

GEL4050 Igneous and Metamorphic Petrology
PLUTONIC IGNEOUS ROCK ID GROUP PROJECT

- 150 POINT field and laboratory hands-on GROUP project (max. 3 members) -

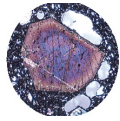
GROUP MEMBERS Maximal 3 group members - Everyone in the group will receive the SAME grade!

Group Member 1 Name:	Activity Description	Date	Hours (Hrs:min)
Contact Info:			
Job Summary:			
<i>Should Group Member 1 receive Full Credit for the project?</i>	Group Member 2	<input type="checkbox"/> Yes <input type="checkbox"/> No ____	Initial
	Group Member 3	<input type="checkbox"/> Yes <input type="checkbox"/> No ____	Initial

Group Member 2 Name:	Activity Description	Date	Hours (Hrs:min)
Contact Info:			
Job Summary:			
<i>Should Group Member 2 receive Full Credit for the project?</i>	Group Member 1	<input type="checkbox"/> Yes <input type="checkbox"/> No ____	Initial
	Group Member 3	<input type="checkbox"/> Yes <input type="checkbox"/> No ____	Initial

Group Member 3 Name:	Activity Description	Date	Hours (Hrs:min)
Contact Info:			
Job Summary:			
<i>Should Group Member 3 receive Full Credit for the project?</i>	Group Member 1	<input type="checkbox"/> Yes <input type="checkbox"/> No ____	Initial
	Group Member 2	<input type="checkbox"/> Yes <input type="checkbox"/> No ____	Initial

The group leader will submit the final report for EVERYBODY in the group!



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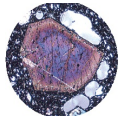
GRADING:

DRAFT DOCUMENT - To be turned in by the draft/redo deadline-

It should include your completed narrative and your figure placement. You will be graded as outlined below:

Names:	Section:	Draft Grade: /50
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-
- /5 COMPOSITION & LAYOUT - one or multiple point deduction per infraction
The appearance of the draft paper is neat and orderly. The draft document is typed and graphics and data are electronically prepared and analyzed. Subscripts and superscripts are appropriately used and equations are explained. The draft is complete with all appropriate pages populated. Graphics and data are placed in a coherent form. Proper formatted citations are included. The conclusion is appropriate for the client and his/her analytical request. The project template was used.
- /15 WRITING & GRAMMAR - one point deduction per infraction
Spelling and grammar are correct. Word repetition and use of first person language is avoided. Statements are factually correct. Appropriate and complete language becoming to a client report is used.
- /16 EXECUTION & DATA COLLECTION - one or multiple point deduction per infraction
Appropriate procedural execution of all analytical procedures is evident from the writing and data. Procedural detail is adequately mentioned. Handsample, thin-section, and geochemical data is tabulated, processed and adequately interpreted. Phase diagrams are prepared and interpreted. Any inconsistencies are mentioned and explained.
- /14 GRAPHICS & ILLUSTRATIONS (map, 3 photos, TAS, QAPF, Phase diag; 2 pts ea.) - one or multiple point deduction per infraction
Graphical representations include location map, photos of collection site, photos of hand-sample and photomicrographs of thin-sections. Adequate TAS & QAPF plots (or equivalents) as well as appropriate Phase diagrams are presented. All illustrations have a caption and are electronically prepared. Pictures should be clear, of high quality, and with neutral background. Graphs should have a title with appropriate axis and unit labels. Citation of source must be included. Graphics need to meet minimum resolution (300 DPI) requirements.
-



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FINAL REPORT -To be turned in by the deadline-

You will be graded on your complete document, including figures, layout, grammar, spelling, content, concept, format, presentation, expression, design, citation, etc. For each infraction you will lose at least one point. (Be aware that repeat mistakes will count MORE THAN ONCE!)

Names:	Section:	Final Report Grade: /100
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/10 COMPOSITION & LAYOUT - one or multiple point deduction per infraction

The appearance of the draft paper is neat and orderly. The draft document is typed and graphics and data are electronically prepared and analyzed. Subscripts and superscripts are appropriately used and equations are explained. The draft is complete with all appropriate pages populated. Graphics and data are placed in a coherent form. Proper formatted citations are included. The conclusion is appropriate for the client and his/her analytical request. The project template was used.

