

Triangular diagram & histogram spreadsheet (TRI-PLOT2)

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modified by Daniel Nývlt (Masaryk University, Brno, Czechia)

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Introduction

This spreadsheet plots triangular (ternary) diagrams for the representation of particle shape following the method recommended by Benn and Ballantyne (1993) and first proposed by Sneed and Folk (1958). Ordinary ternary diagram plotting software is unable to plot these diagrams as the parameters on the three axes do not sum to 1. The spreadsheet also plots standard histograms for the representation of particle roundness recommended by Benn and Ballantyne (1994). The original TRI-PLOT spreadsheet has been developed by Graham and Midgley (2000), it modified version has been developed for Nývlt and Hoare (2011) presentation.

Instructions

[Click here to generate a particle SHAPE triangular diagram](#)

[Click here to generate a particle ROUNDNESS histogram](#)

The workbook contains five sheets:

- This sheet contains instructions and information about TRI-PLOT2.
- The second and third sheets are for the generation of particle SHAPE (Sneed and Folk) triangular diagrams. The second sheet (SHAPE - Data & results) enables data entry and presents the results as a triangular diagram. The fourth sheet (SHAPE - Calcs.) works behind the scenes doing the calculations.
- The third sheet (ROUNDNESS - Data & results) is for the generation of standard histograms to represent particle ROUNDNESS.

Only the curious or those who wish to modify the spreadsheet will need to look at the calculations sheet.

To generate SHAPE (Sneed and Folk) triangular diagrams

This part of the spreadsheet generates ternary diagrams for the representation of particle shape as recommended by Benn and Ballantyne (1993) and first proposed by Sneed and Folk (1958). The inputs required are the a-, b- and c-axis lengths of the particles. The "SHAPE - Data & results" sheet can be accessed using the button above or the tab at the bottom of the screen. The sheet contains three areas: the data entry area, the plotting parameters area and the triangular diagram itself.

Data entry area

Type the a-axis, b-axis and c-axis dimensions of each clast into the table. The units of measurement are not important, as long as they are consistent. Error messages are displayed in blue. The triangular diagram will update as data are entered. The data entry area is set up initially to accept data for 100 clasts. Samples of less than 100 clasts do not require the spreadsheet to be altered. Samples of more than 100 clasts require that the spreadsheet is altered by copying the formulae in columns A - J of the calculations sheet the required number of times.

Plotting parameters area

This area defines aspects of how the triangular diagram will appear on the screen and when printed.

The *printer correction* parameter is used to scale the vertical axis of the diagram so the triangle is equilateral. This is necessary because it is not possible to instruct Excel to scale charts. Experiment to obtain satisfactory results on screen and from a printer. Alternatively, the diagram may be scaled using the mouse.

The *tick interval* parameter defines the frequency of tick marks on the axes of the diagram. Acceptable inputs are 0 and from 0.05 to 0.5 but must divide into 1 (i.e. 0.05, 0.1, 0.2, 0.25, 0.5). If 0 is entered, no ticks are plotted. An error message is given if an unacceptable value is entered.

The *tick length* parameter defines the length of tick marks on the axes of the diagram. Acceptable inputs are from 0 to 0.2. An error message is given if an unacceptable value is entered. If 0 is entered, no ticks are plotted.

The *plot C40 line?* parameter determines whether a line is drawn across the diagram to indicate the C40 index value ($c/a=0.4$). Acceptable inputs are N (line not plotted) and Y (line plotted). Other inputs will result in an error message.

The *Plot C-axis lines?* parameter determines whether lines are drawn across the diagram from the tick marks on

The *Left axis lines?* parameter determines whether lines are drawn across the diagram from the tick marks on the left and right axes. Acceptable inputs are N (line not plotted) and Y (line plotted). Other inputs will result in an error message. The lines are drawn at the interval specified by the tick interval parameter.

