NORM : a program to calculate CIPW- and Mesonorm mineral proportions from rock geochemistry

by

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1. Introduction

NORM is a program to calculate CIPW- and Meso-norms from rock geochemical analyses. I also calculates ternary projection of the normative mineralogy and various geochemical ratios relevant to the study of igneous rocks. NORM is designed for use on computers using the Windows operating system. Data are imported from Excel spreadsheets, so permitting calculations for large data sets.

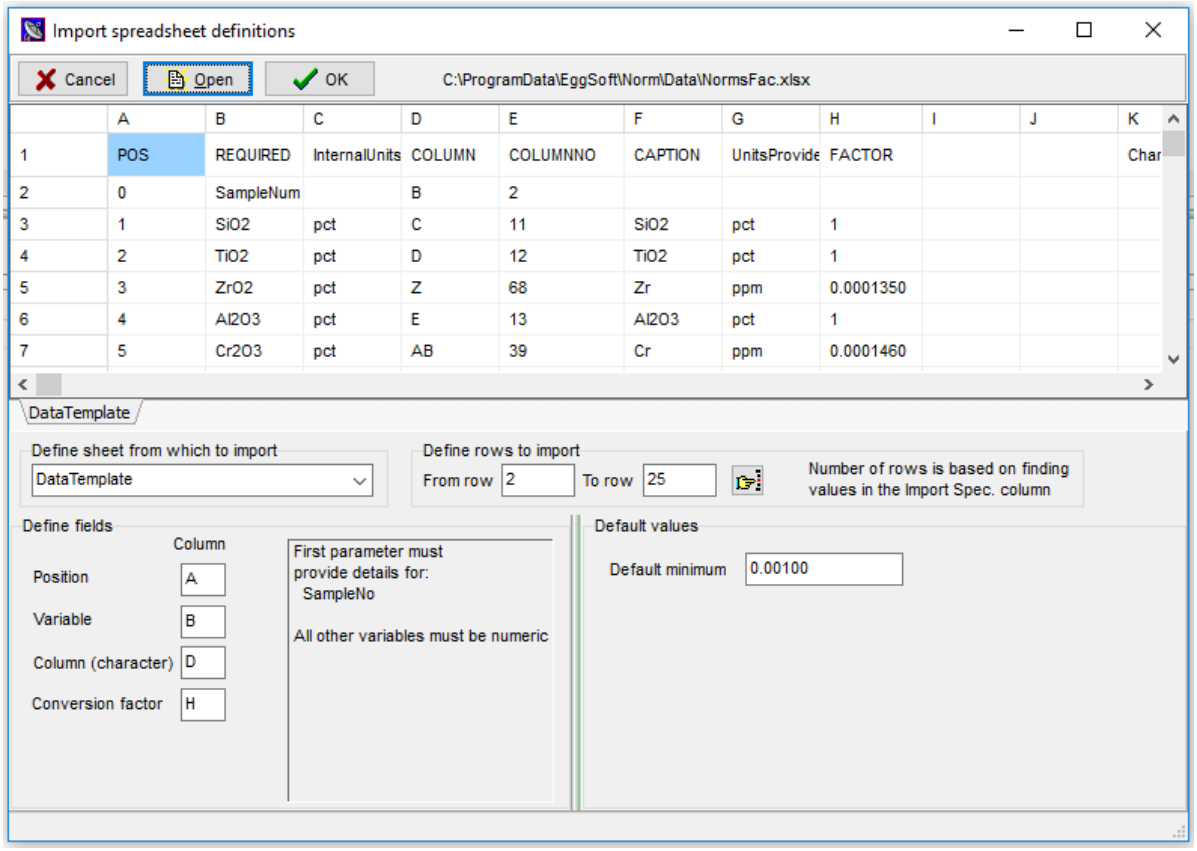
2. Importing Data

Data need to be available in an Excel spreadsheet (both Excel 1997-2003 XLS format and Excel 2007-2017 XLSX formats are supported) and the columns holding the various variables needs to be defined in another spreadsheet or tabsheet.

