FACULTY OF SCIENCE AND TECHNOLOGY

BACHELOR'S THESIS

Study programme / specialisation: Geo- and energy resources	The *Spring* semester, *2023* Open / Confidential
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Thesis title: Operator bias in point counting	
Credits (ECTS): 20	
Keywords:	Pages: 27 + appendix: 51 Stavanger, *15.05.23*

Abstract

Thin section point counting is a method to acquire the mineral composition of a rock. Different errors can affect the final result. The goal of the study is to study the effects of operator bias on point counting results. Operator bias is a type of error that depends on the operator performing the thin section. The effect of this bias is not well known. Point counting of 15 different samples are done, and the result is compared with other operators. The results show large differences in point counting results. The difference is sufficient enough that the point count results cannot be used accurately. The skill of the operator is a determining factor. The bias is mostly in misidentification of quartz and feldspar. Lithic fragments were difficult to identify for most of the operators. Other factors such as staining of thin sections did not greatly affect the bias. The effect of operator bias is great enough that results from different operators cannot be reliably compered to each other.

Introduction

In Petrology thin section analysis by point counting is a method of acquiring the amount of different mineral components in a sample (Chayes, 1956). From this the normalized values for quartz, feldspar and lithic fragments are found. This is useful when classifying sandstone samples. Classification diagrams are ternary diagrams used to display the normalized values for main components. These diagrams can classify sandstone based on composition for example McBride (1963). Diagram from Dickinson (1985) uses the composition to identify the tectonic provenance.

Errors in point counting, results in inaccurate compositions and can affect the classification of the sample if the inaccuracy is large enough. Different types of errors exist. Sampling errors are errors related to the thin section and the original rock (Bayly, 1965). The small section of the rock used for the creation of the thin section does not represent the whole rock. Other types of errors are called counting errors (Bayly, 1965). Counting errors are relative to the thin section itself and not the source rock (Chayes, 1956).

Operator error is an error related to the person performing the point counting (Demirmen, 1972). Misidentification of minerals during point counting leads to either over- or underestimations for minerals. When a thin section is point counted by multiple persons, differences in results are detected (Chayes, 1956). Studies have been conducted to test difference in method used (Ingersoll et al, 1984), and other geological and non-geological biases (Augustsson, 2021). For point counting the effect of operator bias on the result is not well known. On study (Dunkl et al, 2020) focusing on heavy minerals found that the experience of the operator was crucial for the operator bias, but not to the extent as first thought. Also, that automated methods gave better results than optical methods in polarising microscope.

The aim of this study is to get a better understanding of the operator bias in point counting. The objective is to quantify the difference in results between multiple operators. In both in terms of main components, also other components such as porosity and calcite. To investigate how the number of points counted affects the result. Also, to check if samples stained for porosity or calcite influence the bias. 15 different sandstone thin sections are to be point counted by me. These thin sections have previously been counted by between 2-9 different students. Results are taken after 200 and 400 points to investigate the difference of number of counts.

Method

Point counting was done with the help of an automatic sample mover attached to a polarising microscope. When the point under the crosshair was identified as a grain, cement, matrix, or porosity the sample was moved to the next point. The counter moved in a grid pattern. The counter ensures that the distance between points was so that the point counted area was equally represented. Results were noted down after 200 counted points. Because of this the 200 points results only covered half of the point counted area. As it kept count of every point and not number of grains, 200 and 400 points were used to reach 150 and 300 grains.

The method used for point counting is the Gazzi-Dickinson method. Grains in this method are only counted if they are of sand size, between 63 µm and 2 mm (Dickinson, 1970), grains smaller than this are counted as matrix. Chert grains are counted as quartz (Dickinson, 1970). Grains or crystals inside rock fragments that are larger than 63 µm are counted as the mineral itself and not as lithic fragments (Ingersoll et al, 1984). Grains or crystals that are a part of lithic fragments and are smaller than sand size is counted as lithic fragments. This is also true for lithic fragments, if a lithic fragment of sand size is a part of a larger lithic fragment, it is counted as the fragment in the crosshair and not as the larger fragment (Ingersoll et al, 1984).

For the students since it was there first time point counting, it is assumed that they did not use a specific method while point counting. They would instead have classified everything as it is under the crosshair. A lithic fragment would be identified as such, not depending on the crystal or grain size. This should in theory give the students a larger percentage of lithic fragments. They also made the point counts manually and used a movement of 1 mm between points. Almost all students used a matrix limit set at 20 µm.

To ensure that my results were more correct, replicate counts were made. The thin sections were counted multiple times until the results was similar to the last attempt. Special care was taken to not count the same grain more than once as this leads to inaccuracies in the uncertainty calculation (Van der Plas and Tobi, 1965). Equation 1 and 2 (Howarth, 1998) was used to calculates the upper and lower confidence bounds respectively. The uncertainty was calculated with a 95% confidence limit.

$$p(n)^u = 100\left[Beta(1-\frac{\alpha}{2}, n+1, N-n)\right] \tag{1}$$

$$p(n)_l = 100\left[1 - Beta(1-\frac{\alpha}{2}, N-n+1, n)\right] \tag{2}$$

Here p is the percentage, n is the number of grains, u is the upper confidence, l is the lower confidence, $Beta$ is the inverse beta distribution, α is the confidence limit, and N is the total number of points.

The results were plotted in ternary diagrams. To plot the uncertainty, equation 3 (Weltje, 2002) was used to find the QFL values of the six corners of the hexagonal field, using results from equation 1 and 2. A line was then plotted between these points. C in this equation is a constant value, in this case C is 100.

$$\begin{bmatrix} C - F_L - L_U & F_L & L_U \\ Q_L & C - Q_L - L_U & L_U \\ Q_L & F_U & C - Q_L - F_U \\ C - F_U - L_L & F_U & L_L \\ Q_U & C - Q_U - L_L & L_L \\ Q_U & F_L & C - Q_U - F_L \end{bmatrix} \tag{3}$$

To get a quantitative result for the difference in results equation 4 (Weltje, 2004) were used. All student results and my own results are included in the calculation. In this equation n is the main components (QFL) and k is each operator result in that sample. p is the average percentage, whilst π is k operator percentage. This gives values that are low for samples where operators agree more, with 0 being that all operator results are identical. It is possible to use the result to determine if the value is significant. This requires the count length. Due to the count length varying between operators, this equation is only used to give a relative knowledge of which samples the bias is largest.

$$V = \sum_{j=1}^{n} \sum_{i=1}^{k} \frac{(p_{ij} - \pi_i)^2}{\pi_i} \tag{4}$$

Some of the samples were stained blue for porosity and red for calcite. Samples 39650, 39653, 39654, 39656, 33302B, 33302 and 33298 was stained for both porosity and calcite. Samples 33300, 61380 and NN was only stained for porosity. As this was only checked visually with no knowledge of how the thin sections were made, it is possible that these samples were also stained for calcite. As no red stains were spotted this is only possible if there were no calcite in the samples. Samples 48743, 48744, 48745, 48746, and 48747 was not stained for either porosity or calcite.

Results

From my own point counted results (Table 1) almost all samples are classified as Subarkose according to McBride (1969) (Figure 1), except for samples 33302, 33302B and 33298. Comparing student results to mine, gives that Subarkose samples 39654, 48743, 48744 and NN are classified similarly for all operators (Figure 3). In sample 39654 one student result gives a quartz value 9% lower than the next closest result (Table 2). Sample 33302 is classified as Feldspathic litharenite, but is classified differently at 200 counted points as Sub-litharenite. Sample 33302B is classified as Sub-litharenite. This is also true for all operators. Sample 33298 is classified as Arkose, but at 200 counted points it is classified as Subarkose. Between all operators this sample is classified in 5 different ways, and no other student agreed on my result as arkose. The classification area is large, so even though samples are classified similarly the difference can be large.

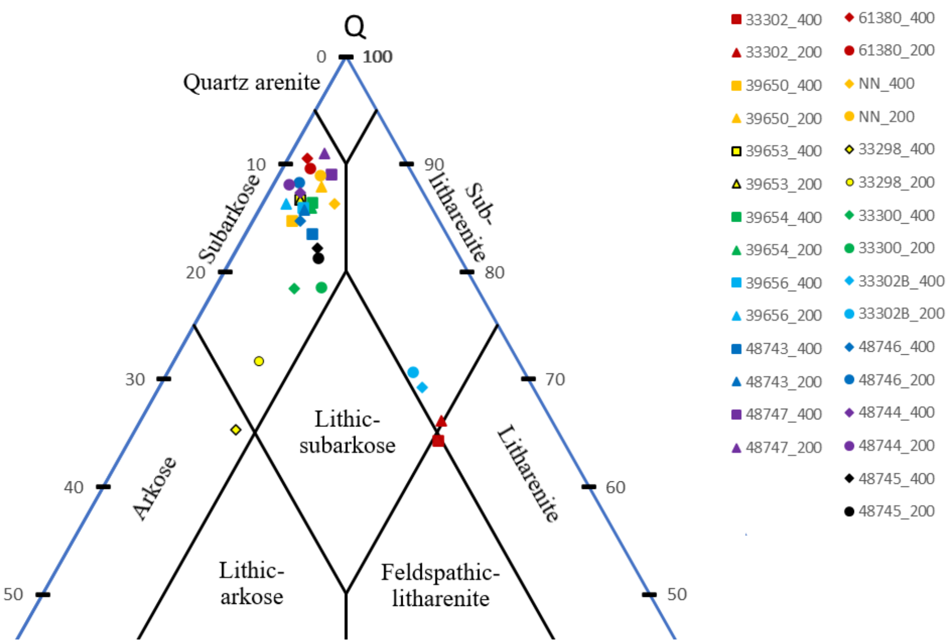


Figure 1: Classification of the thin sections, based on the classification scheme from McBride (1963).

The difference between 200 and 400 counted points is mostly low. Only in two samples they are classified differently. In sample 33302 the difference is only about 2% in quartz, and 1% in feldspar and lithic fragments (Table 1). This is about the average difference between 200 and 400 points. The only reason it classifies differently is due to it already being close to being classified as Sub-litharenite. In sample 33298 the biggest difference occurs, with a 6% difference in quartz, 5% in feldspar and 1% in lithic fragments (Table 1). The uncertainty is observed to be larger at 200 counted points.

For the students the number of counted points is not an obvious factor in the result, apart from making the uncertainty larger. All result that was counted less than 100 grains show no large differences. Of the 5 students that counted more than 300 grains, only 1 student had a result within 3% of mine in any of the main components (Table 1 and 2). The other 4 students had results 10-30% different from mine in any of the main components (Table 1 and 2).

Taking observation from the microscope gives the approximate average grains size of 120 µm for samples 48746, 33302 and 61380. Samples 48747, 33302B, 39656 and 39653 have an average grain size of 140 µm. Sample 48745 have an average grain size of 150 µm. Samples 48744, 48743, NN and 39654 have an average grain size of 160 µm. The second largest average grain size is 180 µm found in samples 33298 and 39650. The largest average grain size is 240 µm in sample 33300.

Generally, pelite is the most common lithic fragment, being found in all samples. Metapelite is the second most common lithic fragment being found in all but samples 39650 and 48744. For volcanic fragments, felsic is the most common being found in most of the samples. Mafic fragments are only found in samples 39654, 39656 and NN. Some psammite fragments are found, but no metapsammite is found. Comparing to the student metapelite is generally found less. Volcanic felsic fragments are also found less. Mafic volcanic fragments are found in more samples by the students. Naturally both psammite and metapsammite are found more by the students, due to the counting method used. Lithic percentage is overall slightly lower than my results.

Samples classified as Subarkose have mostly a lithic fragment percentage lower than 10. Most of them are lower than 5%, only samples 48743, 48745, and NN are higher than 5% and lower than 10% (Table 1). Some students in samples 39650, 39653, 39654, 39656, 48743 and 48746 found no lithic fragments (Table 2).

Sub-litharenite and Feldspathic-litharenite samples 33302B and 33302 have lithic fragment percentages of 21.7% and 25.5% respectively (Table 1). In these two samples metapelite is the most common lithic fragment. In samples 33302 and 33302B where I found the most lithic fragments, the students have found lower values. In sample 33302 the percentage is 2-4 times as low. The types of fragments vary. In these two samples only one of five students found metapelite, but a value half of mine. In Figure 2 an example of what I have identified as metapelite in sample 3302B is shown. The students in this sample have only pelite, and one student also have metapsammite.

The Arkose sample have lithic components of about 8% (Table 1). For the students it varies widely between 1% and 27%.

Table 1: Results of my point counting as quartz, feldspar, and lithic fragments in % of total grains. Lithic fragment types in % of total lithic fragments.

Sample (Number of grains)	Quartz [%]	Feldspar [%]	Lithics [%]	$L_{s, psam}$ [%]	$L_{s, pel}$ [%]	$L_{v, felsic}$ [%]	$L_{v, mafic}$ [%]	$L_{m, psam}$ [%]	$L_{m, pel}$ [%]
39650 (307)	84.7 +3.8/-4.5	12.1 +4.2/-3.4	3.3 +2.7/-1.7	0	60	40	0	0	0
39650 (148)	87.8 +4.8/-6.4	8.1 +5.6/-3.8	4.1 +4.6/-2.6	0	50	50	0	0	0
39653 (278)	86.7 +3.8/-4.6	10.4 +4.2/-3.3	2.9 +2.7/-1.6	12.5	50	25	0	0	12.5
39653 (135)	86.7 +5.2/-6.9	10.4 +6.4/-4.6	3.0 +4.4/-2.1	0	75	25	0	0	0
39654 (293)	86.3 +3.7/-4.5	9.6 +4.0/-3.1	4.1 +2.9/-2.0	16.7	25	25	8.3	0	25
39654 (142)	85.9 +5.3/-6.8	9.9 +6.1/-4.6	4.2 +4.7/-2.7	33.3	16.7	33.3	0	0	16.7
39656 (284)	85.9 +3.8/-4.6	10.6 +4.2/-3.3	3.5 +2.9/-1.8	0	40	30	10	0	20
39656 (153)	86.3 +5.0/-6.5	11.8 +6.2/-4.6	2.0 +3.7/-1.6	0	0	66.7	0	0	33.3
48743 (272)	83.5 +4.2/-5.0	11.0 +4.3/-3.5	5.5 +3.4/-2.4	0	46.7	33.3	0	0	20
48743 (133)	85.7 +5.5/-7.1	10.5 +6.5/-4.7	3.8 +4.8/-2.5	0	20	60	0	0	20
48744 (307)	87.3 +3.5/-4.3	10.1 +3.9/-3.1	2.6 +2.5/-1.5	0	100	0	0	0	0
48744 (151)	88.1 +4.7/-6.3	10.6 +6.0/-4.4	1.3 +3.4/-1.2	0	100	0	0	0	0
48745 (303)	82.2 +4.1/-4.8	11.2 +4.1/-3.3	6.6 +3.4/-2.5	0	45	15	0	0	40
48745 (154)	81.2 +5.8/-7.1	11.7 +6.2/-4.6	7.1 +5.3/-3.5	0	27.3	27.3	0	0	45.4
48746 (281)	84.7 +4.0/-4.8	11.4 +4.3/-3.5	3.9 +3.0/-1.9	0	36.4	9.1	0	0	54.5
48746 (145)	88.3 +4.7/-6.4	9,7 +6.0/-4.3	2.1 +3.9/-1.6	0	66.7	0	0	0	33.3

Sample (Number of grains)	Quartz [%]	Feldspar [%]	Lithics [%]	$L_{s, psam}$ [%]	$L_{s, pel}$ [%]	$L_{v, felsic}$ [%]	$L_{v, mafic}$ [%]	$L_{m, psam}$ [%]	$L_{m, pel}$ [%]
48747 (301)	89.0 +3.3/-4.1	6.6 +3.4/-2.5	4.3 +3.0/-2.0	7.7	61.5	7.7	0	0	23.1
48747 (144)	91.0 +4.1/-5.9	6.3 +5.3/-3.4	2.8 +4.2/-2.0	0	100	0	0	0	0
33300 (306)	78.4 +4.5/-5.0	15.0 +4.5/-3.8	6.5 +3.4/-2.5	5	35	5	0	0	55
33300 (149)	78.5 +6.3/-7.5	12.8 +6.4/-4.9	8.7 +5.7/-4.0	7.7	46.2	7.7	0	0	38.5
33302 (243)	64.2 +6.0/-6.4	10.3 +4.5/-3.5	25.5 +6.0/-5.4	1.6	11.3	9.7	0	0	77.4
33302 (121)	66.1 +8.4/-9.2	9.1 +6.6/-4.5	24.8 +8.7/-7.4	3.3	13.3	10	0	0	73.3
33302B (276)	69.2 +5.4/-5.8	9.1 +4.0/-3.1	21.7 +5.3/-4.7	0	8.3	3.3	0	0	88.3
33302B (143)	70.6 +7.3/-8.2	9.1 +6.0/-4.2	20.3 +7.5/-6.3	0	13.8	3.4	0	0	82.8
33298 (288)	65.3 +5.5/-5.8	26.4 +5.5/-5.0	8.3 +3.8/-2.9	0	25	8.3	0	0	66.7
33298 (141)	71.6 +7.3/-8.2	21.3 +7.7/-6.4	7.1 +5.6/-3.6	0	50	10	0	0	40
61380 (285)	90.5 +3.8/-5.1	7.9 +4.8/-3.4	1.6 +3.0/-1.3	0	66.7	0	0	0	33.3
61380 (86)	89.5 +5.6/-8.5	8.1 +7.9/-4.8	2.3 +5.8/-2.0	0	100	0	0	0	0
NN (285)	86.3 +3.8/-4.5	7.7 +3.7/-2.8	6.0 +3.4/-2.5	17.6	47.1	17.5	5.9	0	11.8
NN (144)	88.9 +4.6/-6.3	7.6 +5.6/-3.8	3.5 +4.4/-2.3	20	40	20	0	0	20

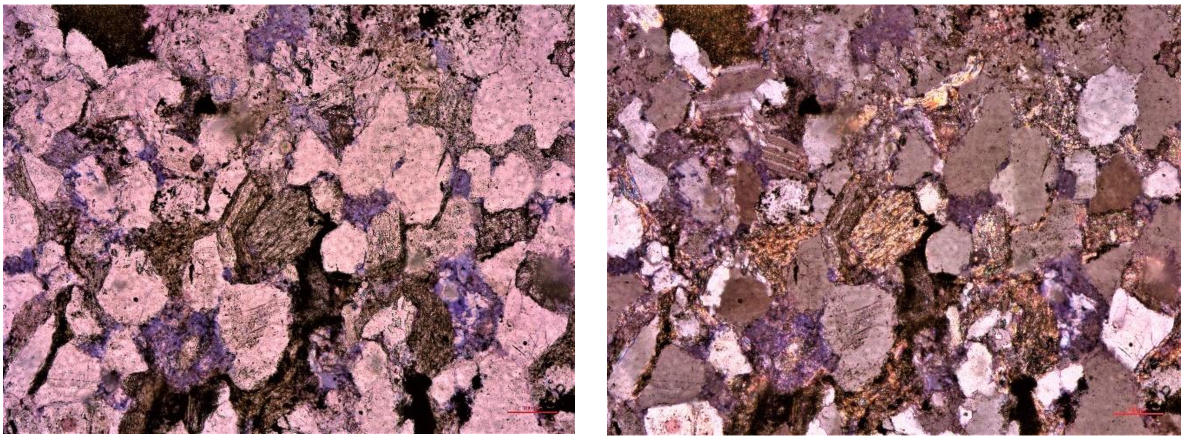


Figure 2: Metapelite fragment in sample 33302B. The magnification is 10x and the scale bar is in 50 μm.

Most often when the quartz value is different the percentage is mostly made up by a change in feldspar content. The worst examples of this are differences of 10-25% lower quartz values, with similar higher values in feldspar. This occurs in Subarkose samples 61380, all off 3965X, 48746 and 48747 (Table 2). A degree of this misidentification is occurring in all samples. I Arkose sample 33298 the only occurrence of 0% feldspar in one of the students result appears (Table 2).

On occasion the change is made up mostly by lithic fragments and not feldspar. In sample 33300 one of the students result the quartz value is 58.1% and the lithic fragments value is 38.8% (Table 2). Compared to the other students and my results these values are significantly different, which are at about 77% quartz and 6% lithic fragments (Table 1 and 2). The feldspar value is also the lowest value of any of the results in the sample. Something similar is also seen in one result in sample 33298. In these samples the polycrystalline quartz values are on average lower than for the other operators (Appendix 2). One student in each sample also had a lower or similar polycrystalline quartz percentages than the other students and my result, but did not have low quartz and high lithic fragment percentages. This student result in sample 33300 the lithic components were 80% metapsammite and 20% psammite (Table 2). In sample 33298 the specific student result the lithic components were 65% pelite and 25% psammite, and some metapsammite and metapelite (Table 2).

Table 2: Student results from point counting as quartz, feldspar, and lithic fragments in % of total grains. Lithic fragment types in % of total lithic fragments.

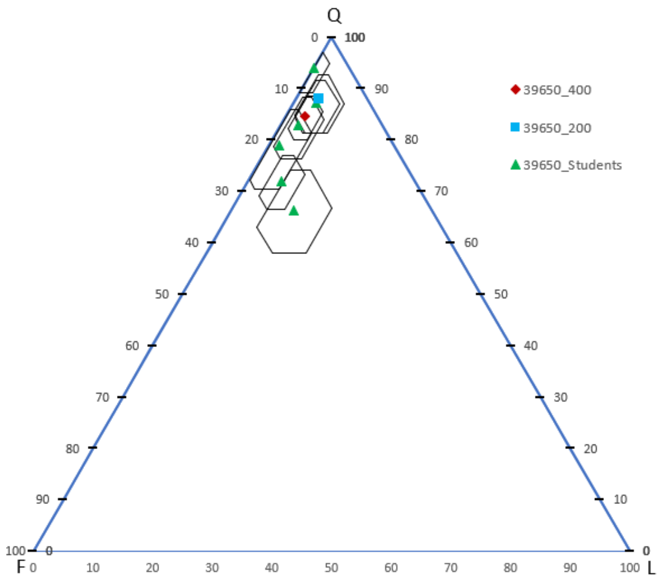
Sample (Number of grains)	Quartz [%]	Feldspar [%]	Lithics [%]	$L_{s,psam}$ [%]	$L_{s,pel}$ [%]	$L_{v,felsic}$ [%]	$L_{v,mafic}$ [%]	$L_{m,psam}$ [%]	$L_{m,pel}$ [%]
33298 (134)	82.8 +6.0/-7.5	11.9 +6.7/-5.0	5.2 +5.2/-3.1	0	14.3	14.3	0	0	71.4
33298 (322)	63.4 +5.3/-5.5	9.6 +3.8/-3.0	27.0 +5.2/-4.8	25.3	65.5	0	0	4.6	4.6
33298 (168)	91.7 +3.7/-5.3	0.0 +2.2/-0	8.3 +5.3/-3.7	0	42.9	0	0	0	57.1
33298 (237)	67.9 +5.9/-6.4	16.5 +5.3/-4.5	15.6 +5.3/-4.4	5.4	75.7	0	0	19.0	0
33298 (182)	78.6 +5.7/-6.7	20.3 +6.6/-5.6	1.1 +2.8/-1.0	100	0	0	0	0	0
33298 (115)	78.3 +7.1/-8.7	17.4 +8.2/-6.4	4.3 +5.5/-2.9	0	0	100	0	0	0
33300 (86)	76.7 +8.4/-10.4	17.4 +9.7/-7.3	5.8 +7.2/-3.9	100	0	0	0	0	0
33300 (151)	80.8 +5.9/-7.2	15.2 +6.7/-5.3	4.0 +4.5/-2.5	100	0	0	0	0	0
33300 (300)	73.7 +4.9/-5.4	17.7 +4.8/-4.1	8.7 +3.8/-2.9	0	3.8	0	0	50	46.2
33300 (160)	58.1 +7.7/-6.8	3.1 +4.0/-2.1	38.8 +8.0/-7.6	19.4	0	0	0	80.6	0
33302 (98)	76.5 +8.0/-9.6	17.3 +9.0/-6.9	6.1 +6.7/-3.8	100	0	0	0	0	0
33302 (144)	79.2 +6.3/-7.6	7.6 +5.6/-3.8	13.2 +6.6/-5.1	0	57.9	0	0	0	42.1
33302B (180)	77.8 +5.8/-6.8	7.8 +4.9/-3.5	14.4 +6.0/-4.8	0	100	0	0	0	0
33302B (177)	74.6 +6.2/-7.1	5.6 +4.5/-2.9	19.8 +7.7/-6.4	0	100	0	0	0	0
33302B (137)	74.5 +7.1/-8.2	5.1 +5.1/-3.0	20.4 +7.7/-6.4	0	39.3	0	0	80.7	0

Sample (Number of grains)	Quartz [%]	Feldspar [%]	Lithics [%]	$L_{s, psam}$ [%]	$L_{s, pel}$ [%]	$L_{v, felsic}$ [%]	$L_{v, mafic}$ [%]	$L_{m, psam}$ [%]	$L_{m, pel}$ [%]
39650 (170)	82.9 +5.3/-6.5	14.1 +6.2/-4.9	2.9 +3.8/-2.0	0	60	0	40	0	0
39650 (180)	87.2 +4.5/-5.8	8.9 +5.1/-3.7	3.9 +4.0/-2.3	14.3	14.3	28.6	42.9	0	0
39650 (300)	72.0 +5.0/-5.4	22.3 +5.1/-4.6	5.7 +3.3/-2.3	0	47.1	5.9	0	47.1	0
39650 (167)	94.0 +3.1/-4.7	6.0 +4.7/-3.1	0.0 +2.2/-0	0	0	0	0	0	0
39650 (143)	66.4 +7.7/-8.4	23.1 +7.8/-6.6	10.5 +6.2/-4.5	33.3	0	6.7	26.7	0	33.3
39650 (119)	79.0 +6.9/-8.4	19.3 +8.2/-6.7	1.7 +4.3/-1.5	0	0	0	100	0	0
39653 (181)	76.2 +6.0/-6.9	21.0 +6.7/-5.7	2.8 +3.6/-1.9	0	60	0	0	40	0
39653 (69)	88.4 +6.5/-10.0	11.6 +10.0/-6.5	0.0 +5.2/-0	0	0	0	0	0	0
39653 (266)	92.1 +2.9/-3.9	4.9 +3.3/-2.3	3.0 +2.8/-1.7	0	100	0	0	0	0
39653 (109)	90.8 +4.7/-7.1	9.2 +7.1/-4.7	0.0 +3.3/-0	0	0	0	0	0	0
39653 (193)	63.7 +6.8/-7.2	33.2 +7.1/-6.6	3.1 +3.5/-2.0	83.3	0	0	0	16.7	0
39653 (122)	79.5 +6.8/-8.3	15.6 +7.7/-5.9	4.9 +5.5/-3.1	50	16.7	0	0	33.3	0
39653 (157)	83.4 +5.4/-6.8	14.6 +6.5/-5.1	1.9 +3.6/-1.5	33.3	0	0	0	66.7	0
39653 (162)	73.5 +6.6/-7.5	19.1 +6.9/-5.7	7.4 +5.2/-3.5	16.7	0	0	0	33.3	50
39653 (176)	80.7 +5.6/-6.6	18.8 +6.6/5.5	0.6 +2.6/-0.6	0	0	0	100	0	0

Sample (Number of grains)	Quartz [%]	Feldspar [%]	Lithics [%]	$L_{s, psam}$ [%]	$L_{s, pel}$ [%]	$L_{v, felsic}$ [%]	$L_{v, mafic}$ [%]	$L_{m, psam}$ [%]	$L_{m, pel}$ [%]
39654 (150)	85.3 +5.2/-6.7	12.7 +6.4/-4.9	2.0 +3.7/-1.6	0	66.7	0	33.3	0	0
39654 (301)	69.1 +5.2/-5.6	23.9 +5.2/-4.7	7.0 +3.5/-2.6	38.1	23.8	9.5	0	28.6	0
39654 (150)	93.3 +3.4/-5.3	6.0 +5.1/-3.2	0.7 +3.0/-0.6	0	0	0	100	0	0
39654 (155)	90.3 +4.2/-5.8	9.7 +5.8/-4.2	0.0 +2.4/-0	0	0	0	0	0	0
39654 (196)	89.3 +4.0/-5.2	8.2 +4.8/-3.4	2.6 +3.3/1.7	0	20	60	0	0	20
39654 (149)	77.9 +6.4/-7.5	20.1 +7.3/-6.1	2.0 +3.8/-1.6	0	0	0	100	0	0
39654 (101)	86.1 +6.1/-8.3	11.9 +8.0/-5.6	2.0 +5.0/-1.7	0	0	0	50	0	50
39654 (164)	80.5 +5.8/-6.9	14.0 +6.3/-4.9	5.5 +4.7/-2.9	55.6	33.3	0	0	0	11.1
39654 (173)	81.5 +5.5/-6.6	16.2 +6.4/-5.2	2.3 +3.5/-1.7	25	50	0	25	0	0
39656 (227)	92.5 +3.1/-4.2	5.3 +3.8/-2.5	2.2 +2.9/-1.5	0	60	20	20	0	0
39656 (294)	76.2 +4.8/-5.3	17.7 +4.9/-4.2	6.1 +3.4/-2.5	61.1	5.6	0	0	0	33.3
39656 (150)	91.3 +4.0/-5.7	8.7 +5.7/-4.0	0.0 +2.4/-0	0	0	0	0	0	0
39656 (104)	92.3 +4.3/-6.9	7.7 +6.9/-4.3	0.0 +3.5/-0	0	0	0	0	0	0
39656 (163)	92.0 +3.7/-5.3	4.3 +4.4/-2.6	3.7 +4.2/-2.3	33.3	66.7	0	0	0	0
48743 (242)	80.2 +4.8/-5.6	18.2 +5.4/-4.6	1.7 +2.5/-1.2	0	0	100	0	0	0
48743 (150)	86.7 +5.0/-6.5	13.3 +6.5/-5.0	0.0 +2.4/-0	0	0	0	0	0	0

Sample (Number of grains)	Quartz [%]	Feldspar [%]	Lithics [%]	$L_{s, psam}$ [%]	$L_{s, pel}$ [%]	$L_{v, felsic}$ [%]	$L_{v, mafic}$ [%]	$L_{m, psam}$ [%]	$L_{m, pel}$ [%]
48743 (225)	74.7 +5.5/-6.2	16.9 +5.5/-4.7	8.4 +4.4/-3.3	47.4	21.1	0	5.3	0	26.3
48743 (212)	76.9 +5.5/-6.3	17.0 +5.7/-4.8	6.1 +4.1/-2.8	7.7	7.7	61.5	0	7.7	15.4
48743 (287)	82.6 +4.2/-4.9	14.6 +4.6/-3.9	2.8 +2.6/-1.6	0	0	62.5	12.5	0	25
48744 (202)	82.2 +5.0/-6.0	9.9 +5.0/-3.7	7.9 +4.6/-3.3	6.3	6.3	0	18.8	50	18.8
48744 (199)	82.4 +5.0/-6.0	17.1 +6.0/-5.0	0.5 +2.3/-0.5	0	100	0	0	0	0
48744 (168)	86.3 +4.8/-6.1	11.3 +5.8/-4.4	2.4 +3.6/-1.7	0	0	75	0	25	0
48744 (250)	76.0 +5.2/-5.8	16.8 +5.2/-4.4	7.2 +3.9/-2.9	16.7	11.1	0	11.1	16.7	44.4
48745 (164)	86.6 +4.8/-6.2	12.8 +6.1/-4.7	0.6 +2.7/-0.6	0	0	0	100	0	0
48745 (150)	88.0 +4.7/-6.3	8.0 +5.6/-3.8	4.0 +4.5/-2.5	0	100	0	0	0	0
48745 (150)	96.7 +2.2/-4.3	3.3 +4.3/-2.2	0.0 +2.4/-0	0	0	0	0	0	0
48745 (152)	80.3 +6.0/-7.2	8.6 +5.6/-3.9	11.2 +6.1/-4.5	0	5.9	76.5	17.6	0	0
48745 (297)	80.5 +4.4/-5.0	14.5 +4.5/-3.8	5.1 +3.1/-2.2	20	13.3	0	0	40	26.7
48745 (149)	92.6 +3.6/-5.4	6.7 +5.3/-3.4	0.7 +3.0/-0.7	0	0	0	100	0	0
48746 (150)	91.3 +4.0/-5.7	8.7 +5.7/-4.0	0.0 +2.4/-0	0	0	0	0	0	0
48746 (202)	75.7 +5.7/-6.5	19.8 +6.2/-5.3	4.5 +3.8/-2.4	0	44.4	0	0	55.6	0
48746 (191)	71.2 +6.3/-7.0	28.3 +7.0/-6.3	0.5 +2.4/-0.5	0	0	0	100	0	0

Sample (Number of grains)	Quartz [%]	Feldspar [%]	Lithics [%]	$L_{s, psam}$ [%]	$L_{s, pel}$ [%]	$L_{v, felsic}$ [%]	$L_{v, mafic}$ [%]	$L_{m, psam}$ [%]	$L_{m, pel}$ [%]
48746 (154)	85.7 +5.1/-6.5	13.0 +6.4/-4.9	1.3 +3.3/-1.1	50	0	50	0	0	0
48746 (185)	82.7 +5.2/-6.2	4.9 +4.2/-2.6	12.4 +5.6/-4.4	0	52.2	0	0	26.1	21.7
48746 (200)	77.0 +5.6/-6.5	12.5 +5.4/-4.2	10.5 +5.1/3.9	23.8	4.8	0	28.6	33.3	9.5
48747 (200)	95.0 +2.6/-4.0	3.5 +3.6/-2.1	1.5 +2.8/-1.2	0	0	0	100	0	0
48747 (183)	88.0 +4.3/-4.0	10.4 +5.4/-4.0	1.6 +3.1/-1.3	0	66.7	33.3	0	0	0
48747 (219)	67.6 +6.2/-6.6	20.5 +6.0/-5.1	11.9 +5.0/-4.0	0	30.8	0	0	0	69.2
61380 (97)	86.6 +6.1/-8.4	11.3 +8.0/-5.5	2.1 +5.2/-1.8	0	0	0	0	100	0
61380 (343)	57.4 +5.3/-5.4	42.0 +5.4/-5.3	0.6 +1.5/-0.5	0	0	0	0	100	0
NN (154)	77.9 +6.3/-7.4	13.0 +6.4/-4.9	9.1 +5.7/-4.0	14.3	50	7.1	28.6	0	0
NN (151)	88.7 +4.6/-6.2	7.3 +5.4/-3.6	4.0 +4.5/-2.5	16.7	66.7	0	0	16.7	0


Q
F
L
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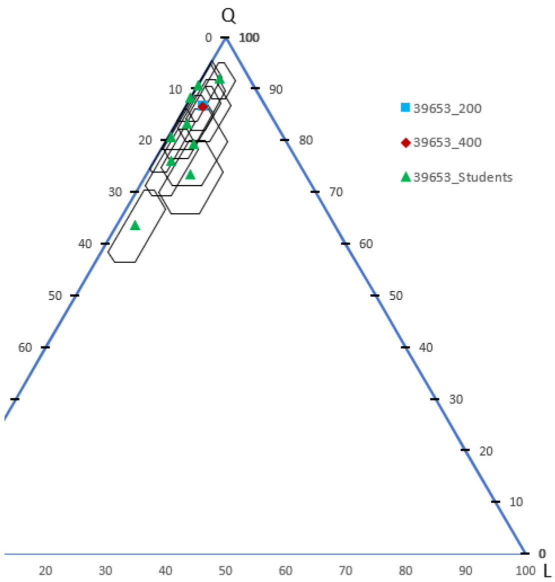
39650_200
39650_Students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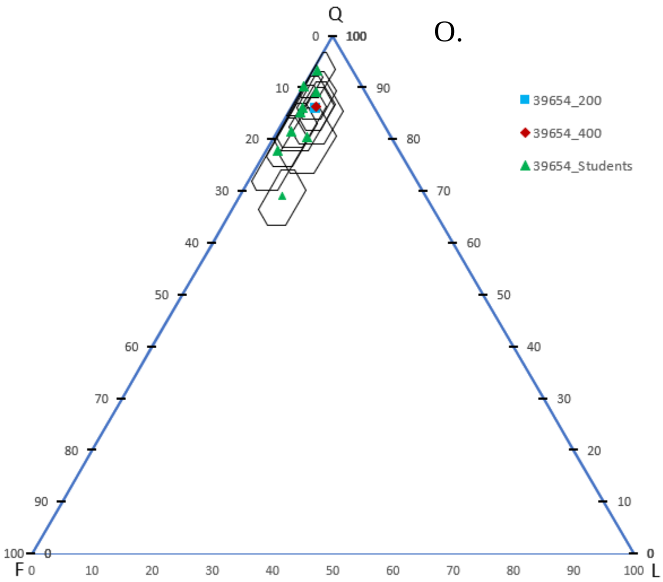
L
39653_200
39653_400
39653_Students

O.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F
L
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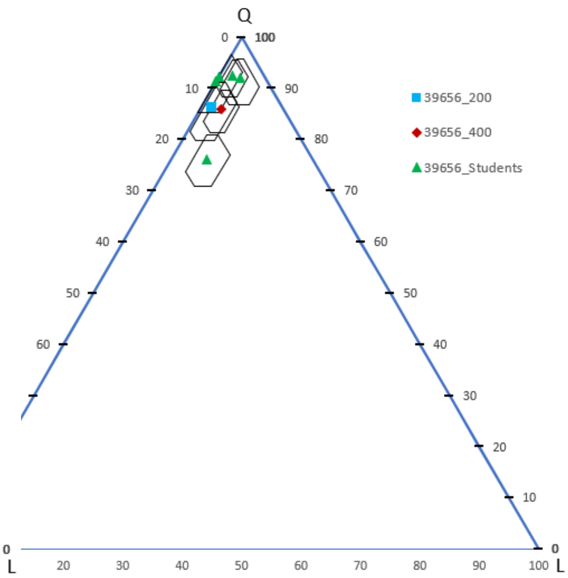
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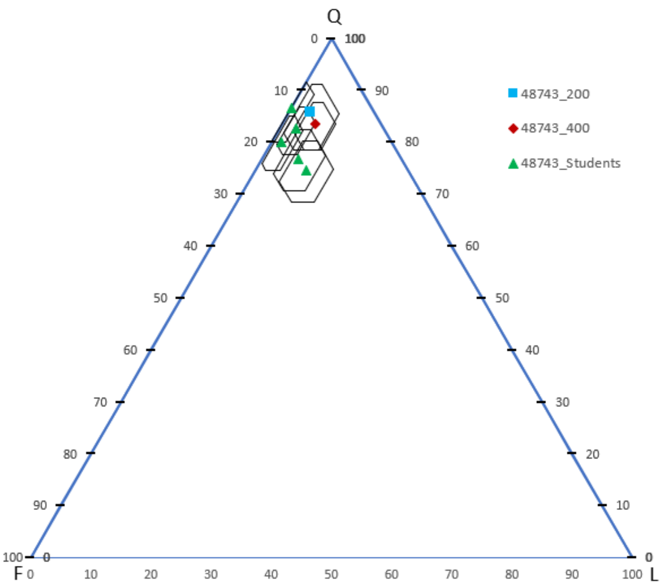
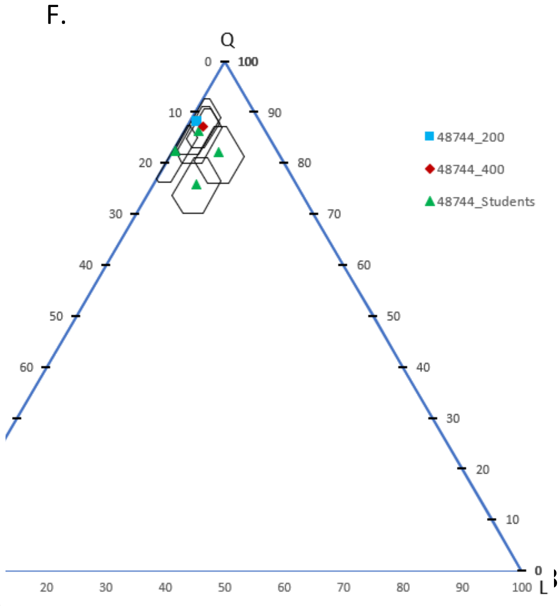
L
39656_200
39656_400
39656_Students

E.


