Texture of the sediments of the Petit Lac (Western Lake Geneva)

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Texture of the Sediments of the Petit Lac (Western Lake Geneva)

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RÉSUMÉ

Les analyses sédimentologiques de 98 échantillons du Petit Lac (partie ouest du Léman) montrent que les sédiments de ce lac sont constitués essentiellement par des mélanges de sable et de silt avec accessoirement des argiles.

Les variations dans la répartition des paramètres granulométriques suggèrent que les sédiments de ce lac peuvent être considérés comme des silts avec une très faible teneur en argiles. Cette matrice de silt/argile est diluée d'une façon très variable par des apports de sable. Le sable et la matrice silt/argile peuvent être considérés comme les deux populations extrêmes. Toutes deux sont «leptocurtiques» mais avec un indice d'asymétrie de signe opposé. Les variations de la taille moyenne, d'asymétrie et de classement, sont donc reliées aux variations du mélange de ces populations. Le type de mélange dépend de l'énergie de l'environnement qui, dans le cas présent, montre que les caractéristiques du sédiment sont conformes à un modèle simplifié lié à la bathymétrie du lac.

Des études précédentes ont montré que les sédiments de la fraction silteuse sont principalement du carbonate de calcium dérivant probablement par précipitation des eaux du lac.

ABSTRACT

Sedimentological analyses of 98 samples from the Petit Lac or the Western basin of Lake Geneva show that the sediments of the Lake are composed predominantly of mixtures of sand and silt with subsidiary clay size material.

Variations in the grain size distribution parameters suggest that the lake sediments may be considered to consist of a matrix of silt with minor clay modified by varying dilutions of physically transported sand. The sand and the silt/clay matrix form two end member populations, both leptokurtic with opposing signs of skewness. Variations in mean grain size, skewness and kurtosis are hence related to variable mixing of these populations. The mixing phenomena is dependant on environmental energy, the trends of which show that the sediment characteristics of the lake conform to a simple model related to bathymetry. Initial investigations show that the silt size material is composed predominantly of carbonate, which is believed to be derived by precipitation from the lake waters.

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Introduction

During the past two years, sediment sampling in Lake Geneva has been proceeding as a part of a geological study of the lake being conducted by the Laboratory of Sedimentology and Limnology of the Department of Earth Sciences of the University of Geneva. Up to the present time the sampling of the western part of the lake (Petit Lac) has been completed and sample analyses for grain size, major and minor elements are being conducted. Of the available data, that pertaining to the distribution of mercury has been previously published (VERNET and THOMAS 1972).

Geophysical investigations involving continuous seismic profiling of the Petit Lac have been completed and published under the auspices of Geolem[4]) (VERNET and HORN 1971). In addition a synthesis and review of all work conducted on Lake Geneva up to 1971 including a complete bibliography has been published by VERNET et al. (1971).

The present paper reports the results of grain size analyses of the sediments of the Petit Lac as background data essential to the future interpretation of the sediment chemistry.

Regional setting and morphology

The Petit Lac comprises the western section of Lake Geneva extending from Geneva in the south, parallel to the Jura mountains to the west, as far as the Straits of Promenthoux (Fig. 1). Bathymetrically, these straits comprise a low amplitude ridge forming a natural sub-division of the Petit Lac from the eastern Grand Lac of Lake Geneva. Structurally the basins of the Petit and Grand Lac are sub-divided by the Yvoire anticline trending north eastwards from the southern shore of the lake at Yvoire (VERNET and HORN 1971). Since this anticline does not form a prominant morphological feature on the lake bottom, then the Petit Lac as defined in this paper is taken to be south west of the axis of the ridge in the Straits of Promenthoux. The sampling as described here (Fig. 1), however, includes the immediate eastern and north eastern part of the Grand Lac in order to encompass the region of the straits.

The basic dimensions of the Petit Lac with comparative data for the Grand Lac are given as follows:

	Petit Lac	Grand Lac
Surface area km^2	79	582
Water volume km^3	3	83
Maximum depth m	76	310
Mean depth m	41	153

The Petit Lac has the general configuration of a flooded river valley 2 to 5 km wide and 20 km long. It constitutes the receiving waters for a number of small rivers the most important being the Promenthoux, Boiron, Versoix and the Hermance. The

[4]) Geolem is the title for a geological working group involving the laboratory of Sedimentology and Limnology, University of Geneva, B.R.G.M. (Bureau de recherches géologiques et minières et Service géologique national), Orléans, France, and Centre de recherches géodynamiques de Thonon, France.

