

## **GG 103 GEOLOGY OF THE HAWAIIAN ISLANDS**

Three Credits

Tues. & Thurs., 1115 - 1230

**INSTRUCTOR:** Dr. Floyd W. McCoy  
**OFFICE:** Hale Imiloa 115  
**OFFICE HOURS:** Mon. & Wed., 1100-1230, 1400-1500; Th., 1630 - 1730  
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**EFFECTIVE DATE:** Fall, 2009

### **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.*

### **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**

Access to the Hawaiian Volcano Observatory (HVO) website (<http://hvo.wr.usgs.gov>) for reading the weekly Volcano Watch feature, in addition to readings, as might be assigned, from other websites and/or from books and magazines in the WCC library.

### **STUDENT LEARNING OUTCOMES**

The student learning outcomes for this course hopefully are:

- Understand formational and evolutionary processes, as well as time-scales for these processes in the construction, modification and destruction of a Hawaiian island and its landscape.
- Relate Hawaiian volcanism to other types of volcanism in terms of plate tectonics, magma/rock types, magmatic plumbing systems, edifice construction/destruction, eruption types, and eruptive products.
- Describe how volcanoes are monitored and eruptions predicted.
- Realize the significance of volcanism in the rock cycle.
- Appreciate the benefits of volcanism to Hawaii as in geothermal energy, ground water, soils, and more.
- Appreciate volcanic hazards and mitigation of those hazards with a focus on Hawaii.
- Comprehend the vastness of geological time and how time is measured thus the time-scale known.

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

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

*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]

## 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 rock:
- 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.

## 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:

A = 90 - 100%    B = 80 - 89%    C = 70 - 79%    D = 60 - 69%

F = < 60%    N = course not completed due to unforeseen difficulties

C/NC = credit/no credit option, assigned only via registration

I = 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.

*"Civilization occurs with the consent of geology."*

[Will Durant, American historian]

## LEARNING RESOURCES (aka TEXTBOOK)

*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.*

Macdonald, Abbott and Peterson; *Volcanoes in the Sea, The Geology of Hawaii*; Univ. Hawaii Press, 1983 (2nd edition)

Macdonald and Abbott; *Volcanoes in the Sea, The Geology of Hawaii*; Univ. Hawaii Press, 1970 (1st edition)

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 Trips:** 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, pass a written final examination, and submit a report on the field exercise; 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. 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.

**GG 210 – Oahu Field Geology:** every fall semester; Tuesday afternoons, 1330–1615, 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 on fieldtrips and satisfactory completion of laboratory exercises [next offered fall, 2009].

**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) [next offered fall, 2009].

**GG 212 – Maui Field Geology:** spring semester, 2010; during first four days of spring recess; may involve a difficult one-day hike into Haleakala.

**GG 213 – Molokai, Lanai and Kaho'olawe Field Geology:** spring semester, 2011; during first five days of spring recess; involves hiking down to Kalaupapa with a day hike around the Kalaupapa peninsula, and four-wheel driving on rough roads on Lanai.

**GG 214 – Kauai and Ni'ihau Field Geology:** spring semester, 2012; first four days of spring recess; involves short easy hikes.

*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.*

**Schedule of lectures and corresponding chapters in the textbook:**

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

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