BUILDING STONES AS RESOURCES FOR STUDENT RESEARCH

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ABSTRACT

Building stones provide conveniently located and accessible “urban outcrops.” As such, building stones may be used for semester-long student research projects in upper-level geology courses. I present students in my Earth Materials class with a scenario: A building owner in downtown St. Petersburg hires you as a geologic consultant. The owner is considering replacing the stone currently adorning the building. Write a persuasive essay discussing the identity, geologic history, and suitability of the building stone in its current use. Compare and contrast the current building stone with several other building stones that might be used for the job.

To gather data for their consulting reports, students use a combination of standard field tests and petrographic techniques to identify the building stones and determine possible geologic histories. The students lead a walking tour during the semester to report on their progress and ask for ideas from their classmates. The project culminates in both oral and written reports aimed at convincing their “clients” to buy the most appropriate building stones. As part of this paper, a student who completed the project in the fall of 2000 provides a brief overview of his research and a positive assessment of his overall experience.

Keywords: Education - undergraduate; education - geoscience; mineralogy and crystallography

INTRODUCTION

Natural outcrops are often inconveniently located far away from college campuses. In central Florida, for example, the selection of natural rock outcrops is limited to limestones and phosphates while the nearest outcrops of igneous and metamorphic rocks are nearly 400 miles away in Georgia. The mixed architecture of downtown St. Petersburg, Florida, however, includes a variety of building stones (Figure 1). To take advantage of this situation, students in my Earth Materials course study these building stones and create a geological walking tour of downtown St. Petersburg.

Rather than taking part in an organized class tour, the students themselves conduct field work early in the semester to identify locations that use building stones. During the semester, the students use field and laboratory techniques to identify minerals and determine the rock types of the building stones. Besides constructing formal written and oral reports, the class takes a walking tour of downtown St. Petersburg where the students describe what they have learned at their chosen “outcrops.”

To simulate a formal research project, the students are presented with a scenario: You are an impartial geologic consultant hired by the owner of your chosen building in downtown St. Petersburg. The owner is considering replacing the stone currently adorning the building and has hired you to draft an opinion based solely on the geological properties of various stones and the current use of those stones on the building. Write a persuasive essay designed to convince the owner that there is a single best stone for the structure. Compare and contrast the properties of the current building stone with other common building stones. Students gather information by completing a series of tasks, culminating in both oral and written reports (Table 1).

I designed this project to be part of a sophomore- to junior-level course entitled Earth Materials. Students who typically take the class are majoring in marine science and specializing in marine geology or geophysics. I condensed the information presented in a more traditional two-semester mineralogy and petrology sequence to accommodate the constraints of the one-semester Earth Materials class. The course provides practical experience with optical mineralogy techniques as a part of the broader study of rock and mineral compositions, properties, occurrences, and classifications. I have taught the Earth Materials class five times and have assigned the building stone project twice. One student has summarized his work and briefly evaluated the project in Figure 2.

FIELD WORK

Within the first month of the semester, students must choose a building site. They may explore downtown St. Petersburg on their own or join a field trip during one of our lab periods. I provide students with maps derived from MapQuest.com and specify that they must choose buildings from an approximately eight by eight block area in the core of downtown. The limited area simplifies planning for the final walking tour when the entire class visits all of the chosen buildings.

During the initial visit, students introduce themselves to the building owners. Most owners are enthusiastic about the project and are happy to provide information. In two cases, the owners provided pieces of the building stones that had come loose. By the time students choose a building, they have studied minerals in hand specimens and have learned basic mineral identification techniques. If the owners are agreeable,
students perform hardness and acid tests, take pictures, and complete sketches.

