Individual Particle Studies

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Sampling –

C-130, using CVI as inlet, sampling on single-stage membrane filters and 3-stage impactor with 3 mm TEM grids
(a)cloud droplet residues,
(b) ambient aerosol with counterflow
(c) ambient aerosol without counterflow

C-130, TAS – (d) ambient aerosol on membrane filters

C-130, giant nuclei slides, particles caught on conductive carbon adhesive

C-130, curved tube inlet on belly, 3-stage impactor with grids

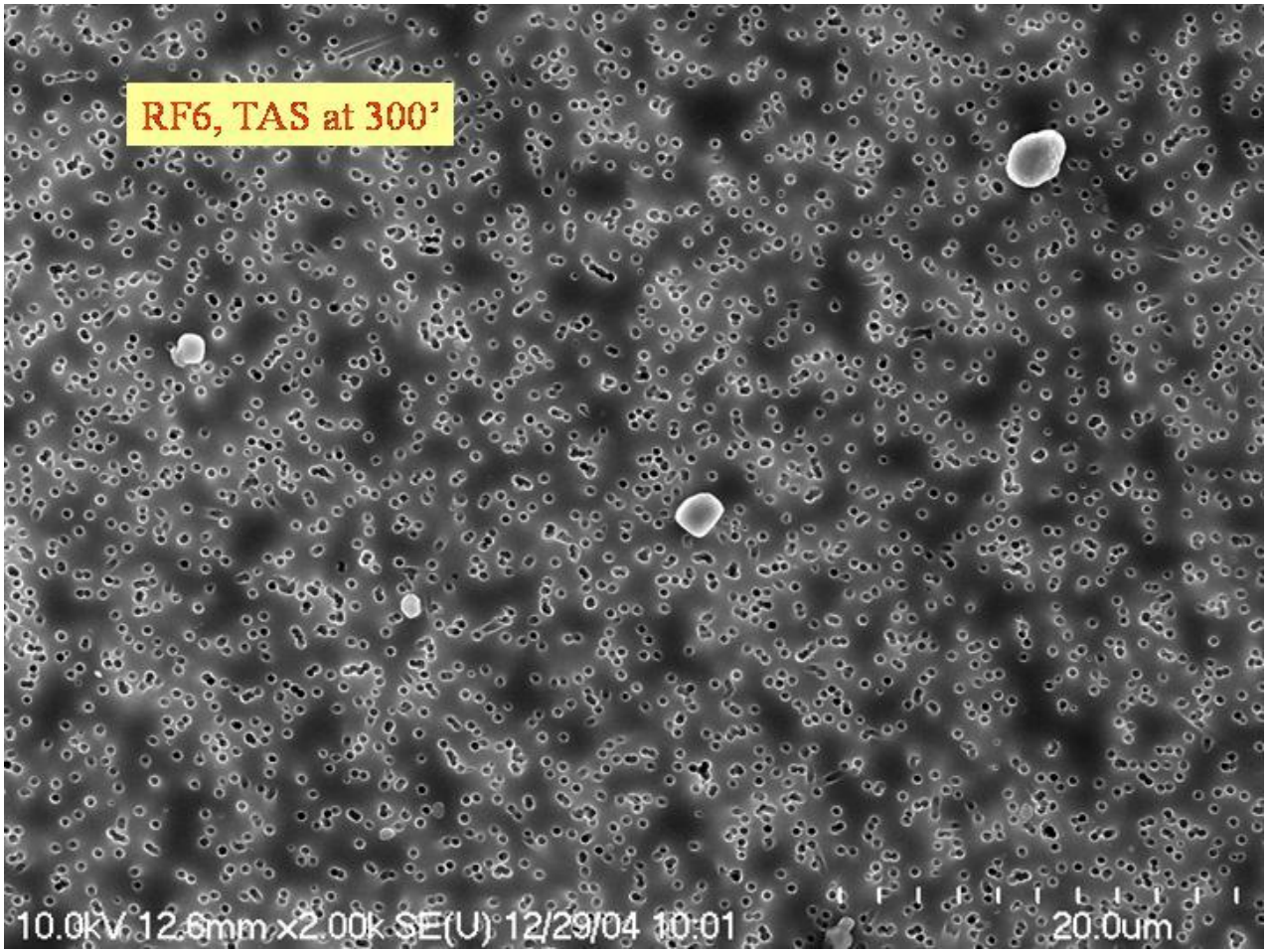
Dian Point, part of Jan. – membrane filter and 3-stage impactor

Analysis:

Automated SEM – size and composition for representative populations on membrane filters and giant nuclei slides ($d > 0.1$ microns)

Manual SEM – imaging and composition of particles on any media, but mostly for membrane filters and slides

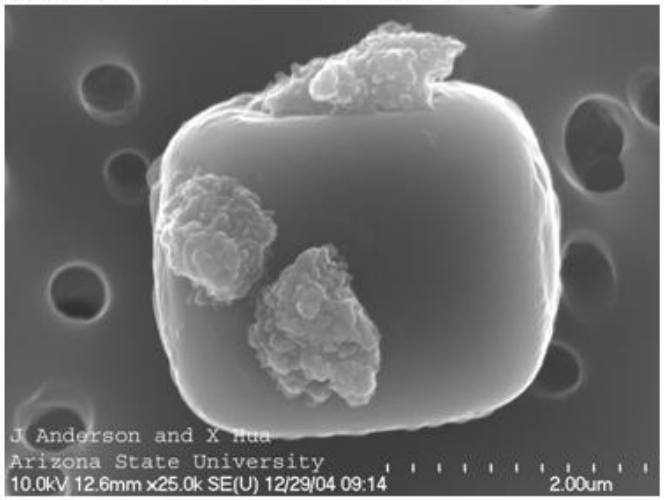
TEM – imaging, structure, and composition of particles on TEM grids taken with micro-impactor