Q
F
L
48743_200
48743_400
48743_Students

F.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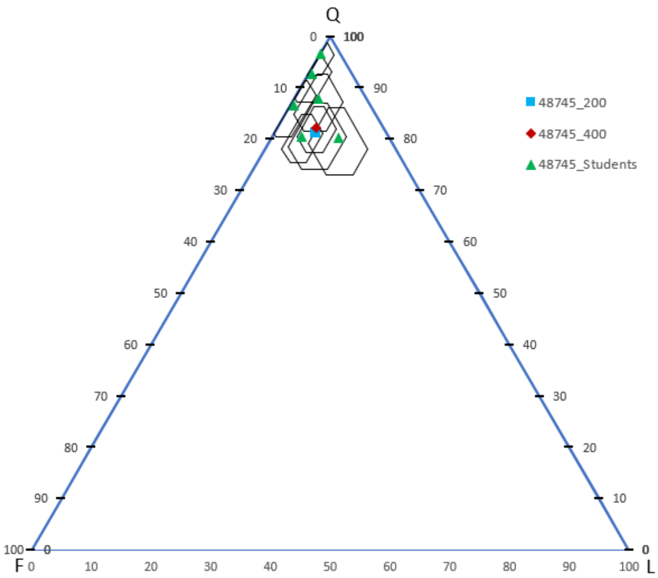
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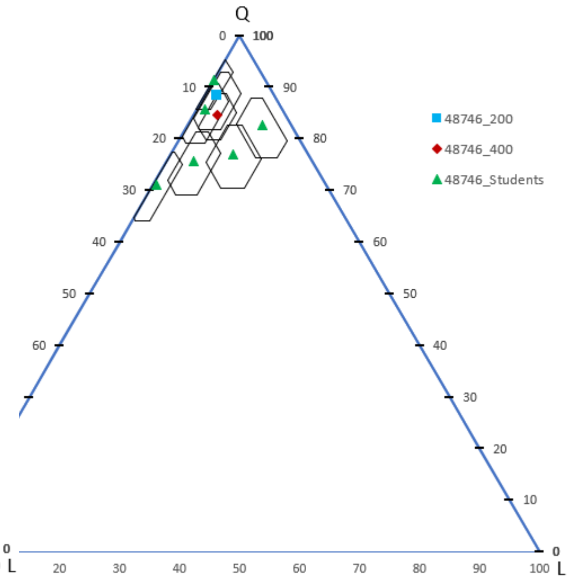
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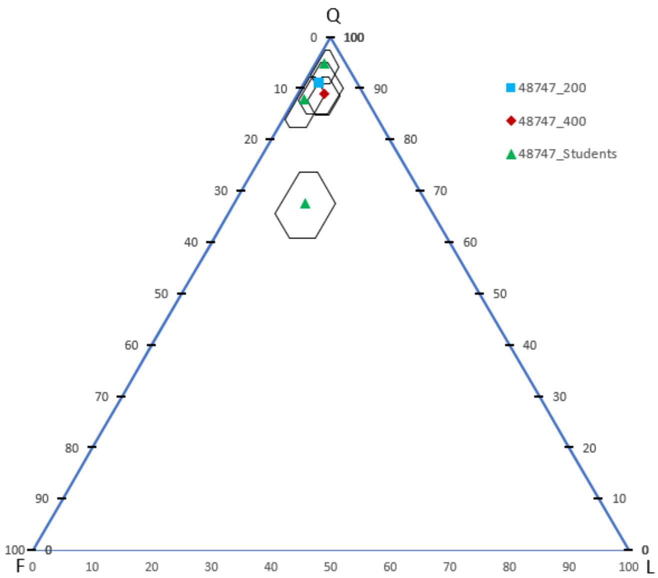
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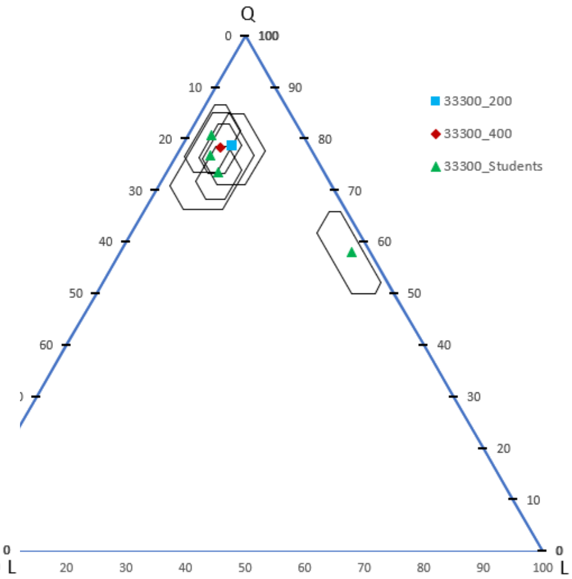
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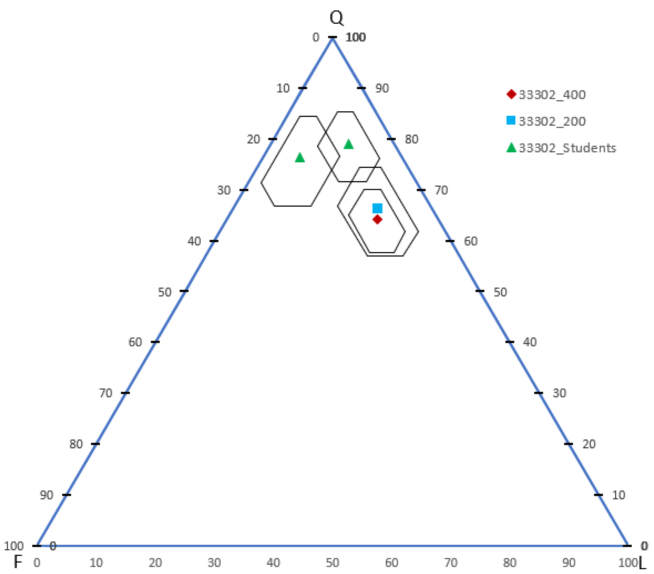
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F
L
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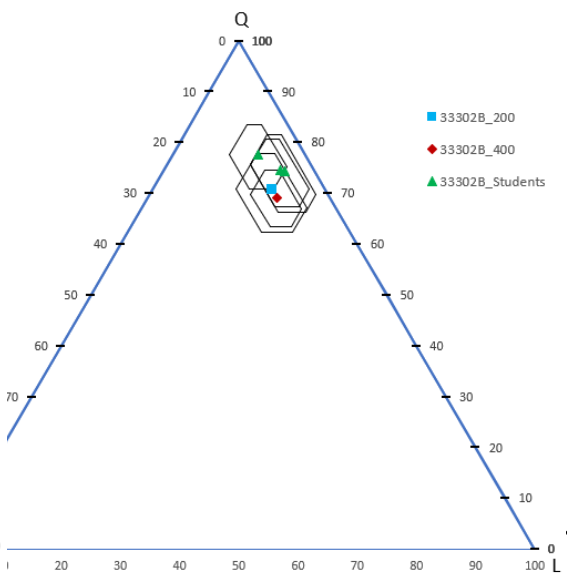
33302_200
33302_Students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L
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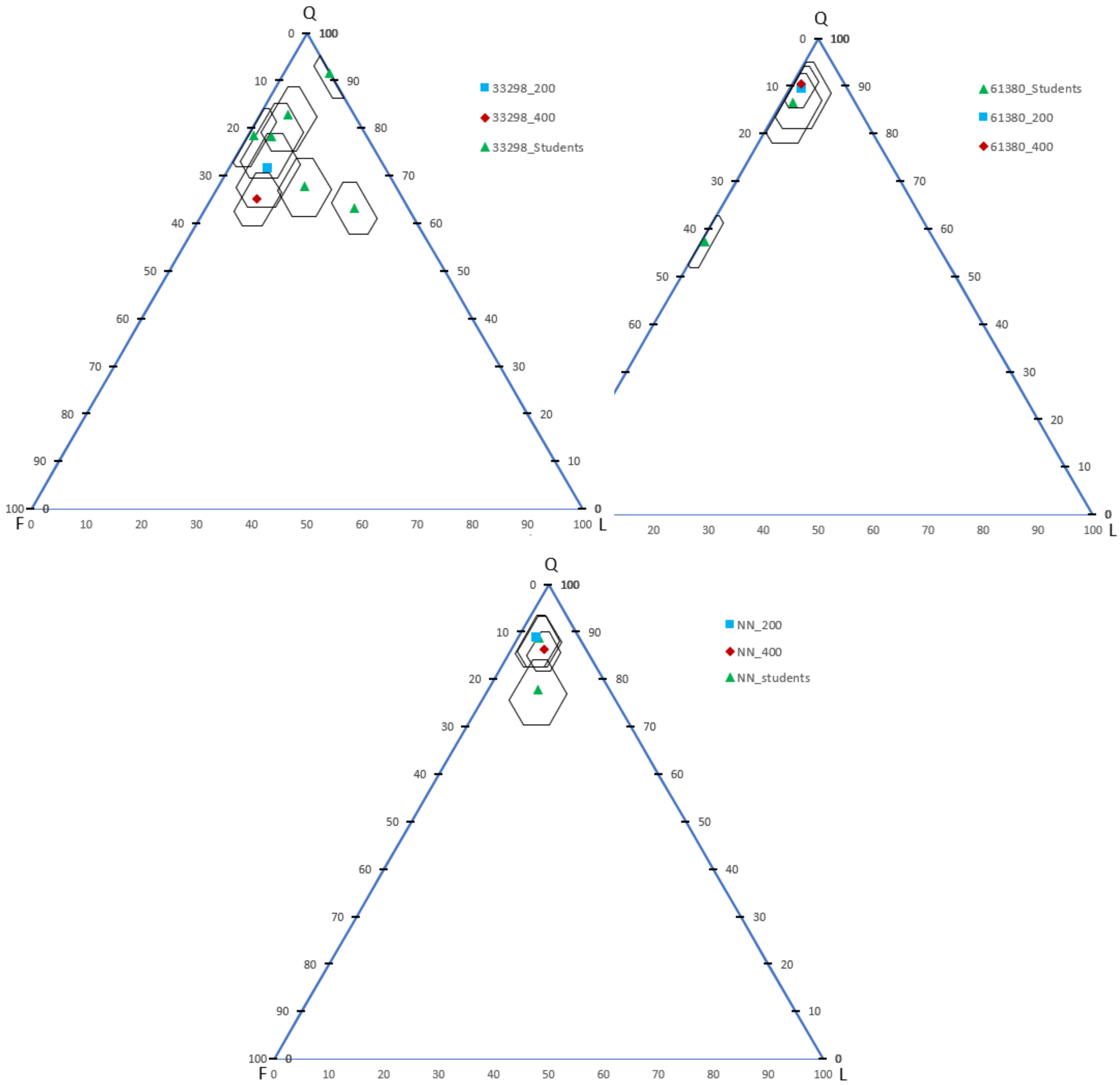
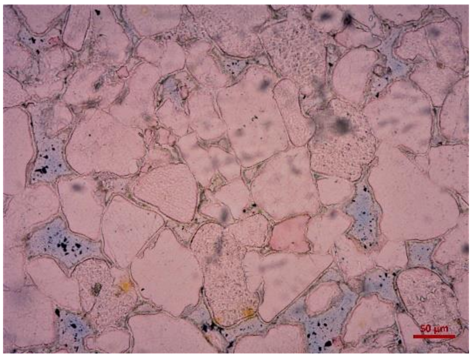
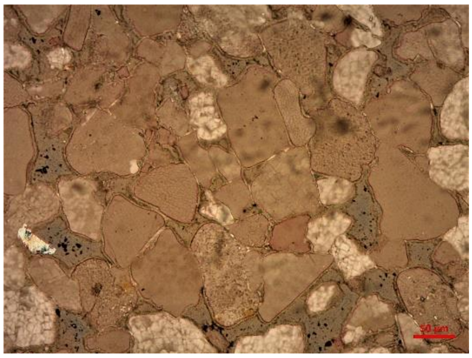


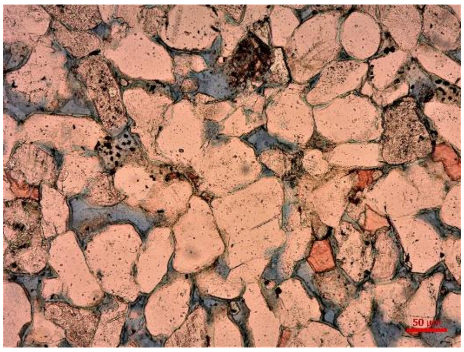
Figure 3: QFl diagrams displaying my results after both 200 and 400 points, and all student results.

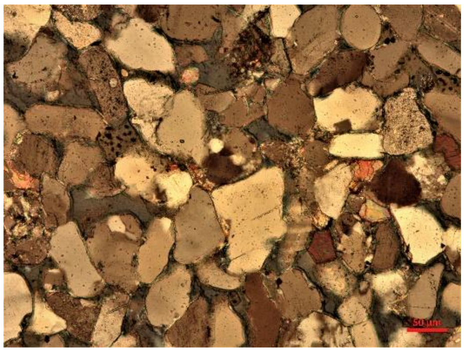
39650



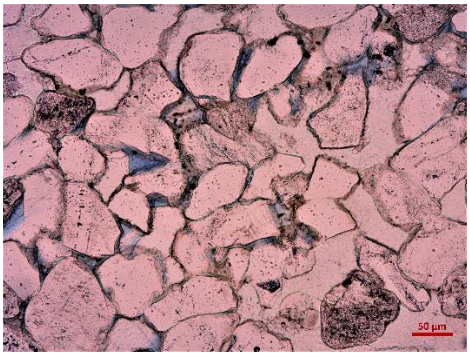


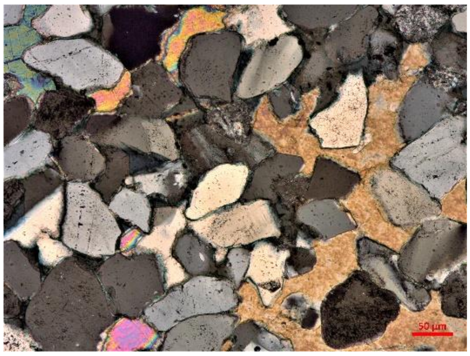
39653



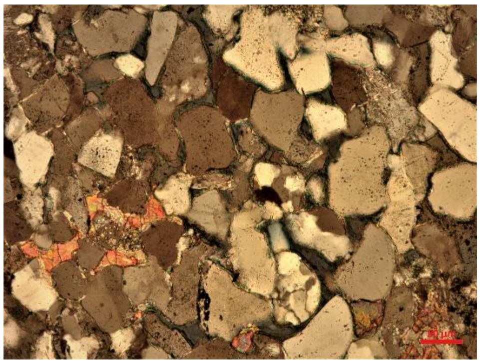


39654

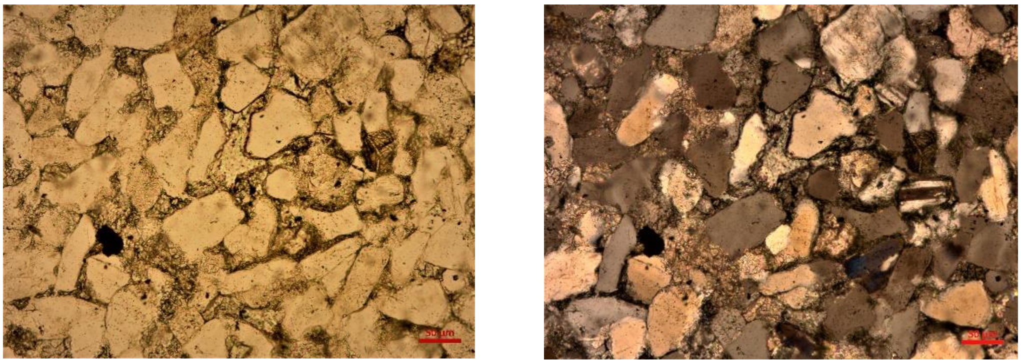




39656



48743



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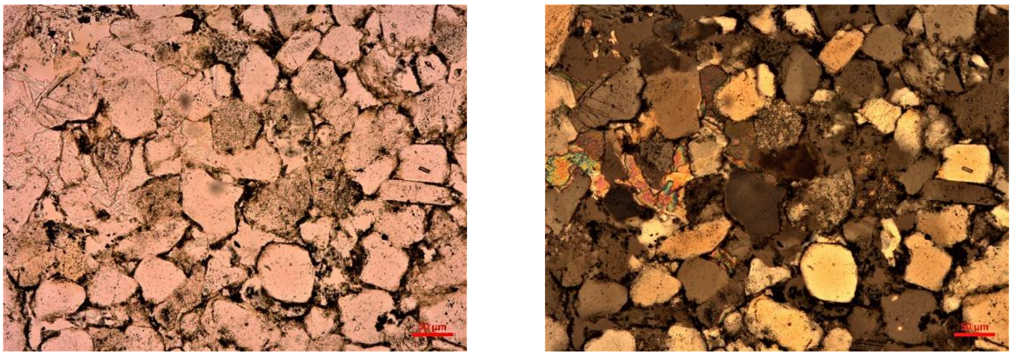

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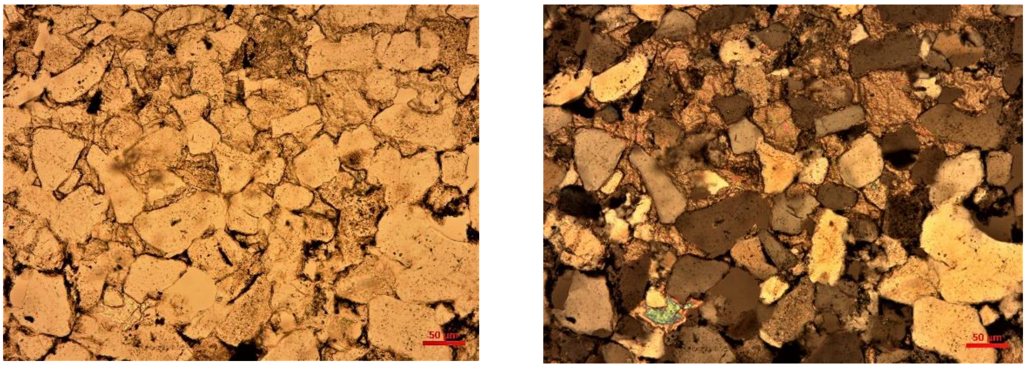

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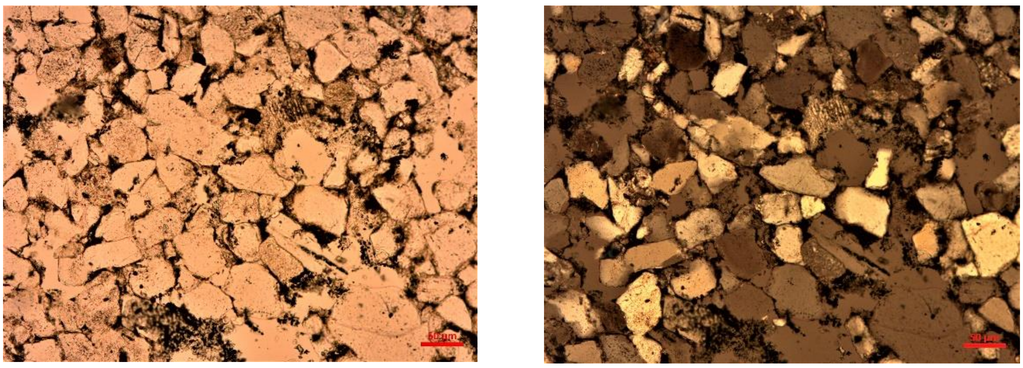

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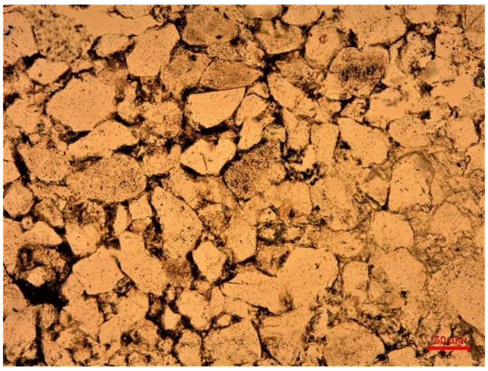
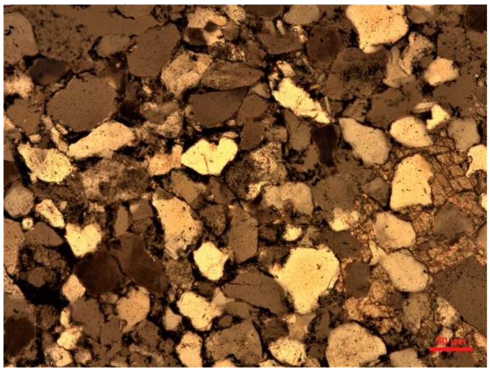
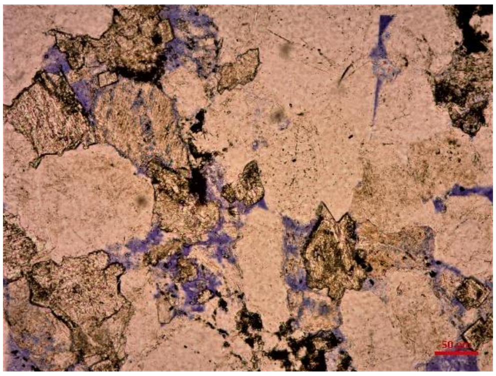
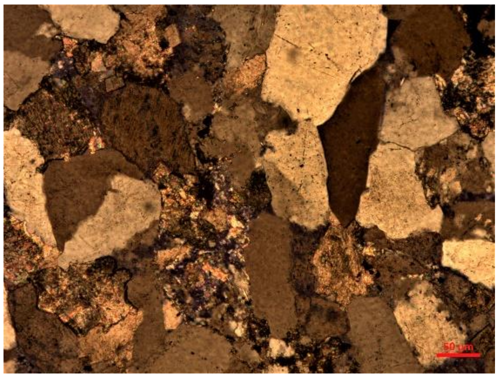


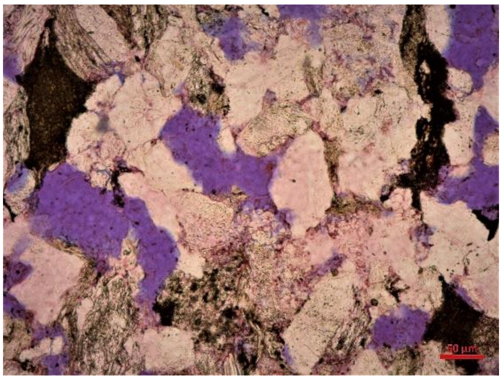


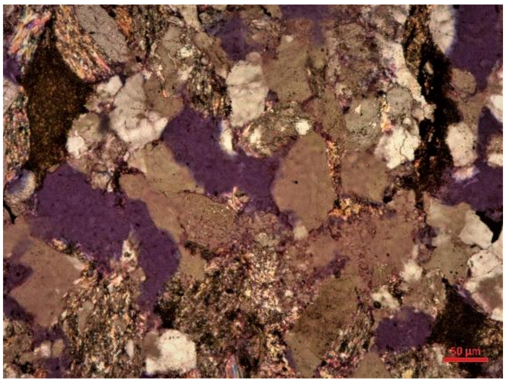
33300



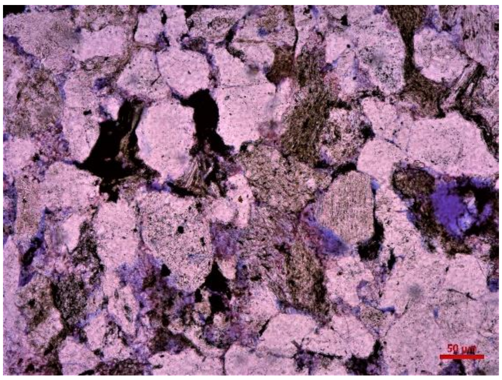


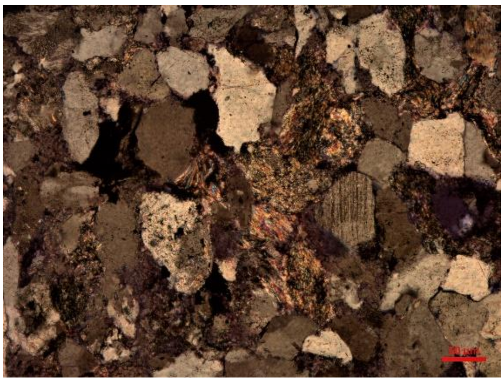
33302





33302B





33298

61380

NN

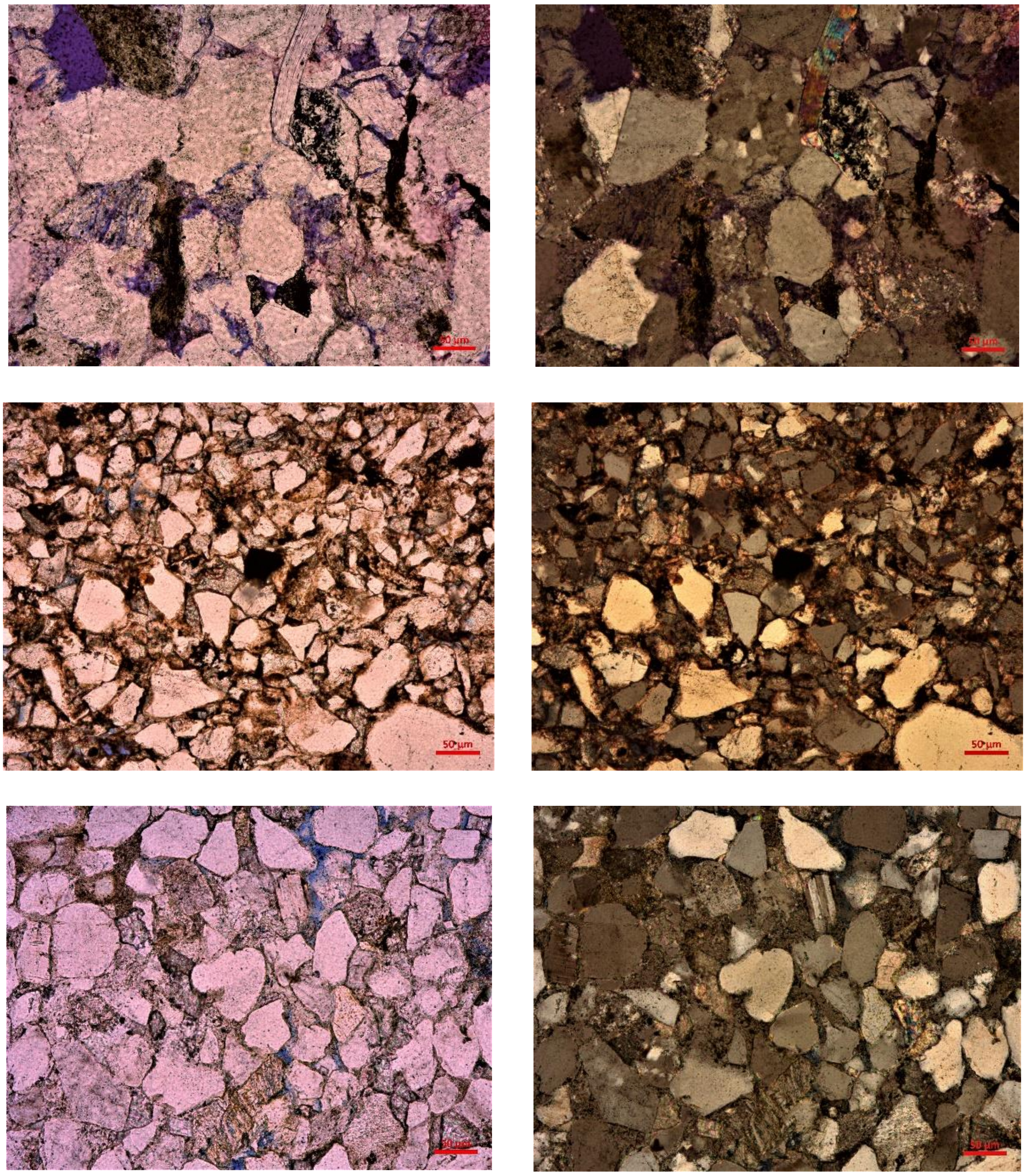


Figure 4: Pictures of every thin section taken in a microscope. In both plane polarised and cross polarised light. Picture are taken with 10x magnification, and the scale bar reads 50 µm.

Sample 61380 has the largest local changes in thin section. It shows local differences in composition. It’s observed that grain size, hematite cement and porosity changes in an area that covers approximately 20% of the thin section (Figure 4). This is the sample with the most obvious local differences. Other local differences are observed in the 3965X series of samples, showing areas of increased cementation (Figure 4).

Table 3: Compositional variability calculated for main components, cement, porosity and calcite cement.

Sample	Compositional variability			
	Main components	Cement	Porosity	Calcite cement
33302B	0.036	0.193	0.045	0.057
NN	0.050	0.007	0.003	0.006
48744	0.152	0.040	0.033	0.117
33302	0.189	0.003	0.002	0.010
48743	0.202	0.130	0.069	0.133
39656	0.260	0.102	0.090	0.004
48747	0.358	0.051	0.103	0.001
48745	0.365	0.134	0.067	0.219
39650	0.411	0.206	0.178	0.091
39654	0.409	0.245	0.153	0.083
61380	0.437	0.025	0.008	0.056
48746	0.600	0.109	0.031	0.031
39653	0.615	0.217	0.458	0.243
33300	0.822	0.117	0.097	0.047
33298	0.839	0.187	0.096	0.053

The compositional variability is best in Sub-litharenite and Feldspathic-litharenite samples. The Arkose sample has the least consistent results between operators. Subarkose samples varies and has both some of the most consistent but also some of the least consistent results between operators (Table 3). Using the main components percentages (Table 1) with the compositional variability (Table 4) indicates that on average the topmost homogenous samples have higher lithic components and less feldspar. Quartz percentages are similar between the top half and bottom half.

The calculation is also done on cement, porosity and calcite. Samples with the most similar cement results are 33302 and NN. The least similar are samples 39654, 39653 and 39650. For porosity the most similar are NN and 61380, the least are 39653. For calcite the most similar are 48747, 39656 and NN, the least are 39653 and 48745 (Table 3). Cement and porosity percentages (Appendix 1 and 2) slightly indicates that a lower percentage gives better compositional variability for main components. For calcite it is the opposite.

Calculating the average compositional variability for those samples stained and those not for both porosity and calcite gives result in Table 4.

Table 4: Mean compositional values for porosity and calcite, for samples stained and not stained.

	Stained	Not stained
Porosity	0.113	0.061
Calcite	0.077	0.076

The mean compositional values for porosity are higher for stained than unstained thin sections. This is due to the stained sample 39653 where the different in porosity are large. Porosity varies between 2 and 30% between operators in this sample (Appendix 2). If it were not for sample 39653 the mean value would be 0.075, still larger than for those not stained. For calcite the difference is insignificant.

Interpretations

The observed difference between quartz and feldspar is probably due to confusion in the identification of these two minerals. Feldspar and quartz can be difficult to distinguish, mostly when feldspar shows no twins. Without twins the identification relies on shape, colour, and relief. This is not always clear, and it is likely all operators have misidentified quartz and feldspar to a degree. Due to this the skill of the operator is a determining factor for the operator bias. This can cause the thin section to be classified differently by different operators.

Something similar was observed between polycrystalline quarts and lithic fragments in two samples. With most of the lithic components being psammite, metapsammite and pelite in these two samples, it is possible that polycrystalline quartz was misidentified as these lithic fragments by these two students.

Lithic fragment percentages for the students are generally lower than my results, this contradicts the theory that my results should have lower percentages due to the selected method. Ingersoll et al. (1984) tested the Gazzi-Dickinson method and found that it gave results with less lithic fragments, tested against a method that counted all rock fragments as such. A similar logic can be used here, due to the method used by students should result in higher lithic fragments. This means that the lower lithic fragment percentages in the student result are due to misidentification.

Count length is a factor that contributes to different results. This is partly due to local differences in the samples. This is what can have created the difference between my results after 200 and 400 points. Due to my 200-point count only covers half the area counted, local variations in the two half's gives different results. Due to the students doing the point count manually, the number of counted points determine how big of an area of the sample is counted. A lesser number of points counted would cover a smaller area of the sample and would therefore be more affected by local differences than a count with more points. The results show this in my results between 200 and 400 points. For the students counts with a low number of grains counted give no obvious negative differences in the results, apart from a larger uncertainty. Counting 300 grains should in theory give results that are more accurate than with fewer counts, as observed this is not always the case. Point counting more than 300 grains manually takes a long time. It is possible this could lead to more mistakes, due to fatigue or physiological state (Demirmen, 1972).

Stained thin sections makes it easier to identify calcite and porosity. Would have assumed this would affect the operator bias in favour of those samples stained. The results do not agree with this. As staining is supposed to help identify porosity it is curious why there is a negative difference. Possibly such factors as area counted or illite concentration in the pores could affect the results. In sample 39653 with the wide range of porosity percentages it is also uncertain why the difference is so large. This large difference is not observed in the similar 3965X series of samples. It appears that misidentification of calcite is not affected by staining, but that to some degree staining for porosity gives more operator bias for porosity.

Cement percentage affects the consistency of the main component results possibly due to it being more difficult to identify than the main components. So that a lower percentage would mean a better result for the main components. The opposite could be true for calcite. As for porosity the operators must determine if the porosity is originally from the rock or if the process of making the thin section have created holes. Therefore, some operators might count the point as porosity whilst others would skip counting that point.

Conclusions

In conclusion results from different operators can not accurately be used to determine the composition. The bias mainly lies in misidentification of quartz and feldspar. Lithic fragments and polycrystalline quartz can affect the bias in rare occurrences. Lithic fragment identification in student result seems to have been challenging, giving less percentages than in theory. These factors rely on the skill of the operator. This can lead to the thin section to be classified differently between multiple operators. Count length seams to give negative result for the students with high point counts. Also, the count length and the distance between points need to be chosen carefully to avoid local changes in the sample affecting the result. Staining of thin sections does not affect the bias in major ways, but for porosity the stained thin sections have results slightly less consistent than those unstained. Operator bias is less affected in samples with high lithic fragments and low feldspar values. Lower percentages for cement, porosity, and higher percentages for calcite cement, does to a less extent affect the operator bias in a positive way. All these factors make it so that results between multiple operators cannot reliably be used in the classification of rocks.

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Appendix 1

Tables A1-A30 are the full thin section protocol for my results, and is used in the results.

Table A1: Thin section protocol for sample 33298 after 400 points

Sample: 33298		Total Points:	400	Total Grains:	288		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	43	10,8	14,9		Q_cement	19	4,8
Quartz_m, non-undulatory	96	24,0	33,3		Calcite_cement	12	3,0
Quartz_p, 2-3	17	4,3	5,9		Carbonate_cement	15	3,8
Quartz_p, > 3	30	7,5	10,4		Anhydrite		0,0
Chert	2	0,5	0,7		Gypsum		0,0
Sum Quartz	**188**	**47,0**	**65,3**		Hematite		0,0
Plagioclase	6	1,5	2,1		Illite		0,0
Alkalifeldspar	70	17,5	24,3		Kaolinite	2	0,5
Sum Feldspar	**76**	**19,0**	**26,4**		Smectite		0,0
L_s, psam	6	1,5	2,1		**Sum cement**	**48**	**12,0**
L_s, pel		0,0	0,0		Matrix	33	8,3
L_v, felsic	2	0,5	0,7		Porosity_inter	7	1,8
L_v, mafic		0,0	0,0		Porosity_intra	21	5,3
L_m, psam		0,0	0,0		Muscovite	2	0,5
L_m, pel	16	4,0	5,6		Biotite		0,0
Sum Lithic Fragments	**24**	**6,0**	**8,3**		Opaque minerals	1	0,3

Table A2: Thin section protocol for sample 33298 after 200 points

Sample: 33298		Total Points:	200	Total Grains:	141		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	16	8,0	11,3		Q_cement	9	4,5
Quartz_m, non-undulatory	63	31,5	44,7		Calcite_cement	5	2,5
Quartz_p, 2-3	7	3,5	5,0		Carbonate_cement	7	3,5
Quartz_p, > 3	14	7,0	9,9		Anhydrite		0,0
Chert	1	0,5	0,7		Gypsum		0,0
Sum Quartz	**101**	**50,5**	71,6		Hematite		0,0
Plagioclase	2	1,0	1,4		Illite		0,0
Alkalifeldspar	28	14,0	19,9		Kaolinite	2	1,0
Sum Feldspar	**30**	**15,0**	21,3		Smectite		0,0
L_s, psam		0,0	0,0		**Sum cement**	**23**	**11,5**
L_s, pel	5	2,5	3,5		Matrix	18	9,0
L_v, felsic	1	0,5	0,7		Porosity_inter	5	2,5
L_v, mafic		0,0	0,0		Porosity_intra	12	6,0
L_m, psam		0,0	0,0		Muscovite	1	0,5
L_m, pel	4	2,0	2,8		Biotite		0,0
Sum Lithic Fragments	**10**	**5,0**	7,1		Opaque minerals		0,0

Table A3: Thin section protocol for sample 33300 after 399 points

Sample: 33300		Total Points:	399	Total Grains:	306		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	70	17,5	22,9		Q_cement	18	4,5
Quartz_m, non-undulatory	120	30,1	39,2		Calcite_cement	12	3,0
Quartz_p, 2-3	15	3,8	4,9		Carbonate_cement		0,0
Quartz_p, > 3	33	8,3	10,8		Anhydrite		0,0
Chert	2	0,5	0,7		Gypsum		0,0
Sum Quartz	**240**	**60,2**	**78,4**		Hematite		0,0
Plagioclase	1	0,3	0,3		Illite	2	0,5
Alkalifeldspar	45	11,3	14,7		Kaolinite	3	0,8
Sum Feldspar	**46**	**11,5**	**15,0**		Smectite		0,0
L_s, psam	1	0,3	0,3		**Sum cement**	**35**	**8,8**
L_s, pel	7	1,8	2,3		Matrix	28	7,0
L_v, felsic	1	0,3	0,3		Porosity_inter	10	2,5
L_v, mafic		0,0	0,0		Porosity_intra	14	3,5
L_m, psam		0,0	0,0		Muscovite	6	1,5
L_m, pel	11	2,8	3,6		Biotite		0,0
Sum Lithic Fragments	**20**	**5,0**	**6,5**		Opaque minerals		0,0

Table A4: Thin section protocol for sample 33300 after 199 points

Sample: 33300		Total Points:	199	Total Grains:	149		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	35	17,6	23,5		Q_cement	11	5,5
Quartz_m, non-undulatory	58	29,1	38,9		Calcite_cement	7	3,5
Quartz_p, 2-3	6	3,0	4,0		Carbonate_cement		0,0
Quartz_p, > 3	17	8,5	11,4		Anhydrite		0,0
Chert	1	0,5	0,7		Gypsum		0,0
Sum Quartz	**117**	**58,8**	78,5		Hematite		0,0
Plagioclase		0,0	0,0		Illite	1	0,5
Alkalifeldspar	19	9,5	12,8		Kaolinite	3	1,5
Sum Feldspar	**19**	**9,5**	12,8		Smectite		0,0
L_s, psam	1	0,5	0,7		**Sum cement**	**22**	**11,1**
L_s, pel	6	3,0	4,0		Matrix	14	7,0
L_v, felsic	1	0,5	0,7		Porosity_inter	2	1,0
L_v, mafic		0,0	0,0		Porosity_intra	9	4,5
L_m, psam		0,0	0,0		Muscovite	3	1,5
L_m, pel	5	2,5	3,4		Biotite		0,0
Sum Lithic Fragments	**13**	**6,5**	8,7		Opaque minerals		0,0

Table A5: Thin section protocol for sample 33302 after 400 points

Sample: 33302		Total Points:	400	Total Grains:	243		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	49	12,3	20,2		Q_cement	14	3,5
Quartz_m, non-undulatory	88	22,0	36,2		Calcite_cement	23	5,8
Quartz_p, 2-3	3	0,8	1,2		Carbonate_cement		0,0
Quartz_p, > 3	16	4,0	6,6		Anhydrite		0,0
Chert		0,0	0,0		Gypsum		0,0
Sum Quartz	**156**	**39,0**	**64,2**		Hematite		0,0
Plagioclase	6	1,5	2,5		Illite		0,0
Alkalifeldspar	19	4,8	7,8		Kaolinite	1	0,3
Sum Feldspar	**25**	**6,3**	**10,3**		Smectite		0,0
L_s, psam	1	0,3	0,4		**Sum cement**	**38**	**9,5**
L_s, pel	7	1,8	2,9		Matrix	47	11,8
L_v, felsic	6	1,5	2,5		Porosity_inter	22	5,5
L_v, mafic		0,0	0,0		Porosity_intra	44	11,0
L_m, psam		0,0	0,0		Muscovite	4	1,0
L_m, pel	48	12,0	19,8		Biotite		0,0
Sum Lithic Fragments	**62**	**15,5**	**25,5**		Opaque minerals	2	0,5

Table A6: Thin section protocol for sample 33302 after 200 points

Sample: 33302		Total Points:	200	Total Grains:	121		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	12	6,0	9,9		Q_cement	7	3,5
Quartz_m, non-undulatory	57	28,5	47,1		Calcite_cement	8	4,0
Quartz_p, 2-3	3	1,5	2,5		Carbonate_cement		0,0
Quartz_p, > 3	8	4,0	6,6		Anhydrite		0,0
Chert		0,0	0,0		Gypsum		0,0
Sum Quartz	**80**	**40,0**	**66,1**		Hematite		0,0
Plagioclase	5	2,5	4,1		Illite		0,0
Alkalifeldspar	6	3,0	5,0		Kaolinite		0,0
Sum Feldspar	**11**	**5,5**	**9,1**		Smectite		0,0
L_s, psam	1	0,5	0,8		**Sum cement**	**15**	**7,5**
L_s, pel	4	2,0	3,3		Matrix	23	11,5
L_v, felsic	3	1,5	2,5		Porosity_inter	15	7,5
L_v, mafic		0,0	0,0		Porosity_intra	26	13,0
L_m, psam		0,0	0,0		Muscovite		0,0
L_m, pel	22	11,0	18,2		Biotite		0,0
Sum Lithic Fragments	**30**	**15,0**	**24,8**		Opaque minerals		0,0

Table A7: Thin section protocol for sample 33302B after 400 points

Sample: 33302B		Total Points:	400	Total Grains:	276		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	54	13,5	19,6		Q_cement	10	2,5
Quartz_m, non-undulatory	100	25,0	36,2		Calcite_cement	27	6,8
Quartz_p, 2-3	8	2,0	2,9		Carbonate_cement		0,0
Quartz_p, > 3	29	7,3	10,5		Anhydrite		0,0
Chert		0,0	0,0		Gypsum		0,0
Sum Quartz	**191**	**47,8**	**69,2**		Hematite		0,0
Plagioclase	3	0,8	1,1		Illite		0,0
Alkalifeldspar	22	5,5	8,0		Kaolinite	1	0,3
Sum Feldspar	**25**	**6,3**	**9,1**		Smectite		0,0
L_s, psam		0,0	0,0		**Sum cement**	**38**	**9,5**
L_s, pel	5	1,3	1,8		Matrix	55	13,8
L_v, felsic	2	0,5	0,7		Porosity_inter	7	1,8
L_v, mafic		0,0	0,0		Porosity_intra	19	4,8
L_m, psam		0,0	0,0		Muscovite	2	0,5
L_m, pel	53	13,3	19,2		Biotite		0,0
Sum Lithic Fragments	**60**	**15,0**	**21,7**		Opaque minerals	3	0,8

Table A8: Thin section protocol for sample 33302B after 200 points

Sample: 33302B		Total Points:	200	Total Grains:	143		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	32	16,0	22,4		Q_cement	3	1,5
Quartz_m, non-undulatory	50	25,0	35,0		Calcite_cement	13	6,5
Quartz_p, 2-3	4	2,0	2,8		Carbonate_cement		0,0
Quartz_p, > 3	15	7,5	10,5		Anhydrite		0,0
Chert		0,0	0,0		Gypsum		0,0
Sum Quartz	**101**	**50,5**	**70,6**		Hematite		0,0
Plagioclase	2	1,0	1,4		Illite		0,0
Alkalifeldspar	11	5,5	7,7		Kaolinite		0,0
Sum Feldspar	**13**	**6,5**	**9,1**		Smectite		0,0
L_s, psam		0,0	0,0		**Sum cement**	**16**	**8,0**
L_s, pel	4	2,0	2,8		Matrix	29	14,5
L_v, felsic	1	0,5	0,7		Porosity_inter	1	0,5
L_v, mafic		0,0	0,0		Porosity_intra	9	4,5
L_m, psam		0,0	0,0		Muscovite		0,0
L_m, pel	24	12,0	16,8		Biotite		0,0
Sum Lithic Fragments	**29**	**14,5**	**20,3**		Opaque minerals	2	1,0

