EOSC 350 : Environmental, Geotechnical and Exploration Geophysics I

Instructor: Doug Oldenburg

Co-instructor: Seogi Kang

Students

- Geologists?
- Geologic engineers?
- Other EOAS programs?
- P. Geo. or P. Eng.?
- Other?

Instructors

- Doug Oldenburg
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- Seogi Kang
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Teaching assistants

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- Thibaut Astic
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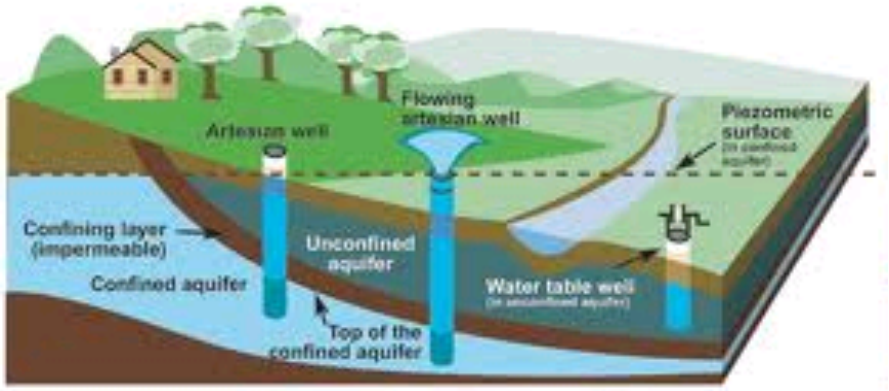
First some problems of relevance

