Fingerprint of last glaciation on ^{2}H and ^{18}O in groundwater of north-east part of Baltic Artesian Basin

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In the northern part of Baltic Artesian Basin (BAB) a groundwater of the multilayered hydrogeological system (mainly the Cambrian and Vendian aquifers) is the principal and most plentiful source for the public water supply in Russia and Estonia. But there are problems with the water quality in many sites due to high salinity and/or the specific components abundance. For example, the natural origin radionuclides (mainly Ra and Rn) and microelements (B, F, Fe, Mn etc.) exceed the sanitary limits.

The BAB is characterized by the limited knowledge about the hydraulic boundaries conductivities of aquifers. Taking into account the complex geological history of the Baltic region in the Pleistocene and Holocene, the isotope archive is significant for the groundwater flow and mass-transport understanding.

The stable isotopes (^{2}H and ^{18}O) were studied in the aquifers near north-east margin of BAB from a crystalline basement to Earth surface. The fingerprint of the Baltic ice lake is clearly fixed for Cambrian aquifer in Tallinn (Estonia). The lightest stable isotope composition of groundwater for Europe was found here ($\delta^{2}H$=-160 ‰, $\delta^{18}O$=-21 ‰, Raidla *et al*., 2009). The isotope composition of water is gradually weighted to the east direction and make up $\delta^{2}H$=-125 ‰, $\delta^{18}O$=-17 ‰ near the boundary between Estonia and Russia, and $\delta^{2}H$=-100 ‰, $\delta^{18}O$=-13 ‰ (that is like to modern precipitation) near the Ladoga lake. It seems, a relicts of the Eemian sea water also was obtained in some cases. It is the salty (M=4-6 g/l) and isotopically fractionated water, which have no ^{14}C or have significant ^{14}C age. Isotope composition is weighting, if the water is the thawed permafrost and become lighter, if it is the residual water after sediment freezing.

Clarification of As(V) Sorption Mechanism with ferrihydrite for Quantitative Modelling of Coprecipitation Process in Wastewater Treatment

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Coprecipitation method using ferrihydrite has been commonly applied to remove As(V) in wasteawtaer such as acid mine drainage. Objective of this study is to clarify how coprecipitation of As(V) with ferrihydrite occures in wastewater and quantitative modelling of them.

We investigated the sorption mechanism of dilute As(V) with ferrihydrite using three kinds of experimental studies for an artificial wastewater in which the ion strength was 0.05 and pH was 5 and 7; (i) sorption isotherm formation, (ii) zeta potential mesurment and (iii) XRD analysis. We confirmed that As(V) was formed a simple two-dimentional adsorption onto the surface of ferrihydrite when the initial As/Fe molar ratio was less than 0.4, whereas a surface precipitation of amorphous ferric arsenate was formed when the initial As/Fe molar ratio was more than 0.4 [1].

Furthermore, both of XANES and EXAFS analysis on K-edge of As showed As(V) coprecipitates with ferrihydrite was mixture of As(V) adsorbed ferrihydrite and amorphous ferric arsenate. Estimated weight ratio of amorphous ferric arsenate in As(V) coprecipitates became above 0.5 when the initial molar ratio of As/Fe≥0.5 was used. These results corresponded with results by XRD analysis. EXAFS analysis assuming three kinds of surface complexes for As-Fe bond showed the coordination number for 2.85 Å of As-Fe bond increased and it for 3.24 Å of As-Fe bond decreased with increasing the initial As/Fe molar ratio. All experimental data obtained in this study showed As(V) co-precipitation mechanism shifted gradually from As(V) complexation to the surface of ferrihydrite toward amorphous ferric arsenate. Therefore, we constructed surface precipitation model to evaluate quantitatively the coprecipitation process of As(V) with ferrihydrite. Good agreement between experimental and calculated values was observed.

[1] C.Tokoro, Y.Yatsugi, H.Koga and S.Owada (2010) Environment Science and Technology, 44, pp.638-643.

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