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**Diatom based transfer function
for estimating the chemical composition of fossil water.
Calibration based on salt lakes of the Lipez area
in the southwestern Bolivian Altiplano.**

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MAURICE ROUX³

Abstract: Diatom assemblages and water chemistry were studied in 13 shallow salt lakes in the southern part of the Bolivian Altiplano. At each locality bottom sediment and water samples were collected simultaneously. Relationships between the composition of the diatom assemblages and variations in water chemistry were collated in order to permit the estimation of ancient water chemistries based on changes in the make up of fossil diatom associations in older sediments. Weighted Averages treated by Partial Least Squares regression (WA and WA-PLS methods) allowed an estimation of optima and the relative tolerances of 61 species to variations in salinity and to the relative quantities of the 15 chemical elements studied, among them boron and lithium.

Key Words: Flora; diatom; Bolivia; Quaternary; water ionic content; water chemistry; transfer function; ecology

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Résumé : *Fonction de transfert pour l'estimation de la composition chimique des eaux fossiles à partir des diatomées. Calibration sur des lacs salés du Lipez, SW de l'Altiplano bolivien.*- L'étude des assemblages de diatomées et de la composition chimique des eaux a été effectuée dans 13 lacs salés peu profonds localisés dans le Sud de l'Altiplano Bolivien. Les points et les dates de prélèvement sont les mêmes pour les deux types d'étude. Les relations entre les assemblages de diatomées et les variables chimiques mesurées sont effectuées dans le but d'estimer ces variables dans le passé à partir des diatomées fossiles conservées dans les sédiments. La méthode des moyennes pondérées (WA et WA-PLS régression) a permis d'estimer les optima et les tolérances de 61 espèces à la salinité et aux différents éléments chimiques dont le bore et le lithium.

Mots-Clefs : Flore ; diatomée ; Bolivie ; Quaternaire ; composition ionique ; chimie des eaux ; fonction de transfert ; écologie

Introduction

It is now well-known that during the last 30,000 years the water level of the lacustrine basins of the Bolivian Altiplano varied markedly. Organisms such as ostracods, diatoms and plant remains preserved in the sediments suggest that modifications in the balance between precipitation and evaporation were associated with drastic changes in salinity. In Lake Titicaca, the highest salinities occurred during the early and mid-Holocene when the level of the lake was below the spillway. In the Uyuni-Coipasa closed basin, salinities remained high even when the levels of the lake were highest. The processes involved in arriving at

such high levels of ionic concentration in ancient deep lakes and the associated climatic conditions are still not well identified. To resolve this problem, future research will require estimations as accurate as possible of salinities in ancient lakes and their variations throughout time. Diatoms are the best tool for attaining this objective because they are always present in the cored sediments. Moreover, existing environments offer a large range of salinities ranging between the very low levels in the lakes and wetlands of the glacial valleys and the very high concentrations of the shallow lakes in the arid areas of the southern Altiplano of Bolivia.

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Figure 1: Map of Bolivia. Map showing the location of the western Lipez. From West to East, the area is divided into 4 main geomorphic units: the Western Cordillera, the Altiplano, the Eastern Cordillera and the Amazonian « llanos ».

The first work linking diatom assemblages with ionic composition in existing environments (SERVANT-VILDARY & ROUX, 1990) was carried out in the southwestern part of the Bolivian Altiplano (South-Lipez). It served as the basis for an estimate of statistical relationships used to reconstruct the paleosalinity during the last Glacial period of a paleolake in the same area (ROUX, SERVANT-VILDARY & SERVANT, 1991). Recently, 11 samples collected near the northern border of the Salar de Uyuni permitted the addition of 11 modern samples to the preexisting data set of this time frame (SYLVESTRE, SERVANT-VILDARY & ROUX, 2001).

In this paper, we present a revision of the data from the Lipez area. Samples from the Salar de Uyuni were not used because measurements on boron and lithium concentrations are lacking. This revision is based on two regression methods: weighted averaging (WA) leave-one-out and weighted averages plus least squares (WA-PLS). Moreover, we present an extensive diatom iconography, not published previously.

A. The studied area

The western Lipez area is located in the southernmost part of the Bolivian Altiplano (21° - 22° S, 67° - 68° W), near the boundary with Chile at around 4,500 m elevation (Figures 1 and 7).

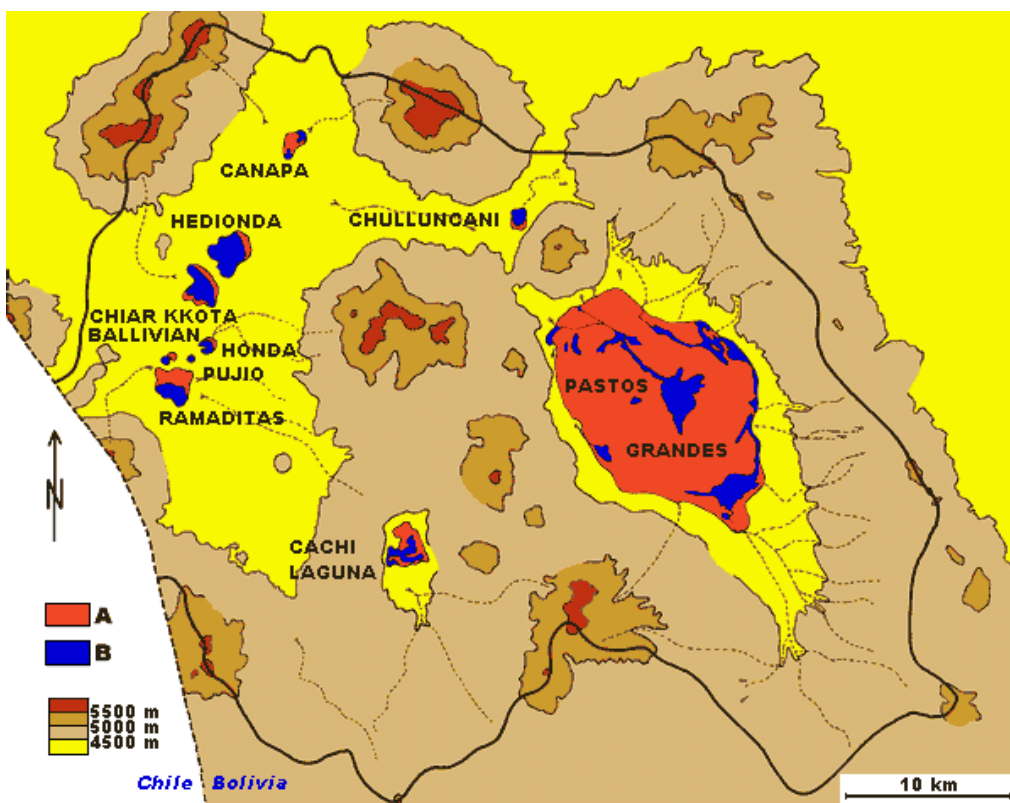


Figure 2: Location of the lakes. Location of the lakes where modern diatoms have been studied in the Pastos Grandes area. See Figure 4 for the locations of Laguna Colorada, Puripica and Laguna Verde lakes, sited farther south (after BALLIVIÁN & RISACHER, 1981, modified).

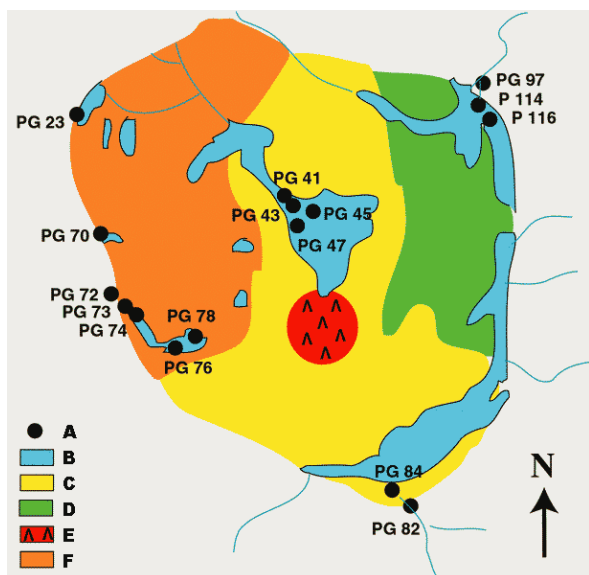


Figure 3: Pastos Grandes. Location of the surface sediment samples taken for diatom analyses.

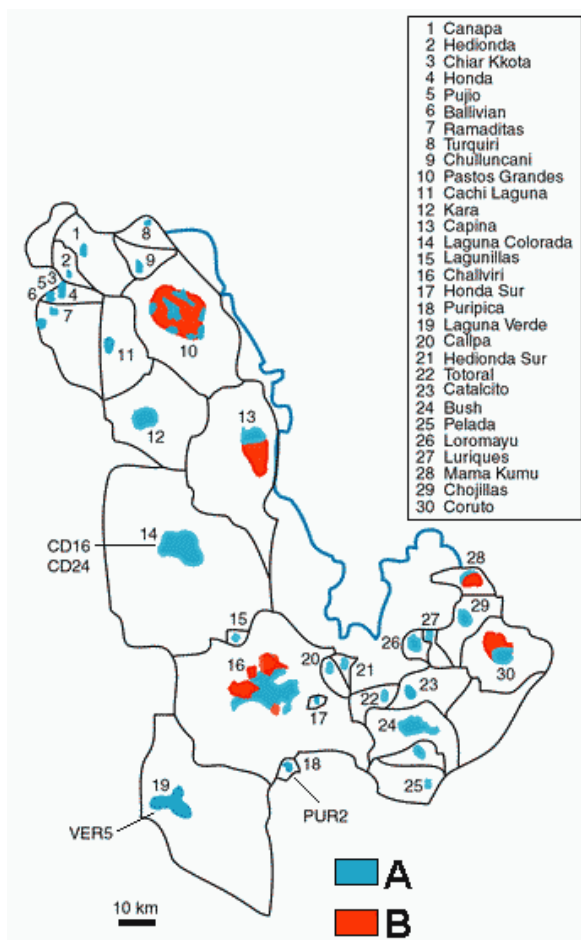


Figure 4: Location of the lakes. Location of the lakes in the Lipez area where water chemistry was studied.

The climate is cold and dry; the lowest temperatures are on the order of -30°C , precipitation is 50 mm annually and evaporation 1,000-1,500 mm annually. The daily range in temperature is as much as 20°C . In winter (June - August), the area is influenced by mid-latitude atmospheric currents from the

west, winds are strong (60 km/h), snow falls occasionally. In summer (December - February), precipitation is fed principally by water vapor from Amazonia.

Geological formations are predominantly volcanic: Mio-Pliocene ignimbrites and Quaternary volcanoes; a few are still active. These volcanic formations occupy very extensive tracts in the western Cordillera and in the southern part of the Bolivian Andes along the Argentina frontier.

The Lipez intravolcanic basins (Figures 2-4) are occupied by shallow endoreic lakes and evaporites (Figures 8-13). Calcareous crusts (Figure 14) and pisolites (Figure 15) are well developed at Pastos Grandes (RISACHER & EUGSTER, 1979; JONES & RENAUT, 1994).

These basins are fed mainly by groundwaters, at least in part, as in the Altiplano of the northern Chile (GEYH, GROSJEAN *et alii*, 1999), recharged during the Quaternary humid cycles, particularly in Late Glacial times. Seasonal and annual fluctuations in water-levels are small.

The lacustrine terraces observed on the edges of the basins (Figures 10-11, 13 and 16-17) (FERNANDEZ, 1980; SERVANT & FONTES, 1978) show three main highstands. They are correlated respectively with the three lacustrine phases in the Uyuni-Coipasa basin (SERVANT, FOURNIER *et alii*, 1995; SYLVESTRE, 1997; SYLVESTRE, SERVANT-VILDARY *et alii*, 1999): Minchin ($> 20,000$ ^{14}C yrs BP), Tauca (15,500-12,000 ^{14}C yrs BP) and Coipasa ($\sim 9,000$ ^{14}C yrs BP). Great changes in water-level and salinity have been inferred from diatom assemblages in the Ramadritas-Ballivián Basin (ROUX, SERVANT-VILDARY & SERVANT, 1991; SERVANT-VILDARY & MELLO E SOUZA, 1993).

B. Water chemistry

The waters are characterized by a high ionic content. Essentially, they are sodium chlorides. Some are rich in boron and lithium (Table 1) (RISACHER, 1992a, 1992b; RISACHER & FRITZ, 1991a, 1991b, 1992, 1995).

Methods of analysis

- Alkalinity: titration by automatic potentiometry
- Cations: Na^+ , K^+ , Li^+ , Ca^{++} , Mg^{++} : atomic absorption spectrometry (standard methods)
- Anions and neutral species: automatic colorimetry (Technicon autoanalyzer)
- Cl^- : mercuric thiocyanate method
- SO_4^{--} : complexation by methythymol blue
- SiO_2 : complexation by ammonium molybdate and reduction with ferrous iron
- B: complexation by azomethane H

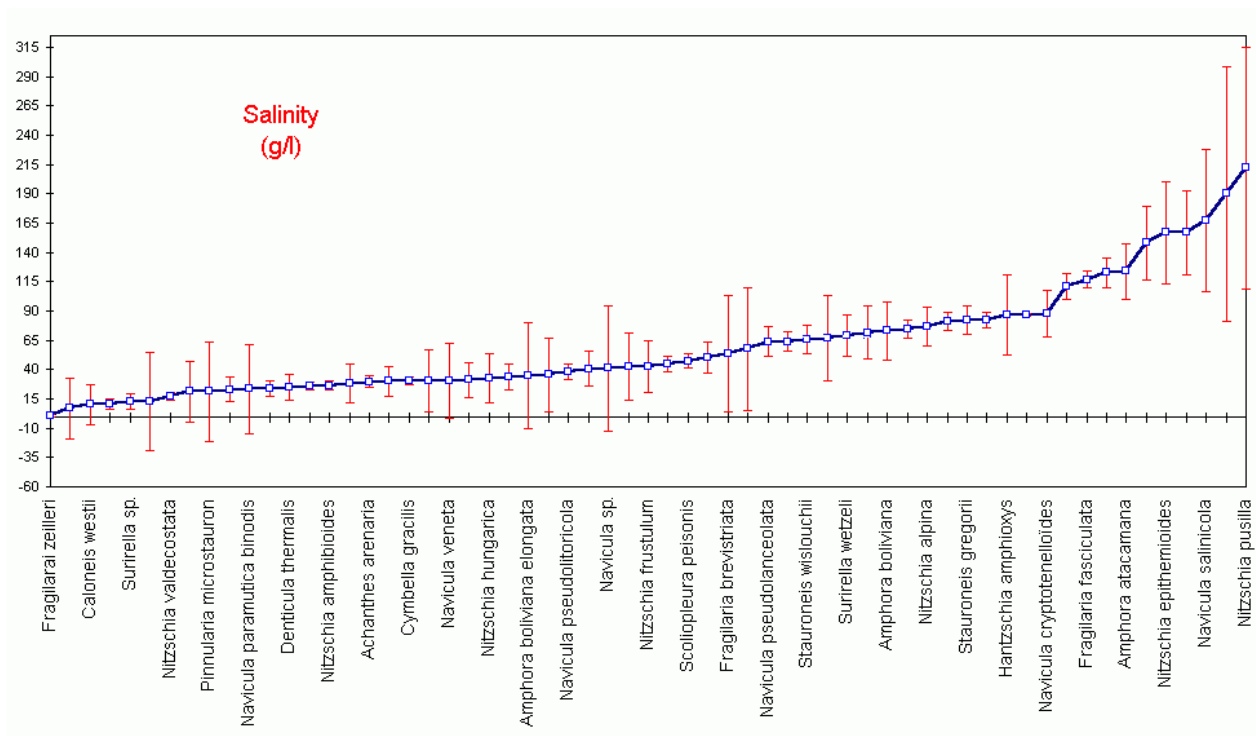


Figure 5A: WA method. Estimated optima and tolerances of 61 species to salinity (All with maximum abundance > 3 and occurrence in three or more samples).

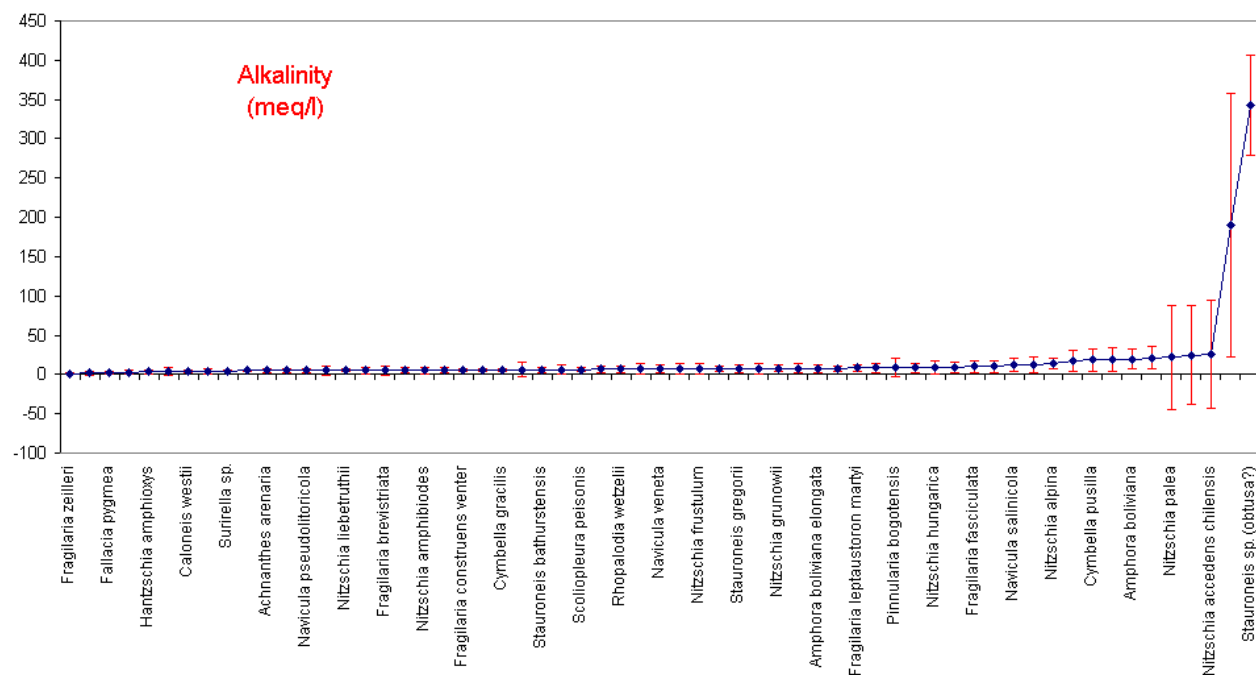


Figure 5B: WA method. Estimated optima and tolerances of 61 species to alkalinity (with maximum abundance > 3 and occurrence in three or more samples).

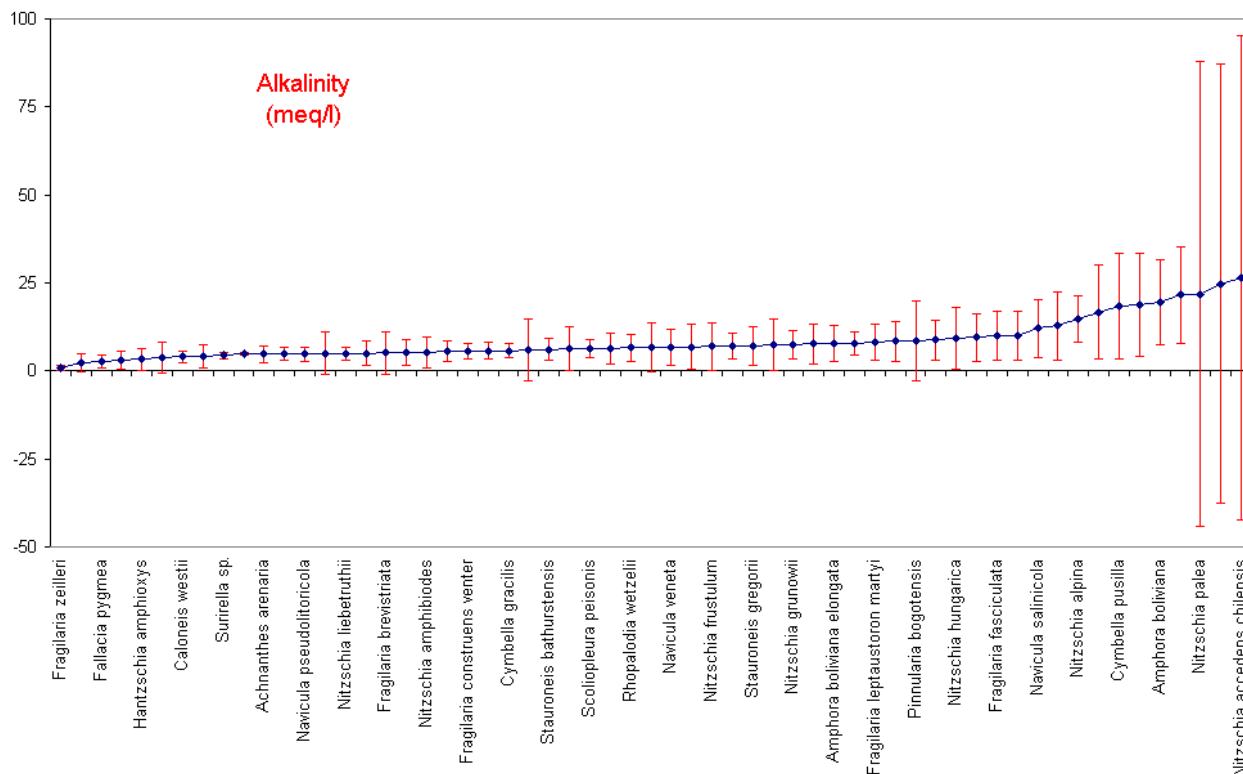


Figure 5C: WA method. Estimated optima and tolerances of 61 species to alkalinity (with maximum abundance > 3 and occurrence in three or more samples). In Figure 5C, the very high values of alkalinity were removed in order to show more clearly the optima and tolerances of species with low alkalinity values.

