LA-ICPMS SC BAM

Single-Collector Burst-wise Analysis Method

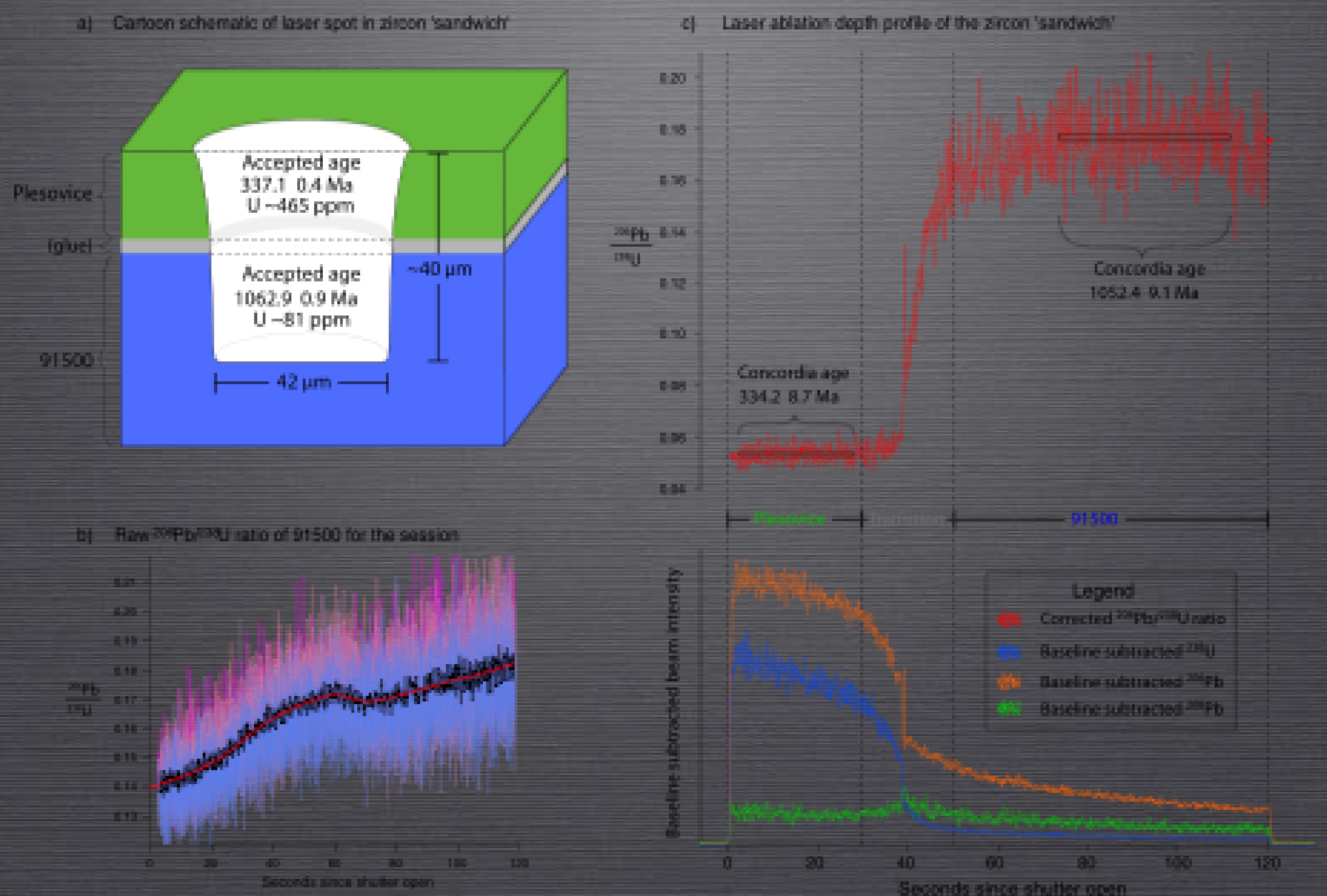
University of California-Santa Cruz
Earth and Planetary Sciences

