**GG 103  GEOLOGY OF THE HAWAIIAN ISLANDS**
Three Credits
Tues. & Thurs., 3:30 – 4:45

**INSTRUCTOR:** Dr. Floyd W. McCoy
**OFFICE:** Hale Imiloa 115
**OFFICE HOURS:** Mon. & Wed., 1030-1230; Mon., 1630 - 1730
**TELEPHONE/E-MAIL:** 236.9115/fmccoy@hawaii.edu
**EFFECTIVE DATE:** Fall, 2011

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**WINDWARD COMMUNITY COLLEGE MISSION STATEMENT**

"Windward Community College is committed to excellence in the liberal arts and career development; we support and challenge individuals to develop skills, fulfill their potential, enrich their lives, and become contributing, culturally aware members of our community."

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**CATALOG DESCRIPTION**

Hawaiian geology and geological processes: origin of Hawaiian Islands, volcanism, rocks and minerals, land forms, stream and coastal processes, landslides, earthquakes and tsunamis, ground water, geological and environmental hazards. Field trips arranged. (3 hrs. lect.) WCC:DP

**Additional Activities Required Outside of Class**

Additional resources besides the textbook are needed such as a series of color brochures, books and magazines in the WCC library, in addition to websites and other sources – these will be discussed and identified in class.

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**STUDENT LEARNING OUTCOMES**

Your learning outcomes from successfully completing this course are:

1. Students can explain the relevance of geology and geophysics to human needs, including those appropriate to Hawaii, and be able to discuss issues related to geology and its impact on society and planet Earth.
2. Students can apply technical knowledge of relevant computer applications, laboratory methods, and field methods to solve real-world problems in geology and geophysics.
3. Students use the scientific method to define, critically analyze, and solve a problem in earth science.
4. Students can reconstruct, clearly and ethically, geological knowledge in both oral presentations and written reports.
5. Students can evaluate, interpret, and summarize the basic principles of geology and geophysics, including the fundamental tenets of the sub-disciplines, and their context in relationship to other core sciences, to explain complex phenomena in geology and geophysics.

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*Na pelepele nna pali o Kalalau
   i kawili o ka makani*

*The cliffs of Kalalau are crumbling
   because of stirring by the winds*

*Ancient Hawaii proverb*
To be ignorant of what occurred before you were born is to always remain a child…

[Marcus Tullius Cicero, Roman statesman, orator, senator, philosopher: 106 – 43 BCE]

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COURSE CONTENT

**Concepts or Topics**

- Structure of the earth
- Plate tectonics
- Hot spot/midplate volcanoes
- Geography of Hawaiian volcanoes
- Structure of Hawaiian volcanoes
- Rocks and minerals
- Extrusive and intrusive igneous
- Hawaiian-type eruptions
- Predicting Hawaiian eruptions
- Types and classification of igneous rocks
- Formation & crystallization of igneous rocks
- Types of eruptions
- Stages of Hawaiian volc. & island evolution
- Geologic history of Oahu
- Mechanical and chemical weathering
- Ground water
- Mass wasting; aeolian processes
- Glaciers, glaciation and sea-level changes
- Landscape evolution; geomorphic cycle
- Rock cycle
- Absolute and relative dating
- Age of the Hawaiian Islands
- Geologic time
- Volc. hazards: identification, management, mitigation

**Skills or Competencies**

1. Understand the scientific method, and how it is used and applied.
2. Understand the metric system.
3. Apply an understanding of physical, chemical, and biological processes to interpreting geological events and processes.
4. Use basic mathematical statements to describe geological properties and processes.
5. Distinguish and reject *faux* science and misrepresentations of science.
6. Appreciate the technology behind the science of geology.
7. Develop an appreciation for geology and rocks good for jocks.
8. Appreciate the spectrum of science and engineering endeavors that underlie the study of the earth.
9. Appreciate the history, literature, music, and mythology of the earth.
10. Comprehend the benefits and dangers of volcanism to society, and the mitigation of geological hazards.

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COURSE TASKS, ASSESSMENT AND GRADING

**Type of examination:** written; questions require essays of varying length from short (single sentence) to longer (no more than a 10 minute composition); some questions may involve the use of maps and cross-sections.

