

Background

Traditional View

- Degradation and decomposition of soil organic matter (SOM) by abiotic and biotic processes form a condensed polymer structure (Figure 1a) (Kononova., 1961).
- The theory was formulated based on molecular weight differences between the isolated SOM fractions by means of solubility separation (Haynes and Swift., 1989; Stevenson, 1994).
- Even though there is no physico-chemical evidence of these properties, the polymer model has been accepted for decades. (Piccolo., 2001).
- The alkaline extraction has been traditionally used to isolate humic substances from soil (Drosos et al., 2017; Drosos et al., 2020).
- **G** Supramolecular Theory
- The SOM linkage is influenced by interactions with soil minerals and SOM functional groups (e.g., aromatic and aliphatic groups).
- Bonding mechanisms in the different zones are dominated by inner and outer-sphere bonds, ligand exchange interactions, Van der Waals forces, hydrogen bonds, and cation bridging (Figure 1b) (Kleber, Sollins, and Sutton., 2007).
- The supramolecular arrangement can be separated without breaking C-C bonds and only breaking intermolecular bonds or non-covalent bonds (Nebbioso and Piccolo., 2011).





Figure 1. a) Models of the structure of the humic substances (Stevenson, 1994, Kosobucki P. and Buszewski B., 2014); b)The zonal model showing the interaction between SOM and different organo-minerals (Kleber, Sollins and Sutton., 2007).

Primary goals of this research

isolate soil organic matter components from lake dredged sediments using Humeomics,

(2) determine the nutrient content (e.g., TOC, TN, TP) associated with the Humeomics sequential extraction fractions, and

(3) characterize soil organic matter components using fluorescence spectroscopy and PARAFAC.

Methodology

□ Sample Collection

The dredged material (DM) collected from Toledo Harbor, OH was dewatered via perforated tiled drainage over several years. The DM was excavated from the Great Lakes Dredged Material Center for Innovation (GLDMCI, Toledo, Ohio) in May 2021.



Characterization of supramolecular humic material obtained from lake-dredged sediments by Humeomics and spectroscopy methods Samira Rifat Prova (ssamira@bgsu.edu.), Angelica Vazquez Ortega, and Joseph C. Furgal School of Earth, Environment and Society, Bowling Green State University, Bowling Green, Ohio 43403.

concentrations for organo-soluble fractions (a, b) and hydrosoluble fractions (c, d), respectively.

Organo-soluble fractions				
Compone nts	Description	Previously reported by		
C1	Terrestrial humic-	Y. Yamashita et al., 2010; H.V. Kulkarni et al., 2017; L.		
	like component	Jorgensen et al., 2011.		
C2	Soil fulvic -like	Sondergaard M et al. 2003: Rose M. Corv.et al. 2005		
	component	Solidergaard, Wi. et al., 2005, Rose Wi. Cory et al., 2005.		
C3	Protein and			
	tryptophan-like	Williams et al.,2010.		
	microbial components			
Organo-soluble fractions				

Figure 8. PARAFAC components from SOLO software A) C1 – Humic-like components, B) C2-soil fulvic-acid-like components, and C) C3- protein and tryptophan-like microbial components.

Table 4: PARAFAC components for Hydro-soluble fractions Hydro-soluble fractions

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Components	Description	Previously reported by
C1	microbial humic-like	N.M. Peleato et al., 2017; L. Jorgensen et
CI	component	al., 2011.
\mathbf{C}	Terrestrial humic-like	L. Jorgensen et al., 2011; M. Chen et
L2	component	al.,2017.
C 2	humia lika component	Stedmon and Markager, 2005; B. Chen et
L3	numic-like component	al., 2018.
	Hydro-solubl	e fractions
() C1	B) (C2 C) C3
420	0.1 420	- 0.06 420
400	- 0.08 400 - 380	400
E 360	0.06 <u>e</u> 360	0.04 E 360

500 600 700 800 Emission (nm) 400 500 600 700 Emission (nm) 400 500 600 700 Emission (nm) Figure 9. PARAFAC components from SOLO software A) C1 – microbial; B) C2- Terrestrial; C) unidentified humic-like components.

Implications

- The TOC is constantly higher in the organo-soluble fractions than hydro-soluble fractions. These results are in an agreement with higher fluorescence EEM spectra for the organo-soluble fractions. The DM when used as a farm soil amendment will contribute organic carbon that could serve as the energy source to maintain optimal soil health.
- In general, extracted SOM fractions contain higher concentrations of nitrogen than phosphorous. The FTIR results agree, as N-O and N-H functional groups were identified in the extracted SOM fractions.
- PARAFAC analysis identified humic-like, fulvic-like, and tryptophan-like microbial components. However, this nomenclature aligns with the polymer view. <u>The next steps</u> will include the identification of the organic compounds using mass spectroscopy to better support the SOM supramolecular view.

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