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Final Research Report November 1998

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Contract No. ENV4-CT95-5013

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A) Background and objectives of the project

Detailed knowledge of the environmental response to natural past climate change on regional and global scales provides climate researchers and modelers with a better understanding of the impact of future change and new data to calibrate their models (e.g. General Circulation Models). For instance, to understand the impact of global warming we need to search for past climates warmer than the present interglacial period as examples of what we may expect in a world with more greenhouse gases. We need also to understand how climate varies naturally during interglacial periods.

Improved understanding of the climate system requires the exploration of past climate using a range of different palaeoindicators, both separately and in combination. Lake sediments contain especially valuable archives. Amongst the few long European sequences from lake sediments that are available, those from Crater lakes in the French Massif Central have provided some of the most significant records of changing climate over the last 500,000 years. Pollen records from these sites (Beaulieu & Reille, 1992) have revealed a greater sensitivity to climate than the deep-sea oxygen isotope record (Tzedakis et al., 1997).

These Massif Central sediments also contain diatoms (unicellular siliceous algae), but until now they have been little used for climate studies. Diatoms are well preserved in the sediments and potentially have highly resolved temporal sensitivity to climate (on the scale of seasons, years and decades). They experience climate change indirectly through changes in lake-level, time of ice-out, stratification pattern and associated chemical changes (Kilham *et al.*, 1996). Such information is stored in lake sediments through changes in the composition of diatom assemblages.

Diatom-based transfer functions can be used to infer past environmental variables including pH (Birks *et al.* 1990), alkalinity (Korsman & Birks, 1996), salinity (Fritz et al., 1993), and nutrient concentrations (Bennion, 1994) over a range of time scales. Some of these environmental variables have been specifically related to climate patterns. For example, links between diatom-inferred pH and climate in alpine lakes (Psenner & Schmidt, 1992) and diatom-inferred salinity and climate in semi-arid regions (Fritz et al., 1993) have been clearly established. Diatom-temperature transfer functions have also been established for high latitudes (Pienitz, et al., 1995) and high altitudes (Lotter et al., 1997; Servant-Vildary & Roux, 1990), although it is unlikely that this relationship is straight forward especially at low altitudes sites (Kilham *et al.*, 1996). Therefore at present it is unclear how climatic signals, such as temperature, are recorded by the past diatom communities in lower altitude temperate lakes such as

those of the Massif Central and over periods as old as the Last Interglacial (or Eemian).

As a prerequisite for interpreting the stratigraphic succession of past diatom assemblages, a solid knowledge of the present day ecology of the dominant taxa is required. Such information can be obtained by appropriate sampling of the contempory diatom communities in lakes of the study area together with analyses of their physical and chemical properties, and can be supplemented by an extensive review of the literature on diatom ecology.
However, samples of living diatom communities provide inadequate analogues of fossil assemblages from cores because the sediment represent an integrated record from different habitats within the lake system and spanning a number of years. Subfossil assemblages currently incorporated into the sediments/water interface constitute more appropriate modern analogues of past fossil assemblages (Brugam, 1983).

Therefore this research had four main objectives.

1. To explore the distributions of diatom taxa along environmental gradients in living communities found in 25 lakes in the Massif Central region.
2. To develop inference models (diatom-based transfer functions) for the gradient that explains most of the variance in the subfossil diatom (surface sediment) distribution and apply these models on short cores taken from contemporary lakes.
3. To compare the results obtained in 1 and 2, especially those concerning the ecological requirements of the most common planktonic diatom taxa.
4. To establish a diatom biostratigraphy for the Last Interglacial (or Eemian) sediment sequence of Ribains (Haute-Loire) and interpret the variations observed from the fossil diatom assemblages, using the results from 1 and 2, in terms of palaeolimnological and, if possible, palaeoclimatic changes.

B) Detailed description of results

1. Distribution of diatom species in lakes from the French Massif Central

- A set of 25 natural lakes was selected from a region ranging from 46° to 43°N and 2° to 6°E (Appendix 1.1, maps of the study area). The lakes show a large heterogeneity in terms of morphological characteristics (Appendix 1.2).

- In these 25 lakes, the planktonic and periphytic diatom communities were sampled quarterly, in addition to water samples from the surface (*ca* 0.5m) from May 1996 to May 1998. Stratification patterns for temperature and dissolved oxygen were also measured in the water column of the deep crater lakes (Appendix 1.3).

- Laboratory analyses of alkalinity, nutrients, major ions, trace metals, and chlorophyll *a* were performed on the water samples, in most cases at UCL, following standard methods. Others determinants such as conductivity, pH, temperature were measured on site. All water samples taken have been analysed, the results of these analyses are presented in Appendix 1.4.

- Identification and enumeration of the planktonic diatom assemblages are completed, but still in progress for the periphytic diatoms. Summary diagrams

showing the seasonal succession of the main planktonic taxa are presented in Appendix 1.5 for 7 lakes. The distributions of some of the most common planktonic species across gradients of temperature, alkalinity, total phosphorus, nitrate and dissolved silica have been explored (Appendix 1.6). From this ecological information such as the optimum and tolerance ranges of the most abundant diatom taxa as well as information on their seasonal distribution can be obtained. The results for diatom distribution across the temperature gradient for example are very comparable to published literature values (*e.g.* Stoermer & Ladewski, 1976). Ecological preferences for the following species (which are present in present day samples from the Massif Central and in the Eemian deposits of Ribains) can be described.

For example:

- *Cyclotella ocellata*: summer blooming planktonic species associated with low nutrient concentrations and strong thermal stratification of the water column.
- *Cyclotella radiosa*: summer or autumn blooming species, requiring higher nutrient concentrations than *C. ocellata*.
- *Aulacoseira subarctica*: planktonic species associated with periods of turbulence (mixing periods at the end of the winter and in autumn), requiring low temperature and fairly high nutrient concentrations (especially silica).
- *Asterionella formosa*: spring or early summer blooming species associated with high nutrient concentrations especially silica and nitrate.
- *Fragilaria crotonensis*: most abundant in summer or spring, associated with average nutrient conditions.

Statistical analyses on the phytoplankton assemblages and the associated water chemistry were performed for 63 samples taken from 7 lakes.

- Ordination analyses

Ordination analyses were performed using the computer program CANOCO (ter Braak, 1987-92) with downweighting of rare species.

(i). Principal component analysis (PCA) was used to summarise the major patterns of variation within the environmental data. PCA determined that alkalinity and strongly correlated variables such as conductivity, and ionic concentrations of [Cl], [Mg], [Na], [Ca], were important variables in explaining the variance in the environmental data (as indicated by their PCA-scores on axis 1). Dissolved silica, temperature and nitrate-N also were important variables (with high scores on PCA axis 2) (Appendix 1.7).

(ii). A detrended correspondence analysis (DCA) was performed to determine if unimodal or linear numerical techniques were better suited for ordinations of diatom-environment relationships. DCA axes 1 and 2 included species gradients with lengths of 3.51 and 3.38 standard deviation units, respectively, suggesting that most taxa were responding non-linearly along the underlying environmental gradients (Korsman & Birks, 1996). Therefore, unimodal ordination techniques (such as CCA) were more appropriate than linear techniques (Birks, 1995). The biplots of DCA-scores against measured values for the different environmental variables showed the relationship between the first axis and SiO_2, whereas total phosphorus and chlorophyll *a* were mainly related to the second axis. DCA also suggested that sample Cb9805 (May-98 from Lac Chambon) was an outlier on DCA axis 1, as the corresponding assemblage is

almost exclusively composed (relative abundance 93%) of *Cyclostephanos tholiformis*, a taxon present only in a few other samples of this dataset and in low abundance. The biplot of DCA-scores on axis 2 against the measured total phosphorus (TP) also showed that several samples had extreme values for TP, with samples A9805, T9611, P9702, Ce9702 showing abnormally high values and samples T9802, P9802, I9802, Ce9802 having very low TP concentrations, below detection limits (Appendix 1.8).

(iii). To explore the relationships between diatom distributions and the measured environmental variables a canonical correspondence analysis (CCA) was performed.
CCA is a technique which simultaneously represents sites, environmental variables and diatom taxa in low dimensional space (ter Braak, 1987-92).
The eigenvalues for CCA axes 1 and 2 explained 12.6% of the variance in the weighted averages of the diatom taxa and the species-environment correlations for CCA axes 1 and 2 were high, indicating a strong relationship between the measured environmental variables and the diatom taxa (see Appendix 1.9 for values). CCA with forward selection was performed in order to identify the minimal number of explanatory variables to be included in the ordinations, explaining statistically significant ($p<0.01$ for the first factor selected) proportions of variation in the diatom data. The forward selection was combined with testing of the significance of each variable using a Monte Carlo permutation test (999 random permutations). Four of the 15 environmental variables made independent and significant contributions to explaining the variance in the diatom species data: dissolved silica, nitrate-N, chloride and potassium.
The species-environment correlations of CCA axes 1 and 2 after selection are still high indicating that the four variables provide a good representation of the major gradients in the diatom data.
Canonical coefficients, which represent the weight that each environmental variable contributes to the ordination axes, their t-values and the inter-set correlations between axes 1 and 2 and the environmental variables indicated that nitrate and chloride contributed most to axis 1, whereas silica and to a less extent potassium contributed most to axis 2.
Axis 1 contrasts the high nitrate and low chloride samples that have diatom assemblages dominated by *Cyclostephanos dubius* [CC001A], *Stephanodiscus parvus* [ST010A], *Aulacoseira subarctica* [AU020A], *Asterionella formosa* [AS001A], *Fragilaria crotonensis* [FR008A], with the low nitrate and high chloride samples that have assemblages dominated by *Aulacoseira ambigua* [AU002A], *Stephanodiscus hantzschii* [ST001A], *Synedra nana* [SY009A], *Cyclotella meneghiniana* [CY003A], *Aulacoseira [subarctica type 2]* [AU9986] and *Rhizosolenia longiseta* [RZ001A]. Axis 2 contrasts samples with high silica dominated by *Cyclostephanos invisitatus* [CC002A], *Cyclostephanos tholiformis* [CC003A] and *Cyclotella wolterecki* [ZZZ981], with the low silica samples dominated by *Cyclotella ocellata* [CY009A], *C. krammeri* [CY054A], *C. distinguenda v. unipunctata* [CY028B], *C. [cf. comensis]* [CY9987], *C. radiosa* [CY019A] and *Stephanodiscus alpinus* [ST009A] (Appendix 1.9).

- Inference models

Weighted-averaging (WA) and Weighted-averaging partial least squares (WAPLS) transfer functions were derived using the program CALIBRATE (Juggins & ter Braak, 1992). These models were used to estimate the optima and tolerances of taxa to total

alkalinity. WA-PLS is an extension of WA that uses the residual correlation in the diatom data to improve the predictive power of the WA regression coefficients. The performance of the models is reported in terms of the squared correlation (r^2) between observed and inferred values, the root mean square error (RMSE) (observed-inferred), and the RMSE of prediction (RMSEP) obtained by jacknifing (ter Braak & Juggins, 1993).
The results showed that WAPLS component 3 maximised the predictive power of the model and reduces the bias in the residuals ($r^2 = 0.84$ and RMSEP = 0.24 $\log_{10}$ µeq/l) (Appendix 1.10). The optima and tolerances for the most common planktonic species in the dataset are given in Appendix 1.11.

2. Construction of inference models from surface sediment diatom assemblages

Diatom assemblages from surface sediments are the most directly comparable modern samples to fossil assemblages from long cores as they account for taphonomic processes. In other words, surface sediment assemblages taken from a central point in the lake represent an average assemblage including species from different habitats existing within the lake. Therefore, they account for the spatial proportions of the different habitats, which highly correlates with the general morphology of the lake. As well as a spatial dimension a temporal one is also represented by surface sediment diatom assemblages. For instance, depending on the sediment accumulation rate, a 1cm thick surface sediment sample can contain a sub-fossil assemblage that represents only a seasonal diatom bloom in the case of a high sediment accumulation rate or several years of diatom production in the case of a low sediment accumulation rate.

- The top 1cm of sediment short cores was taken from each of the 25 lakes in the training set and analysed for diatoms. The corresponding diatom counts, expressed as percentage frequency of the total number of valves counted, were associated with mean values for water chemistry (only water chemistry of samples predating the coring were used to calculate the mean values) and lake physical characteristics.

Appendix 2.1 gives the list of all diatom taxa and authorities identified in each lakes.
Appendix 2.2 shows the distribution in the 28 surface sediment samples (3 lakes were cored twice), arranged along an alkalinity gradient, of planktonic and periphytic species, respectively.

As in objective 1, multivariate statistical analyses were used to identify the main trends in the training set consisting of 28 surface sediment samples.

- <u>Ordination analyses</u>

(i). Principal Component Analysis:
The PCA-scores of the environmental variables indicated that the axis 1 was determined by the ratio of catchment area/lake area as well as the strongly correlated factors alkalinity-pH-chloride. Therefore axis 1 contrasted lakes with large catchment and high alkalinity (e.g. Lac d'Aydat, Ribains) with the lakes presenting low catchment:lake area ratio and low alkalinity especially crater lakes such as Lac de la

Godivelle-d'en-Haut, Lac de Servières and Lac du Bouchet. The second axis was determined by maximum depth, lake area and colour. On this axis, deep, large crater lakes such as Lac Pavin and Gour de Tazenat were contrasted with small, shallow and brown water lakes such as Ribains and Lac Estivadoux (Appendix 2.3).

(ii). Detrended Correspondance Analysis:
DCA axes 1 and 2 included species gradients with lengths of 6.27 and 3.03 standard deviation units, respectively, suggesting that most taxa were responding non-linearly along the underlying environmental gradients (Korsman & Birks, 1996) (Appendix 2.4). The biplot of DCA-scores showed that there was strong relationship between the first axis and alkalinity, whereas no particular variable was clearly related to the second axis. DCA also identified sample #13 from Lac Estivadoux as an outlier on DCA axis 1 (Appendix 2.4). The assemblage from this lake is totally dominated by *Eunotia exigua*, a taxon occuring in few other lakes but with very low abundances (see Appendices 2.1 and 2.2).

(iii). Canonical Correspondence Analysis
The eigenvalues for CCA axes 1 and 2 explained 25.5% of the variance in the weighted averages of the diatom taxa, and the species-environment correlations for CCA axes 1 and 2 were high, indicating a strong relationship between the measured environmental variables and the diatom taxa (see Appendix 1.9 for values). CCA with forward selection combined with Monte Carlo permutation test (999 random permutations) showed that only total alkalinity (Alk.) and maximum depth (Mdepth) were statistically significant. The species-environment correlations of CCA axes 1 and 2 after selection were still high indicating that the four variables provide a good representation of the major gradients in the diatom data (Appendix 2.5). Canonical coefficients, their t-values and inter-set correlations between axes 1 and 2 and the environmental variables indicated that maximum depth contributed most to axis 1, whereas alkalinity contributed most to axis 2. Four groups of diatom assemblages could be identified:
- Assemblages from deep and alkaline lakes (e.g. crater lakes Pavin, Tazenat) dominated by planktonic species.
- Assemblages from deep and acidic lakes (e.g. crater lakes Godivelle-d'en-Haut, Servières) dominated by non-planktonic taxa such as *Achnanthes* spp.
- Assemblages from shallow and alkaline-circumneutral waters dominated by *Fragilaria* spp.
- Assemblages from shallow and acidic lakes dominated by *Eunotia* spp. and *Achnanthes* spp.

• Inference models
Weighted-averaging (WA) and weighted-averaging partial least squares (WAPLS) regression techniques were used to generate inference models (or transfer functions), enabling total alkalinity to be inferred from the diatom species alkalinity optima of 90 common taxa in the training set.
The results show that the two component WAPLS model has low error of prediction (RMSEP = 0.25 $\log_{10}$ alkalinity units) (Appendix 2.6).
Total alkalinity estimated optima (abundance-weighted means) and tolerances (abundance-weighted standard deviation) of common diatom species in the data set are given (Appendix 2.7). The results agree well with those of Korsman and Birks (1996).

- Application of the inference model on short cores

Short Glew cores taken from Lac Pavin and Gour de Tazenat in August 1996 were analysed for diatoms. Summary diatom diagrams and results of the WAPLS transfer function are shown in Appendix 2.8.

Lac Pavin

Profiles of diatom concentration and percentage loss on ignition suggested a more productive environment in the top 4 cm. Diatom assemblages were largely dominated by four planktonic species (*Asterionella formosa, Aulacoseira subarctica, Cyclotella pseudostelligera, Stephanodiscus parvus*). Analysis of this sediment core revealed major shifts between these four dominants species, which were reflected in the WAPLS alkalinity reconstruction. Diatom-inferred alkalinity ranged from 389 µeq/l (top 0-1 cm) to 1139 µeq/l (level 1-2 cm) with maximum abundance of *C. pseudostelligera* and *S. parvus* corresponding to lowest and highest value for DI alkalinity, respectively. The range measured for alkalinity during the water chemistry survey from May-96 to may-98 was 368-600 µeq/l (mean 487.5 µeq/l) and the alkalinity in August 1996 was 565 µeq/l. The WAPLS model suggested a more alkaline environment in the recent past of Lac Pavin.

Gour de Tazenat

Increase in percentage loss on ignition and diatom concentration from the bottom to the top of the core suggested more productive waters. This interpretation is supported by changes in the diatom profile. At the top of the core (level 3-4 cm), diatom analysis showed a shift from *Cyclotella distinguenda v. unipunctata* and *C. cyclopuncta*, species classicaly associated with low nutrient concentrations, to *Stephanodiscus parvus*, *Asterinella formosa*, *Fragilaria crotonensis* and *Cyclotella radiosa*, commonly considered as indicators of nutrient enrichment. The planktonic diatom community in Gour de Tazenat is much more diverse than in Lac Pavin. Diatom-inferred alkalinity ranged from 1064 µeq/l (top 0-1 cm) to 2901 µeq/l (level 19-20 cm) with maximum abundance of *C. distinguenda v. unipunctata* corresponding to the highest value for DI alkalinity. The range measured for alkalinity during the water chemistry survey from May-96 to may-98 was 990-1271 µeq/l (mean 1110.1 µeq/l) and the alkalinity in August 1996 was 1169 µeq/l. The WAPLS model suggested for Gour de Tazenat a recent decrease of alkalinity. However, one should be cautious in the intrepretation of this model because the low effective number of occurences (N_2) of the taxon driving the reconstruction, *C. distinguenda v. unipunctata,* suggesting that its optimum and tolerance for alkalinity (as reported in appendix 3.1) should be considered preliminary.

3. Comparability of data from phytoplankton and surface sediment samples

Information about diatom ecology has been derived from living planktonic communities and surface sediment assemblages. At this stage of the study we can only compare the optima for alkalinity obtained by weighting averaging regression.

Forty-eight diatom species present in at least 3 lakes and/or with a maximum abundance >1% were common at both data-sets. The surface sediment data-set

presented a greater range of alkalinity, including samples with much lower alkalinity than the ones in the phytoplankton data-set. The value of the mean was therefore lower in the sediment data-set than in the phytoplankton data-set.
The optima for alkalinity appeared to be very similar for both data-sets concerning the truly planktonic taxa. Optima did not compare so well for the non-planktonic taxa (Appendix 3.1).

4. Eemiam diatom stratigraphy of Ribains mastercore, palaeolimological and palaeoclimatic interpretations

The high-resolution diatom analysis of Ribains mastercore was focussed on the end of the Last interglacial period (or Eemian) and the transition to the last glacial period (or Würm) as identified in the pollen chronology established by Beaulieu & Reille (1992). The absence of absolute dating for this sequence does not allow us to calculate accumulation rate and hence the time period covered by a single sample (2.5mm thick). However, by correlating pollen zones and boundaries between the Ribains sequence, which shows a succession of vegetation typical of an Interglacial stage in temperate Europe, and other dated terrestrial and marine sequences, the duration of the Eemian period in the Massif Central can be estimated to 20 000 years (Tzedakis *et al.*, 1998).

- A study at low resolution of the transition between the Eemian and the following glacial has been completed (Rioual et al., 1998).

- The core material was sampled at high-resolution. The four sections (1.1 m long) of the core corresponding to the Eemian were divided into ~1360 contiguous 2.5mm thick samples (Appendix 4.1).

Initially the core was analysed for geochemistry. By burning sediment samples at 500° C and 950 °C, organic matter and carbonates contents can be estimated respectively.

- The curve of loss on ignition at 500 °C (LOI) showed significant variations along the sections analysed. Transitions between the Glacial period Riss also referred as Oxygen Isotopic Stage (OIS 6) and the Last Interglacial (Eemian or OIS 5e) and between the Eemian and the Last Glacial (OIS 5d) are very well characterised in the LOI profile by dramatic changes (Appendix 4.2). The transition OIS 6/5e is marked by an increased in LOI suggesting higher productivity of the lake system. During the Eemian several high amplitude variations in LOI can also be observed. A detailed interpretation for all these oscillations is not possible at the present stage of our research but they do suggest high frequency oscillations in palaeoproductivity. However, it is interresting to mention that a peak in LOI at level 30.40 m is associated with the peak of *Carpinus* representing the climatic optimum in the pollen analysis. The transition 5e/5d is characterised by a dramatic decrease in LOI at the beginning of OIS 5d after the highest values recorded for the whole profile at the end of OIS 5e suggesting higher productivity of the lake system or an increased input of organic matter from the catchment at the end of the Eemian.

- A small batch of samples was analysed for carbonates content (loss on ignition at 950° C). The results showed that carbonates concentrations were very low, close to the detection limit of the method. Therefore, analyses for carbonates concentrations were not repeated for the rest of the core.

Diatom diagrams:

- 187 samples were prepared for diatom analysis, corresponding to the end of the Last Interglacial and the transition toward the Last Glacial period. Diatom concentration per gram of dry sediment was calculated following the method described by Battarbee and Kneen (1982) (Appendix 4.3).

Species identification was carried out using light microscopy on a routine basis and Scanning Electron Microscopy (S.E.M.) for problematic taxa. The taxonomy adopted generally followed Krammer and Lange-Bertalot (1986-1991). The diatom assemblages present in the Ribains sediment core is largely dominated by planktonic species. Most of the dominant species are presently found living in lakes of the French Massif Central. One notable exception is *Stephanodiscus medius*, a species prevalent at the end of the Eemian and considered an indicator of alkaline and eutrophic conditions in the literature. Appendix 4.4 and 4.5 show the relative proportions of the most common planktonic and periphytic diatom species, respectively. From the results of our phytoplankton and environmental survey in the Massif Central as well as from the literature, ecological preferences of the dominant species can be used to interpret this sequence.

- Ten phases were distinguished from the diatom diagram.

From bottom to top:

Phase 1 (level 28800-28705): *Cyclotella spp.* assemblages: dominated by *C. ocellata*, the assemblages of this phase indicate strong summer thermal stratification and low nutrient conditions (Fahnenstiel and Glime, 1983).

Phase 2 (level 28705-28585): *Fragilaria crotonensis, Asterionella formosa*, and *Cyclotella spp.*: the assemblages indicate higher nutrient conditions associated with a more turbulent environment.

Phase 3 (level 28585-28400): *Cyclotella ocellata*: the assemblages composition show a return to the conditions that prevailed in phase 1.

Phase 4 (level 28400-28355): *Cyclotella cf. comensis*: no clear interpretation of this phase is possible due to the uncertain taxonomy of the dominant taxon *Cyclotella cf. comensis*. However, the simultaneous increase in *Aulacoseira ambigua, Cyclotella radiosa, As. formosa, Au. subarctica* suggested a more productive and turbulent environment compared with the previous stage.

Phase 5 (28155-28095): *Cyclotella radiosa*: the dominant taxon indicate increased nutrient concentrations in comparison with previous phases 3 and 4.

Phase 6 (28095-27935): *Aulacoseira subarctica* and *Stephanodiscus spp.*: winter blooming species prevailed, they also indicate increased turbulence as well as increased in nutrients concentrations.

Phase 7 (level 27935-27805): *Stephanodiscus spp.*

Stephanodiscus spp. (including *S. medius, S. minutulus, S. parvus*) are associated with high nutrient concentrations and low temperature and light conditions, often blooming at the end of an ice-cover period, thus could be stimulated by shorter ice-cover periods (Kilham et al., 1996). This could indicate a warm phase, but this interpretation do not fit with the pollen result showing an increase in *Pinus*, suggesting cooler conditions. Another interpretation is that the rise of *Stephanodiscus spp.* indicates changing water levels associated with increased input of nutrients to the lake from the catchment (Wolin, 1996).

Phase 8 (27805-27750): *Aulacoseira subarctica* and *Fragilaria pinnata*: a higher proportions of littoral taxa could indicate a shallower environment, associated with increased turbulence.

Phase 9 (27750-27720): *Asterionella formosa* and *Cyclotella spp.*: *Asterionella formosa* could indicate longer ice-cover period as it appears to be stimulated by a later start and hence growth under higher light conditions (Maberly *et al.*, 1994), the assemblages of *Cyclotella spp.* indicate lower nutrient conditions.

Phase 10 (level 27720-27670): *Aulacoseira subarctica*, *Asterionella formosa, Stephanodisus minutulus*: a new phase of increased nutrient inputs and turbulence.

- Quantitative chemical inferences based on diatom-chemistry transfer functions developed in surface sediment training set have yet to be applied to the core assemblages. Statistical analysis of the core diatom assemblages will also be performed, uncluding zonation (cluster analysis using CONISS), sample classification (using TWINSPAN) and principal component analysis.

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C) Training content

The grant holder was provided training in field work (coring techniques, sampling in the field for water chemistry and biological communities)
Theorical courses related to numerical analysis (given by H.J.B. Birks, in 1997 and 1998) and diatom analysis (co-ordinated by R. Battarbee, in 1997) were also completed by the grant holder.
New laboratory skills were acquired for water chemistry analysis, diatom slide preparation and geochemical analysis of sediments.
Skills in miscrocopy were improved, the grant holder was trained in using a Scanning Electron Microscope, a Digital Image Capture system as well as standard light microscopes for routine work.
Knowledge of diatom systematics was much enhanced during the duration of the project.
Computing skills were much improved, especially concerning the use of statistical software routinely used in palaeoenvironmental studies such as CANOCO, CALIBRATE, TILIA, TWINSPAN.

D) Unexpected development
The results obtained from the surface sediment and the study of modern diatom communities showed that concentrations in nutrients such as phosphorus, nitrogen and silica were not as important as expected in explaining the distribution of the diatom species in the training set developed for French Massif Central. Some of the crater lakes included in the training set were characterised by surprisingly acid floras considering the basaltic nature of the substratum.

E) Unsuccessfull research lines
In addition to diatom analysis, analysis of Chrysophytes cysts was planned. However, due to the paucity of these remains in both modern and fossil samples, no quantitative study could be achieved.

F) Potential applications of the results

- Final analysis should help to refine the interpretation of past climate obtained from the pollen studies, highlighting disparities between pollen record and lake response. These results should provide new arguments in the debate on rate of change and climate variability of the Eemian interglacial.
- Future palaeolimnological studies in the French Massif Central, concerning recent or long term changes, could benefit from the results brought by this study. Short cores are available for study of anthropogenic impacts such as eutrophication and acidification on the most interresting sites. Other long sediment cores taken in the same area of Ribains and spanning long period of time (up to 400,000 years) could be analysed for diatoms, and the results from this project would provide a solid base for comparisons.
- The monitoring for water chemistry and diatoms of a large range of lakes in the Massif Central that was realised during this project is a valuable source of

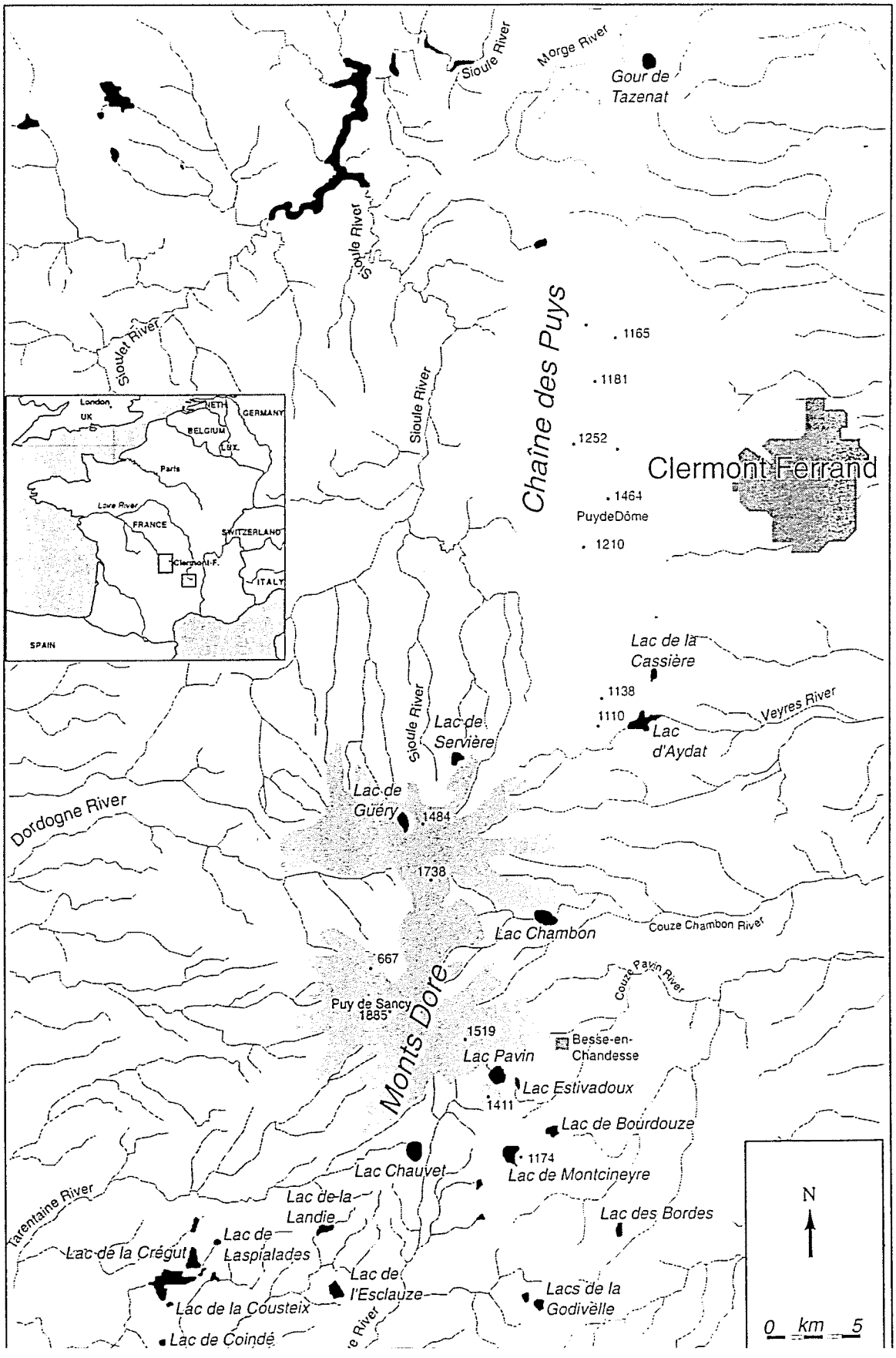
information for local water agencies as little or no information for most of these lakes were available before the start of this project.

G) Interaction with industry
Not applicable.

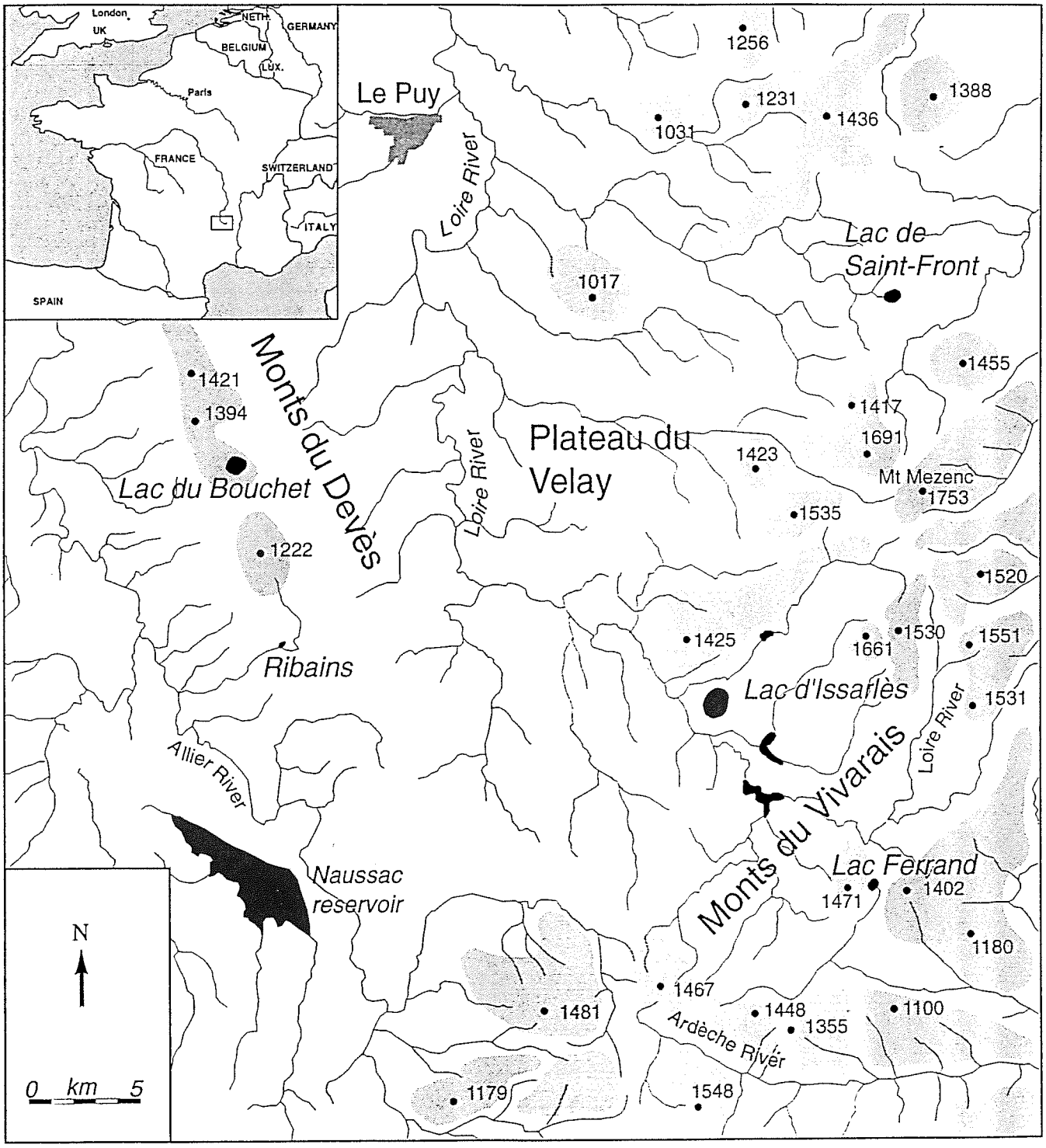
H) Benefit to the host institution
This study had links with research projects concerning Italian crater lakes (Lago di Albano, Lago di Monticchio) carried out at the Environmental Change Research Centre. Results from the present study lead to a better interpretation of those obtained from these previous projects.
Collaborative links were established with universities in France such as Clermont-Ferrand (Pr. Amblard) and Marseilles (Dr. De Beaulieu).

I) Benefit to the Community.
Final analysis should provide a more detailed understanding of natural variability and ecological response to periods of climate warming.
The surface sediment dataset (diatoms and associated water chemistry) developed during the course of this study will be integrated in the EDDI project funded by the European Comission (*European Diatom Database (EDDI): an information system for palaeoenvironmental reconstruction*, Contrat Ref: ENV4-CT97-0562).
This research is directly relevant to the Pole-Equator-Pole transect that runs through Europe and Africa (PEP III) which is part of the PAGES (Past Global Changes) project of the International Geosphere-Biosphere Programme (IGBP).

Appendix 1.1
Map of North-West Massif Central showing the location of 20 sampled lakes.



Appendix 1.1
Map of South-East Massif Central showing the location of 5 sampled lakes.



Appendix 1.2

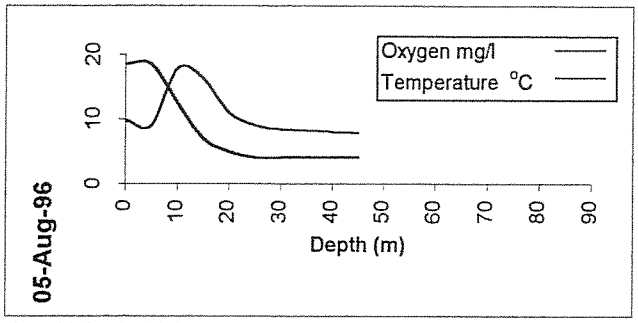
List of the 25 lakes in the training set, with site codes, location and main morphological characters

Name	Code	Latitude N	Longitude E	Origin	Altitude (m.a.s.l.)	Max. relief (m)	Lake area A0 (ha)	Catchment area Ad (ha)	Ad/A0	Max. depth Zmax (m)	Aspect ratio Zm/rsqAo
Lac d'Aydat	AYDA	45°40'00"	2°59'21"	volcanic, dam	825	505	60.3	3000	49.8	15	0.019
Lac des Bordes	BORD	45°25'29"	2°58'28"	artificial ?	1186	87	12.1	33.9	2.8	1	0.003
Lac du Bouchet	BOUC	44°54'36"	3°47'29"	volcanic, maar	1205	96	43.8	97.9	2.2	28	0.042
Lac de Bourdouze	BOUR	45.28'13"	2°55'40"	glacial	1168	86	22.9	209.9	9.2	4	0.008
Lac de la Cassiere	CASS	45°41'18"	3°00'49"	volcanic, dam	861	183	12.4	204.6	16.6	7	0.020
Lac Chambon	CHAB	45.34'16"	2°55'21"	volcanic, dam	880	858	50.6	3604.6	71.3	4	0.006
Lac Chauvet	CHAU	45°27'39"	2°50'00"	volcanic, maar	1166	129	50.9	111.6	2.2	66	0.093
Lac de Coinde	COIN	45.22'15"	2°39'32"	glacial	790	96	2.5	34.6	13.7	5	0.031
Lac de la Cousteix	COUS	45°23'24"	2°39'52"	glacial	857	27	0.9	41.4	45.3	5	0.052
Lac de la Cregut	CREG	45.24'28"	2°40'47"	glacial	900	84	35.5	172.6	4.9	26	0.044
Lac de l'Esclauze	ESCL	45°23'37"	2°46'37"	glacial	1033	37	28.3	132.3	4.7	4	0.008
Lac Estivadoux	ESTI	45.29'35"	2°54'09"	volcanic, maar	1245	57	2.2	35.3	16.0	1	0.007
Lac Ferrand	FERR	44°44'37"	4°09'53"	glacial	1247	73	1.4	20.4	14.6	5	0.042
Lac de la Godivelle d'en Bas	GODB	45.23'06"	2°55'39"	glacial	1200	226	12.1	435.3	36.0	3	0.009
Lac de la Godivelle d'en Haut	GODH	45°23'19"	2°55'08"	volcanic, maar	1239	53	13.8	13.4	1.0	44	0.118
Lac de Guery	GUER	45.36'58"	2°49'24"	volcanic, dam	1246	279	26.8	652.2	24.3	20	0.039
Lac d'Issarles	ISSA	44°49'04"	4°04'19"	volcanic, maar	997	268	88.3	123.3	1.4	109	0.116
Lac de la Landie	LAND	45.25'24"	2°46'03"	glacial	1000	134	23.9	255.1	10.7	21	0.043
Lac de Laspialades	LASP	45°25'07"	2°41'47"	glacial	950	25	2.4	34.7	14.5	5	0.032
Lac de Montcineyre	MONT	45.27'36"	2°53'53"	volcanic, dam	1174	146	39.7	135.7	3.4	18	0.029
Lac Pavin	PAVI	45°29'48"	2°53'17"	volcanic, maar	1197	210	45.2	36.7	0.8	92	0.137
Ribains, Les Narces	RIBA	44.50'09"	3°49'16"	volcanic, maar	1075	146	0.5	1183	2366.0	1	0.014
Lac de Saint Front	FRON	44°58'57"	4°10'15"	volcanic, maar	1235	109	29.8	124.5	4.2	6	0.011
Lac de Servieres	SERV	45.28'48"	2°51'36"	volcanic, maar	1200	180	16.2	50.8	3.1	29	0.072
Gour de Tazenat	TAZE	45°58'52"	5°59'36"	volcanic, maar	630	210	32.9	417.6	12.7	66	0.115

Appendix 1.3

Lac Pavin: temperature and dissolved oxygen depth profiles, Aug-96 to May-98

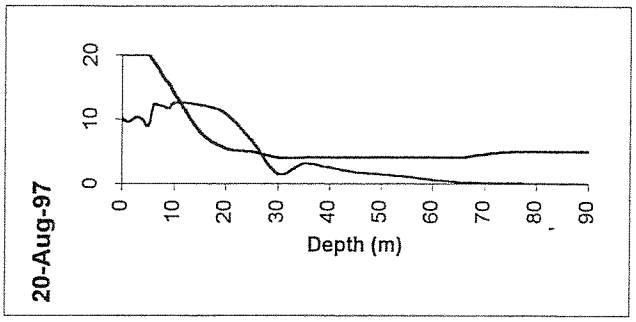
Compositions of the surface diatom plankton are expressed as relative proportions



Secchi depth: 11.0 m

Assemblage dominated by non-planktonic taxa

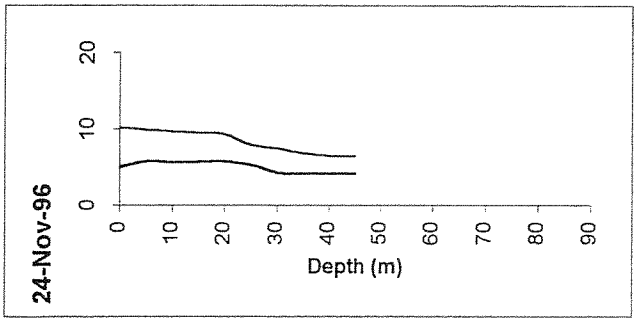
Cyclotella radiosa (5.5%), Aulacoseira subarctica (1.6%)



Secchi depth: 6.8 m

C. radiosa (55.7%), Cyclotella pseudostelligera (3.0%), A. formosa (2.1%),

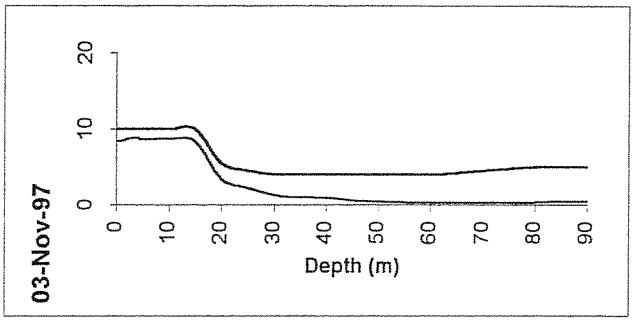
A. subarctica (1.8%)



Secchi depth: 8.5 m

C. pseudostelligera (28.6%), A. subarctica (15.9%),

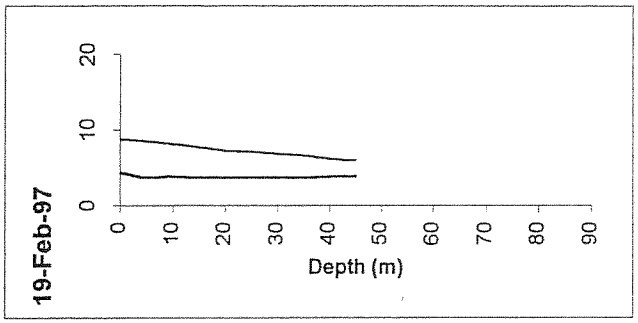
Stephanodiscus parvus (13.8%), A. formosa (9.7%), C. radiosa (1%)



Secchi depth: 7.8 m

C. radiosa (28.6%), A. subarctica (19.3%), A.formosa (4.3%),

C. pseudostelligera (1.9%),



Secchi depth: 4.5 m

A. formosa (73.6%), A. subarctica (15.1%), C. pseudostelligera (8.5%),

S. parvus (2.2%)

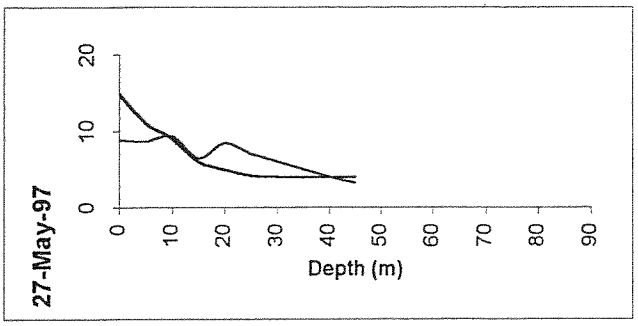
No profile data for February 98

~ 10 cm thick ice-cover

Secchi depth: no data

A. subarctica (49.2%), C. pseudostelligera (39.5%), A. formosa (5.8%),

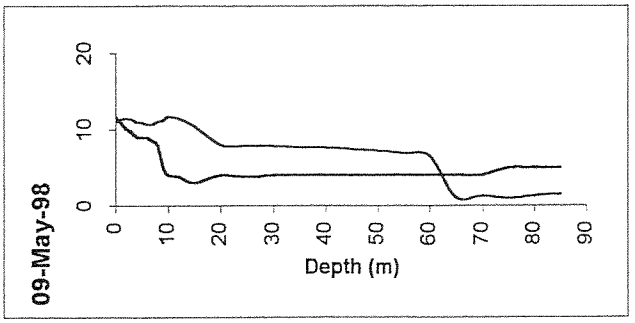
C. radiosa (1.6%)



Secchi depth: 6.9 m

Assemblage dominated by non-planktonic taxa

C. pseudostelligera (14.3%), A. formosa (9.6%), S. parvus (2.6%)



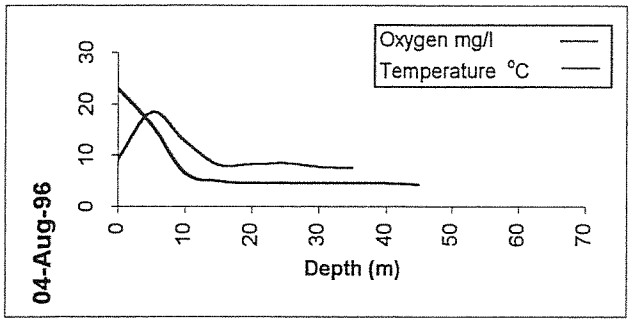
Secchi depth: 5.9 m

A. formosa (25.8%), C. pseudostelligera (24.8%), S. parvus (23.8%),

A. subarctica (20.7%)

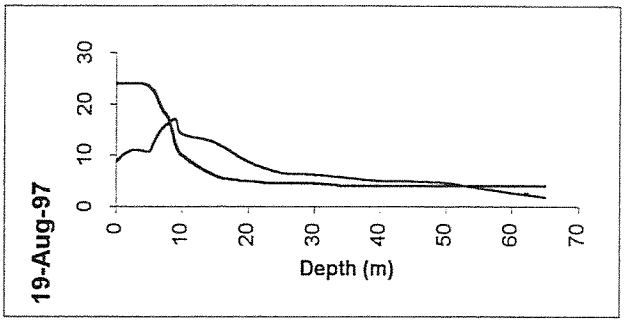
Appendix 1.3
Gour de Tazenat: temperature and dissolved oxygen depth profiles, Aug-96 to May-98

Compositions of the surface diatom plankton are expressed as relative proportions



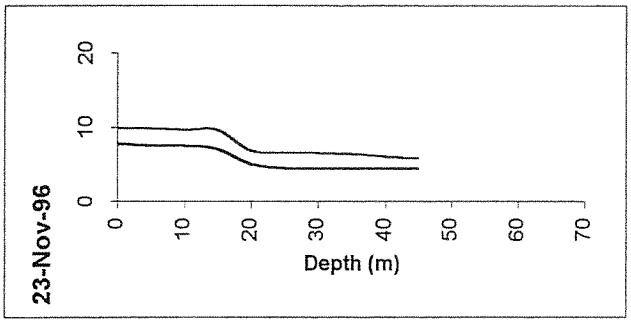
Secchi depth: no data

Cyclotella radiosa (42.6%), Aulacoseira ambigua (5.3%),
Fragilaria crotonensis (1.7%)



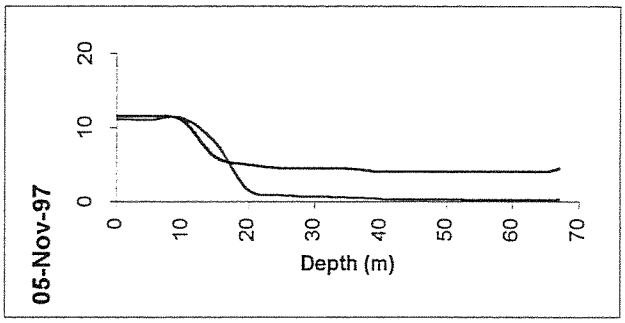
Secchi depth: 7.1 m

Assemblage dominated by non-planktonic taxa (Fragilaria spp.)
C. ocellata (2.1%), C. pseudostelligera (0.6%)



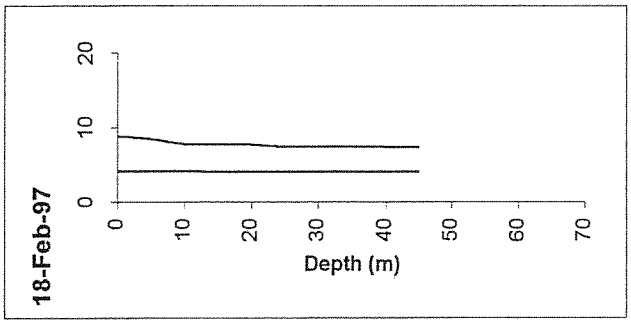
Secchi depth: 5.5 m Asterionella formosa (59.4%),

Synedra delicatissima (10.7%), C. radiosa (9.7%),
Stephanodiscus alpinus (7.8%), A. ambigua (2.6%), Cyclotella ocellata (0.6%)



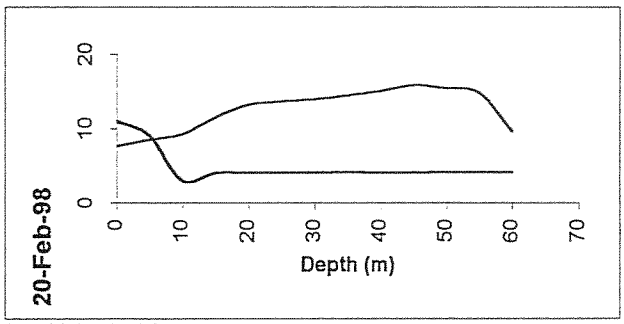
Secchi depth: 5.85 m

Assemblage dominated by non-planktonic taxa (Fragilaria spp.)
Syn. Delicatissima (7.7%), C. ocellata (7.7%), C. pseudostelligera (1.1%), Au. ambigua (1.1%).



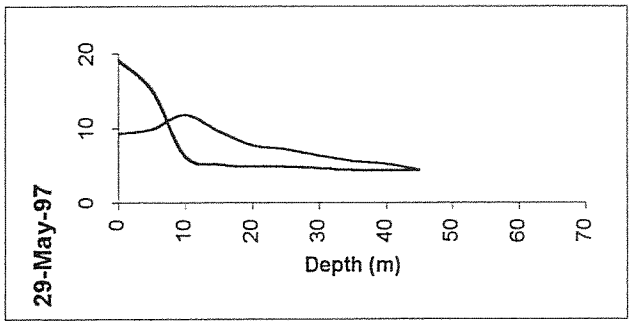
Secchi depth: 4.3 m Asterionella formosa (69.8%),

Syn. delicatissima (4.6%), Stephanodiscus alpinus (3.9%), C. radiosa (2.6%),
Cyc. pseudostelligera (1.3%), St. parvus (0.7%), A. ambigua (0.7%).



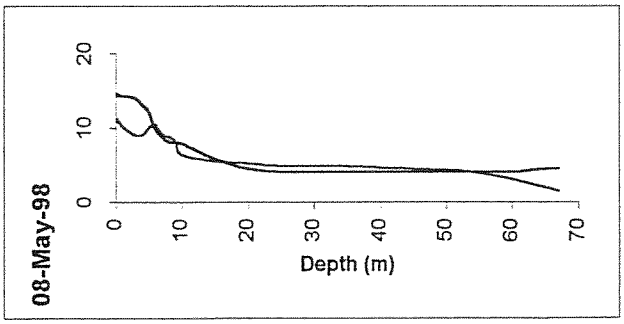
Secchi depth: 4.6 m Syn. delicatissima (29.8%), St. alpinus (20.1%)

Cyc. distinguenda v. unipunctata (12.4%), C. ocellata (9.7%), Cyclotella sp.1 (5.9%),
St. parvus (3.2%), Au. ambigua (2.5%), Cyc. radiosa (2.3%), Ast. Formosa (1.6%).



