

Biochemical Characteristics of Suspended Particulate Matter on a Latitudinal Transect in the North Atlantic

N. V. Politova^{a,*}, A. S. Savvichev^{a,b}, A. A. Klyuvitkin^a, M. D. Kravchishina^a, A. B. Demidov^a,
A. Yu. Lein^a, and V. S. Gladyshev^a

^a*Shirshov Institute of Oceanology, Russian Academy of Sciences, Moscow, 117997 Russia*

^b*Winogradsky Institute of Microbiology, Federal Research Center “Fundamentals of Biotechnology”,
Russian Academy of Sciences, Moscow, 119071 Russia*

**e-mail: politova@ocean.ru*

Received April 4, 2017

Abstract—Dispersed sedimentary matter was studied along the latitudinal transect 59°30′ N from Great Britain to Greenland on cruise 49 of the R/V *Akademik Ioffe* in June 2015. The concentrations of suspended particulate matter (SPM) along the transect were low, increasing from 0.24 to 1.07 mg/L in the surface layer (0–5 m), from 0.24 to 0.99 mg/L in the pycnocline (thermocline) zone, and appreciably decreasing toward the bottom layer, fluctuating from 0.10 to 0.56 mg/L. The isotopic composition of organic carbon in SPM was determined in 18 samples. The $\delta^{13}\text{C-C}_{\text{org}}$ values vary from -17 to -24.6‰ . Judging from the chlorophyll *a* content, the isotopic composition of water masses, and their remoteness from the coast, the carbon in SPM is mainly represented by autochthonous organic matter of phytoplanktonic origin. The presence of SPM with a heavy isotopic composition in the surface layer of the water column can serve as evidence for the current processes of phytoplankton bloom. In this case, differences in the intensity of these processes can be observed, creating a mosaic bloom pattern even within a distance of 150 NM.

DOI: 10.1134/S0001437018040069

INTRODUCTION

It is necessary to study the formation and distribution systems of dispersed sedimentary matter in seawater (suspended particulate matter, SPM) in order to understand the processes of present-day sedimentation. The water column records the interaction of the geosphere: external (the atmo-, hydro-, cryo-, bio-, and other spheres) and internal (the endosphere) [5]. SPM is a source of material for bottom sediments, and matter that settles on the bottom ultimately becomes part of the geological historical record of the ocean. The main source of sedimentary material delivered to the bottom as a kind of a matter mobilization zone is the upper active layer of the ocean [7].

Studies of dispersed sedimentary matter in the Atlantic Ocean began in the 1960s [6, 12, 13, 18, etc.]. By the end of the century, research by Russian scientists in this region became sporadic: they pertained mainly to concurrent investigations [8, 9, etc.]. Published data on the isotopic composition of carbon in SPM in the North Atlantic are scant [10, 15, 23, 27].

The straits connecting the North Atlantic to the Arctic Ocean regulate the input of cold and dense Arctic water into the northern part of the Atlantic. Counterflows of warm water from the Atlantic pass through these same straits into the Arctic Ocean. A multilevel pattern of currents occurs: warm in the upper layers

and cold in the near-bottom layers. Heat, matter, and salinity exchange is complicated by systems of ridges transverse to the currents: rises and transform faults (the western and eastern Icelandic ridges). The transect along 59°30′ N (Fig. 1) crosses the Rockall Passage with depths of up to 1500 m and two deep-water jetstream basins: the Eastern (Iceland Basin) and Western (Irminger Sea), separated by the Reykjanes Ridge (Table 1, Fig. 1). Several provinces are distinguished on this transect based on biogeochemical indicators in surface water [29]: the Northeastern Continental Shelf (NECS), the zone of influence of the North Atlantic Drift (NADR), and the Arctic (ARCT) and Boreal Polar (BPLR) zones (Table 1, Fig. 1). The latter two are separated by the East Greenland Polar Front. In terms of depth, the water masses intersecting the given transect are divided into Intermediate Subpolar Modal Water, derived from water carried by the North Atlantic Current (eastern part of the transect); Labrador Intermediate Water that originated in the Arctic as a result of winter convection (in both basins); and the Northeastern and Northwestern deep water, derived from Arctic and Atlantic water masses [27].

