

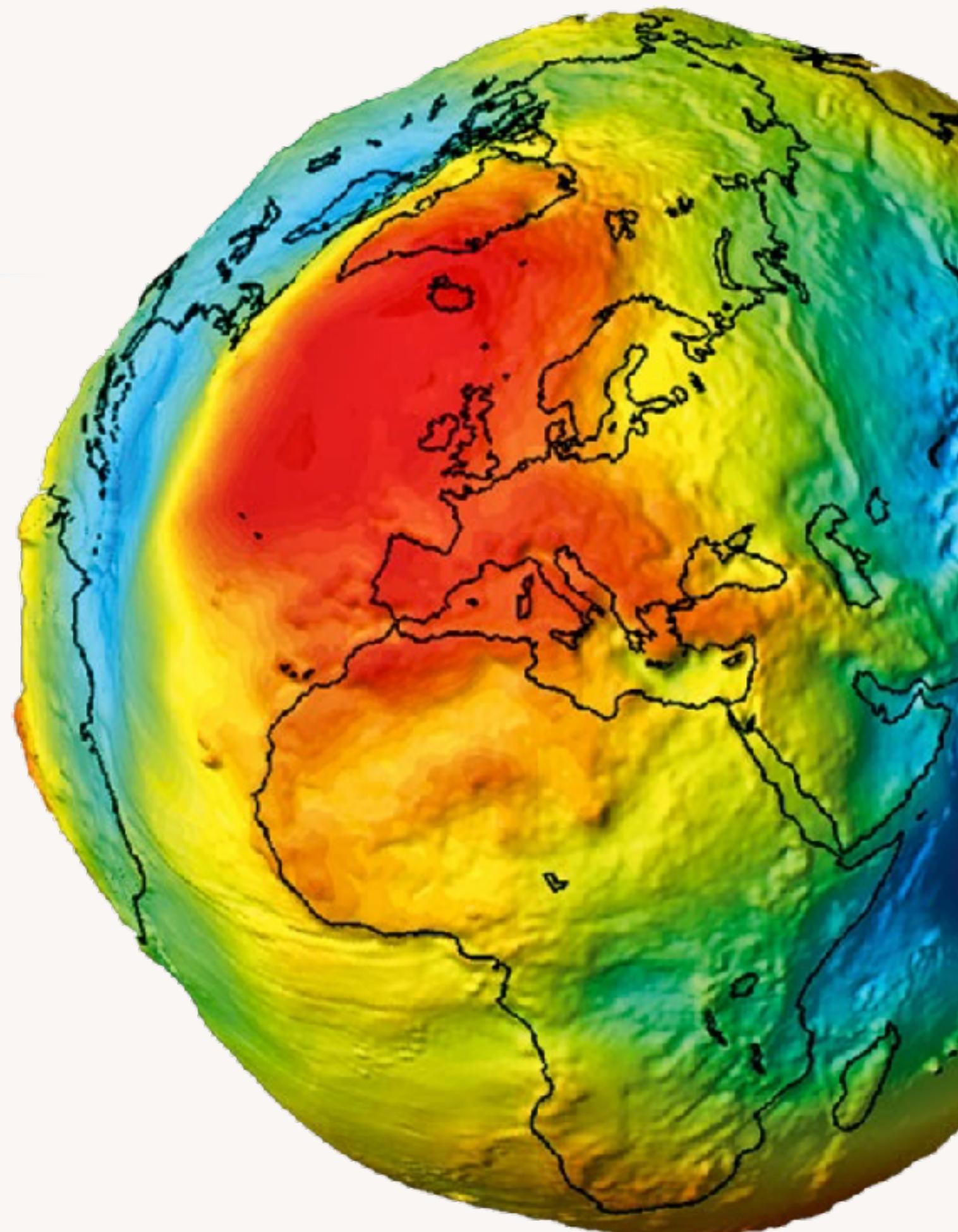
EAS 3610

Introduction to Geophysics

Instructor: Dr. Winnie Chu, Dr. Andy Newman

Email: winnie.chu@eas.gatech.edu
anewman@gatech.edu

Grader: Donglai Yang (dyang379@gatech.edu)



Today's Objectives

1. Introduction
2. Syllabus
3. What's Geophysics?

Let's Introduce Ourselves

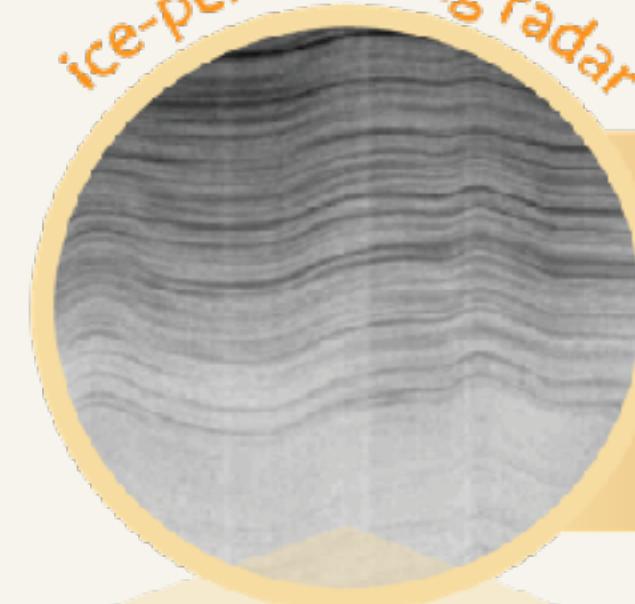


Dr. Winnie Chu

- ▶ **PI** for PGSL
- ▶ **Background:** Ph.D. Earth Sciences
(Columbia University) | Postdoc
(Stanford Geophysics)
- ▶ **Research Interest:** Ice-sheet
dynamics, Subsurface processes,
Radar echo sounding, Model
Synthesis



Polar **G**eophysical
Simulation **L**ab



Combines Geophysics, AI & Modeling
investigate ice sheets interaction with climate
& glacier dynamics



Radioglaciologists



Renee Clavette
(MS 2022)



Angelo Tarzona
(NASA FINESST FI)

