Sediment Contribution in Different Spatial and Temporal Scale off Southwestern Taiwan since 50 kyr BP based on VNIR Reflectance Derivative Spectroscopy

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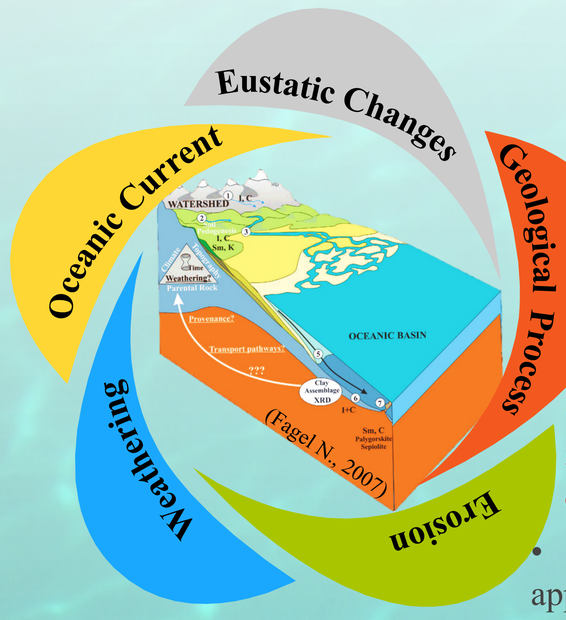
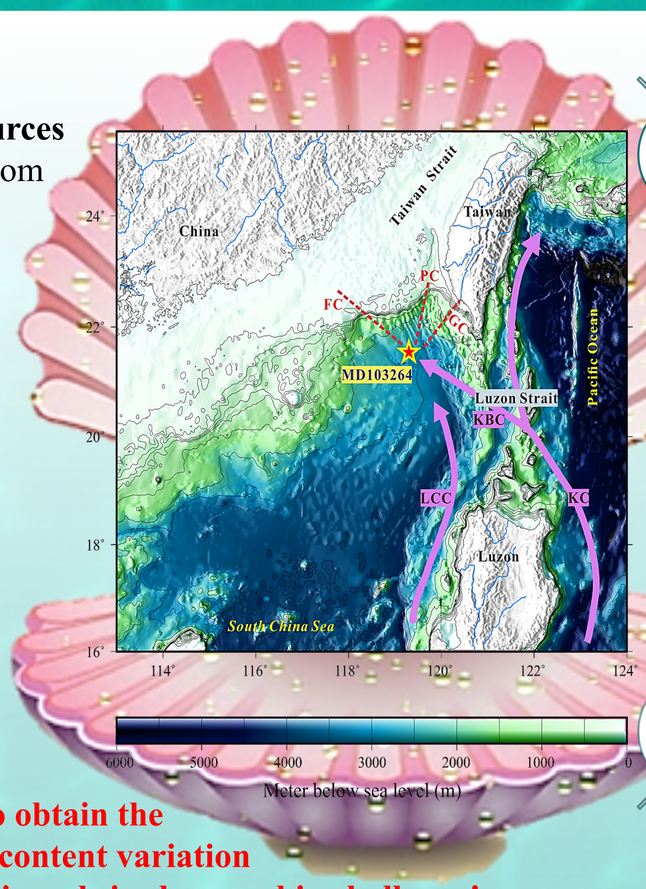
Introduction

- The distribution pattern of **clay mineral assemblages** is a critical proxy to reveal the **sources and transport pathways** of detrital sediment from adjacent mainland.
- The variation of clay mineral in stratigraphic sequences plays a major role in **depicting the paleoenvironmental change** of source areas happening in the geological past.



