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Stručni rad

## Grafička interpretacija rezultata kemijskih analiza vode pomoću ličnog računala

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Razvijen je originalni program, za računalo Apple II, korišten za brzu interpretaciju rezultata kemijskih analiza te za klasifikaciju i usporedbu podzemnih voda.

U interpretaciji rezultata kemijskih analiza korišteni su Stiffovi i Ferreovi dijagrami.

### UVOD

Poznata je činjenica da se kemijski sastav vode može prikazati grafički pomoću raznih vrsta dijagrama. U hidrogeologiji su najuobičajeniji Stiffovi i Ferreovi dijagrami.

Stiffov dijagram, naziv je tipa dijagrama kojeg je prvi načinio i opisao Stiff (1951), kao metodu za vizuelno uspoređivanje serija analiza vode s naftonosnih polja. Ova metoda je vremenom postala standardna metoda za interpretaciju, klasifikaciju i usporedbu kemijskih analiza vode (Morgan C. O., McNellis J. M., 1969).

Ferreovi trokutni dijagrami su jedna od, u hidrogeologiji, uobičajenih metoda za preglednu kemijsku klasifikaciju podzemnih voda. Pri tome se upotrebljavaju dva istostranična trokuta, jedan za katione a drugi za anione (Milojević 1958).

Poticaj za izradu programa za računalo koji bi, osim brze obrade podataka, omogućio i zornu grafičku interpretaciju kemijskih analiza vode, svakako je velika ušteda u vremenu kao i nedostatak ove vrste softwarea kod nas.

Uzimajući u obzir da već velik broj stručnjaka i OUR-a raspolaže kvalitetnim ličnim računalima, objavljivanje razvijenog originalnog programa može imati i praktičnu vrijednost. Osim toga, isti program može poslužiti kao grafički izlaz za banku podataka kemijskih analiza vode.

U ovom radu je opisan isključivo sadržaj i način korištenja programa. Pretpostavlja se naime, da je korisniku programa poznata teorijska osnova i način korištenja grafičkih prikaza kemijskih analiza podzemnih voda te osnove korištenja ličnog računala.

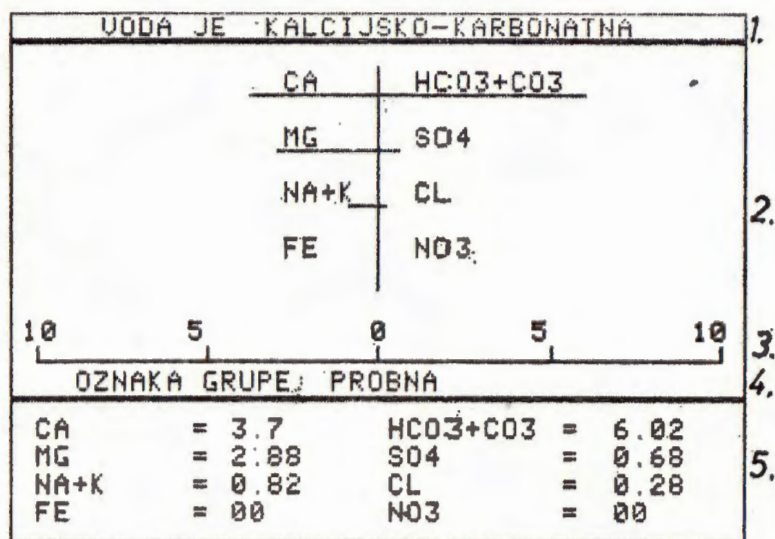
Programi su pisani na Applesoft Basicu i namijenjeni su radu na računalu Apple II. Za ispis rezultata, tj. dijagrama je korišten štampač Epson

MX-82 F/T III, priključen na računalo preko »slot« 1. Zbog ovih činjenica kao i zbog drugih specifičnosti samog računala Apple II, programe je moguće koristiti na drugim ličnim računalima uz manje preinake.

#### OPIS RADA PROGRAMA ZA IZRADU STIFFOVIH DIJAGRAMA

Nakon poziva odgovarajućeg programa (prilog) s diska, potrebno je u varijablu GG\$, koja se nalazi u naredbi 7, unijeti oznaku ili naziv analize koju će računalo ispisati na dijagramu. Po izvršenju naredbe za početak izvođenja, računalo će zatražiti unos podataka o količinama aniona i kationa. Podaci se, u načelu, unose u miligramekvivalentima po  $\text{dm}^3$  ( $\text{Mgekv}/\text{dm}^3$ ), no moguće je unos u bilo kojim drugim jedinicama. Poslije unosa posljednjeg podatka, program prelazi na iscrtavanje dijagrama.

Dijagram je podijeljen na četiri dijela. U prvom, gornjem dijelu, nalazi se dijagnoza tipa vode, slijedi grafički prikaz učešća aniona i kationa, zatim oznaka analize, te u četvrtom dijelu ulazne količine  $\text{mg}/\text{dm}^3$  za svaki



Sl. 1. Stiffov dijagram kemijskog sastava vode

- 1 — Tip vode
- 2 — Grafički odnos koncentracije iona u vodi
- 3 — Relativna skala
- 4 — Oznaka grupe
- 5 — Koncentracija iona ( $\text{mg}/\text{dm}^3$ )

Fig. 1. Stiff's diagram of the chemical analyses of water

- 1 — Type of water
- 2 — Graphicaly description of the water ion content
- 3 — Relative scale
- 4 — Character of the group of the analyse
- 5 — Ion concentration ( $\text{mg}/\text{dm}^3$ )

ion. U dnu drugog dijela dijagrama nalazi se mjerilo, čija skala ovisi o tome u kojem se od pet područja nalazi količina najzastupljenijeg iona u zadanoj analizi. Područja su 0—10, 10—25, 25—30, 30—50 i više od 50.

