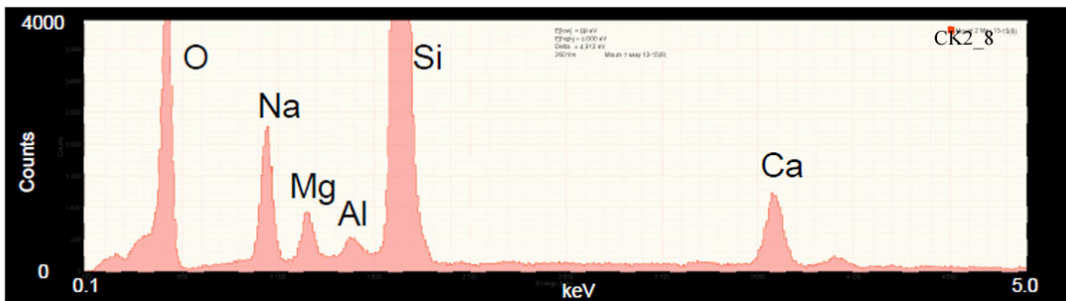
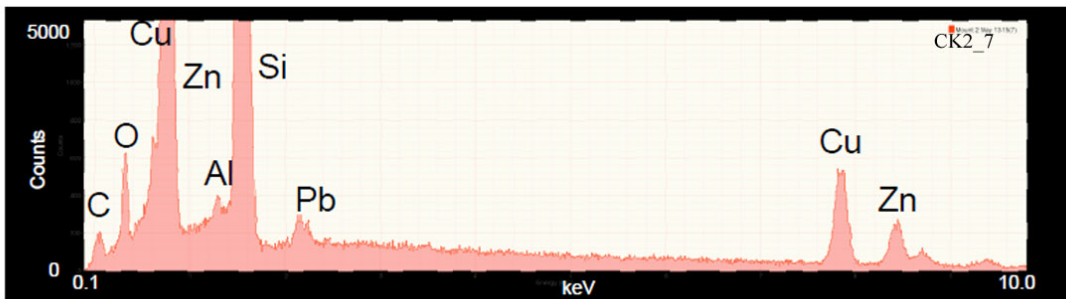
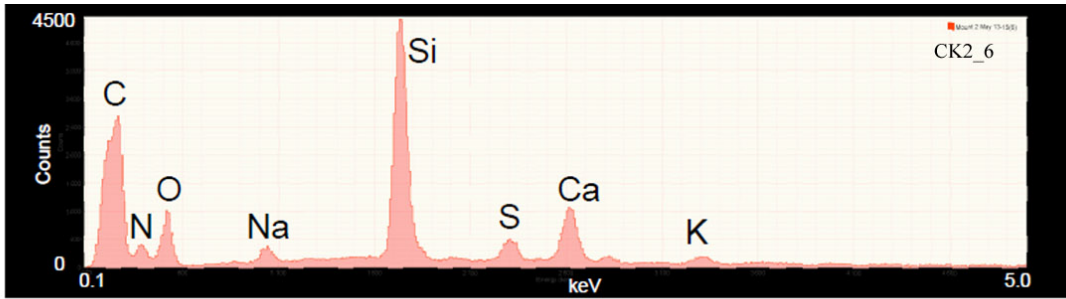
CK1 EDX spectra



