1. Background of study

The southeast Pacific mid- to low-latitudes are an important area of heat transfer from the southern high latitudes to the tropics via the vigorous Peru-Chile Current (PCC). The changes in PCC advection account for about half of the total variability in equatorial SSTs (Feldberg and Mix, 2003). However, currently available mid-latitudes sea surface temperature (SST) records are mostly from the continental convergence zone and are therefore less reliable in the tropical Pacific. (Figure 1)

2. Material, methods and stratigraphy

- 3 piston cores (Geob3388, GeoB3327 and PS75/034) were used to complete the north-south transect along the PCC.
- Sea surface temperature was estimated using L$_{129}$ index with the global core top calibration of Müller et al. (1998).
- Age models were based on visual alignment of benthic benthic 18O record to reference record: core GeoB3388 was tuned to ODP Site 977 as reported in Mohr et al. (2006) while GeoB3327 was tuned to LR04 stack (Lisiecki and Raymo, 2005). (Figure 2)
- Preliminary stratigraphy of core PS75/034 was achieved by tuning its SST record to that of GeoB3327 up till MIS12 and linear extrapolation for interval before MIS12.
- The reconstruction of paleo SST gradient is done based only on visual assessment due to the difficulty in quantitative reconstruction caused by very different sampling interval in the records.
- Due to the preliminary nature of the results, the discussions remain highly speculative.

3. Results

3.1. SST Variations

(a) Subantarctic (Figure 3)

- Gradual warming or warming event (e.g. MIS 6 at 43°S) during the glacials prior to terminations – this feature is not observed in the Ð EPICA, nor the benthic oxygen isotope.
- Coldest glacial – MIS 10; warmest interglacial – MIS 5e.
- Most drastic SST change across the glacial-interglacial (G-I) cycles occurred during the transition from MIS 11 maximum to MIS 9 maximum.
- G-I SST amplitude: ~9°C at 43°S; ~6°C at 55°S but ~3°C before MIS12.

(b) Subtropics (Figure 3)

- The trend and absolute values of SST (low resolution, GeoB3388) is similar to the published record TGT (Calvo et al., 2001) except MIS 4.
- Interglacial intervals are prolonged relative to those from the mid- and high-latitudes.
- Gradual warming as found in higher latitudes (GeoB3327 and PS75/034) is also observed in MIS 6 and MIS 16.

3.2. Severity of glacials

- There is a decoupling between benthic δ¹⁸O and SST at sub-tropical (GeoB3388) and subantarctic (GeoB3327) sites during MIS 6 and MIS 12 – warm SSTs in spite of large global ice volume. (Figure 2 and Figure 3)
- There is an increase in temperature in the subtropical due to substantial cooling at site GeoB3327, it is possible that the wind-driven gyre circulation is strengthened and the PCC became more vigorous during the glacials.

3.3. Meridional thermal gradients

- Steeper gradient between tropics and sub- tropics during glacial – interglacial (G-I) cycles.
- The severity of glacial SSTs correlates with the orbital eccentricity – obliquity – precession.
- Differences in magnitude between mid-latitude and the tropics due to substantial cooling at site GeoB3327, it is possible that the wind-driven gyre circulation is strengthened and the PCC became more vigorous during the glacials.

4. Discussions

4.1. Potential Causes of “glacial warming”

- Not observed in EPICA Ð record – probably not caused by the ice sheet
- Retraction of sea ice - triggered by austral high-latitude glacial spring/summer insolation if it passes a certain “threshold” (Figure 4)
- Remarkable synchrony with T residual of EPICA, which might have a coupling mechanism with the low latitudes (Masson-Delmotte et al., 2010)
- Severity of glacial SSTs correlates with the eccentricity – obliquity – precession.

4.2. PCC variations over G-I cycles

- Glacial equatorward shift of Subantarctic front and ACC, coupled with a glacial northward shift of the Equatorial front and Intertropical convergence zone (Rincón-Martínez et al., 2010) – could imply an equatorward shift of the subantarctic gyre circulation during the glacials in the past 500ka.
- Judging by the steep glacial SST gradients between mid-latitude and the tropics due to substantial cooling at site GeoB3327, it is possible that the wind-driven gyre circulation is strengthened and the PCC became more vigorous during the glacials.

5. Conclusions

- Warming across the glacials in the subtantarctic, especially MIS 6, 8, and 12 probably caused by high austral spring insolation.
- Mismatch between SST and benthic δ¹⁸O regarding the severity of glacial along the latitudinal range of the PCC (MIS 6)

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References