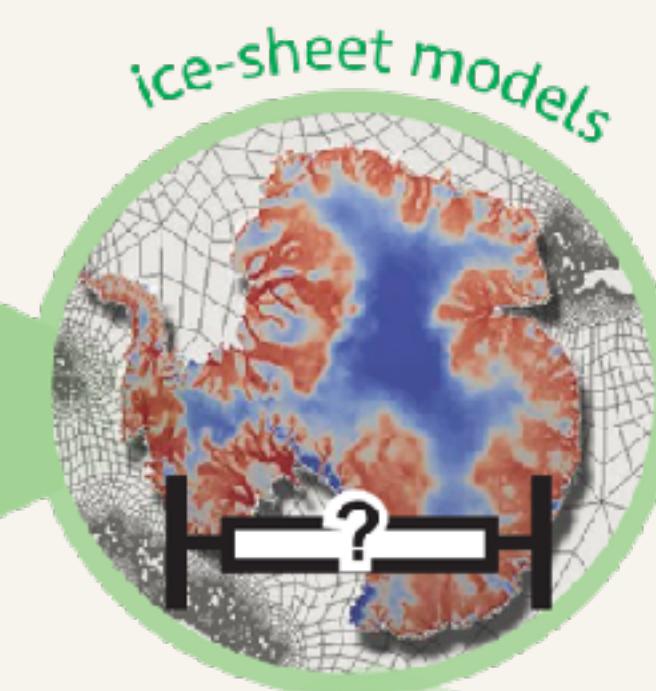


Kiera Tran
(NASA FINESST FI)



Zhuo Wang
(POSTDOC)

Advancing radio sounding technology



Computer modelers & Data scientist



Eliza
Dawson
(NOAA
Postdoc)



Donglai
Yang
(PhD)



Neosha N.
(PhD)

Develop data assimilation workflow in models



Introduce Yourself

1. Your background
2. Year & program
3. Hobbies
4. Why Geophysics?

Course Canvas

EAS 3610: Introduction to Geophysics

Lecture: Monday and Wednesday 9:30 -10:45 am

Location: Ford Environmental Sci & Tech L1116

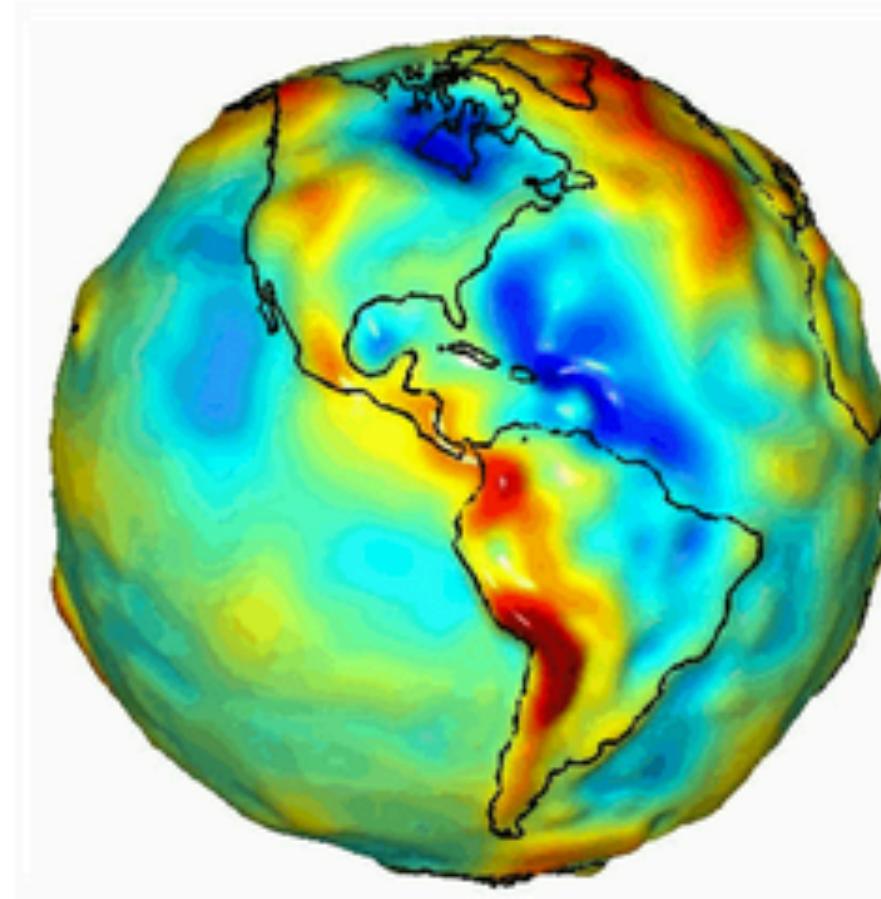
Course Summary: Introduction to how the Earth functions as an integrated system through exploration of the atmosphere, hydrosphere, lithosphere, and the biosphere. Laboratory exercises will supplement the lecture material.

Instructors: Dr. Winnie Chu

(winnie.chu@eas.gatech.edu) and Dr. Andy Newman (anewman@gatech.edu)

Grader: Donglai Yang (dyang379@gatech.edu)