The *Bot'm axis lines?* parameter determines whether lines are drawn across the diagram from the tick marks on the bottom axis. Acceptable inputs are N (line not plotted) and Y (line plotted). Other inputs will result in an error message. The lines are drawn at the interval specified by the tick interval parameter.

The *Bot'm axis ticks?* parameter determines whether tick marks are plotted on the bottom axis. Acceptable inputs are N (ticks not plotted) and Y (ticks plotted). Other inputs will result in an error message. The ticks are drawn with the frequency and length specified by the tick interval and tick length parameters.

Modifications to the triangular diagram

The triangular diagram itself may be modified to change line thickness, symbols used etc.. Each aspect of the diagram is saved as a different data series and may be altered in the standard way for Excel charts. The table below lists the data series that comprise the chart. Additional data series may be added in the standard way to allow multiple data sets to be plotted on a single diagram. Refer to the Excel manual or help for further details of how to modify charts.

Data series that comprise the triangular diagram:

Data series	User entered data
Triangle outline	Defines the triangle
Left ticks	Ticks on the left (c/a) axis
Right ticks	Ticks on the right (b/a) axis
Bottom ticks	Ticks on the bottom axis
C40 line	Defines the line where c/a = 0.4
Left axis lines	Extension of left axis ticks across diagram
Right axis lines	Extension of right axis ticks across diagram
Bottom axis lines	Extension of bottom axis ticks across diagram

To generate ROUNDNESS histograms

This part of the spreadsheet generates standard histograms for the representation of particle roundness. The "ROUNDNESS - Data & results" sheet can be accessed using the button above or the tab at the bottom of the screen.

The procedure for generating a ROUNDNESS histogram is very easy. The inputs required are the proportion of roundness classes (i.e. very angular, angular, subangular, subrounded, rounded, well-rounded). These must be entered as a percentage and total 100.

References

Benn DI, Ballantyne CK. 1993. The description and representation of particle shape. *Earth Surface Processes and Landforms* **18**(7): 665-672.
 Benn DI, Ballantyne CK. 1993. Reconstructing the transport history of glacial sediments: a new approach based on the co-variance of clast form indices. *Sedimentary Geology* **91**: 215-337.
 Graham DJ, Midgley NG. 2000. Graphical representation of particle shape using triangular diagrams: An Excel spreadsheet method. *Earth Surface Processes and Landforms* **25**: 1473-1477.
 Nývlt D, Hoare PG. 2011. Petrology, provenance and shape of clasts in the glaciofluvial sediments of the Mníšek member, northern Bohemia, Czechia. *Journal of Geological Sciences - Anthropozoic* **27**: 5-22.
 Sneed ED, Folk RL. 1958. Pebbles in the lower Colorado River, Texas, a study in particle morphogenesis, *Journal of Geology* **66**(2): 114-150.

Technical notes

The spreadsheet was prepared using Excel 97. It has been tested with Excel 2000 and should work with all subsequent versions, but does not work with earlier versions.

Technical queries and problems with this spreadsheet should be addressed to David Graham, Centre for Glaciology, Institute of Geography and Earth Sciences, University of Wales, Aberystwyth, Ceredigion, Wales SY23 3DB. E-mail djg97@aber.ac.uk.

Users are free to modify and distribute TRI-PLOT2 provided the original source is referenced in any modified version.

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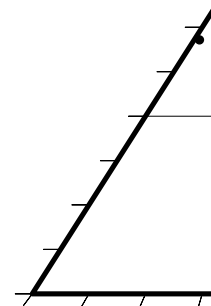
SHAPE - data entry and results sheet

