

Application of lead isotopic mapping to pollution sources

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Based on great quantity of lead isotopic data of rocks and ores derived from various mantle and crust in Continental China, the major geochemical provinces and their geochemical steep zones, i.e. boundaries, have been established through large scale mapping of lead isotopic vectors. The division of geochemical provinces can not only provide important basis for the paleo-continent reconstruction, geochemical exploration and evaluation of resources, but also can be applied to establishment of environment background and pollution sources. Tracing lead pollution sources and levels must be dependent on well establishment of natural lead isotopic background.

Lead isotopic data indicated that the major lead pollution sources of aerosols in the Eastern China should derive from local Pb-Zn-Cu consumption in various industries. According to the lead isotopic and element data of aeolian dust, aerosol and soil from urban areas in the Pearl River Delta, China, the atmosphere lead pollution should not only come from automobile exhausts but also from industry. There were clearly different lead isotopic compositions for lead from natural background, automobile exhausts and industry. The air pollution of lead in Guangzhou and Foshan showed mixing of two sources from the Fankou Pb-Zn giant deposit and automobile exhaust, and the pollution lead in Foshan is mainly from industry. It was found that the serious lead pollution from automobile exhausts has been incorporated into the soils at least within 10 meters and above the depth of 40 centimeters along the Guang-Fo expressway. The Pb concentration of this pollution is about 10-30 ppm. The study of chemical compositions showed that the pollution lead of automobile exhausts was predominately adsorbed in soils and aerosols. The aeolian dusts were mainly composed of aluminosilicates and metal sulfides or sulfates with different molar fractions, which may imply that the industrial pollution lead in eolian dusts was mainly occurred as sulfides. The source regions of aerosols were probably related to homogenous mixing of multi-sources.

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SF₆ tracers and the subsurface attenuation of nutrients

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The goals of our study were two fold. First, we tested the hypothesis that there existed a hydraulic connection between the surface-groundwater in the suburban area south of Tallahassee, FL and the first magnitude spring, Wakulla Springs located 10 km to the south. Sewage effluent in this suburban area is dominated by septic tank discharge and we wanted to evaluate the potential impact of that source of N to the springs. Wakulla Springs has shown evidence of increased N-loading. The entire area is dominated by a karst limestone terrain overlain by a thin layer of sandy soil.

Our second objective was to test the hypothesis that nitrate attenuation is limited to the thin layer of vadose zone within soils overlying the karst aquifer but that once nitrate reached the aquifer it would behave in a conservative fashion flowing unimpeded towards the Spring.

We added SF₆ tracer directly to two shallow groundwater wells drilled for this study. The tracer was added by pressurizing the wells and directly sparging the aquifer water. We observed the first appearance of the tracer in Wakulla Springs, 10 km to the south after 70 days. The tracer peak occurred after 92 days. Nitrate exhibited a linear relationship with conservative tracer over this distance. No change was observed in nitrate stable isotopes ¹⁵N of ¹⁸O.

We also performed SF₆ tracer tests in well fields installed into the karst aquifer surrounding a septic tank drainfield at a nearby state park. In these studies nitrate and phosphate both exhibited linear relationships with the SF₆ concentration suggesting their conservative behavior within the nearby surrounding aquifer. This indicates no nitrate attenuation in the karst aquifer. The data suggest that the limestone in that vicinity is PO₄ saturated.

Our results indicate that nutrient discharge can influence spring water quality over distances of 10 km. To a regulatory state agency, this is quite important. There was no evidence for nitrate attenuation in the limestone aquifer along that pathway.