Table A9: Thin section protocol for sample 39650 after 400 points

Sample: 39650		Total Points:	400	Total Grains:	307		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	69	17,3	22,5		Q_cement	28	7,0
Quartz_m, non-undulatory	168	42,0	54,7		Calcite_cement	7	1,8
Quartz_p, 2-3	11	2,8	3,6		Carbonate_cement	1	0,3
Quartz_p, > 3	11	2,8	3,6		Anhydrite	2	0,5
Chert	1	0,3	0,3		Gypsum	1	0,3
Sum Quartz	**260**	**65,0**	**84,7**		Hematite		0,0
Plagioclase	20	5,0	6,5		Illite		0,0
Alkalifeldspar	17	4,3	5,5		Kaolinite		0,0
Sum Feldspar	**37**	**9,3**	**12,1**		Smectite		0,0
L_s, psam		0,0	0,0		**Sum cement**	**39**	**9,8**
L_s, pel	6	1,5	2,0		Matrix	22	5,5
L_v, felsic	4	1,0	1,3		Porosity_inter	28	7,0
L_v, mafic		0,0	0,0		Porosity_intra	4	1,0
L_m, psam		0,0	0,0		Muscovite		0,0
L_m, pel		0,0	0,0		Biotite		0,0
Sum Lithic Fragments	**10**	**2,5**	**3,3**		Opaque minerals		0,0

Table A10: Thin section protocol for sample 39650 after 200 points

Sample: 39650		Total Points:	200	Total Grains:	148		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	30	15,0	20,3		Q_cement	24	12,0
Quartz_m, non-undulatory	87	43,5	58,8		Calcite_cement	1	0,5
Quartz_p, 2-3	7	3,5	4,7		Carbonate_cement		0,0
Quartz_p, > 3	5	2,5	3,4		Anhydrite		0,0
Chert	1	0,5	0,7		Gypsum		0,0
Sum Quartz	**130**	**65,0**	87,8		Hematite		0,0
Plagioclase	9	4,5	6,1		Illite		0,0
Alkalifeldspar	3	1,5	2,0		Kaolinite		0,0
Sum Feldspar	**12**	**6,0**	8,1		Smectite		0,0
L_s, psam		0,0	0,0		**Sum cement**	**25**	**12,5**
L_s, pel	3	1,5	2,0		Matrix	11	5,5
L_v, felsic	3	1,5	2,0		Porosity_inter	15	7,5
L_v, mafic		0,0	0,0		Porosity_intra	1	0,5
L_m, psam		0,0	0,0		Muscovite		0,0
L_m, pel		0,0	0,0		Biotite		0,0
Sum Lithic Fragments	**6**	**3,0**	4,1		Opaque minerals		0,0

Table A11: Thin section protocol for sample 39653 after 400 points

Sample: 39653		Total Points:	399	Total Grains:	278		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	110	27,6	39,6		Q_cement	23	5,8
Quartz_m, non-undulatory	119	29,8	42,8		Calcite_cement	11	2,8
Quartz_p, 2-3	3	0,8	1,1		Carbonate_cement	4	1,0
Quartz_p, > 3	8	2,0	2,9		Anhydrite	6	1,5
Chert	1	0,3	0,4		Gypsum	1	0,3
Sum Quartz	**241**	**60,4**	**86,7**		Hematite		0,0
Plagioclase	16	4,0	5,8		Illite	2	0,5
Alkalifeldspar	13	3,3	4,7		Kaolinite		0,0
Sum Feldspar	**29**	**7,3**	**10,4**		Smectite		0,0
L_s, psam	1	0,3	0,4		**Sum cement**	**47**	**11,8**
L_s, pel	4	1,0	1,4		Matrix	23	5,8
L_v, felsic	2	0,5	0,7		Porosity_inter	49	12,3
L_v, mafic		0,0	0,0		Porosity_intra	2	0,5
L_m, psam		0,0	0,0		Muscovite		0,0
L_m, pel	1	0,3	0,4		Biotite		0,0
Sum Lithic Fragments	**8**	**2,0**	**2,9**		Opaque minerals		0,0

Table A12: Thin section protocol for sample 39653 after 200 points

Sample: 39653		Total Points:	200	Total Grains:	135		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	52	26,0	38,5		Q_cement	12	6,0
Quartz_m, non-undulatory	59	29,5	43,7		Calcite_cement	4	2,0
Quartz_p, 2-3	2	1,0	1,5		Carbonate_cement	2	1,0
Quartz_p, > 3	4	2,0	3,0		Anhydrite	2	1,0
Chert		0,0	0,0		Gypsum	1	0,5
Sum Quartz	**117**	**58,5**	86,7		Hematite		0,0
Plagioclase	9	4,5	6,7		Illite	2	1,0
Alkalifeldspar	5	2,5	3,7		Kaolinite		0,0
Sum Feldspar	**14**	**7,0**	10,4		Smectite		0,0
L_s, psam		0,0	0,0		**Sum cement**	**23**	**11,5**
L_s, pel	3	1,5	2,2		Matrix	11	5,5
L_v, felsic	1	0,5	0,7		Porosity_inter	31	15,5
L_v, mafic		0,0	0,0		Porosity_intra		0,0
L_m, psam		0,0	0,0		Muscovite		0,0
L_m, pel		0,0	0,0		Biotite		0,0
Sum Lithic Fragments	**4**	**2,0**	3,0		Opaque minerals		0,0

Table A13: Thin section protocol for sample 39654 after 400 points

Sample: 39654		Total Points:	400	Total Grains:	293		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	90	22,5	30,7		Q_cement	25	6,3
Quartz_m, non-undulatory	144	36,0	49,1		Calcite_cement	5	1,3
Quartz_p, 2-3	5	1,3	1,7		Carbonate_cement	2	0,5
Quartz_p, > 3	14	3,5	4,8		Anhydrite	15	3,8
Chert		0,0	0,0		Gypsum	6	1,5
Sum Quartz	**253**	**63,3**	**86,3**		Hematite		0,0
Plagioclase	15	3,8	5,1		Illite		0,0
Alkalifeldspar	13	3,3	4,4		Kaolinite		0,0
Sum Feldspar	**28**	**7,0**	**9,6**		Smectite		0,0
L_s, psam	2	0,5	0,7		**Sum cement**	**53**	**13,3**
L_s, pel	3	0,8	1,0		Matrix	13	3,3
L_v, felsic	3	0,8	1,0		Porosity_inter	39	9,8
L_v, mafic	1	0,3	0,3		Porosity_intra	2	0,5
L_m, psam		0,0	0,0		Muscovite		0,0
L_m, pel	3	0,8	1,0		Biotite		0,0
Sum Lithic Fragments	**12**	**3,0**	**4,1**		Opaque minerals		0,0

Table A14: Thin section protocol for sample 39654 after 200 points

Sample: 39654		Total Points:	200	Total Grains:	142		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	52	26,0	36,6		Q_cement	9	4,5
Quartz_m, non-undulatory	63	31,5	44,4		Calcite_cement	1	0,5
Quartz_p, 2-3		0,0	0,0		Carbonate_cement	2	1,0
Quartz_p, > 3	7	3,5	4,9		Anhydrite	14	7,0
Chert		0,0	0,0		Gypsum	5	2,5
Sum Quartz	**122**	**61,0**	85,9		Hematite		0,0
Plagioclase	6	3,0	4,2		Illite		0,0
Alkalifeldspar	8	4,0	5,6		Kaolinite		0,0
Sum Feldspar	**14**	**7,0**	9,9		Smectite		0,0
L_s, psam	2	1,0	1,4		**Sum cement**	**31**	**15,5**
L_s, pel	1	0,5	0,7		Matrix	8	4,0
L_v, felsic	2	1,0	1,4		Porosity_inter	18	9,0
L_v, mafic		0,0	0,0		Porosity_intra	1	0,5
L_m, psam		0,0	0,0		Muscovite		0,0
L_m, pel	1	0,5	0,7		Biotite		0,0
Sum Lithic Fragments	**6**	**3,0**	4,2		Opaque minerals		0,0

Table A15: Thin section protocol for sample 39656 after 400 points

Sample: 39656		Total Points:	398	Total Grains:	284		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	92	23,1	32,4		Q_cement	20	5,0
Quartz_m, non-undulatory	142	35,7	50,0		Calcite_cement	16	4,0
Quartz_p, 2-3	1	0,3	0,4		Carbonate_cement	1	0,3
Quartz_p, > 3	9	2,3	3,2		Anhydrite	3	0,8
Chert		0,0	0,0		Gypsum	6	1,5
Sum Quartz	**244**	**61,3**	**85,9**		Hematite		0,0
Plagioclase	17	4,3	6,0		Illite		0,0
Alkalifeldspar	13	3,3	4,6		Kaolinite		0,0
Sum Feldspar	**30**	**7,5**	**10,6**		Smectite		0,0
L_s, psam		0,0	0,0		**Sum cement**	**46**	**11,6**
L_s, pel	4	1,0	1,4		Matrix	22	5,5
L_v, felsic	3	0,8	1,1		Porosity_inter	42	10,6
L_v, mafic	1	0,3	0,4		Porosity_intra	4	1,0
L_m, psam		0,0	0,0		Muscovite		0,0
L_m, pel	2	0,5	0,7		Biotite		0,0
Sum Lithic Fragments	**10**	**2,5**	**3,5**		Opaque minerals		0,0

Table A16: Thin section protocol for sample 39656 after 200 points

Sample: 39656		Total Points:	200	Total Grains:	153		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	46	23,0	30,1		Q_cement	11	5,5
Quartz_m, non-undulatory	79	39,5	51,6		Calcite_cement	4	2,0
Quartz_p, 2-3	1	0,5	0,7		Carbonate_cement		0,0
Quartz_p, > 3	6	3,0	3,9		Anhydrite	2	1,0
Chert		0,0	0,0		Gypsum	1	0,5
Sum Quartz	**132**	**66,0**	86,3		Hematite		0,0
Plagioclase	9	4,5	5,9		Illite	1	0,5
Alkalifeldspar	9	4,5	5,9		Kaolinite		0,0
Sum Feldspar	**18**	**9,0**	11,8		Smectite		0,0
L_s, psam		0,0	0,0		**Sum cement**	**19**	**9,5**
L_s, pel		0,0	0,0		Matrix	10	5,0
L_v, felsic	2	1,0	1,3		Porosity_inter	18	9,0
L_v, mafic		0,0	0,0		Porosity_intra		0,0
L_m, psam		0,0	0,0		Muscovite		0,0
L_m, pel	1	0,5	0,7		Biotite		0,0
Sum Lithic Fragments	**3**	**1,5**	2,0		Opaque minerals		0,0

Table A17: Thin section protocol for sample 48743 after 400 points

Sample: 48743		Total Points:	400	Total Grains:	272		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	98	24,5	36,0		Q_cement	11	2,8
Quartz_m, non-undulatory	103	25,8	37,9		Calcite_cement	72	18,0
Quartz_p, 2-3	12	3,0	4,4		Carbonate_cement		0,0
Quartz_p, > 3	13	3,3	4,8		Anhydrite		0,0
Chert	1	0,3	0,4		Gypsum		0,0
Sum Quartz	**227**	**56,8**	**83,5**		Hematite		0,0
Plagioclase	16	4,0	5,9		Illite		0,0
Alkalifeldspar	14	3,5	5,1		Kaolinite		0,0
Sum Feldspar	**30**	**7,5**	**11,0**		Smectite		0,0
L_s, psam		0,0	0,0		**Sum cement**	**83**	**20,8**
L_s, pel	7	1,8	2,6		Matrix	25	6,3
L_v, felsic	5	1,3	1,8		Porosity_inter	5	1,3
L_v, mafic		0,0	0,0		Porosity_intra	11	2,8
L_m, psam		0,0	0,0		Muscovite		0,0
L_m, pel	3	0,8	1,1		Biotite	3	0,8
Sum Lithic Fragments	**15**	**3,8**	**5,5**		Opaque minerals	1	0,3

Table A18: Thin section protocol for sample 48743 after 200 points

Sample: 48743		Total Points:	200	Total Grains:	133		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	51	25,5	38,3		Q_cement	7	3,5
Quartz_m, non-undulatory	49	24,5	36,8		Calcite_cement	37	18,5
Quartz_p, 2-3	6	3,0	4,5		Carbonate_cement		0,0
Quartz_p, > 3	7	3,5	5,3		Anhydrite		0,0
Chert	1	0,5	0,8		Gypsum		0,0
Sum Quartz	**114**	**57,0**	85,7		Hematite		0,0
Plagioclase	8	4,0	6,0		Illite		0,0
Alkalifeldspar	6	3,0	4,5		Kaolinite		0,0
Sum Feldspar	**14**	**7,0**	10,5		Smectite		0,0
L_s, psam		0,0	0,0		**Sum cement**	**44**	**22,0**
L_s, pel	1	0,5	0,8		Matrix	14	7,0
L_v, felsic	3	1,5	2,3		Porosity_inter	2	1,0
L_v, mafic		0,0	0,0		Porosity_intra	6	3,0
L_m, psam		0,0	0,0		Muscovite		0,0
L_m, pel	1	0,5	0,8		Biotite	1	0,5
Sum Lithic Fragments	**5**	**2,5**	3,8		Opaque minerals		0,0

Table A19: Thin section protocol for sample 48744 after 400 points

Sample: 48744		Total Points:	400	Total Grains:	307		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	134	33,5	43,6		Q_cement	18	4,5
Quartz_m, non-undulatory	116	29,0	37,8		Calcite_cement	17	4,3
Quartz_p, 2-3	5	1,3	1,6		Carbonate_cement		0,0
Quartz_p, > 3	13	3,3	4,2		Anhydrite	4	1,0
Chert		0,0	0,0		Gypsum	1	0,3
Sum Quartz	**268**	**67,0**	**87,3**		Hematite	6	1,5
Plagioclase	22	5,5	7,2		Illite		0,0
Alkalifeldspar	9	2,3	2,9		Kaolinite		0,0
Sum Feldspar	**31**	**7,8**	**10,1**		Smectite		0,0
L_s, psam		0,0	0,0		**Sum cement**	**46**	**11,5**
L_s, pel	8	2,0	2,6		Matrix	18	4,5
L_v, felsic		0,0	0,0		Porosity_inter	20	5,0
L_v, mafic		0,0	0,0		Porosity_intra	9	2,3
L_m, psam		0,0	0,0		Muscovite		0,0
L_m, pel		0,0	0,0		Biotite		0,0
Sum Lithic Fragments	**8**	**2,0**	**2,6**		Opaque minerals		0,0

Table A20: Thin section protocol for sample 48744 after 200 points

Sample: 48744		Total Points:	200	Total Grains:	151		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	71	35,5	47,0		Q_cement	8	4,0
Quartz_m, non-undulatory	55	27,5	36,4		Calcite_cement	8	4,0
Quartz_p, 2-3	2	1,0	1,3		Carbonate_cement		0,0
Quartz_p, > 3	5	2,5	3,3		Anhydrite	1	0,5
Chert		0,0	0,0		Gypsum	1	0,5
Sum Quartz	**133**	**66,5**	**88,1**		Hematite	3	1,5
Plagioclase	11	5,5	7,3		Illite		0,0
Alkalifeldspar	5	2,5	3,3		Kaolinite		0,0
Sum Feldspar	**16**	**8,0**	**10,6**		Smectite		0,0
L_s, psam		0,0	0,0		**Sum cement**	**21**	**10,5**
L_s, pel	2	1,0	1,3		Matrix	11	5,5
L_v, felsic		0,0	0,0		Porosity_inter	11	5,5
L_v, mafic		0,0	0,0		Porosity_intra	6	3,0
L_m, psam		0,0	0,0		Muscovite		0,0
L_m, pel		0,0	0,0		Biotite		0,0
Sum Lithic Fragments	**2**	**1,0**	**1,3**		Opaque minerals		0,0

Table A21: Thin section protocol for sample 48745 after 400 points

Sample: 48745		Total Points:	400	Total Grains:	303		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	131	32,8	43,2		Q_cement	13	3,3
Quartz_m, non-undulatory	107	26,8	35,3		Calcite_cement	11	2,8
Quartz_p, 2-3	4	1,0	1,3		Carbonate_cement		0,0
Quartz_p, > 3	7	1,8	2,3		Anhydrite	7	1,8
Chert		0,0	0,0		Gypsum		0,0
Sum Quartz	**249**	**62,3**	**82,2**		Hematite	3	0,8
Plagioclase	14	3,5	4,6		Illite		0,0
Alkalifeldspar	20	5,0	6,6		Kaolinite		0,0
Sum Feldspar	**34**	**8,5**	**11,2**		Smectite		0,0
L_s, psam		0,0	0,0		**Sum cement**	**34**	**8,5**
L_s, pel	9	2,3	3,0		Matrix	33	8,3
L_v, felsic	3	0,8	1,0		Porosity_inter	18	4,5
L_v, mafic		0,0	0,0		Porosity_intra	11	2,8
L_m, psam		0,0	0,0		Muscovite	1	0,3
L_m, pel	8	2,0	2,6		Biotite		0,0
Sum Lithic Fragments	**20**	**5,0**	**6,6**		Opaque minerals		0,0

Table A22: Thin section protocol for sample 48745 after 200 points

Sample: 48745		Total Points:	200	Total Grains:	154		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	64	32,0	41,6		Q_cement	7	3,5
Quartz_m, non-undulatory	53	26,5	34,4		Calcite_cement	7	3,5
Quartz_p, 2-3	3	1,5	1,9		Carbonate_cement		0,0
Quartz_p, > 3	5	2,5	3,2		Anhydrite	3	1,5
Chert		0,0	0,0		Gypsum		0,0
Sum Quartz	**125**	**62,5**	**81,2**		Hematite	1	0,5
Plagioclase	11	5,5	7,1		Illite		0,0
Alkalifeldspar	7	3,5	4,5		Kaolinite		0,0
Sum Feldspar	**18**	**9,0**	**11,7**		Smectite		0,0
L_s, psam		0,0	0,0		**Sum cement**	**18**	**9,0**
L_s, pel	3	1,5	1,9		Matrix	18	9,0
L_v, felsic	3	1,5	1,9		Porosity_inter	6	3,0
L_v, mafic		0,0	0,0		Porosity_intra	3	1,5
L_m, psam		0,0	0,0		Muscovite	1	0,5
L_m, pel	5	2,5	3,2		Biotite		0,0
Sum Lithic Fragments	**11**	**5,5**	**7,1**		Opaque minerals		0,0

Table A23: Thin section protocol for sample 48746 after 400 points

Sample: 48746		Total Points:	400	Total Grains:	281		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	75	18,8	26,7		Q_cement	12	3,0
Quartz_m, non-undulatory	150	37,5	53,4		Calcite_cement	18	4,5
Quartz_p, 2-3	8	2,0	2,8		Carbonate_cement		0,0
Quartz_p, > 3	5	1,3	1,8		Anhydrite	1	0,3
Chert		0,0	0,0		Gypsum		0,0
Sum Quartz	**238**	**59,5**	**84,7**		Hematite	12	3,0
Plagioclase	14	3,5	5,0		Illite		0,0
Alkalifeldspar	18	4,5	6,4		Kaolinite		0,0
Sum Feldspar	**32**	**8,0**	**11,4**		Smectite		0,0
L_s, psam		0,0	0,0		**Sum cement**	**43**	**10,8**
L_s, pel	4	1,0	1,4		Matrix	43	10,8
L_v, felsic	1	0,3	0,4		Porosity_inter	12	3,0
L_v, mafic		0,0	0,0		Porosity_intra	15	3,8
L_m, psam		0,0	0,0		Muscovite	3	0,8
L_m, pel	6	1,5	2,1		Biotite		0,0
Sum Lithic Fragments	**11**	**2,8**	**3,9**		Opaque minerals	3	0,8

Table A24: Thin section protocol for sample 48746 after 200 points

Sample: 48746		Total Points:	200	Total Grains:	145		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	30	15,0	20,7		Q_cement	5	2,5
Quartz_m, non-undulatory	89	44,5	61,4		Calcite_cement	4	2,0
Quartz_p, 2-3	6	3,0	4,1		Carbonate_cement		0,0
Quartz_p, > 3	3	1,5	2,1		Anhydrite		0,0
Chert		0,0	0,0		Gypsum		0,0
Sum Quartz	**128**	**64,0**	**88,3**		Hematite	5	2,5
Plagioclase	6	3,0	4,1		Illite		0,0
Alkalifeldspar	8	4,0	5,5		Kaolinite		0,0
Sum Feldspar	**14**	**7,0**	**9,7**		Smectite		0,0
L_s, psam		0,0	0,0		**Sum cement**	**14**	**7,0**
L_s, pel	2	1,0	1,4		Matrix	24	12,0
L_v, felsic		0,0	0,0		Porosity_inter	8	4,0
L_v, mafic		0,0	0,0		Porosity_intra	5	2,5
L_m, psam		0,0	0,0		Muscovite	2	1,0
L_m, pel	1	0,5	0,7		Biotite		0,0
Sum Lithic Fragments	**3**	**1,5**	**2,1**		Opaque minerals	2	1,0

Table A25: Thin section protocol for sample 48747 after 400 points

Sample: 48747		Total Points:	400	Total Grains:	301		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	120	30,0	39,9		Q_cement	10	2,5
Quartz_m, non-undulatory	138	34,5	45,8		Calcite_cement	18	4,5
Quartz_p, 2-3	1	0,3	0,3		Carbonate_cement		0,0
Quartz_p, > 3	9	2,3	3,0		Anhydrite	4	1,0
Chert		0,0	0,0		Gypsum		0,0
Sum Quartz	**268**	**67,0**	**89,0**		Hematite	2	0,5
Plagioclase	14	3,5	4,7		Illite		0,0
Alkalifeldspar	6	1,5	2,0		Kaolinite		0,0
Sum Feldspar	**20**	**5,0**	**6,6**		Smectite		0,0
L_s, psam	1	0,3	0,3		**Sum cement**	**34**	**8,5**
L_s, pel	8	2,0	2,7		Matrix	29	7,3
L_v, felsic	1	0,3	0,3		Porosity_inter	16	4,0
L_v, mafic		0,0	0,0		Porosity_intra	19	4,8
L_m, psam		0,0	0,0		Muscovite		0,0
L_m, pel	3	0,8	1,0		Biotite		0,0
Sum Lithic Fragments	**13**	**3,3**	**4,3**		Opaque minerals	1	0,3

Table A26: Thin section protocol for sample 48747 after 200 points

Sample: 48747		Total Points:	200	Total Grains:	144		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	45	22,5	31,3		Q_cement	5	2,5
Quartz_m, non-undulatory	79	39,5	54,9		Calcite_cement	10	5,0
Quartz_p, 2-3		0,0	0,0		Carbonate_cement		0,0
Quartz_p, > 3	7	3,5	4,9		Anhydrite		0,0
Chert		0,0	0,0		Gypsum		0,0
Sum Quartz	**131**	**65,5**	**91,0**		Hematite	2	1,0
Plagioclase	5	2,5	3,5		Illite		0,0
Alkalifeldspar	4	2,0	2,8		Kaolinite		0,0
Sum Feldspar	**9**	**4,5**	6,3		Smectite		0,0
L_s, psam		0,0	0,0		**Sum cement**	**17**	**8,5**
L_s, pel	4	2,0	**2,8**		Matrix	20	10,0
L_v, felsic		0,0	0,0		Porosity_inter	8	4,0
L_v, mafic		0,0	0,0		Porosity_intra	11	5,5
L_m, psam		0,0	0,0		Muscovite		0,0
L_m, pel		0,0	0,0		Biotite		0,0
Sum Lithic Fragments	**4**	**2,0**	**2,8**		Opaque minerals		0,0

Table A27: Thin section protocol for sample 61380 after 400 points

Sample: 61380		Total Points:	400	Total Grains:	190		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	51	12,8	26,8		Q_cement	10	2,5
Quartz_m, non-undulatory	107	26,8	56,3		Calcite_cement	20	5,0
Quartz_p, 2-3	7	1,8	3,7		Carbonate_cement		0,0
Quartz_p, > 3	6	1,5	3,2		Anhydrite		0,0
Chert	1	0,3	0,5		Gypsum		0,0
Sum Quartz	**172**	**43,0**	**90,5**		Hematite	73	18,3
Plagioclase	13	3,3	6,8		Illite		0,0
Alkalifeldspar	2	0,5	1,1		Kaolinite		0,0
Sum Feldspar	**15**	**3,8**	**7,9**		Smectite		0,0
L_s, psam		0,0	0,0		**Sum cement**	**103**	**25,8**
L_s, pel	2	0,5	1,1		Matrix	82	20,5
L_v, felsic		0,0	0,0		Porosity_inter	19	4,8
L_v, mafic		0,0	0,0		Porosity_intra	5	1,3
L_m, psam		0,0	0,0		Muscovite		0,0
L_m, pel	1	0,3	0,5		Biotite		0,0
Sum Lithic Fragments	**3**	**0,8**	**1,6**		Opaque minerals	1	0,3

Table A28: Thin section protocol for sample 61380 after 200 points

Sample: 61380		Total Points:	200	Total Grains:	86		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	37	18,5	43,0		Q_cement	5	2,5
Quartz_m, non-undulatory	32	16,0	37,2		Calcite_cement	12	6,0
Quartz_p, 2-3	4	2,0	4,7		Carbonate_cement		0,0
Quartz_p, > 3	3	1,5	3,5		Anhydrite		0,0
Chert	1	0,5	1,2		Gypsum		0,0
Sum Quartz	**77**	**38,5**	**89,5**		Hematite	44	22,0
Plagioclase	5	2,5	5,8		Illite		0,0
Alkalifeldspar	2	1,0	2,3		Kaolinite		0,0
Sum Feldspar	**7**	**3,5**	**8,1**		Smectite		0,0
L_s, psam		0,0	0,0		**Sum cement**	**61**	**30,5**
L_s, pel	2	1,0	2,3		Matrix	35	17,5
L_v, felsic		0,0	0,0		Porosity_inter	15	7,5
L_v, mafic		0,0	0,0		Porosity_intra	2	1,0
L_m, psam		0,0	0,0		Muscovite		0,0
L_m, pel		0,0	0,0		Biotite		0,0
Sum Lithic Fragments	**2**	**1,0**	**2,3**		Opaque minerals	1	0,5

Table A29: Thin section protocol for sample NN after 400 points

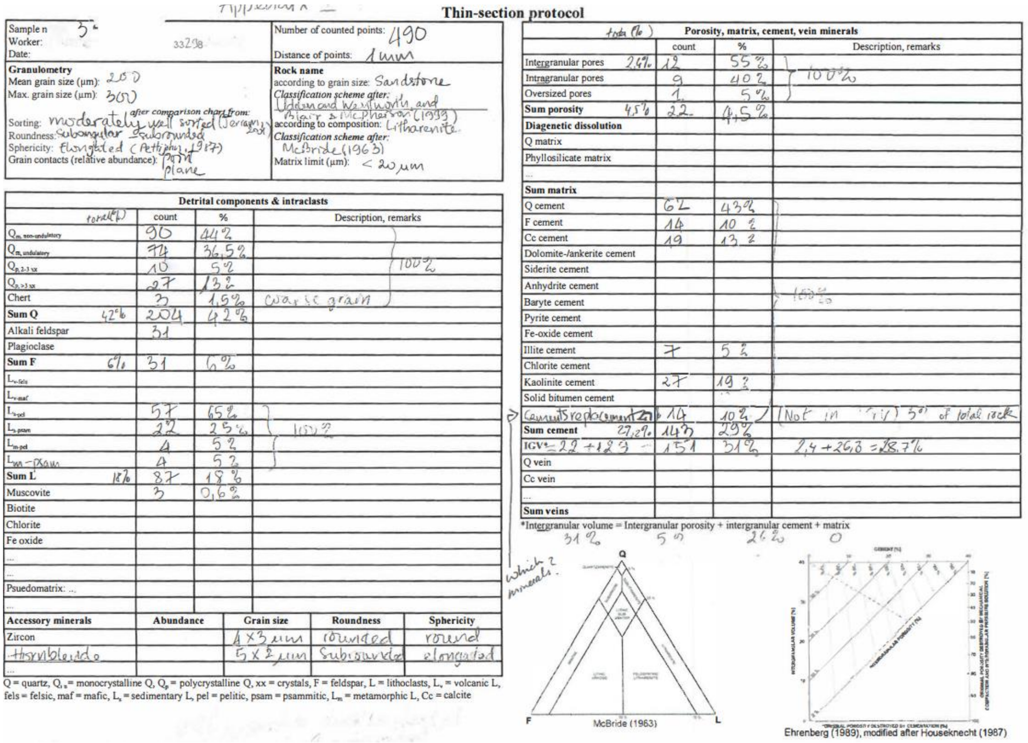
Sample: NN		Total Points:	400	Total Grains:	285		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	81	20,3	28,4		Q_cement	15	3,8
Quartz_m, non-undulatory	139	34,8	48,8		Calcite_cement	32	8,0
Quartz_p, 2-3	9	2,3	3,2		Carbonate_cement		0,0
Quartz_p, > 3	17	4,3	6,0		Anhydrite		0,0
Chert		0,0	0,0		Gypsum		0,0
Sum Quartz	**246**	**61,5**	**86,3**		Hematite		0,0
Plagioclase	15	3,8	5,3		Illite		0,0
Alkalifeldspar	7	1,8	2,5		Kaolinite		0,0
Sum Feldspar	**22**	**5,5**	**7,7**		Smectite	2	0,5
L_s, psam	3	0,8	1,1		**Sum cement**	**49**	**12,3**
L_s, pel	8	2,0	2,8		Matrix	34	8,5
L_v, felsic	3	0,8	1,1		Porosity_inter	12	3,0
L_v, mafic	1	0,3	0,4		Porosity_intra	20	5,0
L_m, psam		0,0	0,0		Muscovite		0,0
L_m, pel	2	0,5	0,7		Biotite		0,0
Sum Lithic Fragments	**17**	**4,3**	**6,0**		Opaque minerals		0,0

Table A30: Thin section protocol for sample NN after 200 points

Sample: NN		Total Points:	200	Total Grains:	144		
Mineral	Count	% of points	% of grains		Mineral	Count	% of points
Quartz_m, undulatory	46	23,0	31,9		Q_cement	9	4,5
Quartz_m, non-undulatory	73	36,5	50,7		Calcite_cement	19	9,5
Quartz_p, 2-3	3	1,5	2,1		Carbonate_cement		0,0
Quartz_p, > 3	6	3,0	4,2		Anhydrite		0,0
Chert		0,0	0,0		Gypsum		0,0
Sum Quartz	**128**	**64,0**	88,9		Hematite		0,0
Plagioclase	9	4,5	6,3		Illite		0,0
Alkalifeldspar	2	1,0	1,4		Kaolinite		0,0
Sum Feldspar	**11**	**5,5**	7,6		Smectite	2	1,0
L_s, psam	1	0,5	0,7		**Sum cement**	**30**	**15,0**
L_s, pel	2	1,0	1,4		Matrix	15	7,5
L_v, felsic	1	0,5	0,7		Porosity_inter	6	3,0
L_v, mafic		0,0	0,0		Porosity_intra	5	2,5
L_m, psam		0,0	0,0		Muscovite		0,0
L_m, pel	1	0,5	0,7		Biotite		0,0
Sum Lithic Fragments	**5**	**2,5**	3,5		Opaque minerals		0,0

Appendix 2

Figures A1-A72 are used as the basis for the student results.



Thin-section protocol

Sample n 5 Worker: 33298 Date:	Number of counted points: 490 Distance of points: 1 mm
Granulometry Mean grain size (µm): 200 Max. grain size (µm): 300 *after comparison chart from:* Sorting: moderately well sorted (Jerram, 2001) Roundness: Subangular - subrounded Sphericity: Elongated (Pettijohn, 1987) Grain contacts (relative abundance): point plane	**Rock name** according to grain size: Sandstone *Classification scheme after:* Udden and Wentworth, and Blair & McPherson (1999) according to composition: Litharenite *Classification scheme after:* McBride (1963) Matrix limit (µm): < 20 µm

Detrital components & intraclasts			
total (%)	count	%	Description, remarks
$Q_{m, non-undulatory}$	90	44 %	100 %
$Q_{m, undulatory}$	74	36,5 %	
$Q_{p, 2-3 xx}$	10	5 %	
$Q_{p, >3 xx}$	27	13 %	
Chert	3	1,5 %	coarse grain
Sum Q 42 %	204	42 %	
Alkali feldspar	31		
Plagioclase			
Sum F 6 %	31	6 %	
L_{v-fels}			
L_{v-maf}			
L_{s-pel}	57	65 %	100 %
L_{s-psam}	22	25 %	
L_{m-pel}	4	5 %	
L_{m-psam}	4	5 %	
Sum L 18 %	87	18 %	
Muscovite	3	0,6 %	
Biotite			
Chlorite			
Fe oxide			
...			
...			
Psuedomatrix: ...			
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon		4 x 3 µm	rounded	round
Hornblende		5 x 2 µm	Subrounded	elongated
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

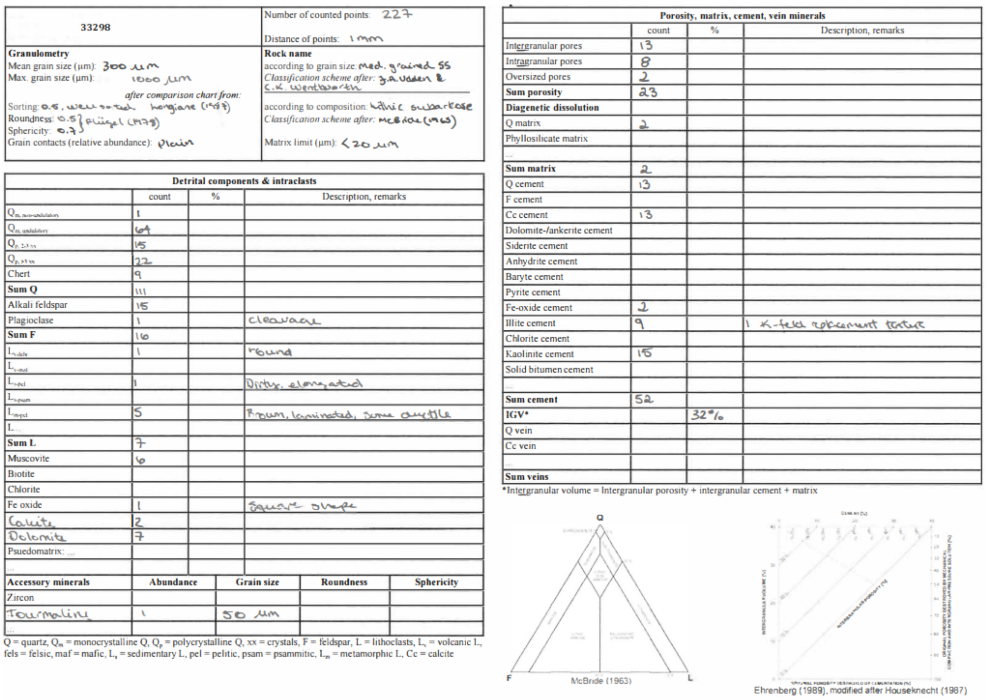
total (%) Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores 2,4 %	12	55 %	100 %
Intragranular pores	9	40 %	
Oversized pores	1	5 %	
Sum porosity 4,5 %	22	4,5 %	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	62	43 %	100 %
F cement	14	10 %	
Cc cement	19	13 %	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement			
Baryte cement			
Pyrite cement			
Fe-oxide cement			
Illite cement	7	5 %	
Chlorite cement			
Kaolinite cement	27	19 %	
Solid bitumen cement			
Cements replacement	14	10 %	(Not in IGV) 3 % of total rock
Sum cement 27,2 %	143	29 %	
IGV* = 22 + 129	151	31 %	2,4 + 26,3 = 28,7 %
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix

31 % 5 % 26 % 0

which 2 minerals

Figure A1: Thin section protocol for sample 33298 by student



33298	Number of counted points: 227 Distance of points: 1 mm
Granulometry Mean grain size (µm): 300 µm Max. grain size (µm): 1000 µm *after comparison chart from:* Sorting: 0.5, well sorted Longiave (1997) Roundness: 0.5 Sphericity: 0.7 Plügel (1978) Grain contacts (relative abundance): Plain	**Rock name** according to grain size: Med. grained SS *Classification scheme after:* J.A. Udden & C.K. Wentworth according to composition: lithic subarkose *Classification scheme after:* McBride (1963) Matrix limit (µm): < 20 µm

Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m, non-undulatory}$	1		
$Q_{m, undulatory}$	64		
$Q_{p, 2-3 xx}$	15		
$Q_{p, >3 xx}$	22		
Chert	9		
Sum Q	111		
Alkali feldspar	15		
Plagioclase	1		cleavage
Sum F	16		
L_{v-fels}	1		round
L_{v-maf}			
L_{s-pel}	1		Dirty, elongated
L_{s-psam}			
L_{m-pel}	5		Brown, laminated, some ductile
L...			
Sum L	7		
Muscovite	6		
Biotite			
Chlorite			
Fe oxide	1		Square shape
Calcite	2		
Dolomite	7		
Psuedomatrix: ...			
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon				
Tourmaline	1	50 µm		
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores	13		
Intragranular pores	8		
Oversized pores	2		
Sum porosity	23		
Diagenetic dissolution			
Q matrix	2		
Phyllosilicate matrix			
...			
Sum matrix	2		
Q cement	13		
F cement			
Cc cement	13		
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement			
Baryte cement			
Pyrite cement			
Fe-oxide cement	2		
Illite cement	9		1 K-feld replacement texture
Chlorite cement			
Kaolinite cement	15		
Solid bitumen cement			
...			
Sum cement	52		
IGV*		32 %	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix

Figure A2: Thin section protocol for sample 33298 by student

Sample name: **33298**	Number of counted points:
Worker:	Distance of points:
Date:	
Granulometry	**Rock name**
Mean grain size (µm):	according to grain size:
Max. grain size (µm):	*Classification scheme after:*
after comparison chart from:	according to composition:
Sorting:	*Classification scheme after:*
Roundness:	
Sphericity:	
Grain contacts (relative abundance):	Matrix limit (µm):

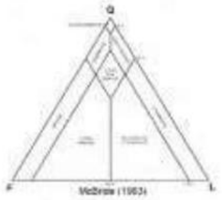
Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m,\ non\ undulatory}$	93	34	
$Q_{m,\ undulatory}$	12	4.4	
$Q_{p,\ 2\text{-}3\ xx}$	14	5.2	
$Q_{p,\ >3\ xx}$	31	11	
Chert	4	2	
Sum Q	154	56.6	
Alkali feldspar	32	12	
Plagioclase			
Sum F			
$L_{v\text{-}fels}$			
$L_{v\text{-}maf}$			
$L_{s\text{-}pel}$	6	2	
$L_{s\text{-}psam}$			
$L_{m\text{-}pel}$	8	3	
L...			
Sum L	14	5.2	
Muscovite	3	1	
Biotite			
Chlorite			
Fe oxide	2	1	
...			
...			
Psuedomatrix: ...	11	4.0	
...			

Accessory minerals	**Abundance**	**Grain size**	**Roundness**	**Sphericity**
Zircon				
...				
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	19	7.0	
Intragranular pores	9	3	
Oversized pores	1	0	
Sum porosity	29	11	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	7	3	
F cement			
Cc cement	19	7.0	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	1	0	
Baryte cement			
Pyrite cement			
Fe-oxide cement			
Illite cement			
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement	27	[illegible]	
IGV*	72	27	100,67.
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



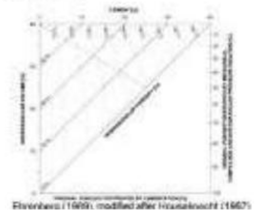


Figure A3: Thin section protocol for sample 33298 by student

Sample name: 33298	Number of counted points: 338
Worker:	Number of counted grains: 246
Date:	Distance of points: 1mm
Granulometry	**Rock name**
Mean grain size (µm): 315	according to grain size: Medium coarse sandstone
Max. grain size (µm): 500	*Classification scheme after:* Miall (1990)
after comparison chart from:	according to composition: Lithic subarkose
Sorting: Good-Moderately good (Longiaru (1987))	*Classification scheme after:* McBride (1963)
Roundness: Subangular-subround (Füchtbauer (1988))	
Sphericity: Bladed/oblate (Flugel (1978))	
Grain contacts (relative abundance): Plane (Tucker (1988)) Some cocave-convex and very few sutured	Matrix limit (µm): 20µm

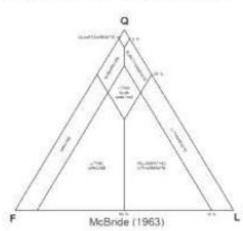
Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m,\ non\ undulatory}$	78	23	
$Q_{m,\ undulatory}$	24	7	
$Q_{p,\ 2\text{-}3\ xx}$	23	6.8	
$Q_{p,\ >3\ xx}$	27	8	
Chert	9	2.6	
Sum Q	161	47.6	
Alkali feldspar	39	11.5	Partly dissolved
Plagioclase	1		Not during the point counting, little amount.
Sum F	39	11.5	
$L_{v\text{-}fels}$			
$L_{v\text{-}maf}$			
$L_{s\text{-}pel}$	28	8.3	Very fine grained
$L_{s\text{-}psam}$	2	0.6	
$L_{m\text{-}pel}$			
L...	7	2	Clasts of quartz with metamorphic origin.
Sum L	37	11	
Muscovite	6	1.8	Elongated, thin layered.
Biotite			
Chlorite			
Fe oxide			
...			
...			
Psuedomatrix: ...			
...			