About two-thirds of the way into the semester, the class visits each “outcrop” as a group during a lab period. Each student describes his or her progress on discovering the identity of the building stone and asks others in the class for their ideas (Figure 3). I ask students to treat their buildings as field trip stops for the class where they are the experts on the outcrops. Students should identify individual minerals and indicate the rock type (e.g., granodiorite, quartz arenite, mica schist, etc.). By the time the class takes the walking tour, students have completed their studies of igneous and sedimentary rocks and have started work on metamorphic rocks. They should, therefore, be able to contribute to a discussion about each building stone.

LABORATORY WORK

In the first year of this project, students obtained samples from building stone suppliers and cut billets that I then sent to a thin sectioning company. This process took a significant amount of time because companies typically require at least four weeks to make thin sections. In subsequent years, therefore, I will prepare the thin sections, occasionally creating new thin sections as students explore new buildings. Reusing the thin sections will save both time and money.

During one class period and on their own time, students study their building stones with the help of petrographic microscopes. I suggest that they complete the following tasks:

- sketch a representative view of the thin section under both plane and polarized light
- identify all minerals
- specify distinguishing characteristics of the minerals such as twinning, crystal habit, cleavage, pleochroism, interference colors, etc.
- discuss textural features
- identify the rock type (e.g., granite, basalt, siltstone, etc.)
- specify any differences between the rock they examine in thin section and the building stone actually used in downtown St. Petersburg on their chosen building.

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Table 1. A brief outline of the building stone project.

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<thead>
<tr>
<th>Phase of the Project</th>
<th>Task Assigned to Students</th>
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<tbody>
<tr>
<td>1</td>
<td>Find a building in downtown St. Petersburg adorned with natural rock.</td>
</tr>
<tr>
<td>2</td>
<td>Determine the rock type using standard field tests.</td>
</tr>
<tr>
<td>3</td>
<td>Use optical techniques to identify minerals and more accurately determine the rock type.</td>
</tr>
<tr>
<td>4</td>
<td>Participate in a walking tour and give a progress report.</td>
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<tr>
<td>5</td>
<td>Write an 8 to 10 page consulting report recommending a particular building stone.</td>
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<tr>
<td>6</td>
<td>Give a 6 to 8 minute oral presentation in the classroom as a final project summary. Display mineral properties using a video camera mounted on a petrographic microscope.</td>
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</tbody>
</table>
The students focus on producing written and oral consulting reports aimed at their “clients,” the owners of their chosen buildings. I specify that they treat their clients as intelligent business people who are interested in the geologic context and the material properties of these building stones. In the written report, the students compare and contrast the properties of the current building stone with three common building stones. In the oral report, for the sake of time, they confine their comments to the properties of the current building stone. In each report, the goal is to persuade the client that the building stone is either appropriate or inappropriate for its current use.

There are four primary components of the written report: (1) A detailed description of the current building stone, including the results of the field and petrographic investigations (e.g., rock and mineral identification, textures, etc.). (2) A description of three other building stones (e.g., serpentine, slate, oolitic limestone, etc.). (3) A comparison of the current building stone with the three other rock types, citing advantages and disadvantages of each when used as a building stone. (4) A conclusion recommending a particular building stone for the client. I suggest that students include the following information for all four rock types described in their essays:

- mineralogy
- geologic processes that create these rock types
- possible sources of the building stone (i.e., quarrying locations)
- additional uses for these rock types (e.g., gemstones, electronic components, road metal, etc.)

I stress that their clients are NOT geologists, so they must explain all specialized terms used in their papers. Students must explain even terms as simple as “igneous” and “carbonate.” In addition, I tell students to include the address of the building and the current use of the stone at their chosen building site as well as any additional information they might find (e.g., historical information, owners, uses for the building, etc.).