Secchi depth: 5.4 m Cyclotella ocellata (55.7%),

Cyc. pseudostelligera (30.7%), Syn. delicatissima (4.4%), C. radiosa (1.4%),
As. formosa (0.3%)



Secchi depth: 2.3m

Cyclotella sp.1 (26.8%), Cyc. distinguenda v. unipunctata (26.8%),
Cyc. radiosa (15.1%), C. ocellata (7.9%), C. pseudostelligera (5.6%), Syn. delicatissima (4.3%),
Cyc. cf. comensis (4.1%), St. parvus (1.4%), As. formosa (0.7%).

Appendix 1.4

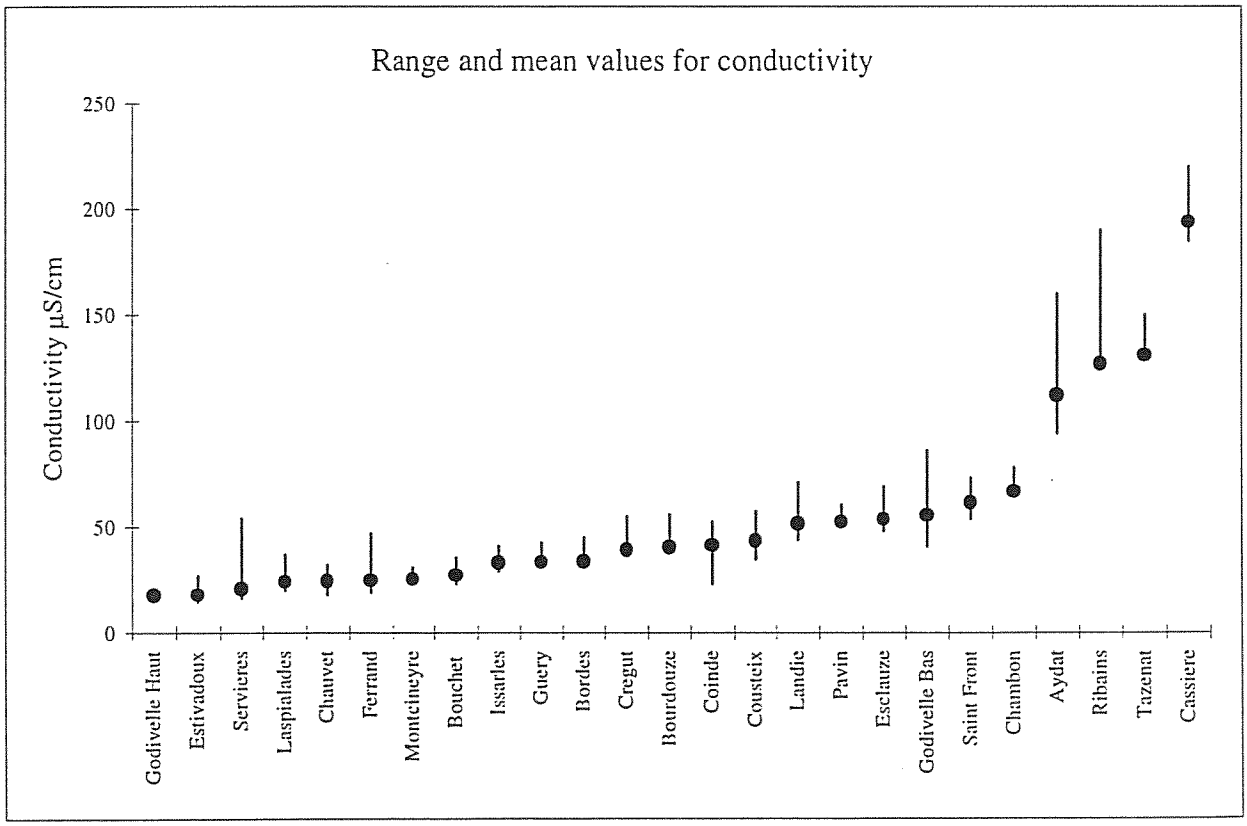
Results of water chemistry analyses

Conductivity

µS/cm

Method: conductimeter, field measurement

Site	May-96	Aug-96	Nov-96	Feb-97	May-97	Aug-97	Nov-97	Feb-98	May-98	**Mean**
Aydat	127.5	94.0	160.0	110.0	125.0	120.0	120.0	82.0	69.5	**112.0**
Bordes	-	45.0	-	33.0	33.0	39.0	39.5	25.0	22.0	**33.8**
Bouchet	-	32.0	31.0	35.5	23.0	31.0	30.0	17.0	19.0	**27.3**
Bourdouze	-	56.0	-	42.5	39.0	46.0	48.0	26.0	25.5	**40.4**
Cassiere	220.0	210.0	190.0	220.0	215.0	185.0	220.0	150.0	135.0	**193.9**
Chambon		78.0	78.0	73.0	70.0	76.5	70.0	49.0	38.0	**66.6**
Chauvet	26.0	18.0	26.5	32.0	31.0	28.5	28.0	11.0	17.5	**-24.3**
Coinde	-	23.0	-	49.5	51.5	51.0	52.5	31.0	30.5	**41.3**
Cousteix	-	35.0	48.0	46.0	57.0	46.0	57.5	30.0	27.5	**43.4**
Cregut	-	44.0	46.0	41.0	37.0	39.0	55.0	26.0	24.5	**39.1**
Esclauze	-	48.0	63.0	53.0	64.0	69.0	63.0	36.0	34.5	**53.8**
Estivadoux	-	-	-	15.0	27.0	16.0	14.5	27.0	8.2	**18.0**
Ferrand	-	19.0	47.0	23.5	26.0	26.0	26.0	8.3	22.5	**24.8**
Godivelle Bas	-	86.0	-	41.0	65.5	66.0	60.0	40.0	31.0	**55.6**
Godivelle Haut	-	20.5	-	20.0	21.0	19.0	19.0	11.0	12.5	**17.6**
Guery	33.0	38.0	36.0	38.0	42.5	38.0	35.5	17.0	21.5	**33.3**
Issarles	-	29.0	39.0	31.5	40.0	41.0	37.5	22.0	24.0	**33.0**
Landie	-	44.0	62.0	71.0	54.0	51.0	55.0	40.0	35.0	**51.5**
Laspialades	-	20.0	29.0	31.0	37.0	21.5	26.0	14.0	13.0	**23.9**
Montcineyre	-	29.0	-	31.0	28.5	27.0	30.5	13.0	17.5	**25.2**
Pavin	56.0	60.5	55.0	59.0	59.5	59.5	52.5	34.0	35.5	**52.4**
Ribains	-	-	190.0	125.0	130.0	145.0	165.0	64.0	69.0	**126.9**
Saint Front	-	54.0	63.0	64.0	73.0	70.0	66.0	-	40.0	**61.4**
Servieres	16.5	16.5	16.5	19.5	23.0	54.0	18.0	9.7	11.5	**20.6**
Tazenat	137.5	150.0	150.0	140.0	150.0	140.0	130.0	95.0	86.0	**130.9**



pH

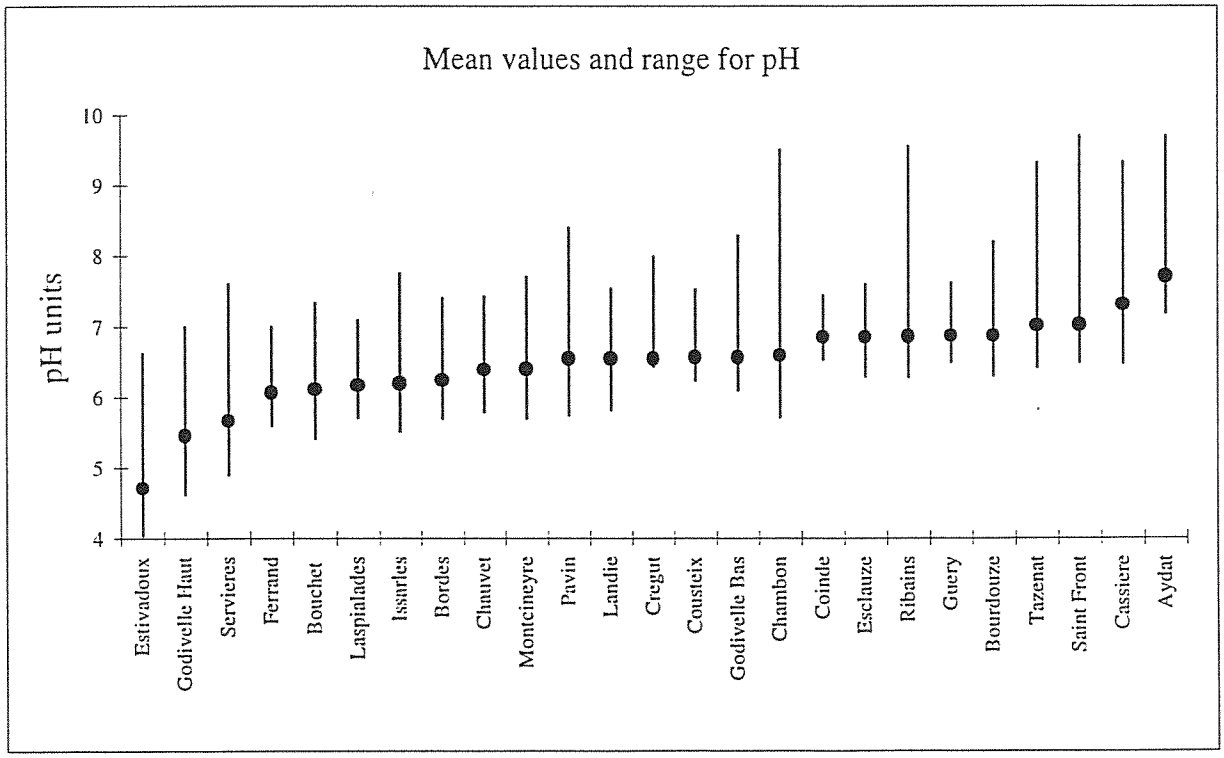
Method: measurement with pH meter in the field

pH unit

Site	May-96	Aug-96	Nov-96*	Feb-97*	May-97	Aug-97	Nov-97	Feb-98	May-98	**Mean****
Aydat	7.96	9.70	7.19	7.42	8.76	9.66	7.24	8.44	9.52	**7.71**
Bordes	-	5.70	-	6.37	6.24	6.64	6.41	6.44	7.41	**6.24**
Bouchet	5.42	6.50	5.85	6.61	6.19	7.33	6.45	7.08	7.07	**6.11**
Bourdouze	-	6.80	-	6.30	7.97	8.20	6.80	6.96	7.58	**6.87**
Cassiere	7.40	8.10	6.48	7.46	9.33	9.30	8.75	7.82	9.19	**7.32**
Chambon	6.50	8.16	5.72	7.70	8.89	8.04	7.43	7.46	9.5	**6.59**
Chauvet	5.80	7.35	5.93	6.75	7.43	7.29	6.38	6.84	7.27	**6.39**
Coinde	-	7.30	-	6.54	6.90	7.44	6.82	6.83	6.75	**6.85**
Cousteix	-	7.40	6.27	6.55	7.43	7.53	6.24	6.30	6.72	**6.56**
Cregut	5.83	7.80	6.44	6.66	7.99	7.87	6.71	6.71	7.2	**6.55**
Esclauze	-	7.60	6.30	6.67	7.51	7.60	7.03	6.76	7.27	**6.85**
Estivadoux	-	-	-	6.62	5.58	5.24	4.75	4.04	5.8	**4.70**
Ferrand	5.60	7.00	5.79	6.80	6.24	6.19	5.83	6.28	6.69	**6.06**
Godivelle Bas	6.10	6.40	-	6.43	6.97	8.11	6.49	6.78	8.29	**6.57**
Godivelle Haut	4.62	6.40	-	6.42	5.85	7.00	6.13	6.15	6.52	**5.46**
Guery	6.50	7.50	6.74	6.69	7.21	7.62	6.94	6.68	7.14	**6.87**
Issarles	5.52	7.50	6.27	6.99	6.73	7.75	5.83	6.51	7.03	**6.19**
Landie	5.82	7.10	6.49	6.54	7.50	7.54	6.93	6.96	7.13	**6.55**
Laspialades	-	6.40	6.46	6.43	7.09	6.31	5.71	5.93	6.35	**6.17**
Montcineyre	5.70	6.90	-	6.42	6.90	7.70	6.84	6.47	7.25	**6.40**
Pavin	5.75	8.40	6.83	6.51	7.11	7.80	6.95	6.91	8.07	**6.54**
Ribains	-	-	6.29	6.67	9.56	8.83	7.29	6.78	7.92	**6.86**
Saint Front	6.50	9.70	6.78	6.89	7.68	9.05	6.97	-	8.12	**7.03**
Servieres	4.90	7.60	5.99	6.85	5.77	5.92	5.87	6.02	6.35	**5.67**
Tazenat	7.49	7.35	6.43	6.44	8.41	8.58	8.35	7.39	9.32	**7.02**

*Average between field and laboratory values calculated from H^+ concentrations

** Mean values calculated from H^+ concentrations



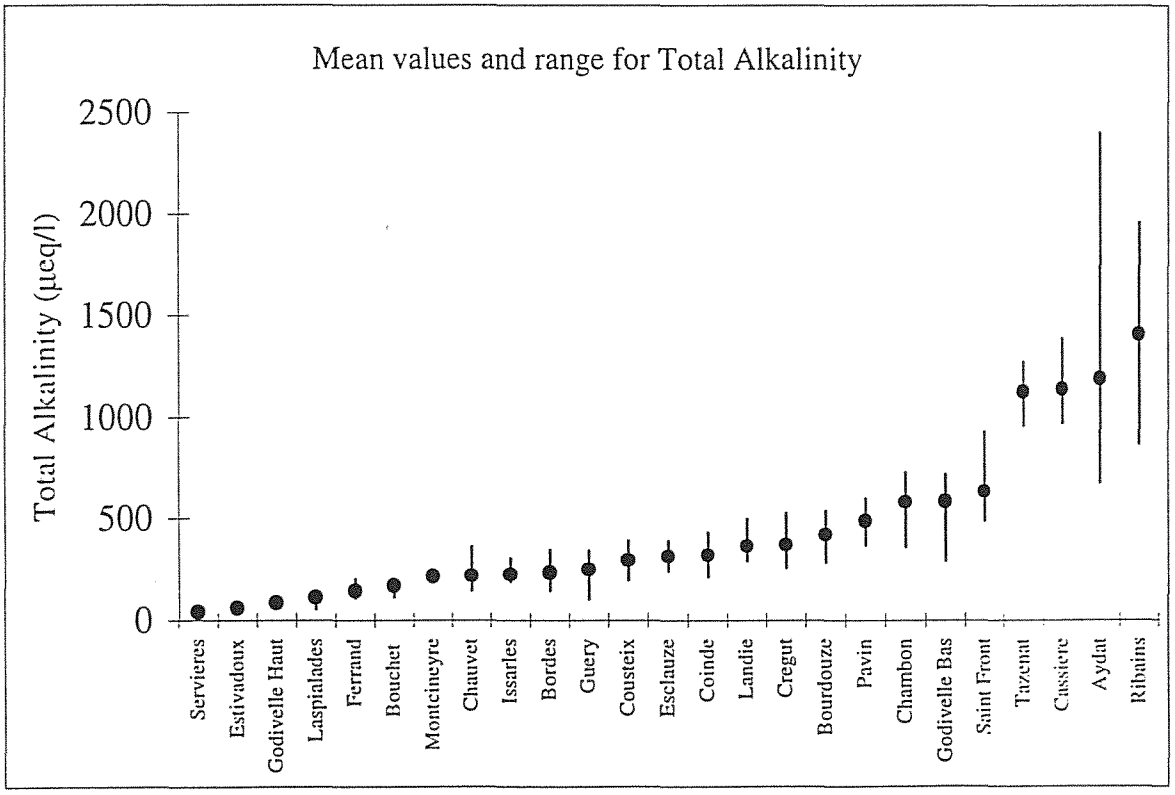
Total Alkalinity

Method: Gran titration

µeq/l

Site	May.96*	Aug-96	Nov-96	Feb-97	May-97	Aug-97	Nov-97	Feb-98	May-98	Mean
Aydat	2400	1055	1132	1133	1073	679	1054	993	726	**1138.3**
Bordes	-	182	-	272	144	220	219	344	197	**225.4**
Bouchet	160	185	113	175	141	182	215	172	152	**166.1**
Bourdouze	-	541	-	510	286	396	451	350	264	**399.7**
Cassiere	1100	1388	1201	971	1073	1127	1164	1067	1019	**1123.4**
Chambon	500	536	597	544	361	720	678	730	525	**576.7**
Chauvet	360	182	180	216	144	235	214	179	171	**209.1**
Coinde	-	-	-	309	322	213	430	312	234	**303.3**
Cousteix	-	387	197	207	284	358	390	222	210	**281.8**
Cregut	440	528	330	257	316	432	337	324	249	**356.9**
Esclauze	-	390	361	309	257	240	342	291	266	**307.0**
Estivadoux	-	-	-	64	37	91	41	63	21	**53.0**
Ferrand	160	125	199	156	105	163	107	126	81	**135.8**
Godivelle Bas	460	721	-	293	697	660	605	662	535	**579.2**
Godivelle Haut	100	80	-	96	72	89	76	68	53	**79.2**
Guery	300	327	197	258	246	103	341	197	210	**242.1**
Issarles	220	187	188	246	216	303	223	197	206	**220.8**
Landie	360	335	402	291	331	497	354	339	278	**354.1**
Laspialades	-	127	133	117	110	56	121	102	84	**106.2**
Montcineyre	230	185	-	207	211	240	224	197	166	**207.5**
Pavin	460	565	456	548	449	600	452	368	489	**487.5**
Ribains	-	-	1264	1191	868	1763	1407	1956	808	**1322.5**
Saint Front	620	580	602	567	489	929	638	-	513	**617.3**
Servieres	50	39	42	30	23	54	45	15	18	**35.0**
Tazenat	1080	1169	1137	1110	956	1271	1145	1133	990	**1110.1**

* value for May 96 were not obtained by Gran titration but converted from the measurement of Calcium Carbonate concentration on the field with a titration kit.

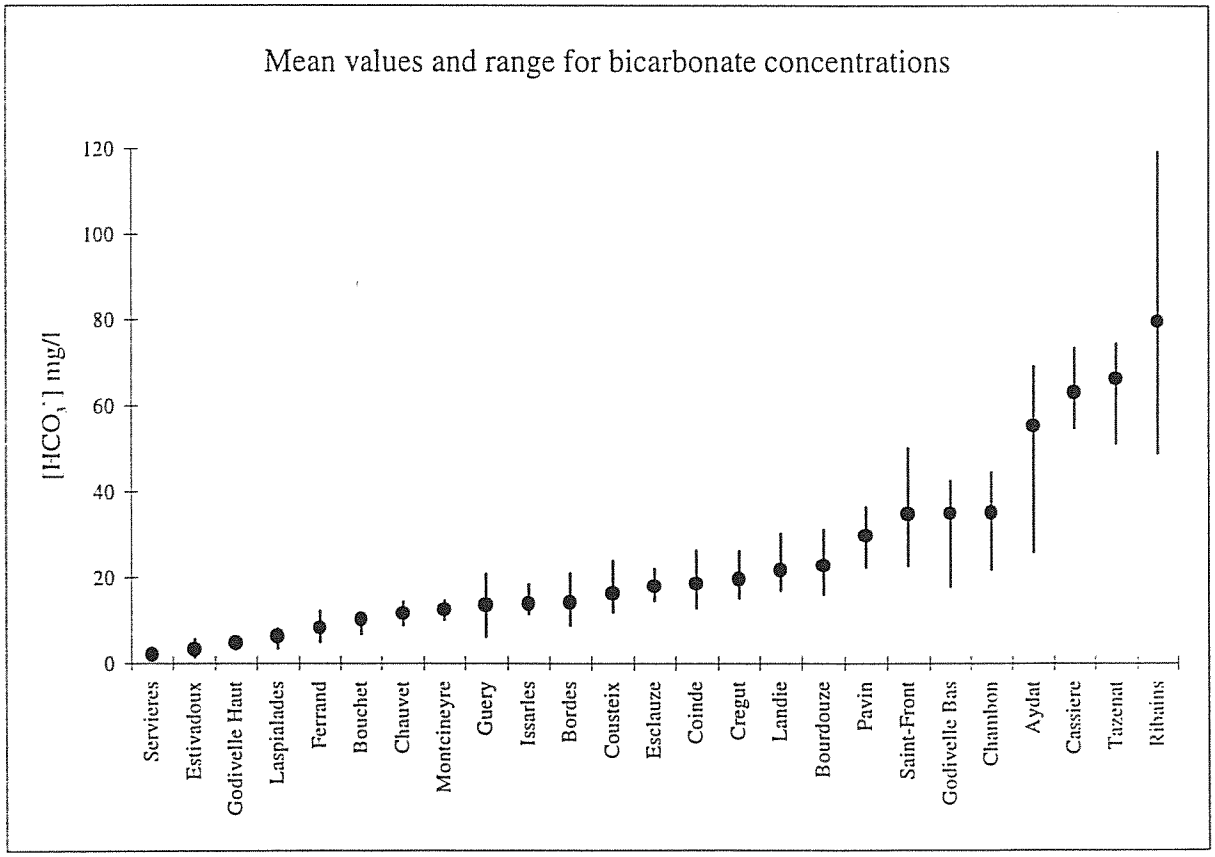


Bicarbonates, HCO_3^-

Method: Gran titration

mg/l

Site	May-96	Aug-96	Nov-96	Feb-97	May-97	Aug-97	Nov-97	Feb-98	May-98	Mean
Aydat	-	-	68.97	69.01	65.25	25.87	64.21	59.40	33.78	**55.21**
Bordes	-	-	-	16.59	8.77	13.41	13.36	21.00	11.97	**14.18**
Bouchet	-	11.28	6.89	10.70	8.57	11.07	13.11	10.50	9.26	**10.17**
Bourdouze	-	-	-	31.11	17.33	23.65	27.50	21.33	16.06	**22.83**
Cassiere	-	-	73.27	59.14	65.21	55.55	68.32	64.80	54.75	**63.01**
Chambon	-	-	36.39	33.07	21.87	43.40	41.28	44.41	24.49	**34.99**
Chauvet	-	11.07	11.00	13.20	8.80	14.30	13.05	10.93	10.43	**11.60**
Coinde	-	-	-	18.82	19.62	12.94	26.22	19.02	14.24	**18.47**
Cousteix	-	-	12.02	12.65	17.29	21.74	23.79	13.50	12.81	**16.26**
Cregut	-	-	20.12	15.67	19.27	26.08	20.55	19.73	15.15	**19.51**
Esclauze	-	-	22.00	18.82	15.67	14.56	20.85	17.76	16.18	**17.97**
Estivadoux	-	-	-	3.92	2.20	5.55	2.50	3.86	1.31	**3.22**
Ferrand	-	-	12.13	9.49	6.42	9.94	6.53	7.67	4.96	**8.16**
Godivelle Bas	-	-	-	17.90	42.40	39.69	36.90	40.38	32.07	**34.89**
Godivelle Haut	-	4.88	-	5.88	4.35	5.42	4.64	4.14	3.22	**4.65**
Guery	-	-	12.01	15.74	14.99	6.24	20.79	12.02	12.81	**13.51**
Issarles	-	-	11.48	15.02	13.18	18.35	13.60	12.02	12.58	**13.75**
Landie	-	-	24.49	17.77	20.15	30.18	21.58	20.66	16.95	**21.68**
Laspialades	-	-	8.11	7.11	6.72	3.41	7.38	6.20	5.09	**6.29**
Montcineyre	-	11.27	-	12.62	12.78	14.53	13.66	12.02	10.09	**12.43**
Pavin	-	33.60	27.80	33.40	27.31	36.35	27.55	22.43	29.55	**29.75**
Ribains	-	-	77.11	72.64	52.89	99.60	85.72	119.30	48.86	**79.44**
Saint-Front	-	22.78	36.72	34.55	29.76	50.08	38.89	-	30.89	**34.81**
Servieres	-	2.35	2.54	1.82	1.38	3.29	2.74	0.90	1.07	**2.01**
Tazenat	-	71.14	69.35	67.71	58.32	74.28	68.64	68.97	51.10	**66.19**

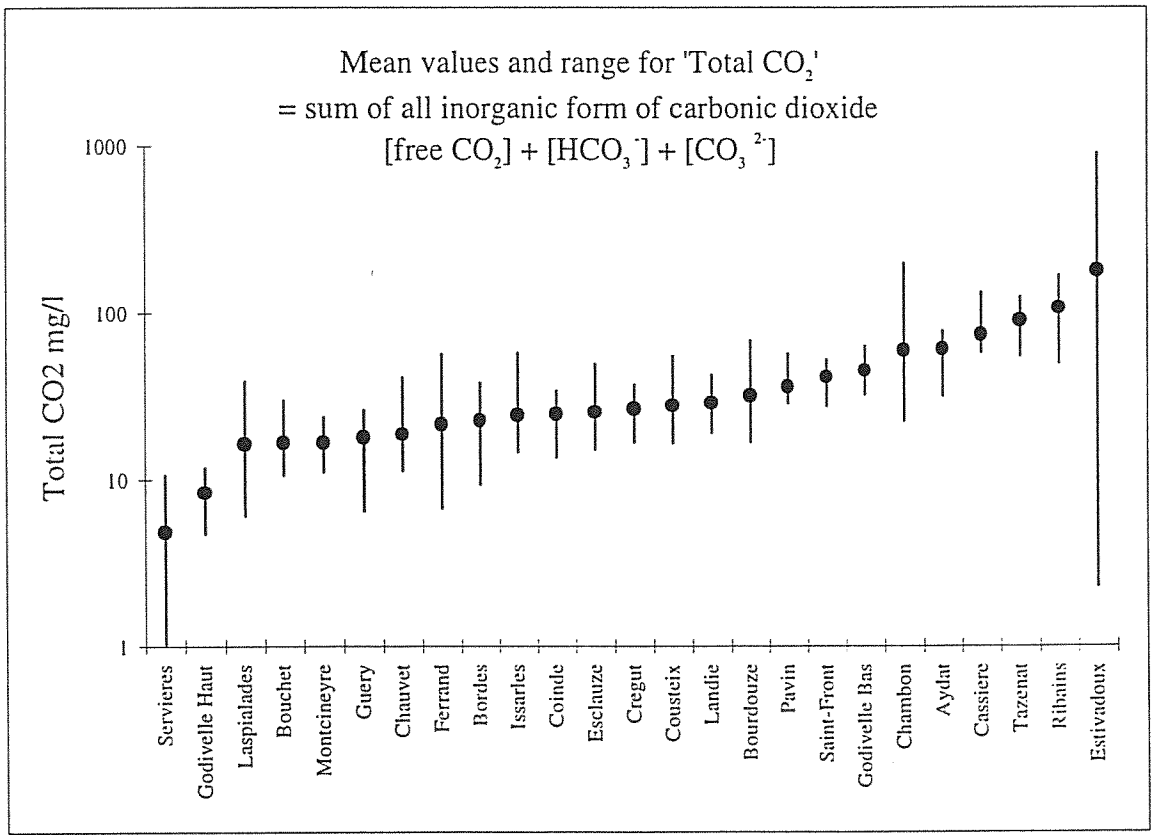


Total CO_2

$[\text{Total } CO_2]\ mg/l = [\text{free } CO_2] + [HCO_3^-] + [CO_3^{2-}]$ Method: Gran titration

mg/l

Site	May-96	Aug-96	Nov-96	Feb-97	May-97	Aug-97	Nov-97	Feb-98	May-98	**Mean**
Aydat	-	-	78.86	75.07	69.52	32.04	71.67	60.42	38.46	**60.86**
Bordes	-	-	-	33.07	9.39	18.00	24.68	38.34	12.81	**22.71**
Bouchet	-	17.31	29.86	16.94	11.90	11.90	22.22	12.66	10.64	**16.68**
Bourdouze	-	-	-	68.49	17.91	24.08	37.32	26.64	16.83	**31.88**
Cassiere	-	-	133.57	63.73	68.75	61.41	69.86	67.09	58.26	**74.67**
Chambon	-	-	199.56	34.59	22.64	44.28	44.60	47.90	27.74	**60.19**
Chauvet	-	11.90	41.00	18.82	11.34	15.51	24.47	15.02	11.50	**18.69**
Coinde	-	-	-	30.65	26.70	13.69	34.34	24.95	18.39	**24.79**
Cousteix	-	-	27.00	20.75	24.69	22.77	55.24	28.42	16.73	**27.94**
Cregut	-	-	37.13	23.64	24.52	26.72	28.82	29.25	16.88	**26.71**
Esclauze	-	-	49.64	28.07	19.03	15.17	25.02	24.65	17.49	**25.58**
Estivadoux	-	-	-	6.31	2.27	58.16	100.15	907.03	4.92	**179.81**
Ferrand	-	-	56.88	12.93	8.22	20.17	27.83	17.81	6.72	**21.51**
Godivelle Bas	-	-	-	33.63	45.94	40.44	63.92	55.71	32.63	**45.38**
Godivelle Haut	-	8.27	-	11.28	4.72	6.27	11.68	11.08	4.96	**8.32**
Guery	-	-	17.30	23.06	19.07	6.50	26.06	18.42	14.66	**17.87**
Issarles	-	-	24.90	18.62	15.10	18.92	58.00	20.56	14.71	**24.40**
Landie	-	-	42.46	29.83	27.06	31.59	26.74	25.94	19.19	**28.97**
Laspialades	-	-	14.54	13.18	10.37	6.08	39.06	22.57	9.12	**16.42**
Montcineyre	-	13.62	-	23.74	13.25	15.03	17.77	22.47	11.14	**16.72**
Pavin	-	34.20	37.21	57.44	29.31	37.41	34.06	28.93	30.18	**36.09**
Ribains	-	-	169.67	107.35	61.20	103.47	95.54	167.98	50.02	**107.89**
Saint-Front	-	27.99	50.21	45.17	33.74	53.04	48.53	-	31.49	**41.45**
Servieres	-	1.02	8.45	2.42	1.62	9.54	10.59	3.00	1.94	**4.82**
Tazenat	-	76.31	124.31	125.26	124.36	76.06	69.82	75.24	55.43	**90.85**

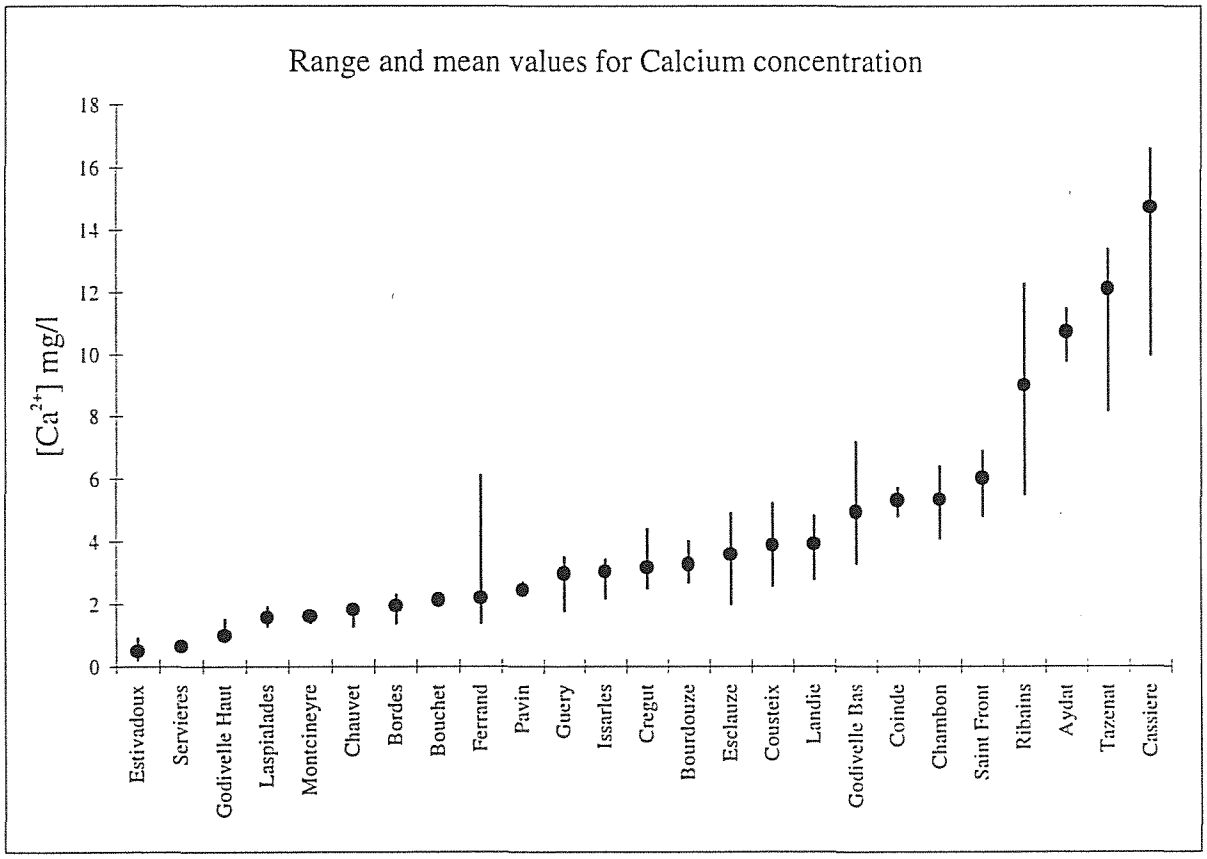


Calcium, Ca^{2+}

mg/l

Method: ICP-AES analyses,
Royal Holloway, Dept. of Geography

Site	May-96	Aug-96	Nov-96	Feb-97	May-97	Aug-97	Nov-97	Feb-98	May-98	Mean
Aydat	10.8	11.1	11.5	10.5	10.7	10.8	11.4	10.1	9.8	**10.74**
Bordes	-	2.3	-	1.4	1.6	2.2	2.0	2.0	2.1	**1.94**
Bouchet	2.3	2.0	2.2	2.0	2.1	2.0	2.1	2.3	2.2	**2.13**
Bourdouze	-	3.9	-	2.7	3.0	4.0	3.6	2.7	2.9	**3.26**
Cassiere	15.8	16.6	10.0	15.5	16.1	11.5	15.9	16.1	15.1	**14.73**
Chambon	5.5	4.9	4.1	5.0	5.4	6.1	6.4	5.6	5.0	**5.33**
Chauvet	1.9	1.7	1.3	1.7	2.0	1.9	2.0	2.0	1.9	**1.82**
Coinde	-	5.4	-	5.4	5.7	5.6	4.8	4.8	5.5	**5.31**
Cousteix	-	4.5	3.9	3.6	3.2	5.2	2.6	3.8	4.1	**3.86**
Cregut	3.4	3.3	3.4	2.7	3.6		3.4	2.5	2.9	**3.15**
Esclauze	-	3.6	3.9	3.5	3.4	3.0	4.3	2.0	4.9	**3.58**
Estivadoux	-	-	-	0.2	0.3	0.9	0.4	0.6	0.5	**0.48**
Ferrand	2.0	1.9	6.1	1.8	1.4	1.4	1.7	1.9	1.5	**2.19**
Godivelle Bas	5.2	7.2	-	3.3	5.7	6.9	3.3	3.5	4.4	**4.94**
Godivelle Haut	1.0	0.8	-	0.8	0.9	1.0	0.9	0.9	1.5	**0.98**
Guery	3.1	3.1	3.3	1.8	3.1	3.2	3.5	2.8	2.8	**2.97**
Issarles	3.4	3.2	3.0	2.4	3.2	3.2	3.3	3.4	2.2	**3.03**
Landie	4.0	3.9	4.3	2.8	3.6	3.0	4.3	4.8	4.5	**3.91**
Laspialades	-	1.5	1.8	1.5	1.6	1.6	1.9	1.4	1.3	**1.58**
Montcineyre	1.8	1.6	-	1.6	1.7	1.7	1.4	1.7	1.4	**1.61**
Pavin	2.5	2.4	2.3	2.4	2.5	2.5	2.3	2.7	2.5	**2.46**
Ribains	-	-	12.3	8.1	7.1	12.2	11.0	5.5	6.9	**9.01**
Saint Front	5.9	6.1	6.0	4.8	5.9	6.9	6.8	-	5.7	**6.01**
Servieres	0.8	0.6	0.8	0.5	0.7	0.5	0.6	0.7	0.7	**0.66**
Tazenat	11.6	13.4	8.2	12.0	12.9	12.9	12.5	13.0	12.7	**12.13**

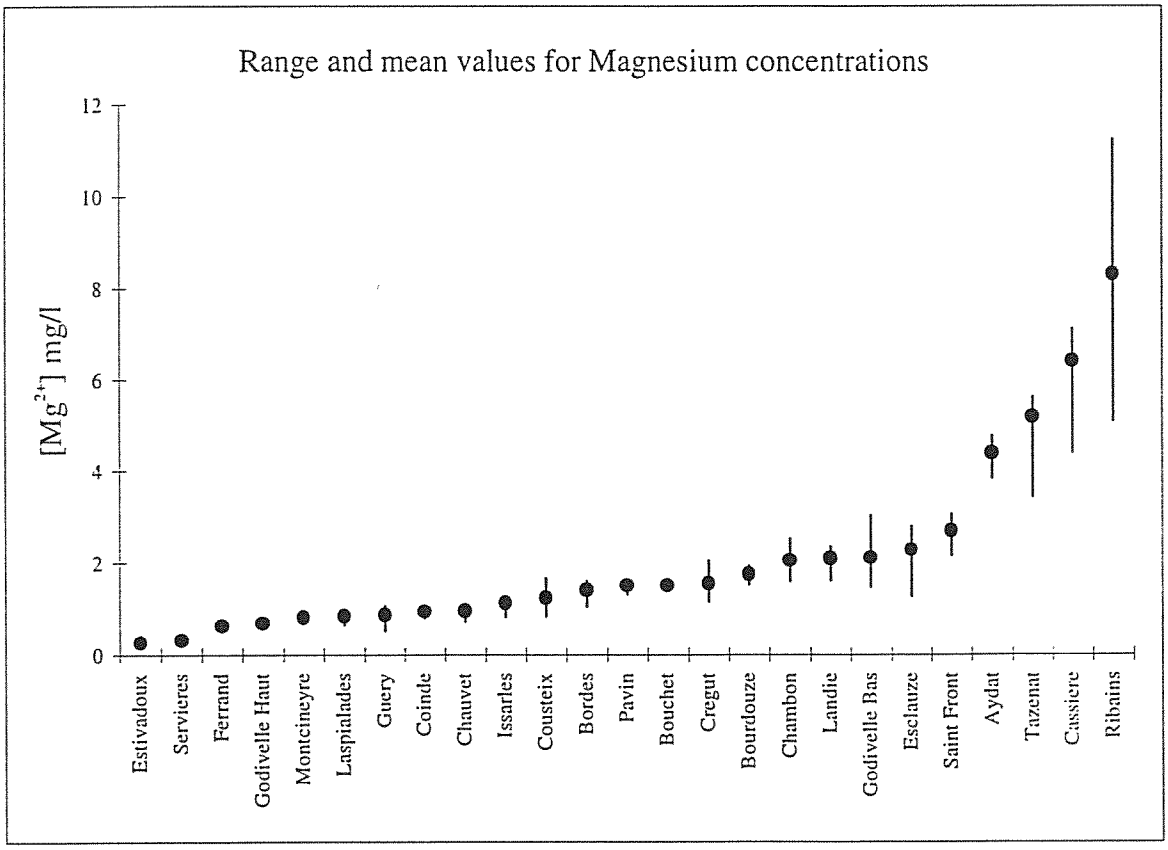


Magnesium, Mg^{2+}

Method: ICP-AES analyses,
Royal Holloway, Dept. of Geography

mg/l

Site	May-96	Aug-96	Nov-96	Feb-97	May-97	Aug-97	Nov-97	Feb-98	May-98	Mean
Aydat	4.32	4.51	4.68	4.24	4.47	4.58	4.77	4.03	3.85	**4.38**
Bordes	-	1.60	-	1.05	1.34	1.59	1.52	1.23	1.47	**1.40**
Bouchet	1.51	1.47	1.52	1.50	1.51	1.51	1.52	1.56	1.51	**1.51**
Bourdouze	-	1.85	-	1.58	1.70	1.93	1.88	1.54	1.71	**1.74**
Cassiere	6.50	7.05	4.40	6.63	7.11	5.13	7.08	7.03	6.67	**6.40**
Chambon	2.09	1.82	1.60	1.89	2.11	2.34	2.51	2.13	1.89	**2.04**
Chauvet	1.00	0.88	0.72	0.86	1.04	1.02	1.03	1.00	1.00	**0.95**
Coinde	-	0.97	-	0.91	1.02	1.05	0.83	0.80	0.95	**0.93**
Cousteix	-	1.51	1.20	1.16	1.02	1.66	0.84	1.26	1.27	**1.24**
Cregut	1.61	1.56	1.57	1.31	1.75	2.05	1.60	1.17	1.28	**1.54**
Esclauze	-	2.49	2.59	2.28	2.28	2.14	2.78	1.28	2.35	**2.27**
Estivadoux	-	-	-	0.14	0.38	0.41	0.19	0.17	0.23	**0.25**
Ferrand	0.66	0.62	0.69	0.67	0.55	0.61	0.67	0.53	0.61	**0.62**
Godivelle Bas	2.22	3.03	-	1.48	2.36	2.91	1.47	1.48	1.82	**2.10**
Godivelle Haut	0.72	0.62	-	0.69	0.73	0.71	0.70	0.66	0.68	**0.68**
Guery	0.89	0.88	0.95	0.53	0.94	0.99	1.07	0.77	0.83	**0.87**
Issarles	1.23	1.21	1.11	0.92	1.19	1.18	1.20	1.21	0.83	**1.12**
Landie	2.03	2.10	2.32	1.62	2.18	1.71	2.34	2.28	2.17	**2.08**
Laspialades	-	0.88	0.95	0.83	0.91	0.86	0.91	0.73	0.66	**0.84**
Montcineyre	0.85	0.81	-	0.82	0.88	0.85	0.68	0.80	0.76	**0.81**
Pavin	1.56	1.40	1.45	1.53	1.59	1.51	1.32	1.59	1.58	**1.50**
Ribains	-	-	11.23	7.99	7.08	10.34	9.51	5.10	6.93	**8.31**
Saint Front	2.65	2.62	2.60	2.16	2.80	3.05	3.03	-	2.60	**2.69**
Servieres	0.38	0.28	0.39	0.25	0.37	0.24	0.25	0.30	0.39	**0.32**
Tazenat	4.86	5.63	3.43	5.16	5.62	5.57	5.46	5.47	5.40	**5.18**

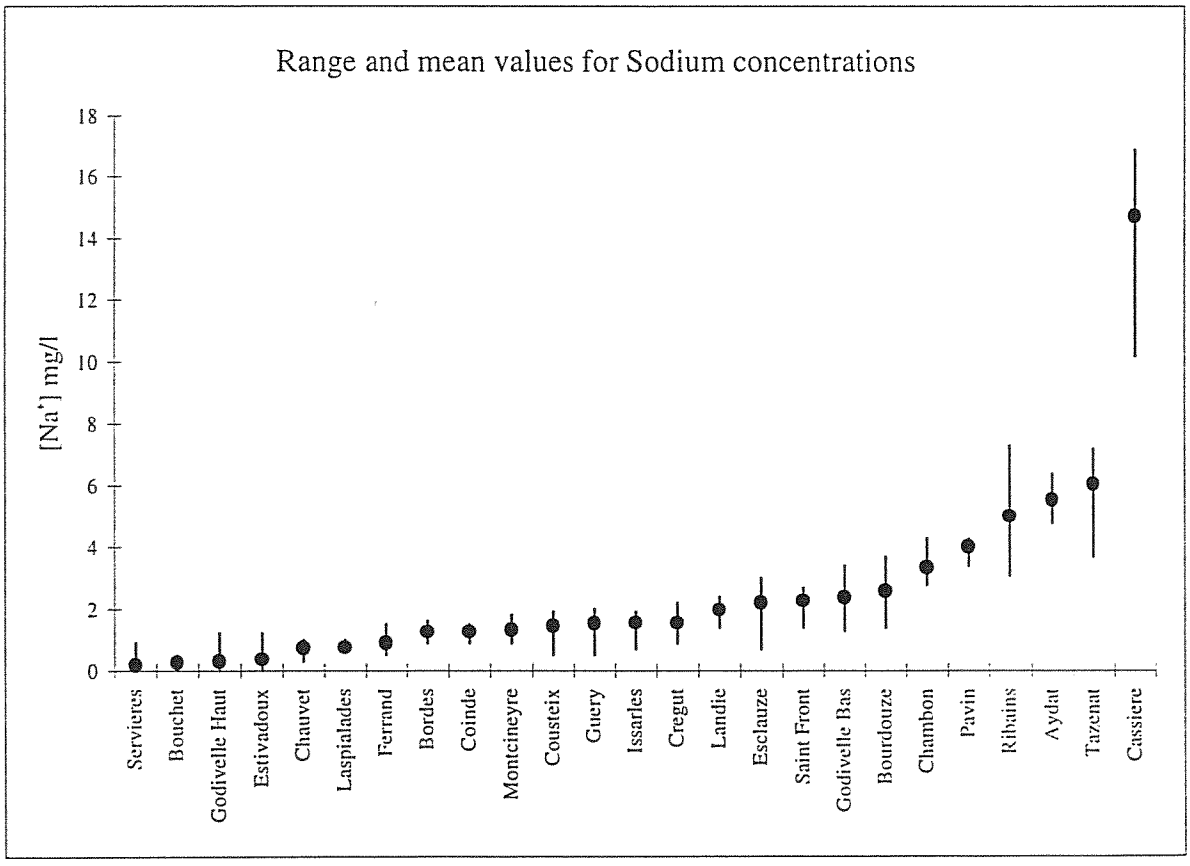


Sodium, Na^+

mg/l

Method: ICP-AES analyses,
Royal Holloway, Dept. of Geography

Site	May-96	Aug-96	Nov-96	Feb-97	May-97	Aug-97	Nov-97	Feb-98	May-98	Mean
Aydat	5.4	5.7	5.7	5.4	6.4	5.8	5.7	5.0	4.8	**5.54**
Bordes	-	1.6	-	1.1	1.3	1.4	1.2	0.9	1.3	**1.26**
Bouchet	0.5	0.4	0.2	0.0	0.3	0.1	0.2	0.3	0.3	**0.26**
Bourdouze	-	3.0	-	3.4	3.7	2.9	1.7	1.4	2.0	**2.59**
Cassiere	14.9	16.9	10.2	15.4	16.8	12.7	16.3	14.7	14.8	**14.74**
Chambon	3.6	3.1	2.8	3.1	3.5	4.3	3.8	3.2	2.8	**3.36**
Chauvet	0.7	0.8	0.3	0.4	1.0	0.8	0.9	0.8	0.8	**0.72**
Coinde	-	1.5	-	1.1	1.5	1.4	0.9	1.1	1.3	**1.26**
Cousteix	-	1.8	1.5	1.5	1.4	1.9	0.5	1.5	1.4	**1.44**
Cregut	1.7	1.5	1.6	1.2	1.9	2.2	1.5	0.9	1.5	**1.56**
Esclauze	-	3.0	2.8	2.0	2.6	2.0	2.5	0.7	2.1	**2.21**
Estivadoux	-	-	-	0.0	0.3	0.7	0.0	1.2	0.0	**0.37**
Ferrand	0.9	1.2	0.6	0.5	1.5	1.0	0.9	0.6	0.9	**0.90**
Godivelle Bas	2.7	3.4	-	1.8	3.0	3.2	1.3	1.5	2.0	**2.36**
Godivelle Haut	0.2	0.1	-	0.0	0.6	0.1	0.1	0.0	1.2	**0.29**
Guery	1.4	1.6	1.6	0.5	1.8	1.7	1.6	1.5	2.0	**1.52**
Issarles	1.9	1.9	1.4	0.7	1.7	1.8	1.7	1.9	0.9	**1.54**
Landie	2.2	2.2	2.4	1.4	2.0	1.4	2.0	2.3	1.8	**1.97**
Laspialades	-	0.7	0.7	0.6	1.0	0.7	0.6	0.7	1.0	**0.75**
Montcineyre	1.4	1.4	-	1.2	1.6	1.8	0.9	1.1	1.1	**1.31**
Pavin	4.2	4.0	4.1	3.9	4.3	4.0	3.4	4.2	4.1	**4.02**
Ribains	-	-	3.1	3.9	5.7	7.3	7.1	3.6	4.5	**5.03**
Saint Front	2.2	2.4	2.2	1.4	2.6	2.7	2.5	-	2.2	**2.28**
Servieres	0.0	0.9	0.2	0.0	0.2	0.0	0.0	0.0	0.2	**0.17**
Tazenat	5.7	7.2	3.7	5.9	6.7	6.6	6.3	6.3	6.2	**6.07**

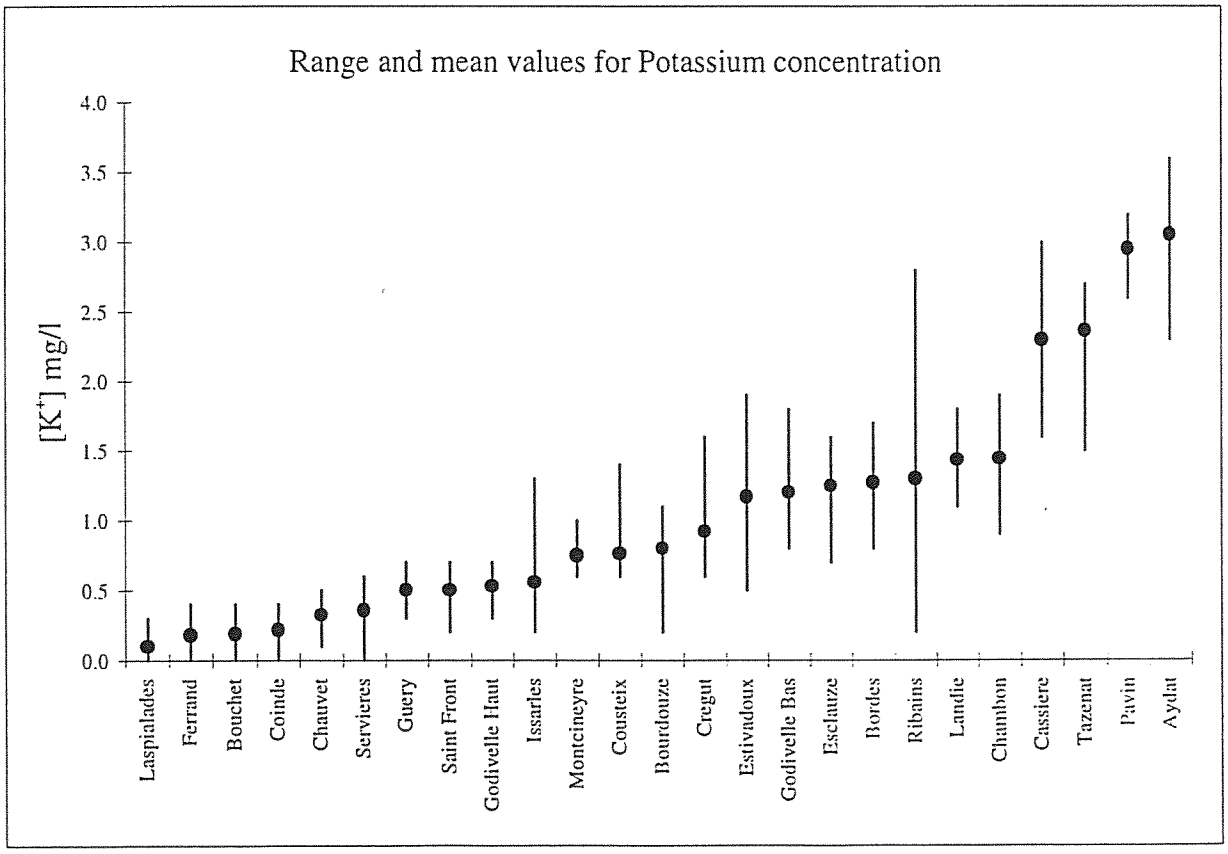


Potassium, K^+

mg/l

Method: ICP-AES analyses,
Royal Holloway, Dept. of Geography

Site	May-96	Aug-96	Nov-96	Feb-97	May-97	Aug-97	Nov-97	Feb-98	May-98	Mean
Aydat	3.1	3.0	3.6	2.7	2.9	3.4	3.5	3.0	2.3	**3.06**
Bordes	-	1.7	-	0.8	1.2	1.4	1.4	1.1	1.3	**1.27**
Bouchet	0.4	0.0	0.1	0.0	0.3	0.2	0.1	0.3	0.3	**0.19**
Bourdouze	-	0.9	-	0.2	0.8	0.8	1.1	0.9	0.9	**0.80**
Cassiere	2.4	3.0	1.6	2.0	2.5	2.1	2.7	2.3	2.1	**2.30**
Chambon	1.6	1.3	0.9	1.4	1.5	1.6	1.9	1.4	1.4	**1.44**
Chauvet	0.4	0.2	0.1	0.2	0.5	0.4	0.3	0.4	0.4	**0.32**
Coinde	-	0.4	-	0.0	0.3	0.3	0.1	0.1	0.3	**0.21**
Cousteix	-	0.7	0.7	0.6	0.6	1.4	0.7	0.8	0.6	**0.76**
Cregut	1.0	1.0	0.6	0.7	1.0	1.6	1.0	0.7	0.7	**0.92**
Esclauze	-	1.5	1.4	1.0	1.3	1.2	1.6	0.7	1.3	**1.25**
Estivadoux	-	-	-	0.9	1.3	1.9	1.5	0.5	0.9	**1.17**
Ferrand	0.1	0.2	0.0	0.2	0.1	0.2	0.2	0.2	0.4	**0.18**
Godivelle Bas	1.3	1.7	-	0.9	1.5	1.8	0.8	0.8	0.8	**1.20**
Godivelle Haut	0.5	0.3	-	0.4	-	0.7	0.6	0.6	0.6	**0.53**
Guery	0.5	0.4	0.3	0.3	0.7	0.6	0.7	0.5	0.5	**0.50**
Issarles	0.6	0.2	0.4	0.2	0.7	0.6	0.6	1.3	0.4	**0.56**
Landie	1.1	1.5	1.5	1.1	1.5	1.2	1.5	1.8	1.7	**1.43**
Laspialades	-	0.0	0.0	0.1	0.3	0.0	0.2	0.1	0.1	**0.10**
Montcineyre	0.9	0.6	-	0.6	1.0	1.0	0.5	0.7	0.7	**0.75**
Pavin	3.2	2.7	2.8	2.8	3.2	3.0	2.6	3.2	3.1	**2.96**
Ribains	-	-	0.6	0.9	0.2	2.1	2.8	1.0	1.5	**1.30**
Saint Front	0.2	0.5	0.3	0.3	0.7	0.7	0.7	-	0.6	**0.50**
Servieres	0.4	0.0	0.4	0.1	0.5	0.5	0.3	0.4	0.6	**0.36**
Tazenat	2.3	2.5	1.5	2.3	2.6	2.7	2.3	2.5	2.6	**2.37**