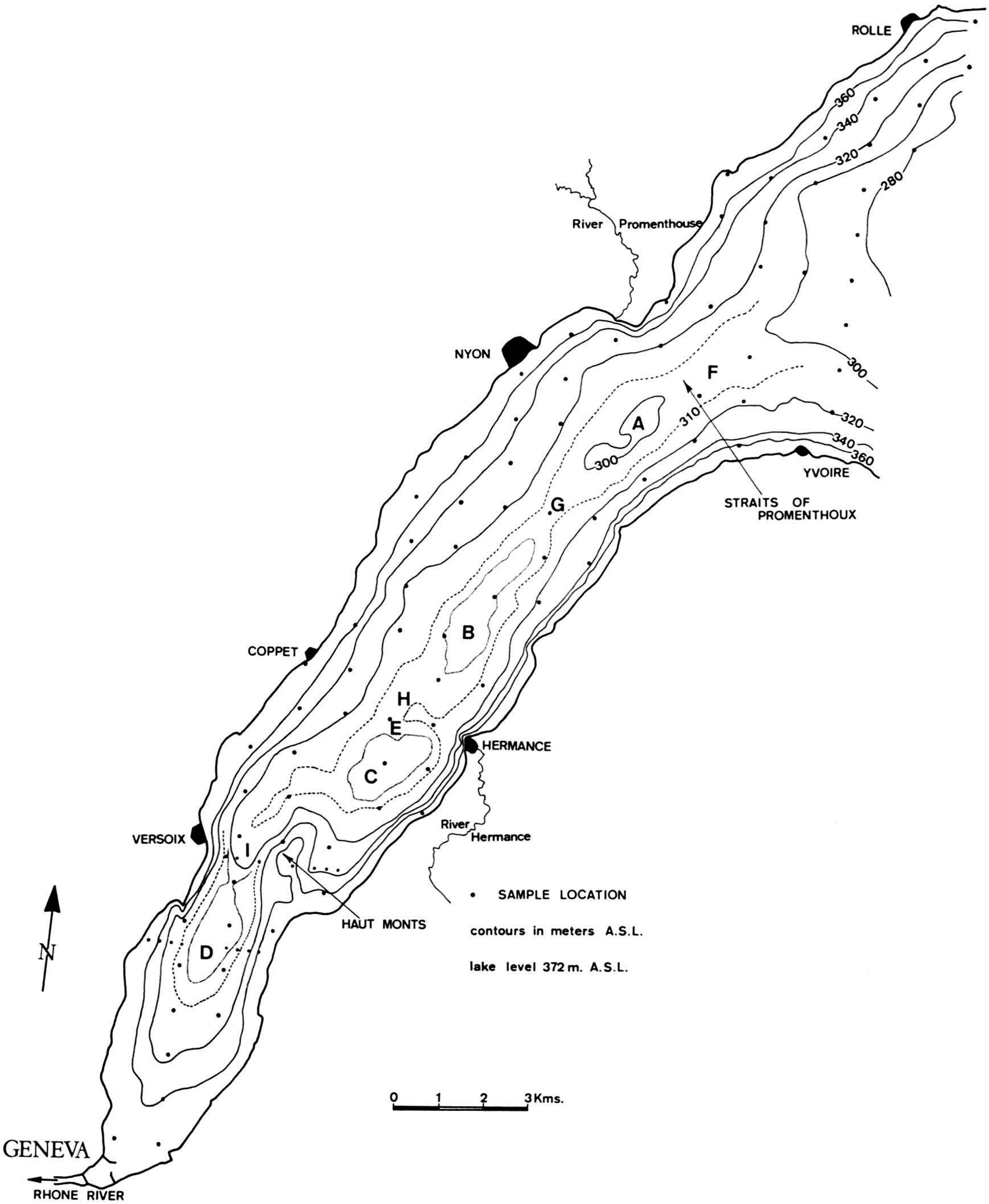

Fig. 1. Bathymetry of the Petit Lac showing sample locations and major morphological features discussed in the text.

rivers in total provide only 5 percent of the water input to the Petit Lac, the remaining 95 percent being derived from the Grand Lac via the Straits of Promenthoux.

Detrital materials are derived from a number of sources including river flood input, coastal and sub-aqueous erosion of Tertiary formations and erosion re-working of glacial and post glacial sediments (VERNET and HORN 1971). The relative quantitative significance of these sources is not yet known.

The bathymetry of the Petit Lac is shown in Figure 1. The morphology of the lake has been well described by FOREL (1892), in which a nomenclature was applied to the individual features observed. These features include basins and intervening ridges or rises and are tabulated below with an assigned code letter referring to individual locations given in Figure 1.

Code letter Figure	Name	Maximum water depth m
F	Barre de Promenthoux (Promenthoux ridge)	66.4
A	Fosse de Nyon (Nyon sub-basin)	76.5
G	Barre de Messery (Messery rise)	63.2
B	Fosse de Tougues (Tougues sub-basin)	70.4
H	Barre d'Hermance (Hermance rise)	64.5
C	Fosse de Chevran (Chevran sub-basin)	70.7
E	Fosse accessoire de Coppet	66.3
I	Barre de Genthod (Genthod ridge)	47.0
D	Fosse de Bellevue (Bellevue sub-basin)	50.4

VERNET and THOMAS (1972) in a study of the mercury distribution in the sediments of the Petit Lac recognised the basins A, B, C and D which, due to the low relief between basin and ridge features, they classified as sub-basins. From a sedimentological viewpoint the classification of the morphological basins into sub-basins is more valid since the central deeper water regions of the Petit Lac encompassing both ridges and basins are covered by modern lacustrine or post glacial sediments (VERNET and HORN 1971).

Stratigraphy and recent history of the Petit Lac

During geophysical investigations of the Petit Lac, VERNET and HORN (1971) briefly reviewed the known stratigraphy of the lake deposits and recognised a general simplified sequence incorporating the following three units:

1. Glacial and interglacial deposits (pre-Würm and Würm)
2. Glaciolacustrine (Late glacial)
3. Lacustrine (Postglacial or Holocene).

From their interpretation of the detailed stratigraphy (p. 307) they postulated the following sequence of events in the glacial and post glacial evolution of the lake:

a) The advance of the Rhône Glacier into the Lake Geneva basin effectively plugged and filled the pre-existing drainage network with morainic and till material.

b) With the start of ice melt, the ice still occupied the Geneva basin but floated on melt water. Lacustrine sedimentation occurred beneath the ice and gave rise to stratified glaciolacustrine clays with a random distribution of angular rocks of alpine origin.

c) With ablation and ice retreat from the lake basin, a zone of transition sediments occurs which show the first occurrence of organic material derived from planktonic production. With final retreat in the Alleröd period, the first molluscs appeared representing the onset of post-glacial sedimentation.

Many theories have been advanced for the geological origins of the Lake Geneva basin. These are not discussed here and interested readers are referred to the review by VERNET et al. (1971).

Methods

98 samples were collected from the Petit Lac (Fig. 1) by a clam type bottom sampler and the topmost 10 cm of sediment retained for sedimentological analysis. The samples were wet sieved from 0 to 4 phi (1 mm to 62.5 μ) and the finer grain sizes analysed by hydrometer at approximately 1 phi intervals to 9 phi (2 μ). The hydrometer analyses were carried out following the procedures given in SNV 70816[5]) (Swiss Association for Normalisation).

Calculation of the grain size distribution statistics was carried out from the raw data using a modified version of the Fortran programme developed by ALLEN (1970). Moment measures, as utilized in this paper for mean, standard deviation, skewness and kurtosis in the programme were calculated using the formulae of COAKLEY and BEAL (1972). The programme was further modified to interpolate the fine size open tails of the distribution curves at 1 phi intervals to a value with a class weight percent of less than 5, and to incorporate a calculation for the weight percent of sand, silt and clay size material as defined by the WENTWORTH (1922) classification. Other than in three samples, deleted from the grain size analysis synthesis, all samples contained less than 5 percent material coarser than 0 phi (1 mm).

Results and discussion

General sediment texture

The percentage composition of the sediments of the Petit Lac in terms of sand, silt and clay has been determined on the basis of the WENTWORTH (1922) classification.

The sediment distribution, or sediment facies, based on the nomenclature of SHEPARD (1954) and derived from a ternary diagram comprising sand, silt and clay as end-members is given in Figure 2. From this diagram, it can be seen that the sands occur predominantly in the western coastal region and in the nearshore shallow water areas in the southern part of the lake. The mid lake regions contain sediments composed predominantly of clayey silts and clays. Other than the Bellevue sub-basin and the Genthod ridge, the sub-basins and rises are not well defined reflecting continuous modern sedimentation in the median, deep water regions of the lake.

[5]) On page 4 of this reference the constant A should be equal to *0,018* and the viscosity η expressed in g/sec per cm.

