On the emanation of thoron (^{220}Rn) from precipitates

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Thoron (^{220}Rn, half-life 55.6 s) is a shorter-lived isotope of the radioactive noble gas radon (the longer-lived isotope is ^{222}Rn; half-life 3.6 d). These isotopes are found in soil-near air and soil-gas, and, in case of radon, its occurrence in groundwater is well known. We expected to find also thoron in groundwater. But, due to their presence in different decay chains (^{232}Th and ^{238}U-series, respectively), the geophysical and geochemical behaviour (e.g. species, number of precursors, half-life, solubility etc.) of their precursors differs, too. While radon has been a subject to research for a long time, the emanation of thoron from solid material containing the precursor ^{224}Ra and its occurrence in aquatic systems is not well known.

To elucidate, two working hypotheses for the emanation of thoron into aquatic systems were devised: Because of their low solubility of in oxic groundwater, the thoron precursors, ^{232}Th and its daughter nuclides, will remain located at almost the same positions in the crystal lattice. Due to its short half-life, thoron has also a restricted mobility. Therefore, occurrence and concentration of thoron in groundwater are function of the distribution of the precursors in aquifer material ("primary emanation"). The second hypothesis is based on the somewhat enhanced solubility of the radon and thoron precursor radium ($^{224, 226, 228}$Ra) in anoxic groundwater. Upon subsequent contact with oxygen, radium tends to co-precipitate with Mn and Fe oxide/hydroxides. Thus, the emanation of thoron to the water phase could be intensified by locally accumulated radium, which is attached to surface coatings of the precipitates ("secondary emanation").

Preliminary field measurements with a RAD7 solid-state detector coupled to a RadAQUA unit (closed gas loop, in contact with continuous flowing, sprayed water) in different environments (oxic/anoxic groundwater, anoxic spring water) showed that thoron can be detected in anoxic spring water. This supports the second hypothesis.

To get a better insight into thoron emanation processes under anoxic conditions, we will accomplish column experiments with ferric and manganese sand.

An *in vivo* and *in vitro* evaluation of mineral-induced formation of reactive oxygen species

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Background

Given the occurrence of several recent major natural disasters and increasing environmental alarm, the link between the environment and human health is of no doubt important concern. And while the links between specific environmental factors and specific diseases might be clear, such as asbestos and coal, there still remains debatable links between many other earth materials and the effects they have on the human body.

Discussion of Results

The role of environmentally-induced reactive oxygen species (ROS) as important bio-markers of toxicity is investigated. ROS are generated by macrophages and neutrophils as a first line of defense in response to foreign substances that have been phagocytosed. However, while ROS can be very helpful in destroying foreigners in the body, they can also damage the environment (tissues, cells, etc) in which they were produced. Here, we present different assays to measure the production of ROS. We aim to draw a parallel connection of the generation of ROS to potential health risks of environmental particulates acellularly utilizing a novel probe 3'-(*p*-Aminophenyl) Fluorescein (APF), *in vitro* using lung epithelial cells and *in vivo*.