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MINERAL CYCLING: THE HUMIC MATERIALS OF LAKE GEORGE

A Preliminary Study (July 1, 1972 - August 31, 1972)

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By

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A Preliminary Study (July 1, 1972 - August 31, 1972)

The mineral cycling studies at the Lake George site during the summer of 1972 included an investigation of the soluble organic material within the lake. Results of a preliminary study are reported, although procedural evaluations represented the major effort.

No specific compounds are studied, but the group comprising the category of humic materials has been chosen to initiate the soluble organic carbon cycle study. It is a group which is especially significant to the ecosystem study because it is derived from the biomass through decomposition and metabolic processes and further altered through re-composition processes (Prakash and Rashid, 1968). It is, however, difficult to evaluate because of a lack of definition in structure and stability. The intended thrust of the study is to evaluate the role of soluble organics within biological processes of Lake George. The preliminary work, however, was aimed at determining level of humics present in the lake.

Methods

Humic materials were prepared from sediment collected at Smith Bay, Lake George. The procedure employed was that of Rashid and King (1969) for the recovery of "humic acid". Because of the ill-defined nature of the latter substance, the preliminary results are reported as "humic materials" and are operationally-defined.

The measurement procedure follows that of Martin and Pierce (1971) with the substitution of hydrochloric acid for acetic acid and the inclusion

of back-extraction of the alcohol solution with 0.5 N NaOH. Thus, the "humic materials" will include the alcohol-soluble hymatomelonic acid fraction. Measurements were made at 420 nm and referenced to the prepared "humic acid" on the basis of carbon content.

Carbon measurements were made with a Beckman Model 915 furnace unit coupled to a MSA Model 200 analyzer employing a 38" IR cell. Carbonates were removed by acidification and purging with nitrogen.

Results

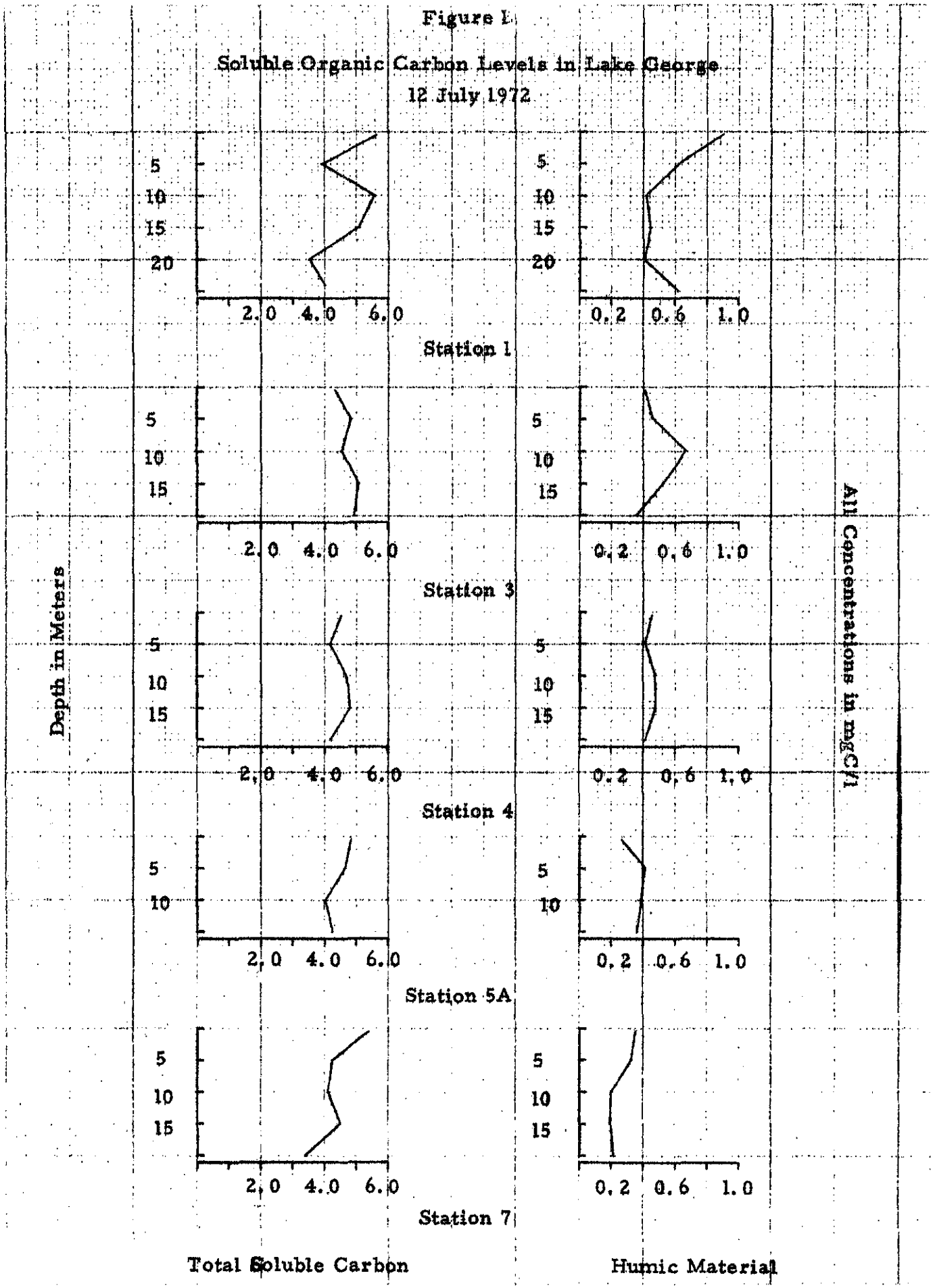
Mid-summer soluble organic carbon averaged 4.51 mgC/l in Lake George, and "humic materials", 0.41 mgC/l. Soluble organic carbon levels tended toward uniformity throughout the lake, although there was a distinct trend toward decreasing levels of "humic materials" in the northern half (Figure 1). Except for the southern-most station, i.e. Station 1, the vertical profiles of both components were also relatively uniform.