Accessory minerals	**Abundance**	**Grain size**	**Roundness**	**Sphericity**
Tourmaline	30 small grains	20µm	0.5-0.7	0.5
Garnet	2 grains	160µm	0.1-0.3	0.7
Opaque minerals	10 grains	165µm	0.3-0.5	0.3-0.5

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	22	6.5	Mainly primary
Intragranular pores	1	0.3	Mainly secondary, honeycomb and fracture
Oversized pores	2	0.6	Intergranular, secondary, vug porosity
Sum porosity	25	7.4	Mean porosity size: 334µm
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	2	0.6	
F cement	1		Dissolved/illitized, nearly gone
Cc cement	23	6.5	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement			
Baryte cement			
Pyrite cement			
Fe-oxide cement	1		Observed apart point-counting
Illite cement	17	5	
Chlorite cement			
Kaolinite cement	28	8.6	
Solid bitumen cement			
...			
Sum cement	70	20.7	
IGV*	95	28	IGV-> 7%+21%=28%
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



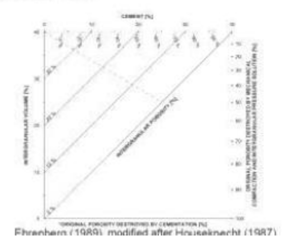


Figure A4: Thin section protocol for sample 33298 by student

Sample name: 33298
Worker:
Date:

Number of counted points: 346
Distance of points: 1000 µm

Granulometry
Mean grain size (µm): 420 µm
Max. grain size (µm): 860 µm
after comparison chart from:
Sorting: moderately to poor
Roundness: subangular to subrounded
Sphericity: low sphericity
Grain contacts (relative abundance): Plane 50%, sutured 30%, concav/convex 20%

Rock name
according to grain size: medium to coarse
Classification scheme after: MIALL (2000)
according to composition: SUBARKOSE
Classification scheme after: McBride (1963)
Matrix limit (µm): <20 µm

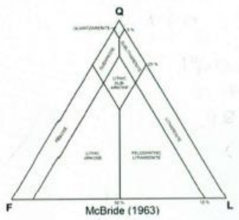
Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m, non-undulatory}$	7	2	
$Q_{m, undulatory}$	74	21	
$Q_{p, 2-3 xx}$	11	3	
$Q_{p, >3 xx}$	45	13	
Chert	6	2	
Sum Q	143	41	
Alkali feldspar	26	8	
Plagioclase	11	3	
Sum F	37	11	
L_{v-fels}			
L_{v-maf}			
L_{s-pel}			
L_{s-psam}	2	0,5	
L_{m-pel}			
L...			
Sum L	2	0,5	
Muscovite	7	2	
Biotite			
Chlorite			
Fe oxide			
...			
...			
Psuedomatrix: ...	2	0,5	
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	11	15-65 µm	round	round-oval
...				
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	38	11	
Intragranular pores	12	3	
Oversized pores	4	1	
Sum porosity	54	16	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	16	5	
F cement			
Cc cement	14	4	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	6	2	
Baryte cement			
Pyrite cement			
Fe-oxide cement	15	4	
Illite cement	12	3	
Chlorite cement			
Kaolinite cement	27	8	
Solid bitumen cement			
...			
Sum cement	78	23	
IGV*	128	37	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



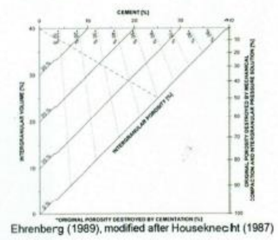


Figure A5: Thin section protocol for sample 33298 by student

Sample name: 33298
Worker:
Date:

Number of counted points: 159
Distance of points: 1 mm

Granulometry
Mean grain size (µm): 0.3 mm
Max. grain size (µm): 0.7 mm
after comparison chart from:
Sorting: Good - V. Good
Roundness: subang - Subrounded
Sphericity: medium
Grain contacts (relative abundance): Point, Plane

Rock name
according to grain size: medium sandstone
Classification scheme after: Wentworth
according to composition:
Classification scheme after: Subarkose
Matrix limit (µm): < 20 µm McBride

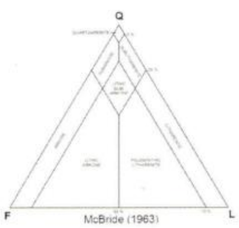
Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m, non-undulatory}$	50		QFL Points: 116
$Q_{m, undulatory}$	20		
$Q_{p, 2-3 xx}$	13		
$Q_{p, >3 xx}$	4		
Chert	5		
Sum Q	90	56.6	77.6 / 78% Q
Alkali feldspar	20		
Plagioclase			
Sum F	20	12.6	17% F
L_{v-fels}	5		
L_{v-maf}			
L_{s-pel}			
L_{s-psam}			
L_{m-pel}			
L... Plutonic	1		
Sum L	6	3.8	5% L
Muscovite			
Biotite			
Chlorite			
Fe oxide			
...			
...			
Psuedomatrix: ...	1		
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	<1%	0.05 mm	subrounded	High
...				
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	14		
Intragranular pores	5		
Oversized pores			
Sum porosity	19	11.9	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix	7		
...			
Sum matrix	7	4.4	
Q cement			
F cement			
Cc cement	15		
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement			
Baryte cement			
Pyrite cement			
Fe-oxide cement			
Illite cement	1		
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement	16	10.1	
IGV*	37	23.3	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



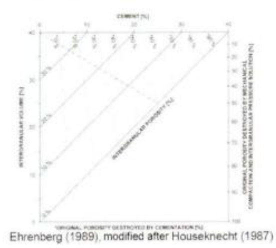


Figure A6: Thin section protocol for sample 33298 by student

Thin-section protocol

Sample name: 33300	Number of counted points: 156
	Distance of points: 1 mm
Granulometry Mean grain size (µm): 1.6 mm; Max. grain size (µm): 6 mm	**Rock name** Subarkose; according to grain size: ; Classification scheme after:
Sorting: moderately; *after comparison chart from:* Roundness: subangular; Sphericity: high (0.7); Grain contacts (relative abundance): plane contact	according to composition: *Classification scheme after:* McBride (1963); Matrix limit (µm): < 20 µm

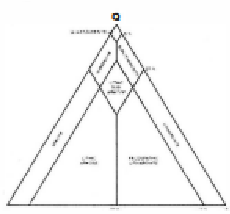
Detrital components & intraclasts	count	%	Description, remarks
$Q_{m, non-undulatory}$		14.7 %	
$Q_{m, undulatory}$		9.6 %	
$Q_{p, 2-3 xx}$		7.7 %	
$Q_{p, >3 xx}$		9.6 %	
Chert	1	0.64 %	
Sum Q			
Alkali feldspar		9.6 %	
Plagioclase			
Sum F		9.6 %	
$L_{v, fels}$			
$L_{v, maf}$			
L_{s}			
$L_{m, psam}$		3.2 %	
$L_{m, pel}$			
L...			
Sum L		3.2 %	
Muscovite		3.2 %	
Biotite			
Chlorite			
Fe oxide		2.6 %	
...			
...			
Psuedomatrix: ...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	10	0.6 - 2 mm	rounded	high

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores		3.8 %	
Intragranular pores		8.3 %	
Oversized pores			
Sum porosity		12.1 %	
Diagenetic dissolution			
Q matrix		7.1 %	
Phyllosilicate matrix			
...			
Sum matrix		7.1 %	
Q cement		9.6 %	
F cement		5.8 %	
Cc cement		1.3 %	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement			
Baryte cement			
Pyrite cement			
Fe-oxide cement		3.8 %	
Illite cement			
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement		20.5 %	
IGV*			
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



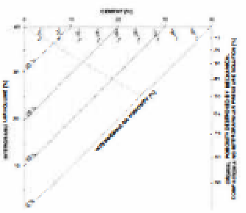


Figure A7: Thin section protocol for sample 33300 by student

Thin-section protocol

Sample name: 333 00 Worker: Date:	Number of counted points: 225
	Distance of points: 1 mm
Granulometry Mean grain size (µm): 1,5 mm; Max. grain size (µm): 6 mm	**Rock name** according to grain size: ; Classification scheme after:
Sorting: Good; *after comparison chart from:* Roundness: subangular; Sphericity: high; Grain contacts (relative abundance): plane	according to composition: *Classification scheme after:* McBride (1963); Matrix limit (µm): < 20 µm

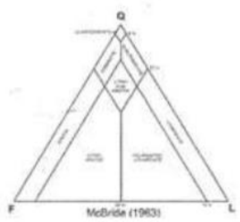
Detrital components & intraclasts	count	%	Description, remarks
$Q_{m, non-undulatory}$		26	
$Q_{m, undulatory}$		15	
$Q_{p, 2-3 xx}$		2.2	
$Q_{p, >3 xx}$		6.7	
Chert	1	0.44	
Sum Q		50.34	
Alkali feldspar		10.2	
Plagioclase			
Sum F		10.2	
$L_{v, fels}$			
$L_{v, maf}$			
L_{s}			
$L_{m, psam}$		2.7	
$L_{m, pel}$			
L...			
Sum L		2.7	
Muscovite		2.7	
Biotite			
Chlorite			
Fe oxide		1.8	
...			
...			
Psuedomatrix: ...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	10	0.5-2 mm	rounded	high

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores		3.6	
Intragranular pores		8.4	
Oversized pores	1	0.44	
Sum porosity		12.44	
Diagenetic dissolution			
Q matrix		5.3	
Phyllosilicate matrix			
...			
Sum matrix		5.3	
Q cement		7.6	
F cement		1.3	
Cc cement		1.3	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement			
Baryte cement			
Pyrite cement			
Fe-oxide cement		4.4	
Illite cement			
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement		14.6	
IGV*			
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



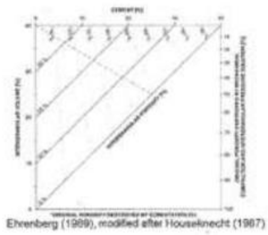


Figure A8: Thin section protocol for sample 33300 by student

Sample name: 33300 Worker: Date:	Number of counted points: 442 Distance of points: 1 mm
Granulometry: Mean grain size (µm): 200 – 300 Max. grain size (µm): 600 after comparison chart from: Sorting: Moderately sorted Roundness: 4 – 5 Sphericity: Grain contacts (relative abundance): Straight	Rock name Subarkose According to grain size: Pettijohn et al., 1987 Classification scheme after: Pettijohn et al., 1987 ————————————— according to composition: Classification scheme after: Pettijohn et al., 1987 Matrix limit (µm): 30

Detrital components & intraclasts					
	count	% (/442x100)	Description, remarks		
Qm, non-undulatory	21	4.8			
Qm, undulatory	69	16			
Qp, 2-3 xx	66	15			
Qp, >3 xx	64	14			
Chert	1	0.2			
Sum Q	221	50			
Alkali feldspar	52	12			
Plagioclase	1	0.2			
Sum F	53	12.2			
Lv-fels	0				
Lv-maf	0				
Ls-pel	1	0.2			
Lm-psam	13	2.9			
Lm-pel	12	2.7			
L...					
Sum L	26	5.8			
Muscovite	5	1.0			
Biotite	0				
Chlorite	0				
Fe oxide	3	0.7			
...					
...					
Psuedomatrix:	4	0.9			
...					
Accessory minerals	Abundance		Grain size	Roundness	Sphericity
Zircon	4				
Biotite	3				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	44	10	
Intragranular pores	42	9.5	
Oversized pores			
Sum porosity	86	19.5	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix	4	0.9	
Q cement			
F cement			
Cc cement			
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	14	3.2	
Baryte cement			
Pyrite cement			
Fe-oxide cement			
Illite cement			
Chlorite cement			
Kaolinite cement	13	2.9	
Solid bitumen cement			
Carbonate	17	3.8	
...			
Sum cement	44	9.9	
IGV*		20.8%	10 + 9.9 + 0.9 = 20.8 %
Q vein			
Cc vein			
...			
Sum veins			

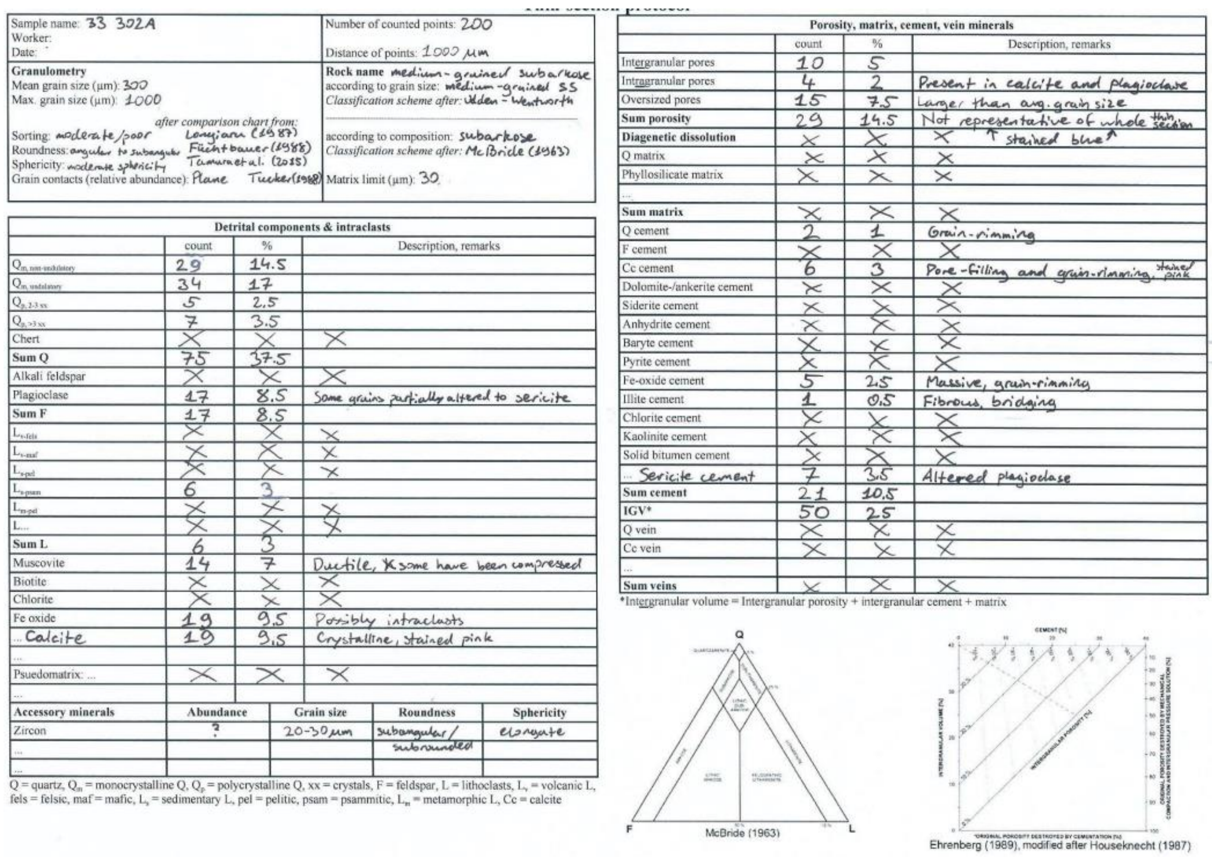
*Intergranular volume = Intergranular porosity + intergranular cement + matrix

Figure A9: Thin section protocol for sample 33300 by student

Name	Counts	% total detrital components & intraclasts	% of the total SUM
$Q_{m, non-undolatory}$	56	35	26
$Q_{m, undulatory}$	16	10	7
$Q_{p, 2-3 xx}$	17	11	8
$Q_{p>3 xx}$	4	3	2
SUM Q	93	58	43
Alkali feldspar	5	3	2
SUM F	5	3	2
$L_{volcanic-felsic}$	x		
$L_{volcanic-mafic}$	x		
$L_{sedimentary-pelitic}$		0	0
$L_{sedimentary-psammitic}$	12	14	6
$L_{sedimentary-carbonate}$	x		
$L_{metamorphic-pelitic}$	x		
$L_{metamorphic-metapsammite}$	50	31	23
$L_{metamorphic-metavolcanic}$	x		
SUM L	62	39	29
Muscovite	1		
Biotite	x		

Name	Counts	% total porosity, matrix, cement, vein minerals	% of the total SUM
Intergranular pores	3	18	1
Intragranular pores	40	60	19
Oversized pores	x		
SUM POROSITY	43	78	20
Q-matrix	x		
Phyllosilicate matrix	x		
Quartz-cement	3	5	1
Feldspar-cement	0	0	0
Carbonate-cement	x		
Calcite-cement	8	15	4
Hematite-cement	0	0	0
Gips&anhydrite-cement	0	0	0
Illite cement			
Meshwork illite cement	0	0	0
Cutanes illite cement			
Grain-rimming crystals illite cement	0	0	0
SUM CEMENT	11	20	5
IGV*	14	25	7
Intergranular volume = Intergranular porosity + intergranular cement + matrix			

Figure A10: Thin section protocol for sample 33300 by student



Sample name: 33 302A Worker: Date:	Number of counted points: 200 Distance of points: 1000 µm
Granulometry Mean grain size (µm): 300 Max. grain size (µm): 1000 *after comparison chart from:* Sorting: moderate/poor — Longiaru (1987) Roundness: angular to subangular — Füchtbauer (1988) Sphericity: moderate sphericity — Tamura et al. (2015) Grain contacts (relative abundance): Plane — Tucker (1988)	**Rock name** medium-grained subarkose according to grain size: medium-grained SS *Classification scheme after:* Udden - Wentworth according to composition: subarkose *Classification scheme after:* McBride (1963) Matrix limit (µm): 30

Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m, non-undulatory}$	29	14.5	
$Q_{m, undulatory}$	34	17	
$Q_{p, 2\text{-}3 xx}$	5	2.5	
$Q_{p, >3 xx}$	7	3.5	
Chert	X	X	X
Sum Q	75	37.5	
Alkali feldspar	X	X	X
Plagioclase	17	8.5	Some grains partially altered to sericite
Sum F	17	8.5	
$L_{v\text{-}fels}$	X	X	X
$L_{v\text{-}maf}$	X	X	X
$L_{s\text{-}pel}$	X	X	X
$L_{s\text{-}psam}$	6	3	
$L_{m\text{-}pel}$	X	X	X
L...	X	X	X
Sum L	6	3	
Muscovite	14	7	Ductile, some have been compressed
Biotite	X	X	X
Chlorite	X	X	X
Fe oxide	19	9.5	Possibly intraclasts
... Calcite	19	9.5	Crystalline, stained pink
...			
Psuedomatrix: ...	X	X	X
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	?	20-30 µm	subangular / subrounded	elongate
...				
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	10	5	
Intragranular pores	4	2	Present in calcite and plagioclase
Oversized pores	15	7.5	Larger than avg. grain size
Sum porosity	29	14.5	Not representative of whole thin section
Diagenetic dissolution	X	X	X stained blue
Q matrix	X	X	X
Phyllosilicate matrix	X	X	X
...			
Sum matrix	X	X	X
Q cement	2	1	Grain-rimming
F cement	X	X	X
Cc cement	6	3	Pore-filling and grain-rimming, stained pink
Dolomite-/ankerite cement	X	X	X
Siderite cement	X	X	X
Anhydrite cement	X	X	X
Baryte cement	X	X	X
Pyrite cement	X	X	X
Fe-oxide cement	5	2.5	Massive, grain-rimming
Illite cement	1	0.5	Fibrous, bridging
Chlorite cement	X	X	X
Kaolinite cement	X	X	X
Solid bitumen cement	X	X	X
... Sericite cement	7	3.5	Altered plagioclase
Sum cement	21	10.5	
IGV*	50	25	
Q vein	X	X	X
Cc vein	X	X	X
...			
Sum veins	X	X	X

*Intergranular volume = Intergranular porosity + intergranular cement + matrix

Figure A11: Thin section protocol for sample 33302 by student

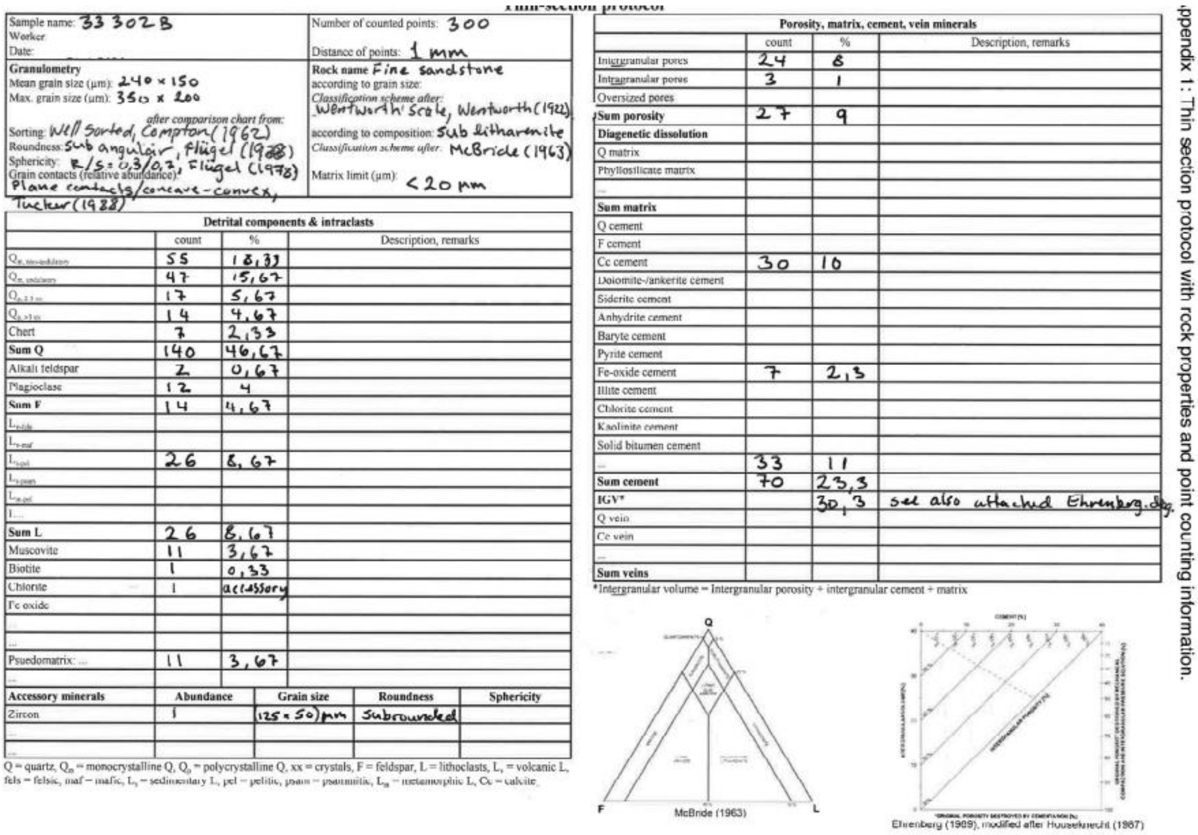
Prøvenavn: 33 302A	Antall punkter telt: 217 Distanse mellom punkter: 1 mm
Granulometri Gjennomsnittlig kornstørrelse (µm): 220 Max. kornstørrelse (µm): 600 Etter sammenligningsdiagram fra: Sortering: Moderat/god sortering (Longiaru, 1987) Rundhet: Subangulær til angulær (Pettijohn et al., 1987) Sfærisitet: Lav sfærisitet (Pettijohn et al., 1987) Kornkontakter: Punkt- og plankontakter (Nichols, 2009, Fig. 18.16)	**Bergartsnavn** Etter kornstørrelse: Finkornet sandstein Klassifikasjonsskjema etter: Udden (1914); Wentworth (1922) Etter komposisjon: Sublitarenitt Klassifikasjonsskjema etter: McBride (1963)

Primære komponenter og intraklaster			
	Telt	%	Beskrivelse, bemerkninger
$K_{m, ikke\text{-}undulatorisk}$	42	19,4	Ikke undulatorisk utslettelse, grå/hvit i dobbeltpolarisert lys, fargeløs i enkeltpolarisert lys. For det meste angulære/subangulære, lav sfærisitet. Kornstørrelse: 150–250 µm.
$K_{m, undulatorisk}$	58	26,7	Den har undulatorisk utslettelse, grå/hvit i dobbeltpolarisert lys, fargeløs i enkeltpolarisert lys. For det meste angulære/subangulære, lav sfærisitet. Kornstørrelse: 150–250 µm.
$K_{p, >3 xx}$	12	5,5	Har mer enn 3 krystaller i seg, det er en retning på krystallene. Fargen varierer dobbeltpolarisert lys pga. forskjellige krystaller i ett korn i. Fargeløst i enkeltpolarisert lys. For det meste angulære/subangulære. Lav til medium sfærisitet. Kornstørrelse: 150–250 µm.
Chert	2	0,9	Svart med hvite små prikker i seg i dobbeltpolarisert lys. Fargeløst, men ser skitten ut i enkeltpolarisert lys. 100–200 µm.
Sum K	**114**	**52,5**	
Feltspat	**11**	**5,1**	Klarer ikke å se tvillinger. Illitt vokser langs tvillingaksene som gjør feltspaten mulig å identifisere. Noen korn er også oppløst slik at man kan se intragranulære porer i den. Grålig farge dobbeltpolarisert lys, hvit skitten enkeltpolarisert lys. Angulære/subangulære, lav til medium sfærisitet. Kornstørrelse: 100–300 µm.
$L_{s\text{-}pel}$	11	5,1	Brune i enkelt- og dobbeltpolarisert lys. Angulære, lav sfærisitet. Ligger klemt mellom korn. Kornstørrelse: 300–600 µm.
$L_{m\text{-}pel}$	8	3,7	Består av flere mineraler, illitt og kvarts. Illitten ser nålete ut med en retning i seg. Klastene er avrundet og avlange. Kornstørrelse: 200–500 µm.
Sum L	**19**	**8,8**	
Muskovitt	10	4,6	Høy dobbeltbrytning i dobbeltpolarisert lys. Fargeløst i enkeltpolarisert lys. Én bestemt kløvretning. Størrelse: 200–500 µm.
Psuedomatriks	9	4,1	Ligger klemt mellom korn. Består av forskjellige komponenter. Brunlig i enkelt- og dobbeltpolarisert lys.

Porøsitet og sement			
	Telt	%	Beskrivelse, bemerkninger
Intergranulære porer	6	2,8	Vanskelig å skille fra intragranulære porer. Størrelse: 100–200 µm.
Intragranulære porer	17	7,8	Oppløste korn. Vanligvis feltspat som er oppløst. Størrelse: 100–300 µm.
Overdimensjonerte porer	13	6,0	Store porerom. Størrelse: 250–1000 µm.
Sum porøsitet	**36**	**16,6**	
Diagenetisk dissolusjon	**30**	**13,8**	
Kvartssement	1	0,5	Finnes kvartssement på noen få korn. Må lete litt for å finne det.
Kalsittsement	8	3,7	Rosa farge i enkelt- og dobbeltpolarisert lys. Kløvretning i to retninger på rundt 90°.
Illittsement	5	2,3	Gult/oransje i dobbeltpolarisert lys, fargeløst i enkeltpolarisert lys. Høy dobbeltbrytning. Ligger mellom korn.
Kaolinittsement	4	1,8	Mørkt med hvite linjer som ligger i et spesielt mønster dobbeltpolarisert lys. Fargeløst i enkeltpolarisert lys med det samme spesielt mønsteret, tåkete. Ligger mellom korn. Størrelse: ca. 100 µm.
Sum sement	**18**	**8,3**	
Intergranulært volum	**24**	**11,1**	

Tilleggsmineraler	Mengde	Kornstørrelse	Rundhet	Sfærisitet
Biotitt	Sjelden	200 µm	Angulær	Lav sfærisitet
Zirkon	Sjelden	40 µm	Avrundet	Høy sfærisitet
Vulkansk litisk fragment	Sjelden	100–200 µm	Avrundet	Høy sfærisitet
Ukjent grønt mineral	Sjelden	110 µm	Avrundet	Høy sfærisitet

Figure A12: Thin section protocol for sample 33302 by student



Thin-section protocol

Sample name: 33 302B
Worker:
Date:

Number of counted points: 300
Distance of points: 1 mm

Granulometry
Mean grain size (µm): 240 × 150
Max. grain size (µm): 350 × 200
after comparison chart from:
Sorting: Well Sorted, Compton (1962)
Roundness: Sub angulair, Flügel (1978)
Sphericity: R/S = 0,3/0,7, Flügel (1978)
Grain contacts (relative abundance): Plane contacts/concave-convex, Tucker (1988)

Rock name Fine sandstone
according to grain size:
Classification scheme after: Wentworth' Scale, Wentworth (1922)
according to composition: Sub litharenite
Classification scheme after: McBride (1963)
Matrix limit (µm): < 20 µm

Detrital components & intraclasts	count	%	Description, remarks
$Q_{m, non-undulatory}$	55	18,33	
$Q_{m, undulatory}$	47	15,67	
$Q_{p, 2-3 xx}$	17	5,67	
$Q_{p, >3 xx}$	14	4,67	
Chert	7	2,33	
Sum Q	140	46,67	
Alkali feldspar	2	0,67	
Plagioclase	12	4	
Sum F	14	4,67	
L_{v-fels}			
L_{v-maf}			
L_{s-pel}	26	8,67	
L_{s-psam}			
L_{m-pel}			
L...			
Sum L	26	8,67	
Muscovite	11	3,67	
Biotite	1	0,33	
Chlorite	1	accessory	
Fe oxide			
...			
...			
Psuedomatrix: ...	11	3,67	
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	1	(125 × 50) µm	Subrounded	
...				
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores	24	8	
Intragranular pores	3	1	
Oversized pores			
Sum porosity	27	9	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement			
F cement			
Cc cement	30	10	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement			
Baryte cement			
Pyrite cement			
Fe-oxide cement	7	2,3	
Illite cement			
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
...	33	11	
Sum cement	70	23,3	
IGV*		30,3	see also attached Ehrenberg diag.
Q vein			
Cc vein			
...			
Sum veins			

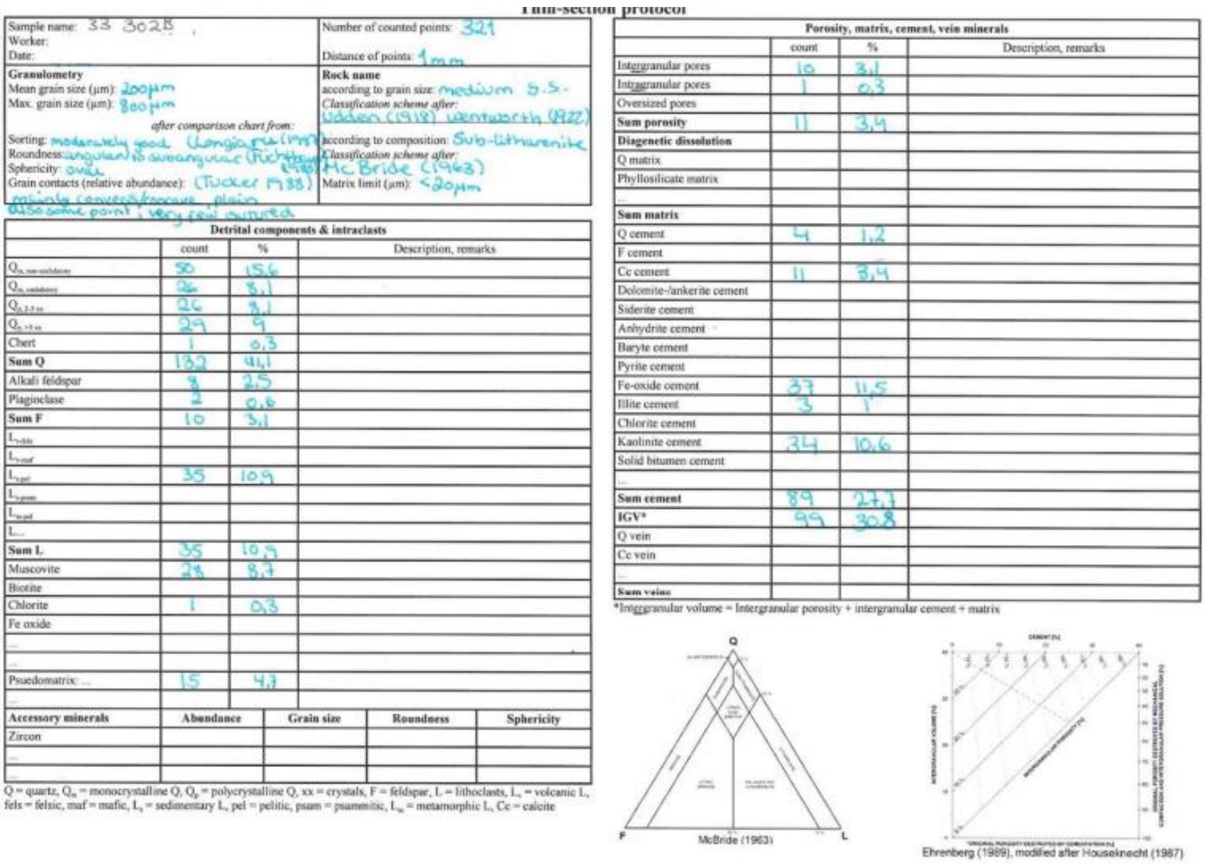
*Intergranular volume = Intergranular porosity + intergranular cement + matrix

McBride (1963)

Ehrenberg (1989), modified after Houseknecht (1987)

Appendix 1: Thin section protocol with rock properties and point counting information.

Figure A13: Thin section protocol for sample 33302B by student



Thin-section protocol

Sample name: 33 302B
Worker:
Date:

Number of counted points: 321
Distance of points: 1 mm

Granulometry
Mean grain size (µm): 200 µm
Max. grain size (µm): 800 µm
after comparison chart from:
Sorting: moderately good (Longiaru (1987))
Roundness: angular to subangular (Fichtbauer (1988))
Sphericity: oval
Grain contacts (relative abundance): (Tucker 1988) mainly convex/concave, plain also some point, very few sutured

Rock name
according to grain size: medium S.S.
Classification scheme after: Udden (1918) Wentworth (1922)
according to composition: Sub-litharenite
Classification scheme after: McBride (1963)
Matrix limit (µm): < 20 µm

Detrital components & intraclasts	count	%	Description, remarks
$Q_{m, non-undulatory}$	50	15,6	
$Q_{m, undulatory}$	26	8,1	
$Q_{p, 2-3 xx}$	26	8,1	
$Q_{p, >3 xx}$	29	9	
Chert	1	0,3	
Sum Q	132	41,1	
Alkali feldspar	8	2,5	
Plagioclase	2	0,6	
Sum F	10	3,1	
L_{v-fels}			
L_{v-maf}			
L_{s-pel}	35	10,9	
L_{s-psam}			
L_{m-pel}			
L...			
Sum L	35	10,9	
Muscovite	28	8,7	
Biotite			
Chlorite	1	0,3	
Fe oxide			
...			
...			
Psuedomatrix: ...	15	4,7	
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon				
...				
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores	10	3,1	
Intragranular pores	1	0,3	
Oversized pores			
Sum porosity	11	3,4	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	4	1,2	
F cement			
Cc cement	11	3,4	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement			
Baryte cement			
Pyrite cement			
Fe-oxide cement	37	11,5	
Illite cement	3	1	
Chlorite cement			
Kaolinite cement	34	10,6	
Solid bitumen cement			
...			
Sum cement	89	27,7	
IGV*	99	30,8	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix

McBride (1963)

Ehrenberg (1989), modified after Houseknecht (1987)

Figure A14: Thin section protocol for sample 33302B by student

Sample name: 33 3028 Worker: Date:	Number of counted points: 197 Distance of points: 1 mm
Granulometry Mean grain size (µm): 250 Max. grain size (µm): 700 *after comparison chart from:* Sorting: Moderate Roundness: Subangular Sphericity: Low – medium is dominating Grain contacts (relative abundance): Point and plane	**Rock name** according to grain size: Fine sandstone *Classification scheme after:* Udden - Wentworth scale according to composition: Sublitharenite *Classification scheme after:* Mc Bride (1963) Matrix limit (µm):

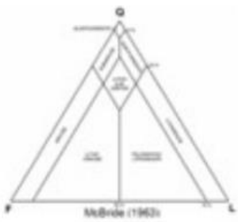
Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m, non-undulatory}$	34	17.3	
$Q_{m, undulatory}$	57	28.9	
$Q_{p, 2-3 xx}$	–	–	
$Q_{p, >3 xx}$	9	4.6	
Chert	2	1	
Sum Q	102	51.8	
Alkali feldspar			
Plagioclase	4	2	
Sum F	7	3.6	Found 3 more, but could not classify
L_{v-fels}	–	–	
L_{v-maf}	–	–	
L_{s-pel}	11	5.6	
L_{s-psam}	–	–	
L_{m-pel}	–	–	
L... metasedimentary	17	8.6	
Sum L	28	14.2	
Muscovite	9	4.6	
Biotite	–	–	
Chlorite	–	–	
Fe oxide	–	–	
...			
...			
Pseudomatrix: ...	5	2.5	
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	–	–	–	–
...				
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	13	6.6	
Intragranular pores	2	1	
Oversized pores	–	–	
Sum porosity	15	7.6	
Diagenetic dissolution	7	3.6	
Q matrix	–	–	
Phyllosilicate matrix	–	–	
...			
Sum matrix	–	–	
Q cement	3	1.5	
F cement	–	–	
Cc cement	17	8.6	
Dolomite-/ankerite cement	–	–	
Siderite cement	–	–	
Anhydrite cement	–	–	
Baryte cement	–	–	
Pyrite cement	–	–	
Fe-oxide cement	–	–	
Illite cement	3	1.5	
Chlorite cement	–	–	
Kaolinite cement	1	0.5	
Solid bitumen cement	–	–	
...			
Sum cement	24	12.2	
IGV*	37	18.8	
Q vein	–	–	
Cc vein	–	–	
...			
Sum veins	–	–	

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



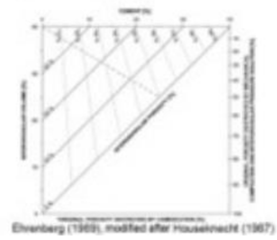


Figure A15: Thin section protocol for sample 33302B by student

39650	Number of counted points: 188 Distance of points: 0,5 mm – 1 mm
Granulometry Mean grain size (µm): 20 Max. grain size (µm): 50 *after comparison chart from:* Sorting: very well sorted Roundness: Rounded Sphericity: vary from low to medium Grain contacts (relative abundance): concave and convex	**Rock name** according to grain size: Fine sand *Classification scheme after:* Wentworth according to composition: Subarkose *Classification scheme after:* Mcbride (1963) Matrix limit (µm):

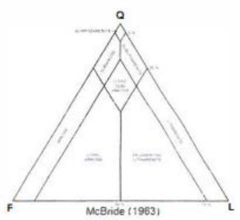
Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m, non-undulatory}$	10	5.3	
$Q_{m, undulatory}$	65	34.6	
$Q_{p, 2-3 xx}$	15	8	
$Q_{p, >3 xx}$			
Chert	4	2,1	
Sum Q	94	50	
Alkali feldspar	5	2,7	
Plagioclase	18	9,6	
Sum F	23	12,3	
L_{v-fels}			
L_{v-maf}	2	1	
L_{s-pel}			
L_{s-psam}			
L_{m-pel}			
L....			
Sum L	2	1	
Muscovite			
Biotite			
Chlorite			
Fe oxide			
...			
...			
Psuedomatrix: ...			
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon				
Amphibole	1	0,5 mm	rounded	low
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	35	18,6	
Intragranular pores	3	1,6	
Oversized pores	2	1	
Sum porosity	40	21,2	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	8	4,3	
F cement	3	1,6	
Cc cement	7	3,7	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	3	1,6	no gypsum counted?
Baryte cement			
Pyrite cement			
Fe-oxide cement			
Illite cement	8	4,3	
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement	29	15,5	
IGV*	64	34%	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



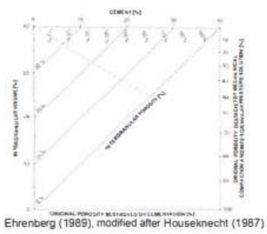


Figure A16: Thin section protocol for sample 39650 by student

Sample name: 39560

Number of counted points: 247
Number of counted grains: 170

Mean grain size: 200 µm
Max grain size: 350 µm

Sorting: Good to moderately good sorted. **Roundness:** Rounded to sub rounded.

Sphericity: Varies.
Grain contact: Primary concave-convex and plane contacts.

