Depositional Characteristics of Organic Materials in Mangrove Swamp in Tamsui

淡水紅樹林沼澤有機質沉積特性研究

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指導教授：蔡龍珎老師
日期：2018.3.22
Outline

• Introduction
• Purpose
• Sample Collection and Preparation
• Materials and Analytical Methods
• Preliminary Results
• Conclusion
• Future Work
Introduction

• Mangrove swamp is an important intertidal wetland ecosystem with **high primary productivity, abundant detritus, rich organic carbon** and **anoxic/reducing** conditions.

• **Coalification**:
  
  plant → peat → lignite → sub-bituminous coal →
  bituminous coal → semi-anthracite → anthracite

• Few studies were concentrated on **peat** research.
Purpose

- To understand the process and mechanism of organic material during burial and preservation processes in a mangrove swamp.
Sample Collection
Sample Preparation

- Samples were collected from different depths (0-5cm, 5-15cm, 15-30cm, 30-40cm)

<table>
<thead>
<tr>
<th></th>
<th>Dissolved oxygen</th>
<th>pH</th>
<th>Electrical conductivity</th>
<th>Turbidity</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>MF</td>
<td>5.08</td>
<td>7.93</td>
<td>3.69 S/M</td>
<td>74 NTU</td>
<td>28.1 °C</td>
</tr>
<tr>
<td>MM</td>
<td>4.65</td>
<td>7.5</td>
<td>1.68 S/M</td>
<td>44 NTU</td>
<td>27.6 °C</td>
</tr>
</tbody>
</table>
Sample Preparation

1. Placed samples in an oven at 40°C until dry.
2. Crushed and pass #40 sieve (0.42 mm mesh) to clay size.
Materials and Analytical Methods

Crush and pulverize samples

- Rock-Eval pyrolysis
- Mineralogical analysis (XRD)
- Biomarker

Synthetic evaluation
Materials and Analytical Methods

(a) Rock-Eval pyrolysis

- $S_1$
- $S_2$
- $S_3$
- $T_{\text{max}}$
- $\text{HI} = \frac{S_2}{\text{TOC}}$

http://docs.dcnr.pa.gov/topogeo/econresource/oilandgas/marcellus/sourcerock_index/sourcerock_quantity/index.htm
<table>
<thead>
<tr>
<th>Quality</th>
<th>TOC</th>
<th>S₁</th>
<th>S₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>&lt;0.5</td>
<td>&lt;0.5</td>
<td>&lt;2.5</td>
</tr>
<tr>
<td>Fair</td>
<td>0.5-1</td>
<td>0.5-1</td>
<td>2.5-5</td>
</tr>
<tr>
<td>Good</td>
<td>1-2</td>
<td>1-2</td>
<td>5-10</td>
</tr>
<tr>
<td>Very good</td>
<td>2-4</td>
<td>2-4</td>
<td>10-20</td>
</tr>
<tr>
<td>Excellent</td>
<td>&gt;4</td>
<td>&gt;4</td>
<td>&gt;20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>HI</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>&gt;600</td>
</tr>
<tr>
<td>II</td>
<td>300-600</td>
</tr>
<tr>
<td>II/III</td>
<td>200-300</td>
</tr>
<tr>
<td>III</td>
<td>50-200</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Immature</th>
<th>T&lt;sub&gt;max&lt;/sub&gt;(°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immature</td>
<td>&lt;435</td>
</tr>
<tr>
<td>Mature</td>
<td>435-470</td>
</tr>
<tr>
<td>Over mature</td>
<td>&gt;470</td>
</tr>
</tbody>
</table>

- Kerogen type
  - Type I: algal
  - Type II: phytoplankton zooplankton
  - Type III: terrestrial plant

(Peters & Cassa, 1994)
Materials and Analytical Methods

(b) Mineralogical analysis

XRD (X-ray Diffraction)

Bruker D2 Phaser

https://www.google.com.tw/search?q=bruker+D2&source=lnms&tbm=isch&sa=X&ved=0ahUKEwiBm8eDhPrZAhXKbrwKHQ4IDHYQ_AUICigB&biw=1517&bih=653#imgrc=FMdn5L0GsuZgwM:

https://www.google.com.tw/search?q=XRD&source=lnms&tbm=isch&sa=X&ved=0ahUKEwj64u--hPrZAhXly7wKHZveD7kO_AUICigB&biw=1517&bih=653#imgrc=w1F7MzmcDpaOaM:
Materials and Analytical Methods
(b) Mineralogical analysis

1. Whole rock analysis
2. Clay mineral composition analysis
   ① Air-dried
   ② Ethylene glycol-solvated state
   ③ Slow scan
Materials and Analytical Methods