C. The diatom flora

In thirteen of these lakes the existing diatom flora (SERVANT-VILDARY, 1984; SERVANT-VILDARY & ROUX, 1990) was studied at the water/sediment interface (Table 2, Figure 2). Throughout the summer of 1978 samples of both water and sediments were collected by F. RISACHER at the same sites and at the same time. At Pastos Grandes, samples were collected from the margins toward the center, in order to relate changes in diatom assemblages to increases in salinity (Figure 3).

Diatom frustules are partially dissolved in the sediments collected (BADAUT, RISACHER *et alii*, 1979; BADAUT & RISACHER, 1983). But a comparison between living diatoms in the water and those in the water/sediment interface showed that this diagenesis is slight (ILTIS, RISACHER & SERVANT-VILDARY, 1984).

The diatom flora is diversified. The image data base is being prepared: 107 species are presented here. The list of images is in Table 3. It includes the abundant species (used in the transfer function calculations) and some rare ones. In columns 5 to 7 species previously published are indicated (SERVANT-VILDARY, 1984; SERVANT-VILDARY & BLANCO, 1984; SERVANT-VILDARY & ROUX, 1990).

Species identifications were based on a considerable number of recent works, not possible to cite here. On the other hand we would like to direct attention to publications that, although less well-known, are fundamental to this study because they concern

areas close to southern Bolivia (FRENGUELLI, 1934, 1936, 1942).

D. Diatom ecology

Optima and tolerance of the species are obtained by the Weighted Averaging [WA] method and the Weighted Averaging Partial Least Squares regression [WA-PLS] (TER BRAAK & JUGGINS, 1993; TER BRAAK, JUGGINS *et alii*, 1993), programmed by M. ROUX and introduced in « Biomeco » for this study. All the sites were used, environmental data were not transformed. The 61 species selected from the total of 104 are those present at least in 3 samples. The values R, R² and that of SEP from WA are listed in Table 4.

The number of components selected for use in the WA-PLS method are deduced from « r » (correlation coefficient between observed and predicted value by the leave-one-out method). Values of R and R² deduced from WA-PLS are listed in Table 4. Optima and tolerances of the species in relation to the ionic composition of the waters (anions and cations), alkalinity, salinity and pH estimated by WA leave-one-out method are listed in Table 4. Alkalinity and silica content are the parameters that can be most accurately estimated from the diatom flora (R = 0.94, R² = 0.88). Multiple correlation coefficients are up to 0.80 for sodium, sulfate, chlorine, salinity and pH. The accuracy of prediction for boron and lithium are relatively low, respectively 0.75 and 0.77. Figure 5A

Fig. 6A

Estimation of salinity in 13 lakes by WA-PLS (bars represent SEP)

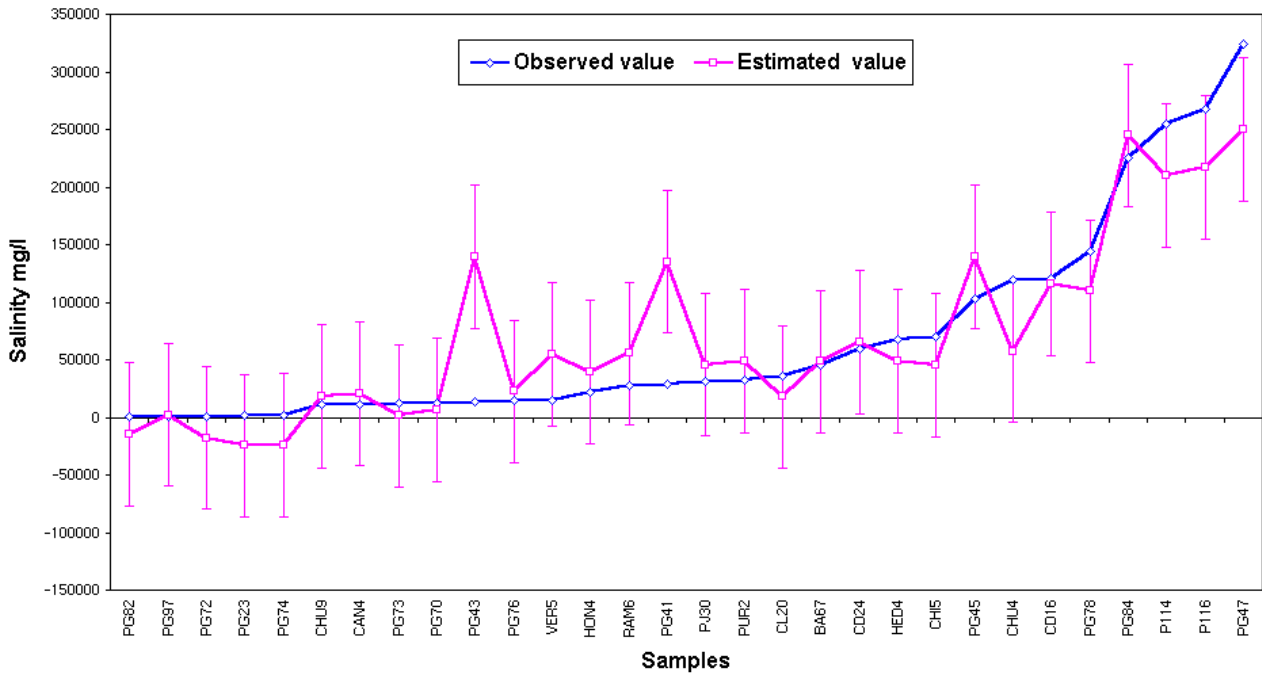
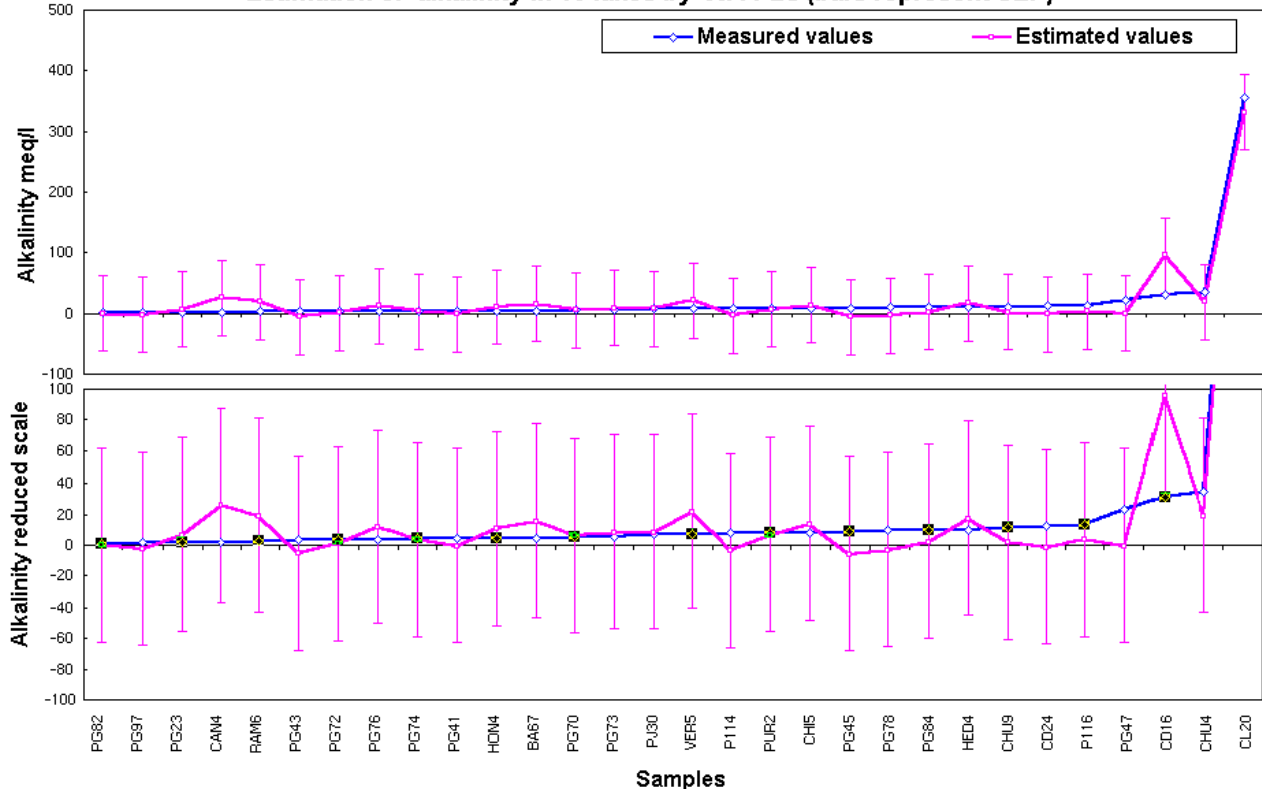


Fig. 6B

Estimation of alkalinity in 13 lakes by WA-PLS (bars represent SEP)



Figures 6A and 6B: WA-PLS method. The salinity and alkalinity of the lakes as inferred from modern diatom assemblages (calibration).



Figure 7: An example of the Lipez landscape: In the foreground a Quaternary glacia with a pebble cover. Note the absence of vegetation. In the background an Upper Cenozoic volcano.



Figure 9: Laguna Ballivián: Playa-type « salar », characterized by a very small watershed.



Figure 8: Laguna Chiar Kkota in the foreground and Laguna Hedionda in the background. Salt deposits fringe the lakes.



Figure 10: Laguna Ramaditas: In the background the threshold which separates Laguna Ramaditas from Laguna Ballivián. The two lakes were connected during the « Minchin » highstand phase.



Figure 11: Laguna Honda. 1: Past shorelines with bioherms, the top one is dated early Holocene (~ 11.800 cal yr BP) by U/Th, 2: Undated lacustrine deposits, 3: Diatomites representing the three main lacustrine phases (Minchin, Tauca and Coipasa).

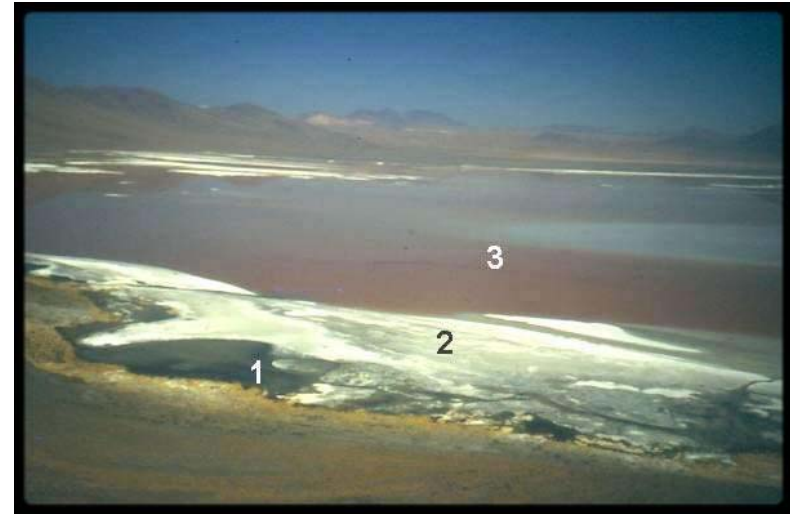


Figure 13: Laguna Colorada: 1: Springs at the foot of the slope, 2: Quaternary diatomites, 3: Open surface salt water.



Figure 12: Cachi Laguna salar: Unconfined aquifer salar.



Figure 14: Pastos Grandes salar: Fossil calcareous crust (undated).



Figure 15: Pastos Grandes salar: Calcareous pisoliths in shallow ephemeral pools fed by hot springs. Diatomites are common in the outer layers.



Figure 17: Laguna Ramaditas: Northern border. 1: Quaternary diatomites eroded by the wind during a Holocene dry phase, 2: Present-day halite efflorescences.



Figure 16: Laguna Ballivián: 1: Diatomites and bioherms of the highest water level, probably of the Minchin phase (Middle Glacial), 2: Diatomites presumably of the Tauca phase. Formations 1 and 2 are separated by an erosion surface, 3: Modern colluvions, 4: Halite efflorescences.

Appendices

Table 1 : Location of the lakes and data regarding water chemistry.

Table 2 : List of species and their abundance in 30 samples.

Table 3 : List of diatom pictures.

Table 4 :

WA method: Optima and tolerances of the species (in alphabetical order) to Na^+ , Mg^{++} , SO_4^{--} , Si, Li^+ , salinity, pH, K^+ , Ca^{++} , Cl^- , B and alkalinity. Estimation of environmental variables for each sample. SEP values are indicated at the end of the list of estimations for all samples. Optima and tolerances of species to salinity and alkalinity are illustrated in Figures 5A, 5B and 5C.

WA-PLS method. Values of r , R , R^2 and SEP listed in table 4 show that this method improves the predictions for all the environmental parameters. Calibration of salinity and alkalinity is illustrated in Figures 6A and 6B.

shows the ecological preferences of 61 species as regards salinity (g/l). Figures 5B and 5C show preferences of these species concerning alkalinity (meq/l) deduced from WA. Error bars represent the values the "tolerance" column of Table 4) above and below the optimum. Figures 6A and 6B show that the salinity and alkalinity of the 13 lakes can be estimated with reasonable accuracy from the diatom flora. Estimation of salinity is excellent except for PG43 and PG41 where measured salinity has mean values (28 and 13 g/l). Alkalinity is well estimated in all samples (except for Canapa and Laguna Colorada).

We cite here examples of the ecology of some species as deduced from these analyses:

- Optimum **salinity** for *Nitzschia liebetruthii* (**NILI**) est 28.4 ± 12 g/l. This species is very abundant at Ramaditas where the measured salinity is 27 g/l and the estimated salinity 30.8 g/l. This species seems to be a good indicator of average salinity in the range of salinities considered here.
- The optimum of *Navicula salinicola* (**NASA**) to **lithium** is 0.6 ± 0.5 g/l. This species is very abundant in Pastos Grandes 47 (measured lithium concentration 1.64 g/l) and estimated lithium concentration from the diatom flora is 0.5 g/l. This species is a good indicator of high concentrations of lithium.
- Concerning **sulfates**, *Surirella wetzeli* (**SUWE**) of which the optimum is 13.6 ± 11 g/l, is very abundant in Chulluncani 4 where measured sulfate concentration is 26.6 g/l and the estimated value is 11.5 g/l. This species is a good indicator of a high concentration of sulfates. We might cite *Mastoglia atacamae* (**MATA**) as an indicator of very low concentration.
- As an indicator for high **alkalinity** we cite *Stauroneis wislouchii* (**STAW**), its optimum is 190 ± 167 meq/l. It is abundant in Cachi Laguna 20, where measured alkalinity is 355 meq/l and the estimated value 211 meq/l. An indicator for low alkalinity could be *Amphora atacamana minor* (**AMPM**), for its optimum is 8.7 ± 5.7 meq/l and the measured alkalinity in the sample Pastos Grandes 78, where it is abundant, is 9.4 meq/l and the inferred alkalinity is 8.6 meq/l.
- As regards **silicon**, we can cite *Fragilaria zeilleri* (**FZ**). Its optimum is 0.020 ± 0.008 g/l, the measured value of silicon concentration being 0.015 g/l in Pastos Grandes sample 82 where this species is abundant and the inferred value is 0.02 g/l. *Stauroneis* sp. (**SSP**) on the contrary is a good indicator for a high concentration of silicon, for its optimum is 1.57 ± 0.02 g/l, and the measured value of silicon in Cachi Laguna 20 is 1.6 g/l and the inferred value 1.08 g/l.
- Concerning **potassium**, the optimum of *Nitzschia pusilla* (**NIPS**) is 7.7 ± 4.3 g/l. In Pastos Grandes sample 116 where it is abundant the measured concentration is 7.3 g/l and the inferred concentration is 4.6 g/l.
- As regards **chlorine**, the optimum of *Nitzschia accedens chilensis* (**NCHI**) is 86.4 ± 70 g/l. The values measured in Pastos Grandes sample 78 where this species is abundant is 85.9 g/l and the inferred value is 57.3 g/l.
- For **sodium**, we may cite *Fallacia pygmaea* (**NPYG**) which although rare in Pastos Grandes sample 43 is a good indicator for, its optimum is 3.3 g/l, whereas the measured concentration in the sample is 4.5 g/l and the inferred concentration 3.7 g/l.

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**TABLEAU 1 : Localisation
des lacs et données
chimiques des eaux**

**TABLE 1: Lake locations and
water chemistry data**

| Lacs | Lakes | | Ballivian | Ramaditas | Laguna Verde | Hedionda | Pujio | Puripica | Honda | Chiar Kkota | Canapa |
|--------------|----------------|--------|-----------|------------|--------------|------------|------------|------------|--------|-------------|------------|
| N° Ech. | N° Ech. | | BA67 | RAM6 | VER5 | HED4 | PJ30 | PUR2 | HON4 | CHI5 | CAN4 |
| Altitude | Altitude | (m) | 4130 | 4120 | 4310 | 4121 | 4110 | 4393 | 4110 | 4110 | 4140 |
| Longitude | Longitude | | 68°05' | 68°05' | 67°48' | 68°04' | 68°04' | 67°30' | 68°04' | 68°04' | 68°01' |
| Latitude | Latitude | | 21°38' | 31°38' | 22°48' | 21°34' | 21°37' | 22°31' | 21°37' | 21°35' | 21° |
| Na | Na | (mg/l) | 13600 | 7590 | 4510 | 20400 | 10000 | 9550 | 6740 | 20700 | 3590 |
| K | K | (mg/l) | 1700 | 1030 | 308 | 2100 | 1020 | 1720 | 989 | 2500 | 212 |
| Mg | Mg | (mg/l) | 605 | 326 | 262 | 649 | 210 | 275 | 140 | 1140 | 34.0 |
| Ca | Ca | (mg/l) | 1200 | 1370 | 218 | 521 | 400 | 465 | 200 | 1340 | 65.0 |
| SO4 | SO4 | (mg/l) | 5700 | 3070 | 2300 | 17900 | 4320 | 4660 | 2600 | 4080 | 5070 |
| Cl | Cl | (mg/l) | 22000 | 13900 | 6460 | 24600 | 14500 | 15300 | 10300 | 38700 | 2250 |
| Si | Si | (mg/l) | 25.2 | 41.4 | 28.6 | 27.5 | 26.1 | 20.6 | 31.6 | 34.4 | 31.4 |
| B | B | (mg/l) | 150 | 77.0 | 125 | 235 | 145 | 238 | 57.0 | 250 | 13.0 |
| Li | Li | (mg/l) | 25.5 | 11.8 | 36.5 | 122 | 37.0 | 109 | 47.0 | 176 | 19.5 |
| Alcalinité | Alkalinity | (mg/l) | 4.88 | 2.93 | 7.25 | 10 | 7.22 | 7.8 | 4.4 | 8.05 | 2.15 |
| Salinité | Salinity | (mg/l) | 45335 | 27658 | 14716 | 67099 | 31139 | 32785 | 21392 | 69439 | 11440 |
| Ions majeurs | Principal ions | | NaCl | Na (Ca) Cl | NaCl (SO4) | NaCl (SO4) | NaCl (SO4) | NaCl (SO4) | NaCl | NaCl | NaCl (SO4) |
| pH | pH | | 8.18 | 8.15 | 8.72 | 8.5 | 8.85 | 8.52 | 9.05 | 8.28 | 9.18 |
| Profondeur | Depth | (cm) | 30 | 30 | 100 | 20 | 100 | 100 | 20 | 20 | 15 |
| Température | Temperature | (°C) | 5 | 1 | 2 | 8 | 1 | 4 | 6 | 8 | 6 |
| Densité | Density | | 1.032 | 1.02 | 1.01 | 1.05 | 1.022 | 1.024 | 1.015 | 1.051 | 1.009 |

| Cachi Laguna | Chulluncani | | Laguna Colorada | | Pastos Grandes | | | | | | | | | | |
|---------------------|--------------------|-------------|------------------------|-------------|-----------------------|-------------|-------------|-------------|-------------|-------------|------------------|-------------|-------------|------------------|-------------|
| | CHU4 | CHU9 | CD24 | CD16 | PG70 | PG23 | PG41 | PG43 | PG45 | PG47 | PG72 | PG73 | PG76 | PG74 | PG78 |
| 4495 | 4430 | 4430 | 4278 | 4278 | 4400 | 4400 | 4400 | 4400 | 4400 | 4400 | 4400 | 4400 | 4400 | 4400 | 4400 |
| 67°57' | 67°53' | 67°53' | 67°47' | 67°47' | 67°47' | 67°47' | 67°47' | 67°47' | 67°47' | 67°47' | 67°47' | 67°47' | 67°47' | 67°47' | 67°47' |
| 21°43' | 21°32' | 21°32' | 22°11' | 22°11' | 21°39' | 21°39' | 21°39' | 21°39' | 21°39' | 21°39' | 21°39' | 21°39' | 21°39' | 21°39' | 21°39' |
| 10600 | 30100 | 2320 | 19900 | 40700 | 4000 | 451 | 9270 | 4510 | 34000 | 103000 | 80.0 | 3910 | 4510 | 350 | 46000 |
| 2850 | 12800 | 1800 | 2110 | 4260 | 532 | 43.0 | 1020 | 500 | 3950 | 14200 | 16.5 | 399 | 579 | 48.1 | 5000 |
| 0.146 | 1900 | 53.0 | 382 | 914 | 89.9 | 11.0 | 265 | 132 | 110 | 3470 | 20.2 | 138 | 132 | 55.4 | 1200 |
| 2.49 | 730 | 200 | 103 | 260 | 200 | 24.5 | 360 | 200 | 1100 | 3100 | 50.9 | 190 | 200 | 32.7 | 1500 |
| 3710 | 26600 | 4360 | 5980 | 6440 | 265 | 72.0 | 465 | 250 | 1270 | 2460 | 105 | 302 | 305 | 130 | 2920 |
| 4540 | 44000 | 1970 | 29500 | 65000 | 7240 | 699 | 16700 | 8060 | 61400 | 194000 | 90.2 | 6750 | 8310 | 600 | 85900 |
| 161 | 21.9 | 18.7 | 32.5 | 45.6 | 36.4 | 38.4 | 31.6 | 17.3 | 20.5 | 31.4 | 37.2 | 58.8 | 32.2 | 30.2 | 34.2 |
| 143 | 959 | 147 | 263 | 612 | 29.9 | 3.49 | 60.0 | 28.4 | 290 | 944 | 0.995 | 25.5 | 32.0 | 2.92 | 320 |
| 54.1 | 22.5 | 2.75 | 86.8 | 196 | 42.5 | 4.80 | 117 | 52.5 | 500 | 1640 | 0.507 | 42.5 | 57.5 | 3.89 | 600 |
| 355 | 35 | 11.4 | 12.9 | 31.5 | 5.09 | 1.51 | 4.25 | 3.21 | 9.08 | 22.9 | 3.3 | 5.13 | 3.85 | 4.2 | 9.42 |
| 36285 | 119261 | 11377 | 59166 | 120357 | 12787 | 1475 | 28564 | 13961 | 103267 | 324141 | 644 | 12189 | 14421 | 1542 | 144099 |
| NaCO3 (Cl) | NaCl (SO4) | NaCl (SO4) | NaCl | NaCl | NaCl | NaCl | NaCl | NaCl | NaCl | NaCl | Na (Ca) CO3 (Cl) | NaCl | NaCl | Na (Ca) Cl (CO3) | NaCl |
| 10.38 | 8.8 | 10.2 | 8.52 | 8.4 | 8.42 | 9.35 | 8.52 | 8.05 | 7.4 | 7.2 | 6.95 | 8.15 | 8.35 | 7.85 | 7.91 |
| 50 | 15 | 15 | 20 | 20 | 20 | 100 | 20 | 100 | 100 | 100 | 20 | 20 | 20 | 20 | 20 |
| 21 | 5 | 8 | 10 | 6 | 5 | 1 | 4 | 6 | 5 | 5 | 10 | 1 | 10 | 1 | 10 |
| 1.029 | 1.087 | 1.008 | 1.04 | 1.081 | 1.009 | 1.001 | 1.02 | 1.01 | 1.073 | 1.211 | 1 | 1.009 | 1.01 | 1.001 | 1.098 |

