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Application of tracer materials in the study of hydrological cycle mechanism

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In this study, the characteristics of hydrogen and oxygen isotopes as well as four kind of ions (K^+ , Na^+ , Ca^{2+} , Mg^{2+}) in rainfall-runoff processes are analyzed through designing an extensible soil water sampler. It is a kind of multipoint sampling installation with the characteristics of synchronous, in-situ and long-term in sampling. The sampling schemes were summarized, including site layout ways, capacities and materials selection, sample pretreatment and storage methods, and valid date. A series of experiments were carried out such as hydrogen and oxygen isotopes memory effects tests, repeatability test and dilution errors analysis. After recognizing the possible error sources in hydrogen and oxygen isotopes as well as the four kind of ions test, the solution on how to improve accuracy and precision were proposed. Moreover, the spatial-temporal evolution laws of the isotopes and cations was discussed by drawing the contour maps of hydrogen and oxygen isotopes as well as the four kind of ions in soil water and underground water. At last, the possibility and applicability of these substances as tracers in hydrological cycles were explored. These work were quite important for researches on coupling mechanism of hydrological and solute transport processes in critical zone.