Can sulfur limit arsenic uptake by rice in paddy soils?

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Human exposure to arsenic through rice consumption is an increasing health concern. High sulfur paddy soils may decrease total uptake and grain concentration of As in rice, but a mechanistic understanding of the inhibition process is lacking. Here we disentangle the fate-controlling processes of sulfur that affect As within the rice rhizosphere in order to determine their relative importance on As uptake. We use a multiple scale approach, combining plant-soil system experiments and bulk analyses with micro-scale observations and single component tests. Within a pot trial using As-containing Cambodian Ultisol, we examined the effect of gypsum addition and the following organic amendments on arsenic uptake: rice husks (charred or dried), rice straw (charred or dried) or cattle manure. We monitored pore water chemistry through extraction with rhizosamplers and analyzed total As uptake in different parts of the rice plant. In addition, we studied bulk As, Fe and S speciation in the soils before and after the experiment and mapped As and S speciation in the intact rhizosphere of selected roots. Differences in treatment effects between the soils occurred, with addition of organic matter increasing dissolved As concentrations in all cases except for charred straw in one soil. Gypsum addition only decreased As mobility in one soil, suggesting that the sulfur control on As uptake in rice is non-universal.