SUCCESS AS A SMALLER FISH IN A BIG POND: A HOLISTIC APPROACH TO UNDERGRADUATE GEOLOGIC EDUCATION AS A COMPETITIVE ADVANTAGE FOR SECURING POST-BACCALAUREATE OPPORTUNITIES

Uwe Kackstaetter, Ph.D.¹
Presenter

Barbara EchoHawk, Ph.D.¹

¹ Metropolitan State University of Denver
Background

Geology at Metropolitan State College of Denver

Department of Earth & Atmospheric Sciences
- Degree LAND USE
  - Concentrations
  - Concentration GEOLOGY
- Degree METEOROLOGY
  - Concentrations
- Degree ENV. SCIENCE
  - Concentrations
  - Concentration ENV. GEOLOGY
The Change

Metropolitan State University of Denver

Students: Large interest in Geosciences
Increase in Geology Concentration
Graduation

“New Degrees”
“No duplication of degrees”

Stand-Alone Geology Degree that does NOT duplicate traditional Geology Degrees offered elsewhere?
Developing the Concept

**Geoscience Graduate Profile**

- ~30% Graduate School
- ~70% Workforce

Next to academically sound proficiency... *workforce readiness?*

**Available Resources**

1. Faculty Expertise

2. Courses
   - *Established Field Courses, International Courses, Internships*

3. Equipment
   - *Thin Section Lab, PLM, XRD, SEM, etc.*
Developing the Concept

The Study

Developing the Concept

What Employers Want?

- Information Literacy
- Written and Oral Communication
- Complex Problem Solving
- Teamwork Skills in Diverse Groups
- Critical Thinking and Analytic Reasoning
- Applied Knowledge in Real-World Settings
The Study

Developing the Concept

Traditional

**EMployers**
Skill sets Wanted

What we offer
Geosciences

Undergraduate Research (UR)

Courses

Labs

Benefits to EMPLOYERS + Benefits to STUDENTS

Applied Knowledge in Real-World Settings

Critical Thinking and Analytic Reasoning

Skills in Diverse Groups
The Study

UNDERGRADUATE RESEARCH
Our Niche?

1. NOT popular
   - Time consuming; NO real compensation; NO real publishable results; Limited pub outlets

2. Limited Resource Friendly
   - NO large research expenditures; Simplified Grading; Private Partnership Opportunities (European Model)
Courses

UR Skills Incorporation into Course Offerings

- No NEW Course Resources
  - Incorporate Work Force Readiness / UR skills into existing coursework
  - Make Assignments RELEVANT to real skills without compromising foundational content
Courses

UR Skills Incorporation into Course Offerings

Traditional Geology Program

UR focused Geology Program

Knowledge in Real-World Settings

Critical Thinking and Analytic Reasoning

Teamwork Skills in Diverse Groups

Written and Oral Communication

% GEL courses

% UR GEL Modules
Participating in Undergraduate Geoscience Research Builds Skills that Employers Value

- Critical Thinking and Analytic Reasoning
- Knowledge in Real-World Settings
- Teamwork Skills in Diverse Groups
- Written and Oral Communication
- Complex Problem Solving
- Information Literacy
- Critical Thinking and Analytic Reasoning
- Knowledge in Real-World Settings
- Teamwork Skills in Diverse Groups
- Written and Oral Communication
- Complex Problem Solving
- Information Literacy
- Critical Thinking and Analytic Reasoning
- Knowledge in Real-World Settings
- Teamwork Skills in Diverse Groups
- Written and Oral Communication
- Complex Problem Solving
- Information Literacy
EXAMPLES

GEL3050 MINERALOGY & OPTICAL MINERALOGY

Skill Sets:
- Thin Sections & PLM
- Rapid Mineral ID Procedure

PROJECT:
- Real Clients
- Instrumentation:
  Portable XRF, Scintag XRD, PLM

FREE MINERAL ID

As part of our public outreach and training of future geoscientists in this course, the Department of Earth & Atmospheric Sciences at Metropolitan State University of Denver offers FREE MINERAL IDENTIFICATION to the public. Click for details.
GEL4250 HYDROGEOLOGY (Groundwater)

- Skill Sets:
  - Data Analysis
  - Result Application

PROJECT:

Successful job search credited to this project alone reported by alumni

YOUR ASSIGNMENT

- You may work in groups. Selected a suitable field site (someone’s property) to dig percolation test holes and do the field study and measurements.
- Do the percolation test. Record all data. You may share the results among your group.
- Do the computations and generate the professional report. This part must be uniquely yours. NO group work allowed!
- Turn in the report by the deadline(s) indicated for grading.

known volume of water enters into the subsoil. In general, the rate of the water loss is observed by measuring the volume of the hole after being filled for 5 minutes. The volume of the hole is estimated by multiplying the area of the hole by the depth of the water loss.
EXAMPLES

Undergraduate Research Projects

New Suspected Kimberlite
Northern Colorado
Stephanie Gallegos and Uwe Kackstaetter, Ph.D.
Undergraduate Research

Introduction

Abstract

Kimberlites are small diameters, usually associated with kimberlite pipes. These pipes are typically found in the cratonic nuclei of major continent, suggesting a magmatic origin. Kimberlites are unique among intrusive igneous rocks because they are typically associated with diamond deposits. Kimberlites are almost exclusively associated with diamond deposits, and as such, are known as "diamondiferous". Kimberlites are also known for their unusual mineralogy, consisting of high concentrations of transition metals and other trace elements. Kimberlites are typically associated with diamond deposits, and as such, are known as "diamondiferous" Kimberlites.

Methodology

Identification of Kimberlites

 Kimberlites are typically identified using the following characteristics:

- High concentrations of transition metals and other trace elements
- Evidence of magmatic upwelling
- Evidence of diamond deposits

Results and Conclusions

1st Place

AIPG National Conference 2013
Using Specific Gravity to Determine the Solid Solution Variation of K+, or Na+ and Ca2+ in Feldspar Hand Samples

By Timothy Olson, EAS Department at Metropolitan State University of Denver
With Assistance from Dr. Uwe Kackstetter

Abstract

Plagioclase and alkali feldspar minerals have slightly varying specific gravities, due to changing chemical compositions within their respective solid solution and evolution series. While qualitative chemical analysis in investigating compositions is desirable, it is either restricted to the laboratory, or requires expensive field instruments. However, advances in inexpensive hand scale technology has led to the development of pocket scales that can be used to make rapid, accurate field measurements of specific gravity (SG) on rock and mineral samples using a single pan hydrometric method (Kackstetter, patent pending). Accuracies such retained does enough resolution to make differentiation in chemical compositions of feldspar samples. Specific gravity measurements were performed on known feldspar species and data was extracted through regression analysis. Additionally, geochemical data of each sample was obtained through acid digestion and ICP Atomic Absorption Spectroscopy to determine the exact proportions of K, Na, and Ca. These results were used to develop a new model for determining the specific gravity of feldspar hand samples. This model allows for the quick and accurate determination of specific feldspar species in the field. By using the hand portable single pan hydrometric method for SG determinations, an accurate and rapid identification of feldspar species is now possible.

Introduction

Specific gravity is measured using the single pan hydrometric method (Kackstetter, patent pending). This method finds the volume of an object by measuring the weight of water that it displaces. Since the density of water = {\text{1.00}} g/cm\text{3}, the weight of the displaced water is equal to the volume. Specific gravity is then determined by dividing the weight of the object by the weight of the water that the object has displaced.

\[ \text{SG} = \frac{W_{\text{object}}}{W_{\text{water}}} \]

Where, \(W_{\text{object}}\) = weight of the sample in air and \(W_{\text{water}}\) = weight of the water that the sample displaces.

Methods

Various feldspar species were obtained from around the world. The specific gravity was then measured and recorded for each sample. Portions of each sample were then crushed and powdered and passed through a 250 mesh sieve. 200 mg of each of the powdered feldspars were then subjected to K and Na digestion and analyzed with ICP to measure the exact proportions of K, Na, or Ca. The ratios of K/Na and Ca/Na were then compared to determine the exact feldspar species of each sample.