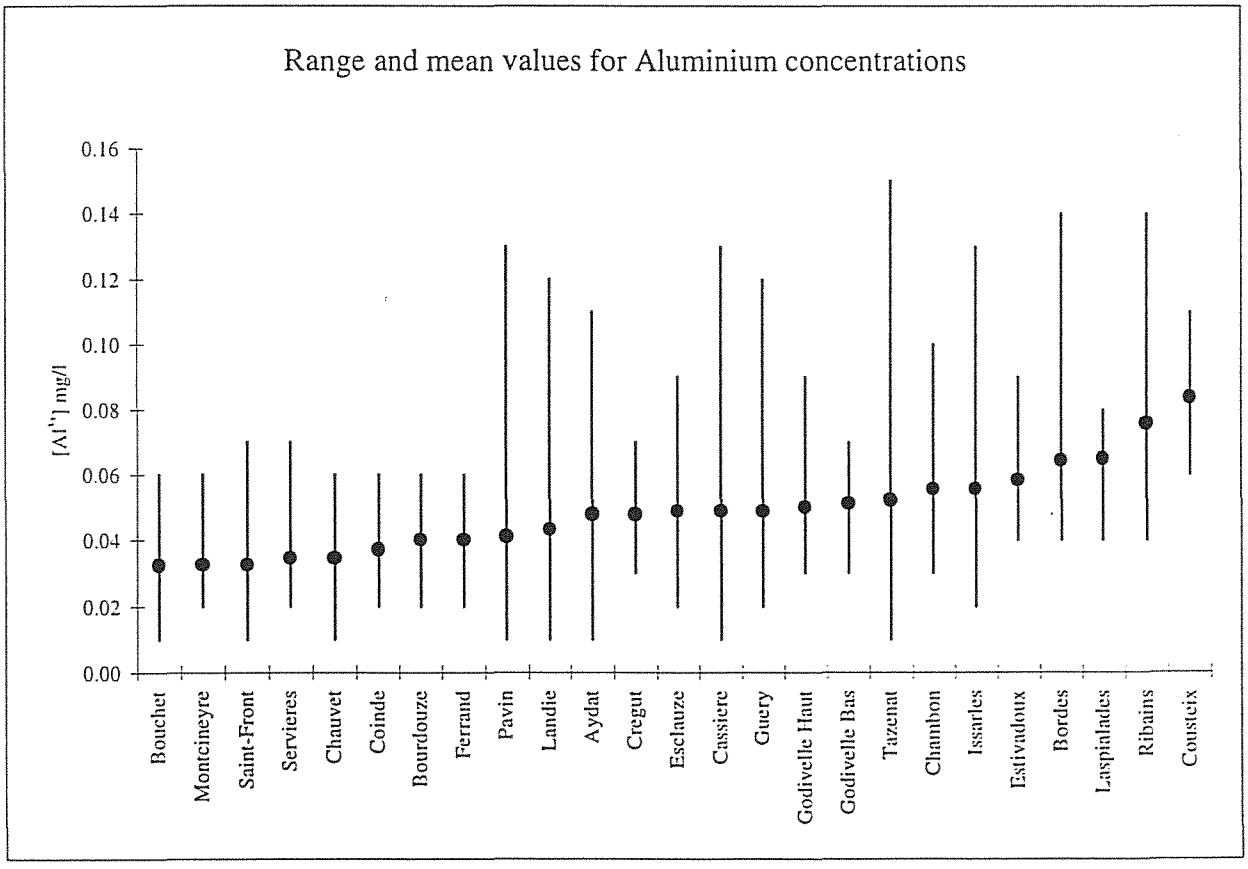


Aluminium, Al^{3+}

mg/l

Method: ICP-AES analyses,
Royal Holloway, Dept. of Geology

Site	May-96	Aug-96	Nov-96	Feb-97	May-97	Aug-97	Nov-97	Feb-98	May-98	Mean
Aydat	0.11	0.06	0.01	0.05	0.03	0.04	0.03	0.04	0.06	**0.048**
Bordes	-	0.14	-	0.04	0.06	0.06	0.04	0.04	0.07	**0.064**
Bouchet	0.03	0.05	0.01	0.02	0.03	0.06	0.03	0.02	0.04	**0.032**
Bourdouze	-	0.06	-	0.04	0.06	0.04	0.02	0.02	0.04	**0.040**
Cassiere	0.13	0.03	0.02	0.03	0.05	0.05	0.05	0.01	0.07	**0.049**
Chambon	0.10	0.09	0.03	0.05	0.04	0.03	0.03	0.03	0.10	**0.056**
Chauvet	0.06	0.04	0.01	0.03	0.05	0.03	0.03	0.03	0.03	**0.034**
Coinde	-	0.04	-	0.04	0.04	0.06	0.02	0.04	0.02	**0.037**
Cousteix	-	0.08	0.10	0.09	0.09	0.11	0.06	0.08	0.06	**0.084**
Cregut	0.04	0.03	0.04	0.06	0.07	0.04	0.05	0.05	0.05	**0.048**
Esclauze	-	0.05	0.03	0.06	0.06	0.04	0.04	0.02	0.09	**0.049**
Estivadoux	-	-	-	0.06	0.07	0.05	0.04	0.04	0.09	**0.058**
Ferrand	0.02	0.06	0.05	0.05	0.05	0.04	0.02	0.03	0.04	**0.040**
Godivelle Bas	0.04	0.06	-	0.06	0.07	0.05	0.03	0.05	0.05	**0.051**
Godivelle Haut	0.06	0.09	-	0.03	0.05	0.06	0.04	0.03	0.04	**0.050**
Guery	0.08	0.03	0.02	0.04	0.03	0.05	0.03	0.04	0.12	**0.049**
Issarles	0.02	0.12	0.05	0.04	0.02	0.05	0.04	0.13	0.03	**0.056**
Landie	0.02	0.04	0.01	0.04	0.05	0.05	0.12	0.03	0.03	**0.043**
Laspialades	-	0.04	0.05	0.08	0.05	0.08	0.07	0.07	0.08	**0.065**
Montcineyre	0.06	0.02	-	0.03	0.03	0.05	0.02	0.02	0.03	**0.033**
Pavin	0.13	0.01	0.01	0.05	0.02	0.05	0.03	0.03	0.04	**0.041**
Ribains	-	-	0.09	0.06	0.06	0.08	0.04	0.14	0.06	**0.076**
Saint-Front	0.01	0.03	0.02	0.02	0.02	0.06	0.07	-	0.03	**0.033**
Servieres	0.07	0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.04	**0.034**
Tazenat	0.15	0.02	0.01	0.04	0.03	0.04	0.07	0.03	0.08	**0.052**

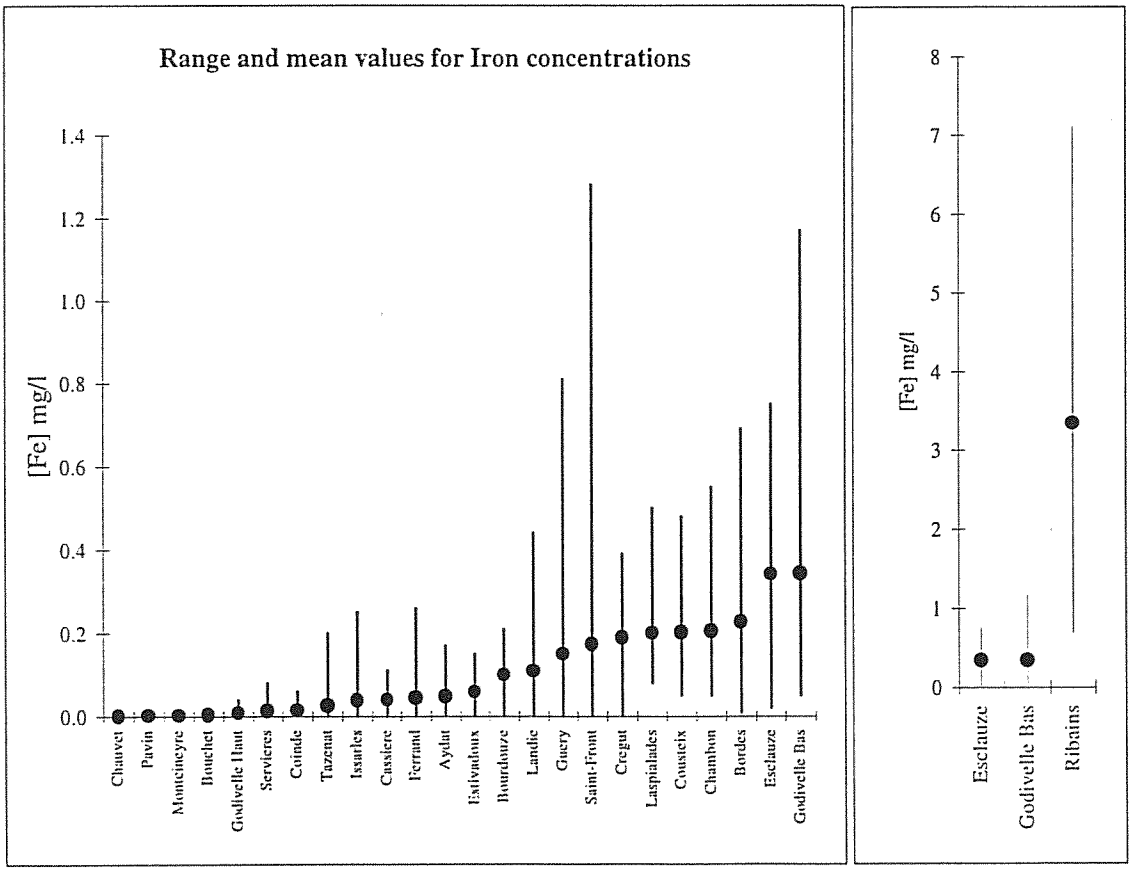


Iron (Fe)

mg/l

ICP-AES analyses,
Royal Holloway, Dept. of Geology

Site	May-96	Aug-96	Nov-96	Feb-97	May-97	Aug-97	Nov-97	Feb-98	May-98	Mean
Aydat	0.06	0.09	0.03	0.04	0.03	0.00	0.01	0.00	0.17	**0.048**
Bordes	-	0.69	-	0.01	0.14	0.24	0.21	0.07	0.23	**0.227**
Bouchet	0.00	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00	**0.003**
Bourdouze	-	0.21	-	0.10	0.15	0.12	0.11	0.00	0.00	**0.099**
Cassiere	0.06	0.03	0.00	0.00	0.01	0.08	0.06	0.00	0.11	**0.039**
Chambon	0.20	0.05	0.16	0.17	0.13	0.10	0.35	0.13	0.55	**0.204**
Chauvet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.000**
Coinde	-	0.04	-	0.00	0.00	0.06	0.00	0.00	0.00	**0.014**
Cousteix	-	0.48	0.19	0.05	0.23	0.30	0.17	0.10	0.09	**0.201**
Cregut	0.15	0.29	0.08	0.00	0.22	0.38	0.39	0.09	0.10	**0.189**
Esclauze	-	0.75	0.34	0.15	0.28	0.42	0.49	0.02	0.28	**0.341**
Estivadoux	-	-	-	0.00	0.06	0.14	0.00	0.00	0.15	**0.058**
Ferrand	0.26	0.10	0.01	0.00	0.00	0.03	0.00	0.00	0.00	**0.044**
Godivelle Bas	0.26	0.66	-	0.05	0.24	1.17	0.21	0.14	0.06	**0.343**
Godivelle Haut	0.00	0.04	-	0.00	0.00	0.00	0.02	0.00	0.00	**0.008**
Guery	0.10	0.03	0.08	0.00	0.02	0.05	0.25	0.00	0.81	**0.149**
Issarles	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.25	0.00	**0.038**
Landie	0.07	0.10	0.05	0.01	0.13	0.08	0.44	0.10	0.00	**0.109**
Laspialades	-	0.10	0.50	0.18	0.08	0.15	0.29	0.21	0.09	**0.200**
Montcineyre	0.00	0.01	-	0.00	0.00	0.00	0.00	0.00	0.00	**0.001**
Pavin	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.001**
Ribains	-	-	0.69	3.10	4.96	7.11	3.08	2.17	2.29	**3.343**
Saint-Front	0.00	0.02	0.02	0.02	0.00	0.04	1.28	-	0.00	**0.173**
Servieres	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	**0.012**
Tazenat	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.20	**0.026**



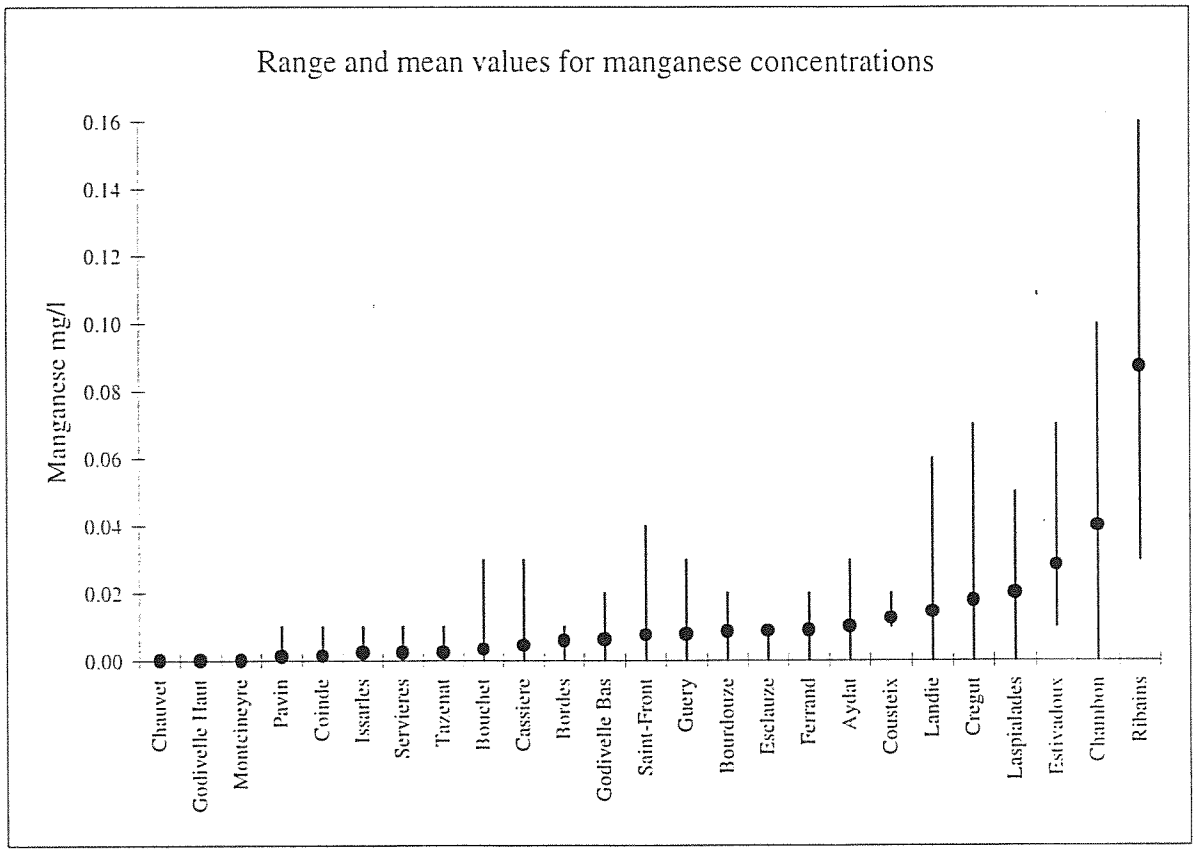
Manganese, (Mn)

mg/l

Method: ICP-AES analyses.

Royal Holloway, Dept. of Geology

Site	May-96	Aug-96	Nov-96	Feb-97	May-97	Aug-97	Nov-97	Feb-98	May-98	Mean
Aydat	0.00	0.02	0.03	0.02	0.01	0.00	0.00	0.00	0.01	**0.010**
Bordes	-	0.01	-	0.00	0.01	0.01	0.00	0.01	0.00	**0.006**
Bouchet	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	**0.003**
Bourdouze	-	0.02	-	0.00	0.01	0.01	0.01	0.01	0.00	**0.009**
Cassiere	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.00	**0.004**
Chambon	0.02	0.01	0.03	0.06	0.00	0.02	0.10	0.08	0.04	**0.040**
Chauvet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.000**
Coinde	-	0.00	-	0.00	0.01	0.00	0.00	0.00	0.00	**0.001**
Cousteix	-	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.02	**0.013**
Cregut	0.00	0.01	0.01	0.01	0.01	0.01	0.07	0.02	0.02	**0.018**
Esclauze	-	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	**0.009**
Estivadoux	-	-	-	0.02	0.07	0.04	0.01	0.02	0.01	**0.028**
Ferrand	0.01	0.01	0.02	0.02	0.00	0.00	0.00	0.01	0.01	**0.009**
Godivelle Bas	0.01	0.00	-	0.00	0.00	0.02	0.00	0.01	0.01	**0.006**
Godivelle Haut	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	**0.000**
Guery	0.01	0.00	0.00	0.01	0.00	0.00	0.03	0.01	0.01	**0.008**
Issarles	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	**0.002**
Landie	0.01	0.01	0.01	0.01	0.01	0.00	0.06	0.01	0.01	**0.014**
Laspialades	-	0.00	0.04	0.03	0.00	0.00	0.05	0.02	0.02	**0.020**
Montcineyre	0.00	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00	**0.000**
Pavin	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	**0.001**
Ribains	-	-	0.03	0.10	0.06	0.16	0.09	0.09	0.08	**0.087**
Saint-Front	0.00	0.00	0.01	0.04	0.00	0.00	0.01	-	0.00	**0.008**
Servieres	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	**0.002**
Tazenat	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	**0.002**

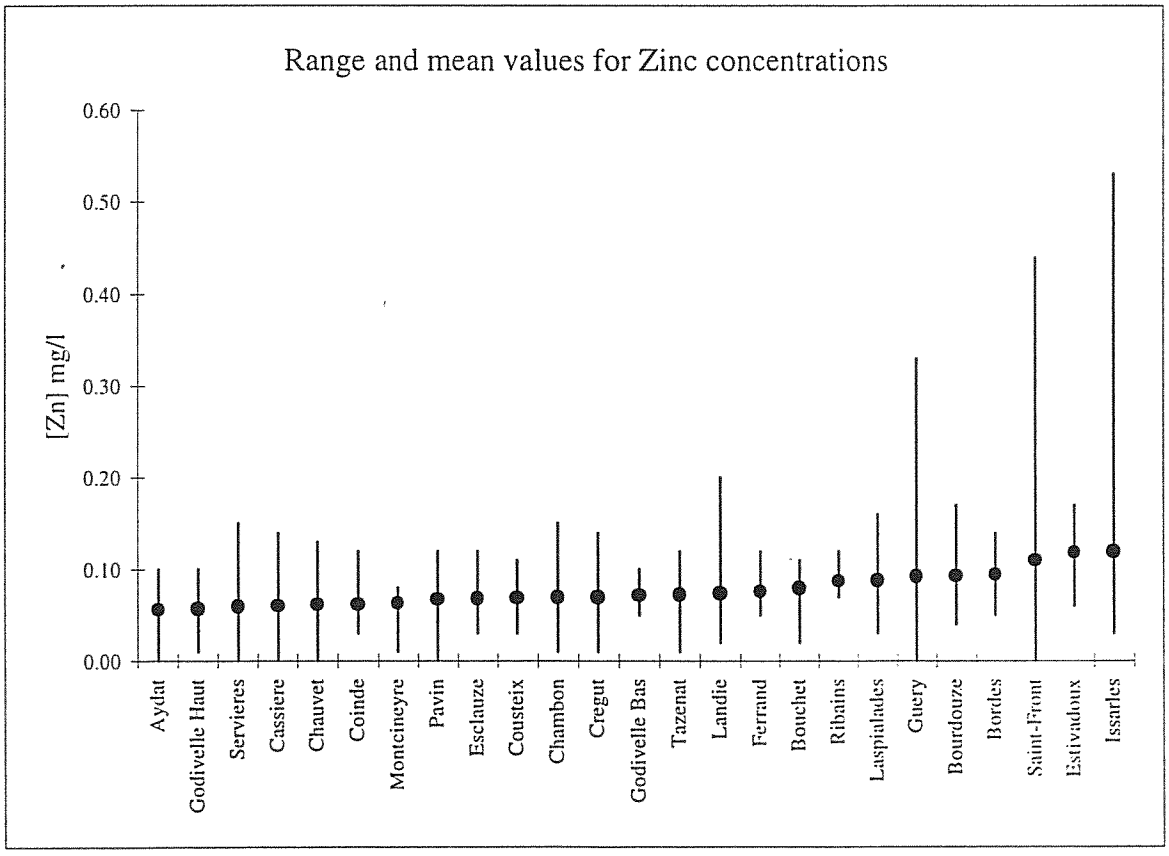


Zinc, (Zn)

mg/l

Method: ICP-AES analyses,
Royal Holloway, Dept. of Geology

Site	May-96	Aug-96	Nov-96	Feb-97	May-97	Aug-97	Nov-97	Feb-98	May-98	Mean
Aydat	0.00	0.00	0.07	0.09	0.10	0.02	0.07	0.06	0.09	**0.056**
Bordes	-	0.14	-	0.06	0.12	0.08	0.05	0.09	0.12	**0.094**
Bouchet	0.11	0.10	0.05	0.07	0.09	0.02	0.07	0.10	0.10	**0.079**
Bourdouze	-	0.12	-	0.07	0.17	0.09	0.09	0.04	0.07	**0.093**
Cassiere	0.00	0.02	0.08	0.04	0.14	0.06	0.06	0.06	0.08	**0.060**
Chambon	0.01	0.07	0.06	0.04	0.08	0.06	0.07	0.08	0.15	**0.069**
Chauvet	0.00	0.02	0.07	0.06	0.13	0.04	0.07	0.07	0.09	**0.061**
Coinde	-	0.03	-	0.06	0.12	0.03	0.04	0.11	0.04	**0.061**
Cousteix	-	0.04	0.07	0.08	0.11	0.03	0.05	0.08	0.09	**0.069**
Cregut	0.07	0.01	0.07	0.08	0.05	0.06	0.07	0.07	0.14	**0.069**
Esclauze	-	0.03	0.06	0.07	0.11	0.04	0.05	0.06	0.12	**0.068**
Estivadoux	-	-	-	0.06	0.16	0.13	0.07	0.12	0.17	**0.118**
Ferrand	0.09	0.12	0.06	0.06	0.08	0.06	0.07	0.09	0.05	**0.076**
Godivelle Bas	0.06	0.10	-	0.07	0.08	0.05	0.05	0.06	0.10	**0.071**
Godivelle Haut	0.01	0.06	-	0.05	0.10	0.03	0.09	0.06	0.05	**0.056**
Guery	0.00	0.10	0.05	0.04	0.12	0.04	0.05	0.10	0.33	**0.092**
Issarles	0.08	0.12	0.06	0.03	0.05	0.06	0.06	0.53	0.08	**0.119**
Landie	0.09	0.03	0.05	0.04	0.10	0.02	0.20	0.09	0.04	**0.073**
Laspialades	-	0.03	0.08	0.07	0.16	0.04	0.09	0.09	0.14	**0.088**
Montcineyre	0.01	0.08	-	0.07	0.08	0.08	0.04	0.07	0.07	**0.063**
Pavin	0.00	0.09	0.08	0.06	0.07	0.02	0.06	0.12	0.10	**0.067**
Ribains	-	-	0.07	0.08	0.08	0.08	0.10	0.08	0.12	**0.087**
Saint-Front	0.07	0.08	0.07	0.06	0.00	0.06	0.44	-	0.10	**0.110**
Servieres	0.00	0.04	0.06	0.04	0.15	0.02	0.04	0.08	0.10	**0.059**
Tazenat	0.01	0.11	0.04	0.06	0.09	0.02	0.08	0.12	0.12	**0.072**

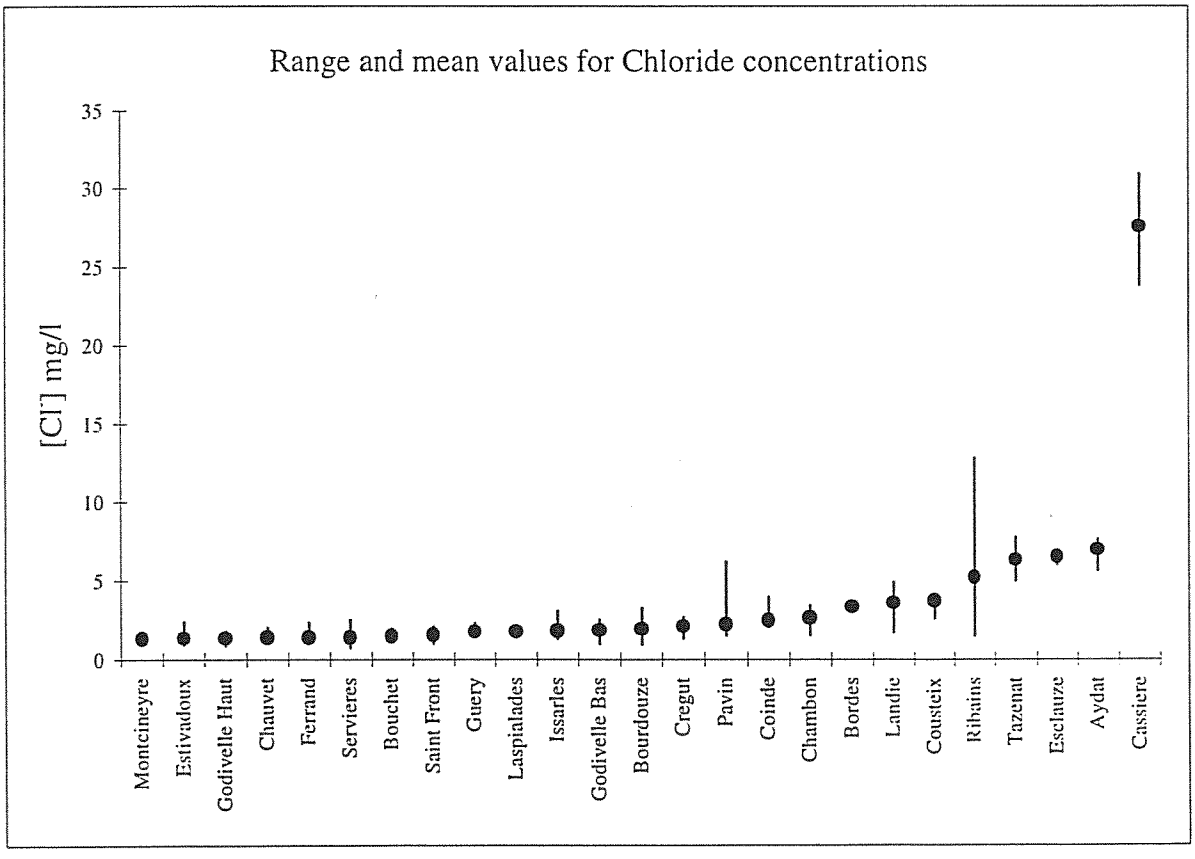


Chloride, Cl^-

Method: Auto-Analyser, Department of Geology, UCL

mg/l

site	May-96	Aug-96	Nov-96	Feb-97	May-97	Aug-97	Nov-97	Feb-98	May-98	Mean
Aydat	7.658	7.060	7.220	6.778	7.403	7.329	7.194	6.416	5.634	**6.97**
Bordes	-	3.710	-	2.992	3.343	3.301	3.615	3.011	3.274	**3.32**
Bouchet	1.613	1.942	1.256	1.197	1.225	1.194	1.715	1.346	1.486	**1.44**
Bourdouze	-	2.809	-	2.379	3.254	1.637	1.036	1.276	0.976	**1.91**
Cassiere	23.843	23.940	25.120	26.915	29.165	29.881	29.686	29.082	30.961	**27.62**
Chambon	2.850	3.426	2.985	3.352	2.275	1.548	1.985	2.642	2.449	**2.61**
Chauvet	1.230	2.002	1.545	1.217	1.245	1.133	1.246	1.275	1.286	**1.35**
Coinde	-	2.134	-	3.958	2.286	2.027	2.332	2.428	2.065	**2.46**
Cousteix	-	3.674	3.773	3.854	3.906	4.077	4.173	2.636	3.627	**3.72**
Cregut	1.928	2.577	1.571	2.652	1.935	2.383	2.488	1.326	1.927	**2.09**
Esclauze	-	6.594	6.800	6.014	6.451	6.605	6.989	6.511	6.333	**6.54**
Estivadoux	-	-	-	0.945	1.082	1.343	1.247	2.360	0.915	**1.32**
Ferrand	1.200	2.308	1.523	1.106	1.406	1.378	1.209	1.062	1.012	**1.36**
Godivelle Bas	1.690	1.202	-	1.840	1.013	2.125	2.399	1.717	2.502	**1.81**
Godivelle Haut	1.300	1.611	-	1.253	1.272	0.881	1.252	1.299	1.768	**1.33**
Guery	1.629	1.505	2.097	2.300	1.536	1.415	1.610	1.811	1.911	**1.76**
Issarles	2.300	2.114	3.048	1.312	1.304	1.373	1.398	1.576	1.663	**1.79**
Landie	3.804	1.723	1.859	4.899	3.739	3.445	3.912	4.833	3.987	**3.58**
Laspialades	-	1.594	1.371	2.126	1.911	1.402	1.737	1.907	2.016	**1.76**
Montcineyre	1.262	1.528	-	1.188	1.205	1.295	1.219	1.062	1.545	**1.29**
Pavin	1.853	2.116	1.647	6.185	1.579	1.557	1.654	1.689	1.539	**2.20**
Ribains	-	-	12.846	4.309	1.490	4.681	6.446	3.186	3.521	**5.21**
Saint Front	1.647	2.095	0.984	1.486	1.535	1.546	1.651	-	1.457	**1.55**
Servieres	1.247	2.500	1.360	1.297	1.296	0.740	1.327	1.106	1.357	**1.36**
Tazenat	6.560	7.766	5.134	5.008	6.082	6.344	6.659	6.395	6.732	**6.30**

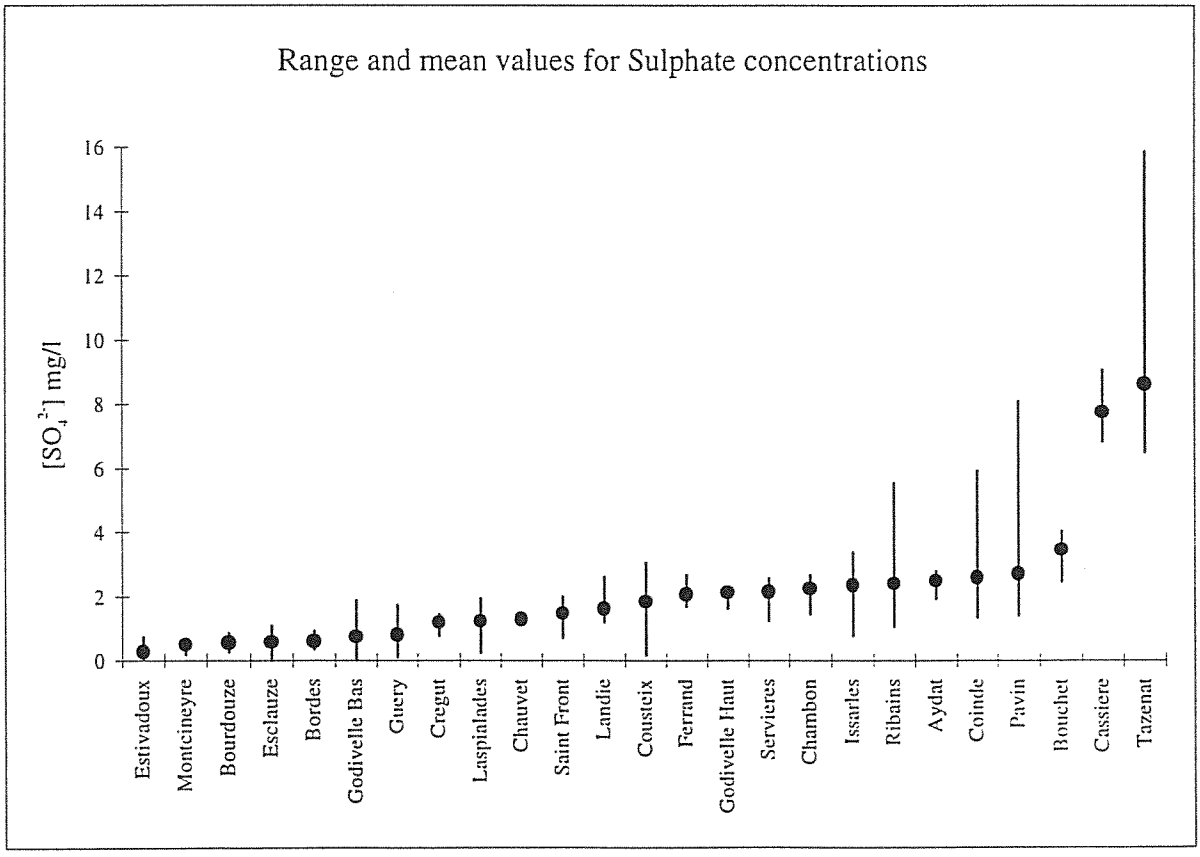


Sulfate, SO_4^{2-}

Method: Auto-Analyser, Department of Geology, UCL

mg/l

Site	May-96	Aug-96	Nov-96	Feb-97	May-97	Aug-97	Nov-97	Feb-98	May-98	Mean
Aydat	2.772	2.630	2.438	2.710	2.565	2.367	1.919	2.595	2.387	**2.49**
Bordes	-	0.423	-	0.921	0.530	0.575	0.620	0.776	0.340	**0.60**
Bouchet	3.808	4.034	2.447	3.413	3.351	3.444	3.714	3.441	3.385	**3.45**
Bourdouze	-	0.565	-	0.845	0.808	0.368	0.274	0.602	0.346	**0.54**
Cassiere	7.969	6.841	8.487	7.997	9.070	7.322	6.965	7.030	8.166	**7.76**
Chambon	2.653	2.300	2.124	2.307	2.173	1.442	2.308	2.246	2.498	**2.23**
Chauvet	1.319	1.383	1.467	1.216	1.152	1.132	1.264	1.299	1.258	**1.28**
Coinde	-	2.185	-	5.929	2.469	1.878	1.347	2.396	1.894	**2.59**
Cousteix	-	1.038	2.814	2.170	3.049	0.170	1.990	1.356	2.098	**1.84**
Cregut	1.360	1.331	0.820	1.448	1.305	1.099	1.369	0.769	1.121	**1.18**
Esclauze	-	0.083	0.777	1.081	0.629	0.009	0.278	0.834	0.808	**0.56**
Estivadoux	-	-	-	0.381	0.035	0.036	0.061	0.723	0.319	**0.26**
Ferrand	2.080	1.927	2.666	1.761	2.145	2.293	2.149	1.722	1.676	**2.05**
Godivelle Bas	0.891	1.867	-	0.884	0.424	0.530	0.537	0.000	0.733	**0.73**
Godivelle Haut	2.285	2.421	-	2.100	2.105	1.622	2.160	2.132	2.136	**2.12**
Guery	0.678	1.514	1.721	0.922	0.525	0.102	0.502	0.597	0.542	**0.79**
Issarles	3.372	1.549	0.764	2.492	2.590	2.283	2.708	2.653	2.615	**2.34**
Landie	1.342	2.410	2.591	1.291	1.305	1.657	1.302	1.369	1.204	**1.61**
Laspialades	-	1.076	0.241	1.928	1.360	0.478	1.189	1.801	1.675	**1.22**
Montcineyre	0.549	0.401	-	0.530	0.539	0.179	0.541	0.517	0.671	**0.49**
Pavin	1.679	1.900	1.498	8.111	1.444	1.407	5.295	1.474	1.449	**2.70**
Ribains	-	-	5.545	1.783	2.308	1.055	1.377	1.780	2.949	**2.40**
Saint Front	1.991	0.712	1.045	1.818	1.706	1.369	1.285	-	1.749	**1.46**
Servieres	2.407	2.370	2.567	2.138	2.125	1.229	2.257	1.823	2.195	**2.12**
Tazenat	8.534	8.382	7.788	6.519	7.599	7.746	7.611	15.860	7.599	**8.63**

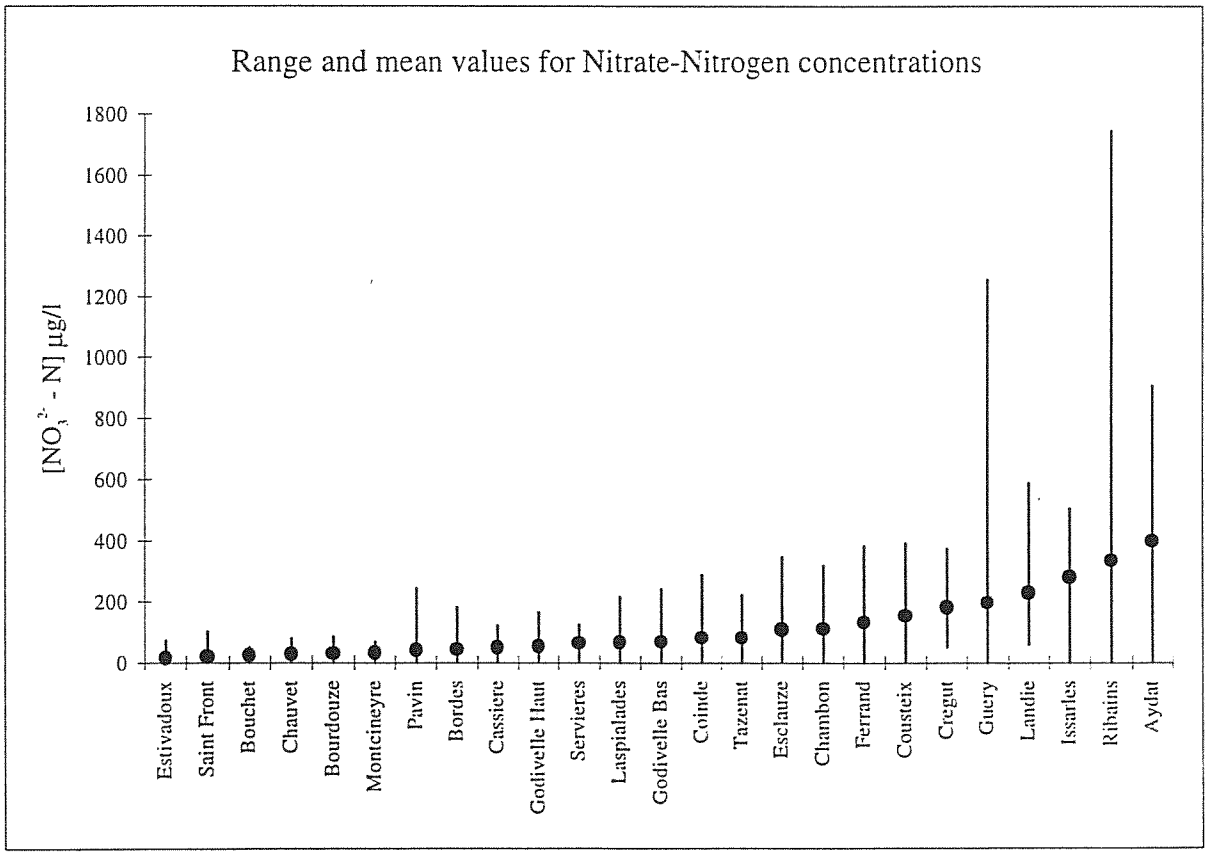


Nitrate-Nitrogen, NO_3^--N

Method: Auto-Analyser, Department of Geology, UCL

µg/l

Site	May-96	Aug-96	Nov-96	Feb-97	May-97	Aug-97	Nov-97	Feb-98	May-98	**Mean**
Aydat	522	18	233	672	446	0	205	905	581	**398**
Bordes	-	182	-	0	0	0	13	73	32	**43**
Bouchet	52	24	19	15	3	0	41	41	24	**24**
Bourdouze	-	85	-	0	83	3	8	29	9	**31**
Cassiere	29	41	38	121	0	44	0	56	121	**50**
Chambon	21	0	214	319	2	0	58	287	101	**111**
Chauvet	13	37	37	49	0	0	7	79	30	**28**
Coinde	-	0	-	288	0	0	19	185	70	**80**
Cousteix	-	132	240	392	4	3	45	275	134	**153**
Cregut	220	108	141	374	67	51	251	224	208	**183**
Esclauze	-	38	142	229	4	12	41	347	56	**109**
Estivadoux	-	-	-	0	0	2	0	72	15	**15**
Ferrand	173	49	383	223	0	1	30	223	115	**133**
Godivelle Bas	43	242	-	65	0	0	57	114	28	**69**
Godivelle Haut	69	165	-	38	33	7	14	37	57	**53**
Guery	5	42	1255	170	0	22	37	154	78	**196**
Issarles	440	16	0	408	332	157	211	505	444	**279**
Landie	314	61	144	342	233	61	103	587	215	**229**
Laspialades	-	25	49	116	0	0	16	110	217	**67**
Montcineyre	64	16	-	47	0	0	15	69	47	**32**
Pavin	27	15	19	243	2	0	16	35	0	**40**
Ribains	-	-	1745	71	13	0	80	95	329	**334**
Saint Front	9	102	11	0	1	5	13	-	18	**20**
Servieres	85	53	87	64	47	3	28	91	124	**65**
Tazenat	76	25	149	183	0	0	22	223	48	**81**

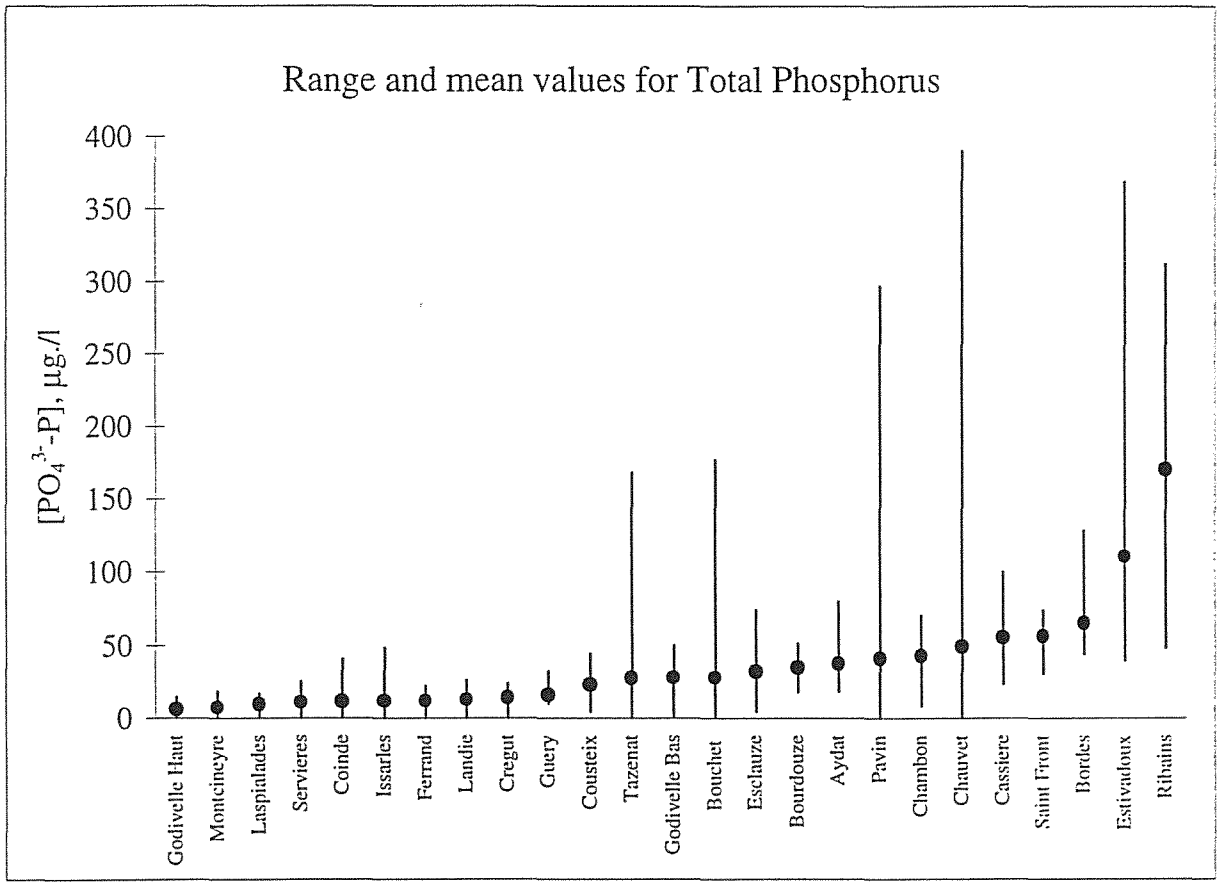


Total Phosphorus

µg/l

Method: persulphate microwave digestion and spectrophometry (Molybdenum blue complex measured colorimetrically at 885 nm).