RF6, TAS at 300'
10.0kV 12.6mm x2.00k SE(U) 12/29/04 10:01
20.0um

Untitled:1

Label A: rico-rf06-tas2-1-2

Sea salt particle from RICO C-130 RF6



Intensity

X-ray energy

rsj42202-1.2.1.eds

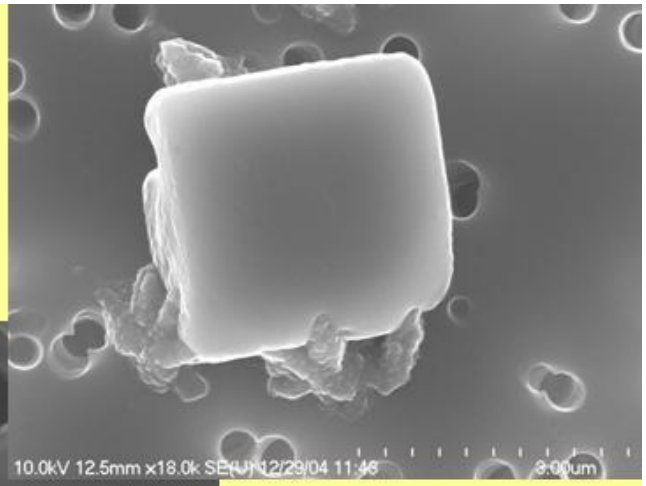
Filter Fit Method
Chi-sqd = 385.88 Livetime = 60.0 Sec. Beam Current = 400.000 nA

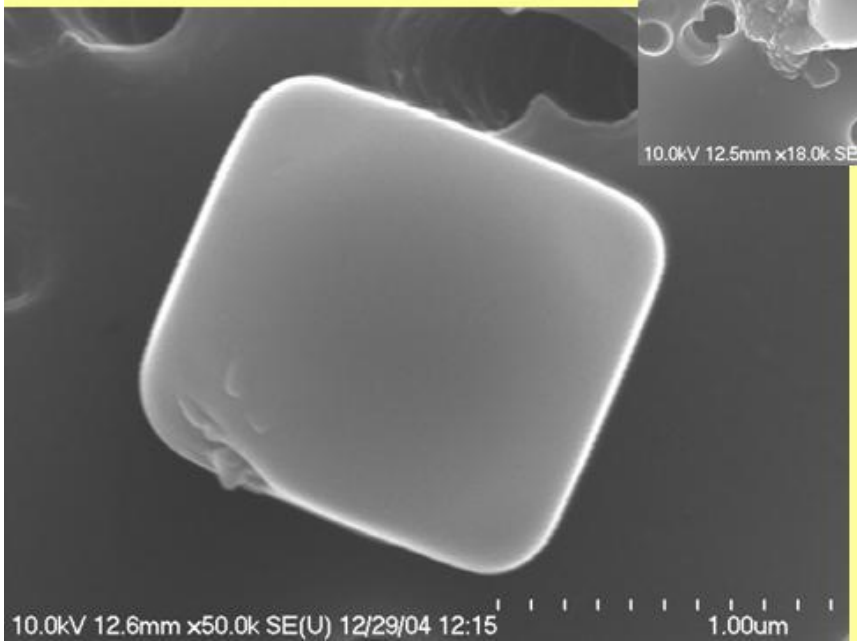
ZAF Correction Acc.Volt.= 15 kV Take-off Angle=35.00 deg
Number of Iterations = 4

