Depositional Characteristics of Organic Material in Guanxin Algal Reef, NW Taiwan

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Outline

• Introduction
• Literature review
• Methods of study
• Preliminary results
• Conclusions
• Future work
Introduction

• Key elements in petroleum geology: source, reservoir, seal and trap.

• More than 60% of the world’s oil and 40% of the world’s gas reserves are held in carbonates. (World Energy Outlook 2006)

• Modern marine carbonate sediments – biotic reef.
Literature review

• Evaporitic environments are one of the most important sedimentary settings for organic matter preservation. (Warren, 2006)

• The mucilaginous coats in marine carbonate grains could be the source of much of the kerogen in carbonate rocks. (Shearman and Skipwith, 1965)
Introduction

Purpose

• To understand the depositional process and mechanism in a young swamp.

• To explore the correlation between early organic matter and hydrocarbon potential.
Sampling location

Introduction
Introduction

Geological background

• Holocene Alluvium
• Formed since 7600-7500 years ago. (戴等人, 2009)
• Coralline algae build biotic reef.
  \[ \text{Ca}^{2+} + 2\text{HCO}_3^- \leftrightarrow \text{CaCO}_3 + \text{H}_2\text{CO}_3 \]
• Reef limestone
Methods of study

Sampling

In situ
- Water quality
  - DO
  - pH
  - Electrical conductivity
  - Turbidity

Ex situ
- XRD
- Biomarker
- Rock-Eval pyrolysis
- TOC
  - Hydrocarbon analysis
  - T_max
  - S1
  - S2

Depositional environment

Hydrocarbon potential
Methods of study

Sampling

• OC: off coast, NS: near shore
• Depth: surface, 5-15 cm, 15-30cm and 30-40cm
Methods of study

Water quality

• In situ measurement.

• Dissolved oxygen, pH, temperature, turbidity and electrical conductivity.
Methods of study

Rock-Eval pyrolysis & Total organic carbon

- Rock-Eval II

S1: HC already present (250°C)
S2: HC generated from the kerogen by thermal decomposition (420-460°C)
S3: carbon dioxide given off by the kerogen

$$PI = \frac{S1}{S1 + S2}$$

$$HI = \frac{S2}{TOC} \times 100$$

(Waples, 1985)

(Hunt, 1996)
Methods of study

X-ray diffraction (XRD)

• Bruker AXS D2 Phaser XRD
• Whole rock
• Clay mineral

https://www.bruker.com/
Methods of study

Biomarker

- Microwave extraction method
- Termovap sample concentrator
- Gas chromatography-mass spectrometry
- Hydrocarbon compounds

(Słowakiewicz, 2016)
## Preliminary results

### Water quality

<table>
<thead>
<tr>
<th></th>
<th>Off coast</th>
<th>Near shore</th>
</tr>
</thead>
<tbody>
<tr>
<td>DO (mg/L)</td>
<td>8.27</td>
<td>6.11</td>
</tr>
<tr>
<td>pH</td>
<td>8.07</td>
<td>8.01</td>
</tr>
<tr>
<td>Electrical conductivity (S/M)</td>
<td>6.85</td>
<td>7.23</td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td>27.3</td>
<td>27.4</td>
</tr>
<tr>
<td>Turbidity (NTU)</td>
<td>25</td>
<td>7</td>
</tr>
<tr>
<td>Salinity (%)</td>
<td>3.57</td>
<td>3.78</td>
</tr>
</tbody>
</table>
Preliminary results

Rock-Eval pyrolysis & Total organic carbon

<table>
<thead>
<tr>
<th>Petroleum Potential</th>
<th>TOC (Wt. %)</th>
<th>S1 (mg HC/g rock)</th>
<th>S2 (mg HC/g rock)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>0-0.5</td>
<td>0-0.5</td>
<td>0-2.5</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>

Peters and Cassa (1994)
Preliminary results

Rock-Eval pyrolysis & Total organic carbon
Preliminary results

Rock-Eval pyrolysis & Total organic carbon

The Type I/Type II and Type II/Type III kerogen boundaries as delineated by Langford and Blanc-Valleron (1990).
Preliminary results

X-ray diffraction (XRD)

Whole rock

![XRD graphs for Off Coast and Near Shore](image)
Preliminary results

X-ray diffraction (XRD)

Clay mineral

Off Coast

Near Shore

Untreated
Glycolated
Preliminary results

X-ray diffraction (XRD)

Clay mineral

![Diagram showing clay mineral composition](image)

- Smectite
- Smectite/Illite
- Illite
- Kaolinite
- Chlorite
Preliminary results

Biomarker

Near Shore 35-40 cm
Conclusions

• Low maturity & poor HC potential.
• Off coast exhibit better preservation of organic matter.
• Similar seawater quality in near shore and off coast.
Future work

- XRD data analysis.
- Biomarker analysis.
- Synthetic evaluation of depositional mechanism.
Thanks