DISSOLVED OXYGEN DISTRIBUTION IN SOUTH ATLANTIC OCEAN ALONG 29-30°S, FROM BRAZIL TO SOUTH AFRICA – MINIMUM LAYER DEPTH VARIATION

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RESUMO

The dissolved oxygen values obtained by precise potentiometric method along the 29-30 °S in Atlantic Ocean as a part of the Trans-Atlantic 1, a Brazilian research cruise contributed to determination of the water types when associated to other conservative parameters as temperature and salinity. The position of the dissolved oxygen minimum value in a vertical water column contributes to understanding the processes that occur in ocean and in coastal waters. Two minima values were observed in some stations, one associated to organic matter oxidation process originated from the surface biological activities, more intense in the water column on African continental shelf and a second minimum, associated to the water type and water parcels present mainly in oceanic water column around 1000 and 1500m depth. The values of salinity varied from 34.20 to 36.21, the temperature varied from 0.75 to 20.37 °C and the dissolved oxygen varied from 2.21 to 6.42 mL L^{-1} with the minor minimum located under the higher productivity waters on the African continental shelf.

Keywords: dissolved oxygen, water types, minimum dissolved oxygen layer

INTRODUCTION

The dissolved oxygen in the ocean is an useful tracer for tracking the movement of water-types and water masses, especially those in the deep and bottom waters. Dissolved oxygen normally is find in saturation degree in the euphotic layer, and its concentration decreases toward the main thermocline where a minimum concentration layer often appears IMASATO, et al., (2000). The dissolved oxygen minimum layer depth depends not only, as cited of the movements and water types present in the especial and depth distribution, but also of the organic matter biogeochemical cycle in the eutrophic zone.

The vertical profile of dissolved oxygen is classically explained by an advection-diffusion model considering two sources, one, from the deep layers, and other from surface layers. The abyssal circulation transports oxygen from the North Atlantic and the Antarctic Sea to deep layers of the Indian and Pacific via the Antarctic Circumpolar Current (ACC) region and the upwelling transport the oxygen toward the sea surface.

The relation between dissolved oxygen/temperature distribution can presents different pattern in function of the climate changes. The presence of one or two dissolved oxygen minima is possible. In an example, in Marsden Square 335, situated below the Equator, near the African coast, where the oxygen/temperature distribution differs from the two former squares in that the dissolved oxygen value decreased steadily, and no oxygen minimum was found down to a depth where the water temperature was 6°C (OREN, 1972).

The climate changes influence the water temperature and circulation and the vertical temperature profile can show the variation in the pattern as result of it, what modify the dissolved minimum layer. The urbanization, anthropogenic input and the intervention on the continental margin also contribute in oxygen concentration, but in a medium scale, the global processes are the most important.

This study make a part of the Brazilian Trans-Atlantic I Expedition and the main objective for instance, when the others chemical data are in treatment is to study dissolved oxygen values in the water column and its relation with the water types and with the minimum depth inferring the surface and deep biogeochemical processes associated to the minimum dissolved oxygen layer.

MATERIAL AND METHODS

The first leg of Brazilian Trans-Atlantic I Expedition occurred in November 2009, from Rio de Janeiro (Brazil) to Cape Town (South Africa), on board of R/V *Cruzeiro do Sul* (Brazilian Scientific Navy Vessel). This study make a part of the Chemical Traces and the Global Changes in South Atlantic Project developed by the Nutrient, Micronutrients and Traces in the Ocean Laboratory/Oceanographic Institute of São Paulo University (LABNUT/IOUSP) and Brazilian Navy Hydrographic Center (CHM).

Along the transect, 55 points were sampled considering some depths, from the surface water to the bottom. The depth sampled sometimes reached few meters upper the bottom sediments. The temperature and salinity were obtained using CDT *Seabird SBE 9 Plus* and *SBE 25 Sealogger*. The water was sampling with Ninskin bottles displayed in a rosette support. The water for salinity analyses and dissolved oxygen analyses were performed. For the dissolved oxygen analyses, the potentiometric method using a Metrohm Dosimat was used and the aliquots were taken from the bottles in a calibrated flaks with diving stopper. The method followed is described in GRASSHOFF et al., (1982).The precision is ± 0.02 mL L^{-1}.

