Environmental fate of glyphosate analyzed by capillary electrophoresis – mass spectrometry

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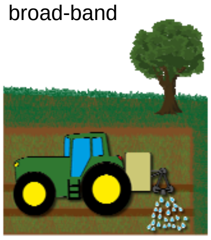
Introduction

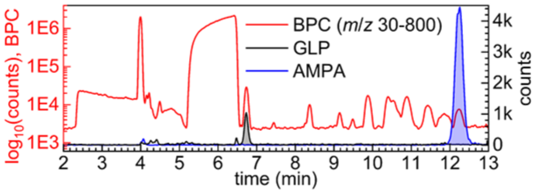
Glyphosate (GLP): most frequently used broad-band herbicide world wide

- applied on plant foliage
- strong sorption onto oxidic soil minerals → **immobilization**
- low bioavailability for microbial degradation
- main degradation product: AMPA (aminomethylphosphonic acid)

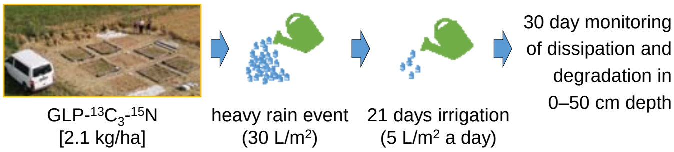


CE-MS method

- Extreme physicochemical properties → incompatible with commonly used multiresidue methods
- derivatization-free method
- BGE buffer at pH 2.8
- separation voltage: –30 kV
- high matrix tolerance
- Q-ToF MS quantification
- LOD: 10 and 30 µg/kg for GLP and AMPA

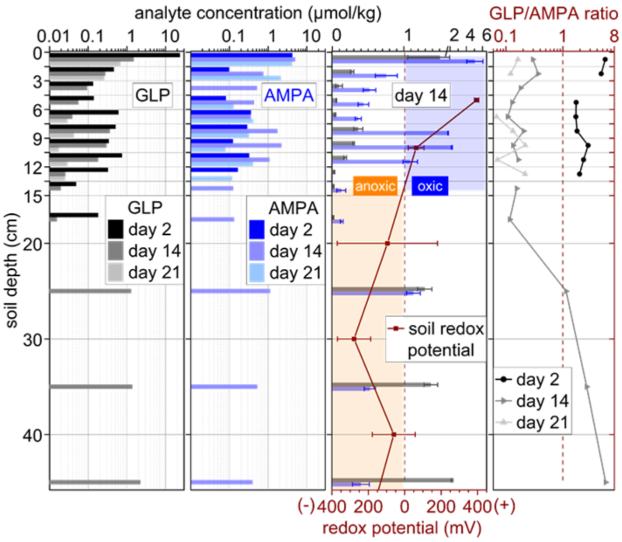


GLP mobility in soils

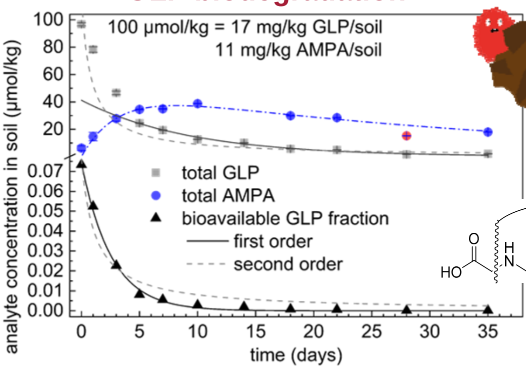


- minor dissipation into deeper soil zones by **particle-facilitated transport**:
  - root canals (15 cm depth)
  - shrinkage cracks (>50 cm depth)
- shrinkage cracks (day 14) cause increasing GLP concentrations in greater depths (GLP/AMPA-ratio similar to day 2)

