Investigation of a Productivity Gradient off NW Africa using SeaWiFS Imagery, Sediment Traps and Analysis of Surface Sediments

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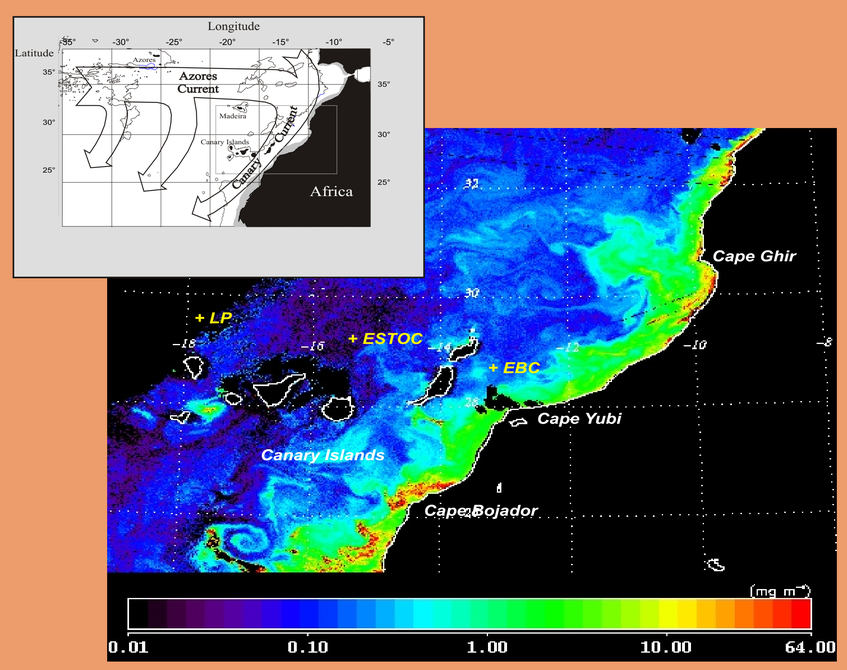
Overview

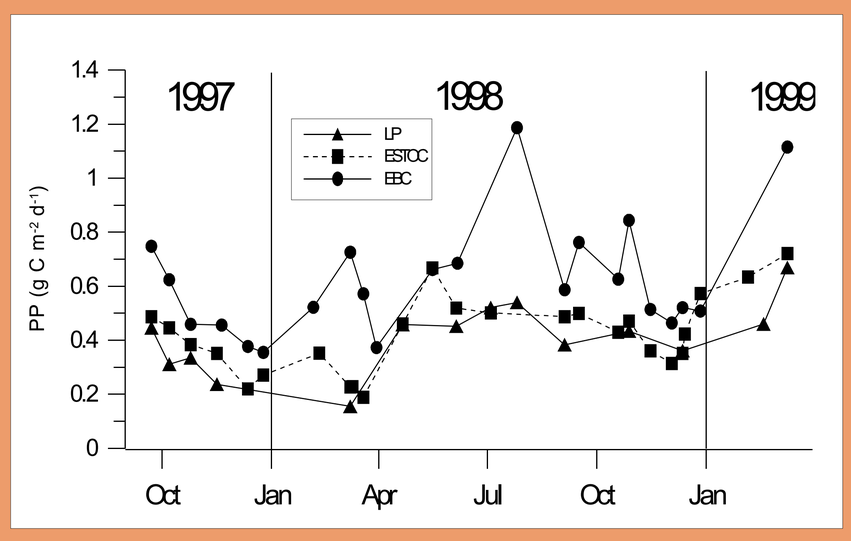
As part of JGOFS and the European Canary Islands Azores Gibraltar Obsevations (CANIGO) project, the NW African upwelling producivity has been investigated using SeaWiFS chlorophyll imagery and geochemical and micropaleontological parameters in trap material and sediments as proxies for surface water properties in the Canary Islands region. SeaWiFS chlorophyll data were used to investigate the near-surface productivity gradient at 3 stations that fall along a quasi-zonal 29°N transect through the Canary Islands, corresponding to 3 fixed sediments traps positioned during the same period east of the island of Fuerteventura (Eastern Boundary Current, EBC) and north of the islands of Gran Canaria (European Station for Time-Series in the Ocean, Canary Islands, ESTOC) and La Palma (LP). Productivity indicating proxies on sediment trap material of the year 1997 (planktic foraminifera distribution, ^{15}N, TOC) confirm the remote sensing results. The modern scenario is also mirrored within the surface sediment, e.g. the distribution of upwelling indicating planktic foraminifera species Data from ESTOC and from the sediment trap transect in the Canary Islands region may be found under http://www.pangaea.de/Projects/ESTOC.

