THE EFFECTS OF NATURALLY-OCCURRING NANOPARTICLES IN NATURAL WATERS ON BIOLOGICAL AQUATIC PROCESSES

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We found that waters from natural sources, including bottled spring water and tap water, contain a significant density of naturally-occurring nanoparticles – about 10^{11}-10^{12} particles/ml. The shapes and chemical content of the nanoparticles were investigated using an aberration corrected and monochromated High Resolution TEM (HRTEM) – FEI TITAN 80-300Kev, which enable both physical and chemical analyses of the nanoparticles. The nanoparticle have spherical shapes with typical size of 10-50nm. Their chemical content is consistent with calcium carbonate (CaCO3) nanoprticles with some additional trace chemicals that vary between the different types of natural water. The HRTEM measurements also indicate that the nanoparticles are homogeneously spread in the natural water solutions with about 0.5mm -1.5 mm mean distances between particles. Hence, we refer to such water as natural, nanoparticle-doped water or N-NPD water. In contrast, purified drinking water (e.g., Aqua Nova) contains much lower density of nanoparticles, and in ultra pure water (UPW) only very few nanoparticles are observed. The shape and chemical contents of most of the naoparticles in these waters are different from the shape and chemical contents of the nanoparticles in N-NPD water. We found that N-NPD water have significant buffering capacity both for acids and bases, dilution buffering effect, stabilization salt precipitation and broken chiral symmetry. Noteworthy, we found that the N-NPD water exhibit protection of DNA-polymerase activity (protection of the Taq polymerase against thermal stress) and have a remarkable effect on bacteria growth and colony development. We propose that the observations indicate the existence of multi-scale (nanometers to microns) water order induced by the nanoparticles. If it exists, such induced order in natural water can have significant effect on a wide range of chemical and biological aquatic processes with far reaching implications.