









EXPLORING NON-TRADITIONAL METAL(LOID) STABLE ISOTOPE TOOLS FOR AGRICULTURAL SYSTEMS

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D. Uhlig, A. E. Berns, B. Wu, W. Amelung, Plant Soil 2023; 489: 613–628. doi: 10.1007/s11104-023-06047-x Mean nutrient uptake depths of cereal crops change with compost incorporation into subsoil – evidence from ⁸⁷Sr/⁸⁶Sr ratios Cluc. (control + lucerne) + compost + lucerne) Depth range of compost incorporation CF 2 2020 (spring barley, flowering Radiogenic Sr isotope ratio (87 Sr/ 86 Sr) of shoots (panels: (\boldsymbol{a})-(\boldsymbol{c}), (\boldsymbol{g})-(\boldsymbol{j})), and the exchangeable fraction in soil (panels: (d)-(f), (k)-(n)) at the central field trials CF 1–1 and CF 2 in Klein-Altendorf, Germany.

- > The Soil³ subsoiling technique disturbed the radiogenic Sr profiles in soil only marginally.
- > Deep loosening alone resulted in more intense involvement of shallower soil horizons in nutrient upta

D. Uhlig, B. Wu, A. E. Berns, W. Amelung, Chem. Geol. 2022; 611:121114. doi: 10.1016/j.chemgeo.2022.121114

Magnesium stable isotopes as a potential geochemical tool in agronomy –

constraints and opportunities

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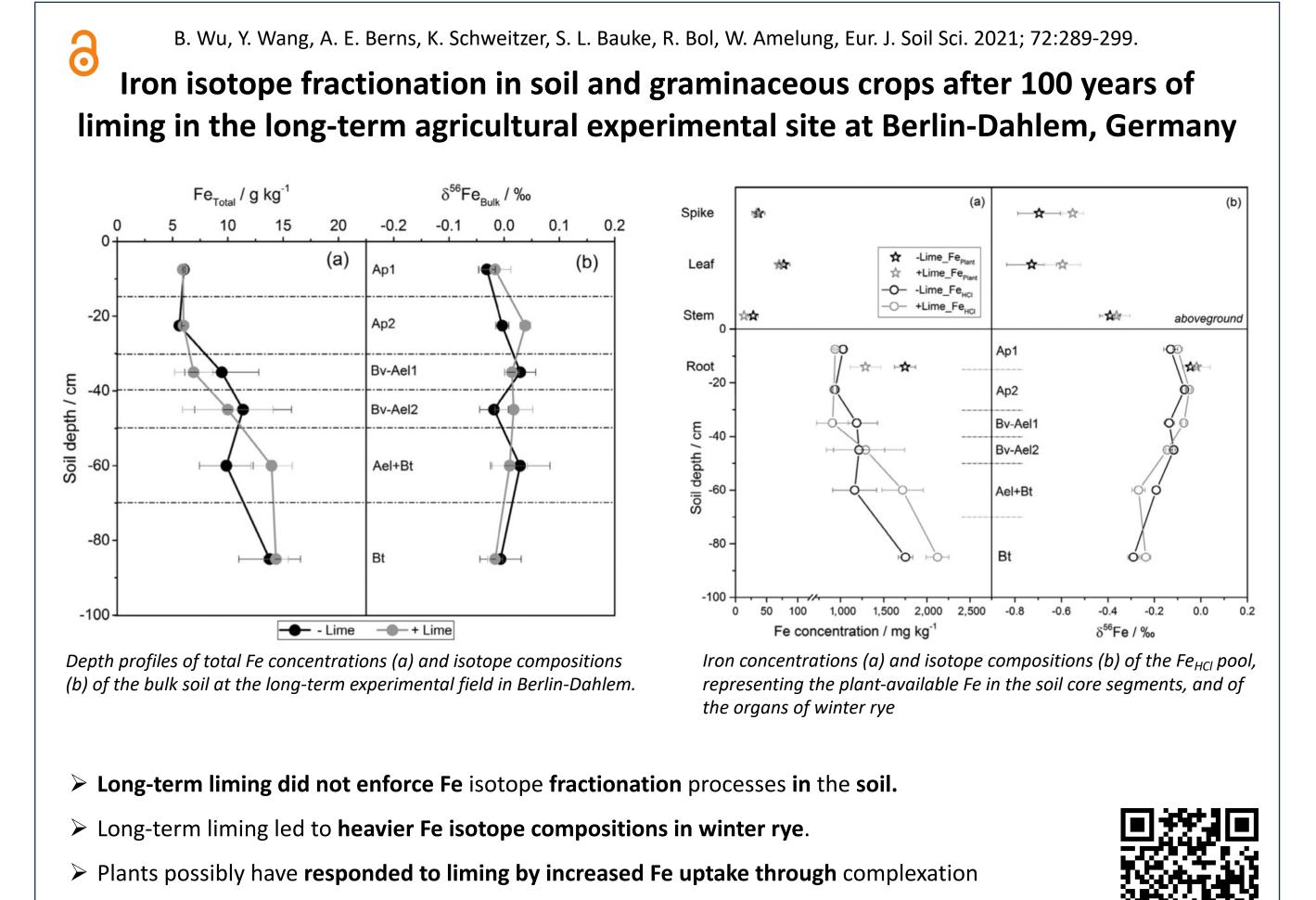
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of Mg isotopes in the soil-plant system

