Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.19089

Multi-approach assessment of groundwater biogeochemistry: implication to site characterization for spent nuclear fuel repository sites

SU-YOUNG PARK[1], YIDAN ZHANG[1], JANG-SOON KWON[2] AND MAN JAE KWON[1]

[1]Korea University
[2]Korea Atomic Energy Research Institute
Presenting Author: psy3756@korea.ac.kr

Disposal of Spent Nuclear Fuel (SNF) in deep subsurface is considered as the most promising method. The design for SNF repository consists of multi-barriers system such as engineered and natural barriers (i.e., bentonite and granite/gneiss) to achieve the long-term stability for preventing leakage of radionuclides. However, the stability of multi-barriers can be affected by the activities of diverse microbes in subsurface environments. Therefore, this study was conducted to assess not only groundwater chemistry but also microbial parameters such as microbial abundance, activity, and community of three sites (DJ, GJ, DS) in Korea. 16S rRNA gene sequencing was performed to investigate microbial community diversity and composition. The total number of cells (TNC), the number of cultivable heterotrophic aerobic bacteria, and the most probable number (MPN) of sulfate-reducing bacteria and autotrophic acetogens were analyzed to estimate microbial biomass. The activity of live cells was determined using adenosine-triphosphate (ATP) analysis. The concentrations of dissolved oxygen and nitrate were relatively high in DS site, while those of sulfate and dissolved organic carbon (DOC) were high in GJ. The total number of cells was highest in GJ likely due to high DOC. The ratio of ATP to TNC and the relative abundance of sulfate reducing bacteria (SRB) was highest in DJ suggesting more activity of SRB among other cells. Microbial community compositions were distinct between sites; fermentative bacteria were found in all sites, but SRB, iron-reducing bacteria, and nitrate-reducing bacteria were predominant in DJ, GJ, and DS, respectively. Interestingly, less relative abundance of SRB but more MPN of SRB in GJ was observed, implying that despite the low abundance of SRB, it can play an important role in sulfate reduction. Redundancy analysis also indicated the significant correlation between uranium concentrations and microbial community compositions suggesting the potential impact of uranium on microbial community. This study highlights the importance of both microbial community composition, cell number, and live cell activity to better understand the biogeochemical properties of groundwater near SNF disposal site.