/30 WRITING & GRAMMAR - one point deduction per infraction

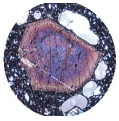
Spelling and grammar are correct. Word repetition and use of first person language is avoided. Statements are factually correct. Appropriate and complete language becoming to a client report is used.

/32 EXECUTION & DATA COLLECTION - one or multiple point deduction per infraction

Appropriate procedural execution of all analytical procedures is evident from the writing and data. Procedural detail is adequately mentioned. Hand-sample, thin-section, and geochemical data is tabulated, processed and adequately interpreted. Phase diagrams are prepared and interpreted. Any inconsistencies are mentioned and explained.

/28 GRAPHICS & ILLUSTRATIONS (map, 3 photos, TAS, QAPF, Phase diag; 4pts ea.) - one or multiple point deduction per infraction

Graphical representations include location map, photos of collection site, photos of hand-sample and photomicrographs of thin-sections. Adequate TAS & QAPF plots (or equivalents) as well as appropriate Phase diagrams are presented. All illustrations have a caption and are electronically prepared. Pictures should be clear, of high quality, and with neutral background. Graphs should have a title with appropriate axis and unit labels. Citation of source must be included. Graphics need to meet minimum resolution (300 DPI) requirements.



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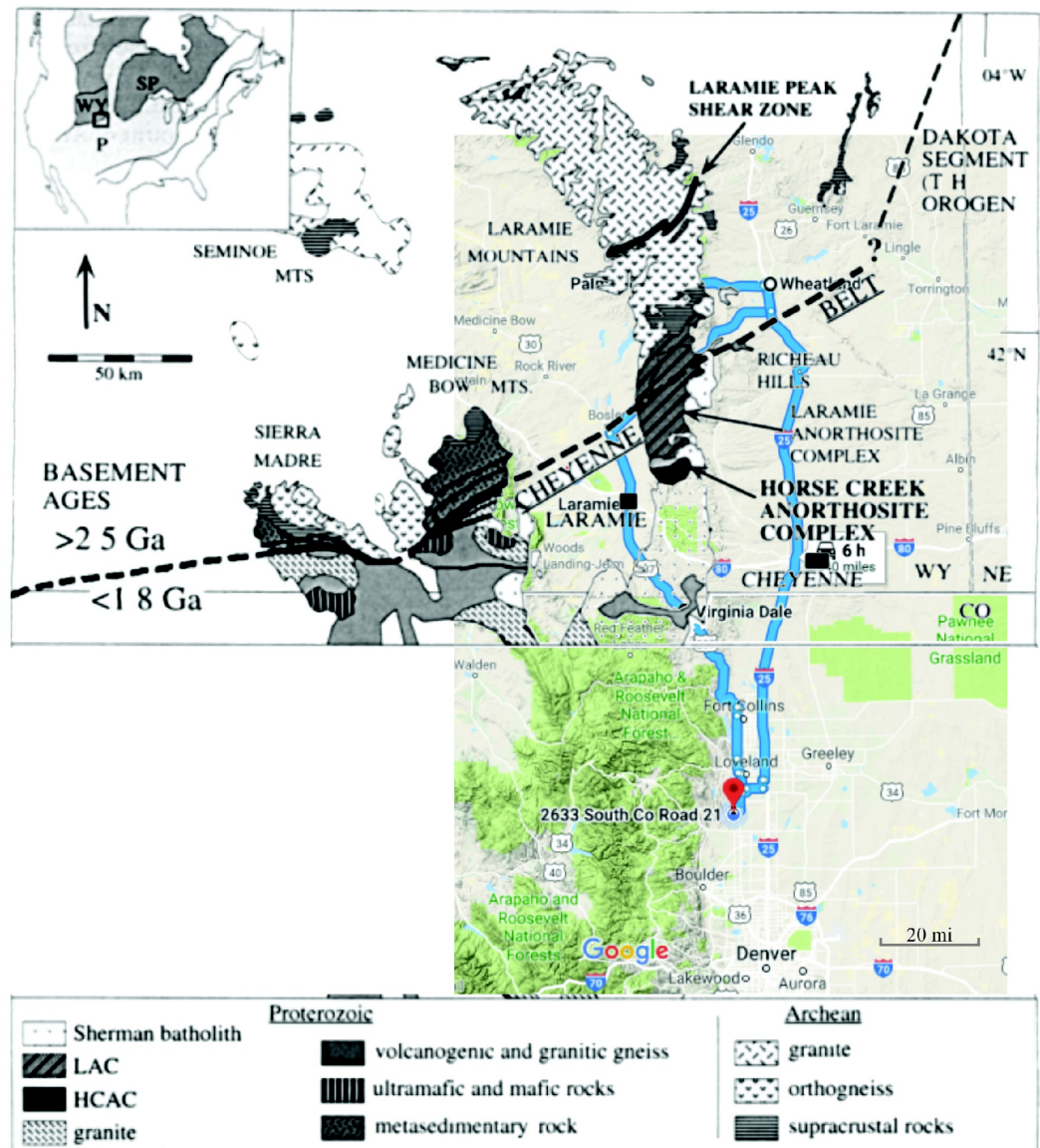
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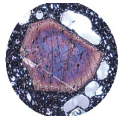
Overview:

Analyzing and classifying igneous rocks is the heart of many igneous assessments. During this group project you will collect an igneous unknown sample during our [course field trip](#), assess its surroundings and then analyze and interpret the sample in the lab.

The Course Field Trip:

Our field trip will follow the route as outlined along US287 through the Ringdike Complex and Kimberlite near Virginia Dale, CO, through Laramie, WY toward Bosler, WY, along WY34 to Wheatland, WY along the Cheyenne Belt, a Precambrian Plate Collision line through the Laramie Mountains. There are a great variety of different plutonic igneous rocks to collect along the route. Each group needs to collect a DIFFERENT sample for the hands-on project. Details about stops and collection sites are given in the [Field Trip instructions](#).





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Materials:

- COLLECT and document Plutonic Igneous Rock Sample during Wyoming Course Field Trip
- Handlense and/or pocket microscope Normative Igneous Software: [MAGMA](#) & [GCDkit](#)

Lab Work:

- Cut / polish handsample Whole Rock Digestion & Analysis Thin Section
- Point Counting (New Microscopes) Hand Sample Analysis

Interpretation:

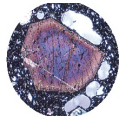
- QAPF & TAS Diagrams (subsequent Diagrams) Phase Diagrams (subsequent Diagrams)

Procedure:

You will collect a plutonic phaneritic igneous rock of your choice Wyoming Course Field Trip. (NO volcanic or porphyritic please). Please note the collecting site and any field observations. Take a picture of the collecting site and collect igneous rock sample. Back home in the lab, prepare a thin section and whole rock geochemical analysis of your sample. Analyzing your sample through polarized light microscope point count from point count and chemical data, classify your igneous rock using the IUGS classification system. Then prepare an appropriate phase diagram to discuss cooling and crystallization and collect history.

INSTRUCTIONS

- Do a mineral assessment of your collected plutonic rock hand sample and thin section slide and identify minerals present. For your thin section, use the NEW screen optical microscopes to do a point count analysis. Rely on mineral associations to identify certain unknowns. [e.g. Biotite and Chlorite, both “wet” minerals are present. An unknown greenish mineral making needles might be tremolite or other amphibole (also “wet”)]
- For your hand sample, use the point counting overlay 10 x 10 = 100 to do a point count analysis of the minerals identified. Use an appropriate size of the template (large for larger crystals and smaller ones for smaller crystals)
- Classify your rock according to mineralogy:
 - Start with the IUGS QAPF diagram.
 - Recalculate QAP or APF to 100 and allot the endmembers
 - Plot on diagram
 - If plot falls within the gabbro / diorite field continue with the mafic and ultramafic IUGS systems.
 - Use Gabbroic Rock IUGS diagram (always recalculate endmembers to 100%)
 - If olivine is present use the PIPxOl diagram
 - If you can distinguish between Opx and Cpx progress to that diagram
 - If hornblende is present, use the PIPxHbl diagram(s)
 - If you can distinguish between olivine, clinopyroxene, and orthopyroxene use that respective diagram for classification
 - Complete table including naming of the plutonic rock.