Conceptual representation of the partitioning

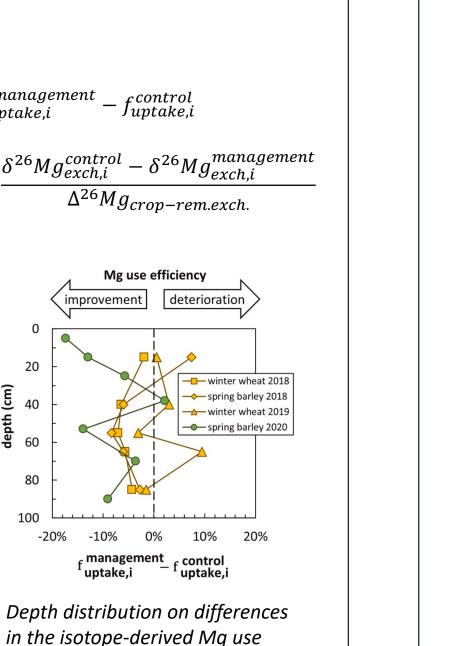
> Deep loosening with compost incorporation deepened the average nutrient uptake depth.





Y. Wang, B. Wu, A. E. Berns, R. Bol, F. Wombacher, F. Ellmer, W. Amelung, Eur. J. Soil Sci. 2021; 72:300–312. A century of liming affects the Mg isotopic composition of the soil and crops in a long-term agricultural field at Berlin-Dahlem, Germany

processes (Strategy II) to counteract the lower solubility of Fe at higher pH values.