2.1. Data Definition

An example Excel spreadsheet defining the column associations for the 23 variables needed by NORM is provided in C:\ProgramData\EggSoft\Norm\Examples\NormsFac.xlsx. Variables corresponding to positions (POS) values from 1 to 23 should always be in the same order in the spreadsheet. Users should only need to change values in the cells coloured yellow. The leftmost of these yellow columns should define the column letter in which the corresponding geochemical variable data is stored in the data spreadsheet. The rightmost of the two yellow columns (FACTOR) needs to contain the factor by which data in the spreadsheet should be multiplied to convert to the variable format expected by NORM e.g. SiO2 is provided as percent concentrations and should be multiplied by a factor 1.0 to match its expected format as SiO2 (as stated in the REQUIRED column). In contrast, zirconium is provided as Zr in ppm but needs to be converted to ZrO2 by applying a factor of 0.0001350.

The import definitions spreadsheet window (Figure **1**) allows users to change the column layout. Users need to specify which columns will contain the POS value, the variable names, column letters and conversion factors. Data for this definition spreadsheet are read from rows 2 to 24. The currently loaded data definition values are shown in the Template tab of NORM

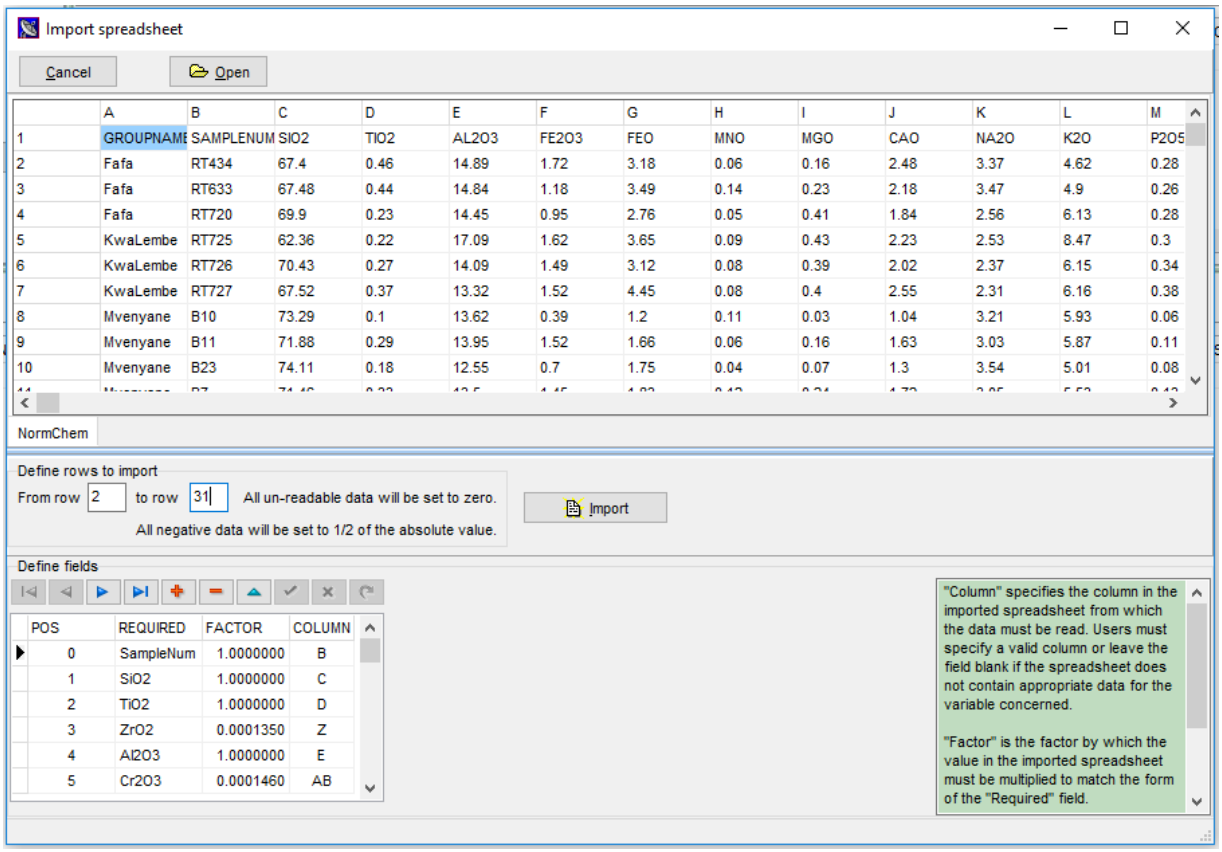


	A	B	C	D	E	F	G	H	I	J	K
1	POS	REQUIRED	InternalUnits	COLUMN	COLUMNNO	CAPTION	UnitsProvide	FACTOR			Char
2	0	SampleNum		B	2						
3	1	SiO2	pct	C	11	SiO2	pct	1			
4	2	TiO2	pct	D	12	TiO2	pct	1			
5	3	ZrO2	pct	Z	68	Zr	ppm	0.0001350			
6	4	Al2O3	pct	E	13	Al2O3	pct	1			
7	5	Cr2O3	pct	AB	39	Cr	ppm	0.0001460			

Figure 1. Window illustrating input of data definition values from a template spreadsheet.

2.2. Data Importing

Rock geochemical data need to be stored one row per sample with a field for sample number (up to 30 characters wide) and numeric data for each of the columns listed in the definitions spreadsheet. One also needs to specify start and end rows for the data to be input before clicking on the Import button (Figure **2**).