Pastos Grandes

| PG82 | PG84 | PG97 | P114 | P116 |
|------------------|-------------|------------------|-------------|-------------|
| 4400 | 4400 | 4400 | 4400 | 4400 |
| 67°47' | 67°47' | 67°47' | 67°47' | 67°47' |
| 21°39' | 21°39' | 21°39' | 21°39' | 21°39' |
| 41.9 | 77100 | 85.1 | 81000 | 92000 |
| 4.42 | 6450 | 12.6 | 9810 | 7390 |
| 3.21 | 1250 | 7.41 | 2550 | 2080 |
| 6.10 | 1650 | 12.5 | 2380 | 2500 |
| 14.0 | 3370 | 4.99 | 3240 | 3180 |
| 63.2 | 134000 | 150 | 154000 | 158000 |
| 15.9 | 33.0 | 22.4 | 16.8 | 31.4 |
| 0.703 | 404 | 1.08 | 545 | 520 |
| 0.347 | 675 | 1.18 | 1160 | 861 |
| 0.523 | 9.7 | 1.36 | 7.68 | 13.1 |
| 195 | 225344 | 402 | 255230 | 267366 |
| Na (Ca) Cl (CO3) | NaCl | Na (Ca) Cl (CO3) | NaCl | NaCl |
| 9.62 | 7.46 | 8.92 | 6.95 | 7.5 |
| 20 | 100 | 20 | 100 | 100 |
| 10 | 15 | 10 | 10 | 7 |
| 1 | 1.147 | 1 | 1.167 | 1.171 |

**TABLEAU 2 : Liste des
espèces et abondance dans
30 échantillons**

**TABLE 2: List of species and
their abundance in 30 samples**

| Codes <i>Codes</i> | Genres <i>Genera</i> | Espèces <i>Species</i> | Ballivian | Ramaditas | Laguna Verde | Hedionda | Pujio | Puripica | Honda | Chiar kkota | Chulluncani | | Canapa |
|-----------------------|-------------------------|------------------------------------|-----------|-----------|--------------|----------|-------|----------|-------|-------------|-------------|-------|--------|
| | | | BA67 | RAM6 | VER5 | HED4 | PJ30 | PUR2 | HON4 | CHI5 | CHU4 | CHU9 | CAN4 |
| ACAR | <i>Achnanthes</i> | <i>arenaria</i> | 2.29 | 0.50 | 0.50 | 0.00 | 0.00 | 0.00 | 12.52 | 0.00 | 0.00 | 0.00 | 0.00 |
| AD | <i>Achnanthes</i> | <i>delicatula</i> | 0.00 | 0.00 | 0.00 | 0.00 | 1.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ASPE | <i>Achnanthes</i> | <i>speciosa</i> | 3.99 | 0.10 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| AMPA | <i>Amphora</i> | <i>atacamana</i> | 0.00 | 0.00 | 0.00 | 0.73 | 3.41 | 1.89 | 0.99 | 0.00 | 0.00 | 0.00 | 1.71 |
| AMPM | <i>Amphora</i> | <i>atacamana minor</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.30 | 0.00 | 1.30 | 0.00 | 0.00 | 0.00 |
| ABOL | <i>Amphora</i> | <i>boliviana</i> | 1.00 | 0.00 | 0.40 | 0.00 | 0.00 | 0.00 | 0.20 | 0.00 | 0.00 | 0.98 | 0.00 |
| ABEL | <i>Amphora</i> | <i>boliviana elongata</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 5.88 | 0.00 |
| AMCJ | <i>Amphora</i> | <i>carvajaliana</i> | 2.29 | 0.00 | 0.00 | 77.24 | 54.32 | 63.01 | 70.07 | 83.50 | 9.60 | 0.00 | 0.00 |
| ANSA | <i>Anomooneis</i> | <i>sphaerophora angusta</i> | 0.00 | 0.00 | 0.00 | 0.18 | 0.20 | 0.00 | 0.00 | 0.00 | 0.70 | 0.98 | 0.00 |
| CSP | <i>Caloneis</i> | <i>silicula minuta</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.80 | 0.98 | 0.00 |
| CAW | <i>Caloneis</i> | <i>westii</i> | 0.10 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| CP | <i>Cocconeis</i> | <i>placentula</i> | 0.00 | 0.99 | 3.70 | 0.00 | 0.40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.98 | 0.00 |
| CYL | <i>Cymbella</i> | <i>gracilis</i> | 4.39 | 0.50 | 0.00 | 0.00 | 11.85 | 0.00 | 2.49 | 1.30 | 0.00 | 0.00 | 0.00 |
| CYMP | <i>Cymbella</i> | <i>pusilla</i> | 0.30 | 0.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.80 | 0.00 | 0.90 | 0.00 | 0.00 |
| DETH | <i>Denticula</i> | <i>thermalis</i> | 0.60 | 0.60 | 0.10 | 0.00 | 0.00 | 0.00 | 0.20 | 0.00 | 0.00 | 0.98 | 0.00 |
| DE | <i>Denticula</i> | <i>elegans</i> | 4.69 | 2.29 | 0.00 | 0.00 | 0.00 | 0.00 | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 |
| DEV | <i>Denticula</i> | <i>valida</i> | 0.00 | 0.70 | 14.80 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FB | <i>Fragilaria</i> | <i>brevistriata</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.50 | 0.00 | 4.01 |
| FRCV | <i>Fragilaria</i> | <i>construens venter</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FE | <i>Fragilaria</i> | <i>fasciculata</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| OM | <i>Fragilaria</i> | <i>leptaustoron martyi</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FP | <i>Fragilaria</i> | <i>pinnata</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 | 1.71 |
| FZ | <i>Fragilaria</i> | <i>zeileri</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| HA | <i>Hantzschia</i> | <i>amphioxys</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| HN | <i>Hantzschia</i> | <i>novsp</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.80 | 0.00 |
| MATA | <i>Mastoglia</i> | <i>atacamae</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| NCA | <i>Navicula</i> | <i>cariocincta</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.30 | 0.00 | 1.60 | 0.00 | 0.00 | 9.23 |
| NCI | <i>Navicula</i> | <i>cincta</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.50 |
| NC | <i>Navicula</i> | <i>veneta</i> | 0.00 | 0.00 | 0.00 | 2.20 | 0.00 | 0.60 | 0.00 | 0.00 | 0.70 | 14.71 | 0.00 |
| NHN | <i>Navicula</i> | <i>nivalis</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 |
| NPB | <i>Navicula</i> | <i>paramutica binodis</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.20 | 0.00 | 2.30 | 2.50 | 0.00 |
| NAO | <i>Navicula</i> | <i>cryptotenelloides</i> | 1.60 | 0.50 | 0.20 | 0.36 | 1.20 | 8.87 | 1.19 | 0.10 | 0.00 | 0.00 | 6.32 |
| NLA | <i>Navicula</i> | <i>pseudolanceolata</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 | 49.40 | 9.75 | 26.08 |
| NLI | <i>Navicula</i> | <i>pseudolitoricola</i> | 0.30 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 | 0.00 | 0.00 |
| NPYG | <i>Fallacia</i> | <i>pygmaeae</i> | 0.10 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 | 0.00 | 0.00 |
| NDC | <i>Navicula</i> | <i>erifuga</i> | 0.60 | 0.30 | 0.40 | 0.00 | 3.82 | 7.88 | 3.78 | 0.00 | 0.00 | 0.00 | 0.00 |
| NASA | <i>Navicula</i> | <i>salinicola</i> | 0.30 | 0.50 | 0.00 | 0.00 | 5.92 | 1.60 | 1.49 | 0.00 | 0.00 | 0.00 | 0.00 |
| NS | <i>Navicula</i> | <i>sp.</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| NILI | <i>Nitzschia</i> | <i>liebetruthii</i> | 62.70 | 80.40 | 70.10 | 0.00 | 2.11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| NCHI | <i>Nitzschia</i> | <i>accedens chilensis</i> | 0.00 | 0.00 | 1.40 | 0.00 | 0.00 | 0.00 | 0.20 | 2.60 | 0.00 | 0.00 | 0.00 |
| NIAL | <i>Nitzschia</i> | <i>alpina</i> | 1.40 | 1.40 | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ND | <i>Nitzschia</i> | <i>amphibiodes</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.30 | 0.00 | 0.00 | 2.31 |
| NICC | <i>Nitzschia</i> | <i>compressa compressa</i> | 0.00 | 0.50 | 0.20 | 0.00 | 1.61 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| NIEP | <i>Nitzschia</i> | <i>epithemioides epithemioides</i> | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.71 |
| NF | <i>Nitzschia</i> | <i>frustulum</i> | 1.20 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.50 | 1.80 | 3.92 | 0.00 |
| NGRU | <i>Nitzschia</i> | <i>grunowii</i> | 0.60 | 0.60 | 0.20 | 0.00 | 2.41 | 0.00 | 0.00 | 0.10 | 0.00 | 0.80 | 0.00 |
| NIH | <i>Nitzschia</i> | <i>hantzschiana</i> | 1.30 | 1.39 | 0.00 | 0.00 | 1.91 | 6.58 | 0.70 | 0.00 | 1.50 | 0.00 | 0.00 |
| NIHU | <i>Nitzschia</i> | <i>hungarica</i> | 0.00 | 0.00 | 0.00 | 0.36 | 0.00 | 2.89 | 0.00 | 0.00 | 4.70 | 25.49 | 15.05 |
| NPA | <i>Nitzschia</i> | <i>palea</i> | 0.00 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 | 0.00 | 0.00 |
| NIPS | <i>Nitzschia</i> | <i>pusilla</i> | 0.00 | 0.00 | 1.40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 5.50 | 0.00 |
| NIVA | <i>Nitzschia</i> | <i>valdecostata</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.80 | 1.89 | 0.00 | 0.00 | 0.00 | 0.00 | 8.02 |
| PB | <i>Pinnularia</i> | <i>bogotensis</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.70 | 0.00 | 0.00 |
| PIMI | <i>Pinnularia</i> | <i>microstauron</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.60 | 0.00 |
| RHWE | <i>Rhopalodia</i> | <i>wetzelii</i> | 0.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.60 | 0.00 | 0.00 | 0.00 |
| SCPE | <i>Scoliopleura</i> | <i>peisonis</i> | 0.00 | 0.99 | 0.00 | 1.72 | 2.01 | 0.60 | 1.29 | 2.60 | 0.00 | 0.00 | 0.00 |
| SG | <i>Stauroneis</i> | <i>gregorii</i> | 0.00 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 | 0.00 | 0.00 |
| SB | <i>Stauroneis</i> | <i>bathurstensis</i> | 0.00 | 0.00 | 0.00 | 3.00 | 1.61 | 1.30 | 1.19 | 0.30 | 0.00 | 0.00 | 3.41 |
| SSP | <i>Stauroneis</i> | <i>species (obtusa?)</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| STAW | <i>Stauroneis</i> | <i>wislouchii</i> | 0.00 | 0.00 | 0.00 | 0.20 | 0.00 | 0.00 | 0.00 | 0.30 | 0.70 | 0.00 | 12.34 |
| SO | <i>Surirella</i> | <i>oregonica</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SUSE | <i>Surirella</i> | <i>sella</i> | 5.98 | 2.98 | 1.90 | 0.00 | 4.82 | 0.00 | 1.89 | 1.00 | 0.10 | 0.00 | 0.00 |
| SUSP | <i>Surirella</i> | <i>sp.</i> | 0.00 | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SUWE | <i>Surirella</i> | <i>wetzelii</i> | 0.00 | 0.00 | 0.00 | 13.78 | 0.40 | 1.99 | 0.10 | 0.10 | 22.10 | 3.92 | 4.81 |

TABLEAU 2 : Liste des espèces et abondance dans 30 échantillons
TABLE 2: List of species and their abundance in 30 samples

| Codes Codes | Genres Genera | Espèces Species | Cachi Laguna | | Laguna Colorada | | Pastos Grandes | | | | | | |
|----------------|--------------------|------------------------------------|--------------|-------|-----------------|-------|----------------|-------|-------|-------|-------|-------|-------|
| | | | CL20 | CD24 | CD16 | PG70 | PG23 | PG41 | PG43 | PG45 | PG47 | PG72 | |
| ACAR | <i>Achnanthes</i> | <i>arenaria</i> | 0.00 | 0.00 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| AD | <i>Achnanthes</i> | <i>delicatula</i> | 0.00 | 0.00 | 0.09 | 0.00 | 0.00 | 0.89 | 1.48 | 4.50 | 1.37 | 0.00 | 0.00 |
| ASPE | <i>Achnanthes</i> | <i>speciosa</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.72 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| AMPA | <i>Amphora</i> | <i>atacamana</i> | 0.00 | 0.00 | 2.94 | 0.72 | 0.00 | 5.43 | 6.70 | 8.40 | 4.94 | 0.00 | 0.00 |
| AMPM | <i>Amphora</i> | <i>atacamana minor</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 5.55 | 4.50 | 0.00 | 2.22 | 0.00 | 0.00 |
| ABOL | <i>Amphora</i> | <i>boliviana</i> | 0.00 | 0.00 | 2.56 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ABEL | <i>Amphora</i> | <i>boliviana elongata</i> | 0.00 | 0.00 | 0.00 | 2.80 | 0.80 | 0.00 | 0.00 | 0.68 | 1.31 | 0.00 | 0.00 |
| AMCJ | <i>Amphora</i> | <i>carvajalliana</i> | 0.00 | 1.00 | 6.08 | 0.00 | 0.00 | 2.50 | 3.90 | 2.73 | 0.40 | 0.50 | 0.00 |
| ANSA | <i>Anomooneis</i> | <i>sphaerophora angusta</i> | 0.00 | 2.00 | 0.09 | 0.72 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| CSP | <i>Caloneis</i> | <i>silicula minuta</i> | 0.00 | 0.00 | 0.00 | 0.31 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.50 |
| CAW | <i>Caloneis</i> | <i>westii</i> | 0.00 | 0.00 | 0.00 | 2.38 | 2.78 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| CP | <i>Cocconeis</i> | <i>placentula</i> | 0.00 | 1.30 | 0.00 | 0.00 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| CYL | <i>Cymbella</i> | <i>gracilis</i> | 0.00 | 0.00 | 0.09 | 1.04 | 0.20 | 0.00 | 0.00 | 0.68 | 0.00 | 0.00 | 0.00 |
| CYMP | <i>Cymbella</i> | <i>pusilla</i> | 0.00 | 0.00 | 1.00 | 0.00 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| DETH | <i>Denticula</i> | <i>thermalis</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| DE | <i>Denticula</i> | <i>elegans</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| DEV | <i>Denticula</i> | <i>valida</i> | 0.00 | 0.00 | 0.00 | 1.55 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FB | <i>Fragilaria</i> | <i>brevistriata</i> | 0.00 | 0.00 | 0.00 | 35.82 | 73.06 | 10.23 | 7.30 | 10.00 | 9.49 | 0.00 | 0.00 |
| FRCV | <i>Fragilaria</i> | <i>construens venter</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 5.80 | 0.00 | 3.65 | 0.00 | 0.00 | 0.00 |
| FE | <i>Fragilaria</i> | <i>fasciculata</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.85 | 0.00 | 0.00 | 5.85 | 0.00 | 0.00 |
| OM | <i>Fragilaria</i> | <i>leptaustoron martyi</i> | 0.00 | 3.00 | 0.00 | 0.00 | 1.89 | 0.00 | 0.00 | 0.46 | 0.00 | 0.00 | 0.00 |
| FP | <i>Fragilaria</i> | <i>pinnata</i> | 0.00 | 0.00 | 0.00 | 0.72 | 0.00 | 1.85 | 0.00 | 2.73 | 1.31 | 0.00 | 0.00 |
| FZ | <i>Fragilaria</i> | <i>zeileri</i> | 0.00 | 0.00 | 0.00 | 0.00 | 9.94 | 0.00 | 0.60 | 0.00 | 0.00 | 0.00 | 0.00 |
| HA | <i>Hantzschia</i> | <i>amphioxys</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| HN | <i>Hantzschia</i> | <i>novsp</i> | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 12.06 |
| MATA | <i>Mastoglia</i> | <i>atacamae</i> | 0.00 | 0.00 | 0.00 | 1.97 | 0.50 | 0.00 | 0.00 | 1.37 | 0.00 | 0.00 | 0.00 |
| NCA | <i>Navicula</i> | <i>cariocincta</i> | 0.00 | 0.00 | 0.09 | 0.00 | 0.10 | 0.74 | 0.60 | 0.00 | 0.40 | 50.25 | 0.00 |
| NCI | <i>Navicula</i> | <i>cincta</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| NC | <i>Navicula</i> | <i>veneta</i> | 0.00 | 21.00 | 0.95 | 2.38 | 0.10 | 0.00 | 0.60 | 0.00 | 0.91 | 0.00 | 0.00 |
| NHN | <i>Navicula</i> | <i>nivalis</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.01 | 0.00 |
| NPB | <i>Navicula</i> | <i>paramutica binodis</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 12.56 |
| NAO | <i>Navicula</i> | <i>cryptotenelloides</i> | 0.00 | 1.00 | 4.84 | 1.55 | 0.80 | 10.97 | 7.30 | 5.40 | 8.58 | 0.00 | 0.00 |
| NLA | <i>Navicula</i> | <i>pseudolanceolata</i> | 0.00 | 12.00 | 0.00 | 7.25 | 0.00 | 12.70 | 12.90 | 0.00 | 0.00 | 0.00 | 0.00 |
| NLI | <i>Navicula</i> | <i>pseudolitoricola</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| NPYG | <i>Fallacia</i> | <i>pygmaea</i> | 0.00 | 0.00 | 0.00 | 0.31 | 1.19 | 0.00 | 0.60 | 0.00 | 0.00 | 0.00 | 0.00 |
| NDC | <i>Navicula</i> | <i>erifuga</i> | 0.00 | 0.00 | 5.22 | 0.00 | 0.00 | 0.00 | 0.00 | 17.70 | 2.72 | 1.51 | 0.00 |
| NASA | <i>Navicula</i> | <i>salinicola</i> | 0.00 | 7.00 | 21.65 | 2.07 | 0.00 | 14.92 | 21.40 | 19.20 | 25.73 | 0.00 | 0.00 |
| NS | <i>Navicula</i> | <i>sp.</i> | 0.00 | 0.00 | 0.00 | 0.00 | 1.09 | 0.37 | 1.60 | 0.00 | 0.40 | 0.00 | 0.00 |
| NILI | <i>Nitzschia</i> | <i>liebetruthii</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| NCHI | <i>Nitzschia</i> | <i>accedens chilensis</i> | 2.30 | 0.00 | 5.89 | 0.31 | 0.10 | 5.70 | 8.50 | 1.37 | 7.37 | 0.00 | 0.00 |
| NIAL | <i>Nitzschia</i> | <i>alpina</i> | 0.00 | 35.00 | 4.56 | 0.00 | 0.10 | 0.00 | 0.00 | 0.00 | 2.22 | 0.00 | 0.00 |
| ND | <i>Nitzschia</i> | <i>amphibiodes</i> | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| NICC | <i>Nitzschia</i> | <i>compressa compressa</i> | 0.00 | 0.00 | 0.00 | 1.04 | 0.10 | 0.37 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| NIEP | <i>Nitzschia</i> | <i>epithemioides epithemioides</i> | 0.00 | 0.00 | 1.61 | 0.00 | 0.00 | 3.45 | 10.10 | 6.60 | 5.45 | 0.00 | 0.00 |
| NF | <i>Nitzschia</i> | <i>frustulum</i> | 0.00 | 0.00 | 0.00 | 3.62 | 0.00 | 1.85 | 0.00 | 1.80 | 0.00 | 0.00 | 0.00 |
| NGRU | <i>Nitzschia</i> | <i>grunowii</i> | 0.00 | 0.00 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| NIH | <i>Nitzschia</i> | <i>hantzschiana</i> | 0.00 | 2.60 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 18.59 |
| NIHU | <i>Nitzschia</i> | <i>hungarica</i> | 0.00 | 2.00 | 1.23 | 0.00 | 0.50 | 0.00 | 1.10 | 1.37 | 0.40 | 0.00 | 0.00 |
| NPA | <i>Nitzschia</i> | <i>palea</i> | 0.30 | 0.00 | 0.00 | 0.00 | 0.89 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| NIPS | <i>Nitzschia</i> | <i>pusilla</i> | 2.30 | 3.00 | 0.00 | 0.00 | 0.00 | 1.48 | 1.10 | 2.73 | 14.63 | 0.00 | 0.00 |
| NIVA | <i>Nitzschia</i> | <i>valdecostata</i> | 0.00 | 1.00 | 0.00 | 2.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.02 |
| PB | <i>Pinnularia</i> | <i>bogotensis</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PIMI | <i>Pinnularia</i> | <i>microstauron</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| RHWE | <i>Rhopalodia</i> | <i>wetzelii</i> | 0.00 | 0.00 | 0.00 | 1.55 | 0.00 | 0.74 | 2.20 | 4.10 | 0.40 | 0.00 | 0.00 |
| SCPE | <i>Scolioleura</i> | <i>peisonis</i> | 0.00 | 0.00 | 0.00 | 1.04 | 0.00 | 0.00 | 1.10 | 1.37 | 0.00 | 0.00 | 0.00 |
| SG | <i>Stauroneis</i> | <i>gregorii</i> | 0.00 | 0.00 | 0.00 | 2.07 | 0.00 | 2.71 | 0.00 | 1.37 | 1.82 | 0.00 | 0.00 |
| SB | <i>Stauroneis</i> | <i>bathurstensis</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SSP | <i>Stauroneis</i> | <i>species (obtusa?)</i> | 19.60 | 0.00 | 0.00 | 0.00 | 0.20 | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| STAW | <i>Stauroneis</i> | <i>wislouchii</i> | 75.80 | 5.00 | 40.79 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SO | <i>Surirella</i> | <i>oregonica</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.30 | 0.00 | 0.00 | 0.00 | 0.40 | 0.00 | 0.00 |
| SUSE | <i>Surirella</i> | <i>sella</i> | 0.00 | 2.00 | 0.09 | 9.32 | 0.10 | 0.00 | 0.10 | 0.91 | 0.10 | 0.00 | 0.00 |
| SUSP | <i>Surirella</i> | <i>sp.</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.20 | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SUWE | <i>Surirella</i> | <i>wetzelii</i> | 0.00 | 0.00 | 0.00 | 3.62 | 0.10 | 0.37 | 0.60 | 4.10 | 0.20 | 0.00 | 0.00 |