Kolnovice

Data entry area					
Clast no.	Clast axes			Error messages	Roundness
	a-axis	b-axis	c-axis		
1	28.90	18.60	9.60		SR
2	15.10	14.45	12.10		SR
3	19.05	12.60	12.00		SR
4	16.00	11.05	7.35		R
5	21.65	10.30	9.20		R
6	13.80	9.75	8.60		R
7	23.15	17.85	7.48		SA
8	16.59	11.37	11.06		SA
9	24.17	15.34	13.58		SR
10	21.88	13.70	12.84		SA
11	24.51	13.99	11.57		A
12	18.52	13.20	9.55		SR
13	19.65	12.88	10.62		R
14	13.63	10.02	9.76		SR
15	18.80	12.35	5.47		SR
16	14.44	13.42	7.92		SR
17	21.03	9.70	5.22		SR
18	16.68	11.24	10.18		R
19	15.84	14.11	8.50		R
20	12.35	9.30	8.92		WR
21	19.54	14.59	2.93		SA
22	22.81	17.69	7.19		SR
23	12.59	11.87	7.77		SR
24	13.77	10.66	6.29		R
25	13.34	11.76	9.51		SR
26	14.56	12.63	11.11		SR
27	14.83	10.25	7.00		WR
28	17.04	11.69	10.63		R
29	26.01	14.55	13.44		SR
30	29.40	15.62	10.91		SR
31	31.25	18.60	16.40		SA
32	18.00	11.65	10.00		SR
33	16.65	11.55	7.50		SA
34	16.60	12.75	6.50		A
35	20.70	15.20	9.60		SA
36	21.35	19.65	13.00		R
37	16.60	12.20	8.45		SA
38	17.45	9.96	6.91		SR
39	17.35	12.81	11.86		SR
40	16.26	15.57	13.87		SR
41	16.89	10.24	5.18		A
42	15.06	11.92	7.69		R
43	16.13	8.69	6.91		SR
44	13.13	10.68	5.90		SR
45	16.89	13.90	10.76		SR
46	16.86	12.40	7.59		SR
47	14.67	11.61	5.50		A

Plotting parameters

Printer color
 Tick interval
 Tick length
 Plot C40 line?
 L+R axis lines?
 Bot'm axis lines?
 Bot'm axis ticks?



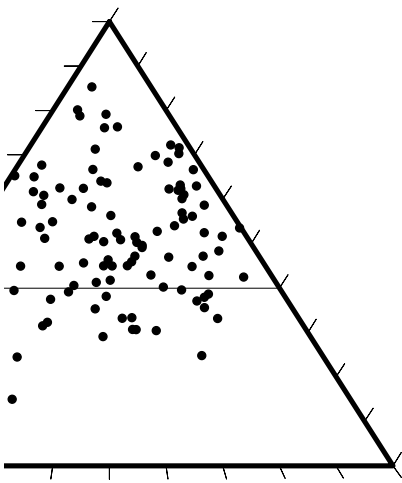
48	15.27	15.13	8.73	SR
49	12.80	8.82	7.94	SR
50	17.51	13.41	7.11	SR

51	12.25	11.74	7.97	A
52	11.11	9.67	5.69	SA
53	11.08	9.12	6.46	SR
54	14.03	10.78	9.80	SR
55	18.34	15.88	7.24	SA
56	17.80	9.77	8.61	R
57	17.21	11.30	9.80	SR
58	16.86	11.46	8.90	A
59	15.90	14.14	12.10	SR
60	13.86	10.38	7.26	SR
61	29.70	18.20	9.12	SR
62	14.48	12.10	9.28	SR
63	13.46	12.30	7.92	R
64	24.42	11.60	8.10	A
65	21.90	11.18	7.80	SR
66	15.20	8.18	8.14	SR
67	16.20	9.82	6.52	SR
68	22.54	15.70	8.60	R
69	14.12	12.12	8.82	SA
70	21.38	15.40	9.62	A
71	19.38	11.04	5.90	SR
72	12.98	11.20	8.66	R
73	14.30	9.62	8.60	SA
74	16.68	13.00	9.40	R
75	15.88	10.01	7.46	SR
76	15.46	10.94	6.46	SR
77	11.92	11.42	8.07	SR
78	15.82	15.72	10.33	R
79	16.85	9.75	7.56	SR
80	18.30	12.65	11.57	SA
81	15.65	14.09	9.79	SA
82	18.39	11.80	7.90	SA
83	14.91	10.87	10.48	A
84	18.70	9.70	7.23	SR
85	17.21	8.99	6.53	SA
86	14.69	11.55	9.89	A
87	14.83	10.43	7.46	SA
88	15.86	10.95	7.87	SR
89	16.07	10.08	5.36	SA
90	14.08	9.69	6.92	SR
91	13.73	10.02	5.67	SR
92	14.82	11.64	3.63	A
93	14.46	10.15	5.11	SA
94	11.04	9.56	6.62	SA
95	9.78	8.82	7.74	SR
96	13.14	11.50	7.22	SR
97	10.78	8.22	5.44	SA
98	12.59	11.10	5.66	A
99	13.20	10.37	6.82	SA
100	11.87	11.23	9.35	SA