Finding Resources

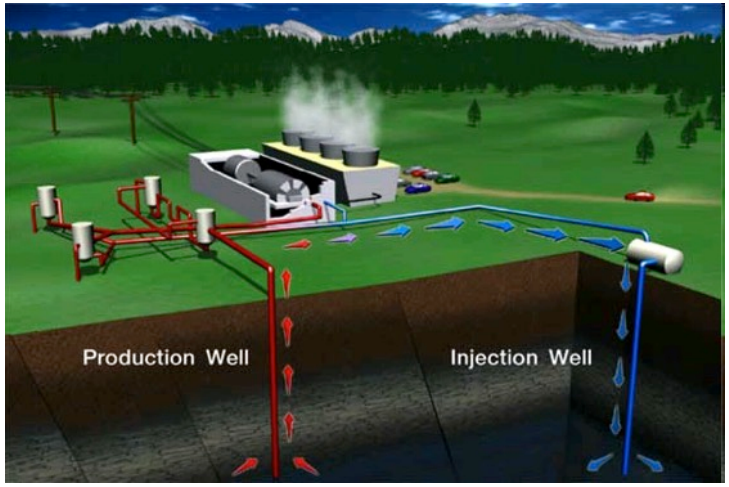
Minerals

Hydrocarbons

Ground Water



Geothermal Energy



Natural Hazards

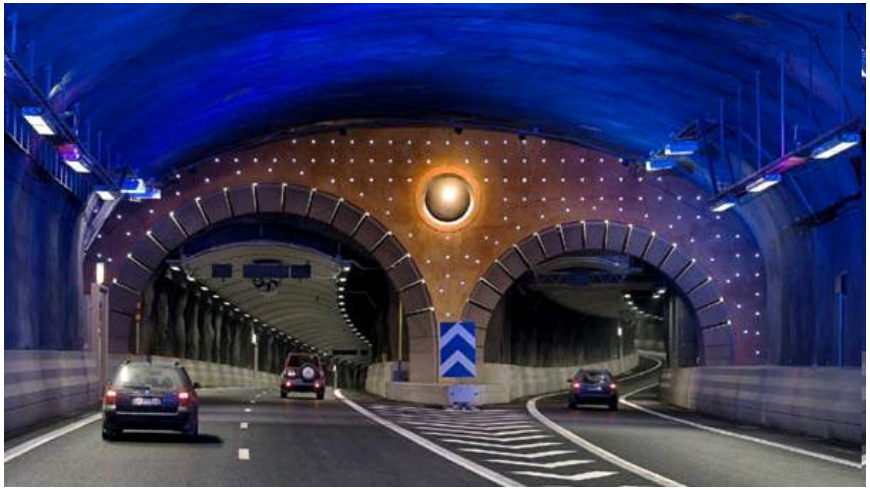
Volcanoes

Tsunami

Earthquakes

Geotechnical engineering

Tunnels

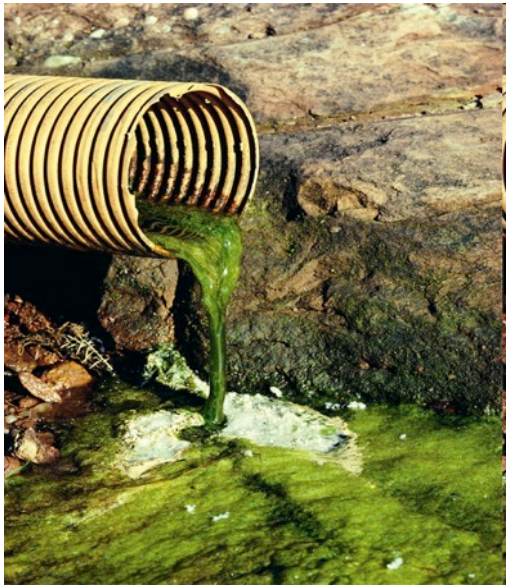


Slope stability

In-mine safety

Environmental

Water contamination



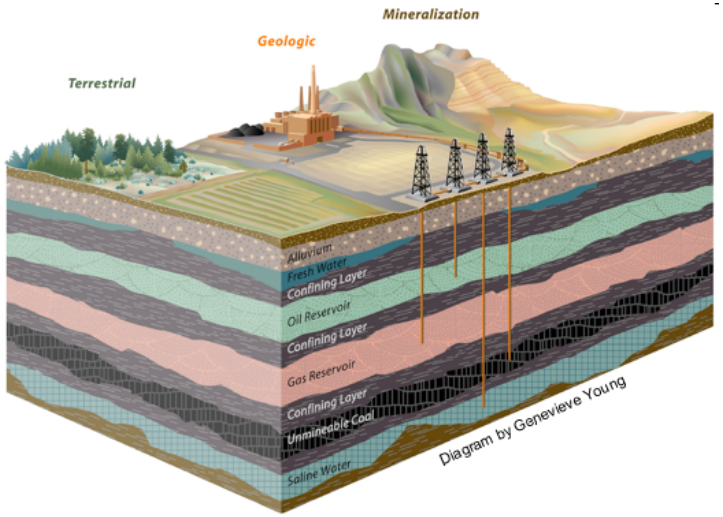
Salt water intrusion

Unexploded Ordnance (UXO)

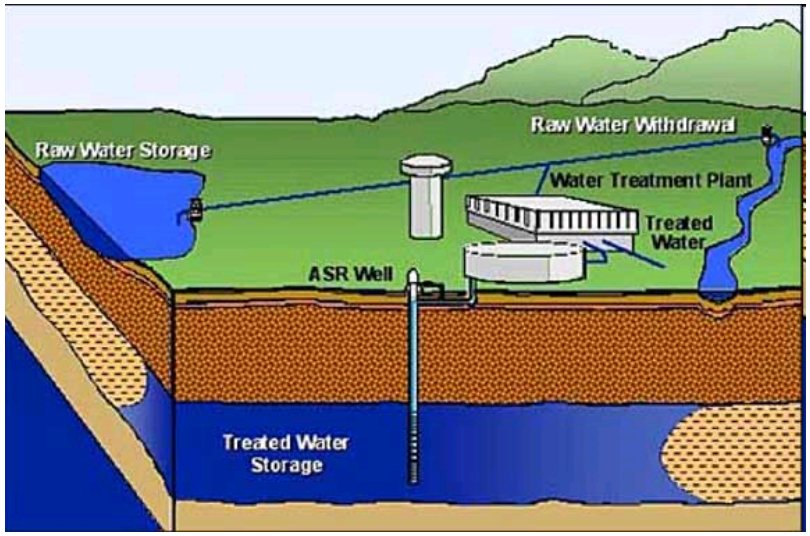
http://www.centennialofflight.gov

Surface or Underground Storage

CO2 sequestration



Aquifer Storage and Recover



Industrial Waste Disposal

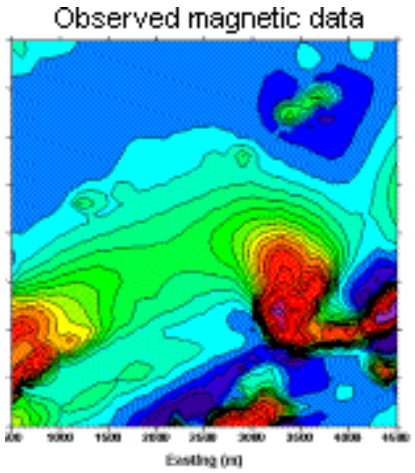
What do problems have in common?