**Examination schedule:**

- **One midterm:** 1 hour, covering all material discussed up to the examination date; if this examination is not taken on schedule, a make-up exam. can be given but will have different and more difficult questions.
- **Final exam:** 2 hours, concerned with the entire course, with some emphasis on the last half of the course; must be taken on scheduled date – no retakes or early takes are possible except in exceptional cases.
- **Extra/special credit:** discouraged; none routinely awarded; no term papers are required; under unusual circumstances, extra/special credit might be devised via consultation with the instructor.

**Grading scheme:** letter grades calculated from an average of all test scores, with the midterm = 40%, and the final = 60% of the total grade; letter grades assigned with:

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<thead>
<tr>
<th>Grade</th>
<th>Description</th>
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<tbody>
<tr>
<td>A</td>
<td>90 - 100%</td>
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<td>B</td>
<td>80 - 89%</td>
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<td>C</td>
<td>70 - 79%</td>
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<td>D</td>
<td>60 - 69%</td>
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<td>N</td>
<td>course not completed due to unforeseen difficulties</td>
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<td>F</td>
<td>&lt; 60%</td>
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<tr>
<td>C/NC</td>
<td>credit/no credit option, assigned only via registration</td>
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<tr>
<td>I</td>
<td>incomplete due to unusual circumstances; assigned only with permission of the instructor; no credit given until this grade is changed to an A-D letter grade - it is your responsibility to make this change.</td>
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To witness a great eruption closely is an awesome privilege. To survive is a bonus.

[Alwyn Scarth, “Vulcan’s Fury: Man against the Volcano”]
"Civilization occurs with the consent of geology."
[Will Durant, American historian]

Note: the books listed below remain basic sources of information concerning the geology of Hawaii but are considerably out-of-date – there is no adequate textbook for this course that discusses current concepts and research on Hawaiian volcanism and the processes of constructing a Hawaiian island.


Four brochures discussing aspects of Oahu geology are posted in the classroom – you are encouraged to consult them as well (see schedule of lectures [below] for correlation to subjects being discussed in class. Supplementary, non-required reading is in libraries at all campuses, both on reserve and on open shelves; you are encouraged to peruse this literature; numerous seminars, talks, symposia and exhibits occur throughout the university system and at various museums, you are particularly encouraged and welcomed to these; announcements made in class, posted on the Marine Option Program bulletin board in Hale 'Imiloa at WCC, or listed on the website; posters depicting various aspects of geology and field trips are on bulletin boards in the Hale 'Imiloa hallway.

ADDITIONAL INFORMATION

Field Courses: Not required but highly recommended; 1 credit awarded for each course. To obtain credit for neighborhood island field trips, you must participate on every day of the trip, either pass a written final examination or submit a report on a field exercise. Each course involves a one-day field exercise, with data analyses done after the trip, and a complete report submitted prior to the end of the semester. The Oahu field-trip course has different requirements that are noted below. Complete course descriptions are given in the WCC catalog and on the WCC website.

GG 210 – Oahu Field Geology: every fall semester; Wednesday afternoons, 1400–1645, meet in Hale 'Imiloa Building (WCC) or at field site; short, easy hikes throughout the island to observe, discuss and map geologic features, field activities are mixed with laboratory exercises; transportation to field sites via private cars; course grade is a function of participation and satisfactory completion of laboratory and field exercises [offered fall, 2011].

GG 211 – Big Island Field Geology: every fall semester; four days during either Veteran's Day week-end or Thanksgiving Day week-end; involves short hikes and two difficult hikes (onto lava flows and on Mauna Kea), with one day on the summit of Mauna Kea (a harsh, cold, high-altitude environment) [offered fall, 2011].

GG 212 – Maui Field Geology: spring semester, 2013; during first four days of spring recess; may involve a difficult one-day hike into Haleakala; also may involve field lab. exercise in difficult terrain.

GG 213 – Molokai, Lanai and Kaho'olawe Field Geology: spring semester, 2014; during first five days of spring recess; involves hike down to Kalaupapa with a day hike around the Kalaupapa peninsula, and four-wheel driving over rough roads on Lanai; also involves field lab. exercise(s) in difficult terrain.

GG 214 – Kauai and Ni'ihau Field Geology: spring semester, 2013; first four days of spring recess; involves short easy hikes; also involves field lab. exercises.