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	GROUPNAME	SAMPLENUM	SIO2	TIO2	AL2O3	FE2O3	FEO	MNO	MGO	CAO	NA2O	K2O	P2O5
2	Fafa	RT434	67.4	0.46	14.89	1.72	3.18	0.06	0.16	2.48	3.37	4.62	0.28
3	Fafa	RT633	67.48	0.44	14.84	1.18	3.49	0.14	0.23	2.18	3.47	4.9	0.26
4	Fafa	RT720	69.9	0.23	14.45	0.95	2.76	0.05	0.41	1.84	2.56	6.13	0.28
5	KwaLembe	RT725	62.36	0.22	17.09	1.62	3.65	0.09	0.43	2.23	2.53	8.47	0.3
6	KwaLembe	RT726	70.43	0.27	14.09	1.49	3.12	0.08	0.39	2.02	2.37	6.15	0.34
7	KwaLembe	RT727	67.52	0.37	13.32	1.52	4.45	0.08	0.4	2.55	2.31	6.16	0.38
8	Mvenyane	B10	73.29	0.1	13.62	0.39	1.2	0.11	0.03	1.04	3.21	5.93	0.06
9	Mvenyane	B11	71.88	0.29	13.95	1.52	1.66	0.06	0.16	1.63	3.03	5.87	0.11
10	Mvenyane	B23	74.11	0.18	12.55	0.7	1.75	0.04	0.07	1.3	3.54	5.01	0.08

POS	REQUIRED	FACTOR	COLUMN
0	SampleNum	1.0000000	B
1	SiO2	1.0000000	C
2	TiO2	1.0000000	D
3	ZrO2	0.0001350	Z
4	Al2O3	1.0000000	E
5	Cr2O3	0.0001460	AB

Figure 2. Import of example geochemical data for a number of rock analyses. Top grid provides a view of the spreadsheet data to be imported. In this example, data will be read from rows 2 to 31 according to the association between variables, columns and conversion factors shown in the lower grid.

3. Calculating and Viewing Normative Mineralogy

Once data have been imported, they are shown in the top grid of the main program interface (). Clicking on the Calculate button will add results to the lower grid for whichever of the normative requirements has been stipulated. One may calculate one or more of the norms and either view the results as one large table (lower grid) or on a per sample basis by selecting one of the other tabsheet views illustrated in Figure **4**, Figure **5**, Figure **6** and Figure **7**). The navigator buttons provided near the top of each screen permit one to step through individual samples (left navigator button array) or the various normative mineralogy results (right navigator buttons).