Rock name:
According to grain size: Arenaccous sandstone
Classification scheme after: Miall (1990)

According to composition: Subarkose
Classification scheme after: McBride (1963)

Quartz	Counted:	% of points:	% of grains:
$Q_{m, non-undulatory}$	69	28	41
$Q_{m, undulatory}$	28	11	16
$Q_{p, 2-3 crystals}$	25	10	15
$Q_{p, >3 crystals}$	11	4	6
Chert	8	3	5
Total	141	57	83
Feldspar			
Alkalifeldspar	16	6	9
Plagioclase	8	3	5
Total	24	10	14
Lithic fragments			
$L_{v maf}$	2	1	1
$L_{s pel}$	3	1	2
Total	5	2	3
Pores			
Intergranular	17	7	
Intragraular	2	1	
Total	19	8	
Cement			
Quartz	15	6	
Feldspar	1	0	
Calcite	16	9	
Anhydrite	5	2	
Gypsum	2	1	
Illite	19	8	
Total	58	23	

Figure A17: Thin section protocol for sample 39650 by student

Sample name:
Worker: **Sample 39650**
Date:

Number of counted points: 206 Total, 180 Detrital grains
Distance of points: 1.0 mm

Granulometry
Mean grain size (µm): 200 µm
Max. grain size (µm): 450 µm
after comparison chart from:
Sorting: Well-Sorted – Pettijohn et al (1987)
Roundness: Subrounded } Powers (1953)
Sphericity: Round to oval }
Grain contacts (relative abundance): Plane, Concave-Convex and Sutured

Rock name
according to grain size: Fine-grained SS
Classification scheme after: Miall (2000)
according to composition: Subarkose/Sub-Litharenite
Classification scheme after: McBride (1963)
Matrix limit (µm): 20 µm

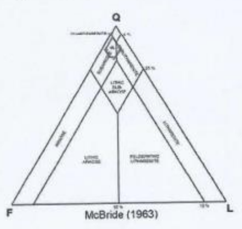
Detrital components & intraclasts	count	%	Description, remarks
$Q_{m, non-undulatory}$	38	21	
$Q_{m, undulatory}$	60	34	
$Q_{p, 2-3 xx}$	29	16	
$Q_{p, >3 xx}$	24	13	Many elongated crystals inside clast
Chert	6	3	
Sum Q	157	87	
Alkali feldspar	11	6	Most with twins
Plagioclase	5	3	
Sum F	16	9	
L_{v-fels}	2	1	
L_{v-maf}	3	2	
L_{s-pel}	1	0.5	
L_{s-psam}	1	0,5	Meta psammite w. Quartz inside lithoclast
L_{m-pel}			
L...			
Sum L	7	4	
Muscovite	—	—	
Biotite	—	—	
Chlorite	—	—	
Fe oxide	—	—	
...			
...			
Psuedomatrix: ...	—	—	
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	7	~ 100 µm	Rounded	Round
... Turmaline	3	~ 40 µm	Angular	Elongated
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores	7	3	
Intragranular pores	—	—	
Oversized pores	—	—	
Sum porosity	7	3	
Diagenetic dissolution	—	—	
Q matrix	—	—	
Phyllosilicate matrix	—	—	
...			
Sum matrix	—	—	
Q cement	6	3	
F cement	—	—	
Cc cement	2	1	
Dolomite-/ankerite cement	—	—	
Siderite cement	—	—	
Anhydrite cement	—	—	
Baryte cement	—	—	
Pyrite cement	—	—	
Fe-oxide cement	2	1	
Illite cement	9	4	
Chlorite cement	—	—	
Kaolinite cement	—	—	
Solid bitumen cement	—	—	
...			
Sum cement	19	9	
IGV*	12	6	3% Pores 9% Cement 0% Matrix
Q vein	—	—	
Cc vein	—	—	
...	—	—	
Sum veins	—	—	

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



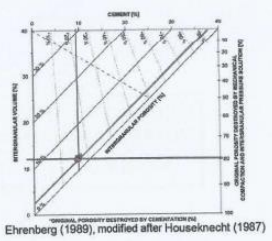


Figure A18: Thin section protocol for sample 39650 by student

Sample name: 39650 Worker: Date:	Number of counted points: 395 Distance of point: 1mm
Granulometry *Mean grain size:* 185µm (based on 100 counts) *Max. grain size:* 360µm (based on 100 counts) *Sorting:* well sorted (Folk, 1968) *Roundness:* sub-rounded to rounded (Pettijohn, 1987) *Sphericity :* elongated to equant *Grain contact:* Plane (45%), Concave-convex (30%), sutured (17%) and point (8%)	**Rock name** *According to mean grain size:* Fine to medium sandstone according to Udden-Wentworth scale (Miall, 2000). Classification: Sub-arkose (McBride, 1963)

Detrital components & Intraclasts			
	Count	*%*	*Remarks*
$Q_{m,\ non\text{-}undulatory}$	83	21	
$Q_{m,\ undulatory}$	93	24	
$Q_{p,\ 2\text{-}3\ xx}$	20	5.1	
$Q_{p,\ >3\ xx}$	17	4.3	Within some grains, crystals are elongated.
Chert	3	0.8	Coarse
Sum Q	**216**	**54.7**	
Alkalifeldspar	51	13	
Plagioclase	16	4.1	Albite twinning is obvious in some of the grains
Sum F	**67**	**17**	Microcline twinning is obvious in some of the grains
$L_{volcanic\text{-}felsic}$	1	0.3	Needle shaped crystals within groundmass
$L_{sedimentary\text{-}pelitic}$	2	0.5	Ductile grain, with clay-minerals
$L_{meta\text{-}sammite}$	8	2	Semi ductile, polycrystalline with mica
$L_{plutonic}$	6	1.5	Grains with phennocrysts of feldspar and quartz
Sum L	**17**	**4.3**	

Accessory minerals	*Abundance*	*Sphericity*
Zircon	2	Elongated
Tourmaline	1	Equant
Rutile	1	Equant to Elongated

Porosity, matrix, cement			
	Count	%	Remarks
Intergranular pores	50	13	
Intragranular pores	1	0.3	Due to dissolved feldspar
Oversized pores	1	0.3	
Sum porosity:	**52**	**13**	
Quartz cement	24	6.1	
Feldspar cement	3	0.8	
Calcite cement	9	2	
Anhydrite cement	3	0.8	
Fe-oxide cement	2	0.5	Grain rim
Chlorite cement	1	0.3	Grain rim
Illite cement	1	0.3	Grain rim
Sum cement	**43**	**11**	

Figure A19: Thin section protocol for sample 39650 by student

Thin-section protocol

Sample name: 79650 Worker: Date: ;	Number of counted points: 208 Distance of points: 0,5mm
Granulometry Mean grain size (µm): 200 Max. grain size (µm): 400 *after comparison chart from:* Sorting: Roundness: 0,5 (FLÜGEL) Sphericity: 0,5-0,7 (FLÜGEL) Grain contacts (relative abundance): PLANE	**Rock name** according to grain size: FINE-MEDIUM SANDSTONE *Classification scheme after:* MIALL 1990. according to composition: *Classification scheme after:* Matrix limit (µm):

Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m,\ non\text{-}undulatory}$	87	41,8	
$Q_{m,\ undulatory}$	32	16,5	
$Q_{p,\ 2\text{-}3\ xx}$	16	7,7	
$Q_{p,\ >3\ xx}$	15	7,2	
Chert	7	3,35	
Sum Q	157	75,55	
Alkali feldspar	3	1,4	
Plagioclase	7	3,35	
Sum F	10	4,75	
$L_{v\text{-}fels}$			
$L_{v\text{-}maf}$			
$L_{s\text{-}pel}$	20		accesory
$L_{s\text{-}psam}$			
$L_{m\text{-}pel}$			
L...PLUTONIC	2	0,96	
Sum L		0,96	
Muscovite			
Biotite			
Chlorite			
Fe oxide			
...			
...			
Psuedomatrix: ...			
...			

Accessory minerals	**Abundance**	**Grain size**	**Roundness**	**Sphericity**
Zircon				
BIOTITE	2	0,1mm	ROUND	0,5 (FLÜGEL)
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	28	13,46	
Intragranular pores	2	0,96	
Oversized pores			
Sum porosity	30	14,42	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	2	0,96	
F cement	1	0,48	
Cc cement	2	0,96	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement			
Baryte cement			
Pyrite cement			
Fe-oxide cement	2	0,96	
Illite cement	2	0,96	
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement	9	4,32	
IGV*			
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix

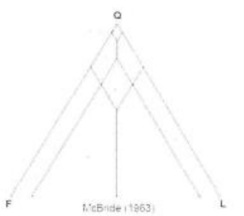


Figure A20: Thin section protocol for sample 39650 by student

Thin-section protocol Appendix 1

Sample name: 39650 Worker: Date:	Number of counted points: 190 Distance of points: 1mm
Granulometry Mean grain size (µm): 212 Max. grain size (µm): 400 after comparison chart from: Sorting: moderate to well Roundness: Subangular to subrounded Sphericity: medium to high Grain contacts (relative abundance): Plane with some point	**Rock name** Arenaceous sediments according to grain size: mean 212 µm Classification scheme after: Udden-Wentworth scale according to composition: Subarkose Classification scheme after: McBride 1963 Matrix limit (µm): 20µm

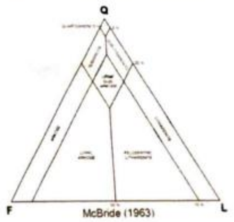
Detrital components & intraclasts	count	%	Description, remarks
$Q_{m, non-undulatory}$	3	1,6	
$Q_{m, undulatory}$	44	23,2	
$Q_{p, 2-3 xx}$	7	3,7	
$Q_{p, >3 xx}$	39	20,5	
Chert	2	1,1	
Sum Q	95	50	
Alkali feldspar	20	10,5	
Plagioclase	13	6,8	
Sum F	33	17,4	
L_{v-fels}	1	0,5	
L_{v-maf}	4	2,1	
L_{s-pel}	0	20	
L_{s-psam}	5	2,6	
L_{m-pel}	5	2,6	
L...	0	0	
Sum L	15	7,9	
Muscovite	2	1,1	
Biotite	0	0	
Chlorite	0	0	
Fe oxide	0	0	
...			
...			
Psuedomatrix: ...	1	0,5	
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	0			
Gypsum	1	200 µm	Subrounded	High
Sand stone Clast	3	310 µm	Rounded	Medium

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores	20	10,5	
Intragranular pores	0	0	
Oversized pores	0	0	
Sum porosity	20	10,5	
Diagenetic dissolution	0	0	
Q matrix	3	1,6	
Phyllosilicate matrix	3	1,6	
...			
Sum matrix	6	3,2	
Q cement	4	2,1	
F cement	5	2,6	
Cc cement	3	1,6	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement			
Baryte cement			
Pyrite cement			
Fe-oxide cement			
Illite cement	2	1,1	
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement	14	7,4	
IGV*	40	21,1	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



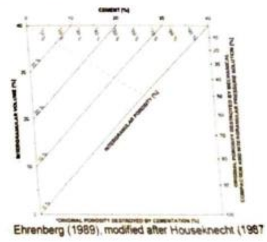


Figure A21: Thin section protocol for sample 39650 by student

Sample name: 39653 _ 0 4	Number of counted points: 200 Distance of points: 1mm
Granulometry Mean grain size (µm): 170µm [Tucker (1981)] Max. grain size (µm): 360µm [Longiaru (1987)] [Füchtbauer (1988)] after comparison chart from: Sorting: Good to very good sorting [Flügel (1978)] Roundness: Subrounded [Hiatt (1993)] Sphericity: moderate to high (0,5-0,7) [Pettijohn (1975)] Grain contacts (relative abundance): dominant is ~~...~~ concave contact, secondary is Plane contact	**Rock name** ~~Arkose-Subarkose~~ according to grain size: fine grained Sandstone Classification scheme after: [Udden-Wentworth scale] [McBride (1963)] according to composition: Subarkose Classification scheme after: [McBride (1963)] Matrix limit (µm): 20µm

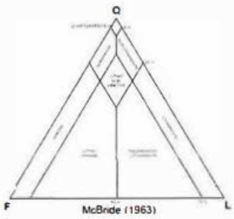
Detrital components & intraclasts	count	%	Description, remarks
$Q_{m, non-undulatory}$	53	26,5	
$Q_{m, undulatory}$	23	11,5	
$Q_{p, 2-3 xx}$	4	2	
$Q_{p, >3 xx}$	4	2	
Chert	13	6,5	
Sum Q	97	48,5	
Alkali feldspar	17	8,5	
Plagioclase	2	1	
Sum F	19	9,5	
L_{v-fels}	–	–	
L_{v-maf}	–	–	
L_{s-pel}	1	0,5	
L_{s-psam}	2	1	
L Carbonate clast	1	0,5	
L metamorphic clast	2	–	
Sum L	6	3	
Muscovite	1	0,5	
Biotite	2	1	
Chlorite	–	–	
Fe oxide	1	0,5	
Hornblende	1	0,5	
...			
Psuedomatrix ...	–	–	
...	5	2,5	

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon				
Apatite	1	0,04mm	SRounded	high

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores	15	7,5	
Intragranular pores	3	1,5	
Oversized pores	1	0,5	
Sum porosity	19	9,5	
Diagenetic dissolution	13	6,5	
Q matrix	3	1,5	
Phyllosilicate matrix	–	–	
...			
Sum matrix	3	1,5	
Q cement	9	4,5	
F cement	2	1	
Cc cement	7	3,5	
Dolomite-/ankerite cement	–	–	
Siderite cement	–	–	
Anhydrite cement	6	3	
Baryte cement	–	–	
Pyrite cement	–	–	
Fe-oxide cement	3	1,5	
Illite cement	6	3	
Chlorite cement	1	0,5	
Kaolinite cement	–	–	
Solid bitumen cement	–	–	
Gypsum cement	4	2	
Sum cement	37	18,5	
IGV*		28	
Q vein	–	–	
Cc vein	–	–	
...			
Sum veins	–	–	

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



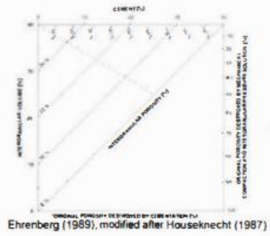
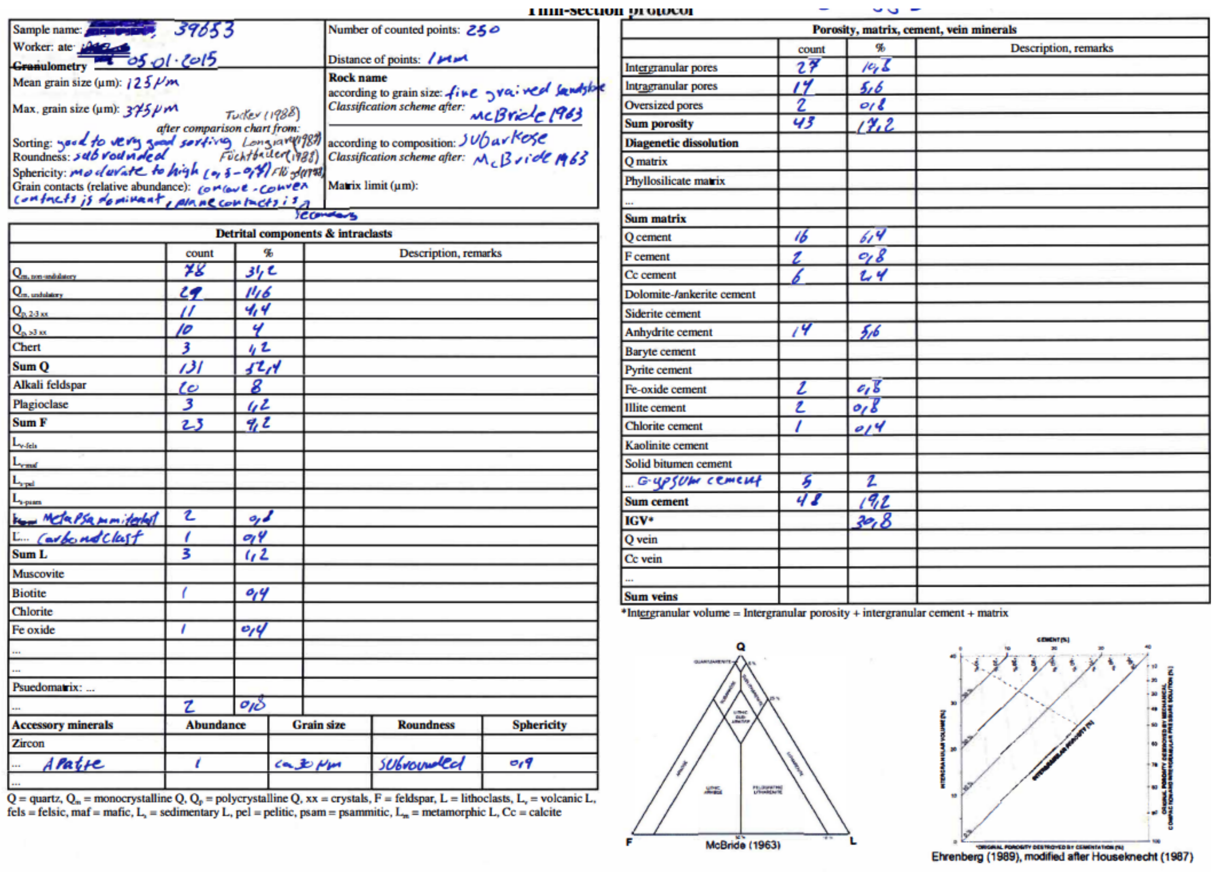


Figure A22: Thin section protocol for sample 39653 by student



Sample name: [redacted] 39653	Number of counted points: 250
Worker: [redacted] ate: 05.01.2015	Distance of points: 1 mm
~~Granulometry~~	**Rock name**
Mean grain size (µm): 125 µm	according to grain size: fine grained sandstone; *Classification scheme after:* McBride 1963
Max. grain size (µm): 375 µm	
after comparison chart from: Tucker (1988)	
Sorting: good to very good sorting — Longiaru (1987)	according to composition: subarkose; *Classification scheme after:* McBride 1963
Roundness: subrounded — Füchtbauer (1988)	
Sphericity: moderate to high (0,8–0,9) Flügel (1978)	
Grain contacts (relative abundance): concave-convex contacts is dominant, plane contacts is a secondary	Matrix limit (µm):

Detrital components & intraclasts	count	%	Description, remarks
$Q_{m, non-undulatory}$	78	31,2	
$Q_{m, undulatory}$	29	11,6	
$Q_{p, 2\text{-}3\ xx}$	11	4,4	
$Q_{p, >3\ xx}$	10	4	
Chert	3	1,2	
Sum Q	131	52,4	
Alkali feldspar	20	8	
Plagioclase	3	1,2	
Sum F	23	9,2	
$L_{v\text{-}fels}$			
$L_{v\text{-}maf}$			
$L_{s\text{-}pel}$			
$L_{s\text{-}psam}$			
L_m Metapsammiteclast	2	0,8	
L... Carbonateclast	1	0,4	
Sum L	3	1,2	
Muscovite			
Biotite	1	0,4	
Chlorite			
Fe oxide	1	0,4	
...			
...			
Psuedomatrix: ...			
...	2	0,8	

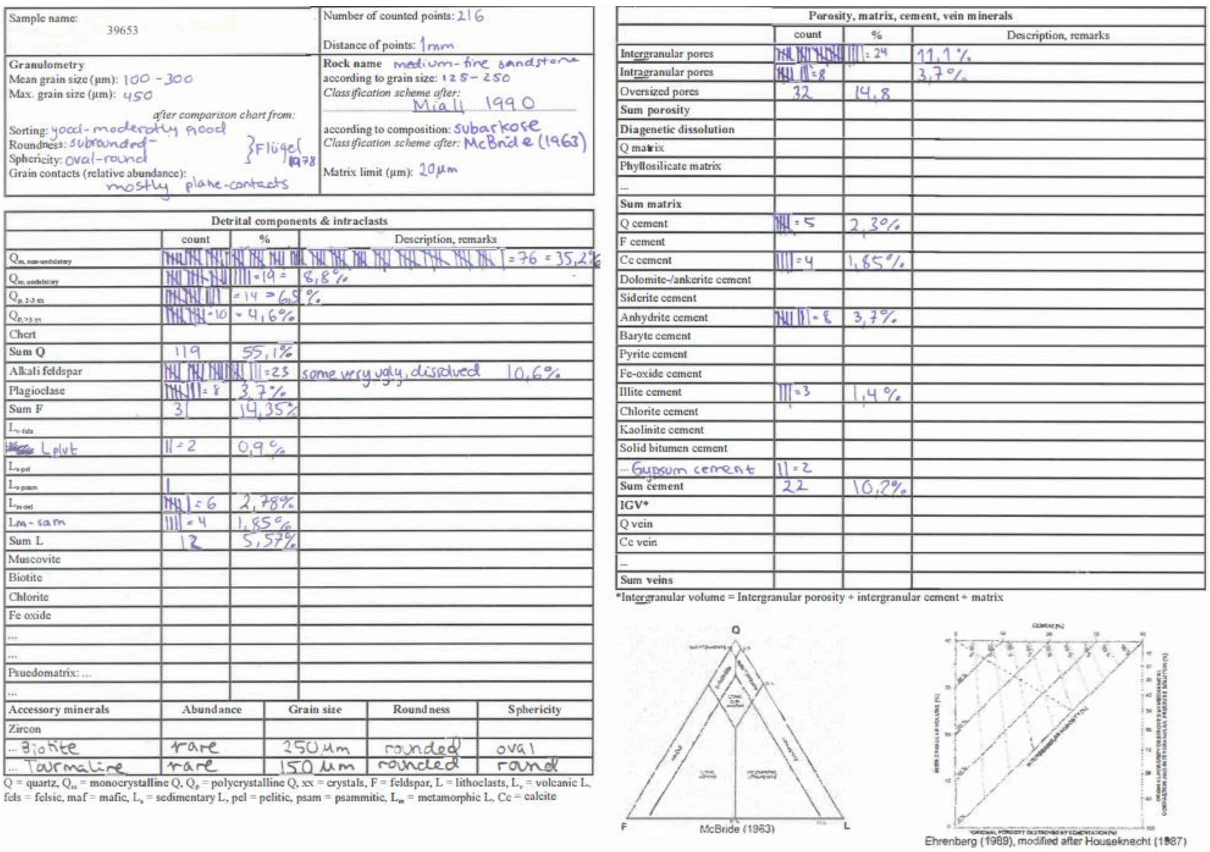
Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon				
... Apatite	1	ca 30 µm	subrounded	0,9
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores	27	10,8	
Intragranular pores	14	5,6	
Oversized pores	2	0,8	
Sum porosity	43	17,2	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	16	6,4	
F cement	2	0,8	
Cc cement	6	2,4	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	14	5,6	
Baryte cement			
Pyrite cement			
Fe-oxide cement	2	0,8	
Illite cement	2	0,8	
Chlorite cement	1	0,4	
Kaolinite cement			
Solid bitumen cement			
... Gypsum cement	5	2	
Sum cement	48	19,2	
IGV*		30,8	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix

Figure A23: Thin section protocol for sample 39653 by student



Sample name: 39653	Number of counted points: 216
	Distance of points: 1 mm
Granulometry	Rock name medium-fine sandstone
Mean grain size (µm): 100 – 300	according to grain size: 125 – 250; *Classification scheme after:* Miall 1990
Max. grain size (µm): 450	
after comparison chart from:	
Sorting: good – moderately good	according to composition: subarkose; *Classification scheme after:* McBride (1963)
Roundness: subrounded – } Flügel 1978	
Sphericity: oval – round	
Grain contacts (relative abundance): mostly plane-contacts	Matrix limit (µm): 20 µm

Detrital components & intraclasts	count	%	Description, remarks
$Q_{m, non-undulatory}$	= 76	= 35,2%	
$Q_{m, undulatory}$	= 19	= 8,8%	
$Q_{p, 2\text{-}3\ xx}$	= 14	= 6,5%	
$Q_{p, >3\ xx}$	= 10	= 4,6%	
Chert			
Sum Q	119	55,1%	
Alkali feldspar	= 23		some very ugly, dissolved 10,6%
Plagioclase	= 8	3,7%	
Sum F	31	14,35%	
$L_{v\text{-}fels}$			
L plut	= 2	0,9%	
$L_{s\text{-}pel}$			
$L_{s\text{-}psam}$	I		
$L_{m\text{-}sed}$	= 6	2,78%	
Lm – sam	= 4	1,85%	
Sum L	12	5,57%	
Muscovite			
Biotite			
Chlorite			
Fe oxide			
...			
...			
Psuedomatrix: ...			
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon				
... Biotite	rare	250 µm	rounded	oval
Tourmaline	rare	150 µm	rounded	round

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores	= 24		11,1%
Intragranular pores	= 8		3,7%
Oversized pores	32	14,8	
Sum porosity			
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	= 5	2,3%	
F cement			
Cc cement	= 4	1,85%	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	= 8	3,7%	
Baryte cement			
Pyrite cement			
Fe-oxide cement			
Illite cement	= 3	1,4%	
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
... Gypsum cement	= 2		
Sum cement	22	10,2%	
IGV*			
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix

Figure A24: Thin section protocol for sample 39653 by student

Thin-section protocol

Sample name: 39653 . . Worker: Date:	Number of counted points: 255 Distance of points: 1mm
Granulometry Mean grain size (µm): 200 Max. grain size (µm): 500 *after comparison chart from:* Sorting: moderately good Roundness: subrounded - subangular Sphericity: round to oval Grain contacts (relative abundance): point contacts and plane contacts	**Rock name** according to grain size: medium sandstone *Classification scheme after:* Miall 1990 according to composition: Sub Arkose *Classification scheme after:* McBride 1963 Matrix limit (µm): < 20 um

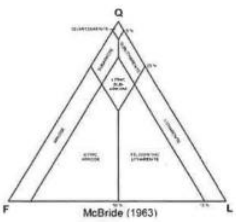
Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m, non-undulatory}$	17	6.7	
$Q_{m, undulatory}$	98	38.4	
$Q_{p, 2-3 xx}$	7	2.7	
$Q_{p, >3 xx}$	11	4.3	
Chert	9	3.5	
Sum Q	142	55.7	
Alkali feldspar	32	12.5	
Plagioclase	1	0.4	
Sum F	33	12.9	
L_{v-fels}			
L_{v-maf}	1	0.4	
L_{s-pel}			
L_{s-psam}			
L_{m-pel}			
L....			
Sum L	1	0.4	
Muscovite			
Biotite			
Chlorite			
Fe oxide			
...			
...			
Psuedomatrix: ...			
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	1	0.1 mm	sub angular	oval
...				
...				

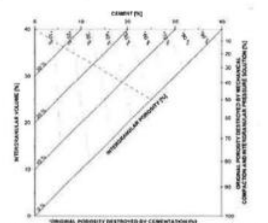
Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	31	12.2	
Intragranular pores	1	0.4	
Oversized pores			
Sum porosity	32	12.5	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	4	1.6	
F cement	1	0.4	
Cc cement	12	4.7	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	22	8.6	
Baryte cement			
Pyrite cement			
Fe-oxide cement			
Illite cement	7	2.7	
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement	46	18	
IGV*	77	30.2	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



McBride (1963)



Ehrenberg (1989), modified after Houseknecht (1987)

Figure A25: Thin section protocol for sample 39653 by student

Sample name: 39653 Worker: Date:	Number of counted points: Distance of points: 202
Granulometry Mean grain size (µm): 140µm Max. grain size (µm): 400 µm *after comparison chart from:* Sorting: good / moderately good Roundness: subrounded (0,4 - 0,5) Sphericity: (0.5) equant / bladed Grain contacts (relative abundance): Plane contacts / concave-convex	**Rock name** medium to fine sandstone according to grain size: 0,125 - 0,25 *Classification scheme after:* Miall (1990) according to composition: Subarkose *Classification scheme after:* McBride (1963) Matrix limit (µm): < 20µm

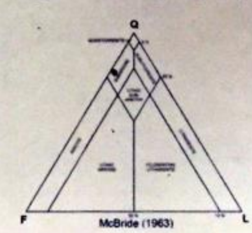
Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m, non-undulatory}$	65	32,18	
$Q_{m, undulatory}$	33	16,34	
$Q_{p, 2-3 xx}$	14	6,93	See drawings
$Q_{p, >3 xx}$	21	10,39	mosaic structure,
Chert	5	2,48	Coarse crystalline
Sum Q	138	68,32	
Alkali feldspar	25	12,38	see drawings
Plagioclase	13	6,44	— 11 —
Sum F	38	18,81	
L_{v-fels}			
L_{v-maf}			
L_{s-pel}	3	1,49	
L_{s-psam}			
L_{m-pel}			
Lm psam	2	0,99	See drawing
Sum L	5	2,48	
Muscovite	1	0,50	See drawings
Biotite			
Chlorite			
Fe oxide	1	0,50	See drawings
...			
...			
Psuedomatrix: ...			
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	Some	25 µm	Subangular	Prolate/bladed
...Rutile	Some	6 µm	Subrounded	oblate/equant
...				

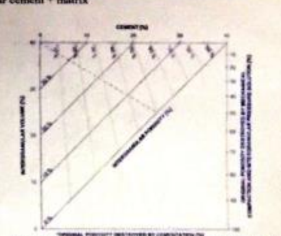
Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	4	1,98	see drawings
Intragranular pores			
Oversized pores			
Sum porosity	4	1,98	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	2	0,99	See drawings
F cement			
Cc cement	5	2,48	See drawings
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	3	1,49	See drawings
Baryte cement			
Pyrite cement			
Fe-oxide cement	1	0,50	Hematite
Illite cement	2	0,99	See drawings
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
... Gypsum	2	0,99	
Sum cement	15	7,43	
IGV*	19	9,41	
Q vein			
Cc vein			
...			
Sum veins	0	0	

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



McBride (1963)



Ehrenberg (1989), modified after Houseknecht (1987)

Figure A26: Thin section protocol for sample 39653 by student

Sample name: 39653 Worker: Date: ?	Number of counted points: 136, or "271" Distance of points: ?
Granulometry Mean grain size (µm): 100 – 200 Max. grain size (µm): 400 *after comparison chart from:* Sorting: Good Roundness: Sub-rounded Sphericity: Oval Grain contacts (relative abundance): Plane also point, convex/concave	**Rock name** according to grain size: Fine-grained sandstone *Classification scheme after:* Udden – Wentworth according to composition: Subarkose *Classification scheme after:* McBride Matrix limit (µm): 63

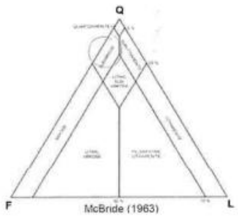
Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m, non-undulatory}$	20		
$Q_{m, undulatory}$	26		
$Q_{p, 2-3 xx}$	8		
$Q_{p, >3 xx}$	7		
Chert			
Sum Q	61	44,9	87% of grains
Alkali feldspar	7		
Plagioclase	1		
Sum F	8	5,9	11% of grains
L_{v-fels}			(-> looks like more)
L_{v-maf}			
L_{s-pel}			
L_{s-psam}			
L_{m-pel}			
L...			
Sum L	X		
Muscovite			
Biotite			
Chlorite			
Fe oxide			
Zircon?	1	0,7	Longoid, dark, red? Tiny
...			
Psuedomatrix: ...			
... TOTAL	70	51,5	

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	1		Round	
Tourmaline	1	0,125 mm	Rounded	oblate
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	34		
Intragranular pores	1		
Oversized pores			
Sum porosity	35	25,5	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix	X		
Q cement	(8)		
F cement	(Yes)		Most of fsp was deteriorating
Cc cement	15		↳ counted as fsp
Dolomite-/ankerite cement	12		Incl. crystals
Siderite cement			
Anhydrite cement	4		Incl. crystals
Baryte cement			
Pyrite cement			
Fe-oxide cement	(1)		
Illite cement	(76)		
Chlorite cement	(45)		
Kaolinite cement	(5)		
Solid bitumen cement			
...			
Sum cement	31 (166)	23	
IGV*	66	48,5	Too high
Q vein			
Cc vein			
...			
Sum veins	X		

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



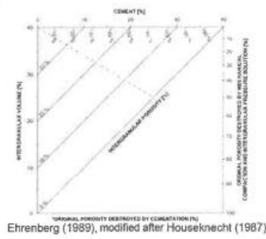


Figure A27: Thin section protocol for sample 39653 by student

Sample name: 39653 **Worker:** **Date:**	**Number of counted points:** 471 **Distance of points:** 1cm to 2 cm
Granulometry Mean grain size (nanometer) 200 Max grain size (nanometer) 500 after comparison chart from: Sorting: Well sorting Roundness: Sub rounded to rounded Sphericity: Discoidal to spherical Grain contacts (relative abudance): Point, plane and saturated contacts	**Rock name** according to grain size: 0.06-2 mm Classification scheme after: according to composition: Subarkose Classification scheme after: Matrix limit (nanometer): <20

Porosity loss

Pi 40

Compaction:

$$COPL = Pi - \frac{(100-P\ ) * IGV}{100 - IGV}$$

Cementation

$$CEPL = (Pi - COPL)\frac{CEM}{IGV}$$

COPL	13
CEPL	25
Total porosity loss	38

Detrital components & intraclasts:

Name	Counts	% total detrital components & intraclasts	% of the total SUM	Description, remarks
$Q_{m, non-undulatory}$	47	18	10	Dark
$Q_{m, undulatory}$	134	50	28	Light color
$Q_{p, 2-3 xx}$	17	6	4	
$Q_{p>3 xx}$	18	7	4	
Chert	29	11	6	Both coarse- & fine-crystalline
SUM Q	245	92	52	
Alkali feldspar	2	1	0	
Plagioclase	11	4	2	
SUM F	13	5	3	
$L_{volcanic-felsic}$	x			
$L_{volcanic-mafic}$	x			
$L_{sedimentary-pelitic}$	8	3	2	
$L_{sedimentary-psammitic}$	x			
$L_{sedimentary-carbonate}$	x			
$L_{metamorphic-pelitic}$	x			
$L_{metamorphic-metapsammite}$	x			
$L_{metamorphic-metavolcanic}$	x			
SUM L	8	3	2	
Muscovite	x			
Biotite	x			
Chlorite	x			
Psudeomatrix	x			

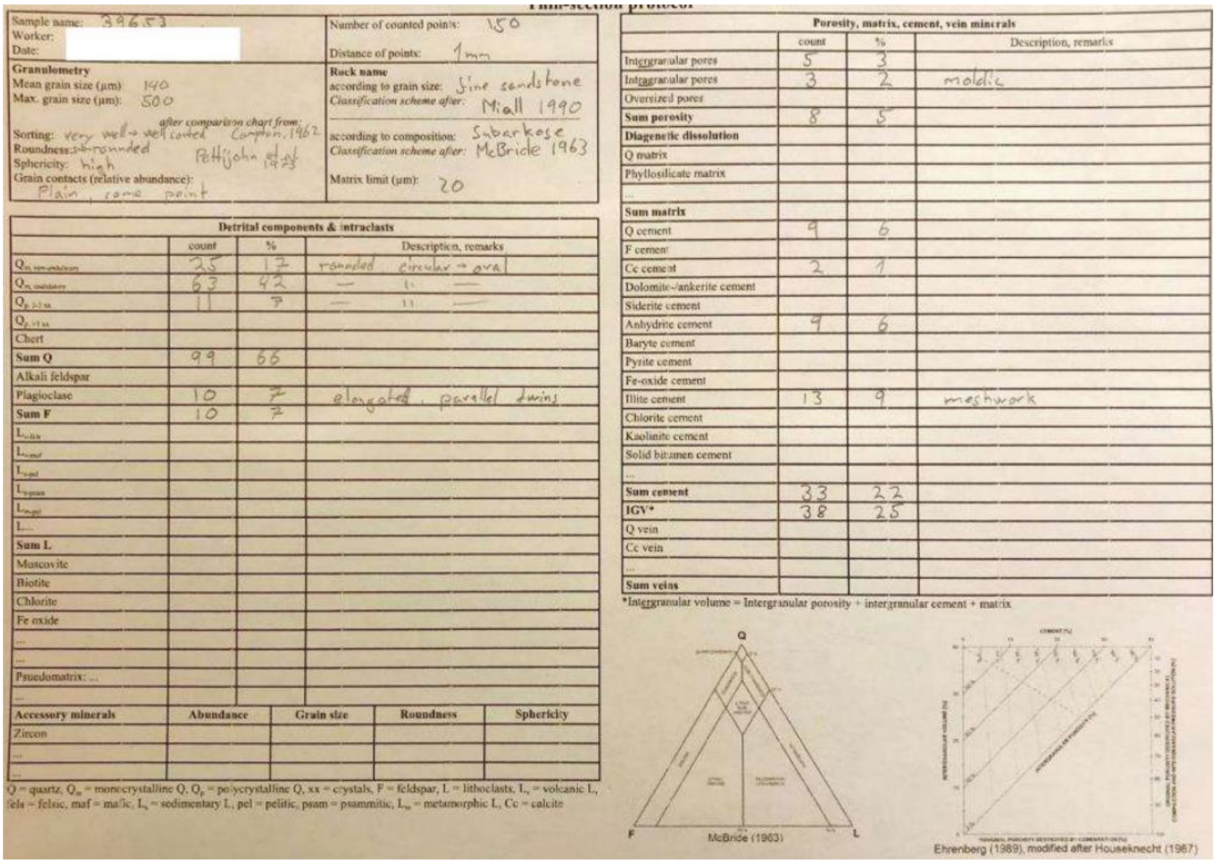
Porosity, matrix, cement, vein minerals

Name	Counts	% total porosity, matrix, cement, vein minerals	% of the total SUM	Description, remarks
Intergranular pores	13	6	3	
Intragranular pores	59	29	13	
Oversized pores	x			
SUM POROSITY	72	35	15	
DIAGENETIC DISSOLUTION	x			
Q-matrix	x			
Phyllosilicate matrix	x			
SUM MATRIX	0	0	0	
Quartz-cement	35	17	7	
Feldspar-cement	4	2	1	Both alkali and plagioclase
Carbonate-cement	x			
Calcite-cement	x			
Hematite-cement	2	1	0	
Gips&anhydrite-cement	29	14	6	Colorful color
Illite cement				
Meshwork illite cement	48	23	10	
Cutanes illite cement	x			
Grain-rimming crystals illite cement	15	7	3	
SUM CEMENT	133	65	28	
IGV* Intergranular volume = Intergranular porosity + intergranular cement + matrix	146	71	31	
CEM	133	65	28	
SUM VEINS				

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Quartz	92%	Coarse sand	Sub rounded to rounded	Discoidal or spherical, Low to high
Plagioclase feldspar	1%	Coarse sand	Sub rounded to rounded	Discoidal or spherical,, Low to high
Alkali feldspar	4%	Coarse sand	Sub rounded to rounded	Discoidal or spherical,, Low to high

		% of total SUM
Total of SUM	471	
Total of Detrital components & intraclasts	266	56
Total of Porosity matrix, cement, vein minerals	205	44

Figure A28: Thin section protocol for sample 39653 by student



Thin-section protocol

Sample name: 39653
Worker:
Date:

Number of counted points: 150
Distance of points: 1mm

Granulometry
Mean grain size (µm): 140
Max. grain size (µm): 500
Sorting: very well → well sorted (after comparison chart from: Compton, 1962)
Roundness: sub-rounded (Pettijohn et al. 1973)
Sphericity: high
Grain contacts (relative abundance): Plain, some point

Rock name
according to grain size: fine sandstone
Classification scheme after: Miall 1990
according to composition: Subarkose
Classification scheme after: McBride 1963
Matrix limit (µm): 20

Detrital components & intraclasts	count	%	Description, remarks
$Q_{m, non-undulatory}$	25	17	rounded circular → oval
$Q_{m, undulatory}$	63	42	— 〃 —
$Q_{p, 2-3 xx}$	11	7	— 〃 —
$Q_{p, >3 xx}$			
Chert			
Sum Q	99	66	
Alkali feldspar			
Plagioclase	10	7	elongated, parallel twins
Sum F	10	7	
$L_{v,fels}$			
$L_{v,maf}$			
$L_{s,pel}$			
$L_{s,psam}$			
$L_{m,pel}$			
L…			
Sum L			
Muscovite			
Biotite			
Chlorite			
Fe oxide			
…			
…			
Psuedomatrix: …			
…			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon				
…				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores	5	3	
Intragranular pores	3	2	moldic
Oversized pores			
Sum porosity	8	5	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
…			
Sum matrix			
Q cement	9	6	
F cement			
Cc cement	2	1	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	9	6	
Baryte cement			
Pyrite cement			
Fe-oxide cement			
Illite cement	13	9	meshwork
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
…			
Sum cement	33	22	
IGV*	38	25	
Q vein			
Cc vein			
…			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix

Figure A29: Thin section protocol for sample 39653 by student

Thin section protocol

Sample name:	#69653
Worker:	213074
Number of counted points:	303
Distance of points:	1mm

Detrital components & intraclasts	Count	%
Qm, non-undulatory	85	28,0528053
Qm, undulatory	24	7,92079208
Qp, 2-3 xx	7	2,31023102
Qp,>3xx	7	2,31023102
Chert	0	0
Sum Q:	**123**	40,5940594
Alkali feldspar:	57	18,8118812
Plagioclase:	7	2,31023102
Sum F:	**64**	21,1221122
Ls,psamite	5	1,65016502
Lm,psamite	1	0,330033
Sum L:	**6**	1,98019802
Others:		
Fe-oxide:	1	0,330033
Opaque:	1	0,330033
Psuedomatrix	1	0,330033

Porosity, matrix, cement, vein minerals	Count	%	Relative %
Intergranular pores	28	9,24092409	
Intragranular pores	2	0,66006601	
Oversized pores	3	0,99009901	
Sum porosity:	33	10,8910891	
Sum matrix:	0	0	
Q-cement	18	5,94059406	24,3243243
F-cement	8	2,64026403	10,8108108
Cc-cement	20	6,60066007	27,027027
Anhydrite cement	15	4,95049505	20,2702703
Fe-Oxide cement	3	0,99009901	4,05405405
Illite cement	6	1,98019802	8,10810811
Gypsum	4	1,32013201	5,40540541
Sum cement:	74	24,4224422	100
IGV:	105	34,6534653	

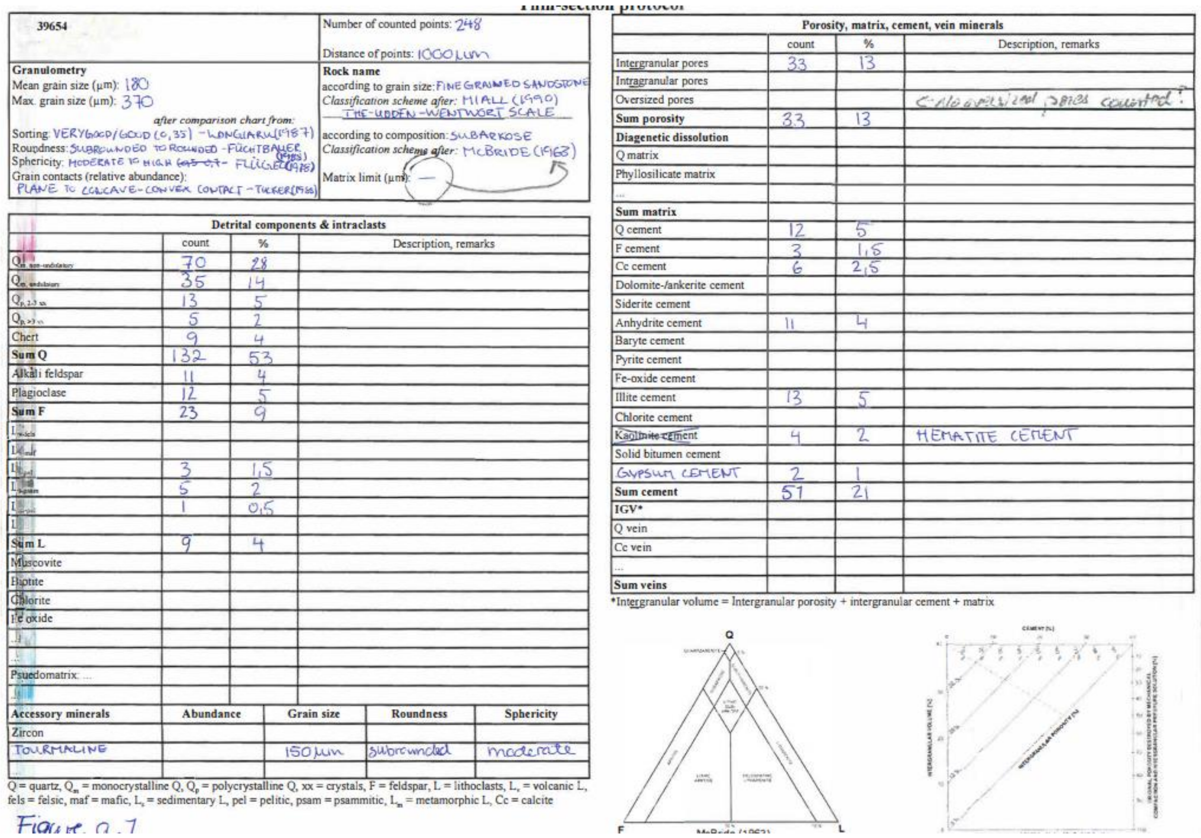
Relative QFL percentages for McBride(1965:	N= 193	
	Count(n)	Relative %
Q	123	63,7305699
F	64	33,1606218
L	6	3,10880829