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- Do a whole rock geochemical digest and analysis of your rock sample. The sample run from digest to ICP-MS analysis should be completed in a single day. Please plan accordingly! Make sure you powder a large enough representative sample of your specimen to get ALL the minerals present. Too small a sample may unwittingly exaggerate certain minerals.

Instruction:

The exact digestion procedure is outlined in *Kackstaetter, U.R., 2019, 1st ed., Manual of Rapid Mineral Identification - Vol I, ISBN 978-0-9820580-2-2* You will need a representative sample fragment that includes ALL minerals present. From that powder with a particle size of 200 mesh (75 μm) about 2 g (2,000 mg) are needed.

Materials: Small sample fragment, mortar and pestle, analytical balance, weighing dish, mesh sieve
Depending on the digestive procedure used, you will also need acids, chemicals, beakers, etc.
Please follow the instructions in the Lab Manual precisely.

Digestive method: For silicates use the lithium metaborate flux digestion.

Note: If sample is mailed to an analytical lab, ignore the digestive method.

PREP - Make sure your sample is clean / fresh with no impurities or oxidized surfaces.

1 - Powder a small fragment to 200 mesh (75 μm)

2 - Follow procedure as explicitly outlined in *Kackstaetter, U.R., 2019, 1st ed., Manual of Rapid Mineral Identification - Vol I, ISBN 978-0-9820580-2-2* . **Make sure you weigh and record everything!**

Note: Si measurements can be finicky! Please note alternate method below if Si analytical results are off.

Alternate Si Measurements:



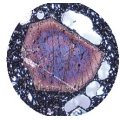
VERY IMPORTANT: Use this HACH method if the ICP analysis can NOT be performed immediately after the sample digest or if ICP-MS Si results appear to be erroneous. The HACH Si analysis should still be completed within 24 hours after sample digestion.

Check with Lab Coordinator concerning the availability of the Hach™ method instrument and chemicals and your own availability to do this lab in order to meet the 24 hours deadline.

1 - Use the same sample digest and sample blank prepared for the ICP analysis.

2 - Use Method Hach™ 8185. Download directly from Hach™
<https://www.hach.com/asset-get.download.jsa?id=7639983849> and print out!

3 - Analyze your sample digest to see if it falls below the 100mg/L upper detection limit. If it is out of range, dilute the sample until you are within range. Several tests might be necessary to get this right.



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- Use a split of your powdered rock to do a LOI (Loss-on-ignition) analysis.

LOSS-ON-IGNITION (LOI):

Note: If sample is mailed to an analytical lab, ignore LOI procedures. Use LOI data reported by the analytical Lab.

1. Get a heat resistant weighing boat. Weigh about 1,000 mg of a 200 mesh sample split with the analytical balance to at least 3 decimals exactly directly into the weighing boat.
2. Preheat the furnace to 1,000°C. Place the weighing boat with your sample into the hot furnace. Once 1,000°C is reached, start timer for 30 minutes.
3. After 30 minutes remove weighing boat and let cool.
4. Weigh sample again on the analytical balance to at least 3 decimals (just the sample, NOT the boat).
5. Calculate %LOI: (Sample weight - Heated weight) / Sample weight x 100

- Unless your sample is analyzed by a contract lab, your analytical results at this point are all for concentration in the sample digest, NOT concentration in the actual sample.

$$26.42\%_{SiO_2} = 123,500 ppm_{Si} \times \frac{60.0843}{28.0855} \div 10,000$$

Therefore you will have to recalculate all your reported sample concentrations to the actual concentration of your solid rock sample. The calculation procedure and equation

can be found in *Kackstaetter, U.R., 2019, 1st ed., Manual of Rapid Mineral Identification - Vol I, ISBN 978-0-9820580-2-2*

- The following rock forming oxides should be reported as percent concentration: SiO₂, Al₂O₃, Fe₂O₃, MgO, CaO, Na₂O, K₂O, TiO₂, P₂O₅, MnO, Cr₂O₃, as well as LOI. Remember, even after recalculating the ICP analysis to the actual concentrations in your solid sample, you still have the unit of ppm and for a single element. You will have to convert single elements to oxide concentration as outlined below. Then present your results in table format.

CONVERTING ELEMENT TO OXIDE CONCENTRATIONS

USE THE FOLLOWING EQUATION:

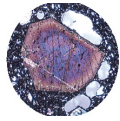
$$\%_{Oxide} = PPM_{element} \times \frac{AMU_{oxide}}{AMU_{element}} \div 10,000$$

- Example Calculation: My results show 123,500 ppm or mg/kg of Si. What would be the equivalent SiO₂ concentration?

