Phytoplankton Absorption and Assimilation Numbers

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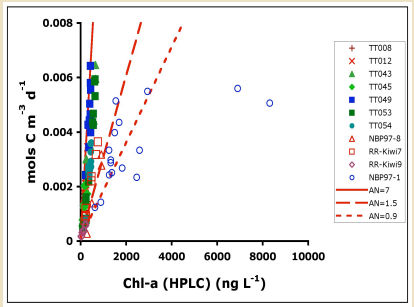
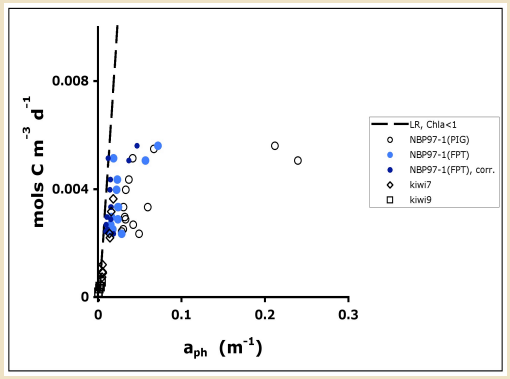
The Assimilation Number is defined as

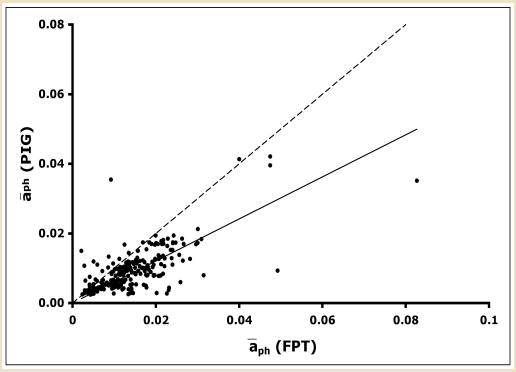
$$AN = PP_{nearsurf.} \bullet (Chla_{nearsurf.})^{-1}$$



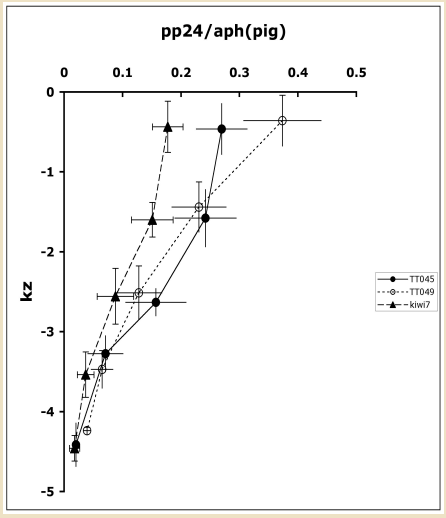
Near-surface primary productivity (y-axis) plotted against chlorophyll-*a* measured by HPLC using data from the equatorial Pacific (TT008, TT012), the Arabian Sea (TT043-TT054), the Ross Sea (NBP97-1, NBP98-4) and the Southern Ocean south of New Zealand (Kiwi-7,-9). The line segments correspond to Assimilation Numbers (AN's) or P^B's, of 7, 1.5, and 0.9 mg C (mg Chla)$^{-1}$ h^{-1}. (To improve visualization of these data, three high data points from TT049 are not plotted, but correspond to an AN ≈ 7).



Primary production (y-axis) plotted against a_{ph}. A linear regression line has replaced the data from the equatorial Pacific and Arabian Sea. The open circles are a_{ph} from pigment reconstruction. The **light blue** filled circles are a_{ph} data from the FPT method. The smaller, **dark blue** circles are a_{ph}(FPT) data corrected for excess absorption, according to Fig. 2 (i.e., a reduction of 40%). The data needed for the PIG/FPT comparisons were only available for NBP97-1.



A comparison between spectrally-averaged absorption by phytoplankton (a_{ph}), based on pigment reconstruction (PIG) and the filter-pad technique (FPT), from near-surface values. The solid line is a trend-line, with an intercept at zero, and where *y = 0.62x*; the dashed line is the 1:1 relationship. Theoretically, a_{ph}(PIG) should always be greater than a_{ph}(FPT) because of the package effect, indicating that, on average, the FPT method is biased high by about 38%.



Productivity (24 h rate) normalized to a_{ph} as a function of optical depth. Data were binned to 0-1, 1-2,... optical depths. The approximate factor of 2 difference near the surface we believe is caused by differences in quantum efficiency. These three cruises show a good range of environmental variability from low temperature, high nutrients (kiwi-7) to high-temperature, low nutrients (TN045), to high temperature, high nutrients (TN049)

Conclusions:

(1) productivity in the ocean varies with phytoplankton absorption, and not always with the quantity of chlorophyll-*a*;
(2) how pigments are packaged in cells is important in many ocean regimes, and more important than the quantity of chlorophyll-*a*, and
(3) phytoplankton absorption integrates, to a large extent, variability in nutrients, temperature, and irradiance.

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