Site	May-96	Aug-96	Nov-96	Feb-97	May-97	Aug-97	Nov-97	Feb-98	May-98	Mean
Aydat	26	39	47	40	35	26	23	19	80	**37.3**
Bordes	-	44	-	46	79	128	51	61	48	**65.3**
Bouchet	6	5	*177*	15	12	10	12	1	11	**27.7**
Bourdouze	-	51	-	40	41	35	23	33	18	**34.5**
Cassiere	29	23	86	48	45	72	100	29	66	**55.4**
Chambon	31	26	70	50	41	70	47	9	39	**42.6**
Chauvet	11	4	8	*390*	8	8	9	0	3	**49.1**
Coinde	-	41	-	6	10	10	12	0	0	**11.3**
Cousteix	-	23	12	20	44	30	33	5	14	**22.7**
Cregut	8	17	10	12	24	22	23	0	8	**13.8**
Esclauze	-	74	30	24	50	28	26	5	17	**31.9**
Estivadoux	-	-	-	*369*	68	90	39	42	54	**110.5**
Ferrand	3	13	8	10	22	22	20	0	8	**11.9**
Godivelle Bas	16	50	-	28	30	48	30	1	18	**27.7**
Godivelle Haut	3	15	-	4	4	6	10	0	2	**5.6**
Guery	10	12	20	12	12	16	16	11	32	**15.8**
Issarles	4	2	*48*	10	6	8	14	0	11	**11.5**
Landie	8	7	8	20	26	17	14	0	10	**12.4**
Laspialades	-	11	8	12	12	16	16	0	0	**9.5**
Montcineyre	3	4	-	8	12	18	11	0	0	**7.2**
Pavin	9	2	10	*297*	14	12	14	0	9	**40.9**
Ribains	-	-	48	116	254	312	161	155	143	**170.0**
Saint Front	31	74	44	38	68	70	56	-	68	**56.2**
Servieres	5	10	8	6	8	25	14	0	22	**11.0**
Tazenat	5	5	*168*	18	10	12	14	0	15	**27.5**

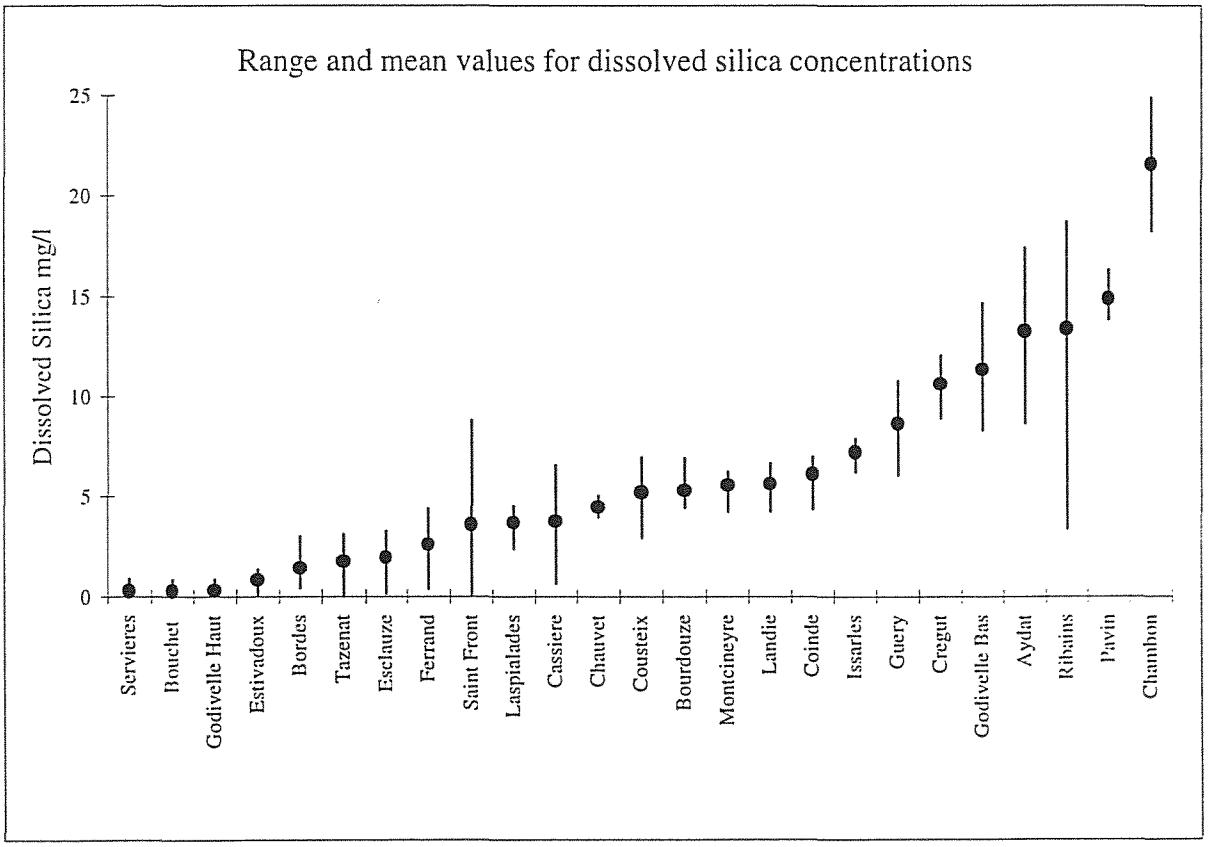


Dissolved Silica

Method: spectrophotometry (molydate blue complex, 700 nm).

mg/l

Site	May-96	Aug-96	Nov-96	Feb-97	May-97	Aug-97	Nov-97	Feb-98	May-98	Mean
Aydat	-	-	16.84	17.43	8.69	10.12	14.73	13.75	11.38	**13.28**
Bordes	-	-	-	1.36	0.43	0.74	1.90	2.99	0.94	**1.39**
Bouchet	-	-	0.00	0.00	0.00	0.00	0.61	0.46	0.84	**0.27**
Bourdouze	-	-	-	6.91	5.83	4.99	4.63	4.46	5.07	**5.32**
Cassiere	-	-	0.65	6.23	0.96	4.01	2.52	6.57	5.19	**3.73**
Chambon	-	-	20.76	19.37	21.12	23.64	24.89	23.15	18.27	**21.60**
Chauvet	-	-	4.21	4.55	3.98	4.06	4.47	5.04	4.92	**4.46**
Coinde	-	-	-	6.28	4.40	5.82	6.59	6.99	6.52	**6.10**
Cousteix	-	-	5.96	5.60	2.92	4.11	6.95	6.04	4.78	**5.19**
Cregut	-	-	9.73	8.95	10.75	11.52	12.05	11.88	9.49	**10.62**
Esclauze	-	-	2.36	2.83	0.12	1.16	2.31	3.25	1.33	**1.91**
Estivadoux	-	-	-	0.52	1.33	0.07	0.66	0.94	1.33	**0.81**
Ferrand	-	-	3.95	4.40	1.65	1.36	0.40	3.09	3.20	**2.58**
Godivelle Bas	-	-	-	12.09	8.32	9.81	12.21	14.67	10.99	**11.35**
Godivelle Haut	-	-	-	0.00	0.00	0.00	0.40	0.52	0.84	**0.29**
Guery	-	-	9.42	10.37	6.10	7.42	7.67	8.67	10.80	**8.63**
Issarles	-	-	7.10	7.70	7.31	6.23	7.15	7.88	7.20	**7.23**
Landie	-	-	5.50	6.18	5.72	4.26	5.20	6.67	5.89	**5.63**
Laspialades	-	-	3.44	4.14	3.50	2.37	3.91	4.52	3.90	**3.68**
Montcineyre	-	-	-	6.23	5.41	4.26	5.45	5.94	5.99	**5.55**
Pavin	-	-	14.06	15.39	14.08	13.85	14.73	16.36	15.75	**14.89**
Ribains	-	-	17.10	17.07	12.50	10.95	3.39	18.73	13.95	**13.38**
Saint Front	-	-	3.64	8.80	0.06	3.31	2.05	-	3.66	**3.59**
Servieres	-	-	0.00	0.00	0.00	0.00	0.45	0.46	0.89	**0.26**
Tazenat	-	-	1.63	2.93	1.33	0.00	0.92	3.09	2.25	**1.74**

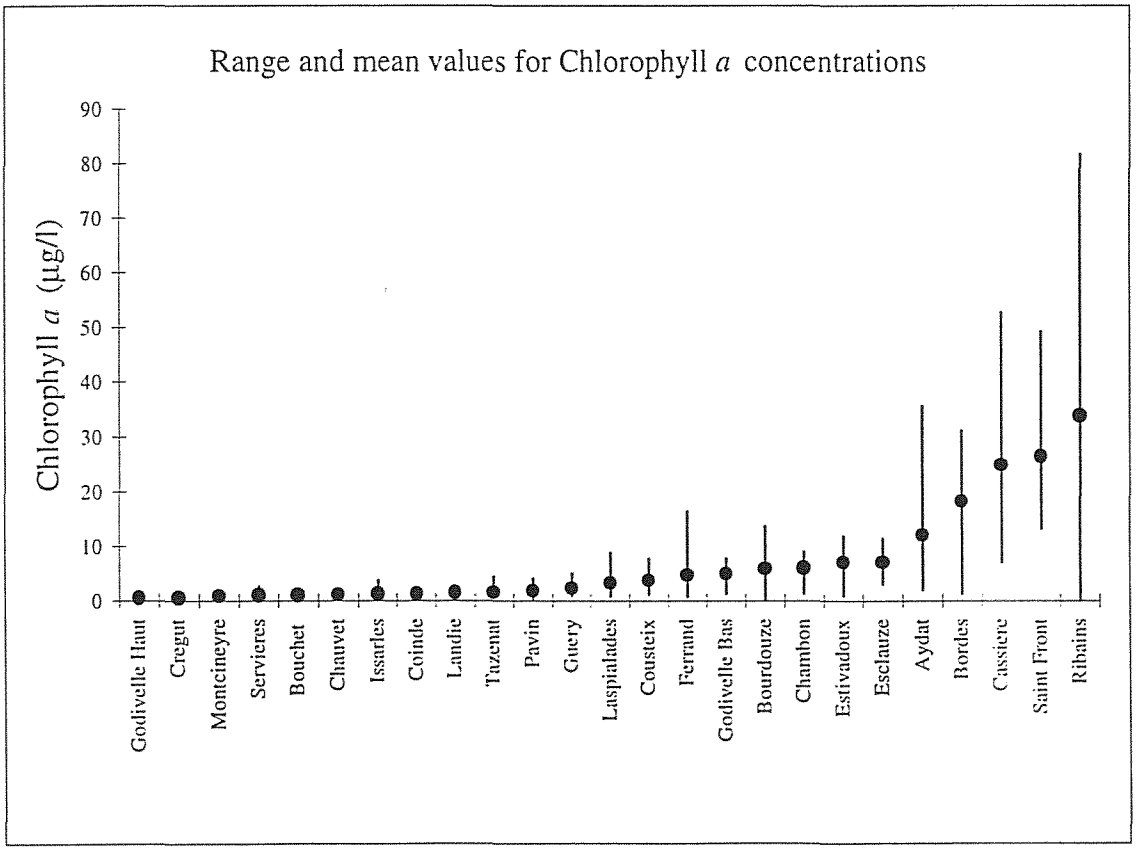


Chlorophyll *a*

Method: acetone extraction, spectrophotometry

µg/l

site	May-96	Aug-96	Nov-96	Feb-97	May-97	Aug-97	Nov-97	Feb-98	May-98	Mean
Aydat	-	-	5.3	11.4	2.0	35.7	6.1	3.6	19.8	**11.98**
Bordes	-	-	-	21.2	9.8	*1.3*	31.3	21.3	24.7	**18.25**
Bouchet	-	-	0.4	1.0	0.6	0.5	0.8	2.1	1.8	**1.01**
Bourdouze	-	-	-	13.7	7.5	*0.0*	3.3	1.8	8.8	**5.84**
Cassiere	-	-	15.0	16.9	7.0	32.3	52.7	19.8	30.4	**24.87**
Chambon	-	-	4.8	6.6	2.9	*1.3*	9.0	8.4	8.8	**5.96**
Chauvet	-	-	1.1	1.5	1.2	0.2	0.7	1.2	1.8	**1.11**
Coinde	-	-	-	0.7	1.1	*1.1*	2.1	1.5	1.1	**1.25**
Cousteix	-	-	3.5	5.4	2.4	1.2	7.7	4.1	1.5	**3.69**
Cregut	-	-	0.0	0.0	1.8	*0.9*	0.9	0.1	0.0	**0.52**
Esclauze	-	-	7.9	10.7	6.2	6.2	3.6	11.4	3.1	**7.01**
Estivadoux	-	-	-	3.3	7.0	12.0	9.6	9.1	1.0	**7.00**
Ferrand	-	-	1.0	1.0	16.5	*1.8*	1.7	10.0	0.7	**4.68**
Godivelle Bas	-	-	-	5.7	1.3	5.3	7.3	7.8	2.1	**4.91**
Godivelle Haut	-	-	-	0.5	0.1	0.1	1.6	0.2	0.3	**0.47**
Guery	-	-	1.3	1.5	3.0	1.6	5.1	0.8	2.9	**2.30**
Issarles	-	-	0.0	0.1	1.2	1.8	3.7	0.5	0.6	**1.16**
Landie	-	-	1.3	1.5	0.9	2.4	1.0	0.8	1.8	**1.40**
Laspialades	-	-	0.9	1.9	1.8	8.8	5.5	3.2	0.8	**3.27**
Montcineyre	-	-	-	1.9	1.3	1.1	0.5	0.0	0.3	**0.83**
Pavin	-	-	2.9	2.5	0.3	0.5	0.8	4.0	1.2	**1.76**
Ribains	-	-	0.0	14.3	44.4	52.5	81.7	19.3	24.4	**33.80**
Saint Front	-	-	49.3	25.7	17.6	26.6	26.3	-	13.2	**26.45**
Servieres	-	-	0.4	2.7	0.6	1.5	0.8	0.0	0.5	**0.94**
Tazenat	-	-	2.2	1.1	0.6	0.5	0.7	1.4	4.4	**1.56**

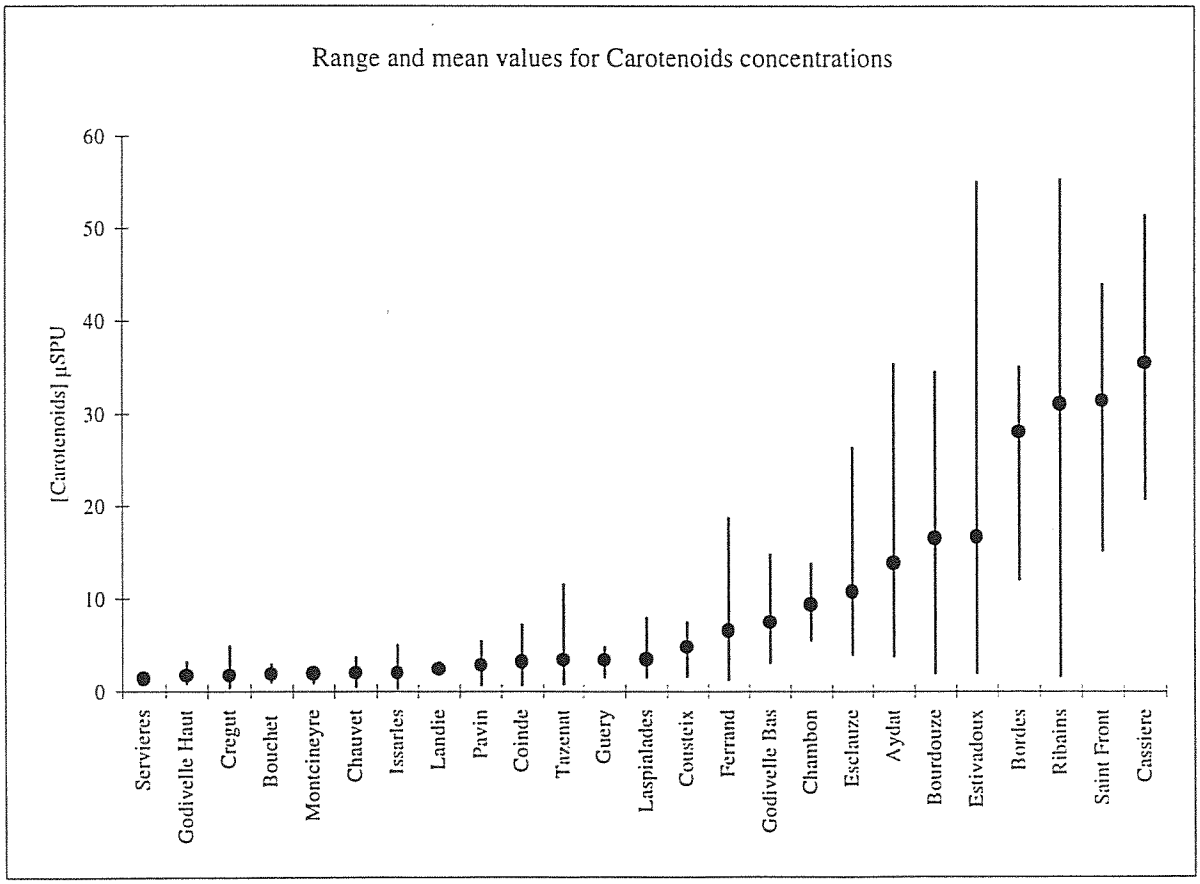


Carotenoids

Method: extraction acetone, spectrophotometry

µSPU

Site	May-96	Aug-96	Nov-96	Feb-97	May-97	Aug-97	Nov-97	Feb-98	May-98	Mean
Aydat	-	-	5.2	10.4	3.8	35.4	4.7	5.0	32.8	**13.89**
Bordes	-	-	-	28.0	12.1	35.1	36.5	28.6	28.2	**28.09**
Bouchet	-	-	1.2	1.3	2.5	1.0	1.2	2.9	2.8	**1.84**
Bourdouze	-	-	-	34.6	30.8	11.1	7.6	2.0	13.2	**16.55**
Cassiere	-	-	28.0	21.0	20.8	46.0	47.9	33.4	51.5	**35.52**
Chambon	-	-	6.8	8.0	5.6	13.0	9.2	9.0	13.8	**9.35**
Chauvet	-	-	1.8	2.2	2.7	0.5	1.3	1.4	3.7	**1.95**
Coinde	-	-	-	0.7	2.4	7.2	4.0	2.1	2.5	**3.14**
Cousteix	-	-	1.6	6.5	3.0	7.5	6.6	4.4	3.7	**4.76**
Cregut	-	-	0.8	0.6	3.2	4.8	1.4	0.4	0.6	**1.70**
Esclauze	-	-	10.0	8.8	9.0	26.4	4.3	12.9	4.0	**10.79**
Estivadoux	-	-	-	3.6	9.2	55.0	13.1	17.3	2.0	**16.71**
Ferrand	-	-	2.1	2.1	18.8	12.2	2.4	6.9	1.3	**6.54**
Godivelle Bas	-	-	-	9.0	3.2	14.8	7.1	7.5	3.1	**7.45**
Godivelle Haut	-	-	-	2.2	1.3	1.7	3.2	0.8	0.9	**1.68**
Guery	-	-	4.8	2.2	4.5	2.5	4.0	1.5	4.2	**3.38**
Issarles	-	-	1.2	0.3	2.0	3.0	5.0	0.7	1.7	**2.00**
Landie	-	-	2.4	2.4	2.2	3.2	1.9	1.8	2.9	**2.40**
Laspialades	-	-	2.8	2.1	2.6	8.0	4.0	3.3	1.5	**3.47**
Montcineyre	-	-	-	2.4	2.1	2.4	1.2	0.9	2.5	**1.93**
Pavin	-	-	4.0	3.6	0.7	0.6	1.5	5.4	3.7	**2.79**
Ribains	-	-	1.6	17.4	55.3	45.9	43.2	30.9	23.4	**31.10**
Saint Front	-	-	44.0	43.6	24.0	35.2	26.8	-	15.2	**31.46**
Servieres	-	-	1.2	2.1	1.5	1.6	1.2	0.7	1.1	**1.33**
Tazenat	-	-	4.4	1.4	1.7	0.7	1.4	2.5	11.6	**3.38**



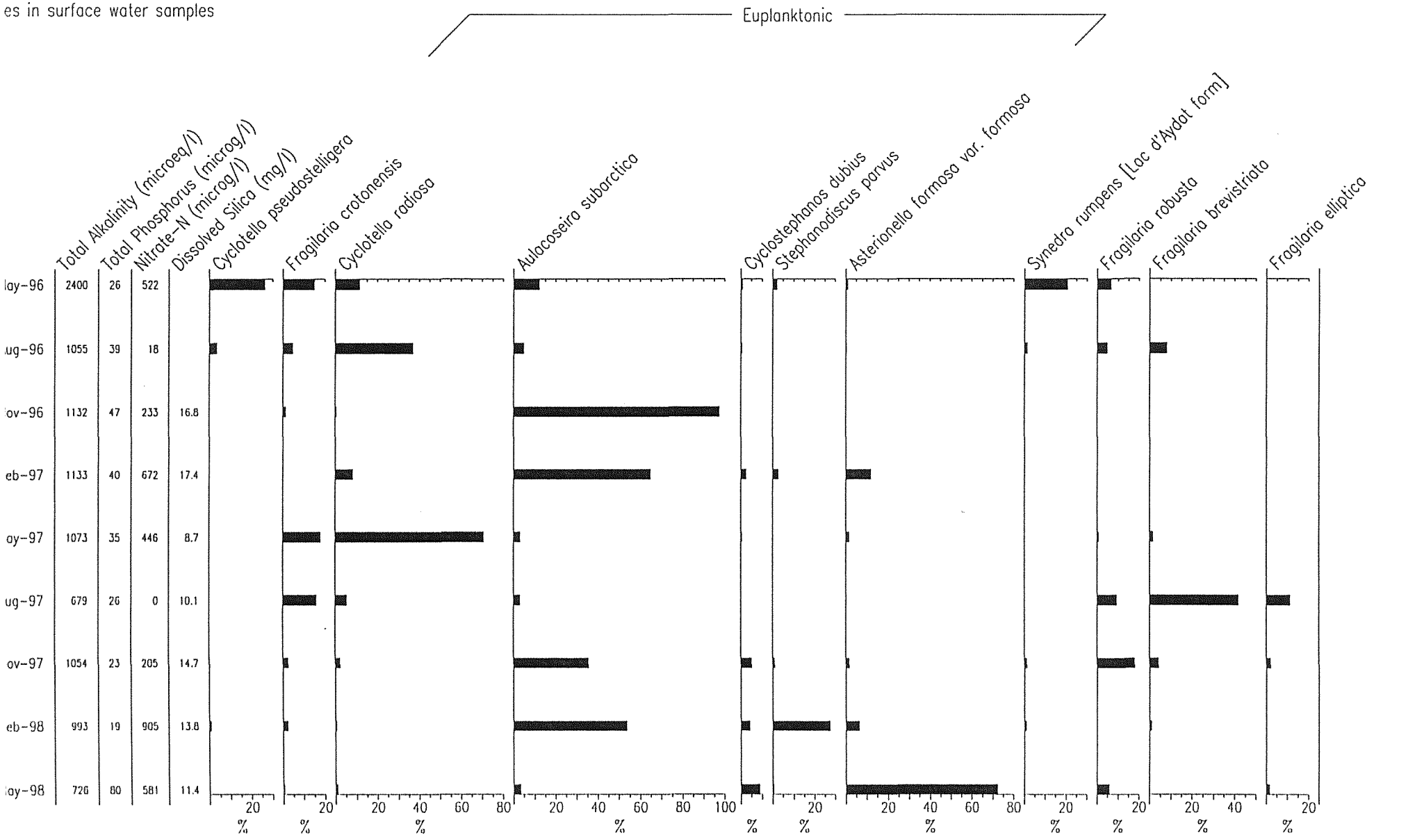
Appendix 1.5

Summary diatom diagrams of surface water samples used in the statistical analyses

endix 1.5

c d'Aydat

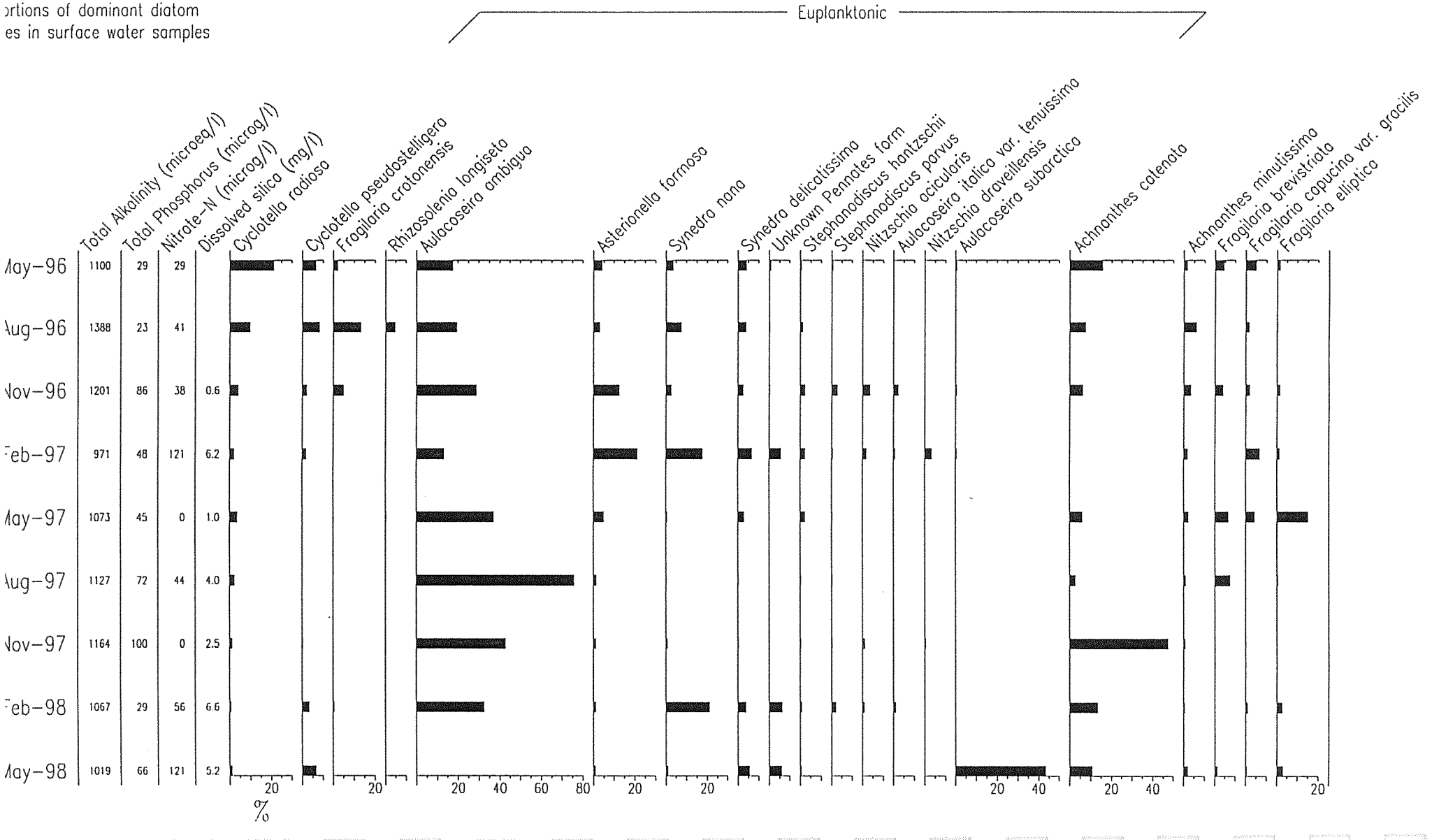
ortions of dominant diatom
es in surface water samples



endix 1.5

c de la Cassiere

ortions of dominant diatom
es in surface water samples

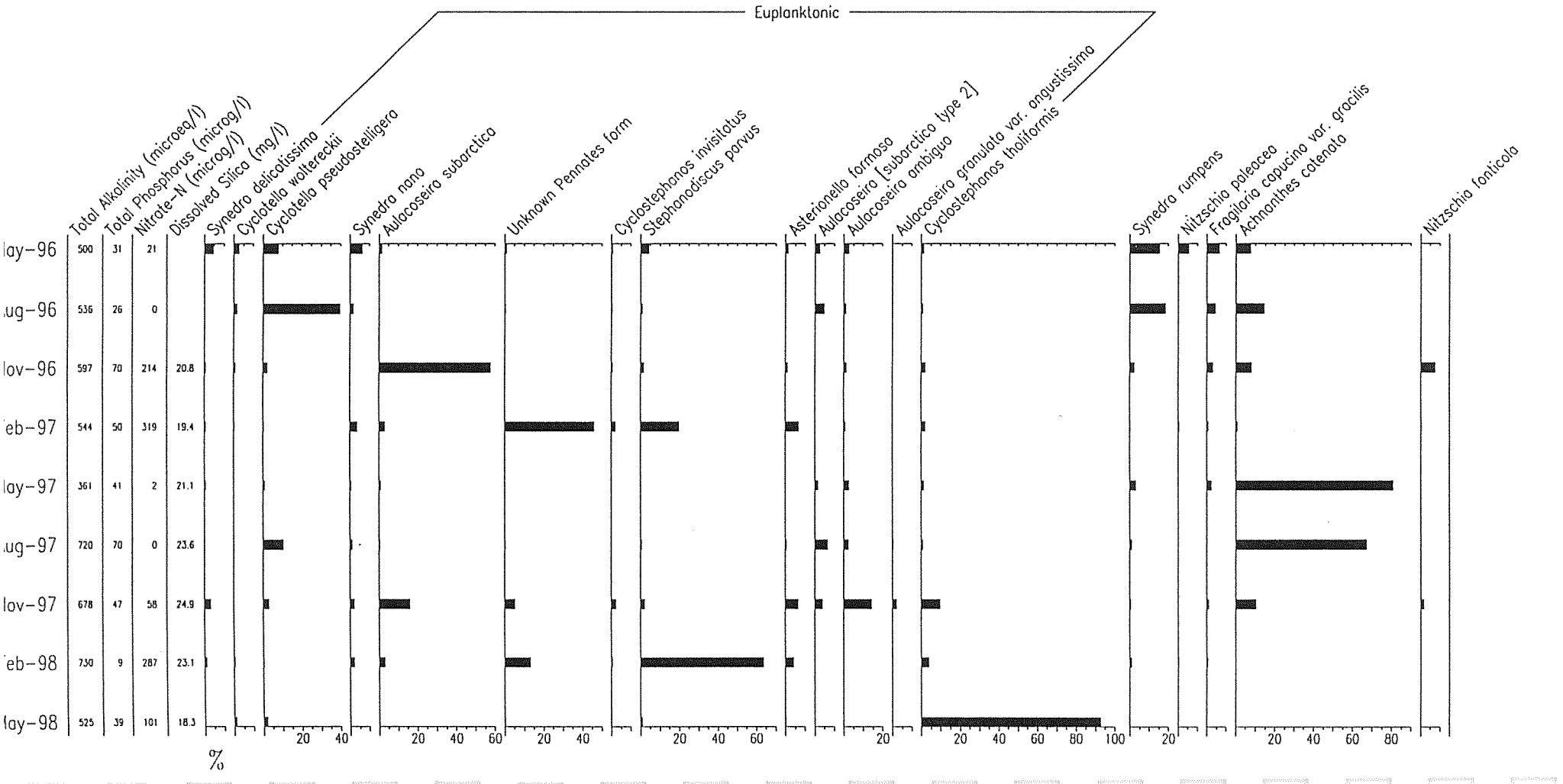


endix 1.5

: Chambon

rtions of dominant diatom

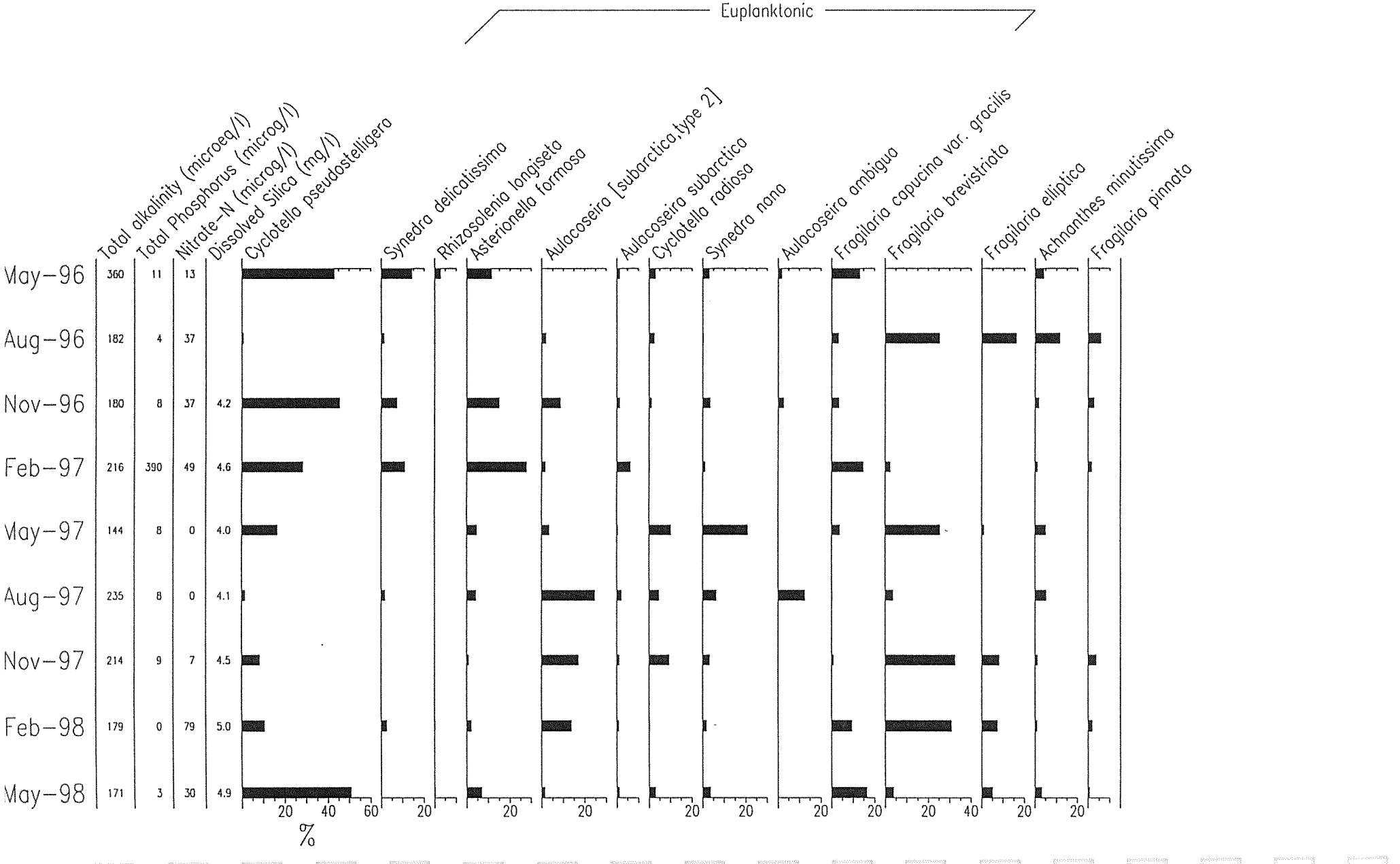
es in surface water samples



Appendix 1.5

Lac Chauvet

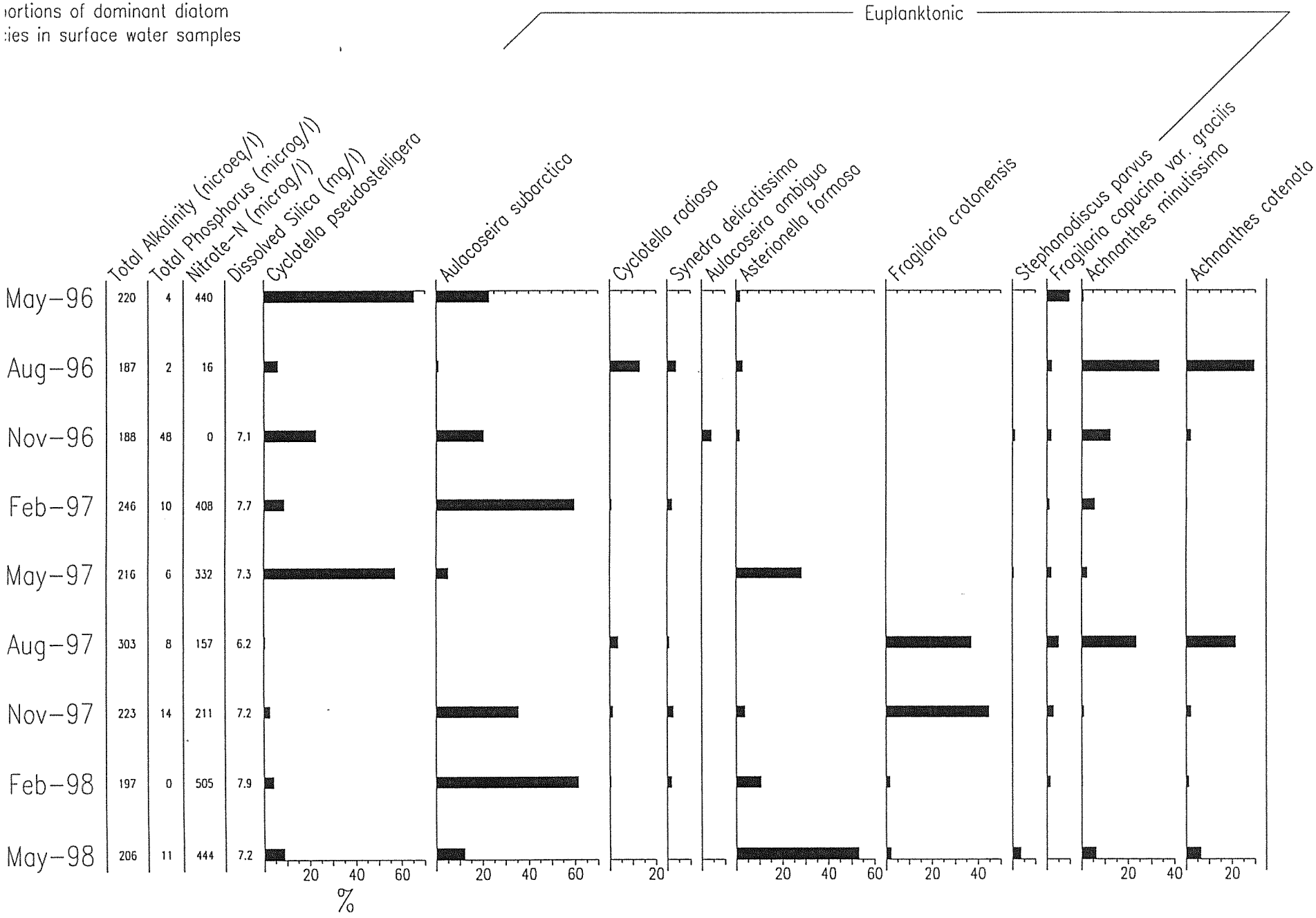
Proportions of dominant diatom species in surface water samples



)endix 1.5

c d'Issarles

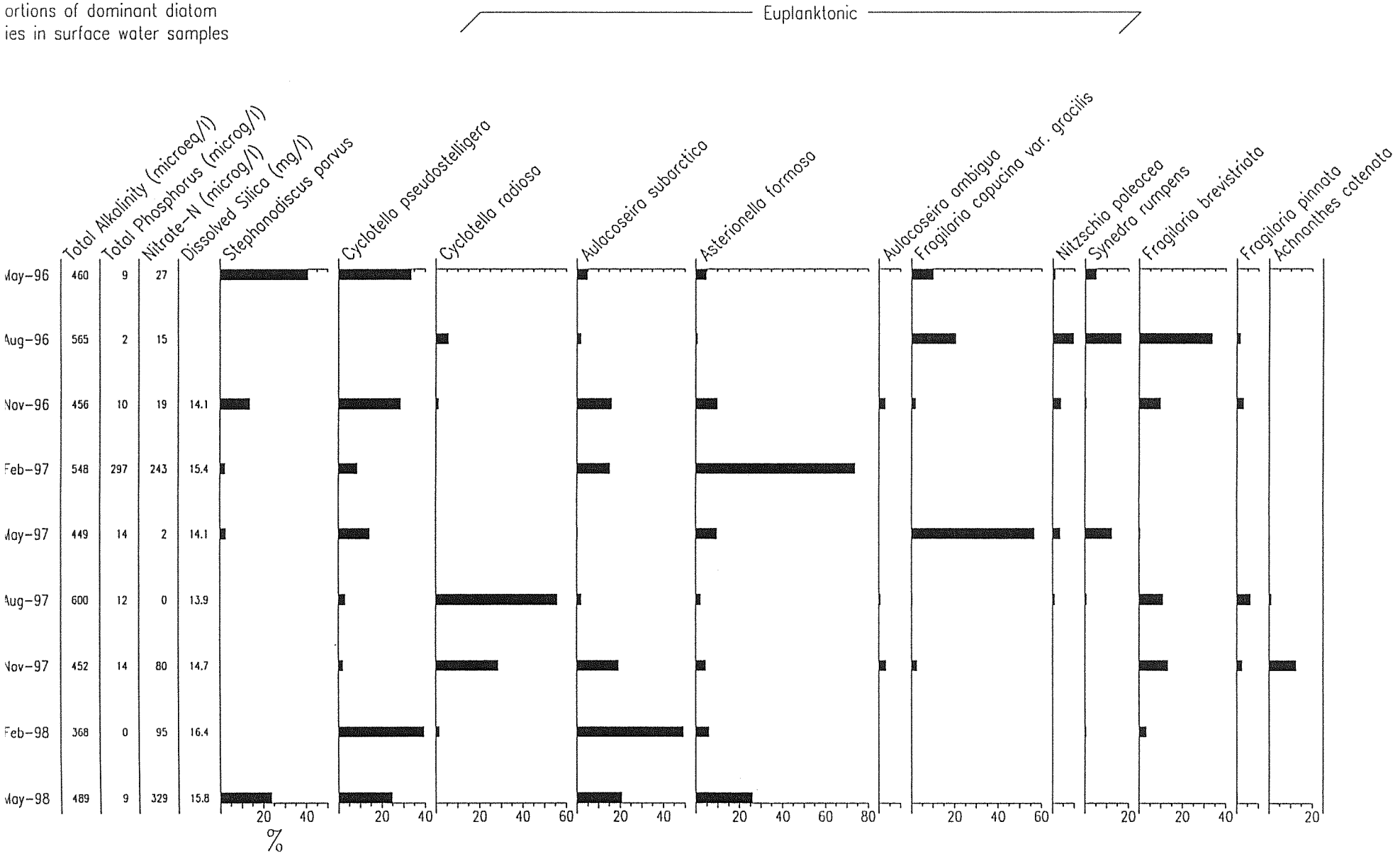
)ortions of dominant diatom
:ies in surface water samples



ıendix 1.5

c Pavin

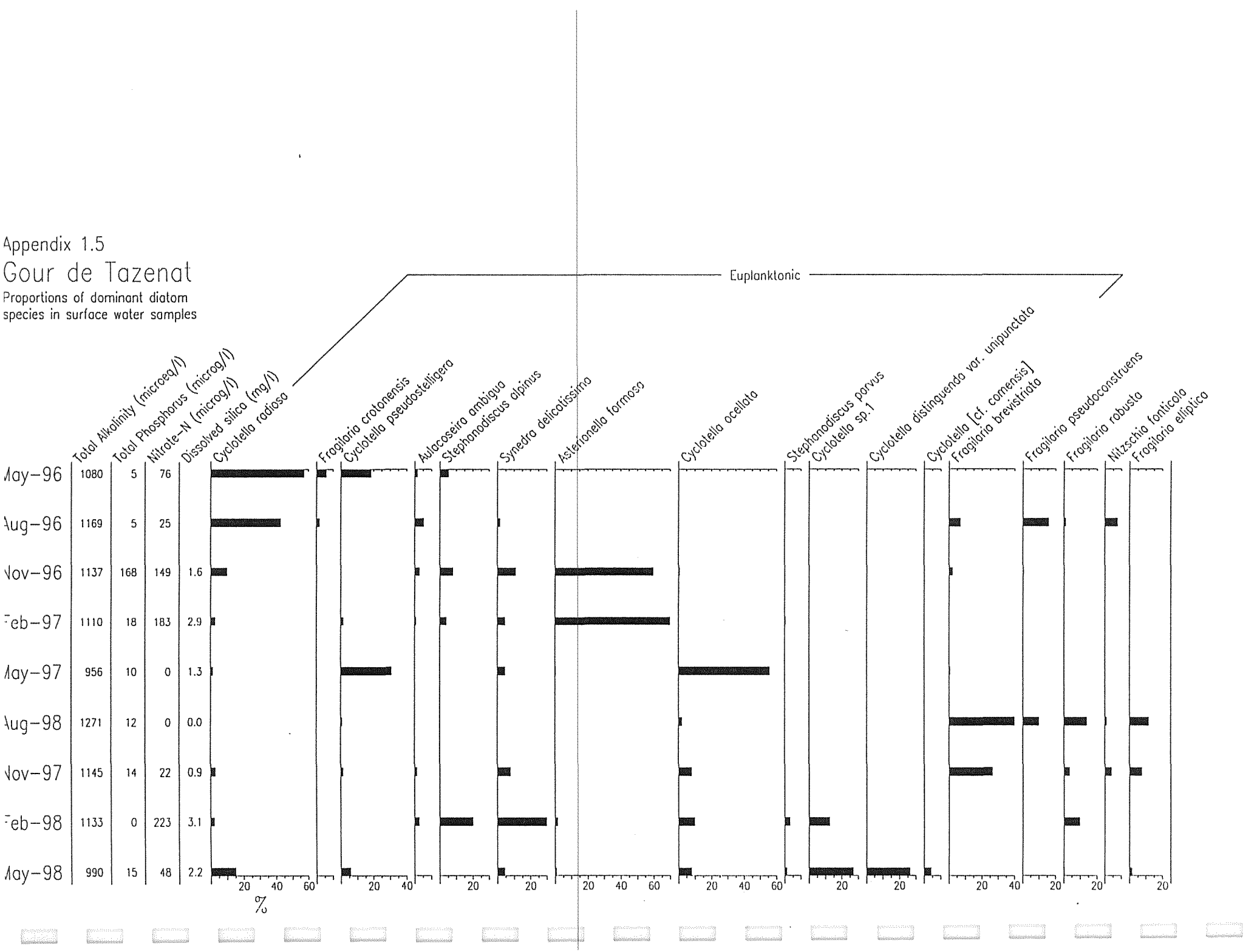
ortions of dominant diatom
ies in surface water samples



Appendix 1.5

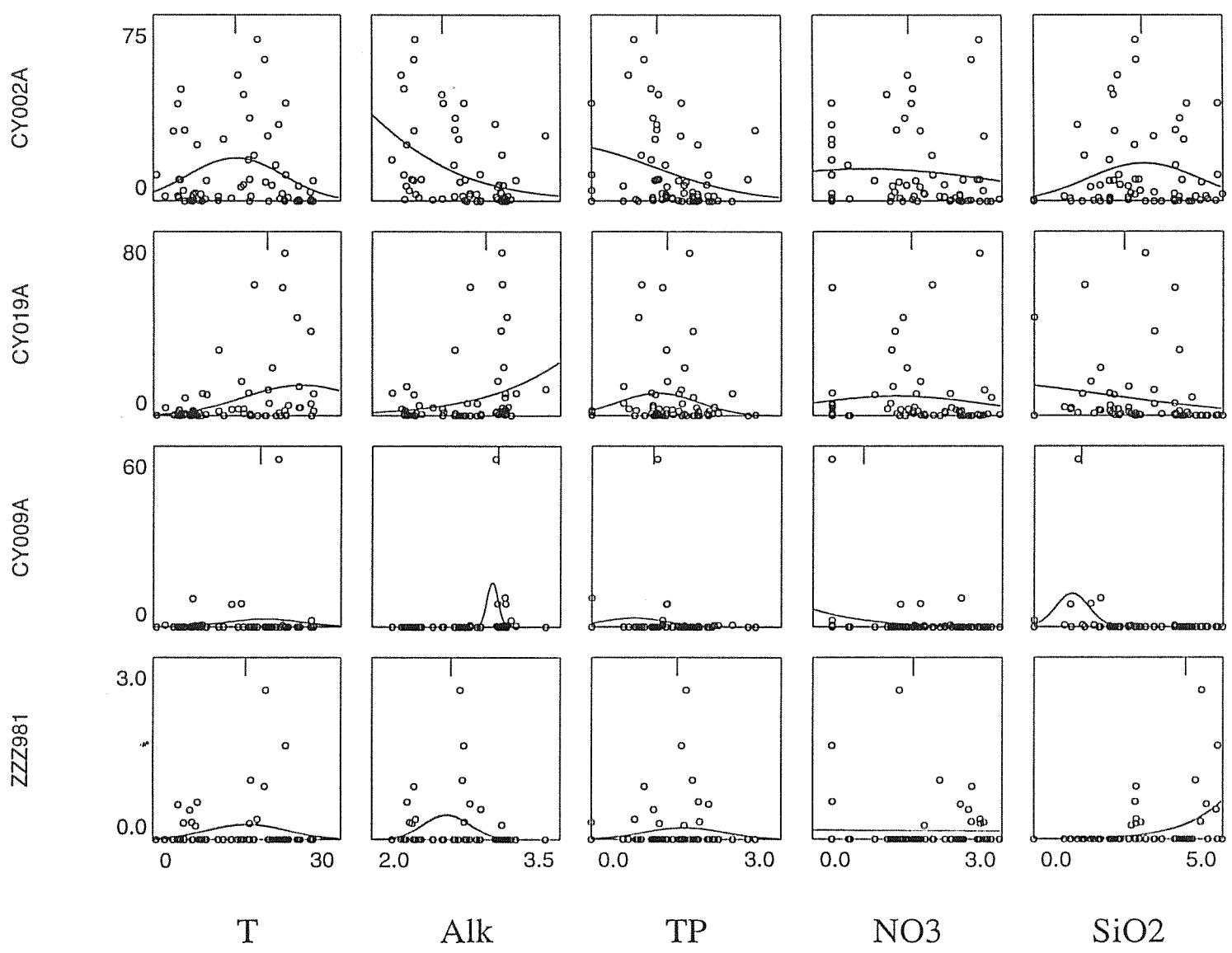
Gour de Tazenat

Proportions of dominant diatom species in surface water samples



Appendix 1.6

Relative distribution of four planktonic *Cyclotella* species plotted along five physio-chemical gradients.



The estimated WA optimum is shown as a vertical line at the top of each plot.

A Gaussian logit model (ter Braak & Looman, 1986) was fitted as a quasi-likelihood model for percentage data by logit regression with binomial error structure using the program CALIBRATE (ter Braak & Juggins, 1993).

Species code:
CY002A = *Cyclotella pseudostelligera*
CY019A = *Cyclotella radiosa*
CY009A = *Cyclotella ocellata*
ZZZ981 = *Cyclotella woltereckii*

T = Temperature (°C)

Alk = Total Alkalinity in $\log_{10}$ (x) units with x is measured in $\mu eq.l^{-1}$.

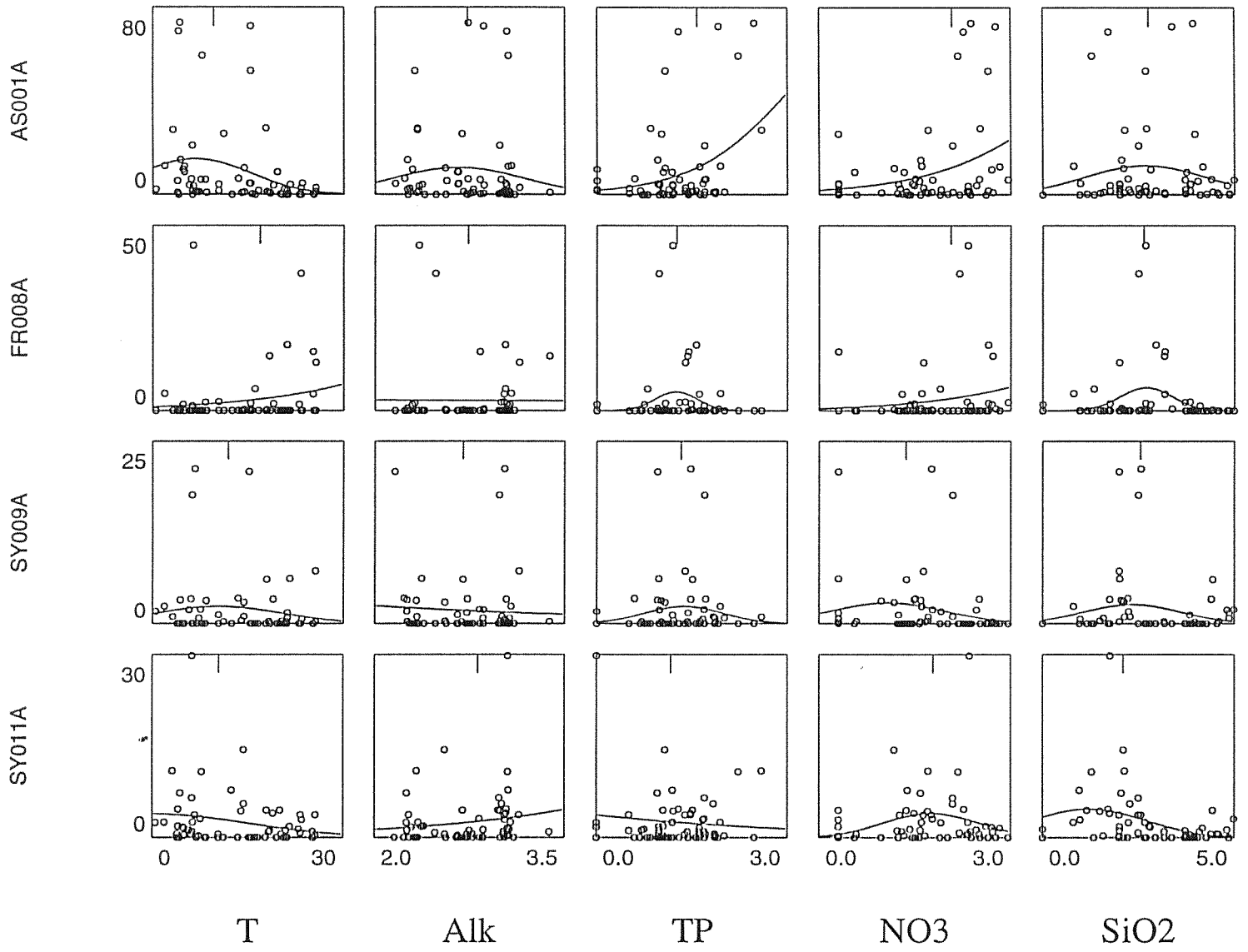
TP = Total Phosphorus in $\log_{10}$ (x+1) units with x in $\mu g.l^{-1}$.

NO_3 = Nitrate-Nitrogen in $\log_{10}$ (x+2) units with x in $\mu g.l^{-1}$.

SiO_2 = Dissolved silica in Sqrt (x) units with x in $mg.l^{-1}$.

Appendix 1.6

Relative distribution of four planktonic Pennates diatoms plotted along five physio-chemical gradients.



The estimated WA optimum is shown as a vertical line at the top of each plot.

A Gaussian logit model (ter Braak & Looman, 1986) was fitted as a quasi-likelihood model for percentage data by logit regression with binomial error structure using the program CALIBRATE (ter Braak & Juggins, 1993).

Species code:
AS001A = *Asterionella formosa*
FR008A = *Fragilaria crotonensis*
SY009A = *Synedra nana*
SY011A = *Synedra delicatissima*

T = Temperature (°C)

Alk = Total Alkalinity in $\log_{10}$ (x) units with x is measured in $\mu eq.l^{-1}$.

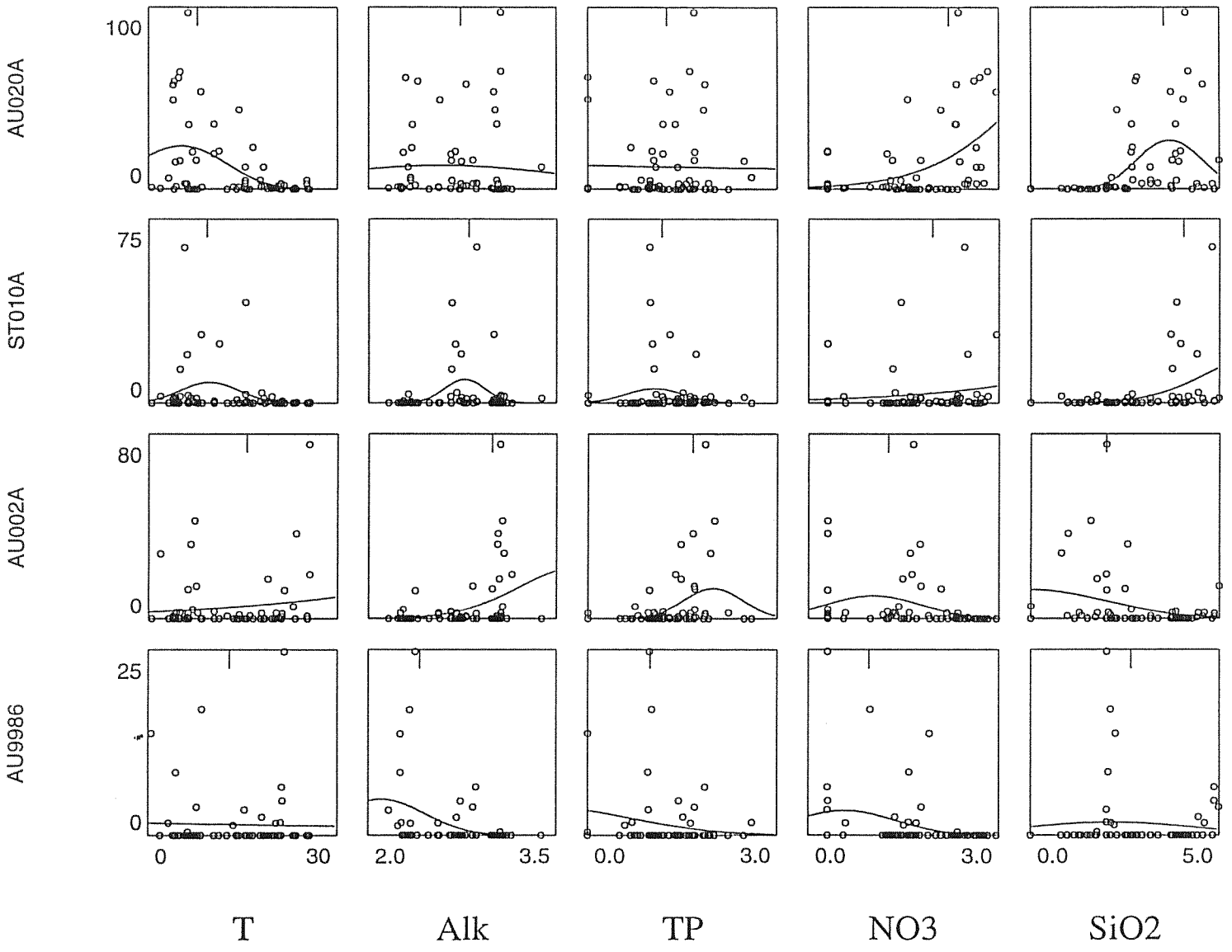
TP = Total Phosphorus in $\log_{10}$ (x+1) units with x in $\mu g.l^{-1}$.

NO_3 = Nitrate-Nitrogen in $\log_{10}$ (x+2) units with x in $\mu g.l^{-1}$.