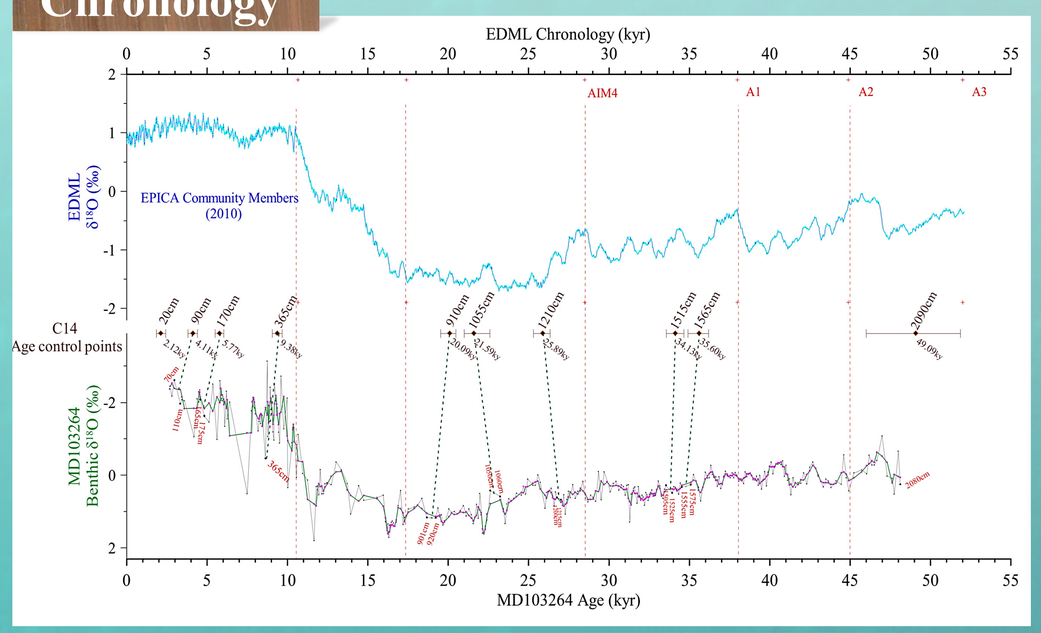


- **How to obtain the absolute content variation of clay minerals is always a big challenge!**
- To fill this gap, this study applied **visible near-infrared (VNIR) Reflectance Derivative Spectroscopy (RDS)** procedure to acquire high-resolution clay mineralogical signals for the past 50 kyr off Southwestern Taiwan.

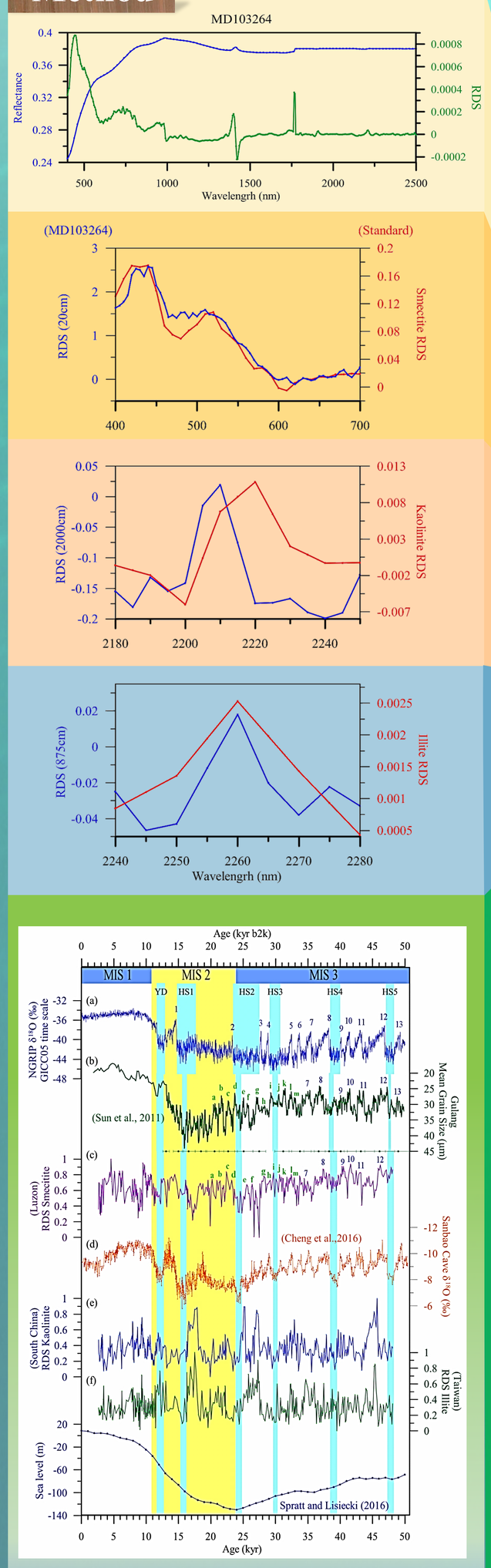
ASD (Analytical Spectral Devices, Inc.) LabSpec Pro FR UV/VIS/NIR Spectrometer