1. Get / calculate AMU for Si and SiO₂
 - a. Si = 28.0855
 - b. SiO₂ = 28.0855 + (2*15.9994) = 60.0843
2. Plug into equation

$$26.42\%_{SiO_2} = 123,500 ppm_{Si} \times \frac{60.0843}{28.0855} \div 10,000$$

- As an accuracy check, adding all your percentages together should give you close to 100%. If deviation is too great, something is wrong.
- Use your oxide results and the GCDkit software to classify your rock chemically. Include the appropriate classification in your lab report.
- Find a ternary phase diagram that includes major minerals found in your sample. Use this phase diagram to explain the crystallization process of the three minerals present. Some phase diagrams are listed below. However, these may not fit your particular rock.



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PROJECT WRITE-UP CONTENTS:

1. Title Page: Project Name, Authors, Course
2. Introduction with location and geologic overview
 - a. Figures: Location Map + Sample site photo
3. Hand Sample Macroscopic Overview - interpretative tables
 - a. Figure: Polished handsample with Minerals Identified
4. Point Count Analysis Thin Section and Handsample
 - a. Figures: Photomicrograph(s) in PPL and XPL
5. Whole Rock Geochemical Analysis
 - a. Table of Rock forming Oxide concentrations plus LOI
6. QAPF and TAS Diagram Discussion
 - a. Figure: QAPF and TAS diagram with classification plot. Subsequent Mafic Plots if necessary. Use the GeoChemical Data toolkit (GCDkit) [<http://www.gcdkit.org/>]for your analysis.
7. Cooling and Crystallization History
 - a. Ternary Cooling Phase Diagram plot from minerals
8. Conclusion Paragraph
9. Citations - Should be compiled using Zotero (<https://www.zotero.org/>) Use the United States Geologies Survey (USGS) citation style in your document. You should have a minimum of 5 credible citations.

Note: Once Zotero Standalone is installed, click on "Preferences" under the Edit tab. Once there click on "Cite" and go to the "Styles" tab. Click on the "Get additional styles..." below the Styles Manger Box. When the Zotero Styles Repository Window opens, click on the "geology" button within the "Fields" section. A list of geology journals should now appear. Scroll down to the U.S.Geological Survey and click on it. The U.S.G.S style will now be part of your Zotero system and you can now set your citations to be formatted accordingly in Zotero.

Basic background and preparation:

Here is a list of software applications necessary to work through the Project report.

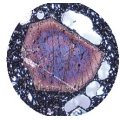
Product	Description	Download
MS Word or equivalent Word Processor	A word processor capable of generating quality reports with pictures, graphs and tables.	Office 365 with Word available to students through the University
MS Excel or equivalent Spreadsheet	A programmable spreadsheet capable of manipulating data incl. programming and able to generate graphs.	Office 365 with Excel available to students through the University
Zotero citations database	Zotero is a citations database that incorporates itself into Word and your Browser.	Free open source software available at https://www.zotero.org/
Graphics Editor: Windows Paint editor or equivalent	A graphics editor to create graphics or to modify or enhance external pictures / graphics.	Windows paint or GIMP: https://www.gimp.org/

Word:

Be familiar with formatting text, using subscripts and superscripts, inserting and editing equations, and inserting and captioning graphics. Understand the wrapping format for inserted graphics, so text flows meaningfully around your insertions.

Camera:

A cell phones with a 7.2MP camera are usually ok. When taking pictures, lighting and background is the key. This means dark objects should be photographed with light or white backgrounds (sheet of paper) and visa versa for light objects. Having adequate lighting will also help to get sharp, crisp, in focus pictures. Blurry and out of focus pictures are not acceptable.



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Graphics:

You should be able to modify, enhance, annotate or overlay graphics. Minimum resolution is 300dpi. Make sure graphics are crisp, clear and any label is easily readable. All graphics should have a caption stating the author and/or citation. Preferably use lossless graphic formats, such as .tif or .bmp. Unfortunately .jpg is NOT lossless and will degrade a little every time you open and save it again in order to manipulate picture contents.