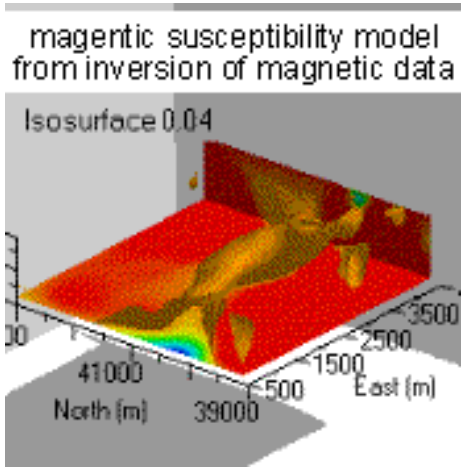
- All require ways to see into the earth without direct sampling.

- Geophysics is the only discipline that is devoted to this goal.

Broad overview

- Who uses geophysics?
- How does geophysics work?
- What can geophysics tell us?





Broad overview

- What this course is:

  Introduction to applied geophysics, focus on what information geophysics can provide and how to approach solving problems with geophysics

- What the course is not:

  A rigorous theoretical treatment of geophysical methods

- Goal:

help you understand how to use and apply geophysics in your professional careers, not turn you into a geophysicist!

Your expectations for this course?

- New knowledge?
  - “Geophysics 101”
  - Some physics, a little math
  - Application-oriented
- New skills?
  - Using geophysical information to make decisions
- Attitudes?
  - Geophysics is not intellectually scary
  - It is fun!

Outline of topics

- Foundations:
  - Physical properties
  - A 7-step framework for applying geophysics
- Geophysical surveys (modules):
  - Magnetic (magnetic susceptibility)
  - Seismic (density, elastic parameters)
  - Ground penetrating radar (electrical permittivity)
  - DC resistivity (electrical conductivity/resistivity)
  - Electromagnetic (electrical conductivity/resistivity)
- Emphasis throughout:
  - Understand the basics of the surveys.
  - Have reasonable expectations for when and a survey should be used and information provided.

Teaching and learning activities

- Lecture:
  - Presentations by the instructors
  - Demos/hands-on practice using interactive apps

- Team-based learning (TBL) case history:
  - A publication on the use of a geophysical method to solve a practical problem
  - Read the paper and answer individual TBL questions as homework; submit your answers online before the team discussion
  - Answer team TBL questions as a team and submit worksheets in class

Teaching and learning activities

- Quiz:
  - Ten multiple choice questions at the end of each topic are answered individually.
  - Same questions are discussed as part of TBL and submitted as a team

- Lab:
  - Mostly computer-based exercises using interactive apps
  - Use the department's computers (get user account from the main office) or your own devices
  - Instructed by TA's
  - Turn in worksheets before deadlines (assignment)

TBL: App competition

- Individual:
  - Choose a problem of interest and adopt a 7-step procedure.
  - Show how an app can be used
  - Projects can be done at any time throughout the year
  - Marked as part of Individual TBL

- Team:
  - Select the “best” project from your team
  - Improve it
  - Present to class at the end of the term
  - Marked as part of group TBL

Contribution to final grade

- Final …… 40%
- Midterm …….. 15%
- Labs …….. 20%
- Individual quizzes 8%
- Individual TBL … ... 8%
- Team quizzes* .. …. . 4%
- Team TBL* .. .. .. …. . 5%

* Zero grade for missed team activities

Marking

- Individual TBL:
  - multiple choice questions;
  - online form submission

- Individual quiz:
  - multiple choice questions;
  - paper-based bubble sheet

- Team TBL and labs: (short-answer questions; paper-based worksheet)
  - Word grade evaluation
  - No specific comments will be made on papers
  - Answers available after worksheets are evaluated.

