

Atmospheric Particulate Matter in Proximity to Mountaintop Coal Mines

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Introduction

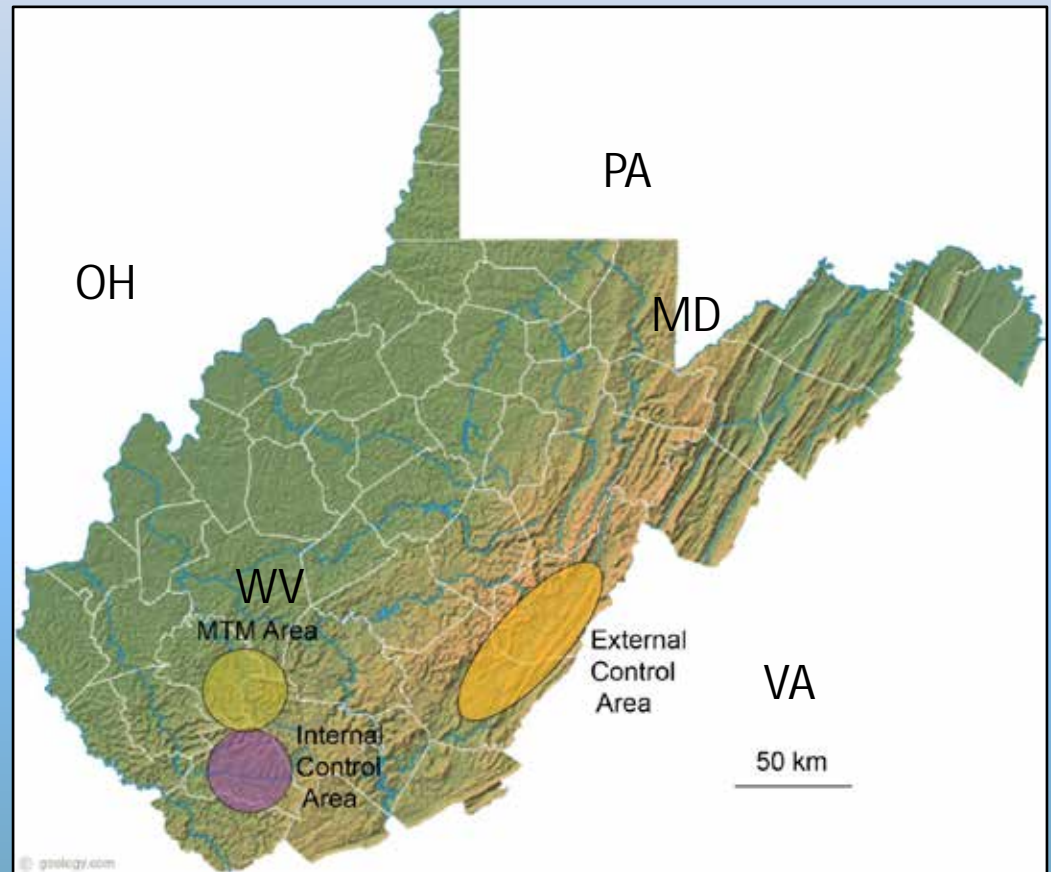
- Mountaintop mining (MTM) is a common method of coal extraction in parts of the U.S. Appalachian region.
- The method exposes coal for production by explosion and removal of non-coal bearing siliceous overburden.
- Past studies have primarily concerned the impact of overburden disposal in stream valleys on aquatic life.
- Recent epidemiologic work suggests disparities in the rates of some diseases between comparable MTM and non-MTM areas¹.

Approach

- The present study considers the potential for human exposure to air- and water-sourced contaminants from MTM activities.
- Initial results from air sampling studies are presented here.
- Samples collected include:
 - 1) High-volume 24-hour sampling of sized ambient particulate matter. Separate inorganic and organic sampling.
 - 2) Geochemical window-wide samples for inorganic and organics.
 - 3) Extended sampling on greased surrogate deposition surfaces.
- Study compares active MTM areas with internal (coal mining by other methods) and external (no coal mining) controls.