Alexander Steely
Jeremy Hourigan

Motivation

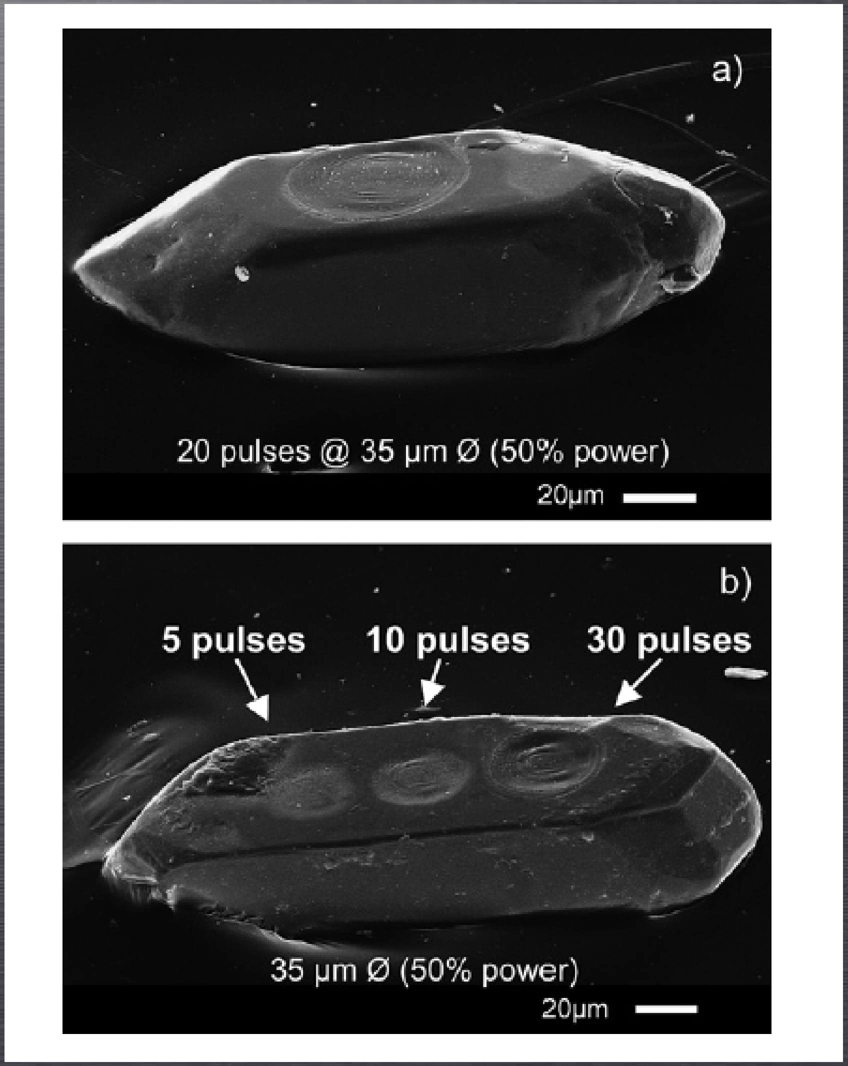
- Many users of LA systems-not just U/Pb
- U/Pb world
    - Thin overgrowths
    - Chemical zonation
        - Ages
        - Trace elements
- Thermochronology
    - Depth-resolved concentration
- Igneous Petrology
    - Diffusion profiles of olivene, cpx, opx, etc
- Paleoclimate studies
    - Micro-stratigraphy of calcareous forams
- Lots of information in the depth-resolved analysis of grains

