Particle export in the Eastern Tropical North Pacific

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Eastern Tropical North Pacific – oxygen minimum zone

$O_2$ (μM) at depths where $O_2$ is minimal (Paulmer & Ruiz-Pino, 2009)

Low $b$ due to:

- Low PP?
- Slow degradation in anoxic conditions?
- Fewer zooplankton?
- Lithogenic ballasting?

Martin’s $b$ -> ‘average’ - 0.86 (Martin et al., 1987)

Sediment traps - 0.36 (Van Mooy et al., 2002)
Sediment cores -0.4 (Devol & Hartnett, 2001)
Underwater vision profiler - 0.22 (Roullier et al., 2013)
ETNP
28th Dec-10th Feb 2014

Onshore = depth < 600 m
Offshore = depth > 600 m

Upper oxycline
Lower oxycline
ETNP Nutrients

Primary Production = 480-630 mgC m\(^{-2}\) d\(^{-1}\)
(Stephanie Henson, NOCS)

Denitrification > 200 m

Increase of phosphate with depth due to remineralisation
Marine snow catcher

Collect:
• **Suspended POC**
• **Slow sinking (and suspended) POC**
• **Fast sinking POC**

**Midday:** 4 MSCs below deep chlorophyll maxima to <220 m (onshore) and <350 m (offshore)

**Midnight:** 2 MSCs min/max depth

Calculate...
• Sinking rates
• Fluxes
• Martins b

**Aim:**

Understand why transfer efficiency to deep ocean (if it is) is high in oxygen minimum zones
Particulate organic carbon
Sinking rates – Flow cam

Range = 6-750 m d\(^{-1}\), mean = \(~150\) m d\(^{-1}\)

With Mike Zubkov, NOCS
Midday mgC m\(^{-2}\) d\(^{-1}\)

Midnight mgC m\(^{-2}\) d\(^{-1}\)

Significant different in POC flux between onshore (1-3) and offshore (4-6), p<0.01
During day transfer efficiency is highest offshore.
During night it's highest onshore.
POC flux is significantly higher onshore during day, no significant difference at night.
• During day AND night increase in Aggregate flux with depth offshore
• Onshore low transfer in day, high at night
• Aggregate flux is significantly higher onshore during day
### Faecal pellet flux

#### Midday

**FP POC flux (mgC/m²/d)**

- **Depth (m)**
  - Onshore: \( b = 0.33 \)
  - Offshore: \( b = 0.83 \)

#### Midnight

**Night FP POC flux (mgC/m²/d)**

- **Depth (m)**
  - Onshore: \( b = 0.19 \)
  - Offshore: \( b = 0.69 \)

#### Observations

- High transfer efficiency onshore, low offshore
- Offshore Faecal pellet flux is highest at night
- No sig difference day/night

![Graphs showing faecal pellet flux comparison](image)
Increase/decrease in both particulate type is variable onshore

Offshore aggregates increase with depth, faecal pellets decrease

What controls this difference???
Preliminary conclusions

POC flux significantly higher onshore than offshore

Onshore – Aggregates remineralised
Offshore – Aggregates transferred efficiently
  – Faecal Pellets remineralised

Hypotheses for low b/high transfer efficiency:

Lower PP? – Low comparable to oxic studies, will compare b with primary production
Slower degradation in oxic conditions? – only have low O₂ environments so no control
Fewer zooplankton? – Faecal pellet flux is similar to aggregate flux at night, highly remineralised, will use lipid analysis of particles and analyse echosounder data for DVM
Lithogenic ballasting? – Greater attenuation of aggregate flux onshore than offshore, suggested not ballast from horizontal inputs √

Further work:
Lipid samples
Echosounder for DVM
Slow/Suspended fractions
Particulate respiration
Particulate respiration

Unisense OX50, 50 μm tip
Microrespiration system

![Graph showing O2 Consumption rate (umol O2/L/h) vs. Depth (m) with data points for fast sinking, slow sinking, and suspended particles. The bottom depth is approximately 500 m.]
Thank you

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Sinking rate vs b
Faecal pellets preferentially remineralised?

**Onshore**
Aggregates undergo majority of remineralisation

**Offshore**
Faecal pellets undergo majority of remineralisation – linked to nutrient cycles?