Study Area

- Study area in south central West Virginia (WV), USA.
- Control areas in southern WV (internal control) and southeastern WV (external control).
- Sampling in June, Aug., Dec., 2011; Feb., May, 2012
- Results to date for 2011.



Sampling Activities



Total suspended particulate (TSP) samplers



Sampling Activities



Geochemical window wipes



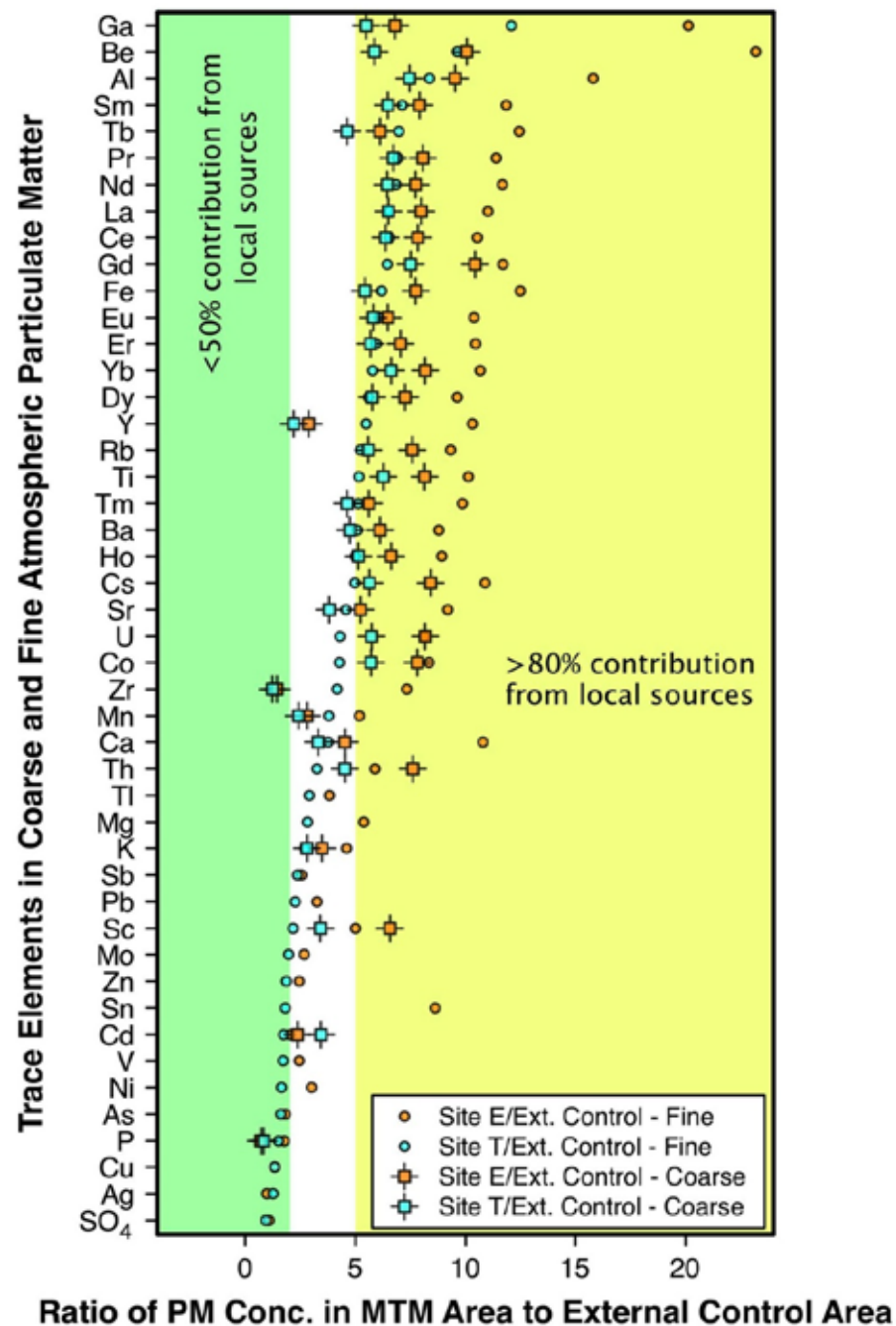
Greased surrogate deposition surfaces

Comparison of MTM Areas E and T with External Control (June, 2011)