Convolution



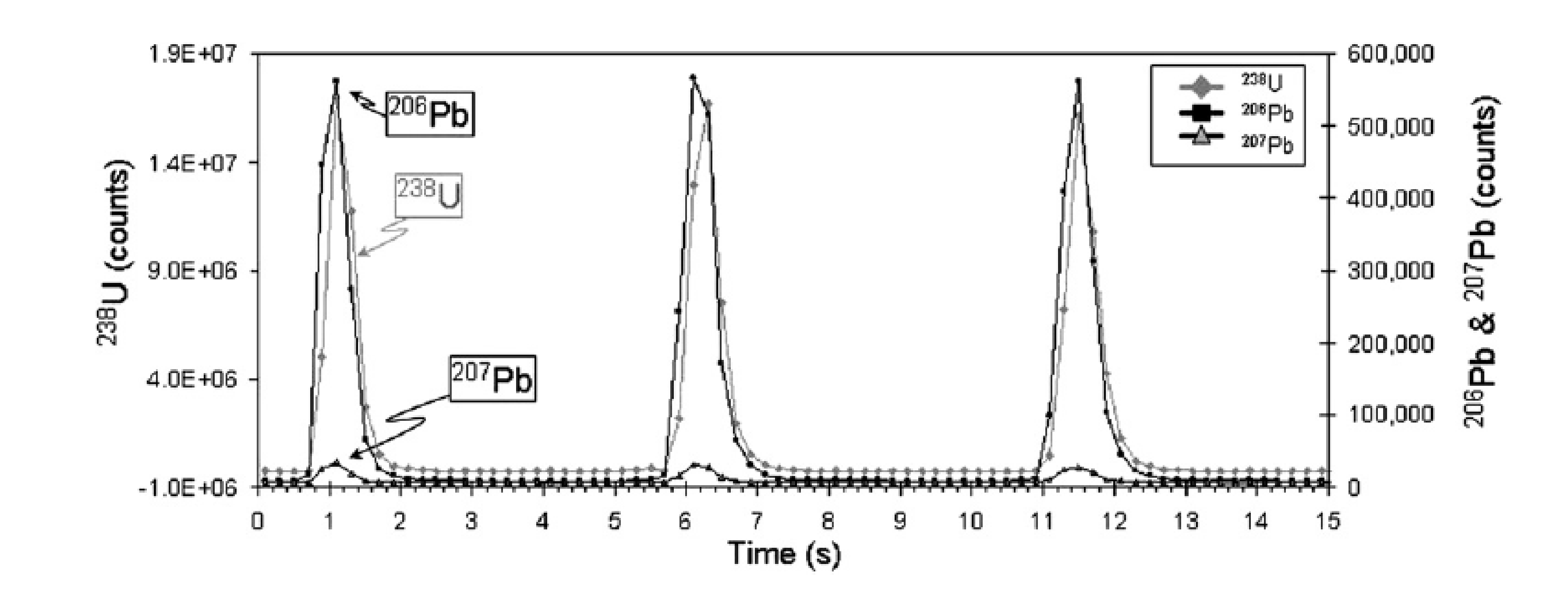
Patton, 2010

Pulse by Pulse Geochronology

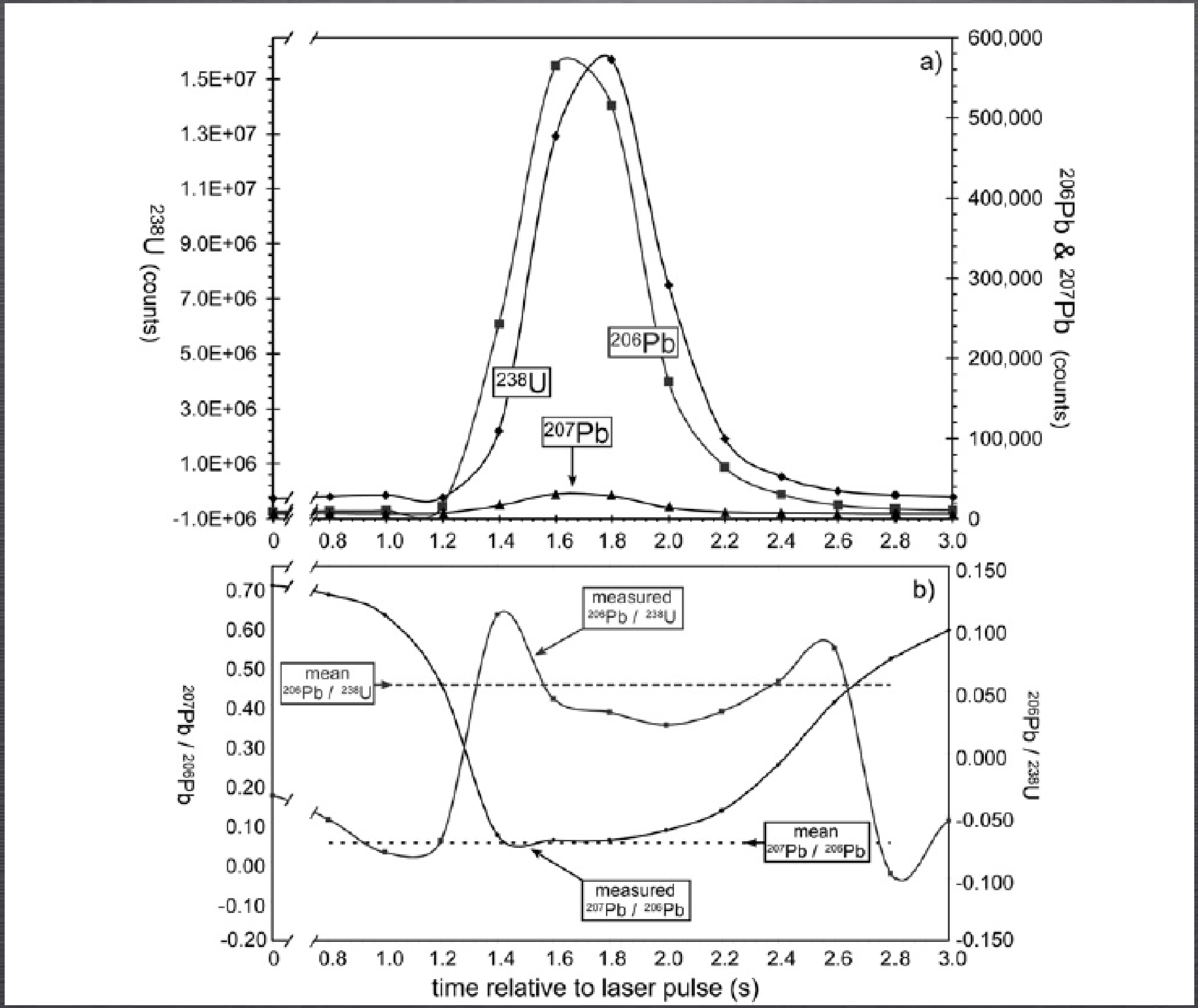


- Cottle et al., 2009

Pulse-wise Geochronology



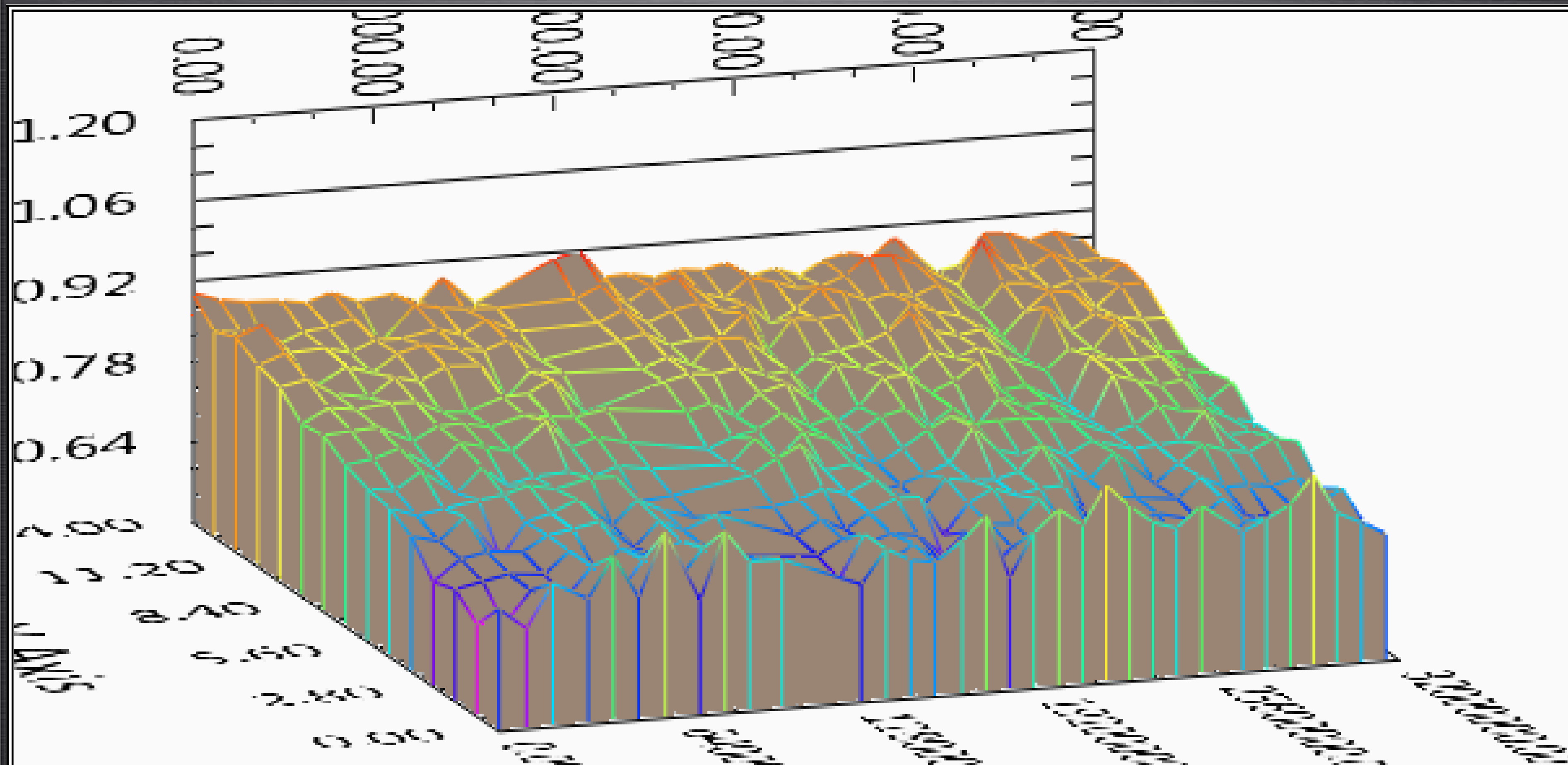
Aliasing



