Bruker Tracer Ceramic/Mudrock Calibration

This it the fine print in the when the calibration works

When and how must you use xrf to analyze ceramics/mud rocks??

The answers are simple and based on fundamental physics, which we have not yet found a way to violate:

1. One can never determine the weight percent of a non-uniform material because it is non-uniform UNLESS you covert it to a uniform material.
2. Nor can one ever use xrf to report content it cannot measure like C and O and H, So note that the content listed in the presentation is only of the elements that are measured. It does not add up to 100 percent.
3. The Tracer spot size is 3 by 4 mm, if you substance has a mixture of particles smaller than 0.2 mm and they are well mixed then you will get a reasonable answer relative to wt %
4. Mud rock is mother nature's fine grain ceramic(both in content variation and density) and Dr Harry Rowe at the UT Bureau of Economic Geology selected those that cover the entire range of elements found in natural ceramic materials.
5. If you material is a conglomerate then it is ***not*** uniform and the only way to get a reasonable estimate of its average elemental content is to take a large quantity of it grind it up and then press it into a pellet, there is no other method that will work.
6. How did Bruce check / corrected for any matrix effect due to material containing heterogeneous particles with size larger than mud (silt/clay)? Actually you have to do this by grinding your material up and pressing it to pellets. See item 5 ☺
7. So what has Bruker provided: a calibration that is very accurate on uniform fine grain ceramics without preparation and non-uniform ceramics ground and pressed in to pellets.
8. Note ceramics with paint, slip, and glaze or any covering like dirt on them are VERY non uniform!
9. Also look carefully at the "scans of the 4 test specimens, the specimens were not uniform along the path, despite the fact that they "looked" very uniform
10. Note your sample also has to be infinitely thick see table on next page, you sample must be thicker than the values list for each element noted

Element	Photon Emitted energy (keV)	Analysis depth in Ceramic(cm)
O	0.53	0.000001
Na	1.04	0.0007
Mg	1.2	0.00096
Al	1.47	0.0017
Si	1.74	0.0027
P	2.01	0.0013
Ca	3.69	0.0064
Cr	5.41	0.0192
Fe	6.4	0.03
Cu	8.01	0.058
Zn	8.64	0.077
Pb	10.55	0.113
Zr	15.78	0.384

A Tracer IV SD system was calibrated using mud rock press powder references developed by Dr Harry Rowe at the University of Texas at the Bureau of Economic Geology for the State of Texas. The system was calibrated by measuring 23 of these references and then inputting that data in the Bruker S1CALPROCESS.

Two sets of data were taken on the references. One for the Major constituents using settings of 15 kV, 55 micro amps and the vacuum. The Traces elements were analyzed using 40 kV 14 micro amps and the 0.001” TI/ .012” Al beam filter and no vacuum.

4 samples unknown were then scanned across one face each of the samples as indicated in the pictures below for 20 seconds at each location, taking 3 mm steps between each analysis. The resulting data was then processes through the Major and Trace calibration respectively and all the results are listed the charts below

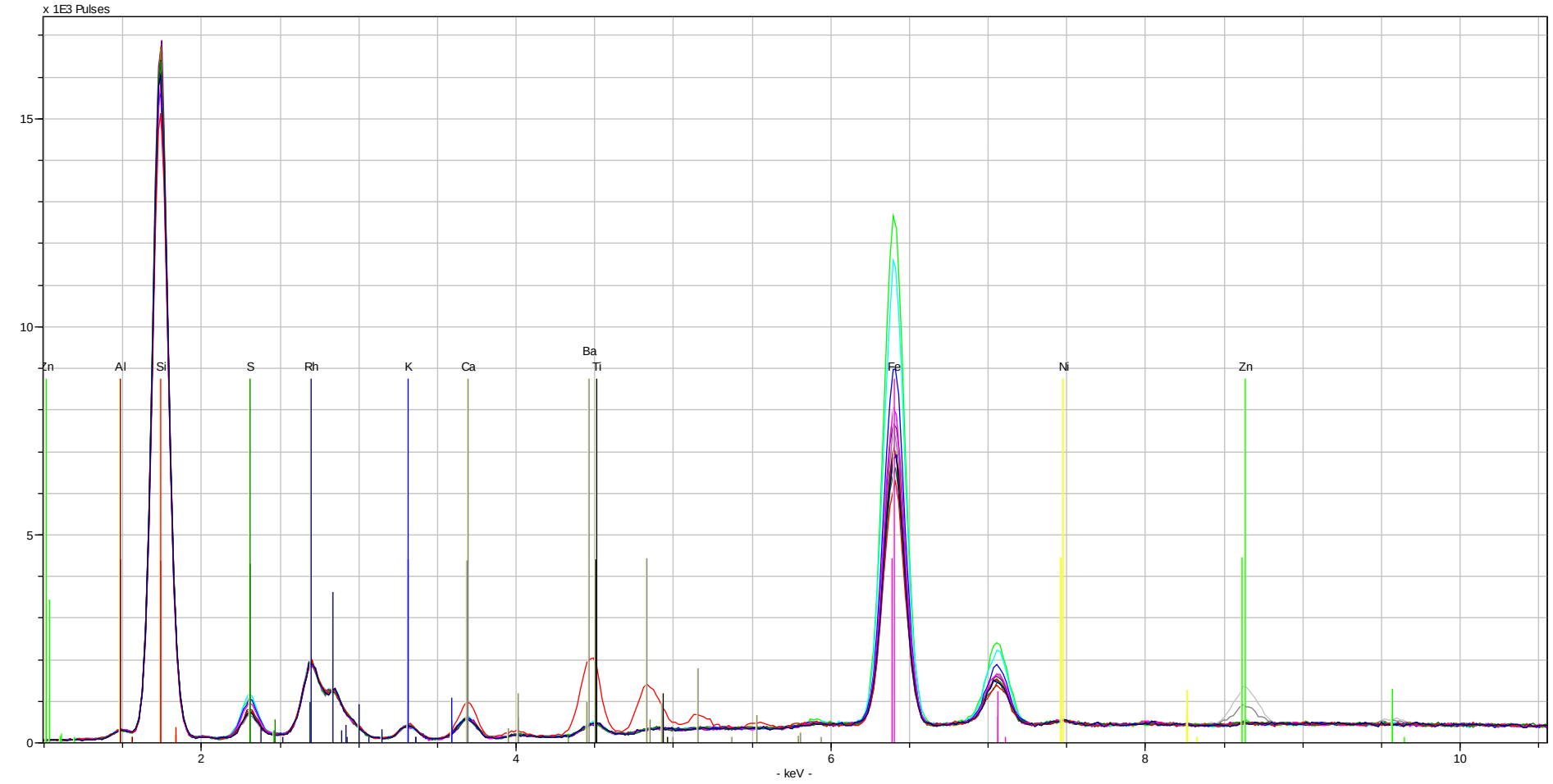
University of Texas Reference standards used for calibration