Study of the distribution of suspended particulate matter (SPM) and its biogeochemical indicators along the transect in the summer season will aid in under-

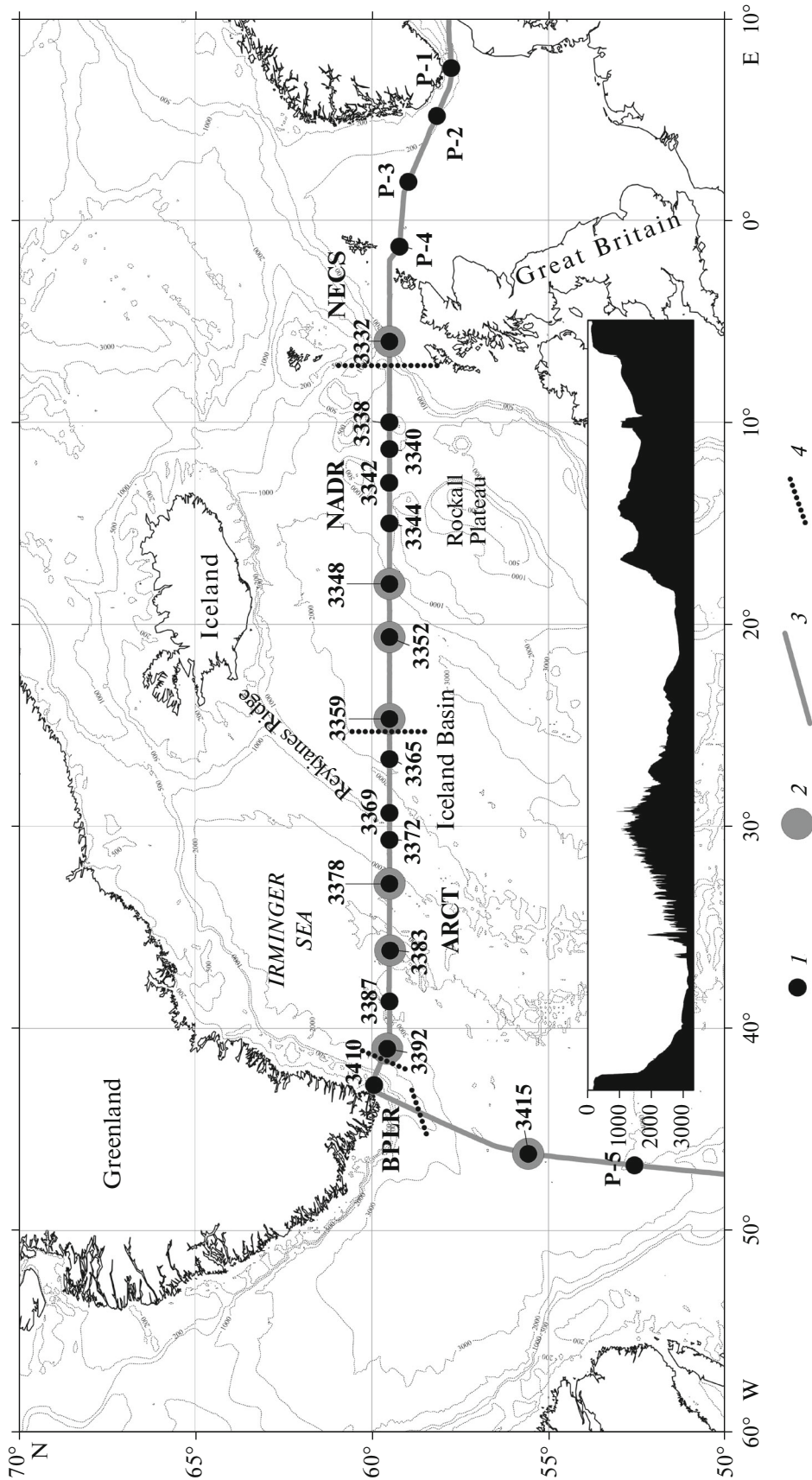


Fig. 1. Route of cruise 49 of R/V *Akademik Lofje*. Inset: bathymetric profile along transect. (1) Collection of water samples from surface; (2) collection of water samples in water column; (3) route of vessel; (4) conditional boundaries of biogeochemical provinces after [29].