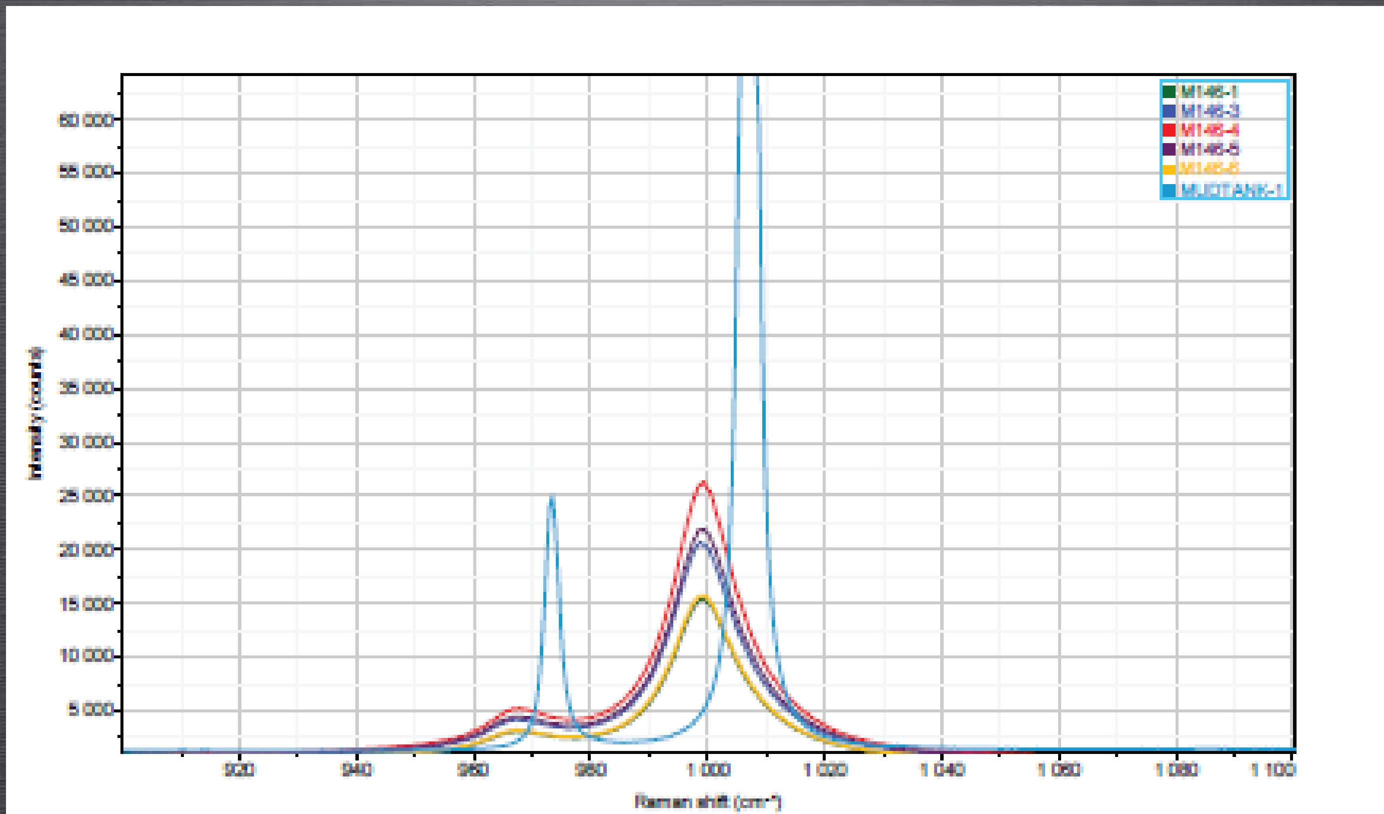
a)
b)
238U
206Pb
207Pb
238U (counts)
206Pb & 207Pb (counts)
measured 206Pb / 238U
mean 206Pb / 238U
mean 207Pb / 206Pb
measured 207Pb / 206Pb
207Pb / 206Pb
206Pb / 238U
time relative to laser pulse (s)