TABLEAU 2 : Liste des espèces et abondance dans 30 échantillons

TABLE 2: List of species and their abundance in 30 samples

| Codes Codes | Genres Genera | Espèces Species | Pastos Grandes | | | | | | | | | | | |
|----------------|---------------------|------------------------------------|----------------|-------|-------|-------|-------|-------|-------|-------|-------|------|------|------|
| | | | PG73 | PG76 | PG74 | PG78 | PG82 | PG84 | PG97 | P114 | P116 | | | |
| ACAR | <i>Achnanthes</i> | <i>arenaria</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.30 |
| AD | <i>Achnanthes</i> | <i>delicatula</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.43 | 0.00 | 0.00 |
| ASPE | <i>Achnanthes</i> | <i>speciosa</i> | 1.46 | 0.90 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| AMPA | <i>Amphora</i> | <i>atacamana</i> | 0.00 | 2.90 | 0.00 | 10.59 | 0.68 | 7.75 | 0.00 | 3.70 | 1.79 | 0.00 | 0.00 | 0.00 |
| AMPM | <i>Amphora</i> | <i>atacamana minor</i> | 0.00 | 0.00 | 0.00 | 5.34 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 3.79 |
| ABOL | <i>Amphora</i> | <i>boliviana</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ABEL | <i>Amphora</i> | <i>boliviana elongata</i> | 3.11 | 1.90 | 3.67 | 0.00 | 0.00 | 0.18 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| AMCJ | <i>Amphora</i> | <i>carvajaliana</i> | 0.00 | 0.00 | 0.00 | 1.31 | 1.07 | 1.25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ANSA | <i>Anomooneis</i> | <i>sphaerophora angusta</i> | 0.29 | 0.00 | 0.00 | 0.00 | 0.19 | 0.00 | 0.56 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| CSP | <i>Caloneis</i> | <i>silicula minuta</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| CAW | <i>Caloneis</i> | <i>westii</i> | 3.02 | 0.00 | 3.10 | 0.00 | 0.19 | 0.18 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| CP | <i>Cocconeis</i> | <i>placentula</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| CYL | <i>Cymbella</i> | <i>gracilis</i> | 9.14 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| CYMP | <i>Cymbella</i> | <i>pusilla</i> | 0.00 | 3.53 | 7.53 | 2.62 | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| DETH | <i>Denticula</i> | <i>thermalis</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| DE | <i>Denticula</i> | <i>elegans</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| DEV | <i>Denticula</i> | <i>valida</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| FB | <i>Fragilaria</i> | <i>brevistriata</i> | 6.42 | 0.00 | 5.27 | 1.31 | 0.00 | 0.00 | 0.00 | 0.00 | 11.26 | 5.18 | 0.00 | 0.00 |
| FRCV | <i>Fragilaria</i> | <i>construens venter</i> | 0.00 | 0.00 | 1.32 | 1.71 | 0.00 | 1.51 | 0.00 | 1.95 | 0.00 | 0.00 | 0.00 | 0.00 |
| FE | <i>Fragilaria</i> | <i>fasciculata</i> | 1.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| OM | <i>Fragilaria</i> | <i>leptaustoron martyi</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.07 | 0.74 | 0.32 | 0.30 | 0.00 | 0.00 | 0.00 |
| FP | <i>Fragilaria</i> | <i>pinnata</i> | 0.00 | 0.00 | 0.00 | 1.70 | 11.99 | 0.00 | 0.00 | 0.00 | 8.97 | 0.00 | 0.00 | 0.00 |
| FZ | <i>Fragilaria</i> | <i>zelleri</i> | 0.00 | 0.00 | 1.69 | 0.00 | 41.52 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| HA | <i>Hantzschia</i> | <i>amphioxys</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.19 | 0.00 | 0.56 | 0.43 | 0.00 | 0.00 | 0.00 | 0.00 |
| HN | <i>Hantzschia</i> | <i>novsp</i> | 0.00 | 0.00 | 0.56 | 0.00 | 0.19 | 0.00 | 13.30 | 0.43 | 0.00 | 0.00 | 0.00 | 0.00 |
| MATA | <i>Mastoglia</i> | <i>atacamae</i> | 15.18 | 7.40 | 16.65 | 1.30 | 0.19 | 0.71 | 1.12 | 0.00 | 0.60 | 0.00 | 0.00 | 0.00 |
| NCA | <i>Navicula</i> | <i>cariocincta</i> | 0.00 | 0.00 | 0.00 | 0.80 | 0.20 | 5.79 | 4.80 | 3.40 | 2.20 | 0.00 | 0.00 | 0.00 |
| NCI | <i>Navicula</i> | <i>cincta</i> | 2.00 | 0.00 | 0.00 | 0.00 | 4.30 | 1.06 | 0.00 | 6.90 | 0.00 | 0.00 | 0.00 | 0.00 |
| NC | <i>Navicula</i> | <i>veneta</i> | 7.50 | 5.90 | 17.78 | 0.81 | 19.10 | 1.07 | 3.72 | 3.68 | 2.19 | 0.00 | 0.00 | 0.00 |
| NHN | <i>Navicula</i> | <i>nivalis</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.19 | 0.00 | 5.03 | 0.00 | 0.30 | 0.00 | 0.00 | 0.00 |
| NPB | <i>Navicula</i> | <i>paramutica binodis</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.19 | 0.53 | 10.90 | 0.43 | 0.60 | 0.00 | 0.00 | 0.00 |
| NAO | <i>Navicula</i> | <i>cryptotenelloides</i> | 0.00 | 4.40 | 1.13 | 11.40 | 3.10 | 2.40 | 28.80 | 8.30 | 6.70 | 0.00 | 0.00 | 0.00 |
| NLA | <i>Navicula</i> | <i>pseudolanceolata</i> | 15.66 | 24.30 | 5.27 | 31.37 | 0.20 | 0.00 | 0.00 | 0.00 | 10.97 | 0.00 | 0.00 | 0.00 |
| NLI | <i>Navicula</i> | <i>pseudolitoricola</i> | 0.00 | 1.94 | 0.00 | 0.40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| NPYG | <i>Fallacia</i> | <i>pygmae</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| NDC | <i>Navicula</i> | <i>erifuga</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 5.59 | 6.49 | 0.00 | 0.00 | 0.00 | 0.00 |
| NASA | <i>Navicula</i> | <i>salinicola</i> | 0.00 | 2.90 | 0.00 | 12.30 | 1.85 | 35.65 | 0.00 | 30.40 | 22.90 | 0.00 | 0.00 | 0.00 |
| NS | <i>Navicula</i> | <i>sp.</i> | 0.00 | 0.00 | 0.56 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| NILI | <i>Nitzschia</i> | <i>liebethuthii</i> | 1.95 | 0.00 | 0.38 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| NCHI | <i>Nitzschia</i> | <i>accedens chilensis</i> | 0.00 | 0.42 | 0.00 | 2.22 | 0.88 | 6.32 | 0.00 | 1.95 | 8.18 | 0.00 | 0.00 | 0.00 |
| NIAL | <i>Nitzschia</i> | <i>alpina</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| ND | <i>Nitzschia</i> | <i>amphibiodes</i> | 0.00 | 0.94 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| NICC | <i>Nitzschia</i> | <i>compressa compressa</i> | 5.84 | 2.40 | 0.38 | 0.40 | 0.19 | 0.89 | 0.00 | 0.00 | 0.60 | 0.00 | 0.00 | 0.00 |
| NIEP | <i>Nitzschia</i> | <i>epithemioides epithemioides</i> | 0.00 | 0.00 | 0.00 | 1.70 | 0.68 | 8.01 | 0.00 | 4.44 | 7.28 | 0.00 | 0.00 | 0.00 |
| NF | <i>Nitzschia</i> | <i>frustulum</i> | 5.00 | 10.90 | 0.38 | 1.31 | 1.56 | 1.25 | 0.00 | 1.41 | 0.00 | 0.00 | 0.00 | 0.00 |
| NGRU | <i>Nitzschia</i> | <i>grunowii</i> | 0.29 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| NIH | <i>Nitzschia</i> | <i>hantzschiana</i> | 4.96 | 0.00 | 0.40 | 1.30 | 1.36 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| NIHU | <i>Nitzschia</i> | <i>hungarica</i> | 2.24 | 3.90 | 0.56 | 1.31 | 3.31 | 0.53 | 4.66 | 0.43 | 0.60 | 0.00 | 0.00 | 0.00 |
| NPA | <i>Nitzschia</i> | <i>palea</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.23 | 0.00 | 0.00 | 0.30 | 0.00 | 0.00 | 0.00 |
| NIPS | <i>Nitzschia</i> | <i>pusilla</i> | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 9.70 | 0.00 | 11.47 | 13.86 | 0.00 | 0.00 | 0.00 |
| NIVA | <i>Nitzschia</i> | <i>valdecostata</i> | 0.00 | 0.00 | 0.40 | 0.00 | 1.17 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PB | <i>Pinnularia</i> | <i>bogotensis</i> | 1.07 | 0.00 | 1.69 | 0.00 | 0.39 | 0.18 | 0.56 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PIMI | <i>Pinnularia</i> | <i>microstauron</i> | 0.00 | 0.00 | 1.89 | 0.00 | 0.40 | 0.00 | 0.60 | 0.00 | 0.30 | 0.00 | 0.00 | 0.00 |
| RHWE | <i>Rhopalodia</i> | <i>wetzeli</i> | 0.00 | 3.20 | 0.00 | 0.40 | 0.19 | 0.98 | 0.56 | 0.43 | 0.30 | 0.00 | 0.00 | 0.00 |
| SCPE | <i>Scoliopleura</i> | <i>peisonis</i> | 1.75 | 2.90 | 0.00 | 1.71 | 0.19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SG | <i>Stauroneis</i> | <i>gregorii</i> | 0.00 | 0.00 | 0.40 | 0.00 | 0.88 | 0.36 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SB | <i>Stauroneis</i> | <i>bathurstensis</i> | 0.00 | 0.00 | 0.38 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SSP | <i>Stauroneis</i> | <i>species (obtusa?)</i> | 0.29 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| STAW | <i>Stauroneis</i> | <i>wislouchii</i> | 0.00 | 4.90 | 0.00 | 0.00 | 0.00 | 3.74 | 0.56 | 0.87 | 1.50 | 0.00 | 0.00 | 0.00 |
| SO | <i>Surirella</i> | <i>oregonica</i> | 0.70 | 1.35 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SUSE | <i>Surirella</i> | <i>sella</i> | 0.00 | 1.46 | 9.78 | 0.40 | 0.10 | 0.00 | 0.56 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SUSP | <i>Surirella</i> | <i>sp.</i> | 1.90 | 1.20 | 0.40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| SUWE | <i>Surirella</i> | <i>wetzeli</i> | 3.79 | 1.56 | 3.29 | 0.10 | 0.10 | 0.18 | 0.00 | 0.43 | 0.00 | 0.00 | 0.00 | 0.00 |

TABLEAU 3 : Liste des images de diatomées

TABLE 3: List of diatom pictures

| Genres <i>Genera</i> | Espèces <i>Species</i> | | Images <i>Pictures</i> | SERVANT-VILDARY & ROUX (1990) | SERVANT-VILDARY & BLANCO (1984) | SERVANT-VILDARY (1984) |
|-------------------------|---------------------------------------|--------------------------|-------------------------------------------------------------------|----------------------------------|------------------------------------|----------------------------------|
| <i>Achnanthes</i> | <i>arenaria</i> | Amossé | CG2001_M01_SSV-FR-MR_Photo_001 | d2-80 | | |
| <i>Achnanthes</i> | <i>brevipes intermedia</i> | Kützing | CG2001_M01_SSV-FR-MR_Photo_002 | d1-73 | | |
| <i>Achnanthes</i> | <i>chilensis</i> | Hustedt | | | Fig. 31-32 | |
| <i>Achnanthes</i> | <i>delicatula</i> | (Kütz) Grunow | | | Fig. 33 | |
| <i>Achnanthes</i> | <i>speciosa</i> | Hustedt | CG2001_M01_SSV-FR-MR_Photo_003 | d2-101 | | PI. IV, fig. 1-2 |
| <i>Amphora</i> | <i>atacamana</i> | Frenguelli | CG2001_M01_SSV-FR-MR_Photo_004 | d1-09a | | PI. I, fig. 19; PI. VIII, fig. 4 |
| <i>Amphora</i> | <i>atacamana minor</i> | | CG2001_M01_SSV-FR-MR_Photo_005 | d2-29 | Fig. 12b & c | |
| <i>Amphora</i> | <i>boliviana</i> | Patrick | CG2001_M01_SSV-FR-MR_Photo_006, CG2001_M01_SSV-FR-MR_Photo_007 | d2-53, d2-17 | Fig. 10 | |
| <i>Amphora</i> | <i>boliviana elongata</i> | | CG2001_M01_SSV-FR-MR_Photo_008 | d2-12 | | Fig. 13 |
| <i>Amphora</i> | <i>carvajaliana</i> | Patrick | CG2001_M01_SSV-FR-MR_Photo_009 | d1-71 | | Fig. 9, 14 |
| <i>Amphora</i> | <i>coffaeiformis</i> | Agardh | CG2001_M01_SSV-FR-MR_Photo_010 | d2-99 | | PI. IV, fig. 9 |
| <i>Amphora</i> | <i>lineolata</i> | Ehrenberg | CG2001_M01_SSV-FR-MR_Photo_011 | d2-52a | | Fig. 47-48 |
| <i>Amphora</i> | <i>lybica</i> | Ehrenberg | CG2001_M01_SSV-FR-MR_Photo_012 | d1-06 | | Fig. 44 |
| <i>Amphora</i> | <i>platensis</i> | Frenguelli | CG2001_M01_SSV-FR-MR_Photo_013 | d2-65 | | PI. II, fig. 25 |
| <i>Anomooneis</i> | <i>sphaerophora angusta</i> | Frenguelli | CG2001_M01_SSV-FR-MR_Photo_014 | d2-11 | | PI. II, fig. 16-17 |
| <i>Anomooneis</i> | <i>sphaerophora navicularis</i> | (Ehr.) O. Muller | CG2001_M01_SSV-FR-MR_Photo_015 | d4-05 | | PI. II, fig. 12-13 |
| <i>Anomooneis</i> | <i>sphaerophora platensis</i> | Frenguelli | CG2001_M01_SSV-FR-MR_Photo_016 | d2-09 | | |
| <i>Anomooneis</i> | | | CG2001_M01_SSV-FR-MR_Photo_017 | d2-23 | Fig. 49 | |
| <i>Brachysira</i> | <i>aponina</i> | Kützing | CG2001_M01_SSV-FR-MR_Photo_018 | d1-57 | | Fig. 25 |
| <i>Caloneis</i> | <i>silicula minuta</i> | (Grun) Mills | CG2001_M01_SSV-FR-MR_Photo_019 | d1-02 | | |
| <i>Caloneis</i> | <i>westii</i> | (W. Smith) Hendey | CG2001_M01_SSV-FR-MR_Photo_020 | d1-37 | | Fig. 50 |
| <i>Cocconeis</i> | <i>placentula euglypta</i> | (Ehr) Cleve | CG2001_M01_SSV-FR-MR_Photo_021 | d2-83 | | PI. I, fig. 7 |
| <i>Cymbella</i> | <i>cymbiformis</i> | (Agardh Kütz) Van Heurck | CG2001_M01_SSV-FR-MR_Photo_022 | d1-81 | | |
| <i>Cymbella</i> | <i>pusilla</i> | Grunow | CG2001_M01_SSV-FR-MR_Photo_023 | d2-24 | Fig. 14 | |
| <i>Denticula</i> | <i>elegans</i> | Kützing | CG2001_M01_SSV-FR-MR_Photo_024 | d2-57 | | Fig. 51 |
| <i>Denticula</i> | <i>eximia</i> | Krammer & Lange-Bertalot | CG2001_M01_SSV-FR-MR_Photo_025 | d2-43 | | |
| <i>Denticula</i> | <i>kuetzingii</i> | Grunow | CG2001_M01_SSV-FR-MR_Photo_026 | d1-18 | | |
| <i>Denticula</i> | <i>subtilis</i> | Grunow | CG2001_M01_SSV-FR-MR_Photo_027 | d2-22 | | |
| <i>Denticula</i> | <i>tenuis</i> var.? | Kützing | CG2001_M01_SSV-FR-MR_Photo_028 | d3-60 | | Fig. 36 |
| <i>Denticula</i> | <i>thermalis</i> | Kützing | CG2001_M01_SSV-FR-MR_Photo_029 | d2-60 | | |
| <i>Denticula</i> | <i>valida</i> | (Pedicino) Grunow | CG2001_M01_SSV-FR-MR_Photo_030 | d3-75 | | Fig. 35 |
| <i>Entomoneis</i> | <i>paludosa</i> | (W. Smith) Reimer | CG2001_M01_SSV-FR-MR_Photo_031 | d2-100 | | PI. IV, fig. 10 |
| <i>Fallacia</i> | <i>pygmaea</i> | Kützing | CG2001_M01_SSV-FR-MR_Photo_032 | d2-98 (PAG 70) | Fig. 38 | PI. II, fig. 23 |
| <i>Fragilaria</i> | <i>brevistriata</i> | | CG2001_M01_SSV-FR-MR_Photo_033 | d2-07a (PAG 73) | | |
| <i>Fragilaria</i> | <i>brevistriata</i> | | CG2001_M01_SSV-FR-MR_Photo_034 | d1-41 (PAG 23) | Fig. 27 | |
| <i>Fragilaria</i> | <i>brevistriata</i> | | CG2001_M01_SSV-FR-MR_Photo_035 | d1-45 (PAG 41) | | |
| <i>Fragilaria</i> | <i>brevistriata elliptica</i> | Héribaud | CG2001_M01_SSV-FR-MR_Photo_036 | d2-86 | | |
| <i>Fragilaria</i> | <i>construens binodis</i> | (Ehrenberg) Hustedt | CG2001_M01_SSV-FR-MR_Photo_037 | d1-43 | | |
| <i>Fragilaria</i> | <i>construens</i> f. <i>subsalina</i> | Hustedt | CG2001_M01_SSV-FR-MR_Photo_038 | d1-44 | | |
| <i>Fragilaria</i> | <i>fasciculata</i> | (Agardh) Lange-Bertalot | | | | |
| <i>Fragilaria</i> | <i>pinnata</i> | Ehrenberg | | | PI. III, fig. 2 | |