Table 1. Biogeochemical (after [29]) and bathymetric zoning of Atlantic on transect 59°30' N

Province	Station	Depth, m	T_0 , °C	Thickness of euphotic zone, m	PP ₀ , mgC m ⁻³ day ⁻¹	Bathymetric zoning
NECS—Northeastern Continental Shelf	3332	134	10.25	29	41.45	Eastern shelf and slope (<1500 m)
	3338	1500	9.84			
	3340	1613	9.94			
	3342	1000	9.88			Eastern Transition Zone (1500–2000 m)
	3344	1411	9.11	58 ± 20	27.87 ± 15.57	
NADR—North Atlantic Drift	3348	2186	8.69			Eastern Basin (>2000 m)
	3352	2818	9.25			
	3359	2507	8.80			
	3365	2235	8.31			
	3369	1500	7.95			
ARCT—Arctic	3372	1529	7.32			Reykjanes Ridge (1400–2000 m)
	3378	2192	6.80	58 ± 28	33.95 ± 28.62	
	3383	3084	5.96			Western Basin (>2000 m)
	3387	2996	5.51			
	3392	2394	5.82			Western slope (200–2000 m)
	3415	2985	5.58			Labrador Sea (mean depth 1898 m)
	3410	100	-0.94	142	3.27	Greenland shelf (<200 m)
BPLR—Boreal Polar						

standing the origin of dispersed sedimentary matter in this region.

MATERIALS AND METHODS

A study of dispersed sedimentary matter along the latitudinal transect 59°30' N from Great Britain to Greenland was carried out from June 11 through July 4, 2015, on cruise 49 of the R/V *Akademik Ioffe* under the Russian Science Foundation project "The World Ocean in the 21st Century: Climate, Ecosystems, Resources, Catastrophes" [4]. Water samples were also collected in the North and Labrador seas along the route of the vessel (Fig. 1). Water samples were taken from the surface with a plastic bucket, while at complex oceanographic stations, samples were taken in the water column by a shipboard system equipped with 5 and 12 L Niskin bottles targeted at depths determined from the results of early hydrophysical sounding. To determine the total SPM concentration, seawater was run through weighted nuclear filters with a diameter of 47 mm (pore diameter 0.45 μm) under vacuum of -0.4 atm. To determine the concentration of particulate organic carbon (C_{org}) and chlorophyll, filtration was carried out through Whatman GF/F fiberglass filters calcined to remove organic substances ($\sim 450^\circ\text{C}$); the diameter was 47 mm (an effective pore size of around 0.7 μm) under vacuum of -0.2 atm (for more detail, see [1, 25, 26]). Filters were dried in situ at $t = 55^\circ\text{C}$ to the total concentration of SPM and C_{org} , while the fiberglass filters for determining the chlorophyll content were frozen and sent to Moscow.

C_{org} was determined on an AN-7529 device of the Shirshov Institute of Oceanology, Russian Academy of Sciences (analyst L.V. Demina). A coefficient of 2 was used to recalculate the organic component of SPM [19, 22].

The concentration of phytoplankton pigments chlorophyll *a* (chl *a*) and pheophytin *a* (pheo *a*) was determined by a fluorometric method [17] with a Trilogy fluorometer (Turner, United States). The device was calibrated with standard chl *a* powder (C6144-1MG Sigma, Austria), in the solution of which the initial pigment concentration was determined spectrophotometrically. The pheo *a* fraction (%) was determined from the sum of the chl *a* and pheo *a* concentrations.

SPM samples were studied at the Shirshov Institute of Oceanology on a VEGA 3 SEM scanning electron microscope (Tescan, Czech Republic) equipped with an INCA Energy microanalyzer (Oxford Instruments) (analyst A.G. Boev).

Phytoplankton primary production was measured by a radiocarbon modification of the light-and-dark-bottle method [30]. The experiment was set up to imitate light conditions in situ [21].

Microorganisms were observed and counted with the aid of an Olympus BX-41 epifluorescent micro-

scope equipped with a visualization system based on the ImageScopeM computer program, after fixation with glutardialdehyde (final concentration 2%) and deposition onto black polycarbonate filters (Osmonix, diameter 25 mm, pore diameter 0.22 μm) with staining with a 0.2% acridine orange solution over the course of 15 min [16].

To determine the methane concentration in the studied samples, the headspace sampling method was used: immediately after the Niskin bottles were raised aboard the vessel, the water samples from different horizons were poured into glass vials with a preadded fixer (dry acridine orange) to suppress microbial processes. A plastic doser was used to squeeze out an equal volume of water from a vial. The vials were sealed with an airtight butyl rubber stopper. The methane concentration in the gas equilibrium phase of the prepared samples was determined at a stationary laboratory at the Winogradsky Institute of Microbiology, Russian Academy of Sciences, on a gas chromatograph with a flame ionization detector using the phase equilibrium degassing technique [2].