The ten-fold difference between soluble carbon and "humic materials" may be misleading in estimating the total composition of the latter. This is due to the fact that the colorimetric extraction procedure is by no means inclusive of all the components which can be classified as humics, particularly the fulvic acids which are both acid-and-base-soluble.

Ghasseimi and Christman (1968) reporting on their gel permeation studies, noted that all color molecules, i.e. measured at 420 nm, were excluded by Sephadex G-10, which has an apparent molecular weight (AMW) exclusion level of 700. Kumar (1971)fractionated a sample from Smith

Figure 1

Soluble Organic Carbon Levels in Lake George
12 July 1972



Bay with various Sephadex resins and found that 64% of the recovered organics had an AMW of less than 600. Thus, a significant portion of the humics may not be accounted for by the techniques used. Rashid and King (1969) found in their studies of marine sediments that 32% of their recovered fulvic acids had an AMW of less than 700.

On the other hand, Prakash and Rashid (1968) showed that humic acids were almost twice as effective in stimulating marine algal growth as were the fulvic acids. Hymatomelonic acids, however, apparently had negligible stimulatory effects.

For sources of humic materials, two wetland areas of the lake were surveyed. Northwest Bay Brook which supplies approximately 10% of the annual surface flow into Lake George enters the bay through a large marsh. Surface waters of the bay were measured for humic acids, exclusive of the hymatomelonic acids incorporated in the "humic materials", and there appeared to be a significant contribution from the brook even at mid-summer flows (Figure 2). Soluble organic carbon levels were found to be slightly above those in the lake proper, ranging between 4.0 and 7.5 mg C/l.

Dunham Bay Brook is another marshland stream and humic contributor. Soluble organic carbon in the bay is approximately at lake levels, i.e. 5.0 to 5.4 mgC/l, but "humic materials" constitute over one-third of the total. The "humic material in the bay thus represent a three-fold increase in the composition of soluble organic carbon relative to the lake proper.

Besides the wetlands, "humic materials" undoubtedly also arise from decomposition products of the biomass present in the lake itself. One indication of this is the relationship between soluble organic carbon and soluble organic phosphorus, i. e. total soluble phosphorus exclusive of the soluble reactive phosphorus. From the 12 July 1972 sampling, correlation coefficients for the parameters were derived. Between soluble organic carbon and soluble organic phosphorus, $r = 0.24$, indicating the lack of a stable phosphorus composition. However, when soluble organic phosphorus is correlated with "humic materials" r increases to a value of 0.71.