TABLEAU 3 : Liste des images de diatomées

TABLE 3: List of diatom pictures

| Genres <i>Genera</i> | Espèces <i>Species</i> | | Images <i>Pictures</i> | SERVANT-VILDARY & ROUX (1990) | SERVANT-VILDARY & BLANCO (1984) | SERVANT-VILDARY (1984) |
|-------------------------|------------------------------------|----------------------------|--------------------------------|----------------------------------|------------------------------------|------------------------|
| <i>Fragilaria</i> | <i>zellleri</i> | Héribaud | CG2001_M01_SSV-FR-MR_Photo_039 | d4-08 | Fig. 29 | |
| <i>Hantzschia</i> | <i>amphioxys</i> | (Ehrenberg) Grunow | CG2001_M01_SSV-FR-MR_Photo_040 | d1-10 | | Pl. V, fig. 12-13 |
| <i>Hantzschia</i> | <i>amphioxys</i> var. <i>maior</i> | Grunow | CG2001_M01_SSV-FR-MR_Photo_041 | d2-93 | | Pl. V, fig. 1-11 |
| <i>Hantzschia</i> | sp. | | CG2001_M01_SSV-FR-MR_Photo_042 | d2-89 | | |
| <i>Hippodonta</i> | <i>hungarica</i> | (Grun) Lange-Bertalot | CG2001_M01_SSV-FR-MR_Photo_043 | d2-06 | | |
| <i>Mastoglia</i> | <i>atacamae</i> | Frenguelli | CG2001_M01_SSV-FR-MR_Photo_044 | d2-25, d2-47 | Fig. 53 | |
| <i>Mastoglia</i> | <i>smithii lacustris</i> | Grunow | CG2001_M01_SSV-FR-MR_Photo_045 | | | |
| | | | CG2001_M01_SSV-FR-MR_Photo_046 | d2-14 | | |
| <i>Navicula</i> | <i>arctotenelloides</i> | Lange-Bertalot & Metzeltin | CG2001_M01_SSV-FR-MR_Photo_047 | d2-95 (Pag 72) | | |
| <i>Navicula</i> | <i>carlocincta</i> | Lange-Bertalot | CG2001_M01_SSV-FR-MR_Photo_048 | d2-103 | | |
| <i>Navicula</i> | cf. <i>multicopsis</i> | Van Heurck | CG2001_M01_SSV-FR-MR_Photo_049 | d2-103 | | |
| <i>Navicula</i> | cf. <i>paramutica binodis</i> | Bock | CG2001_M01_SSV-FR-MR_Photo_050 | d2-04 (ag 116) | Fig. 39 | Pl. II, fig. 20 |
| <i>Navicula</i> | <i>cincta</i> | Ehrenberg | CG2001_M01_SSV-FR-MR_Photo_051 | d2-37 | | |
| <i>Navicula</i> | <i>cryptotenelloides</i> | Hustedt | CG2001_M01_SSV-FR-MR_Photo_052 | d1-09c | | |
| <i>Navicula</i> | <i>digitoradiata minor</i> | Krasske | CG2001_M01_SSV-FR-MR_Photo_053 | d1-36, d1-27 | Fig. 54 | |
| <i>Navicula</i> | <i>eriluga</i> | Lange-Bertalot | CG2001_M01_SSV-FR-MR_Photo_054 | | Fig. 34 | |
| | | | CG2001_M01_SSV-FR-MR_Photo_055 | d2-05 (Pag 73) | | |
| <i>Navicula</i> | <i>incertata</i> | Lange-Bertalot | CG2001_M01_SSV-FR-MR_Photo_056 | d4-11 | | |
| <i>Navicula</i> | <i>nivalis</i> | Ehrenberg | CG2001_M01_SSV-FR-MR_Photo_057 | d1-35 | | Pl. II, fig. 21 |
| <i>Navicula</i> | <i>novadeciplus</i> | Hustedt | CG2001_M01_SSV-FR-MR_Photo_058 | d2-18 (Can 4) | | |
| <i>Navicula</i> | <i>phyllepta</i> | Kützing | CG2001_M01_SSV-FR-MR_Photo_059 | d1-31 | | |
| <i>Navicula</i> | <i>podzorskii</i> | Lange-Bertalot | CG2001_M01_SSV-FR-MR_Photo_060 | d2-55 (Bal 67) | | |
| <i>Navicula</i> | <i>pseudolitoricola</i> | Håkansson | CG2001_M01_SSV-FR-MR_Photo_061 | d2-15 (Pag 84) | | |
| <i>Navicula</i> | <i>salnicola</i> | | CG2001_M01_SSV-FR-MR_Photo_062 | d2-32 | Fig. 22, 23 | |
| <i>Navicula</i> | sp. | | CG2001_M01_SSV-FR-MR_Photo_063 | d1-98 | | |
| <i>Navicula</i> | <i>tripunctata</i> | (O.F. Muller) Bory | CG2001_M01_SSV-FR-MR_Photo_064 | d2-07b (Pag 73) | | |
| <i>Navicula</i> | <i>veneta</i> | Kützing | CG2001_M01_SSV-FR-MR_Photo_065 | d2-85 | Fig. 45 | |
| <i>Neldium</i> | <i>bisulcatum subampliatum</i> | Krammer | CG2001_M01_SSV-FR-MR_Photo_066 | d2-84 | | |
| <i>Neldium</i> | <i>koslowii</i> | Mereschkowski | CG2001_M01_SSV-FR-MR_Photo_067 | d3-72 | | |
| <i>Nitzschia</i> | <i>accedens chilensis</i> | Patrick | CG2001_M01_SSV-FR-MR_Photo_068 | d1-08 | | Pl. I, Fig. 1-5 |
| <i>Nitzschia</i> | aff. <i>valdecostata</i> | | CG2001_M01_SSV-FR-MR_Photo_069 | d2-59 (Cl20) | | Pl. IV, Fig. 4-11 |
| <i>Nitzschia</i> | <i>amphibia</i> | Grunow | CG2001_M01_SSV-FR-MR_Photo_070 | d2-21 (Can 4) | | |
| <i>Nitzschia</i> | cf. <i>amphibioides</i> | Hustedt | CG2001_M01_SSV-FR-MR_Photo_071 | d3-62 | | |
| <i>Nitzschia</i> | <i>compressa compressa</i> | Lange-Bertalot | CG2001_M01_SSV-FR-MR_Photo_072 | d2-13, d1-89 | | Pl. I, Fig. 26 |
| <i>Nitzschia</i> | <i>epithemioides epithemioides</i> | Lange-Bertalot | CG2001_M01_SSV-FR-MR_Photo_073 | | | Pl. I, Fig. 12-15 |
| | | | CG2001_M01_SSV-FR-MR_Photo_074 | d1-86 (Pag 84) | | |
| <i>Nitzschia</i> | <i>frustulum (modesta)</i> | (Kützing) Grunow | CG2001_M01_SSV-FR-MR_Photo_075 | d2-46 (Bal) | | Pl. I, Fig. 16-17 |
| <i>Nitzschia</i> | <i>grunowii</i> | (Cleve) Hasle | CG2001_M01_SSV-FR-MR_Photo_076 | d2-94 (Pag 72) | | Pl. II, Fig. 13-16 |
| <i>Nitzschia</i> | <i>hantzschiana (modesta)</i> | Rabenhorst | | | | |

TABLEAU 3 : Liste des images de diatomées

TABLE 3: List of diatom pictures

| Genres <i>Genera</i> | Espèces <i>Species</i> | | Images <i>Pictures</i> | SERVANT-VILDARY & ROUX (1990) | SERVANT-VILDARY & BLANCO (1984) | SERVANT-VILDARY (1984) |
|-------------------------|------------------------------|----------------------------------|-------------------------------------------------------------------|----------------------------------|------------------------------------|----------------------------------------|
| <i>Nitzschia</i> | <i>hungarica</i> | Grunow | CG2001_M01_SSV-FR-MR_Photo_077 | d1-49 | | |
| <i>Nitzschia</i> | <i>liebetruhi</i> | Lange-Bertalot | CG2001_M01_SSV-FR-MR_Photo_078, CG2001_M01_SSV-FR-MR_Photo_079 | d2-20, d2-58 | | Pl. II, Fig. 1-9 Pl. IV, Fig. 19-25 |
| <i>Nitzschia</i> | <i>alpina</i> | Hustedt | CG2001_M01_SSV-FR-MR_Photo_080 | d1-40 (CLD 16) | | |
| <i>Nitzschia</i> | <i>palea</i> | (Kützing) W. Smith | CG2001_M01_SSV-FR-MR_Photo_081 | d2-36 (Can) | | Pl. I, Fig. 6-9 |
| <i>Nitzschia</i> | <i>palea</i> | (Kützing) W. Smith | CG2001_M01_SSV-FR-MR_Photo_082 | d1-48 (Pag 23) | | Pl. III, Fig. 6-7 |
| <i>Nitzschia</i> | <i>pusilla</i> | Grunow | CG2001_M01_SSV-FR-MR_Photo_083 | d4-16 | | |
| <i>Nitzschia</i> | <i>valdecostata</i> | Lange-Bertalot & Simonsen | CG2001_M01_SSV-FR-MR_Photo_084 | d1-54 | | |
| <i>Nitzschia</i> | <i>valdestrata</i> | Aleem & Hustedt | CG2001_M01_SSV-FR-MR_Photo_085 | d2-38 | | Pl. IV, Fig. 1-3 |
| <i>Pinnularia</i> | <i>borealis f. ovalis</i> | Boye Petersen | CG2001_M01_SSV-FR-MR_Photo_086 | d2-92 | | |
| <i>Pinnularia</i> | <i>microstauron</i> | Ehrenberg Cleve | CG2001_M01_SSV-FR-MR_Photo_087 | d2-90 | | |
| <i>Placoneis</i> | aff. <i>elginensis</i> | (Greg) Cox var <i>elginensis</i> | CG2001_M01_SSV-FR-MR_Photo_088 | d2-48 (Pur 2) | | |
| <i>Rhopalodia</i> | <i>sculpta</i> | Krammer | CG2001_M01_SSV-FR-MR_Photo_089 | d4-10 | | |
| <i>Rhopalodia</i> | <i>wetzlii</i> | Hustedt | CG2001_M01_SSV-FR-MR_Photo_090 | d2-34 | Fig. 15-17 | |
| <i>Scolioleptura</i> | <i>peisonis</i> | Grunow | CG2001_M01_SSV-FR-MR_Photo_091 | d3-64 | Fig. 52 | |
| <i>Stauroneis</i> | <i>anceps</i> | Ehrenberg | CG2001_M01_SSV-FR-MR_Photo_092 | d2-16 | | |
| <i>Stauroneis</i> | <i>bathurstensis</i> | Giffen | CG2001_M01_SSV-FR-MR_Photo_093 | d2-50 | Fig. 34 | |
| <i>Stauroneis</i> | <i>elata</i> | Hustedt | CG2001_M01_SSV-FR-MR_Photo_094 | d2-68, | | |
| <i>Stauroneis</i> | <i>gregorii</i> | Ralfs | CG2001_M01_SSV-FR-MR_Photo_095 | d1-46 | Fig. 55 | |
| <i>Stauroneis</i> | <i>gregorii densestriata</i> | Hustedt | CG2001_M01_SSV-FR-MR_Photo_096 | d3-76 | | |
| <i>Stauroneis</i> | <i>gregorii var linearis</i> | Hustedt | CG2001_M01_SSV-FR-MR_Photo_097 | d2-19 | | |
| <i>Stauroneis</i> | <i>legleri</i> | Hustedt | CG2001_M01_SSV-FR-MR_Photo_098 | d1-26 | Fig. 40 | |
| <i>Stauroneis</i> | sp. (<i>obtusa?</i>) | | CG2001_M01_SSV-FR-MR_Photo_099 | d2-40 | Fig. 37 | |
| <i>Stauroneis</i> | <i>wislouchii</i> | Poretzky & Anisimova | CG2001_M01_SSV-FR-MR_Photo_100, CG2001_M01_SSV-FR-MR_Photo_101 | d4-02, d2-49 | Fig. 41 | |
| <i>Suriella</i> | <i>chilensis</i> | Janish | CG2001_M01_SSV-FR-MR_Photo_102 | d1-05 | Fig. 56 | |
| <i>Suriella</i> | <i>dubia</i> | Frenguelli | CG2001_M01_SSV-FR-MR_Photo_103 | d1-12 | | |
| <i>Suriella</i> | <i>oregonica</i> | Ehrenberg | CG2001_M01_SSV-FR-MR_Photo_104 | d1-70 | | Pl. I, fig. 17; Pl. VIII, fig. 1-2 |
| <i>Suriella</i> | <i>ovata utahensis</i> | Grunow | CG2001_M01_SSV-FR-MR_Photo_105 | d2-27 | Fig. 26 | Pl. VIII, fig. 8-9; Pl. II, fig. 6 |
| <i>Suriella</i> | <i>peisonis</i> | Hustedt | | | | Pl. II, fig. 5 & 10 |
| <i>Suriella</i> | <i>sella</i> | Hustedt | CG2001_M01_SSV-FR-MR_Photo_106 | d1-13 | Fig. 19 | Pl. II, fig. 7; Pl. VII, fig. 3-7 |
| <i>Suriella</i> | <i>wetzlii</i> | Hustedt | CG2001_M01_SSV-FR-MR_Photo_107 | d1-73a | Fig. 20 | |
| Chiar Kkota | | | CG2001_M01_SSV-FR-MR_Photo_108 | d1-44 | | |
| Pastos Grandes 23 | | | CG2001_M01_SSV-FR-MR_Photo_063, | d1-98, d1-09 | | |
| Pastos Grandes 84 | | | CG2001_M01_SSV-FR-MR_Photo_108 | | | |

TABLEAU 4 : Optima et tolérances estimées des espèces

TABLE 4: Optima and tolerances of the species

Weighted Averaging (WA) method. Results: R, R², Standard error of prediction (SEP).Weighted Averaging Plus Least Squares regression (WA-PLS). Results: number of components, r, R, R² and S

| Genres | Espèces | Codes | Na+ (mg/l) | | | |
|---------------------|------------------------------------|---------|------------|----------|-----------|-----------|
| | | | codes | OPTIMUM | TOLERANCE | FREQUENCE |
| Genera | Species | Samples | | | | |
| <i>Achnanthes</i> | <i>arenaria</i> | ACAR | | 9440.02 | 11850.67 | 6 |
| <i>Achnanthes</i> | <i>delicatula</i> | AD | | 13217.75 | 17837.34 | 7 |
| <i>Achnanthes</i> | <i>speciosa</i> | ASPE | | 9437.31 | 4670.60 | 6 |
| <i>Amphora</i> | <i>atacamana</i> | AMPA | | 40443.13 | 32684.07 | 17 |
| <i>Amphora</i> | <i>atacamana minor</i> | AMPM | | 40196.09 | 36663.85 | 7 |
| <i>Amphora</i> | <i>boliviana</i> | ABOL | | 23994.03 | 17053.50 | 5 |
| <i>Amphora</i> | <i>boliviana elongata</i> | ABEL | | 10787.01 | 25830.84 | 9 |
| <i>Amphora</i> | <i>carvajaliana</i> | AMCJ | | 15297.68 | 11510.65 | 21 |
| <i>Anomoeoneis</i> | <i>sphaerophora angusta</i> | ANSA | | 13427.04 | 10983.83 | 9 |
| <i>Caloneis</i> | <i>silicula minuta</i> | CSP | | 16067.21 | 14089.92 | 4 |
| <i>Caloneis</i> | <i>westii</i> | CAW | | 3332.06 | 9349.22 | 8 |
| <i>Cocconeis</i> | <i>placentula</i> | CP | | 7358.88 | 6013.96 | 7 |
| <i>Cymbella</i> | <i>gracilis</i> | CYL | | 9520.02 | 10816.22 | 13 |
| <i>Cymbella</i> | <i>pusilla</i> | CYMP | | 21344.87 | 15054.82 | 7 |
| <i>Denticula</i> | <i>thermalis</i> | DETH | | 6761.96 | 4415.52 | 5 |
| <i>Fragilaria</i> | <i>brevistriata</i> | FB | | 17235.64 | 33302.23 | 11 |
| <i>Fragilaria</i> | <i>construens venter</i> | FRCV | | 26823.29 | 29188.60 | 5 |
| <i>Fragilaria</i> | <i>fasciculata</i> | FE | | 37721.56 | 34753.68 | 5 |
| <i>Fragilaria</i> | <i>leptaustoron martyi</i> | OM | | 27283.28 | 29857.10 | 7 |
| <i>Fragilaria</i> | <i>pinnata</i> | FP | | 37365.34 | 41497.84 | 9 |
| <i>Fragilaria</i> | <i>zeilleri</i> | FZ | | 177.13 | 488.35 | 4 |
| <i>Hantzschia</i> | <i>amphioxys</i> | HA | | 27347.08 | 38222.20 | 4 |
| <i>Hantzschia</i> | nov. sp. | HN | | 2085.29 | 10485.98 | 7 |
| <i>Mastoglia</i> | <i>atacamae</i> | MATA | | 6873.58 | 15864.44 | 11 |
| <i>Navicula</i> | <i>cariocincta</i> | NCA | | 22097.43 | 34459.92 | 14 |
| <i>Navicula</i> | <i>cincta</i> | NCI | | 50355.07 | 38808.34 | 4 |
| <i>Navicula</i> | <i>veneta</i> | NC | | 9779.83 | 20579.58 | 20 |
| <i>Navicula</i> | <i>nivalis</i> | NHN | | 4366.02 | 18936.03 | 5 |
| <i>Navicula</i> | <i>paramutica binodis</i> | NPB | | 6935.49 | 19702.86 | 9 |
| <i>Navicula</i> | <i>cryptotenelloides</i> | NAO | | 28421.04 | 34981.70 | 25 |
| <i>Navicula</i> | <i>pseudolanceolata</i> | NLA | | 16821.11 | 12651.41 | 7 |
| <i>Navicula</i> | <i>pseudolitoricola</i> | NLI | | 12031.41 | 14350.63 | 5 |
| <i>Fallacia</i> | <i>pygmaea</i> | NPYG | | 3339.75 | 4620.82 | 7 |
| <i>Navicula</i> | <i>erifuga</i> | NDC | | 28247.65 | 28971.50 | 19 |
| <i>Navicula</i> | <i>salinicola</i> | NASA | | 55122.24 | 34786.00 | 18 |
| <i>Navicula</i> | sp. | NS | | 13124.38 | 30099.34 | 5 |
| <i>Nitzschia</i> | <i>liebetruthii</i> | NILI | | 8307.35 | 3635.29 | 6 |
| <i>Nitzschia</i> | <i>accedens chilensis</i> | NCHI | | 48925.66 | 38497.14 | 17 |
| <i>Nitzschia</i> | <i>alpina</i> | NIAL | | 25431.24 | 19047.58 | 7 |
| <i>Nitzschia</i> | <i>amphibiodes</i> | ND | | 8500.04 | 7345.89 | 4 |
| <i>Nitzschia</i> | <i>compressa compressa</i> | NICC | | 14086.18 | 24500.73 | 13 |
| <i>Nitzschia</i> | <i>epithemioides epithemioides</i> | NIEP | | 52051.10 | 37543.32 | 12 |
| <i>Nitzschia</i> | <i>frustulum</i> | NF | | 13205.34 | 20836.79 | 16 |
| <i>Nitzschia</i> | <i>grunowii</i> | NGRU | | 9150.83 | 5819.79 | 8 |
| <i>Nitzschia</i> | <i>hantzschiana</i> | NIH | | 6869.44 | 10104.02 | 12 |
| <i>Nitzschia</i> | <i>hungarica</i> | NIHU | | 9519.94 | 17046.45 | 20 |
| <i>Nitzschia</i> | <i>palea</i> | NPA | | 64909.73 | 28127.99 | 6 |
| <i>Nitzschia</i> | <i>pusilla</i> | NIPS | | 69579.49 | 35585.78 | 11 |
| <i>Nitzschia</i> | <i>valdecostata</i> | NIVA | | 5422.61 | 4662.80 | 7 |
| <i>Pinnularia</i> | <i>bogotensis</i> | PB | | 8636.53 | 17258.04 | 6 |
| <i>Pinnularia</i> | <i>microstauron</i> | PIMI | | 6689.21 | 22072.75 | 5 |
| <i>Rhopalodia</i> | <i>wetzelii</i> | RHWE | | 24527.57 | 27391.25 | 14 |
| <i>Scoliopleura</i> | <i>peisonis</i> | SCPE | | 14800.99 | 13101.88 | 13 |
| <i>Stauroneis</i> | <i>gregorii</i> | SG | | 26378.85 | 30284.68 | 13 |
| <i>Stauroneis</i> | <i>bathurstensis</i> | SB | | 10397.72 | 6982.38 | 7 |
| <i>Stauroneis</i> | <i>species (obtus?)</i> | SSP | | 10391.23 | 1275.46 | 4 |
| <i>Stauroneis</i> | <i>wislouchii</i> | STAW | | 21298.95 | 18691.32 | 13 |
| <i>Surirella</i> | <i>oregonica</i> | SO | | 18356.95 | 35103.41 | 4 |
| <i>Surirella</i> | <i>sella</i> | SUSE | | 7995.52 | 9242.72 | 19 |
| <i>Surirella</i> | sp. | SUSP | | 4010.54 | 1994.34 | 6 |
| <i>Surirella</i> | <i>wetzelii</i> | SUWE | | 19125.02 | 14219.46 | 21 |