To determine the isotopic composition of C_{org} in SPM, water samples from different horizons were filtered through calcined GF/F fiberglass filters and dried at $t = 55^\circ\text{C}$. The filtrate was collected separately to determine the isotopic composition of dissolved carbon in the form of bicarbonate ion.

The intensities of microbial processes in the methane, carbon, and sulfur cycles were studied by the radioisotope method: (1) measurement of dark assimilation of carbon dioxide (bacterial chemosynthesis and heterotrophic fixation of carbon dioxide) by the radiocarbon method for inclusion of ^{14}C -bicarbonate into the composition of cellular and dissolved organic matter; (2) determination of the rates of microbial methanogenesis in bottom sediments by the radiocarbon method; to determine methanogenic microbe activity, ^{14}C -bicarbonate was used (autotrophic methanogenesis); (3) determination of the rate of sulfate reduction using ^{35}S -sulfate [3]. The material was processed at the mass spectrometry laboratory of the Winogradsky Institute of Microbiology on a Delta Plus mass spectrometer (Germany) (analyst T.S. Prusakova).

RESULTS

During the observation period on the transect, the water temperature in the euphotic zone varied from 10.25°C on the eastern shelf to -0.91°C on the western (Greenland) shelf. The thickness of the euphotic zone increased from 29 to 142 m in this direction.

Increased concentrations of (unused) phosphates and dissolved silica are indirect evidence for the initial stage of the phytoplankton bloom during the expedition on the transect from June 16 through 29 (Table 2).

The primary production (PP_0) values varied from $41.45 \text{ mgC m}^{-3} \text{ day}^{-1}$ on the eastern shelf to

Table 2. Biogeochemical characteristics of SPM and surface layer of water column on Atlantic transect 59°30' N

Zone	Station no.	Depth, m	SPM, mg L ⁻¹	C _{org} , mg L ⁻¹	δ ¹³ C, ‰	CH ₄		chl <i>a</i> , μg L ⁻¹	TAM, 10 ³ cells mL ⁻¹	Biomass, μg L ⁻¹	Dark assimilation of CO ₂ (in cell composition), μg C L ⁻¹ day ⁻¹	Si, μM	PO ₄ , μM
						nL L ⁻¹	nM L ⁻¹						
NECS	3332	134	0.74	0.113	-23.1	220	9.7	1.51	450	4.95	0.121	1.57 ± 0.39	0.41 ± 0.09
	3338	1500	0.39	0.137	-20.2	210	9.3	1.16	500	5.50	0.116		
	3340	1613	0.69	0.134				0.98					
	3342	1000	0.76	0.156	-19.1	180	8.1	1.27	480	5.28	0.127	1.72 ± 0.72	0.55 ± 0.11
NADR	3344	1411	0.38	0.094	-20.2	220	9.9	0.61	260	2.86	0.094		
	3348	2186	0.33	0.096	-21.3	260	11.4	0.53	270	2.97	0.079		
	3352	2818	0.24	0.075		280	12.9	0.37	280	3.08	0.069	1.93 ± 0.44	0.66 ± 0.03
	3359	2507	0.46	0.112	-18.1	230	10.4	0.41	400	4.40	0.114		
	3365	2235	0.45	0.124				0.65					
	3369	1500	0.57	0.112	-21.3	370	16.7	0.69	270	2.97	0.022	0.58 ± 0.54	0.66 ± 0.15
ARCT	3372	1529	0.98	0.106				0.74					
	3378	2192	0.77	0.129				1.27	300	3.30	0.051		
	3383	3084	0.86	0.127		130	5.9	1.15	320	3.52	0.037	3.78 ± 2.73	0.72 ± 0.09
	3387	2996	0.24	0.055				0.51					
	3392	2394	0.51	0.089	-18.9	220	9.7	0.36	240	2.64	0.028	6.27 ± 0.28	0.82 ± 0.16
	3415	2985	1.07	0.197	-16.5	320	14.4	1.16	220	2.42	0.018		
BPLR	3410	100	0.74	0.151	-17.9	330	15.0	0.60	270	2.97	0.067	0.03 ± 0.07	0.15 ± 0.06

Table 3. Biogeochemical characteristics of SPM in water column in area of pycnocline (thermocline) zone

