

Arsenic and manganese contamination in Cambodia: relation to 'micro-topography'?

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Arsenic contamination of groundwater in Cambodia was recently identified. Similar to other areas of South-East Asia, millions of rural families have installed a private tube-well for their daily water needs. This study presents the results of a survey conducted in 2004, comprising 131 groundwater samples that were collected randomly from tube-wells in the rural floodplain south of the Cambodian capital Phnom Penh (sampling density ≈ 1 sample per 30 km²). In addition to As, Fe, and Mn, a set of 25 parameters was determined in these groundwaters to shed light on geochemical factors leading to As and Mn contamination. With an overall average of 163 $\mu\text{g L}^{-1}$, the As levels varied from 1–1340 $\mu\text{g L}^{-1}$, with 48% of the tube-wells exceeding 10 $\mu\text{g L}^{-1}$. The occurrence of elevated As concentrations is sharply restricted to the close vicinity of the Bassac and Mekong River banks and the alluvium braided by these rivers (Kandal Province). Arsenic levels in this highly affected area averaged at 232 $\mu\text{g L}^{-1}$ (n = 90, median 100 $\mu\text{g L}^{-1}$), while concentrations to the west and east of the rivers were below the WHO guideline value of 10 $\mu\text{g L}^{-1}$ (9 $\mu\text{g L}^{-1}$ west of Bassac, n=25; 3 $\mu\text{g L}^{-1}$ east of Mekong, n = 16). The high As levels are predominantly caused by reductive dissolution of metal oxides leading to subsequent As release from Holocene sediments between the Mekong and Bassac Rivers, and, to a lesser degree enhanced by pH values ≥ 7 . Low groundwater As concentrations are associated with topography featuring gently increasing elevation to the west and east of a shallow valley. Despite its low As levels, the groundwater west of the Bassac River cannot be considered agreeable for drinking, since 57% of the tubewells showed Mn levels above the WHO guideline value of 0.4 mg L⁻¹, averaging at 1.1 mg L⁻¹ (n = 25, range 0.1–2.6 mg L⁻¹). Elevated Mn concentrations (average 0.6 mg L⁻¹) were also present in the arsenic-affected Kandal Province, posing an additional health threat to the 1.2 million people living in this area. Total hardness has a pronounced west to east gradient.