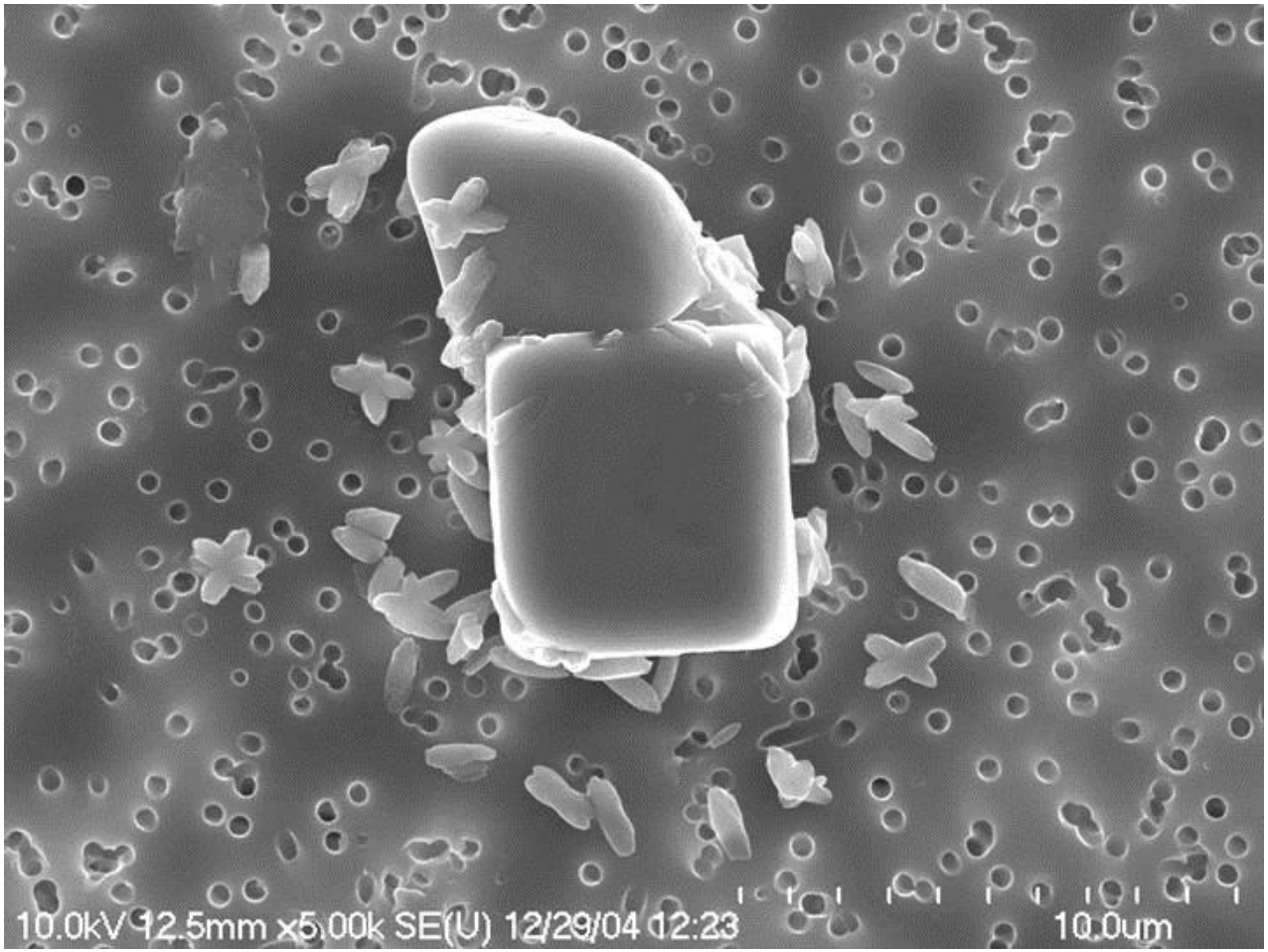
Element	k-ratio	ZAF	Atom %	Element Wt %	Err. Wt % (1-Sigma)
Na-K	0.0025	1.624	6.02	0.41	+/- 0.05
Mg-K	0.0006	1.374	1.16	0.08	+/- 0.03
Al-K	0.0191	1.252	30.00	2.39	+/- 0.04
Si-K	0.0275	1.393	46.28	3.84	+/- 0.06
P -K	0.0002	1.694	0.36	0.03	+/- 0.04
S -K	0.0005	1.429	0.76	0.07	+/- 0.04
Cl-K	0.0004	1.348	0.47	0.05	+/- 0.04
K -K	0.0076	1.174	7.72	0.89	+/- 0.06
Ca-K	0.0005	1.133	0.49	0.06	+/- 0.05
Ti-K	0.0008	1.176	0.65	0.09	+/- 0.05
Cr-K	0.0000	1.125	0.00	0.00	+/- 0.00
Mn-K	0.0000	1.151	0.00	0.00	+/- 0.00
Fe-K	0.0072	1.124	4.9	0.81	+/- 0.16
Br-L	0.0000	1.244	0.00	0.00	+/- 0.00
Ba-L	0.0000	1.352	0.0	0.00	+/- 0.00
Pb-M	0.0000	1.635	0.00	0.00	+/- 0.00
Ni-K	0.0001	1.106	0.03	0.01	+/- 0.09
As-L	0.0000	1.346	0.00	0.00	+/- 0.00
Sn-L	0.0017	1.320	0.64	0.22	+/- 0.17
Sb-L	0.0005	1.315	0.19	0.07	+/- 0.11
Sr-L	0.0000	1.440	0.00	0.00	+/- 0.00
Zn-L	0.0000	1.539	0.00	0.00	+/- 0.00
Cu-K	0.0004	1.162	0.27	0.05	+/- 0.13
Total			100.00	9.08	

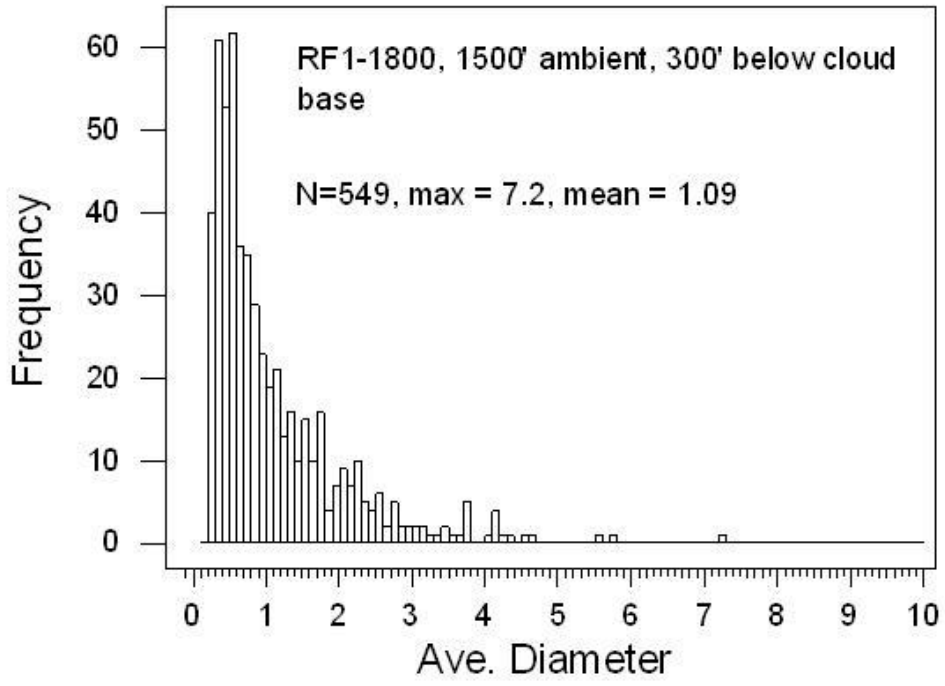
Correction of X-ray data from irregular particles poses some problems. Aggregation makes the problems worse. However, when dealing with analyses from large populations subjected to cluster analysis, the problems tend to cancel out.