Sample	MgKa 1	AlKa1	SiKa1	P Ka1	S Ka1	K Ka1	CaKa1	BaLa1	TiKa1	V Ka1	CrKa1	MnKa 1	FeKa1	NiKa1	CuKa 1	ZnKa1	ThLa1	RbKa 1	U La1	SrKa1	Y Ka1	ZrKa1	NbKa 1	MoKa 1
BL-1-122A	0.712	5.504	26.320	0.982	1.737	1.419	6.397	0.026	0.300	0.017	0.027	0.015	2.133	0.012	0.004	0.029	0.001	0.008	0.001	0.051	0.006	0.009	0.001	0.001
BL-1-19A	2.268	3.096	14.633	0.100	0.936	0.764	18.797	0.011	0.168	0.006	0.010	0.015	1.574	0.008	0.003	0.013	0.001	0.005	0.000	0.052	0.002	0.005	0.001	0.000
BL-1-32A	0.929	1.201	6.218	0.070	0.251	0.274	31.161	0.017	0.066	0.002	0.004	0.008	0.643	0.004	0.001	0.006	0.000	0.002	0.000	0.087	0.001	0.003	0.000	
BL-1-5A	0.609	4.144	29.686	0.759	1.388	1.021	5.082	0.012	0.222	0.014	0.030	0.008	1.707	0.017	0.008	0.039	0.001	0.006	0.001	0.035	0.005	0.007	0.001	0.001
BL-1-61A	0.736	8.044	25.385	0.118	1.897	1.768	4.445	0.018	0.408	0.015	0.024	0.015	2.553	0.009	0.003	0.019	0.001	0.012	0.000	0.044	0.004	0.012	0.001	0.001
BL-1-67A	2.491	3.038	11.828	0.175	0.511	0.589	21.084	0.006	0.150	0.007	0.013	0.031	3.077	0.006	0.002	0.009	0.000	0.004	0.000	0.066	0.003	0.005	0.001	0.000
D4R-118	1.080	10.775	27.914	0.170	0.720	4.325	0.500	0.055	0.504	0.015	0.008	0.023	3.651	0.003	0.002	0.008	0.001	0.022	0.001	0.015	0.003	0.015	0.002	0.000
D4R-83	0.856	9.367	26.769	0.026	2.250	3.744	0.300	0.050	0.492	0.019	0.008	0.015	4.413	0.009	0.004	0.008	0.001	0.019	0.002	0.012	0.003	0.016	0.002	0.005
LEP12	0.507	5.874	19.587	0.057	2.507	1.594	12.507	0.026	0.276	0.025	0.006	0.023	2.357	0.005	0.005	0.009	0.001	0.008	0.000	0.049	0.001	0.009	0.001	0.001
LEP49	0.241	1.074	3.749	0.039	0.330	0.141	34.663	0.003	0.048	0.005	0.001	0.023	0.427	0.001	0.001	0.002	0.000	0.001	0.000	0.045	0.001	0.005	0.000	0.001
LEP81	0.265	2.980	10.518	0.118	1.680	0.747	24.728	0.009	0.144	0.017	0.008	0.008	1.399	0.005	0.004	0.008	0.000	0.004	0.001	0.054	0.001	0.006	0.001	0.005
LEP83	0.314	3.826	12.248	0.083	2.026	0.930	22.799	0.011	0.180	0.012	0.010	0.015	1.770	0.006	0.005	0.009	0.001	0.005	0.001	0.057	0.002	0.007	0.001	0.004
RTCW021	0.482	3.022	36.836	0.039	1.613	1.204	0.150	0.227	0.150	0.172	0.014	0.015	1.567	0.020	0.006	0.050	0.000	0.007	0.005	0.006	0.002	0.005	0.001	0.017
RTCW050	0.308	2.069	37.771	0.022	1.170	0.739	0.079	0.094	0.108	0.018	0.006	0.054	1.021	0.013	0.004	0.019	0.000	0.004	0.004	0.005	0.002	0.004	0.000	0.007
RTCW099	2.237	5.065	24.635	0.022	5.320	2.300	2.752	0.127	0.276	0.016	0.007	0.031	4.924	0.017	0.004	0.016	0.001	0.011	0.004	0.010	0.003	0.010	0.001	0.011
RTCW160	1.025	1.439	38.192	0.009	1.493	0.573	0.529	0.253	0.072	0.005	0.005	0.023	1.315	0.009	0.003	0.002	0.000	0.003	0.001	0.004	0.001	0.003	0.000	0.007
RTCW205	5.373	0.910	22.953	0.009	0.468	0.332	8.576		0.048	0.019	0.003	0.046	0.629	0.005	0.001	0.007	0.000	0.002	0.001	0.037	0.001	0.002	0.000	0.002
RTCW260	10.252	1.000	5.890	0.013	0.459	0.299	18.082	0.294	0.048	0.008	0.002	0.039	0.609	0.002	0.001	0.002	0.000	0.002	0.000	0.048	0.001	0.002	0.000	0.001
RTCW265	0.724	3.075	34.873	0.441	1.563	1.544	1.794	0.095	0.174	0.065	0.019		1.224	0.030	0.043	0.084	0.000	0.008	0.002	0.005	0.004	0.008	0.001	0.007
SARM-41	4.885	7.144	26.493	0.022	0.150	1.154	1.072	0.082	0.330	0.014	0.012	0.046	2.958	0.012	0.005	0.008	0.001	0.006	0.000	0.005	0.002	0.015	0.001	0.001
SDO-1	0.929	6.493	23.038	0.048	5.350	2.781	0.750	0.040	0.426	0.016	0.007	0.033	6.532	0.010	0.006	0.006	0.001	0.013	0.005	0.008	0.004	0.017	0.001	0.013
W16	1.085	0.995	8.788	0.057	0.320	0.216	27.731	0.905	0.048	0.002	0.004	0.077	1.658	0.004	0.001	0.005	0.000	0.002	0.000	0.052	0.002	0.002	0.000	
W17	0.923	13.073	22.484	0.083	0.020	2.100	0.608	0.047	0.534	0.019	0.011	0.124	4.987	0.007	0.003	0.013	0.001	0.012	0.000	0.021	0.003	0.012	0.001	
W25	1.242	9.050	27.439	0.057	0.230	2.881	0.572	0.045	0.432	0.016	0.009	0.046	3.756	0.009	0.004	0.016	0.001	0.015	0.000	0.019	0.002	0.012	0.001	
W4	0.754	6.087	33.563	0.031	0.190	2.250	1.086	0.043	0.372	0.009	0.008	0.008	2.525	0.004	0.002	0.011	0.001	0.011	0.000	0.013	0.003	0.034	0.001	
W8	1.875	2.551	16.688	0.057	0.450	0.714	17.367	0.042	0.132	0.004	0.006	0.039	2.658	0.006	0.002	0.008	0.000	0.004	0.000	0.043	0.002	0.004	0.000	0.000

It shows the values in % for the majors and traces.

Note all values are in weight % for the majors and traces.

