Copper isotopic fractionation in paddy soils of Suzhou, China

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During rice-growing period in paddy soils, seasonal flooding and drying processes dominate redox conditions, elemental transportation, and mineral evolution in soils. Copper isotopes can be used to investigate the behaviour of Cu in paddy soils because they can be fractionated during adsorption, secondary mineral precipitation, and redox reactions.

Soil samples in this study were collected from a 2.6m vertical paddy soil profile from Suzhou, located in the lower reaches of the Yangtze River of China. It includes an anthrostagnic epipedon (0-28cm), a hydragric horizon (28-205cm), and a gley horizon (205-260cm). Samples were intensively collected every 3-5 cm through the profile to monitor Cu concentrations and isotopic variations along the profile. Copper isotopes were analysed by MC-ICP-MS, and the precision is better than ±0.05‰ (2sd).

Except the two top samples containing the rice roots which likely uptake light Cu isotopes [e.g. 1-2], δ^{65}Cu of soils above 70cm vary slightly from 0.15 to 0.25‰, decrease from 0.15‰ to -0.20‰ at 70-100 cm, keep constant (~ -0.05‰) at 110-190cm, and then decrease again from -0.05‰ to -0.35‰ at 200-250cm. δ^{65}Cu are not strongly correlated with Cu concentrations, Eh, and total organic carbon (TOC) of the soil profile, but they show a nice negative correlation with δ^{56}Fe. This indicates that the variation of δ^{65}Cu in the paddy soil profile was affected by redox processes which also controlled Fe isotope fractionations ($Cu^{2+} + Fe^{2+} = Cu^{+} + Fe^{3+}$). It possible that ^{65}Cu is enriched in aqueous phase while ^{63}Cu prefers to precipitate in secondary minerals as immobile Cu (I) species [e.g. 3-4].

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