QUARTERLY PROGRESS REPORT

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Title: The Pittsburgh PM Supersite Program: A Multidisciplinary Consortium for Atmospheric Aerosol Research

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Institution: Carnegie Mellon University

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Objectives: Characterization of the atmospheric aerosol in the Pittsburgh region. Development and evaluation current and next generation atmospheric aerosol monitoring techniques. Quantification of the impact of the various sources to the PM concentrations in the area. Elucidation of the links between PM characteristics and their health impacts. Quantification of the relationship between indoor and outdoor concentrations. Study of the responses of the PM characteristics to changes in emissions.

Work Status: The construction of the new air quality laboratory where most of the analysis of the Supersite samples will be performed started in January and is progressing according to schedule. The laboratory will be ready in the middle of March. The construction of the sampling site in Schenley Park was delayed for a few weeks as the City of Pittsburgh and Carnegie Mellon University tried to finalize the details of their legal agreement. The construction will start in the middle of March and it will be completed in the middle of April. This schedule will still allow the Supersite team to start the planned measurements on time in the beginning of May.

The CMU team has performed in January a mini-sampling campaign in a location a hundred yards or so from the "official" sampling site. The results did not indicate any problems because of near-by sources. The development of samplers and techniques is progressing according to schedule. We expect that all the baseline measurements will be ready for deployment by the end of April, in time for the start of the Supersite operations.

A number of additional measurements are added to the original set. The CMU team (Khlystov) has built a steam sampler and combined it with a continuous ammonium detectors developed in the Netherlands. The set-up coupled with a denuder will provide continuous measurements of the gas and aerosol ammonia complimenting the continuous measurements of the other major aerosol components and metals. The technique performed well in the laboratory tests and will be evaluated in the field in March.

The UC Davis team (Wexler) is constructing one of the two single particle mass spectrometers that will be used in the Supersite. All the lead-time items have arrived except for the power supply and turbo pumps. A new turbo pump configuration has been designed and ordered. It consists of two split turbo pumps along with one extra stage on the inlet. This will enable one less pump to be used while decreasing the gas load to the source region. The reduced gas load will keep the machine cleaner and lower the background signal from the gas phase components. The new pumps will arrive in March. The supporting rack has been built. The machine shops are working on the various custom parts. The laser control software has been completed.

A portable instrument for on-line single particle analysis is being constructed at the University of Delaware (Murray) and will be deployed at the Pittsburgh Supersite. This device measures particle size by laser velocimetry and chemical composition by laser ablation ion mobility spectrometry. To perform these functions, the Delaware team is adapting a commercial ultraviolet Aerosol Particle Sizer (UV-APS from TSI, Inc.) for operation with ion mobility spectrometry (IMS). After a particle is detected and sized by laser velocimetry, it is ablated with a high power excimer laser. Positive and negative ions produced by the ablation process are characterized by mobility analysis. The mobility tubes and excimer laser are directly attached to the UV-APS. The entire instrument, called an APS-IMS, fits on a cart that can be easily

transported in the back of a standard minivan. Since the mobility tubes operate at near atmospheric pressure, high-vacuum pumps are not needed. The anticipated advantages of this approach are 1) increased portability for on-site analysis, 2) improved sizing and characterization of particles between 0.5 and 10 micrometers in diameter. The potential disadvantages of this approach are 1) the inability to characterize particles below about 0.3 micrometer in diameter and 2) less certainty (relative to mass spectrometry) for ion determination and hence chemical characterization. Our plan is to test the instrument in the summer of 2001 along side the laser ablation mass spectrometer (RSMS III) that will be deployed by UC Davis for ultrafine particle analysis. Once the capabilities of the APS-IMS are well understood, the device will be deployed in subsequent measurement venues that exploit its advantages.

The Rogge team has updated their standard operating procedure for organic sample collection and handling, and is getting their laboratory upgraded to handle the speciation of the organic aerosol samples from the Supersite. Target compounds have been selected according to their suitability to serve as organic marker compounds for source/receptor reconciliation. As far as possible, standard compounds for the target compounds are searched for and being acquired.