SiO_2 = Dissolved silica in Sqrt (x) units with x in $mg.l^{-1}$.

Appendix 1.6

Relative distribution of four planktonic Centric diatoms plotted along five physio-chemical gradients.



The estimated WA optimum is shown as a vertical line at the top of each plot.
A Gaussian logit model (ter Braak & Looman, 1986) was fitted as a quasi-likelihood model for percentage data by logit regression with binomial error structure using the program CALIBRATE (ter Braak & Juggins, 1993).

Species code:
AU020A = *Aulacoseira subarctica*
ST010A = *Stephanodiscus parvus*
AU002A = *Aulacoseira ambigua*
AU9986 = *Aulacoseira* [*subarctica* type 2]

T = Temperature (°C)

Alk = Total Alkalinity in $\log_{10}$ (x) units with x is measured in $\mu eq.l^{-1}$.

TP = Total Phosphorus in $\log_{10}$ (x+1) units with x in $\mu g.l^{-1}$.

NO_3 = Nitrate-Nitrogen in $\log_{10}$ (x+2) units with x in $\mu g.l^{-1}$.

SiO_2 = Dissolved silica in Sqrt (x) units with x in $mg.l^{-1}$.

Appendix 1.7

Principal Component Analysis

As environmental variables are expressed in different units the option centring and standardisation by species was selected.
The PCA was performed with downweighting of rare species.

Summary statistics for the first four axes of PCA.

DCA axes	1	2	3	4
Eigenvalues	0.532	0.124	0.112	0.069
Variance explained (%)	53.2	12.4	11.2	6.9

PCA-scores of the 15 environmental variables on the first 4 axes

N	Variable	AX1	AX2	AX3	AX4
1	T	208	**558**	612	-82
2	Alk	**896**	-21	-45	307
3	Cond	**945**	86	-103	24
4	pH	581	181	584	-47
5	K	655	9	172	678
6	Mg	**954**	167	-143	7
7	Ca	**946**	58	-105	42
8	Na	**945**	52	-1	72
9	Cl	**949**	-10	-136	-136
10	SO4	757	239	-451	-51
11	TP	448	-445	189	-330
12	NO3	20	**-551**	-557	129
13	SiO2	-254	**-678**	474	413
14	Chla	740	-466	194	-233
15	Caro	703	-484	238	-314

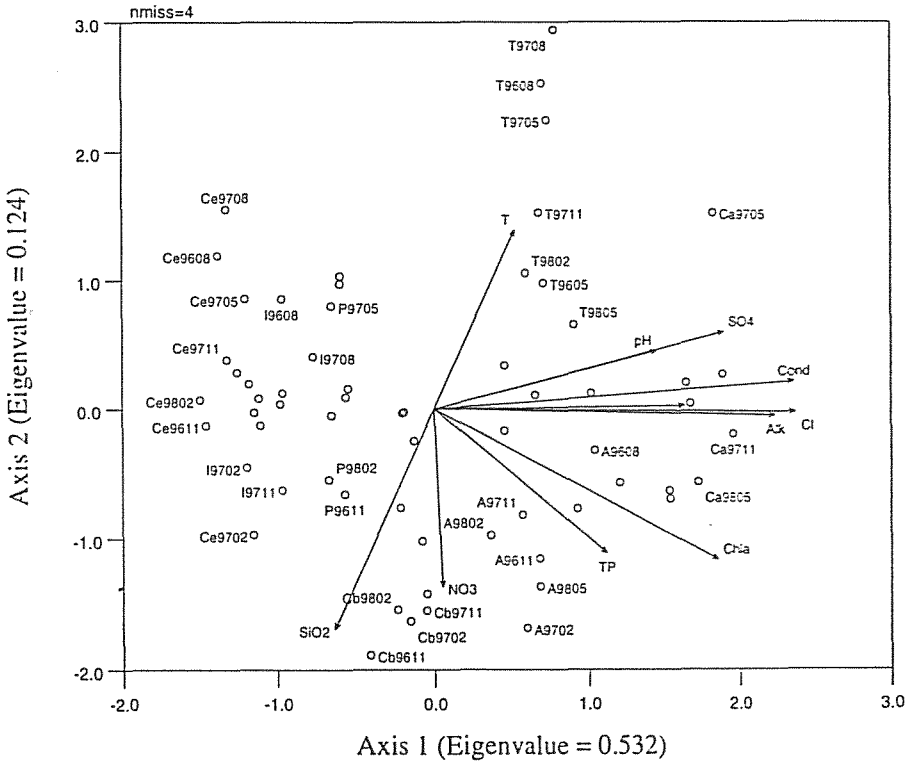
PCA correlation biplot of environmental variables in the 63 water samples dataset.

Variables with high positive correlations have small angles between their biplot arrows. Variables with long arrows have high variance and their proximity to the axes summarise the relative weight of each variable in determining each axis (ter Braak, 1987). The direction of each arrow indicates ascending values for each environmental variable.

Sample code:

Composed of lake code + date code (YYMM)
Example:
Ce9802 corresponds to water sample of Feb-98 from Lac Chauvet

A: Lac d'Aydat
Ca: Lac de la Cassière
Cb: Lac Chambon
Ce: Lac Chauvet
I: Lac d'Issarlès
P: Lac Pavin
T: Gour de Tazenat



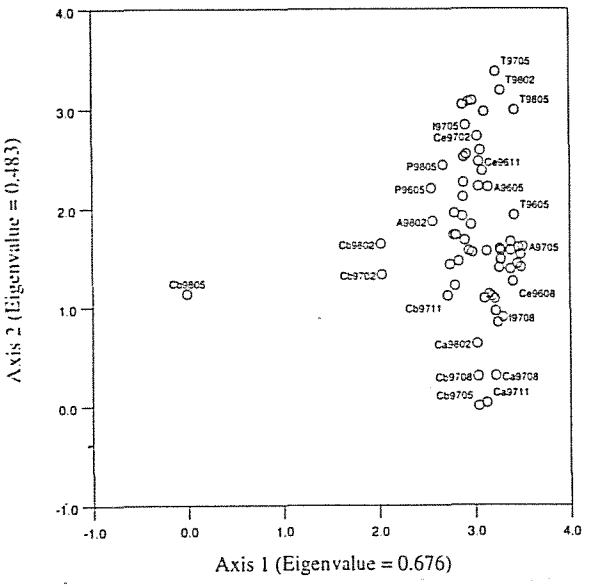
Appendix 1.8

Detrented Correspondence Analysis

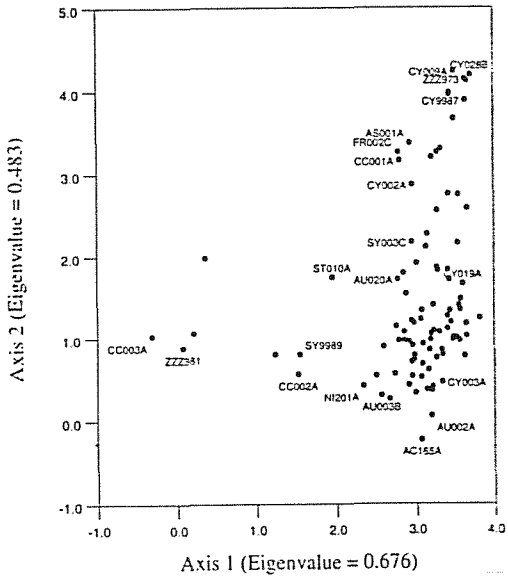
Detrending was done by segments with non linear rescaling of axes (ter Braak, 1988).
Rare species were downweighted.
Summary of DCA ordination of the diatom assemblages found in 63 water samples from 7 lakes.

DCA axes	1	2	3	4
Eigenvalues	0.676	0.483	0.345	0.256
Lengths of gradient (std. dev. units)	3.507	3.381	2.762	2.508
Variance explained (%)	10.9	7.7	5.5	4.1

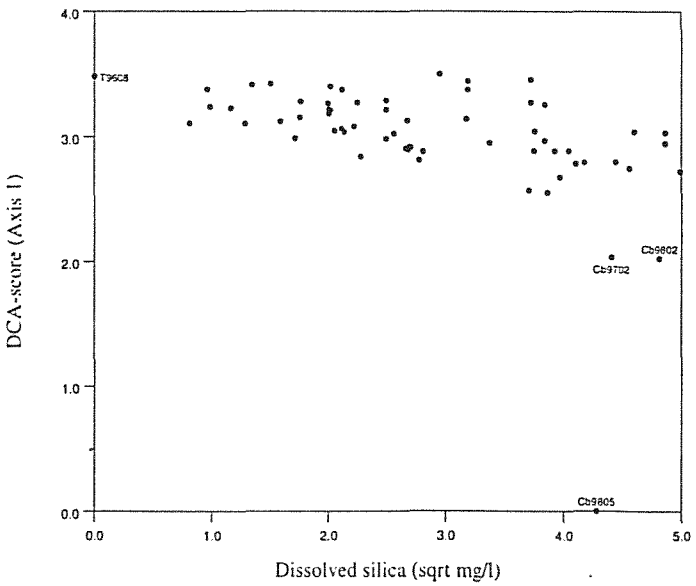
DCA plot of axes 1 and 2 with 63 samples, shown as open circles and 96 diatom species (the most common taxa only), shown as closed black circles.

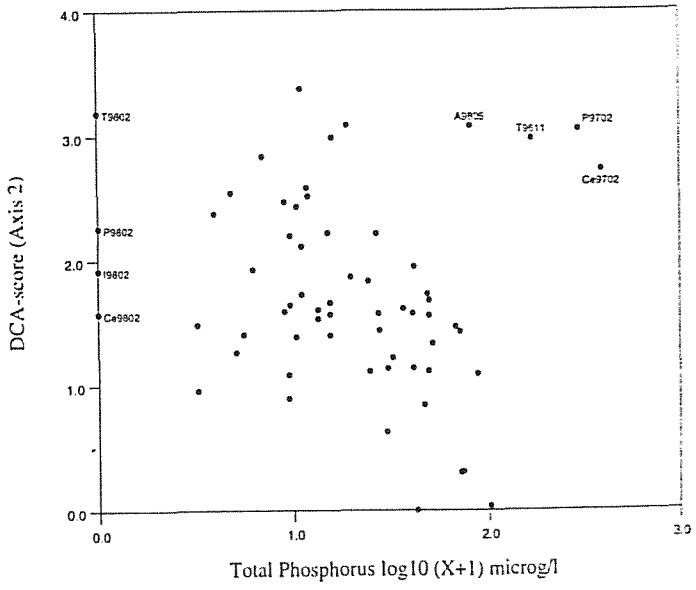


Relationship between the scores on the first DCA axis and observed water concentrations of dissolved silica.



Relationship between the scores on the second DCA axis and observed water concentrations of total phosphorus.





Appendix 1.9

Canonical Correspondence Analysis

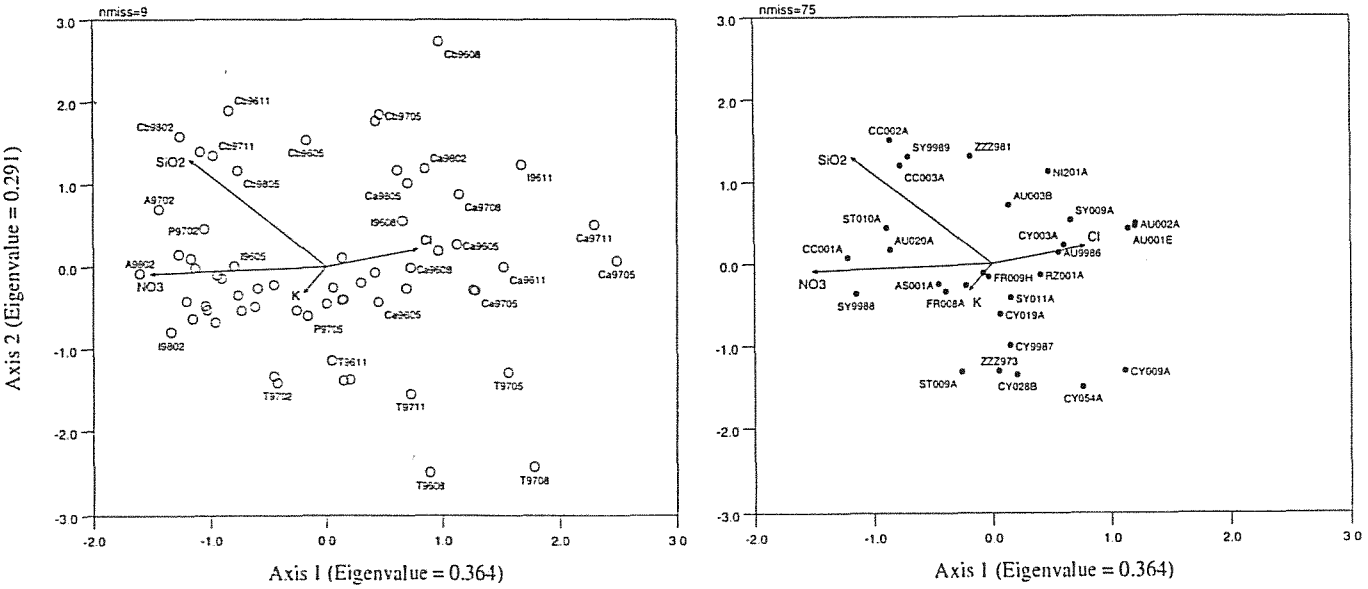
Summary statistics for the first four axes of CCA, with 63 samples, 96 diatom species.

CCA axes	1	2	3	4
a) with 15 environmental variables				
Eigenvalues	0.428	0.355	0.256	0.200
Species-environment correlations	0.888	0.865	0.853	0.753
Cumulative % variance:				
- of species data	6.9	12.6	16.7	19.2
- of species-environment relationship	20.3	37.1	49.2	58.7
b) with 4 selected environmental variables				
Eigenvalues	0.364	0.291	0.215	0.101
Species-environment correlations	0.832	0.791	0.809	0.689
Cumulative % variance:				
- of species data	5.9	10.5	14.0	15.6
- of species-environment relationship	37.5	67.5	89.6	100.0

Variance potentially explained by each environmental variable before forward selection and variance explained with the addition of each environmental variable during forward selection of CCA.

Variable	Before forward selection	Added with selection
SiO_2	0.28	0.28
NO_3	0.28	0.26
Temperature	0.24	
Cl	0.24	0.23
Na	0.23	
SO_4 -	0.23	
Conductivity	0.23	
Mg	0.23	
Ca	0.23	
Carotenoids	0.22	
pH	0.21	
Chlorophyll a	0.21	
Alkalinity	0.19	
Total phosphorus	0.16	
K	0.14	0.21
Sum of variance	2.11	0.98

CCA biplot of a reduced data set (63 samples from 7 sites) showing samples (open circles), diatom species (filled circles) and environmental variables (arrows). A forward selection of environmental variables showed that only disolved silica (SiO_2), nitrate-N (NO_3), chloride (Cl) and potassium (K) were statistically significant.



Canonical coefficients of the 4 environmental variables retained after forward selection, their *t*-values, and their inter-set correlations.

Environmental variable	Canonical coefficients		t-values of canonical coefficients		Inter-set correlation	
	Axis 1	Axis 2	Axis 1	Axis 2	Axis 1	Axis 2
Potassium (K)	-0.39	-0.84	-3.43	-6.42	-0.82	-1.29
Chloride (Cl)	0.56	0.94	4.71	6.81	3.24	0.84
Nitrate-N (NO_3)	-0.79	-0.30	-8.74	-2.87	-6.30	-0.34
Silica (SiO_2)	-0.24	1.15	-2.30	9.46	-4.92	5.17

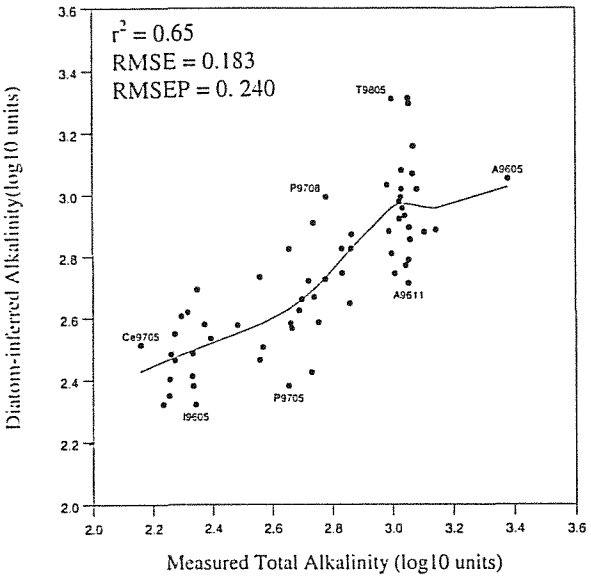
Appendix 1.10

Inferrence models developed from the phytoplankton data-set

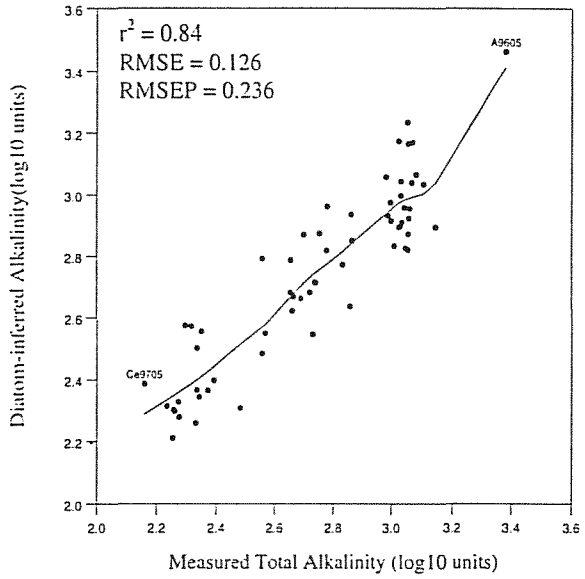
Relationship between (a) diatom-inferred Total Alkalinity and (b) residuals (inferred T.Alkalinity - observed T. Alkalinity) and observed Total Alkalinity for the one and three-component WAPLS models. Total Alkalinity is expressed in $\log_{10}(x)$ units where x is measured in $\mu eq.l^{-1}$.

(a)

One-component WA-PLS model

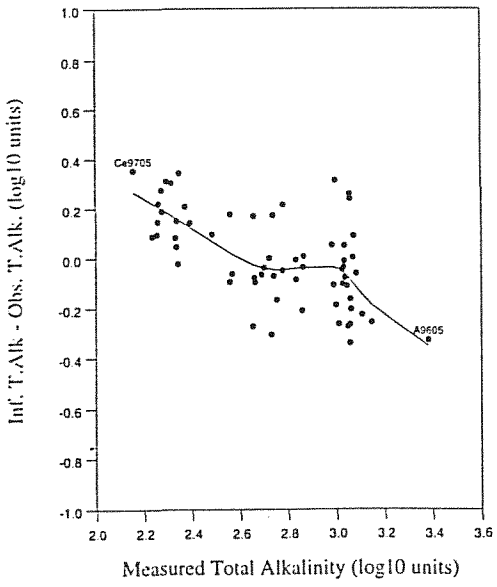


Three-component WA-PLS model

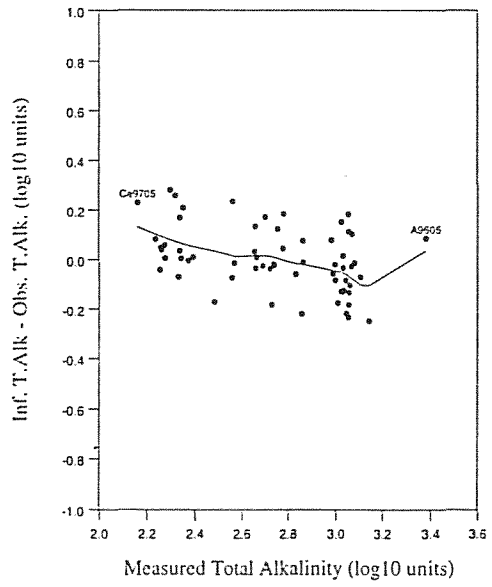


(b)

One-component WA-PLS model



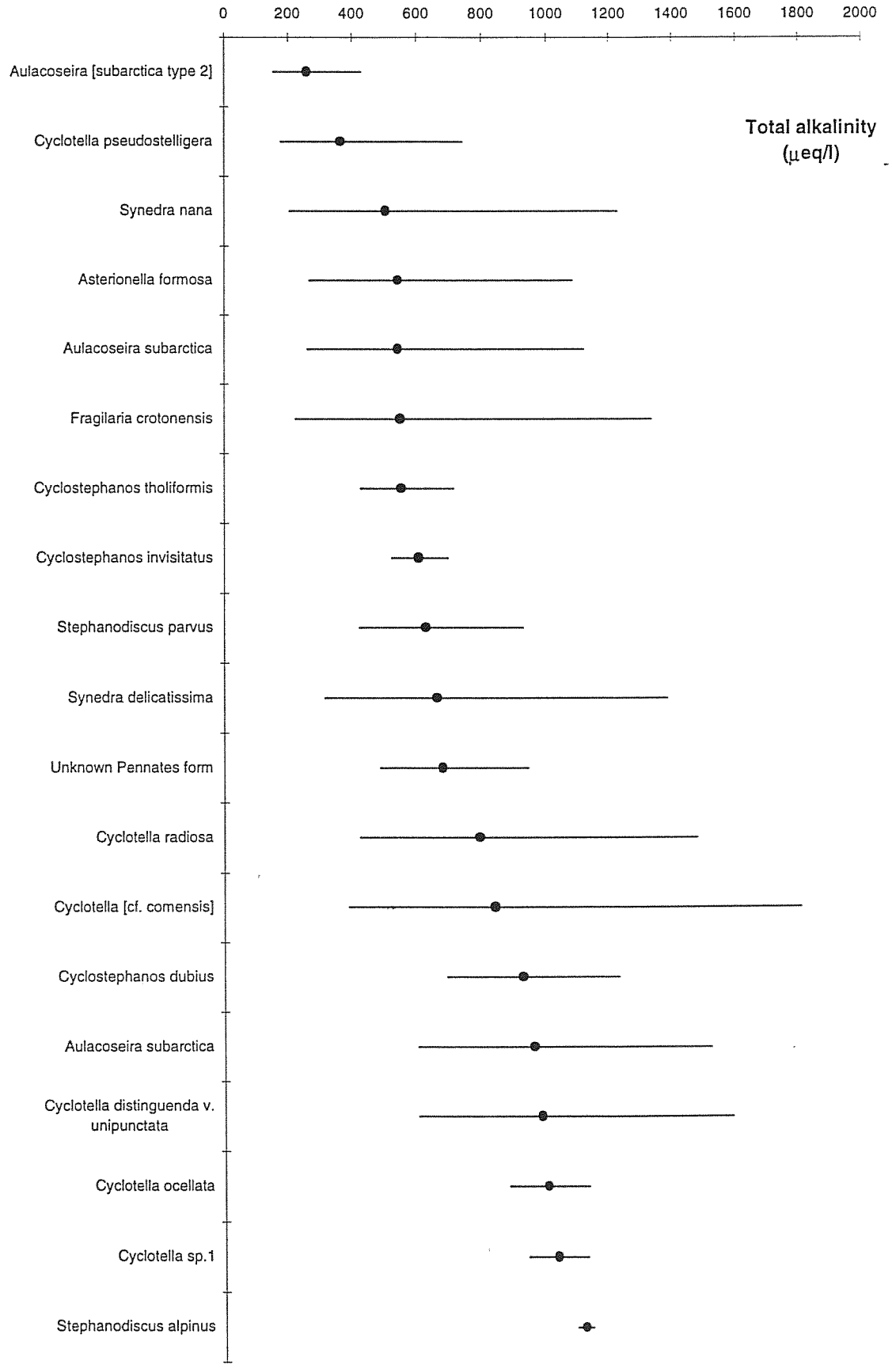
Three-component WA-PLS model



Appendix 1.11

Alkalinity optima and tolerances for planktonic taxa

Total Alkalinity estimated optima (abundance-weighted means) and tolerances (abundance-weighted standard deviations) of most common planktonic diatom taxa. The values obtained are back transformed of the $\log_{10}$ (X) values used in developing calibration models.



Appendix 2.1
Diatom counts for each surface sediment samples analysed (with species codes and authorithies)

Lac d'Aydat

code	Name	Authority	Sample code AYDA 1
AC165A	Achnanthes catenata	Bily & Marvan 1959	4
AC006A	Achnanthes clevei clevei	Grun. in Cleve & Grun. 1880	1
AC168A	Achnanthes delicatula hauckiana	(Grunow)LB in LB & Ruppel 1980	2
AS001A	Asterionella formosa formosa	Hassall 1850	5
AU020A	Aulacoseira subarctica	(O.Mull.) Haworth	237
CC001A	Cyclostephanos dubius	(Fricke in A. Schmidt) Round 1982	21
CY002A	Cyclotella pseudostelligera	Hust. 1939	108
CY019A	Cyclotella radiosa	(Grunow) Lemmermann 1900	26
CM022A	Cymbella affinis	Kutz. 1844	2
CM003A	Cymbella sinuata sinuata	Greg. 1856	2
FR009H	Fragilaria capucina gracilis	(Oestrup) Hustedt 1950	2
FR002C	Fragilaria construens venter	(Ehrenb.) Grun. in Van Heurck 1881	4
FR008A	Fragilaria crotonensis	Kitton 1869	24
FR001A	Fragilaria pinnata pinnata	Ehrenb. 1843	1
FR063A	Fragilaria robusta	(Fusey) Manguin	5
FR007A	Fragilaria vaucheriae vaucheriae	(Kutz.) J.B. Petersen 1938	4
MR001A	Meridion circulare circulare	(Grev.) Ag. 1831	2
NA042A	Navicula minima minima	Grun. in Van Heurck 1880	3
NA112A	Navicula minuscula minuscula	Grun. in Van Heurck 1880	2
NA003A	Navicula radiosa radiosa	Kutz. 1844	2
NI002A	Nitzschia fonticola	Grun. in Van Heurck 1881	1
NI201A	Nitzschia graciliformis	Lange-Bertalot & Simonsen 1978	2
UN9994	Pennate undif.		1
PI9999	Pinnularia sp.		1
ST001A	Stephanodiscus hantzschii	Grun. in Cleve & Grun. 1880	2
ST010A	Stephanodiscus parvus	Stoermer & Hakansson 1984	53
SY011A	Synedra delicatissima delicatissima	W. Sm. 1853	29
SY009A	Synedra nana	Meister 1912	8
SY004B	Synedra parasitica subconstricta	(Grun. in Van Heurck) Hust. 1930	2
SY9988	Synedra rumpens [Lac d'Aydat form]	P. Rioual & C. Sayer 1998	32
SY001G	Synedra ulna amphirhynchus	(Ehrenb.) Grun. 1862	1

Lac des Bordes

code	Name	Authority	Sample code BORD 1
AC046A	Achnanthes altaica	(Poretzky) A. Cleve-Euler 1953	2
AC153A	Achnanthes impexa	Lange-Bertalot 1989	7
AC002A	Achnanthes linearis	(W. Sm.) Grun. in Cleve & Grun. 1880	2
AC013A	Achnanthes minutissima minutissima	Kutz. 1833	65
AC105A	Achnanthes petersenii	Hust. 1937	5
AC035A	Achnanthes pusilla pusilla	Grun. in Cleve & Grun. 1880	1
AC9999	Achnanthes sp.		2
AC136A	Achnanthes subatomoides	(Hust.) Lange-Bertalot & Archibald in Krammer & Lange-Bertalot 1985	19
AC161A	Achnanthes ventralis	(Krasske) Lange-Bertalot 1989	1
AS001A	Asterionella formosa formosa	Hassall 1850	2
AU002A	Aulacoseira ambigua	(Grun. in Van Heurck) Simonsen 1979	1
AU005D	Aulacoseira distans tenella	(Nygaard) R. Ross in Hartley 1986	1
AU9999	Aulacoseira sp.		2
BR012A	Brachysira garrensis	(Lange-Bertalot & Krammer) L-B 1994	4
BR010A	Brachysira neoexilis	Lange-Bertalot 1994	5
UN9995	Centric undif.		3
CM015A	Cymbella cesatii cesatii	(Rabenh.) Grun. in A. Schmidt 1881	4
CM018A	Cymbella gracilis	(Rabenh.) Cleve 1894	3
CM004A	Cymbella microcephala microcephala	Grun. in Van Heurck 1880	1
CM031A	Cymbella minuta minuta	Hilse ex Rabenh. 1862	1
DT005A	Diatoma anceps	(Ehrenb.) Kirchner 1878	1
EU070A	Eunotia bilunaris	(Ehrenb.) F.W. Mills 1934	3
EU070B	Eunotia bilunaris mucophila	LB & Norpel 1991	2
EU109A	Eunotia circumborealis	Norpel & LB 1991	1
EU024A	Eunotia glacialis	Meister 1912	1
EU107A	Eunotia implicata	Norpel Lange-Bertalot & Alles 1991	1
EU108A	Eunotia intermedia	(Hust) Norpel Lange-Bertalot & Alles 1991	1
EU048A	Eunotia naegelii	Migula 1907	1
EU9999	Eunotia sp.		4
FR009H	Fragilaria capucina gracilis	(Oestrup) Hustedt 1950	5
FR002C	Fragilaria construens venter	(Ehrenb.) Grun. in Van Heurck 1881	38
FR018A	Fragilaria elliptica	Schum. 1867	186
FR068A	Fragilaria nanoides	Lange-Bertalot 1996	4
FR001A	Fragilaria pinnata pinnata	Ehrenb. 1843	16
FR007A	Fragilaria vaucheriae vaucheriae	(Kutz.) J.B. Petersen 1938	19
FU002G	Frustulia rhomboides crassinervia	(Breb. ex W.Sm.) Ross	1
GO013A	Gomphonema parvulum parvulum	(Kutz.) Kutz. 1849	7
GO9999	Gomphonema sp.		1
ME9999	Melosira sp.		1
MR001B	Meridion circulare constrictum	(Ralfs) Van Heurck 1885	2
NA190A	Navicula agrestis	Hust. 1937	6
NA084A	Navicula atomus	(Kutz.) Grun. 1860	2
NA121A	Navicula begeri	Krasske 1932	1
NA046A	Navicula contenta contenta	Grun. in Van Heurck 1885	1
NA007A	Navicula cryptocephala cryptocephala	Kutz. 1844	2
NA322A	Navicula detenta	Hust. 1943	4
NA115A	Navicula difficillima	Hust. 1950	1
NA766A	Navicula heimansioides	Lange-Bertalot	1
NA042A	Navicula minima minima	Grun. in Van Heurck 1880	9
NA112A	Navicula minuscula minuscula	Grun. in Van Heurck 1880	1
NA759A	Navicula nolensoides	Bock 1970	1
NA013A	Navicula pseudoscutiformis	Hust. 1930	6
NA005A	Navicula seminulum	Grun. 1860	11
NA166A	Navicula submuralis	Hust. 1945	3

Lac des Bordes

code	Name	Authority	Sample code BORD 1
NA063A	Navicula trivialis	Lange-Bertalot 1980	2
NA738A	Navicula vitiosa	Schimanski 1978	1
NE003A	Neidium affine affine	(Ehrenb.) Pfitz. 1871	3
NE006A	Neidium alpinum	Hust. 1943	1
NI030A	Nitzschia acidoclinata	Lange Bertalot	3
NI002A	Nitzschia fonticola	Grun. in Van Heurck 1881	5
NI017A	Nitzschia gracilis	Hantzsch 1860	3
NI043A	Nitzschia inconspicua	Grun. 1862	2
NI031C	Nitzschia linearis subtilis	(Grun) Hustedt 1923	1
NI009A	Nitzschia palea palea	(Kutz.) W. Sm. 1856	3
NI033A	Nitzschia paleacea	(Grun. in Cleve & Grun.) Grun. in Van Heurck 1881	4
NI193A	Nitzschia perminuta	(Grun.) M. Perag. 1903	6
NI9999	Nitzschia sp.		2
UN9994	Pennate undif.		8
PI012A	Pinnularia borealis	Ehrenb. 1843	1
PI9999	Pinnularia sp.		4
PI007A	Pinnularia viridis viridis	(Nitzsch) Ehrenb. 1843	1
SY002A	Synedra rumpens rumpens	Kutz. 1844	4
SY003A	Synedra acus acus	Kutz. 1844	1
SY013A	Synedra tenera	W. Sm. 1856	4
TA001A	Tabellaria flocculosa flocculosa	(Roth) Kutz. 1844	17

Lac du Bouchet

code	Name	Authority	Sample code BOUC 1
AC9948	Achnanthes [microscopica/curtissima]	P. Rioual 1997	8
AC008A	Achnanthes exigua	Grun. in Cleve & Grun. 1880	1
AC169A	Achnanthes grischuna	Wuthrich 1975	2
AC146A	Achnanthes lacus-vulcani	Lange-Bertalot & Krammer 1989	12
AC044A	Achnanthes levanderi	Hust. 1933	2
AC013A	Achnanthes minutissima minutissima	Kutz. 1833	36
AC007A	Achnanthes oestrupii	(A. Cleve-Euler) Hust. 1930	2
AC004A	Achnanthes pseudoswazi	J.R. Carter 1963	1
AC035A	Achnanthes pusilla pusilla	Grun. in Cleve & Grun. 1880	11
AC9999	Achnanthes sp.		1
AC178A	Achnanthes straubiana	Lange-Bertalot 1996 nov. spec.	5
AC034A	Achnanthes suchlandtii	Hust. 1933	2
AP001A	Amphipleura pellucida	(Kutz.) Kutz. 1844	2
AU020A	Aulacoseira subarctica	(O.Müll.) Haworth	2
BR010A	Brachysira neoexilis	Lange-Bertalot 1994	5
CO066A	Cocconeis neodiminuta	Krammer 1991	1
CY002A	Cyclotella pseudostelligera	Hust. 1939	185
CM015A	Cymbella cesatii cesatii	(Rabenh.) Grun. in A. Schmidt 1881	1
CM004A	Cymbella microcephala microcephala	Grun. in Van Heurck 1880	7
CM031A	Cymbella minuta minuta	Hilse ex Rabenh. 1862	4
CM009A	Cymbella naviculiformis	Auersw. ex Heib. 1863	2
CM103A	Cymbella silesiaca	Bleisch ex Rabenh. 1864	1
CM003A	Cymbella sinuata sinuata	Greg. 1856	1
EP001A	Epithemia sorex sorex	Kutz. 1844	2
FR006A	Fragilaria brevistriata brevistriata	Grun. in Van Heurck 1885	15
FR009H	Fragilaria capucina gracilis	(Oestrup) Hustedt 1950	2
FR002C	Fragilaria construens venter	(Ehrenb.) Grun. in Van Heurck 1881	1
FR018A	Fragilaria elliptica	Schum. 1867	40
FR068A	Fragilaria nanoides	Lange-Bertalot 1996	14
FR001A	Fragilaria pinnata pinnata	Ehrenb. 1843	25
FR056A	Fragilaria pseudoconstruens	Marciniak 1982	4
GO077A	Gomphonema lacus-vulcani	Reichardt & Lange-Bertalot	5
NA118A	Navicula confervacea	(Kutz.) Grun. in Van Heurck 1880	1
NA007A	Navicula cryptocephala cryptocephala	Kutz. 1844	1
NA751A	Navicula cryptotenella	Lange-Bertalot 1985	3
NA322A	Navicula detenta	Hust. 1943	1
NA042A	Navicula minima minima	Grun. in Van Heurck 1880	14
NA112A	Navicula minuscula minuscula	Grun. in Van Heurck 1880	3
NA577B	Navicula porifera opportuna	(Hust.) LB 1985	6
NA013A	Navicula pseudoscutiformis	Hust. 1930	14
NA003A	Navicula radiosa radiosa	Kutz. 1844	1
NA133A	Navicula schassmannii	Hust. 1937	3
NA9999	Navicula sp.		1
NA166A	Navicula submuralis	Hust. 1945	2
NA114A	Navicula subrotundata	Hust. 1945	11
NA738A	Navicula vitiosa	Schimanski 1978	4
NE007A	Neidium dubium dubium	(Ehrenb.) Cleve 1894	1
NI002A	Nitzschia fonticola	Grun. in Van Heurck 1881	11
NI017A	Nitzschia gracilis	Hantzsch 1860	1
NI033A	Nitzschia paleacea	(Grun. in Cleve & Grun.) Grun. in Van Heurck 1881	5
NI193A	Nitzschia perminuta	(Grun.) M. Perag. 1903	3
NI152A	Nitzschia pusilla	Grun. 1862	1
NI9999	Nitzschia sp.		2
PI012A	Pinnularia borealis	Ehrenb. 1843	1

Lac du Bouchet

code	Name	Authority	Sample code BOUC 1
PI9999	Pinnularia sp.		1
SA001A	Stauroneis anceps anceps	Ehrenb. 1843	2
ST010A	Stephanodiscus parvus	Stoermer & Hakansson 1984	1
FR009G	Synedra rumpens rumpens	Kutz. 1844	1
SY013A	Synedra tenera	W. Sm. 1856	5

Lac de Bourdouze

code	Name	Authority	Sample code BOUR 1
AC039A	Achnanthes didyma didyma	Hust. 1933	2
AC158A	Achnanthes grana	Hohn & Hellerman 1963	1
AC001A	Achnanthes lanceolata	(Breb. ex Kutz.) Grun. in Cleve & Grun. 1880	1
AC044A	Achnanthes levanderi	Hust. 1933	7
AC013A	Achnanthes minutissima minutissima	Kutz. 1833	17
AC105A	Achnanthes petersenii	Hust. 1937	1
AC035A	Achnanthes pusilla pusilla	Grun. in Cleve & Grun. 1880	1
AC172A	Achnanthes rechtensis	Leclercq 1983	2
AC178A	Achnanthes straubiana	Lange-Bertalot 1996 nov. spec.	4
AC136A	Achnanthes subatomoides	(Hust.) Lange-Bertalot & Archibald in Krammer & Lange-Bertalot 1985	6
AC161A	Achnanthes ventralis	(Krasske) Lange-Bertalot 1989	4
AU002A	Aulacoseira ambigua	(Grun. in Van Heurck) Simonsen 1979	7
AU9999	Aulacoseira sp.		3
BR010A	Brachysira neoexilis	Lange-Bertalot 1994	4
CY002A	Cyclotella pseudostelligera	Hust. 1939	6
CM015A	Cymbella cesatii cesatii	(Rabenh.) Grun. in A. Schmidt 1881	2
CM006A	Cymbella cistula cistula	(Ehrenb. in Hempr. & Ehrenb.) Kirchner 1878	1
CM027A	Cymbella leptoceros	(Ehr.) Grun.	1
CM103A	Cymbella silesiaca	Bleisch ex Rabenh. 1864	3
EP001A	Epithemia sorex sorex	Kutz. 1844	1
EU107A	Eunotia implicata	Norpel, Lange-Bertalot & Alles 1991	1
EU9999	Eunotia sp.		1
FR006A	Fragilaria brevistriata brevistriata	Grun. in Van Heurck 1885	2
FR009H	Fragilaria capucina gracilis	(Oestrup) Hustedt 1950	2
FR002C	Fragilaria construens venter	(Ehrenb.) Grun. in Van Heurck 1881	185
FR018A	Fragilaria elliptica	Schum. 1867	58
FR064A	Fragilaria exigua	Grun in Cleve & Moller 1878	12
FR001A	Fragilaria pinnata pinnata	Ehrenb. 1843	98
FR056A	Fragilaria pseudoconstruens	Marciniak 1982	28
GO9999	Gomphonema sp.		2
NA161A	Navicula absoluta	Hust. 1950	1
NA045A	Navicula bryophila bryophila	J.B. Petersen 1928	2
NA042A	Navicula minima minima	Grun. in Van Heurck 1880	3
NA013A	Navicula pseudoscutiformis	Hust. 1930	7
NA590A	Navicula pseudoventralis	Hust. 1953	1
NA003A	Navicula radiosa radiosa	Kutz. 1844	1
NA9999	Navicula sp.		2
NA166A	Navicula submuralis	Hust.	1
NA738A	Navicula vitiosa	Schimanski 1978	8
NI002A	Nitzschia fonticola	Grun. in Van Heurck 1881	2
NI017A	Nitzschia gracilis	Hantzsch 1860	2
NI043A	Nitzschia inconspicua	Grun. 1862	3
NI198A	Nitzschia lacuum	Lange-Bertalot 1980	3
NI9999	Nitzschia sp.		1
UN9994	Pennate undif.		2
SY002A	Synedra rumpens rumpens	Kutz. 1844	1
SY011A	Synedra delicatissima delicatissima	W. Sm. 1853	1
TA001A	Tabellaria flocculosa flocculosa	(Roth) Kutz. 1844	4

Lac de la Cassiere

code	Name	Authority	Sample code CASS 1
AC9948	Achnanthes [microscopica/curtissima]	P. Rioual 1997	1
AC165A	Achnanthes catenata	Bily & Marvan 1959	12
AC023A	Achnanthes conspicua conspicua	A. Mayer 1919	1
AC001A	Achnanthes lanceolata	(Breb. ex Kutz.) Grun. in Cleve & Grun. 1880	1
AC013A	Achnanthes minutissima minutissima	Kutz. 1833	31
AS001A	Asterionella formosa formosa	Hassall 1850	40
AU002A	Aulacoseira ambigua	(Grun. in Van Heurck) Simonsen 1979	150
AU001E	Aulacoseira italica tenuissima	(Grun. in Van Heurck) Simonsen 1979	2
AU020A	Aulacoseira subarctica	(O.Mull.) Haworth	2
CC002A	Cyclostephanos invisitatus	Theriot, Stoermer & Hakansson, comb. nov. 1987	1
CC003A	Cyclostephanos tholiformis	Stoermer, Hakansson & Theriot 1987	2
CY9987	Cyclotella [cf. comensis]	P. Rioual (Massif Central) 1997	2
CY003A	Cyclotella meneghiniana meneghiniana	Kutz. 1844	1
CY009A	Cyclotella ocellata	Pant. 1902	6
CY002A	Cyclotella pseudostelligera	Hust. 1939	21
CY019A	Cyclotella radiosa	(Grunow) Lemmermann 1900	31
CY052A	Cyclotella rossii	Hakansson 1990	1
CY004A	Cyclotella stelligera	(Cleve & Grun. in Cleve) Van Heurck 1882	1
CM006A	Cymbella cistula cistula	(Ehrenb. in Hempr. & Ehrenb.) Kirchner 1878	2
CM004A	Cymbella microcephala microcephala	Grun. in Van Heurck 1880	1
CM113A	Cymbella reichardtii	Krammer 1985	2
CM103A	Cymbella silesiaca	Bleisch ex Rabenh. 1864	1
CM9999	Cymbella sp.		1
DP001A	Diploneis ovalis	(Hilse) Cleve 1894	1
EP001A	Epithemia sorex sorex	Kutz. 1844	1
EU110A	Eunotia minor	(Kutz) Grunow in Van Heurck 1881	1
FR003A	Fragilaria bicapitata	A. Mayer 1917	1
FR006A	Fragilaria brevistriata brevistriata	Grun. in Van Heurck 1885	3
FR009H	Fragilaria capucina gracilis	(Oestrup) Hustedt 1950	5
FR009B	Fragilaria capucina mesolepta	(Rabenh.) Rabenh. 1864	1
FR002B	Fragilaria construens binodis	(Ehrenb.) Grun. 1862	2
FR002C	Fragilaria construens venter	(Ehrenb.) Grun. in Van Heurck 1881	2
FR008A	Fragilaria crotonensis	Kitton 1869	5
FR018A	Fragilaria elliptica	Schum. 1867	1
FR064A	Fragilaria exigua	Grun in Cleve & Moller 1878	1
FR001A	Fragilaria pinnata pinnata	Ehrenb. 1843	31
FR9999	Fragilaria sp.		1
FR9973	Fragilaria sp. [cf. F. utermoehlii]	Krammer & Lange-Bertalot 1991	2
FR007A	Fragilaria vaucheriae vaucheriae	(Kutz.) J.B. Petersen 1938	7
GO006A	Gomphonema acuminatum acuminatum	Ehrenb. 1832	2
GO013A	Gomphonema parvulum parvulum	(Kutz.) Kutz. 1849	1
GO9999	Gomphonema sp.		1
GO023A	Gomphonema truncatum truncatum	Ehrenb. 1832	1
HA001A	Hantzschia amphioxys amphioxys	(Ehrenb.) Grun. 1877	1
NA190A	Navicula agrestis	Hust. 1937	2
NA751A	Navicula cryptotenella	Lange-Bertalot 1985	1
NA023A	Navicula gregaria	Donk. 1861	4
NA766A	Navicula heimansioides	Lange-Bertalot	2
NA030A	Navicula menisculus menisculus	Schum. 1867	1
NA042A	Navicula minima minima	Grun. in Van Heurck 1880	5
NA014A	Navicula pupula pupula	Kutz. 1844	2
NA008A	Navicula rhyncocephala rhyncocephala	Kutz. 1844	2
NA005A	Navicula seminulum	Grun. 1860	4
NA9999	Navicula sp.		2

Lac de la Cassiere

code	Name	Authority	Sample code CASS 1
NA063A	Navicula trivialis	Lange-Bertalot 1980	11
NA054A	Navicula veneta	Kutz. 1844	1
NI017A	Nitzschia gracilis	Hantzsch 1860	2
NI209A	Nitzschia incognita	Legler & Krasske 1940	6
NI043A	Nitzschia inconspicua	Grun. 1862	2
NI031C	Nitzschia linearis subtilis	(Grun) Hustedt 1923	2
NI031B	Nitzschia linearis tenuis	Grun. in Cleve & Grun. 1880	1
NI009A	Nitzschia palea palea	(Kutz.) W. Sm. 1856	1
NI033A	Nitzschia paleacea	(Grun. in Cleve & Grun.) Grun. in Van Heurck 1881	1
NI171A	Nitzschia subacicularis	Hust. 1937	3
NI049A	Nitzschia vermicularis	(Kutz.) Hantzsch. in Rabenh. 1859	3
PI012A	Pinnularia borealis	Ehrenb. 1843	1
PI075A	Pinnularia brevicostata brevicostata	Cleve 1891	1
PI001A	Pinnularia gibba	(Ehrenb.) Ehrenb. 1843	1
ST001A	Stephanodiscus hantzschii	Grun. in Cleve & Grun. 1880	7
ST021A	Stephanodiscus minutulus	(Kutz.) Cleve & Moller	1
ST010A	Stephanodiscus parvus	Stoermer & Hakansson 1984	1
SY011A	Synedra delicatissima delicatissima	W. Sm. 1853	25
SY009A	Synedra nana	Meister 1912	19
SY004B	Synedra parasitica subconstricta	(Grun. in Van Heurck) Hust. 1930	2
SY002B	Synedra rumpens familiaris	(Kutz.) Hust. 1930	4
SY002C	Synedra rumpens fragilarioides	Grun. in Van Heurck 1881	1
SY002A	Synedra rumpens rumpens	Kutz. 1844	26
SY9989	Synedra sp. [cf. S. nana, swollen central area]	P. Rioual 1997	7
SY001C	Synedra ulna danica	(Kutz.) Van Heurck 1885	1
SY001A	Synedra ulna ulna	(Nitzsch) Ehrenb. 1836	1

Lac Chambon

code	Name	Authority	Sample code CHAB 1
AC037A	Achnanthes biasolettiana	Grun. in Cleve & Grun. 1880	2
AC037B	Achnanthes biasolettiana subatomus	Lange-Bertalot 1989	2
AC165A	Achnanthes catenata	Bily & Marvan 1959	63
AC006A	Achnanthes clevei clevei	Grun. in Cleve & Grun. 1880	2
AC008A	Achnanthes exigua	Grun. in Cleve & Grun. 1880	2
AC158A	Achnanthes grana	Hohn & Hellerman 1963	3
AC154A	Achnanthes imperfecta	Schimanski 1978	1
AC001A	Achnanthes lanceolata	(Breb. ex Kutz.) Grun. in Cleve & Grun. 1880	9
AC001R	Achnanthes lanceolata frequentissima	Lange-Bertalot 1991	2
AC013A	Achnanthes minutissima minutissima	Kutz. 1833	5
AC007A	Achnanthes oestrupii	(A. Cleve-Euler) Hust. 1930	1
AC011A	Achnanthes peragalli	Brun & Herib. in Herib. 1893	1
AM012A	Amphora pediculus	(Kutz.) Grun.	1
AS001A	Asterionella formosa formosa	Hassall 1850	8
AU9986	Aulacoseira [subarctica, type 2]	Haworth 1989	20
AU002A	Aulacoseira ambigua	(Grun. in Van Heurck) Simonsen 1979	18
AU020A	Aulacoseira subarctica	(O.Mull.) Haworth	25
UN9995	Centric undif.		3
CC002A	Cyclostephanos invisitatus	Theriot, Stoermer & Hakansson, comb. nov. 1987	7
CC003A	Cyclostephanos tholiformis	Stoermer, Hakansson & Theriot 1987	21
CY002A	Cyclotella pseudostelligera	Hust. 1939	30
CY019A	Cyclotella radiosa	(Grunow) Lemmermann 1900	1
CY004A	Cyclotella stelligera	(Cleve & Grun. in Cleve) Van Heurck 1882	1
CY048A	Cyclotella woltereckii	Hustedt	4
CM031A	Cymbella minuta minuta	Hilse ex Rabenh. 1862	2
CM103A	Cymbella silesiaca	Bleisch ex Rabenh. 1864	2
DT021A	Diatoma mesodon	(Ehrenber) Kutzing 1844	1
EU070A	Eunotia bilunaris	(Ehrenb.) F.W. Mills 1934	1
EU009A	Eunotia exigua exigua	(Breb. ex Kutz.) Rabenh. 1864	2
EU9999	Eunotia sp.		1
FR003A	Fragilaria bicapitata	A. Mayer 1917	1
FR006A	Fragilaria brevistriata brevistriata	Grun. in Van Heurck 1885	3
FR002C	Fragilaria construens venter	(Ehrenb.) Grun. in Van Heurck 1881	3
FR018A	Fragilaria elliptica	Schum. 1867	1
FR001A	Fragilaria pinnata pinnata	Ehrenb. 1843	5
FR9973	Fragilaria sp. [cf. F. utermoehlii]	Krammer & Lange-Bertalot 1991	4
FR007A	Fragilaria vaucheriae vaucheriae	(Kutz.) J.B. Petersen 1938	1
GO003A	Gomphonema angustatum angustatum	(Kutz.) Rabenh. 1864	1
GO073A	Gomphonema angustum	Agardh 1831	1
GO013A	Gomphonema parvulum parvulum	(Kutz.) Kutz. 1849	5
GO9999	Gomphonema sp.		2
HN001A	Hannaea arcus arcus	(Ehrenb.) Patr. in Patr. & Reimer 1966	2
MR001A	Meridion circulare circulare	(Grev.) Ag. 1831	1
NA190A	Navicula agrestis	Hust. 1937	2
NA084B	Navicula atomus permitis	(Hust.)Lange-Bertaot 1985	2
NA007A	Navicula cryptocephala cryptocephala	Kutz. 1844	9
NA751A	Navicula cryptotenella	Lange-Bertalot 1985	5
NA317A	Navicula decussis	Ostr. 1910	2
NA023A	Navicula gregaria	Donk. 1861	1
NA030A	Navicula menisculus menisculus	Schum. 1867	2
NA042A	Navicula minima minima	Grun. in Van Heurck 1880	8
NA112D	Navicula minuscula muralis	(Grun. in Van Heurck) Lange-Beralot in Lange-Bertalot & Rumrich 1981	1
NA768A	Navicula reichardtiana	Lange-Bertalot	3
NA008A	Navicula rhyncocephala rhyncocephala	Kutz. 1844	2

Lac Chambon

code	Name	Authority	Sample code CHAB 1
NA005A	Navicula seminulum	Grun. 1860	1
NA114A	Navicula subrotundata	Hust. 1945	1
NI042A	Nitzschia acicularis	(Kutz.) W. Sm. 1853	3
NI014A	Nitzschia amphibia amphibia	Grun. 1862	1
NI015A	Nitzschia dissipata	(Kutz.) Grun. 1862	2
NI002A	Nitzschia fonticola	Grun. in Van Heurck 1881	9
NI201A	Nitzschia graciliformis	Lange-Bertalot & Simonsen 1978	3
NI017A	Nitzschia gracilis	Hantzsch 1860	1
NI209A	Nitzschia incognita	Legler & Krasske 1940	1
NI043A	Nitzschia inconspicua	Grun. 1862	2
NI009A	Nitzschia palea palea	(Kutz.) W. Sm. 1856	9
NI033A	Nitzschia paleacea	(Grun. in Cleve & Grun.) Grun. in Van Heurck 1881	2
NI025A	Nitzschia recta	Hantzsch ex Rabenh. 1861	1
NI9999	Nitzschia sp.		1
UN9994	Pennate undif.		4
RC002A	Rhoicosphenia abbreviata	(Ag.) Lange-Bertalot 1980	1
ST001A	Stephanodiscus hantzschii	Grun. in Cleve & Grun. 1880	2
ST021A	Stephanodiscus minutulus	(Kutz.) Cleve & Moller	2
ST010A	Stephanodiscus parvus	Stoermer & Hakansson 1984	42
SY003C	Synedra acus angustissima	(Grun. in Van Heurck) Van Heurck 1885	1
SY007B	Synedra amphicephala austriaca	(Grun. in Van Heurck) Hust. 1932	4
SY009A	Synedra nana	Meister 1912	11
SY002B	Synedra rumpens familiaris	(Kutz.) Hust. 1930	12
SY002C	Synedra rumpens fragilarioides	Grun. in Van Heurck 1881	2
SY9989	Synedra sp. [cf. S. nana, swollen central area]	P. Rioual 1997	82

