**State of California**
**AIR RESOURCES BOARD**

**Joint Meeting with the Board and the Research Screening Committee to present the Planned Air Pollution Research, Fiscal Year 2003/2004**

**Cal/EPA Headquarters Building**
**1001 I Street**
**Conference Room 550**
**Sacramento, California 95814**
**(916) 445-0753**
**November 20, 2003**
**9:00 a.m.**

**ADVANCE AGENDA**

## Requests for Proposals

**1. "Climate Change - Characterization of Black Carbon and Organic Carbon Air Pollution Emissions and Evaluation of Measurement Method," $450,000.**

The ARB is required under AB 1493 to adopt regulations that reduce greenhouse gas emissions from motor vehicles. However, particulate emissions are also believed to play a significant role in global warming. Highly absorbing aerosols, such as soot, are so highly efficient as light absorbers that their net radiative impact could result in a net warming of the climate system. Other commonly found aerosols, such as mineral dust or weakly absorbing organic species, exhibit a delicate balance between cooling and warming that varies with their precise and highly variable chemical composition and other factors. Aside from the direct radiative warming effect, these vast quantities of atmospheric aerosols (which can exceed the accumulated impact of greenhouse gases) can reduce rainfall by "burn off" cloud cover, causing further radiative and hydrological feedbacks. Thus the climatic role of aerosols has been shown to be far more profound, complex, and wide reaching than was believed only a few years ago. For the purposes of climate change emissions inventories, black carbon is defined as the carbon component of particulate matter that absorbs light. However, this specific component of particulate matter is difficult to measure. Most measurements of light-absorbing carbon are not well related, and consensus on interpretation has not yet been reached for the current suite of available measurement techniques. This project will compare and contrast results from laboratory and an ambient air field study of particulate carbon testing/sampling using optical and filter-based sampling techniques. This project will also clarify the role of different combustion processes in determining

emission rates of black carbon (BC) and organic carbon (OC) to the atmosphere including the uncertainty inherent in these factors. A comprehensive review of literature on combustion processes and source characterization will be included to support the selected emission factors. This project will result in an improved understanding of the effect of different combustion sources and their particle emissions, in particular BC and OC, on air pollution and climate change. This solicitation has been developed in response to recommendations of the ARB's Research Screening Committee.

**Interagency Proposals**

**2. Polycyclic Aromatic Hydrocarbons (PAHS) as Sources of Ambient Quinones," University of California, Riverside, $120,000, Proposal No. 2539-232.**

Exposure to fine particulate matter in ambient air has been associated with high rates of morbidity and mortality from cardiorespiratory disease. Although the mechanisms are not established, researchers have theorized that quinones residing on the particles may play a large role in the health impacts. After inhalation, quinones can generate large amounts of toxic 'reactive oxygen species' that can overwhelm cellular defenses. PAH-quinones, which are formed from atmospheric reactions of polycyclic aromatic compounds (PAHs) present in vehicle exhaust, therefore may have significant consequences for the health of Californians. In order to understand the extent of PAH-quinone formation in ambient air, PAHs will be chosen based upon their abundance in ambient air, and photolyzed in an environmental chamber. Reaction products will be analyzed, with an emphasis on quinones. This study will provide data needed for future assessments of the human health risk associated with atmospheric reactions of traffic-derived PAHs. This study will also complement research currently underway by the Southern California Particle Center and Supersite (SCPCS) on the quinone health hypotheses and related exposure modeling.

**3. "Effect of GSTM1 Genotype on Ozone-Induced Allergic Airway Inflammation," University of California, San Francisco, $448,717, Proposal No. 2541-232.**

Epidemiological data suggest that asthmatics may be more sensitive to ozone ($O_3$) than nonasthmatics. Animal studies provide evidence that that $O_3$ can enhance allergic inflammatory responses in the lungs. Controlled studies of the airway inflammatory responses of allergic asthmatics to $O_3$ suggest that $O_3$ can enhance both early and late bronchoconstrictor responses to inhaled antigen in some, but not all, allergic asthmatics. Data also indicate that allelic variants of several genes that regulate aspects of defense against and repair from oxidative stress in airway cells may affect responses to $O_3$ exposure. One particular gene, GSTM1, which codes for the antioxidant enzyme glutathione S-transferase, has been implicated in protection from and repair of oxidative stress damage to