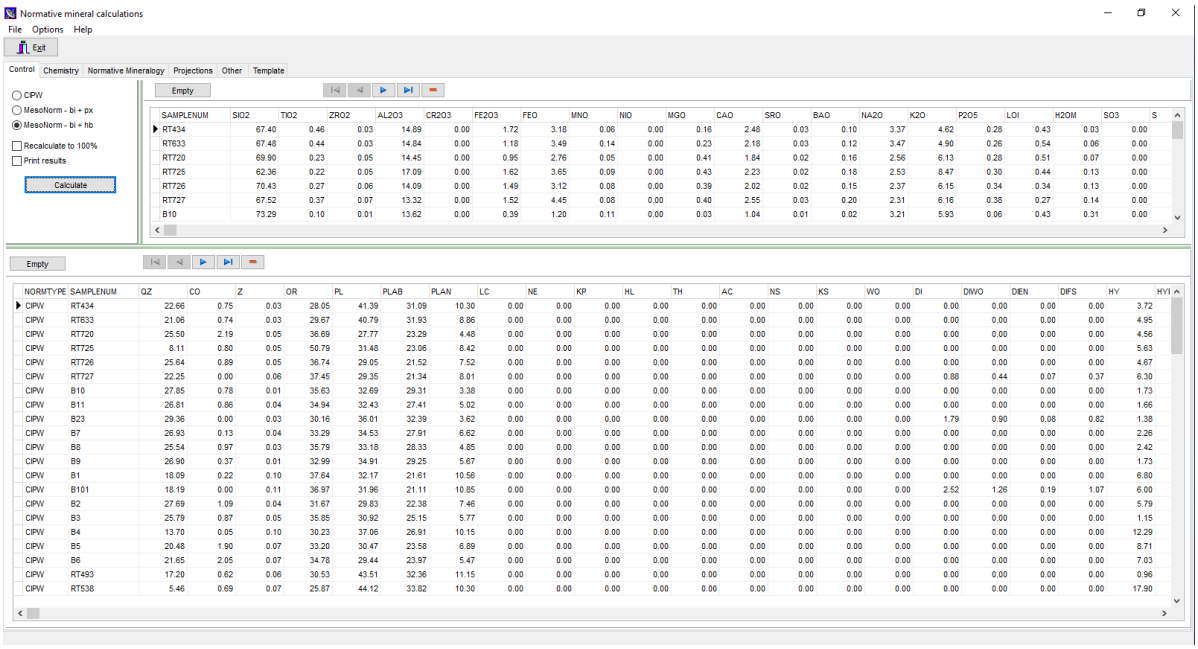


Figure 3. Main view of geochemical data, normative mineralogy and program calculation options.