Station no.	Depth, m	Horizon, m	SPM concentration, mg L ⁻¹	C _{org} , mg L ⁻¹	δ ¹³ C-C _{org} , ‰	CH ₄		chl <i>a</i> , μg L ⁻¹	TAM, 10 ³ cells mL ⁻¹	Biomass, μg L ⁻¹	Dark assimilation of CO ₂ (in cell composition), μg C L ⁻¹ day ⁻¹
						nL L ⁻¹	nM L ⁻¹				
3332	134	20	0.70	0.147	-20.7	210	9.4	0.93	450	4.95	0.13
3348	2186	35	0.39	0.072	-21.7	230	10.1	0.63	280	3.08	0.07
3352	2818	20	0.31	0.074	-22.4	320	14.5	0.35	350	3.85	0.14
		33	0.24	0.056	-21.7	400	17.6	0.36	320	3.52	0.12
3359	2507	28	0.31	0.051	-21.1	280	12.5	0.48	410	4.51	0.10
3378	2192	30	0.51	0.138	-20.4	300	13.4	1.12	300	3.30	0.06
3383	3084	20	0.76	0.089		50	2.1	1.93	340	3.74	0.06
3392	2394	30	0.42	0.070	-20.3	270	11.9	0.45	320	3.52	0.03
3415	2985	35	0.99	0.120		360	15.9	1.24	690	7.59	0.05

3.27 mgC m⁻³ day⁻¹ on the shelf near the Greenland coast (Table 1). On the eastern continental slope and in the Eastern Basin, the PP₀ values are 27.87 mgC m⁻³ day⁻¹; above the Reykjanes Ridge and in the Western Basin, they are 33.95 mgC m⁻³ day⁻¹ (Table 1).

The SPM concentration on the transect increased from 0.24 to 1.07 mg/L in the surface layer (0–5 m), from 0.24 to 0.99 mg/L in the pycnocline (thermocline), and appreciably decreased toward the near-bottom layer, fluctuating from 0.10 to 0.56 mg/L. No dependence of the SPM concentration on ocean depth was observed (Tables 2–4).

Surface layer. The relatively high SPM concentrations at the eastern shelf station (3332) are related to the input of allochthonous terrigenous matter from land, evidenced by the relatively light isotopic composition of C_{org} in SPM compared to all other areas on the transect: -23.1‰ (Table 2).

The SPM concentration in the surface water layer at stations 3340, 3342, 3344, 3348 of the Eastern Transition Area located within the boundaries of the warm NADR varies from 0.33 to 0.76 mg/L. The C_{org} content in SPM differed almost twofold, with the maximum at station 3342 (C_{org} = 0.156 mg/L). At this station, the chl *a* content, the total abundance of microorganisms (TAM), bacterioplankton biomass, and integral value of the rate of microbial dark assimilation of CO₂ are appreciably higher (Table 2). The δ¹³C-C_{org} (-19‰) values in the surface water layer are characteristic of the biomass of marine phytoplankton at the bloom stage. At station 3344 with smaller contents of chl *a* and other parameters, the isotopic composition of C_{org} is somewhat lighter (δ¹³C = -20.2‰).

Another region of the initial phytoplankton bloom stage is assumed from the aggregate characters and value

of δ¹³C-C_{org} = -18‰ in the area of station 3359 (ARCT province) in the Eastern Basin. In the surface layer of the water column above the Reykjanes Ridge (station 3369), an isotopic composition of C_{org} (-21.3‰) common for oceanic phytoplankton was noted (Table 2).

Finally, near Greenland, independent of ocean depth (station 3410, BPLR province), the heaviest isotopic composition of C_{org} was determined (δ¹³C = -17.8‰), which we consider an indication of the phytoplankton bloom process in this coldest area on the transect 59°30' N. The low, negative water temperature apparently slowed the bloom, the periods of which were shifted by 6–11 days compared to other areas on this transect.

We also obtained close values of the isotopic composition of C_{org} in SPM in the Labrador Sea (station 3415, ARCT province, δ¹³C = -16.5‰). Here, we noted concentrations of SPM (1.07 mg/L), chl *a* (1.16 μ/L), and C_{org} (0.197 mg/L) that are high for oceanic areas.

The pycno- and thermocline layer. In the thermocline layer (occurrence depth of 20–40 m), the SPM concentration hardly varies compared to the surface layer, whereas the C_{org} concentration in SPM decreases at almost all stations except for eastern shelf station 3332 and station 3352 at the center of the Eastern Basin (Table 3).