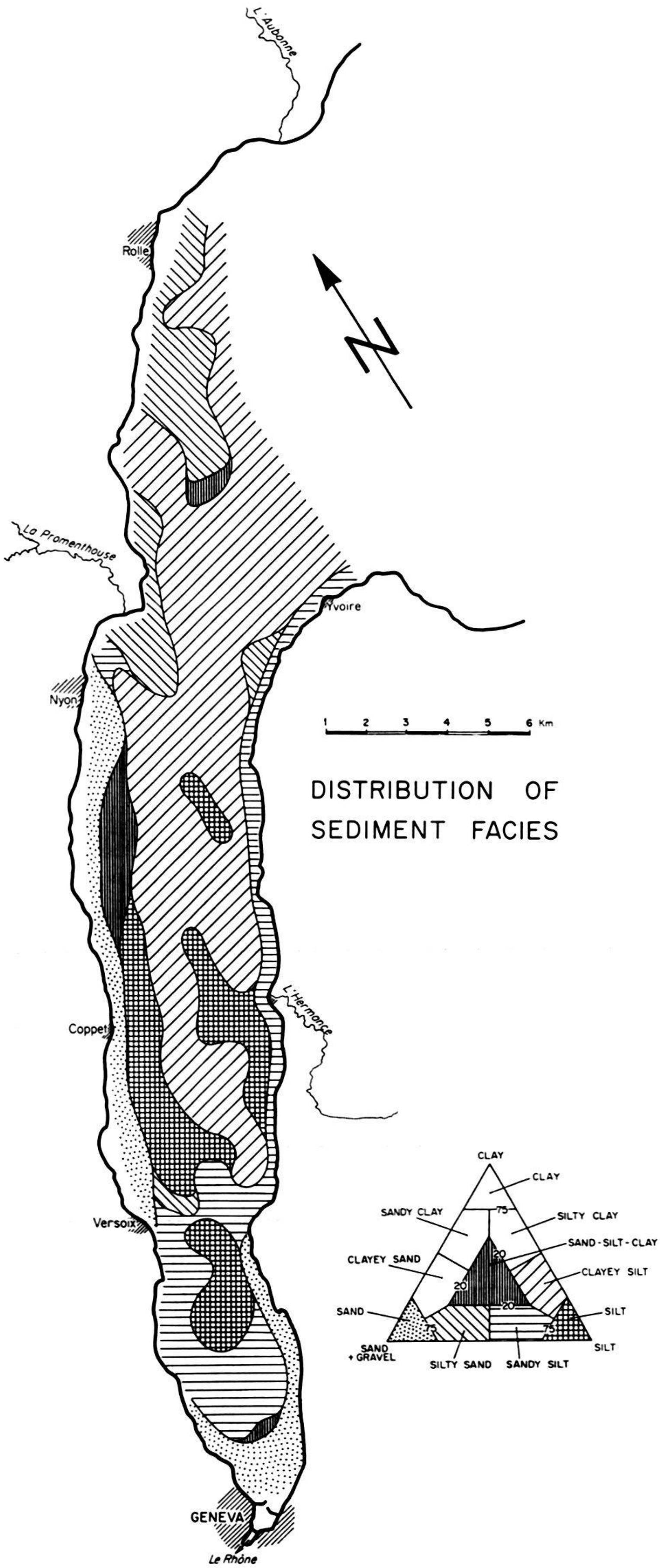

Fig. 2. Sediment textural facies map with nomenclature after SHEPARD (1954).

The sediment facies map in Figure 2 emphasises the essentially silty character of the lake sediments which is further demonstrated by the scatter of individual sample points in the ternary diagram given in Figure 3. From this ternary diagram it can be

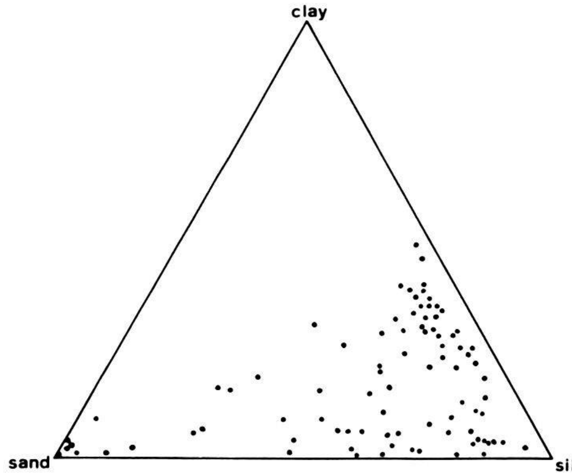

Fig. 3. Ternary diagram showing individual sample composition in terms of percent sand, silt and clay size fractions.

seen that there is a complete absence of samples with a clay content exceeding 50 percent. Statistically the silt content ranges from 0 to 93 percent with a lake mean of 58 percent and a standard deviation of 21 percent. These values are in distinct contrast for silt values for the North American Great Lakes, Ontario and Huron (THOMAS et al. 1972a, 1972b) in which the silt size fraction accounted for 26 and 23 percent respectively. The distribution of the percentage silt content in the sediments of the Petit Lac is given in Figure 4 and shows that the lowest silt values occur in the western nearshore zone, in the shallow waters in the southern extremity of the lake and in the region of the "Haut Monts" on the Genthod ridge. All these regions are characterised by high concentrations of sand size material. High silt levels occur throughout the remainder of the lake in a random manner with no obvious trends. This distribution suggests that energy levels in the nearshore, shallow water regions of the lake are sufficient to prohibit the settling of silt size particles which in the lower energy regions shows essentially a random distribution.

THOMAS et al. (1972a and 1972b) were able to show a high degree of correlation between carbonate and silt in the sediments of the Great Lakes. A similar correlation is also observed in the sediments of the Petit Lac, in which a correlation coefficient of 0.529 has been computed for the relationship of percent silt size fraction to CO_2.

In order to check this relationship further, 6 samples were size fractionated using sedimentation techniques similar to those described by WALKER (1963). The results of the CO_2 distribution expressed as $CaCO_3$ for the individual size fractions is summarized in Table 1. This table shows very well the consistantly high carbonate levels in the silt fraction. Two samples, numbers 75 and 607 show high carbonate contents in the sand fraction which is believed to be due to shell debris. The origin of the high carbonate levels of the silt is not known at the present time (VERNET et al. 1971) but is probably derived by precipitation from the lake waters.