→ **low GLP degradation due to anoxic redox potential**



GLP biodegradation

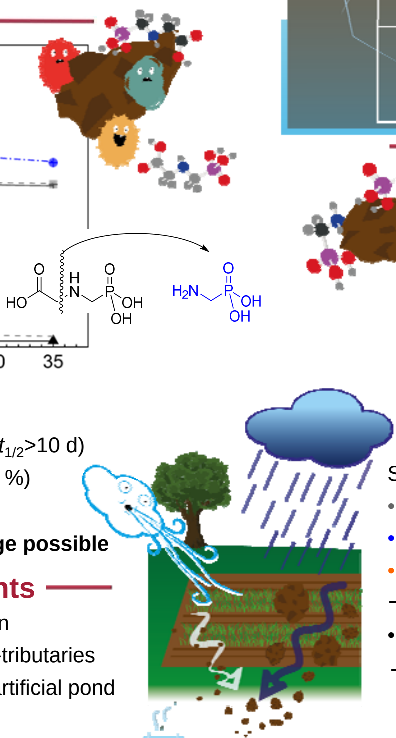


Complex degradation kinetics:

>3 mg/kg: fast ($t_{1/2}$<5 d) or <3 mg/kg: slower ($t_{1/2}$>10 d)

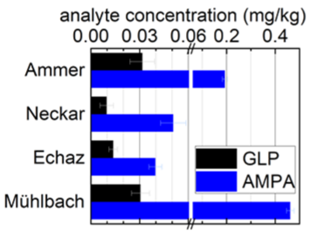
- isotherm data unveil strong sorption (>99.9 %)
- considering bioavailable GLP fraction only:

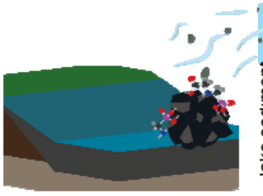
→ **single fit over a large concentration range possible**

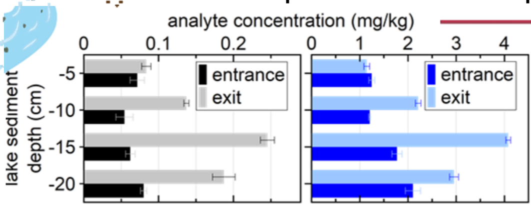


GLP in aquatic sediments

- Sampling area: Ammer Valley and Tübingen
- cannal and stream sediments from Neckar-tributaries
- sediment cores from inlet and outlet in an artificial pond



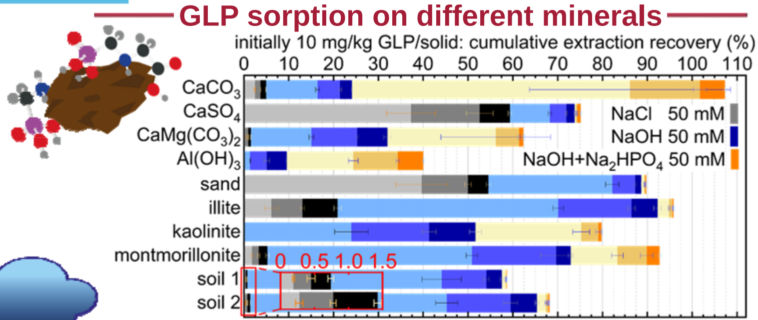




- 4 of 7 river sediments tested positive
- bottom sediment layer from pond may originate from the 1980s

→ **GLP and AMPA are potential legacy compounds**

GLP sorption on different minerals



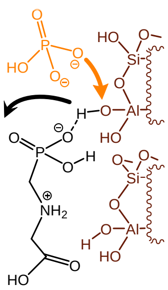
Sequential extraction revealed different GLP pools:

- saline extraction: readily desorbable GLP
- NaOH extracts: semi-strong sorption
- NaOH and phosphate: most of residual GLP

→ phosphate competes with GLP to binding sites

- low recoveries from Al-OH containing minerals

→ **results aid understanding GLP mobilization in the environment upon P-fertilization and particle-facilitated transport**



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