and the campfire would start smoldering. The smoke was collected in stainless steel canisters (figure 2) for analysis.

Figure 2—Using canisters to collect gas samples from a simulated campfire for analysis with a gas chromatograph-mass spectrometer.

Organic compounds contain carbon atoms. Inorganic compounds do not.

The Rocky Mountain Research Station's (RMRS) fire chemistry unit in Missoula, MT, used a gas chromatograph-mass spectrometer to analyze the smoke samples. The gas chromatograph-mass spectrometer uses a library with thousands of known signature peaks to identify the organic chemical compounds in each canister. Of the 29 canisters analyzed, two were from the baseline campfires that just burned wood and 27 were from campfires burning specific garbage items in addition to wood.

Ash samples (figure 3) were collected from all the fires and analyzed for 29 inorganic elements. The ash was analyzed by the University of Montana geology department, which used an inductively coupled plasma optical emission-atomic emission spectrometer. The ash samples were dissolved in acid and fed into a plasma unit. Atoms in the plasma emit light with characteristic wavelengths, allowing each element to be identified.

Figure 3—Ash with some yellow residue left after burning four white plastic lids for disposable hot beverage cups.

Campfires with Wood, but No Garbage

Smoke—Many hazardous air pollutants and toxic metals are known to be human carcinogens that may increase the incidence of cancer. Air pollutants may have other effects on human health that are more difficult to measure, such as immunological, neurological, reproductive, developmental, mutagenic, or respiratory effects.

The hazardous air pollutants we measured in campfire smoke that are known to adversely affect human health were: acrolein (2-propenal), acetaldehyde, benzene, furan, naphthalene, styrene, toluene, and xylene. We did not analyze the smoke for toxic metals.