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FRACTAL PROPERTIES OF HUMIC SUBSTANCES REVEALED FROM NEUTRON SCATTERING AND SYNCHROTRON X-RAY SCATTERING STUDIES

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Introduction

Humic acids (HA) are an important component of natural ecological systems and represent a polydisperse complex of natural biopolymers with molecular masses from several to hundreds kilodaltons. In our previous reports[1] we have shown the variability of conformations of HA of different origin. The main goal of our study was the systematic comparison of physico-chemical properties of humic substances prepared from different sources using small angle scattering methods. Here the results for HA from budetorf are represented.

Experimental

Synchrotron X-ray measurements were done on a small-angle camera BL15-A (Photon Factory, Tsukuba). Neutron scattering experiments were performed using the SANS-1 instrument of the GKSS Research Centre (Germany). HA samples were prepared by new procedure including the treatment of organic material by 0.2 M ammonium hydroxide with the consequent air drying. Dried HA samples were dissolved in 0.1M NaOH or 0.1M NaOD.

Results

To characterise such irregular systems as HA the methods of fractal geometry have been used. In application to scattering data they are based on the study of asymptotic behaviour of scattering patterns at large scattering angles. The log-log dependence of scattered intensity on the scattering vector module has a long linear part whose slope is connected to the fractal dimension of the object. Fig.1 represents such plot for neutron and X-ray scattering data in a heavy water with the slope 1.65 and 2.64, respectively. The same value 2.64 is valid for the sample in light water. Thus, the neutron and X-ray scattering patterns give different fractal dimension. Moreover, at large scattering angles ($Q>0.1$ A^{-1}, where $Q=(4\pi/\lambda)\sin(\theta/2)$, λ- the wavelength, θ- scattering angle) the patterns are different: concave for neutrons and convex for X-ray scattering. Possibly it reflects nonuniform H-D exchange and now is under consideration.

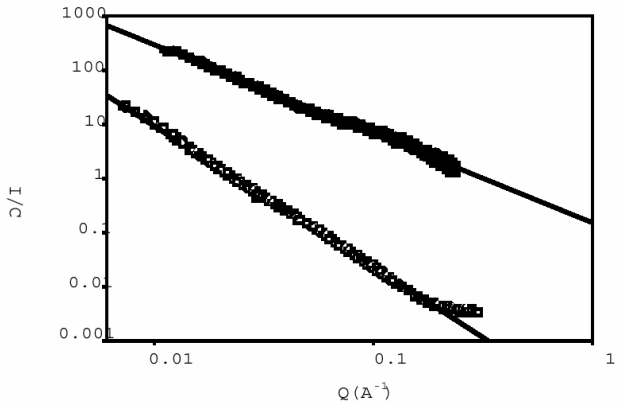

Fig.1 Log-log plot for HA of budetorf in heavy water for neutrons (o) and X-rays (•).

References

1. A.A.Timchenko *et al.* **PPAR** (1998), 176;.(1999), 182. Proposal 97-G152, 99-G275.