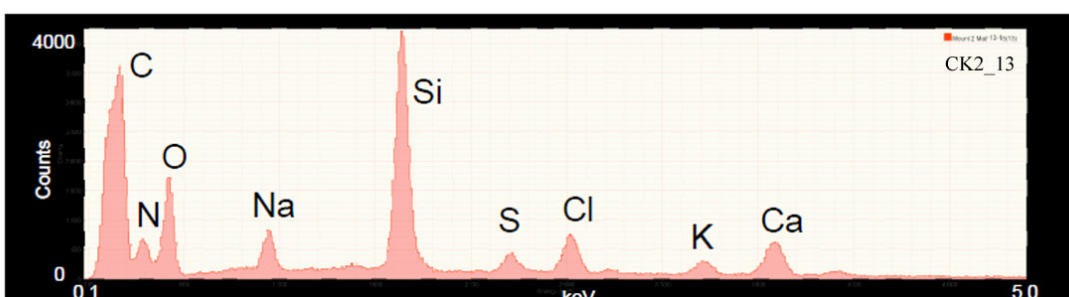
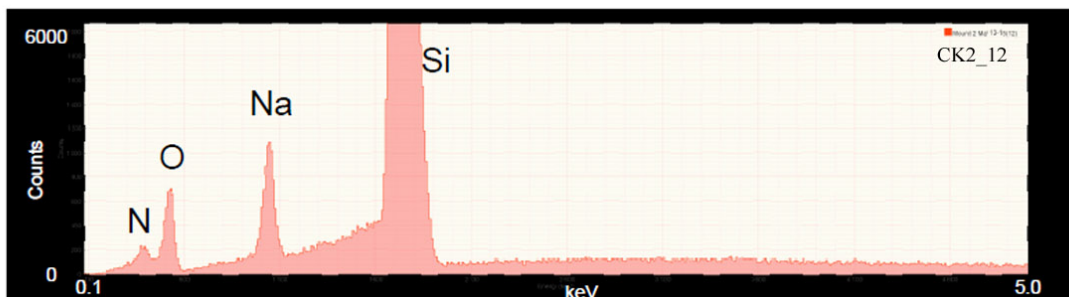
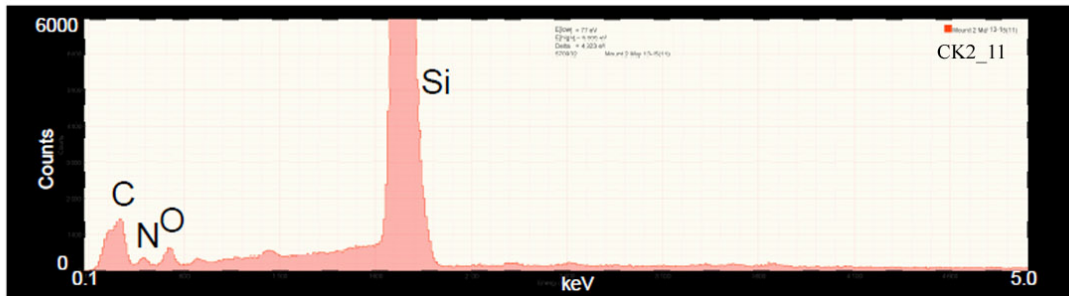
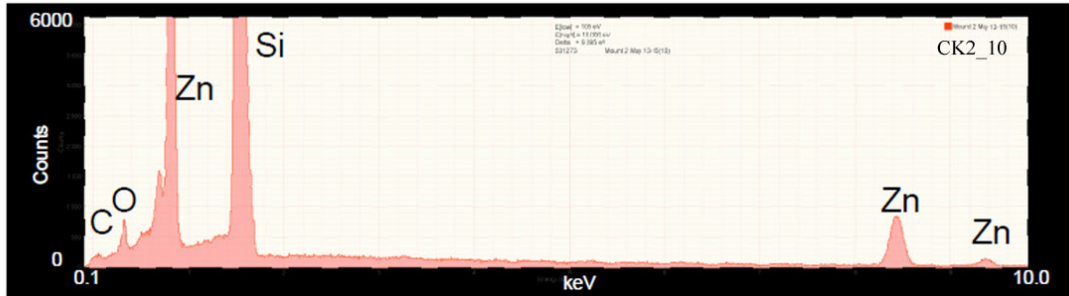
CK2 EDX spectra