airway tissue. This study has two objectives: (1) To determine whether $O_3$ exposure enhances specific lower airway inflammatory responses of asthmatic subjects during late-phase reactions to inhaled allergen, and (2) to determine whether the GSTM1 genotype is an important predictor of susceptibility to develop enhanced late-phase reactions to allergen challenge after $O_3$ exposure. Thirty mild-moderate allergic asthmatics will be exposed for 4-hours with moderate intermittent exercise to filtered air and 0.16 ppm $O_3$. Subjects will be exposed to both conditions with the experiments separated by at least 3 weeks. Subjects will be genotyped for GSTM1, and 50% of the participants will have the null genotype. They will also be genotyped for GSTP1, GSTT1, NQO1 ser187 variants, SOD2, GPX1 and catalase, the results of which will be used in exploratory analyses of the role of these genetic factors in allergic airway inflammation with $O_3$ exposure. Eighteen hours after each exposure subjects will undergo local endobronchial allergen challenge, followed six hours later by bronchoscopy with bronchoalveolar lavage to collect samples of airway lining fluid and cells. Dependent variables will include cell distribution in bronchoalveolar lavage fluid, analysis for biochemicals indicative of airway inflammation (total protein, GM-CSF, RANTES, MPO, ECP, tryptase, IL-4, IL-5, IL-8, IL-13), and spirometric pulmonary function. The results of this study will help to better characterize the susceptibility of asthmatics to $O_3$ exposure, clarify whether $O_3$ enhances allergen-induced airway inflammation, and help to explain the wide variability in responses of asthmatics to $O_3$.

4. **"The Use of Multi-Isotope Ratio Measurements and a New and Unique Technique To Resolve NO Transformation, Transport and Nitrate Deposition in the Lake Tahoe Basin," University of California, San Diego, $75,000, Proposal No. 2543-232.**

The world-famous clarity of Lake Tahoe has declined significantly since the mid-1960s due to increased inputs of particulate matter, phosphorus and nitrate. Water runoff containing fertilizers, seepage of contaminated groundwater into the Lake, and direct atmospheric deposition are likely contributors to the loss of clarity of Lake Tahoe. The ARB is currently conducting the Lake Tahoe Atmospheric Deposition Study (LTADS) with the goal of developing improved estimates of the annual and seasonal loading of phosphorus, nitrogen, and particulate matter from atmospheric deposition to Lake Tahoe and improved attribution of the in-basin and out-of-basin sources of these materials.

To design effective control strategies which will restore the clarity of the Lake it is important to know what are the sources the inputs to the Lake. This proposal will perform nitrate isotope measurements on both aerosol and Lake water nitrates to identify and quantify the sources and variability of nitrate in the region and to the Lake. Measurements of rain and snow samples can also quantify their potential role in the region for the delivery of nitrates. This new technique has already been demonstrated to be unique in its ability to provide this information and will be a powerful complement to other work being done to support the Total

Maximum Daily Load for Lake Tahoe under development by the Lahontan Regional Water Quality Board and the Nevada Division of Environmental Protection.

**5. "Updated Chemical Mechanisms for Airshed Model Applications," University of California, Riverside, $166,132, Proposal No. 2542-232.**

The gas phase chemical reaction mechanism is a critical component in air quality simulation models. The SAPRC99 atmospheric mechanism, developed in 1999 by Dr. William Carter at the University of California, Riverside, was considered a state-of-the-science mechanism and has been used in many air quality modeling applications. For example, it was employed to develop the reactivity scales for volatile organic compounds (VOCs) for California's reactivity-based regulations (*i.e.,* aerosol coatings regulation). Since the chemical information used in SAPRC99 mechanism is evolving and improving, it is crucial that the mechanism is reviewed and updated periodically. This project is intended to develop and comprehensively evaluate the updated mechanism for use in photochemical airshed models for prediction of secondary gas-phase pollutants (*i.e.,* ozone and air toxics). The updated mechanism will incorporate the most recent laboratory and environmental chamber data, improve representations for aromatics, and develop a capability of representing chlorine chemistry. This project also includes conducting environmental chamber experiments most needed to support this objective and developing a more scientifically based condensed mechanism for model applications requiring high computational efficiency. In addition, this project will incorporate the updated mechanism into a regional air quality model and conduct simulations to compare predictions of the same model and other chemical mechanisms. The results of this project will provide the ARB, other regulatory agencies, and researchers with improved and more up-to-date models for the prediction of secondary pollutants.