A8711 68: The Raw photon spectra of this sample shows it is primarily Si with traces of Fe and S. With significant traces of volcanic ash as can be seen in the traces on the next chart of Rb, Sr, Y, and Zr.
This rock is unique in this set of 4 for the Zn content seen in the Traces. Note the variation of the Zn as a function of position in the Trace slide below.
This sample uniform across its face and is primarily Si.

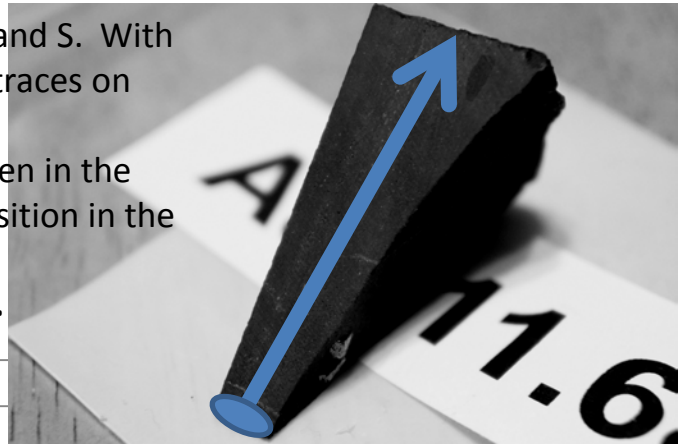


	MgKa1	AlKa1	SiKa1	P Ka1	S Ka1	K Ka1	CaKa1	BaLa1	TiKa1	V Ka1	CrKa1	MnKa1	FeKa1
A8711 68 S1 MAJ-0001	0.71	0.54	39.14	0.05	0.82	0.14	0.07	0.15	-0.04	0.17	0.00	0.03	0.50
A8711 68 S1 MAJ-0002	0.76	0.45	38.93	0.07	0.80	0.10	-0.15	0.13	0.05	0.02	0.01	0.04	0.59
A8711 68 S1 MAJ-0003	0.75	0.67	39.05	0.08	1.19	0.09	-0.14	0.13	0.07	0.02	0.01	0.04	0.81
A8711 68 S1 MAJ-0004	0.73	0.59	39.17	0.09	1.29	0.11	-0.13	0.12	0.08	0.02	0.01	0.04	0.94
A8711 68 S1 MAJ-0005	0.83	0.39	39.16	0.06	0.79	0.11	-0.14	0.13	0.07	0.02	0.01	0.04	0.64
A8711 68 S1 MAJ-0006	0.75	0.56	38.93	0.07	0.91	0.11	-0.12	0.13	0.05	0.02	0.01	0.04	0.67
A8711 68 S1 MAJ-0007	0.74	0.44	39.03	0.07	0.81	0.11	-0.12	0.13	0.06	0.02	0.01	0.05	0.64
A8711 68 S1 MAJ-0008	0.90	0.58	38.47	0.09	0.84	0.13	-0.13	0.13	0.08	0.02	0.02	0.04	0.74
A8711 68 S1 MAJ-0009	0.95	0.71	39.09	0.09	1.39	0.11	-0.13	0.13	0.07	0.02	0.01	0.05	1.25
A8711 68 S1 MAJ-0010	1.05	0.60	38.87	0.10	1.32	0.09	-0.12	0.13	0.06	0.02	0.02	0.05	1.40
A8711 68 S1 MAJ-0011	0.93	0.58	38.62	0.08	0.71	0.09	-0.13	0.13	0.06	0.02	0.02	0.05	0.69
A8711 68 S1 MAJ-0012	0.75	0.47	39.07	0.09	1.40	0.07	-0.16	0.13	0.02	0.02	0.01	0.04	0.83

A8711 68: This sample is primarily Si with traces of Fe and S. With significant traces of volcanic ash as can be seen in the traces on the next chart of Rb, Sr, Y, and Zr.

This rock is unique in this set of 4 for the Zn content seen in the Traces. Note the variation of the Zn as a function of position in the Trace slide below.

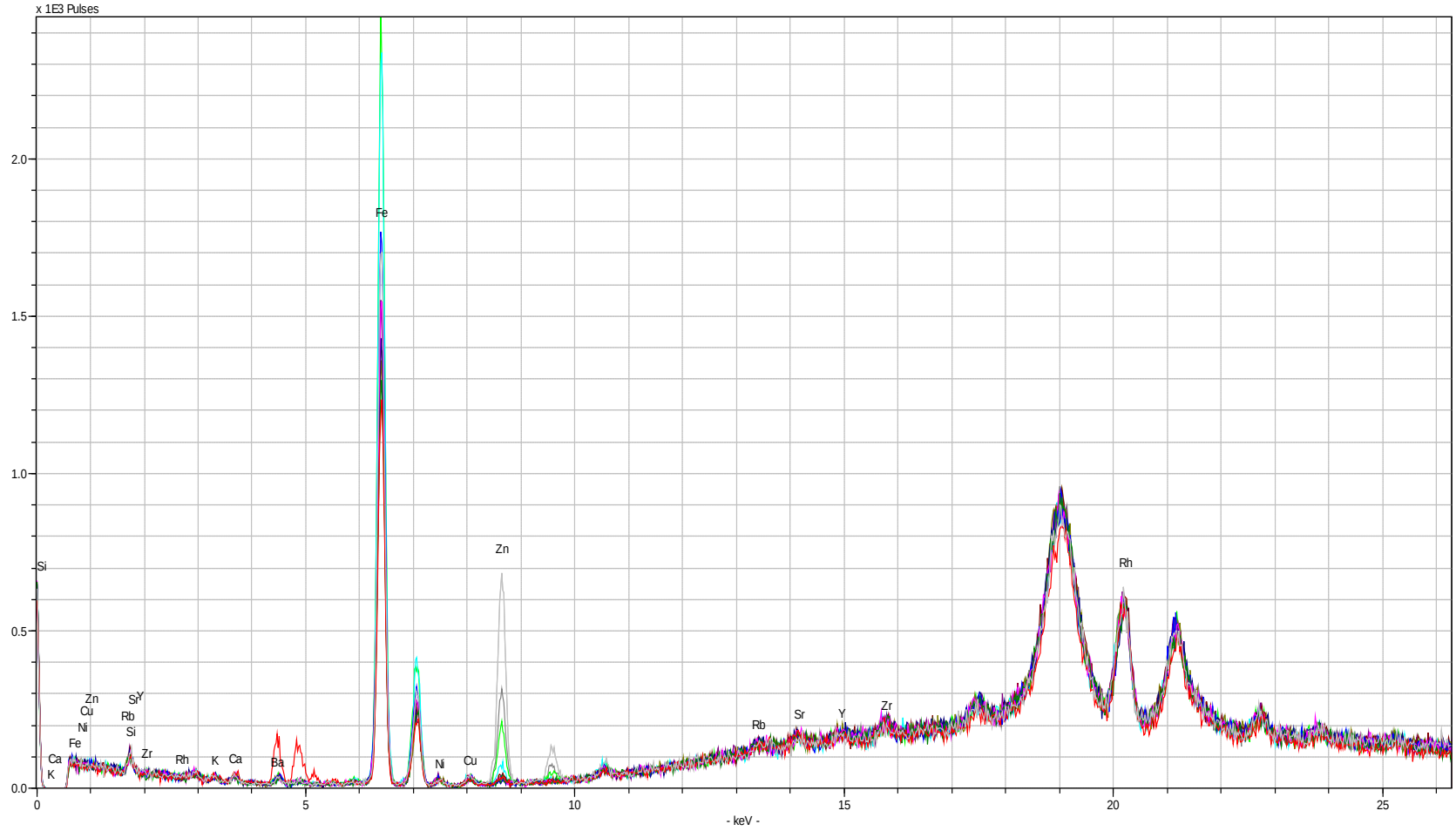
This sample uniform across its face and is primarily Si.