Marking: Word-grade evaluation

- Awesome: = 95% (you did the work very well and very clearly understand the material)
- Brilliant:= 80% (did the work and understand all of the concepts)
- Competent: = 65% (you did the work and understand most of the concepts)
- Decent: 50% (you did the work but don't quite understand all the concepts)
- Fall-Short = 0% (you didn't do the work, or only some of it)

Important web links

- Course website
  - http://eosc350.geosci.xyz/en/latest/index.html

- “Textbook”
  - GPG: Geophysics for Practicing Geoscientists
  - http://gpg.geosci.xyz/

- Interactive apps
  - GPG labs

Rules

- Electronic devices are used only for course-related teaching and learning purposes.

- Quizzes, midterm and final exams can be rescheduled individually for medical or emergency reasons.

- Flexibility in attending one of the two lab sessions – contact the TA

Other logistics

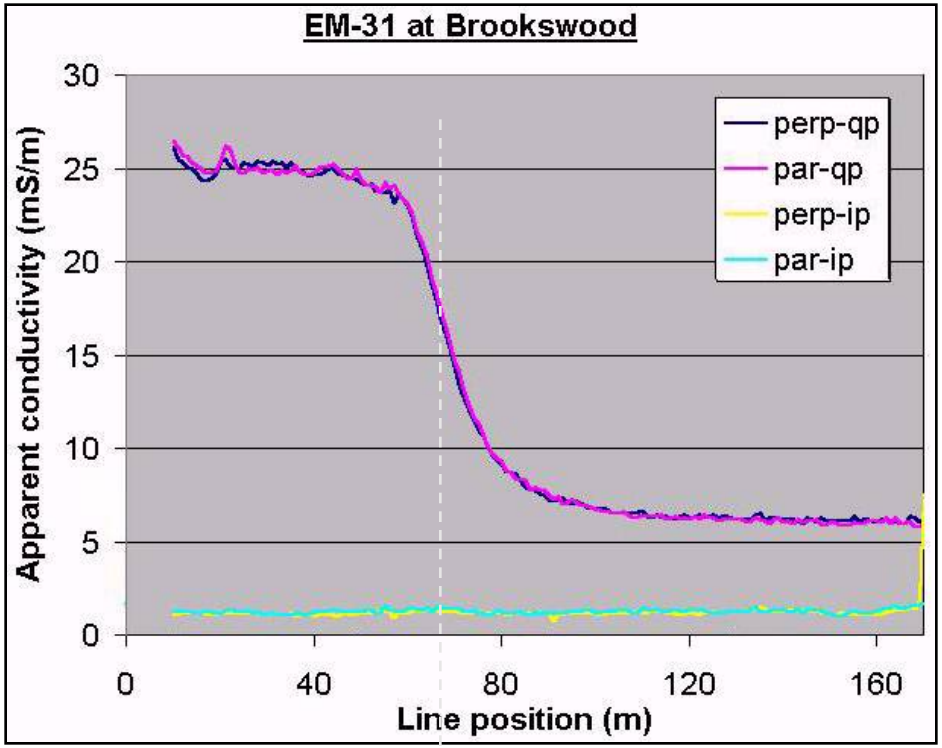
- Your 350 ID number
  - First four digits of your student ID/username
  - ID for online submission/announcement

- Team
  - 7 people per team
  - Checkout the 350 website for teams

- Advanced learning opportunities
  - Prep for honors/grad school
  - Want to be a geophysicist
  - Have specific geoscientific problems