Anthropogenic Sources Crustal Sources

June, 2011	V	As	Cd	Al	Ga	Rb	Ce
E/EC fine	2.4	1.8	2.0	15.8	20.1	9.3	10.6
T/EC fine	1.7	1.6	1.7	8.4	12.1	5.2	6.5
E/EC coarse	ND	ND	2.4	9.5	6.8	7.6	10.1
T/EC coarse	ND	ND	3.4	7.5	5.5	5.6	5.9

Results indicate more pronounced enrichment in "crustal" elements (e.g. Al, Ga, Rb, Ce) in MTM areas E and T vs. external control (EC).

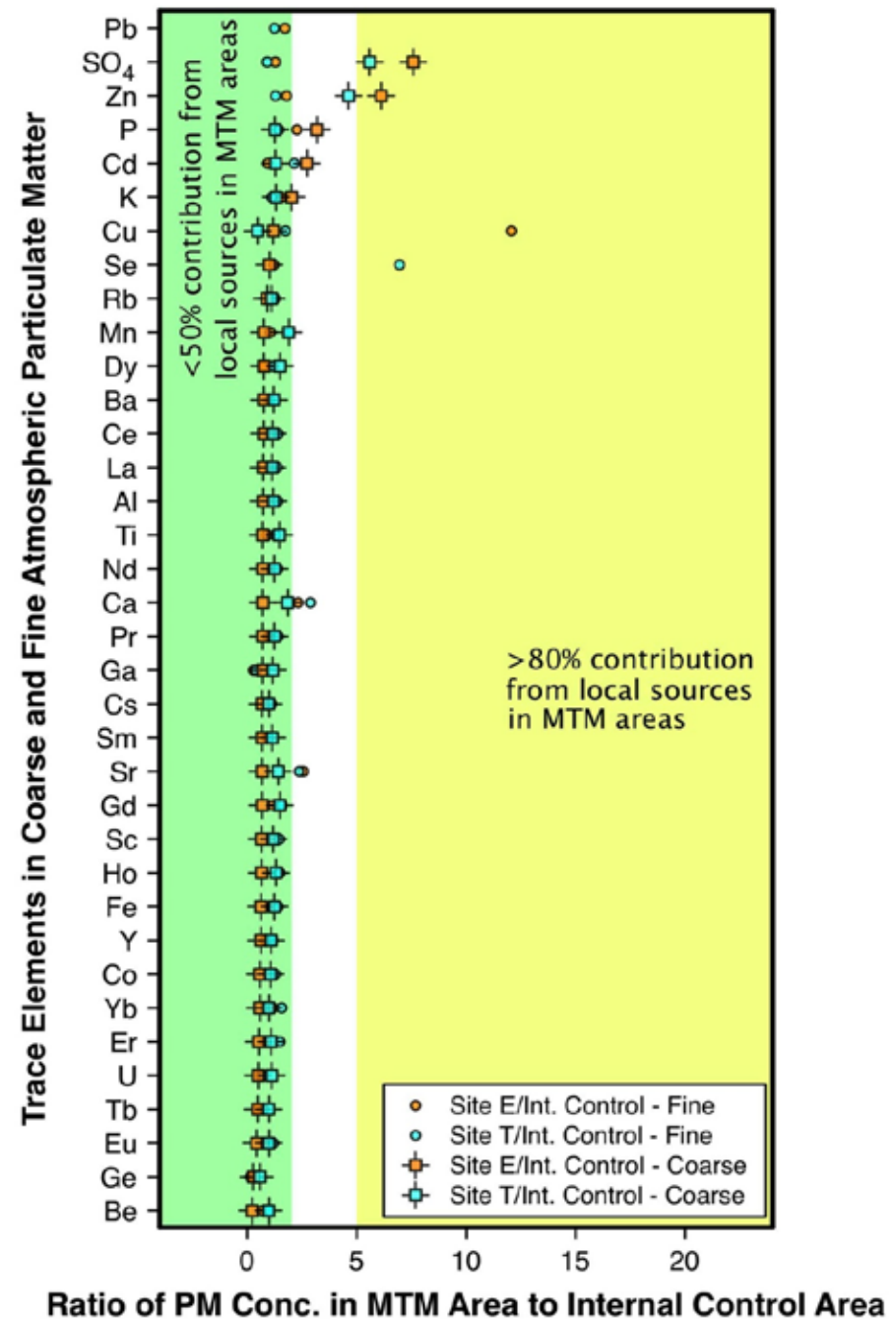


Comparison of MTM Areas E and T with Internal Control (August, 2011)

Anthropogenic Sources Crustal Sources

Aug., 2011	V	As	Cd	Al	Ga	Rb	Ce
E/IC fine	ND	1.2	0.90	1.1	0.28	1.1	1.1
T/IC fine	ND	0.90	2.1	1.4	0.39	1.3	1.4
E/IC coarse	ND	ND	2.7	0.73	0.69	0.90	0.74
T/IC coarse	ND	ND	1.3	1.2	1.2	1.1	1.1

Results indicate similar enrichment in most "crustal" elements (e.g. Al, Ga, Rb, Ce) in MTM areas E and T vs. internal control (IC).

