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Vertical dynamics of the aquifer microbial community associated with groundwater chemistry in the artificial recharge site in Korea

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Artificial groundwater recharge offers an opportunity to better manage groundwater resources by storing water in aquifers and increasing the amount of groundwater available for abstraction during high demand periods. It is important to understand the linkage of microbial ecology to groundwater chemistry to assess changes in groundwater quality caused by artificial groundwater recharge. In this study, we investigated how the structure and diversity of this subsurface microbial community correlates with and impacts upon groundwater chemistry. Groundwater samples at two different depths (10 and 33 m) were collected from three monitoring wells (MLW 1, MLW 2 and MLW 3) in the artificial groundwater recharge demonstration site in Changwon, Korea. The groundwater samples were filtered with 0.45 um membrane filters and then used for the anion and cation analysis. A 4L of each groundwater sample was immediately filtered with 0.2 um membrane filters and the filters were used for DNA extraction using Fast DNA Spin Kit for soil (MP Bio, USA). Further molecular work processes including pyrosequencing were carried out at Chunlab, Inc. (Seoul, Korea). Pyrosequencing results showed all major phyla were OD 1, OD3, and OD 11 in shallow groundwater samples while *Proteobacteria* (β*-proteobacteria* and δ*-proteobacteria*) and *Bacterioidetes* were dominant phyla in deep groundwater. The Shannon diversity index indicated that the microbial community was much more diverse in shallow groundwater than in deep groundwater. Heat map and hierarchical cluster analysis based on the relative abundance of OTUs at genus level showed a clear distinction between shallow and deep groundwater. Differences in the vertical community structure were driven by the major species such as *Sufuicurvum sp., Pseudomonas sp., Acidiferrobacter sp., Gallionella sp.,* and *Ferribacterium sp*. The results show that several distinct factors such as iron and sulfate concentration control the vertical composition of microbial communities in this aquifer. In conclusion, iron and sulfur chemistry combined with microbial community structure is useful in predicting groundwater ecology and groundwater quality changes caused by the surface water injection in the artificial recharge of aquifers.