Hydrochemical and isotopic characteristics of shallow groundwater in areas affected by the Norovirus

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Potential contamination of groundwater by the Norovirus is a major concern in South Korea and elsewhere. In order to understand the occurrence, source (s), transport, and fate of the Norovirus in groundwater environments, hydrochemical (major ions and trace metals) and environmental isotopic analyses in addition to microbiological surveys focusing on total coliform, *E.Coli*, fecal bacteria and the Norovirus were performed for groundwater from 86 wells in four chosen areas with known Norovirus contamination in South Korea. Top soils of the study areas are permeable with moderately high hydraulic conductivities (10^{-4}~10^{-5} cm/sec). Shallow groundwater samples tended to be rich in anthropogenic pollutants such as chloride, nitrate and sulfate. Large seasonal fluctuations of groundwater chemistry suggested that the studied groundwater systems are mostly susceptible to rapid recharge after large rainfall events. Cl versus Cl/Br plots suggested the origin of them and the potentially related Norovirus from septic effluents and animal wastes. The carbon isotopic compositions of dissolved inorganic carbon (DIC) (n=33) ranged from -8.4 to -18.6‰ (avg. -16.1‰), indicating that DIC was derived from soil organic matter and/or manure. The isotopic compositions of nitrate in 39 samples [$\delta^{15}N$ = 3.5 to 29.1‰ (avg. 13.4‰), $\delta^{18}O$ = -0.4 to 12.7‰ (avg. 4.4‰)] indicated that nitrate was derived predominantly from manure and/or sewage. Combined with field observations, we consider that leakage from latrines and sewage pipes as well as agricultural manure are likely the major sources of the Norovirus and related contaminants such as nitrate, chloride and sulfate.

Adsorption of amino acids on oxide surfaces as a function of environmental conditions

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A fundamental understanding of amino acid adsorption to TiO_2 can provide insight into biomolecular and biomaterial interactions and may have implications for prebiotic chemistry. Potentiometric titrations and batch adsorption experiments were used to study the adsorption of L-lysine on rutile (α-TiO_2) over a range of environmental conditions such as pH, surface loading and the presence of another amino acid in the system. The maximum amount of lysine adsorbed was about 0.73 μmol per m^2 at pH ~ 9 in water solutions containing glutamate. Theoretical surface complexation calculations suggest that lysine forms a rather weakly bound complex via coordination of the ω-NH_3^+ group as an outer-sphere complex on the rutile surface, similar to previous studies of lysine adsorption on amorphous silica [2]. In addition, it is predicted that lysine adsorption will be enhanced when it is mixed with glutamate, which facilitates a favorable surface charge for lysine to attach. This study enables a better understanding of molecular level interactions between biological molecules and biomaterials such as titanium implants and may also be of importance for understanding the role of mineral-surface interactions in the origin of life [3].

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