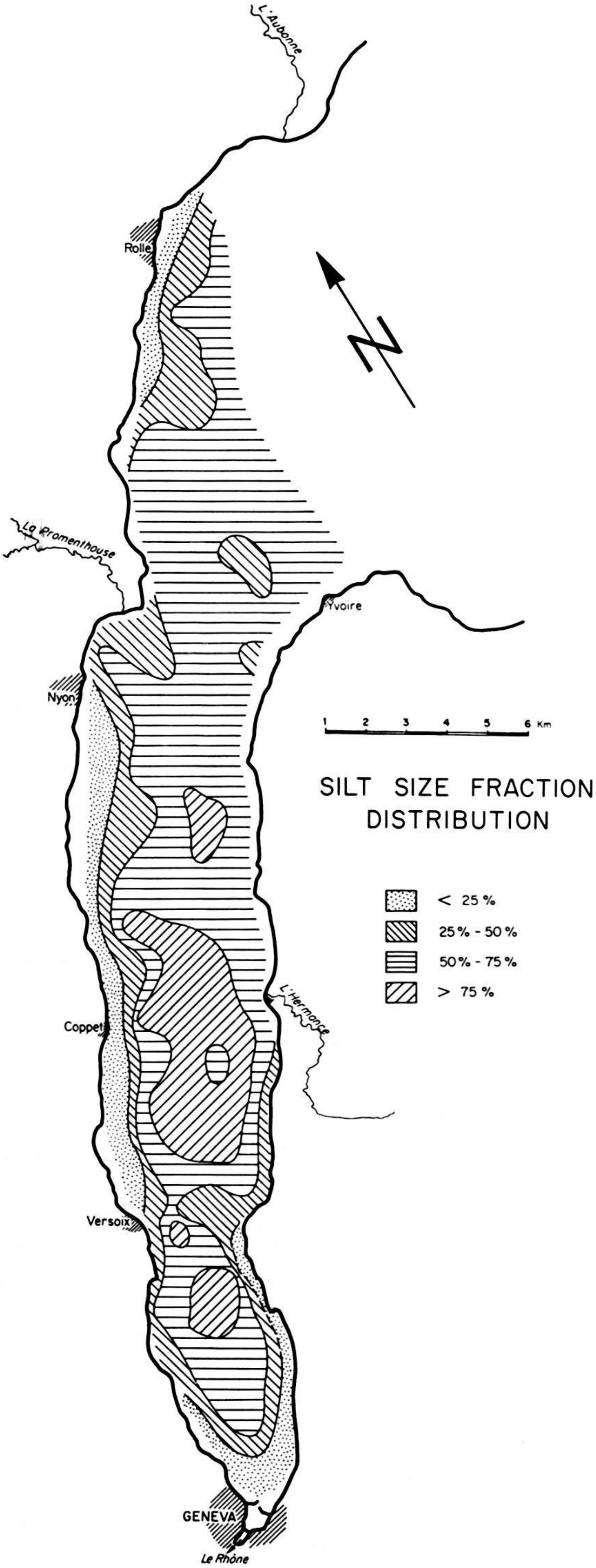

Fig. 4. Distribution of percent silt in the Petit Lac.

Table 1. Size fractionation of carbonate in six samples from the Petit Lac.

Size fractions in microns	Corrected carbonate as % $CaCO_3$ 60	65	75	108	120	607	Sample No.
> 500	1.03	0.53	3.45	0.24	0.37	–	
250–500	1.71	1.18	12.11	1.10	2.04	23.95	Sand
125–250	–	3.20	11.89	0.54	1.41	9.08	
63–125	–	5.80	8.66	1.80	1.85	0.39	
32– 63	11.40	10.00	47.99	11.90	13.80	12.40	
16– 32	13.57	9.20	7.69	7.68	17.47	9.14	Silt
8– 16	19.34	19.30	4.45	15.44	22.06	20.63	
4– 8	23.42	22.80	1.85	23.53	6.18	11.95	
2– 4	18.99	17.50	1.22	16.08	20.15	7.84	
< 2	10.52	10.40	0.70	21.71	14.68	4.62	Clay
Total Sand $CaCO_3$ %	2.74	10.71	36.11	3.68	5.67	33.42	
Total Silt $CaCO_3$ %	67.73	61.30	61.98	58.55	59.51	54.12	
Total Clay $CaCO_3$ %	29.51	27.90	1.92	37.79	34.83	12.46	

Table 2. Mean values and standard deviation for mean grain size, sand, silt and clay size fractions for the sediments of the Petit Lac.

Mean grain size		Sand fraction		Silt fraction		Clay fraction	
mean phi	S. D. phi	mean %	S. D. %	mean %	S. D. %	mean %	S. D. %
6.2	1.3	25.6	23.2	58.4	21.0	16.1	13.6

The mean textural composition of the sediments of the Petit Lac is given in Table 2. This table shows the obvious deficiency in the Petit Lac of clay size particulate material. The distribution of the clay is given in Figure 5. Low concentrations occur around the periphery of the lake and on the Genthod ridge. In addition apparent "plumes" of sediment with low clay can be seen in association with the rivers Promenthouse and Hermance which may well indicate dispersal pathways of sediments derived from these two rivers. Clay concentrations increase offshore into the deeper water regions of the lake but at no locality show concentrations exceeding 40 percent. With a lake mean of only 16 percent, it would appear that in general the energy levels and water velocities are such that the bulk of the clay size material is being carried in suspension to the Rhone River outlet at Geneva. Such a phenomena may well be related to increasing current velocities due to constriction of water input from the large Grand Lac into the Petit Lac. No published data is, however, available to verify such an accelerated waterflow.

The highest values observed for clay in the study area occur immediately east of the Promenthoux ridge (Fig. 5). The region of higher clay content would seem to be due to settling from a current circulation gyre in the extreme western part of the