Lac Chauvet

code	Name	Authority	Sample code CHAU 1 (Aug. 96)	CHAU 2 (May. 98)
AC165A	Achnanthes catenata	Bily & Marvan 1959		2
AC039A	Achnanthes didyma didyma	Hust. 1933	1	
AC158A	Achnanthes grana	Hohn & Hellerman 1963		1
AC163A	Achnanthes helvetica	(Hustedt) Lange-Bertalot in LB & K 1989	1	
AC018A	Achnanthes laterostrata	Hust. 1933	2	
AC002A	Achnanthes linearis	(W. Sm.) Grun. in Cleve & Grun. 1880	1	
AC013A	Achnanthes minutissima minutissima	Kutz. 1833		11
AC9999	Achnanthes sp.		1	
AC136A	Achnanthes subatomoides	(Hust.) Lange-Bertalot & Archibald in Krammer & Lange-Bertalot 1985	1	1
AM012A	Amphora pediculus	(Kutz.) Grun.		2
AS001A	Asterionella formosa formosa	Hassall 1850	81	35
AU9986	Aulacoseira [subarctica, type 2]	Haworth 1989	119	26
AU002A	Aulacoseira ambigua	(Grun. in Van Heurck) Simonsen 1979		1
AU9999	Aulacoseira sp.		11	
AU020A	Aulacoseira subarctica	(O.Mull.) Haworth	2	4
BR9999	Brachysira sp.			2
UN9995	Centric undifferent			1
CU001A	Chamaepinnularia sp. [sp. # 2 Julma Olkky]	Lange-bertalot & Metzeltin 1996		2
CO067A	Cocconeis neothumensis	Krammer 1991		3
CO001A	Cocconeis placentula placentula	Ehrenb. 1838	2	
CO9999	Cocconeis sp.			1
CY007A	Cyclotella glomerata	Bachm. 1911	45	13
CY002A	Cyclotella pseudostelligera	Hust. 1939	79	191
CY019A	Cyclotella radiosa	(Grunow) Lemmermann 1900	9	14
CY004A	Cyclotella stelligera	(Cleve & Grun. in Cleve) Van Heurck 1882	14	10
CM007A	Cymbella cymbiformis cymbiformis	Ag. 1830		2
CM004A	Cymbella microcephala microcephala	Grun. in Van Heurck 1880		1
CM031A	Cymbella minuta minuta	Hilse ex Rabenh. 1862	1	1
CM103A	Cymbella silesiaca	Bleisch ex Rabenh. 1864	2	3
CM003A	Cymbella sinuata sinuata	Greg. 1856		2
DT021A	Diatoma mesodon	(Ehrenber) Kutzing 1844	1	
EU017A	Eunotia flexuosa flexuosa	Kutz. 1849		1
EU018A	Eunotia formica	Ehrenb. 1843		1
FR006A	Fragilaria brevistriata brevistriata	Grun. in Van Heurck 1885	18	11
FR009H	Fragilaria capucina gracilis	(Oestrup) Hustedt 1950	61	52
FR002A	Fragilaria construens construens	(Ehrenb.) Grun. 1862	1	
FR002C	Fragilaria construens venter	(Ehrenb.) Grun. in Van Heurck 1881		1
FR008A	Fragilaria crotonensis	Kitton 1869	9	
FR018A	Fragilaria elliptica	Schum. 1867		20
FR001A	Fragilaria pinnata pinnata	Ehrenb. 1843	7	1
FR9973	Fragilaria sp [F. utermoehlii]	K & L-B 1991		10
FR007A	Fragilaria vaucheriae vaucheriae	(Kutz.) J.B. Petersen 1938	2	1
GO073A	Gomphonema angustum	Agardh 1831	2	
GO029A	Gomphonema clavatum	Ehr. 1832		1
GO013A	Gomphonema parvulum parvulum	(Kutz.) Kutz. 1849	3	
GO072A	Gomphonema pseudotenellum	Lange Bertalot 1985		5
GO9999	Gomphonema sp.			2
GO9985	Gomphonema sp.[cf pumilum]	K & L-B 1991		2
NA772A	Navicula aquaedurae	Lange-Bertalot 1993		1
NA751A	Navicula cryptotenella	Lange-Bertalot 1985	2	
NA389B	Navicula gallica perpusilla	(Grun) Lange-Bertalot 1985		1
NA042A	Navicula minima minima	Grun. in Van Heurck 1880	2	
NA003A	Navicula radiosa radiosa	Kutz. 1844		1

Lac Chauvet

code	Name	Authority	Sample code CHAU 1 (Aug. 96)	CHAU 2 (May. 98)
NA008A	Navicula rhyncocephala rhyncocephala	Kutz. 1844		1
NA005A	Navicula seminulum	Grun. 1860		1
NA114A	Navicula subrotundata	Hust. 1945		1
NA738A	Navicula vitiosa	Schimanski 1978	1	1
NE036A	Neidium ampliatum	(Ehren) Krammer 1985	1	
NI015A	Nitzschia dissipata	(Kutz.) Grun. 1862	1	
NI002A	Nitzschia fonticola	Grun. in Van Heurck 1881		7
NI017A	Nitzschia gracilis	Hantzsch 1860		1
PI9999	Pinnularia sp.			2
SA001A	Stauroneis anceps anceps	Ehrenb. 1843		1
SP006A	Stenopterobia curvula	(W Smith) Krammer 1987	1	
SU076A	Surirella roba	Leclercq 1983	1	
SY011A	Synedra delicatissima delicatissima	W. Sm. 1853	15	28
SY009A	Synedra nana	Meister 1912	17	16
SY004A	Synedra parasitica parasitica	(W. Sm.) Hust. 1930		2
SY002C	Synedra rumpens fragilarioides	Grun. in Van Heurck 1881		2
SY013A	Synedra tenera	W. Sm. 1856	1	
SY001G	Synedra ulna amphirhynchus	(Ehrenb.) Grun. 1862	3	1
TA001A	Tabellaria flocculosa flocculosa	(Roth) Kutz. 1844	15	1

Lac de Coinde

code	Name	Authority	Sample code COIN 1
AC022A	Achnanthes marginulata	Grun. in Cleve & Grun. 1880	2
AC013A	Achnanthes minutissima minutissima	Kutz. 1833	55
AC035A	Achnanthes pusilla pusilla	Grun. in Cleve & Grun. 1880	2
AC136A	Achnanthes subatomoides	(Hust.) Lange-Bertalot & Archibald in Krammer & Lange-Bertalot 1985	1
AC174A	Achnanthes subexigua	Hustedt 1934	1
AC161A	Achnanthes ventralis	(Krasske) Lange-Bertalot 1989	7
AP004A	Amphipleura kriegerana	(Krasske) Hust. 1954	1
AS001A	Asterionella formosa formosa	Hassall 1850	1
AU005L	Aulacoseira distans humilis	(A. Cleve-Euler) R. Ross in Hartley 1986	2
AU005D	Aulacoseira distans tenella	(Nygaard) R. Ross in Hartley 1986	17
AU004C	Aulacoseira lirata biseriata		32
BR010A	Brachysira neoexilis	Lange-Bertalot 1994	14
BR011A	Brachysira procera	Lange-Bertalot & Moser 1994 nov. spec.	3
BR004A	Brachysira styriaca	(Grun. in Van Heurck) R. Ross in Hartley 1986	1
CY002A	Cyclotella pseudostelligera	Hust. 1939	23
CY019A	Cyclotella radiosa	(Grunow) Lemmermann 1900	2
CY004A	Cyclotella stelligera	(Cleve & Grun. in Cleve) Van Heurck 1882	4
CM015A	Cymbella cesatii cesatii	(Rabenh.) Grun. in A. Schmidt 1881	11
CM006A	Cymbella cistula cistula	(Ehrenb. in Hempr. & Ehrenb.) Kirchner 1878	3
CM052A	Cymbella descripta	(Hust.) Krammer & Lange-Bertalot 1985	2
CM013A	Cymbella helvetica helvetica	Kutz. 1844	2
CM004A	Cymbella microcephala microcephala	Grun. in Van Heurck 1880	5
CM9999	Cymbella sp.		4
EU107A	Eunotia implicata	Norpel, Lange-Bertalot & Alles 1991	2
EU048A	Eunotia naegelii	Migula 1907	1
EU9999	Eunotia sp.		1
FR006A	Fragilaria brevistriata brevistriata	Grun. in Van Heurck 1885	11
FR002A	Fragilaria construens construens	(Ehrenb.) Grun. 1862	41
FR002C	Fragilaria construens venter	(Ehrenb.) Grun. in Van Heurck 1881	48
FR064A	Fragilaria exigua	Grun in Cleve & Moller 1878	43
GO006A	Gomphonema acuminatum acuminatum	Ehrenb. 1832	1
GO004A	Gomphonema gracile	Ehrenb. 1838	3
GO9999	Gomphonema sp.		1
NA756A	Navicula fossaloides	Hustedt 1957	1
NA389B	Navicula gallica perpusilla	(Grun) Lange-Bertalot 1985	1
NA433D	Navicula ignota acceptata	(Hustedt) Lange-Bertalot 1985	2
NA002A	Navicula jaernefeltii	Hust. 1942	1
NA590A	Navicula pseudoventralis	Hust. 1953	46
NA014A	Navicula pupula pupula	Kutz. 1844	3
NA003A	Navicula radiosa radiosa	Kutz. 1844	12
NA048D	Navicula soehrensis hassiaca	(Krasske)Lange-Bertalot 1985	1
NA9999	Navicula sp.		5
NA114A	Navicula subrotundata	Hust. 1945	3
NA076A	Navicula variostriata	Krasske 1923	3
NA168A	Navicula vitabunda	Hust. 1930	4
NA738A	Navicula vitiosa	Schimanski 1978	9
NI002A	Nitzschia fonticola	Grun. in Van Heurck 1881	1
NI009A	Nitzschia palea palea	(Kutz.) W. Sm. 1856	2
NI9999	Nitzschia sp.		3
NI171A	Nitzschia subacicularis	Hust. 1937	1
PI007A	Pinnularia viridis viridis	(Nitzsch) Ehrenb. 1843	1
SP006A	Stenopterobia curvula	(W Smith) Krammer 1987	1
SY009A	Synedra nana	Meister 1912	2
SY013A	Synedra tenera	W. Sm. 1856	5

Lac de Coinde

code	Name	Authority	Sample code COIN 1
UN9994	Tabellaria fenestrata	(Lyngb.) Kutz. 1844	3
TA001A	Tabellaria flocculosa flocculosa	(Roth) Kutz. 1844	6

Lac de la Cousteix

code	Name	Authority	Sample code COUS 1
AC163A	Achnanthes helvetica	(Hustedt) Lange-Bertalot in LB & K 1989	2
AC013A	Achnanthes minutissima minutissima	Kutz. 1833	47
AC105A	Achnanthes petersenii	Hust. 1937	1
AC035A	Achnanthes pusilla pusilla	Grun. in Cleve & Grun. 1880	1
AC116A	Achnanthes rossii	Hust. 1954	2
AC048A	Achnanthes scotica	Jones & Flower	1
AC136A	Achnanthes subatomoides	(Hust.) Lange-Bertalot & Archibald in Krammer & Lange-Bertalot 1985	1
AS001A	Asterionella formosa formosa	Hassall 1850	7
AU002A	Aulacoseira ambigua	(Grun. in Van Heurck) Simonsen 1979	4
AU005D	Aulacoseira distans tenella	(Nygaard) R. Ross in Hartley 1986	111
AU001C	Aulacoseira italica valida	(Grun. in Van Heurck) Simonsen 1979	5
AU9999	Aulacoseira sp.		2
BR006A	Brachysira brebissonii brebissonii R. Ross in Hartley 1986		4
BR012A	Brachysira garrensis	(Lange-Bertalot & Krammer) L-B 1994	3
BR010A	Brachysira neoexilis	Lange-Bertalot 1994	3
BR011A	Brachysira procera	Lange-Bertalot & Moser 1994 nov. spec.	2
CY002A	Cyclotella pseudostelligera	Hust. 1939	3
CY9999	Cyclotella sp.		1
CY004A	Cyclotella stelligera	(Cleve & Grun. in Cleve) Van Heurck 1882	2
CM018A	Cymbella gracilis	(Rabenh.) Cleve 1894	4
CM9999	Cymbella sp.		4
EU070A	Eunotia bilunaris	(Ehrenb.) F.W. Mills 1934	5
EU070B	Eunotia bilunaris mucophila	Lange-Bertalot & Norpel 1991	6
EU009A	Eunotia exigua exigua	(Breb. ex Kutz.) Rabenh. 1864	1
EU107A	Eunotia implicata	Norpel, Lange-Bertalot & Alles 1991	1
EU047A	Eunotia incisa	W. Sm. ex Greg. 1854	1
EU040A	Eunotia paludosa	Grun. 1862	1
EU9999	Eunotia sp.		6
FR006A	Fragilaria brevistriata brevistriata	Grun. in Van Heurck 1885	80
FR009H	Fragilaria capucina gracilis	(Oestrup) Hustedt 1950	7
FR002B	Fragilaria construens binodis	(Ehrenb.) Grun. 1862	1
FR002C	Fragilaria construens venter	(Ehrenb.) Grun. in Van Heurck 1881	9
FR018A	Fragilaria elliptica	Schum. 1867	45
FR064A	Fragilaria exigua	Grun in Cleve & Moller 1878	43
FR001A	Fragilaria pinnata pinnata	Ehrenb. 1843	11
FU002A	Frustulia rhomboides rhomboides	(Ehrenb.) De Toni 1891	1
GO004A	Gomphonema gracile	Ehrenb. 1838	1
GO074A	Gomphonema hebridense	Gregory 1854	8
GO013A	Gomphonema parvulum parvulum	(Kutz.) Kutz. 1849	9
NA007A	Navicula cryptocephala cryptocephala	Kutz. 1844	3
NA751A	Navicula cryptotenella	Lange-Bertalot 1985	1
NA766A	Navicula heimansioides	Lange-Bertalot	1
NA042A	Navicula minima minima	Grun. in Van Heurck 1880	3
NA737A	Navicula obsoleta	Hust. 1942	2
NA590A	Navicula pseudoventralis	Hust. 1953	3
NA003A	Navicula radiosa radiosa	Kutz. 1844	1
NA008A	Navicula rhyncocephala rhyncocephala	Kutz. 1844	1
NA048D	Navicula soehrensis hassiaca	(Krasske)Lange-Bertalot 1985	2
NA9999	Navicula sp.		1
NA168A	Navicula vitabunda	Hust. 1930	1
NA738A	Navicula vitiosa	Schimanski 1978	3
NE003A	Neidium affine affine	(Ehrenb.) Pfitz. 1871	1
NE006A	Neidium alpinum	Hust. 1943	1
NI017A	Nitzschia gracilis	Hantzsch 1860	4

Lac de la Cousteix

code	Name	Authority	Sample code COUS 1
NI193A	Nitzschia perminuta	(Grun.) M. Perag. 1903	4
UN9994	Pennate undif.		2
PI022A	Pinnularia subcapitata subcapitata	Greg. 1856	1
PI007A	Pinnularia viridis viridis	(Nitzsch) Ehrenb. 1843	4
RZ001A	Rhizosolenia longiseta	Zacharias 1893	1
SA9999	Stauroneis sp.		1
SY007B	Synedra amphicephala austriaca	(Grun. in Van Heurck) Hust. 1932	3
SY011A	Synedra delicatissima delicatissima	W. Sm. 1853	1
SY009A	Synedra nana	Meister 1912	1
SY004B	Synedra parasitica subconstricta	(Grun. in Van Heurck) Hust. 1930	2
SY002A	Synedra rumpens rumpens	Kutz. 1844	2
SY013A	Synedra tenera	W. Sm. 1856	2
SY001C	Synedra ulna danica	(Kutz.) Van Heurck 1885	1
TA001A	Tabellaria flocculosa flocculosa	(Roth) Kutz. 1844	21

Lac de la Cregut

code	Name	Authority	Sample code CREG 1
AC037B	Achnanthes biasolettiana subatomus	Lange-Bertalot 1989	2
AC163A	Achnanthes helvetica	(Hustedt) Lange-Bertalot in LB & K 1989	1
AC153A	Achnanthes impexa	Lange-Bertalot 1989	1
AC142A	Achnanthes kuelbsii	Lange-Bertalot 1989	1
AC001A	Achnanthes lanceolata	(Breb. ex Kutz.) Grun. in Cleve & Grun. 1880	4
AC044A	Achnanthes levanderi	Hust. 1933	1
AC022A	Achnanthes marginulata	Grun. in Cleve & Grun. 1880	3
AC013A	Achnanthes minutissima minutissima	Kutz. 1833	59
AC143A	Achnanthes oblongella	Ostr. 1902	4
AC035A	Achnanthes pusilla pusilla	Grun. in Cleve & Grun. 1880	1
AC116A	Achnanthes rossii	Hust. 1954	1
AC9999	Achnanthes sp.		1
AC136A	Achnanthes subatomoides	(Hust.) Lange-Bertalot & Archibald in Krammer & Lange-Bertalot 1985	2
AS001A	Asterionella formosa formosa	Hassall 1850	6
AU9986	Aulacoseira [subarctica, type 2]	Haworth 1989	4
AU002A	Aulacoseira ambigua	(Grun. in Van Heurck) Simonsen 1979	5
AU005D	Aulacoseira distans tenella	(Nygaard) R. Ross in Hartley 1986	8
BR006A	Brachysira brebissonii brebissonii R. Ross in Hartley 1986		2
BR010A	Brachysira neoexilis	Lange-Bertalot 1994	4
UN9995	Centric undif.		1
CO001A	Cocconeis placentula placentula	Ehrenb. 1838	3
CY007A	Cyclotella glomerata	Bachm. 1911	1
CY002A	Cyclotella pseudostelligera	Hust. 1939	18
CY004A	Cyclotella stelligera	(Cleve & Grun. in Cleve) Van Heurck 1882	8
CM018A	Cymbella gracilis	(Rabenh.) Cleve 1894	1
CM031A	Cymbella minuta minuta	Hilse ex Rabenh. 1862	9
CM009A	Cymbella naviculiformis	Auersw. ex Heib. 1863	1
CM103A	Cymbella silesiaca	Bleisch ex Rabenh. 1864	9
CM003A	Cymbella sinuata sinuata	Greg. 1856	1
CM9999	Cymbella sp.		8
DT021A	Diatoma mesodon	(Ehrenber) Kutzing 1844	1
EU070A	Eunotia bilunaris	(Ehrenb.) F.W. Mills 1934	3
EU009D	Eunotia exigua bidens	Hust. 1930	2
EU009A	Eunotia exigua exigua	(Breb. ex Kutz.) Rabenh. 1864	2
EU017A	Eunotia flexuosa flexuosa	Kutz. 1849	1
EU047A	Eunotia incisa	W. Sm. ex Greg. 1854	2
EU048A	Eunotia naegelii	Migula 1907	1
EU002D	Eunotia pectinalis undulata	(Ralfs) Rabenh. 1864	1
EU106A	Eunotia rhyncocephela	Hustedt 1936	1
EU032C	Eunotia serra tetraodon	(Ehren) Norpel 1991	2
FR006A	Fragilaria brevistriata brevistriata	Grun. in Van Heurck 1885	4
FR009H	Fragilaria capucina gracilis	(Oestrup) Hustedt 1950	8
FR002C	Fragilaria construens venter	(Ehrenb.) Grun. in Van Heurck 1881	18
FR008A	Fragilaria crotonensis	Kitton 1869	8
FR018A	Fragilaria elliptica	Schum. 1867	67
FR064A	Fragilaria exigua	Grun in Cleve & Moller 1878	4
FR067A	Fragilaria oldenburgioides	Lange-Bertalot nov spec 1996	1
FR001A	Fragilaria pinnata pinnata	Ehrenb. 1843	18
FR056A	Fragilaria pseudoconstruens	Marciniak 1982	2
FR063A	Fragilaria robusta	(Fusey) Manguin	12
FR9999	Fragilaria sp.		6
FR9973	Fragilaria sp. [cf. F. utermoehlii]	Krammer & Lange-Bertalot 1991	2
FR007A	Fragilaria vaucheriae vaucheriae	(Kutz.) J.B. Petersen 1938	4
FR005A	Fragilaria virescens virescens	Ralfs 1843	1

Lac de la Cregut

code	Name	Authority	Sample code CREG 1
GO003A	Gomphonema angustatum angustatum	(Kutz.) Rabenh. 1864	1
GO004A	Gomphonema gracile	Ehrenb. 1838	1
GO074A	Gomphonema hebridense	Gregory 1854	1
GO013A	Gomphonema parvulum parvulum	(Kutz.) Kutz. 1849	19
HN001A	Hannaea arcus arcus	(Ehrenb.) Patr. in Patr. & Reimer 1966	26
MR001A	Meridion circulare circulare	(Grev.) Ag. 1831	1
MR001B	Meridion circulare constrictum	(Ralfs) Van Heurck 1885	1
NA161A	Navicula absoluta	Hust. 1950	1
NA032A	Navicula cocconeiformis cocconeiformis	Greg. ex Greville 1855	1
NA046A	Navicula contenta contenta	Grun. in Van Heurck 1885	1
NA007A	Navicula cryptocephala cryptocephala	Kutz. 1844	8
NA115A	Navicula difficillima	Hust. 1950	2
NA389B	Navicula gallica perpusilla	(Grun) Lange-Bertalot 1985	2
NA023A	Navicula gregaria	Donk. 1861	6
NA766A	Navicula heimansioides	Lange-Bertalot	3
NA755A	Navicula kuelbsii	Lange-Bertalot 1985	3
NA769A	Navicula lundii	Reichardt	4
NA030A	Navicula menisculus menisculus	Schum. 1867	1
NA042A	Navicula minima minima	Grun. in Van Heurck 1880	4
NA112D	Navicula minuscula muralis	(Grun. in Van Heurck) Lange-Beralot in Lange-Bertalot & Rumrich 1981	5
NA590A	Navicula pseudoventralis	Hust. 1953	1
NA014A	Navicula pupula pupula	Kutz. 1844	4
NA003A	Navicula radiosa radiosa	Kutz. 1844	2
NA008A	Navicula rhyncocephala rhyncocephala	Kutz. 1844	2
NA166A	Navicula submuralis	Hust.	1
NA691A	Navicula tridentula tridentula	Krasske 1923	1
NA738A	Navicula vitiosa	Schimanski 1978	4
NE006A	Neidium alpinum	Hust. 1943	1
NI042A	Nitzschia acicularis	(Kutz.) W. Sm. 1853	2
NI202A	Nitzschia alpina	Hustedt 1943	1
NI015A	Nitzschia dissipata	(Kutz.) Grun. 1862	3
NI002A	Nitzschia fonticola	Grun. in Van Heurck 1881	1
NI017A	Nitzschia gracilis	Hantzsch 1860	1
NI043A	Nitzschia inconspicua	Grun. 1862	1
NI198A	Nitzschia lacuum	Lange-Bertalot 1980	1
NI009A	Nitzschia palea palea	(Kutz.) W. Sm. 1856	12
NI193A	Nitzschia perminuta	(Grun.) M. Perag. 1903	2
UN9994	Pennate undif.		7
PI014A	Pinnularia appendiculata	(Ag.) Cleve 1896	1
PI022A	Pinnularia subcapitata subcapitata	Greg. 1856	3
SU001A	Surirella angusta	Kutz. 1844	1
SY002A	Synedra rumpens rumpens	Kutz. 1844	6
SY011A	Synedra delicatissima delicatissima	W. Sm. 1853	2
SY002B	Synedra rumpens familiaris	(Kutz.) Hust. 1930	4
SY002C	Synedra rumpens fragilarioides	Grun. in Van Heurck 1881	2
SY002D	Synedra rumpens scotica	Grun.	3
TA001A	Tabellaria flocculosa flocculosa	(Roth) Kutz. 1844	1

Lac de l'Esclauze

code	Name	Authority	Sample code ESCL 1
AC9948	Achnanthes [microscopica/curtissima]	P. Rioual 1997	1
AC025B	Achnanthes flexella alpestris	Brun 1880	1
AC091A	Achnanthes lutheri	Hust. 1933	1
AC022A	Achnanthes marginulata	Grun. in Cleve & Grun. 1880	1
AC013A	Achnanthes minutissima minutissima	Kutz. 1833	50
AC136A	Achnanthes subatomoides	(Hust.) Lange-Bertalot & Archibald in Krammer & Lange-Bertalot 1985	6
AC161A	Achnanthes ventralis	(Krasske) Lange-Bertalot 1989	3
AM011A	Amphora libyca	Ehr. 1840	1
AS001A	Asterionella formosa formosa	Hassall 1850	1
AU002A	Aulacoseira ambigua	(Grun. in Van Heurck) Simonsen 1979	13
AU005D	Aulacoseira distans tenella	(Nygaard) R. Ross in Hartley 1986	4
AU032A	Aulacoseira lacustris	Krammer 1990	1
BR010A	Brachysira neoexilis	Lange-Bertalot 1994	3
CY002A	Cyclotella pseudostelligera	Hust. 1939	6
CM015A	Cymbella cesatii cesatii	(Rabenh.) Grun. in A. Schmidt 1881	4
CM018A	Cymbella gracilis	(Rabenh.) Cleve 1894	2
CM031A	Cymbella minuta minuta	Hilse ex Rabenh. 1862	6
CM103A	Cymbella silesiaca	Bleisch ex Rabenh. 1864	1
CM9999	Cymbella sp.		1
EU013A	Eunotia arcus arcus	Ehrenb. 1837	2
EU070A	Eunotia bilunaris	(Ehrenb.) F.W. Mills 1934	3
EU070B	Eunotia bilunaris mucophila	LB & Norpel 1991	2
EU009A	Eunotia exigua exigua	(Breb. ex Kutz.) Rabenh. 1864	1
EU017A	Eunotia flexuosa flexuosa	Kutz. 1849	1
EU107A	Eunotia implicata	Norpel, Lange-Bertalot & Alles 1991	1
EU108A	Eunotia intermedia	(Hust) Norpel, Lange-Bertalot & Alles 1991	1
EU008D	Eunotia monodon bidens	(W. Sm.) Hust. 1932	1
EU002D	Eunotia pectinalis undulata	(Ralfs) Rabenh. 1864	1
EU9999	Eunotia sp.		3
FR003A	Fragilaria bicapitata	A. Mayer 1917	2
FR009H	Fragilaria capucina gracilis	(Oestrup) Hustedt 1950	4
FR002A	Fragilaria construens construens	(Ehrenb.) Grun. 1862	28
FR002C	Fragilaria construens venter	(Ehrenb.) Grun. in Van Heurck 1881	85
FR018A	Fragilaria elliptica	Schum. 1867	108
FR064A	Fragilaria exigua	Grun in Cleve & Moller 1878	21
FR062A	Fragilaria microstriata	Marciniak in Metzeltin & Witkowski 1996	1
FR001A	Fragilaria pinnata pinnata	Ehrenb. 1843	4
FR007A	Fragilaria vaucheriae vaucheriae	(Kutz.) J.B. Petersen 1938	6
GO006A	Gomphonema acuminatum acuminatum	Ehrenb. 1832	1
GO004A	Gomphonema gracile	Ehrenb. 1838	1
GO013A	Gomphonema parvulum parvulum	(Kutz.) Kutz. 1849	1
GO9999	Gomphonema sp.		1
GO023A	Gomphonema truncatum truncatum	Ehrenb. 1832	2
NA161A	Navicula absoluta	Hust. 1950	2
NA190A	Navicula agrestis	Hust. 1937	1
NA121A	Navicula begeri	Krasske 1932	1
NA007A	Navicula cryptocephala cryptocephala	Kutz. 1844	1
NA175A	Navicula gerloffi	Schimanski 1978	2
NA002A	Navicula jaernefeltii	Hust. 1942	8
NA042A	Navicula minima minima	Grun. in Van Heurck 1880	2
NA013A	Navicula pseudoscutiformis	Hust. 1930	1
NA590A	Navicula pseudoventralis	Hust. 1953	13
NA014A	Navicula pupula pupula	Kutz. 1844	5
NA003A	Navicula radiosa radiosa	Kutz. 1844	7

Lac de l'Esclauze

code	Name	Authority	Sample code ESCL 1
NA166A	Navicula submuralis	Hust. 1945	8
NA076A	Navicula variostriata	Krasske 1923	2
NA168A	Navicula vitabunda	Hust. 1930	9
NA738A	Navicula vitiosa	Schimanski 1978	22
NE006A	Neidium alpinum	Hust. 1943	1
NI002A	Nitzschia fonticola	Grun. in Van Heurck 1881	2
NI017A	Nitzschia gracilis	Hantzsch 1860	2
NI209A	Nitzschia incognita	Legler & Krasske 1940	1
NI031C	Nitzschia linearis subtilis	(Grun) Hustedt 1923	3
NI033A	Nitzschia paleacea	(Grun. in Cleve & Grun.) Grun. in Van Heurck 1881	4
NI193A	Nitzschia perminuta	(Grun.) M. Perag. 1903	2
NI048A	Nitzschia tubicola	Grun. in Cleve & Grun. 1880	2
UN9994	Pennate undif.		1
PI003A	Pinnularia hemiptera hemiptera	(Kutz.) Rabenh. 1853	1
PI9999	Pinnularia sp.		2
PI007A	Pinnularia viridis viridis	(Nitzsch) Ehrenb. 1843	1
RH001A	Rhopalodia gibba gibba	(Ehrenb.) O. Mull. 1895	1
SP006A	Stenopterobia curvula	(W Smith) Krammer 1987	1
TA001A	Tabellaria flocculosa flocculosa	(Roth) Kutz. 1844	10

Lac Estivadoux

code	Name	Authority	Sample code ESTI 1
AC141A	Achnanthes bioretii	Germain 1957	1
AC163A	Achnanthes helvetica	(Hustedt) Lange-Bertalot in LB & K 1989	1
AC001A	Achnanthes lanceolata	(Breb. ex Kutz.) Grun. in Cleve & Grun. 1880	1
AC013A	Achnanthes minutissima minutissima	Kutz. 1833	1
AC9999	Achnanthes sp.		1
AS003A	Asterionella ralfsii	W. Sm. 1856	16
EU009A	Eunotia exigua exigua	(Breb. ex Kutz.) Rabenh. 1864	191
EU107A	Eunotia implicata	Norpel, Lange-Bertalot & Alles 1991	7
EU047A	Eunotia incisa	W. Sm. ex Greg. 1854	10
EU045A	Eunotia nymanniana	Grun. in Van Heurck 1881	14
EU040A	Eunotia paludosa	Grun. 1862	16
EU9999	Eunotia sp.		52
EU105A	Eunotia subarcuoides	Alles, Norpel, Lange-Bertalot 1991	22
FU002B	Frustulia rhomboides saxonica	(Rabenh.) De Toni 1891	13
NA033A	Navicula subtilissima	Cleve 1891	5
NE9999	Neidium sp.		1
NI017A	Nitzschia gracilis	Hantzsch 1860	26
UN9994	Pennate undif.		1
PI011A	Pinnularia microstauron microstauron	(Ehrenb.) Cleve 1891	43
PI9999	Pinnularia sp.		3
PI022A	Pinnularia subcapitata subcapitata	Greg. 1856	22
SA001A	Stauroneis anceps anceps	Ehrenb. 1843	4
TA001A	Tabellaria flocculosa flocculosa	(Roth) Kutz. 1844	62

Lac Ferrand

code	Name	Authority	Sample code FERR 1
AC046A	Achnanthes altaica	(Poretzky) A. Cleve-Euler 1953	3
AC141A	Achnanthes bioretii	Germain 1957	1
AC152A	Achnanthes carissima	Lange-Bertalot 1990	1
AC039A	Achnanthes didyma didyma	Hust. 1933	10
AC163A	Achnanthes helvetica	(Hustedt) Lange-Bertalot in LB & K 1989	1
AC001A	Achnanthes lanceolata	(Breb. ex Kutz.) Grun. in Cleve & Grun. 1880	1
AC044A	Achnanthes levanderi	Hust. 1933	16
AC022A	Achnanthes marginulata	Grun. in Cleve & Grun. 1880	15
AC013A	Achnanthes minutissima minutissima	Kutz. 1833	30
AC105A	Achnanthes petersenii	Hust. 1937	2
AC035A	Achnanthes pusilla pusilla	Grun. in Cleve & Grun. 1880	2
AC116A	Achnanthes rossii	Hust. 1954	1
AC136A	Achnanthes subatomoides	(Hust.) Lange-Bertalot & Archibald in Krammer & Lange-Bertalot 1985	1
AU002A	Aulacoseira ambigua	(Grun. in Van Heurck) Simonsen 1979	7
AU9999	Aulacoseira sp.		2
BR006A	Brachysira brebissonii brebissonii	R. Ross in Hartley 1986	4
BR012A	Brachysira garrensis	(Lange-Bertalot & Krammer) L-B 1994	5
BR010A	Brachysira neoexilis	Lange-Bertalot 1994	5
CY002A	Cyclotella pseudostelligera	Hust. 1939	1
CY004A	Cyclotella stelligera	(Cleve & Grun. in Cleve) Van Heurck 1882	16
CM015A	Cymbella cesatii cesatii	(Rabenh.) Grun. in A. Schmidt 1881	3
CM018A	Cymbella gracilis	(Rabenh.) Cleve 1894	5
CM004A	Cymbella microcephala microcephala	Grun. in Van Heurck 1880	1
CM009A	Cymbella naviculiformis	Auersw. ex Heib. 1863	3
DT021A	Diatoma mesodon	(Ehrenber) Kutzing 1844	1
EU009A	Eunotia exigua exigua	(Breb. ex Kutz.) Rabenh. 1864	2
EU107A	Eunotia implicata	Norpel, Lange-Bertalot & Alles 1991	1
EU047A	Eunotia incisa	W. Sm. ex Greg. 1854	1
FR009H	Fragilaria capucina gracilis	(Oestrup) Hustedt 1950	2
FR002C	Fragilaria construens venter	(Ehrenb.) Grun. in Van Heurck 1881	1
FR018A	Fragilaria elliptica	Schum. 1867	92
FR064A	Fragilaria exigua	Grun in Cleve & Moller 1878	148
FR068A	Fragilaria nanoides	Lange-Bertalot 1996	4
FR067A	Fragilaria oldenburgioides	Lange-Bertalot nov spec 1996	27
FR001A	Fragilaria pinnata pinnata	Ehrenb. 1843	107
FR007A	Fragilaria vaucheriae vaucheriae	(Kutz.) J.B. Petersen 1938	2
NA007A	Navicula cryptocephala cryptocephala	Kutz. 1844	1
NA766A	Navicula heimansioides	Lange-Bertalot	12
NA006A	Navicula mediocris	Krasske 1932	1
NA042A	Navicula minima minima	Grun. in Van Heurck 1880	2
NA013A	Navicula pseudoscutiformis	Hust. 1930	2
NA048D	Navicula soehrensis hassiaca	(Krasske)Lange-Bertalot 1985	1
NA9999	Navicula sp.		3
NI002A	Nitzschia fonticola	Grun. in Van Heurck 1881	24
NI193A	Nitzschia perminuta	(Grun.) M. Perag. 1903	4
PI005A	Pinnularia major major	(Kutz.) W. Sm. 1853	1
PI9999	Pinnularia sp.		1
PI022A	Pinnularia subcapitata subcapitata	Greg. 1856	2
SA001A	Stauroneis anceps anceps	Ehrenb. 1843	1
SY002B	Synedra rumpens familiaris	(Kutz.) Hust. 1930	14
TA001A	Tabellaria flocculosa flocculosa	(Roth) Kutz. 1844	4

Lac de la Godivelle-d'en-Bas

code	Name	Authority	Sample code GODB 1
AC001A	Achnanthes lanceolata	(Breb. ex Kutz.) Grun. in Cleve & Grun. 1880	4
AC013A	Achnanthes minutissima minutissima	Kutz. 1833	12
AC035A	Achnanthes pusilla pusilla	Grun. in Cleve & Grun. 1880	3
AC116A	Achnanthes rossii	Hust. 1954	1
AM011A	Amphora libyca	Ehr. 1840	1
AS001A	Asterionella formosa formosa	Hassall 1850	5
AU002A	Aulacoseira ambigua	(Grun. in Van Heurck) Simonsen 1979	16
AU020A	Aulacoseira subarctica	(O.Mull.) Haworth	4
CO001B	Cocconeis placentula euglypta	(Ehrenb.) Grun. 1884	1
CO001A	Cocconeis placentula placentula	Ehrenb. 1838	1
CY004A	Cyclotella stelligera	(Cleve & Grun. in Cleve) Van Heurck 1882	5
CY048A	Cyclotella woltereckii	Hustedt	1
CM006A	Cymbella cistula cistula	(Ehrenb. in Hempr. & Ehrenb.) Kirchner 1878	2
CM031A	Cymbella minuta minuta	Hilse ex Rabenh. 1862	5
CM103A	Cymbella silesiaca	Bleisch ex Rabenh. 1864	2
EP007A	Epithemia adnata adnata	(Kutz.) Rabenh. 1853	4
EU047A	Eunotia incisa	W. Sm. ex Greg. 1854	1
EU9999	Eunotia sp.		2
FR006A	Fragilaria brevistriata brevistriata	Grun. in Van Heurck 1885	17
FR009A	Fragilaria capucina capucina	Desm. 1825	7
FR009H	Fragilaria capucina gracilis	(Oestrup) Hustedt 1950	3
FR009B	Fragilaria capucina mesolepta	(Rabenh.) Rabenh. 1864	4
FR002C	Fragilaria construens venter	(Ehrenb.) Grun. in Van Heurck 1881	329
FR018A	Fragilaria elliptica	Schum. 1867	32
FR066A	Fragilaria neoproducta	Lange- Bertalot 1991	29
FR001A	Fragilaria pinnata pinnata	Ehrenb. 1843	83
FR007A	Fragilaria vaucheriae vaucheriae	(Kutz.) J.B. Petersen 1938	5
GO004A	Gomphonema gracile	Ehrenb. 1838	1
GO077A	Gomphonema lacus-vulcani	Reichardt & Lange-Bertalot	1
GO023A	Gomphonema truncatum truncatum	Ehrenb. 1832	6
MT001A	Martyana martyi	(Heribaud) Round 1990	1
MR001A	Meridion circulare circulare	(Grev.) Ag. 1831	1
NA007A	Navicula cryptocephala cryptocephala	Kutz. 1844	2
NA769A	Navicula lundii	Reichardt	1
NA042A	Navicula minima minima	Grun. in Van Heurck 1880	13
NA013A	Navicula pseudoscutiformis	Hust. 1930	1
NA014A	Navicula pupula pupula	Kutz. 1844	3
NA008A	Navicula rhyncocephala rhyncocephala	Kutz. 1844	1
NA166A	Navicula submuralis	Hust. 1945	1
NI042A	Nitzschia acicularis	(Kutz.) W. Sm. 1853	1
NI015A	Nitzschia dissipata	(Kutz.) Grun. 1862	1
NI002A	Nitzschia fonticola	Grun. in Van Heurck 1881	6
NI017A	Nitzschia gracilis	Hantzsch 1860	1
NI193A	Nitzschia perminuta	(Grun.) M. Perag. 1903	3
NI171A	Nitzschia subacicularis	Hust. 1937	1
UN9994	Pennate undif.		4
RH001A	Rhopalodia gibba gibba	(Ehrenb.) O. Mull. 1895	1
SY009A	Synedra nana	Meister 1912	2
SY004B	Synedra parasitica subconstricta	(Grun. in Van Heurck) Hust. 1930	1
SY002B	Synedra rumpens familiaris	(Kutz.) Hust. 1930	3
SY002C	Synedra rumpens fragilarioides	Grun. in Van Heurck 1881	1
SY002A	Synedra rumpens rumpens	Kutz. 1844	2
SY013A	Synedra tenera	W. Sm. 1856	1
TA001A	Tabellaria flocculosa flocculosa	(Roth) Kutz. 1844	5

Lac de la Godivelle-d'en-Haut

code	Name	Authority	Sample code GODH 1
AC9948	Achnanthes [microscopica/curtissima]	P. Rioual 1997	5
AC046A	Achnanthes altaica	(Poretzky) A. Cleve-Euler 1953	8
AC163A	Achnanthes helvetica	(Hustedt) Lange-Bertalot in LB & K 1989	14
AC083A	Achnanthes laevis	Ostr. 1910	1
AC044A	Achnanthes levanderi	Hust. 1933	1
AC091A	Achnanthes lutheri	Hust. 1933	1
AC022A	Achnanthes marginulata	Grun. in Cleve & Grun. 1880	12
AC013A	Achnanthes minutissima minutissima	Kutz. 1833	130
AC048A	Achnanthes scotica	Jones & Flower	1
AC136A	Achnanthes subatomoides	(Hust.) Lange-Bertalot & Archibald in Krammer & Lange-Bertalot 1985	10
AS001A	Asterionella formosa formosa	Hassall 1850	2
BR012A	Brachysira garrensis	(Lange-Bertalot & Krammer) L-B 1994	39
BR010A	Brachysira neoexilis	Lange-Bertalot 1994	5
BR011A	Brachysira procera	Lange-Bertalot & Moser 1994 nov. spec.	2
CY020A	Cyclotella iris	Brun et Heribaud 1893	1
CY002A	Cyclotella pseudostelligera	Hust. 1939	1
CM020A	Cymbella gaeumannii	Meister 1934	17
CM018A	Cymbella gracilis	(Rabenh.) Cleve 1894	11
CM004A	Cymbella microcephala microcephala	Grun. in Van Heurck 1880	10
CM031A	Cymbella minuta minuta	Hilse ex Rabenh. 1862	15
EU070A	Eunotia bilunaris	(Ehrenb.) F.W. Mills 1934	2
EU9999	Eunotia sp.		1
FR009H	Fragilaria capucina gracilis	(Oestrup) Hustedt 1950	9
FR064A	Fragilaria exigua	Grun in Cleve & Moller 1878	14
FR007A	Fragilaria vaucheriae vaucheriae	(Kutz.) J.B. Petersen 1938	6
GO003A	Gomphonema angustatum angustatum	(Kutz.) Rabenh. 1864	3
GO004A	Gomphonema gracile	Ehrenb. 1838	5
GO013A	Gomphonema parvulum parvulum	(Kutz.) Kutz. 1849	9
GO023A	Gomphonema truncatum truncatum	Ehrenb. 1832	2
NA045A	Navicula bryophila bryophila	J.B. Petersen 1928	1
NA007A	Navicula cryptocephala cryptocephala	Kutz. 1844	3
NA766A	Navicula heimansioides	Lange-Bertalot	23
NA112A	Navicula minuscula minuscula	Grun. in Van Heurck 1880	2
NA9999	Navicula sp.		2
NA753A	Navicula sublucidula	Hust. 1950	2
NA160A	Navicula submolesta	Hust. 1949	2
NI015A	Nitzschia dissipata	(Kutz.) Grun. 1862	8
NI002A	Nitzschia fonticola	Grun. in Van Heurck 1881	3
NI009A	Nitzschia palea palea	(Kutz.) W. Sm. 1856	3
NI193A	Nitzschia perminuta	(Grun.) M. Perag. 1903	26
NI9999	Nitzschia sp.		1
PI001A	Pinnularia gibba	(Ehrenb.) Ehrenb. 1843	2
PI011A	Pinnularia microstauron microstauron	(Ehrenb.) Cleve 1891	4
SA001A	Stauroneis anceps anceps	Ehrenb. 1843	3
SY002A	Synedra rumpens rumpens	Kutz. 1844	64
SY001A	Synedra ulna ulna	(Nitzsch) Ehrenb. 1836	1
TA001A	Tabellaria flocculosa flocculosa	(Roth) Kutz. 1844	12
TA004A	Tabellaria quadriseptata	Knudson 1952	3

Lac de Guery

code	Name	Authority	Sample code GUER 1
AC141A	Achnanthes bioretii	Germain 1957	3
AC166A	Achnanthes childanos	Hohn & Hellerman 1963	6
AC158A	Achnanthes grana	Hohn & Hellerman 1963	1
AC163A	Achnanthes helvetica	(Hustedt) Lange-Bertalot in LB & K 1989	5
AC153A	Achnanthes impexa	Lange-Bertalot 1989	1
AC083A	Achnanthes laevis	Ostr. 1910	2
AC001A	Achnanthes lanceolata	(Breb. ex Kutz.) Grun. in Cleve & Grun. 1880	3
AC044A	Achnanthes levanderi	Hust. 1933	5
AC013A	Achnanthes minutissima minutissima	Kutz. 1833	36
AC105A	Achnanthes petersenii	Hust. 1937	1
AC116A	Achnanthes rossii	Hust. 1954	1
AC173A	Achnanthes stolida	(Krasske) Krasske 1949	4
AC136A	Achnanthes subatomoides	(Hust.) Lange-Bertalot & Archibald in Krammer & Lange-Bertalot 1995	6
AM012A	Amphora pediculus	(Kutz.) Grun.	2
AS001A	Asterionella formosa formosa	Hassall 1850	16
AU9986	Aulacoseira [subarctica, type 2]	Haworth 1989	21
AU002A	Aulacoseira ambigua	(Grun. in Van Heurck) Simonsen 1979	141
AU005D	Aulacoseira distans tenella	(Nygaard) R. Ross in Hartley 1986	1
CY002A	Cyclotella pseudostelligera	Hust. 1939	80
CY004A	Cyclotella stelligera	(Cleve & Grun. in Cleve) Van Heurck 1882	10
CM018A	Cymbella gracilis	(Rabenh.) Cleve 1894	3
CM031A	Cymbella minuta minuta	Hilse ex Rabenh. 1862	3
DT021A	Diatoma mesodon	(Ehrenber) Kutzing 1844	4
EU070B	Eunotia bilunaris mucophila	LB & Norpel 1991	1
EU009A	Eunotia exigua exigua	(Breb. ex Kutz.) Rabenh. 1864	2
EU110A	Eunotia minor	(Kutz) Grunow in Van Heurck 1881	2
FR006A	Fragilaria brevistriata brevistriata	Grun. in Van Heurck 1885	40
FR009H	Fragilaria capucina gracilis	(Oestrup) Hustedt 1950	9
FR018A	Fragilaria elliptica	Schum. 1867	21
FR001A	Fragilaria pinnata pinnata	Ehrenb. 1843	4
FR007A	Fragilaria vaucheriae vaucheriae	(Kutz.) J.B. Petersen 1938	8
GO073A	Gomphonema angustum	Agardh 1831	1
GO013A	Gomphonema parvulum parvulum	(Kutz.) Kutz. 1849	3
GO9999	Gomphonema sp.		2
HN001A	Hannaea arcus arcus	(Ehrenb.) Patr. in Patr. & Reimer 1966	1
MR001A	Meridion circulare circulare	(Grev.) Ag. 1831	1
NA007A	Navicula cryptocephala cryptocephala	Kutz. 1844	8
NA751A	Navicula cryptotenella	Lange-Bertalot 1985	2
NA755A	Navicula kuelbsii	Lange-Bertalot 1985	1
NA042A	Navicula minima minima	Grun. in Van Heurck 1880	2
NA008A	Navicula rhyncocephala rhyncocephala	Kutz. 1844	1
NA005A	Navicula seminulum	Grun. 1860	1
NI030A	Nitzschia acidoclinata	Lange Bertalot	1
NI017A	Nitzschia gracilis	Hantzsch 1860	3
NI009A	Nitzschia palea palea	(Kutz.) W. Sm. 1856	3
NI025A	Nitzschia recta	Hantzsch ex Rabenh. 1861	4
UN9994	Pennate undif.		4
PI014A	Pinnularia appendiculata	(Ag.) Cleve 1895	1
PI011A	Pinnularia microstauron microstauron	(Ehrenb.) Cleve 1891	1
PI022A	Pinnularia subcapitata subcapitata	Greg. 1856	1
SA001A	Stauroneis anceps anceps	Ehrenb. 1843	1
SY002A	Synedra rumpens rumpens	Kutz. 1844	2
SY011A	Synedra delicatissima delicatissima	W. Sm. 1853	1
SY004A	Synedra parasitica parasitica	(W. Sm.) Hust. 1930	2

Lac de Guery

code	Name	Authority	Sample code GUER 1
SY002B	Synedra rumpens familiaris	(Kutz.) Hust. 1930	1
SY9988	Synedra rumpens [Lac d'Aydat form]	P. Rioual & C. Sayer 1998	18
SY013A	Synedra tenera	W. Sm. 1856	3
SY001G	Synedra ulna amphirhynchus	(Ehrenb.) Grun. 1862	1
TA001A	Tabellaria flocculosa flocculosa	(Roth) Kutz. 1844	2

Lac d'Issarles

code	Name	Authority	Sample code ISSA 1
AC037B	Achnanthes biasolettiana subatomus	Lange-Bertalot 1989	3
AC005A	Achnanthes calcar	Cleve 1891	1
AC006A	Achnanthes clevei clevei	Grun. in Cleve & Grun. 1880	1
AC065A	Achnanthes exilis	Kutz. 1833	8
AC158A	Achnanthes grana	Hohn & Hellerman 1963	4
AC001A	Achnanthes lanceolata	(Breb. ex Kutz.) Grun. in Cleve & Grun. 1880	1
AC001R	Achnanthes lanceolata frequentissima	Lange-Bertalot 1991	3
AC013A	Achnanthes minutissima minutissima	Kutz. 1833	30
AC9999	Achnanthes sp.		1
AC136A	Achnanthes subatomoides	(Hust.) Lange-Bertalot & Archibald in Krammer & Lange-Bertalot 1985	2
AS001A	Asterionella formosa formosa	Hassall 1850	29
AU020A	Aulacoseira subarctica	(O.Mull.) Haworth	225
CO067A	Cocconeia neothumensis	Krammer 1991	1
CO001B	Cocconeis placentula euglypta	(Ehrenb.) Grun. 1884	4
CY9987	Cyclotella [cf. comensis]	P. Rioual (Massif Central) 1997	1
CY054A	Cyclotella krammeri	Hakansson 1990	1
CY002A	Cyclotella pseudostelligera	Hust. 1939	89
CY019A	Cyclotella radiosa	(Grunow) Lemmermann 1900	2
CM031A	Cymbella minuta minuta	Hilse ex Rabenh. 1862	9
CM103A	Cymbella silesiaca	Bleisch ex Rabenh. 1864	5
CM003A	Cymbella sinuata sinuata	Greg. 1856	2
CM9999	Cymbella sp.		1
DT021A	Diatoma mesodon	(Ehrenber) Kutzing 1844	4
EU009A	Eunotia exigua exigua	(Breb. ex Kutz.) Rabenh. 1864	1
FR003A	Fragilaria bicapitata	A. Mayer 1917	1
FR006A	Fragilaria brevistriata brevistriata	Grun. in Van Heurck 1885	3
FR009A	Fragilaria capucina capucina	Desm. 1825	1
FR009H	Fragilaria capucina gracilis	(Oestrup) Hustedt 1950	9
FR002C	Fragilaria construens venter	(Ehrenb.) Grun. in Van Heurck 1881	1
FR008A	Fragilaria crotonensis	Kitton 1869	2
FR018A	Fragilaria elliptica	Schum. 1867	1
FR001E	Fragilaria pinnata intercedens	(Grun. in Van Heurck) Hust. 1931	1
FR001A	Fragilaria pinnata pinnata	Ehrenb. 1843	1
FR007A	Fragilaria vaucheriae vaucheriae	(Kutz.) J.B. Petersen 1938	5
GO003A	Gomphonema angustatum angustatum	(Kutz.) Rabenh. 1864	1
GO013A	Gomphonema parvulum parvulum	(Kutz.) Kutz. 1849	5
GY9999	Gyrosigma sp.		1
HN001A	Hannaea arcus arcus	(Ehrenb.) Patr. in Patr. & Reimer 1966	11
MR001A	Meridion circulare circulare	(Grev.) Ag. 1831	1
NA751A	Navicula cryptotenella	Lange-Bertalot 1985	1
NA023A	Navicula gregaria	Donk. 1861	1
NA433D	Navicula ignota acceptata	(Hustedt) Lange-Bertalot 1985	1
NA042A	Navicula minima minima	Grun. in Van Heurck 1880	2
NA112D	Navicula minuscula muralis	(Grun. in Van Heurck) Lange-Beralot in Lange-Bertalot & Rumrich 1981	1
NA577B	Navicula porifera opportuna	(Hust.) LB 1985	2
NA013A	Navicula pseudoscutiformis	Hust. 1930	2
NA9999	Navicula sp.		2
NI042A	Nitzschia acicularis	(Kutz.) W. Sm. 1853	1
NI015A	Nitzschia dissipata	(Kutz.) Grun. 1862	1
NI002A	Nitzschia fonticola	Grun. in Van Heurck 1881	2
NI034A	Nitzschia hantzschiana	Rabenh. 1860	2
NI031C	Nitzschia linearis subtilis	(Grun) Hustedt 1923	2
NI009A	Nitzschia palea palea	(Kutz.) W. Sm. 1856	2
NI033A	Nitzschia paleacea	(Grun. in Cleve & Grun.) Grun. in Van Heurck 1881	3

