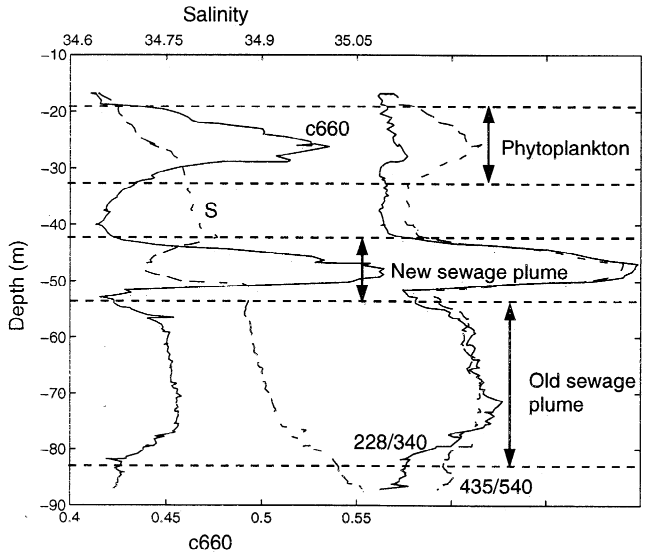

Figure 2. Profiles of salinity, beam attenuation coefficient at 660 nm (c660), and fluorescence, in arbitrary units, for Ex/Em = 228/340 nm and Ex/Em = 435/540 nm. Data are from the second downcast of towyo 32. Three layers were observed: shallow phytoplankton, new and old sewage plumes.

particle suspension, the laser beam provides a diffraction pattern, whose intensity is measured by silicon photodetectors at 17 angles between 0° and 23°. Diffraction intensities are used to determine volume distribution (in percentages) for 30 size classes with upper size limits from 0.7 to 400 μm, using an algorithm based on Fraunhöfer diffraction equations for spherical particles [*Gentien et al.*, 1995]. Full Mie theory could be used to refine the results for particles smaller than 2.56 μm but was not applied here, since interest focused on larger particles. The size distribution in a.u., that is, the relative numerical concentration of particles as a function of particle diameter, is calculated from the volume distribution by dividing each volume percentage by the mean volume of that size class, defined as the spherical volume of a particle, with diameter equal to the midpoint between the extremes of the size class. The density function of size distribution, $F(D)$, is obtained by dividing the size distribution by the width of each size class which increased logarithmically with size.

3. Results

Before describing the biology, optical characteristics, and particle size distributions at the site, it is useful to subdivide the water column vertically into layers affected or not affected by discharged effluent.

3.1. Effect of Discharged Effluent

Up to four layers could be distinguished in the water column, two affected by sewage (recently discharged ("new") sewage plume waters and "old" plume waters) and two unaffected by effluent (shallow and deep phytoplankton layers). Recently discharged or new sewage plume waters were recognized by strong decreases in salinity and increases in c660 (Figure 2). Old sewage plume waters were observed on October 1, 1994, and were characterized by the same signals as new sewage plume waters (low salinity signal, high c660) but smaller in magnitude (Figure 2). This particle field was considered to be older than the sewage plume layer above, since (1) it was deeper and more diluted than new sewage plume; and (2) isopycnal surfaces were rising during the few hours prior to data collection [*Jones et al.*, 1995], so that the old plume would be expected to be deeper than recently discharged effluent. Phytoplankton fields were characterized by increased absorption and beam attenuation coefficients and increased chlorophyll fluorescence compared to clearer waters. One phytoplankton component was located close to the surface; the other one was deeper in the water column near the base of the euphotic zone (Figures 2 and 3). The c660 versus salinity plots have previously provided clear partitioning of the various particle components (*Washburn et al.* [1992]; in conjunction with chlorophyll fluorescence

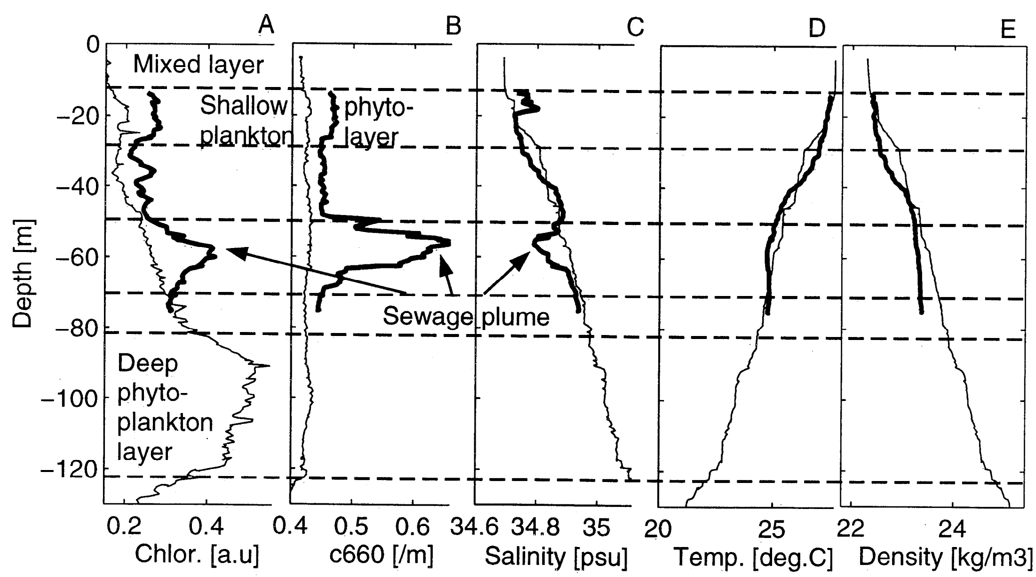

Figure 3. (a) Chlorophyll fluorescence, (b) beam attenuation coefficient at 660 nm (c660), (c) salinity, (d) temperature, and (e) density anomaly. Data are shown for cast 9 (thick line) and cast 12 (thin line).