30. CARBOHYDRATE RESIDUES IN LEG 44 CORE-SAMPLES

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INTRODUCTION

Selected parts of core samples from Holes 390, 391A, 391B, 391C, and 392A were frozen on board ship and subsequently delivered to the writers for study of residual carbohydrates. The samples were analyzed for total carbohydrates, water-soluble monosaccharides, acid-extractable monosaccharides, and several polysaccharides (starch, cellulose, and laminaran).

LABORATORY PROCEDURES

Total carbohydrates were analyzed by means of a modified phenol-sulfuric acid method (Dubois et al., 1956; Swain, 1966). The method is effective for determining the content of sugars with reducing groups, but not for those that lack reducing groups. The weights of the samples analyzed for total carbohydrates ranged from 2 to 6 grams.

Additional samples ranging from 1 to 12 grams were extracted with boiling water under reflux conditions for 24 hours, followed by extraction with 0.5 *N* sulfuric acid for 24 hours. The two extracts were further processed as described previously (Swain, 1970) for analysis of free sugars and polysaccharide residues in the water extracts and polymeric sugars in the acid extracts. Monosaccharides were analyzed by paper chromatography, and β-D-glucose and β-D-galactose contents were analyzed by enzymatic methods using galactose- and glucose-oxidases and galactose dehydrogenase procedures (Swain and Bratt, 1972). Analyses for cellulose, starch, and laminaran were made using cellulase, amylase, and laminarase enzyme preparations, respectively. The results are shown in the accompanying tables. The total carbohydrate values (Table 1) range from 0.03 to 0.94 mg/g and average 0.24 mg/g. There is no apparent relationship between total carbohydrate values to either age, lithofacies, or organic content of the sediments. Calculation of the content of total carbohydrates on a carbonate-free basis, although accentuating the values in the carbonate oozes, did not yield other new results (Table 1).

Free sugars and polysaccharide contents of the Leg 44 sediments are below levels of detection in the samples. Acid extractable monosaccharides, analyzed by paper chromatography are below detectable levels except in the samples of upper Pleistocene-Holocene and Miocene sediments (Table 2). In the former sample, in addition to galactose and glucose, small amounts of mannose, arabinose, and xylose are present and in the latter, traces of galactose and glucose.

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The values for galactose and glucose in Table 2 were enzymatically determined and represent the β-D forms of the two sugars. We are uncertain as to how much of the enzymatically inactive forms of the two sugars are present, but in view of the generally negative paper chromatographic results, such values are probably negligible.

We conclude from these analyses that characterizable carbohydrate components of the sediments are generally very low in spite of the moderate values for total carbohydrates. The values for total carbohydrates are comparable to those of modern tidal marsh sediments (Swain and Bratt, 1972) although these are 1 to 2 orders of magnitude less than values for many other marine sediments. Much of the carbohydrate material in the Leg 44 sediments appears to have degraded to furfurals.

The negative values for galactose in the samples of pre-Miocene sediments is surprising in view of the common association of this sugar with glucose in other geologic samples (Rogers, 1965; Swain, 1972; Swain et al., 1970). In the open ocean, dinoflagellates may be the most common source of carbohydrates, and these would yield glucose rather than galactose. In nearshore environments, on the other hand, larger algae, which yield large amounts of galactose are potentially the main source of sedimentary carbohydrates.

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TABLE 1
Total Carbohydrate Residues in Leg 44 Core Samples

Sample (Interval in cm)	Age	Total Carbohydrate (mg/g)	Total Carbohydrate (mg/g carbonate free)	Sediment Type
391B-2-1, 0-6	L. Pleist.-Holo.	0.94	1.29	Silty clay
391A-3-4, 28-32	L. Miocene	0.08	0.08	Calc. silt
391C-7-2, 132-136	Cretaceous?	0.04	0.04	Claystone
392A-1-1, 117-119	L. Campanian	0.17	1.75	Calc. ooze
392A-1-2, 58-60	L. Campanian	0.14	1.42	Calc. ooze
390-4-2, 42-44	E. Albian	0.13	0.26	Clayey calc. ooze
390-3-1, 116-120	E. Albian	0.03	0.04	Clay
392A-2-2, 135-137	E. Albian	0.46	0.84	Calc. ooze
392A-2-3, 111-113	E. Albian	0.58	1.06	Clayey calc. ooze
392A-3-1, 52-54	L. Aptian	0.07	0.22	Calc. ooze
392A-3-2, 127-129	L. Aptian	0.15	0.77	Calc. ooze
392A-3-3, 56-58	L. Aptian	0.29	1.47	Calc. ooze
391C-14-3, 138-142	L. Valang.-E. Barrem.	0.16	0.55	Calc. claystone
390-8-4, 106-110	Pre-Barremian	0.12	2.02	Calc. claystone
391C-52-2, 0-3	E. Tithonian	0.23	0.31	Red claystone

TABLE 2
β-D-Glucose and β-D-Galactose Contents of Leg 44 Core Samples

Sample (Interval in cm)	Age	Glucose (mg/g)	Glucose (% of TC)	Galactose (mg/g)	Galactose (% of TC)	Gal/Glu
391B-2-1, 0-6[a]	L. Pleisto.-Holo.	0.005a[b] 0.003b	0.53a 0.32b	0.009	0.95	1.8
391A-3-4, 28-32[c]	L. Miocene	0.0011	1.38	0	1.25	0.9
391C-7-2, 132-136	Cretaceous?	0.0003	0.75	0	0	0
391A-1-1, 117-119	L. Campanian	0.002	1.18	0	0	0
391A-1-2, 58-60	L. Campanian	0.0014	1.0	0	0	0
390-4-2, 42-44	E. Albian	0	0	0	0	0
390-3-1, 116-120	E. Albian	0.0002	0.67	0	0	0
392A-2-2, 135-137	E. Albian	0.001	0.22	0	0	0
392-2-3, 111-113	E. Albian	0	0	0	0	0
392A-3-1, 52-54	L. Aptian	0.0017	2.43	0	0	0
392A-3-2, 127-129	L. Aptian	0	0	0	0	0
392A-3-3, 56-58	L. Aptian	0.004	1.38	0	0	0
391C-14-3, 138-142	L. Valang.-E. Barrem.	0.0061	3.81	0	0	0
390-8-4, 106-110	Pre-Barremian	0.0004	0.33	0	0	0
391C-52-2, 0-3	E. Tithonian	0.0007	0.30	0	0	0

[a]The sample also yielded, by paper chromatography (in mg/g) mannose 0.003, arabinose 0.003, xylose 0.002, ribose 0, rhamnose 0. The other samples were negative for all these sugars.
[b]a, chromatographic analysis; b, enzymatic analysis
[c]The sample yielded, by paper chromatography, traces of galactose and glucose.