The University of Colorado (Hernandez) is responsible to the Pittsburgh Supersite for providing selected bioaerosol analysis of PM materials (termed PM_{bio}) collected during multi-season sampling campaigns. During this quarter, the team finalized the SOP and protocol(s) used to analyze PM material collected at the site; this required careful and extensive synchronization with the Rutgers team operating the high-volume sampler, as well as obtaining cooperative agreements at the University of Colorado's Biochemistry Department, which hosts specialized analytical equipment that will be used for Endotoxin analysis. To ensure that all analytical equipment is working properly, and that our research group is ready to handle the large volume of PM samples that will be collected at the Supersite, we have begun "mock" analytical trials using quartz PM_x filters provided by the Rutgers group, as well as on urban bioaerosol samples collected in the Denver metropolitan area. This "mock" analytical series will help us determine recovery and detection limits for the sampling campaign at Pittsburgh (no information is currently available regarding the recovery and detection limits for the PM_{bio} analysis proposed).

The Rutgers University group (Turpin) will bring and install their $PM_{2.5}$ HiVol sampler in April. We have checked the plumbing and calibrated the orifice meter that we will use for flow calibrations. We are working on getting a Gast pump to replace the HiVol motor and prevent potential motor emissions. HiVol samples will be analyzed by thermal optical transmittance for OC and EC and then will be extracted. The extract will be separated by polarity into approximately 4 fractions in a silica gel column. Each fraction will be taken to dryness, weighed, an FTIR spectrum taken, and analyzed for OC and EC. An OC/EC mass balance will be conducted by also analyzing the remaining carbon on the filter. This method was developed last year as an undergraduate thesis. Further method refinements are ongoing. These measurements will enable us to better characterize the organic aerosol and obtain values for the average molecular weight per carbon weight. Our original plan was to analyze composites of daily samples. We are currently looking for additional funding to analyze each daily sample. This would provide valuable data that can be used in the epidemiological assessments. Sunset Labs has now commercialized our in situ carbon analyzer. We have one of these instruments. We have tested it for one week in Seattle in January. Our plan is to run our original instrument and the new Sunset Labs instrument side by side in New Jersey in May, and bring the Sunset labs instrument to Pittsburgh towards the end of June, in time for the first intensive. The original instrument has been operated during the Southern California Air Quality Study and the Atlanta Supersite. The Sunset Labs electronics are much improved over our original instrument and it is small and easy to transport. So far, we are very happy with it. The only technical change in the instrument is that this instrument only has one port, and therefore a denuder is used to substantially reduce the adsorption of vapors on the quartz sampling filter, rather than measuring the adsorption artifact measured in a parallel port containing a Teflon followed by a quartz filter. We have calibrated all flows, performed leak checks, measured the calibration loop volume, run instrument blanks, independent standards, dynamic blanks, and samples. The dynamic blanks are run with a Teflon filter in front of the denuder to remove the particles, so the denuder "sees" particle-free ambient air and the instrument only measures the organic vapors that are not removed by the denuder and adsorb to the sampling filter. The dynamic blank was consistently around 0.3 micrograms. Our experiments to date indicate that this instrument will work well in Pittsburgh. We are thinking about the possibility that we might, at some point during the

experiment, be able to put 2-3 carbon analyzers in the field along the wind direction (up and downwind of the main site) to examine the evolution of the organic aerosol with atmospheric transit.

Changes in Key Personnel Involved in the Project: A new post-doctoral researcher, Dr. Lars Angenent, was hired this quarter by the University of Colorado group to supervise and execute all the PM_{bio} assays designated for the coming sampling campaigns.

Expenditures to Date: During the year of the project the Supersite team has used approximately 90% of the budget for the corresponding period.

Quality Assurance Requirements: The Quality Assurance/Quality Control plans for the project are coordinated with the other six Supersites and EPA. The QAPP for the project will be sent to EPA in March of 2001. Drs. Suzanne Hering and Cliff Davidson are currently managing the QA/QC activities of the project.

Planned Activity for the Subsequent Reporting Period: Major activities planned for the fifth quarter of the project include:

- Completion of the central sampling site preparation.
- Completion of the construction of the Air Quality Laboratory and the corresponding clean rooms.
- Completion of the construction of the single particle mass spectrometer by the Wexler group
- Multi-day pilot studies in the central sampling location to inter-compare the different samplers and techniques.

Supplemental Key Words: Airborne particulate matter, aerosol, size distribution, ultrafine, fine and coarse particles, atmospheric chemistry, source-receptor, measurement error, study design, epidemiology, regional modeling, source/receptor analysis, Pittsburgh, Ohio River Valley, Western Pennsylvania, photochemistry, meteorology, trajectory modeling, peroxides.

Relevant Web Sites: homer.cheme.cmu.edu