AVER 16.92 12.10 8.50

[Click here to return to the](#)

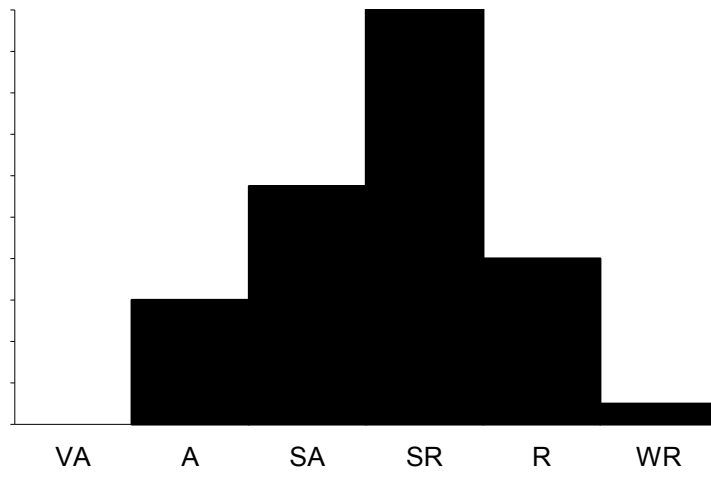
Parameters area		Error messages
Reaction:	1.1	
(0 - 0.5):	0.1	
(0 - 0.2):	0.03	
(Y or N):	y	
(Y or N):	n	
(Y or N):	n	
(Y or N):	y	



8-16 mm	quartz
	<i>shares (%)</i>
very angular	0
angular	12
subangular	23
subrounded	47
rounded	16
well rounded	2

100

Lahoda_Dobias (RA=12)



SHAPE - calculations

[Click here](#)

It should not be necessary to modify the contents of this sheet unless you wish to modify the operation of TRI-PLOT.

Plotting parameters

Printer correction:	1.1	Bot'm axis lines?:
Tick interval:	0.1	Bot'm axis ticks?:
Tick length:	0.03	
Plot C40 line?:	1	
Plot lines?:	0	

