Iodide uptake by forest soils is principally related to the activity of extracellular oxidases

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Iodine-129 is a nuclear fission decay product of concern because of its long half-life (16 Ma) and propensity to bioaccumulte. Historically, ^{129}I was assumed to exist primarily as iodide (I^-) in terrestrial enviornments, but recent studies have clearly demonstrated that iodate (IO^{3-}) and organo-iodine comprise a significant fraction of ^{129}I species in soils. Biotic processes are thought to be a primary driver of iodination of soil organic matter. Here we examined iodide uptake by soils collected at two depths (0-10 and 10-20 cm) from 5 decidious and coniferous forests in Japan and United States. Autoclaved soils, and soils amended with an enzyme inhibitor (sodium azide) or an antibacterial agent (bronopol), exhibited significantly less uptake of the I-125 tracer (93.81%, 81.18%, 61.16% decrease; respectively) than the untreated control, confirming a biotic role in soil iodide uptake. Oxidase enzyme activities measured at pH 7 using the substrate L-DOPA exhibited the strongest correlation with iodide uptake (p= 5.6E-06), followed by the substrate ABTS at pH 5.5 (p= 4.0E-05), *Actinomycetes* biomass (p= 1.7E-04; measured via phospholipid fatty acid analysis) and soil nitrogen content (p= 5.0E-04). Significant differences in the relationships between I-125 uptake and soil enzyme activity or biomass measures were not observed based on forest type, soil type, location or soil depth. Together, measurements of L-DOPA oxidation and *Actinomycetes* biomass accounted for 75% of the variation in I-125 uptake results by these forest soils (addition of ABTS measurements improves the explanatory power to 82%).