Removal of contaminants in soil aquifer treatment and possible indicators for process efficiency and leakage to the nearby aquifer

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Water scarcity in arid and semiarid countries shifts water resource allocation from agricultural and recreation water uses to domestic usages, and as a result, agriculture and recreation consumers are increasingly driven to rely on treated wastewater. The Israeli wastewater treatment system results in relatively high water quality attributes, but some pharmaceuticals and refractory micropollutants from different agricultural and industrial origins demonstrate high removal variability; they may escape this intensive treatment at levels of sub-ppb and found their way to nearby drinking water supply wells. The most important probe compounds that were found in our research were carbamazepine - a sedative drug, and the fire retardants tris(2-chloropropyl)-phosphate and tris(2-chloroethyl)-phosphate.

In this study we examine the prediction power of the generally used aggregate carbon and nitrogen water quality parameters (BOD, COD, N-Kjeldhal, ammonia) for micropollutants removal in the Soil Aquifer Treatment (SAT) wastewater treatment process. We show that carbamazepine may serve as excellent probe to quantify the leakage from a (SAT) area to nearby water wells. A way to use the carbamazepine as an operative indicator is discussed.

Carbonaceous material associated with apatite in the Akilia Qp rock

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Evidence for ancient life in ~3.8 Ga sedimentary rocks from West Greenland has been argued on the basis of ^{13}C-depleted carbonaceous material (CM) that preserves C-isotope fractionations resembling those induced by microbial metabolisms. However these rocks experienced metamorphic conditions that could conceivably have produced ^{13}C-depleted graphite via decarbonation reactions or other abiotic pathways. What needs to be demonstrated is the indigenecity of CM *and* whether it is compositionally consistent with metamorphosed biological CM. Graphite in microdrilled powders from the ~3.83 Ga Akilia quartz-pyroxene (Qp) rock has $\delta^{13}C$ values between -21.1 and -25.7‰ and occurs in association with apatite, quartz, pyroxene, sulfides, magnetite and calcite. In one thin section of the Aklia Qp rock, about 20% of more than 600 apatite grains are associated with graphite. Raman spectra of this graphite exhibit sharp and prominent G-bands accompanied by small D-bands and also reveal the occasional presence of curled graphite structures as detected with strong D* bands. While the formation mechanism for these curled graphite structures in the Akilia Qp rock is still unknown, similar structures are known to form during high temperature experiments. FIB extraction of graphite associated with apatite was also attempted for TEM and STXM analyses. NanoSIMS is currently being used to search for traces of H, N, O, P, and S in the graphite. Coordinated micro-analytical techniques have been successfully used to provide a considerable amount of geochemical information on this rock and offer highly promising avenues to help trace the origin of CM in ancient rocks.