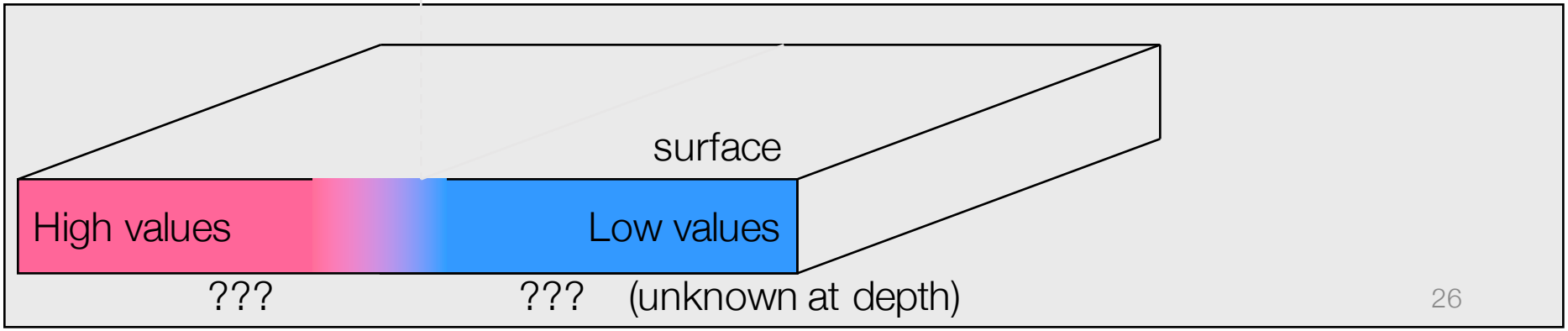
A few more examples

Electromagnetics

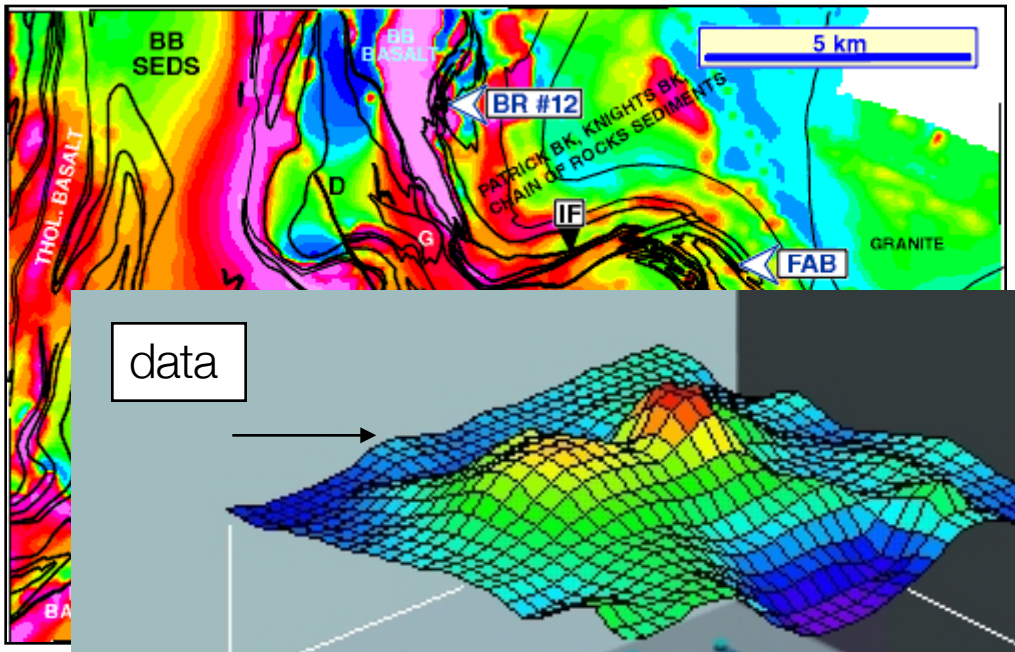


Profile of measured electrical conductivity over an aquifer

Outcome:
physical property values.



