Triangular diagram & histogram spreadsheet (TRI-PLOT2)

by David Graham (University of Wales, Aberystwyth)
and Nicholas Midgley (Liverpool John Moores University)

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 *L+R 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 glacigenic 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*.

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SHAPE - data entry and results sheet

Data entry area

	Clast axes				
Clast no.	a-axis	b-axis	c-axis	Error messages	Roundness
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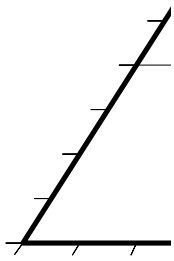
47					

Plotting paramet

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



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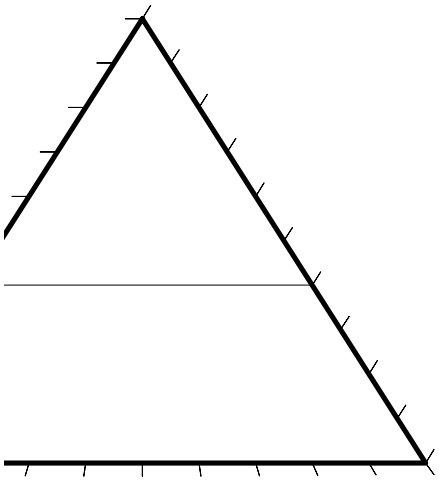
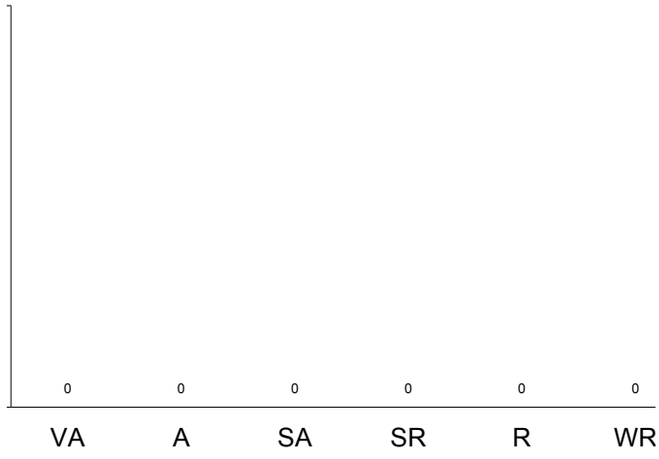
ters area

		Error messages
rection:	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	



roundness	pieces
	shares (%)
very angular	**0**
angular	**0**
subangular	**0**
subrounded	**0**
rounded	**0**
well rounded	**0**

0



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 axes			Clast axis ratios		Graph c
Clast no.	a-axis	b-axis	c-axis	c/a	b/a	x
1	0	0	0	0	0	-1
2	0	0	0	0	0	-1
3	0	0	0	0	0	-1
4	0	0	0	0	0	-1
5	0	0	0	0	0	-1
6	0	0	0	0	0	-1
7	0	0	0	0	0	-1
8	0	0	0	0	0	-1
9	0	0	0	0	0	-1
10	0	0	0	0	0	-1
11	0	0	0	0	0	-1
12	0	0	0	0	0	-1
13	0	0	0	0	0	-1
14	0	0	0	0	0	-1
15	0	0	0	0	0	-1
16	0	0	0	0	0	-1
17	0	0	0	0	0	-1
18	0	0	0	0	0	-1
19	0	0	0	0	0	-1
20	0	0	0	0	0	-1
21	0	0	0	0	0	-1
22	0	0	0	0	0	-1
23	0	0	0	0	0	-1
24	0	0	0	0	0	-1
25	0	0	0	0	0	-1
26	0	0	0	0	0	-1
27	0	0	0	0	0	-1
28	0	0	0	0	0	-1
29	0	0	0	0	0	-1
30	0	0	0	0	0	-1
31	0	0	0	0	0	-1
32	0	0	0	0	0	-1
33	0	0	0	0	0	-1
34	0	0	0	0	0	-1
35	0	0	0	0	0	-1
36	0	0	0	0	0	-1

37	0	0	0	0	0	-1
38	0	0	0	0	0	-1
39	0	0	0	0	0	-1
40	0	0	0	0	0	-1
41	0	0	0	0	0	-1
42	0	0	0	0	0	-1
43	0	0	0	0	0	-1
44	0	0	0	0	0	-1
45	0	0	0	0	0	-1
46	0	0	0	0	0	-1
47	0	0	0	0	0	-1
48	0	0	0	0	0	-1
49	0	0	0	0	0	-1
50	0	0	0	0	0	-1