Data area

Calculated values: do not change

Clast no.	Clast axes			Clast axis ratios		Graph α
	a-axis	b-axis	c-axis	c/a	b/a	x
1	28.9	18.6	9.6	0.33218	0.643599	0.522491
2	15.1	14.45	12.1	0.801325	0.956954	0.443709
3	19.05	12.6	12	0.629921	0.661417	0.653543
4	16	11.05	7.35	0.459375	0.690625	0.539063
5	21.65	10.3	9.2	0.424942	0.475751	0.736721
6	13.8	9.75	8.6	0.623188	0.706522	0.605072
7	23.15	17.85	7.48	0.32311	0.771058	0.390497
8	16.59	11.37	11.06	0.666667	0.685353	0.647981
9	24.17	15.34	13.58	0.561854	0.634671	0.646256
10	21.88	13.7	12.84	0.586837	0.626143	0.667276
11	24.51	13.99	11.57	0.472052	0.570787	0.665239
12	18.52	13.2	9.55	0.515659	0.712743	0.545086
13	19.65	12.88	10.62	0.540458	0.655471	0.614758
14	13.63	10.02	9.76	0.716067	0.735143	0.622891
15	18.8	12.35	5.47	0.290957	0.656915	0.488564
16	14.44	13.42	7.92	0.548476	0.929363	0.344875
17	21.03	9.7	5.22	0.248217	0.461246	0.662863
18	16.68	11.24	10.18	0.610312	0.673861	0.631295
19	15.84	14.11	8.5	0.536616	0.890783	0.377525
20	12.35	9.3	8.92	0.722267	0.753036	0.608097
21	19.54	14.59	2.93	0.149949	0.746673	0.328301
22	22.81	17.69	7.19	0.315213	0.775537	0.382069
23	12.59	11.87	7.77	0.617156	0.942812	0.365766
24	13.77	10.66	6.29	0.45679	0.774147	0.454248
25	13.34	11.76	9.51	0.712894	0.881559	0.474888
26	14.56	12.63	11.11	0.763049	0.867445	0.51408
27	14.83	10.25	7	0.472016	0.691167	0.544842
28	17.04	11.69	10.63	0.623826	0.686033	0.62588
29	26.01	14.55	13.44	0.516724	0.5594	0.698962
30	29.4	15.62	10.91	0.371088	0.531293	0.654252
31	31.25	18.6	16.4	0.5248	0.5952	0.6672
32	18	11.65	10	0.555556	0.647222	0.630556
33	16.65	11.55	7.5	0.45045	0.693694	0.531532
34	16.6	12.75	6.5	0.391566	0.768072	0.427711
35	20.7	15.2	9.6	0.463768	0.7343	0.497585
36	21.35	19.65	13	0.608899	0.920375	0.384075

37	16.6	12.2	8.45	0.509036	0.73494	0.519578
38	17.45	9.96	6.91	0.395989	0.570774	0.627221
39	17.35	12.81	11.86	0.683573	0.738329	0.603458
40	16.26	15.57	13.87	0.853014	0.957565	0.468942
41	16.89	10.24	5.18	0.30669	0.606276	0.547069
42	15.06	11.92	7.69	0.510624	0.791501	0.463811
43	16.13	8.69	6.91	0.428394	0.538748	0.675449
44	13.13	10.68	5.9	0.449353	0.813404	0.411272
45	16.89	13.9	10.76	0.637063	0.822972	0.49556
46	16.86	12.4	7.59	0.450178	0.735469	0.48962
47	14.67	11.61	5.5	0.374915	0.791411	0.396046
48	15.27	15.13	8.73	0.571709	0.990832	0.295023
49	12.8	8.82	7.94	0.620313	0.689063	0.621094
50	17.51	13.41	7.11	0.406054	0.765848	0.437179

To expand the number of clasts, copy the contents of columns A-J into the rows below.