Office hours: Directly after classes or by email appointments

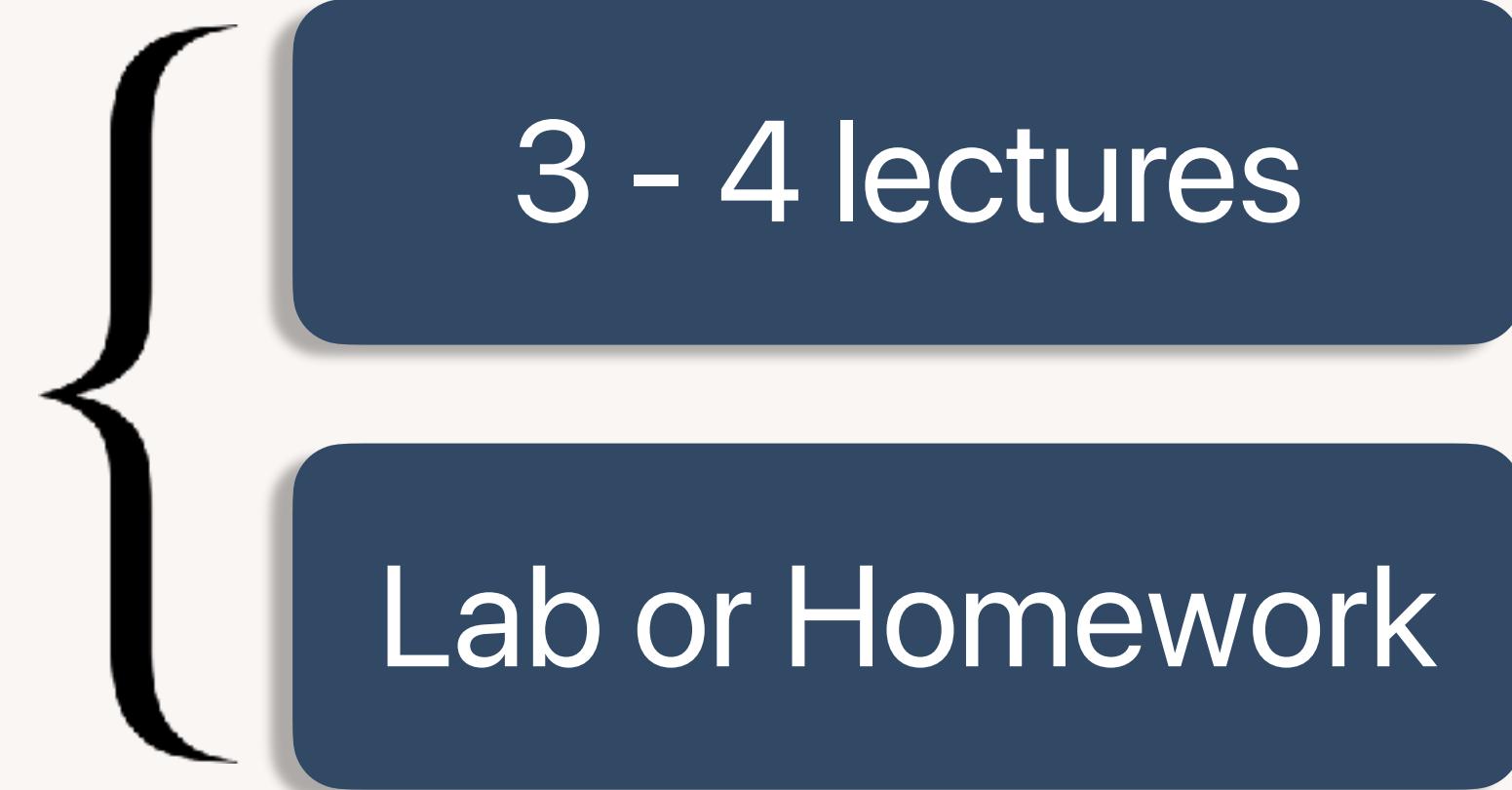


Canvas Link:

[https://
gatech.instructure.
com/courses/
392946](https://gatech.instructure.com/courses/392946)

Structure & Grading

In each module:



Due 1 week after

Homework 40%

Lab 40%

7 total modules

Aiming to finish at ~ Nov 25th

Final Exam (20%)

Dec 11th
8:00 - 10:50 a.m.

Final Exam Structure

3 sections:

1. Multiple choice

Section 1. Multiple choice section (answer ALL questions) [12 points]

1. The radius of Earth's core (both the inner and outer) is approximately:

- (A) The radius of the Moon
- (B) Half the size of the Earth
- (C) 6,000 km
- (D) 1,000 km
- (E) None of the above

2. The S-wave shadow zone is evidence that:

- (A) The outer core is liquid
- (B) The outer core is composed of iron and nickel oxides
- (C) The inner core is solid
- (D) It is very hot near the core