Our Method

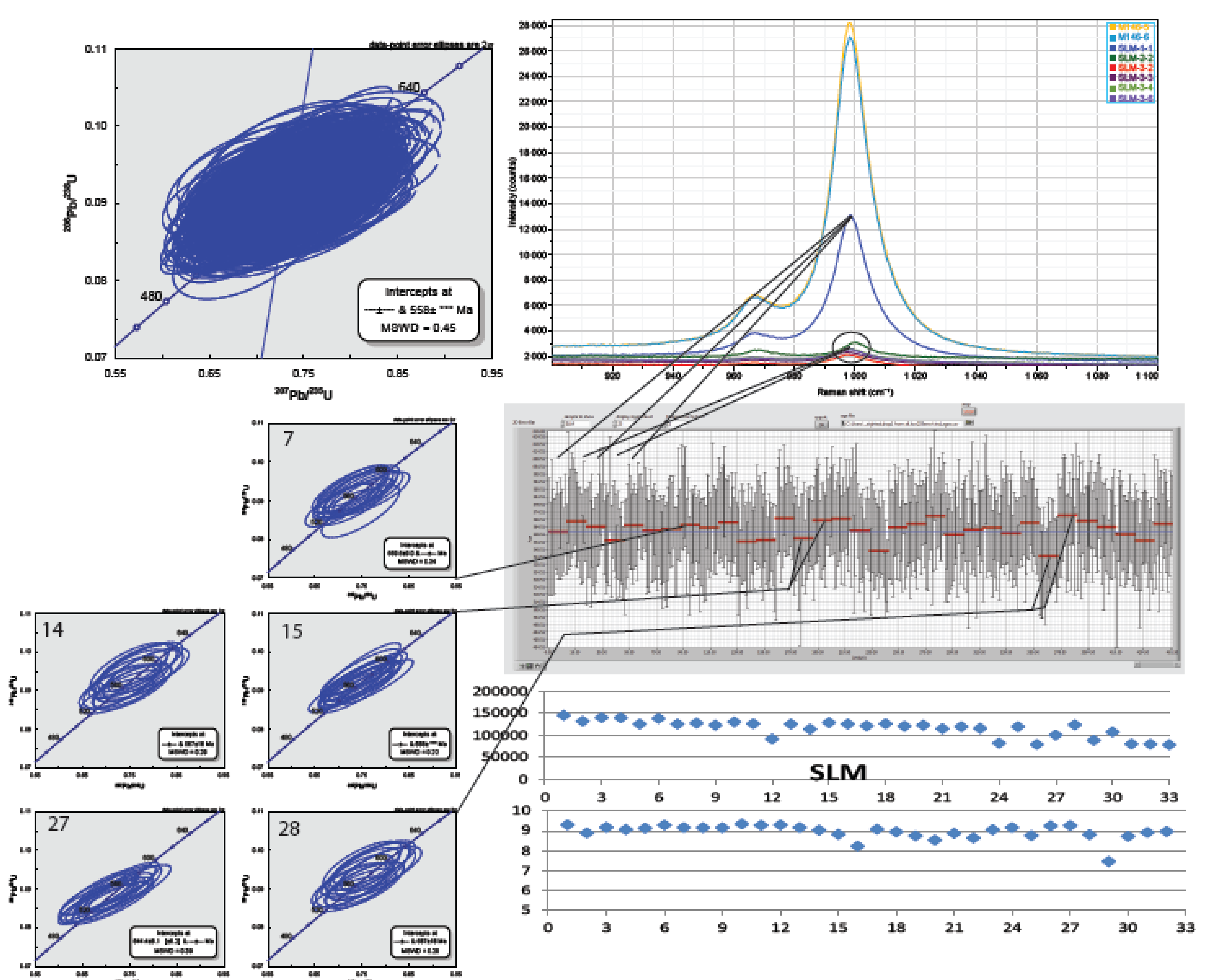
- Not tied to a particular data style
- Not tied to a particular analysis style
- Flexibility is a key component of inspiring innovation
- Bursts of 5 pulses, 5 sec washout, 15 cycles
- Integrate signal area under the peak
- Round Robin analysis, std every 5 unknowns
- Single cycle ~0.5um depth, 35um spot
  - 4-6%2s uncertainty, counting stats