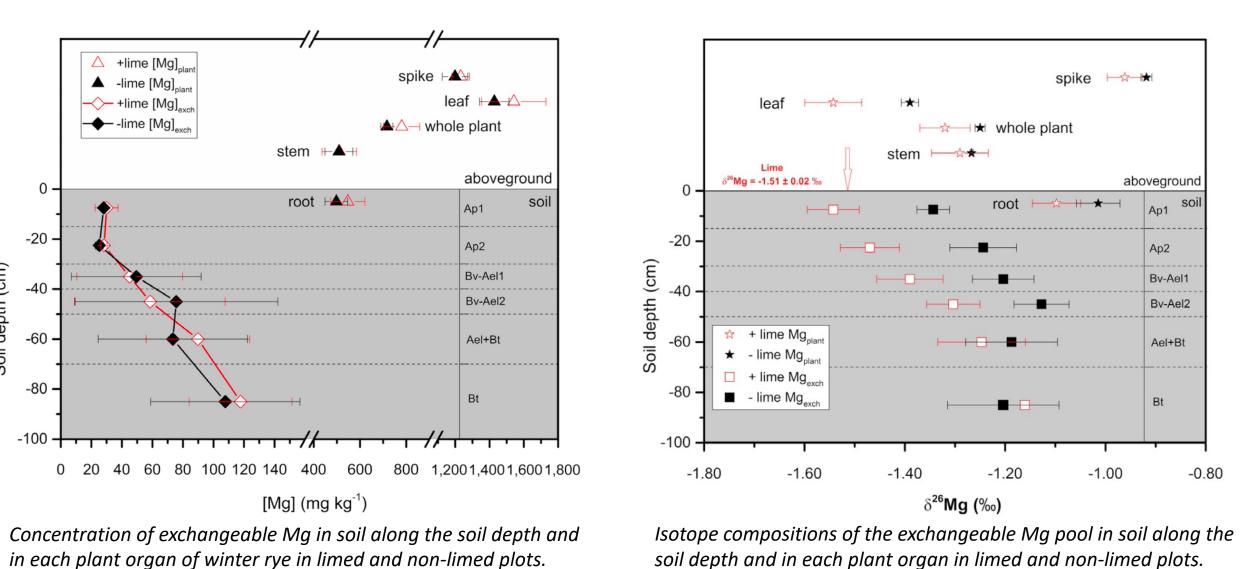


- > A conceptual Mg isotope model was established and positively tested in the field. > Mg use efficiency of crops can solely be quantified from Mg stable isotopes.
- > Lime application limits Mg use efficiency determination solely from Mg isotopes.

Simplified illustration of Mg fluxes and inven-

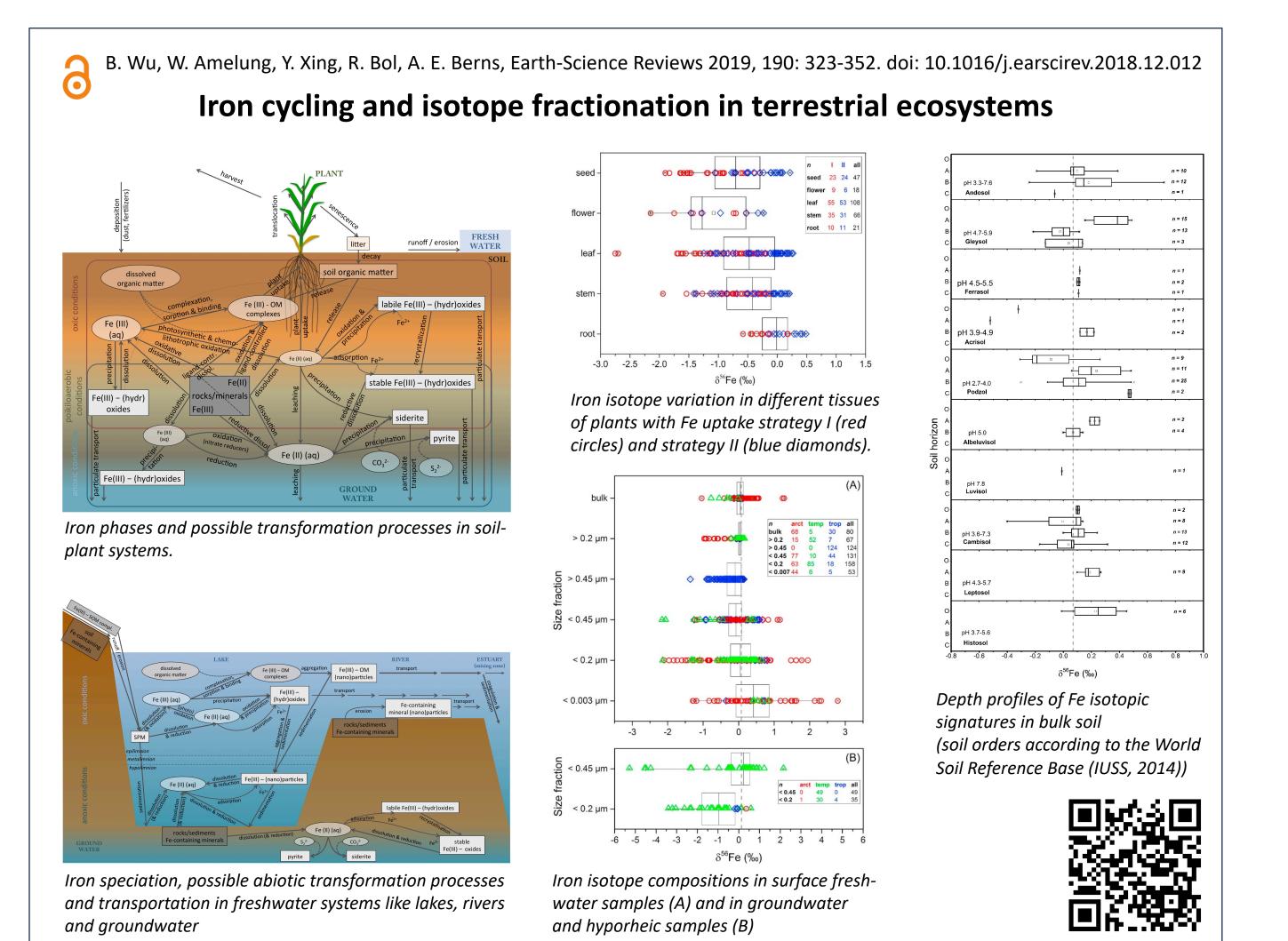
tories in an agricultural soil-plant system

