Source apportionment of PM_{10} in the urban-rural fringe area of central Taiwan using chemical properties and Sr-Nd-Pb isotope ratios

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This study aims to investigate chemical characteristics (including PM_{10} mass, water-soluble ions, and bulk compositions) and to trace possible sources of PM_{10} in the urban and rural fringe area of central Taiwan, where the environment is affected by intense industrial activities, such as coal-fired power plants, petrochemical complex, and industrial parks. PM_{10} samples were collected at 6 rural sites in central Taiwan at different wind conditions in wintertime, 2018.

The PM_{10} concentrations are low (15.7-74.0 μg m^{-3}) at low wind-speed conditions (≤ 3 m/s, average wind speed), and have elevated nitrate and sulfate, and EF (enrichment factor, relative to UCC) values of V, Cu, Zn, As, Mo, Sb, and Pb. The Sr-Nd-Pb isotope ratios ($^{87}Sr/^{86}Sr$ = 0.70830-0.71158; ε_{Nd} = -8.5 to -10.6; $^{206}Pb/^{207}Pb$ = 1.144-1.161; $^{208}Pb/^{207}Pb$ = 2.419-2.434) of the collected aerosol particles vary greatly and are significantly different from the natural dusts collected in the Choshui River catchment ($^{87}Sr/^{86}Sr$ = 0.71617-0.71930; ε_{Nd} = -11.1 to -13.1; $^{206}Pb/^{207}Pb$ = 1.174-1.188; $^{208}Pb/^{207}Pb$ = 2.468-2.486). These elemental and isotope data indicate that the PM_{10} samples collected at low wind-speed condition most likely come from the petrochemical complex and vehicle exhaust. In contrast, PM_{10} concentrations are high (42.2-121 μg m^{-3}) at median and high wind-speed conditions (> 3 m/s), and the Sr-Nd-Pb isotope ratios ($^{87}Sr/^{86}Sr$ = 0.71106-0.71468; ε_{Nd} = -10.1 to -11.4; $^{206}Pb/^{207}Pb$ = 1.156-1.168; $^{208}Pb/^{207}Pb$ = 2.428-2.455) shift towards those of the natural end-member, suggesting that natural dusts contributed to PM_{10} when wind speed is strong. The results show the great potential for tracing sources of ariborne particles in the urban-rural fringe area using the Sr-Nd-Pb isotope ratios.