A8711 68 is unique in this set of 4 for the Zn content seen in the Traces**.**

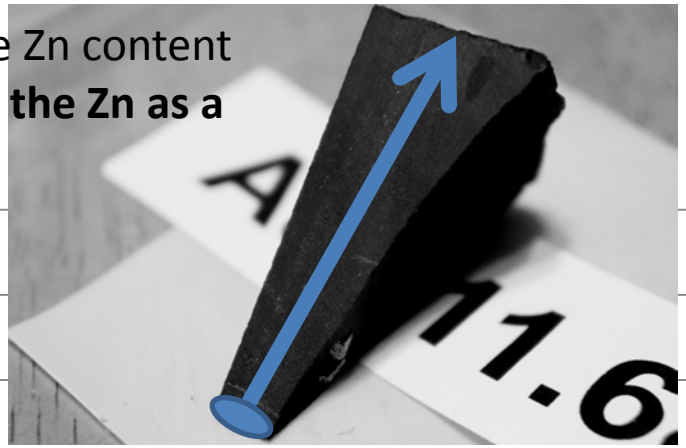
Below is the Raw data from the scan analysis across the face.

Note the variation of the Zn as a function of position.



	CaKa1	BaLa1	TiKa1	V Ka1	CrKa1	MnKa1	FeKa1	NiKa1	CuKa1	ZnKa1	ThLa1	RbKa1	U La1	SrKa1	Y Ka1	ZrKa1	NbKa1	MoKa1
A8711 68 MOR-0001	0.279	0.060	0.133	0.068	0.008	0.016	0.781	0.004	0.002	0.004	0.001	0.002	0.002	0.005	0.001	0.003	0.001	0.004
A8711 68 MOR-0002	0.805	0.176	0.054	0.005	0.003	0.012	0.797	0.006	0.001	0.004	0.001	0.001	0.002	0.004	0.001	0.004	0.000	0.005
A8711 68 MOR-0003	0.838	0.173	0.062	0.008	0.004	0.014	0.971	0.006	0.003	0.005	0.001	0.002	0.002	0.005	0.001	0.004	0.001	0.006
A8711 68 MOR-0004	0.800	0.167	0.085	0.008	0.004	0.011	1.065	0.005	0.003	0.004	0.001	0.002	0.002	0.004	0.001	0.003	0.000	0.005
A8711 68 MOR-0005	0.826	0.167	0.125	0.006	0.004	0.011	0.887	0.005	0.002	0.003	0.001	0.002	0.002	0.004	0.001	0.004	0.001	0.006
A8711 68 MOR-0006	0.826	0.174	0.104	0.008	0.003	0.016	0.839	0.006	0.004	0.006	0.000	0.001	0.002	0.004	0.001	0.004	0.001	0.005
A8711 68 MOR-0007	0.828	0.171	0.094	0.007	0.003	0.012	0.819	0.005	0.003	0.006	0.000	0.001	0.002	0.004	0.001	0.003	0.000	0.005
A8711 68 MOR-0008	0.781	0.169	0.080	0.007	0.004	0.010	0.902	0.007	0.003	0.005	0.000	0.002	0.002	0.004	0.001	0.004	0.001	0.005
A8711 68 MOR-0009	0.799	0.166	0.087	0.009	0.005	0.014	1.393	0.006	0.003	0.010	0.000	0.002	0.002	0.004	0.001	0.003	0.001	0.005
A8711 68 MOR-0010	0.816	0.166	0.054	0.008	0.005	0.018	1.430	0.006	0.004	0.029	0.000	0.002	0.002	0.004	0.001	0.003	0.001	0.006
A8711 68 MOR-0011	0.818	0.171	0.101	0.008	0.003	0.011	0.936	0.006	0.003	0.044	0.000	0.002	0.002	0.004	0.001	0.003	0.001	0.005
A8711 68 MOR-0012	0.816	0.171	0.127	0.007	0.004	0.011	1.066	0.006	0.005	0.102	0.000	0.002	0.002	0.004	0.001	0.003	0.001	0.005

A8711 68 is unique in this set of 4 for the Zn content seen in the Traces**. Note the variation of the Zn as a function of position.**

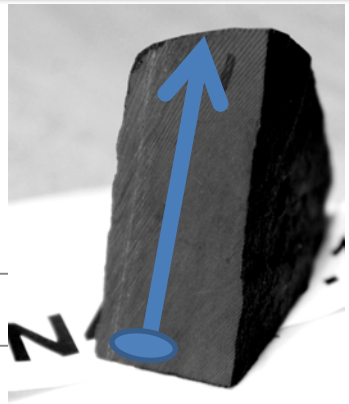


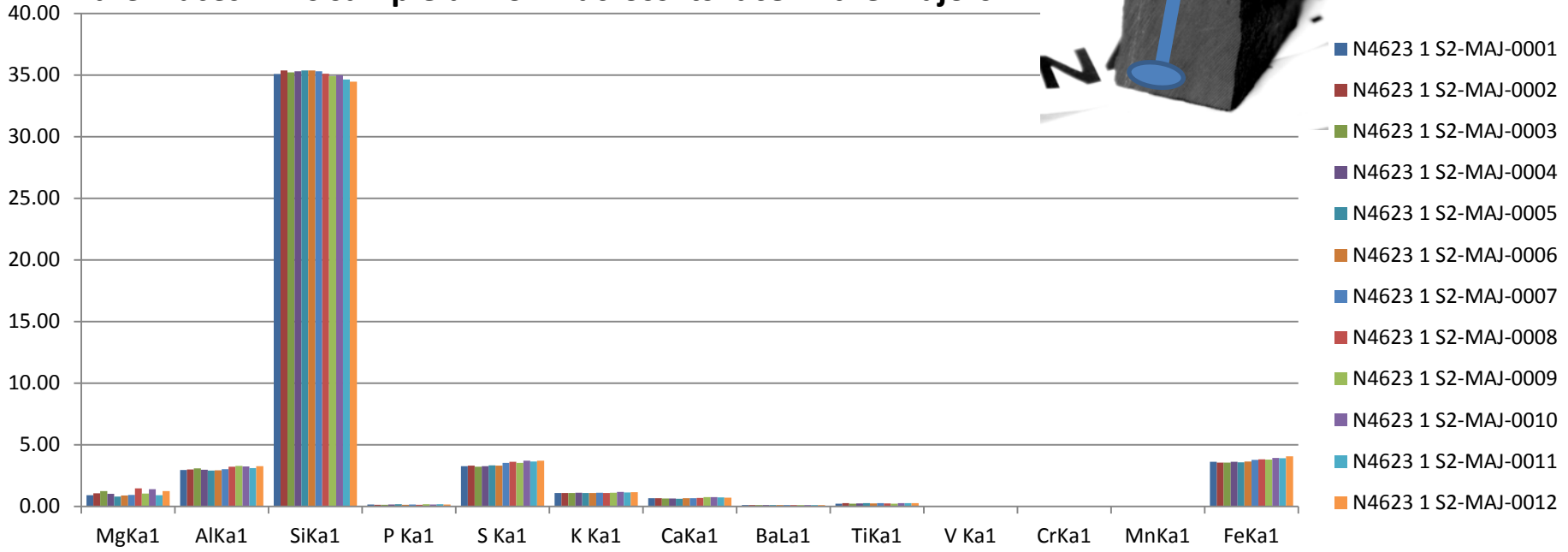
For the remaining 3 samples only the numerical data is given.