Graphics Editor Software: You will need a graphics editor and learn how to use it. Windows comes with its default Windows Paint editor. It is found in the Windows Accessories Folder. For a more advanced option with many more professional features you may try GIMP:

<https://www.gimp.org/> This is a FREE, open source image editor working across all computing platforms (Windows, Apple, Linux, etc.). The software comes with ample documentation and examples on how to manipulate any picture or graphic.

Screen Capture Software: A screen capture or snipping software is advantageous in order to only grab the part of a graphic from the screen that is important or necessary. Windows 10 comes with a default snipping tools, such as "Snip & Sketch" found in its own folder or "Snipping Tool" found in the Windows Accessories Folder. Note: When snapping a picture, make sure it is large enough on the screen to capture enough pixels to have adequate resolution for the final product.

NOTE: Compiling acceptable and good looking graphics and photographs is very involved and can not be rushed. These are often the heart of any report and should be compiled BEFORE writing. Last minute thrown together graphics will without doubt lower your grade on the client report significantly.

Citations:

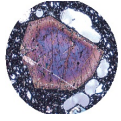
Should be compiled and tracked using Zotero (<https://www.zotero.org/>). As citation style use the United States Geologies Survey (USGS) format. Your report should have a minimum of 5 credible citations. Do NOT forget to cite inserted maps and photos.

Loading the USGS citation format: Once Zotero Standalone is installed, click on "Preferences" under the Edit tab. Once there click on "Cite" and go to the "Styles" tab. Click on the "Get additional styles..." below the Styles Manger Box. When the Zotero Styles Repository Window opens, click on the "geology" button within the "Fields" section. A list of geology journals should now appear. Scroll down to the U.S.Geological Survey and click on it. The U.S.G.S style will now be part of your Zotero system and you can set your citations to be formatted accordingly in Zotero.

Compiling the Final Report:

The final report should be worthy of the effort expended. Neatness is absolutely essential and you will be graded on appearance as well as content. The draft report that has been graded and returned to you will serve as your feedback that you will need to be compiled a great final report. **WARNING: Just because something wasn't marked in the draft as wrong doesn't mean that it is ok for the final report. I do NOT necessarily mark repeat mistakes in the draft. Read your work thoroughly and apply comments and markings in the draft to ALL paragraphs, even if not marked.**

Please incorporate tracking sheets into your report, like the one on Page 1 of these project instructions.



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GRADING and NOTATIONS



ALL ANSWERS MUST BE TYPED USING A WORD PROCESSOR! This includes chemical formulas, equations, tables and special characters. Become intimately familiar with these functions in your preferred word processor. Where graphics are indicated insert the proper graphic or picture. Be familiar with placing and sizing visuals into a written document. Attach your completed document(s) to this sheet!

For ALL assignments use a citation's database:

ZOTERO citations
database

ZOTERO is a citations database that
incorporates itself into Word and your Browser.

Free open source software available
at <https://www.zotero.org/>

Note: You may use a different citations database, if desired. But you MUST use a citations database!

NOTE: After downloading and installing ZOTERO, take an hour or two to become familiar with the operation of the software. One of your first tasks will be to set the citation style to the United States Geologies Survey (USGS) format in ZOTERO. The USGS citation system will be required for this course and your final product.

Loading the USGS citation format into ZOTERO: Once Zotero Standalone is installed, click on "Preferences" under the Edit tab. Once there click on "Cite" and go to the "Styles" tab. Click on the "Get additional styles..." below the Styles Manger Box. When the Zotero Styles Repository Window opens, click on the "geology" button within the "Fields" section. A list of geology journals should now appear. Scroll down to the U.S.Geological Survey and click on it. The U.S.G.S style will now be part of your Zotero system and you can set your citations to be formatted accordingly in Zotero.

General Writing Instruction Summary:

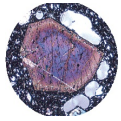
- Use professional language, which means AVOID first person expressions such as "I", "we", "our". Use normal prose, active voice and third party language. Do NOT use informal wording, contractions, jargon, slang terms, or superlatives. Exclude similes/metaphors (and humor!)
- Use present tense to report well accepted facts, e.g. 'Pyrite is a sulfide mineral'. Use past tense to describe specific results, e.g. 'When acid was applied, the specimen effervesced'
- Be quantitative wherever relevant (stats, numbers etc.).