Results and Conclusions

Specific Gravity of Feldspar Minerals

<table>
<thead>
<tr>
<th>K+</th>
<th>Na+</th>
<th>Ca2+</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>0.50</td>
<td>0.00/1.00</td>
</tr>
<tr>
<td>2.10</td>
<td>2.35</td>
<td>2.40</td>
</tr>
</tbody>
</table>

1st Place

AIPG National Conference 2015

AIPG National Conference 2013
Using Specific Gravity to Determine the Solid Solution Variation of K+, or Na+ and Ca2+ in Feldspar Hand Samples

By Timothy Olson, ESE Department at Metropolitan State University of Denver
With Assistance from Dr. Uwe Ruckstetter

Abstract

Page 1216 and 1217 about feldspar minerals have slightly varying specific gravities due to changing chemical compositions within their respective alkali and alkaline earth series. While quantitative chemical analysis in investigating compositions is desirable, it is either confined to the laboratory or requires expensive field instruments. However, advances in inorganic and small scale technology have led to the development of pocket scales that can be used to make rapid, precise field measurements of specific gravity (SG) on rock and mineral samples using a simple single-hydrometer method (Ruckstetter, patent pending). These scales are able to resolve differences in chemical compositions of feldspar minerals. Specific gravity measurements were performed on known feldspar species and data was stratified through regression analysis. Additionally, geochronological data of each sample was obtained through acid digestion and flame atomic absorption spectrometry to determine the exact proportions of K, Na, or Ca. Trend line regression for acid solution proportion samples as well as acid feldspar solution samples were developed to relate the specific gravity to the chemical composition of each sample. Densities can now be assigned to exact chemical compositions within feldspar. By using the field portable single pan hydrometer method for fast determinations, an accurate and rapid identification of specific feldspar species is now possible.

Introduction

Specific gravity is measured using the single pan hydrometer (Ruckstetter, patent pending). This method finds the volume of air displaced by dividing the weight of the object by the weight of the water that has displaced it:

\[ \text{SG} = \frac{W_o - W_d}{W_d} \]

Where, \( W_o \) = weight of the sample in air and \( W_d \) = weight of the sample in water.

Methods

Various feldspar species were obtained from around the world. The specific gravity was then measured using the single-pan hydrometer method for each sample. Portions of each sample were then crushed and powdered and passed through 100 mesh screen. 200mg of each of the powdered feldspar were then digested in HNO3 and AGNO3 with AAS to measure the exact proportions of K, Na, or Ca. The ratios of K, Na, or Ca were then compared to determine the exact feldspar species of each sample.

Results

Specific Gravity of Feldspar Minerals

![Graph showing specific gravity vs. Al, Si, K, Na, and Ca concentrations.]

Discussion

- Rumors that cattle that graze on a hillsides with mine tailings get sick, whereas, the other side of the hill is perfectly safe grazing grounds.
- The longer mine waste rocks are around the longer they have to leach heavy metals into the environment.

GSA 2014 Presentation

Erzgebirge, Germany
Program Goals
1. To build student’s knowledge base in geoscientific concepts, principles and processes;
2. To prepare and train students in field and laboratory technologies and techniques used in geoscientific investigation and interpretation; **Skills with a purpose!!!**
3. To develop competency in written and oral scientific communication and presentation; **Not only research papers!!!**
4. To construct habits of critical thinking and creative problem solving that lead to informed decision making, life-long learning, and leadership based on current scientific knowledge; and
5. To prepare students for successful entry into **career** or **graduate** programs.
Title: APPLIED GEOLOGY MAJOR (B.S.)

Applied Geology Major Required Core Courses

- GEL 1010 Physical Geology
- GEL 1030 Historical Geology
- GEL 2530 Introduction to Field Methods
- GEL 3050 Intro to Mineralogy and Optical Mineralogy
- GEL 4450 Sedimentary Geology and Stratigraphy
- GEL 4460 Structural Geology and Mapping
- GEL 3120 Geomorphology
- GEL 3530 Adv. Geology of the Colorado Plateau
- GIS 1220 Introduction to Geospatial Sciences
- GIS 2250 Geographic Information Systems

Prerequisites:

- GEL 1010 & GEL 1030
- MTH 1120 or equivalent
- CSS 1010 or equivalent

GEL Field Course Offerings

- National & International

Samples:

**Applied Volcanology**

3,400 miles: Incl. Yellowstone, Craters of the Moon, Mt. Rainier, Mt. St. Helens, Crater Lake, Lassen Volcanic Park, and more!

Variable Topics: 10 days

Can be taken up to 4 times; 4 different destinations

- Burren Geologic Field School
  - Caherconnell, Ireland
  - 2 weeks
- Structural Geology & Mineralogy of the Alps
  - Germany, Austria, Italy, Switzerland
  - 2 weeks

Applied Geology Core Credits

- GEL 4970 Undergraduate Research in Geology

Total Credits: 120

*Students must have 40-hours of upper division course work (3000 & 4000 level)
Questions, Comments,...