All the raw data for all samples is available if requested.

	MgKa1	AlKa1	SiKa1	P Ka1	S Ka1	K Ka1	CaKa1	BaLa1	TiKa1	V Ka1	CrKa1	MnKa1	FeKa1
N4623 1 S2-MAJ-0001	0.91	2.95	35.09	0.16	3.25	1.08	0.67	0.11	0.21	0.02	0.01	0.03	3.61
N4623 1 S2-MAJ-0002	1.06	3.00	35.36	0.13	3.31	1.08	0.66	0.11	0.26	0.02	0.01	0.03	3.55
N4623 1 S2-MAJ-0003	1.23	3.09	35.20	0.12	3.22	1.08	0.64	0.11	0.22	0.02	0.01	0.03	3.55
N4623 1 S2-MAJ-0004	1.02	2.98	35.30	0.15	3.26	1.09	0.65	0.11	0.24	0.02	0.01	0.03	3.61
N4623 1 S2-MAJ-0005	0.79	2.91	35.37	0.16	3.32	1.08	0.62	0.11	0.25	0.02	0.01	0.03	3.57
N4623 1 S2-MAJ-0006	0.88	2.93	35.37	0.12	3.31	1.09	0.65	0.11	0.23	0.02	0.01	0.03	3.64
N4623 1 S2-MAJ-0007	0.94	3.02	35.30	0.16	3.54	1.11	0.66	0.11	0.25	0.02	0.01	0.03	3.77
N4623 1 S2-MAJ-0008	1.47	3.22	35.10	0.13	3.61	1.08	0.69	0.11	0.23	0.02	0.01	0.03	3.80
N4623 1 S2-MAJ-0009	1.03	3.29	34.91	0.17	3.52	1.10	0.75	0.11	0.21	0.02	0.01	0.03	3.78
N4623 1 S2-MAJ-0010	1.40	3.23	34.99	0.16	3.70	1.17	0.76	0.11	0.25	0.02	0.01	0.03	3.92
N4623 1 S2-MAJ-0011	0.91	3.10	34.64	0.17	3.63	1.12	0.72	0.11	0.27	0.02	0.01	0.03	3.91
N4623 1 S2-MAJ-0012	1.23	3.26	34.46	0.15	3.71	1.16	0.70	0.11	0.26	0.02	0.01	0.03	4.06

N4623 1: This sample is primarily Si/Al/ Mg with Fe and S. With significant traces of volcanic ash as can be seen in the traces on the next chart of Rb, Sr, Y, and Zr.
This rock is unique in this set of 4 for the Mo content seen in the Traces. **This sample uniform across its face in the majors.**



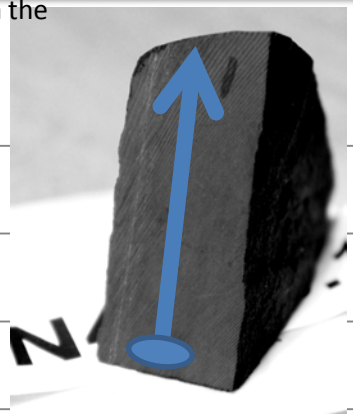


	CaKa1	BaLa1	TiKa1	V Ka1	CrKa1	MnKa1	FeKa1	NiKa1	CuKa1	ZnKa1	ThLa1	RbKa1	U La1	SrKa1	Y Ka1	ZrKa1	NbKa1	MoKa1
N4623 1 MOR-0001	1.316	0.128	0.221	0.014	0.011	0.015	3.958	0.009	0.005	0.007	0.000	0.007	0.002	0.006	0.001	0.006	0.000	0.010
N4623 1 MOR-0002	1.303	0.131	0.293	0.015	0.011	0.021	3.774	0.007	0.005	0.006	0.000	0.007	0.002	0.006	0.001	0.006	0.001	0.010
N4623 1 MOR-0003	1.286	0.127	0.243	0.013	0.009	0.017	3.864	0.008	0.005	0.007	0.000	0.006	0.002	0.006	0.001	0.006	0.000	0.010
N4623 1 MOR-0004	1.225	0.129	0.300	0.014	0.009	0.017	3.885	0.008	0.004	0.006	0.000	0.006	0.002	0.006	0.001	0.006	0.001	0.009
N4623 1 MOR-0005	1.275	0.128	0.241	0.013	0.010	0.014	4.016	0.009	0.005	0.008	0.000	0.006	0.002	0.006	0.002	0.006	0.001	0.010
N4623 1 MOR-0006	1.300	0.129	0.249	0.015	0.010	0.014	3.954	0.008	0.005	0.007	0.000	0.006	0.002	0.006	0.001	0.006	0.000	0.009
N4623 1 MOR-0007	1.333	0.126	0.276	0.012	0.009	0.016	4.068	0.008	0.004	0.007	0.000	0.006	0.002	0.006	0.001	0.007	0.000	0.010
N4623 1 MOR-0008	1.332	0.123	0.241	0.014	0.010	0.020	4.090	0.009	0.005	0.012	0.001	0.006	0.002	0.006	0.002	0.006	0.001	0.009
N4623 1 MOR-0009	1.258	0.128	0.328	0.015	0.011	0.016	4.017	0.008	0.005	0.009	0.000	0.006	0.002	0.005	0.001	0.006	0.000	0.009
N4623 1 MOR-0010	1.281	0.131	0.217	0.015	0.010	0.020	4.065	0.008	0.003	0.006	0.000	0.007	0.002	0.005	0.001	0.006	0.000	0.009
N4623 1 MOR-0011	1.307	0.125	0.356	0.017	0.011	0.016	4.310	0.008	0.006	0.008	0.000	0.006	0.002	0.006	0.001	0.006	0.000	0.010
N4623 1 MOR-0012	1.216	0.118	0.304	0.017	0.010	0.020	4.543	0.009	0.010	0.009	0.000	0.007	0.002	0.006	0.001	0.006	0.001	0.010

N4623 1: This sample has significant traces of volcanic ash as can be seen in the traces on the next chart of Rb, Sr, Y, and Zr.