Nakon završenog iscertavanja na ekranu moguće je dobiti dijagram na štampaču i to u dvije verzije. Pritiskom na tipku sa slovom N, na štampač će biti prenijet dijagram u veličini 99x67 mm (slika 1), a pritiskom na tipku sa slovom U, dobija se uvećana verzija (198x135 mm). Pritiskom na bilo koju drugu tipku izlazi se iz programa bez prijenosa dijagrama na papir (Epson, MX82-Type III Operation Manual).

#### OPIS RADA PROGRAMA ZA PRIKAZ KEMIJSKIH ANALIZA POMOCU FARREOVIH TROKUTA

Prije izvođenja, potrebno je osim podataka o postocima, u programsku naredbu 90 (varijabla NA\$) upisati oznaku analize. Podaci o postocima iona unose se direktno u program. Potrebno je ponovo upisati programsku naredbu broj 80, s točnim brojem analiza, koje se unose u varijablu N. U naredbu broj 140, pomoću instrukcije DATA unosi se postotak sulfatnog ( $\text{SO}_4$ ) aniona i to redom, jedna analiza za drugom. Naredbom 160, te naredbom 180 unose se, istim redosljedom, podaci za kloride (Cl) i karbonate ( $\text{HCO}_3 + \text{CO}_3$ ). Istim redosljedom kao do sada, pomoću naredbe 290, 310 i 330 unose se u program podaci za magnezij (Mg), klor (Cl) i alkalije (Na + K), tj. za katione.

Nakon završenog upisa podataka, izvodi se program. Na ekranu će prvo biti nacrtan Ferreov trokut za anione, kojeg korisnik može prenijeti na štampač pomoću tipke U ili tipke N kao u prethodnom primjeru (slika 2). Pritiskom na bilo koju drugu tipku nestaje anionski trokut i iscertava se Ferreov trokut za katione, koji se može prenijeti na papir istim postupkom.

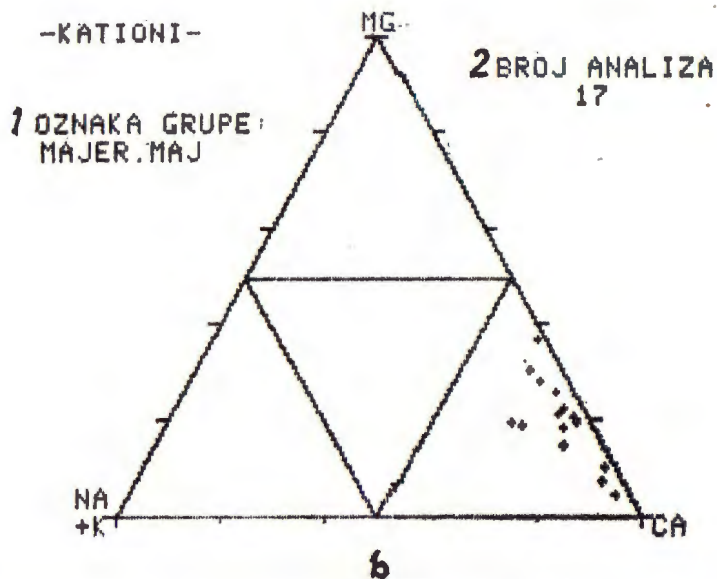
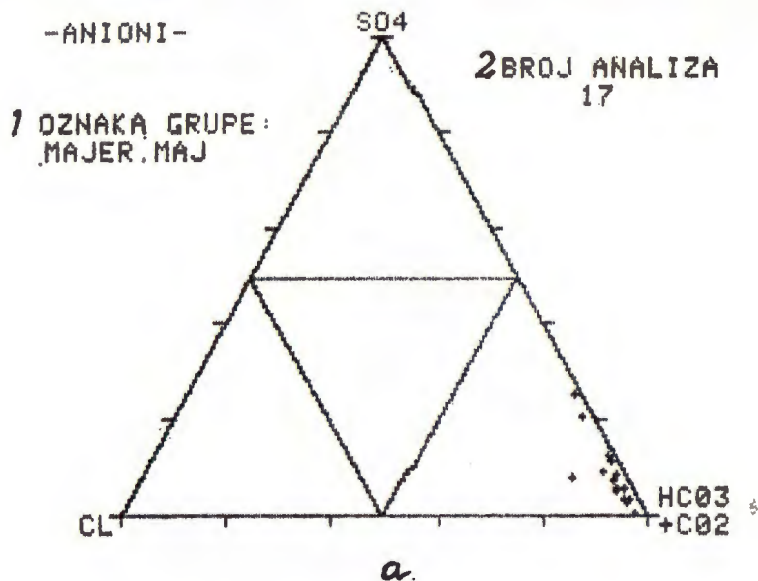
#### KOMENTAR

Kad se na disketu unesu programi čiji su listinzi dani u prilogu, potrebno je prvo izvesti program »ABECEDA«, koji će na disketi kreirati binarni zapis s nazivom »GO.ABC«. Nakon toga se mogu izvoditi i programi opisani u ovom radu. Prilikom svakog startanja programa »STIFFOVI DIAGRAMI« ili programa »FERREOVI TROKUTI«, nužno je da u disk jedinici bude i disketa s generiranim programom »GO.ABC«. (Apple II Reference Manual, 1978.)

#### ZAKLJUČAK

Testiranje programa pokazalo je vrlo dobru preglednost dijagrama kao i zadovoljavajuću brzinu rada te preciznost. Programi su gotovo univerzalni s obzirom na to da su pisani na vrlo jednostavnom BASIC-u, a rukovanje njima ne zahtijeva veliko predznanje s područja programiranja te su vrlo pogodni za široku upotrebu.

Programi su načinjeni u okviru teme SIZ-a III (gospodarenje podzemnim vodama) i testirani na računalu Zavoda za mehaniku, RGN fakulteta u Zagrebu.