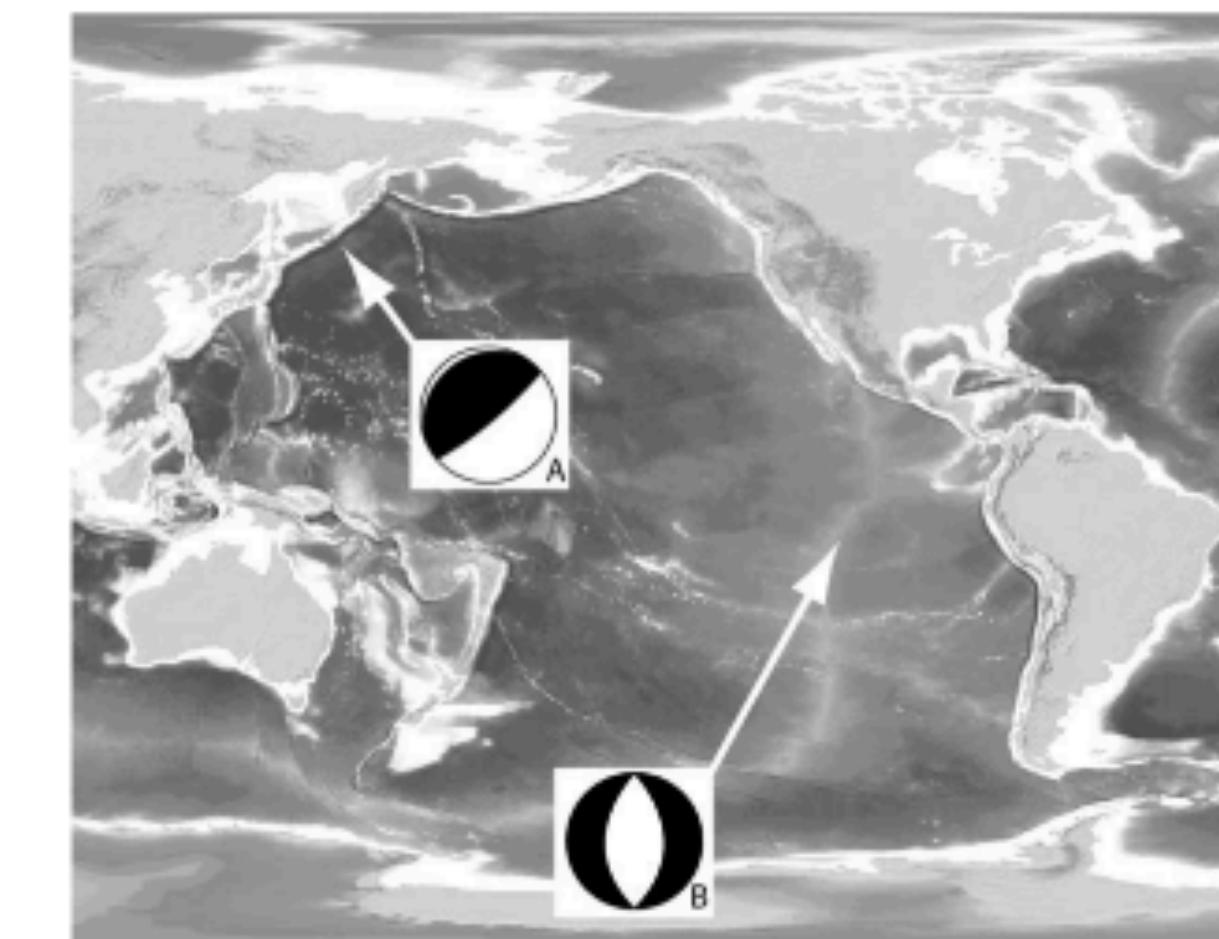
2. Short questions

Section 2. Short Questions (Answer ALL questions)

Question 1. [17 points]

- (a) Describe the two types of surface wave. Sketch the particle motion for each wave. [5 points]
- (b) For each, name the type of fault that caused the earthquake. Explain how it is related to its location and local stress distribution (i.e. extension, shearing, compression). [6 points]

Two earthquake focal mechanisms are shown below: (A and B)



Final Exam Structure

3. Calculations (answer 1 of 2)

C. Calculations (Answer 1 of 2 questions)

Question 1. [15 points]

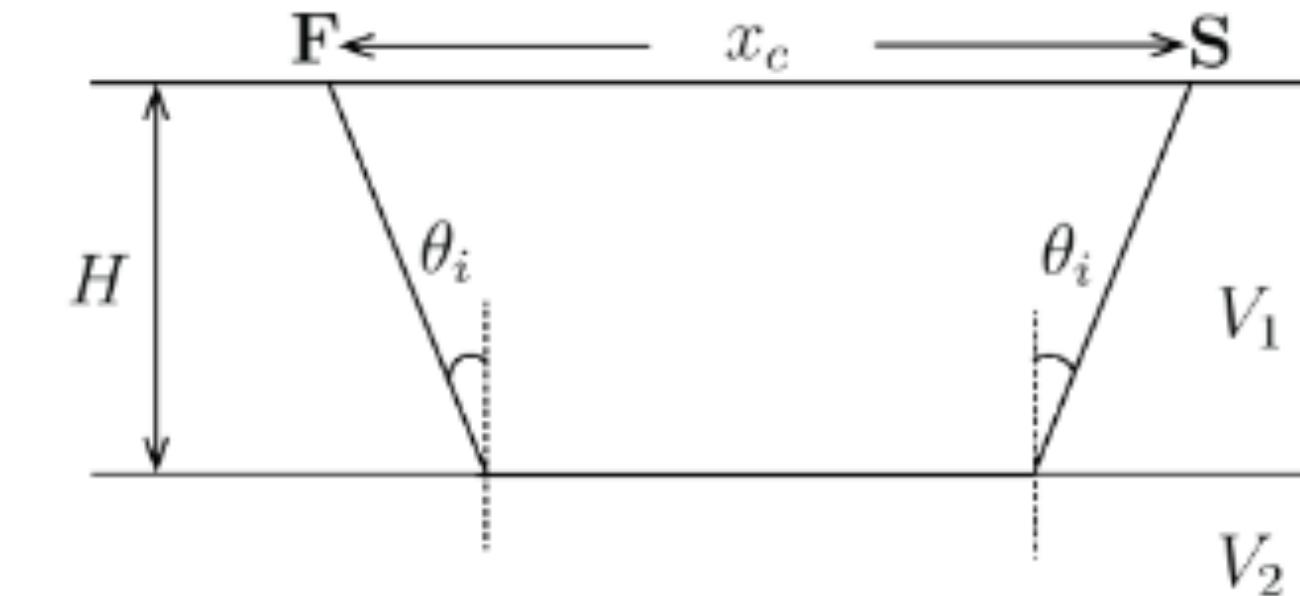
The table below gives the densities and seismic P- and S-wave velocities at various depths in the Earth.

- (a) From these quantities calculate the rigidity modulus (μ) and bulk modulus (κ) at each depth. [6 points]