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

51	0	0	0	0	0	-1
52	0	0	0	0	0	-1
53	0	0	0	0	0	-1
54	0	0	0	0	0	-1
55	0	0	0	0	0	-1
56	0	0	0	0	0	-1
57	0	0	0	0	0	-1
58	0	0	0	0	0	-1
59	0	0	0	0	0	-1
60	0	0	0	0	0	-1
61	0	0	0	0	0	-1
62	0	0	0	0	0	-1
63	0	0	0	0	0	-1
64	0	0	0	0	0	-1
65	0	0	0	0	0	-1
66	0	0	0	0	0	-1
67	0	0	0	0	0	-1
68	0	0	0	0	0	-1
69	0	0	0	0	0	-1
70	0	0	0	0	0	-1
71	0	0	0	0	0	-1
72	0	0	0	0	0	-1
73	0	0	0	0	0	-1
74	0	0	0	0	0	-1
75	0	0	0	0	0	-1
76	0	0	0	0	0	-1
77	0	0	0	0	0	-1
78	0	0	0	0	0	-1
79	0	0	0	0	0	-1
80	0	0	0	0	0	-1
81	0	0	0	0	0	-1
82	0	0	0	0	0	-1
83	0	0	0	0	0	-1
84	0	0	0	0	0	-1
85	0	0	0	0	0	-1
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95	0	0	0	0	0	-1
96	0	0	0	0	0	-1
97	0	0	0	0	0	-1
98	0	0	0	0	0	-1
99	0	0	0	0	0	-1
100	0	0	0	0	0	-1

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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
-1
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ı not change

C40 line

x	y
0.2	0.38104
0.8	0.38104

t (c/a ratio) axis ticks

x	y
0	0
-0.03	0
0	0
0.05	0.09526
0.02	0.09526
0.05	0.09526
0.1	0.19052
0.07	0.19052
0.1	0.19052
0.15	0.28578
0.12	0.28578
0.15	0.28578
0.2	0.38104
0.17	0.38104
0.2	0.38104
0.25	0.4763
0.22	0.4763
0.25	0.4763
0.3	0.57156
0.27	0.57156
0.3	0.57156
0.35	0.66682
0.32	0.66682
0.35	0.66682
0.4	0.76208
0.37	0.76208
0.4	0.76208
0.45	0.85734
0.42	0.85734
0.45	0.85734
0.5	0.9526
0.47	0.9526
0.5	0.9526
0.5	0.9526
0.5	0.9526
0.5	0.9526
0.5	0.9526
0.5	0.9526
0.5	0.9526
0.5	0.9526
0.5	0.9526

Right (b/a ratio) axis ticks

x	y
1	0
1.015	0.028578
1	0
0.95	0.09526
0.965	0.123838
0.95	0.09526
0.9	0.19052
0.915	0.219098
0.9	0.19052
0.85	0.28578
0.865	0.314358
0.85	0.28578
0.8	0.38104
0.815	0.409618
0.8	0.38104
0.75	0.4763
0.765	0.504878
0.75	0.4763
0.7	0.57156
0.715	0.600138
0.7	0.57156
0.65	0.66682
0.665	0.695398
0.65	0.66682
0.6	0.76208
0.615	0.790658
0.6	0.76208
0.55	0.85734
0.565	0.885918
0.55	0.85734
0.5	0.9526
0.515	0.981178
0.5	0.9526
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Left axis lines

x	y
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Right axis lines

x	y
0	0
0	0
0	0
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Bottom axis lines

x	y
0.5	0.9526
0.5	0.9526
0.5	0.9526
0.5	0.9526
0.5	0.9526
0.5	0.9526
0.5	0.9526
0.5	0.9526
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0.5	0.9526
0.5	0.9526
0.5	0.9526
0.5	0.9526
0.5	0.9526
0.5	0.9526

Bottom axis ticks

x-calc	y-calc	x
0	0	0
-0.015	-0.02475	-0.015
0	0	0
0.1	0	0.1
0.08742	-0.02594	0.08742
0.1	0	0.1
0.2	0	0.2
0.19018	-0.027	0.19018
0.2	0	0.2
0.3	0	0.3
0.293249	-0.02785	0.293249
0.3	0	0.3
0.4	0	0.4
0.396559	-0.02839	0.396559
0.4	0	0.4
0.5	0	0.5
0.5	-0.02858	0.5
0.5	0	0.5
0.6	0	0.6
0.603441	-0.02839	0.603441
0.6	0	0.6
0.7	0	0.7
0.706751	-0.02785	0.706751
0.7	0	0.7
0.8	0	0.8
0.80982	-0.027	0.80982
0.8	0	0.8
0.9	0	0.9
0.91258	-0.02594	0.91258
0.9	0	0.9
1	0	1
1.015	-0.02475	1.015
1	0	1
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	0.5	0.9526	0	0	0
0	0	0.5	0.9526	0	0	0
		0.5	0.9526	0	0	0
0	0			0	0	0
0	0			0	0	0
				0	0	0
0	0	0.5	0.9526	0	0	0
0	0	0.5	0.9526	0	0	0
		0.5	0.9526	0	0	0
0	0			0	0	0
0	0			0	0	0
				0	0	0
0	0	0.5	0.9526	0	0	0
0	0	0.5	0.9526	0	0	0
		0.5	0.9526	0	0	0
0	0			0	0	0
0	0			0	0	0
				0	0	0
0	0	0.5	0.9526	0	0	0
0	0	0.5	0.9526	0	0	0
		0.5	0.9526	0	0	0

y
0
-0.02475
0
0
-0.02594
0
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-0.027
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-0.02785
0
0
-0.02839
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-0.02858
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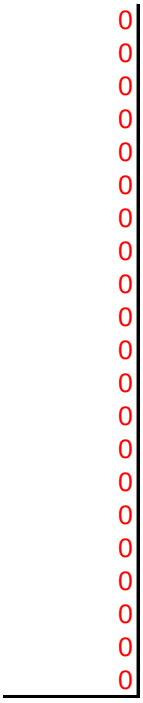
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