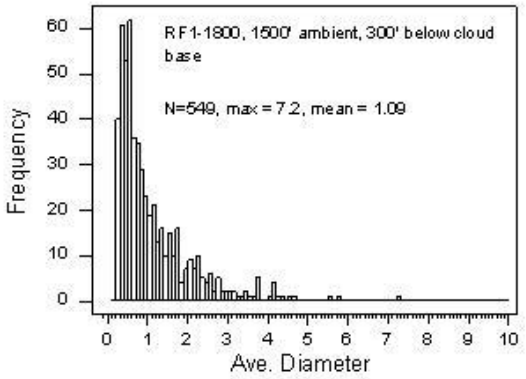
Some separation of sea salt components is observed – some occurred in atmosphere, but also occasionally on filters as an artifact.

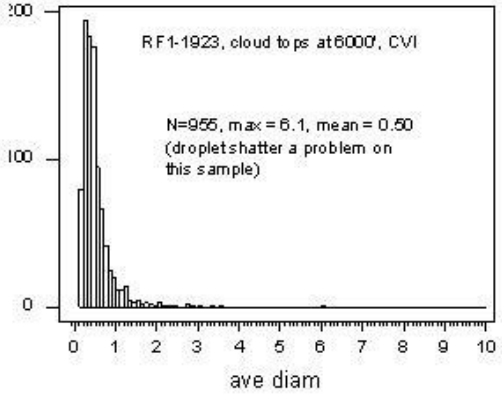


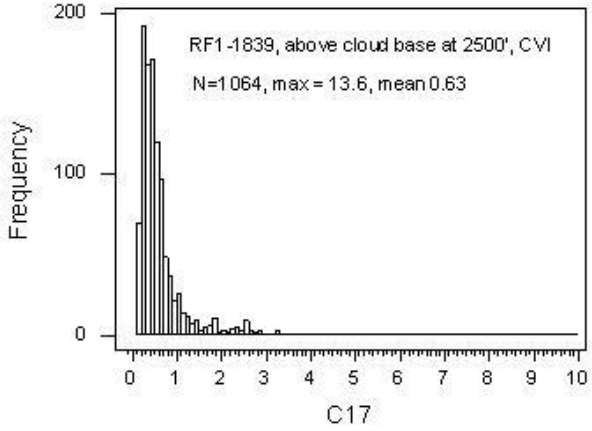


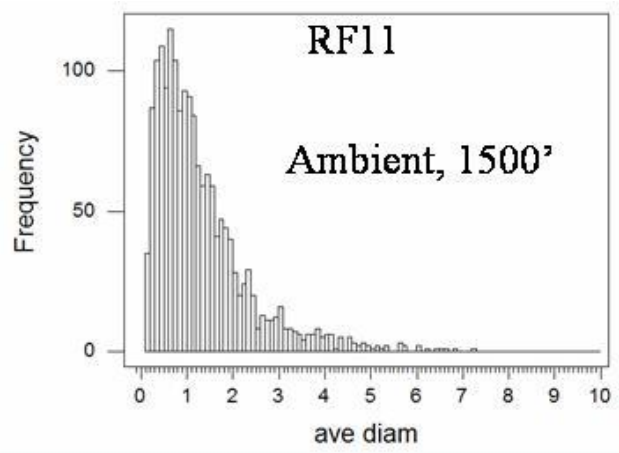

10.0kV 12.5mm x5.00k SE(U) 12/29/04 12:23
10.0um

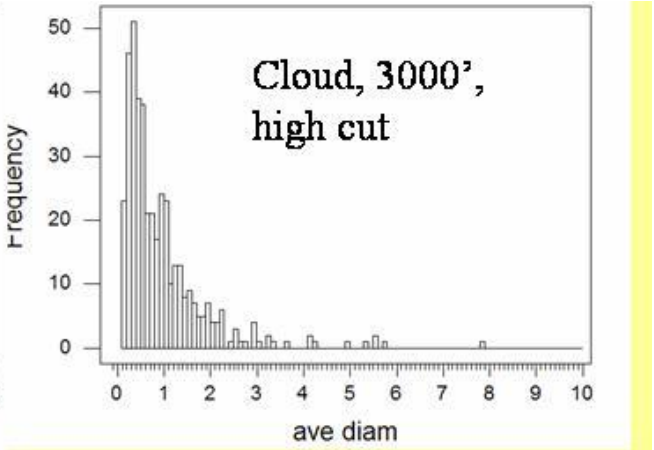

RF1-1800, 1500' ambient, 300' below cloud base
N=549, max = 7.2, mean = 1.09
Frequency
60
50
40
30
20
10
0
0
1
2
3
4
5
6
7
8
9
10
Ave. Diameter

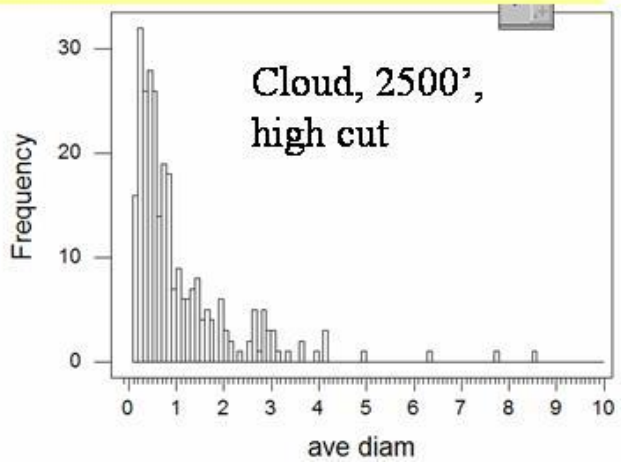

RF1-1800, 1500' ambient, 300' below cloud base
N=549, max = 7.2, mean = 1.09
Frequency
Ave. Diameter