Sl. 2. Ferreovi trokutni dijagrami

Sl. 2a. Ferreov dijagram za anione

Sl. 2b. Ferreov dijagram za katione

1 — Oznaka grupe analiza

2 — Broj analiza

Fig. 2. Ferre's triangular diagrams

Fig. 2a. Ferre's diagram for anions

Fig. 2b. Ferre's diagram for cations

1 — Character of the group of analyses

2 — Number of analyses

Zahvaljujemo se profesorima Dr Pavelu Miletiću i Dr Mladenu Hudecu, koji su nas potakli na objavljivanje ovoga rada, te Dr Darku Mayeru iz čijeg smo magistarskog rada koristili rezultate kemijskih analiza, u svrhu testiranja programa.

Primitljeno: 15. 06. 1984.

#### LITERATURA

- Milojević, N.: Hidrogeologija, Građevinska knjiga, Beograd, 1958.
- Morgan, C. O., McNellis, J. M., Stiff: Diagrams of Water-Quality Data Programmed for the Digital Computer, State Geol. Sur. Univer. of Kansas, Lawrence, *Special Distr. Publ.* 43, (1969) 27.
- Mayer, D.: Kemijske značajke podzemnih voda porječja Save na području SR Hrvatske, Magistarski rad, RGN fakultet, Zagreb, 1977.
- Apple II Reference Manual, January 1978.
- Epson, MX-82 TYPE III Operation manual.




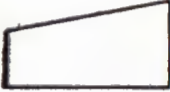




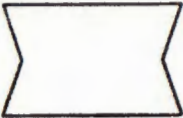

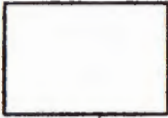




### Graphic Interpretation of Chemical Analyses for Personal Computer

R. Skansi, G. Hrženjak

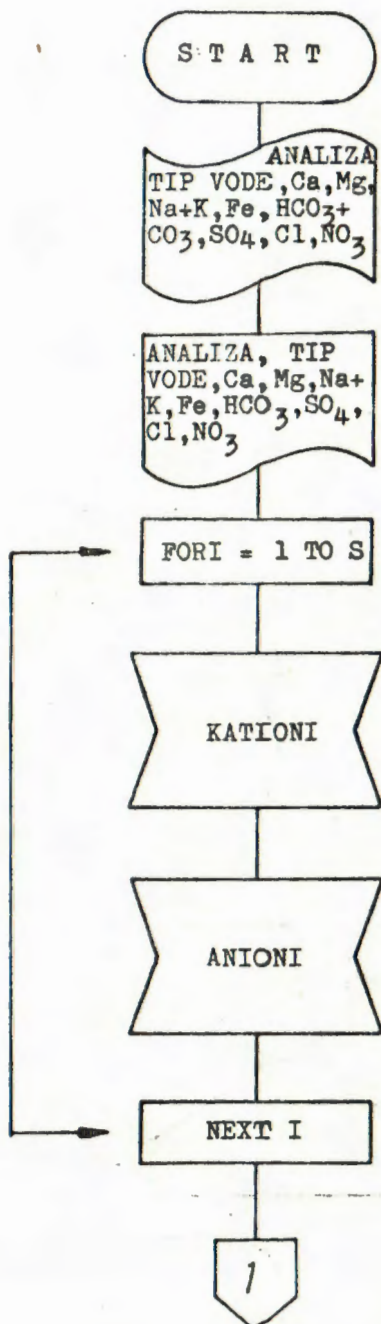
Apple II software for the interpretation, comparison and classification of ground water has been developed.

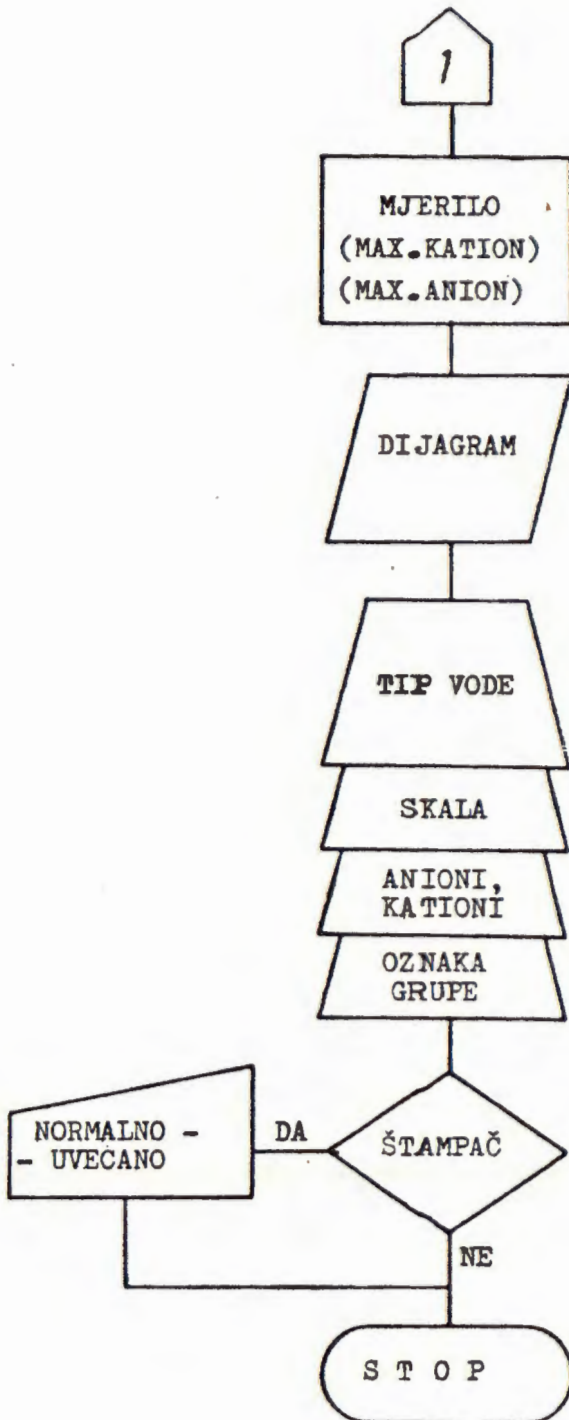
In a graphical interpretations of chemical analyses data, the Stiff diagrams and Ferre triangular diagrams have been used.

