Stable isotopic evidence of biodegradation in a landfill site

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Stable isotopes have been routinely used as valuable tools for investigating hydrologic systems and contamination processes. In other to assess contamination of groundwater by a landfill leachate plume, hydrogeochemical and environmental isotope studies were carried out in a municipal landfill site, Korea. Leachates were characterized by high contents of bicarbonates with no sulfates, indicating that large amount of carbon dioxides produced by biodegradation of organic wastes under anoxic environments was added to leachates. Dissolved ions contents of leachates were distinctly higher than those of peripheral groundwaters.

The deuterium isotopic values of leachates were strongly enriched relative to uncontaminated peripheral groundwaters, indicating intensive isotopic reaction with methane gases produced by biodegradation of organic wastes. Some groundwater samples also showed deuterium enrichment, and this indicated that they were severely contaminated by leachate plumes.

Alkalinity showed a positive relationship with carbon isotopic compositions of dissolved inorganic carbons in water samples collected from the study area. Carbon isotopic compositions of dissolved inorganic carbons in leachates were strongly enriched in ¹³C compared to uncontaminated peripheral groundwater, indicating methane production via carbon dioxide reduction. This study shows that stable isotopes can be used as powerful tracers to trace subsurface migration of leachate plumes and to evaluate biodegradation of waste organics by microbial activities.