At the majority of stations, the chl *a* content also decreases with the exception of the deepest station from the Western Basin, where an increase in chl *a* is observed, from 1.15 μ/L in the surface layer to 1.93 μ/L in the thermocline layer (Table 3).

Biogeochemical microbial indexes (TAM, bacterial biomass, and dark assimilation of CO₂) in the thermocline layer (stations of the eastern part of the transect) are either equal to or higher than the values of the above-mentioned parameters compared to the surface

Table 4. Biogeochemical characteristics of SPM in near-bottom layer of water column

Station no.	Depth, m	Horizon, m	SPM concentration, mg L ⁻¹	C _{org} , mg L ⁻¹	$\delta^{13}\text{C}-\text{C}_{\text{org}}$, ‰	CH ₄		Chl <i>a</i> , $\mu\text{g L}^{-1}$	TAM, 10 ³ cells mL ⁻¹	Biomass, $\mu\text{g L}^{-1}$	Dark assimilation of CO ₂ (in cell composition), $\mu\text{g C L}^{-1} \text{day}^{-1}$
						nL L ⁻¹	nM L ⁻¹				
3332	134	130	0.27	0.074	-22.9	50	2.10	0.07	130	1.43	0.01
3348	2186	2180	0.17	0.020	-24.1	140	6.50	0.03	60	1.20	0.00
3352	2818	2815	0.56	0.032	-18.7	160	7.10	0.47	200	4.00	0.01
3359	2507	2541	0.39	0.020	-21.9	20	0.70	0.20	140	2.80	0.00
3378	2192	2189	0.13	0.011	-21.0	50	2.10	0.03	100	2.00	0.00
3383	3084	3130	0.20	0.012	-21.2	60	2.90	0.07	40	0.80	0.00
3392	2394	2390	0.10	0.009	-21.6	30	1.30	0.02	30	0.60	0.00
3415	2985	2981	0.30	0.007	-17.4	160	6.90	0.01	20	0.40	0.00

layer (stations of the Eastern and Western basins) (Table 3).

Near-bottom layer. In the near-bottom layer, the minimum (1.2–6 times smaller) values of SPM, chl *a*, C_{org} content in SPM, TAM values, bacteriophytoplankton biomass, and CO₂ assimilation rates (Table 4) are observed at all stations except 3352 at the center of the Eastern Basin. An increase in SPM concentration (0.56 mg/L) is characteristic of the area of this station in comparison to the surface layer (0.46 mg/L) and thermocline layer (0.31 mg/L). The isotopic composition of C_{org} in SPM of the near-bottom layer at this station is close to that of oceanic phytoplankton in the bloom period ($\delta^{13}\text{C}-\text{C}_{\text{org}} = -18.7\text{‰}$). Noteworthy are the larger values in the near-bottom layer compared to the water column, as well as larger TAM values, bacteriophytoplankton biomass, and dark assimilation of CO₂.

The methane concentrations in the water layer on the Atlantic transect 59°30' N are lower, varying at deep-water stations from from 5.9 to 9.3 nM in the surface layer and increasing to 17.6 nM in the thermocline zone. In the near-bottom layer, the methane concentration decreases to 1.3–7.1 nM (Tables 2–4). A similar distribution for the methane concentration is evidence of methanogenetic processes occurring in situ in the water column. No methane flux from the bottom was recorded.

DISCUSSION

The obtained SPM concentrations are characteristic of open Atlantic Ocean water [7, 9, etc.]. The appearance of circum-continental zoning are particularly noticeable in the eastern part of the transect, near the coasts of Europe, where the influence of terrigenous matter transported from land is appreciable in surface waters. On the remaining part of the transect,

the influence of biological factors is more marked, although the transect along 59°30' N passes through eutrophic and mesotrophic areas of the ocean and the phytoplankton bloom process itself transpires nonuniformly; therefore, spottiness in the distribution of the concentration of dispersed sedimentary material in ocean surface waters are seen on the transect.

In marine ecosystems, an inorganic carbon source participating in photosynthesis is carbon dioxide (CO₂) dissolved in seawater. The $\delta^{13}\text{C}$ values of atmospheric CO₂ are from -7 to -8‰. The isotopic composition of carbon in the form of bicarbonate ion in seawater and in equilibrium with gaseous atmospheric CO₂ fluctuations is around 0‰ [11].

The $\delta^{13}\text{C}$ value of dissolved inorganic carbon in seawater deeper than the euphotic zone varies from 0 to -1‰ depending on depth and the presence of dissolved inorganic carbon from other sources [20].

