# Kinetic benchmarking of Fe mineral-catalyzed P recycling from ribonucleotides

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Plants and microorganisms solely rely on dissolved inorganic phosphate ($P_i$) as their bioavailable phosphorus (P) source. Despite the widespread presence of P-containing organic molecules ($P_o$) in soils, what controls the turnover of $P_o$ to $P_i$ remains unknown. This P recycling can potentially represent an important component in nutrient cycling. Iron (Fe) (oxyhydr)oxide minerals, which are ubiquitous in natural soils, are known to serve as P sinks by adsorbing both $P_i$ and $P_o$. In addition to adsorption, these Fe minerals have been reported to catalyze hydrolysis of $P_o$ including synthetic $P_o$ [1], sugar phosphates [2], and ribonucleotides [3].

The kinetics of this mineral-catalyzed $P_o$ hydrolysis is not well understood. Here, we investigate the kinetic parameters for the reactivity of goethite and hematite to catalyze the release of $P_i$ from two ribonucleotide structures (Fig. 1). To parameterize the catalytic efficiency, we determined the maximum rate of catalysis ($V_{max}$) and the catalytic rate constant ($k_{cat}$) normalized to measured surface sites for $P_i$. To account for both solution $P_i$ and mineral surface-bound $P_i$ recycled from the ribonucleotides, we applied high-resolution liquid chromatography-mass spectrometry to measure unreacted and reacted organic species. We found that the catalytic efficiency of Fe-oxide minerals for P recycling is dependent both on the mineral type and the ribonucleotide structure (Fig. 1). Our findings shed light on the role of organic matter as a potential source of $P_i$ widely found to be in close associations with Fe-oxide minerals in soils.

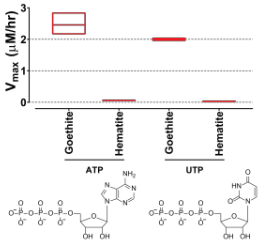


**Figure 1**. $V_{max}$ values for mineral-catalyzed $P_i$ recycled from adenosine triphosphate (ATP) and uridine triphosphate (UTP).

[1] Baldwin *et al.*(1995), *Environ.Sci.Technol.*29,1706-1709.
[2] Olsson *et al.*(2010), *Langmuir.*26, 18760-18770.
[3] Klein *et al.*(2019), *J. Colloid Interface Sci.*547, 171-182.