Apportionment of Ambient PM$_{10}$ Crustal Component Using SEM Data -Corcoran Fall 2000 Study-
SEM/CCSEM Analysis

• Analytical techniques that provide information on size, morphology and elemental composition on individual particles.
  – SEM: Scanning Electron Microscopy
  – CCSEM: Computer Controlled Scanning Electron Microscopy
Corcoran Fall 2000 Study

- Determine the impact of crustal sources of PM$_{10}$ at six ambient monitoring sites in Corcoran using SEM and CCSEM techniques.
- Assess the extent of contributions from urban and regional sources.
- Conclusions directed toward supporting PM$_{10}$ emissions reduction plans in the State Implementation Plan (SIP).
Sampling Locations

- Samples collected at 6 locations.
  - COP: Corcoran core site
  - GRA: Grain Elevators
  - GRAS: 200 m South of GRA site
  - BAI: Cotton handling area
  - H43: Highway near airport
  - HAN: Hanford (background location)
Map of Corcoran Ambient Sites
BAI Sampling Site
COP Sampling Site
GRA Sampling Site
Corcoran Sampling Site

H43

GRAS
Fall 2000 Corcoran Study
Ambient Concentrations

Collection Date

Concentration (ug/m3)
Project Methodology

- “Bulk” soil (source) samples collected near each ambient monitor.
- PM$_{10}$ samples collected on 37 mm PC filters over 24 hour period using “minivol” samplers operating at 5 l/min.
- Section of as-collected filter place on SEM stub.
- Examined and analyzed using SEM and CCSEM techniques.
Minivol Sampler: 5 l/min

Polycarbonate Filter
Example of SEM Data

Size, Shape/Morphology
Elemental composition
  - Association
  - Identification

• Peak location related to element
• Peak area related to abundance

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SEM/CCSEM Analysis Protocol

- Select Days for Analysis
- Initial SEM Examination
  - Manual SEM screening
- CCSEM Analysis/Data Review
- Detailed Manual SEM Analysis
- Final Data Summary
CCSEM Analysis Methodology

• 2500 particles analyzed per sample.
  – Focus analysis on crustal particles >1\(\mu\)m.
  – Digital images acquired for each particle.

• Particles sorted into classes (particle types) based on individual particle data.
  • Elemental composition + (shape)

• Frequency/mass distributions determined for each class and for total sample.
Particle Type Classification

- Individual particles were classified into one of 25 specific particle type classes based on elemental composition.
- The samples were comprised primarily of earth crustal material rich in silicon and aluminum often containing sodium, magnesium, potassium, calcium and iron either singularly or in combination.
Si/Al/K-rich
Si/Al/Na-rich

7000x

5 µm
Source Apportionment of Corcoran PM$_{10}$ Samples Using the Chemical Mass Balance (CMB) Model
CMB Methodology

- Develop crustal source profiles based on CCSEM analysis of soil samples collected near ambient monitors.
- Ambient samples analyzed using CCSEM.
- Hanford ambient data used as regional background source profile.
- Source and ambient CCSEM data used as input in CMB (version 8) receptor model.
Crustal Results

<table>
<thead>
<tr>
<th>Site</th>
<th>Total</th>
<th>Local Soil</th>
<th>Regional</th>
<th>Unk</th>
<th>Local Soil</th>
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**CMB8 Crustal Results**

### Concentration (g/m³)

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### Percent

- **R²**
- **Chi²**
- **OC**
- **EC**

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**Crustal Results**

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Results

Concentration (µg/m³)

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Carbonaceous Particle Characterization

- Manual SEM analysis was performed on each of the fugitive dust samples in an effort to provide insight on the nature of the carbon-rich particulate.

- Carbon-rich particles have the potential to provide additional information which can be used to distinguish among the sources that have similar inorganic elemental composition.
Vegetative Particles
10-14-00  BAI
Vegetative Particles
10-14-00  BAI
Vegetative Particles
11-9-00 GRA
Vegetative Particles
11-9-00  GRA
Vehicular Particles
11-9-00 GRA
Vegetative Particles
11-11-00  H43
Vegetative Particles
11-11-00  H43

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Conclusions

• Minivols provided samples well suited for SEM/CCSEM analysis.
• CCSEM can be used to effectively apportion the crustal component in ambient PM$_{10}$ samples.
• On average, regional background dust was the dominant crustal source at COP, GRA, GRAS and H43.
• BAI site was attributed to local and regional crustal sources nearly equally.
• Organic carbon component appears composed mainly of vegetative material.
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