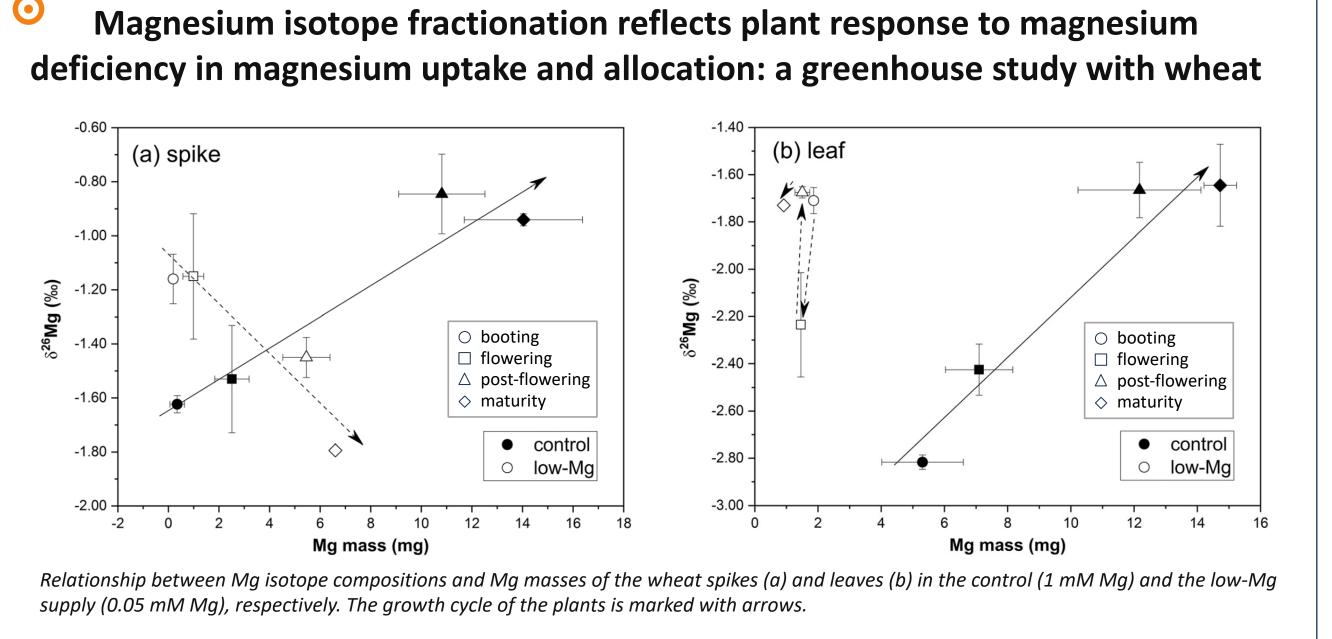
> A criteria catalogue ensures a successful application of Mg isotopes in agronomy.



- ➤ Mg concentrations and stocks were more heterogeneous in subsoils than in topsoils, but **not significantly different** in both treatments
- \triangleright Liming induced a pronounced shift towards lighter δ^{26} Mg values in exchangeable Mg pools down to a soil depth of 50 cm.
- > Isotope mixing model revealed that only 25% of the shift were due to the addition of light isotope from lime, the rest was due to an increased removal of heavy Mg isotopes by plant uptake.







Y. Wang, B. Wu, A. E. Berns, Y. Xing, A. J. Kuhn, W. Amelung, Plant Soil 2020; 455:93–105.

- In the control treatment, both leaves and spikes displayed an enrichment in heavy Mg isotopes during growth In the low-Mg treatment, spikes grew enriched in light Mg isotopes, while Mg content of leaves stagnated with an intermittent increase in light Mg isotopes
- Mg-deficiency caused significant changes in Mg translocation within plants and the shift towards lighter isotopes in the spikes indicated that the Mg source for grain filling differed.
- Mg-deficiency accelerated the process of chlorophyll breakdown and caused an early outflux of lighter Mg isotopes from the leaves.