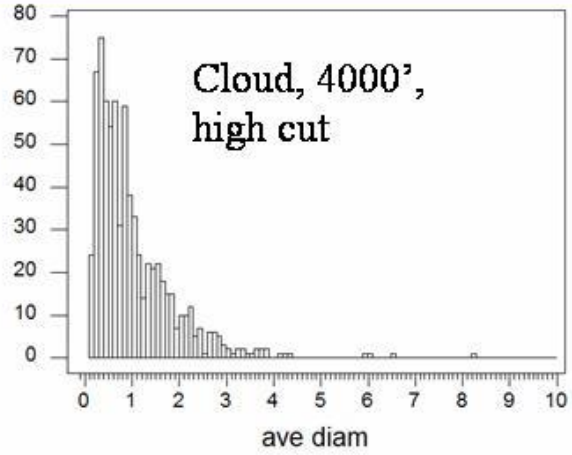

RF1-1923, cloud tops at 6000', CVI
N=955, max = 6.1, mean = 0.50
(droplet shatter a problem on this sample)
ave diam


RF1-1839, above cloud base at 2500', CVI
N=1064, max = 13.6, mean 0.63
Frequency
C17


RF11
Ambient, 1500'
Frequency
ave diam


Cloud, 3000',
high cut
ave diam

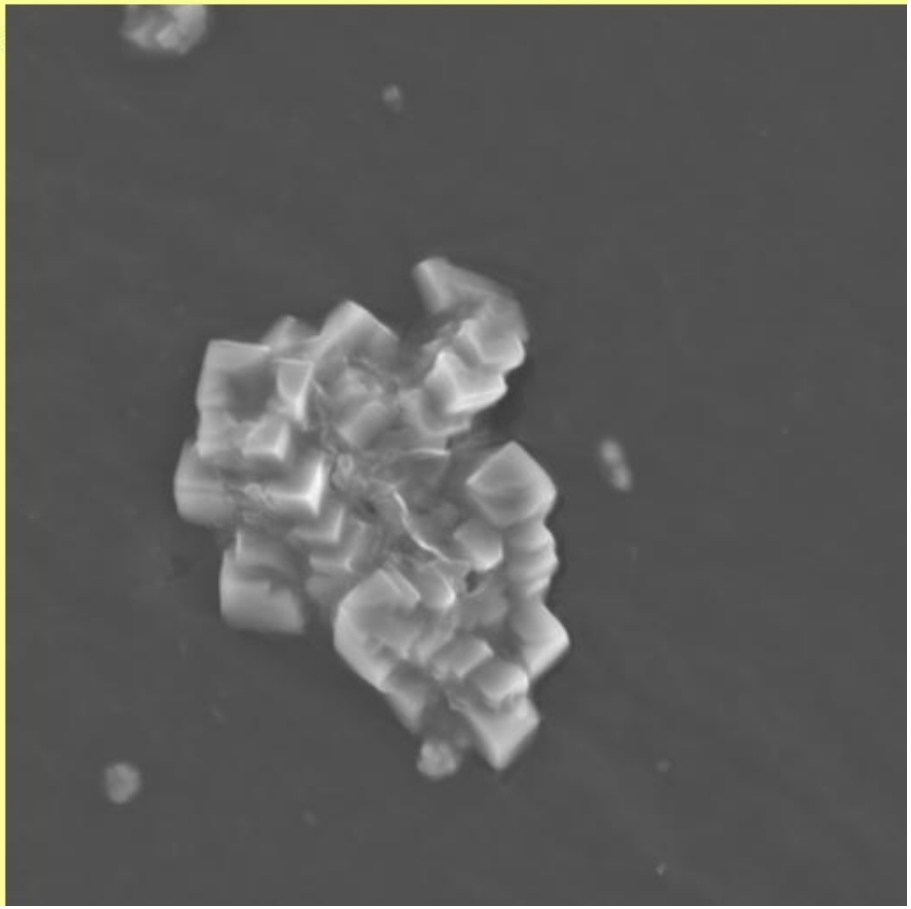

Cloud, 2500',
high cut
Frequency
ave diam


Cloud, 4000',
high cut
ave diam

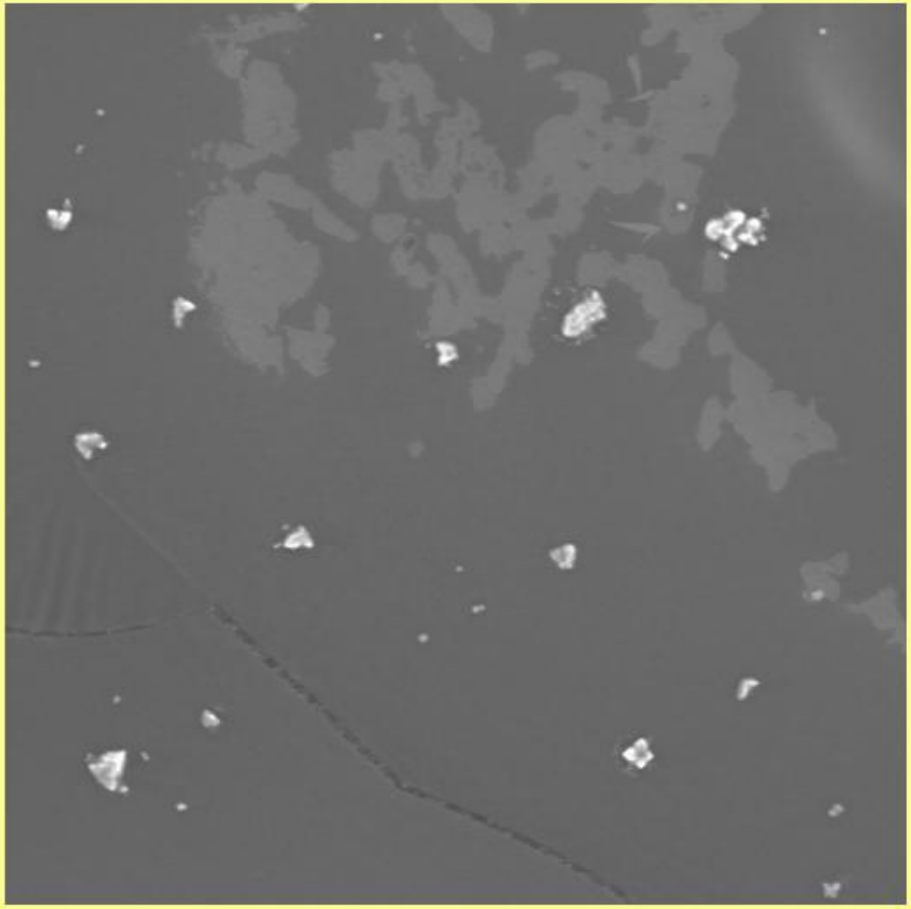
Preliminary observations from automated SEM results:

a) Largely unaltered sea salt, cleaner than even ACE-1
b) Main pollutant is Al oxide or hydroxide (likely candidate is bauxite mining or processing). (Possible associated Ca)
c) Biogenic fragments are common from 10's of nm to largest sizes
d) Any processing involving sulfate is very subtle in the samples analyzed to date.
e) Very little silicate dust in samples analyzed to date (less than 200 out of over 26,000 particles).

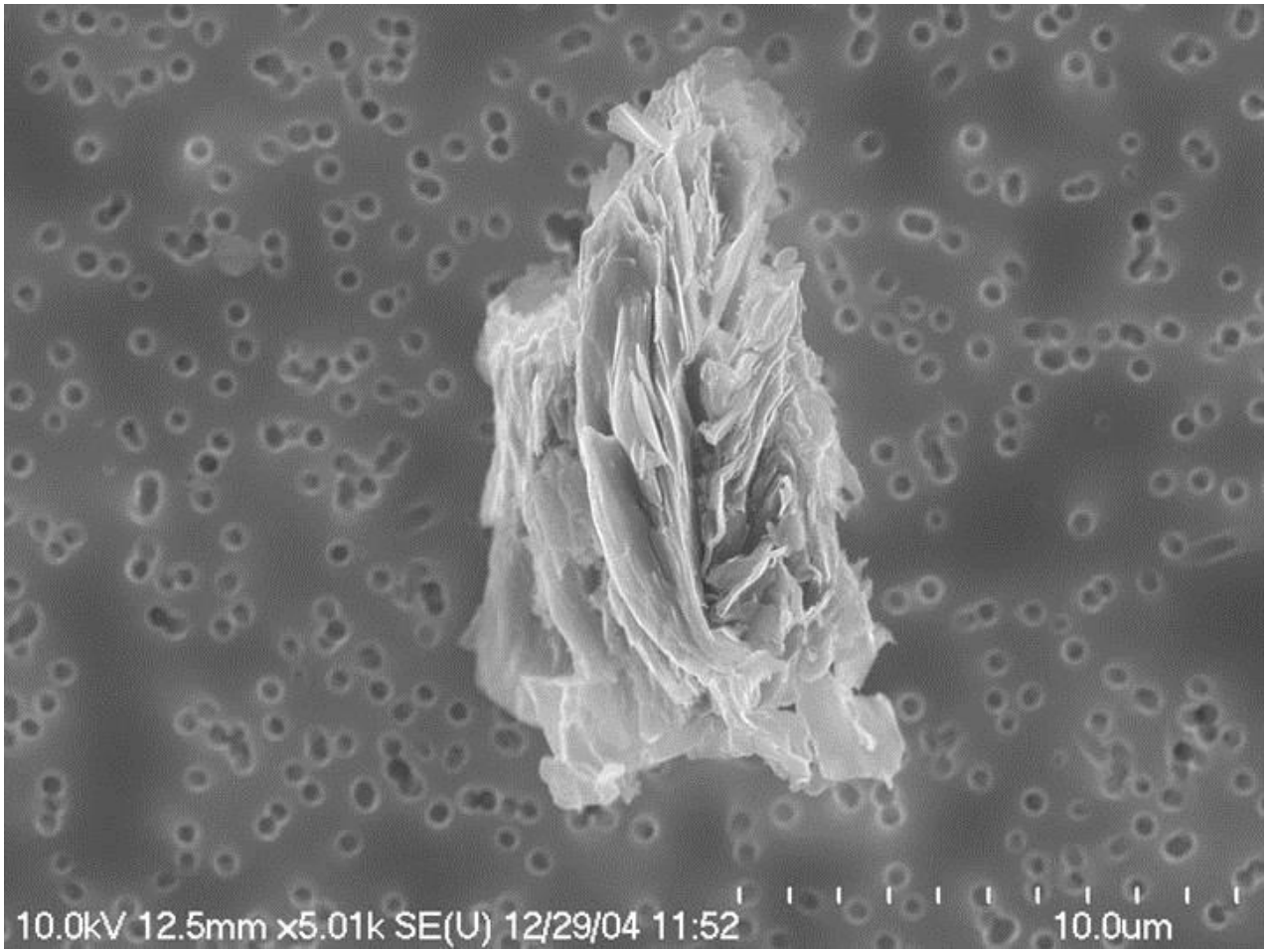
Giant nucleii slides

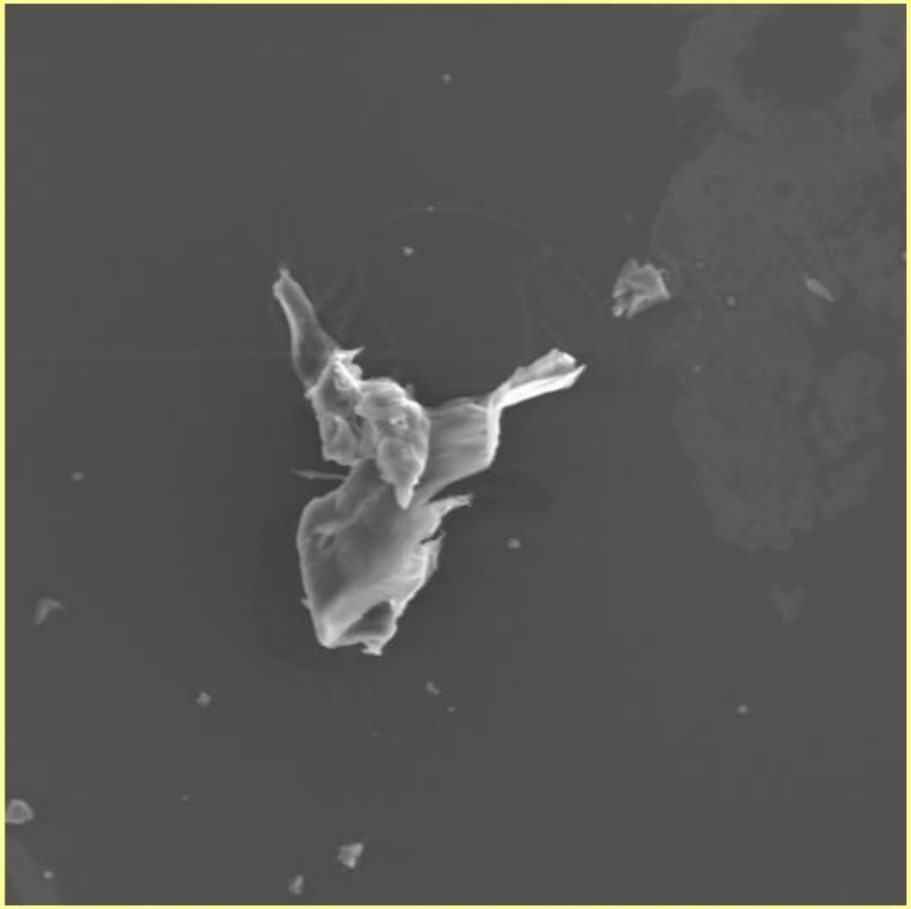


56 microns
width of field



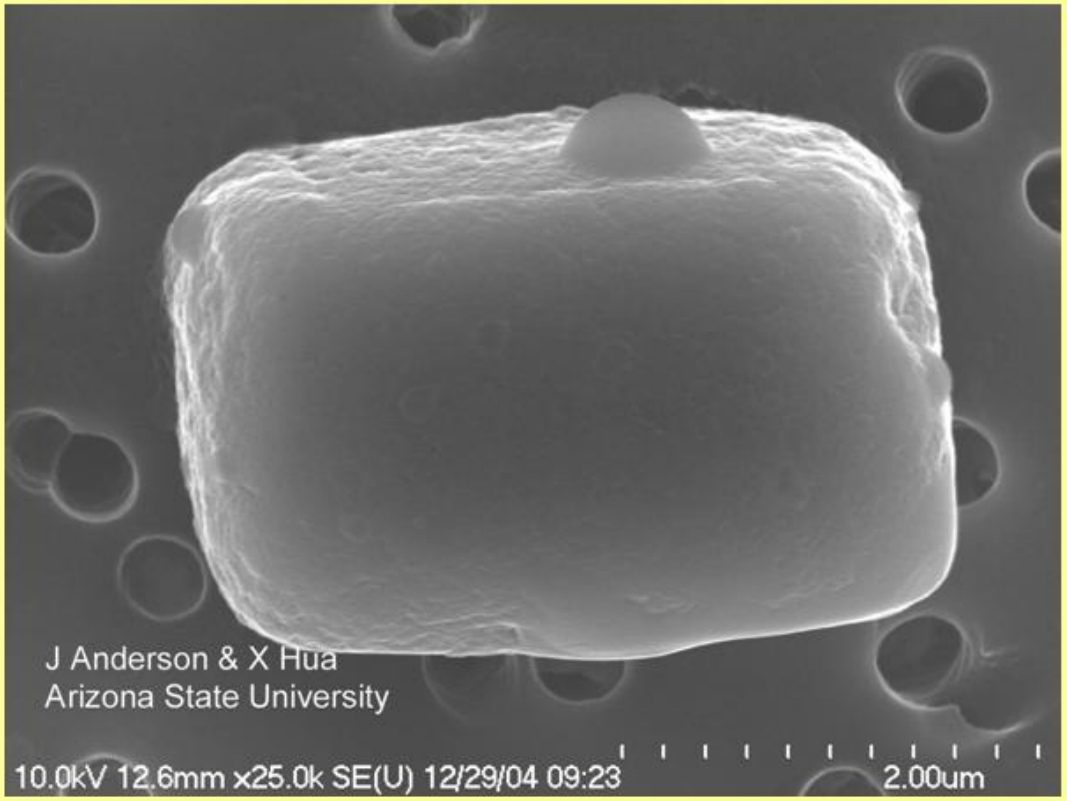
225 microns
width of field