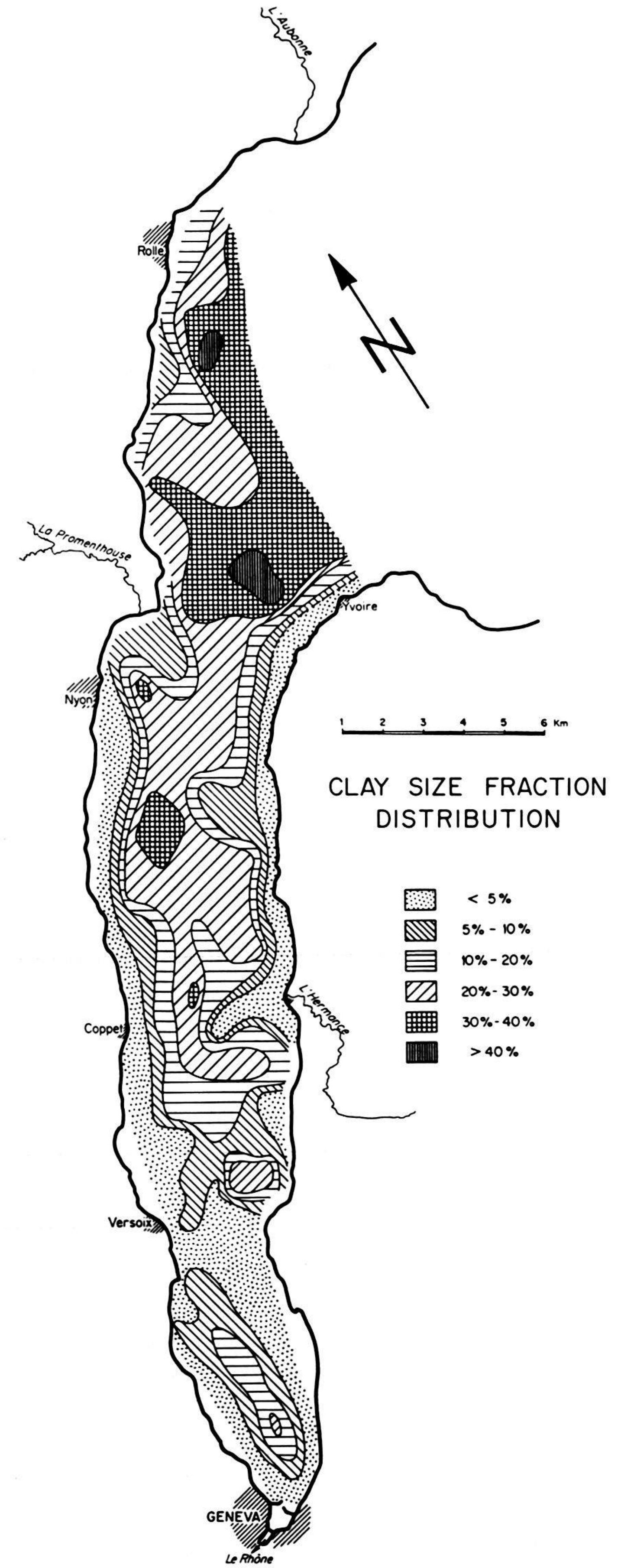

Fig. 5. Distribution of percent clay in the Petit Lac.

Grand Lac. However, current circulation data is insufficient to confirm whether or not such a gyre exists.

Sediment textural properties

Over the years many authors have debated the environmental sensitivity of grain size distribution properties (MASON and FOLK 1958; FRIEDMAN 1961; MOIOLA and WEISER 1968). These studies were directed towards differentiating major environmental sediment types, for examples, beach, river and dune sands. Other studies have been made in an endeavour to ascertain the sensitivity of grain size parameters for differentiating sediments within a single environmental system (FOLK and WARD 1957; DUANE 1964; HUBERT 1964; DAVIS 1970; CRONAN 1971; THOMAS et al. 1972a, 1972b).

FOLK and WARD (1957) working with coarse river sediments concluded that the sediment properties could be defined by the variable mixing of a sand and gravel population. SPENCER (1963) in theoretical observations of grain size distribution data of earlier authors and noting the dearth of sediment material in the coarse silt size range (HOUGH 1942; PETTIJOHN 1957; WOLFF 1964) concluded that all sediments could be described by the mixing of three or less modal populations consisting of gravel, sand and clay. This hypothesis has been utilized successfully to account for the variations in sediment texture in a number of aqueous environments both marine (CRONAN 1971; DAVIS 1970; JONES 1971) and lacustrine (THOMAS et al. 1972a, 1972b).

The thesis of mixing of modal populations may also be applied to the sediments of the Petit Lac, though with a major difference to previously published works in that there is a marked increase in the concentration of silt size material; this silt in conjunction with the clay behaving in the capacity of a modal population.

Mean grain size

The distribution of the mean grain size in phi for the Petit Lac is shown in Figure 6. The distribution shows a pronounced trend towards decreasing particle size offshore into the deeper water regions of the lake. Other than the southern Bellevue sub-basin and the Genthod ridge, the individual sub-basins and rises are not well defined, again reflecting continuous offshore sedimentation. A distinct coarsening of the mean grain size can also be observed in the shallow water area of the "Haut Monts". Mean grain size in the Petit Lac ranges from 1.59 to 8.18 phi with a lake average of 6.2 phi (Table 2).

It was shown by THOMAS et al. (1972a, 1972b) in the lacustrine sediments of the Great Lakes that variation in mean grain size was related to percentage sand content with an inverse relationship to percentage clay. Hence, the mean grain size was inferred to be an index of the degree of mixing of a sand and a clay population. The relationship of percent sand to mean grain size for the Petit Lac is shown in Figure 7a. This diagram shows an excellent relationship between the two variables ($r = -0.936$). By virtue of a summation to 100 percent in the three size fractions it is obvious that a similar but inverse relationship must exist between mean grain size and the sum of the percentages of silt and clay size material, though a good relationship cannot be

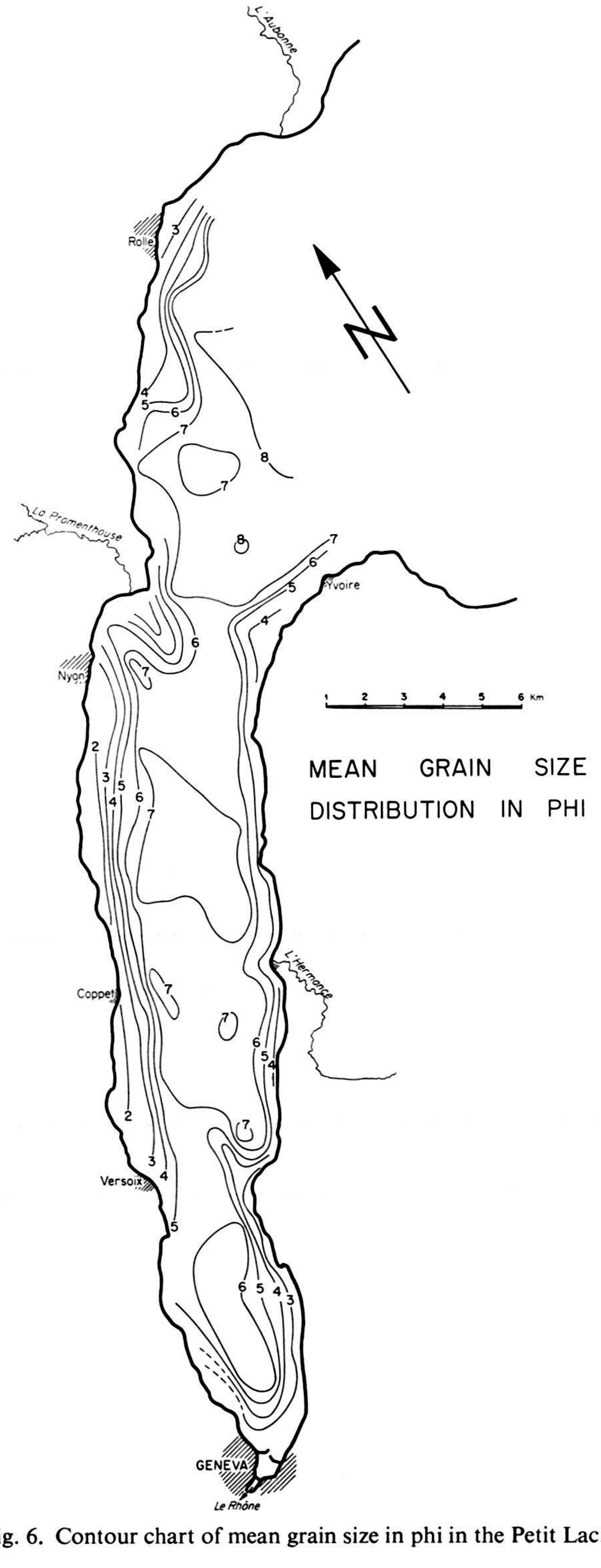

Fig. 6. Contour chart of mean grain size in phi in the Petit Lac.