This gives: $Q_{64}F_{33}L_3$

	Lower	Upper	Interval(≈)
Interval Q	56,518533	70,5136501	[57,71] : 64%±7%
Interval F	26,5653953	40,2824366	[27,40] : 33%+7%/-6%
Interval L	1,14925608	6,64344514	[01,07] : 3%+4%/-2%

Pu = 100(BETA.INV(1-a/2, n+1, N-n))
Pl = 100(1-BETA.INV(1-a/2, N-n+1, n))

Figure A30: Thin section protocol for sample 39653 by student



Thin-section protocol

39654	Number of counted points: 248
	Distance of points: 1000 μm
Granulometry Mean grain size (μm): 180 Max. grain size (μm): 370	**Rock name** according to grain size: FINE GRAINED SANDSTONE Classification scheme after: MIALL (1990) THE UDDEN-WENTWORTH SCALE
after comparison chart from: Sorting: VERY GOOD/GOOD (0,35) – LONGIARU (1987) Roundness: SUBROUNDED TO ROUNDED – FÜCHTBAUER (1988) Sphericity: MODERATE TO HIGH (0.5-0.7) – FLÜGEL (1978) Grain contacts (relative abundance): PLANE TO CONCAVE-CONVEX CONTACT – TUCKER (1988)	according to composition: SUBARKOSE Classification scheme after: McBRIDE (1963) Matrix limit (μm): —

Detrital components & intraclasts	count	%	Description, remarks
Q_{m} non-undulatory	70	28	
Q_{m} undulatory	35	14	
Q_{p} 2-3 xx	13	5	
Q_{p} >3 xx	5	2	
Chert	9	4	
Sum Q	132	53	
Alkali feldspar	11	4	
Plagioclase	12	5	
Sum F	23	9	
L_{v-fels}			
L_{v-maf}			
L_{s-pel}	3	1,5	
L_{s-psam}	5	2	
L_{m-pel}	1	0,5	
L...			
Sum L	9	4	
Muscovite			
Biotite			
Chlorite			
Fe oxide			
...			
...			
Psuedomatrix: ...			
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon				
TOURMALINE		150 μm	subrounded	moderate

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

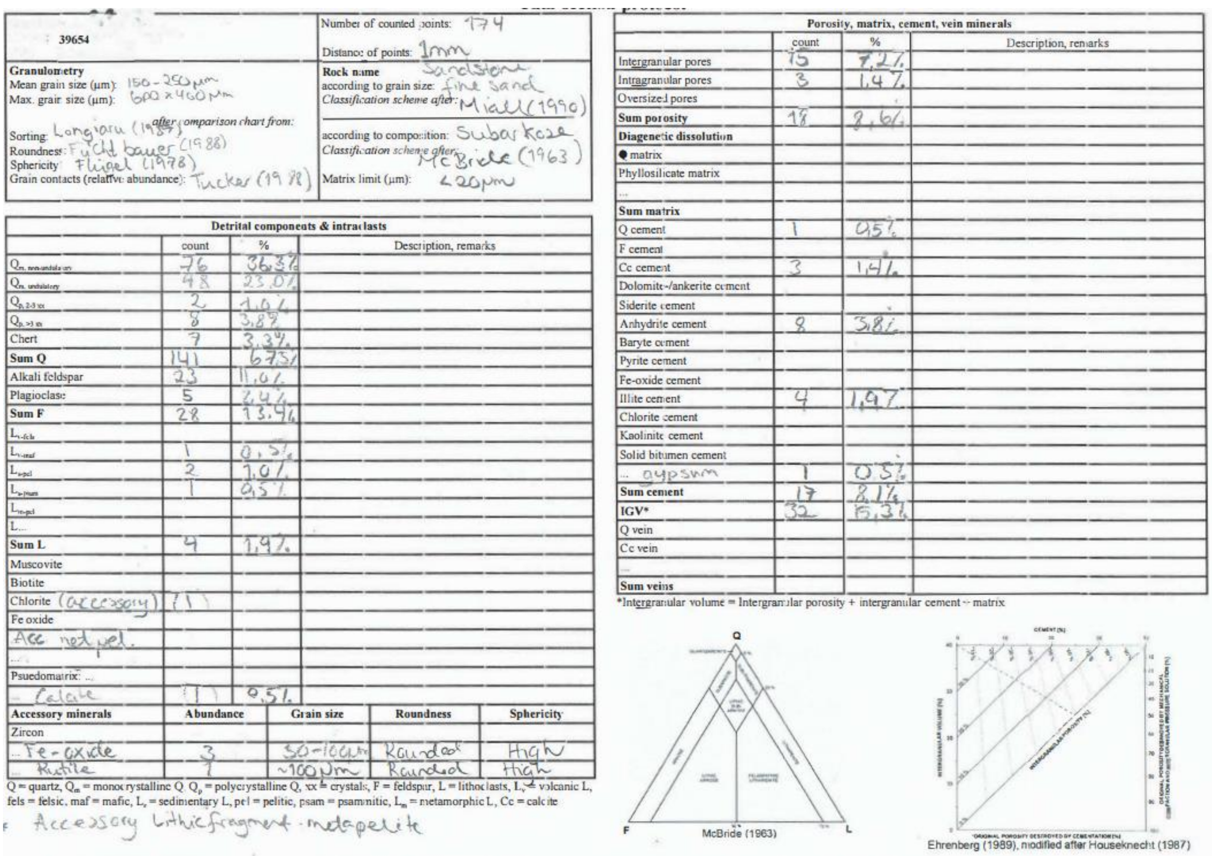
Figure a.7

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores	33	13	
Intragranular pores			
Oversized pores			?Also oversized pores counted?
Sum porosity	33	13	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	12	5	
F cement	3	1,5	
Cc cement	6	2,5	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	11	4	
Baryte cement			
Pyrite cement			
Fe-oxide cement			
Illite cement	13	5	
Chlorite cement			
~~Kaolinite cement~~	4	2	HEMATITE CEMENT
Solid bitumen cement			
GYPSUM CEMENT	2	1	
Sum cement	51	21	
IGV*			
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix

McBride (1963)

Figure A31: Thin section protocol for sample 39654 by student



39654	Number of counted points: 174
	Distance of points: 1mm
Granulometry Mean grain size (μm): 150-250 μm Max. grain size (μm): 600 x 400 μm	**Rock name** Sandstone according to grain size: fine sand Classification scheme after: Miall (1990)
after comparison chart from: Sorting: Longiaru (1987) Roundness: Fuchtbauer (1988) Sphericity: Flügel (1978) Grain contacts (relative abundance): Tucker (1988)	according to composition: Subarkose Classification scheme after: McBride (1963) Matrix limit (μm): < 20 μm

Detrital components & intraclasts	count	%	Description, remarks
Q_{m} non-undulatory	76	36.3%	
Q_{m} undulatory	48	23.0%	
Q_{p} 2-3 xx	2	1.0%	
Q_{p} >3 xx	8	3.8%	
Chert	7	3.3%	
Sum Q	141	67.5%	
Alkali feldspar	23	11.0%	
Plagioclase	5	2.4%	
Sum F	28	13.4%	
L_{v-fels}			
L_{v-maf}	1	0.5%	
L_{s-pel}	2	1.0%	
L_{s-psam}	1	0.5%	
L_{m-pel}			
L...			
Sum L	4	1.9%	
Muscovite			
Biotite			
Chlorite (accessory)	(1)		
Fe oxide			
Acc not rel.			
...			
Psuedomatrix: ...			
Calcite	(1)	0.5%	

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon				
Fe-oxide	3	50-100 μm	Rounded	High
Rutile		~100 μm	Rounded	High

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Accessory Lithic fragment - metapelite

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores	15	7.2%	
Intragranular pores	3	1.4%	
Oversized pores			
Sum porosity	18	8.6%	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	1	0.5%	
F cement			
Cc cement	3	1.4%	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	8	3.8%	
Baryte cement			
Pyrite cement			
Fe-oxide cement			
Illite cement	4	1.9%	
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
gypsum	1	0.5%	
Sum cement	17	8.1%	
IGV*	32	15.3%	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix

McBride (1963)

Ehrenberg (1989), modified after Houseknecht (1987)

Figure A32: Thin section protocol for sample 39654 by student

Sample name: **39654**
Worker:
Date:

Number of counted points: 198
Distance of points: 1mm

Granulometry
Mean grain size (µm): 150
Max. grain size (µm): 400
after comparison chart from: LONGIARU PETTIJOHN
Sorting: GOOD-VERY GOOD
Roundness: SUBROUND
Sphericity: HIGH SPHERICITY
Grain contacts (relative abundance): MOSTLY PLANE + CONCAVE

Rock name
according to grain size: FINE SANDSTONE
Classification scheme after: WENTWORTH 1922
according to composition: SUBARKOSE
Classification scheme after: MCBRIDE 1963
Matrix limit (µm):

Detrital components & intraclasts	count	%	Description, remarks
$Q_{m, non-undulatory}$	87	43,9	
$Q_{m, undulatory}$	18	9,1	
$Q_{p, 2-3 xx}$	15	7,6	
$Q_{p, >3 xx}$	5	2,5	
Chert	3	1,5	
Sum Q	128	64,6	
Alkali feldspar	17	8,6	
Plagioclase	2	1,0	
Sum F	19	9,6	
L_{v-fels}			
L_{v-maf}	1	0,5	
L_{s-pel}	2	1,0	
L_{s-psam}			
L_{m-pel}			
L...			
Sum L	3	1,5	
Muscovite			
Biotite			
Chlorite			
Fe oxide			
...			
...			
Psuedomatrix: ...			
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon				
...RUTILE	I	100um	ROUND	OVAL

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores	27	13,6	
Intragranular pores	6	3,0	
Oversized pores			
Sum porosity	33	16,6	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	2	1,0	
F cement			
Cc cement	2	1,0	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	6	3,0	
Baryte cement			
Pyrite cement			
Fe-oxide cement			
Illite cement	2	1,0	
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
...GYPSUM	3	1,5	
Sum cement	15	7,6	
IGV*	42	21,2	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix

Figure A33: Thin section protocol for sample 39654 by student

Thin-section protocol

Sample name: 39654
Worker:
Date: (

Number of counted points: 420
Distance of points: 1mm

Granulometry
Mean grain size (µm): 180 – 200 µm
Max. grain size (µm): 420 µm
after comparison chart from:
Sorting: Well sorted
Roundness: Sub rounded
Sphericity: medium to high
Grain contacts (relative abundance): plane contacts, concave-convex Sutured

Rock name
according to grain size: Fine – medium
Classification scheme after: UDDEN-Wentworth (Miall 1990)
according to composition: Subarkose
Classification scheme after: McBrid (1963)
Matrix limit (µm): < 20 µm

Detrital components & intraclasts	count	%	Description, remarks
$Q_{m, non-undulatory}$	136	32 %	
$Q_{m, undulatory}$	53	13 %	
$Q_{p, 2-3 xx}$	7	2 %	
$Q_{p, >3 xx}$	10	2 %	
Chert	2	< 1 %	
Sum Q	208	50 %	
Alkali feldspar	54	13 %	
Plagioclase	18	4 %	
Sum F	72	17 %	
L_{v-fels}	2	< 1 %	
L_{v-maf}			
L_{s-pel}	5	1 %	
~~L_{s-psam}~~ Lm-s	6	1 %	
L_{m-pel}			
L... Lp	8	2 %	
Sum L	21	5 %	
Muscovite			
Biotite			
Chlorite			
Fe oxide			
...			
...			
Psuedomatrix: ...			
...			

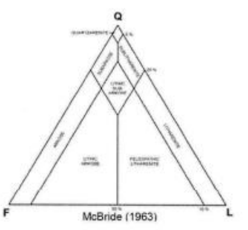
Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	I	50 µm	round	high
...Tourmaline	IIII	60 – 100 µm	Sub round	Medium
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Lm-s: metapsammite
Lp: plutonic

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores	55	13 %	
Intragranular pores	10	2 %	
Oversized pores	4	1 %	
Sum porosity	69	16 %	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	23	5 %	
F cement	5	1 %	
Cc cement	10	2 %	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	10	2 %	
Baryte cement			
Pyrite cement			
Fe-oxide cement	1	< 1 %	
Illite cement	1	< 1 %	
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement	50	12 %	
IGV*	109	26 %	Inter + oversized + cement
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



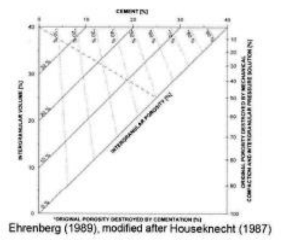


Figure A34: Thin section protocol for sample 39654 by student

Thin-section protocol

Sample name: 39654 Worker: Date:	Number of counted points: 200 Distance of points: 1mm
Granulometry Mean grain size (µm): 120 µm Max. grain size (µm): 500 µm *after comparison chart from:* Sorting: good / moderately good Roundness: subangular to subrounded Sphericity: Oval, some blocky and elongated Grain contacts (relative abundance): point to planar	**Rock name** according to grain size: medium to fine sandstone *Classification scheme after:* according to composition: Subarkose *Classification scheme after:* Mc Bride (1963) Matrix limit (µm):

Detrital components & intraclasts	count	%	Description, remarks
$Q_{m, non-undulatory}$	40	20%	
$Q_{m, undulatory}$	75	39%	
$Q_{p, 2-3 xx}$	3	1,5%	
$Q_{p, >3 xx}$	15	7,5%	
Chert	4	2%	
Sum Q	140	70%	
Alkali feldspar	4	2%	
Plagioclase	5	2,5%	
Sum F	9	4,5%	
L_{v-fels}	0	–	
L_{v-maf}	1	0,5%	
L_{s-pel}	0	–	
L_{s-psam}	0	–	
L_{m-pel}	0	–	
L...	0	–	
Sum L	1	0,5%	
Muscovite	0	–	
Biotite	0	Accessory	Heavy mineral
Chlorite	0	–	
Fe oxide	0	–	
...	–	–	
...	–	–	
Psuedomatrix: ...	0	–	
...	–	–	

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	–	–	–	–
...	–	–	–	–
...	–	–	–	–

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores	23	11,5%	
Intragranular pores	1	0,5%	
Oversized pores	0	–	
Sum porosity	24	12%	
Diagenetic dissolution	–	–	
Q matrix	–	–	
Phyllosilicate matrix	–	–	
...	–	–	
Sum matrix	–	–	
Q cement	–	–	
F cement	0	–	
Cc cement	9	4,5	
Dolomite-/ankerite cement	0	–	
Siderite cement	0	–	
Anhydrite cement	14	7%	
Baryte cement	0	–	
Pyrite cement	0	–	
Fe-oxide cement	0	–	
Illite cement	1	0,5%	
Chlorite cement	0	–	
Kaolinite cement	0	–	
Solid bitumen cement	0	–	
Gypsum cement	2	1%	
Sum cement	26	13%	
IGV*	49	24,5%	
Q vein	–	–	
Cc vein	–	–	
...	–	–	
Sum veins	–	–	

*Intergranular volume = Intergranular porosity + intergranular cement + matrix

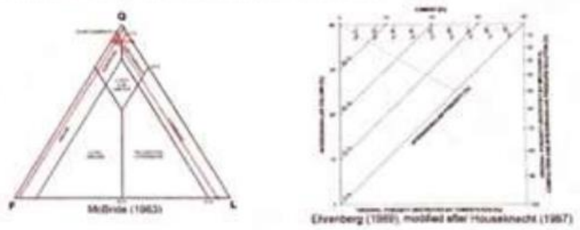


Figure A35: Thin section protocol for sample 39654 by student

Sample name: 39654 Worker: Date:	Number of counted points: 212 Distance of points: 1 mm
Granulometry Mean grain size (µm): 0,2 mm Max. grain size (µm): 0,6 mm *after comparison chart from:* Sorting: Longiaru (1987) Roundness: Flügel (1978) Sphericity: Flügel (1978) Grain contacts (relative abundance): Tucker (1988)	**Rock name** according to grain size: fine sandstone *Classification scheme after:* Miall (1990) according to composition: subarkose *Classification scheme after:* McBride (1963) Matrix limit (µm):

Detrital components & intraclasts	count	%	Description, remarks
$Q_{m, non-undulatory}$	81	38,2	
$Q_{m, undulatory}$	34	16,0	
$Q_{p, 2-3 xx}$	9	4,2	
$Q_{p, >3 xx}$	13	6,1	
Chert	3	1,4	
Sum Q	140	65,9	
Alkali feldspar	11	5,2	
Plagioclase	4	1,9	Twinned, black, grey, white
Sum F	15	7,1	
L_{v-fels}	X	accessory	Colorless in single polarized light and dark in double, "spotty"
L_{v-maf}	X	accessory	Dark in both single and double polarized light
L_{s-pel}			
L_{s-psam}			
L_{m-pel}	X	accessory	Brown and black in both single and double light
L...			
Sum L			
Muscovite			
Biotite	1	0,5	Brown to black, pleochroism, lamellar
Chlorite			
Fe oxide			
...			
...			
Psuedomatrix: ...			
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon				
...				
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores	14	6,6	
Intragranular pores	10	4,7	
Oversized pores			
Sum porosity	24	11,3	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	5	2,4	
F cement	X	accessory	
Cc cement	16	7,6	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	11	5,2	
Baryte cement			
Pyrite cement			
Fe-oxide cement			
Illite cement	X	accessory	
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement	32	15,2	
IGV*	46	21,8	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix

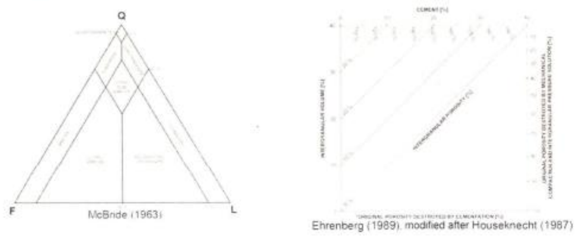


Figure A36: Thin section protocol for sample 39654 by student

Sample name: Werner Becker 39654 Worker: Date:	Number of counted points: 220 Distance of points: 1mm
Granulometry Mean grain size (µm): ~0.5mm / 500µm Max. grain size (µm): ~2mm / 2000µm *after comparison chart from:* Sorting: Good Roundness: subrounded Sphericity: low – medium Grain contacts (relative abundance):	**Rock name** according to grain size: Medium - Coarse sand stone *Classification scheme after:* Wentworth scale size according to composition: Sublith-arenite *Classification scheme after:* DOTT Matrix limit (µm): < 30µm

chert or feldspar / lithic frag
Plagio maybe 卌 |

Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m,\ non-undulatory}$ 卌 ||	7	3.2	
$Q_{m,\ undulatory}$	155	70.5	
$Q_{p,\ 2\text{-}3\ xx}$ ||	2	0.9	
$Q_{p,\ >3\ xx}$ 卌 卌 |	11	5	
Chert			
Sum Q		79.6	
Alkali feldspar	卌 || 13	5.9	
Plagioclase	||| 3	1.4	
Sum F		7.3	
$L_{v\text{-}fels}$	||| 3	1.4	
$L_{v\text{-}maf}$			
$L_{s\text{-}pel}$	| 1	0.5	
$L_{s\text{-}psam}$			
$L_{m\text{-}pel}$	| 1	0.5	
L...			
Sum L		2.4	
Muscovite			
Biotite			
Chlorite			
Fe oxide			
...			
...			
Psuedomatrix: ...			
...			

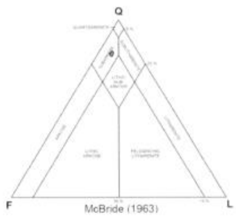
Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon				
...Opaque	~5%	1mm	Sub rounded	med-high
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

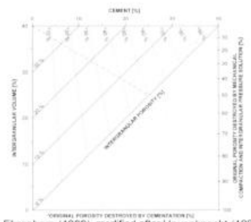
Arkose

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	卌 | 6	2.7	
Intragranular pores	|| 2	0.9	
Oversized pores			
Sum porosity	8	3.6	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix	|| 2	0.9	
... Pseudomatrix?			
Sum matrix		0.9	
Q cement			
F cement			
Cc cement	卌 5	2.3	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	卌 |||| 9	4.1	
Baryte cement			
Pyrite cement			
Fe-oxide cement			
Illite cement			
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement	14	6.4	
IGV*		10.9	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



McBride (1963)



Ehrenberg (1989), modified after Houseknecht (1987)

Figure A37: Thin section protocol for sample 39654 by student

Sample name: 39654	Number of counted points: 195 Distance of points: 1 mm
Granulometry Mean grain size (µm): 210 Max. grain size (µm): 320 after comparison chart from: Sorting: Well sorted after Longiaru (1987). Roundness: Subrounded-rounded after Pettijohn et al. (1987). Sphericity: Medium-high after Pettijohn et al. (1987). Grain contacts (relative abundance): Plane (long) contacts and concave-convex (concavo-convex) contacts are abundant, but some point contacts are observed, after Nichols (2009, Fig. 18.16).	**Rock name** according to grain size: Fine sandstone Classification scheme after: Wentworth (1922) According to composition: Subarkose Classification scheme after: McBride (1963)

Counting – Detrital components & lithoclasts

Minerals	Count	Percent [%]	Description
$Q_{m,\ non\text{-}undulatory}$	61	31.3	Colorless, non-undulatory extinction
$Q_{m,\ undulatory}$	43	22.1	Colorless, undulatory extinction
$Q_{P,\ 2\text{-}3\ xx}$	6	3.1	No direction, sutured contacts among the indented grains
$Q_{P,\ >3\ xx}$	2	1.0	No direction, sutured contacts among the indented grains
Chert (Microcrystalline quartz)	4	2.0	Coarse- and fine grained, various shapes: elongated to round, rounded to subrounded, grain size: 110-130 µm
Total Quartz	**116**	**59.5**	**Colorless, low birefringence (white-grey to light yellow), high relief, grain size: 120-320 µm**
Plagioclase	1	0.5	Albite twins
Alkalifeldspar	2	1.0	Cross-hatched twinning
Feldspar (not classified further)	27	13.9	Colorless to slightly "dirty-looking" or cloudy, no cleavage, no twinning, can be slightly dissolved, can be elongated, rectangular, blocky or xenomorphic in shape. Illitisation of feldspar occurs. Some grains have undulatory extinction.
Total Feldspar	**30**	**15.4**	**Lower relief than quartz, grain size: 100-260 µm**
$L_{v\text{-}maf}$	3	1.5	No direction, phenocrysts, opaque minerals and needle-shaped plagioclase crystals within the darker groundmass. Round to elongated shapes, sometimes partly dissolved (probably feldspar). Subrounded to rounded. Some of them are ductile and squeezed into the pore space. Often contains quartz and feldspar. Variance in relief within the clast due to different components.
Total Lithoclasts	**3**	**1.5**	**Grain size: 180 – 310 µm**
Apatite	**1**	**0.5**	**High relief, "dirty-looking", low birefringence (1st order), grain size: 150-200 µm**

Counting – Porosity & cement

	Count	Percent [%]	Description
Intergranular pores	27	13.9	Primary, Size: 0.13, 0.07, 0.25, 0.08, 0.28, 0.1, 0.08, 0.2,
Intragranular pores	6	3.1	Secondary, often dissolved feldspar and sometimes dissolved lithoclasts. Size: 25-50 µm
Sum Porosity	**33**	**17.0**	**Varies in the rock**
Q cement	3	1.5	Quartz-cement rim is not very clear, often difficult to identify.
Carbonate cement	1	0.5	High relief, two strongly-developed cleavage directions, colorless, high birefringence
Anhydrite cement	2	1.0	Two strongly-developed cleavage directions (approximately 90° between them), colorless, high birefringence (vivid colors), high relief, poikilotopic (surrounds smaller detrital grains)
Gypsum cement	2	1.0	Colorless, light grey / white birefringence color, two strongly-developed cleavage directions (approximately 90° between them). High relief, poikilotopic (surrounds smaller detrital grains)
Illite cement	4	2.1	Grain-coating – thin rim. High birefringence color (yellow). Illitisation of feldspar occur.
Sum cement	**12**	**6.1**	**Quartz and illite form first (closest to grains), followed by calcite and carbonate, and then anhydrite and gypsum.**
Total Sum:	**195**	**100**	
IGV		20	Intergranular porosity + intergranular cement (all cement in this case) = IGV

Accessory minerals, cements and lithoclasts

Accessory minerals, cements and lithoclasts	Abundance	Grain size	Roundness and Sphericity	Description
Biotite	Rare	140 µm	Low-medium sphericity, rounded	Strong pleochroism, brown, one cleavage direction, elongated. Only one grain is found.
Tourmaline	Rare	100-150 µm	Medium sphericity, subrounded	No (or very weak) pleochroism, brown-green color, no cleavage, high relief
Calcite cement	Not abundant			Clear cleavage directions, angle between them is less than 90°. Colored red.
Feldspar cement	Not abundant			Close to grain, not very extensive.

Figure A38: Thin section protocol for sample 39654 by student

Thin-section protocol

Sample name: 39654 Worker: Date:	Number of counted points: 150 Distance of points: 1 mm
Granulometry Mean grain size (µm): 100-300 Max. grain size (µm): 500 *after comparison chart from:* Sorting: Very good/good Roundness: sub-rounded to rounded Sphericity: Medium to high Grain contacts (relative abundance): plain and point	**Rock name** Fine to medium grained according to grain size: Sandstone *Classification scheme after:* Miall (1990) according to composition: Subarkose *Classification scheme after:* McBride (1963) Matrix limit (µm): 20 µm

Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m, non-undulatory}$	24	15,9	
$Q_{m, undulatory}$	55	36,6	
$Q_{p, 2-3 xx}$	2	1,3	
$Q_{p, >3 xx}$	4	2,7	
Chert	2	1,3	
Sum Q	87	57,8	
Alkali feldspar	1	0,7	
Plagioclase	11	7,3	
Sum F	12	8,0	
L_{v-fels}			
L_{v-maf}	1	0,7	
L_{s-pel}	1	0,7	
L_{s-psam}			
L_{m-pel}			
L...			
Sum L	2	1,4	
Muscovite	1	0,7	
Biotite			
Chlorite			
Fe oxide			
...			
...			
Psuedomatrix: ...			
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon				
...				
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	6	4,0	Blue
Intragranular pores	3	2,0	Blue
Oversized pores			
Sum porosity	9	6,0	
Diagenetic dissolution			
Q matrix	1	0,7	
Phyllosilicate matrix	2	1,3	
...			
Sum matrix	3	2,0	
Q cement	10	6,8	
F cement	2	1,3	
Cc cement	4	2,8	Pink
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	6	3,9	Perfect cleavage / ooo
Baryte cement			
Pyrite cement			
Fe-oxide cement	2	1,3	Black
Illite cement	11	7,3	Rim / Pore filling
Chlorite cement			
Kaolinite cement	1	0,7	
Solid bitumen cement			
...			
Sum cement	36	24,1	
IGV*			
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix

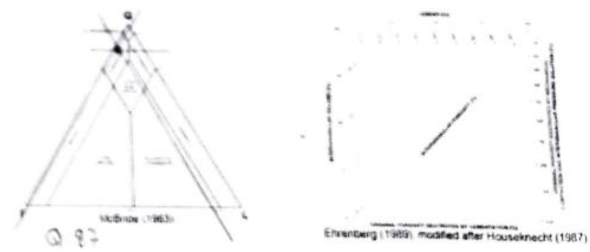


Figure A39: Thin section protocol for sample 39654 by student

Sample name: 39656 Worker: Date: -	Number of counted points: 225 Distance of points: 1mm
Granulometry Mean grain size (µm): 5 Max. grain size (µm): 350 *after comparison chart from:* Sorting: moderately sorted Roundness: sub-rounded Sphericity: equant Grain contacts (relative abundance): plane contact, point contact and convex contact.	**Rock name** according to grain size: Sandstone *Classification scheme after:* Quartzarenite → McBride according to composition: Quartzarenite *Classification scheme after:* Matrix limit (µm): no matrix

Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m, non-undulatory}$	75		HH HH HH HH HH HH HH HH HH HH HH HH HH HH HH
$Q_{m, undulatory}$	55		HH HH HH HH HH HH HH HH HH HH HH
$Q_{p, 2-3 xx}$	15		HH HH HH
$Q_{p, >3 xx}$	5		HH
Chert			
Sum Q	150	67%	
Alkali feldspar	7		HH ||
Plagioclase			
Sum F	7	3%	
L_{v-fels}			
L_{v-maf}			
L_{s-pel}	4		||||
L_{s-psam}	2		||
L_{m-pel}			
L...			
Sum L	6	2%	
Muscovite			|
Biotite			
Chlorite			
Fe oxide			|
...			
...			
Psuedomatrix: ...			
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon				
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	29		HH HH HH HH HH ||||
Intragranular pores	2		||
Oversized pores			
Sum porosity	31	14%	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			X
Q cement	17		HH HH HH ||
F cement	1		|
Cc cement	7		HH ||
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	2		||
Baryte cement			
Pyrite cement			
Fe-oxide cement			
Illite cement	3		|||
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
Hematite cement	1		|
Sum cement	31	14%	
IGV*			
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix

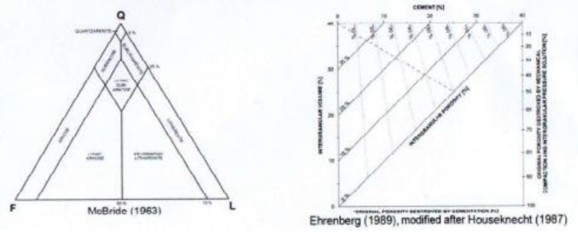


Figure A40: Thin section protocol for sample 39656 by student

Sample name: 34656 Worker: Date:	Number of counted points: 323 Distance of points: 1 mm
Granulometry Mean grain size (µm): 180 µm Max. grain size (µm): 350 µm *after comparison chart from:* Sorting: Good Roundness: Rounded Sphericity: Low Grain contacts (relative abundance): Plane and Poi	**Rock name** according to grain size: Fine sandstone *Classification scheme after:* Wentworth 1922. according to composition: Subarkose *Classification scheme after:* McBride Matrix limit (µm):

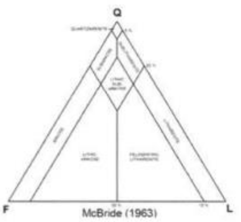
Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m, non-undulatory}$	106	33	
$Q_{m, undulatory}$	62	19	
$Q_{p, 2-3 xx}$	13	4	
$Q_{p, >3 xx}$	18	6	
Chert	11	3	
Sum Q	210	65	
Alkali feldspar	4	1	
Plagioclase	8	2	
Sum F	12	3	
L_{v-fels}	1	0.5	
L_{v-maf}	1	0.5	
L_{s-pel}	3	1	
L_{s-psam}			
L_{m-pel}			
L...			
Sum L		2	
Muscovite			
Biotite			
Chlorite			
Fe oxide			
...			
...			
Psuedomatrix: ...			
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon				
...				
...				

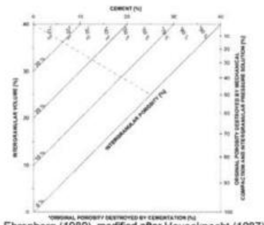
Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	29	9	
Intragranular pores	3	1	
Oversized pores			
Sum porosity		10	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	28	9	
F cement	4	1	
Cc cement	15	5	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	6	2	
Baryte cement			
Pyrite cement			
Fe-oxide cement			
Illite cement	4	1	
Chlorite cement	3	1	
Kaolinite cement			
Solid bitumen cement			
... Gypsum	4	1	
Sum cement		20	
IGV*		27	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



McBride (1963)



Ehrenberg (1989), modified after Houseknecht (1987)

Figure A41: Thin section protocol for sample 39656 by student

Sample name: 39656 Worker: Date:	Number of counted points: 413 Distance of points: 1000 µm
Granulometry Mean grain size (µm): 164 µm Max. grain size (µm): 335 µm *after comparison chart from:* Sorting: Very well sorted; Longiafu, 1987 Roundness: subrounded/subangular; Pettijohn 1987 Sphericity: low sphericity; Pettijohn 1987 Grain contacts (relative abundance): long (plain) to concavo-convex; Pettijohn 1987	**Rock name** according to grain size: Fine sandstone; *Classification scheme after:* Udden-Wentworth, 1922 according to composition: Subarkose arenites; *Classification scheme after:* Pettijohn *et al.* 1973 Matrix limit (µm): 20 µm

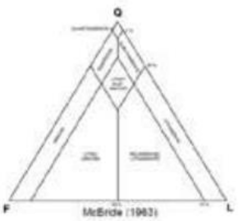
Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m, non-undulatory}$	114	27.60	Fresh look; subangular/subrounded
$Q_{m, undulatory}$	78	18.89	Usually low undulosity, arround 5°
$Q_{p, 2-3 xx}$	24	5.08	
$Q_{p, >3 xx}$	7	1.70	Often < 10 crystals
Chert	1	0.22	Very rear, coarse chert
Sum Q	224	54.24	Very rear, coarse chert
Alkali feldspar	37	8.96	Partly dissolved
Plagioclase	15	3.63	Sometimes with twinning
Sum F	52	12.59	
L_{v-fels}			
L_{v-maf}			
L_{s-pel}	1	0.24	Unrecognizable minerals, dark color, ductile
L_{s-psam}	2 1	0.48 0.24	Larger Qz minerals, mica minerals, cc
L_{m-pel}	6 2	1.45 0.48	Schistosity, greenesh-brownish color
L plut	9 6	2.18 1.45	Qz, Fld and Mica (muscovite)
Sum L	18 9	4.36 2.18	
Muscovite			
Biotite			
Chlorite			
Fe oxide	2	0.48	c. 75 µm, 7:7 roundnes/sphericity
...			
...			
Psuedomatrix: ...			
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	2 grains, 0.48%	13-60 µm	round/subrounded	elongated
Tourmaline	2 grains, 0.48%	c.125 µm	round	elongated
Glauconite	Not in counting	c. 85µm	round	elongated

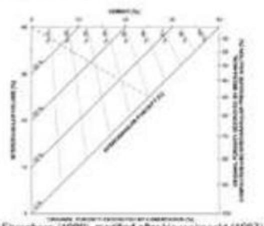
Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	51	12.35	c. 175 µm
Intragranular pores	6	1.45	Very small amount, corroded grains
Oversized pores			
Sum porosity	57	13.80	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	12	2.91	Usually small syntaxial, on few places little larger
F cement	3	0.72	It is not often
Cc cement	19	4.60	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	8	1.45	On specific places
Baryte cement			
Pyrite cement			
Fe-oxide cement	4	0.96	Rim around grain or fills cracks in dissolved grains
Illite cement			
Chlorite cement	1	0.24	Inside dissolved grains
Kaolinite cement			
Solid bitumen cement			
Gypsum	3	0.73	On the same places where is anhydrite
Sum cement	56	13.56	
IGV*	113	27.36	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



McBride (1963)



Ehrenberg (1989), modified after Houseknecht (1987)

Figure A42: Thin section protocol for sample 39656 by student

Detrital components	Count		%	
$Q_{m, non-undulatory}$	51			
$Q_{m, undulatory}$	59			
$Q_{p, 2\text{-}3\ xx}$	11			
$Q_{p, >3\ xx}$	8			
Chert	8			
Sum Q	137		85	
Alkali feldspar	6			
Plagioclase	7			
Sum F	13		8	
Intergranular pores & cement	Count		%	
Intergranular pores	4		3	
Calcite cement	7		4	
Sum Total	161		100	
Accessory minerals, intraclasts & cement	Abundance	Grain Size (µm)	Roundness (Grain)	Sphericity (Grain)
Tourmaline	Not common	200-250	Rounded	High
Zircon	Not common	75-150	Rounded	High
$L_{v\text{-}maf}$	Common	200-300	Sub Rounded	Medium
$L_{v\text{-}fel}$	Not common	150-200	Sub Rounded	Medium
Muscovite	Common			
Illite cement	Common			
Gypsum cement	Common			
Anhydrite cement	Common			
Quartz cement	Not common			

Figure A43: Thin section protocol for sample 39656 by student

Sample Name: 39656		***Number of counted points:*** 150 ***Distance of points:*** 1mm/2mm
Mean grain size: 10 µm ***Max. grain size:*** 24 µm ***Sorting:*** Very good to good sorting (Longiaru 1987) ***Roundness:*** sub rounded to rounded ***Sphericity:*** high ***Grain contacts:*** plane-directed-concave/convex		***Rock name:*** medium to coarse siltstone ***According to composition:*** Litharenite to sub-litharenite
	Count	%
Q_m, non-undulatory	40	26.6
Q_m, undulatory	51	34
Chert	2	1.33
$Q_{polycristalline}$	3	2
Alkali Feldspar	2	1.33
Plagioclase	6	4
Magnetite	1	0.66
Intergranular porosity	15	10
Intragranular porosity	6	4
Quartz cement	13	8.66
Calcite cement	7	4.66
Anhydrite cement	2	1.33
Albite cement	2	1.33
Sum	**150**	**99.9**
Accessory minerals	Remarks	
Carbonate cement	Looks like calcite, but not coloured in red in the thin section, so carbonate cement, but not calcite cement	
muscovite	High birefringence colour	

Figure A44: Thin section protocol for sample 39656 by student

Quartz		% of points	% of grains
Qm, non undulatory	125	28	44
Qm, undulatory	90	20	31
Qp, 2-3 xx	11	2	4
Qp, >3 xx	10	2	3
Chert	1	0	0
SUM QUARTZ	237	53	82
Feldspar		**% of points**	
Alkalifeldspar	34	8	12
Plagioclase	8	2	3
SUM FELDSPAR	42	9	15
Lithic Fragments		% of points	
Lvolcanic felsic	5	1	2
Lvolcanic mafic	1	0	0
Lmetapellite	2	0	1
SUM Lithic Fragments	8	2	3
Pores		% of points	
Intergranular pores	9	2	
Intragranular pores	5	1	
SUM PORES	14	3	
Cement		% of points	
Quartz cement	8	2	
Calsium carbonate cement	98	22	
Hematite cement	17	4	
Gypsum cement	9	2	
Anhydrite cement	2	0	
Illite cement	14	3	
SUM CEMENT	148	33	

Total count:	449
Total grains:	287
IGV =	162
Cement, intergranular porosity and matri›	
% IGV =	36
Cement, intergranular, porosity and matri	
% grains =	64

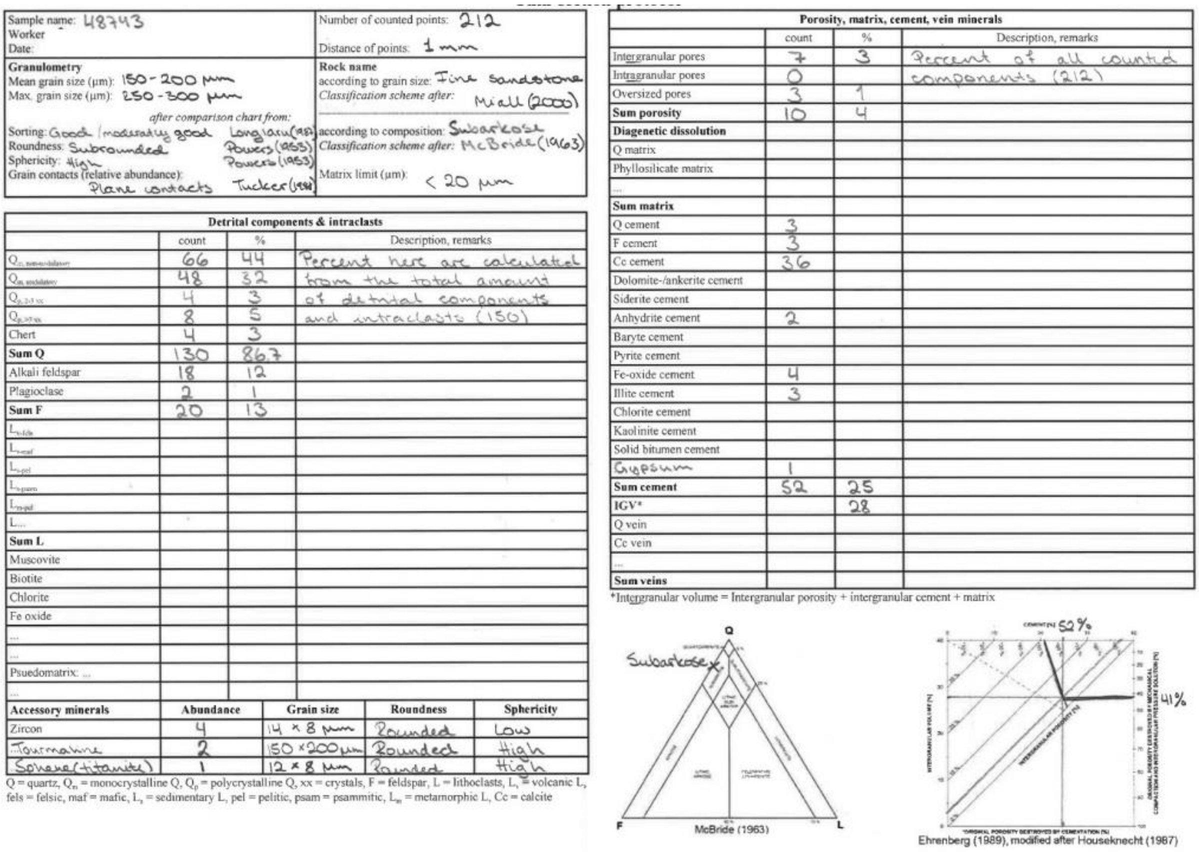
Figure A45: Thin section protocol for sample 48743 by student

Detrital components & intraclasts			
Quartz	**Count**	**% of points**	**% of grains**
Q_m, non-undulatory	146	33	60
Q_m, undulatory	31	7	13
Q_p, 2-3 crystals	6	1	2
Q_p, >3 crystals	11	2	5
SUM QUARTZ	**194**	**44**	**80**
Feldspar	**Count**	**% of points**	**% of grains**
Alkali feldspar	34	8	14
Plagioclase	10	2	4
SUM FELDSPAR	**44**	**10**	**18**
Lithic Fragments	**Count**	**% of points**	**% of grains**
Felsic volcanic fragments	4	1	2
SUM Lithic Fragments	**4**	**1**	**2**

Q_m = monocrystalline quartz, Q_p = polycrystalline quartz

Pores	Count	% of points
Intergranular pores	12	3
Intragranular pores	7	2
Oversized pores	1	0
SUM PORES	**20**	**5**
Cement	**Count**	**% of points**
Quartz cement	21	5
Calsium carbonate cement	113	26
Hematite cement	29	7
Gypsum cement	3	1
Anhydrite cement	4	1
Illite cement	11	2
SUM CEMENT	**181**	**41**
Intergranular porosity + intergranular cement	**193**	**44**

Figure A46: Thin section protocol for sample 48743 by student



Sample name: 48743
Worker
Date:

Number of counted points: 212
Distance of points: 1 mm

Granulometry
Mean grain size (µm): 150 - 200 µm
Max. grain size (µm): 250 - 300 µm
after comparison chart from:
Sorting: Good / moderately good — Longiaru (1987)
Roundness: Subrounded — Powers (1953)
Sphericity: High — Powers (1953)
Grain contacts (relative abundance): Plane contacts — Tucker (1988)

Rock name
according to grain size: Fine sandstone
Classification scheme after: Miall (2000)
according to composition: Subarkose
Classification scheme after: McBride (1963)
Matrix limit (µm): < 20 µm

Detrital components & intraclasts	count	%	Description, remarks
$Q_{m, non-undulatory}$	66	44	Percent here are calculated
$Q_{m, undulatory}$	48	32	from the total amount
$Q_{p, 2-3\ xx}$	4	3	of detrital components
$Q_{p, >3\ xx}$	8	5	and intraclasts (150)
Chert	4	3	
Sum Q	130	86.7	
Alkali feldspar	18	12	
Plagioclase	2	1	
Sum F	20	13	
L_{v-fels}			
L_{v-maf}			
L_{s-pel}			
L_{s-psam}			
L_{m-pel}			
L...			
Sum L			
Muscovite			
Biotite			
Chlorite			
Fe oxide			
...			
...			
Psuedomatrix: ...			
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	4	14 × 8 µm	Rounded	Low
Tourmaline	2	150 × 200 µm	Rounded	High
Sphene (titanite)	1	12 × 8 µm	Rounded	High

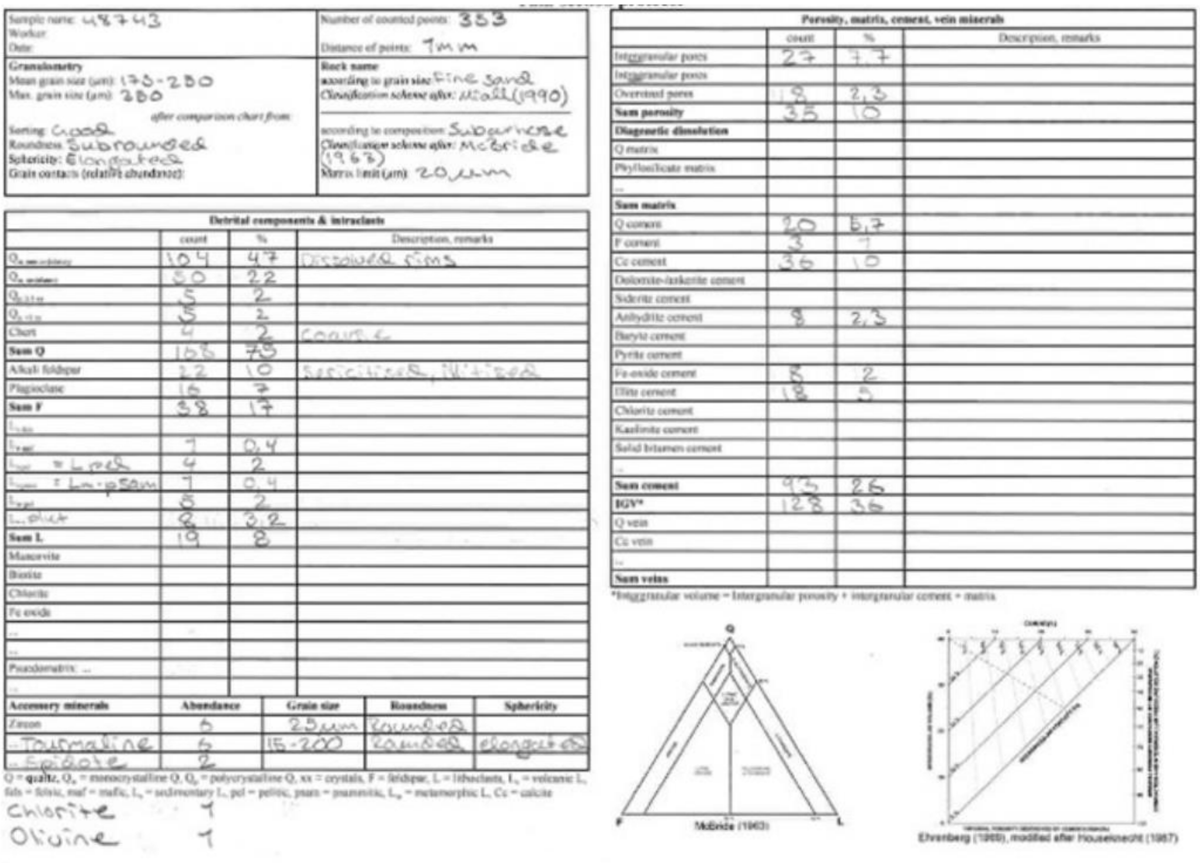
Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores	7	3	Percent of all counted
Intragranular pores	0		components (212)
Oversized pores	3	1	
Sum porosity	10	4	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	3		
F cement	3		
Cc cement	36		
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	2		
Baryte cement			
Pyrite cement			
Fe-oxide cement	4		
Illite cement	3		
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
Gypsum	1		
Sum cement	52	25	
IGV*		28	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix

Subarkose
Q
F
L
McBride (1963)
CEMENT [%] 52 %
41%
Ehrenberg (1989), modified after Houseknecht (1987)

Figure A47: Thin section protocol for sample 48743 by student



Sample name: 48743
Worker
Date:

Number of counted points: 353
Distance of points: 1 mm

Granulometry
Mean grain size (µm): 175 - 250
Max. grain size (µm): 350
after comparison chart from:
Sorting: Good
Roundness: Subrounded
Sphericity: Elongated
Grain contacts (relative abundance):

Rock name
according to grain size: Fine sand
Classification scheme after: Miall (1990)
according to composition: Subarkose
Classification scheme after: McBride (1963)
Matrix limit (µm): 20 µm

Detrital components & intraclasts	count	%	Description, remarks
$Q_{m, non-undulatory}$	104	47	Dissolved rims
$Q_{m, undulatory}$	50	22	
$Q_{p, 2-3\ xx}$	5	2	
$Q_{p, >3\ xx}$	5	2	
Chert	4	2	Coarse
Sum Q	168	75	
Alkali feldspar	22	10	Sericitized, illitized
Plagioclase	16	7	
Sum F	38	17	
L_{v-fels}			
L_{v-maf}	1	0,4	
L_{s-pel} = Lpel	4	2	
L_{s-psam} = Lm-psam	1	0,4	
L_{m-pel}	5	2	
L... plut	8	3,2	
Sum L	19	8	
Muscovite			
Biotite			
Chlorite			
Fe oxide			
...			
...			
Pseudomatrix: ...			
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	6	25 µm	Rounded	
Tourmaline	6	15 - 200	Rounded	elongated
Epidote	2			

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

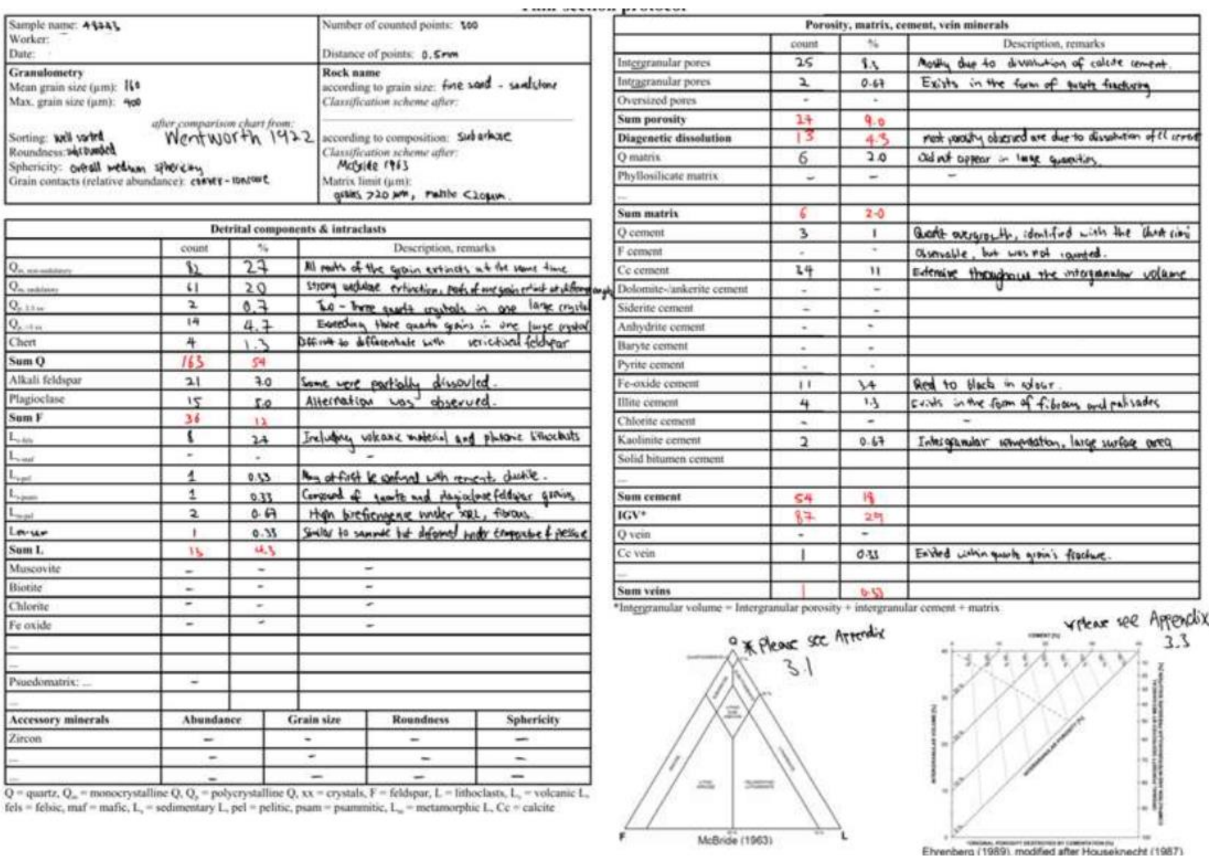
Chlorite 1
Olivine 1

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores	27	7,7	
Intragranular pores			
Oversized pores	8	2,3	
Sum porosity	35	10	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	20	5,7	
F cement	3	1	
Cc cement	36	10	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	8	2,3	
Baryte cement			
Pyrite cement			
Fe-oxide cement	8	2	
Illite cement	18	5	
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement	93	26	
IGV*	128	36	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix

Q
F
L
McBride (1963)
Ehrenberg (1989), modified after Houseknecht (1987)

Figure A48: Thin section protocol for sample 48743 by student



Sample name: 48743 Worker: Date:	Number of counted points: 300 Distance of points: 0.5mm
Granulometry Mean grain size (μm): 160 Max. grain size (μm): 400 *after comparison chart from:* Wentworth 1922 Sorting: well sorted Roundness: subrounded Sphericity: overall medium sphericity Grain contacts (relative abundance): convex - concave	**Rock name** according to grain size: fine sand - sandstone *Classification scheme after:* according to composition: Subarkose *Classification scheme after:* McBride 1963 Matrix limit (μm): grains >20 μm, matrix <20μm.

Detrital components & intraclasts	count	%	Description, remarks
$Q_{m, non-undulatory}$	82	27	All parts of the grain extincts at the same time
$Q_{m, undulatory}$	61	20	Strong undulose extinction, parts of one grain extinct at different angle
$Q_{p, 2-3 xx}$	2	0.7	Two - three quartz crystals in one large crystal
$Q_{p, >3 xx}$	14	4.7	Exceeding three quartz grains in one large crystal
Chert	4	1.3	Difficult to differentiate with sericitised feldspar
Sum Q	163	54	
Alkali feldspar	21	7.0	Some were partially dissolved.
Plagioclase	15	5.0	Alternation was observed.
Sum F	36	12	
L_{v-fels}	8	2.7	Including volcanic material and plutonic lithoclasts
L_{v-maf}	-	-	-
L_{s-pel}	1	0.33	May at first be confused with cement, ductile.
L_{s-psam}	1	0.33	Compound of quartz and plagioclase feldspar grains
L_{m-pel}	2	0.67	High birefringence under XPL, fibrous.
L_{m-psam}	1	0.33	Similar to sammite but deformed under temperature & pressure
Sum L	13	4.3	
Muscovite	-	-	-
Biotite	-	-	-
Chlorite	-	-	-
Fe oxide	-	-	-
...			
...			
Psuedomatrix: ...	-		
...			

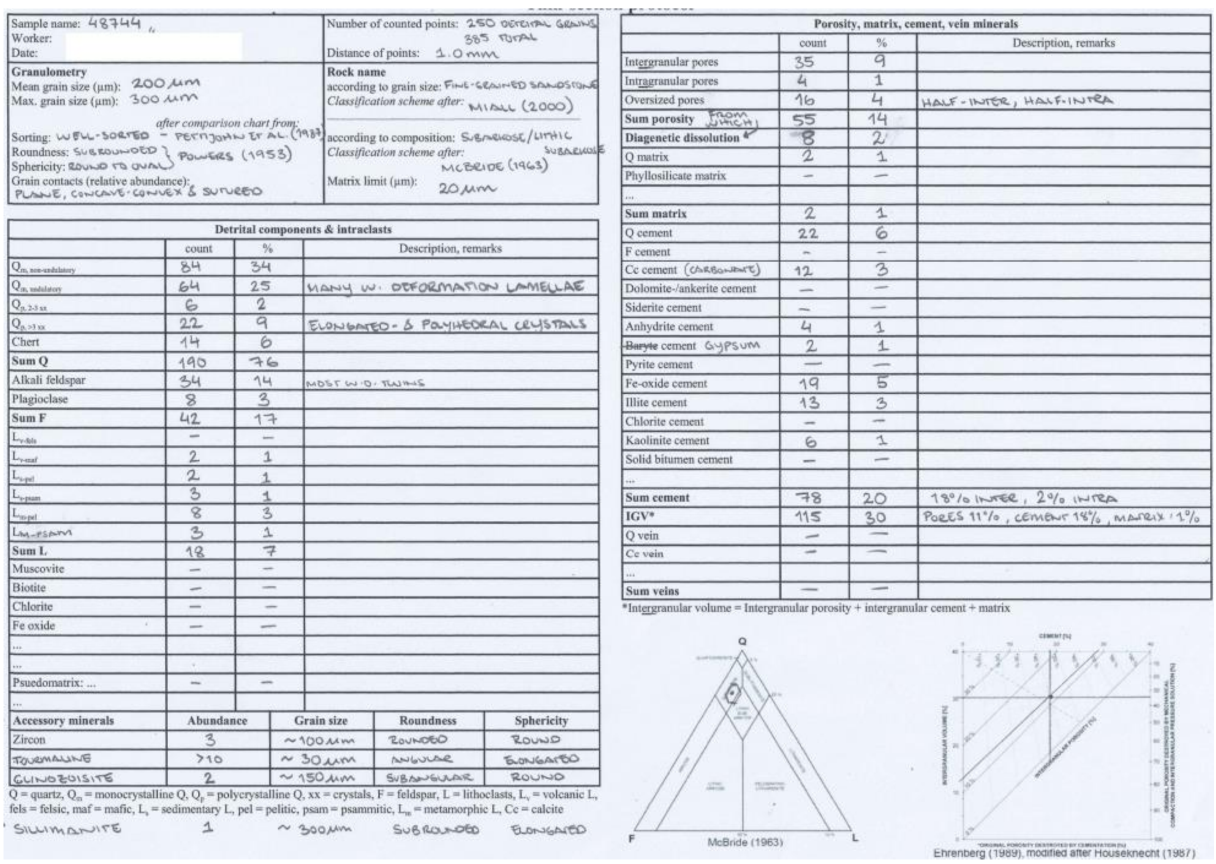
Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	-	-	-	-
...	-	-	-	-
...	-	-	-	-

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores	25	8.3	Mostly due to dissolution of calcite cement.
Intragranular pores	2	0.67	Exists in the form of quartz fracturing
Oversized pores	-	-	
Sum porosity	27	9.0	
Diagenetic dissolution	13	4.3	most porosity observed are due to dissolution of CC cement
Q matrix	6	2.0	did not appear in large quantities.
Phyllosilicate matrix	-	-	-
...			
Sum matrix	6	2.0	
Q cement	3	1	Quartz overgrowth, identified with the 'dust rim'
F cement	-	-	Observable, but was not counted.
Cc cement	34	11	Extensive throughout the intergranular volume.
Dolomite-/ankerite cement	-	-	
Siderite cement	-	-	
Anhydrite cement	-	-	
Baryte cement	-	-	
Pyrite cement	-	-	
Fe-oxide cement	11	3.4	Red to black in colour.
Illite cement	4	1.3	Exists in the form of fibrous and palisades
Chlorite cement	-	-	-
Kaolinite cement	2	0.67	Intergranular cementation, large surface area
Solid bitumen cement			
...			
Sum cement	54	18	
IGV*	87	29	
Q vein	-	-	
Cc vein	1	0.33	Existed within quartz grain's fracture.
...			
Sum veins	1	0.33	

*Intergranular volume = Intergranular porosity + intergranular cement + matrix

Figure A49: Thin section protocol for sample 48743 by student



Sample name: 48744 Worker: Date:	Number of counted points: 250 DETRITAL GRAINS 385 TOTAL Distance of points: 1.0 mm
Granulometry Mean grain size (μm): 200 μm Max. grain size (μm): 300 μm *after comparison chart from:* Sorting: WELL-SORTED - PETTIJOHN ET AL. (1987) Roundness: SUBROUNDED } POWERS (1953) Sphericity: ROUND TO OVAL } Grain contacts (relative abundance): PLANE, CONCAVE-CONVEX & SUTURED	**Rock name** according to grain size: FINE-GRAINED SANDSTONE *Classification scheme after:* MIALL (2000) according to composition: SUBARKOSE/LITHIC SUBARKOSE *Classification scheme after:* MCBRIDE (1963) Matrix limit (μm): 20 μm

Detrital components & intraclasts	count	%	Description, remarks
$Q_{m, non-undulatory}$	84	34	
$Q_{m, undulatory}$	64	25	MANY W. DEFORMATION LAMELLAE
$Q_{p, 2-3 xx}$	6	2	
$Q_{p, >3 xx}$	22	9	ELONGATED- & POLYHEDRAL CRYSTALS
Chert	14	6	
Sum Q	190	76	
Alkali feldspar	34	14	MOST W.O. TWINS
Plagioclase	8	3	
Sum F	42	17	
L_{v-fels}	—	—	
L_{v-maf}	2	1	
L_{s-pel}	2	1	
L_{s-psam}	3	1	
L_{m-pel}	8	3	
L_{M-PSAM}	3	1	
Sum L	18	7	
Muscovite	—	—	
Biotite	—	—	
Chlorite	—	—	
Fe oxide	—	—	
...			
...			
Psuedomatrix: ...	—	—	
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	3	~100 μm	ROUNDED	ROUND
TOURMALINE	>10	~ 30 μm	ANGULAR	ELONGATED
CLINOZOISITE	2	~ 150 μm	SUBANGULAR	ROUND

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

SILLIMANITE	1	~ 300 μm	SUBROUNDED	ELONGATED

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores	35	9	
Intragranular pores	4	1	
Oversized pores	16	4	HALF-INTER, HALF-INTRA
Sum porosity (FROM WHICH)	55	14	
Diagenetic dissolution	8	2	
Q matrix	2	1	
Phyllosilicate matrix	—	—	
...			
Sum matrix	2	1	
Q cement	22	6	
F cement	—	—	
Cc cement (CARBONATE)	12	3	
Dolomite-/ankerite cement	—	—	
Siderite cement	—	—	
Anhydrite cement	4	1	
~~Baryte~~ cement GYPSUM	2	1	
Pyrite cement	—	—	
Fe-oxide cement	19	5	
Illite cement	13	3	
Chlorite cement	—	—	
Kaolinite cement	6	1	
Solid bitumen cement	—	—	
...			
Sum cement	78	20	18% INTER, 2% INTRA
IGV*	115	30	PORES 11%, CEMENT 18%, MATRIX 1%
Q vein	—	—	
Cc vein	—	—	
...			
Sum veins	—	—	

*Intergranular volume = Intergranular porosity + intergranular cement + matrix

Figure A50: Thin section protocol for sample 48744 by student

Sample name: 48744 Worker: Date:	Number of counted points: 284 Distance of points: 1 mm
Granulometry Mean grain size (µm): 100 - 150 Max. grain size (µm): 200 *after comparison chart from:* Sorting: good Longiaru (1987) Roundness: 0.6 - 0.7 Flügel (2004) Sphericity: 0.4 - 0.7 Flügel (2004) Grain contacts (relative abundance): mainly plane and concave-convex	**Rock name** according to grain size: Fine-grained sandstone *Classification scheme after:* Pettijohn (1973) according to composition: subarkose *Classification scheme after:* McBride (1963) Matrix limit (µm): 63

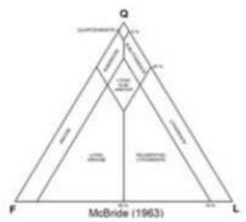
Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m, non-undulatory}$	85	42	
$Q_{m, undulatory}$	62	31	
$Q_{p, 2-3 xx}$	11	5	
$Q_{p, >3 xx}$	6	3	
Chert	2	1	
Sum Q	166	82	
Alkali feldspar	13	6	
Plagioclase	7	4	
Sum F	20	10	
L_{v-fels}			
L_{v-maf}	3	1.5	
L_{s-pel}	1	0.5	
L_{s-psam}	1	0.5	
L_{m-pel}	3	1.5	
L... Lm-psam	8	4.0	
Sum L	16	8	
Muscovite			
Biotite			
Chlorite			
Fe oxide			
...			
...			
Psuedomatrix: ...			
...			

Accessory minerals	**Abundance**	**Grain size**	**Roundness**	**Sphericity**
Zircon	2	140	0.8	0.7
... Glauconite	1	140	0.8	0.7
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	7	3	
Intragranular pores	3	1	
Oversized pores	18	6	
Sum porosity	28	10	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	16	6	
F cement			
Cc cement	10	3	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	1	0	
Baryte cement			
Pyrite cement			
Fe-oxide cement	25	9	
Illite cement			
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
... Gypsum	2	1	
Sum cement	54	19	
IGV*			
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



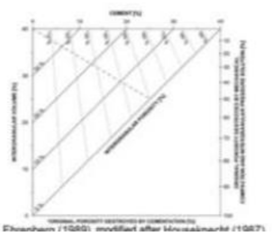


Figure A51: Thin section protocol for sample 48744 by student

Sample name: 48744 Worker: Date:	Number of counted points: 290 Distance of points: 1 mm
Granulometry Mean grain size (µm): 150 × 150 µm Max. grain size (µm): 300 × 200 µm *after comparison chart from:* Sorting: well sorted Roundness: sub-rounded to rounded Sphericity: 0.83 - 0.73 Grain contacts (relative abundance): Plane and Point mostly.	**Rock name** according to grain size: Fine Sandstone *Classification scheme after:* Wenthworth (1922) according to composition: Subarkose *Classification scheme after:* McBride (1963) Matrix limit (µm): 20 µm

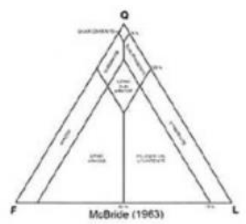
Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m, non-undulatory}$	91	31	
$Q_{m, undulatory}$	53	18	
$Q_{p, 2-3 xx}$	9	3	
$Q_{p, >3 xx}$	11	3.8	
Chert			
Sum Q	164	56.6	
Alkali feldspar	18	6.2	
Plagioclase	16	5.5	
Sum F	34	12	
L_{v-fels}			
L_{v-maf}			
L_{s-pel}	1	0.3	
L_{s-psam}			
L_{m-pel}			
L...			
Sum L	1	0.3	
Muscovite			accessory
Biotite			
Chlorite			accessory
Fe oxide	1	0.3	
...			
...			
Psuedomatrix: ...			
...			

Accessory minerals	**Abundance**	**Grain size**	**Roundness**	**Sphericity**
Zircon	accessory	50 × 70 µm	Sub rounded	0.71
... TOURMALINE	accessory	200 × 50 µm	rounded	0.71
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	16	5.5	
Intragranular pores	0	0	
Oversized pores	7	2	
Sum porosity	23	7.9	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	38	13	
F cement	5	1.7	
Cc cement	9	3.1	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	4	1.4	
Baryte cement			
Pyrite cement			
Fe-oxide cement	3	1	
Illite cement	8	2.8	
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
GYPSUM			Seen
Sum cement	67	23	
IGV*	83	29	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



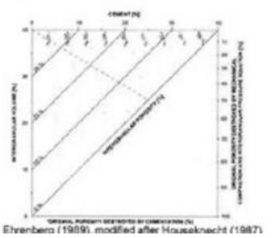


Figure A52: Thin section protocol for sample 48744 by student

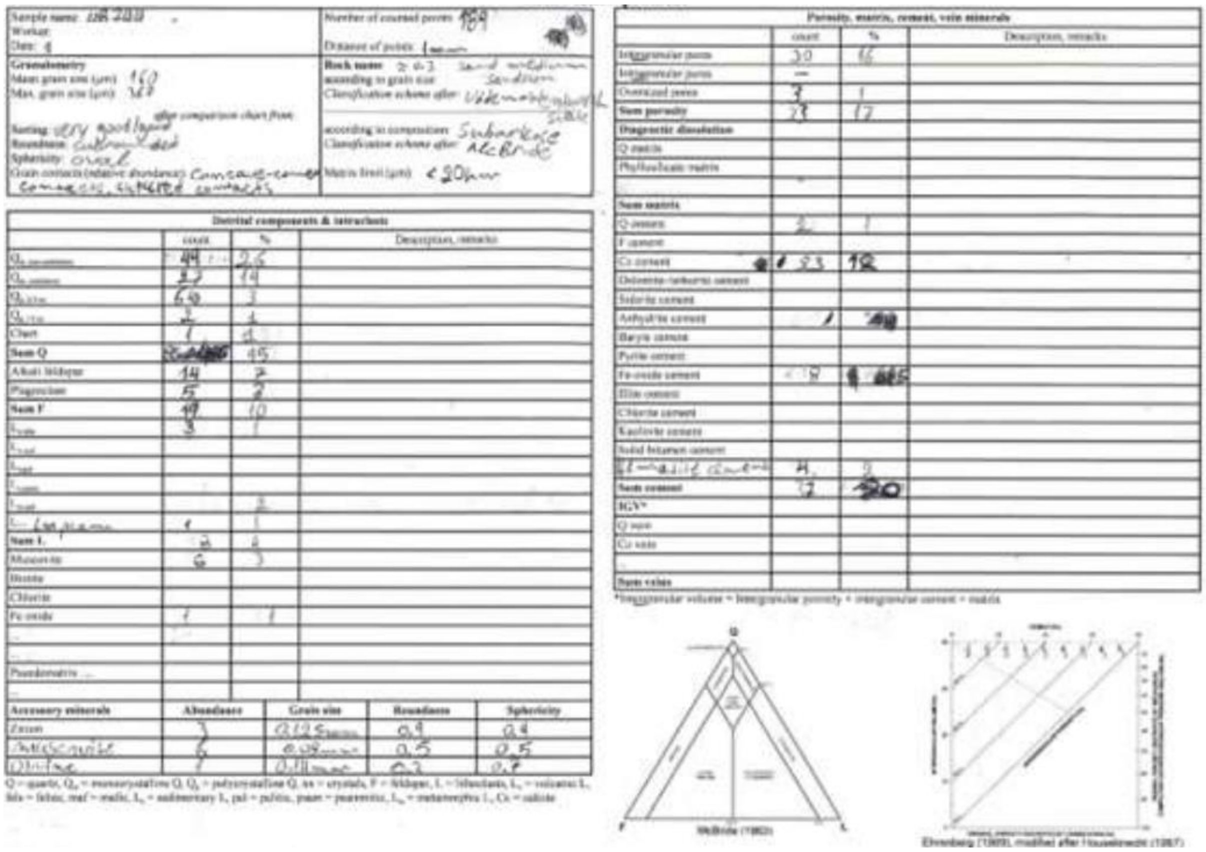


Figure A53: Thin section protocol for sample 48744 by student

	A	B	C	D	E	F
1	Thin section protocol, point counting.					
2	*Thin section: 48745*					
3		Detrital components & intraclasts				
4		Count:	Percentage	Remarks		
5	Monocrystalline quartz, non-undulatory:	78	32,8			
6	Monocrystalline quartz, undulatory:	42	17,6			
7	Polycrystalline quartz, 2-3 crystals:	2	0,8			
8	Polycrystalline quartz, more than 3 crystals:	4	1,7			
9	Chert:	6	2,5			
10	Sum quartz:	132	55,5			
11	Alkali feldspar:	5	2,1			
12	Plagioclase:	7	2,9			
13	Sum feldspar:	12	5,0			
14	Pelitic sedimentary lithoclast:	6	2,5			
15	Sum lithoclasts:	6	2,5			
16	Muscovite:	5	2,1			
17	Iron oxide:	1	0,4	Opaque grain with red/brown colors around/inside it,		
18	Sum	6	2,5	there are several other grains like this as well.		
19						
20	Accesory minerals:	Abundance	**Grain size**	**Roundness**	**Sphericity**	
21	Zircon:	3	80-100 µm	rounded	oval / round	
22	Volcanic lithoclast:	3	460 µm & 190 µm	sub rounded	round	
23	Glauconite	2	50 µm	rounded	round	
24	Sum accessory minerals:	8				
25		Porosity, cement				
26		**Count**	**Percentage**	**Remarks:**		
27	Intergranular pores:	29	12,2			
28	Intragranular pores:	0	-			
29	Oversized pores:	10	4,2			
30	Sum porosity:	39	16,4			
31						
32	Carbonate cement:	24	10,1			
33	Fe-oxide (hematite) cement:	19	8,0			
34	**Sum cement:**	43	18,1			
35	**IGV:**	82	34,5			
36		Count	Percentage			
37	Sum of all grains counted:	156	**65,5**			
38	Sum of all porosity & cement	82	**34,5**			
39	Sum of all points counted:	238	**100,0**			

Figure A54: Thin section protocol for sample 48745 by student

Sample name: 48745		Number of counted points:	227
Worker:			
Date:		Distance of points:	1mm
Granulometry		**Rock name**	
Mean grain size (µm):	200	according to grain size:	Fine Sandstone
Max. Grain size (µm):	1000	Classification scheme after:	Udden-Wentworth scale
	After comparison chart from:	according to composition:	Subarkose
Sorting:	Good	Classification scheme after:	McBride
Roundness:	Subangular		
Sphericity:	Low to high	Matrix limit (µm):	
Grain contact (relative abundance):	Point and plane most abundant		

Detrital components & intraclasts			
	Count	%	Description, remarks
Q(m, non-undulatory)	66		
Q(m, undulatory)	36		
Q(p, 2-3xx)	16		
Q(p, >3 xx)	16		
Chert	8		
Sum Q	142		
Alkali feldspar	9		
Plagioclase	12		
Sum F	21		
L(v-fels)			
L(v-maf)	1		Qz+mica
L(s-pel)			
L(s-psam)			
L(m-pel)			
Sum L	1		
Muscovite			
Biotite			
Chlortie	2		
Fe oxide			
...			
...			
Psuedomatrix:			
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Opaque	2			
Zircon				
...				

Q = quartz, Q(m) = monocrystalline Q, Q(p) = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L(v) = volcanic L, fels = felsic, maf = mafic, L(s) = sedimentary L, pel = pelitic, psam = psammitic, L(m) = metamorphic L, Cc = calcite

Porosity, matrix,cement, vein minerals			
	Count	%	Description, remarks
Intergranular pors	22		
Intragranular pores			
Oversize pores	2		
Sum porosity	24		
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix	0		
Q cement			
F cement			
Cc cement	17		
Dolomite-/ankerite cememnt			
Siderite cement			
Anyhdrite cement	1		
Baryte cement			
Pyrite cement			
Fe-oxide cement	14		
Illite cement			
Chlorite cement	5		
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement	37		
IGV*	27		
Q vein			
Cc vein			
...			
Sum veins	0		

*Intergranular volume = intergranular porosity + intergranular cement + matrix

Figure A55: Thin section protocol for sample 48745 by student

Sample name: 48745	Number of counted points: 242
Worker:	
Date:	Distance of points: 1mm
Granulometry	**Rock name**
Mean grain size (µm): 100	according to grain size: Very fine sand
Max. grain size (µm): 500	*Classification scheme after:* Miall, 2000
after comparison chart from:	
Sorting: Good - Longiaru, 1987	according to composition: Subarkose
Roundness: Subrounded - Powers, 1953	*Classification scheme after:* McBride, 1963
Sphericity: 0,7×0,7 - Flügel, 2004	Matrix limit (µm): <20 µm
Grain contacts (relative abundance): Plane contact - Tucker, 1988	

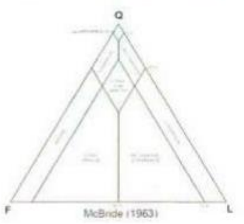
Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m, non-undulatory}$	76	51	
$Q_{m, undulatory}$	20	13	
$Q_{p, 2-3 xx}$	10	7	
$Q_{p, >3 xx}$	27	8	
Chert	5	3	
Sum Q	138	92	
Alkali feldspar	7	5	
Plagioclase	3	2	
Sum F	10	7	
L_{v-fels}			
L_{v-maf}	1	1	
L_{s-pel}			
L_{s-psam}			
L_{m-pel}			
L...			
Sum L	1	1	
Muscovite			
Biotite			
Chlorite			
Fe oxide			
...			
...			
Psuedomatrix: ...			
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon				
Tourmaline	5	90 µm	Subrounded	Low / 0,3
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	10	4	
Intragranular pores	10	4	
Oversized pores	6	2	
Sum porosity	26	10	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	14	6	
F cement			
Cc cement	28	12	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	4	2	
Baryte cement			
Pyrite cement			
Fe-oxide cement	12	5	
Illite cement	8	3	
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement	66	28	
IGV*		31	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



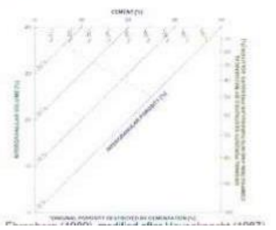


Figure A56: Thin section protocol for sample 48745 by student

Sample name: 48745 Work: Date:	Number of counted points: 493 Distance of points: 1mm
Granulometry Mean grain size (µm): 140µm Max. grain size (µm): 800µm *after comparison chart from:* Sorting: Good/moderatly good — Longiaru (1987) Roundness: Subangular-subrounded — Füchtbauer (1988) Sphericity: Equant-bladed — Tucker (1991) Grain contacts (relative abundance): Plane contact — Tucker (1988)	**Rock name** according to grain size: Fine sandstone *Classification scheme after:* Wentworth (1922) according to composition: Subarkose *Classification scheme after:* Mcbride (1963) Matrix limit (µm): 20µm

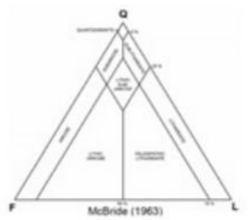
Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m,\ non\ undulatory}$	183	37%	
$Q_{m,\ undulatory}$	28	6%	
$Q_{p,\ 2\text{-}3\ xx}$	8	1.5%	
$Q_{p,\ >3\ xx}$	10	2%	
Chert	10	2%	
Sum Q	239	48.5%	
Alkali feldspar	38	8%	
Plagioclase	5	1%	
Sum F	43	9%	
$L_{v,\ fels}$			
$L_{v,\ maf}$			
$L_{s,\ pel}$	2	0.4%	
$L_{s,\ psam}$	3	0.5%	
$L_{m,\ pel}$	4	1%	
Lm-psam	6	1%	
Sum L	15	2.9%	
Muscovite	2	0.4%	
Biotite	1	0.2%	
Chlorite			
Fe oxide			
...			
...			
Psuedomatrix: ...			
-- Total grains:	300	61%	

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	3	50µm	Subangular	Equant
-Rutile	2	50µm	Subrounded	Bladed
-Tourmaline	4	15-50µm	Rounded	Bladed and equant

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	70	14%	Also secondary moldic porosity
Intragranular pores	4	1%	
Oversized pores	4	1%	
Sum porosity	78	16%	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement			
F cement			
Cc cement	41	8%	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	5	1%	
Baryte cement			
Pyrite cement			
Fe-oxide cement	54	11%	
Illite cement	15	3%	Grain rimming crystals, plate shaped
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement	115	23%	
IGV*	185	37%	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



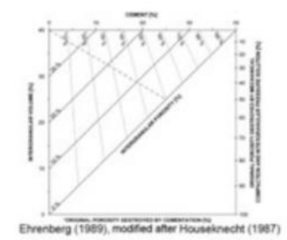


Figure A57: Thin section protocol for sample 48745 by student

Thin-section protocol

Sample name: WKJ4E Worker: Date:	Number of counted points: 267 Distance of points: 1mm
Granulometry Mean grain size (µm): 200 Max. grain size (µm): 600 *after comparison chart from:* Sorting: VERY WELL – WELL SORTED Roundness: SUBANGULAR Sphericity: OVAL Grain contacts (relative abundance): CONCAVE - CONVEX	**Rock name** according to grain size: SUB-LITHARENITE *Classification scheme after:* McBRIDE according to composition: SUB-LITHARENITE *Classification scheme after:* McBRIDE Matrix limit (µm): < 20 µm

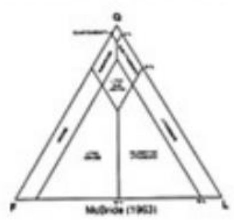
Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m,\ non\ undulatory}$	41	15	
$Q_{m,\ undulatory}$	70	26	
$Q_{p,\ 2\text{-}3\ xx}$	5	2	
$Q_{p,\ >3\ xx}$	5	2	
Chert	1	0	
Sum Q	122	45	
Alkali feldspar	9	3	
Plagioclase	4	2	
Sum F	13	5	
$L_{v,\ fels}$	13	5	
$L_{v,\ maf}$	3	1	
$L_{s,\ pel}$	1	0	
$L_{s,\ psam}$	—	—	
$L_{m,\ pel}$	—	—	
L...	—	—	
Sum L	17	6	
Muscovite	1	0	
Biotite	2	0	
Chlorite	5	2	
Fe oxide	2	0	
HEMATITE	3	1	
...			
Psuedomatrix: ...	—	—	
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	3	25 µm	ROUNDED	ELONGATED
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	30	11	
Intragranular pores	—	—	
Oversized pores	5	2	
Sum porosity	35	13	
Diagenetic dissolution	—	—	
Q matrix	1	0	
Phyllosilicate matrix	—	—	
UNKNOWN TYPE	1	0	
Sum matrix	2	0	
Q cement	20	7	
F cement	[illegible]		
Cc cement	8	3	
Dolomite-/ankerite cement	—	—	
Siderite cement	—	—	
Anhydrite cement	1	0	
Baryte cement	—	—	
Pyrite cement	—	—	
Fe-oxide cement	16	7	
Illite cement	15	6	
Chlorite cement	2	0	
Kaolinite cement	—	—	
Solid bitumen cement	—	—	
...			
Sum cement	62	23	
IGV*			
Q vein	—	—	
Cc vein	—	—	
...			
Sum veins	—	—	

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



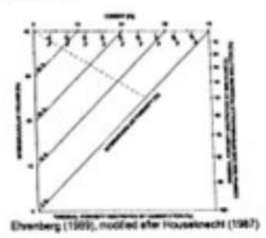


Figure A58: Thin section protocol for sample 48745 by student

Q m, non-undulatory	109	Alkali feldspar	0	L v-fels		Intergranular pores	
Q m, undulator	24	Plagioclase	5	L v-ma		Intragranular pores	16
Q p, 2-3 xx	6	Sum F	5	L s-pe		Oversized pores	2
Q p, >3 xx	1			L s-psam		Sum porosity	18
Chert	5			L m-pe		Q cement	
Sum Q	145			L...		F cement	
				Sum L	0	Cc cement	31
						Dolomite-/ankerite cement	
						Siderite cement	
						Anhydrite cement	
						Baryte cement	
All elements	232	Cc vein		Muscovite	2	Pyrite cement	
Grain total	150	Q vein		Biotite	1	Fe-oxide cement	1
Opaque mineral	2	Sum veins	0	Chlorite		Illite cement	
Percent Q	96,66666667			Fe oxide	1	Chlorite cement	
Percent F	3,333333333			Psuedomatrix:	28	Kaolinite cement	
Percent L	0			Sum other	32	Solid bitumen cement	
Percent porosity	7,75862069					Sum cement	32
Percent cement	13,79310345						

Figure A59: Thin section protocol for sample 48745 by student

48746	Number of counted points: 300 Number of counted grains: 185 Distance between points: 1 mm
Granulometry Mean grain size (µm): 100 µm = 0.1 mm Max. grain size (µm): 500 µm = 0.5 mm Sorting: very well/well (Longiaru, 1987) Roundness: subangular to subrounded (Füchtbauer, 1988) Grain shape: quartz grains mostly round/equant (Tucker, 1991) Grain to grain contacts: mostly planar contacts, also some interpenetrating (concave-convex) contacts (Tucker, 1988)	**Rock name** according to grain size: Very fine-grained sandstone *Classification scheme after: Wentworth (1922)* according to composition: Sublitharenite *Classification scheme after: McBride (1963)* Matrix limit (µm):

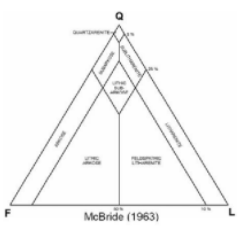
Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m, non-undulatory}$	29	9.7	0.03-0.5 mm, most are 0.1 mm, equant, subangular to subrounded
$Q_{m, undulatory}$	101	33.7	
$Q_{p, 2-3 xx}$	6	2.0	0.2-0.4 mm, most are equant, subangular to subrounded
$Q_{p, >3 xx}$	8	2.7	
Chert	9	3.0	0.2-0.4 mm, oval, rounded, microcrystalline
Sum Q	153	51.1	Is 82.7 % out of sum of grains (Q+F+L)
Alkali feldspar	7	2.3	Albite and pericline, microcline and orthoclase, 0.2 mm
Plagioclase	2	0.7	Albite twinning, round to oval, rounded, 0.2 mm
Sum F	9	3.0	Is 4.9 % out of sum of grains (Q+F+L)
L_{v-fels}			
L_{v-maf}			
L_{s-pel}	12	4.0	Oval, rounded, 0.1-0.2 mm, microcrystalline, mica+quartz
L_{m-pel}	5	1.7	Platy, oval, rounded, 0.15-0.2 mm, mica+quartz, lamellae
L_{m-psam}	6	2.0	Oval to elongated, rounded, 0.1-0.25 mm, quartz
L…			
Sum L	23	7.7	Is 12.4 % out of sum of grains (Q+F+L)
Sum of grains (Q+F+L)	**185**		
Chlorite	3	1.0	Elongated, bending around quartz, 0.1 mm in length
Opaque minerals	2	0.7	Always black, equant, subangular, 0.07 mm
Glauconite	1	0.3	Green, grains with many small crystals, 0.1 mm
Muscovite	2	0.7	Elongated, 0.07-0.5 mm in length, bending around quartz
Zircon	1	0.3	0.05-.01 mm, rounded
…			
…			