| Samples | Observed values | Estimated values | Residus |
|----------------|------------------------------------------------------------------|-------------------------|-----------------------------|
| BA67 | 13600.000 | 9850.410 | 3749.590 |
| RAM6 | 7590.000 | 9189.363 | -1599.363 |
| VER5 | 4510.000 | 10314.528 | -5804.528 |
| HED4 | 20400.000 | 15766.853 | 4633.147 |
| PJ30 | 10000.000 | 17438.639 | -7438.639 |
| PUR2 | 9550.000 | 17764.068 | -8214.068 |
| HON4 | 6740.000 | 15732.725 | -8992.725 |
| CHI5 | 20700.000 | 16570.824 | 4129.176 |
| CAN4 | 3590.000 | 17847.662 | -14257.662 |
| CHU4 | 30100.000 | 16336.339 | 13763.661 |
| CHU9 | 2320.000 | 15377.588 | -13057.588 |
| CL20 | 10600.000 | 21038.520 | -10438.520 |
| CD24 | 19900.000 | 22094.158 | -2194.158 |
| CD16 | 40700.000 | 31594.473 | 9105.527 |
| PG70 | 4000.000 | 17107.711 | -13107.711 |
| PG23 | 451.000 | 15642.589 | -15191.589 |
| PG41 | 9270.000 | 33827.559 | -24557.559 |
| PG43 | 4510.000 | 37911.148 | -33401.148 |
| PG45 | 34000.000 | 36413.168 | -2413.168 |
| PG47 | 103000.000 | 43389.824 | 59610.176 |
| PG72 | 80.000 | 8339.988 | -8259.988 |
| PG73 | 3910.000 | 12262.317 | -8352.317 |
| PG76 | 4510.000 | 19992.775 | -15482.775 |
| PG74 | 350.000 | 11090.177 | -10740.177 |
| PG78 | 46000.000 | 31939.594 | 14060.406 |
| PG82 | 41.900 | 15822.397 | -15780.497 |
| PG84 | 77100.000 | 47132.605 | 29967.395 |
| PG97 | 85.100 | 16681.498 | -16596.398 |
| P114 | 81000.000 | 41826.746 | 39173.254 |
| P116 | 92000.000 | 43336.016 | 48663.984 |
| | WA: Coefficient de corrélation multiple | | R = 0.8117 |
| | | | R² = 0.66 |
| | Variance de la variable Na à expliquer | | 8.31E+08 |
| | Variance des résidus | | 4.25E+08 |
| | Ecart-type des résidus = SEP Standard error of prediction | | 20614.64 |
| | WA-PLS : 2 composants, SEP = 19442 | | R = 0.89 |
| | | | R² = 0.80 |
| | | | r = 0.7428 |

| K+ (mg/l) | | | | Salinity (mg/l) | | | |
|------------------|----------------|------------------|------------------|------------------------|----------------|------------------|------------------|
| <i>codes</i> | <i>OPTIMUM</i> | <i>TOLERANCE</i> | <i>FREQUENCE</i> | <i>codes</i> | <i>OPTIMUM</i> | <i>TOLERANCE</i> | <i>FREQUENCE</i> |
| | 1207.12 | 925.77 | 6 | | 29884.19 | 34429.63 | 6 |
| | 1511.25 | 2143.75 | 7 | | 40795.95 | 55567.99 | 7 |
| | 1166.47 | 600.42 | 6 | | 31176.80 | 15906.11 | 6 |
| | 4426.33 | 3845.48 | 17 | | 123735.41 | 99822.04 | 17 |
| | 4257.09 | 4103.14 | 7 | | 122779.11 | 110397.41 | 7 |
| | 2860.24 | 1447.47 | 5 | | 72972.30 | 48567.10 | 5 |
| | 1825.20 | 3406.29 | 9 | | 34962.11 | 80398.52 | 9 |
| | 2077.72 | 2147.55 | 21 | | 50363.23 | 37055.72 | 21 |
| | 2897.28 | 3823.70 | 9 | | 44776.31 | 38354.55 | 9 |
| | 6951.01 | 5887.35 | 4 | | 64038.06 | 55436.06 | 4 |
| | 350.89 | 795.83 | 8 | | 10419.22 | 27379.88 | 8 |
| | 923.81 | 743.64 | 7 | | 23819.22 | 17230.23 | 7 |
| | 1071.23 | 1196.17 | 13 | | 30254.42 | 33905.07 | 13 |
| | 4631.94 | 4764.32 | 7 | | 71689.87 | 48995.69 | 7 |
| | 1464.69 | 419.25 | 5 | | 24453.56 | 13426.39 | 5 |
| | 2142.83 | 4228.09 | 11 | | 53828.97 | 103370.23 | 11 |
| | 2866.36 | 3155.15 | 5 | | 82480.13 | 89476.72 | 5 |
| | 4810.78 | 4884.37 | 5 | | 116897.13 | 109656.84 | 5 |
| | 2635.38 | 2740.90 | 7 | | 81122.17 | 88503.35 | 7 |
| | 3477.70 | 3933.59 | 9 | | 110897.58 | 122287.35 | 9 |
| | 18.46 | 53.66 | 4 | | 627.79 | 1512.63 | 4 |
| | 3312.03 | 4629.13 | 4 | | 86242.18 | 120386.45 | 4 |
| | 288.91 | 1278.51 | 7 | | 6799.33 | 32799.58 | 7 |
| | 705.25 | 1446.05 | 11 | | 21127.10 | 46977.82 | 11 |
| | 2131.09 | 3435.69 | 14 | | 66718.63 | 103268.48 | 14 |
| | 5849.73 | 4612.14 | 4 | | 157232.81 | 121336.81 | 4 |
| | 1264.47 | 2378.74 | 20 | | 30542.75 | 62613.84 | 20 |
| | 369.78 | 1523.23 | 5 | | 12920.90 | 54997.88 | 5 |
| | 1541.78 | 3682.57 | 9 | | 23503.87 | 61560.73 | 9 |
| | 3238.18 | 4138.50 | 25 | | 87662.23 | 107368.46 | 25 |
| | 6070.26 | 5953.59 | 7 | | 63646.28 | 50895.54 | 7 |
| | 1407.68 | 1534.89 | 5 | | 38474.49 | 44953.49 | 5 |
| | 400.11 | 569.66 | 7 | | 10917.80 | 15497.66 | 7 |
| | 3065.24 | 3031.91 | 19 | | 86752.94 | 87606.20 | 19 |
| | 5914.08 | 4163.34 | 18 | | 167355.16 | 106348.25 | 18 |
| | 1732.16 | 4169.37 | 5 | | 41231.30 | 94724.01 | 5 |
| | 983.03 | 547.96 | 6 | | 28432.38 | 12116.65 | 6 |
| | 5219.24 | 4429.53 | 17 | | 148070.84 | 116343.82 | 17 |
| | 2867.35 | 2681.80 | 7 | | 76748.71 | 59978.92 | 7 |
| | 856.53 | 866.66 | 4 | | 26391.02 | 22403.08 | 4 |
| | 1313.88 | 2022.91 | 13 | | 42439.33 | 71431.60 | 13 |
| | 5416.01 | 4283.07 | 12 | | 157145.11 | 113644.09 | 12 |
| | 2049.83 | 3191.30 | 16 | | 42566.63 | 64692.72 | 16 |
| | 1249.43 | 614.71 | 8 | | 29977.37 | 17128.71 | 8 |
| | 1199.49 | 2455.08 | 12 | | 23025.32 | 33768.41 | 12 |
| | 2176.01 | 3286.98 | 20 | | 32533.97 | 53575.68 | 20 |
| | 5508.15 | 2199.18 | 6 | | 190057.30 | 81420.38 | 6 |
| | 7761.39 | 4335.74 | 11 | | 212075.11 | 108571.73 | 11 |
| | 586.82 | 652.96 | 7 | | 17276.65 | 14251.57 | 7 |
| | 2315.01 | 4612.97 | 6 | | 30407.47 | 57011.78 | 6 |
| | 1085.02 | 1823.82 | 5 | | 21220.58 | 63804.37 | 5 |
| | 2710.03 | 3007.51 | 14 | | 74965.75 | 82850.99 | 14 |
| | 1708.77 | 1435.23 | 13 | | 47373.04 | 40977.83 | 13 |
| | 3107.44 | 3915.96 | 13 | | 82300.65 | 94715.86 | 13 |
| | 1148.16 | 801.92 | 7 | | 33961.54 | 23164.52 | 7 |
| | 2769.21 | 435.99 | 4 | | 35521.27 | 4497.50 | 4 |
| | 3094.82 | 1616.26 | 13 | | 65771.20 | 53788.02 | 13 |
| | 2472.09 | 4863.69 | 4 | | 57857.84 | 110435.44 | 4 |
| | 972.41 | 1242.84 | 19 | | 25807.73 | 28999.84 | 19 |
| | 461.16 | 249.10 | 6 | | 12834.27 | 6515.62 | 6 |
| | 5394.96 | 5449.09 | 21 | | 69143.63 | 51302.73 | 21 |

| Observed values | Estimated values | RESIDUS | Observed values | Estimated values | RESIDUS |
|------------------------------------------------------------------|-------------------------|-----------------------------|------------------------------------------------------------------|-------------------------|-----------------------------|
| 1700.000 | 1190.587 | 509.413 | 45335.000 | 32671.533 | 12663.467 |
| 1030.000 | 1100.207 | -70.207 | 27658.000 | 30878.086 | -3220.086 |
| 308.000 | 1204.500 | -896.500 | 14716.000 | 34239.449 | -19523.449 |
| 2100.000 | 2508.819 | -408.819 | 67099.000 | 52600.191 | 14498.809 |
| 1020.000 | 2161.026 | -1141.026 | 31139.000 | 55710.945 | -24571.945 |
| 1720.000 | 2335.447 | -615.447 | 32785.000 | 57165.410 | -24380.410 |
| 989.000 | 2062.277 | -1073.277 | 21392.000 | 50968.250 | -29576.250 |
| 2500.000 | 2163.798 | 336.202 | 69439.000 | 53829.586 | 15609.414 |
| 212.000 | 3499.940 | -3287.940 | 11440.000 | 59072.313 | -47632.313 |
| 12800.000 | 4922.541 | 7877.459 | 119261.000 | 59508.641 | 59752.359 |
| 1800.000 | 2976.847 | -1176.847 | 11377.000 | 50853.691 | -39476.691 |
| 2850.000 | 3194.134 | -344.134 | 36285.000 | 65473.848 | -29188.848 |
| 2110.000 | 3085.000 | -975.000 | 59166.000 | 68947.984 | -9781.984 |
| 4260.000 | 3810.768 | 449.232 | 120357.000 | 96830.477 | 23526.523 |
| 532.000 | 2218.201 | -1686.201 | 12787.000 | 54032.887 | -41245.887 |
| 43.000 | 1913.913 | -1870.913 | 1475.000 | 48721.523 | -47246.523 |
| 1020.000 | 3764.239 | -2744.239 | 28564.000 | 103717.336 | -75153.336 |
| 500.000 | 4202.771 | -3702.771 | 13961.000 | 115942.891 | -101981.891 |
| 3950.000 | 4206.625 | -256.625 | 103267.000 | 111875.195 | -8608.195 |
| 14200.000 | 4819.732 | 9380.268 | 324141.000 | 132470.984 | 191670.016 |
| 16.500 | 1244.068 | -1227.568 | 644.000 | 26697.957 | -26053.957 |
| 399.000 | 2304.313 | -1905.313 | 12189.000 | 40753.777 | -28564.777 |
| 579.000 | 2433.364 | -1854.364 | 14421.000 | 62155.457 | -47734.457 |
| 48.100 | 1482.448 | -1434.349 | 1542.000 | 35173.887 | -33631.887 |
| 5000.000 | 3514.777 | 1485.223 | 144099.000 | 97949.422 | 46149.578 |
| 4.420 | 1703.133 | -1698.713 | 195.000 | 48293.891 | -48098.891 |
| 6450.000 | 5043.687 | 1406.313 | 225344.000 | 142971.688 | 82372.313 |
| 12.600 | 2056.703 | -2044.103 | 402.000 | 51884.598 | -51482.598 |
| 9810.000 | 4639.320 | 5170.680 | 255230.000 | 127894.984 | 127335.016 |
| 7390.000 | 4677.638 | 2712.362 | 267366.000 | 131722.109 | 135643.891 |
| WA: Coefficient de corrélation multiple | | R = 0.7559 | WA: Coefficient de corrélation multiple | | R = 0.8022 |
| | | R² = 0.57 | | | R² = 0.57 |
| Variance de la variable K à expliquer | | 1.37E+07 | Variance de la variable Salinité à expliquer | | 7.69E+09 |
| Variance des résidus | | 8377185 | Variance des résidus | | 4.07E+09 |
| Ecart-type des résidus = SEP Standard error of prediction | | 2894.337 | Ecart-type des résidus = SEP Standard error of prediction | | 63814.21 |
| WA-PLS : 1 component | | | WA-PLS : 2 components, SEP = 62130 | | R = 0.8849 |
| | | | | | R² = 0.78 |
| | | | | | r = 0.71 |

| Alkalinity meq/l | | | | Mg++ (mg/l) | | | |
|-------------------------|----------------|------------------|------------------|--------------------|----------------|------------------|------------------|
| <i>codes</i> | <i>OPTIMUM</i> | <i>TOLERANCE</i> | <i>FREQUENCE</i> | <i>codes</i> | <i>OPTIMUM</i> | <i>TOLERANCE</i> | <i>FREQUENCE</i> |
| | 4.83 | 2.42 | 6 | | 255.58 | 302.83 | 6 |
| | 4.96 | 3.53 | 7 | | 259.71 | 498.06 | 7 |
| | 4.81 | 0.48 | 6 | | 393.67 | 236.63 | 6 |
| | 9.55 | 6.85 | 17 | | 934.53 | 1001.13 | 17 |
| | 8.77 | 5.79 | 7 | | 1114.11 | 1031.01 | 7 |
| | 19.57 | 12.10 | 5 | | 609.18 | 351.06 | 5 |
| | 7.83 | 5.10 | 9 | | 310.19 | 837.84 | 9 |
| | 8.45 | 5.60 | 21 | | 559.31 | 507.79 | 21 |
| | 12.83 | 9.73 | 9 | | 436.95 | 583.08 | 9 |
| | 21.54 | 13.74 | 4 | | 976.78 | 925.04 | 4 |
| | 4.00 | 1.65 | 8 | | 96.89 | 159.22 | 8 |
| | 7.93 | 3.34 | 7 | | 251.37 | 105.36 | 7 |
| | 5.76 | 2.04 | 13 | | 279.62 | 315.07 | 13 |
| | 18.34 | 14.90 | 7 | | 811.12 | 681.13 | 7 |
| | 7.05 | 3.65 | 5 | | 267.74 | 218.89 | 5 |
| | 5.14 | 6.02 | 11 | | 526.02 | 1045.61 | 11 |
| | 5.67 | 2.19 | 5 | | 699.55 | 774.64 | 5 |
| | 9.92 | 6.88 | 5 | | 787.64 | 1328.67 | 5 |
| | 8.16 | 5.01 | 7 | | 515.12 | 666.24 | 7 |
| | 6.86 | 6.51 | 9 | | 848.94 | 1063.83 | 9 |
| | 0.85 | 0.76 | 4 | | 7.73 | 16.18 | 4 |
| | 3.37 | 3.08 | 4 | | 863.02 | 1201.80 | 4 |
| | 3.02 | 2.67 | 7 | | 67.10 | 316.65 | 7 |
| | 4.85 | 1.77 | 11 | | 170.92 | 316.38 | 11 |
| | 3.82 | 4.47 | 14 | | 519.20 | 852.05 | 14 |
| | 5.22 | 3.57 | 4 | | 1485.00 | 1200.18 | 4 |
| | 6.80 | 5.04 | 20 | | 261.44 | 571.33 | 20 |
| | 2.24 | 2.49 | 5 | | 105.26 | 426.55 | 5 |
| | 6.04 | 8.87 | 9 | | 260.79 | 643.18 | 9 |
| | 7.45 | 7.39 | 25 | | 759.29 | 1050.31 | 25 |
| | 18.84 | 14.61 | 7 | | 901.39 | 884.16 | 7 |
| | 4.86 | 2.03 | 5 | | 375.59 | 403.90 | 5 |
| | 2.69 | 1.74 | 7 | | 126.12 | 239.36 | 7 |
| | 7.77 | 5.70 | 19 | | 662.75 | 805.69 | 19 |
| | 12.08 | 8.31 | 18 | | 1351.85 | 1118.83 | 18 |
| | 4.95 | 6.07 | 5 | | 434.87 | 1015.02 | 5 |
| | 4.95 | 1.81 | 6 | | 382.49 | 145.35 | 6 |
| | 26.48 | 68.77 | 17 | | 1251.83 | 1133.28 | 17 |
| | 14.67 | 6.52 | 7 | | 592.65 | 676.83 | 7 |
| | 5.26 | 4.32 | 4 | | 203.84 | 283.87 | 4 |
| | 5.70 | 2.34 | 13 | | 325.96 | 480.09 | 13 |
| | 9.98 | 7.00 | 12 | | 1212.33 | 1150.28 | 12 |
| | 6.96 | 6.71 | 16 | | 376.29 | 624.60 | 16 |
| | 7.45 | 4.09 | 8 | | 274.68 | 214.97 | 8 |
| | 6.25 | 6.17 | 12 | | 235.63 | 394.34 | 12 |
| | 9.22 | 8.70 | 20 | | 287.81 | 596.76 | 20 |
| | 21.86 | 66.12 | 6 | | 1081.25 | 490.77 | 6 |
| | 24.73 | 62.45 | 11 | | 1840.32 | 1214.60 | 11 |
| | 4.14 | 3.21 | 7 | | 101.32 | 112.42 | 7 |
| | 8.67 | 11.32 | 6 | | 392.05 | 680.48 | 6 |
| | 6.50 | 4.37 | 5 | | 171.03 | 493.83 | 5 |
| | 6.55 | 3.88 | 14 | | 451.37 | 747.87 | 14 |
| | 6.41 | 2.45 | 13 | | 427.65 | 422.44 | 13 |
| | 7.24 | 5.49 | 13 | | 703.45 | 958.14 | 13 |
| | 6.11 | 3.14 | 7 | | 293.92 | 281.30 | 7 |
| | 343.05 | 63.68 | 4 | | 4.85 | 30.72 | 4 |
| | 190.15 | 167.55 | 13 | | 353.31 | 500.26 | 13 |
| | 6.71 | 6.78 | 4 | | 609.79 | 1186.10 | 4 |
| | 5.62 | 3.01 | 19 | | 253.96 | 304.65 | 19 |
| | 4.34 | 0.92 | 6 | | 137.36 | 63.04 | 6 |
| | 16.68 | 13.32 | 21 | | 854.15 | 817.65 | 21 |

| Observed values | Estimated values | RESIDUS | Observed values | Estimated values | RESIDUS |
|------------------------------------------------------------------|-------------------------|-----------------------------|------------------------------------------------------------------|-------------------------|-----------------------------|
| 4.880 | 5.629 | -0.749 | 605.000 | 386.463 | 218.537 |
| 2.930 | 5.367 | -2.437 | 326.000 | 385.820 | -59.820 |
| 7.250 | 5.943 | 1.307 | 262.000 | 416.459 | -154.459 |
| 10.000 | 9.825 | 0.175 | 649.000 | 585.043 | 63.957 |
| 7.220 | 7.909 | -0.689 | 210.000 | 542.507 | -332.507 |
| 7.800 | 8.281 | -0.481 | 275.000 | 568.564 | -293.564 |
| 4.400 | 7.968 | -3.568 | 140.000 | 525.182 | -385.182 |
| 8.050 | 9.280 | -1.230 | 1140.000 | 570.364 | 569.636 |
| 2.150 | 33.674 | -31.524 | 34.000 | 577.680 | -543.680 |
| 35.000 | 17.005 | 17.995 | 1900.000 | 772.366 | 1127.634 |
| 11.400 | 11.218 | 0.182 | 53.000 | 506.815 | -453.815 |
| 355.000 | 211.978 | 143.022 | 0.146 | 342.099 | -341.953 |
| 12.900 | 21.075 | -8.175 | 382.000 | 593.984 | -211.984 |
| 31.500 | 85.025 | -53.525 | 914.000 | 721.933 | 192.067 |
| 5.090 | 6.856 | -1.766 | 89.900 | 506.458 | -416.558 |
| 1.510 | 5.726 | -4.216 | 11.000 | 459.126 | -448.126 |
| 4.250 | 15.215 | -10.965 | 265.000 | 856.742 | -591.742 |
| 3.210 | 10.760 | -7.550 | 132.000 | 933.127 | -801.127 |
| 9.080 | 10.065 | -0.985 | 110.000 | 883.374 | -773.374 |
| 22.900 | 12.948 | 9.952 | 3470.000 | 1097.798 | 2372.202 |
| 3.300 | 6.202 | -2.902 | 20.200 | 246.155 | -225.955 |
| 5.130 | 9.467 | -4.337 | 138.000 | 427.681 | -289.681 |
| 3.850 | 17.223 | -13.373 | 132.000 | 497.498 | -365.498 |
| 4.200 | 6.356 | -2.156 | 55.400 | 320.698 | -265.298 |
| 9.420 | 8.664 | 0.756 | 1200.000 | 793.382 | 406.618 |
| 0.523 | 4.055 | -3.532 | 3.210 | 398.847 | -395.637 |
| 9.700 | 20.107 | -10.407 | 1250.000 | 1129.245 | 120.755 |
| 1.360 | 7.315 | -5.955 | 7.410 | 446.102 | -438.692 |
| 7.680 | 12.414 | -4.734 | 2550.000 | 1071.368 | 1478.632 |
| 13.100 | 15.249 | -2.149 | 2080.000 | 1080.861 | 999.139 |
| WA: Coefficient de corrélation multiple | | R = 0.9460 | WA: Coefficient de corrélation multiple | | R = 0.7260 |
| | | R² = 0.89 | | | R² = 0.53 |
| Variance de la variable Alcalinité à expliquer | | 3929.396 | Variance de la variable Mg à expliquer | | 724201.7 |
| Variance des résidus | | 847.3527 | Variance des résidus | | 478831.7 |
| Ecart-type des résidus = SEP Standard error of prediction | | 29.10932 | Ecart-type des résidus = SEP Standard error of prediction | | 691.9767 |
| WA-PLS : 2 components, SEP = 62.26 | | R = 0.9661 | WA-PLS : 2 components, SEP = 857 | | R = 0.8437 |
| | | R² = 0.93 | | | R² = 0.71 |
| | | r = 0.29 | | | r = 0.43 |