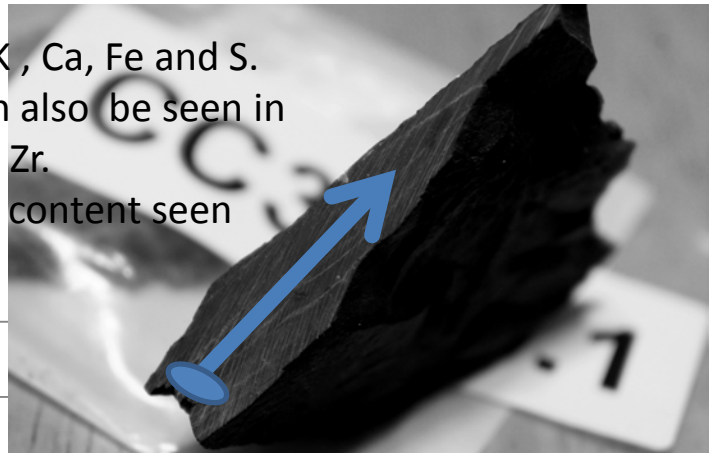
This rock is unique in this set of 4 for the Mo content seen in the Traces.

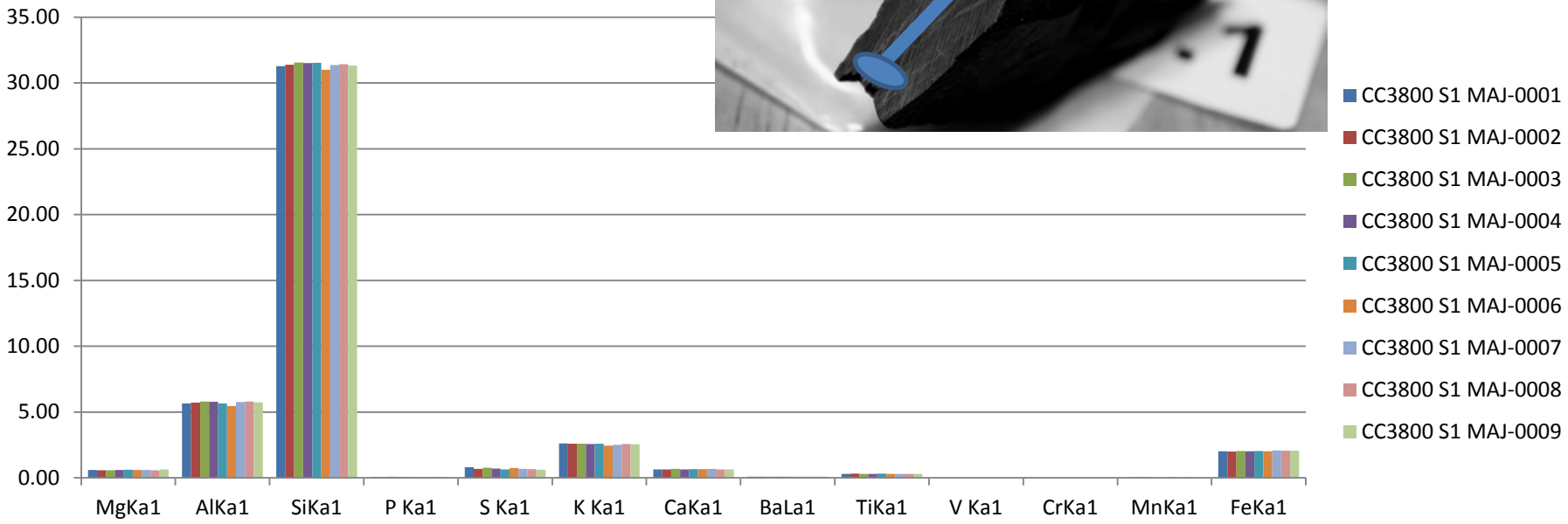
This samples varies in the Cu and Zn trace content across its face.



	MgKa1	AlKa1	SiKa1	P Ka1	S Ka1	K Ka1	CaKa1	BaLa1	TiKa1	V Ka1	CrKa1	MnKa1	FeKa1
CC3800 S1 MAJ-0001	0.59	5.65	31.27	0.06	0.81	2.61	0.63	0.09	0.30	0.02	0.01	0.03	2.02
CC3800 S1 MAJ-0002	0.57	5.72	31.38	0.08	0.69	2.59	0.64	0.09	0.32	0.02	0.01	0.04	2.01
CC3800 S1 MAJ-0003	0.58	5.80	31.55	0.08	0.76	2.60	0.68	0.09	0.31	0.02	0.01	0.04	2.03
CC3800 S1 MAJ-0004	0.59	5.79	31.51	0.08	0.70	2.56	0.65	0.09	0.31	0.02	0.01	0.04	2.03
CC3800 S1 MAJ-0005	0.63	5.64	31.52	0.08	0.65	2.60	0.66	0.09	0.32	0.02	0.01	0.04	2.03
CC3800 S1 MAJ-0006	0.60	5.45	31.00	0.06	0.75	2.44	0.66	0.09	0.31	0.02	0.01	0.04	2.02
CC3800 S1 MAJ-0007	0.61	5.76	31.35	0.08	0.68	2.52	0.69	0.09	0.30	0.02	0.01	0.04	2.08
CC3800 S1 MAJ-0008	0.57	5.81	31.43	0.07	0.67	2.56	0.65	0.09	0.31	0.02	0.01	0.04	2.05
CC3800 S1 MAJ-0009	0.65	5.74	31.32	0.07	0.62	2.55	0.65	0.09	0.31	0.02	0.01	0.04	2.07

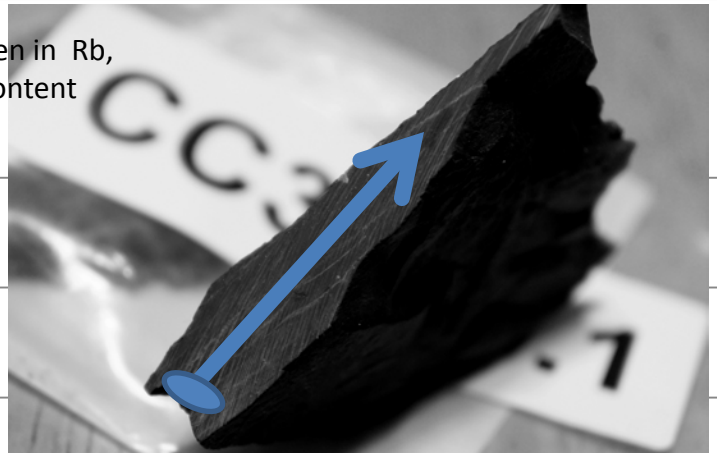
CC3800: This sample is primarily Si/Al with K , Ca, Fe and S. With significant traces of volcanic ash as can also be seen in the traces on the next chart of Rb, Sr, Y, and Zr. This rock is unique in this set of 4 for the Zn content seen through out the scan in the Traces.





