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Long Element Profile of Layered Coastal Sediments by SEM/EDS

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Historically, SEM/EDS has been used to analyze a single field of view at relatively low count rates [1]. In recent years, advances in all aspects of instrumentation (SEM automated sample stages, SDD sensitivity and count rate, SEM and analyzer networking, computer speed, pulse processor speed and mass storage capacity) have improved such that collecting large area maps has become practical [2,3].

Line profiles up to several centimeters long can now be acquired in several hours or less putting this technique within reach of many analysts with existing equipment. Compared to similar sized line profiles by small spot XRF, analysis by SEM/EDS is faster, is sensitive to light elements, and by using a 1D array of maps it provides more spatial information. SEM/EDS can produce a 1D array of maps, each with roughly micron precision, that show the details of each segment of the profile. Instead of integrating over a 20 – 50 micron spot, SEM/EDS shows the compositions of the individual particles in that spot.

An example is shown in Figure 1. This is a segment of a row of x-ray maps about 100 microns wide by over 3cm long acquired in about three hours. This segment shows a trace of Te in the Ag paste. This long profile revealed these somewhat rare inclusions and their distribution. Map resolution about 2 microns.

In this work a profile will be measured across layered sediments collected on the California coast in Half Moon Bay. Figure 2 shows the general location and Figure 3 shows a detail of the sample. Figure 4 shows two representative spectra of this material overlaid, normalized to Si. Note that the red layer contained significantly more Fe. The large Na and Cl peaks are due to salt from the nearby ocean.

For the final analysis extensive sample preparation is required. This material does not have enough strength to stand by itself. Likely a long segment will be isolated, rinsed to remove salt, dried, then impregnated with epoxy. After hardening this must be sectioned and polished to reveal a surface for SEM/EDS observation. It is expected that less than four hours will be required for the analysis.

An issue with such a very rich data set is its display. There is far too much data for one view so the analyst must find ways to condense and edit the data while keeping the original data set for confirmation and further analysis.

This work will be done with several SEMs using Thermo Scientific Pathfinder analyzers and UltraDry SDDs.

References:

[1] CE Fiori and CR Swyt, Microbeam Analysis (1992), p. 89.
[2] SM Seddio and PK Carpenter, Micros. Microanal. **23** (2017), p. 1066.
[3] J McCarthy and J Konopka Micros. Microanal. **24** (2018), p. 726.

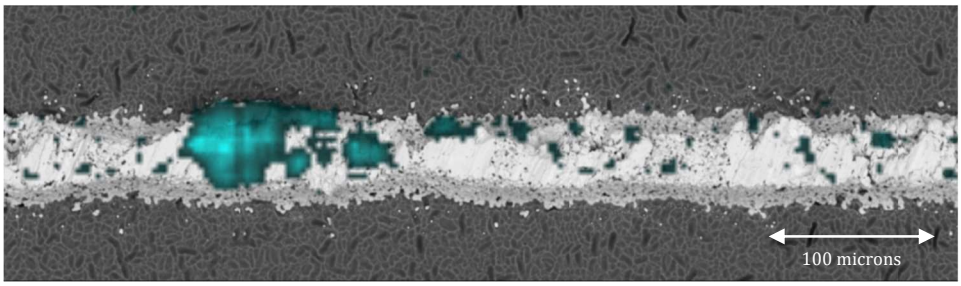

Figure 1. Overlay of Te map on BSE image of Ag paste trace on a Si solar cell.

Figure 2. Image of coastal bluff. Arrow indicates location of sample.

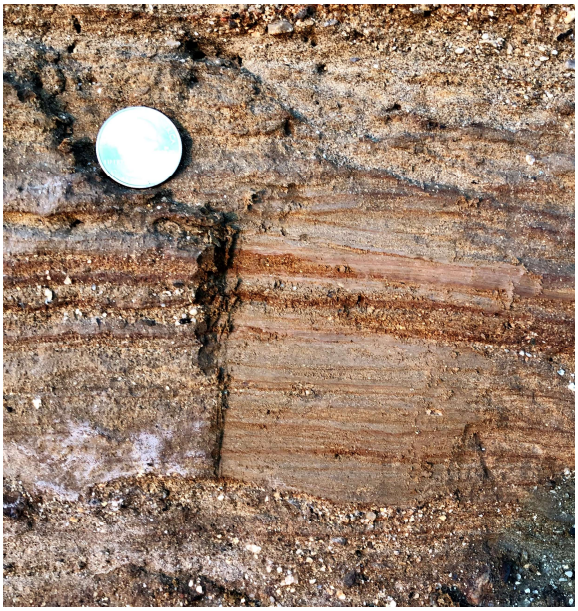

Figure 3. Close up of layered sediments. US 25 cent coin for scale.

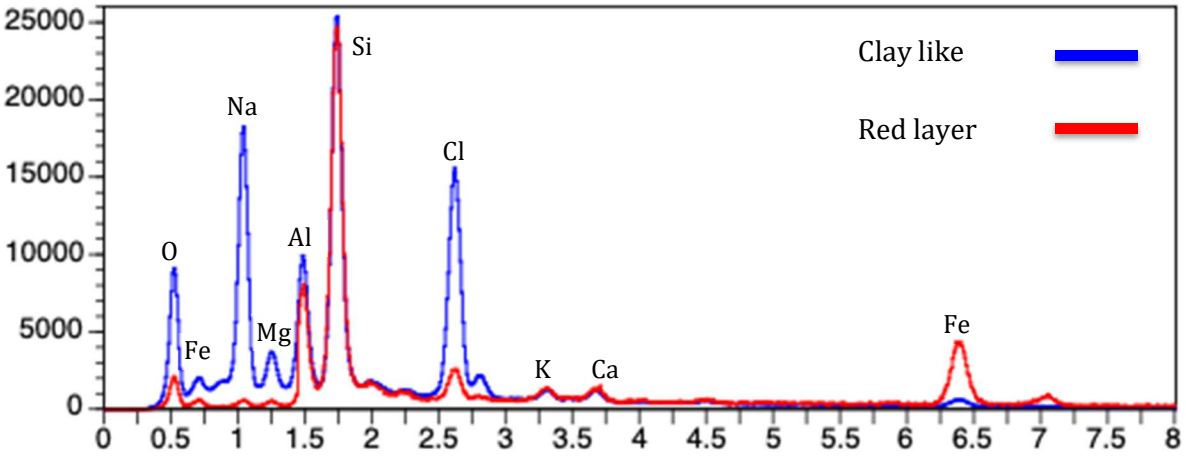

Figure 4. Spectra from representative areas of clay-like layer and red layer.

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