## OPIS SIMBOLA (prema U. S. Computer Service Biro)

	START, STOP, RETURN		IF NAREDBA IF STATEMENT
	DATA NAREDBA DATA STATEMENT		ŠTAMPAČ PRINTER
	READ NAREDBA READ STATEMENT		PREKID BLOK DIJAGRAMA BREAK OF THE FLOWING CHART
	FOR, NEXT PETLJA FOR, NEXT LOOP		GOSUB NAREDBA GOSUB STATEMENT
	INPUT NAREDBA INPUT STATEMENT		PERIFERNA JEDINICA PERIPHERALS
	PRORAČUN CALCULATION		
	CRTANJE PLOTING		SAVE, CREATE NAREDBA SAVE, CREATE STATEMENT
	ISPIS PRINT		

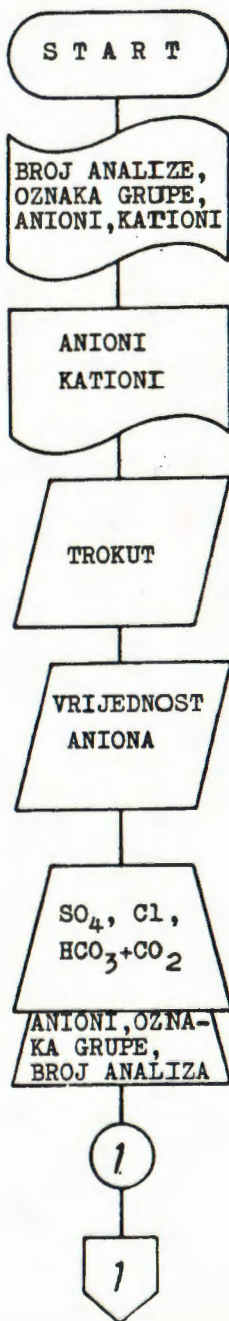
PROGRAM "STIFFOVI DIJAGRAMI"