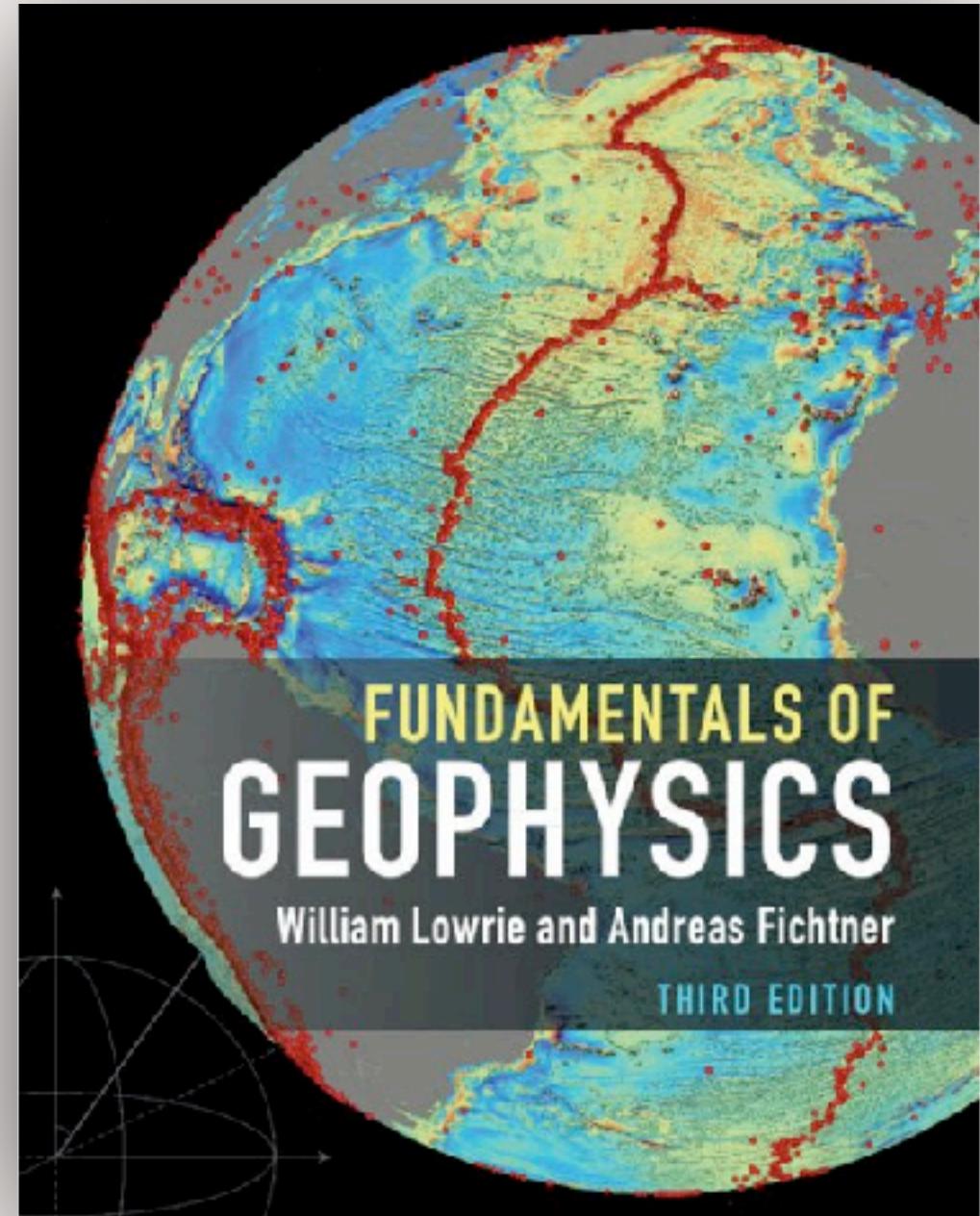
Depth (km)	ρ (1000 kg m ⁻³)	V_p (km s ⁻¹)	V_s (km s ⁻¹)
100	3.38	8.05	4.45
500	3.85	9.65	5.22
1000	4.58	11.46	6.38
2900	9.90	8.07	0
5500	12.92	11.14	3.58
6470	13.09	11.26	3.67

- (b) Discuss in your own words the information that these data give about the deep interior of the Earth. [3 points]

- (c) Assume that the Earth's crust consists of a single layer of thickness H and a constant speed of propagation of seismic waves of v_1 on top of a mantle of velocity of propagation 20% greater than the crust. Given that a focus on the surface produces a reflected wave that takes 17.2 s to reach a distance of 99 km, and that this is the critical distance, calculate the values of H , v_1 , and v_2 . [6 points]

