Atmospheric particulate matter in proximity to mountaintop coal mines

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Introduction and Approach

In collaboration with West Virginia University, the U.S. Geological Survey is conducting a study of potential human health impacts associated with coal extraction by mountaintop mining (MTM). This practice, common in portions of Appalachia, exposes coal for production by explosion and removal of non-coal-bearing siliceous overburden. Past studies have primarily considered the geochemical impact of overburden disposal in valleys on aquatic life. Recent epidemiological work suggests disparities in the rates of some diseases between comparable MTM and non-MTM areas [1]. In the present study, we are evaluating potential human exposure to air- and water-sourced contaminants from MTM activity. Preliminary results reported here focus on air quality impacts. For this portion of the study, sized atmospheric particulate matter (PM) and geochemical window wipes were collected in two MTM areas and a control site over several days in June, 2011 (Table 1).

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

Table 1: Results for selected trace elements in sized PM samples expressed as concentration ratios for MTM communities E and T vs. control area M. ND = Not detected.

Results and Conclusions

Results for PM and window wipes show anthropogenic contaminants (SO_4, V, Ni, Cu, As, and Cd) are comparable in concentration for MTM and non-MTM sites suggesting little additional local contribution in the MTM areas. However, "crustal" elements (Al, Ti, Fe, Ga, Rb, and rare earths) were much higher in concentration in the MTM areas. A preliminary analysis shows that local sources contributed 80 to 96% of these elements at sites E and T during the sampling period. Based on this analysis, residents of MTM communities are exposed to much higher levels of locally derived siliceous lithogenic material compared to the control. These results will be combined with drinking water quality data, expanded epidemiological mapping, and toxicologic studies to assess the impact of environmental factors in MTM areas on health outcomes.

[1] Hendryx et al. (2011) *J Community Heath* DOI: 10.1007/s10900-011-9448-5.

Geology of the Nain Complex, Labrador, Canada: Occurrence of the Early Archean Supracrustals

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The Hadean is the most mysterious period because no rocks and geologic bodies are preserved except for only the zircons in Western Australia, Canada, China and Greenland [1]. But, it is the most important period because the early evolution possibly clinched the earth's history. We try to find the earliest supracrustal rocks in the world to investigate the Hadean tectonics. As far, the oldest supracrustal rocks are found in Akilia association in West Greenland, Nuvvuagittuq in Quebec, and Nain Complex in Labrador [2,3].

We made geological survey in the Nain Complex, and reinvestigated the occurrence of the supracrustal rocks and their relationship with the ambient orthogneisses. Previous works focused on distribution of the supracrustal belts within the orthogneisses [e.g. 4], but the detailed field occurrence of the supracrustal rocks within the belts is still ambiguous. Therefore, we focus on their internal structures.

The supracrustal belts are repeatedly intruded by granitic intrusions with some ages and their original structures are obscured, but their lithostratigraphies are relatively well preserved in Nulliak, Big and Shuldham islands and St Jones Harbor. The supracrustal belts in Nulliak and Big islands comprise ultramafic rocks, mafic rocks and mafic sediments intercalated with feldspathic sediments and banded iron formations in ascending order. In the St Jones Harbor, it is composed of ultramafic rocks, mafic rocks, banded iron formation, and clastic sediments, intercalated with chert in the middle and with bedded carbonate rocks in the upper part, respectively, in ascending order. In the Shuldham Island, it consists of ultramafic rocks, layered gabbro with precursors of plagioclase and pyroxene accumulation layers, mafic rocks and terrigenous sediments in ascending order. The lithostratigraphies are very similar to oceanic plate stratigraphy. The fact that some supracrustal belts are intruded by Uivak I orthogneisses and presence of >3.86 Ga zircons in the supracrustal rocks [e.g. 3] suggest that the supracrustal belts have early Archean ages. In addition, despite of the still ambiguous relationship between Nanok Gneiss and supracrustal rocks, presence of Nanok Gneiss (3.85 to 3.91 Ga) in this area [5] implies that the supracrustal belts date back to the earliest Archean.

[1] Froude *et al.* (1983) *Nature* **304**, 616-618; Nelson *et al.* (2000) *EPSL* **181**, 89-102; Mojzsis & Harrison (2002) *EPSL* **202**, 563-576; Iizuka *et al.* (2006) *Geology* **34**, 245-248; Wang *et al.* (2007) *CSB* **52**, 3002-3010. [2] Bowring & Williams (1999) *CMP* **134**, 3-16; Nutman *et al.* (1996) *Precamb. Res.* **78**, 1-39; O'Neil *et al.* (2008) *Science* **321**, 1828-1831. [3] Schiøtte *et al.* (1989) *Can Jour Earth Sci.* **26**, 2636-2644. [4] Bridgwater *et al.* (1974) *Geol Surv Canada, Paper* **75-1 Part A**, 282-296. [5] Collerson (1983) in *Abstracts for Early Crustal Genesis Field Workshop, LPI,*