Photodegradation of Australian Freshwater Microlayers

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The composition of microlayers on freshwater storages in Northern Europe have been studied for decades. Research in Australia is more recent, highlighting differences in microlayer and subsurface water composition associated with vegetation and climate. Freshwater microlayers in Northern Europe are primarily formed on peat, whereas in Australia they are formed from bark and leaf litter. The hydrophobic, aromatic compounds concentrating within the microlayer strongly absorb ultraviolet light to produce photoreactive compounds.

Rates of photodegradation are likely to be higher in subtropical Australia. South East Queensland (SEQ) experiences 290 clear days per year, in contrast to Sweden with only 165 clear days per year. Leaf fall in Europe occurs in Autumn prior to winter rain, whereas in SEQ leaf and bark fall predominantly in the dry winter, prior to summer storms. Furthermore, the hole in the ozone layer above Australia allows more UVB light to reach the surface.

In this study, the concentration and reactivity of humic substances (HS) present in natural microlayers on water storages in SEQ was investigated. Microlayer and subsurface samples were taken from eight water storages with dissolved organic carbon (DOC) used to quantify HS concentration. The E_2/E_3 ratio (ratio of absorbance at 250 nm to 365 nm) was used to indicate the molecular weight of DOC compounds, and absorbance at 253.7 nm and the permanganate index were used to compare the reactivity of humified DOC. The concentration of carbonyl compounds in the microlayer was also investigated as carbonyls are considered the most photoreactive functional group present in HS.

Significant regressions were obtained for the E_2/E_3 ratio and absorbance at 253.7 nm (r^2 = 0.89), and the E_2/E_3 ratio and the permanganate index (r^2 = 0.95). The regression for the permanganate index and UV absorbance was initially significant (r^2 = 0.91), primarily reflecting differences in HS concentration. When data was standardised for DOC concentration, results for the eight storages tested clustered into four groups, reflecting the attributes of the water catchments. Results indicate that larger molecules more recently derived from wooded catchments absorb UV light more strongly, and are more chemically reactive (higher permanganate index). Smaller molecules derived from highly resilient carbon in the black vertisol soil of a cleared catchment absorbed less UV light, and were relatively unreactive (lower permanganate index). These preliminary results will be used to develop bioassays to compare the rate of photodegradation in the microlayers of freshwater storages in SEQ.