

## NEXAFS Studies of Flocculation of Natural Organic Matter with the Scanning Transmission X-ray Microscope

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Beamline(s): X1A

**Introduction:** The aim of this project is to clarify parameters influencing flocculation of natural organic matter NOM by aluminum salts and to study reactions leading to flocculation. Therefore, flocculation of NOM has been studied by NEXAFS spectroscopy under various chemical conditions.

**Methods and Materials:** The aquatic humic acid HO 19, fulvic acid and humic acid BS1 FA and BS1 HA from soil seepage water and humic substances from a chernozem soil have been used for these studies [1,2].

**Results:** Figures 1 and 2 show NEXAFS spectra of the substances under investigation, all in a dry state. All of these show resonance peaks at  $E=285.3$  eV,  $E=286.9$  eV and  $E=288.7$  eV. They can be assigned to the transitions  $\pi^*$  of aromatic C=C, 3s of  $\text{CH}_3, \text{CH}_2$  and  $\pi^*$  of C=O. The peaks at  $E=297.2$  eV and  $E=299.8$  eV are  $L_{III}$ - and  $L_{II}$ -transitions of potassium. The peak at  $E=290.6$  eV might be the 3s transition of the carboxylic group COOH.

**Conclusions:** From the spectra it is possible to draw conclusions on the interactions between metals and NOM, e.g. during flocculation in water treatment. Thus, this method can be used to determine, whether NOM is incorporated within the aluminum hydroxide precipitates or whether it is bound to  $\text{Al}(\text{OH})_3$  via ligand exchange. However, prior to reliable statements about flocculation of NOM, more of these studies have to be performed.

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### References:

- [1] F. H. Frimmel and G. Abbt-Braun, "Basic Characterization of Reference NOM from Central Europe - Similarities and Differences", *Environment International*, **25**, No 2/3, 191-207, (1999).
- [2] J. Thieme and J. Niemeyer, "Interaction of colloidal soil particles, humic substances and cationic detergents studied by X-ray microscopy", *Progr Colloid Polym Sci*, **111**, 193-201 (1998).

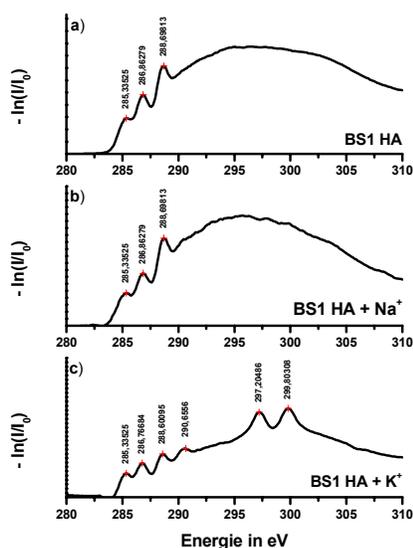


Fig.1. NEXAFS spectra of humic acid BS1 HA, before and after the addition of alkali metals.

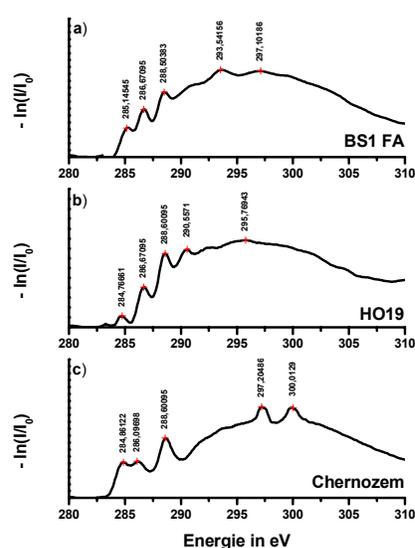


Fig. 2. NEXAFS spectra of fulvic acid BS1 FA, the aquatic NOM HO19 and humic substance from a chernozem soil.