| Ca++ (mg/l) | | | | pH | | | |
|--------------------|----------------|------------------|------------------|--------------|----------------|------------------|------------------|
| <i>codes</i> | <i>OPTIMUM</i> | <i>TOLERANCE</i> | <i>FREQUENCE</i> | <i>codes</i> | <i>OPTIMUM</i> | <i>TOLERANCE</i> | <i>FREQUENCE</i> |
| | 420.70 | 482.06 | 6 | | 8.86 | 0.38 | 6 |
| | 450.58 | 515.59 | 7 | | 8.20 | 0.59 | 7 |
| | 768.25 | 499.24 | 6 | | 8.22 | 0.10 | 6 |
| | 1137.33 | 899.67 | 17 | | 7.93 | 0.60 | 17 |
| | 1267.27 | 1008.59 | 7 | | 7.98 | 0.42 | 7 |
| | 425.29 | 380.82 | 5 | | 8.75 | 0.73 | 5 |
| | 391.49 | 746.98 | 9 | | 8.70 | 1.04 | 9 |
| | 618.80 | 470.62 | 21 | | 8.57 | 0.34 | 21 |
| | 224.58 | 217.28 | 9 | | 8.92 | 0.63 | 9 |
| | 444.63 | 289.77 | 4 | | 8.89 | 1.01 | 4 |
| | 149.26 | 253.17 | 8 | | 8.42 | 0.59 | 8 |
| | 347.14 | 401.19 | 7 | | 8.84 | 0.58 | 7 |
| | 452.72 | 458.50 | 13 | | 8.34 | 0.42 | 13 |
| | 559.39 | 447.41 | 7 | | 8.67 | 0.41 | 7 |
| | 724.62 | 544.64 | 5 | | 9.07 | 0.95 | 5 |
| | 533.64 | 965.21 | 11 | | 8.63 | 0.81 | 11 |
| | 803.03 | 755.73 | 5 | | 8.13 | 0.55 | 5 |
| | 1193.96 | 1020.58 | 5 | | 7.62 | 0.40 | 5 |
| | 533.20 | 800.76 | 7 | | 8.44 | 0.74 | 7 |
| | 1065.66 | 1146.64 | 9 | | 8.50 | 1.00 | 9 |
| | 12.50 | 21.53 | 4 | | 9.50 | 0.35 | 4 |
| | 809.48 | 1118.84 | 4 | | 8.40 | 1.06 | 4 |
| | 73.82 | 289.37 | 7 | | 8.06 | 1.02 | 7 |
| | 243.75 | 422.97 | 11 | | 8.08 | 0.32 | 11 |
| | 591.31 | 906.16 | 14 | | 8.80 | 0.93 | 14 |
| | 1428.50 | 1117.31 | 4 | | 7.98 | 1.25 | 4 |
| | 244.79 | 552.35 | 20 | | 7.94 | 1.02 | 20 |
| | 134.18 | 511.41 | 5 | | 8.59 | 0.76 | 5 |
| | 211.87 | 503.34 | 9 | | 8.12 | 1.12 | 9 |
| | 840.19 | 1005.36 | 25 | | 8.27 | 0.70 | 25 |
| | 388.21 | 304.07 | 7 | | 8.89 | 0.51 | 7 |
| | 570.76 | 548.83 | 5 | | 8.26 | 0.16 | 5 |
| | 231.90 | 395.92 | 7 | | 8.83 | 0.61 | 7 |
| | 871.76 | 823.57 | 19 | | 8.05 | 0.51 | 19 |
| | 1445.32 | 1030.71 | 18 | | 7.73 | 0.58 | 18 |
| | 434.01 | 895.48 | 5 | | 8.33 | 0.69 | 5 |
| | 927.70 | 514.60 | 6 | | 8.35 | 0.27 | 6 |
| | 1300.92 | 1111.42 | 17 | | 7.97 | 0.74 | 17 |
| | 341.29 | 691.18 | 7 | | 8.42 | 0.30 | 7 |
| | 185.37 | 311.36 | 4 | | 8.80 | 0.39 | 4 |
| | 474.54 | 610.27 | 13 | | 8.24 | 0.39 | 13 |
| | 1419.81 | 1033.84 | 12 | | 7.71 | 0.56 | 12 |
| | 464.34 | 570.43 | 16 | | 8.34 | 0.84 | 16 |
| | 573.43 | 428.60 | 8 | | 8.84 | 0.66 | 8 |
| | 296.95 | 389.41 | 12 | | 7.81 | 0.82 | 12 |
| | 292.24 | 448.64 | 20 | | 9.25 | 0.84 | 20 |
| | 1428.95 | 617.70 | 6 | | 7.80 | 0.79 | 6 |
| | 1917.29 | 1060.52 | 11 | | 7.75 | 1.00 | 11 |
| | 147.19 | 147.26 | 7 | | 8.93 | 0.41 | 7 |
| | 233.75 | 375.63 | 6 | | 8.33 | 0.58 | 6 |
| | 238.36 | 590.28 | 5 | | 8.89 | 1.08 | 5 |
| | 788.48 | 737.93 | 14 | | 7.96 | 0.53 | 14 |
| | 648.31 | 518.15 | 13 | | 8.32 | 0.41 | 13 |
| | 858.91 | 897.79 | 13 | | 8.20 | 0.63 | 13 |
| | 329.35 | 257.23 | 7 | | 8.79 | 0.35 | 7 |
| | 8.93 | 41.58 | 4 | | 10.32 | 0.34 | 4 |
| | 181.14 | 400.04 | 13 | | 9.44 | 1.01 | 13 |
| | 603.60 | 1036.06 | 4 | | 8.24 | 0.55 | 4 |
| | 459.95 | 507.47 | 19 | | 8.31 | 0.39 | 19 |
| | 235.36 | 266.56 | 6 | | 8.26 | 0.29 | 6 |
| | 523.62 | 367.16 | 21 | | 8.61 | 0.60 | 21 |

| Observed values | Estimated values | RESIDUS | Observed values | Estimated values | RESIDUS |
|------------------------------------------------------------------|-------------------------|-----------------------------|------------------------------------------------------------------|-------------------------|-----------------------------|
| 1200.000 | 809.649 | 390.351 | 8.180 | 8.358 | -0.178 |
| 1370.000 | 870.791 | 499.209 | 8.150 | 8.352 | -0.202 |
| 218.000 | 903.878 | -685.878 | 8.720 | 8.359 | 0.361 |
| 521.000 | 591.004 | -70.004 | 8.500 | 8.563 | -0.063 |
| 400.000 | 655.317 | -255.317 | 8.850 | 8.416 | 0.434 |
| 465.000 | 636.018 | -171.018 | 8.520 | 8.450 | 0.070 |
| 200.000 | 609.795 | -409.795 | 9.050 | 8.548 | 0.502 |
| 1340.000 | 639.713 | 700.287 | 8.280 | 8.536 | -0.256 |
| 65.000 | 430.164 | -365.164 | 9.180 | 8.889 | 0.291 |
| 730.000 | 433.077 | 296.923 | 8.800 | 8.755 | 0.045 |
| 200.000 | 440.114 | -240.114 | 10.200 | 8.663 | 1.537 |
| 2.490 | 216.707 | -214.217 | 10.380 | 9.532 | 0.848 |
| 103.000 | 447.579 | -344.579 | 8.520 | 8.380 | 0.140 |
| 260.000 | 684.664 | -424.664 | 8.400 | 8.632 | -0.232 |
| 200.000 | 569.280 | -369.280 | 8.420 | 8.452 | -0.032 |
| 24.500 | 479.207 | -454.707 | 9.350 | 8.683 | 0.667 |
| 360.000 | 971.286 | -611.286 | 8.520 | 8.138 | 0.382 |
| 200.000 | 1084.233 | -884.233 | 8.050 | 7.988 | 0.062 |
| 1100.000 | 1053.445 | 46.555 | 7.400 | 7.983 | -0.583 |
| 3100.000 | 1202.642 | 1897.358 | 7.200 | 7.991 | -0.791 |
| 50.900 | 247.577 | -196.677 | 6.950 | 7.984 | -1.034 |
| 190.000 | 411.541 | -221.541 | 8.150 | 8.374 | -0.224 |
| 200.000 | 610.692 | -410.692 | 8.350 | 8.269 | 0.081 |
| 32.700 | 383.106 | -350.406 | 7.850 | 8.273 | -0.423 |
| 1500.000 | 944.818 | 555.182 | 7.910 | 8.078 | -0.168 |
| 6.100 | 451.328 | -445.228 | 9.620 | 8.939 | 0.681 |
| 1650.000 | 1237.152 | 412.848 | 7.460 | 7.972 | -0.512 |
| 12.500 | 489.792 | -477.292 | 8.920 | 8.305 | 0.615 |
| 2380.000 | 1147.982 | 1232.018 | 6.950 | 8.025 | -1.075 |
| 2500.000 | 1192.603 | 1307.397 | 7.500 | 8.033 | -0.533 |
| WA: Coefficient de corrélation multiple | | R = 0.7652 | WA: Coefficient de corrélation multiple | | R = 0.8598 |
| | | R² = 0.58 | | | R² = 0.74 |
| Variance de la variable Ca à expliquer | | 679352.3 | Variance de la variable pH à expliquer | | 0.6853808 |
| Variance des résidus | | 395522.8 | Variance des résidus | | 0.3132309 |
| Ecart-type des résidus = SEP Standard error of prediction | | 628.906 | Ecart-type des résidus = SEP Standard error of prediction | | 0.5596703 |
| WA-PLS : 2 components, SEP = 723 | | R = 0.8873 | WA-PLS : 5 components, SEP = 0.5 | | R = 0.9910 |
| | | R² = 0.78 | | | R² = 0.98 |
| | | r = 0.60 | | | r = 0.71 |

| Water Depth (cm) | | | | SO4-- (mg/l) | | | |
|-------------------------|----------------|------------------|------------------|---------------------|----------------|------------------|------------------|
| <i>codes</i> | <i>OPTIMUM</i> | <i>TOLERANCE</i> | <i>FREQUENCY</i> | <i>codes</i> | <i>OPTIMUM</i> | <i>TOLERANCE</i> | <i>FREQUENCY</i> |
| | 25.67 | 17.34 | 6 | | 3076.92 | 1110.96 | 6 |
| | 87.37 | 29.17 | 7 | | 1086.05 | 1485.76 | 7 |
| | 26.11 | 7.40 | 6 | | 3344.37 | 2655.90 | 6 |
| | 67.16 | 39.49 | 17 | | 2597.65 | 2315.38 | 17 |
| | 57.59 | 39.93 | 7 | | 1891.93 | 1392.47 | 7 |
| | 27.21 | 21.68 | 5 | | 5429.08 | 1346.65 | 5 |
| | 30.23 | 28.93 | 9 | | 1630.14 | 1850.29 | 9 |
| | 45.72 | 37.44 | 21 | | 6809.94 | 6514.59 | 21 |
| | 21.36 | 15.29 | 9 | | 7057.99 | 8108.55 | 9 |
| | 16.13 | 2.09 | 4 | | 14551.30 | 12160.47 | 4 |
| | 40.15 | 34.56 | 8 | | 305.49 | 687.34 | 8 |
| | 64.47 | 39.29 | 7 | | 3305.58 | 1521.19 | 7 |
| | 43.53 | 35.40 | 13 | | 2286.84 | 2091.15 | 13 |
| | 23.03 | 13.65 | 7 | | 9398.68 | 9766.64 | 7 |
| | 26.08 | 16.73 | 5 | | 4148.31 | 1100.49 | 5 |
| | 69.60 | 39.02 | 11 | | 1008.27 | 2799.18 | 11 |
| | 36.56 | 32.41 | 5 | | 1276.23 | 1276.24 | 5 |
| | 92.14 | 23.81 | 5 | | 1168.87 | 773.41 | 5 |
| | 61.50 | 39.97 | 7 | | 3118.10 | 2558.73 | 7 |
| | 53.22 | 39.73 | 9 | | 1688.03 | 2099.76 | 9 |
| | 35.69 | 31.76 | 4 | | 31.01 | 37.12 | 4 |
| | 53.12 | 39.40 | 4 | | 1100.61 | 1524.19 | 4 |
| | 21.08 | 9.86 | 7 | | 433.10 | 1332.44 | 7 |
| | 25.40 | 20.08 | 11 | | 413.01 | 682.88 | 11 |
| | 39.88 | 35.71 | 14 | | 1972.44 | 2097.02 | 14 |
| | 69.70 | 39.02 | 4 | | 2235.71 | 1622.06 | 4 |
| | 24.70 | 20.03 | 20 | | 2131.15 | 3533.38 | 20 |
| | 23.56 | 16.49 | 5 | | 238.03 | 770.94 | 5 |
| | 23.35 | 18.01 | 9 | | 2616.59 | 7012.43 | 9 |
| | 51.25 | 39.16 | 25 | | 2074.23 | 2163.68 | 25 |
| | 16.24 | 2.16 | 7 | | 13831.40 | 11352.57 | 7 |
| | 21.40 | 3.47 | 5 | | 1473.46 | 1854.03 | 5 |
| | 75.99 | 35.93 | 7 | | 616.91 | 1375.98 | 7 |
| | 51.35 | 39.00 | 19 | | 1853.26 | 1681.74 | 19 |
| | 77.21 | 36.07 | 18 | | 2854.64 | 1770.38 | 18 |
| | 81.46 | 33.76 | 5 | | 425.92 | 687.68 | 5 |
| | 53.12 | 33.05 | 6 | | 3561.97 | 1428.39 | 6 |
| | 71.78 | 37.41 | 17 | | 2617.36 | 1841.58 | 17 |
| | 25.12 | 18.42 | 7 | | 5723.60 | 986.38 | 7 |
| | 17.46 | 2.50 | 4 | | 4223.57 | 2051.06 | 4 |
| | 39.06 | 33.72 | 13 | | 1241.51 | 1528.46 | 13 |
| | 85.37 | 31.13 | 12 | | 2249.66 | 1569.41 | 12 |
| | 28.60 | 25.54 | 16 | | 2425.68 | 5523.68 | 16 |
| | 62.55 | 38.67 | 8 | | 4066.46 | 1230.23 | 8 |
| | 36.40 | 31.84 | 12 | | 2703.45 | 5066.40 | 12 |
| | 25.50 | 25.97 | 20 | | 5042.76 | 6079.36 | 20 |
| | 96.22 | 14.93 | 6 | | 3008.68 | 1053.60 | 6 |
| | 85.99 | 30.13 | 11 | | 3096.90 | 1026.16 | 11 |
| | 31.44 | 31.72 | 7 | | 3878.28 | 2092.21 | 7 |
| | 22.34 | 15.71 | 6 | | 4307.58 | 9477.35 | 6 |
| | 23.34 | 19.95 | 5 | | 1708.62 | 2017.53 | 5 |
| | 62.35 | 39.77 | 14 | | 1219.75 | 1320.91 | 14 |
| | 41.56 | 34.99 | 13 | | 3528.86 | 4783.96 | 13 |
| | 45.42 | 37.20 | 13 | | 1283.33 | 1244.81 | 13 |
| | 39.24 | 36.04 | 7 | | 7900.61 | 6144.05 | 7 |
| | 49.76 | 6.80 | 4 | | 3593.35 | 622.02 | 4 |
| | 38.05 | 19.86 | 13 | | 4569.58 | 2230.61 | 13 |
| | 40.39 | 34.87 | 4 | | 594.93 | 776.31 | 4 |
| | 36.60 | 30.16 | 19 | | 2281.74 | 2523.52 | 19 |
| | 24.39 | 17.26 | 6 | | 417.85 | 605.88 | 6 |
| | 27.40 | 27.15 | 21 | | 13693.55 | 11044.40 | 21 |

| <i>Observed values</i> | <i>Estimated values</i> | <i>RESIDUS</i> | <i>Observed values</i> | <i>Estimated values</i> | <i>RESIDUS</i> |
|------------------------------------------------------------------|-------------------------|-----------------------------|------------------------------------------------------------------|-------------------------|-----------------------------|
| 30.000 | 48.048 | -18.048 | 5700.000 | 3467.345 | 2232.655 |
| 30.000 | 51.388 | -21.388 | 3070.000 | 3516.977 | -446.977 |
| 100.000 | 53.718 | 46.282 | 2300.000 | 3491.296 | -1191.296 |
| 20.000 | 42.499 | -22.499 | 17900.000 | 7575.381 | 10324.619 |
| 100.000 | 48.317 | 51.683 | 4320.000 | 5001.739 | -681.739 |
| 100.000 | 45.509 | 54.491 | 4660.000 | 5550.414 | -890.414 |
| 20.000 | 43.393 | -23.393 | 2600.000 | 5734.399 | -3134.399 |
| 20.000 | 46.190 | -26.190 | 4080.000 | 6263.509 | -2183.509 |
| 15.000 | 32.839 | -17.839 | 5070.000 | 6937.772 | -1867.772 |
| 15.000 | 23.971 | -8.971 | 26600.000 | 11548.886 | 15051.114 |
| 15.000 | 29.545 | -14.545 | 4360.000 | 5405.575 | -1045.575 |
| 50.000 | 42.387 | 7.613 | 3710.000 | 4295.603 | -585.603 |
| 20.000 | 32.489 | -12.489 | 5980.000 | 5253.148 | 726.852 |
| 20.000 | 50.686 | -30.686 | 6440.000 | 3957.202 | 2482.798 |
| 20.000 | 51.707 | -31.707 | 265.000 | 2787.123 | -2522.123 |
| 100.000 | 63.598 | 36.402 | 72.000 | 1061.000 | -989.000 |
| 20.000 | 58.745 | -38.745 | 465.000 | 2484.437 | -2019.437 |
| 100.000 | 67.860 | 32.140 | 250.000 | 2533.728 | -2283.728 |
| 100.000 | 64.911 | 35.089 | 1270.000 | 2736.314 | -1466.314 |
| 100.000 | 70.009 | 29.991 | 2460.000 | 2559.531 | -99.531 |
| 20.000 | 26.840 | -6.840 | 105.000 | 2165.341 | -2060.341 |
| 20.000 | 33.344 | -13.344 | 302.000 | 4186.065 | -3884.065 |
| 20.000 | 41.007 | -21.007 | 305.000 | 2404.631 | -2099.631 |
| 20.000 | 34.938 | -14.938 | 130.000 | 2193.485 | -2063.485 |
| 20.000 | 55.110 | -35.110 | 2920.000 | 2207.240 | 712.760 |
| 20.000 | 41.971 | -21.971 | 14.000 | 1402.441 | -1388.441 |
| 100.000 | 70.063 | 29.937 | 3370.000 | 2777.558 | 592.442 |
| 20.000 | 36.766 | -16.766 | 4.990 | 1957.775 | -1952.785 |
| 100.000 | 66.741 | 33.259 | 3240.000 | 2404.016 | 835.984 |
| 100.000 | 66.259 | 33.741 | 3180.000 | 2383.299 | 796.701 |
| WA: Coefficient de corrélation multiple | | R = 0.7413 | WA: Coefficient de corrélation multiple | | R = 0.8500 |
| | | R² = 0.55 | | | R² = 0.72 |
| Variance de la variable Tranche d'eau à expliquer | | 1397.806 | Variance de la variable SO4 à expliquer | | 2.94E+07 |
| Variance des résidus | | 836.4213 | Variance des résidus | | 1.41E+07 |
| Ecart-type des résidus = SEP Standard error of prediction | | 28.92095 | Ecart-type des résidus = SEP Standard error of prediction | | 3750.238 |
| WA-PLS : 2 components, SEP = 41 | | R = 0.8648 | WA-PLS : 5 components, SEP = 3537 | | R = 0.9917 |
| | | R² = 0.74 | | | R² = 0.98 |
| | | r = 0.41 | | | r = 0.76 |

