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*IN SITU* BIO-OPTICAL AND BIOGEOCHEMICAL PROPERTIES IN THE WESTERN ROSS SEA,  
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The Southern Ocean is still one of the less known regions of the world because of the extent of the area, its relative inaccessibility and high variability. In particular the bio-optical properties of the S.O. have been poorly described, nevertheless this knowledge is essential for ecological studies of the pelagic system, especially when we use remote sensing of the ocean color to describe its variability.

During the XVIII Italian Antarctic Expedition (January to March 2003, R/V *Italica*) the near surface seawater (4m) was continuously pumped on board to provide samples for the analyses detailed below, all along the way from New Zealand to the Ross Sea and back. The water column was sampled at discrete depths of the photic zone with Niskin-type bottles, in 25 stations of the Western Ross Sea. Filtration (Whatmann GF/F) of up to 3 liters of seawater provided assessment of the concentration of the photosynthetic lipophylic pigments (HPLC analysis) and of organic C and N composition of the particulated matter (CHN elemental analyser, PE). Filters were also collected to analyze the spectral variation of the absorption coefficient of total particulated matter, detritus and phytoplankton (Kishino, 1985). Spectral measurements of the inherent and apparent optical properties were performed through an AC-9-25 (Wetlabs) and a spectral radiometer OCI-200 (Satlantic) in 19 stations of the Western Ross Sea. From these measurements, the euphotic zone depth ( $Z_{eu}$ ), the mean vertical attenuation coefficient of downwelling PAR and of spectral irradiance, and the sub-surface (1-5m) spectral reflectance ratio ( $R_{\lambda}$ ) were derived. A Pulse Amplitude Modulated fluorimeter (Walz) was used to monitor the photosynthetic activity of phytoplankton; the potential photochemical activity ( $F_v/F_m$ ) was assessed on about 120 samples, after 30 min of dark adaptation, measurements were repeated up to 5 times.

Highly significant statistical relationships between organic carbon, nitrogen and chlorophyll a, have been found to characterize the composition of the total suspended matter in the region (e.g.  $C = 4.92 N + 33$ ,  $r = 0.99$ ) which also allow to distinguish peculiar areas, such as one close to Terra Nova Bay, corresponding to a bloom of moderate intensity and to C/chl-a ratios as low as 56.

Beside a relatively uniform pigments composition some preliminar analysis based on pigments ratios, show a differentiation in big subareas. Coastal stations placed to the South of the Terra Nova Bay polynya (e.g. st 5, 7, 15, 26) exhibit high fucoxanthin to chlorophyll a ratios (0.5 to 1.0) indicating classical assemblages dominated by diatoms with relatively high phytomass (2 to 4 mg chl/m<sup>3</sup>). On the other hand, stations near Cape Adare and in the southernmost part of the Ross Sea, around 77 °S (e.g. st 40, 52, 92), phytoplankton show high 19'HF+19'BF to chl ratios (0.2 to 0.4) typical of assemblages characterized by phytoflagellates with rather low phytomass (0.3-0.8 mg chl/m<sup>3</sup>). Moreover few stations of the first group (e.g. st. 5, 7, 26) appear as characterized by high values of phaeophorbides, which reveal an important grazing activity in that area.



The relationship between the phytoplankton absorption peak at 675 nm and chloro- phaeopigments<sub>2</sub> (chlph) allows to clearly identify an average specific absorption value of 0.014 mg chlph /m<sup>2</sup> . which is rather low, as expected from the few existing data for antarctic phytoplankton (Mitchell and Holm Hansen, 1991; Stramska et al., 2003). Reflectance spectra in the first meters reveal the presence of blue waters at the station 92 (Cape Adare), while station 07 clearly shows the maximum at 555nm in the green region.

The potential photochemical efficiency (Fv/Fm) recorded in the Ross Sea varies from a minimum of 0.143 (st 31, m10) to a maximum of 0.411 (st. 08, m30). Superficial values from continuous sampling range between 0.088 to 0.324. Samples from the surface waters of the Southern Ocean (56.7 °S - 60.3 °S; approx. 175 °E) are lower than 0.160. High superficial values were found just South of the polynya of Terra Nova Bay (st. 08, 15, 24, 26), in the range 0.27- to 0.37. The phytoplankton population appears potentially rather productive here, also at greater depths. An opposite situation was found nearby Cape Adare (st 70, 79, 92) where values never exceeded 0.30, and were rather low on the average.

The variability of the biological and optical properties of the Ross Sea is significant and appears distributed in largely distant spatial subsets. A finer detail of this variability was impossible to achieve because of the exceptional coverage of thick sea-ice encountered.