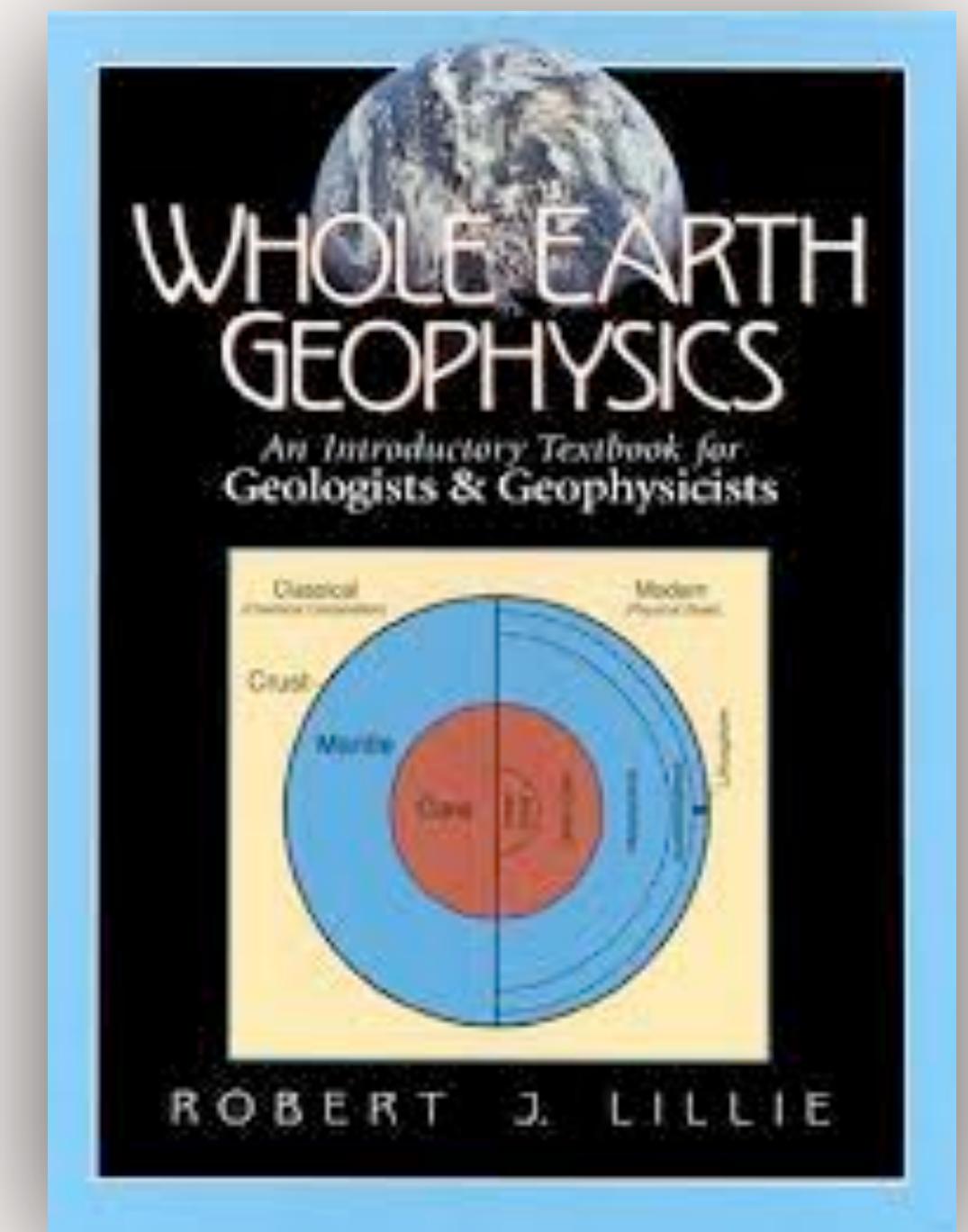


Syllabus: Textbook

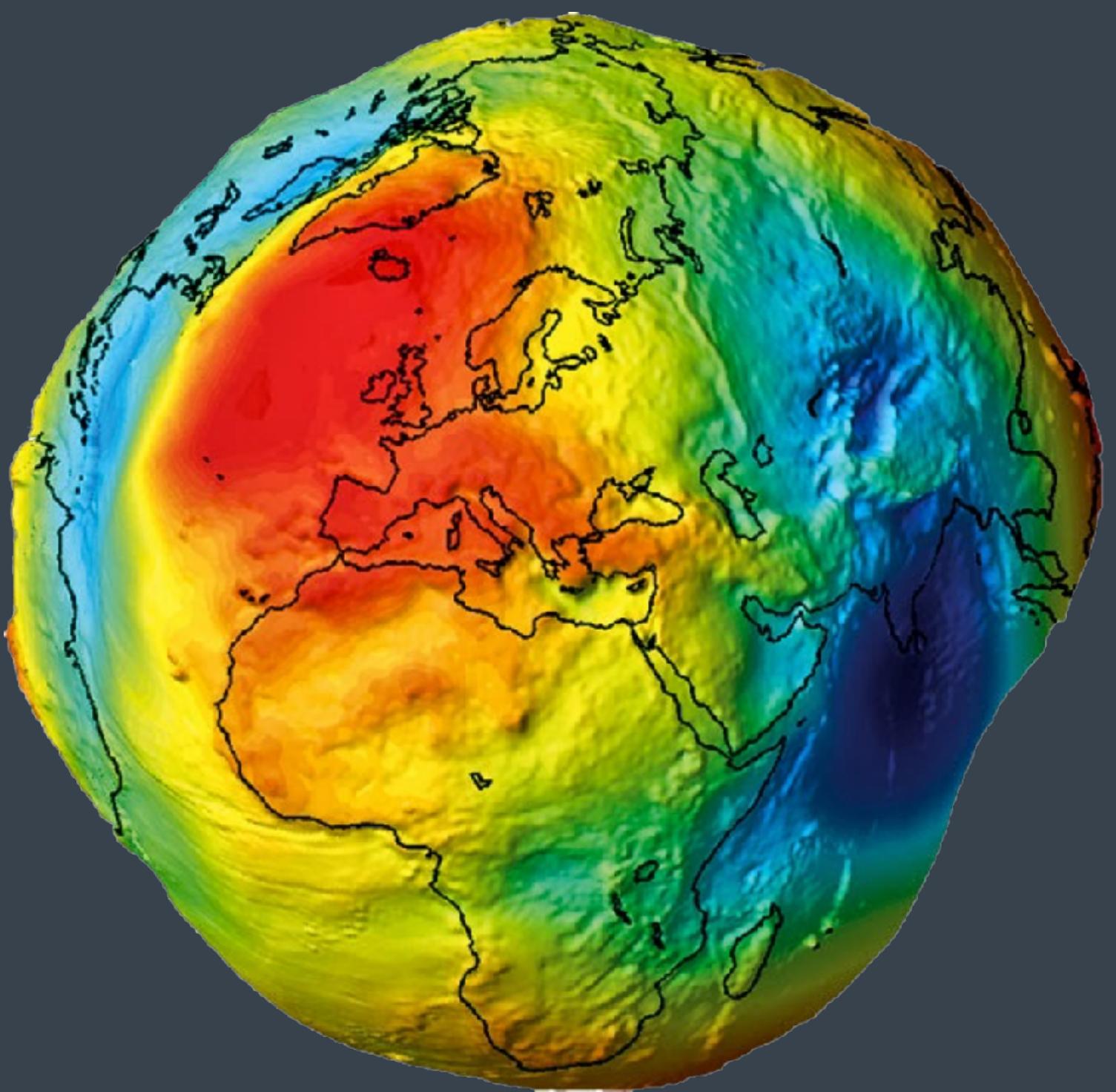


Lowrie. **Fundamentals of Geophysics** (3rd Ed)

Lillie. **Whole Earth Geophysics**
(1st Ed.)