Note: All field classes require medical clearance and legal waiver forms; all involve hiking over irregular ground and can be difficult with potentially dangerous conditions; students are responsible for their expenses during the trip including transportation. Students are responsible to the WCC Business office for all expenses including room, board, transportation, and admission fees where applicable- grades cannot be issued until these expenses are paid.

And the heat from them both gripped the purple sea, the heat of thunder and lightning and of fire from such a monster, the heat of fiery storm-winds and flaming thunderbolt; and the whole earth… and sea boiled. And long waves spreading out in circles went seething over the headlands, and unquenchable earthquakes broke out…
[Hesiod, Archaic Period, Greek poet, ca. 750-650 BCE; Theogony]
Ke pahu nei ka honua. The earth rumbles and explodes.  
[Ancient Hawaii proverb]

Schedule of lectures and corresponding chapters in the textbook:

<table>
<thead>
<tr>
<th>Week</th>
<th>Subject</th>
<th>Chapter(s)*</th>
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<tbody>
<tr>
<td>1</td>
<td>Introduction to course; geology as a science; scale, rates and time;</td>
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<tr>
<td></td>
<td>metric system, Marine Option Program (MOP)</td>
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<tr>
<td></td>
<td>Structure of the earth</td>
<td>1, 3, 13</td>
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<td>2</td>
<td>Structure of the earth (continued)</td>
<td>1, 3, 13</td>
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<td></td>
<td>Plate tectonics</td>
<td>1, 3, 13, 16</td>
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<tr>
<td>3</td>
<td>Plate tectonics (continued)</td>
<td>1, 3, 6, 13</td>
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<td></td>
<td>Hot spot/midplate volcanoes</td>
<td>8</td>
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<tr>
<td></td>
<td>Geography of Hawaiian volcanoes</td>
<td>7</td>
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<tr>
<td>4</td>
<td>Structure of Hawaiian volcanoes</td>
<td>7, 10</td>
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<tr>
<td></td>
<td>Rocks and minerals</td>
<td>16</td>
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<td></td>
<td>Extrusive and intrusive igneous rocks</td>
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<tr>
<td>5</td>
<td>Extrusive and intrusive igneous rocks (continued)</td>
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<td></td>
<td>Extrusive igneous rocks: lava flows</td>
<td>3, 9</td>
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<td>6</td>
<td>Extrusive igneous rocks: pyroclastic debris and rocks</td>
<td>6, 9, HB, KC, DH</td>
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<td>Hawaiian-type eruptions</td>
<td>7</td>
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<tr>
<td>7</td>
<td>Predicting Hawaiian Eruptions</td>
<td>7, 18</td>
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<td>Types and classification of igneous rocks</td>
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<td>Formation and crystallization of igneous rocks</td>
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<td>8</td>
<td>Types of eruptions</td>
<td>2-5, 7, 9, 11, 12, 17</td>
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<tr>
<td>9</td>
<td>Review</td>
<td>1-13, 16-18, HB, KC, DH</td>
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<td>10</td>
<td>Stages of Hawaiian volcanism and island evolution</td>
<td>7-9, 10, HB, KC, MP, DH</td>
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<td>11</td>
<td>Geologic history of Oahu</td>
<td>7-9, HB</td>
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<td></td>
<td>Mechanical and chemical weathering</td>
<td>DH</td>
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<td>12</td>
<td>Hydrologic cycle</td>
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<td>Ground water</td>
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<td>13</td>
<td>Mass wasting; aeolian processes</td>
<td>MP</td>
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<td>Glaciers, glaciation and sea-level changes</td>
<td>HB, DH</td>
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<td></td>
<td>Landscape evolution; geomorphic cycle</td>
<td>10, HB</td>
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<td>--------------- Fall recess    GG 211 Big Island geology field course</td>
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<td>14</td>
<td>Rock cycle</td>
<td>13</td>
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<td>Absolute and relative dating</td>
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<td>15</td>
<td>Age of the Hawaiian Islands</td>
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<td>Geologic time</td>
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<td></td>
<td>Volcanic hazards: identification, management, mitigation</td>
<td>15-18</td>
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<tr>
<td>16</td>
<td>Volcanic hazards: identification, management, mitigation</td>
<td>15-18</td>
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Note: Schedule of lectures is tentative and likely will change as geologic events occur during the semester.

