A preliminary study on the tsunami deposits appeared in the archeological test pits, Heping Island, Keelung

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Introduction

• In recent year, there are lots of tsunami risks which occurred in coastal towns, so that we must pay attention to it.

• In Taiwan, there are lots of researches which focus on issues of the tsunami warning, geophysical modeling and historic record, except tsunami deposits.
Keelung Tsunami Event: 1867/12/18

「淡水廳志」記載：
「同治六年發生大地震，雞籠頭、金包里沿海，山傾地裂，海水暴漲，屋宇傾壞，漲數百人。」

《福爾摩沙紀事：馬偕台灣回憶錄》記載：
「數年之前，在雞籠聽到隆隆之聲，港內的水忽然退去......海水像軍隊衝鋒似地回來，越過堤防，把沿岸低地上的房屋都掃去。」
The layer is rich in marine bio-clast
Study area

- Pits are located on Holocene Alluvium, southwest of Heping Island.
- Elevation of pits are 6.3m.
Layer and Succession

Unit 1 - backfill

Unit 3 - pebbly sandstone
Unit 4 - cultural layer

Unit 5 - Cultural layer

Unit 2 - Disturbed cultural layer

Unit 6 - massive sandstone

basement
Correlation

- The Unit 3 is pinch out from seaward to landward
Sedimentary texture of Unit 3

- **Unit 1**
- **Unit 3**
- **Unit 4**

**Landward to seaward**

- **T2P6/T2P5I/T2P5**
- **Fireston**
- **Pavement**

**Rip-up clast** (r)

**Bio-clast** (b)

**Tile** (t)

**Marine bio-clast**

**Matrix-supported**

**Angular to sub-angular**

**Coral**

**Paleocurrent:** seaward to landward
Sedimentary texture of Unit 3

landward

Unit 1

Unit 3

Unit 4

seaward

Japanese tile

imbricated pebble

bio-clast

matrix-supported

angular to sub-angular

r: rip-up clast
b: bio-clast
t: tile
c: carbonaceous material
f: fire stone
Sublayer and imbrication of Unit 3

I:  
II:  
III:  
IV:
Facies model


Age of the tsunami deposits, Unit 3

Keelung Tsunami Event

1867 / 12 / 18

Departure of the Japanese

A. D. 1945

A. D. 1683

Occupied by the Manchu

A. D. 1895

Occupied by the Japanese

Unit 1

Unit 3

Unit 4

T2P6/T2P5I/T2P5
Conclusion

- According to sedimentary facies and composition, Unit 3 was deposited by marine process which is high concentration flow.

- By the result of facies analysis, Unit 3 is a deposits of tsunami event.

- Base on Japanese tile and Manchujar, we correlate Unit 3 with Keelung Tsunami Event.
Thank you!
沉積模式比對

<table>
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<tr>
<th>海嘯層特徵/海嘯</th>
<th>Fujiwra (2008)</th>
<th>本研究</th>
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<tr>
<td>沉積序列</td>
<td>向上變細</td>
<td>向上變細</td>
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<td>岩層垂直接觸狀況</td>
<td>侵蝕性接觸，具有泥帶</td>
<td>侵蝕性接觸</td>
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<td>沉積物組織成熟度</td>
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<td>古水流</td>
<td>具有多次的海水上湧與回退</td>
<td>具有多次的海水上湧與回退</td>
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基隆港的海象資料

<table>
<thead>
<tr>
<th>海象資料</th>
<th>示性波高(95%)</th>
<th>最高潮位</th>
<th>平均高潮位</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4</td>
<td>2.31</td>
<td>1.16</td>
</tr>
</tbody>
</table>

基隆港1999~2008颱風期間最大波高與波向統計表

![示性波高公尺](image)

![波向(來向)](image)

![波浪監測儀](image)

![潮汐監測儀](image)

![研究區域](image)
1858年基隆港航海圖

參考資料:
海水面變動

- 1867年海水面比
  現今高出0.13m

Chen, Y. G. and Liu, T. K. (1996) Sea Level Changes in the Last Several Thousand Years, Penghu Islands, Taiwan Strait. Quaternary research, 45, p254-262
Global sea level - tide gauge data - 1807 to 2001

長期及短期之地殼變動

2002-2009年垂直速度場
GPS移動站/連続站/水準測量
(相對於澎湖S01R)

参考資料：饒瑞鈞、李元希、胡植慶(2009)地震地質與地變動潛勢分析地變動監測分析(3/4)。經濟部中央地質調查所，共400頁。
海嘯沉積物的特性

海嘯沉積物的特性：海嘯沉積物在垂直與側向上變薄變細。沉積物指示 run up 以及 back flow 在 run up 與 back flow 間沉積 mud drap。受控於古地理型態—連續或不連續沉積。堆積在相對高及內陸的位置。

