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Characteristics and environmental significance of the minerals in atmospheric dust of Shijiazhuang, China

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Atmospheric pollution in Shijiazhuang of China has attracted wide attention by local government and a number of research groups in recent years. In fact, pollutant source identification is the key scientific question for air pollution control. Therefore, this study is focused on the mineralogical characteristics of atmospheric dust to explore the environmental influences.

Thirty-six samples of atmospheric dust near ground (1.5-2m) and eighteen samples of atmospheric dry and wet deposition (barrels for sample collection were placed on the top of open buildings with height of 5-10m for one year) were collected from different regions in Shijiazhuang. Study by X-Ray Diffraction (XRD) indicated that the mineral compositions of atmospheric dust near ground and the atmospheric dry and wet deposition in the Shijiazhuang region were basically the same, containing primary minerals such as quartz, clay minerals, potash feldspar and plagioclase which were mainly from soil dust and accounted for 70%, and a small amount of calcite, dolomite, hornblende and zeolite, as well as secondary minerals such as gypsum, anhydrite, halite, glauberite, thenardite, pyrite, magnesite, and siderite. Hematite was also determined from more than half of the samples which were mainly collected from the nearby of steel mills and coal-burning enterprises. In addition, the content of gypsum in atmospheric dry and wet deposition was significantly higher than that in the atmospheric dust near ground.

The result of Scanning Electron Microscope with Energy Dispersive X-ray (SEM-EDX) analysis on mineral compositions was consistent with the study of XRD. Based on the EDX spectrum, the content of Pb was extremely high, and O, Si, Al, Fe and Ca were observed as particles with residue shapes and loosen texture in small quantities, which were likely arise from automobile exhaust emissions. SEM photographs showed that the micro-morphology of the atmospheric dust varied with different minerals, such as gypsum occurring as euhedral crystal, calcite with cleavages, clay minerals with lamellar crystallization morphology, hematite appearing a typical spherical shape, and quartz with a round shape in most cases, but also with some angular shape.

Synthesizing the chemical components, the mineral compositions and mineral characteristics, we suggest that its main pollutant source in Shijiazhuang is soil dust and there are other sources such as coal burning dust, exhaust emissions and construction dust. Notably, the appearance of the secondary sulfide minerals implies that the degree of coal desulfurization still remains to improve.