51	12.25	11.74	7.97	0.650612	0.958367	0.366939
52	11.11	9.67	5.69	0.512151	0.870387	0.385689
53	11.08	9.12	6.46	0.583032	0.823105	0.468412
54	14.03	10.78	9.8	0.698503	0.768354	0.580898
55	18.34	15.88	7.24	0.394766	0.865867	0.331516
56	17.8	9.77	8.61	0.483708	0.548876	0.692978
57	17.21	11.3	9.8	0.569436	0.656595	0.628123
58	16.86	11.46	8.9	0.527877	0.679715	0.584223
59	15.9	14.14	12.1	0.761006	0.889308	0.491195
60	13.86	10.38	7.26	0.52381	0.748918	0.512987
61	29.7	18.2	9.12	0.307071	0.612795	0.540741
62	14.48	12.1	9.28	0.640884	0.835635	0.484807
63	13.46	12.3	7.92	0.58841	0.913819	0.380386
64	24.42	11.6	8.1	0.331695	0.47502	0.690827
65	21.9	11.18	7.8	0.356164	0.510502	0.66758
66	15.2	8.18	8.14	0.535526	0.538158	0.729605
67	16.2	9.82	6.52	0.402469	0.606173	0.595062
68	22.54	15.7	8.6	0.381544	0.696539	0.494232
69	14.12	12.12	8.82	0.624646	0.858357	0.453966
70	21.38	15.4	9.62	0.449953	0.720299	0.504677
71	19.38	11.04	5.9	0.304438	0.569659	0.582559
72	12.98	11.2	8.66	0.66718	0.862866	0.470724
73	14.3	9.62	8.6	0.601399	0.672727	0.627972
74	16.68	13	9.4	0.563549	0.779376	0.502398
75	15.88	10.01	7.46	0.469773	0.630353	0.604534
76	15.46	10.94	6.46	0.417853	0.707633	0.501294
77	11.92	11.42	8.07	0.677013	0.958054	0.380453
78	15.82	15.72	10.33	0.652971	0.993679	0.332807
79	16.85	9.75	7.56	0.448665	0.578635	0.645697
80	18.3	12.65	11.57	0.63224	0.691257	0.624863
81	15.65	14.09	9.79	0.625559	0.900319	0.41246
82	18.39	11.8	7.9	0.429581	0.641653	0.573138
83	14.91	10.87	10.48	0.702884	0.729041	0.622401
84	18.7	9.7	7.23	0.386631	0.518717	0.674599
85	17.21	8.99	6.53	0.379431	0.522371	0.667345
86	14.69	11.55	9.89	0.673247	0.786249	0.550374
87	14.83	10.43	7.46	0.503034	0.703304	0.548213
88	15.86	10.95	7.87	0.496217	0.690416	0.557692
89	16.07	10.08	5.36	0.333541	0.627256	0.539515
90	14.08	9.69	6.92	0.491477	0.68821	0.557528
91	13.73	10.02	5.67	0.412964	0.729789	0.476693

92	14.82	11.64	3.63	0.244939	0.785425	0.337045
93	14.46	10.15	5.11	0.353389	0.701936	0.474758
94	11.04	9.56	6.62	0.599638	0.865942	0.433877
95	9.78	8.82	7.74	0.791411	0.90184	0.493865
96	13.14	11.5	7.22	0.549467	0.87519	0.399543
97	10.78	8.22	5.44	0.504638	0.762523	0.489796
98	12.59	11.1	5.66	0.449563	0.881652	0.343129
99	13.2	10.37	6.82	0.516667	0.785606	0.472727
100	11.87	11.23	9.35	0.7877	0.946083	0.447767

to return to the

Calculations area: do

Triangle outline

x	y
0.5	0.9526
0	0
1	0
0.5	0.9526

0
1

Lef

Tick position

0

0.1

0.2

0.3

0.4

0.5

0.6

0.7

0.8

0.9

1

o-ordinates

y

0.316435

0.763342

0.600063

0.437601

0.4048

0.593649

0.307795

0.635067

0.535222

0.559021

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0.511181

0.688032

0.142841

0.300272

0.587903

0.435138

0.679102

0.726881

0.449643

0.594257

0.492232

0.353499

0.499924

0.529222

0.429099

0.373006

0.441786

0.580037

0.484908
0.377219
0.651172
0.812581
0.292153
0.486421
0.408088
0.428053
0.606867
0.42884
0.357144
0.54461
0.59091
0.386807

0.619773
0.487875
0.555397
0.665394
0.376054
0.46078
0.542445
0.502855
0.724935
0.498981
0.292516
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0.560519
0.315973
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0.383392
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0.62202
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0.641335
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0.472696
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0.468181
0.39339

0.233329
0.336638
0.571215
0.753898
0.523423
0.480718
0.428254
0.492177
0.750363