Subscript & Superscript Use appropriate subscript and superscript, especially when it comes to chemical formulas and mathematical units..

Acceptable examples: 2.9 g/cm^3 , H_2O , PO_4^{3-} , $a_g=9.8\text{m/s}^2$

Unacceptable examples: $2.9 \text{ g/cm}3$, $\text{H}2\text{O}$, $\text{PO}4 \text{ } 3-$, $a_g=9.8\text{m/s}^2$

- Use precise concrete language, no ambiguity e.g. 'correlated' \neq 'related'. Use simple language – no unnecessary "frills" (distractions). Pay attention to sentence structure and grammar



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COMPOSITION, LAYOUT, WRITING & GRAMMAR SUMMARY

Language

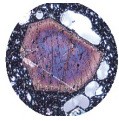
The following list is an example of common faults in language usage and attribution.

Errors / Mistakes / Faults	Examples with margin <i>Fault Counts & Codes</i>
Spelling: incl. capitalization errors & spacing	The mineral <u>florite</u> has a <u>mohs</u> hardness of four. Nicolas Steno <u>_</u> was trained in the classical texts on science.
Grammar: incl. punctuation, superfluous words, transpositions	Isometric crystals are also isotropic <u>Here</u> light propagates at the same speed. Rocks are composed of many <u>many</u> <u>minerals</u> mixed.)
Style: incl. paragraph, repetitive expressions / words erroneous expression / words, sub- or superscription, unprofessional style, word insertion	<i>Para.</i> ... in the geologic sciences. ¶ Near the end of the 19 th a new theory ... <i>rep</i> ... is a <u>light</u> colored mineral. These <u>light</u> colored minerals are often <u>light</u> ... Stalactites hang from the <u>sealing?</u> of a limestone cave. <i>sup</i> The density of quartz is 2.65 g/cm ³ . I <u>was</u> investigating the outcrop with <u>my</u> group. Sodium sulfate forms a chalky, <u>incoherent</u> precipitate. <i>amorphous?</i> ^
Sentence: incl. grammar, run-on, strings of nouns	The density of gold is greater <u>then?</u> the density of silver. Pyrite has a symmetrical crystal <u>structure</u> , <u>it</u> is cubic. <u>Skarn mineral zonation?</u> is apparent in the sample.

Content

Errors in content are spelled out. Severe infractions may count for multiple errors.

Errors / Mistakes / Faults	Examples with margin <i>Fault Counter & Codes</i>
Unclear / erroneous statements	<i>unclear, units?</i> <u>Mohs hardness of the mineral in question is 16.5.</u>
False / nonsense	<i>Nonsense</i> Glaciation cause severe metamorphism of the region



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TABLES, FIGURES & EQUATIONS SUMMARY

Tables

Each table must be sufficiently complete that it could stand on its own, separate from text.

Only HORIZONTAL lines are allowed in tables. Do NOT use any VERTICAL lines.

DO consecutively number and caption tables and refer to them accordingly within your text. Captions go ABOVE the table.

DO provide a short description of your table within the caption.

DO place your tables appropriately, closest to their mention in the text.

DO make sure tables are legible and reproduce well. Print can be smaller than text, with an 8pt size minimum.

DO appropriately label columns. Do NOT forget units for numeric values.

AVOID splitting tables across pages.

Figures

Each figure must be sufficiently complete that it could stand on its own, separate from text.

DO number and caption figures consecutively and refer to them accordingly within your text. Captions go BELOW the figure.

DO provide a short description of your figure within the caption.

DO place your figures appropriately, closest to their mention in the text.

DO use appropriate citations for figures that are NOT your own. If you use a figure that has been modified by you, the phrase “modified after...” is most appropriate. Photos should show the name of the photographer.

DO make sure figures are legible and reproduce well. Print can be smaller than text, with an 8pt size minimum. Use a minimum resolution of 300dpi. This is a common publication standard.

AVOID cluttering of figures with too much detail. Simplify if necessary.

AVOID moire patterns in photos, a nuisance in copied or scanned pictures. Most scanners come with a moire pattern removal tool.

GRAPHS

Understand graphs: Bar graphs and/or line graphs are used when plotting nominal vs. ratio or interval data. Scatter plot graphs are used when plotting numeric vs. numeric data.