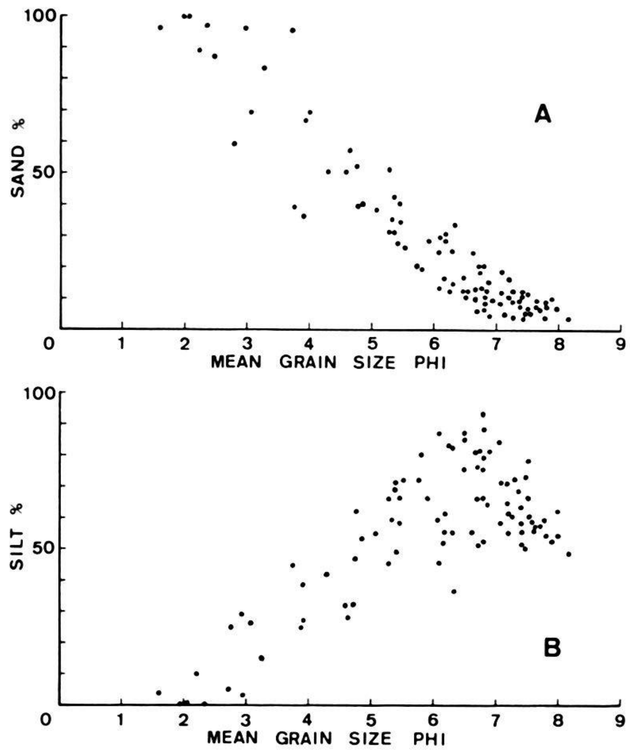

Fig. 7a. Plot of mean grain size to percent sand.
Fig. 7b. Plot of mean grain size to percent silt.

seen for either of these two fractions independantly (r = 0.608 for silt and 0.658 for clay). As an example, the relationship of mean grain size to silt is shown in Figure 7b. The scatter of points shows a good relationship between 1 to 5 phi where clay content is low but become more scattered in the finer grain sizes where the concentrations of clay size material are higher and having a modifying effect on the mean grain size.

In Lakes Ontario and Huron (THOMAS et al. 1972a, 1972b) silt showed no relationship whatsoever with mean grain size; yet in the Petit Lac, due to the paucity of clay, it is behaving in the manner of a modal population with the effect of clay size material becoming evident only in sediments with a mean grain size finer than 5 phi. In this region, it can only be concluded that both silt and clay combined are serving as a single end member population.

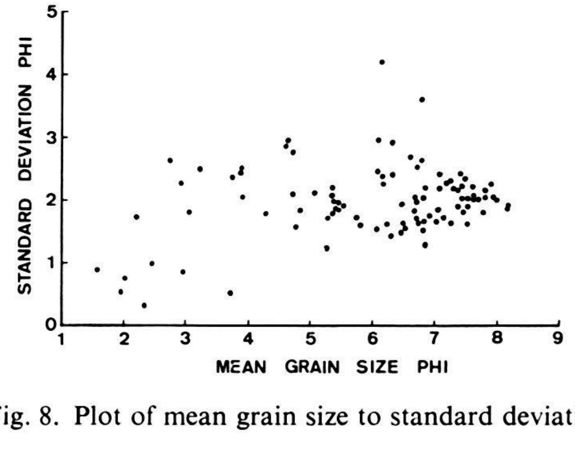

Fig. 8. Plot of mean grain size to standard deviation.

A sinusoidal relationship between mean grain size and standard deviation has been observed in many earlier studies (FOLK and WARD 1957; HUBERT 1964; CRONAN 1969; JONES 1971; THOMAS et al. 1972a, 1972b). A similar relationship can be seen in the sediments of the Petit Lac (Fig. 8). The relationship is not as well defined as that observed in the North American Great Lakes (THOMAS et al. 1972) and the greater scatter of points may be ascribed to the higher concentrations of more randomly distributed silt and calcium carbonate. However, Figure 8 illustrates very well that the best sorted sediments occur in the coarser mean grain sizes 1 to 4 phi with a trend for increasing standard deviation to approximately 5 phi. In sediments finer than 5 phi, there a flattening of the curve with only slightly improved average sorting in the fine grained samples, with mean grain size values in the range of 7 to 8 phi.

As for the Great Lakes this relationship between mean grain size and standard deviation is interpreted as being the result of mixing of two grain size populations. The first or sand population occurs in the mean grain size range of 1 to 4 phi and the other a combination silt/clay population in the range 5 to 8 phi. Clay, as such, does not attain sufficient quantities to serve directly as a discreet population.

Since much of the silt is composed of carbonate derived probably by random precipitation and accumulation in the lake it cannot be construed as being a direct product of physical erosion, transport and deposition. In terms of definition, therefore, the silt/clay population as defined above should be considered as a sediment or grain size matrix, the distribution statistics of which are being modified and controlled by variable input of physically transported sand. Sand is thus the environmentally sensitive population.

Skewness

DUANE (1964) and JONES (1971) have both discussed the environmental sensitivity of skewness in terms of erosional and depositional energy. THOMAS et al. (1972a, 1972b) also concluded that skewness was environmentally sensitive and served as an index of the dominant population in a sand, clay mixture.

The distribution of skewness values in the Petit Lac (Fig. 9) shows that nearshore, shallow water samples are positively skewed whereas the deeper water, finer grained sediments are characterized by negative skewness. This is perhaps better shown in the scatter diagram in Figure 10 illustrating the relationship between skewness and mean grain size. The diagram demonstrates an excellent linear relationship between the two variable, with positive skewness occurring in sediments with a mean grain size coarser than 5 phi and negative skewness in the finer sediments. This is in good agreement with the findings from the North American Great Lakes (THOMAS et al. 1972a, 1972b) and it can be concluded in a similar manner that the dominant population in a bi-modal mixture is indicated by the sign of the skewness. This can be further illustrated by reference to Figure 11 showing the relationship of skewness to the percent concentration of the sand size fraction. From this diagram it can be seen that positive skewness is characteristic of coarse sediments enriched in sand, whereas sediments with low sand are negatively skewed and fine grained with a dominant silt/clay population.