RESULTS AND DISCUSSION

In general, the dissolved oxygen observed from Brazil to Africa along 29-30°S showed values between 2,21 mL L^{-1} to 6,42 mL L^{-1} with minima values on the western basin, on the African continental shelf, near the bottom. Along the transect it was possible to observe a first dissolved oxygen minimum, variable in most depth points, it was around 400-600m depth. The constant presence of a second minimum of dissolved oxygen between 1000 and 1200m depth was observed in the depth points. On the African continental shelf, the minimum was observed, generally near the bottom or in the deep waters. The minima values were present in salinity < 35 and temperatures around 10 °C (Fig. 1).

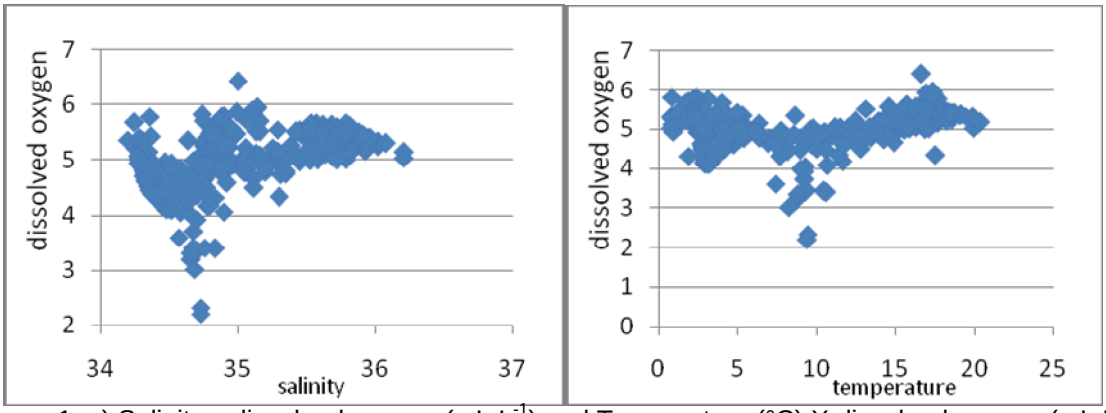

Figure 1. a) Salinity x dissolved oxygen (mL L^{-1}) and Temperature (°C) X dissolved oxygen (mL L^{-1}).

The vertical profiles showed the presence of two dissolved oxygen minima in the column, one near 500m and the second around 1000m. On the African continental shelf, the depth is reduced and the dissolved oxygen minimum decrease in function of the presence of an important concentration of organic matter resulted from the expressive primary production in surface waters and the proximity of the bottom contribute to the dissolved oxygen consume.

The figure 2 shows the position of the dissolve oxygen minimum around 500m depth in the most western point at 500m depth (st 31), a constant minimum located between 1000 and 1500 m depth in almost all oceanic stations sampled and on the African continental shelf in the depth less than 300m, the minimum values were reduced under 100m depth, and in the most eastern station, the minimum value reached (~2 mL L^{-1}).