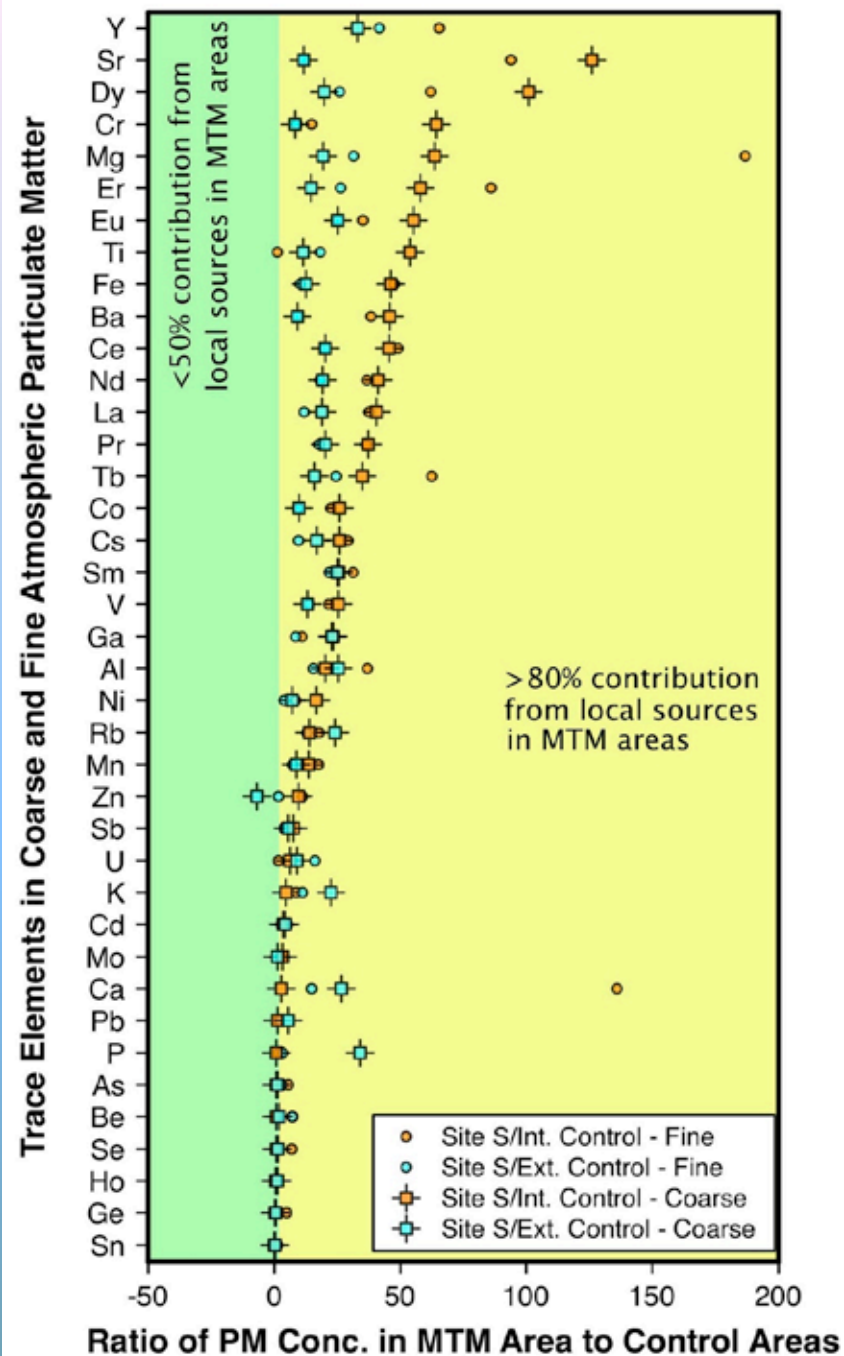


Comparison of MTM Area S with Internal and External Controls (December, 2011)

Anthropogenic Sources Crustal Sources

Dec. 2011	V	As	Cd	Al	Ga	Rb	Ce
S/IC fine	22	5.6	5.3	37	11	17	49
S/EC fine	14	3.1	2.7	15	8.3	13	20
S/IC coarse	25	ND	3.4	20	23	14	46
S/EC coarse	13	ND	4.4	25	23	24	20

Results indicate higher concentration of nearly all constituents in MTM area S vs. internal (IC) and external (EC) control sites.