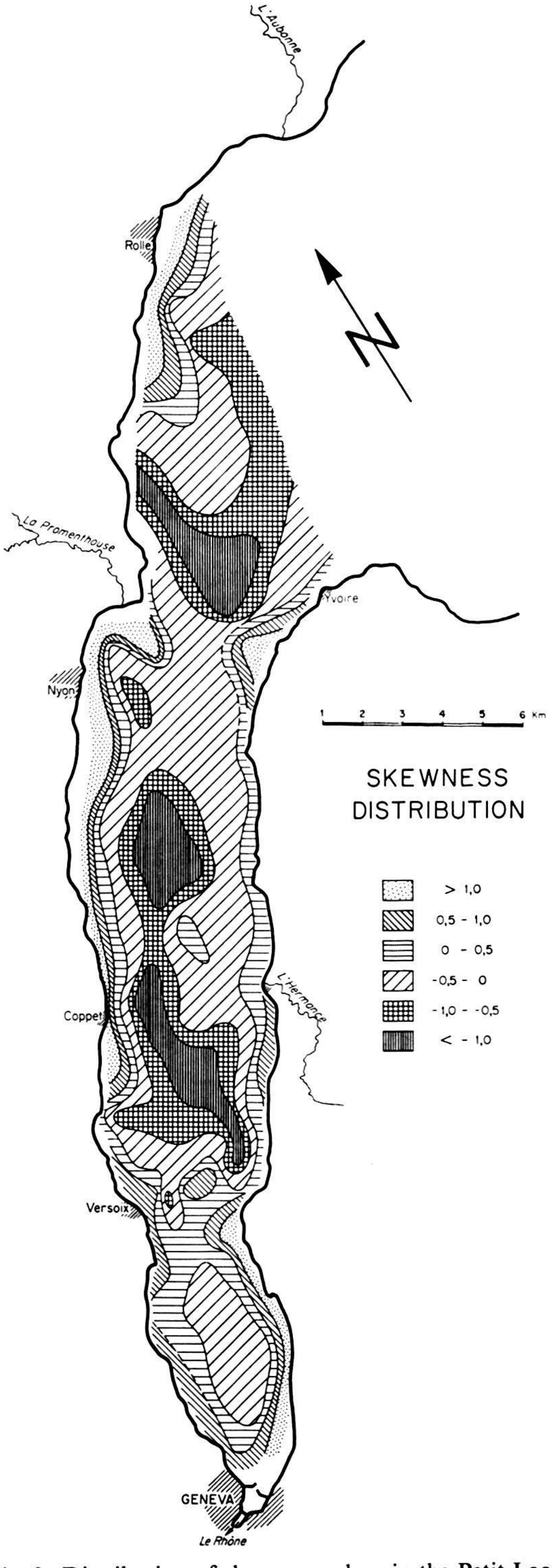

Fig. 9. Distribution of skewness values in the Petit Lac.

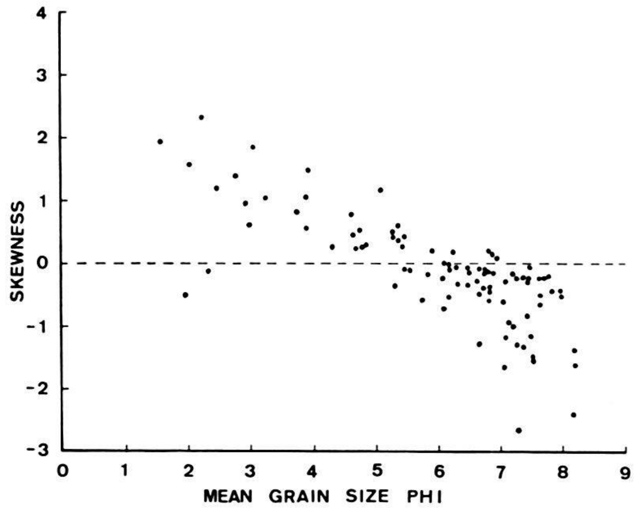

Fig. 10. Plot of skewness to mean grain size.

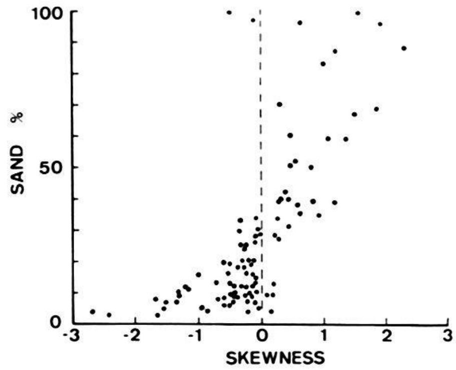

Fig. 11. Plot of skewness to percent sand.

Kurtosis

THOMAS et al. (1972a, 1972b) were able to show that the end member populations in sediments composed primarily of sand and clay mixtures yet with high levels of silt were strongly leptokurtic. Mixing of these populations produced intermediate sediments with a platykurtic distribution. A similar relationship can be seen to occur in the sediments of the Petit Lac and is illustrated in the graph of kurtosis to mean grain size given in Figure 12. The general trend is U shaped with leptokurtic distributions occurring in the coarse and fine mean grean sizes with a flattering of the distribution curves in the intervening samples.

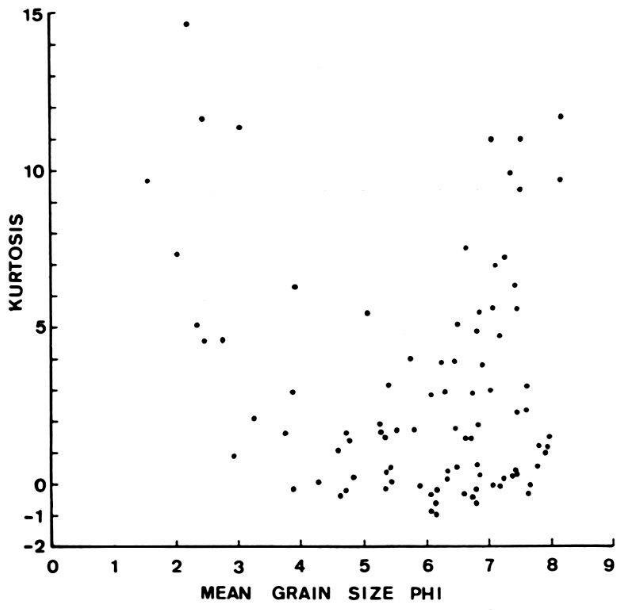

Fig. 12. Plot of kurtosis to mean grain size.

Relationship of kurtosis to skewness

The relationship of kurtosis to skewness has been discussed by a number of previous authors, in particular, FOLK and WARD (1957); FRIEDMAN (1961) and THOMAS et al. (1972a, 1972b). The latter authors concluded that these two parameters summarized the grain size distribution characteristics of the end member populations and that the trends observed between the two variables were directly related to the variable mixing of the populations as a function of environmental energy.

The relationship of skewness to kurtosis in the Petit Lac is similar to that observed in the North American Great Lakes and is shown in Figure 13. The diagram has been

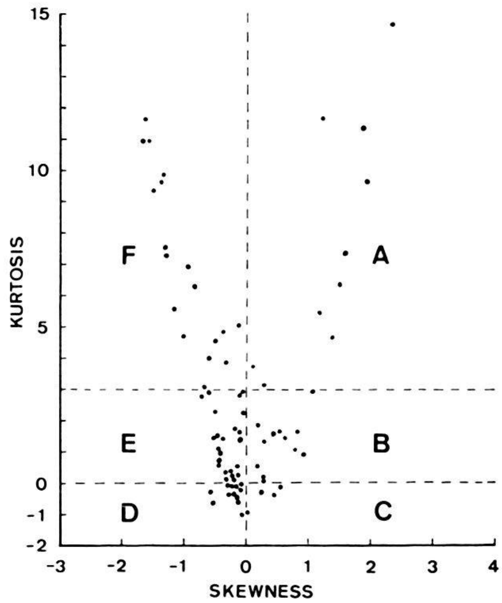

Fig. 13. Plot of skewness to kurtosis, see text for explanation of lettered zones.

subdivided into 6 zones A to F, demarcating what is considered to be a transitional gradient in energy from a high energy zone A to a low energy zone F. Zone A is leptokurtic and positively skewed defining the characteristics of the sand size population. Zone F is also leptokurtic but negatively skewed and defines the characteristics of the silt/clay population or matrix of the sediments of the Petit Lac. Zones B, C, D and E represent transitional mixtures of zones A and F with the dominant population being indicated by the sign of the skewness.