What's Geophysics

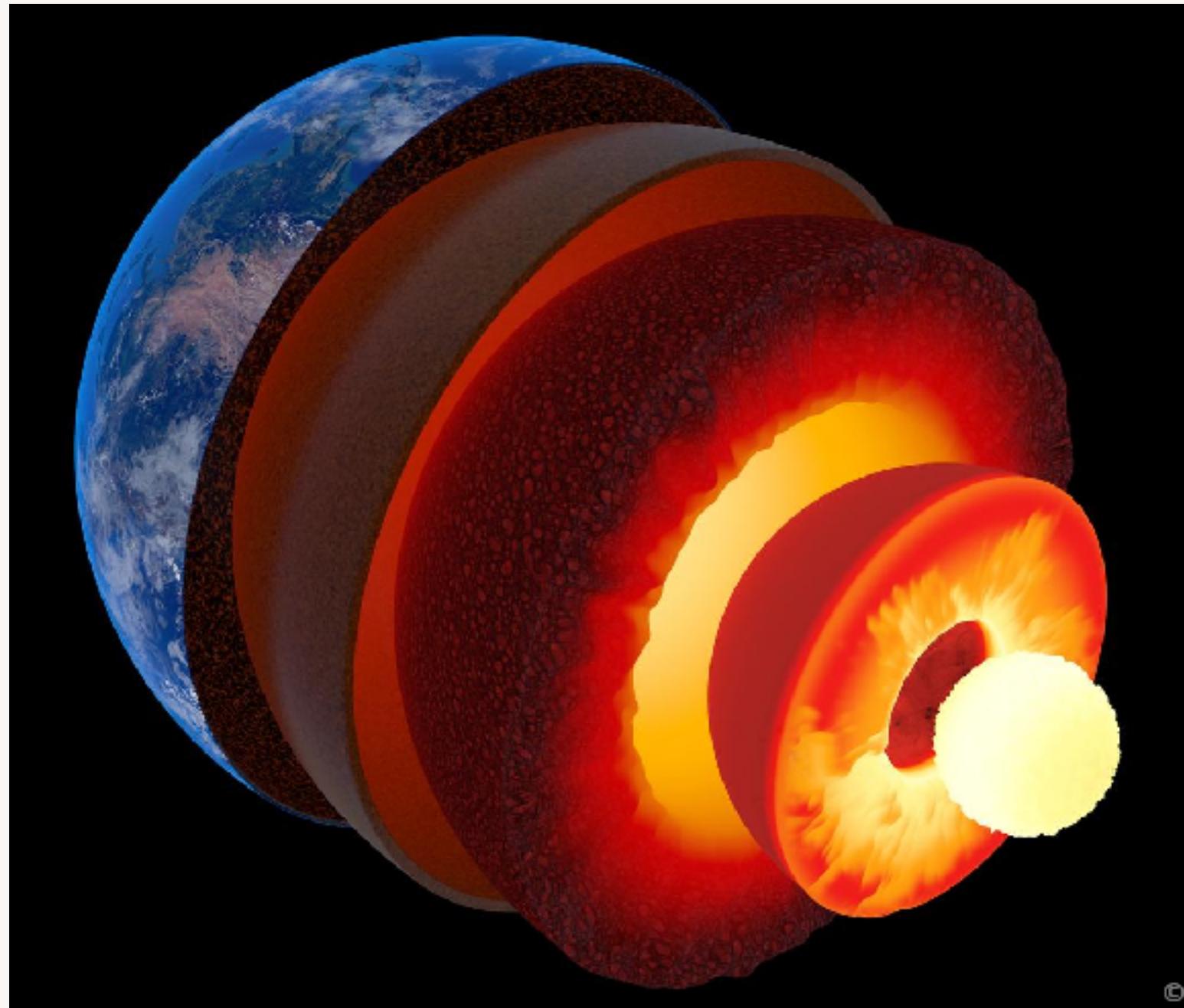


Geophysics

Study of the physics of the Earth and its environment in space

1

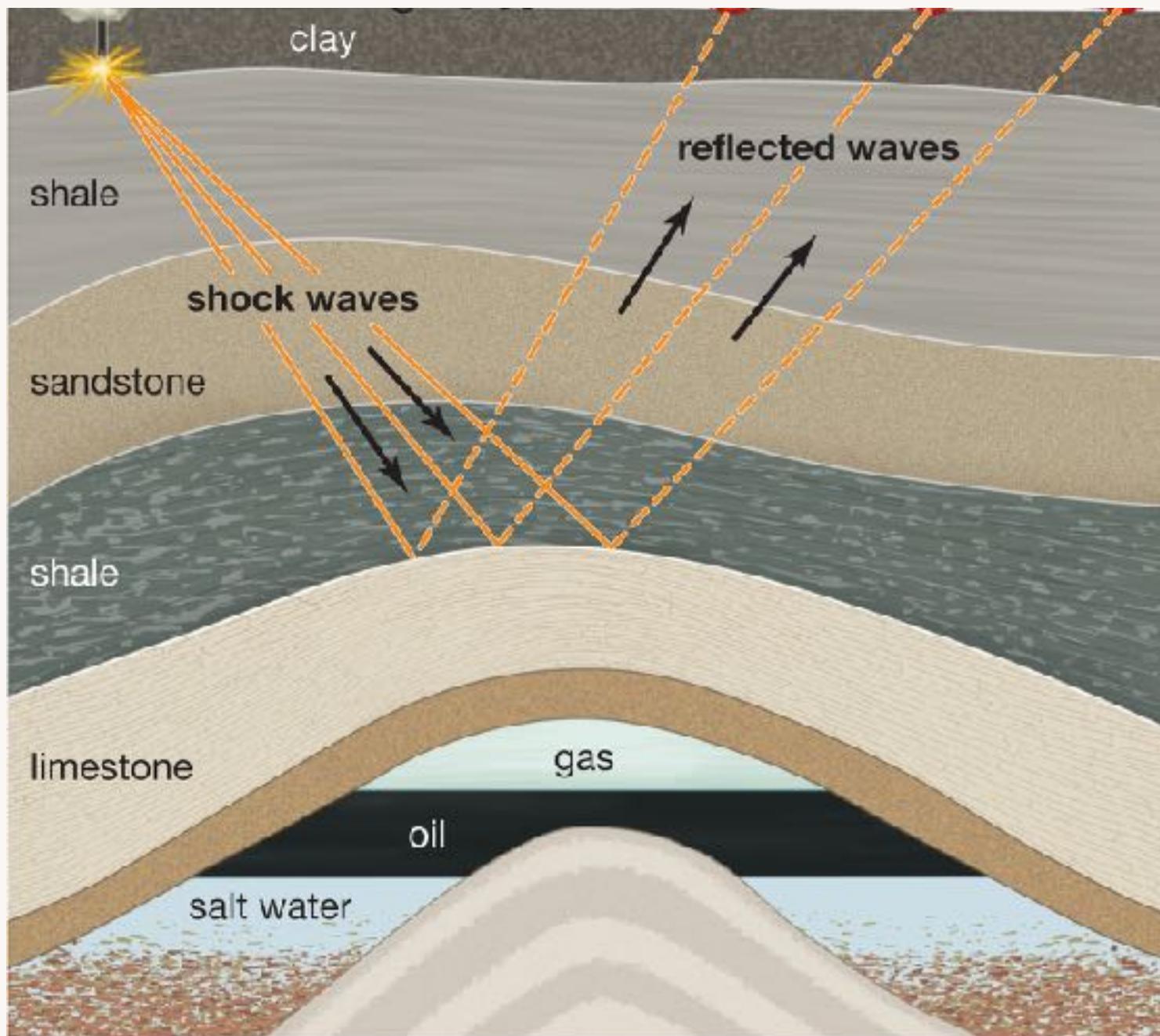
Solid Earth Geophysics



Geodynamics

2

Exploration Geophysics



Oil & Gas Exploration

3

Environmental Geophysics



Groundwater Exploration

Geophysicists at Georgia Tech

1 Solid Earth Geophysics: Geodynamics & Tectonics



Samer Narif

- ❖ Marine Geodynamics
- ❖ Electromagnetic methods



Joyce Sim

- ❖ Thermodynamic modeling
- ❖ Melt transport at plate boundaries



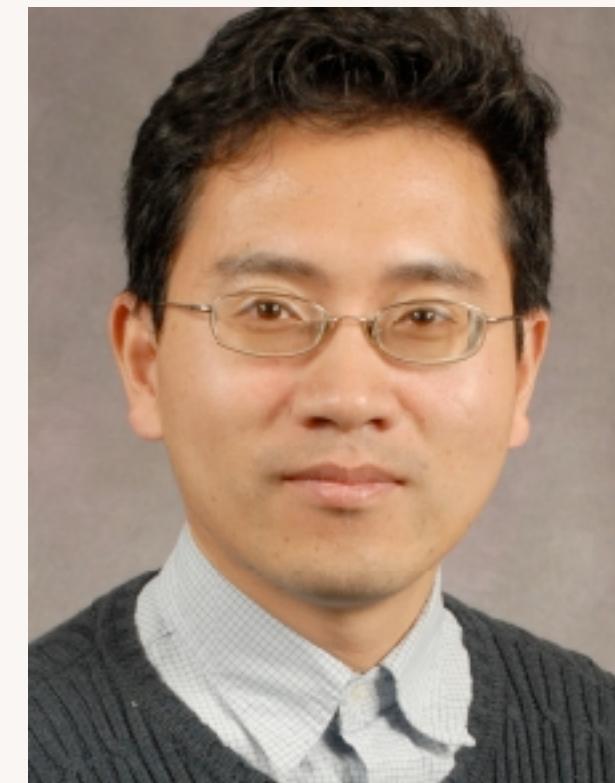
Andy Newman

- ❖ Seismology
- ❖ Ground deformation and failure



Karl Lang

- ❖ Surface tectonics process
- ❖ Thermochronology, sediment provenance



Zhigang Peng

- ❖ Seismology
- ❖ Earthquake source properties

Geophysicists at Georgia Tech



EAS

Felix Herrmann

- ❖ Computational seismic imaging
- ❖ Inverse problems, machine learning



CEE

2 Exploration Geophysics



CEE

Haiying Huang

- ❖ Geomechanics
- ❖ Rock drilling, cutting, reservoir stimulation

**... and more in CEE
Geosystem engineering**

Geophysicists at Georgia Tech

3 Environmental Geophysics



EAS

Alex Robel

- ❖ Ice-sheet modeling
- ❖ Glacial dynamics, ice-climate interaction



CEE

Chris Lai

- ❖ Experimental fluid mechanics
- ❖ Turbulence theory and modeling

...and more in CEE Water Resource & Environmental engineering

Student Internships & Opportunities



**Sandia
National
Laboratories**

<https://www.sandia.gov/>

CONTACT:

Scottie-Beth Fleming
eflemin@sandia.gov



Programs

- Arctic Science & Security
- Climate Security
- Electric Grid
- Energy Efficiency
- Energy & Water
- Energy Storage
- Fossil Energy
- Nuclear Energy
- Nuclear Waste Management
- Renewable Energy
- Sustainable Transportation
- Tribal Energy Security

Student Internships & Opportunities