(c) Biomarker

Pr/Ph > 1 oxic condition
Pr/Ph < 1 anoxic condition

Oleanane – terrestrial angiosperm flowering plant
C27 Steranes - algae     C29 Steranes – terrestrial land plants

(Peters & Moldowan, 1994)
## Preliminary Results

(a) Rock-Eval pyrolysis

### MF

<table>
<thead>
<tr>
<th>Depth(cm)</th>
<th>TOC(%)</th>
<th>$S_1$(mg HC/g Rock)</th>
<th>$S_2$(mg HC/g Rock)</th>
<th>$T_{max}$(°C)</th>
<th>HI(mg HC/g TOC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0~5</td>
<td>0.804</td>
<td>0.19</td>
<td>0.36</td>
<td>417</td>
<td>44.78</td>
</tr>
<tr>
<td>5~15</td>
<td>0.489</td>
<td>0.2</td>
<td>0.3</td>
<td>424</td>
<td>61.35</td>
</tr>
<tr>
<td>15~30</td>
<td>0.558</td>
<td>0.09</td>
<td>0.22</td>
<td>443</td>
<td>39.43</td>
</tr>
<tr>
<td>30~40</td>
<td>0.598</td>
<td>0.15</td>
<td>0.24</td>
<td>436</td>
<td>40.13</td>
</tr>
</tbody>
</table>

### MM

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<th>Depth(cm)</th>
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<th>$S_2$(mg HC/g Rock)</th>
<th>$T_{max}$(°C)</th>
<th>HI(mg HC/g TOC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0~5</td>
<td>0.236</td>
<td>0.19</td>
<td>0.47</td>
<td>399</td>
<td>199.15</td>
</tr>
<tr>
<td>5~15</td>
<td>0.333</td>
<td>0.15</td>
<td>0.17</td>
<td>400</td>
<td>51.05</td>
</tr>
<tr>
<td>15~30</td>
<td>0.490</td>
<td>0.13</td>
<td>0.23</td>
<td>413</td>
<td>46.94</td>
</tr>
<tr>
<td>30~40</td>
<td>0.176</td>
<td>0.08</td>
<td>0.07</td>
<td>365</td>
<td>39.77</td>
</tr>
</tbody>
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<thead>
<tr>
<th>Type</th>
<th>HI</th>
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<tbody>
<tr>
<td>Immature</td>
<td>&gt;600</td>
<td>algal</td>
</tr>
<tr>
<td>Mature</td>
<td>300-600</td>
<td>phytoplankton zooplankton</td>
</tr>
<tr>
<td>Over mature</td>
<td>200-300</td>
<td>terrestrial plant</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Type</th>
<th>$S_1$</th>
<th>$S_2$</th>
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<tbody>
<tr>
<td>Immature</td>
<td>&lt;0.5</td>
<td>&lt;2.5</td>
</tr>
<tr>
<td>Mature</td>
<td>0.5-1</td>
<td>2.5-5</td>
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<tr>
<td>Over mature</td>
<td>2-4</td>
<td>10-20</td>
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<tr>
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<td>2-4</td>
<td>10-20</td>
</tr>
</tbody>
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- **TOC**: Total Organic Carbon
- **$S_1$**: Saturates
- **$S_2$**: Oligo-aromatics
- **$T_{max}$**: Maximum temperature
- **HI**: Hydrogen Index
- **Kerogen type**: Type of organic matter
- **Type**: Type of kerogen

- **Immature**: $T_{max} < 435$°C
- **Mature**: $435 \leq T_{max} < 470$°C
- **Over mature**: $T_{max} \geq 470$°C

- **Kerogen type I**: Algal
- **Kerogen type II**: Phytoplankton
- **Kerogen type III**: Zooplankton
- **Kerogen type II/III**: Algal-phytoplankton
- **Kerogen type III**: Algal-terrestrial plant
- **Kerogen type II/III**: Algal-zooplankton
Preliminary Results
(a) Rock-Eval pyrolysis

- Kerogen type
  Type I: algal
  Type II: phytoplankton zooplankton
  Type III: terrestrial plant
Preliminary Results

(b) Mineralogical analysis

Whole rock analysis
Preliminary Results
(b) Mineralogical analysis

Clay mineral composition analysis
Preliminary Results
(b) Mineralogical analysis

Clay mineral composition analysis
Preliminary Results
(c) Biomarker

MF-1

MM-2
Conclusion

• Both locations are affected by **marine water**.

• **All samples possess poor to fair hydrocarbon potential** based on Rock-Eval pyrolysis.

• Organic matter types analyzed are dominated in **Type III**.

• All samples are **immature** in organic maturity.

• All of the soils are characterized by **quartz and feldspar**.

• **Illite and Kaolinite** are major clay minerals in the study area.
Future Work

- XRD analysis
- Biomarker analysis
- Synthetic evaluation
Thanks for listening.