

3rd Weekly Report M145, Mindelo-Recife

26.02.-04.03.2018

In the middle of the third week of METEOR cruise M145 from Mindelo to Recife, we finished the 23°W hydrographic section running from 15°N to 6°S. The observational program along this section included profiles with the CTD rosette measuring temperature-salinity-depth, oxygen, particle size classes with the underwater vision profiler, and velocity with the lowered acoustic Doppler current profilers. At the mooring positions and near PIRATA buoys microstructure profiles were taken. Water samples were analyzed for numerous variables including salinity, oxygen concentrations, transient tracer concentrations, and nutrients. Filtered samples were taken for flow cytometry, DNA/RNA, and chlorophyll a. Near-surface trace metal concentration was continuously measured from a towed trace metal clean "fish". Furthermore, on-board incubations to quantify nitrogen and carbon fixation and primary productivity were performed. The measurement program was successfully completed and first analyses of the data, in particular the transient tracer and CTD data, could be performed.

The transient tracer fieldwork along 23°W consisted of measurements of CFC-12 and SF₆ in the upper 1300m from 15°N to 5°N and for the full depth range between 5°N and 5°S. The partial pressure distributions of the full depth section are shown in Fig. 1 for CFC-12 and in Fig. 2 for SF₆. These transient tracers enter the ocean via gas-exchange at the air-sea interface only. The atmospheric concentration history of such tracers provide time information that can be used to determine different types of "ages" of a water parcel due to the ventilation of the tracers from the surface into the ocean's interior (the age of a water mass is considered to be zero when it leaves the ocean surface and start flowing into the interior ocean thereby increasing its age). CFC-12 and SF₆ have distinct differences in their atmospheric history, i.e. CFC-12 was released into the atmosphere since the late 1920s whereas SF₆ was produced on an industrial scale since the beginning of the 1950s. Therefore, the CFC-12 tracer can be found in less ventilated or older water masses (see lower panel of Fig. 1) whereas the SF₆ tracer is mostly absent in regions occupied by older water masses (see Fig. 2).

Signals of higher CFC-12 and SF₆ concentrations in the deeper water layers are associated with comparatively young North Atlantic Deep Water in the depth range 1500-4000m. This water, which is formed in the subpolar North Atlantic, follows the continental slope of North America toward the equator, where it detaches from the Brazilian coast into the interior basin with a major eastward pathway along the

southern slope of the Mid-Atlantic Ridge at about 2°S. Signals of higher tracer concentration are associated with higher oxygen concentrations from CTD measurements (Fig. 3), which show the stronger ventilation of these water layers.

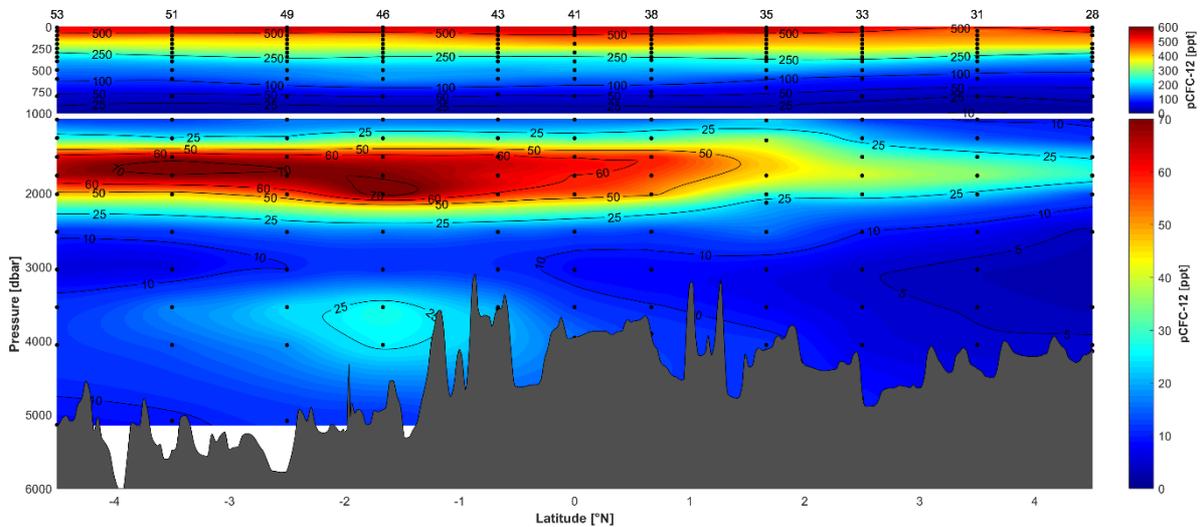


Fig. 1: Partial pressure distribution of CFC-12 in ppt along 23°W (Fig. TS).