The image shows the homepage of the Undergraduate Research Internships in Seismology (URISE) website. The header features the NSF logo, the SAGE logo, and the EarthScope logo. The main title "URISE" is prominently displayed in large white letters, followed by the subtitle "Undergraduate Research Internships in Seismology". The navigation bar includes links for Home, About, Interns, Apply, FAQs, Recruitment, News, Resources, and Log In. A featured section titled "Where are they now?" displays a group photo of URISE alumni and two bar charts showing their employment distribution by gender and sector.

Where are they now?

Survey finds most alumni employed in the geosciences, but across a variety of employment sectors

Employed Full Time by Gender

Category	Men	Women
Geoscience	51	45
Non-STEM	5	5
STEM	15	20

Employed Full Time by Sector

Sector	Percentage
4-Year University	22%
Agriculture/Food Services	2%
Arts/Entertainment/Fishing	1%
Construction	2%
Health Care/Social Services	7%
Information Services	2%
Information Technology	1%
K-12 Education	1%
Federal Government	11%
Manufacturing/Trade	1%
Nongovernmental/NGO	18%
Oil and Gas	1%
Other Educational Services	1%
Research Institute	1%
State/Local Government	4%

<https://www.iris.edu/hq/internship/>

Student Internships & Opportunities



[https://www.jpl.nasa.gov/edu/intern/
apply/summer-internship-program/](https://www.jpl.nasa.gov/edu/intern/apply/summer-internship-program/)

A large banner image for Earth Science at JPL. It features a photograph of Earth from space, showing clouds and continents. Overlaid on the left side is a white graphic of a satellite or aircraft wing with small, faint drawings of leaves and other organic shapes. The text 'EARTH SCIENCE' is prominently displayed in large white letters, followed by 'Studying Our Home Planet at JPL' in smaller white text. At the top of the banner, the JPL logo and name are visible, along with a navigation bar with links for About JPL, Missions, News, Galleries, Events, Visit, Topics (which is underlined), and a search icon.