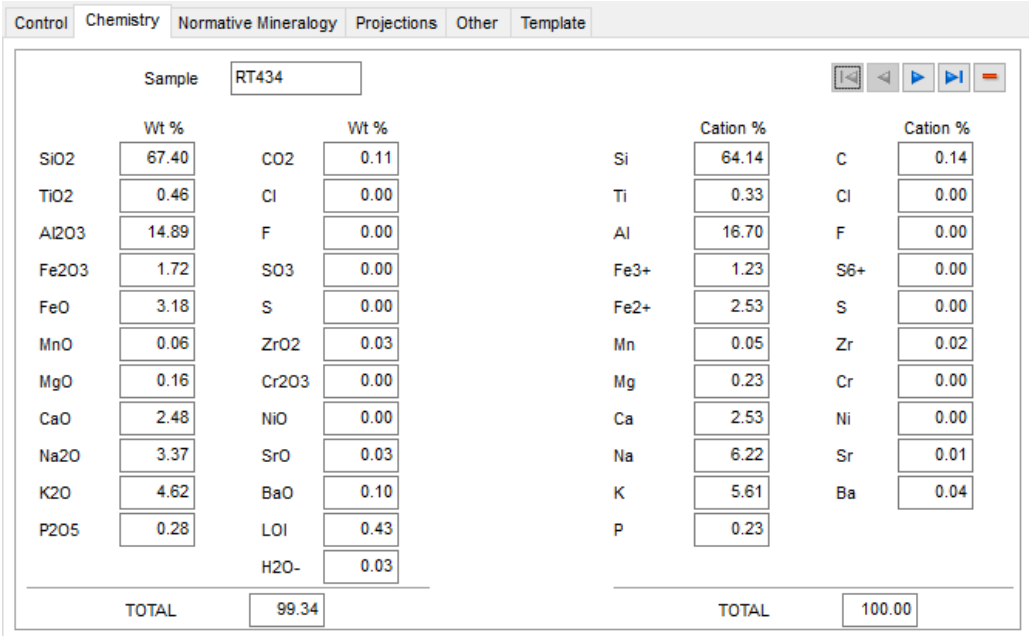


Figure 4. Per sample view of geochemistry for a sample, providing both weight percent and cation percent concentrations.

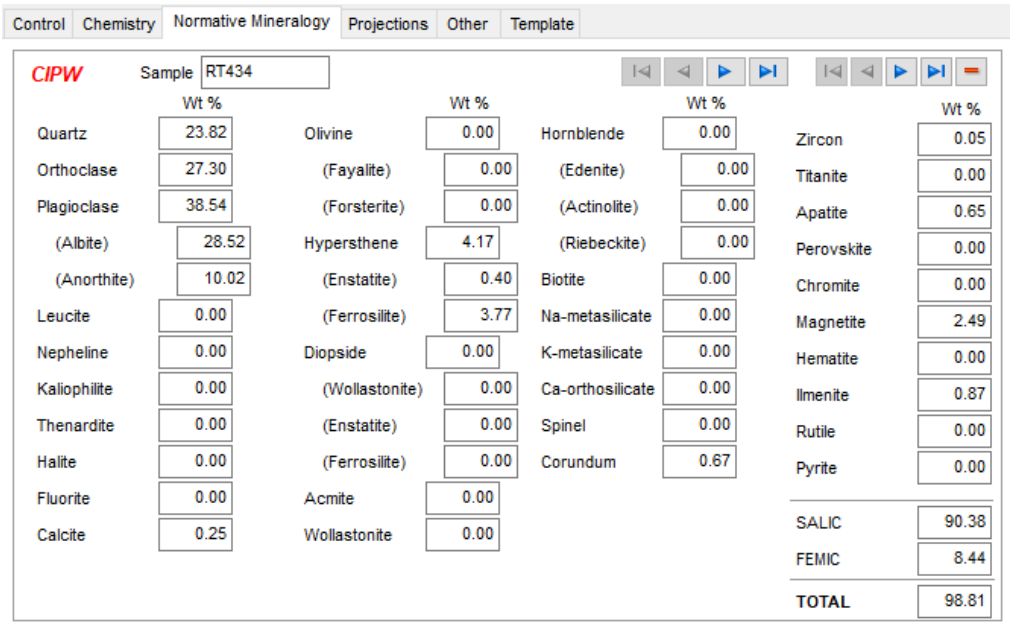


Figure 5. Normative mineralogy (in this case CIPW) for a sample.

