Contribution of fly ash to heavy metal contamination of Chinese croplands revealed with Q-ICP-MS

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China is currently the largest energy consumer in the world, where over 65% of the country's installed electricity capacity is fueled by coal combustion. China is also the world's largest producer and consumer of coal in the world, accounting for nearly half of the world's coal consumption. During the coal combustion process, many toxic by-products, including fly ash containing high concentrations of metals and metalloids, are produced and released from the stacks. These particles can deposit on agricultural land within the vicinity of the power plant, eventually releasing metal contaminants into the soil solution available for plant uptake.

In this study, we determine the contribution of fly ash to Pb contamination of agricultural soils near Yangluo Power Plant (PP), the largest coal-fired power plant (2400 MW capacity) in Hubei Province, China. Soils were collected at two depths (surface and 10 cm) along the preferential wind path from the power plant at 62 sites within a 10 km radius. Furthermore, we were able to obtain fly ash and pulverized coal mix from the Yangluo PP to obtain the isotopic ratios of the two end members considered in the mixing model. Dilute nitric acid extractable Pb was quantified using quadrupole inductively coupled plasma-mass spectrometry (Q-ICP-MS) as a high through-put method (precision 0.1 to 0.3%) for determining the Pb isotope ratios ($^{207}Pb/^{206}Pb$ and $^{208}Pb/^{206}Pb$) of the exchangable fraction. Supervised land use classification was applied to SPOT4 imagery of the study area to determine the total cropland area potentially receiving fly ash deposition from Yangluo PP using a comprehensive dispersion modeling system.

Together, these data can provide insight into the contribution of coal combustion to metal contamination of croplands using a high-throughput stable isotope source tracing method.