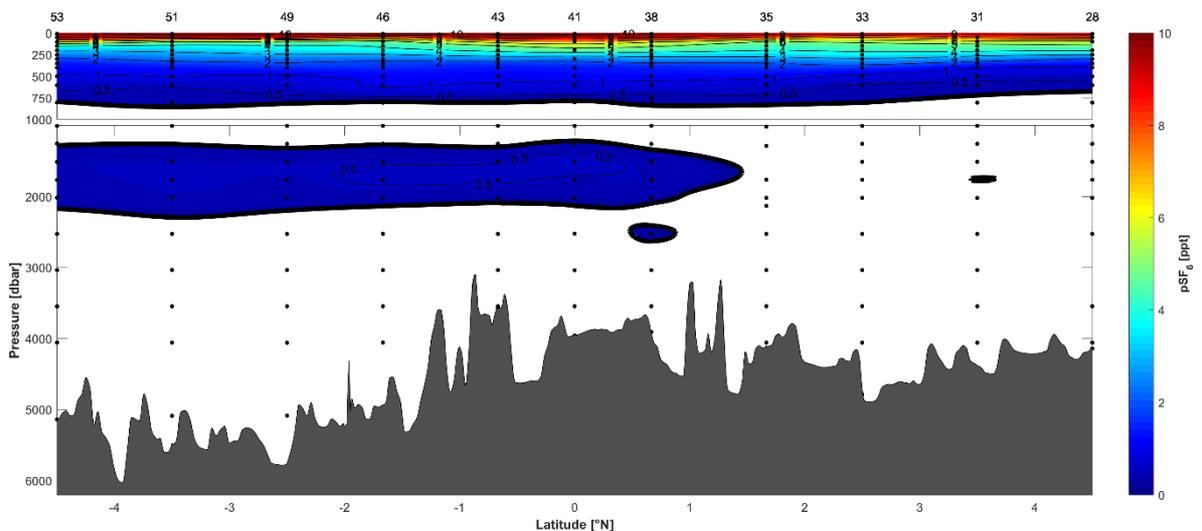


Fig. 2: Partial pressure distribution of SF₆ in ppt along 23°W (Fig. TS).

Depending on the used ventilation model, the time information of the transient tracers allow for additional calculations on the anthropogenic carbon content in the water column and provide a proxy on integrated oxygen utilization rates (OURs). The identification of OURs in the oxygen minimum zone of the eastern tropical North Atlantic is a major objective of the collaborative research centre SFB-754. Therefore, the relation between the transient tracer and oxygen (Fig. 3) distributions along 23°W over the past decade can be used as an indicator for the temporal changes in ventilation and it's relation to changes in the oxygen budget of the OMZ. Furthermore, the SFB754 transient tracer dataset not only covers the respective area of the OMZ it is also an important contribution to the comprehensive data set of

transient tracer measurements in the Atlantic sector of the world ocean. Based on this data collection it is possible to track the corresponding water masses from the outcrop regions along their density layer into the ETNA-OMZ and can be used to characterize the oxygen related water mass properties and changes along the flow pathway.

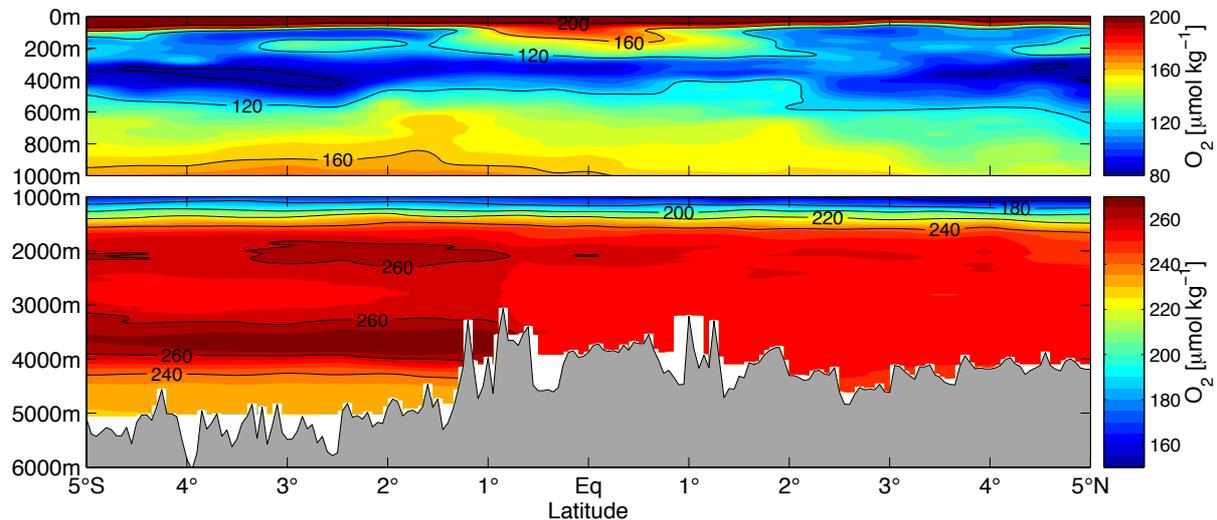


Fig. 3: Oxygen distribution along 23°W (Fig. JH).

After slightly more than two days of transit from 23°W, 6°S to 32°W, 11.5°S, we started with our CTD station work along the 11°S section. On Sunday morning we successfully recovered the first mooring of the Western Boundary Current array off Brazil with mooring recoveries and deployments following in the afternoon and during the next days.

The transit came just in time for our obligatory "Bergfest", which included a barbeque with fresh fish from the tropical Atlantic excellently prepared by the ship's cook. With great food and drinks and a beautiful sunset, we had a good time in between our main working areas along the 23°W section and at the western boundary off the Brazilian coast.

Greetings from the tropics,

Rebecca Hummels und Peter Brandt and the cruise participants of M145