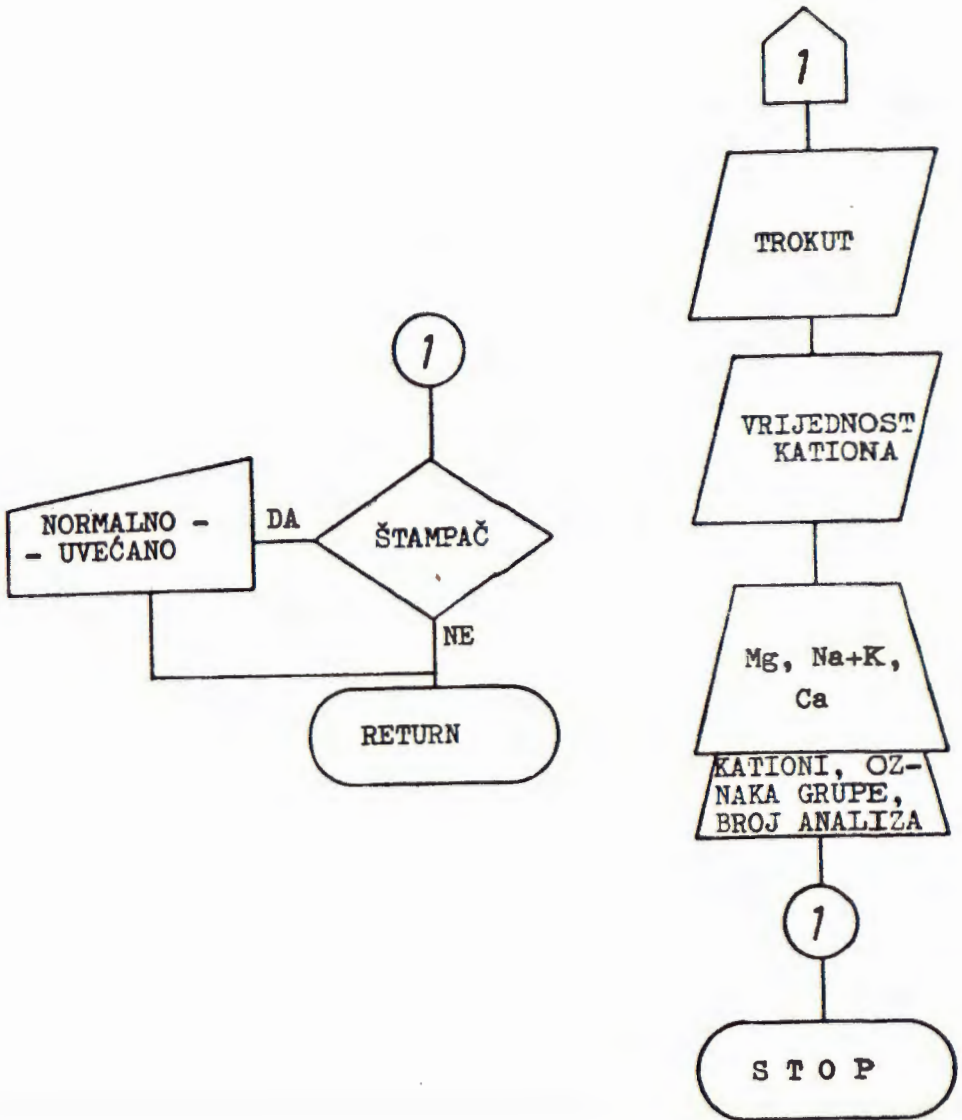




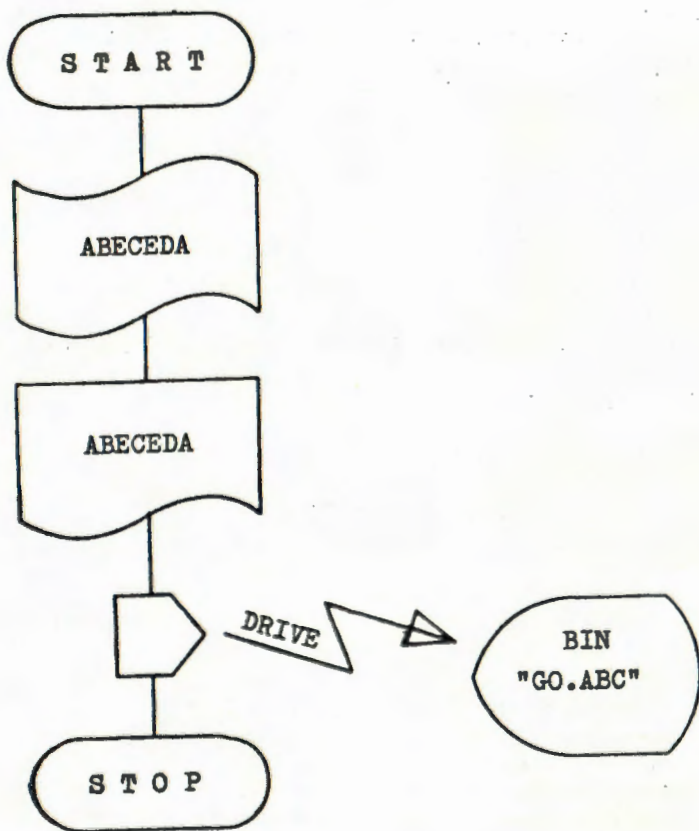


PROGRAM "FERREOVI TROKUTI"





PROGRAM "ABECEDA"



```

0 REM *****
1 REM STIFFOVI DIAGRAMI*
2 REM *****
3 TEXT
4 PRINT CHR$(4);"BLOAD GO.ABC,A$6000"
5 POKE 232,0: POKE 233,96
6 ROT= 1: SCALE= 1
7 GG$ = "PROBNA"
10 DATA KALCIJSKO,MAGNEZIJSKO,ALKALNO,ZELJEZOVI TO
11 FOR I = 1 TO 4: READ Q$(I): NEXT I
13 N = 5
15 DATA KARBONATNA,SULFATNA,KLORIDNA,NITRATNA
16 FOR I = 1 TO 4: READ W$(I): NEXT I
20 DATA CA,MG,NA,K,FE
25 DATA CA,MG,NA+K,FE
30 FOR I = 1 TO N: READ K$(I): NEXT I
35 FOR I = 1 TO N - 1: READ KP$(I): NEXT I
40 DATA HCO3,CO3,SO4,CL,NO3
45 DATA HCO3+CO3,SO4,CL,NO3
50 FOR I = 1 TO N: READ A$(I): NEXT I
52 FOR I = 1 TO N - 1: READ AP$(I): NEXT I
65 HOME
70 PRINT "*** UPIŠI VRIJEDNOSTI ZA IONE (MG/L) ***"
80 PRINT
90 FOR I = 1 TO N
95 PRINT
100 PRINT K$(I);" = ";
110 INPUT K(I)
120 HTAB 20: PRINT A$(I);" = ";
130 INPUT A(I)
140 NEXT I
150 K(3) = K(3) + K(4):K(4) = K(5):K(5) = 0
160 A(1) = A(1) + A(2):A(2) = A(3):A(3) = A(4):A(4) =
A(5):A(5) = 0
170 FOR I = 1 TO N - 1
180 A(I) = ABS (A(I)):K(I) = ABS (K(I))
190 NEXT I
200 REM NAJVECI ANION. I KATION
210 AM = A(1):KM = K(1):QK = 1:WK = 1
220 FOR I = 2 TO 4
230 IF A(I) > AM THEN AM = A(I):WK = I
250 IF K(I) > KM THEN KM = K(I):QK = I
260 NEXT I
265 WA$ = Q$(QK) + "-" + W$(WK)
270 IF AM > KM THEN EE = AM: GOTO 285
280 EE = KM
285 IF EE < = 10 THEN MM = 10
287 IF EE > 10 AND EE < = 25 THEN MM = 25
289 IF EE > 25 AND EE < = 30 THEN MM = 30
292 IF EE > 30 AND EE = < 50 THEN MM = 50
294 IF EE > 50 THEN MM = EE
300 REM MJERILOU
310 FOR I = 1 TO N - 1

```

```

320 AC(I) = (130 * A(I)) / MM
330 AC(I) = AC(I) + 140
340 NEXT I
350 FOR I = 1 TO N - 1
360 KC(I) = (130 * K(I)) / MM
370 KC(I) = KC(I) + 10
380 KC(I) = KC(I) - 150
390 KC(I) = ABS(KC(I))
400 NEXT I
500 REM DIJAGRAM
510 HGR2 : HCOLOR= 3
520 HPLOT 0,0 TO 0,191 TO 279,191 TO 279,0 TO 0,0.
525 HPLOT 0,10 TO 279,10: HPLOT 0,11 TO 279,11
527 HPLOT 0,139 TO 279,139: HPLOT 0,140 TO 279,140
530 HPLOT 140,20 TO 140,100
533 HPLOT 10,126 TO 270,126
534 HPLOT 10,121 TO 10,126: HPLOT 140,121 TO 140,126:
HPLOT 270,121 TO 270,126: HPLOT 75,121 TO 75,126: HPLOT
205,121 TO 205,126
535 Y = 30
540 FOR I = 1 TO N - 1
550 HPLOT KC(I),Y TO 140,Y
555 HPLOT 140,Y TO AC(I),Y
560 Y = Y + 20
570 NEXT I
600 REM PISANJE PORUKA
610 P$ = "VODA JE " + " " + WA$
612 XP = 30:YP = 5
614 GOSUB 1000
617 YY = 25
620 FOR I = 1 TO N - 1
625 P$ = KP$(I):XP = 100:YP = YY
630 GOSUB 1000
632 P$ = AP$(I):XP = 150
634 GOSUB 1000
635 YY = YY + 20
640 NEXT I
650 P$ = "0":XP = 133:YP = 115
655 GOSUB 1000
660 P$ = STR$(MM):XP = 0:YP = 115
665 GOSUB 1000
670 XP = 255: GOSUB 1000
675 P$ = STR$(MM / 2)
680 XP = 63:YP = 115: GOSUB 1000
685 XP = 193: GOSUB 1000
690 FOR I = 1 TO N - 1
695 P$ = KP$(I):XP = 5:YP = 140 + I * 10
700 GOSUB 1000
702 P$ = AP$(I):XP = 140: GOSUB 1000
705 P$ = "=":XP = 65: GOSUB 1000
707 XP = 205: GOSUB 1000
710 NEXT I
750 FOR I = 1 TO N - 1