To assess the term paper, I employ a grading rubric (Table 2) and pay particular attention to their persuasive arguments. I emphasize that students must take a position on the assigned topic: Which building stone do they recommend for their client? They must support their positions with evidence and cite appropriate references. A substantial bibliography and appropriately cited references are important parts of convincing their client—and their professor—that they are experts in Earth materials. I provide many building stone articles and geologic walking tours from other cities (e.g., Fickies, 1986; Hebrank, 1989; Withington, 1998). Hannibal and Park (1992) give a particularly detailed description of sources for information on building stones. More recently, Winkler (1997) has written *Stone in Architecture: Properties, Durability*, a thorough summary of the characteristics of building stones. I also provide several books about downtown St. Petersburg so that students can explore building histories. I leave these resources in our laboratory so that students may use them as they write their consulting reports.

Why focus on a persuasive perspective for the final products? As consultants or as private citizens, students may be asked to express their expert opinions on geologic issues. This project is designed to improve students’ abilities to express their opinions in concise, confident, and informed essays. Overall, students enjoyed the persuasive focus of the assignment. They appreciated having a goal other than simply writing about a particular topic in a standard term paper format. One student created her own fictitious firm, Eckerd 406 Journal of Geoscience Education, v. 50, n. 4, September, 2002, p. 404-409
College Geological Consultants, and provided a cover letter with an original letterhead (Figure 4). Another student chose a building with a beautiful labradorite facade damaged in a tropical storm. Those owners were particularly interested in the student’s opinion regarding replacing or retaining the stone panels.

FURTHER SUGGESTIONS

An urban center of a city is only one possible place where students can study building stones. College campuses, cemeteries, art museums, or historical monuments may also provide a diverse selection of building stones for a class project. Although I specify that students must choose exterior building stones for convenient access, they could also investigate interior building stones. To view an even greater variety of rock types, a field trip to a building stone supplier could be added.

To explore subjects beyond science, students and faculty could collaborate with local preservation and historical societies. I have spoken with an archivist at the St. Petersburg Museum of History and we are considering creating a walking tour of downtown for tourists. I may also modify the written assignment so that students create documents useful to researchers at the museum.

If an extended building stone project is too time consuming, consider creating a simple walking tour of local building stones. Several instructors have used building stones to stimulate student interest in topics ranging from mineral identification to rock weathering, especially in introductory geology courses (e.g., Dragovich, 1978; Kemp, 1992; Judson et al., 2000; Kvale et al., 2000; Hoskin, 2000).

CONCLUSIONS

Building stones provide an opportunity to integrate research into the classroom in an unusual way. By using easily accessible, local resources, students can experience the fundamental aspects of original and independent research. The semester-long project requires students to frame hypotheses as they determine the suitability of specific building stones, develop strategies for collecting and assessing data, form a conclusion, and present focused oral and written reports.

The primary disadvantage of this project is the significant investment of time required from both students and faculty. At the very least, students require one lab period to hold the walking tour and several class periods to give their oral presentations. Students may spend additional class time choosing building sites and identifying minerals using the petrographic microscope. To prepare for the project, the instructor must acquire building stone samples, find appropriate buildings in a downtown area, and conduct historical research. The time commitments, however, are offset by a substantial number of benefits beyond providing a research experience for students:

It enhances the college’s visibility to the public.

Table 2. The grading rubrick for the written report.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Criteria</th>
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<tbody>
<tr>
<td>A</td>
<td>meets criteria for a B, but also has a sense of style, going beyond grammatical correctness to be a quality manuscript suitable for presentation to a building owner</td>
</tr>
<tr>
<td>B</td>
<td>thoroughly describes the rocks &amp; takes a stand on the issue; excellent paper organization, paragraphs flow and fit together, interesting sentences, good grammar, reads like a polished draft</td>
</tr>
<tr>
<td>C</td>
<td>acceptable content &amp; organization, reasonable prose, reads like an early draft</td>
</tr>
<tr>
<td>D</td>
<td>disorganized, awkward sentence structure, poor grammar, reads like a first draft</td>
</tr>
<tr>
<td>F</td>
<td>similar problems to a D paper, but worse</td>
</tr>
</tbody>
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A STUDENT'S PERSPECTIVE OF THE BUILDING STONE RESEARCH PROJECT

By Adrian Holmes
Earth Materials Class of 2000

PROJECT SUMMARY

As the topic of my study, I chose the downtown St. Petersburg Post Office (Figure 3). It was built in 1917, at a cost of $518,000, as part of the mayors plan to improve the appearance of the city. Fashioned in the Mediterranean Revival style of the time, the building was adorned with stone columns, fresco ornamentation, and keystone arches. My project focused solely on the columns.