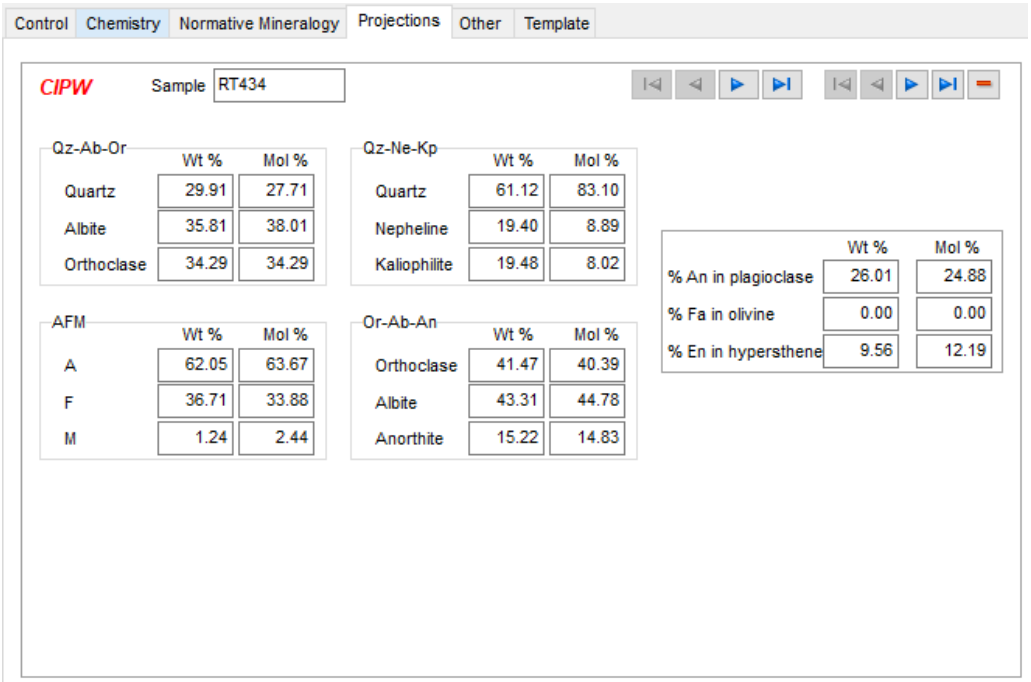


Figure 6. Ternary weight percent and molar percent values and major normative mineral compositions for a single sample.

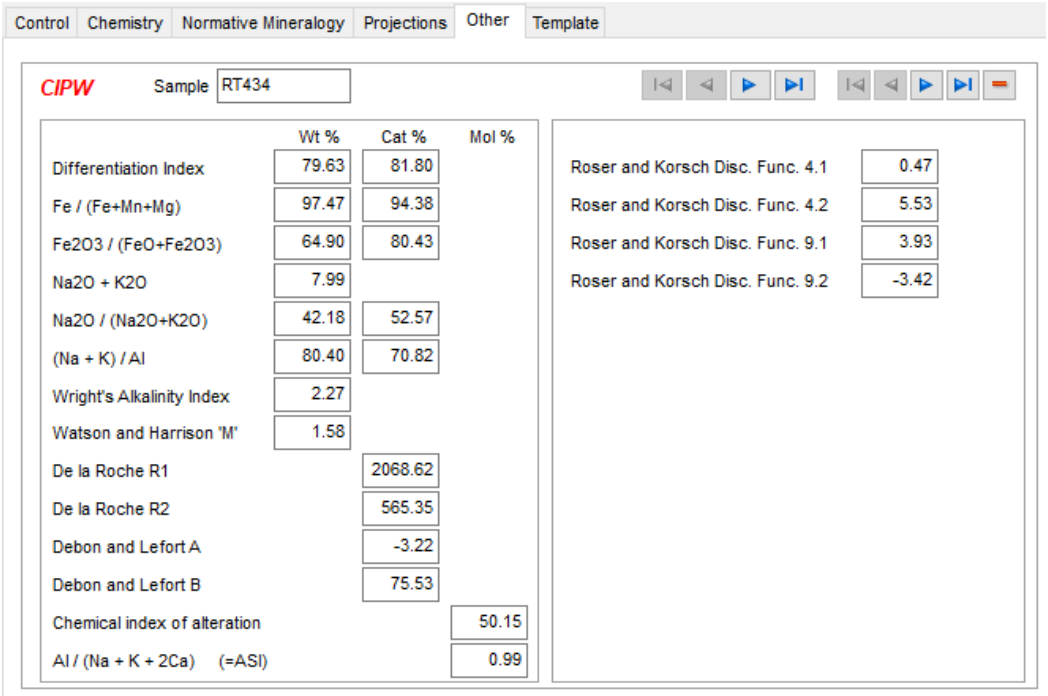


Figure 7. Geochemical ratios and parameters for a sample.

4. Exporting or Printing Results

Normative mineralogy and geochemical ratios or parameters may either be printed (one sample per page, assuming A4 page size) or exported to an Excel spreadsheet for plotting or entry to other software packages, databases, etc.