```

```
752 YP = 140 + I * 10
755 IF K(I) < 1 THEN P$ = "0" + STR$ (K(I)):XP = 80
760 IF K(I) = > 1 AND K(I) < 10 THEN P$ = STR$
(K(I)):XP = 80
770 IF K(I) = > 10 THEN P$ = STR$ (K(I)):XP = 73
775 GOSUB 1000
780 IF A(I) < 1 THEN P$ = "0" + STR$ (A(I)):XP = 225
785 IF A(I) = > 1 AND A(I) < 10 THEN P$ = STR$
(A(I)):XP = 225
790 IF A(I) = > 10 THEN P$ = STR$ (A(I)):XP = 218
795 GOSUB 1000
800 NEXT I
810 P$ = "OZNAKA GRUPE: " + GG$
820 XP = 20:YP = 133
830 GOSUB 1000
900 REM STAMPAC DA ILI NE
910 POKE - 16368,0
915 GET O$
920 IF O$ < > "N" AND O$ < > "U" THEN TEXT : END
925 PR# 1
930 POKE 1913,2
935 IF O$ = "U" THEN POKE 1913,66
936 PRINT CHR$ (17)
950 PR# 0
999 TEXT : END
1000 REM PISANJE
1010 FOR K = 1 TO LEN (P$)
1020 CR = ASC ( MID$ (P$,K,1))
1030 IF CR = 32 GOTO 1050
1040 DRAW CR - 31 AT (K * 7) + XP,YP
1050 NEXT K
1060 RETURN
```

```

10 REM *****
20 REM **FEREOVI TROKUTI**
30 REM *****
40 REM
50 PRINT CHR$(4);"BLOAD GO.ABC,A$6000"
60 POKE 232,0: POKE 233,96
70 ROT= 1: SCALE= 1
80 N = 17
90 NA$ = "MAJER.MAJ"
100 DIM
SO(N), CL(N), HC(N), MG(N), NA(N), CA(N), X(N), Y(N), SU(N)
110 DATA SO4, HCO3, +CO2, CL, MG, CA, NA, +K
120 FOR I = 1 TO 8: READ I$(I): NEXT I
130 REM ANIONI SO4, CL, HCO3
140 DATA
10.2, 8.76, 14.9, 11.5, 88.9, 61.4, 34.1, 38.6, 27.4, 63.9, 15.3,
2.6, 129.9, 19.7, 34.0, 1.4, 25.0
150 FOR I = 1 TO N: READ SO(I): NEXT I
160 DATA
10, 4.4, 8, 10.8, 8, 5, 7.2, 50.6, 19.6, 7.6, 12, 12, 6.4, 12, 13.8, 6
2, 7
170 FOR I = 1 TO N: READ CL(I): NEXT I
180 DATA
367.2, 274.9, 432.9, 425.2, 339, 432, 375.9, 401, 511, 500, 440, 4
6.9, 383.7, 340, 323.9, 314, 402
190 FOR I = 1 TO N: READ HC(I): NEXT I
200 FOR I = 1 TO N
210 SU(I) = SO(I) + CL(I) + HC(I)
220 NEXT I
230 FOR I = 1 TO N
240 SO(I) = (SO(I) * 50) / SU(I)
250 CL(I) = (CL(I) * 50) / SU(I)
260 NEXT I
280 REM KATIONI MG, CA, NA+K
290 DATA
35, 15.4, 7.4, 10.5, 19.9, 50.2, 25.4, 29.4, 31.7, 32.2, 31.2, 28.
, 23.6, 29.3, 27.7, 20.4, 25.2
300 FOR I = 1 TO N: READ MG(I): NEXT I
310 DATA
74.2, 80.1, 153.6, 126.7, 177, 84.5, 96.5, 105, 106.9, 132.7, 102
7, 99.2, 92.5, 70, 77.3, 69.6, 100.7
320 FOR I = 1 TO N: READ CA(I): NEXT I
330 DATA
7.3, 7.6, 3.8, 5.4, 3.5, 2.3, 3.3, 21.0, 25, 9.7, 4.8, 6.9, 2.8, 5.8
3.8, 4, 3.5
340 FOR I = 1 TO N: READ NA(I): NEXT I
350 FOR I = 1 TO N
360 SU(I) = MG(I) + CA(I) + NA(I)
370 NEXT I
380 FOR I = 1 TO N
390 MG(I) = (MG(I) * 50) / SU(I)
400 NA(I) = (NA(I) * 50) / SU(I)
410 NEXT I

