Plio/Pleistocene surface and subsurface temperature and salinity changes off South Chile – Responses to the transition from permanent El Niño-like to modern La Niña-like conditions

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The Pliocene with its high atmospheric CO_2 concentrations and globally enhanced temperatures serves as an analogue scenario for the expected future global climate development. The notion of permanent El Niño-like conditions changing into modern La Niña-like conditions with the onset of the Northern Hemisphere Glaciation (NHG) is still debated widely. Here we present the first Pliocene to Pleistocene ocean surface and subsurface temperature and salinity reconstruction from the eastern S-Pacific region.

We analysed piston core SO213-01-2 retrieved during RV SONNE cruise SO213 from offshore southern Chile. According to our preliminary stratigraphy based on planktonic biodatums and the correlation of XRF scanner data to a well-dated reference record, the core covers the time span from mid-Pliocene to late Pleistocene. The mixed layer planktonic foraminiferal species *Globigerinoides ruber* and the deep dweller *Globorotalia inflata* were investigated for $\delta^{18}O$ and Mg/Ca to reconstruct temperatures and salinities for the surface ($SST_{Mg/Ca}$, $\delta^{18}O_{sw}$) and subsurface watermasses ($subSST_{Mg/Ca}$, $sub\delta^{18}O_{sw}$).

While the surface is reflecting the global Pliocene cooling trend of 2-3°C and slight freshening, the subsurface ocean shows prominent cooling of ~8°C and freshening between mid- and late Pliocene implying large changes in thermocline depth. The comparison of our proxy records to similar datasets from the equatorial W- and E-Pacific as well as from the subtropical SW-Pacific supports the notion of permanent El Niño-like conditions with a low west-to-east SST-gradient across the equatorial Pacific and the subsequent transition to modern La Niña-like conditions. Further, our data suggest that the pronounced oceanographic changes at the subsurface level off Chile occur in consequence to the Pliocene/Pleistocene climatic adjustments:

With the invigorating SST-gradient between the equatorial W- and E-Pacific establishing since ~4.0 Ma, the strengthened Walker-Circulation and the southward shift of the Westerlies resulted in a stronger Antarctic Circumpolar Current and the enhanced intermediate water formation southwest of southern Chile. The pronounced formation and northward migration of intermediate southern component waters, i.e. cool and fresh Subantarctic Water and Antarctic Intermediate Water, caused considerable cooling and freshening at subsurface level at our core location and the shoaling of the thermocline. The enhanced northward movement of intermediate southern component waters between mid- and late Pliocene might even have affected the equatorial E-Pacific via ocean tunnelling and might have facilitated the development of the equatorial E-Pacific cold tongue, which expanded between ~ 3.6 and 3.5 Ma.