1.20
1.06
8.40
5.60

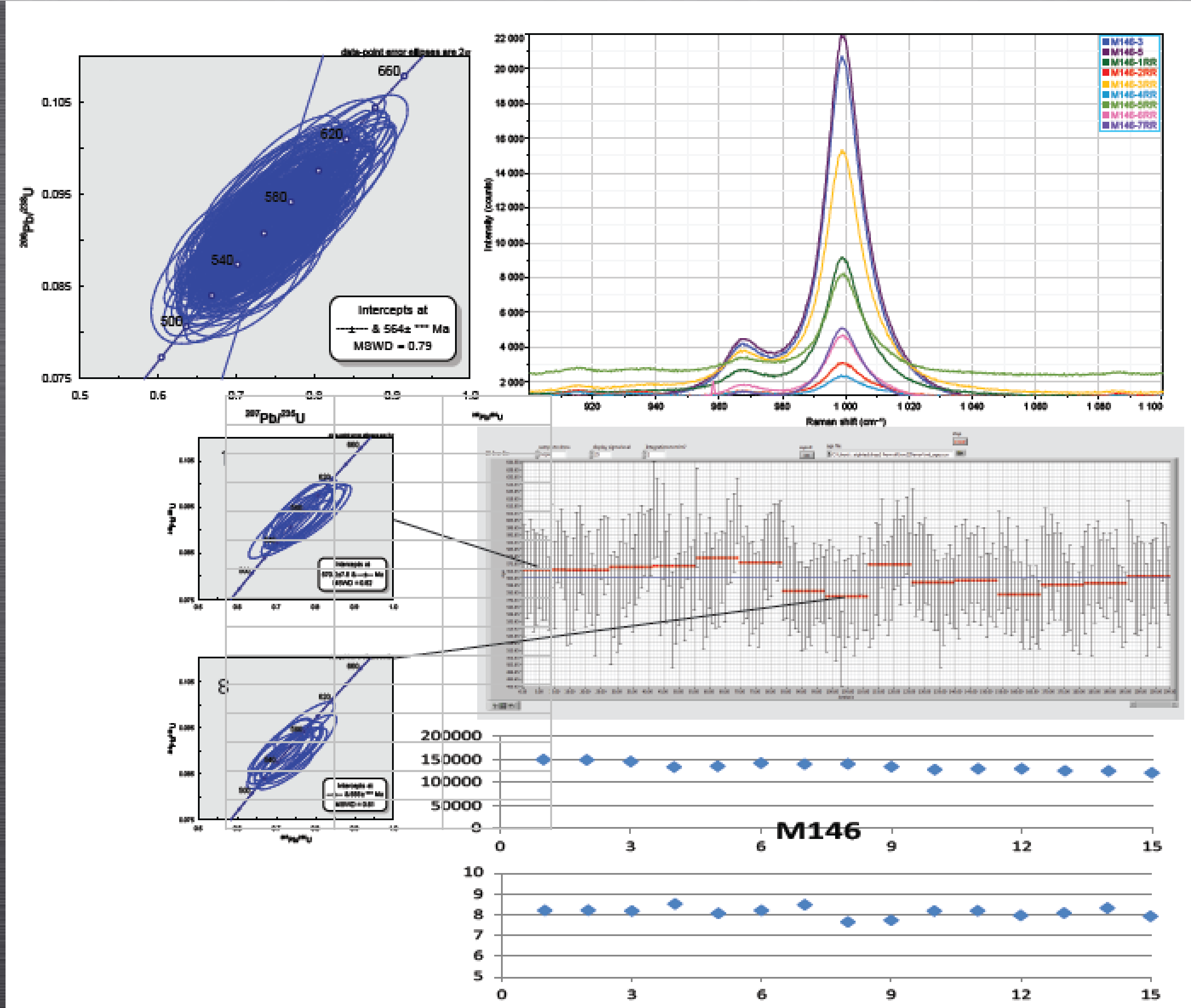
Raman spectroscopy-radiation damage



	SLM-_S_w.mean	SLM-_S_w.se. %1s	SLM-_S_mswd
Sample1	561.24	0.41	0.36
Sample2	568.28	0.53	0.60
Sample3	564.52	0.64	0.86
Sample4	555.39	0.63	0.84
Sample5	565.47	0.43	0.40
Sample6	561.95	0.53	0.59
Sample7	563.26	0.63	0.85
Sample8	565.75	0.61	0.78
Sample9	563.76	0.60	0.77
Sample10	567.36	0.44	0.41
Sample11	554.73	0.51	0.57
Sample12	555.63	0.54	0.63
Sample13	570.20	0.52	0.58
Sample14	556.83	0.59	0.74
Sample15	568.97	0.45	0.43
Sample16	569.88	0.48	0.50
Sample17	561.93	0.69	1.02
Sample18	548.40	0.66	0.92
Sample19	564.06	0.53	0.60
Sample20	566.60	0.40	0.34
Sample21	571.90	0.67	0.97
Sample22	559.32	0.53	0.60
Sample23	562.78	0.70	1.05
Sample24	563.93	0.70	1.03
Sample25	560.17	0.49	0.51
Sample26	567.20	0.42	0.38
Sample27	545.08	0.42	0.36
Sample28	571.95	0.72	1.12
Sample29	568.35	0.46	0.44
Sample30	564.41	0.61	0.82
Sample31	559.55	0.48	0.49
Sample32	555.31	0.49	0.51
Sample33	566.43	0.55	0.62

