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Understanding microbial arsenic-release at two, hydro-geologically contrasting aquifers in Kandal Province, Cambodia

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Understanding microbial arsenic release in two, hydro-geologically contrasting aquifers in Kandal Province, Cambodia

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It is estimated that between 94 and 220 million people are affected globally by arsenic contamination of drinking water, a significant portion of whom reside in Southeast Asia [1]. In the alluvial and deltaic aquifers of this region, it is widely accepted that arsenic release occurs via microbial reduction of arsenic-bearing iron (oxy)hydroxides [2]. Despite many studies in the last two decades, the bioavailability of specific electron donors driving arsenic release remains poorly understood. Historic studies have suggested the importance of transported[3] vs in-situ aquifer organic matter [4,5], and more recently methane has been identified as a potential electron donor [6].

Our work focuses on two hydro-geologically contrasting aquifers (one clay-dominated, characterised by slower recharge rates; one sand-dominated, characterised by faster recharge rates) in Kandal Province, Cambodia, which have been characterised in detail previously [7,8]. We aimed to further understand the Fe(III)/As(V)-bio-reduction processes via incubation of indigenous aquifer microbial communities collected (in-situ) on simplified mineral phases. This work was complemented by analyses of the composition of dissolved organic matter (DOM) in aquifer samples, by application of excitation emission matrix (EEM) and Fourier transform ion cyclotron resonance mass spectrometry (FTICR-MS). Key discussion points are the contrast between the two sites; and the relationships between microbial communities, DOM-composition (and role as electron donors, electron shuttles, and complexants), methane (as an alternative electron donor), and ultimately arsenic release.

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