Lac d'Issarles

code	Name	Authority	Sample code ISSA 1
NI9999	Nitzschia sp.		1
UN9994	Pennate undif.		1
PI012A	Pinnularia borealis	Ehrenb. 1843	2
PI022A	Pinnularia subcapitata subcapitata	Greg. 1856	1
ST001A	Stephanodiscus hantzschii	Grun. in Cleve & Grun. 1880	1
ST010A	Stephanodiscus parvus	Stoermer & Hakansson 1984	3
SY011A	Synedra delicatissima delicatissima	W. Sm. 1853	14
SY002B	Synedra rumpens familiaris	(Kutz.) Hust. 1930	6
TA001A	Tabellaria flocculosa flocculosa	(Roth) Kutz. 1844	2

Lac de la Landie

code	Name	Authority	Sample code LAND 1
AC9948	Achnanthes [microscopica/curtissima]	P. Rioual 1997	2
AC046A	Achnanthes altaica	(Poretzky) A. Cleve-Euler 1953	1
AC037A	Achnanthes biasolettiana	Grun. in Cleve & Grun. 1880	2
AC153A	Achnanthes impexa	Lange-Bertalot 1989	1
AC001A	Achnanthes lanceolata	(Breb. ex Kutz.) Grun. in Cleve & Grun. 1880	1
AC044A	Achnanthes levanderi	Hust. 1933	6
AC013A	Achnanthes minutissima minutissima	Kutz. 1833	106
AC035A	Achnanthes pusilla pusilla	Grun. in Cleve & Grun. 1880	2
AC116A	Achnanthes rossii	Hust. 1954	1
AC136A	Achnanthes subatomoides	(Hust.) Lange-Bertalot & Archibald in Krammer & Lange-Bertalot 1985	6
AC161A	Achnanthes ventralis	(Krasske) Lange-Bertalot 1989	5
AS001A	Asterionella formosa formosa	Hassall 1850	7
AU9986	Aulacoseira [subarctica, type 2]	Haworth 1989	6
AU002A	Aulacoseira ambigua	(Grun. in Van Heurck) Simonsen 1979	30
AU005D	Aulacoseira distans tenella	(Nygaard) R. Ross in Hartley 1986	5
AU001C	Aulacoseira italica valida	(Grun. in Van Heurck) Simonsen 1979	1
AU9999	Aulacoseira sp.		6
BR002A	Brachysira follis	(Ehrenb.) R. Ross in Hartley 1986	1
BR010A	Brachysira neoexilis	Lange-Bertalot 1994	3
BR011A	Brachysira procera	Lange-Bertalot & Moser 1994 nov. spec.	5
CO001A	Cocconeis placentula placentula	Ehrenb. 1838	1
CY007A	Cyclotella glomerata	Bachm. 1911	11
CY002A	Cyclotella pseudostelligera	Hust. 1939	33
CY019A	Cyclotella radiosa	(Grunow) Lemmermann 1900	16
CY004A	Cyclotella stelligera	(Cleve & Grun. in Cleve) Van Heurck 1882	6
CM022A	Cymbella affinis	Kutz. 1844	2
CM015A	Cymbella cesatii cesatii	(Rabenh.) Grun. in A. Schmidt 1881	12
CM018A	Cymbella gracilis	(Rabenh.) Cleve 1894	2
CM031A	Cymbella minuta minuta	Hilse ex Rabenh. 1862	4
CM009A	Cymbella naviculiformis	Auersw. ex Heib. 1863	2
CM103A	Cymbella silesiaca	Bleisch ex Rabenh. 1864	5
CM9999	Cymbella sp.		3
DT021A	Diatoma mesodon	(Ehrenber) Kutzing 1844	1
EP007A	Epithemia adnata adnata	(Kutz.) Rabenh. 1853	3
EU009A	Eunotia exigua exigua	(Breb. ex Kutz.) Rabenh. 1864	2
EU008D	Eunotia monodon bidens	(W. Sm.) Hust. 1932	5
FR006A	Fragilaria brevistriata brevistriata	Grun. in Van Heurck 1885	16
FR002A	Fragilaria construens construens	(Ehrenb.) Grun. 1862	15
FR002C	Fragilaria construens venter	(Ehrenb.) Grun. in Van Heurck 1881	9
FR018A	Fragilaria elliptica	Schum. 1867	23
FR064A	Fragilaria exigua	Grun in Cleve & Moller 1878	5
FR042A	Fragilaria nitzschioides	Grun. in Van Heurck 1881	3
FR067A	Fragilaria oldenburgioides	Lange-Bertalot nov spec 1996	5
FR001A	Fragilaria pinnata pinnata	Ehrenb. 1843	24
FR056A	Fragilaria pseudoconstruens	Marciniak 1982	4
FR9999	Fragilaria sp.		2
FR9973	Fragilaria sp. [cf. F. utermoehlii]	Krammer & Lange-Bertalot 1991	1
FR007A	Fragilaria vaucheriae vaucheriae	(Kutz.) J.B. Petersen 1938	1
GO006A	Gomphonema acuminatum acuminatum	Ehrenb. 1832	3
GO004A	Gomphonema gracile	Ehrenb. 1838	4
GO013A	Gomphonema parvulum parvulum	(Kutz.) Kutz. 1849	4
GO9999	Gomphonema sp.		2
GO023A	Gomphonema truncatum truncatum	Ehrenb. 1832	2
NA161A	Navicula absoluta	Hust. 1950	1

Lac de la Landie

code	Name	Authority	Sample code LAND 1
NA084B	Navicula atomus permitis	(Hust.)Lange-Bertaot 1985	2
NA007A	Navicula cryptocephala cryptocephala	Kutz. 1844	3
NA751A	Navicula cryptotenella	Lange-Bertalot 1985	1
NA175A	Navicula gerloffi	Schimanski 1978	1
NA766A	Navicula heimansioides	Lange-Bertalot	2
NA433D	Navicula ignota acceptata	(Hustedt) Lange-Bertalot 1985	2
NA016A	Navicula indifferens	Hust. 1942	1
NA002A	Navicula jaernefeltii	Hust. 1942	9
NA042A	Navicula minima minima	Grun. in Van Heurck 1880	4
NA581A	Navicula pseudobryophila	Hust. 1942	1
NA013A	Navicula pseudoscutiformis	Hust. 1930	2
NA590A	Navicula pseudoventralis	Hust. 1953	4
NA014A	Navicula pupula pupula	Kutz. 1844	1
NA003A	Navicula radiosa radiosa	Kutz. 1844	3
NA008A	Navicula rhyncocephala rhyncocephala	Kutz. 1844	2
NA005A	Navicula seminulum	Grun. 1860	6
NA9999	Navicula sp.		4
NA033A	Navicula subtilissima	Cleve 1891	3
NA076A	Navicula variostriata	Krasske 1923	1
NA738A	Navicula vitiosa	Schimanski 1978	21
NI030A	Nitzschia acidoclinata	Lange Bertalot	1
NI002A	Nitzschia fonticola	Grun. in Van Heurck 1881	7
NI017A	Nitzschia gracilis	Hantzsch 1860	1
NI009A	Nitzschia palea palea	(Kutz.) W. Sm. 1856	1
NI033A	Nitzschia paleacea	(Grun. in Cleve & Grun.) Grun. in Van Heurck 1881	1
NI9999	Nitzschia sp.		1
NI171A	Nitzschia subacicularis	Hust. 1937	1
UN9994	Pennate undif.		11
PE002A	Peronia fibula	(Breb. ex Kutz.) R. Ross 1956	2
PI007A	Pinnularia viridis viridis	(Nitzsch) Ehrenb. 1843	1
SU075A	Surirella lapponica	A. Cleve 1895	1
SY007B	Synedra amphicephala austriaca	(Grun. in Van Heurck) Hust. 1932	6
SY011A	Synedra delicatissima delicatissima	W. Sm. 1853	13
SY004B	Synedra parasitica subconstricta	(Grun. in Van Heurck) Hust. 1930	1
SY002B	Synedra rumpens familiaris	(Kutz.) Hust. 1930	4
SY002C	Synedra rumpens fragilarioides	Grun. in Van Heurck 1881	1
SY001G	Synedra ulna amphirhynchus	(Ehrenb.) Grun. 1862	1
SY001C	Synedra ulna danica	(Kutz.) Van Heurck 1885	1
TA001A	Tabellaria flocculosa flocculosa	(Roth) Kutz. 1844	6

Lac de Laspialades

code	Name	Authority	Sample code LASP 1
AC046A	Achnanthes altaica	(Poretzky) A. Cleve-Euler 1953	1
AC153A	Achnanthes impexa	Lange-Bertalot 1989	1
AC013A	Achnanthes minutissima minutissima	Kutz. 1833	9
AC136A	Achnanthes subatomoides	(Hust.) Lange-Bertalot & Archibald in Krammer & Lange Bertalot 1985	6
AS001A	Asterionella formosa formosa	Hassall 1850	1
AU002A	Aulacoseira ambigua	(Grun. in Van Heurck) Simonsen 1979	2
AU030A	Aulacoseira crenulata	Thwaites 1848	3
AU005D	Aulacoseira distans tenella	(Nygaard) R. Ross in Hartley 1986	327
BR006A	Brachysira brebissonii brebissonii	R. Ross in Hartley 1986	3
BR010A	Brachysira neoexilis	Lange-Bertalot 1994	1
CY002A	Cyclotella pseudostelligera	Hust. 1939	11
CY004A	Cyclotella stelligera	(Cleve & Grun. in Cleve) Van Heurck 1882	6
CM014A	Cymbella aequalis	W. Sm. ex Grev. 1855	2
CM018A	Cymbella gracilis	(Rabenh.) Cleve 1894	6
CM103A	Cymbella silesiaca	Bleisch ex Rabenh. 1864	2
EU070A	Eunotia bilunaris	(Ehrenb.) F.W. Mills 1934	1
EU070B	Eunotia bilunaris mucophila	LB & Norpel 1991	2
EU009A	Eunotia exigua exigua	(Breb. ex Kutz.) Rabenh. 1864	3
EU110A	Eunotia minor	(Kutz) Grunow in Van Heurck 1881	2
EU048A	Eunotia naegelii	Migula 1907	1
EU002D	Eunotia pectinalis undulata	(Ralfs) Rabenh. 1864	2
EU011A	Eunotia rhomboidea	Hust. 1950	1
EU9999	Eunotia sp.		1
FR003A	Fragilaria bicapitata	A. Mayer 1917	1
FR002A	Fragilaria construens construens	(Ehrenb.) Grun. 1862	1
FR002C	Fragilaria construens venter	(Ehrenb.) Grun. in Van Heurck 1881	12
FR018A	Fragilaria elliptica	Schum. 1867	14
FR064A	Fragilaria exigua	Grun in Cleve & Moller 1878	4
FR007A	Fragilaria vaucheriae vaucheriae	(Kutz.) J.B. Petersen 1938	1
FU002G	Frustulia rhomboides crassinervia	(Breb. ex W.Sm.) Ross	1
FU002A	Frustulia rhomboides rhomboides	(Ehrenb.) De Toni 1891	1
GO9999	Gomphonema sp.		2
NA121A	Navicula begeri	Krasske 1932	2
NA751A	Navicula cryptotenella	Lange-Bertalot 1985	1
NA039A	Navicula festiva	Krasske 1925	1
NA766A	Navicula heimansioides	Lange-Bertalot	1
NA016A	Navicula indifferens	Hust. 1942	2
NA758A	Navicula maceria	Schimanski 1978	4
NA006A	Navicula mediocris	Krasske 1932	1
NA042A	Navicula minima minima	Grun. in Van Heurck 1880	2
NA590A	Navicula pseudoventralis	Hust. 1953	2
NA003A	Navicula radiosa radiosa	Kutz. 1844	1
NA9999	Navicula sp.		3
NA166A	Navicula submuralis	Hust. 1945	3
NA033A	Navicula subtilissima	Cleve 1891	1
NA076A	Navicula variostriata	Krasske 1923	1
NA738A	Navicula vitiosa	Schimanski 1978	5
NI017A	Nitzschia gracilis	Hantzsch 1860	3
NI009A	Nitzschia palea palea	(Kutz.) W. Sm. 1856	2
NI193A	Nitzschia perminuta	(Grun.) M. Perag. 1903	2
NI025A	Nitzschia recta	Hantzsch ex Rabenh. 1861	1
UN9994	Pennate undif.		6
PE002A	Peronia fibula	(Breb. ex Kutz.) R. Ross 1956	2
PI011A	Pinnularia microstauron microstauron	(Ehrenb.) Cleve 1891	1

Lac de Laspialades

code	Name	Authority	Sample code LASP 1
PI007A	Pinnularia viridis viridis	(Nitzsch) Ehrenb. 1843	1
SP005A	Stenopterobia delicatissima	(Lewis) M. Perag. 1897	2
SY011A	Synedra delicatissima delicatissima	W. Sm. 1853	2
SY9988	Synedra rumpens [Lac d'Aydat form]	P. Rioual & C. Sayer 1998	1
TA001A	Tabellaria flocculosa flocculosa	(Roth) Kutz. 1844	9

Lac de Montcineyre

code	Name	Authority	Sample code MONT 1
AC9948	Achnanthes [microscopica/curtissima]	P. Rioual 1997	2
AC141A	Achnanthes bioretii	Germain 1957	1
AC039A	Achnanthes didyma didyma	Hust. 1933	2
AC083A	Achnanthes laevis	Ostr. 1910	1
AC001R	Achnanthes lanceolata frequentissima	Lange-Bertalot 1991	3
AC018A	Achnanthes laterostrata	Hust. 1933	4
AC044A	Achnanthes levanderi	Hust. 1933	5
AC022A	Achnanthes marginulata	Grun. in Cleve & Grun. 1880	1
AC013A	Achnanthes minutissima minutissima	Kutz. 1833	66
AC105A	Achnanthes petersenii	Hust. 1937	6
AC136A	Achnanthes subatomoides	(Hust.) Lange-Bertalot & Archibald in Krammer & Lange-Bertalot 1985	1
AS001A	Asterionella formosa formosa	Hassall 1850	14
AU9986	Aulacoseira [subarctica, type 2]	Haworth 1989	18
AU002A	Aulacoseira ambigua	(Grun. in Van Heurck) Simonsen 1979	1
AU005B	Aulacoseira distans nivaloides	Camburn 1987	1
AU014A	Aulacoseira nygaardii	Camburn	1
AU010A	Aulacoseira perglabra	(Oestrup) Haworth 1988	20
AU020A	Aulacoseira subarctica	(O.Mull.) Haworth	3
BR010A	Brachysira neoexilis	Lange-Bertalot 1994	19
BR004A	Brachysira styriaca	(Grun. in Van Heurck) R. Ross in Hartley 1986	1
CY002A	Cyclotella pseudostelligera	Hust. 1939	180
CM015A	Cymbella cesatii cesatii	(Rabenh.) Grun. in A. Schmidt 1881	1
CM018A	Cymbella gracilis	(Rabenh.) Cleve 1894	2
CM004A	Cymbella microcephala microcephala	Grun. in Van Heurck 1880	6
CM031A	Cymbella minuta minuta	Hilse ex Rabenh. 1862	6
CM010A	Cymbella perpusilla	A. Cleve 1895	1
CM103A	Cymbella silesiaca	Bleisch ex Rabenh. 1864	4
CM9999	Cymbella sp.		2
DT021A	Diatoma mesodon	(Ehrenber) Kutzing 1844	2
EP007A	Epithemia adnata adnata	(Kutz.) Rabenh. 1853	1
EU070A	Eunotia bilunaris	(Ehrenb.) F.W. Mills 1934	9
EU070B	Eunotia bilunaris mucophila	LB & Norpel 1991	2
EU017A	Eunotia flexuosa flexuosa	Kutz. 1849	1
EU107A	Eunotia implicata	Norpel, Lange-Bertalot & Alles 1991	2
EU002D	Eunotia pectinalis undulata	(Ralfs) Rabenh. 1864	3
EU9999	Eunotia sp.		1
FR006A	Fragilaria brevistriata brevistriata	Grun. in Van Heurck 1885	12
FR009A	Fragilaria capucina capucina	Desm. 1825	1
FR009H	Fragilaria capucina gracilis	(Oestrup) Hustedt 1950	5
FR018A	Fragilaria elliptica	Schum. 1867	8
FR064A	Fragilaria exigua	Grun in Cleve & Moller 1878	64
FR068A	Fragilaria nanoides	Lange-Bertalot 1996	4
FR001A	Fragilaria pinnata pinnata	Ehrenb. 1843	4
FR056A	Fragilaria pseudoconstruens	Marciniak 1982	3
FR007A	Fragilaria vaucheriae vaucheriae	(Kutz.) J.B. Petersen 1938	2
FU002G	Frustulia rhomboides crassinervia	(Breb. ex W.Sm.) Ross	2
FU002A	Frustulia rhomboides rhomboides	(Ehrenb.) De Toni 1891	2
GO013A	Gomphonema parvulum parvulum	(Kutz.) Kutz. 1849	7
GO072A	Gomphonema pseudotenellum	Lange Bertalot 1985	3
GO9999	Gomphonema sp.		4
GO023A	Gomphonema truncatum truncatum	Ehrenb. 1832	2
MR001A	Meridion circulare circulare	(Grev.) Ag. 1831	1
NA751A	Navicula cryptotenella	Lange-Bertalot 1985	1
NA389B	Navicula gallica perpusilla	(Grun) Lange-Bertalot 1985	1

Lac de Montcineyre

code	Name	Authority	Sample code MONT 1
NA766A	Navicula heimansioides	Lange-Bertalot	2
NA013A	Navicula pseudoscutiformis	Hust. 1930	2
NA014A	Navicula pupula pupula	Kutz. 1844	1
NA003A	Navicula radiosa radiosa	Kutz. 1844	4
NA133A	Navicula schassmannii	Hust. 1937	1
NA9999	Navicula sp.		2
NA738A	Navicula vitiosa	Schimanski 1978	6
NA078A	Navicula vulpina	Kutz. 1844	1
NI002A	Nitzschia fonticola	Grun. in Van Heurck 1881	13
NI017A	Nitzschia gracilis	Hantzsch 1860	1
NI034A	Nitzschia hantzschiana	Rabenh. 1860	1
NI198A	Nitzschia lacuum	Lange-Bertalot 1980	2
NI9999	Nitzschia sp.		1
PE002A	Peronia fibula	(Breb. ex Kutz.) R. Ross 1956	4
PI001A	Pinnularia gibba	(Ehrenb.) Ehrenb. 1843	6
PI022A	Pinnularia subcapitata subcapitata	Greg. 1856	1
SY002D	Synedra rumpens scotica	Grun.	2
SY001C	Synedra ulna danica	(Kutz.) Van Heurck 1885	1
TA001A	Tabellaria flocculosa flocculosa	(Roth) Kutz. 1844	9

Lac Pavin

code	Name	Authority	Sample code PAVI 1 (Aug. 96)	PAVI 2 (May. 98)
AM011A	Amphora libyca	Ehr. 1840		1
AS001A	Asterionella formosa formosa	Hassall 1850	60	81
AU020A	Aulacoseira subarctica	(O.Mull.) Haworth	287	178
CY002A	Cyclotella pseudostelligera	Hust. 1939	115	125
CY019A	Cyclotella radiosa	(Grunow) Lemmermann 1900		1
EP007A	Epithemia adnata adnata	(Kutz.) Rabenh. 1853	2	
FR006A	Fragilaria brevistriata brevistriata	Grun. in Van Heurck 1885	6	4
FR009H	Fragilaria capucina gracilis	(Oestrup) Hustedt 1950	6	3
FR001A	Fragilaria pinnata pinnata	Ehrenb. 1843	8	3
NA161A	Navicula absoluta	Hustedt 1950		2
NA042A	Navicula minima minima	Grun. in Van Heurck 1880		1
NI002A	Nitzschia fonticola	Grun. in Van Heurck 1881	1	
NI201A	Nitzschia gracilliformis	Lange-Bertalot & Simonsen 1978		1
NI033A	Nitzschia paleacea	(Grun. in Cleve & Grun.) Grun. in Van Heurck 1881		2
NI9999	Nitzschia sp.		2	
UN9994	Pennate undif.			2
ST010A	Stephanodiscus parvus	Stoermer & Hakansson 1984	38	125
SY011A	Synedra delicatissima delicatissima	W. Sm. 1853	2	
SY002A	Synedra rumpens rumpens	Kutz. 1844	10	4
SY001C	Synedra ulna danica	(Kutz.) Van Heurck 1885	7	2

Ribains, Les Narces

code	Name	Authority	Sample code RIBA 1
AC163A	Achnanthes helvetica	(Hustedt) Lange-Bertalot in LB & K 1999	1
AC032A	Achnanthes hungarica	(Grun.) Grun. in Cleve & Grun. 1880	1
AC001R	Achnanthes lanceolata frequentissima	Lange-Bertalot 1991	2
AC013A	Achnanthes minutissima minutissima	Kutz. 1833	63
AP001A	Amphipleura pellucida	(Kutz.) Kutz. 1844	1
AU009B	Aulacoseira islandica helvetica	(O. Mull.) Simonsen 1979	8
BR9999	Brachysira sp.		1
CO001A	Cocconeis placentula placentula	Ehrenb. 1838	52
CC002A	Cyclostephanos invisitatus	Theriot, Stoermer & Hakansson, comb. nov. 1987	3
CY003A	Cyclotella meneghiniana meneghiniana	Kutz. 1844	2
CY002A	Cyclotella pseudostelligera	Hust. 1939	3
CM006A	Cymbella cistula cistula	(Ehrenb. in Hempr. & Ehrenb.) Kirchner 1878	2
CM007A	Cymbella cymbiformis cymbiformis	Ag. 1830	3
CM004A	Cymbella microcephala microcephala	Grun. in Van Heurck 1880	15
CM009A	Cymbella naviculiformis	Auersw. ex Heib. 1863	2
CM103A	Cymbella silesiaca	Bleisch ex Rabenh. 1864	3
EP007A	Epithemia adnata adnata	(Kutz.) Rabenh. 1853	2
EP001A	Epithemia sorex sorex	Kutz. 1844	3
EU110A	Eunotia minor	(Kutz) Grunow in Van Heurck 1881	1
FR003A	Fragilaria bicapitata	A. Mayer 1917	4
FR009A	Fragilaria capucina capucina	Desm. 1825	2
FR009B	Fragilaria capucina mesolepta	(Rabenh.) Rabenh. 1864	23
FR002B	Fragilaria construens binodis	(Ehrenb.) Grun. 1862	11
FR002E	Fragilaria construens subsalina	Hust. 1925	56
FR002C	Fragilaria construens venter	(Ehrenb.) Grun. in Van Heurck 1881	45
FR018A	Fragilaria elliptica	Schum. 1867	22
FR042A	Fragilaria nitzschioides	Grun. in Van Heurck 1881	33
FR001A	Fragilaria pinnata pinnata	Ehrenb. 1843	2
FR007A	Fragilaria vaucheriae vaucheriae	(Kutz.) J.B. Petersen 1938	8
GO073A	Gomphonema angustum	Agardh 1831	3
GO004A	Gomphonema gracile	Ehrenb. 1838	2
GO013A	Gomphonema parvulum parvulum	(Kutz.) Kutz. 1849	24
GO9999	Gomphonema sp.		1
GO023A	Gomphonema truncatum truncatum	Ehrenb. 1832	7
NA042A	Navicula minima minima	Grun. in Van Heurck 1880	7
NA014A	Navicula pupula pupula	Kutz. 1844	1
NA005A	Navicula seminulum	Grun. 1860	2
NA9999	Navicula sp.		1
NI042A	Nitzschia acicularis	(Kutz.) W. Sm. 1853	4
NI014A	Nitzschia amphibia amphibia	Grun. 1862	5
NI209A	Nitzschia incognita	Legler & Krasske 1940	5
NI009A	Nitzschia palea palea	(Kutz.) W. Sm. 1856	1
NI033A	Nitzschia paleacea	(Grun. in Cleve & Grun.) Grun. in Van Heurck 1881	12
NI193A	Nitzschia perminuta	(Grun.) M. Perag. 1903	2
NI9999	Nitzschia sp.		2
UN9994	Pennate undif.		1
PI005A	Pinnularia major major	(Kutz.) W. Sm. 1853	1
PI007A	Pinnularia viridis viridis	(Nitzsch) Ehrenb. 1843	1
SA006A	Stauroneis phoenicenteron phoenicenteron	(Nitzsch) Ehrenb. 1943	1
SY003A	Synedra acus acus	Kutz. 1844	16
SY011A	Synedra delicatissima delicatissima	W. Sm. 1853	3
SY009A	Synedra nana	Meister 1912	2
SY002B	Synedra rumpens familiaris	(Kutz.) Hust. 1930	8
SY002C	Synedra rumpens fragilarioides	Grun. in Van Heurck 1881	5

Ribains, Les Narces

code	Name	Authority	Sample code RIBA 1
SY002A	Synedra rumpens rumpens	Kutz. 1844	7
SY001G	Synedra ulna amphirhynchus	(Ehrenb.) Grun. 1862	3
SY001H	Synedra ulna biceps	(Kutz.) Schonf. 1907	1
SY001C	Synedra ulna danica	(Kutz.) Van Heurck 1885	1
SY001A	Synedra ulna ulna	(Nitzsch) Ehrenb. 1836	4
TA002A	Tabellaria fenestrata	(Lyngb.) Kutz. 1844	3

Lac de Saint Front

code	Name	Authority	Sample code FRON 1
AC9948	Achnanthes [microscopica/curtissima]	P. Rioual 1997	2
AC037A	Achnanthes biasolettiana	Grun. in Cleve & Grun. 1880	1
AC165A	Achnanthes catenata	Bily & Marvan 1959	1
AC008A	Achnanthes exigua	Grun. in Cleve & Grun. 1880	13
AC001B	Achnanthes lanceolata rostrata	(Ostr.) Hust. 1911	1
AC013A	Achnanthes minutissima minutissima	Kutz. 1833	2
AC9999	Achnanthes sp.		1
AS001A	Asterionella formosa formosa	Hassall 1850	21
AU002A	Aulacoseira ambigua	(Grun. in Van Heurck) Simonsen 1979	82
AU020A	Aulacoseira subarctica	(O.Mull.) Haworth	10
CA003A	Caloneis silicula	(Ehrenb.) Cleve 1894	1
CO001A	Cocconeis placentula placentula	Ehrenb. 1838	4
CC001A	Cyclostephanos dubius	(Fricke in A. Schmidt) Round 1982	19
CC002A	Cyclostephanos invisitatus	Theriot, Stoermer & Hakansson comb. nov. 1987	3
CC003A	Cyclostephanos tholiformis	Stoermer, Hakansson & Theriot 1987	19
CY002A	Cyclotella pseudostelligera	Hust. 1939	3
CY019A	Cyclotella radiosa	(Grunow) Lemmermann 1900	12
CM006A	Cymbella cistula cistula	(Ehrenb. in Hempr. & Ehrenb.) Kirchner 1878	2
CM031A	Cymbella minuta minuta	Hilse ex Rabenh. 1862	9
CM103A	Cymbella silesiaca	Bleisch ex Rabenh. 1864	4
CM9999	Cymbella sp.		1
CM109A	Cymbella tumidula	Grun. ex A. Schmidt 1875	1
EP007A	Epithemia adnata adnata	(Kutz.) Rabenh. 1853	4
EP001A	Epithemia sorex sorex	Kutz. 1844	1
FR006A	Fragilaria brevistriata brevistriata	Grun. in Van Heurck 1885	12
FR009A	Fragilaria capucina capucina	Desm. 1825	1
FR018A	Fragilaria capucina gracilis	(Oestrup) Hustedt 1950	47
FR009B	Fragilaria capucina mesolepta	(Rabenh.) Rabenh. 1864	6
FR009H	Fragilaria capucina rumpens	(Kutz.) Lange-Bertalot 1991	2
FR009J	Fragilaria capucina perminuta	(Grunow) Lange-Bertalot	2
FR002B	Fragilaria construens binodis	(Ehrenb.) Grun. 1862	5
FR002A	Fragilaria construens construens	(Ehrenb.) Grun. 1862	8
FR002C	Fragilaria construens venter	(Ehrenb.) Grun. in Van Heurck 1881	38
FR008A	Fragilaria crotonensis	Kitton 1869	1
FR056A	Fragilaria elliptica	Schum. 1867	1
FR069A	Fragilaria neoproducta	Lange- Bertalot 1991	2
GO004A	Fragilaria opacolineata	Lange- Bertalot 1996 nov. spec.	1
FR001A	Fragilaria pinnata pinnata	Ehrenb. 1843	40
FR063A	Fragilaria pseudoconstruens	Marciniak 1982	20
FR066A	Fragilaria robusta	(Fusey) Manguin	16
MT001A	Gomphonema angustum	Agardh 1831	1
GO013A	Gomphonema gracile	Ehrenb. 1838	13
GO023A	Gomphonema parvulum parvulum	(Kutz.) Kutz. 1849	6
GO073A	Gomphonema pseudotenellum	Lange Bertalot 1985	1
GO072A	Gomphonema truncatum truncatum	Ehrenb. 1832	5
NA003A	Martyana martyi	(Heribaud) Round 1990	2
NA102A	Navicula bacillum bacillum	Ehrenb. 1840	1
NA013A	Navicula cryptocephala cryptocephala	Kutz. 1844	1
NA769A	Navicula cryptotenella	Lange-Bertalot 1985	2
NA166A	Navicula laevissima	Kutz. 1844	2
NI002A	Navicula lundii	Reichardt	1
NA071A	Navicula minima minima	Grun. in Van Heurck 1880	1
NA042A	Navicula pseudoscutiformis	Hust. 1930	24
NA007A	Navicula radiosa radiosa	Kutz. 1844	1

Lac de Saint Front

code	Name	Authority	Sample code FRON 1
NA751A	Navicula submuralis	Hust.	5
NI008A	Nitzschia fonticola	Grun. in Van Heurck 1881	1
NI043A	Nitzschia frustulum	(Kutz.) Grun. in Cleve & Grun. 1880	1
NI193A	Nitzschia inconspicua	Grun. 1862	2
NI214A	Nitzschia perminuta	(Grun.) M. Perag. 1903	1
PI001A	Nitzschia sp.		4
NI9999	Nitzschia wuellerstorffii	Lange-Bertalot 1987	2
PI007A	Pinnularia gibba	(Ehrenb.) Ehrenb. 1843	1
SA001A	Pinnularia viridis viridis	(Nitzsch) Ehrenb. 1843	1
ST010A	Stauroneis anceps anceps	Ehrenb. 1843	7
SY001A	Stephanodiscus minutulus	(Kutz.) Cleve & Moller	1
ST021A	Stephanodiscus parvus	Stoermer & Hakansson 1984	4
SY004A	Synedra acus acus	Kutz. 1844	1
SY011A	Synedra nana	Meister 1912	1
SY004B	Synedra parasitica parasitica	(W. Sm.) Hust. 1930	2
SY009A	Synedra parasitica subconstricta	(Grun. in Van Heurck) Hust. 1930	3
SY002D	Synedra rumpens familiaris	(Kutz.) Hust. 1930	5
SY002B	Synedra rumpens rumpens	Kutz. 1844	13
SY003A	Synedra rumpens scotica	Grun.	1
SY002A	Synedra ulna amphirhynchus	(Ehrenb.) Grun. 1862	10
SY001G	Synedra ulna ulna	(Nitzsch) Ehrenb. 1836	1

Lac de Servieres

code	Name	Authority	Sample code SERV 1
AC9948	Achnanthes [microscopica/curtissima]	P. Rioual 1997	27
AC046A	Achnanthes altaica	(Poretzky) A. Cleve-Euler 1953	9
AC037A	Achnanthes biasolettiana	Grun. in Cleve & Grun. 1880	2
AC141A	Achnanthes bioretii	Germain 1957	1
AC039A	Achnanthes didyma didyma	Hust. 1933	2
AC163A	Achnanthes helvetica	(Hustedt) Lange-Bertalot in LB & K 1989	51
AC142A	Achnanthes kuelbsii	Lange-Bertalot 1989	1
AC146A	Achnanthes lacus-vulcani	Lange-Bertalot & Krammer 1989	4
AC044A	Achnanthes levanderi	Hust. 1933	14
AC022A	Achnanthes marginulata	Grun. in Cleve & Grun. 1880	9
AC013A	Achnanthes minutissima minutissima	Kutz. 1833	67
AC143A	Achnanthes oblongella	Ostr. 1902	4
AC105A	Achnanthes petersenii	Hust. 1937	1
AC116A	Achnanthes rossii	Hust. 1954	5
AC136A	Achnanthes subatomoides	(Hust.) Lange-Bertalot & Archibald in Krammer & Lange-Bertalot 1985	10
AS001A	Asterionella formosa formosa	Hassall 1850	1
AU033A	Aulacoseira pfaffiana	(Reinsch) Krammer 1990	9
BR012A	Brachysira garrensis	(Lange-Bertalot & Krammer) L-B 1994	29
UN9995	Centric undif.		1
CU001A	Chamaepinnularia sp. [sp. # 2 Julma Olkky]	Lange-bertalot & Metzeltin 1996	2
CY002A	Cyclotella pseudostelligera	Hust. 1939	3
CM020A	Cymbella gaeumannii	Meister 1934	60
CM018A	Cymbella gracilis	(Rabenh.) Cleve 1894	13
CM008B	Cymbella hybrida lanceolata Krammer 1985		2
CM031A	Cymbella minuta minuta	Hilse ex Rabenh. 1862	14
EU070A	Eunotia bilunaris	(Ehrenb.) F.W. Mills 1934	10
EU009A	Eunotia exigua exigua	(Breb. ex Kutz.) Rabenh. 1864	13
EU110A	Eunotia minor	(Kutz) Grunow in Van Heurck 1881	1
EU011A	Eunotia rhomboidea	Hust. 1950	1
EU032B	Eunotia serra diadema	(Ehrenb.) Patr. 1958	1
EU9999	Eunotia sp.		3
FR006A	Fragilaria brevistriata brevistriata	Grun. in Van Heurck 1885	2
FR009H	Fragilaria capucina gracilis	(Oestrup) Hustedt 1950	1
FR002C	Fragilaria construens venter	(Ehrenb.) Grun. in Van Heurck 1881	1
FR064A	Fragilaria exigua	Grun in Cleve & Moller 1878	24
FU002G	Frustulia rhomboides crassinervia	(Breb. ex W.Sm.) Ross	6
FU002A	Frustulia rhomboides rhomboides	(Ehrenb.) De Toni 1891	1
FU029A	Frustulia spicula	Amosse 1932	1
GO013A	Gomphonema parvulum parvulum	(Kutz.) Kutz. 1849	5
GO9999	Gomphonema sp.		10
HA001A	Hantzschia amphioxys amphioxys	(Ehrenb.) Grun. 1877	1
NA766A	Navicula heimansioides	Lange-Bertalot	15
NA125A	Navicula omissa	Hust. 1945	2
NA013A	Navicula pseudoscutiformis	Hust. 1930	2
NA9999	Navicula sp.		2
NA160A	Navicula submolesta	Hust. 1949	2
NE003A	Neidium affine affine	(Ehrenb.) Pfitz. 1871	3
NE006A	Neidium alpinum	Hust. 1943	8
NI202A	Nitzschia alpina	Hustedt 1943	7
NI002A	Nitzschia fonticola	Grun. in Van Heurck 1881	3
NI017A	Nitzschia gracilis	Hantzsch 1860	12
NI193A	Nitzschia perminuta	(Grun.) M. Perag. 1903	2
NI9999	Nitzschia sp.		7
UN9994	Pennate undif.		2

Lac de Servieres

code	Name	Authority	Sample code SERV 1
PI012D	Pinnularia borealis rectangularis	Carlson 1913	1
PI011A	Pinnularia microstauron microstauron	(Ehrenb.) Cleve 1891	6
PI9999	Pinnularia sp.		2
SA001A	Stauroneis anceps anceps	Ehrenb. 1843	3
SA006A	Stauroneis phoenicenteron phoenicenteron	(Nitzsch) Ehrenb. 1943	1
SP005A	Stenopterobia delicatissima	(Lewis) M. Perag. 1897	1
SU9999	Surirella sp.		2
TA001A	Tabellaria flocculosa flocculosa	(Roth) Kutz. 1844	14

Gour de Tazenat

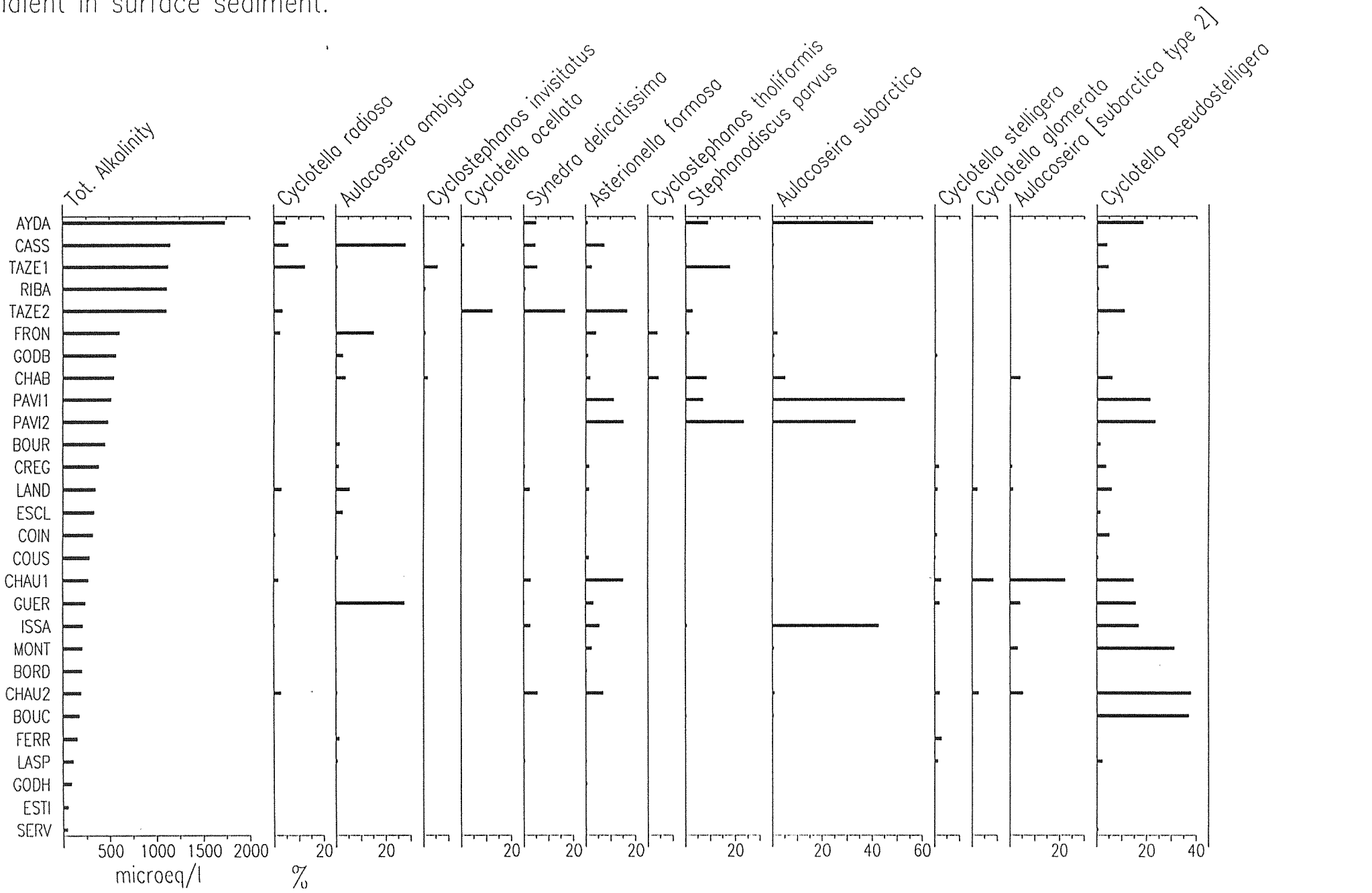
code	Name	Authority	Sample code TAZE 1 (Aug. 96)	TAZE 2 (May 98)
AC037A	Achnanthes biasolettiana	Grun. in Cleve & Grun. 1880	2	
AC141A	Achnanthes bioretii	Germain 1957	1	
AC165A	Achnanthes catenata	Bily & Marvan 1959	12	4
AC006A	Achnanthes clevei clevei	Grun. in Cleve & Grun. 1880	2	2
AC023A	Achnanthes conspicua conspicua	A. Mayer 1919	1	
AC008A	Achnanthes exigua	Grun. in Cleve & Grun. 1880		3
AC146A	Achnanthes lacus-vulcani	Lange-Bertalot & Krammer 1989	1	
AC083A	Achnanthes laevis	Ostr. 1910	5	1
AC001A	Achnanthes lanceolata lanceolata	(Breb. ex Kutz.) Grun. in Cleve & Grun. 1880		1
AC001B	Achnanthes lanceolata rostrata	(Ostr.) Hust. 1911	2	2
AC001R	Achnanthes lanceolata frequentissima	Lange-Bertalot 1991	5	
AC013A	Achnanthes minutissima minutissima	Kutz. 1833	28	15
AC178A	Achnanthes straubiana	Lange-Bertalot 1996 nov. spec.		4
AC136A	Achnanthes subatomoides	(Hust.) Lange-Bertalot & Archibald in Krammer & Lange-Bertalo 1985		1
AM011A	Amphora libyca	Ehr. 1840		1
AM012A	Amphora pediculus	(Kutz.) Grun.	10	14
AS001A	Asterionella formosa formosa	Hassall 1850	15	98
AU002A	Aulacoseira ambigua	(Grun. in Van Heurck) Simonsen 1979	3	
AU020A	Aulacoseira subarctica	(O.Mull.) Haworth	2	
CO067A	Cocconeis neothumensis	Krammer 1991	4	6
CO001B	Cocconeis placentula euglypta	(Ehrenb.) Grun. 1884	3	
CO001A	Cocconeis placentula placentula	Ehrenb. 1838		3
CC002A	Cyclostephanos invisitatus	Theriot, Stoermer & Hakansson, comb. nov. 1987	34	
CC003A	Cyclostephanos tholiformis	Stoermer, Hakansson & Theriot, 1987		1
CY9987	Cyclotella [cf. comensis]	P. Rioual, Massif Central 1997		15
CY9986	Cyclotella [cf. rossii]	P. Rioual, Massif Central 1997		4
CY010A	Cyclotella comensis	Grun. in Van Heurck 1882	4	
CY059A	Cyclotella cyclopuncta	Hakansson & Carter 1990	3	3
CY028B	Cyclotella distinguenda unipunctata	(Hustedt) Hakansson & Carter 1990	13	7
CY054A	Cyclotella krammeri	Hakansson 1990		2
CY009A	Cyclotella ocellata	Pant. 1902	1	73
CY002A	Cyclotella pseudostelligera	Hust. 1939	28	65
CY019A	Cyclotella radiosa	(Grunow) Lemmermann 1900	78	19
CY9999	Cyclotella sp.		1	
ZZZ973	Cyclotella sp.1	P. Rioual, Massif Central, 1997		27
CY004A	Cyclotella stelligera	(Cleve & Grun. in Cleve) Van Heurck 1882		1
CM004A	Cymbella microcephala microcephala	Grun. in Van Heurck 1880	1	1
CM031A	Cymbella minuta minuta	Hilse ex Rabenh. 1862	2	
CM103A	Cymbella silesiaca	Bleisch ex Rabenh. 1864	1	
CM003A	Cymbella sinuata sinuata	Greg. 1856	1	
DP003A	Diploneis oculata	(Breb.) Cleve 1894	3	
FR006A	Fragilaria brevistriata brevistriata	Grun. in Van Heurck 1885	24	31
FR009A	Fragilaria capucina capucina	Desm. 1825	2	
FR009H	Fragilaria capucina gracilis (Oestrup) Hustedt 1950		11	1
FR002B	Fragilaria construens binodis	(Ehrenb.) Grun. 1862	2	2
FR002A	Fragilaria construens construens	(Ehrenb.) Grun. 1862	1	
FR002C	Fragilaria construens venter	(Ehrenb.) Grun. in Van Heurck 1881	10	2
FR008A	Fragilaria crotonensis	Kitton 1869	21	
FR018A	Fragilaria elliptica	Schum. 1867		7
FR001A	Fragilaria pinnata pinnata	Ehrenb. 1843	16	7
FR056A	Fragilaria pseudoconstruens	Marciniak 1982		7
FR063A	Fragilaria robusta	(Fusey) Manguin	61	21
FR007A	Fragilaria vaucheriae vaucheriae	(Kutz.) J.B. Petersen 1938	1	

Gour de Tazenat

code	Name	Authority	Sample code TAZE 1 (Aug. 96)	TAZE 2 (May 98)
GO9999	Gomphonema sp.			1
GY005A	Gyrosigma acuminatum	(Kutz.) Rabenh. 1853		2
NA007A	Navicula cryptocephala cryptocephala	Kutz. 1844	2	
NA751A	Navicula cryptotenella	Lange-Bertalot 1985	3	1
NA771A	Navicula cryptotenelloides	Lange-Bertalot		1
NA433D	Navicula ignota acceptata	(Hustedt) Lange-Bertalot 1985	6	
NA042A	Navicula minima minima	Grun. in Van Heurck 1880	1	1
NA537A	Navicula notha	Wallace	5	
NA589A	Navicula pseudotuscula	Hustedt 1943		1
NA768A	Navicula reichardtiana	Lange-Bertalot		1
NA128A	Navicula schoenfeldii	Hust. 1930		2
NA063A	Navicula trivialis	Lange-Bertalot 1980	1	1
NA144A	Navicula utermoehlii	Hust. 1943	2	
NA027A	Navicula viridula viridula	(Kutz.) Ehrenb. 1836	1	
NI211A	Nitzschia bacillum	Hustedt in A.Schmidt et al 1922	11	2
NI015A	Nitzschia dissipata	(Kutz.) Grun. 1862	2	
NI093A	Nitzschia draveillensis	Coste & Ricard 1980		1
NI002A	Nitzschia fonticola	Grun. in Van Heurck 1881	2	
NI209A	Nitzschia incognita	Legler & Krasske 1940 non sensu Krasske 1941		1
NI043A	Nitzschia inconspicua	Grun. 1862		1
NI198A	Nitzschia lacuum	Lange-Bertalot 1980	3	2
NI009A	Nitzschia palea palea	(Kutz.) W. Sm. 1856		1
NI164C	Nitzschia sinuata tabellaria	(Grun.) Grun. ex Van Heurck 1885		1
NI9999	Nitzschia sp.		1	
PI9999	Pinnularia sp.		1	
ST009A	Stephanodiscus alpinus	Hust.	22	6
ST010A	Stephanodiscus parvus	Stoermer & Hakansson 1984	112	16
SY003A	Synedra acus acus	Kutz. 1844		1
SY011A	Synedra delicatissima delicatissima	W. Sm. 1853	34	98
SY009A	Synedra nana	Meister 1912	4	1
SY001C	Synedra ulna danica	(Kutz.) Van Heurck 1885	1	

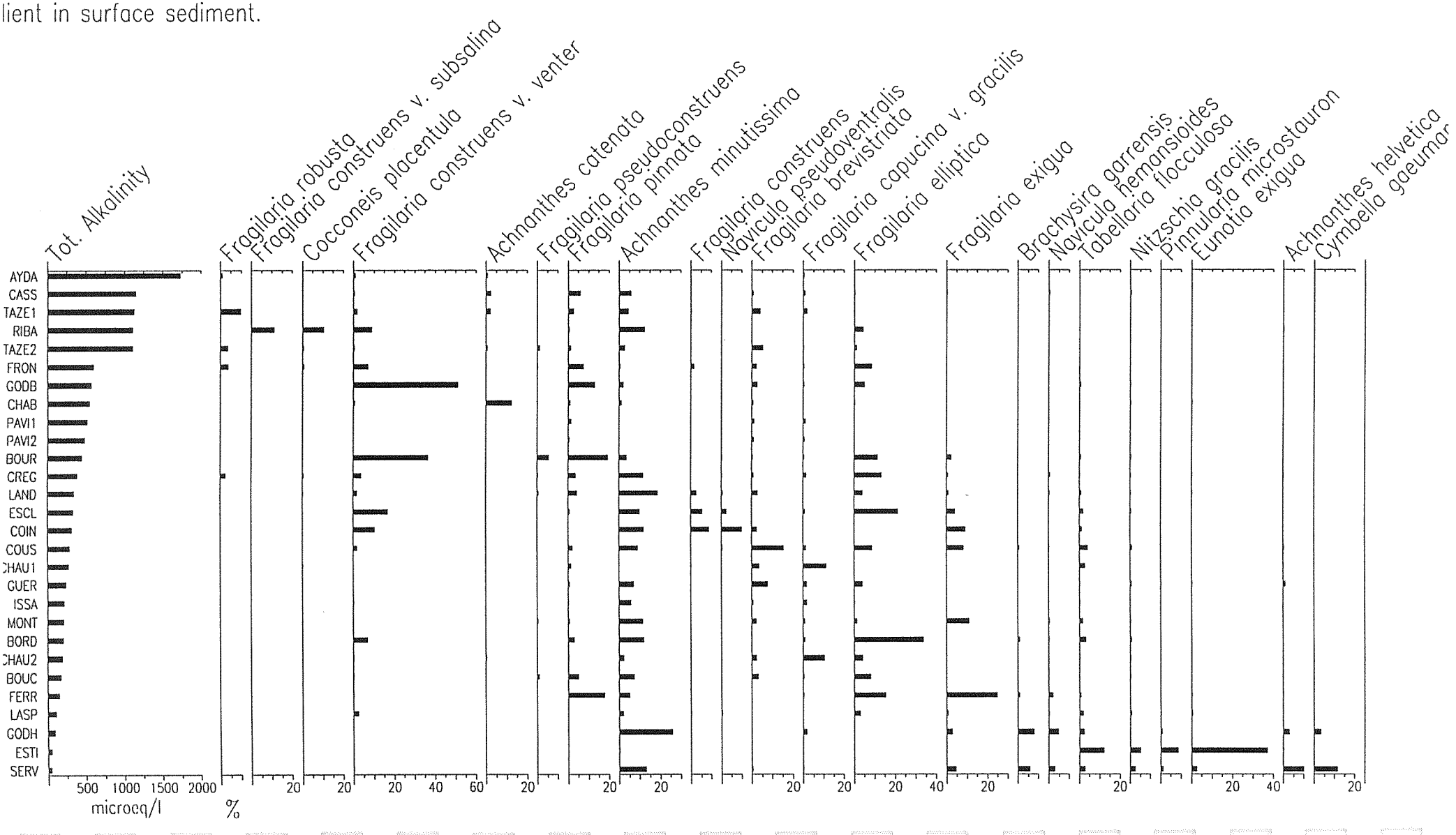
endix 2.2

tribution of the most common planktonic taxa along the alkalinity
ıdient in surface sediment.



dix 2.2

ibution of the most common periphytic taxa along the alkalinity
lient in surface sediment.



Appendix 2.3

Principal Component Analysis

As environmental variables are expressed in different units the option centring and standardisation by species was selected.
The PCA was performed with downweighting of rare species.

Summary statistics for the first four axes of PCA.

DCA axes	1	2	3	4
Eigenvalues	0.357	0.249	0.107	0.091
Variance explained (%)	35.7	60.6	71.3	80.4

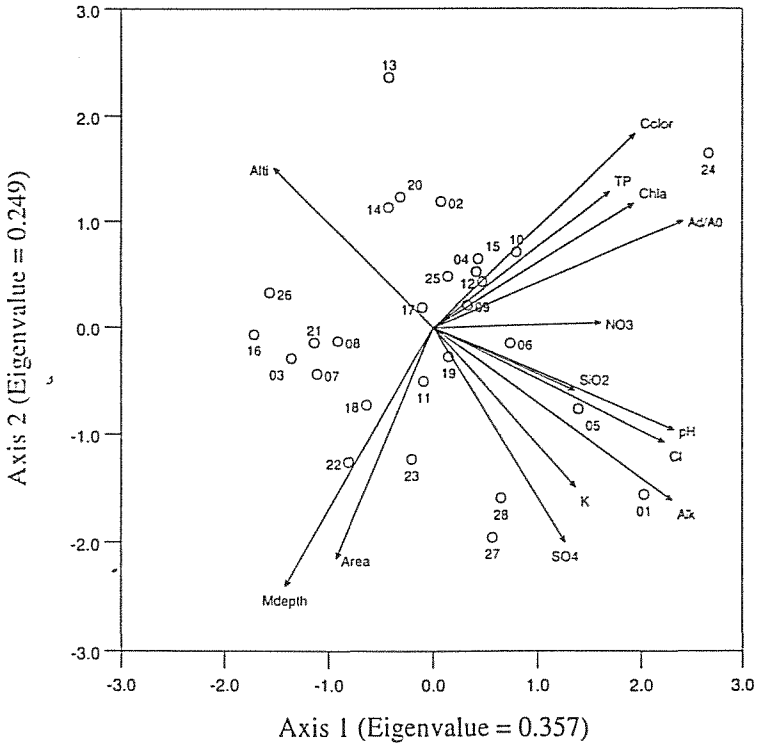
PCA-scores of environmental variables on the first 4 axes.