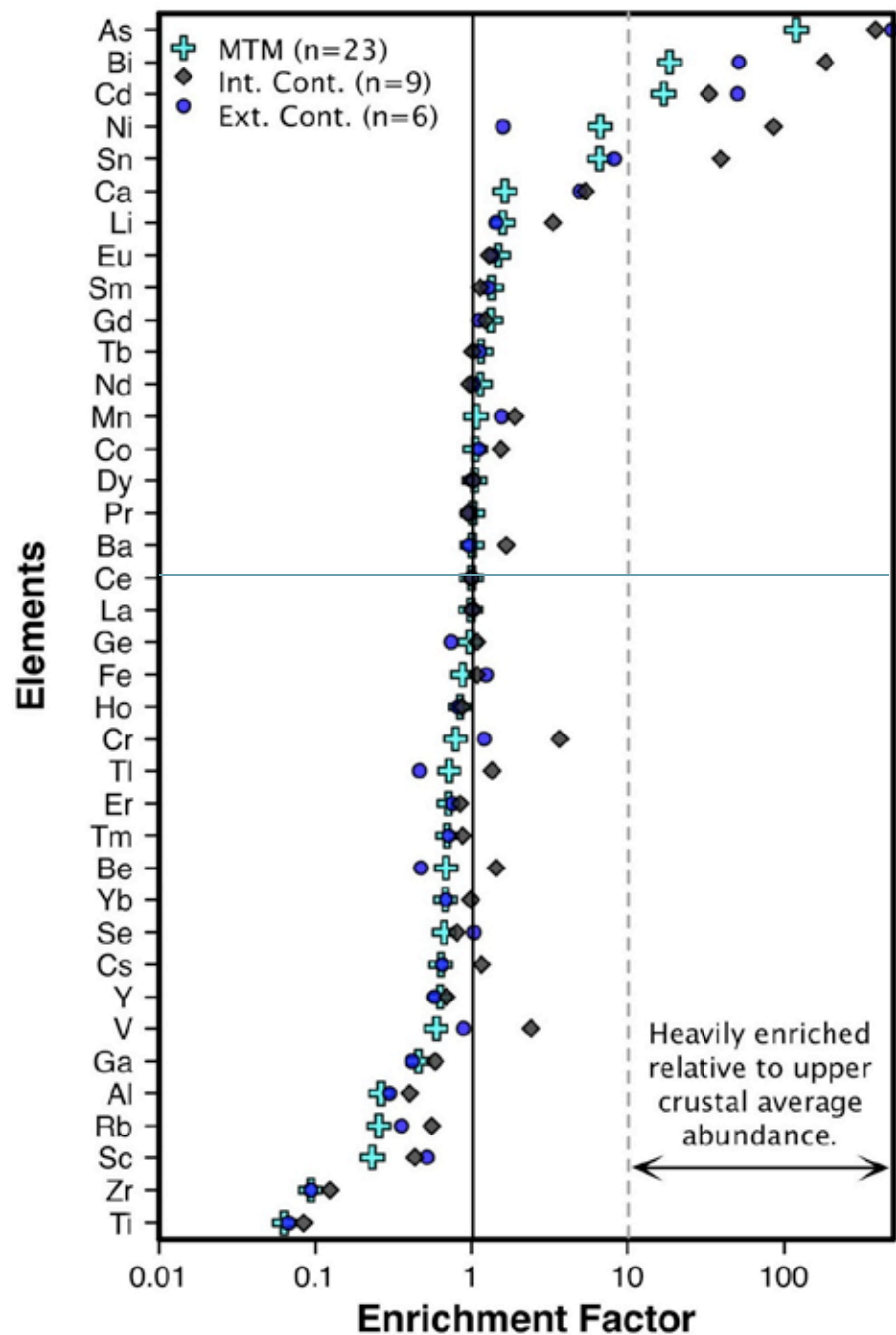


Comparison of Window-Wipe Samples in MTM Areas and Controls (June and August, 2011)

Anthropogenic Sources Crustal Sources

	V	As	Cd	Al	Ga	Rb	Ce
MTM	0.59	120	17	0.26	0.46	0.26	1
Int. Cntrl.	0.89	490	50	0.30	0.42	0.36	1
Ext. Cntrl	2.39	382	33	0.40	0.58	0.55	1