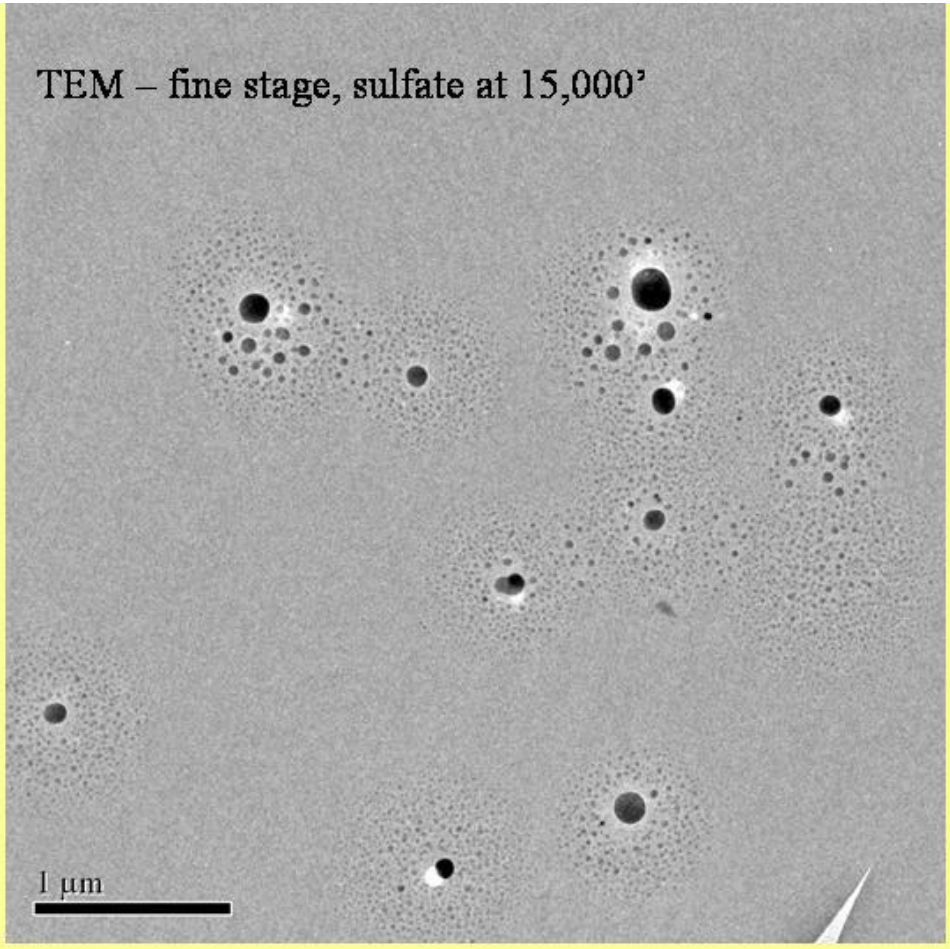

10.0kV 12.5mm x5.01k SE(U) 12/29/04 11:52
10.0um

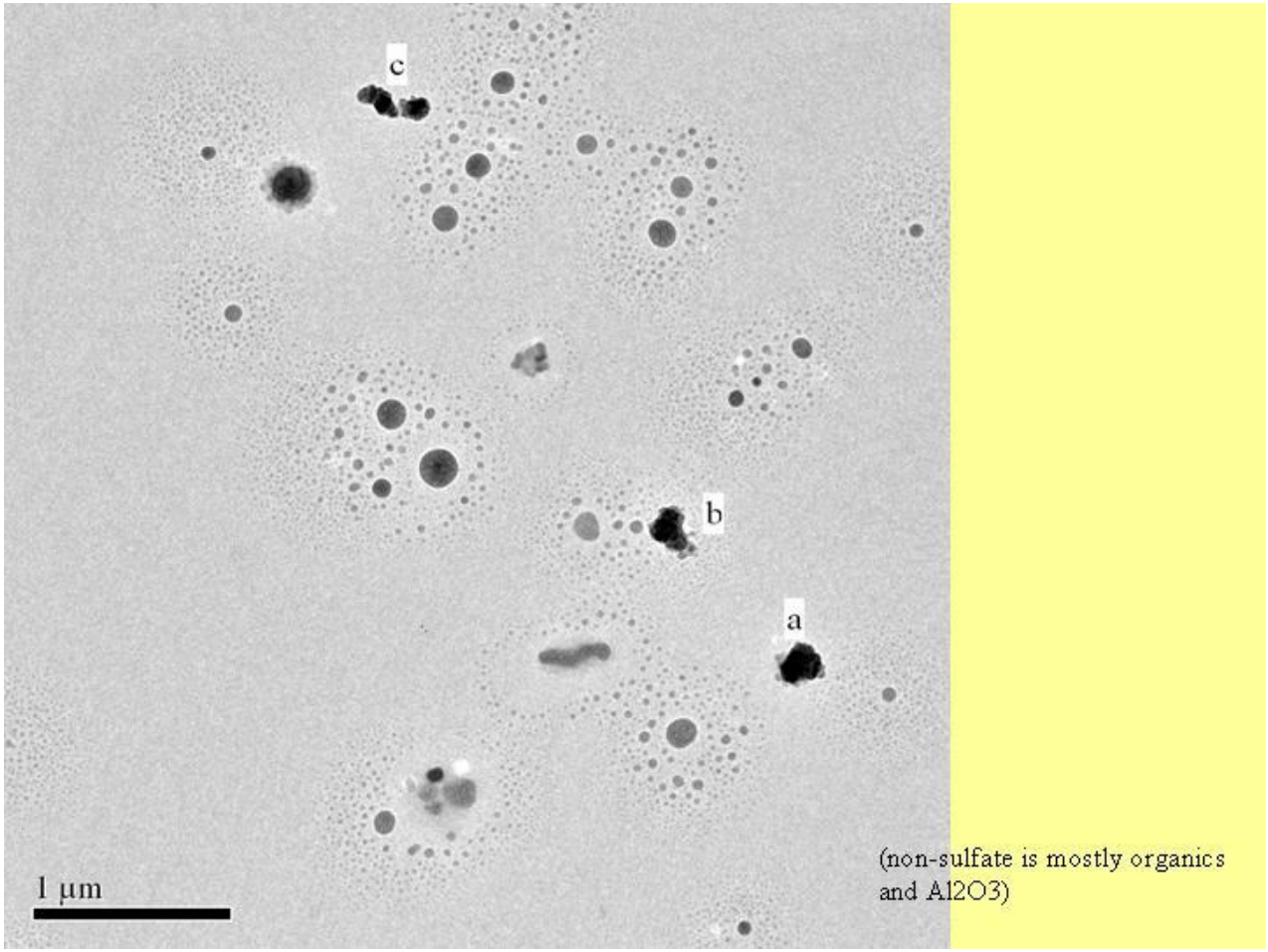


225 micron
width of field

Possible evidence of organic films on some sea salt particles




TEM – fine stage, sulfate at 15,000'
1 µm


c
b
a
1 µm
(non-sulfate is mostly organics
and Al2O3)

… more to come.