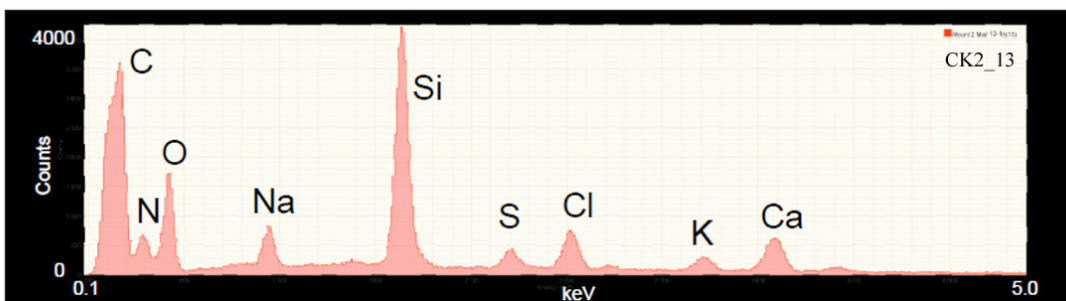
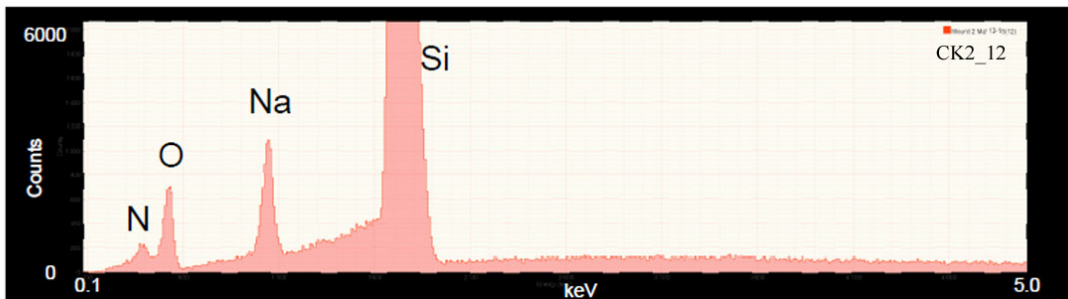
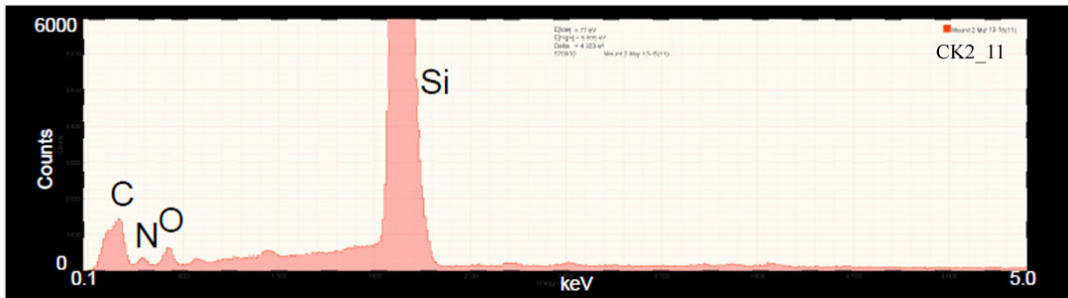
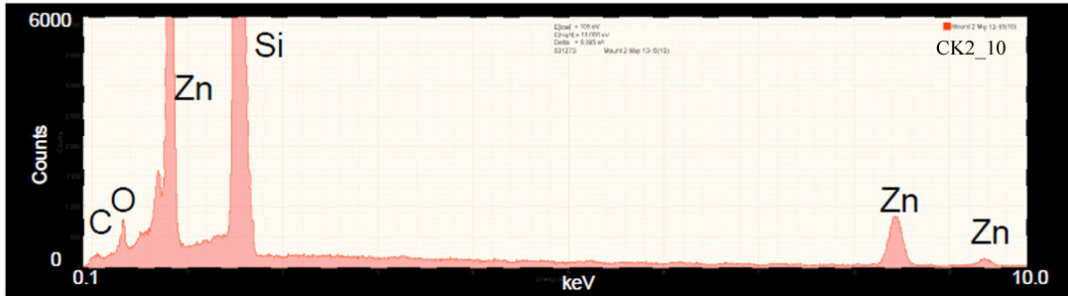
CK2 EDX spectra



CK2 EDX spectra



CK2 EDX spectra



CK2 EDX spectra