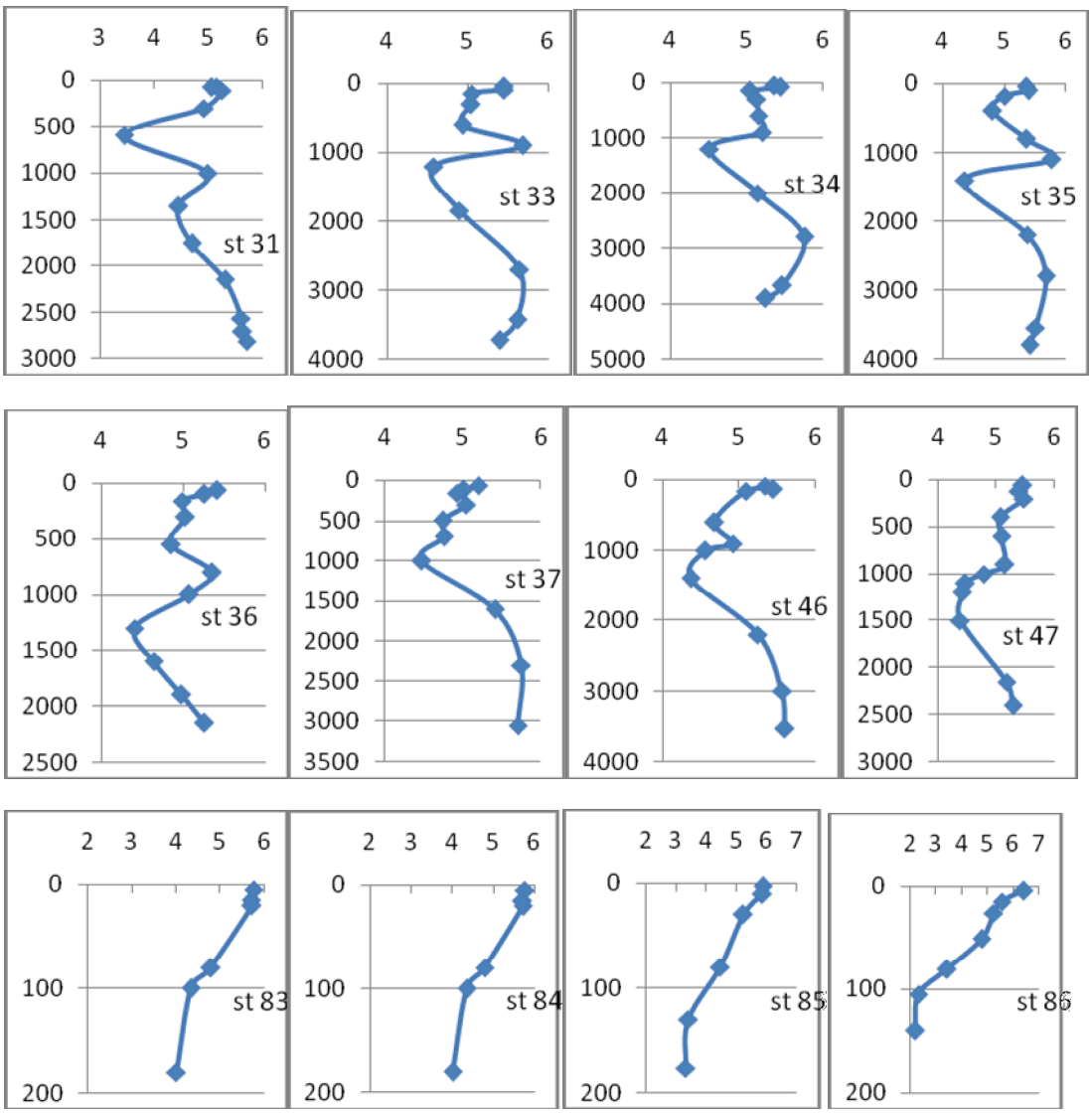

Figure 2. Dissolved oxygen vertical profile in some stations sampled during Trans-Atlantic 1 cruise. (X= dissolved oxygen in mL L^{-1} and Y = depth in m).

CONCLUSION

The dissolved oxygen distribution along the 29-30°S in Atlantic ocean showed minimum layer associated to organic matter decomposition originated from surface waters resulting in the first one minimum, and a regular minimum between 1000 and 1500 m depth is explained by the water parcel that circulate at this depth associate to different transport of oxygen. The nutrient data will give more details of these water type present at this transect. The productive waters locate on the African platform contribute to an intense consummation of dissolved oxygen verified in the most eastern points sampled. Water types could be identified by the traditional salinity, temperature and density data, but also by dissolved oxygen distribution and biogeochemical dynamics. These values reveal the most important productivity area associated to decreasing of the dissolved oxygen minimum depth.

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