	CaKa1	BaLa1	TiKa1	V Ka1	CrKa1	MnKa1	FeKa1	NiKa1	CuKa1	ZnKa1	ThLa1	RbKa1	U La1	SrKa1	Y Ka1	ZrKa1	NbKa1	MoKa1
CCC3800 1 MOR-0001	1.047	0.099	0.237	0.016	0.008	0.018	2.118	0.003	0.002	0.012	0.001	0.015	0.002	0.008	0.003	0.011	0.001	0.001
CCC3800 1 MOR-0002	0.937	0.090	0.316	0.016	0.007	0.018	2.196	0.003	0.004	0.011	0.001	0.015	0.002	0.009	0.004	0.012	0.001	0.002
CCC3800 1 MOR-0003	0.987	0.100	0.323	0.018	0.008	0.021	2.144	0.004	0.002	0.010	0.001	0.016	0.002	0.008	0.004	0.012	0.001	0.001
CCC3800 1 MOR-0004	0.924	0.095	0.293	0.015	0.008	0.022	2.146	0.003	0.002	0.010	0.001	0.015	0.002	0.008	0.003	0.011	0.001	0.001
CCC3800 1 MOR-0005	0.956	0.089	0.244	0.015	0.008	0.020	2.192	0.003	0.001	0.011	0.000	0.016	0.002	0.008	0.004	0.012	0.001	0.001
CCC3800 1 MOR-0006	0.979	0.093	0.245	0.017	0.008	0.023	2.183	0.004	0.001	0.011	0.001	0.015	0.002	0.008	0.003	0.012	0.001	0.001
CCC3800 1 MOR-0007	1.070	0.096	0.263	0.015	0.008	0.019	2.139	0.003	0.001	0.012	0.000	0.015	0.002	0.007	0.003	0.011	0.001	0.001
CCC3800 1 MOR-0008	0.991	0.093	0.303	0.015	0.007	0.020	2.205	0.003	0.001	0.014	0.001	0.014	0.002	0.008	0.003	0.011	0.001	0.001
CCC3800 1 MOR-0009	0.976	0.088	0.252	0.016	0.008	0.023	2.304	0.004	0.002	0.024	0.001	0.015	0.002	0.009	0.004	0.012	0.001	0.001
CCC3800 1 MOR-0010	0.999	0.092	0.277	0.016	0.008	0.022	2.205	0.003	0.002	0.013	0.000	0.015	0.002	0.008	0.003	0.010	0.001	0.002

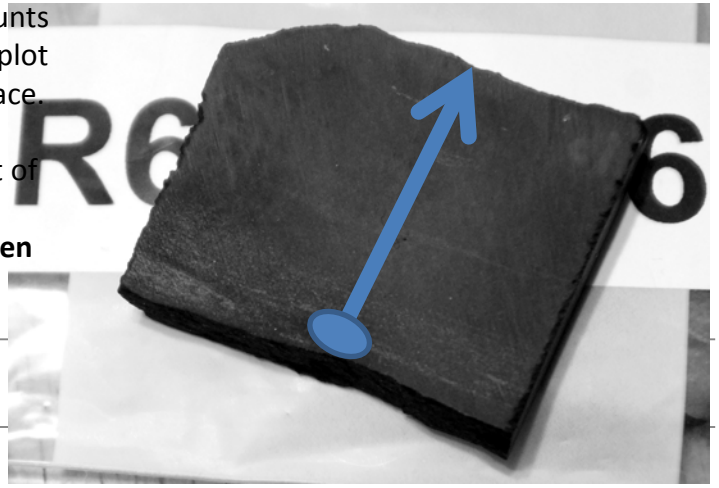
CC3800: There are traces of volcanic ash as can also be seen in Rb, Sr, Y, and Zr. This rock is unique in this set of 4 for the Zn content seen through out the scan in the Traces.

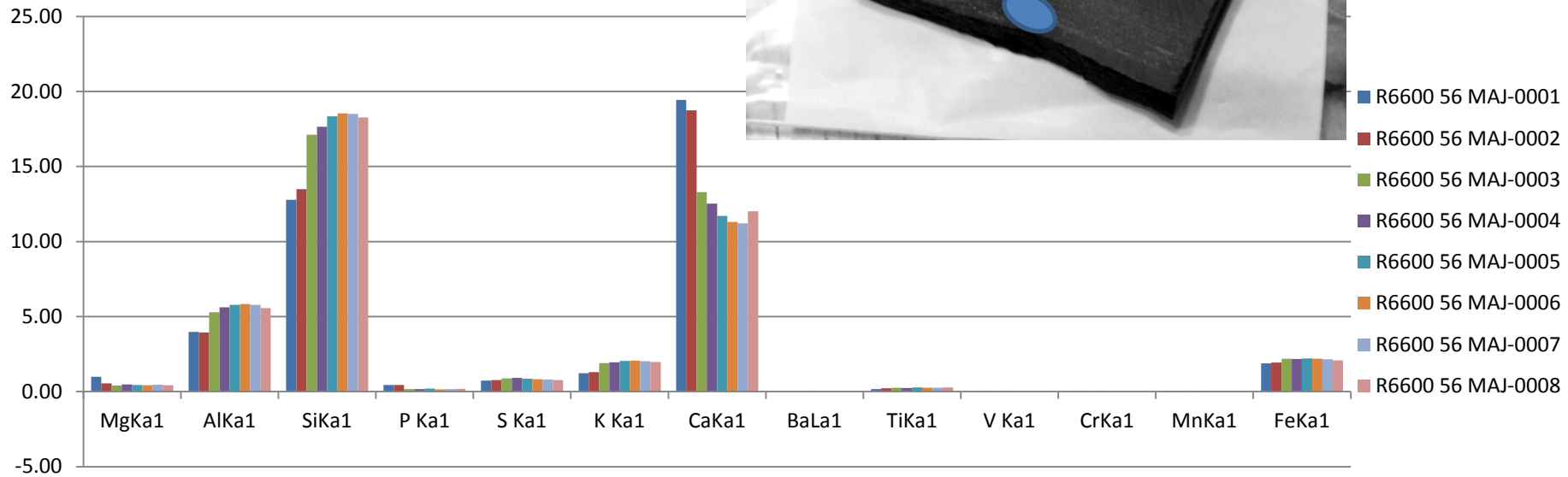


	MgKa1	AlKa1	SiKa1	P Ka1	S Ka1	K Ka1	CaKa1	BaLa1	TiKa1	V Ka1	CrKa1	MnKa1	FeKa1
R6600 56 MAJ-0001	0.99	3.98	12.79	0.44	0.74	1.24	19.44	-0.01	0.16	0.01	0.01	0.04	1.89
R6600 56 MAJ-0002	0.56	3.95	13.49	0.44	0.78	1.29	18.75	-0.01	0.23	0.01	0.01	0.04	1.94
R6600 56 MAJ-0003	0.41	5.29	17.13	0.17	0.89	1.90	13.30	0.00	0.25	0.01	0.01	0.04	2.20
R6600 56 MAJ-0004	0.47	5.63	17.66	0.17	0.92	1.96	12.52	0.00	0.24	0.01	0.01	0.04	2.17
R6600 56 MAJ-0005	0.44	5.78	18.34	0.20	0.87	2.04	11.71	0.01	0.28	0.01	0.01	0.04	2.22
R6600 56 MAJ-0006	0.42	5.84	18.54	0.15	0.83	2.07	11.31	0.01	0.26	0.01	0.01	0.04	2.19
R6600 56 MAJ-0007	0.46	5.79	18.51	0.16	0.82	2.04	11.22	0.01	0.26	0.01	0.01	0.04	2.16
R6600 56 MAJ-0008	0.43	5.57	18.28	0.18	0.77	1.97	12.02	0.01	0.28	0.01	0.01	0.04	2.09

