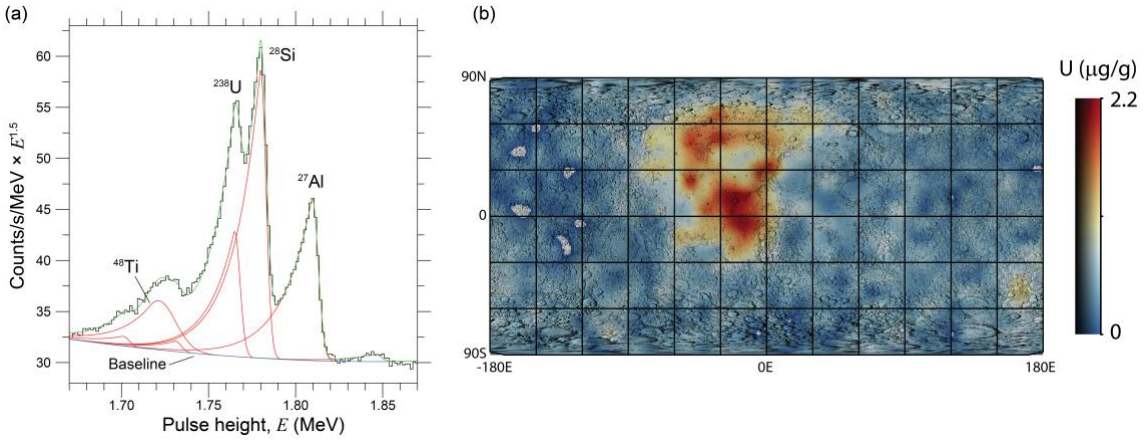
ERTH 711 FALL 2020
CRN 78358
Gamma-ray, X-ray and Neutron Spectroscopy in Terrestrial and Planetary Remote Sensing
W 2:30 to 5:00 pm, POST 544



Analysis of uranium on the Moon. a) The full-energy peak for the 1.765 MeV gamma ray produced by the decay of ^{214}Bi in the U decay series overlaps adjacent peaks from cosmogenic reactions in the instrument and regolith. The peak area of the 1.765 MeV peak, which is proportional to the concentration of U in the regolith, is determined by simultaneously fitting peaks in the energy window shown. The peak shapes are modeled as a Gaussian and exponential tail. The gamma ray continuum is modeled as a polynomial. b) The map of U was determined from peak areas extracted from many spectra acquired in a circular polar mapping orbit using methods described by Yamashita et al. (2010). For context, the map of uranium is superimposed on shaded relief. For regions with no data (grey), the peak area determined by the fitting procedure was negative.

Instructor

Peter Englert, Hawaii Institute of Geophysics and Planetology
Contact information: office - POST 508 B, penglert@hawaii.edu

Office hours: by appointment

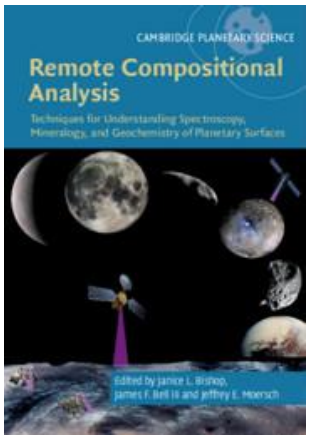
Course information

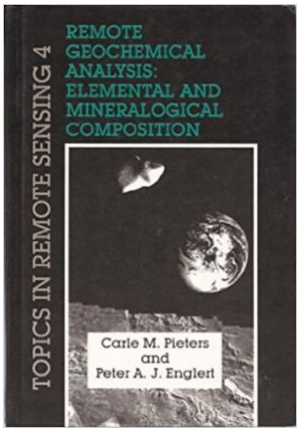
This course will introduce participants to research areas of Earth and Planetary Science that make use of cosmic radiation and natural radioactivity. The course will provide basic knowledge in nuclear science and in instrumentation and methods of gamma -ray, X-ray, and neutron spectroscopy. It will then focus on gamma-ray, X-ray, and neutron remote sensing applications in Earth and Planetary science.

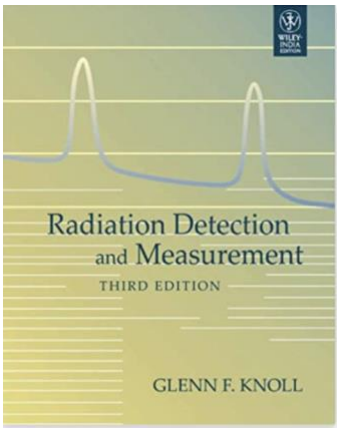
Prerequisites

Graduate standing or consent of instructor. The course is for students that have fulfilled all perquisites for upper division classes in Earth and Ocean sciences, chemistry, physics, engineering, and/or computer science. Students who are willing to complete prerequisites through co-enrollment in courses or self-study assignments approved by the instructor are welcome.

Textbooks:







Remote Compositional Analysis: Techniques for Understanding Spectroscopy, Mineralogy, and Geochemistry of Planetary Surfaces, Editors: Janice L. Bishop, Jeffrey E. Moersh, and James F. Bell, III. Publisher: Cambridge University, 2019.
Remote Geochemical Analysis: Elemental and Mineralogical Composition, Carle M. Pieters and Peter A.J. Englert, Cambridge University Press 1993.
Radiation Detection and Measurement, Glenn F. Knoll, John Wiley & Sons Inc., 1999.
A copy of each textbook will be available for class use.