DO make sure that the graph axis are appropriately labeled and scaled. Axis should have titles as well as scalar units.

DO use electronic means to generated graphs. Hand drawn graphs are no longer acceptable.

Equations & Computations

- Equations should contain explanation of symbols used.
- A reader should be able to follow where your values or numbers come from. Indicate accordingly.

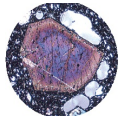
WRITE DOWN UNITS!!!!

Show equations used before indicating any computation

Acceptable Example: $F = m \times a = 0.034kg \times 9.8m/s^2 = 0.33kgm/s^2$

where m is mass of the object in kg as determined with a triple beam balance and a is the gravitational acceleration. F indicates force expressed in kgm/s^2 or N (Newtons).

Unacceptable example: The answer is 0.33. This is obtained by multiplying gravity by 0.034.

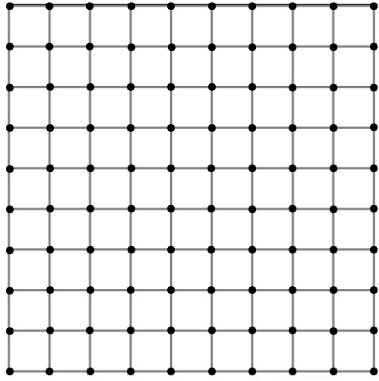


PLUTONIC IGNEOUS ROCK ID GROUP PROJECT

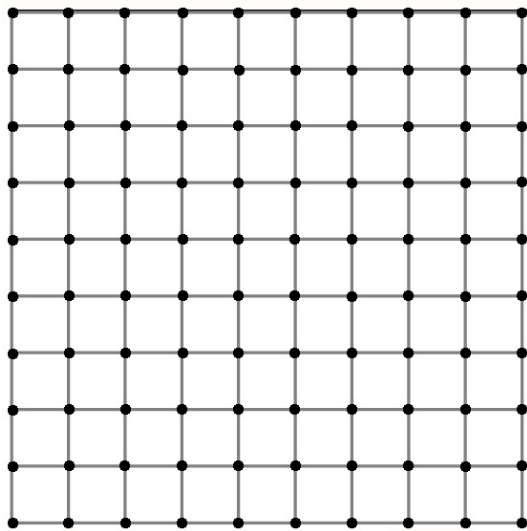
- 150 POINT field and laboratory hands-on GROUP project (max. 3 members) -

Point Counting Templates

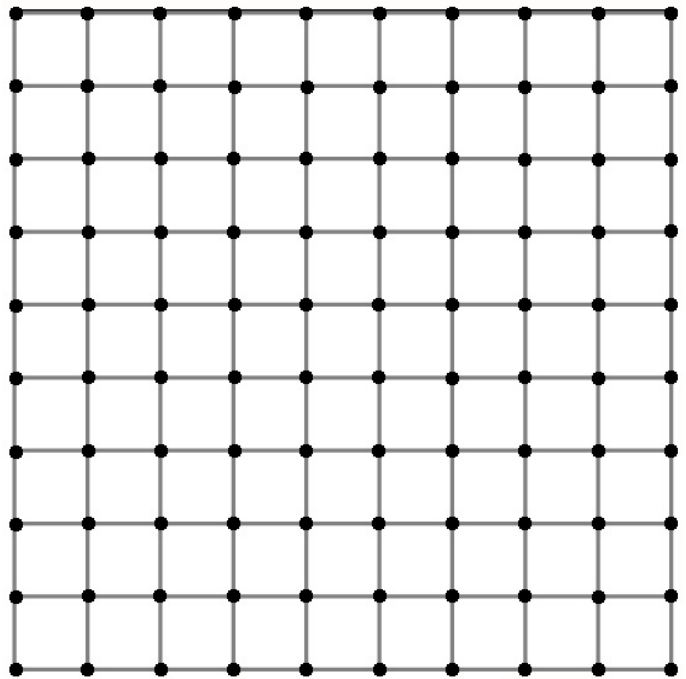
Please Print on clear plastic foil



SMALL Point Counting Template
10 x 10 = 100



MEDIUM Point Counting Template 10 x 10 =
100



LARGE Point Counting Template 10 x 10 = 100