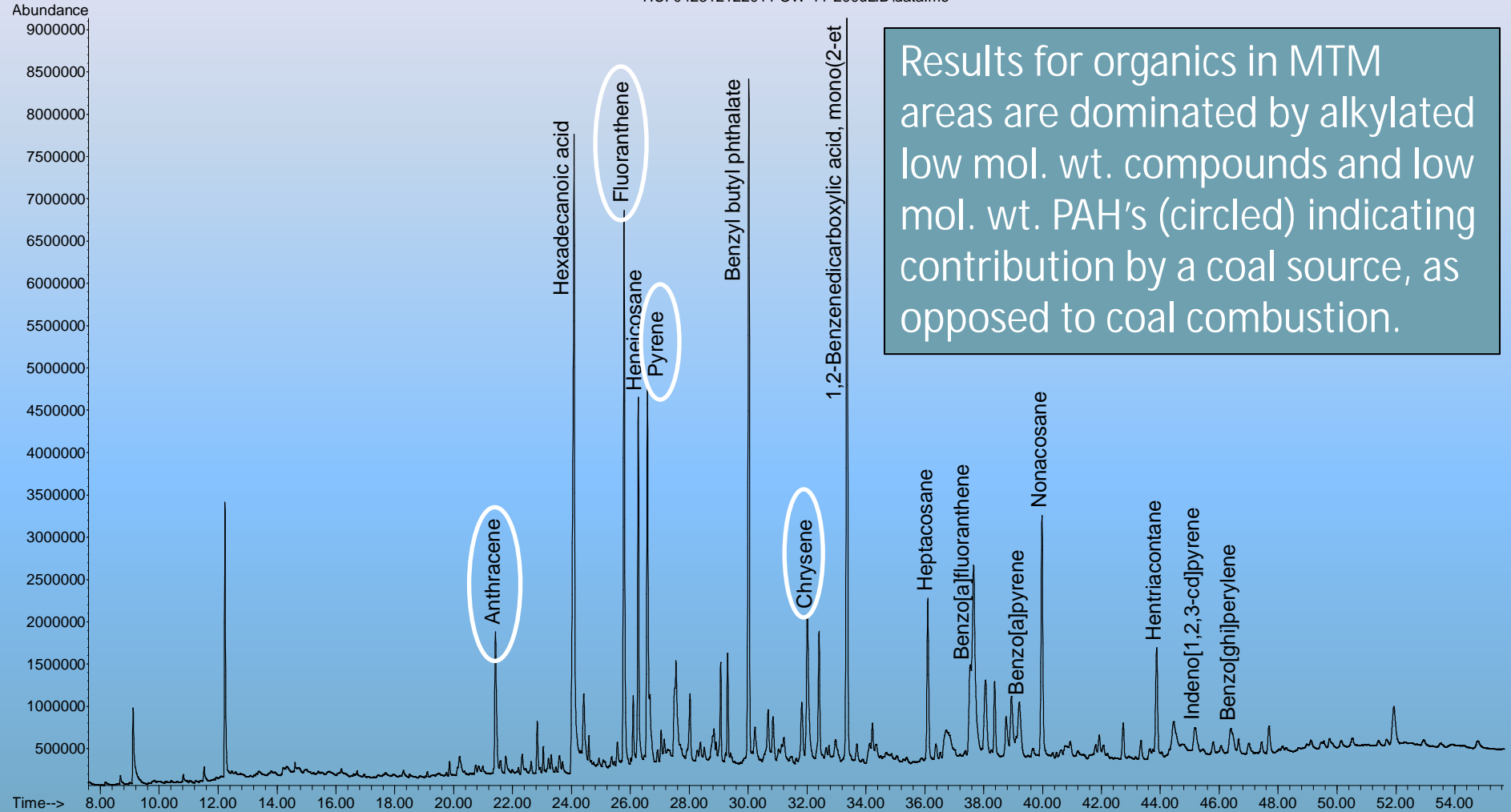
Results indicate enrichment in “anthropogenic” elements (Se, As, Bi, Cd, Ni, Sn) is less in MTM areas than internal control, consistent with dilution by “crustal” material in proximity to MTM operations.