Carbon of living organisms is depleted in ¹³C with respect to their initial mineral carbon in the ecosystem. The largest-scale biological fractionation of carbon isotopes in nature occurs at the initial stage of CO₂ assimilation by photoautotrophs [24].

The isotopic composition of photoautotrophic microorganisms depends on the isotopic composition of initial CO₂ and on the amount of CO₂ used. Under the condition when all mineral carbon of the environment is completely involved in biosynthesis, the living matter of organisms can inherit the isotopic composition of this initial mineral carbon. This occurs extremely rarely in nature.

When marine and oceanic phytoplankton photosynthetically fix carbon using the enzyme RuBP (rubisco), phytoplankton biomass is produced at a ratio of stable carbon isotopes from -15 to -22‰ [11, 14].

Our obtained $\delta^{13}\text{C}-\text{C}_{\text{org}}$ values in SPM lie precisely in the mentioned range from -15 to -22‰ and in

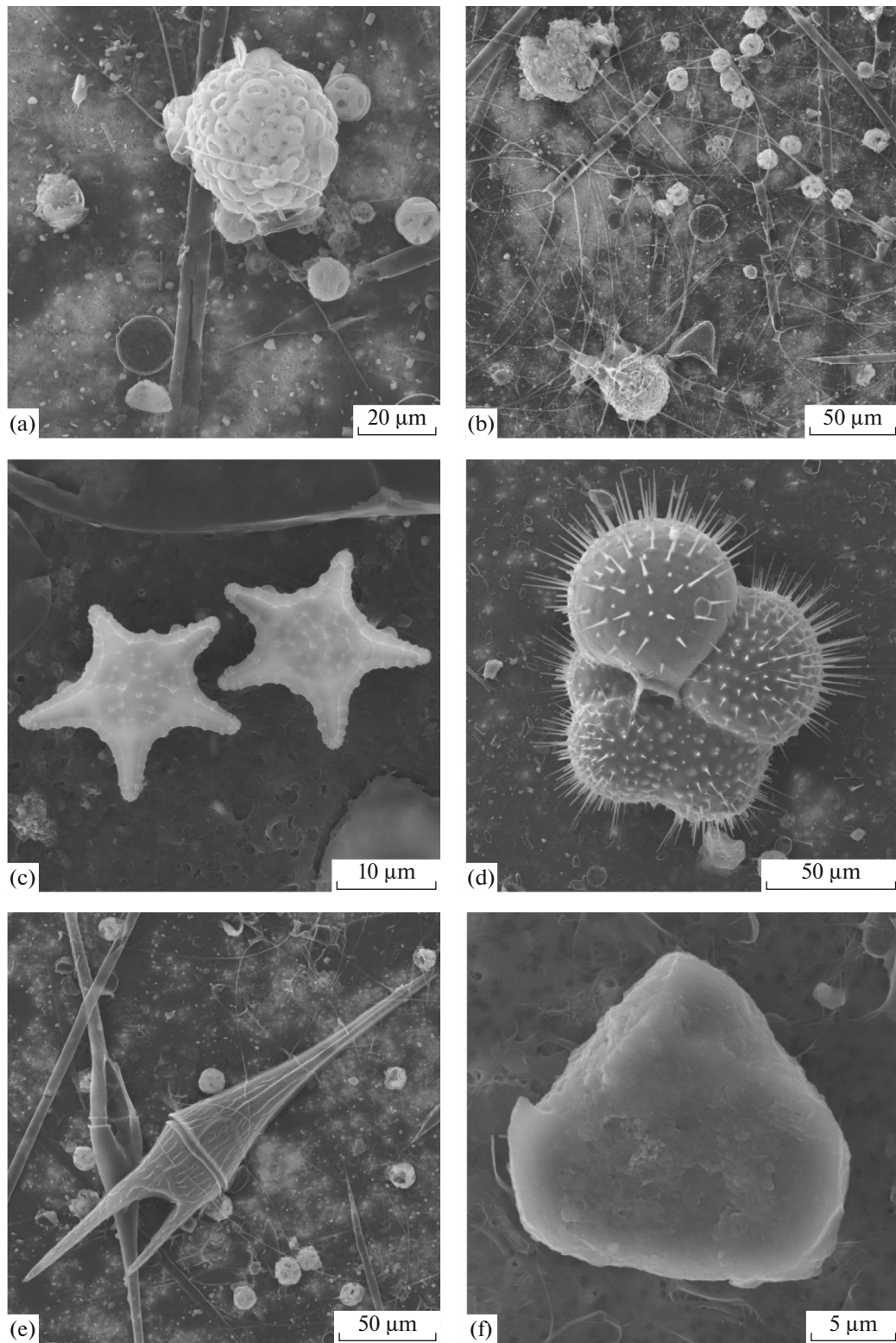


Fig. 2. Photomicrographs of SPM of North Atlantic water: (a, b) overall view of SPM collected on filter with diatoms *Chaetoceros* and coccolithophorids; (c) dinoflagellates *Actiniscus*; (d) foraminifera *Globegirina*; (e) dinoflagellates *Ceratium furca* and *Ceratium fuscus*; (f) clastic component of SPM, quartz fragment.

essence almost completely exclude the participation of allochthonous organic matter in the SPM composition on the transect of 59°30' N, except for the area of the eastern shelf. The minimum fractionation of isotopes happens at a high rate of biological processes (the kinetic isotope effect). Precisely such minimum fractionation of carbon isotopes takes place at a high rate of photosynthesis during the bloom.

The presence of C_{org} in SPM with an isotopic composition of -17 to -19% in the surface layer of the water column on the transect 59°30' N may be evidence for the occurring processes of phytoplankton bloom. An SEM study of SPM also confirms its predominantly biogenic origin (Fig. 2). As well, it is possible to observe differences in the intensity of these processes, which creates a mosaic bloom pattern even within a distance of 150 NM.

It can be considered proved that the low, close to negative temperatures impact the onset of the bloom near Greenland in the zone of influence of the cold polar current coming from the Arctic Ocean through the Fram and Denmark straits.

