Mature Siliciclastic Sedimentary Rock Thin-sections

Quartz arenite sandstones in thin section (field of view for each approximately 2 mm).

Introduction: Mature siliciclastic sedimentary rocks are those that have been derived from sediment that underwent extensive chemical alteration before or during transportation. These rocks are usually enriched in quartzose grains (quartz, chert etc), but may be cemented by a variety of different minerals. They may also contain some matrix.

Lab exercise (do in your note books, not re-doable): The list of thin-sections at the bottom of this page were all collected from mature sandstones and will be available in the lab for the next week or so. All have accompanying hand specimens. I would like you to examine one example from each group. Make sure that you can identify the major grains and any properties identifiable at hand specimen-scale. I would also like you to produce one petrography summary of each of the thin-sections that you examined in your hard covered note book using the basic format attached to the back of this lab (including one or more decent sketches of the thin section). For this lab, only deal with the grains. Leave space below your grains section and an additional blank page after each lab. In 2 weeks time, you will come back to re-examine one of the thin-sections for its diagenesis/cementation history. Eventually, you will deal with grains and cements at the same time using the same format in the guide for all of the thin-section reports that you do in this class. Take your time. Your thin section reports should each take at least 45 minutes to do.

Discussion Question (re-doable): Nothing this week.

Due Date: I expect 2 thin section reports in your notebooks and a separate discussion page by the deadline specified on the website and the class calendar.

Final words: Please take care in your drawings. The better they are drawn, the higher your grade will be. Use pencil, label important constituents and add a scale. See the attached example. I expect everyone to improve in both their writing style and their drawing quality with each successive lab.

Thin-sections for this lab (n)- number of thin sections per sample

Group A: (incipient cementation); SED 56 (4), SED 112 (2) [use SED 56 hand specimen]

Group B: (pervasive cementation);
I: Iron oxide: Justin 1(4), SED 138(4)
II: Glauconite: RI 1434 (2)
III: Quartz/clay: A1007(3), SED 144(3), SED 163* (2), *[use SED 144 hand specimen]
SED 1108 (2), SED 1109** *[use SED 1108 hand specimen]
A: Rock Description.

The sample is well cemented, gray-brown in color and highly fractured. It contains weak parallel laminations, carbonaceous (plant) remains and in situ rootlets. Grains are very fine to medium grained, well sorted, sub-angular and dominantly siliciclastic in composition. Dominant minerals include orthoclase, muscovite and quartz. The rock fizzes weakly with HCl suggesting that some of the matrix/cement is calcite.

B: Thin-section Description.

I) Grains

Quartz  45%
Orthoclase  10
Muscovite  4
Plagioclase  3
Rock frags (meta)  2
Chert  2
Opaque minerals tr
unidentifiable tr

Mean Grain Size:  125 to 500 μm
Sorting:  fair (0.7)
Rounding:  sub-angular (0.3)

II) Intra-particular materials

calcite cement  22%
Matrix  8%
Total  100%

QFR Normalization Calculations
Q:  45%  45/62 x 100% = 72.6%
F: 13  17/62 x 100% = 27.4%
R: 4  45/62 x 100% = 6.4%
  66%  100.1%

Rock Name = Feldsarenite (Arkose)
**Discussion Question:** Discuss the origin of the lithic grains in your thin section and describe any evidence of chemical alteration that might have occurred in the rock.

Most of the lithic fragments in thin section RI 2323 are metamorphic in origin as indicated by the foliation that is apparent in many "schist" fragments. The ultimate source of the sediment was probably a metamorphosed continental suite of rocks as evidenced by the elongated or foliated nature of the clasts (see Figure 1 below).

![Figure 1: Sketch of a metamorphic rock fragment contained within thin section RI 2323.](image1)

This sample contains a high percentage of immature grains (feldspar, muscovite) suggesting limited chemical weathering prior to transport and that the source of the sediment was probably fairly close to the eventual place of deposition. Many of the feldspar grains are "cloudy" indicating *in situ* chemical weathering to kaolinite (see Figure 2 below). This implies that the alteration process was incomplete prior to sedimentation.

![Figure 2: Sketch of kaolinite alteration in an orthoclase grain in thin section RI 2323.](image2)
GY 402 Sedimentary Petrology

Sedimentary Rock Classification (QFL) Ternary Plot
(Folk, 1968)

Field Index:
1 – Quartz Arenite
2 – Subfeldsarenite
3 – Sublitharenite
4 – Feldsarenite (Arkose)
5 – Lithic Arkose
6 – Feldspathic Litharenite
7 – Litharenite
GENETIC CLASSIFICATION OF LITHIC ROCK FRAGMENTS IN THIN SECTION

**Plutonic Fragments**

1. contain large, anhedral, intergrown crystals of common igneous minerals (i.e. quartz, feldspar, biotite [granite]; plagioclase, pyroxene, amphibole [gabbro])

2. some feldspars display zonation; some quartz crystals display vacuoles or inclusions.

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**Sedimentary Fragments**

1. contain smaller, frequently rounded, grains of variable mineralogy depending upon origin (i.e. quartz, chert, feldspar [siliciclastic]; carbonate ± fossil fragments [limestone]).

2. siltstone fragments commonly grain-free, but laminated.

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**Volcanic Fragments**

1. contain euhedral crystals (esp. plagioclase) in fine grained or glassy matrix.

2. may contain virtually inclusion-free, hexagonal-bipyramidal quartz crystals.

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**Metamorphic Fragments**

1. contain elongated, and/or foliated minerals such as biotite and muscovite.

2. Quartz displays strong, undulose extinction and common inclusions of mica.
ROUNDNESS AND SPHERICITY, RELATIVE RESISTANCE TO ABRASIVE ROUNDED, AND PARTICLE SIZE TERMINOLOGY FOR SEDIMENTARY AND PYROCLASTIC PARTICLES

1. ROUNDNESS AND SPHERICITY

   SPHERICITY
   High
   Low

   Very angular  Angular  Sub-angular  Sub-rounded  Rounded  Well-rounded

   (O)-----------------(1)

2. RELATIVE RESISTANCE TO ABRASIVE ROUNDED

Quartz (most resistant), tourmaline, microcline, staurolite, titanite, magnetite, garnet, ilmenite, epidote, zircon, hornblende, rutile, diopside, hypersthene, spodumene, apatite, monazite, augite, hematite, bronzite, kyanite, enstatite, fluorite, siderite, barite (least resistant).