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Turnover of Diffuse Pollutants on the Catchment Scale

Biogeochemical Transformation of Phosphorus between the Groundwater and Sediments in Floodplain Aquifers

Wen Shao[a], H. Neidhardt[a], S. Martin[b], C. Nagel[a], Y. Li[a,c], Y. Oelmann[a]

[a] Geoecology, Eberhard Karls University Tübingen, Germany

[b] Center for Applied Geoscience, Eberhard Karls University Tübingen, Germany

[c] Department of Water Resources and Environment, China University of Geosciences, PR China

Background: Elevated Phosphorus (P) concentrations of up to 0.61 mg L^{-1} have been recently found in groundwater of the Ammer floodplain near Tübingen.

Objective: Investigate potential sources and biogeochemical processes of phosphate in the floodplain aquifers.

Hypotheses and Research Questions:

- ❖ H1: Inorganic phosphate (PO_4^{3-}) represents the dominant P species in Ammer valley's aquifer.
- ❖ The elevated P in groundwater is mainly derived by *in-situ* reductive release from minerals in the sediments.
- ➢ Q1: Are there changes in biogeochemical P cycling over time?
- ➢ Q2: How much P does sediment contribute to groundwater?

Study sites & Methods:

- ❑ Groundwater samples collected from the Ammer floodplain, including shallow (3-7 m bls, n=26) and deep aquifers (7-16 m bls, n=16).
- ❑ Monitoring major and trace elements in the groundwater. Characterization of total dissolved P in groundwater and P pools in aquifer sediments.
- ❑ Analyzing the O isotope signature of PO_4^{3-} ($\delta^{18}O_{PO4}$) in groundwater and aquifer materials (after Joshi et al. 2015 and Neidhardt et al. 2018).

Fig. 2: Simplified flowchart of $\delta^{18}O_{PO4}$ measurement: (a) the groundwater samples are collected from wells on the catchment, (b) and then go through a series of concentration and purification, (c) finally be measured by isotope-ratio mass spectrometer (IRMS).

Results:

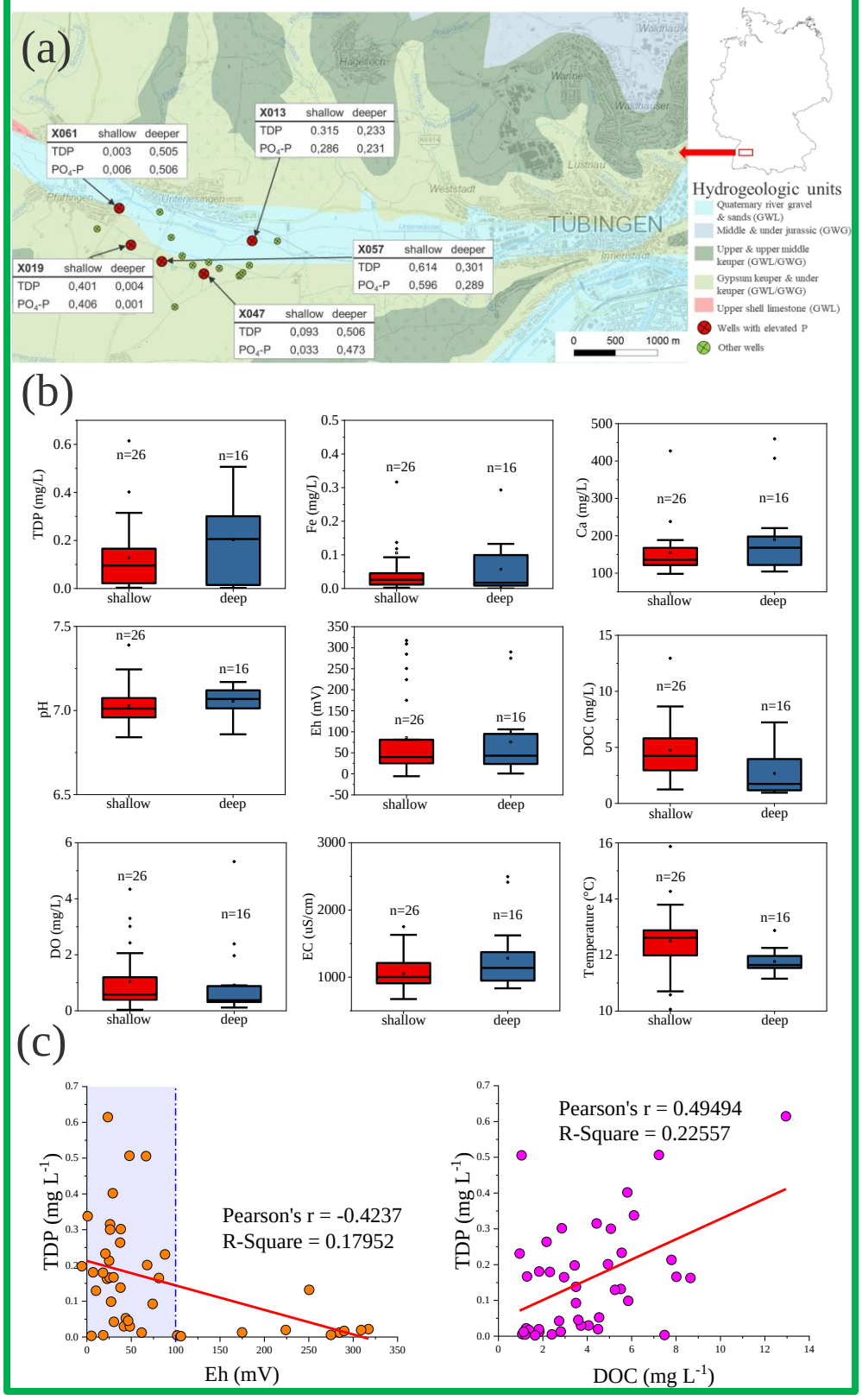

Fig. 1: Study areas in the Ammer floodplain. (a): For some of the sampling sites, high concentrations (mg L^{-1}) of total dissolved P (TDP) and dissolved inorganic phosphate as phosphorus (PO_4-P) are depicted in red points, other wells are depicted in green. (b): Physico-chemical characteristics of groundwater in different aquifers. (c) The relationship of TDP with redox potential (Eh) and dissolved organic carbon (DOC) for all well sites.

Literature:

1) Neidhardt et al. 2018: Biogeochemical phosphorus cycling in groundwater ecosystems – Insights from South and Southeast Asian floodplain and delta aquifers. Sci. Total. Environ. 644: 1357-1370.

2) Joshi et al. 2015: Organic matter remineralization predominates phosphorus cycling in the mid-bay sediments in the Chesapeake Bay. Environ. Sci. Technol. 49: 5887-5896.

3) Neidhardt et al. 2019: Phosphorus Pool Composition in Soils and Sediments of Transitional Ecotones under the Influence of Agriculture. J. Environ. Qual. 48: 1325-1335.

EBERHARD KARLS UNIVERSITÄT TÜBINGEN

M.Sc. Wen Shao, Geoecology
wen.shao@student.uni-tuebingen.de

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