Arsenic Contamination in Shallow Aquifers of Holocene: A Case Study from Three Union Councils of Tando Muhammad Khan District, Sindh, Pakistan

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Abstract: Groundwater samples (n = 72) were collected from shallow (depth < 30 meters) wells located in three union councils (Lakhat, Sheikh Bhirkyo, Tando Saindad) of Tando Muhammad Khan district. Data reveal that all three union councils are sewage impacted where severity increases in the order of Tando Saindad > Lakhat > Sheikh Bhirkyo. The same order of intensity is reported for As concentration i.e. Tando Saindad (n = 25; range: 10-600 µg/L) >Lakhat (n = 15; range: 20-250 µg/L) >Sheikh Bhirkyo (n = 6; range: 50-100 µg/L) suggesting the strong control of sewage mixing in arsenic release. Tando Saindad union council is worst arsenic affected which is located adjacent to Tando Muhammad Khan city suggesting the transport of anthropogenic contaminants to groundwater system through aquifer recharge. Principal component analysis (PCA) was applied on 15 variables with outcome of four significant factors (F) explaining the 79% of total variance. F1 suggested the intense water sediment interaction as indicated by strong loading (F1 > ± 0.6). F2 revealed the organic matter (natural and sewage derived) decomposition leading to arsenic and fluoride release from host sediments (mainly biotite). F3 strongly supports the prevalence of anoxia which is expressed by strong loading of pH and NO_3. Factor 4 is supporting the widely known mechanism of reductive dissolution of FeOOH which is mainly derived by organic matter respiration by bacteria in the host sediments of shallow aquifers.

Keywords: Holocene, shallow aquifers, anoxia, organic matter, sewage, arsenic.