```

```

440 REM. TROKUT
450 HGR2 : HCOLOR= 3
460 HPLOT 40,182 TO 240,182 TO 140,9 TO 40,182
470 HPLOT 140,182 TO 190,96 TO 90,96 TO 140,182
480 FOR I = 40 TO 240 STEP 40: HPLOT I,182 TO I,182 +
3: NEXT I
490 FOR I = 0 TO 5: HPLOT 36 + 20 * I,182 - 34.6 * I
TO 40 + 20 * I,182 - 34.6 * I: NEXT I
500 FOR I = 0 TO 5: HPLOT 240 - 20 * I,182 - 34.6 * I
TO 244 - 20 * I,182 - 34.6 * I: NEXT I
510 FOR I = 1 TO N
520 Y(I) = 182 - .86603 * SO(I) * 4
530 X(I) = 240 - CL(I) * 4 - 2 * SO(I)
540 DRAW 64 AT X(I),Y(I)
550 NEXT I
560 REM UPISIVANJE
570 REM ZA ANIONE
580 P$ = I$(1):XP = 126:YP = 3: GOSUB 1030
590 P$ = I$(2):XP = 240:YP = 175: GOSUB 1030
600 P$ = I$(3):XP = 240:YP = 185: GOSUB 1030
610 P$ = I$(4):YP = 185:XP = 20: GOSUB 1030
620 P$ = "-ANIONI-":XP = 7:YP = 7: GOSUB 1040
630 P$ = "OZNAKA GRUPE:":XP = 5:YP = 40: GOSUB 1030:P$
= NA$:XP = 7:YP = 50: GOSUB 1030
640 P$ = "BROJ ANALIZA":XP = 180:YP = 20: GOSUB 1030:P$
= STR$ (N):XP = 210:YP = 30: GOSUB 1030
650 GOTO 750
660 REM ZA KATIONE
670 P$ = I$(5):XP = 130:YP = 3: GOSUB 1030
680 P$ = I$(6):XP = 240:YP = 185: GOSUB 1030
690 P$ = I$(7):XP = 20:YP = 175: GOSUB 1030
700 P$ = I$(8):XP = 20:YP = 185: GOSUB 1030
710 P$ = "-KATIONI-":XP = 7:YP = 7: GOSUB 1040
720 P$ = "OZNAKA GRUPE:":XP = 5:YP = 40: GOSUB 1030:P$
= NA$:XP = 7:YP = 50: GOSUB 1030
730 P$ = "BROJ ANALIZA":XP = 180:YP = 20: GOSUB 1030:P$
= STR$ (N):XP = 210:YP = 30: GOSUB 1030
740 RETURN
750 REM CRTANJE KATIONA I ODLUKA
760 GET O$
770 IF O$ < > "U" AND O$ < > "N" THEN 830
780 PR# 1
790 POKE 1913,2
800 IF O$ = "U" THEN POKE 1913,66
810 PRINT CHR$ (17)
820 PR# 0
830 HGR2 : HCOLOR= 3
840 HPLOT 40,182 TO 240,182 TO 140,9 TO 40,182
850 HPLOT 140,182 TO 190,96 TO 90,96 TO 140,182
860 FOR I = 40 TO 240 STEP 40: HPLOT I,182 TO I,182 +
3: NEXT I
870 FOR I = 0 TO 5: HPLOT 36 + 20 * I,182 - 34.6 * I
TO 40 + 20 * I,182 - 34.6 * I: NEXT I

```



```
880 FOR I = 0 TO 5: HPLLOT 240 - 20 * I, 182 - 34.6 * I
TO 244 - 20 * I, 182 - 34.6 * I: NEXT I
890 FOR I = 1 TO N
900 Y(I) = 182 - .86603 * MB(I) * 4
910 X(I) = 240 - NA(I) * 4 - 2 * MB(I)
920 DRAW 64 AT X(I), Y(I)
930 NEXT I
940 GOSUB 660
950 GET O$
960 IF O$ < > "U" AND O$ < > "N" THEN 1020
970 PR# 1
980 POKE 1913, 2
990 IF O$ = "U" THEN POKE 1913, 66
1000 PRINT CHR$(17)
1010 PR# 0
1020 TEXT : END
1030 REM PISANJE
1040 FOR K = 1 TO LEN (P$)
1050 CR = ASC ( MID$ ( P$, K, 1))
1060 IF CR = 32 GOTO 1080
1070 DRAW CR - 31 AT ( K * 7) + XP, YP
1080 NEXT K
1090 RETURN
```

```

5 REM *****
6 REM ***ABECEDA***
7 REM *****
9 DIM P(1240)
10 DATA 66,0,146,1,148,1,155,1,1
        63,1,181,1,199,1,221,1,251,1
        ;254,1,6,2,14,2,29,2,39,2,43
        ,2,48,2,51,2,58,2,77,2,87,2,
        101,2,115,2,129,2,144,2,156,
        2,168,2,185,2,204,2,207,2;21
        1,2,222,2,230,2,243,2,255,2,
        16
11. DATA 3,30,3,44,3,56,3,69,3,82
        ,3,93,3,106,3,120,3,131,3,14
        3,3,161,3,171,3,190,3,207,3,
        220,3,231,3,246,3,12,4,29,4,
        37,4,49,4,64,4,80,4,96,4,109
        ,4,124,4,143,4,150,4,168,4,1
        74,4,180,4,191,4,213,4,0,0
12 DATA 0,0,0,0,0,0,0,0,0,0,0,0,
        0,0,0,0,0,0,0,0,0,0,0,0,
        0,0,0,0,0,0,0,0,0,0,0,0,
        0,0,0,0,0,0,0,0,0,0,0,0,
        0,0,0,0,0,0,0,0,0,0,0,0,
        0
13 DATA 0,0,0,0,0,0,0,0,0,0,0,0,
        0,0,0,0,0,0,0,0,0,0,0,0,
        0,0,0,0,0,0,0,0,0,0,0,0,
        0,0,0,0,0,0,0,0,0,0,0,0,
        0,0,0,0,0,0,0,0,0,0,0,0,
        0
14 DATA 0,0,0,0,0,0,0,0,0,0,0,0,
        0,0,0,0,0,0,0,0,0,0,0,0,
        0,0,0,0,0,0,0,0,0,0,0,0,
        0,0,0,0,0,0,0,0,0,0,0,0,
        0,0,0,0,0,0,0,0,0,0,0,0,
        0
15 DATA 0,0,0,0,0,0,0,0,0,0,0,0,
        0,0,0,0,0,0,0,0,0,0,0,0,
        0,0,0,0,0,0,0,0,0,0,0,0,
        0,0,0,0,0,0,0,0,0,0,0,0,
        0,0,0,4,0,8,24,48,54,150,4,0
        ,8,24,24
16 DATA 54,13,36,4,0,8,24,8,54,5
        4,54,31,36,36,36,214,45,45,2
        2,63,63,4,0,8,216,40,117,223
        ,51,14,45,21,190,63,15,24,13
        ,36,36,36,0,210,99,13,24,13,
        24,13,24,150,58,94,253,27,8,
        24,8,24,8,24,53,39,0,146,9,1
        5,24,15,24
17 DATA 28,36,44,213,27,77,246,3
        0,30,14,109,8,24,77,219,219,