**6. "Identification and Atmospheric Reactions of Polar Products of Selected Aromatic Hydrocarbons," University of California, Riverside, $49,999, Proposal No. 2538-232.**

Aromatic hydrocarbons are important precursors to secondary organic aerosols and also play a significant role in the formation of photooxidants in the lower atmosphere. Yet chemical reaction paths, reaction rates, and products for most aromatic hydrocarbons are poorly understood. This lack of knowledge translates into a corresponding weakness in the aromatic mechanism in SAPRC-99, which has been developed by Prof. W. Carter under ARB funding and is used in MIR (maximum incremental reactivity) estimates and airshed model applications. This project addresses these questions through chamber studies of some of the most prevalent aromatic species: toluene, xylenes, trimethylbenzene and naphthalene. For these species, the reaction rates with the hydroxyl radical and the concentrations of the products will be measured. In addition, the atmospheric reaction rates of the products from these reactions with hydroxyl radical will be

measured, along with photolysis rates and the products of these processes. The primary benefit provided by this project would be accurate kinetic and mechanistic data for atmospheric reactions of aromatic hydrocarbons, which will assist in the formulation of more accurate atmospheric chemistry models of air pollution, including the formation of secondary organic aerosols. Such models will also help in the development of effective air pollution control strategies and in assessments of the human health risks associated with aromatic hydrocarbons.

**7. "Traffic Pollution and Children's Health: Refining Estimates of Exposure for the East Bay Children's Respiratory Health Study," Office of Environmental Health Hazard Assessment, $243,854, Proposal No. 2540-232.**

The health impacts of exposure to pollutants from local sources, such as traffic, have not been well characterized. Most epidemiological studies have used pollutant concentrations measured at central monitoring stations, and have drawn conclusions about health effects using these regional scale pollutant concentrations. The main objective of this project is to add to the scant body of literature regarding the health effects of local source pollution (i.e. traffic) by expanding upon an already completed study.

The Office of Environmental Health Hazard Assessment (OEHHA) recently conducted a school-based, cross-sectional epidemiological study (referred to as the East Bay Children's Respiratory Health Study (EBCHRS)) to examine associations between proximity to traffic and respiratory health among children living and attending school at varying distances from high-traffic roadways in Alameda, CA. Pollutant concentrations were increased at schools nearby versus more distant from (or upwind of) major roads, and were associated with both bronchitis and episodes of asthma. Additional neighborhood-scale monitoring was also conducted near several of the schools, but those data have not yet been incorporated into the analysis.

The objective of the proposed study is to expand upon the EBCHRS by refining estimates of exposure to traffic related pollutants through the integration of traffic, air pollution, and time activity data using geographic information (GIS) methods. The results of the proposed study will carry several implications: (1) By reducing measurement error, the investigators will be able to elucidate more clearly the relationships of traffic to respiratory health outcomes among a vulnerable population of children; (2) The investigators will be able to determine the relative importance of different approaches to refining exposure estimates, and in doing so, will provide methodological guidance for future traffic studies; (3) The investigators will address issues of environmental justice for subpopulations who are often highly exposed to traffic, but whose pollutant exposures are not routinely monitored; and (4) Information generated from this study will be useful for both ambient air quality standards and pollution control strategies by identifying vulnerable populations and determining ambient concentrations that are levels of concern for these groups.

## Final Reports

**8. "Collection of Evaporative Emissions Data From Off-Road Equipment," Automotive Testing Laboratories, $ 285,912, Contract No. 00-315.**

This project provided data that supported the regulation for evaporative emissions from off-road equipment that the Board approved in September 2003*. The data allowed the creation of the inventory of evaporative emissions from off-road gasoline-powered equipment. ATL took data on diurnal emissions, hot-soak emissions, and resting losses from a total of 38 pieces of equipment in the categories of lawn and garden, recreational vehicles, commercial equipment (generators), and marine engines. Some units also were tested for running losses and refueling losses. Data were taken with both summer and winter gasolines and at controlled ambient temperatures representing summer and winter.

* "Exhaust and Evaporative Emissions Control Requirements for Small Off-Road Engines Less Than or Equal to 19 Kilowatts and Equipment That Use Such Engines"