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Redox Processes in an Alluvial Aquifer Near a River with an Agricultural land use

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ABSTRACT

Biogeochemical characteristics of groundwater was investigated for an alluvial aquifer which composed of sand and silt in a riverine environment with 6 multi-level monitoring wells with depth up to 30m to elucidate redox processes, where paddy fields are developed. Major species, redox-sensitive species and organic carbon were measured. Unstable species are analyzed in the field with portable spectrophotometers. Ca and Mg shows highest concentrations 10 to 20m depth interval. K is high in uppermost zones and decreases with depth. Na increases with depth. The aquifer is largely in an anaerobic conditions with dissolved oxygen less than 2 mg/L for most of wells except for the uppermost zones. Fe(II) ion is characteristically high with concentrations up to 40 mg/L for the interval of 10 to 20m depth with peak concentrations at about 10m depth. Dissolved organic carbon (DOC) which can be used as substrate for microbial activity, is ranged from 1 to 6 mg/L. DOC shows peak concentrations at 15m depth. Nitrate is less than 1 mg/L except for uppermost zones less than 10m depth, which suggest denitrification processes actively remove nitrate within the aquifer. In 4 monitoring wells, aerobic zones reappear below iron-reducing zone. Sulfate is high in the interval of 10 to 20m. Sulfide is detected up to 80 μg/L near the bottom of the wells and sulfate decreases below the depth of 20m, which suggests sulfate reduction occurs in this zone. The relatively low DOC level in iron-reducing zone indicate that active Fe(III) reduction process consumes organic carbon. For the interval of 10 to 15m depth, Fe(III) oxyhydroxides and organic matter in aquifer sediments is readily available to iron-reducing bacteria. However, It seems that Fe(III) in sediments is poor or residual

in the depth below 15m, which limits microbial Fe(III) reduction and favor sulfate reduction process.

Key words: organic carbon, redox zonation, iron reduction, denitrification, sulfate reduction.