When visually inspecting the pillar stone, I suspected that it was a marble. It had the characteristic texture and swirls, with a suite of low grade metamorphic minerals. Much to my surprise, I touched one of the pillars with a drop of HCl and there was no apparent reaction! I was baffled until my professor reminded me to try the acid test on the powdered form of the stone. Sure enough, a small sample of the powder we scraped off reacted, suggesting the pillars were carved from a dolostone.

During the next class, I selected a building stone sample analogous to the Post Office pillars for thin section analysis. In the subsequent weeks, I researched dolostone (formation, metamorphism, etc.) and worked on the thin section. Eventually, a picture started to come together for me of how the pillar stone and thin section stone were formed. The two stones differed slightly. I was able to work out detailed histories for both of the stones in my paper and then share them with the class in my presentation. As for a recommendation to the building owner, I would suggest keeping the current stone. It is reasonably durable and is not subject to rapid chemical weathering.

THIN SECTION ANALYSIS

The large spherical grains in the sample were determined to be dolomite by characteristic extinction, birefringence, and interference figures. They were distinguished from calcite by an acid test or the hand specimen. The regions labeled as quartz in the figure are filled with chert-like grains (clearer in XPL). Their extinction is strongly uniform among grains in particular regions, suggesting some realignment due to metamorphism. The diamond shaped cross sections of tremolite are consistent with a mid-grade siliceous dolostone. The region labeled "***" is comprised of yellow anhedral grains that defy identification. Given the context of the rock, the region may contain calcite, dolomite, or tremolite.

A view of the Post Office building stone under plane polarized light.

ROCK TYPE

The abundance of dolomite means that the stone is or was a dolostone. The optically aligned microcrystalline quartz grains suggest metamorphism. Putting this together, the stone is probably a cherty dolomite marble. The presence of the metamorphic mineral tremolite is congruent with this hypothesis.

ROCK HISTORY

Calcite was deposited first, creating porous limestone. Subsequently, magnesium-rich water was pumped through the pores to convert the stone to dolomite. Then, silica-rich water passed through, leaving chert deposits behind in the pores. The stone was then metamorphosed (medium grade), reassigning the quartz grains and allowing the crystallization of tremolite.

PROJECT EVALUATION

Overall, this project was a very positive experience. I think there are definite advantages to working with one sample in depth over extensive memorization. I am certain that knowing how to investigate a specimen in detail will serve me better and longer than memorizing facts that, in the real world, I will be able to look up. Having the clear goal of unraveling the rock's history and having the necessary resources readily available, the building stone project was an enjoyable framework in which to learn about Earth materials.

Figure 2. A brief overview and assessment of the building stone project written by a student.
It introduces students to a downtown area, providing them with a greater familiarity with their geographic surroundings.

It is an interdisciplinary exercise linking geology and history, providing a greater appreciation for a city's past.

It develops students' skills in identifying building stones, which they commonly see and can then discuss with friends and family.

Figure 3. During the walking tour, students examine the dolomite marble columns of the downtown St. Petersburg Post Office.

ACKNOWLEDGMENTS

I extend many thanks to Adrian Holmes and Cristin Ashmankas, two Eckerd College students who contributed to this manuscript. Adrian summarized his experience with the building stone project (Figure 2) and Cristin provided a portion of her final report (Figure 4). I also thank Karen Bartels and Jennifer Thomson whose reviews greatly improved this document.

REFERENCES