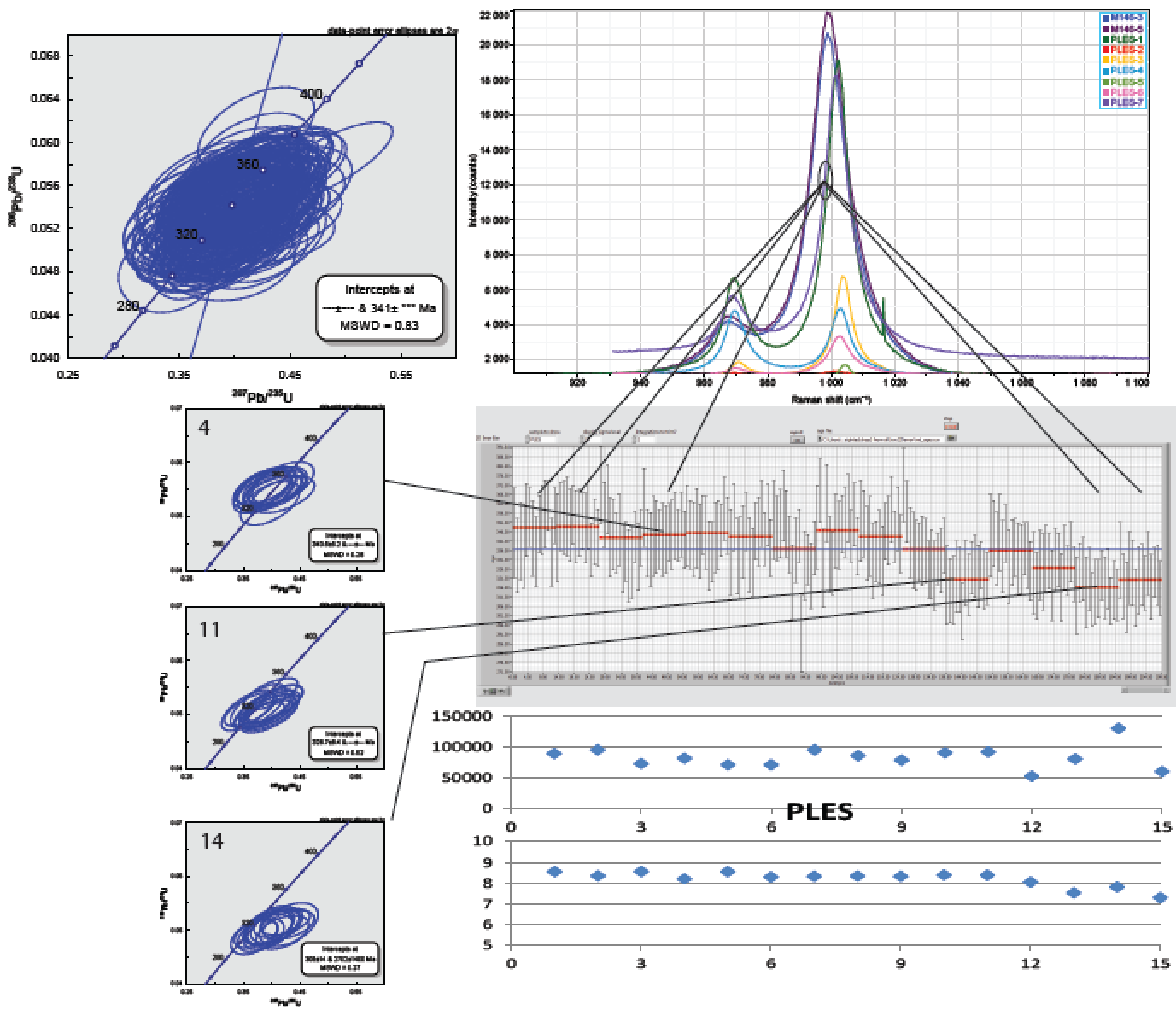


	M146-_S_w.mean	M146-_S_w.se.%1s	M146-_S_mswd
Sample1	569.40	0.51	0.54
Sample2	569.00	0.68	0.98
Sample3	571.06	0.75	1.21
Sample4	571.92	1.05	2.35
Sample5	577.55	0.91	1.79
Sample6	574.30	0.79	1.35
Sample7	554.64	0.37	0.30
Sample8	550.89	0.73	1.13
Sample9	573.13	0.64	0.88
Sample10	560.55	0.64	0.88
Sample11	561.83	0.39	0.34
Sample12	552.27	0.63	0.87
Sample13	558.90	0.72	1.11
Sample14	559.91	0.58	0.75
Sample15	564.58	0.58	0.74



	M146-_I_w.mean	M146-_I_w.se.%1s	M146-_I_mswd
Integ_0	596.58	1.96	0.48
Integ_1	555.78	1.11	1.58
Integ_2	559.92	1.10	2.42
Integ_3	569.45	0.94	1.51
Integ_4	561.61	1.02	1.50
Integ_5	561.04	0.71	0.90
Integ_6	566.36	0.87	2.07
Integ_7	570.02	1.04	1.91
Integ_8	570.80	0.75	1.18
Integ_9	567.66	0.59	0.99
Integ_10	566.52	0.73	1.04
Integ_11	567.09	0.61	0.73
Integ_12	558.38	0.60	1.31
Integ_13	561.93	0.54	0.65
Integ_14	562.03	0.53	0.83

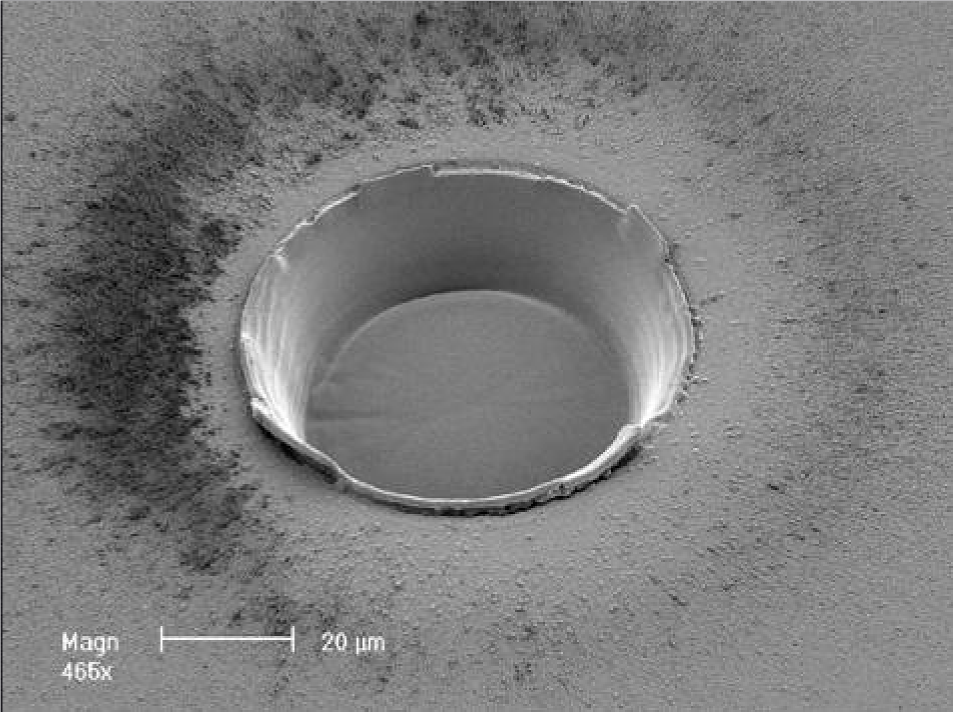
	PLES-_S_w.mean	PLES-_S_uw.%1s	PLES-_S_mswd
Sample1	348.46	0.67	1.03
Sample2	348.96	0.43	0.48
Sample3	343.16	0.99	1.77
Sample4	344.57	0.42	0.30
Sample5	345.51	0.49	0.54
Sample6	343.62	0.71	1.02
Sample7	337.04	1.39	3.31
Sample8	347.05	0.93	1.75
Sample9	343.67	0.65	0.83
Sample10	336.86	1.00	1.93
Sample11	320.70	0.54	0.74
Sample12	336.39	0.53	0.56
Sample13	326.91	0.50	0.50
Sample14	316.44	0.46	0.52
Sample15	320.54	0.52	0.52