Variables	AX1	AX2	AX3	AX4
Alk	**766**	-537	139	-81
pH	**772**	-317	166	-45
K	455	-497	516	31
Cl	**741**	-357	-55	430
SO4	422	-667	-378	159
TP	566	430	460	54
NO3	538	16	-531	-432
SiO2	452	-196	162	-796
Chla	645	392	362	178
Color	649	611	-112	-24
Alti	-511	502	335	-356
Area	-309	-717	400	-152
Ad/A0	**802**	337	-303	-177
Mdepth	-473	**-803**	-127	-151

PCA correlation biplot showing 28 surface sediment samples (open circles) and 14 environmental variables (arrows).

Sample codes:

01 - AYDA	Aydat
02 - BORD	Bordes
03 - BOUC	Bouchet
04 - BOUR	Bourdouze
05 - CASS	Cassière
06 - CHAB	Chambon
07 - CHAU1	Chauvet 1 (Aug. 96)
08 - CHAU2	Chauvet 2 (May 98)
09 - COIN	Coindé
10 - COUS	Cousteix
11 - CREG	Crégut
12 - ESCL	Esclauze
13 - ESTI	Estivadoux
14 - FERR	Ferrand
15 - GODB	Godivelle-d'en-Bas
16 - GODH	Godivelle-d'en-Haut
17 - GUER	Guéry
18 - ISSA	Issarlès
19 - LAND	Landie
20 - LASP	Laspialades
21 - MONT	Monteineyre
22 - PAVI1	Pavin 1 (Aug. 96)
23 - PAVI2	Pavin 2 (May 98)
24 - RIBA	Ribains
25 - FRON	Saint Front
26 - SERV	Servières
27 - TAZE1	Tazenat 1 (Aug. 96)
28 - TAZE2	Tazenat 2 (May 98)



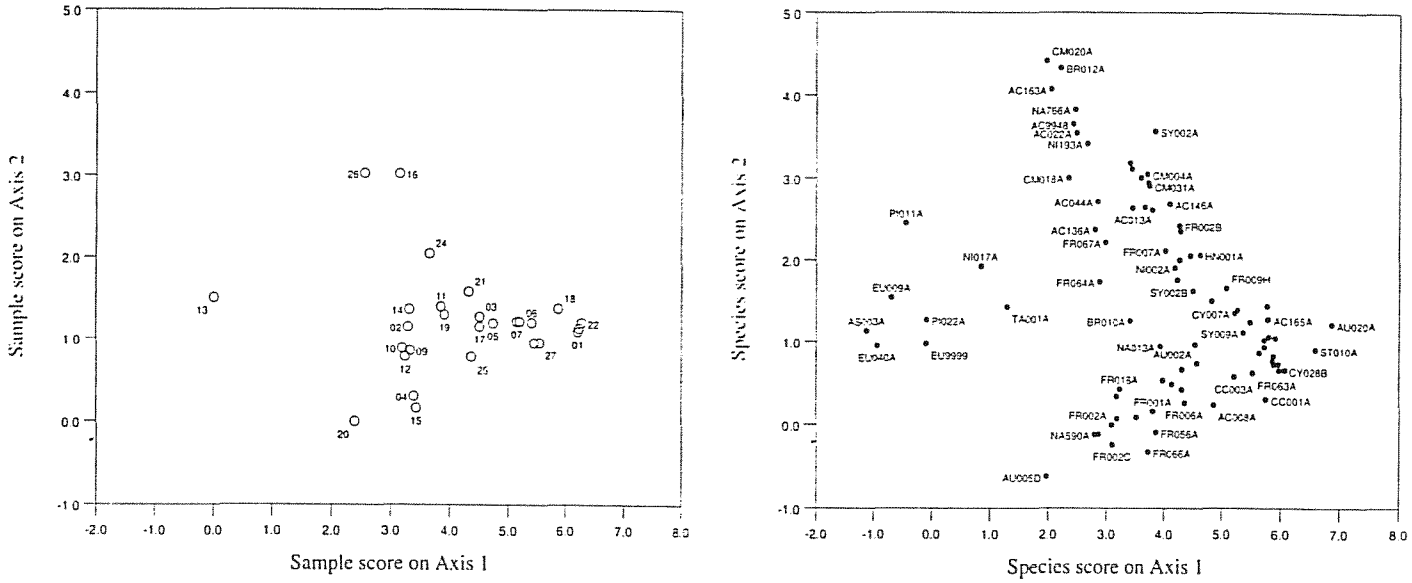
Appendix 2.4

Detrented Correspondence Analysis

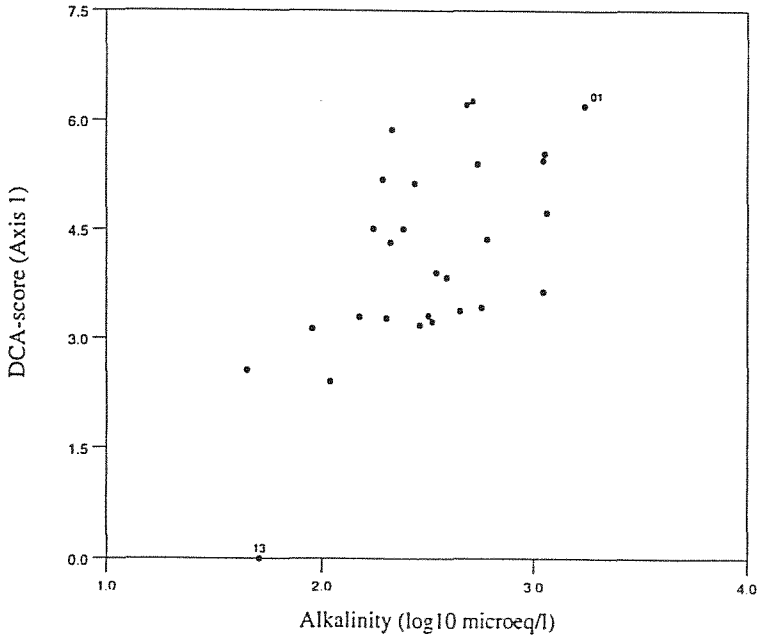
Detrending was done by segments with non linear rescaling of axes (ter Braak, 1988).
Rare species were downweighted.
Summary of DCA ordination of the diatom assemblages found in 28 surface sediment samples.

DCA axes	1	2	3	4
Eigenvalues	0.706	0.338	0.246	0.146
Lengths of gradient (std. dev. units)	6.265	3.031	2.139	2.059
Variance explained (%)	13.9	6.6	4.9	2.9

DCA plot of axes 1 and 2 with 28 samples, shown as open circles and 90 diatom species (the most common taxa only), shown as closed black circles.



Relationship between the scores on the first DCA axis and observed water alkalinity.



Appendix 2.5

Canonical Correspondance Analysis

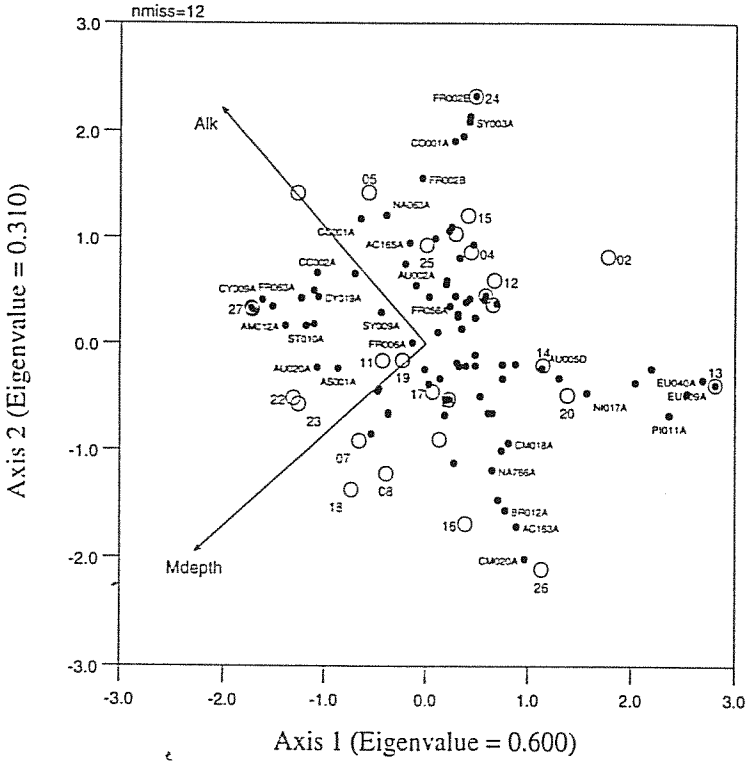
Summary statistics for the first four axes of CCA, with 28 sites, 90 diatom species.

CCA axes	1	2	3	4
a) with 22 environmental variables				
Eigenvalues	0.695	0.601	0.451	0.397
Species-environment correlations	0.995	0.978	0.975	0.993
Cummulative % variance:				
- of species data	13.7	25.5	34.3	42.2
- of species-environment relationship	15.3	28.6	38.5	47.3
b) with 2 selected environmental variables				
Eigenvalues	0.600	0.310	0.625	0.489
Species-environment correlations	0.945	0.880	0.0	0.0
Cummulative % variance:				
- of species data	11.8	17.9	30.2	39.8
- of species-environment relationship	65.9	100.0	0.0	0.0

Variance potentially explained by each environmental variable before forward selection and variable explained with the addition of each environmental variable during forward selection of CCA.

Variable	Before forward selection	Added with selection
Maximum depth	0.48	0.48
Alkalinity	0.44	0.43
Lake area	0.42	
Color	0.37	
SiO_2	0.33	
SO_4	0.32	
K	0.32	
pH	0.31	
Altitude	0.27	
Ad/A0	0.25	
Total Phosphorus	0.24	
Chlorophyll a	0.24	
NO_3	0.23	
Cl	0.20	
Sum of variance	3.24	0.91

CCA biplot of a reduced data set set (28 samples, 14 environmental variables) showing samples (open circles), species (filled circles) and environmental variables (arrows). A forward selection of environmental variables showed that only total alkalinity (Alk) and maximum depth (Mdepth) were statistically significant. For species and samples codes see Appendices 2.1 and 2.4, respectively.



Canonical coefficients of the 4 environmental variables retained after forward selection, their *t*-values, and their inter-set correlations.

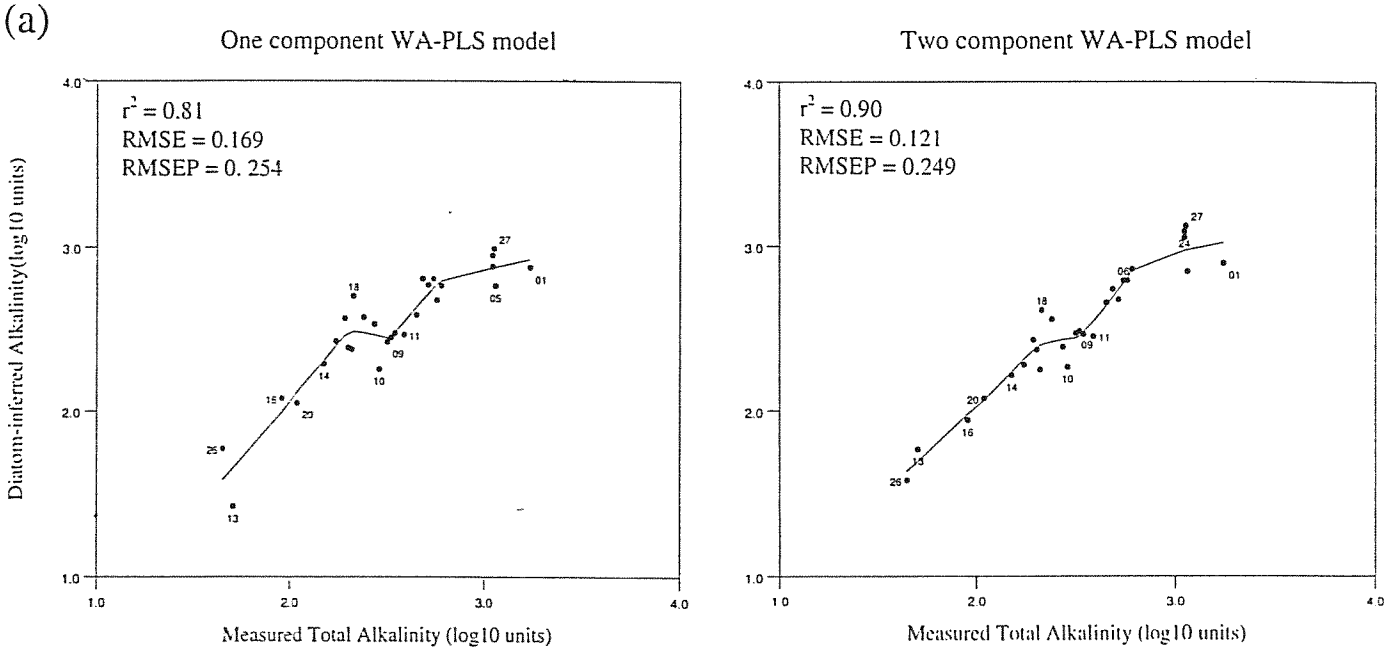
Environmental variable	Canonical coefficients		t-values of canonical coefficients		Inter-set correlation	
	Axis 1	Axis 2	Axis 1	Axis 2	Axis 1	Axis 2
Alkalinity	-6.51	7.60	-0.94	0.70	-6.36	6.50
Maximum depth	-7.39	-6.74	-1.06	-0.62	-7.17	-5.72

Appendix 2.6

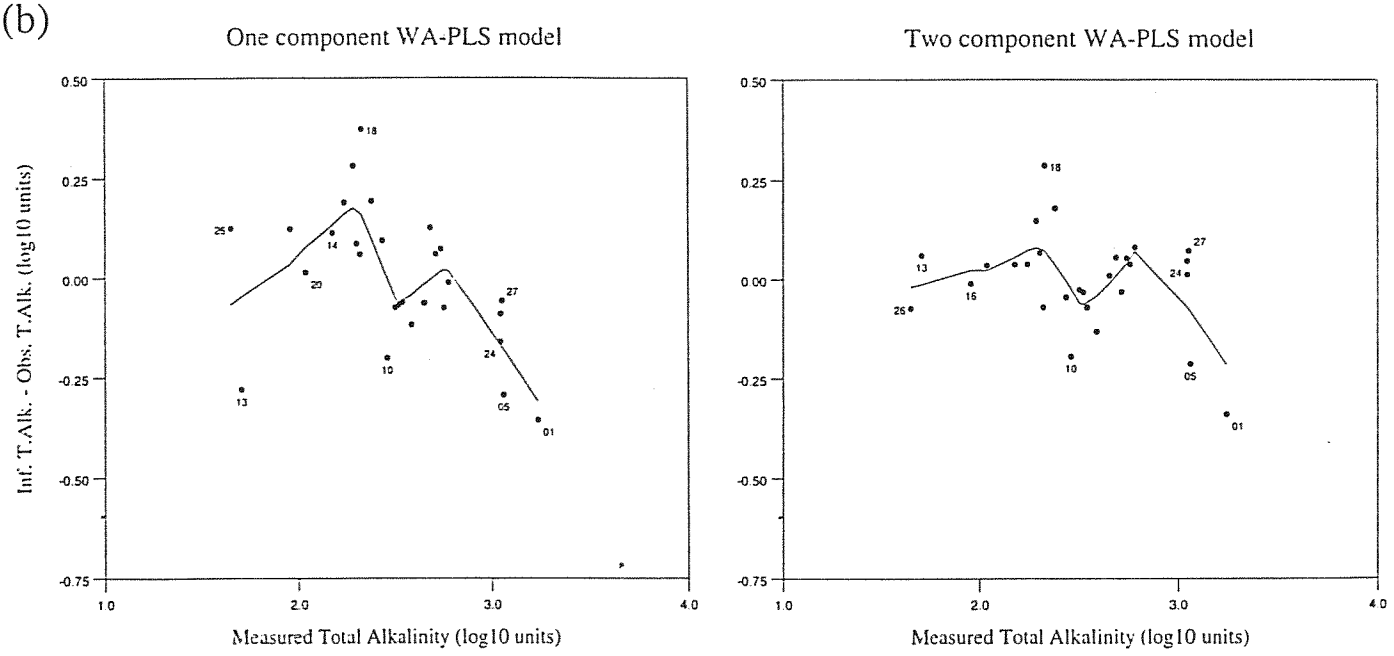
Inferrence models developed from surface sediment dataset.

Relationship between (a) diatom-inferred Total Alkalinity and (b) residuals (inferred T.Alkalinity - observed T. Alkalinity) and observed Total Alkalinity for the one and two component WAPLS models. Total Alkalinity is expressed in $\log_{10}(x)$ units where x is measured in $\mu eq.l^{-1}$.

(a)

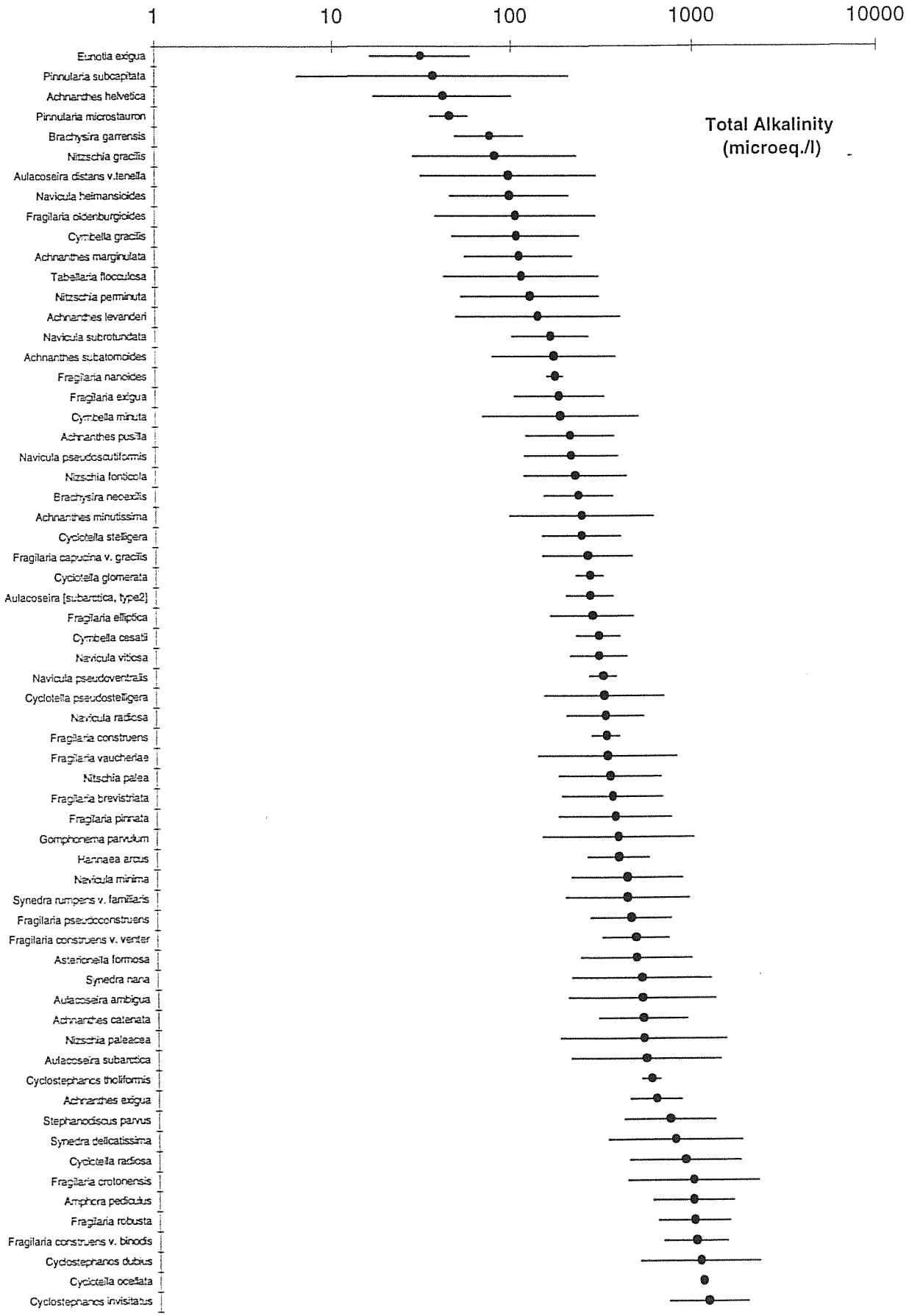


(b)



Diatom alkalinity optima and tolerances

Total Alkalinity estimated optima (abundance-weighted means) and tolerances (abundance-weighted standard deviations) of diatom taxa with maximum abundance >2% and occurences in three or more samples. The values obtained are back transformed of the $\log_{10}(X)$ values used in developing calibration models.

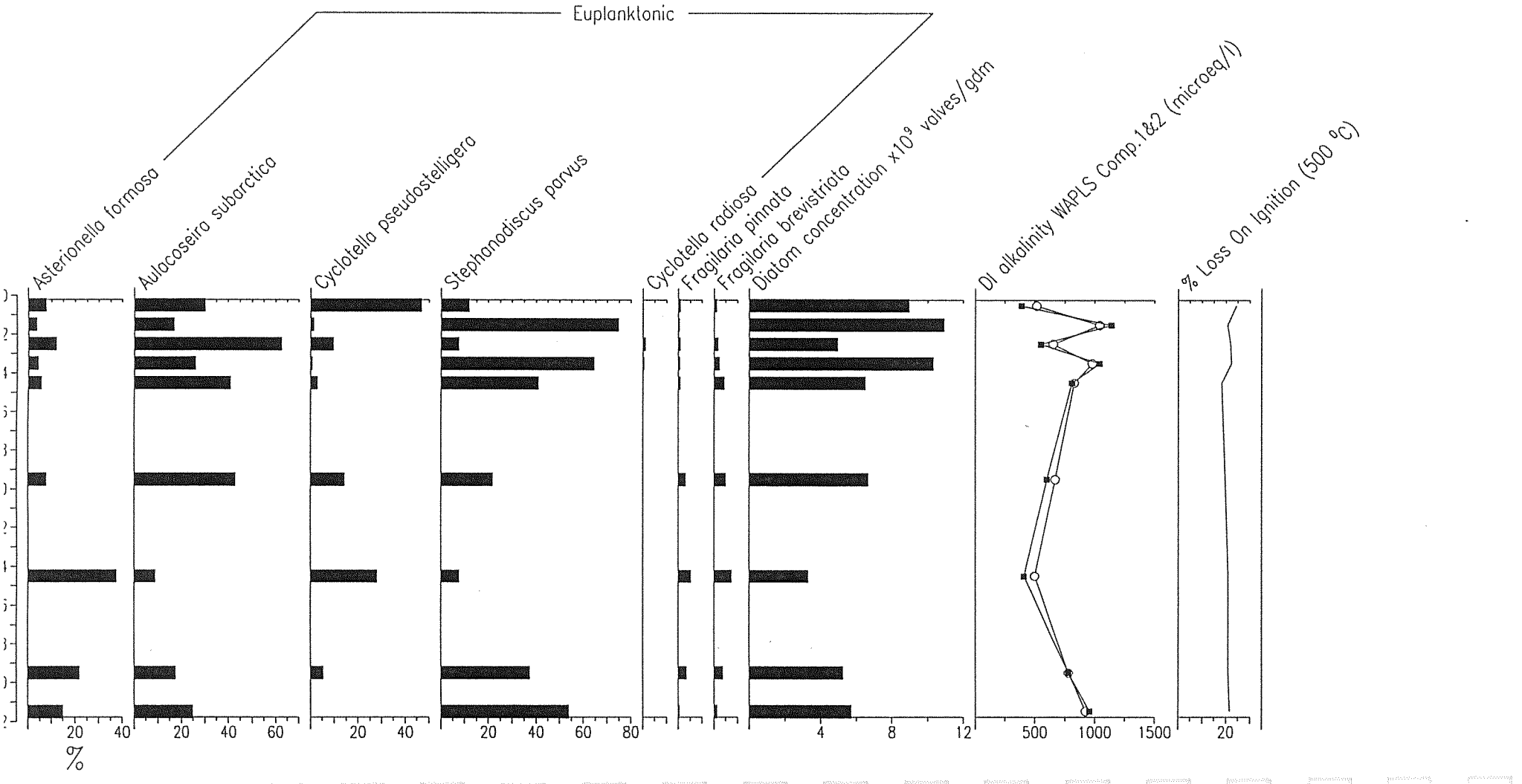


endix 2.8

c pavin

core – August 1996

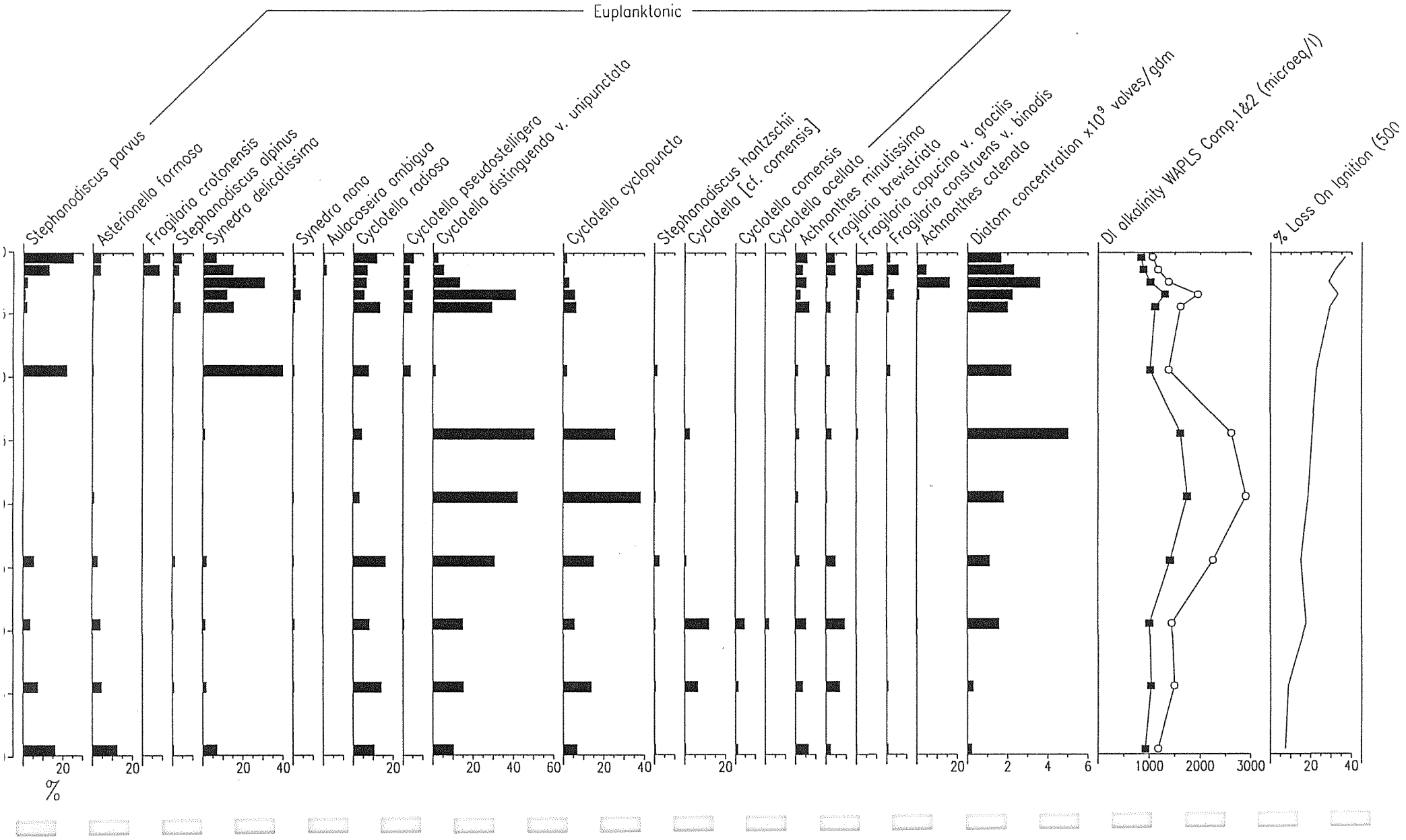
ıary diatom diagram and Diatom Inferred alkalinity



endix 2.8

ur de Tazenat

core – August 1996: Summary diatom diagram
n-Inferred alkalinity (WAPLS models: Component 1 & 2)



Optima and tolerance for diatom taxa common at both datasets

Alkalinity values are expressed in $\log_{10}$ µeq/l, species code are given in Appendix 2.1.

Summary statistics	Phytoplankton dataset	Surface sediment dataset
Number of samples	63	28
Mean	2.74	2.50
Standard Error	0.04	0.08
Median	2.78	2.51
Standard Deviation	0.31	0.40
Sample Variance	0.10	0.16
Kurtosis	-1.15	-0.10
Skewness	-0.32	-0.25
Range	1.22	1.59
Minimum	2.16	1.65
Maximum	3.38	3.24

Phytoplankton dataset

Code	Occurences	Max. abundance	N2	Optimum	Tolerance
AC008A	5	1.1	3.928	2.8162	0.4065
AC013A	52	33.11	13.5821	2.5532	0.3474
AC165A	31	80.69	9.3334	2.7431	0.2762
AM012A	14	2.75	9.857	2.9564	0.2473
AS001A	53	73.58	14.1947	2.7319	0.3033
AU002A	29	75.58	9.1403	2.9826	0.2008
AU020A	47	97.38	15.7877	2.7329	0.3168
AU9986	14	24.74	6.6178	2.4096	0.2229
CC001A	8	8.77	3.7662	2.9668	0.125
CC002A	6	2.26	3.7501	2.7816	6.20E-02
CC003A	14	92.68	1.5913	2.7419	0.1121
CM004A	5	1.1	3.6167	2.97	0.2707
CM031A	13	2.79	7.7168	2.577	0.3665
CO001A	17	1.11	13.7318	2.7651	0.3441
CY002A	52	65.13	21.1093	2.5592	0.3108
CY009A	12	55.68	2.2466	3.0012	5.45E-02
CY019A	47	70.56	12.477	2.8996	0.2713
CY028B	2	26.35	1.019	2.9928	0.2097
CY9987	4	4.05	1.7875	2.9249	0.3335
FR001A	35	6.33	19.1295	2.7315	0.3237
FR002A	4	1.97	2.5825	2.5662	0.4345
FR002C	12	4.59	4.3256	2.6519	0.2731
FR006A	31	41.62	13.6026	2.6779	0.3553
FR007A	35	3.67	17.4225	2.7961	0.3388
FR008A	21	44.66	6.7731	2.7382	0.388
FR009H	42	56.51	10.4617	2.5824	0.2592
FR018A	24	16.18	10.4452	2.7135	0.3847
FR056A	3	15.84	1.9354	3.0812	2.55E-02
FR063A	13	17.85	7.6709	2.9701	0.2611
GO013A	12	1.86	8.8629	2.7134	0.3689
HN001A	7	1.85	4.4894	2.35	0.129
NA042A	22	1.55	17.1424	2.7248	0.3516
NA766A	7	1.23	5.9824	2.3538	7.43E-02
NI002A	23	7.59	9.9214	2.7607	0.3199
NI009A	17	3.69	10.8304	2.7582	0.3144
NI017A	13	1.31	11.3131	2.7791	0.2769
NI033A	14	9.34	5.8094	2.7641	0.1632
NI193A	6	1.19	5.5389	2.5709	0.2842
ST009A	4	20.09	2.7038	3.0506	9.49E-03
ST010A	32	63.57	6.7068	2.7974	0.1709
SY002A	31	18.27	8.2588	2.7245	0.1706
SY002B	10	4.68	3.4602	2.6012	0.2669
SY009A	29	21.23	9.5598	2.7005	0.389
SY011A	40	29.8	14.4198	2.8204	0.3222
SY9988	4	20.62	1.3352	3.3297	0.2516
SY9989	16	46	3.3315	2.8322	0.1433
TA001A	13	1.31	10.2824	2.3748	0.2256
ZZZ973	5	26.8	1.8813	3.0145	3.95E-02

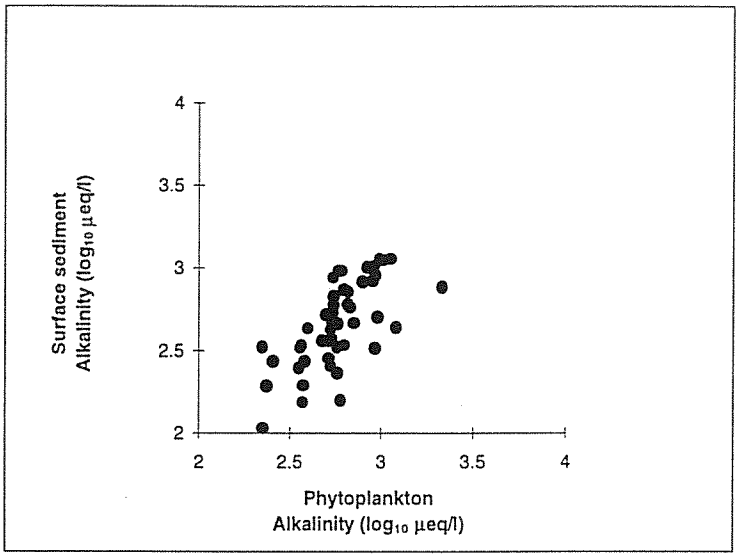
Surface sediment dataset

Code	Occurences	Max. abundance	N2	Optimum	Tolerance
AC008A	4	2.38	1.9799	2.7811	0.2352
AC013A	23	25.9	14.6217	2.3925	0.3864
AC165A	7	12.4	2.085	2.8269	0.2471
AM012A	5	2.36	2.8881	2.9193	0.3283
AS001A	23	16.53	9.3103	2.6736	0.3002
AU002A	16	27.78	4.4684	2.699	0.3276
AU020A	13	52.76	4.3575	2.7298	0.3603
AU9986	7	22.2	2.8929	2.4343	0.1457
CC001A	2	3.57	1.9996	3.011	0.3248
CC002A	5	5.41	2.0696	2.9785	0.1802
CC003A	4	4.13	2.2642	2.7745	0.1037
CM004A	11	2.94	5.3276	2.5114	0.481
CM031A	16	2.99	9.874	2.2867	0.4056
CO001A	7	10.2	1.5425	2.9789	0.2682
CY002A	25	37.82	11.3126	2.5158	0.3245
CY009A	3	12.31	1.207	3.0451	1.05E-02
CY019A	12	12.4	5.5261	2.913	0.3188
CY028B	2	2.07	1.8605	3.0483	5.09E-03
CY9987	3	2.53	1.4524	3.0014	0.3103
FR001A	23	19.29	8.2665	2.572	0.2952
FR002A	7	8.86	3.0689	2.5301	0.1227
FR002C	21	51.09	5.0509	2.6634	0.2094
FR006A	20	15.38	8.4661	2.5579	0.2792
FR007A	18	3.45	9.7755	2.5304	0.3788
FR008A	7	4.07	4.3418	2.941	0.3573
FR009H	22	11.38	6.0328	2.4318	0.2725
FR018A	19	33.76	8.899	2.452	0.2339
FR056A	7	5.51	2.5927	2.6362	0.261
FR063A	5	9.7	3.2077	2.9526	0.2129
GO013A	15	4.71	8.7324	2.5587	0.3931
HN001A	4	5.18	1.9608	2.5179	0.1783
NA042A	21	4.39	10.1884	2.6266	0.3041
NA766A	10	4.58	4.0201	2.027	0.3741
NI002A	19	4.02	9.3875	2.3631	0.2932
NI009A	12	2.39	5.8719	2.5213	0.301
NI017A	15	2.31	6.9506	2.1968	0.4647
NI033A	9	2.35	5.1621	2.6607	0.3729
NI193A	12	5.18	4.0592	2.1855	0.3698
ST009A	2	3.5	1.5328	3.0493	5.09E-03
ST010A	10	23.36	4.626	2.8677	0.2449
SY002A	12	12.75	3.5758	2.4062	0.5502
SY002B	10	2.38	7.1894	2.6342	0.3181
SY009A	12	3.52	6.4149	2.7151	0.3648
SY011A	16	16.53	5.598	2.8529	0.3736
SY9988	3	5.43	1.9954	2.8814	0.6145
SY9989	2	16.14	1.1601	2.759	0.2295
TA001A	17	4.04	11.1682	2.2825	0.3034
ZZZ973	1	4.55	1	3.0438	0.2792

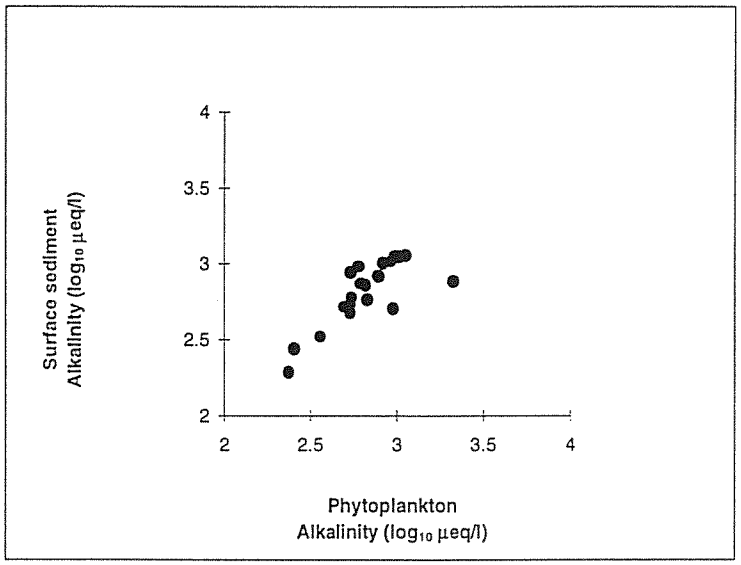
Appendix 3.1

Comparison of Weighted-average optima obtained from the phytoplankton and surface sediment datasets.

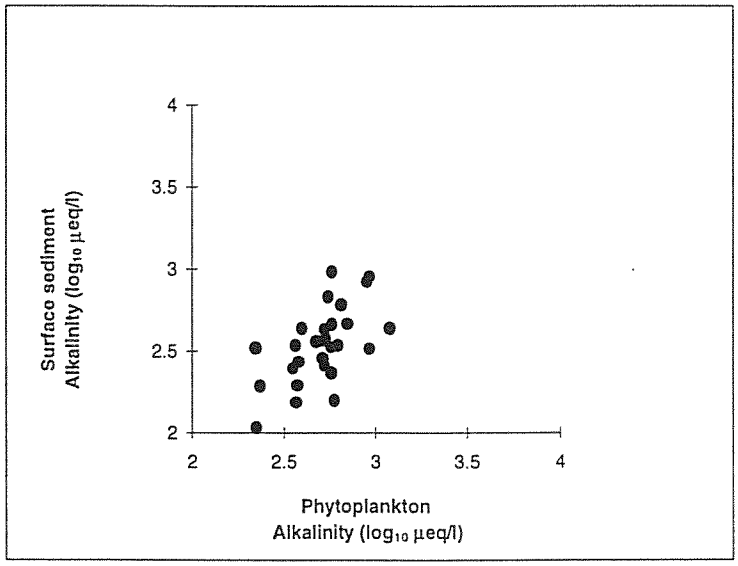
Correlation between WA optima obtained from the phytoplankton and surface sediment assemblages (all taxa common to both datasets are included).



Correlation between WA optima obtained from both datasets for planktonic taxa only.



Correlation between WA optima obtained from both datasets for non-planktonic taxa only.

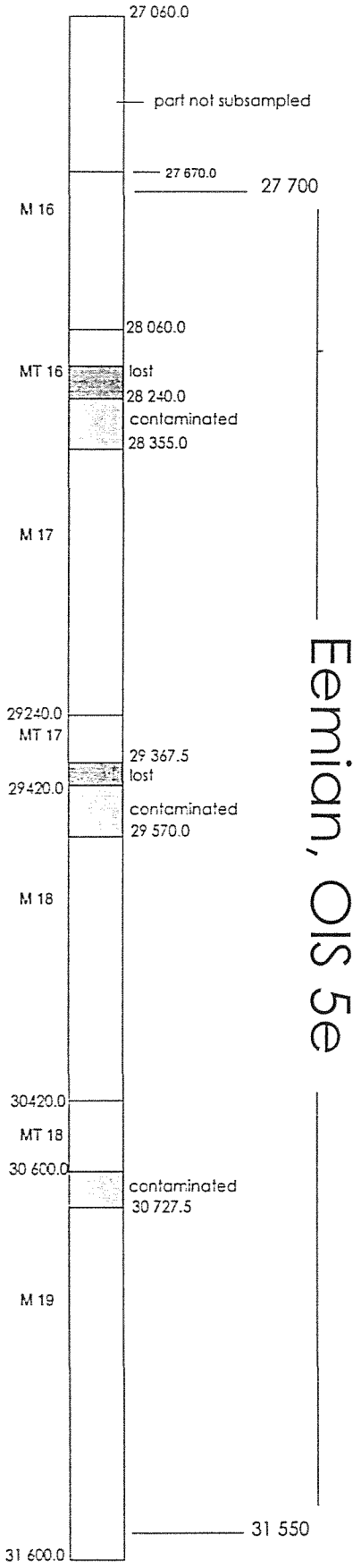


Ribains mastercore

Sections M16 to M19, recording the Last Interglacial (Eemian)

- Levels are expressed in mm below surface
- Subsamplling every 2.5 mm

- Number of samples: around 1360



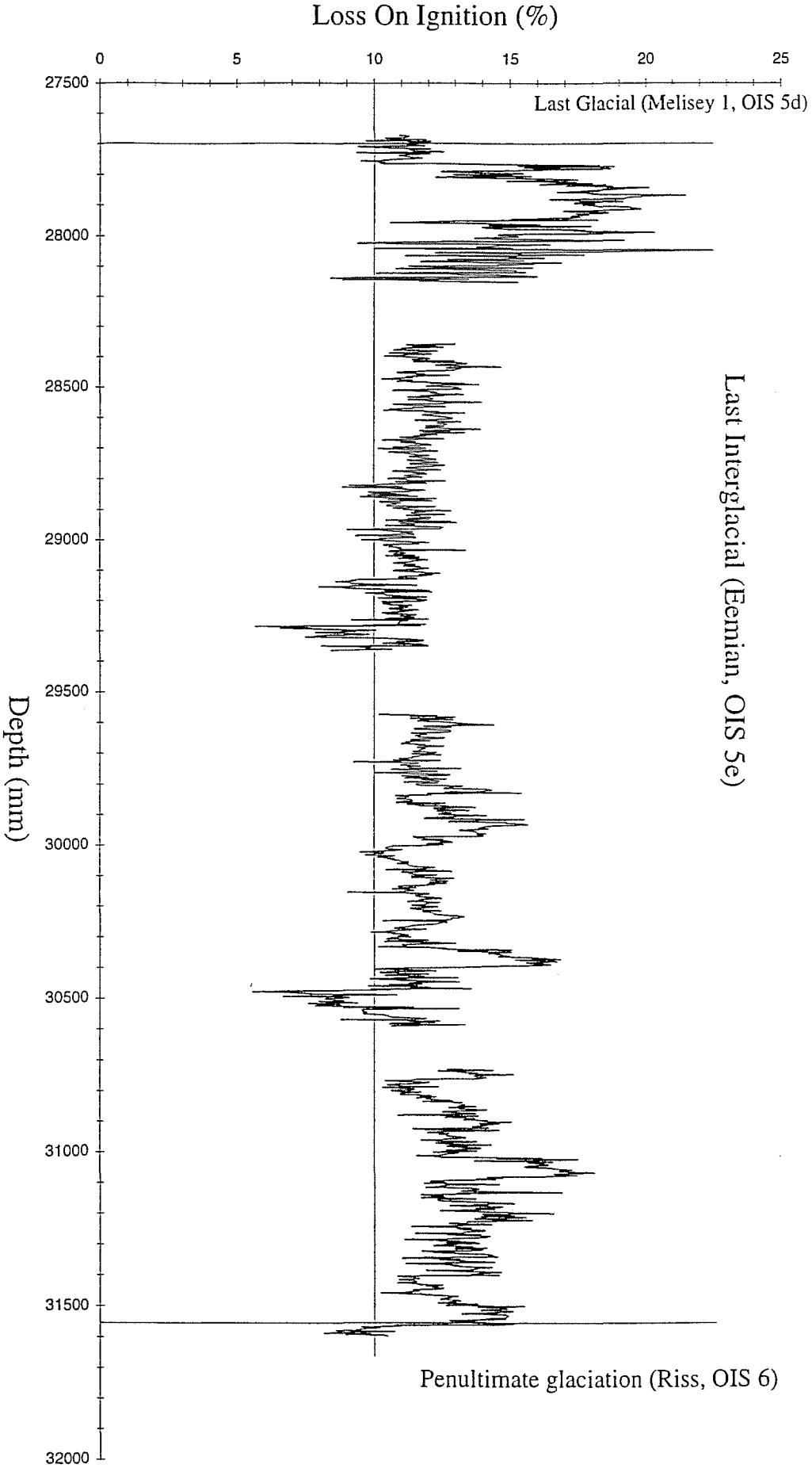
The Eemian Interglacial:

- Duration: from ~130 to ~117 Kyr BP (Van Andel & Tzedakis, 1996)
- Sediment accumulation rate estimation:

3850 mm / 13000 yr = ~0.3 mm/yr

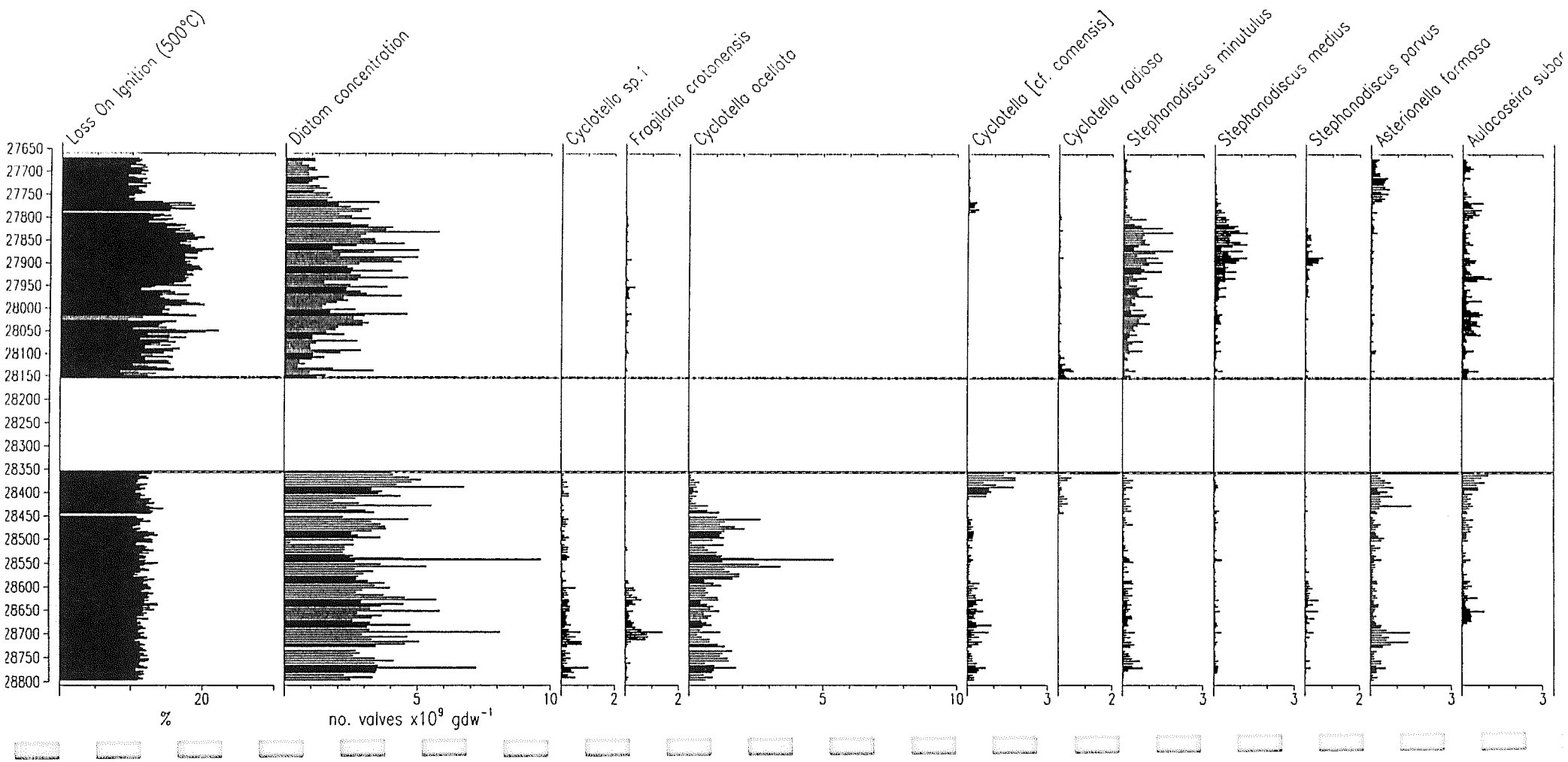
2.5 mm represent ~8.5 yrs

Percentage loss on ignition (LOI) for sections M16 to M19 of Ribains core. Gaps in the profile correspond to material not recovered during coring on site.



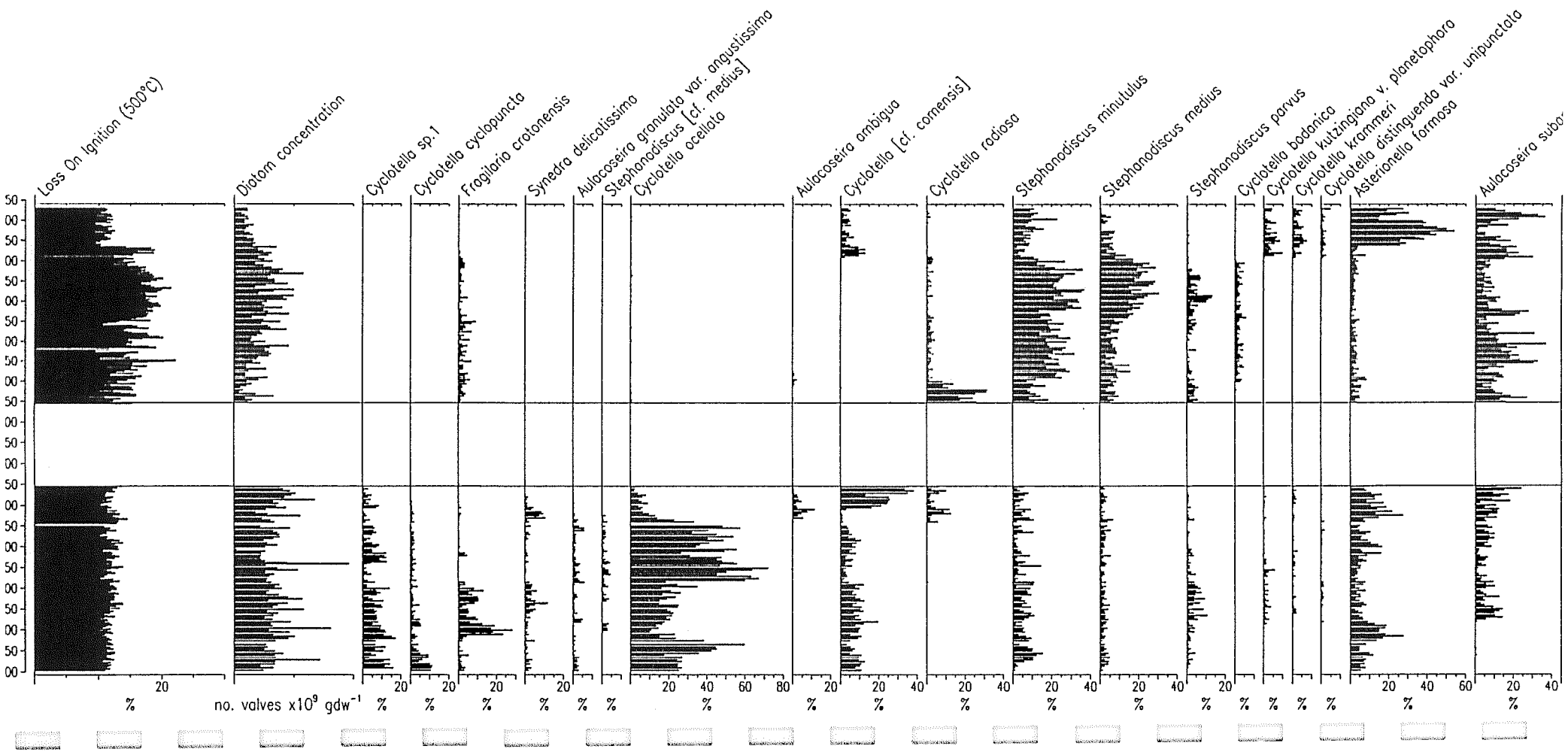
Appendix 4.3

Concentration (valves × 10^9 g^{-1} dry weight sediment) of major diatoms in Ribains core (sections M16 and M17 corresponding to the transition between the Eemian and the last glacial).



Appendix 4.4

Relative abundance (%) of the major planktonic diatom species in Ribains core (sections M16 and M17 corresponding to the transition between the Eemian and the last glacial).



Appendix 4.5

Relative abundance (%) of the major periphytic diatom species in Ribains core (sections M16 and M17 corresponding to the transition between the Eemian and the last glacial).