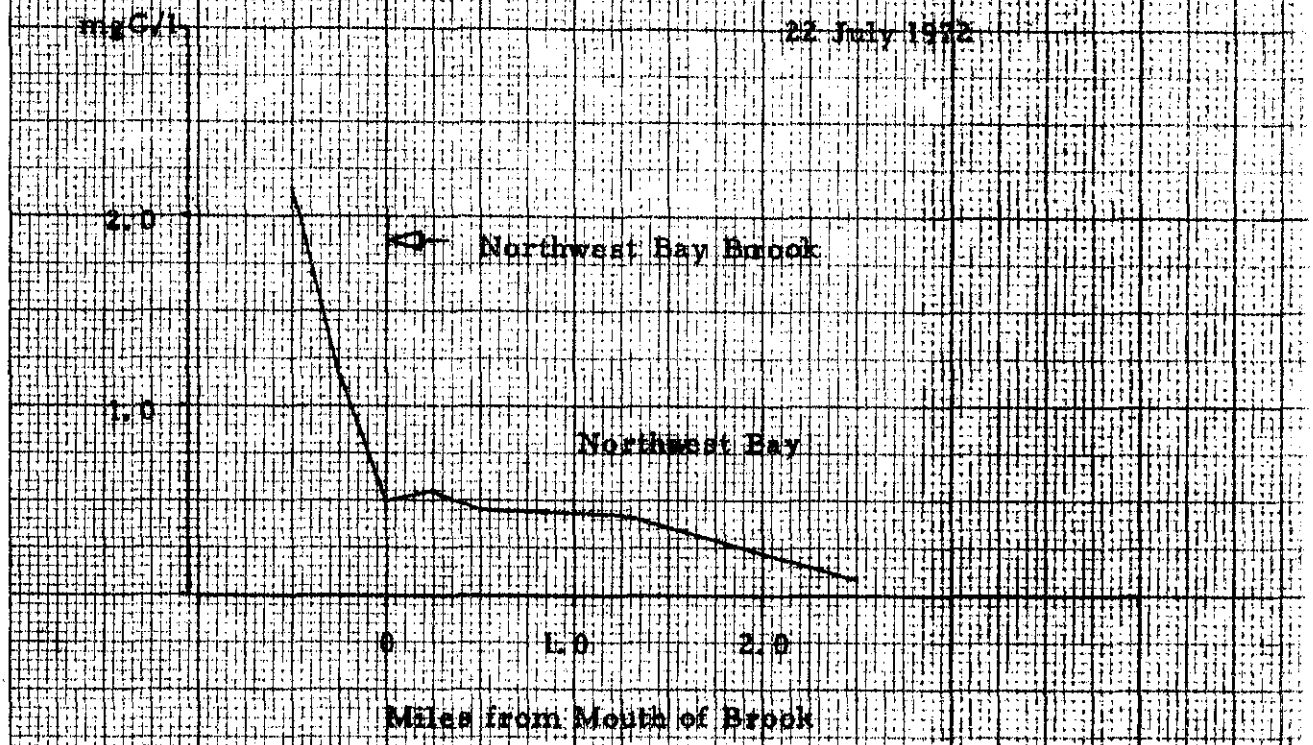
A reasonable speculation of the increased r value would follow from the two trends occurring in Lake George of decreasing concentrations of "humic materials" from south to north, i. e. from Stations 1 to 7 (Figure 1), and of decreasing algal populations from south to north reported by Williams and Kohberger (1972). Relating the two is the work of Christman and Minear (1971) with gel studies of algal extracts. They found a range of soluble organic phosphorus compounds (using Sephadex G-25) which could contribute to or constitute humic fractions.

Summation

The results of the preliminary work point to the importance of "humic materials" in delineating the cycling of soluble organic carbon and other nutrients. Its significance in phosphorus cycling has yet to be assessed, but the work suggest it must be considered.

Figure 2

Concentration of Humic Acid in Northwest Bay
Surface Waters



The complexity of structures of the humic group also imposes a limitation on the usefulness of the acid-extraction procedure of measurement. While it can be undoubtedly useful for the monitoring of "humic materials" in the lake, contributions to the primary productivity and decomposition projects at Lake George require a more detailed analysis. Evaluations and incorporation of both the non-ionic styrene/divinylbenzene resins and the dextran resins are in process to this end.

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