Accessory minerals	**Abundance**	**Grain size**	**Roundness**	**Sphericity**
Zircon	Found > 10	0.050-0.1 mm	Rounded	High
Rutile	Found 2	0.050-0.07 mm	Rounded	High

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	12	4.0	0.05-0.1 mm, similar to quartz shape/size, some elongated
Intragranular pores	8	2.7	Small, secondary, in feldspar grains
Oversized pores	17	5.7	Looks like many formed preparing the thin-section
Sum porosity	37	12.4	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
…			
Sum matrix			
Quartz cement	12	4.0	Overgrowth on quartz grains
Feldspar cement	1	0.3	Overgrowth on feldspar grains
Calcite cement	23	7.7	Pore-filling, sparry
Anhydrite cement	8	2.7	Poikilotopic
Fe-oxide cement	17	5.7	Coat on the grains, microcrystalline
Illite cement	7	2.3	Near the Fe-oxide, fibres
Gypsum cement	1	0.3	Poikilotopic
…			
…			
…			
…			
…			
…			
…			
Sum cement	69	23.0	
IGV*	98	32.7	
Q vein			
Cc vein			
…			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



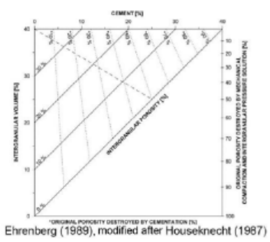
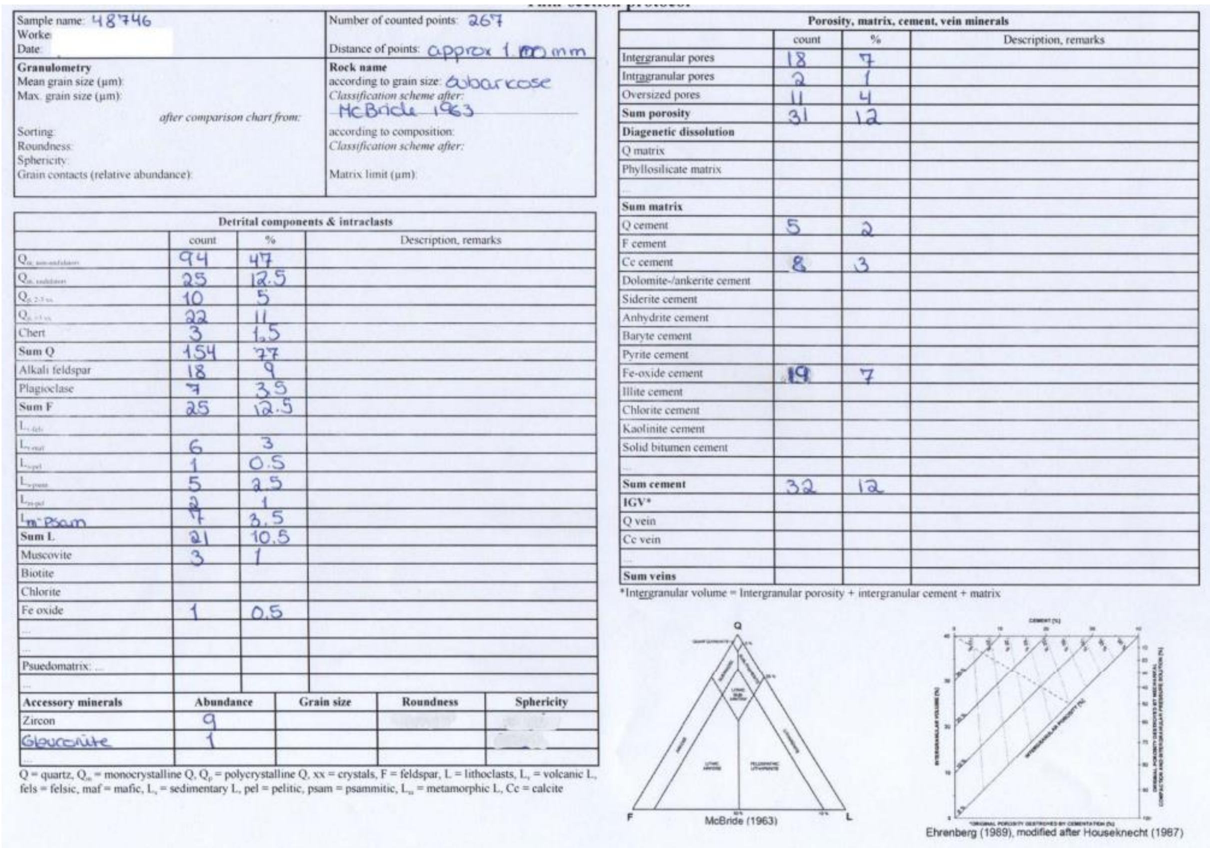


Figure A60: Thin section protocol for sample 48746 by student



Sample name: 48746
Worker:
Date:
Number of counted points: 267
Distance of points: approx 1 mm

Granulometry
Mean grain size (µm):
Max. grain size (µm):
after comparison chart from:
Sorting:
Roundness:
Sphericity:
Grain contacts (relative abundance):

Rock name
according to grain size: subarkose
Classification scheme after: McBride 1963
according to composition:
Classification scheme after:
Matrix limit (µm):

Detrital components & intraclasts	count	%	Description, remarks
$Q_{m, non-undulatory}$	94	47	
$Q_{m, undulatory}$	25	12.5	
$Q_{p, 2-3 xx}$	10	5	
$Q_{p, >3 xx}$	22	11	
Chert	3	1.5	
Sum Q	154	77	
Alkali feldspar	18	9	
Plagioclase	7	3.5	
Sum F	25	12.5	
$L_{v, fels}$			
$L_{v, maf}$	6	3	
$L_{s, pel}$	1	0.5	
$L_{s, psam}$	5	2.5	
$L_{m, pel}$	2	1	
L_{m}-psam	7	3.5	
Sum L	21	10.5	
Muscovite	3	1	
Biotite			
Chlorite			
Fe oxide	1	0.5	
...			
...			
Psuedomatrix: ...			
...			

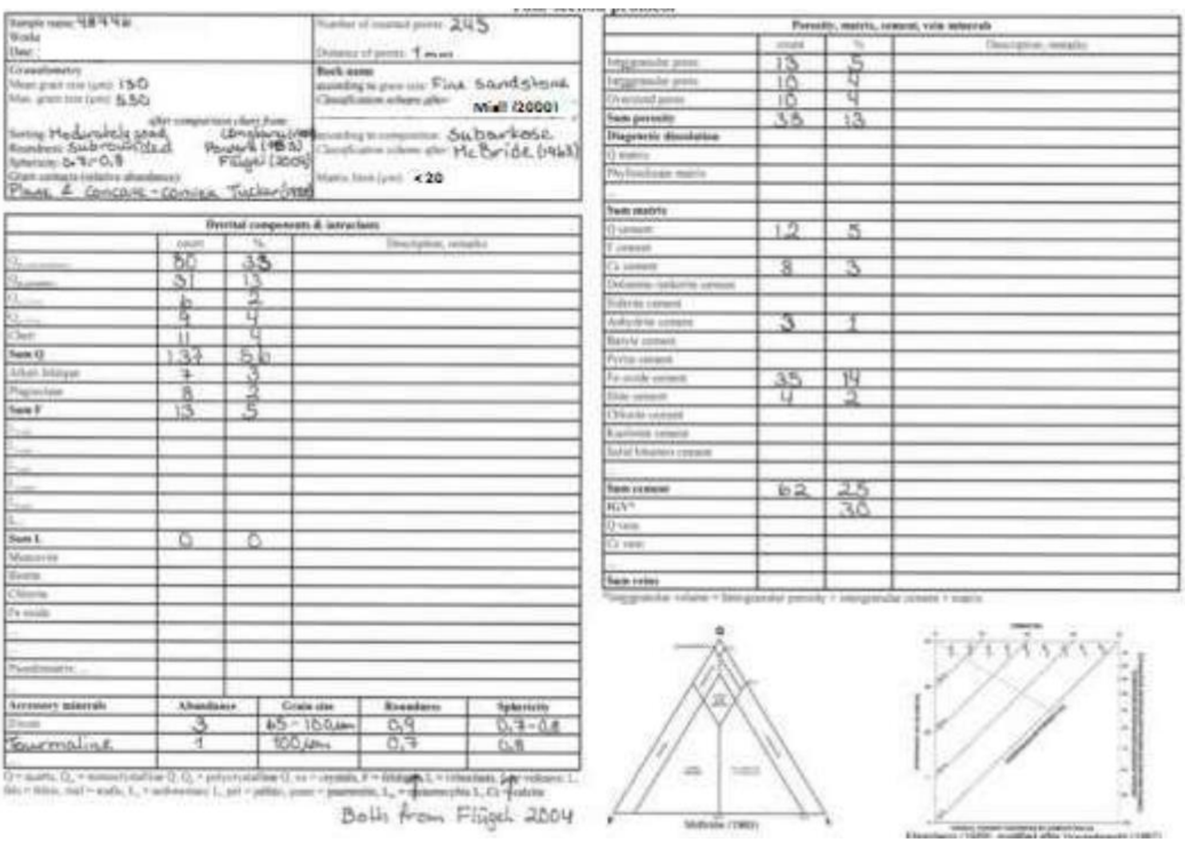
Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	9			
Glauconite	1			

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores	18	7	
Intragranular pores	2	1	
Oversized pores	11	4	
Sum porosity	31	12	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	5	2	
F cement			
Cc cement	8	3	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement			
Baryte cement			
Pyrite cement			
Fe-oxide cement	19	7	
Illite cement			
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement	32	12	
IGV*			
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix

Figure A61: Thin section protocol for sample 48746 by student



Sample name: 48746
Worker:
Date:
Number of counted points: 245
Distance of points: 1 mm

Granulometry
Mean grain size (µm): 150
Max. grain size (µm): 550
after comparison chart from:
Sorting: Moderately good
Roundness: Subrounded
Sphericity: 0.7-0.9
Longiaru (1987), Powers (1953), Flügel (2005)
Grain contacts (relative abundance): Planar & Concave-convex Tucker (1988)

Rock name
according to grain size: Fine sandstone
Classification scheme after: Miall (2000)
according to composition: Subarkose
Classification scheme after: McBride (1963)
Matrix limit (µm): <20

Detrital components & intraclasts	count	%	Description, remarks
Q_{m}	80	33	
Q_{m}	31	13	
Q_{p}	6	2	
Q_{p}	9	4	
Chert	11	4	
Sum Q	137	56	
Alkali feldspar	7	3	
Plagioclase	8	3	
Sum F	15	5	
L_{v}			
L_{v}			
L_{s}			
L_{s}			
L_{m}			
L_{m}			
Sum L	0	0	
Muscovite			
Biotite			
Chlorite			
Fe oxide			
...			
...			
Psuedomatrix: ...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	3	45-100 µm	0.9	0.7-0.8
Tourmaline	1	100 µm	0.7	0.8

Both from Flügel 2004

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores	13	5	
Intragranular pores	10	4	
Oversized pores	10	4	
Sum porosity	33	13	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	12	5	
F cement			
Cc cement	8	3	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	3	1	
Baryte cement			
Pyrite cement			
Fe-oxide cement	35	14	
Illite cement	4	2	
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement	62	25	
IGV*		38	
Q vein			
Cc vein			
...			
Sum veins			

Figure A62: Thin section protocol for sample 48746 by student

Sample name: 48746 Worker Date:	Number of counted points: 300 Distance of points: 1 mm
Granulometry Mean grain size (µm): 114 Max. grain size (µm): 600 *after comparison chart from:* Sorting: Good to moderate Roundness: Subangular to subrounded Sphericity: Elongated to equant Grain contacts (relative abundance):	**Rock name** according to grain size: Quartz arenite *Classification scheme after:* Miall (1990) according to composition: Subarkose *Classification scheme after:* McBride (1963) Matrix limit (µm): 20

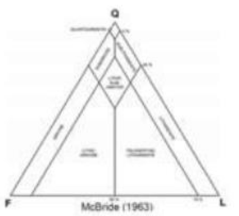
Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m, non-undulatory}$	114	38	
$Q_{m, undulatory}$	31	10,4	
$Q_{p, 2-3 xx}$	4	1,3	
$Q_{p, >3 xx}$	1	0,3	
Chert	3	1	
Sum Q	153	51	
Alkali feldspar	36	12	
Plagioclase	4	1,3	
Sum F	40	13,3	
L_{v-fels}	0	0	
L_{v-maf}	0	0	
L_{s-pel}	4	1,3	
L_{s-psam}	0	0	
L_{m-pel}	0	0	
L... metapsammite	5	1,6	
Sum L	9	2,9	
Muscovite			
Biotite			
Chlorite			
Fe oxide			
...			
...			
Psuedomatrix: ...			
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	2			
... Tourmaline	4			
... Rutile	1			

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	40	13,4	
Intragranular pores	0	0	
Oversized pores	3	1	
Sum porosity	43	14,4	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix	0	0	
Q cement	5	1,7	
F cement			
Cc cement	15	5	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	1	0,3	
Baryte cement			
Pyrite cement			
Fe-oxide cement	19	6,4	
Illite cement	13	4,4	
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement	53	17,8	
IGV*	96	32,2	
Q vein			
Cc vein			
...			
Sum veins	0	0	

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



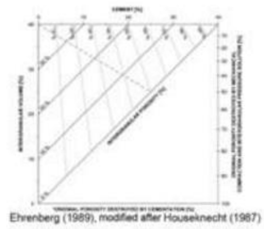


Figure A63: Thin section protocol for sample 48746 by student

Sample name: 48746 Worker: Date:	Number of counted points: 312 Distance of points: 1 mm
Granulometry Mean grain size (µm): 0.125 mm Max. grain size (µm): 0,400 mm *after comparison chart from:* Sorting: Moderately sorted Roundness: subangular Sphericity: oval Grain contacts (relative abundance):	**Rock name** according to grain size: FINE SANDSTONE *Classification scheme after:* Miall (2000) according to composition: ARKOSE (SUBARKOSE) *Classification scheme after:* McBride (1963) Matrix limit (µm): <20 µm

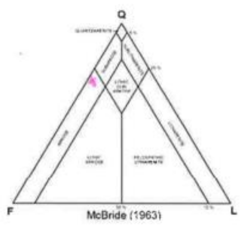
Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m, non-undulatory}$	50	16	
$Q_{m, undulatory}$	73	23	
$Q_{p, 2-3 xx}$	7	2	
$Q_{p, >3 xx}$	5	2	
Chert	1	0	
Sum Q	136	44	
Alkali feldspar	47	15	
Plagioclase	7	2	
Sum F	54	17	
L_{v-fels}			
L_{v-maf}	1	0	Fenocryst in dark brown volcanic glass.
L_{s-pel}			
L_{s-psam}			
L_{m-pel}			
L...			
Sum L	1	0	
Muscovite	3	1	
Biotite	2	1	
Chlorite			
Fe oxide	1	0	
...			
...			
Psuedomatrix: ...			
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon		25-75 µm	very round	
...				
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	32	10	
Intragranular pores	—		
Oversized pores	6	2	
Sum porosity	38	12	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	17	4	
F cement	—		
Cc cement	15	5	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	2	1	
Baryte cement			
Pyrite cement			
Fe-oxide cement	37	12	
Illite cement	8	2	
Chlorite cement	3	1	
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement	77	25	
IGV*	115	37	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



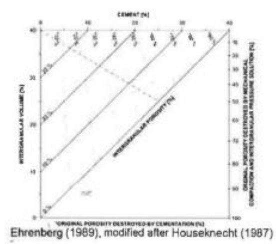
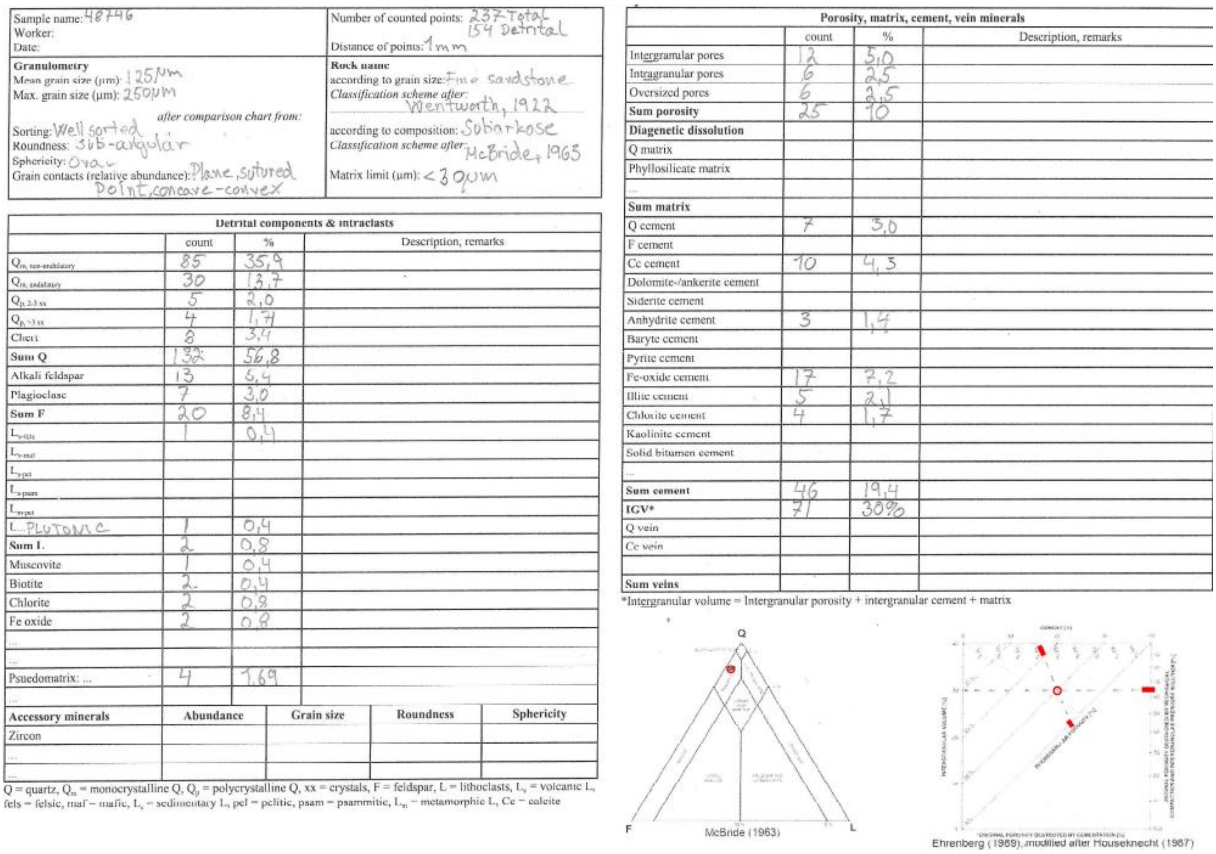


Figure A64: Thin section protocol for sample 48746 by student



Sample name: 48746 Worker: Date:	Number of counted points: 237 Total, 154 Detrital Distance of points: 1 mm
Granulometry Mean grain size (µm): 125 µm Max. grain size (µm): 250 µm *after comparison chart from:* Sorting: Well sorted Roundness: Sub-angular Sphericity: Oval Grain contacts (relative abundance): Plane, sutured, Point, concave-convex	**Rock name** according to grain size: Fine sandstone *Classification scheme after:* Wentworth, 1922 according to composition: Subarkose *Classification scheme after:* McBride, 1963 Matrix limit (µm): < 30 µm

Detrital components & intraclasts	count	%	Description, remarks
$Q_{m, non-undulatory}$	85	35,9	
$Q_{m, undulatory}$	30	13,7	
$Q_{p, 2-3 xx}$	5	2,0	
$Q_{p, >3 xx}$	4	1,71	
Chert	8	3,4	
Sum Q	132	56,8	
Alkali feldspar	13	6,4	
Plagioclase	7	3,0	
Sum F	20	8,4	
L_{v-fels}	1	0,4	
L_{v-maf}			
L_{s-pel}			
L_{s-psam}			
L_{m-pel}			
L...PLUTONIC	1	0,4	
Sum L	2	0,8	
Muscovite	1	0,4	
Biotite	2	0,4	
Chlorite	2	0,8	
Fe oxide	2	0,8	
...			
...			
Psuedomatrix: ...	4	1,69	
...			

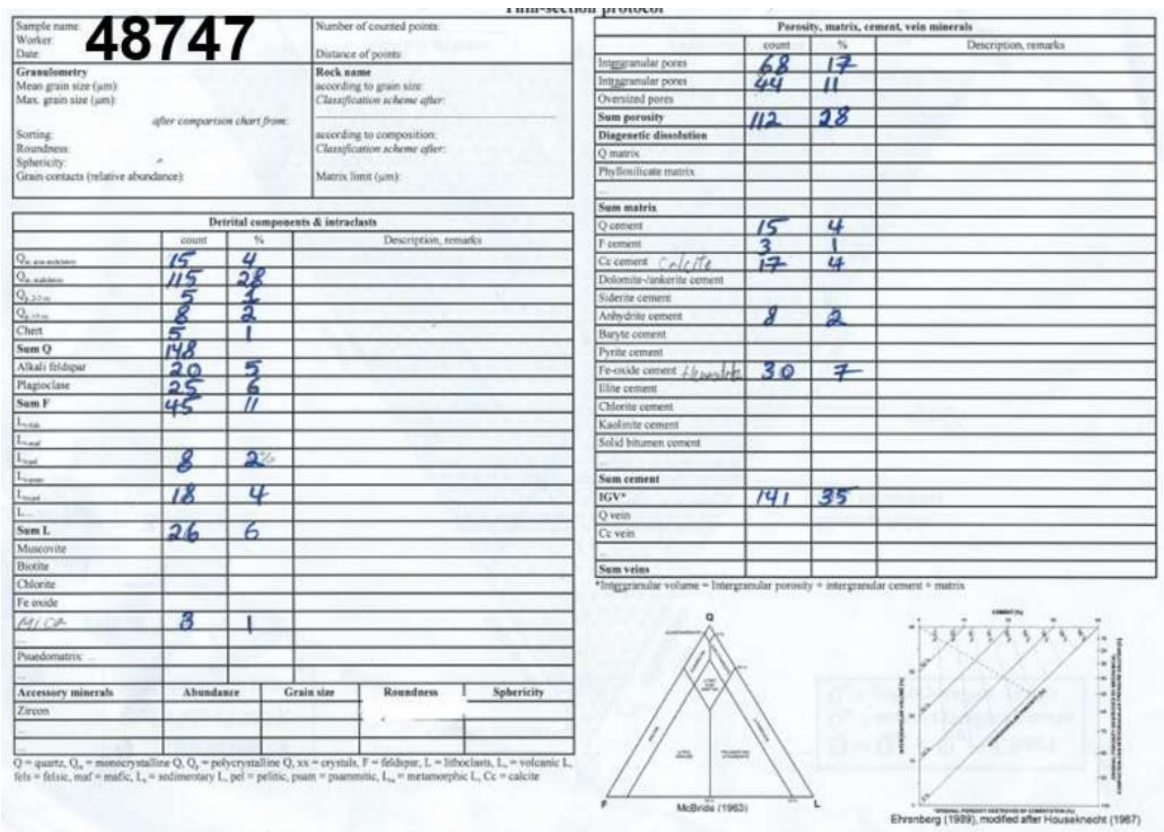
Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon				
...				
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores	12	5,0	
Intragranular pores	6	2,5	
Oversized pores	6	2,5	
Sum porosity	25	10	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	7	3,0	
F cement			
Cc cement	10	4,3	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	3	1,4	
Baryte cement			
Pyrite cement			
Fe-oxide cement	17	7,2	
Illite cement	5	2,1	
Chlorite cement	4	1,7	
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement	46	19,4	
IGV*	71	30%	
Q vein			
Cc vein			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix

Figure A65: Thin section protocol for sample 48746 by student



Thin-section protocol

Sample name: **48747** Worker: Date:	Number of counted points: Distance of points:
Granulometry Mean grain size (µm): Max. grain size (µm): *after comparison chart from:* Sorting: Roundness: Sphericity: Grain contacts (relative abundance):	**Rock name** according to grain size: *Classification scheme after:* according to composition: *Classification scheme after:* Matrix limit (µm):

Detrital components & intraclasts	count	%	Description, remarks
$Q_{m, non-undulatory}$	15	4	
$Q_{m, undulatory}$	115	28	
$Q_{p, 2-3 xx}$	5	1	
$Q_{p, >3 xx}$	8	2	
Chert	5	1	
Sum Q	148		
Alkali feldspar	20	5	
Plagioclase	25	6	
Sum F	45	11	
L_{v-fels}			
L_{v-maf}			
L_{s-pel}	8	2%	
L_{s-psam}			
L_{m-pel}	18	4	
L...			
Sum L	26	6	
Muscovite			
Biotite			
Chlorite			
Fe oxide			
MICA	3	1	
...			
Psuedomatrix: ...			
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon				
...				
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores	68	17	
Intragranular pores	44	11	
Oversized pores			
Sum porosity	112	28	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	15	4	
F cement	3	1	
Cc cement Calcite	17	4	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	8	2	
Baryte cement			
Pyrite cement			
Fe-oxide cement [illegible]	30	7	
Illite cement			
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement			
IGV*	141	35	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix

Figure A66: Thin section protocol for sample 48747 by student

Thin-section protocol

Sample name: 48747 Worker: Date:	Number of counted points: 267(200) Distance of points: 1mm
Granulometry Mean grain size (µm): 80 - 140 Max. grain size (µm): 600 *after comparison chart from:* Sorting: WELL SORTED COMPTON (1962) Roundness: SUBROUNDED - ROUNDED POWERS (1982) Sphericity: SPHERICAL POWERS (1982) Grain contacts (relative abundance): PLANAR - INTERPENETRATING TUCKER (1988)	**Rock name** according to grain size: FINE - V.FINE SANDSTONE *Classification scheme after:* UDDEN-WENTWORTH (1922) according to composition: Quartz arenite *Classification scheme after:* McBride (1963) Matrix limit (µm):

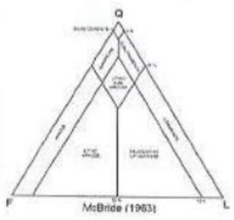
Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m, non-undulatory}$	120	45 %	
$Q_{m, undulatory}$	50	19 %	
$Q_{p, 2-3 xx}$	8	3 %	
$Q_{p, >3 xx}$	12	4 %	
Chert	Accessory	Accessory	
Sum Q	190	71 %	
Alkali feldspar	Accessory	Acc.	
Plagioclase	7	3 %	
Sum F	7	3 %	
L_{v-fels}			
L_{v-maf}	3	1 %	
L_{s-pel}			
L_{s-psam}			
L_{m-pel}			
L...			
Sum L	3	1 %	
Muscovite		Acc.	
Biotite			
Chlorite		Acc.	
Fe oxide			
...			
...			
Psuedomatrix: ...			
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	Accessory			
- RUTILE	Acc.			
- KYANITE	Acc.			

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	30	11 %	
Intragranular pores			
Oversized pores	13	5 %	
Sum porosity	43	16 %	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
Sum matrix			
Q cement	3	1 %	
F cement			
Cc cement	10	4 %	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	1	< 1 %	
Baryte cement			
Pyrite cement			
Fe-oxide cement	10	4 %	
Illite cement			
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement	24	9 %	
IGV*	54	20 %	
Q vein			
Cc vein			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



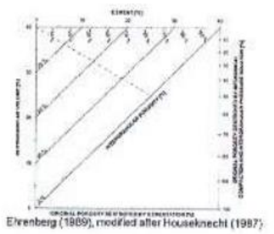


Figure A67: Thin section protocol for sample 48747 by student

Sample name: 48747 Worker: Date:	Number of counted points: 286 Distance of points: 1mm
Granulometry **Mean grain** size (µm): 116 µm Max. grain size (µm): 600 µm *after comparison chart from:* Sorting: Moderately Good/ moderate, Longiaru (1987) Roundness: Subrounded - sub angular, Füchtbauer (1988) Sphericity: middle to high? Flügel (1978) Grain contacts (relative **abundance**): Plane contacts & concave - convex contacts, Tucker (1988)	**Rock name** according to grain **size**: Very fine sandstone ***Classification scheme after:*** Udden (1918) & Wentworth (1922) according to composition: Subarkose *Classification scheme after:* McBride (1963) Matrix limit (µm): < 20 µm

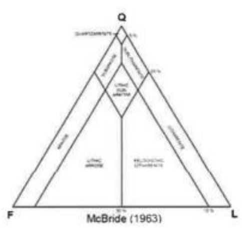
Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m, non-undulatory}$	24	8,4	
$Q_{m, undulatory}$	120	41,95	
$Q_{p, 2-3 xx}$	5	1,75	
$Q_{p, >3 xx}$	7	2,45	
Chert	5	1,75	
Sum Q	161	56,3	
Alkali feldspar	18	6,3	
Plagioclase	1	0,35	
Sum F	19	6,65	
L_{v-fels}	1	0,35	
L_{v-maf}			
L_{s-pel}	2	0,7	
L_{s-psam}			
L_{m-pel}			
L....			
Sum L	3	1,05	
Muscovite		Accessory	
Biotite		Accessory	
Chlorite			
Fe oxide			
....			
....			
Psuedomatrix: ...			
....			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	Accessory			
....				
....				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	34	11,88	
Intragranular pores			
Oversized pores	33	11,53	
Sum porosity	67	23,42	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement		Accessory	
F cement			
Cc cement	13	4,54	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement		Accessory	
Baryte cement			
Pyrite cement			
Fe-oxide cement	16	5,6	Mostly as rim
Illite cement	5	1,75	
Chlorite cement			
Kaolinite cement	2	0,7	
Solid bitumen cement			
...			
Sum cement	36	12,6	
IGV*	70	24,5	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



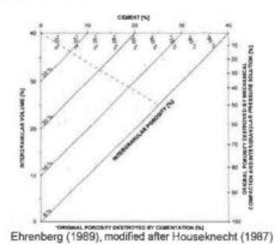


Figure A68: Thin section protocol for sample 48747 by student

Sample name: 61380 Worker: Date:	Number of counted points: 200 Distance of points: 1 mm
Granulometry Mean grain size (µm): 100 µm Max. grain size (µm): 940 µm *after comparison chart from:* Sorting: Moderately Longiaru (1987) Roundness: Subangular Füchtbauer (1988) Sphericity: Grain contacts (relative abundance): Mostly plane contacts	**Rock name** according to grain size: Very fine sandstone *Classification scheme after:* Udden-Wentworth (1922) according to composition: Subarkose *Classification scheme after:* McBride (1963) Matrix limit (µm): < 20 µm

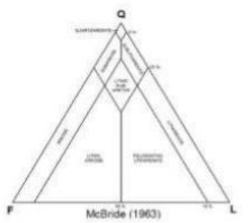
Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m, non-undulatory}$	68	34 %	
$Q_{m, undulatory}$	7	3,5 %	
$Q_{p, 2-3 xx}$	3	1,5 %	
$Q_{p, >3 xx}$	3	1,5 %	
Chert	3	1,5 %	
Sum Q	84	42 %	
Alkali feldspar	10	5 %	
Plagioclase	1	0,5 %	
Sum F	11	5,5 %	
L_{v-fels}			
L_{v-maf}			
L_{s-pel}			
L_{s-psam}			
L_{m-pel}			
L... Lm(psam)	2	1 %	
Sum L	2	1 %	
Muscovite			
Biotite			
Chlorite			
Fe oxide	4	2 %	
... Carbonate	16	8 %	
...			
Psuedomatrix: ...			
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon	1			
...				
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	4	2 %	
Intragranular pores	3	1,5 %	
Oversized pores			
Sum porosity	7	3,5 %	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	10	5 %	
F cement			
Cc cement	13	6,5 %	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement			
Baryte cement			
Pyrite cement			
Fe-oxide cement	52	26 %	
Illite cement			
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement	75	37,5 %	
IGV*	79	39,5 %	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



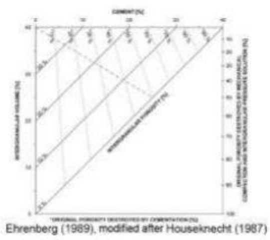


Figure A69: Thin section protocol for sample 61380 by student

Sample name: 61380 Worker: Date:	Number of counted points: 624 Distance of points: 1mm
Granulometry Mean grain size (µm): 100µm Max. grain size (µm): 600µm *after comparison chart from:* Sorting: Moderately / Poorly Longiaru, 1987 Roundness: Subangular to subrounded Sphericity: Low sphericity Grain contacts (relative abundance): Plane contacts Tucker 1988	**Rock name** according to grain size: very fine-grained sandstone *Classification scheme after:* Pettijohn et al 1987 according to composition: Arkose *Classification scheme after:* McBride 1963 Matrix limit (µm): <20µm

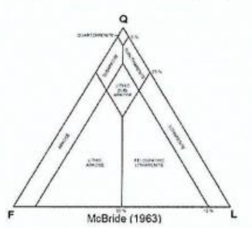
Detrital components & intraclasts			
	count	%	Description, remarks
$Q_{m, non-undulatory}$	170	27,30	Colorless in PPL, grey to black XPL
$Q_{m, undulatory}$	2	0,32	
$Q_{p, 2-3 xx}$	18	2,88	
$Q_{p, >3 xx}$	7	1,12	
Chert	0		
Sum Q	197	31,57	
Alkali feldspar	141	22,59	Colorless, dusty in PPL
Plagioclase	3	0,48	Albite twinning
Sum F	144	23,08	
L_{v-fels}			
L_{v-maf}			
L_{s-pel}			
L_{s-psam}			
L_{m-pel}			
Lm-psam	2	0,32	
Sum L	2	0,32	
Muscovite	1	0,16	
Biotite	11	1,76	
Chlorite			
Fe oxide	8	1,28	
... SUM	20	3,21	
...			
Psuedomatrix: ...			
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon				
...				
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals			
	count	%	Description, remarks
Intergranular pores	20	3,20	
Intragranular pores	16	2,56	
Oversized pores	0	0	
Sum porosity	36	5,77	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement	7	1,12	
F cement			
Cc cement	1	0,16	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	56	8,97	
Baryte cement			
Pyrite cement			
Fe-oxide cement	161	25,80	Brown
Illite cement			
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement	225	36,06	
IGV*	244	38	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix



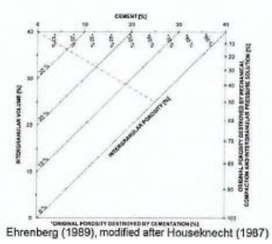
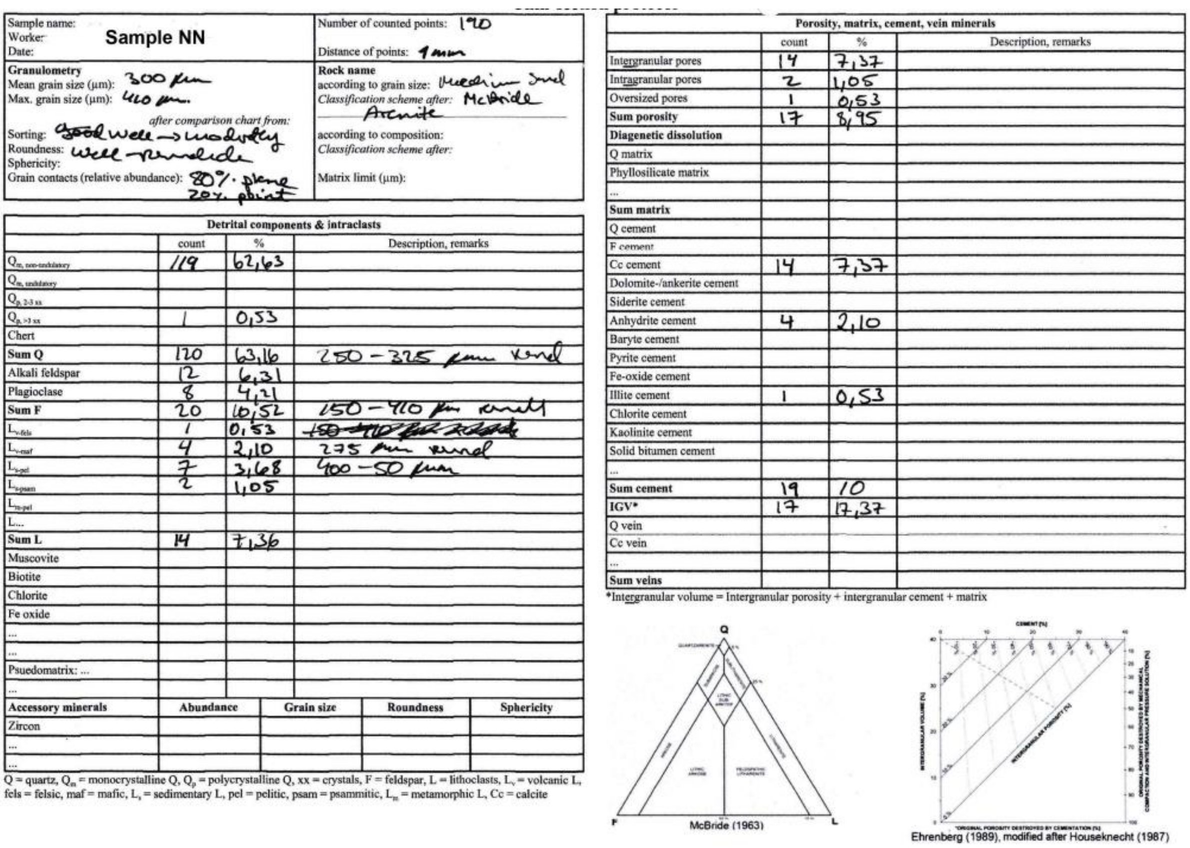


Figure A70: Thin section protocol for sample 61380 by student



Sample name: / Worker: / Date: Sample NN	Number of counted points: 190 / Distance of points: 1 mm
Granulometry Mean grain size (µm): 300 µm; Max. grain size (µm): 410 µm. *after comparison chart from:* Sorting: ~~good~~ well → moderately; Roundness: well-rounded; Sphericity: ; Grain contacts (relative abundance): 80% plane, 20% point	**Rock name** according to grain size: Medium sand; *Classification scheme after:* McBride — Arenite; according to composition: ; *Classification scheme after:* ; Matrix limit (µm):

Detrital components & intraclasts	count	%	Description, remarks
$Q_{m, non-undulatory}$	119	62,63	
$Q_{m, undulatory}$			
$Q_{p, 2-3 xx}$			
$Q_{p, >3 xx}$	1	0,53	
Chert			
Sum Q	120	63,16	250 – 325 µm round
Alkali feldspar	12	6,31	
Plagioclase	8	4,21	
Sum F	20	10,52	150 – 410 µm round
L_{v-fels}	1	0,53	~~150 – 410 µm rounded~~
L_{v-maf}	4	2,10	275 µm round
L_{s-pel}	7	3,68	400 – 50 µm
L_{s-psam}	2	1,05	
L_{m-pel}			
L...			
Sum L	14	7,36	
Muscovite			
Biotite			
Chlorite			
Fe oxide			
...			
...			
Psuedomatrix: ...			
...			

Accessory minerals	Abundance	Grain size	Roundness	Sphericity
Zircon				
...				
...				

Q = quartz, Q_m = monocrystalline Q, Q_p = polycrystalline Q, xx = crystals, F = feldspar, L = lithoclasts, L_v = volcanic L, fels = felsic, maf = mafic, L_s = sedimentary L, pel = pelitic, psam = psammitic, L_m = metamorphic L, Cc = calcite

Porosity, matrix, cement, vein minerals	count	%	Description, remarks
Intergranular pores	14	7,37	
Intragranular pores	2	1,05	
Oversized pores	1	0,53	
Sum porosity	17	8,95	
Diagenetic dissolution			
Q matrix			
Phyllosilicate matrix			
...			
Sum matrix			
Q cement			
F cement			
Cc cement	14	7,37	
Dolomite-/ankerite cement			
Siderite cement			
Anhydrite cement	4	2,10	
Baryte cement			
Pyrite cement			
Fe-oxide cement			
Illite cement	1	0,53	
Chlorite cement			
Kaolinite cement			
Solid bitumen cement			
...			
Sum cement	19	10	
IGV*	17	17,37	
Q vein			
Cc vein			
...			
Sum veins			

*Intergranular volume = Intergranular porosity + intergranular cement + matrix

Figure A71: Thin section protocol for sample NN by student

Detrital components and intraclasts	Count	%	Description, remarks
Qm, non-undulatory	68	32,1	
Qm, undulatory	34	16,0	
Qp, 2-3 crystals	12	5,7	
Qp, >3 crystals	13	6,1	
Chert	7	3,3	
Sum Q	134	63,2	
Alkali feldspar	2	0,9	Albite twins
Plagioclase	9	4,2	Mostly with twins
Sum F	11	5,2	
Ls-pel	4	1,9	Bended between grains
Ls-psam	1	0,5	Small grains in clay matrix
Lm-psam	1	0,5	
Sum L	6	2,8	
Iron oxide	1	0,5	Strong brown/red color
Opaque	2	0,9	Black in both polars
Sum detrital components & intraclasts	154	72,6	
Porosity, matrix and cement			

	Count	%	
Intergranular pores	5	2,4	
Intragranular pores	6	2,8	
Oversized pores	3	1,4	Completely dissolved grain
Sum porosity	14	6,6	
CO3 cement	22	10,4	
Illite cement	8	3,8	
Sum cement	30	14,2	
Matrix	14	6,6	Pseudomatrix
Sum porosity, matrix and cement	58	27,4	
Sum total points	212	100,0	

Accesory components	Abundance	Grain size	Roundess	Sphericity
Zircon	2	100/70 µm	Rounded/rounded	Round/oval
Volcanoclast	7	120-330 µm	subrounded->rounded	Oval

Figure A72: Thin section protocol for sample NN by student