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Preliminary results of laboratory experiments on the field use of ion exchange resins for environmental sulfur isotope study of soil water

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요 약 문

The "plant root simulator probes" (PRS^{TM}-probes; Western Ag Innovation of Saskatoon) contain a membrane plate of ion-exchange resin within a plastic holding device. The probes have been used to adsorb nutrients directly from a soil in a similar way to how a plant root take up nutrients but are currently used for many scientific researches (http://www.westernag.ca). In order to investigate its potential use for sulfur isotope study of soil water, we performed laboratory scale experiments to examine both the sulfate exchange characteristics and sulfate-sulfur isotope fractionation of the probe in aqueous solution and simulated soil solution. The sulfate-exchange tests in aqueous solution under varying experimental conditions indicated that the sulfate content exchanged onto PRS^{TM}-probe tends to increase with increasing reaction time, initial sulfate concentration, and the number of probes used. However, the percentage of sulfate removal was constant regardless of the initial sulfate concentration because of the ion diffusion in solution. However, the competition of nitrate and chloride in the solution seems to lower the exchanged sulfate concentration. The exchange experiments in a simulated soil solution with variable sulfate concentrations showed that more than 30% of sulfate sorbed onto the test soil was exchanged by the PRS^{TM}-probes after about ten days even in an unsaturated soil state. Although the exchanged sulfate contents vary with the experimental condition, no significant sulfate-sulfur isotope fractionation was observed during exchange reaction. To test the field applicability, the PRS^{TM}-probes were installed at five sites of forest soil in British Columbia, Canada, with the known sulfur isotope composition. The results were very satisfactory. We recommend the use of PRS^{TM}-probes as an efficient and easy way to investigate the sulfur isotope composition of soil water.

key word: sulfur isotope, ion-exchange resin, soil water, sulfur isotope fractionation