RR660 56: This sample is primarily Si/Al/K/Ca, with significant amounts of Fe and S. With significant traces Sr as can be seen in the traces plot on the next slide. This sample is unique in its variation over its surface. Ca is 30% HIGER in the first 6 mm and after that Al, Si, K and Fe increase and Ca goes down. This sample is also is unique in this set of 4 for the Sr content seen through out the scan in the Traces.

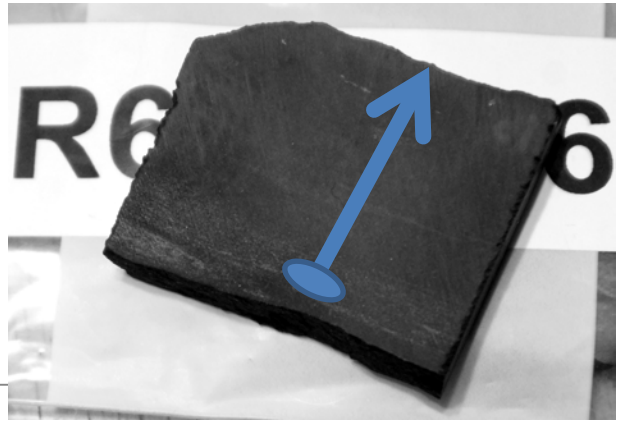
This sample NOT uniform across its face, the variation can also been seen visually in colour variation across the sample

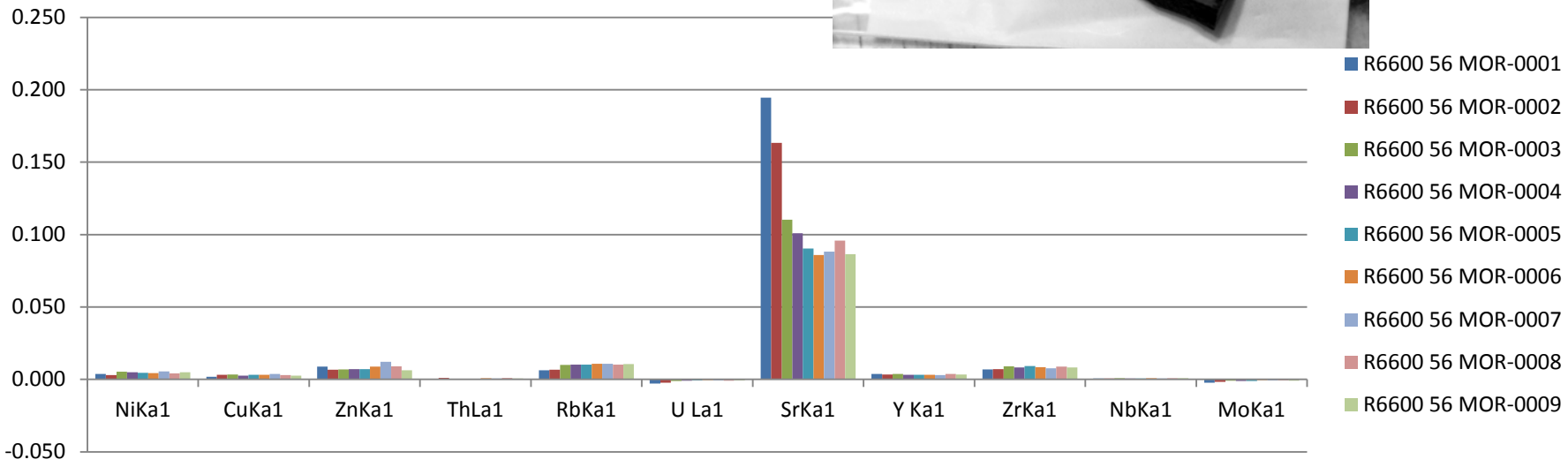




	CaKa1	BaLa1	TiKa1	V Ka1	CrKa1	MnKa1	FeKa1	NiKa1	CuKa1	ZnKa1	ThLa1	RbKa1	U La1	SrKa1	Y Ka1	ZrKa1	NbKa1	MoKa1
R6600 56 MOR-0001	20.253	-0.013	0.180	0.010	0.006	0.035	2.061	0.004	0.002	0.009	0.000	0.006	-0.003	0.195	0.004	0.007	0.001	-0.002
R6600 56 MOR-0002	18.027	-0.017	0.211	0.013	0.006	0.032	2.199	0.003	0.003	0.007	0.001	0.007	-0.002	0.163	0.003	0.007	0.001	-0.002
R6600 56 MOR-0003	13.007	0.006	0.267	0.013	0.007	0.031	2.479	0.005	0.003	0.007	0.000	0.010	-0.001	0.110	0.004	0.009	0.001	-0.001
R6600 56 MOR-0004	12.073	0.005	0.222	0.015	0.008	0.031	2.469	0.005	0.003	0.007	0.000	0.010	-0.001	0.101	0.003	0.008	0.001	-0.001
R6600 56 MOR-0005	11.112	0.021	0.251	0.014	0.007	0.032	2.446	0.005	0.003	0.007	0.000	0.010	-0.001	0.090	0.003	0.009	0.001	-0.001
R6600 56 MOR-0006	10.463	0.019	0.197	0.011	0.007	0.031	2.398	0.004	0.003	0.009	0.001	0.011	-0.001	0.086	0.003	0.008	0.001	0.000
R6600 56 MOR-0007	10.845	0.015	0.220	0.012	0.008	0.031	2.396	0.005	0.004	0.012	0.001	0.011	-0.001	0.088	0.003	0.008	0.001	-0.001
R6600 56 MOR-0008	11.417	0.005	0.213	0.015	0.008	0.032	2.445	0.004	0.003	0.009	0.001	0.010	-0.001	0.096	0.004	0.009	0.001	-0.001
R6600 56 MOR-0009	11.020	0.015	0.260	0.014	0.008	0.033	2.284	0.005	0.003	0.006	0.001	0.011	-0.001	0.086	0.003	0.008	0.001	-0.001

This sample is also is unique in this set of 4 for the Sr content seen through out the scan in the Traces. Note it varies with the Ca content.





Conclusion

The Tracer uniquely is capable of providing very rapid, accurate and detailed elemental content analysis of mudrock samples.