| Cl- (mg/l) | | | | Lithium (mg/l) | | | |
|-------------------|----------------|------------------|------------------|-----------------------|----------------|------------------|------------------|
| <i>codes</i> | <i>OPTIMUM</i> | <i>TOLERANCE</i> | <i>FREQUENCE</i> | <i>codes</i> | <i>OPTIMUM</i> | <i>TOLERANCE</i> | <i>FREQUENCE</i> |
| 14993.11 | 20451.81 | | 6 | 58.45 | 111.05 | | 6 |
| 23639.56 | 33514.01 | | 7 | 166.63 | 262.07 | | 7 |
| 15569.22 | 7225.07 | | 6 | 34.52 | 11.72 | | 6 |
| 72787.46 | 60379.97 | | 17 | 490.04 | 456.92 | | 17 |
| 72700.10 | 65890.75 | | 7 | 489.38 | 481.26 | | 7 |
| 37967.34 | 27712.32 | | 5 | 107.90 | 88.53 | | 5 |
| 19267.58 | 48614.77 | | 9 | 147.96 | 406.09 | | 9 |
| 24130.00 | 20875.09 | | 21 | 117.22 | 153.79 | | 21 |
| 19628.20 | 16419.76 | | 9 | 48.22 | 42.67 | | 9 |
| 23215.80 | 20889.64 | | 4 | 15.76 | 12.78 | | 4 |
| 5807.30 | 16248.26 | | 8 | 31.95 | 81.62 | | 8 |
| 10938.92 | 9193.09 | | 7 | 36.21 | 26.45 | | 7 |
| 16042.57 | 20076.66 | | 13 | 77.18 | 144.18 | | 13 |
| 33282.25 | 23423.09 | | 7 | 70.51 | 76.11 | | 7 |
| 10540.70 | 8016.47 | | 5 | 15.35 | 13.76 | | 5 |
| 31637.72 | 61943.40 | | 11 | 231.40 | 479.69 | | 11 |
| 49128.13 | 53852.89 | | 5 | 329.55 | 366.88 | | 5 |
| 69660.26 | 65760.14 | | 5 | 574.26 | 562.33 | | 5 |
| 46050.76 | 53391.00 | | 7 | 238.19 | 328.66 | | 7 |
| 65349.60 | 72704.67 | | 9 | 403.86 | 455.04 | | 9 |
| 286.94 | 864.62 | | 4 | 1.86 | 5.67 | | 4 |
| 51973.35 | 72683.44 | | 4 | 391.45 | 547.51 | | 4 |
| 3568.51 | 19498.65 | | 7 | 21.70 | 142.62 | | 7 |
| 12221.71 | 27972.67 | | 11 | 78.36 | 169.18 | | 11 |
| 38783.57 | 62138.53 | | 14 | 234.57 | 392.79 | | 14 |
| 94506.10 | 73370.53 | | 4 | 684.15 | 545.30 | | 4 |
| 16210.28 | 37029.64 | | 20 | 87.80 | 254.26 | | 20 |
| 7456.06 | 32517.56 | | 5 | 40.63 | 177.12 | | 5 |
| 11373.54 | 34209.47 | | 9 | 48.48 | 199.27 | | 9 |
| 51249.82 | 64592.64 | | 25 | 354.27 | 488.55 | | 25 |
| 23962.93 | 19259.33 | | 7 | 29.68 | 21.89 | | 7 |
| 22025.46 | 26822.35 | | 5 | 133.68 | 191.39 | | 5 |
| 5919.56 | 8371.95 | | 7 | 27.65 | 36.36 | | 7 |
| 50956.84 | 52497.13 | | 19 | 343.67 | 366.05 | | 19 |
| 98857.86 | 64366.08 | | 18 | 643.94 | 510.25 | | 18 |
| 24428.40 | 56771.34 | | 5 | 197.62 | 482.28 | | 5 |
| 13756.07 | 6121.92 | | 6 | 24.21 | 10.55 | | 6 |
| 86499.48 | 70530.56 | | 17 | 549.66 | 537.87 | | 17 |
| 40356.13 | 36909.32 | | 7 | 170.07 | 337.54 | | 7 |
| 11904.31 | 12867.56 | | 4 | 52.48 | 42.71 | | 4 |
| 24349.91 | 42594.55 | | 13 | 131.35 | 230.65 | | 13 |
| 93201.18 | 68176.38 | | 12 | 613.43 | 500.96 | | 12 |
| 23300.64 | 38014.12 | | 16 | 139.97 | 261.14 | | 16 |
| 13999.22 | 9801.08 | | 8 | 33.29 | 33.36 | | 8 |
| 11111.16 | 17226.60 | | 12 | 50.05 | 105.49 | | 12 |
| 14437.85 | 30423.25 | | 20 | 70.78 | 201.00 | | 20 |
| 112249.90 | 49845.83 | | 6 | 568.25 | 252.74 | | 6 |
| 125270.74 | 67082.82 | | 11 | 860.92 | 551.53 | | 11 |
| 6736.76 | 7800.39 | | 7 | 37.07 | 33.10 | | 7 |
| 13728.14 | 28535.13 | | 6 | 41.14 | 128.41 | | 6 |
| 10814.46 | 38052.54 | | 5 | 56.56 | 207.94 | | 5 |
| 44325.84 | 49602.85 | | 14 | 309.45 | 356.24 | | 14 |
| 25510.28 | 24406.43 | | 13 | 152.19 | 183.42 | | 13 |
| 48898.94 | 56756.38 | | 13 | 362.75 | 457.35 | | 13 |
| 13299.95 | 9791.01 | | 7 | 66.50 | 48.26 | | 7 |
| 4654.01 | 1288.13 | | 4 | 54.07 | 8.05 | | 4 |
| 27943.74 | 35632.36 | | 13 | 122.35 | 156.06 | | 13 |
| 34312.12 | 66225.71 | | 4 | 279.98 | 563.92 | | 4 |
| 13291.57 | 16382.25 | | 19 | 52.33 | 118.69 | | 19 |
| 7145.56 | 3654.46 | | 6 | 43.42 | 24.42 | | 6 |
| 28007.31 | 24131.16 | | 21 | 92.79 | 173.32 | | 21 |

| Observed values | Estimated values | RESIDUS | Observed values | ESTIMATIONS | and RESIDUS |
|------------------------------------------------------------------|-------------------------|-----------------------------|------------------------------------------------------------------|--------------------|-----------------------------|
| 22000.000 | 16382.306 | 5617.694 | 25.500 | 49.242 | -23.742 |
| 13900.000 | 15258.410 | -1358.410 | 11.800 | 37.755 | -25.955 |
| 6460.000 | 17306.295 | -10846.295 | 36.500 | 52.718 | -16.218 |
| 24600.000 | 24605.609 | -5.609 | 122.000 | 115.566 | 6.434 |
| 14500.000 | 29036.055 | -14536.055 | 37.000 | 158.964 | -121.964 |
| 15300.000 | 29399.520 | -14099.520 | 109.000 | 164.771 | -55.771 |
| 10300.000 | 25460.934 | -15160.934 | 47.000 | 129.877 | -82.877 |
| 38700.000 | 26699.959 | 12000.041 | 176.000 | 137.293 | 38.707 |
| 2250.000 | 27770.922 | -25520.922 | 19.500 | 130.516 | -111.016 |
| 44000.000 | 24015.320 | 19984.680 | 22.500 | 61.906 | -39.406 |
| 1970.000 | 25116.932 | -23146.932 | 2.750 | 130.094 | -127.344 |
| 4540.000 | 27219.348 | -22679.348 | 54.100 | 137.076 | -82.976 |
| 29500.000 | 35892.352 | -6392.352 | 86.800 | 175.138 | -88.338 |
| 65000.000 | 51764.414 | 13235.586 | 196.000 | 301.824 | -105.824 |
| 7240.000 | 30018.563 | -22778.563 | 42.500 | 192.471 | -149.971 |
| 699.000 | 28448.877 | -27749.877 | 4.800 | 202.218 | -197.418 |
| 16700.000 | 60321.617 | -43621.617 | 117.000 | 399.189 | -282.189 |
| 8060.000 | 67867.867 | -59807.867 | 52.500 | 453.979 | -401.479 |
| 61400.000 | 65206.918 | -3806.918 | 500.000 | 442.065 | 57.935 |
| 194000.000 | 77789.156 | 116210.844 | 1640.000 | 522.698 | 1117.302 |
| 90.200 | 13854.553 | -13764.353 | 0.507 | 72.611 | -72.104 |
| 6750.000 | 20275.330 | -13525.330 | 42.500 | 101.736 | -59.236 |
| 8310.000 | 34917.531 | -26607.531 | 57.500 | 221.704 | -164.204 |
| 600.000 | 19036.701 | -18436.701 | 3.890 | 111.431 | -107.541 |
| 85900.000 | 57354.555 | 28545.445 | 600.000 | 381.853 | 218.147 |
| 63.200 | 27945.895 | -27882.695 | 0.347 | 176.855 | -176.508 |
| 134000.000 | 83734.867 | 50265.133 | 675.000 | 536.504 | 138.496 |
| 150.000 | 29453.436 | -29303.436 | 1.180 | 190.823 | -189.643 |
| 154000.000 | 75271.078 | 78728.922 | 1160.000 | 503.956 | 656.044 |
| 158000.000 | 77381.148 | 80618.852 | 861.000 | 509.584 | 351.416 |
| WA: Coefficient de corrélation multiple | | R = 0.8132 | WA: Coefficient de corrélation multiple | | R = 0.77 |
| | | R² = 0.66 | | | R² = 0.59 |
| Variance de la variable CI à expliquer | | 2.80E+09 | Variance de la variable Li à expliquer | | 149337.2 |
| Variance des résidus | | 1.42E+09 | Variance des résidus | | 79096.27 |
| Ecart-type des résidus = SEP Standard error of prediction | | 37698.6 | Ecart-type des résidus = SEP Standard error of prediction | | 281.2406 |
| WA-PLS : 2 composants, SEP = 35726 | | R = 0.8823 | WA-PLS : 2 composants, SEP = 266 | | R = 0.8739 |
| | | R² = 0.79 | | | R² = 0.76 |
| | | | | | r = 0.68 |

| Boron (mg/l) | | | | Si (mg/l) | | | |
|---------------------|----------------|------------------|------------------|------------------|----------------|------------------|------------------|
| <i>codes</i> | <i>OPTIMUM</i> | <i>TOLERANCE</i> | <i>FREQUENCE</i> | <i>codes</i> | <i>OPTIMUM</i> | <i>TOLERANCE</i> | <i>FREQUENCE</i> |
| | 84.66 | 79.84 | 6 | | 30.98 | 3.13 | 6 |
| | 108.74 | 139.96 | 7 | | 23.06 | 7.45 | 7 |
| | 96.98 | 59.88 | 6 | | 34.23 | 13.01 | 6 |
| | 309.41 | 252.11 | 17 | | 28.32 | 7.54 | 17 |
| | 288.37 | 276.56 | 7 | | 29.37 | 6.22 | 7 |
| | 374.34 | 237.75 | 5 | | 34.65 | 11.35 | 5 |
| | 128.41 | 227.70 | 9 | | 32.39 | 13.05 | 9 |
| | 208.90 | 166.22 | 21 | | 28.86 | 5.78 | 21 |
| | 265.04 | 285.04 | 9 | | 27.54 | 7.02 | 9 |
| | 523.20 | 439.22 | 4 | | 24.42 | 6.88 | 4 |
| | 22.06 | 50.54 | 8 | | 40.50 | 11.41 | 8 |
| | 141.29 | 62.67 | 7 | | 29.33 | 6.44 | 7 |
| | 96.48 | 92.71 | 13 | | 35.18 | 12.38 | 13 |
| | 422.29 | 375.90 | 7 | | 33.12 | 10.08 | 7 |
| | 122.73 | 35.56 | 5 | | 27.18 | 8.94 | 5 |
| | 135.42 | 272.93 | 11 | | 35.71 | 7.47 | 11 |
| | 169.76 | 182.32 | 5 | | 30.16 | 4.95 | 5 |
| | 330.69 | 324.31 | 5 | | 23.93 | 8.64 | 5 |
| | 217.52 | 171.69 | 7 | | 31.63 | 6.02 | 7 |
| | 241.04 | 271.12 | 9 | | 24.72 | 7.73 | 9 |
| | 1.60 | 3.06 | 4 | | 20.53 | 8.87 | 4 |
| | 184.32 | 256.95 | 4 | | 20.77 | 5.84 | 4 |
| | 22.74 | 84.07 | 7 | | 28.97 | 7.48 | 7 |
| | 45.66 | 97.59 | 11 | | 39.74 | 13.48 | 11 |
| | 136.34 | 213.21 | 14 | | 23.63 | 7.74 | 14 |
| | 328.98 | 256.78 | 4 | | 18.42 | 5.28 | 4 |
| | 107.12 | 171.49 | 20 | | 33.42 | 9.42 | 20 |
| | 25.78 | 107.02 | 5 | | 25.09 | 5.73 | 5 |
| | 111.57 | 268.04 | 9 | | 28.51 | 7.73 | 9 |
| | 231.93 | 275.46 | 25 | | 26.87 | 7.25 | 25 |
| | 465.68 | 440.31 | 7 | | 30.04 | 12.48 | 7 |
| | 94.53 | 105.20 | 5 | | 32.15 | 2.98 | 5 |
| | 30.12 | 53.74 | 7 | | 31.05 | 9.75 | 7 |
| | 218.55 | 207.91 | 19 | | 28.89 | 7.11 | 19 |
| | 416.32 | 267.21 | 18 | | 28.74 | 8.61 | 18 |
| | 112.65 | 277.83 | 5 | | 27.55 | 8.81 | 5 |
| | 113.56 | 31.92 | 6 | | 32.60 | 7.49 | 6 |
| | 382.55 | 300.96 | 17 | | 35.51 | 27.28 | 17 |
| | 321.62 | 183.27 | 7 | | 33.82 | 4.47 | 7 |
| | 87.60 | 109.44 | 4 | | 32.01 | 0.79 | 4 |
| | 94.87 | 135.43 | 13 | | 42.62 | 13.73 | 13 |
| | 363.02 | 282.07 | 12 | | 26.53 | 7.73 | 12 |
| | 139.56 | 222.38 | 16 | | 32.68 | 11.94 | 16 |
| | 141.03 | 75.15 | 8 | | 29.13 | 9.85 | 8 |
| | 114.33 | 193.31 | 12 | | 34.67 | 11.24 | 12 |
| | 174.68 | 247.15 | 20 | | 25.35 | 8.96 | 20 |
| | 347.25 | 140.06 | 6 | | 38.52 | 24.37 | 6 |
| | 509.18 | 272.62 | 11 | | 31.86 | 25.16 | 11 |
| | 65.00 | 92.58 | 7 | | 29.33 | 5.77 | 7 |
| | 169.14 | 343.71 | 6 | | 33.55 | 14.67 | 6 |
| | 83.02 | 131.40 | 5 | | 24.26 | 5.81 | 5 |
| | 183.99 | 198.35 | 14 | | 26.58 | 7.08 | 14 |
| | 144.36 | 111.20 | 13 | | 32.49 | 10.28 | 13 |
| | 203.25 | 259.98 | 13 | | 35.19 | 11.17 | 13 |
| | 128.32 | 100.06 | 7 | | 28.40 | 3.60 | 7 |
| | 139.13 | 21.03 | 4 | | 157.05 | 21.14 | 4 |
| | 275.44 | 228.50 | 13 | | 100.98 | 61.14 | 13 |
| | 160.96 | 324.66 | 4 | | 39.52 | 11.43 | 4 |
| | 90.54 | 104.74 | 19 | | 31.12 | 5.17 | 19 |
| | 28.32 | 16.29 | 6 | | 45.05 | 13.00 | 6 |
| | 421.25 | 397.04 | 21 | | 27.18 | 9.22 | 21 |

| Observed values | Estimated values | RESIDUS | Observed values | Estimated values | RESIDUS |
|------------------------------------------------------------------|-------------------------|-----------------------------|------------------------------------------------------------------|-------------------------|-----------------------------|
| 150.000 | 123.807 | 26.193 | 25.200 | 32.419 | -7.219 |
| 77.000 | 120.656 | -43.656 | 41.400 | 32.550 | 8.850 |
| 125.000 | 128.298 | -3.298 | 28.600 | 32.431 | -3.831 |
| 235.000 | 233.375 | 1.625 | 27.500 | 28.893 | -1.393 |
| 145.000 | 194.662 | -49.662 | 26.100 | 30.078 | -3.978 |
| 238.000 | 209.196 | 28.804 | 20.600 | 28.957 | -8.357 |
| 57.000 | 192.644 | -135.644 | 31.600 | 29.424 | 2.176 |
| 250.000 | 208.042 | 41.958 | 34.400 | 29.419 | 4.981 |
| 13.000 | 271.104 | -258.104 | 31.400 | 37.281 | -5.881 |
| 959.000 | 384.899 | 574.101 | 21.900 | 29.686 | -7.786 |
| 147.000 | 228.941 | -81.941 | 18.700 | 29.181 | -10.481 |
| 143.000 | 256.833 | -113.833 | 161.000 | 108.663 | 52.337 |
| 263.000 | 274.761 | -11.761 | 32.500 | 35.529 | -3.029 |
| 612.000 | 307.855 | 304.145 | 45.600 | 58.906 | -13.306 |
| 29.900 | 164.081 | -134.181 | 36.400 | 32.689 | 3.711 |
| 3.490 | 123.997 | -120.507 | 38.400 | 34.046 | 4.354 |
| 60.000 | 265.911 | -205.911 | 31.600 | 31.744 | -0.144 |
| 28.400 | 298.557 | -270.157 | 17.300 | 28.375 | -11.075 |
| 290.000 | 297.368 | -7.368 | 20.500 | 28.086 | -7.586 |
| 944.000 | 336.567 | 607.433 | 31.400 | 30.057 | 1.343 |
| 0.995 | 103.283 | -102.288 | 37.200 | 32.256 | 4.944 |
| 25.500 | 175.538 | -150.038 | 58.800 | 34.981 | 23.819 |
| 32.000 | 179.071 | -147.071 | 32.200 | 35.390 | -3.190 |
| 2.920 | 114.049 | -111.129 | 30.200 | 33.632 | -3.432 |
| 320.000 | 248.693 | 71.307 | 34.200 | 29.630 | 4.570 |
| 0.703 | 115.891 | -115.188 | 15.900 | 23.444 | -7.544 |
| 404.000 | 349.545 | 54.455 | 33.000 | 32.587 | 0.413 |
| 1.080 | 149.260 | -148.180 | 22.400 | 28.209 | -5.809 |
| 545.000 | 314.913 | 230.087 | 16.800 | 29.672 | -12.872 |
| 520.000 | 324.056 | 195.944 | 31.400 | 30.689 | 0.711 |
| WA: Coefficient de corrélation multiple | | R = 0.7577 | WA: Coefficient de corrélation multiple | | R = 0.9411 |
| | | R² = 0.57 | | | R² = 0.88 |
| Variance de la variable B à expliquer | | 66730.07 | Variance de la variable Si à expliquer | | 633.5131 |
| Variance des résidus | | 41769.64 | Variance des résidus | | 149.972 |
| Ecart-type des résidus = SEP Standard error of prediction | | 204.3762 | Ecart-type des résidus = SEP Standard error of prediction | | 12.24631 |
| WA-PLS : 1 component | | | WA-PLS : 3 components, SEP = 16.95 | | R = 0.9812 |
| | | | | | R² = 0.96 |
| | | | | | r = 0.75 |

Density

| <i>codes</i> | <i>OPTIMUM</i> | <i>TOLERANCE</i> | <i>FREQUENCE</i> |
|--------------|----------------|------------------|------------------|
| | 1.02 | 0.02 | 6 |
| | 1.03 | 0.04 | 7 |
| | 1.02 | 0.01 | 6 |
| | 1.08 | 0.06 | 17 |
| | 1.08 | 0.07 | 7 |
| | 1.05 | 0.03 | 5 |
| | 1.02 | 0.05 | 9 |
| | 1.04 | 0.03 | 21 |
| | 1.03 | 0.03 | 9 |
| | 1.05 | 0.04 | 4 |
| | 1.01 | 0.02 | 8 |
| | 1.02 | 0.01 | 7 |
| | 1.02 | 0.02 | 13 |
| | 1.05 | 0.03 | 7 |
| | 1.02 | 0.01 | 5 |
| | 1.04 | 0.07 | 11 |
| | 1.06 | 0.06 | 5 |
| | 1.08 | 0.07 | 5 |
| | 1.05 | 0.06 | 7 |
| | 1.07 | 0.08 | 9 |
| | 1.00 | 0.00 | 4 |
| | 1.06 | 0.08 | 4 |
| | 1.00 | 0.02 | 7 |
| | 1.01 | 0.03 | 11 |
| | 1.04 | 0.07 | 14 |
| | 1.10 | 0.08 | 4 |
| | 1.02 | 0.04 | 20 |
| | 1.01 | 0.04 | 5 |
| | 1.02 | 0.04 | 9 |
| | 1.06 | 0.07 | 25 |
| | 1.05 | 0.04 | 7 |
| | 1.03 | 0.03 | 5 |
| | 1.01 | 0.01 | 7 |
| | 1.06 | 0.06 | 19 |
| | 1.11 | 0.07 | 18 |
| | 1.03 | 0.06 | 5 |
| | 1.02 | 0.01 | 6 |
| | 1.10 | 0.07 | 17 |
| | 1.05 | 0.04 | 7 |
| | 1.02 | 0.02 | 4 |
| | 1.03 | 0.05 | 13 |
| | 1.10 | 0.07 | 12 |
| | 1.03 | 0.04 | 16 |
| | 1.02 | 0.01 | 8 |
| | 1.02 | 0.02 | 12 |
| | 1.02 | 0.04 | 20 |
| | 1.12 | 0.05 | 6 |
| | 1.14 | 0.07 | 11 |
| | 1.01 | 0.01 | 7 |
| | 1.02 | 0.04 | 6 |
| | 1.01 | 0.04 | 5 |
| | 1.05 | 0.05 | 14 |
| | 1.03 | 0.03 | 13 |
| | 1.06 | 0.06 | 13 |
| | 1.03 | 0.02 | 7 |
| | 1.03 | 0.00 | 4 |
| | 1.05 | 0.03 | 13 |
| | 1.04 | 0.07 | 4 |
| | 1.02 | 0.02 | 19 |
| | 1.01 | 0.00 | 6 |
| | 1.05 | 0.04 | 21 |

| Observed values | Estimated values | RESIDUS |
|------------------------------------------------------------------|-------------------------|-----------------------------|
| 1.032 | 1.023 | 0.009 |
| 1.020 | 1.022 | -0.002 |
| 1.010 | 1.024 | -0.014 |
| 1.050 | 1.038 | 0.012 |
| 1.022 | 1.039 | -0.017 |
| 1.024 | 1.040 | -0.016 |
| 1.015 | 1.036 | -0.021 |
| 1.051 | 1.038 | 0.013 |
| 1.009 | 1.041 | -0.032 |
| 1.087 | 1.043 | 0.044 |
| 1.008 | 1.035 | -0.027 |
| 1.029 | 1.046 | -0.017 |
| 1.040 | 1.047 | -0.007 |
| 1.081 | 1.065 | 0.016 |
| 1.009 | 1.037 | -0.028 |
| 1.001 | 1.032 | -0.031 |
| 1.020 | 1.069 | -0.049 |
| 1.010 | 1.077 | -0.067 |
| 1.073 | 1.075 | -0.002 |
| 1.211 | 1.087 | 0.124 |
| 1.000 | 1.018 | -0.018 |
| 1.009 | 1.028 | -0.019 |
| 1.010 | 1.042 | -0.032 |
| 1.001 | 1.024 | -0.023 |
| 1.098 | 1.065 | 0.033 |
| 1.000 | 1.032 | -0.032 |
| 1.147 | 1.094 | 0.053 |
| 1.000 | 1.035 | -0.035 |
| 1.167 | 1.084 | 0.083 |
| 1.171 | 1.087 | 0.084 |
| WA: Coefficient de corrélation multiple | | R = 0.8003 |
| | | R² = 0.64 |
| Variance de la variable Densité à expliquer | | 3.25E+00 |
| Variance des résidus | | 1.7 |
| Ecart-type des résidus = SEP Standard error of prediction | | 4.1 |
| WA-PLS : 2 components, SEP = 0.04 | | R = 0.8827 |
| | | R² = 0.78 |
| | | r = 0.70 |