Course Content

The course will include the following major topics

- Radiation detection and measurement: radiation sources, principles of radiation detection, radiation detectors, counting statistics, electronics and pulse processing, fundamentals of gamma-ray, X-ray, and neutron spectroscopy.
- Planetary exploration missions with gamma-ray, X-ray, and neutron spectroscopy: Apollo 15&16, Lunar Prospector, Mars Odyssey, MESSENGER, DAWN.

Learning Objectives/ Course Objectives

By the end of the course students will be:

- be proficient in applying technical knowledge of planetary remote sensing in theory, laboratory methods, field methods, and the supporting disciplines to help advance the fields of geology and geophysics.
- be able to (a) construct scientific hypotheses, (b) define and carry out research to evaluate them in a timely manner, (c) analyze and synthesize the results of their research, and (d) derive conclusions that help advance the fields of geology and geophysics.
- be able to effectively communicate about the findings of their planetary remote sensing research in writing at a level comparable to that of a scientific journal publication, and defend it orally to the satisfaction of a scientific audience.

- having acquired knowledge and skills that contribute to pursuing employment or other activities that contribute to the advancement of Earth and Planetary Sciences and/or the solution of societal problems.

This will be achieved through:

- acquiring a foundational understanding of the principles of planetary remote sensing research with cosmic radiation.
- developing an ability to make sound assessments of applications of measurement/experiment modalities of planetary remote sensing research.
- learning how to address increasingly complex geosciences problems that can be addressed using planetary remote sensing.
- improving critical reasoning skills and expanded ability to formulate scientific arguments in the area of planetary remote sensing research.
- improving research and writing skills

Course delivery

The course will be delivered as regularly scheduled class on Wednesdays, from 2:30 to 5:00 pm, in POST 544. Flexible delivery is anticipated in agreement with all participants. Participants on travel or otherwise not able to be present can participate remotely through a communication tool (e.g. Zoom, will be provided) at the scheduled class meeting time.

Course elements

- **Lectures, discussions, and participation:** The main elements of course delivery are mini-lectures, guided group discussions, and project-based learning activities, following the general outline of the textbook during the first half of the semester. A seminar style course expects an active role in the learning process from students and instructor alike, assisting each other through participation in in-class activities. Some learning objectives will be achieved through group-based problem solving in class. Group problem solving results will be presented and discussed in class when completed.
- **Foundational publication reports:** Students will be studying foundational publications in the field and will be asked to critically evaluate research design, data acquisition, and data analysis and research outcomes. Two seminal/major publications will be assigned to each student for analysis and presentation (5-10 min) in class.
- **Research Projects:** The main assignment of the course will be individual (yet coordinated) research projects resulting in a term paper and presentation at the end of the semester.

Grading

Participation in and completion of course elements will be the basis of grading:
Discussions and participation – 20%
Foundational publication reports – 20%
Research project, paper, and presentation – 60%

Letter grade breakdown

A- = 90 – 92%, A = 93 – 96%, A+ = 97 – 100%
B- = 80 – 82%, B = 83 – 86%, B+ = 87 – 89%
C- = 70 – 72%, C = 73 – 76%, C+ = 77 – 79%
D- = 60 – 62%, D = 63 – 66%, D+ = 67 – 69%
F = < 60%

Details of grading components will be discussed and finalized in the first class meeting.

Course preparation and supporting materials

Computer access is required for this course. At the beginning of the semester or a major instructional section, participants will be receiving all necessary materials through Laulima. Please check for pre-class assignments before each class period in the Laulima Resources folder!

Standard Policies

Plagiarism includes but is not limited to submitting, in fulfillment of an academic requirement, any work that has been copied in whole or in part from another individual's work without attributing that borrowed portion to the original author; neglecting to identify as a quotation another's idea and particular phrasing that was not assimilated into the student's language and style or paraphrasing a passage so that the reader is misled as to the source; submitting the same written or oral or artistic material in more than one course without obtaining authorization from the instructors involved. (The University of Hawai'i Student Conduct Code)

Any student who plagiarizes in this course will receive a failing grade and will be referred to the Dean of Students.

If you feel you need reasonable accommodation because of the impact of a disability, please 1) contact the KOKUA Program housed in Room 013 of QLCSS, 956-7511 or 956-7612; 2) speak with the instructor privately to discuss your specific needs. I will be glad to work with you and the KOKUA Program to meet your access needs related to your disability.

Title IX:

The University of Hawai'i is committed to providing a learning, working and living environment that promotes personal integrity, civility, and mutual respect and is free of all forms of sex discrimination and gender-based violence, including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence, and stalking. If you or someone you know is experiencing any of these, the University has staff and resources on your campus to support and assist you. Staff can also direct you to resources that are in the community. Here are some of your options:

As members of the University faculty, your instructors are required to immediately report any incident of potential sex discrimination or gender-based violence to the campus Title IX Coordinator. Although the Title IX Coordinator and your instructors cannot guarantee confidentiality, you will still have options about how your case will be handled. Our goal is to make sure you are aware of the range of options available to you and have access to the resources and support you need.

If you wish to remain ANONYMOUS, speak with someone CONFIDENTIALLY, or would like to receive information and support in a CONFIDENTIAL setting, use the confidential resources available here: http://www.manoa.hawaii.edu/titleix/resources.html#confidential

If you wish to directly REPORT an incident of sex discrimination or gender-based violence including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence or stalking as well as receive information and support, contact: Dee Uwono, Title IX Coordinator (808) 956-2299 t9uhm@hawaii.edu.