

GEOS 606
Syllabus GEOS 606 Physical Volcanology

FALL 2005
SPRING 2004

September 2 Introduction -student information forms
the physical approach, boundary conditions

Week 1

5 *Labor Day (no classes)*

Part 1: "Introduction to physical processes"

7 Important physical variables and constants
types of geological models

9 Statics -homework 1: statics
stress and strain, properties of matter, stress distributions

Week 2

12 Statics and Dynamics
how stress effects strain, fracture, propagation of movement
kinematics and kinetics

14 Dynamics
classic models, internal vs. external processes

16 Thermodynamics -homework 2: thermo
the 3 laws, and 3 methods of heat transfer, the phase transition

Week 3

26 Factor Dimensional Analysis
how to brew your own models

Part 2: "Intrusive Processes"

28 Introduction
physical and/vs. chemical processes, magma generation, viscosity

30 Stress in and Around Magma Chambers -homework 3: FDA
sampling a magma chamber, physical interactions

Week 4

October 03 Pipe Flow
Simple models, Hagen-Poiseuille, Reynolds, Rayleigh, and worse

05 **Magma & Dikes**
John Eichelberger guest lecture

07 Dikes, Lacoliths, and Conduits -EXAM 1: physical properties
real cases, emplacement mechanisms

Week 5

- 10** Conduit mechanics
flow-type transitions, bubbles and density
- 12** **Bubble Formation Growth & Coalescence**
Jessica Larsen guest lecture
- 14** Eruption Mechanisms -homework 4: conduits
mixing, the role of volatiles, pressure, temperature and cyclicity

Part 3: "Extrusive Processes"

Week 6

- 17** Measuring Subsurface Movement
intro to seismicity, long period tremor, displacement, inflation
Introduction to Rheology and Flow
laminar vs. turbulent flows, thixotropic and power law fluids
- 19** Fissures, Flows and Fountaining
changes during eruptions
- 21** Flow Structures
channels, levies, textures, and vesiculation -homework 5: bubbles

Week 7

- 24** Lava Domes
endogenous and exogenous growth, brittle ductile transition
- 26** Flow Monitoring and Measurement
field methods, flux
- 28** Mafic Volcanoes
examine the entire primitive volcanic system-homework 6: lavas

Week 8

- 31** **Bubble Formation Growth & Coalescence**
Jessica Larsen guest lecture
- November 02** The Role of Viscosity and Hazards
flow dynamics of domes and Merapi-type pyroclastic flows
- 04** The Role of Temperature -EXAM 2: hawaiian-type
higher silica contents, increase in explosivity
-project proposals due-

Week 9

- 07** The Cooling of Lavas
Stefan cooling problem, lakes, flows, domes
- 09** The Role of External Water
rain, subaqueous to submarine flows
- 11** Measurement of Temperature -homework 7: cooling
thermocouples, radiometers, FLIR, field methods

Part 4: "Pyroclastic Processes"

Week 10

- 14** Strombolian Eruptions
ballistics, drag
- 16** Fragmentation Processes
ash, lapilli, bombs, blocks, and "JCs"
- 18** Cooling and Energy Transfer in Eruptions -homework 8: explosions
cold ash clouds, gas emissions

Week 11

- 21** Vulcanian, Plinian, and Worse part 1
eruption columns, pf, base surge, fallout
- 23** Vulcanian, Plinian, and Worse part 2
calderas, secondary processes, rheomorphism

****** Thanksgiving Weekend 24-27 November ******

Week 12

- 28** Pyroclastic Flow Mechanisms
models, deposits
- 30** Slope Stability
debris avalanche, volcanic and non-volcanic hazards
- December 02** Lahars -FINAL EXAM
volcanic vs. non-volcanic, types of flow, hazards

Week 13

****** American Geophysical Union Meeting 5-9 December ******

Week 14

- 12** Volcano Monitoring
78 Organizations, AVO, seismic, remote sensing, geology
- 14** Volcanic Hazards
management and mitigation, responsibilities of the science

Student Presentations

- 16** "Micro-Meeting" (final exams due)
Talks/Poster Presentations

Homework Format: 3 Questions; 2 analytical (@25%), 1 qualitative (50%)

Exam Format: 10 Questions; 6 analytical (@5%), 3 qualitative (@10%), 1 fda (40%)

Final: 15 Questions; 9 analytical (@4%), 4 qualitative (@5%), 2 fda (@22%)

Project:

The student will pick a physical problem relating to volcanology which has not been previously solved, and write a 3 page proposal (due October 7th) for evaluation. The proposal should include a statement of the problem, and a plan for creating a solution. The instructor will assign the project to a poster session or oral session for the “micro-meeting.”

Suggested Additional Reading:

Part 1:

Clift, Bubbles Drops & Particles
Johnson, Physical Processes in Geology
Kreith and Brohn, Principles of Heat Transfer
Turcotte and Schubert, Geodynamics

Part 2:

Schmincke, Volcanism
Dobran, Volcanic Processes
Bursik & Freundt, From Magma to Tephra

Part 3:

Kilburn & Guest, Active Lavas
Fink, Lava Flows and Domes
USGS Prof. Paper 1350
USGS Prof. Paper 1250
USGS Prof. Paper 1676

Part 4:

Fisher & Schmincke, Pyroclastic Rocks
Sparks, Volcanic Plumes
Calvari et al., Mt. Etna: Volcano Laboratory