- Rapid mountain **uplift** and high **erosion** rates (3-6 mm/yr);
- Frequent **earthquakes**, heavy **monsoon and typhoon** precipitation;
- Large quantities of **terrigenous material discharged** to the coastal oceans throughout the year;
- Complex **submarine canyons** and **deep-sea channels** have been defined as major pathways of terrigenous sediment;
- Offshore SW Taiwan has been ideal to study the **sediment transport mechanism** and the **source-to-sink** issue.

Chronology



Method



Results and Discussions

- The first-derivative values for each sample at 5 nm intervals was calculated from 350 to 2500 nm.
- The variability of percent reflectance spectra can be intensified by applying the first-derivative calculation.
- The first-derivative (center-weighted) peaks are characteristic of specific minerals and sediment components.

- **Smectite** RDS has a significant peak between 420-440 nm and 510-520 nm in **VIS** band.
- We choose the first outstanding peak and utilize the peak height as smectite content index.

- **Kaolinite** RDS of the spectral library database has a characteristic peak between 2200-2230 nm in **NIR** band.
- MD103264 RDS has a little **shift forward** to 2200-2220 nm.
- The downcore content variation can be obtained from the peak height of every sample.

- **Illite** RDS has a significant peak between 2250-2270 nm in **NIR** band.
- We track the highest value between 2250-2270 nm in each depth as the index of down core illite content variations.

- **Source from Luzon (Smectite):** the higher smectite values well aligned to the millennial-scale **D-O events** in $\delta^{18}O$ records of NGRIP ice core (label as "7"-"12") and the fine loess grain size records (label as "a"-"m"). =>We suggest that the **rapid warming interstadials** and **weak winter monsoon strengthen the KBC and the year-round northward LCC** and bring more Luzon-sourced sediment to SW Taiwan offshore.
- **Source from China (Kaolinite) and Taiwan (Illite):** kaolinite and illite have a similar pattern in past 48kyrs, and the correlative nature probably contemporaneous with $\delta^{18}O$ variation (summer monsoon intensity) observed in Sanbao Cave.
- **In Heinrich 1-5 stadials**, the abundances of smectite, kaolinite and illite decreased in conjunction. Meanwhile, the coarsening of mean grain size appeared in Gulang loess profile which echoed to the strong winter monsoon circulation. =>This may represent South China experienced a **weak chemical weathering condition** and **the KBC were blocked** by the strengthened winter monsoon in these stadials.
- **During 27-16 ky and the Last Glacial Maximum (LGM) period**, the smectite has lower values, the illite and kaolinite content exhibited higher value on the contrary. =>We assume that the approximately **120 m sea level drops** is **not conducive to the KBC transportation** and reduces the suspended sediment delivery from Luzon Island to offshore SW Taiwan. This low sea-level also **enhance the weathering erosion and shortens the distance between the source areas and the study site**, leads to the higher sediment contribution from both Taiwan and South China.
- **In Younger Dryas (YD)**, a clear differences between kaolinite, illite and Sanbao Cave $\delta^{18}O$ variation and need further investigations.

References

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