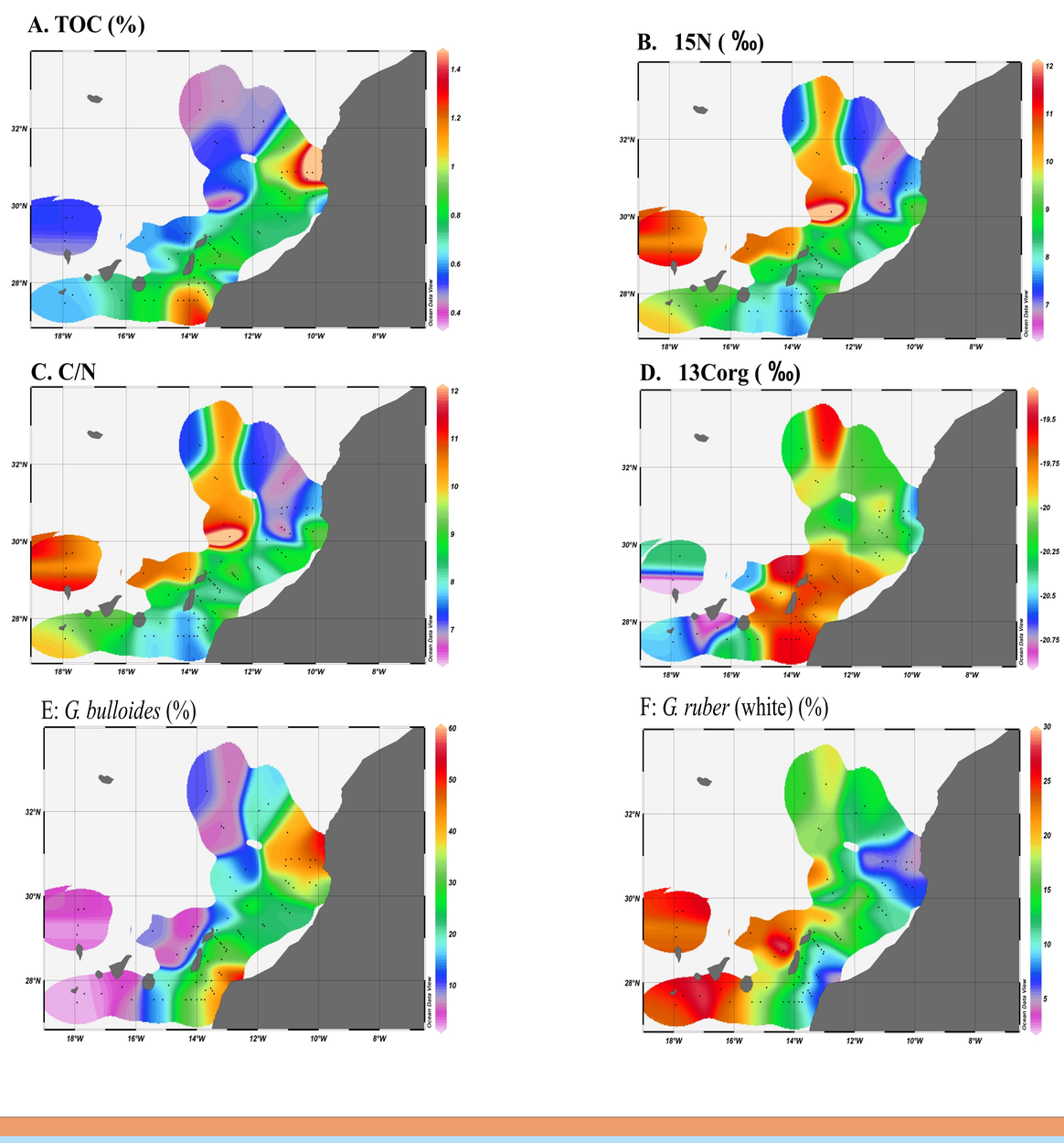


SeaWiFS chlorophyll image from 19 March 1998. The location of the LP, ESTOC and EBC traps are indicated along the 29°N transect through the Canary Islands. Note the Cape Ghir filament extending some 500 km offshore and the filament activity associated with the Cape Yubi south of the Canary Islands. The insert shows the main geostrophic transport and topography in the subtropical Atlantic (modifed after Siedler and Onken, 1996).

(Data supplied by the SeaWiFS Project and the Distributed Active Archive Center, Goddard Space Flight Center, Greenbelt, MD, USA)

Primary productivity at LP, ESTOC and EBC for the period September 1997-March 1999 as determined by the Antoine and Morel (1996) method using SeaWiFS chlorophyll and AVHRR SST. Note the elevated productivity throughout the period at EBC (nearest to the African coast) in comparison with LP and ESTOC and the productivity peaks associated with incursions of the Cape Yubi filament over the EBC station. The mean annual productivity during the 19-month period was observed to decrease steeply westwards along the transect, from 237 g C m^{-2} yr^{-1} at EBC to 164 and 145 g C m^{-2} yr^{-1} at ESTOC and LP, respectively.





Spatial distribution of geochemical parameters and relative abundances of planktic foraminifera species in the surface sediments from the Canary Islands region (A: Total organic carbon (TOC) in %; B: ^{15}N of bulk sediment in ‰; C: Organic carbon/total nitrogen weight-%-ratio (C/N-ratio); D: ^{13}C of the organic fraction in ‰; E: Planktic foraminifera *G. Bulloides* in %; F: Planktic foraminifera *G. ruber (white)* in %.)

The geochemical and microfossil data from surface sediments of the Canary Islands region mirror the high biomass-gradient from the coast towards the oligotrophic subtropical gyre. A decrease in TOC, an increase in the C/N ratio, decreasing relative abundances of *G. bulloides* and the opposite trend for *G. ruber (white)* were typical representatives of several proxies mirroring the E-W productivity gradient. Overall the multiproxy approach reflected the present day condition in many details (e.g. mixing zone between the capes and the subtropical gyre domain; island-generated eddies south of the Canary Islands). The signals within the surface sediments are therefore good averages of the present day oceanographic conditions and can be applied for future paleoceanographic reconstructions.

References

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