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Isotope studies in rock phosphates

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Isotope studies comprise tracer experiments and the determination of isotope ratios in fertilizers. So, it is for instance possible to discriminate crops in relation to soil characteristics and fertilizer type which have been labeled with the ^{34}S isotope by calculating δ^{34} S after measuring the ratio of stable $^{34}S/^{32}S$ isotope masses. The determination of the $^{87}Sr/^{86}Sr$ ratio proved to be suitable to distinguish phosphates bound in phosphorites from those in carbonatites. Such discrimination delivers further information about the contamination with heavy metals or rare earth elements which can be beneficiated and taken as raw material for industrial purposes. A major obstacle in fertilizer research is that the effective, long-term utilization of phosphate cannot be determined empirically as P is anisotopic with only one stabile isotope, ^{31}P so that fractionation studies are not feasible. Radioactive P tracers cannot be employed either as the half-live time of ^{33}P is with only 25.3 days and that of ^{32}P 14.3 days too short for long-term experiments. Accordingly, the geological origin of rock phosphates cannot be determined by stable P isotope ratios. Here, the δ^{18} O and activity ratio of $^{234}U/^{238}U$ are used to monitor provenances. It is the objective of this study to outline the current status of isotopic studies in rock phosphates, to summarize the significance of these data and to depict future analytical options in order to enable a proper attribution of the origin of rock phosphates and to follow up fluxes of contaminants in the environment.