Since the zones described above are inferred to represent the range of energy operating on the sediments of the Petit Lac, then a distribution of these zones as given in Figure 14 may be taken to represent an energy map defining sedimentation processes in the lake. From Figure 14 it can be seen that high energy zones A and B occur predominantly in the nearshore regions around the periphery of the lake. Zone A type sediments also occur on the Genthod ridge and in the shallow waters to the north of Geneva; these two regions being particularly susceptible to the periodic strong northerly winds down the axis of the Petit Lac. High energy zone A sediments also occur to the south of the input of the River Promenthouse. This occurrence may be related to coarse sediment derivation from the river but is more likely to be a product of south westerly littoral drift in this area. The deeper water regions of the lake are

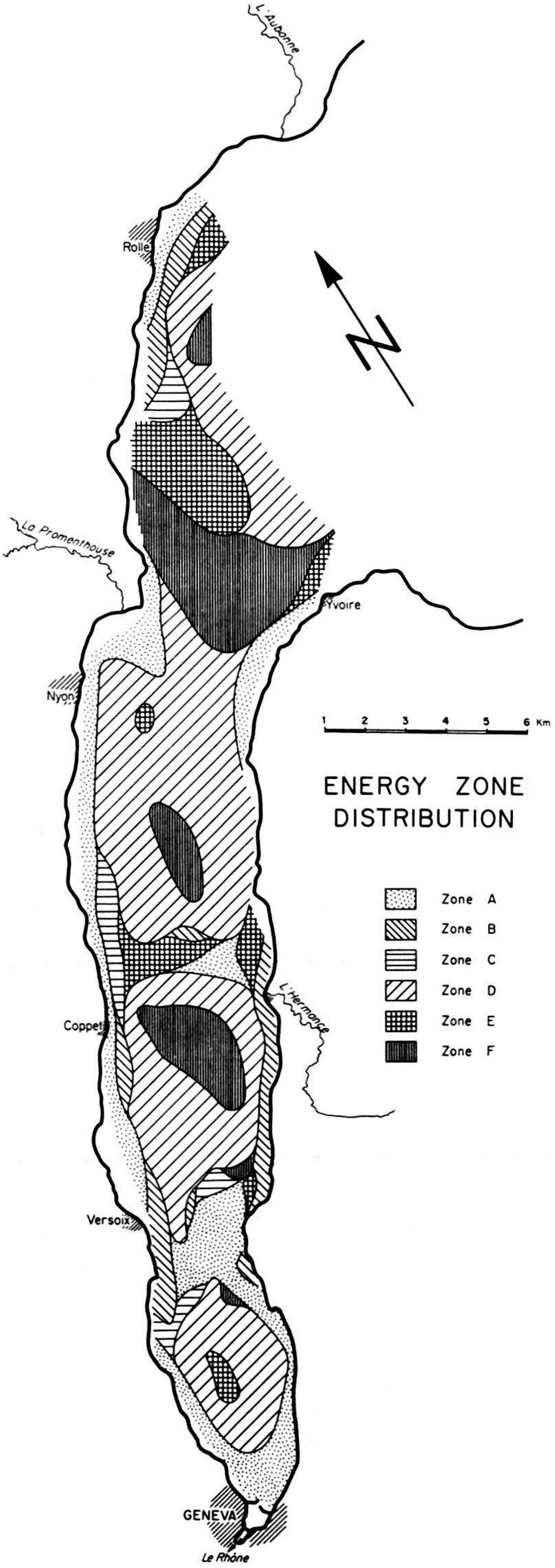

Fig. 14. Energy distribution map of the sediments of the Petit Lac with code lettering derived from the relationship of skewness to kurtosis given in Figure 13.

characterised by the low energy sediments of zones E and F with a good definition of the Bellevue and Chevran sub-basins. The Hermance rise is also discriminated in the energy zone map by the occurrence of higher energy zones A, B and D relative to zones E and F occurring north and south of the rise.

On the basis of the data given in Figure 14, it can be concluded that sedimentation is depth dependant, with the net sediment characteristics responding to the depth dissipation of predominantly wind generated energy as a function of the bathymetry of the lake. This relationship is further confirmed by the correlation of water depth to mean grain size and percent sand which give correlation coefficients of 0.670 and −0.605 respectively.

Conclusions

The surface sediments of the Petit Lac are composed primarily of sand and silt with subsidiary clay. The sediments are coarse in nature, ranging from sands to silts and clayey silts. There is a marked deficiency of silty clays and a complete absence of clays. The coarse nature of the sediments is due to the high percentages of silt which, in large part, is composed of calcium carbonate derived from the lake waters by chemical precipitation. The silt is deficient in the high energy, nearshore environment where energy conditions prohibit deposition but shows a random distribution throughout the remaining deeper water regions of the lake. Other than in the region east of the Straits of Promenthoux and in a few samples from the deeper water sub-basins of the lake, clay is not an important constituant and exerts only a minor influence on the grain size characteristics of the sediments. It is possible that the contribution of clay size material to the Petit Lac is small and associated with flow from the Grand Lac to the east. However, the constriction of Lake Geneva from the large Grand Lac through the Straits of Promenthoux to the shallower, elongated, narrow Petit Lac may induce an acceleration of water velocities sufficient to reduce the settling of fine clay size materials which may, in large measure, be transported to the Rhone River at Geneva.

The sediments of the Petit Lac are thus interpreted as being a matrix of predominantly silt with subsidiary clay modified by variable quantities of physically transported sand size material. As such, variations in the sediment textural characteristics of mean grain size, standard deviation, skewness and kurtosis are interpreted on the basis of the mixing of two populations. Firstly, a sand population in the size range 1 to 4 phi showing a low standard deviation, leptokurtic peakedness and positive skewness and secondly, a silt/clay population or the sediment matrix. This fine grained population occurs in the size range 5 to 8 phi with a higher standard deviation, negative skewness and again with a leptokurtic distribution.

Variation in the grain size distribution measures is fundamentally related to variation in the sand population which is energy dependent. Hence the sediments conform to a simple model of pro-grading from coarse, shallow water, high energy sediments to fine grained, low energy sedimentation in the deeper water sub-basins of the lake.

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