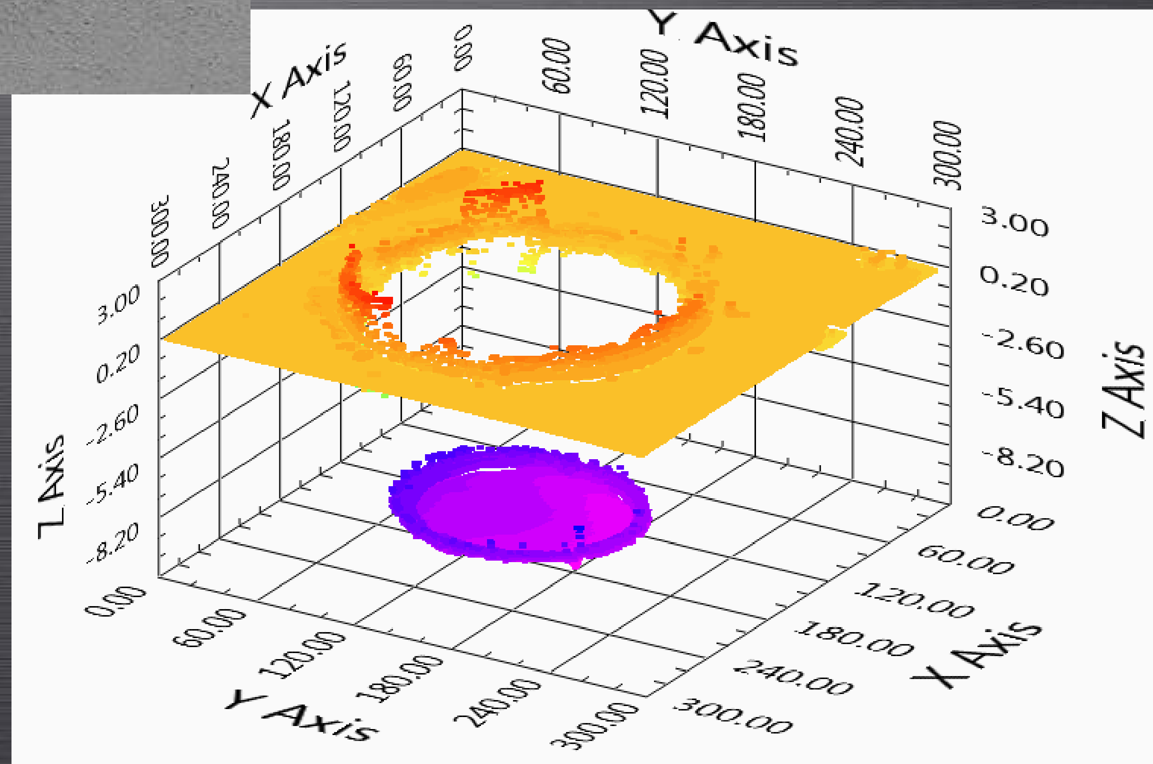


	PLES-_I_w.mean	PLES-_I_w.se.%1s	PLES-_I_mswd
Integ_0	354.12	1.42	0.25
Integ_1	327.92	1.30	2.06
Integ_2	330.00	0.95	1.68
Integ_3	335.39	1.33	2.89
Integ_4	332.19	1.10	1.66
Integ_5	335.85	1.29	2.79
Integ_6	338.01	0.92	2.13
Integ_7	338.98	1.07	1.92
Integ_8	338.80	1.23	3.01
Integ_9	334.51	1.20	3.77
Integ_10	338.96	1.50	4.07
Integ_11	334.36	1.10	2.23
Integ_12	337.11	1.12	4.06
Integ_13	334.04	1.06	2.29
Integ_14	338.66	1.00	2.70

Work in Progress

- Burstwise analysis ~0.5um depth resolution,2-6% ind. cycle error, 1-2% sample error
- Much more work to be done
- Flexibility is crucial component
  - Cope with variations in timing, dynamic range, data formating, etc *implement newest b.w.p
- Using matrix-tracers (Hf, Zr, Si) to understand [U] as a f(x) of depth…


Magn
465x
20 µm


Y Axis
X Axis
Z Axis
0.00
60.00
120.00
180.00
240.00
300.00
3.00
0.20
-2.60
-5.40
-8.20