The relatively high concentrations of nutrients (P and Si) in the water column on June 16–27, 2015 speak to the incomplete phytoplankton bloom process. The phytoplankton bloom leads to a decrease in the concentration of phosphates and an increase in the abundance of bacterioplankton, its biomass, and the rate of microbial processes (stations 3342, 3359, 3383, 3410). The initial stage of the bloom is also indicated by high assimilation numbers in the NADR, ARCT, and BPLR provinces (6.09 ± 2.93 , 2.78 ± 1.64 , and $4.35 \text{ mgC mg chl } a^{-1} \text{ h}^{-1}$, respectively). These correspond to relatively low, on average, values of chl *a* concentration at the surface ($<1 \mu\text{g L}^{-1}$). Such a pattern is observed when the carbon assimilation rate overtakes the phytoplankton biomass accumulation process, which is characteristic of the onset of bloom.

From the surface to the bottom, there is a decrease in the concentrations of SPM, C_{org} , CH_4 , and a number of biogeochemical parameters related to them.

Only at station 3352 in the Eastern Basin was it observed that the values of the concentrations of SPM, chl *a*, TAM, bacterioplankton biomass, and dark assimilation of CO_2 in the near-bottom layer were higher than those in the water column. Such anomalies, in our opinion, can only be explained by assuming the intrusion of surface water to the bottom of the Eastern Basin owing to powerful convection from an anticyclonic eddy.

Also observed are a higher chl *a* concentration in the eastern (warm) part of the transect (shelf, transition zone), a decline in chl *a* in the Eastern Basin and above the Reykjanes Ridge, a new increase on the western slope of the ridge, a decline in the Western Basin, and an increase on the Greenland shelf.

Low methane concentrations are characteristic of the water column of the open (calm) ocean.

Thus, dispersed sedimentary matter on the transect 59°30' N in the summer was predominantly autochthonous in origin, except for the eastern area. In the upper water layer, phytoplankton bloom processes took place, which constituted the majority of SPM.

ACKNOWLEDGMENTS

The authors are grateful to Academician A.P. Lisitzin for overall supervision of investigations, as well as to Captain A.V. Zybin, the crew of the R/V *Akademik Ioffe*, the supervisor of the expedition S.V. Gladyshev, and the entire scientific team for assistance on the expedition, as well as to the analysts who aided in processing the material.

The expedition was financially supported by the Russian Science Foundation (grant no. 14-50-00095 “Interaction of Geospheres and Mineral Resources of the World Ocean” (supervisor, Academic A.P. Lisitzin). Processing of material in particular was carried out under State Assignment, topic no. 0149-2018-0016.

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Translated by A. Carpenter