* Brochures: DH = Diamond Head; HB = Hanauma Bay; KC = Koko Crater; MP = Makapu‘u Point
You Might Be a Geologist If...

1. You own more pieces of quartz than underwear.
2. Your rock collection weighs more than you do.
3. Your rock garden is located inside your house.
4. You can pronounce the word "molybdenite" correctly on the first try.
5. You don't think of "cleavage" the same way everyone else does.
6. You have ever uttered the phrase "have you tried licking it" with no sexual connotations involved.
7. You think the primary function of road cuts is tourist attractions.
8. You find yourself compelled to examine individual rocks in driveway gravel.
9. You're planning on using a pick and shovel while you're on vacation.
10. Your internet home page has pictures of your rocks.
11. You will walk across eight lanes of freeway traffic to see if the outcrop on the other side of the highway is the same type of rock as the side you're parked on.
12. You can point out where Tsumeb is on a world globe.
13. The baggage handlers at the airport know you by name and refuse to help with your luggage.
14. You have ever found yourself trying to explain to airport security that a rock hammer isn't really a weapon.
15. You never throw away anything.
16. You have ever taken a 22-passenger van over "roads" that were really intended only for cattle.
17. You consider a "recent event" to be anything that has happened in the last hundred thousand years.
18. You have ever had to respond "yes" to the question, "What have you got in here, rocks?"

Geologists are amazing. They know hundreds of words for different sorts of dirt and hundreds of words for things it does when left alone for a few million years.
GG 103 Geology of the Hawaiian Islands

Resources

The list below presents resources that contribute to understanding the geological evolution of the Hawaiian Islands. There is no single adequate and updated source for this information, thus this list. The books and brochures should be in the WCC library.

Books with focus on Hawaiian geology


[Both editions are dated, lacking much new information although most of the basic premise and story remain the foundation for Hawaii’s geological history, and remain the only adequate source published in book form.]

Hazlett & Hyndman; Roadside Geology of Hawaii; Mountain Press Publ. Co., 1996

[Good general presentation, albeit increasingly dated and outdated; road logs for every island describe geological sights, unfortunately marred by many mistakes in descriptions of these sights.]

Blay & Siemers; Kauai’s Geologic History; TEOK Investigations, 2004

[Nice treatment of the geology of Kauai, also with a brief accounting of the geological history of any Hawaiian Island; book is the text for GG 214, Field Geology of Kauai.]

Natural History Books with chapter(s) on Hawaiian geology

Carlquist; Hawaii A Natural History; SB Printers, 1980

[Dated but nice summary.]

Morgan; Hawaii A Unique Geography; Bess Press, 1996

[Also dated but succinct.]

Ziegler; Hawaiian Natural History, Ecology, and Evolution; UH Press, 2002

[Good summary on geology and geologic evolution of Hawaii.]

Brochures

Hanauma Bay, Koko Crater, Diamond Head Crater, Makapu’u Point.

[These are a series of brochures put together to explain geological phenomena at these four areas, and are excellent. They were fabricated for a professional meeting here a few years ago.]

Hallway Posters

[Posters are mounted in the hallway of Hale Imiloa that provide additional information on subjects currently under discussion in lecture.]
Websites

http://hvo.wr.usgs.gov/volcanowatch/

[Weekly posting of articles written by U.S. Geological Survey scientists and technicians published in the Hawaii Tribune Herald in Hilo; well-written accounts of current volcanic activity, of tools and techniques used in research; of cultural ties to Hawaiian volcanism; and more; postings to the website are often delayed by on-going volcanic activity.]

http://www.soest.hawaii.edu/GG/index.html

[Website for the Department of Geology and Geophysics at Manoa; often with short articles of current research pertaining to Hawaiian geology; elsewhere on the site are virtual geology tours.]

http://www.higp.hawaii.edu/~scott/GG103/PowerPoints/

[Many PowerPoint presentations of various subjects taught in GG 103 both on this campus and at Manoa, assembled by my colleague teaching the course at UHM – these are excellent as a review resource.]


[Glossary of terms used in class, with pictures and text, very nicely done.]