Window Wipe from MTM area

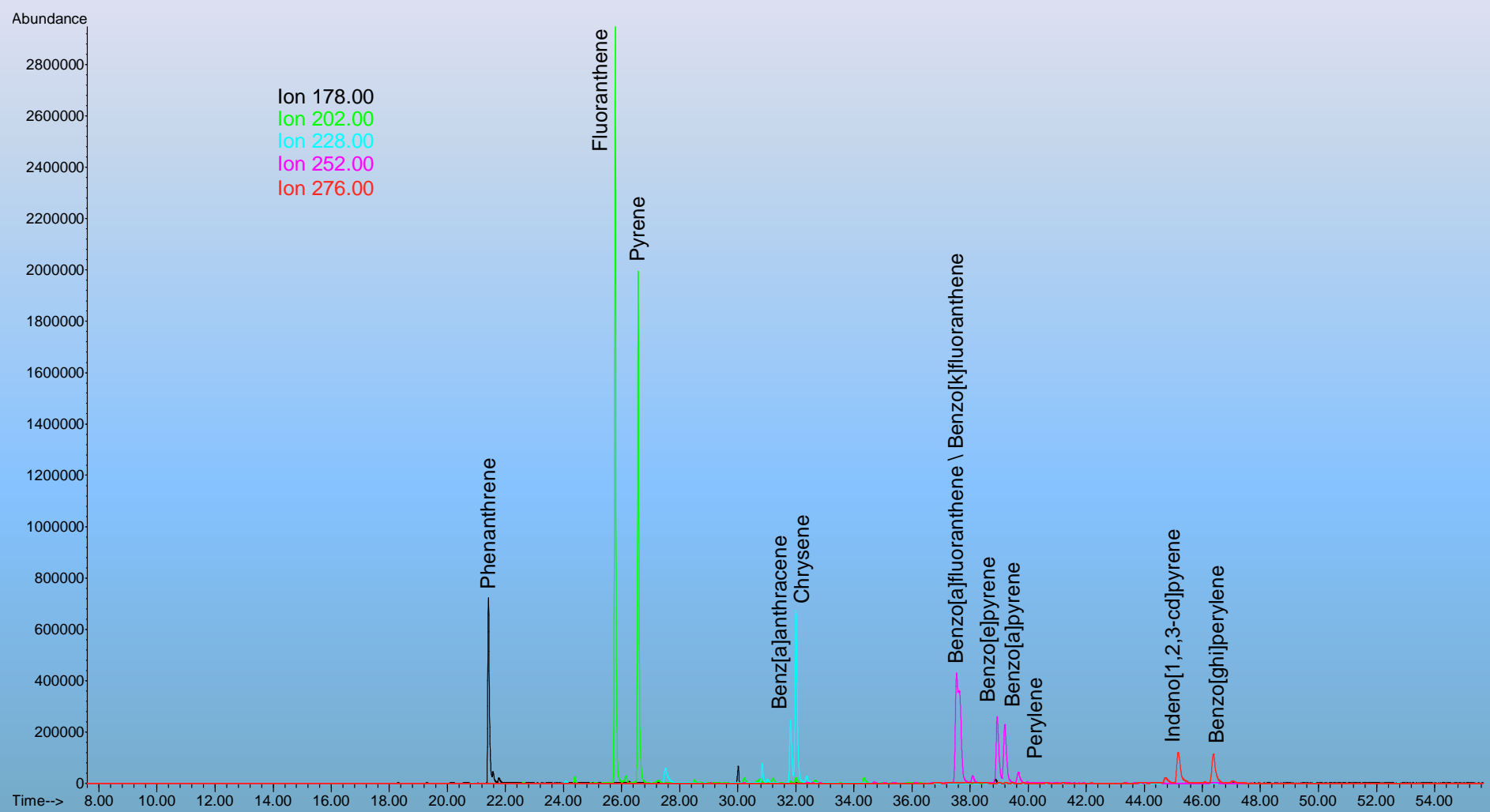
GC-MS Total Ion Chromatogram

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Hi-Vol Fine Air Filter from MTM Residential Property

GC-MS Extracted Ion Chromatogram



Conclusions

- Proportions of crustal elements in MTM areas studied are greater than, or similar to, those in external and internal controls, respectively.
- Concentrations of anthropogenic elements derived primarily from combustion sources, are proportionally lower in MTM areas relative to control areas.
- These results are consistent with dilution of anthropogenic elements by locally-derived siliceous material.
- Organics are dominated by low molecular weight alkylated compounds consistent with derivation from coal itself rather than coal combustion.

Ongoing Work

- Integrate air- and water quality sampling.
- Further use of surrogate surfaces to obtain time-integrated particulate samples.
- Integrate environmental sampling with epidemiologic studies conducted by WVU.
- Focus environmental sampling on specific communities with evidence of health impacts.