```

- 11, 24, 8, 88, 11, 53, 4, 0, 32, 36, 0  
 , 138, 226, 28, 36, 12, 12, 4, 0, 146  
 , 99, 12, 36, 28, 28, 4, 0, 146, 36, 3  
 6, 36, 222, 14, 142, 113, 223, 99, 1  
 3, 88, 40, 32, 0, 27, 45, 45, 223, 9,  
 24, 48, 22, 38, 0, 50
- 18 DATA 159, 33, 0, 27, 45, 45, 4, 0, 14  
 6, 4, 0, 210, 43, 40, 40, 40, 32, 0, 1  
 46, 63, 32, 36, 44, 40, 173, 54, 54,  
 30, 31, 8, 24, 13, 24, 13, 24, 4, 0, 1  
 1, 24, 40, 48, 54, 54, 30, 45, 4, 0, 7  
 4, 18, 63, 63, 13, 216, 12, 12, 101,  
 228, 212, 191, 4, 0, 8, 24, 216, 45,  
 45, 246, 30, 117
- 19 DATA 246, 14, 216, 63, 32, 0, 74, 63  
 , 63, 204, 12, 13, 24, 13, 24, 54, 54  
 , 54, 4, 0, 8, 24, 72, 63, 63, 54, 45,  
 173, 54, 23, 63, 15, 24, 4, 0, 27, 45  
 , 117, 246, 63, 15, 24, 36, 96, 12, 3  
 7, 0, 8, 24, 216, 45, 45, 94, 30, 30,  
 30, 54, 4, 0, 8, 24, 24, 45, 21, 246,  
 63, 15, 24, 180
- 20 DATA 50, 14, 45, 13, 24, 36, 0, 8, 24  
 , 24, 45, 21, 246, 63, 15, 24, 108, 1  
 37, 210, 9, 24, 30, 30, 30, 4, 0, 176  
 , 4, 0, 176, 246, 4, 0, 8, 88, 8, 30, 3  
 0, 30, 14, 14, 14, 4, 0, 9, 56, 63, 18  
 3, 45, 45, 4, 0, 8, 24, 216, 206, 10,  
 88, 14, 14, 30, 30, 30, 4, 0, 8, 24, 8  
 , 63
- 21 DATA 23, 77, 241, 57, 30, 182, 4, 0,  
 9, 36, 28, 63, 30, 54, 54, 14, 45, 37  
 , 8, 24, 24, 247, 41, 4, 0, 8, 24, 240  
 , 30, 54, 54, 77, 33, 36, 228, 22, 63  
 , 4, 0, 27, 36, 44, 45, 14, 246, 63, 2  
 3, 54, 45, 45, 32, 4, 0, 27, 36, 13, 2  
 4, 45, 21, 150, 242, 63, 28, 36, 0, 2  
 7, 54, 46, 45
- 22 DATA 13, 24, 36, 36, 28, 63, 55, 38,  
 0, 27, 36, 44, 45, 181, 26, 63, 23, 5  
 4, 45, 45, 4, 0, 155, 18, 36, 36, 36,  
 45, 45, 150, 59, 39, 0, 8, 24, 72, 63  
 , 247, 54, 54, 14, 45, 37, 60, 4, 0, 2  
 7, 54, 110, 9, 36, 60, 63, 15, 24, 36  
 , 77, 49, 38, 0, 8, 24, 24, 45, 23, 54  
 , 54, 62, 13
- 23 DATA 4, 0, 75, 9, 24, 8, 24, 54, 54, 2  
 46, 63, 28, 4, 0, 155, 18, 36, 36, 36  
 , 150, 8, 12, 13, 24, 150, 146, 15, 2  
 4, 15, 24, 4, 0, 27, 8, 24, 48, 54, 54  
 , 46, 45, 37, 0, 155, 18, 36, 36, 36,  
 77, 49, 54, 54, 254, 8, 24, 8, 24, 13  
 , 24, 31, 4, 0, 155, 18, 36, 36, 36, 7

```

7,49,54
24 DATA 54,62,8,24,15,24,28,4,0,
27,36,12,45,21,54,54,30,63,1
5,24,36,0,155,18,36,36,36,45
,173,246,63,4,0,27,36,12,45,
21,54,246,94,63,15,24,108,14
2,33,0,155,18,36,36,100,45,9
4,49,30,63,14,14,14,223,11,2
4,8,24,8,24,32
25 DATA 0,8,24,88,137,28,63,30,9
4,14,45,14,246,63,15,24,4,0,
146,36,36,228,43,45,37,0,146
,45,32,36,36,223,51,54,54,14
,4,0,27,8,24,48,54,118,14,13
,24,13,24,36,36,4,0,155,18,3
6,36,36,79,73,54,54,54,15,24
,60,240,38,0
26 DATA 155,18,228,9,204,97,13,2
4,252,27,246,9,142,113,38,0,
27,8,24,48,14,45,13,24,180,2
11,54,38,0,8,24,216,45,45,24
6,10,24,206,243,30,46,45,37,
0,155,18,36,36,36,53,54,54,4
6,45,12,24,8,24,8,24,63,4,0,
138,225,28,28,28,4
27 DATA 0,9,8,24,48,54,54,62,16
0,34,32,36,60,63,150,146,45,
4,0,30,23,77,225,4,0,47,176,
13,24,4,0,31,174,45,13,24,36
,28,63,23,4,0,219,219,219,21
9,27,36,100,36,13,24,44,40,4
0,40,40,13,24,45,12,45,37,0,
255
30 FOR I = 1 TO 1238
40 READ P(I)
50 NEXT I
100 FOR I = 1 TO 1238
110 POKE 24575 + I,P(I)
120 NEXT I
130 PRINT CHR$(4);"BSAVE GD.AB
C,A#6000,L1240"

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