Nutrients and Upwelling

By Anja Risser

Nutrients, as the basic building blocks of living matter, are a prerequisite for primary production. The principal chemical elements constituting organic material, such as phytoplankton, are oxygen, hydrogen, carbon, nitrogen and phosphorus. Of these, the first three are abundant and widely found in nature. These are the bio-unlimited elements. The elements nitrogen and phosphorus are not always available in the required suitable chemical form and so can become limiting factors for the growth of plants.

In the marine environment nitrogen, mainly in the form of nitrate, is often the biolimiting factor for phytoplankton production. Nitrogen and phosphorus are therefore regarded as the two most important biological nutrients. Another quantitatively important nutrient in seawater is silica. It forms part of the skeletal shells or outer casings of many planktonic organisms such as diatoms and radiolarians.

The Benguela upwelling system generates an abundance of marine life along the Namibian coast. Southerly winds blowing parallel to the coastline and the earth's rotation or Coriolis force result in a westerly offshore movement of coastal surface water. This water mass is replaced by the upwelling of cold, nutrient-rich water from deeper layers. In the presence of sunlight, phytoplankton flourishes on these dissolved nutrients brought to the surface from the seabed.

During phytoplankton blooms surface waters become depleted in nutrients as they are incorporated into organic or skeletal material. These blooms die when there are no more nutrients available. As the planktonic organisms sink to the bottom, they decompose, thus releasing the nutrients. Deep ocean water and the seabed are rich in nutrients in comparison to surface waters. The nutrients are recycled through the upwelling process where once again they reach surface waters and are available to the phytoplankton.

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The Benguela Niños

By Mick O'Toole and Chris Bartholomae

Unusual environment conditions prevailed off the coast of Namibia in 1994. Sea surface temperature patterns during 1994 were typical for those times of the year. Warm stratified surface layers of between 18° and 21°C typical of summer/autumn months (December – April) occurred over the continental shelf off northern Namibia. In the south, cooler water was more widespread and active upwelling was characteristic along much of the coast, especially around Lüderitz where cold 13°C water predominated.

Later in the year during spring (September – November), intense upwelling characterised by 11° to 14°C was found off the Lüderitz area whereas further north, around Walvis Bay warmer more stable waters prevailed.

Off northern and central Namibia low oxygenated bottom water is a seasonal feature of coastal oceanographic processes especially during summer and autumn months. At these times upwelling is reduced and the prevailing southwest winds slacken. The ocean becomes warmer and more stable and favourable for the production of high levels of phytoplankton and zooplankton. The organic decay of plankton leads to a build up of low levels of oxygen near the seabed. This area of anoxic (oxygen depleted) water usually concentrates in a coastal band downstream of the main upwelling cell off Lüderitz. It is particularly pronounced for most of the year from Conception Bay to Cape Cross within the 100 m isobath or depth contour. Traditionally this area has been referred to as the "Azoic Zone".