Magnetic



Map: magnetic response, NB

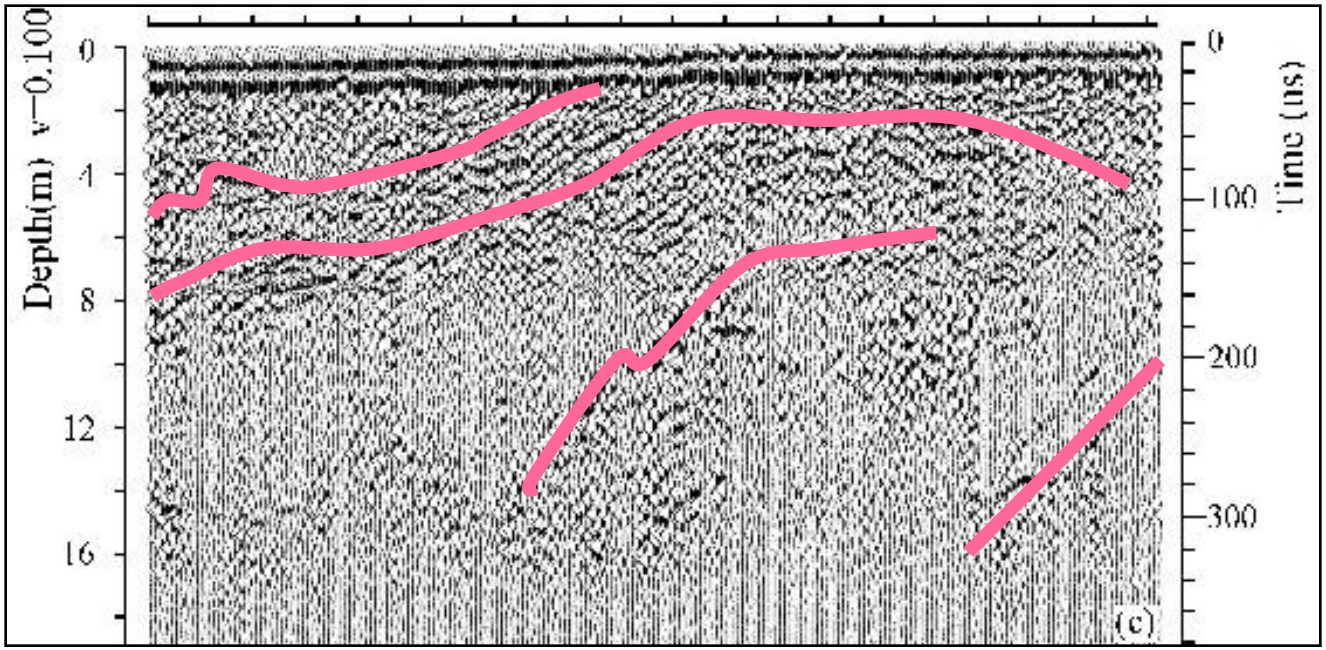
Possible outcomes:

1) Structures on surface map.
2) Structures under surface.
3) Physical property distribution

Model of susceptibility:

Red=high values

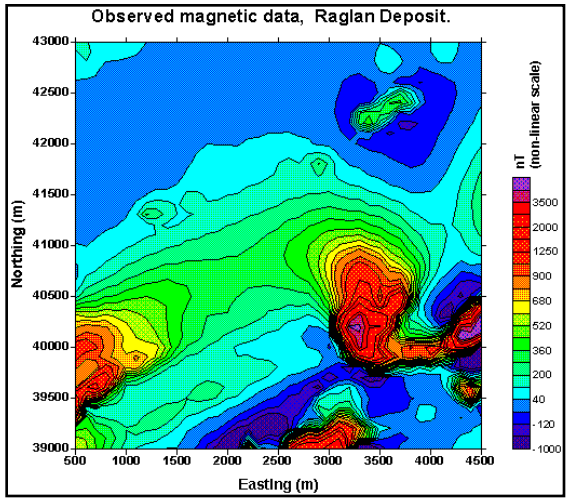
Geo-penetrating Radar (GPR)

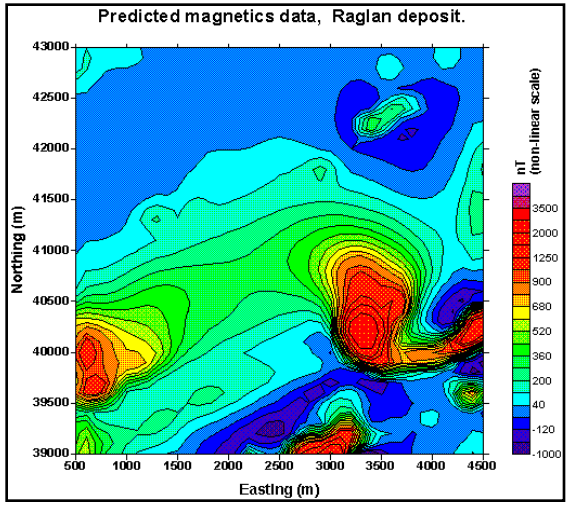


Seismic data:
Echoes of
sound energy

Model: locations of interfaces.

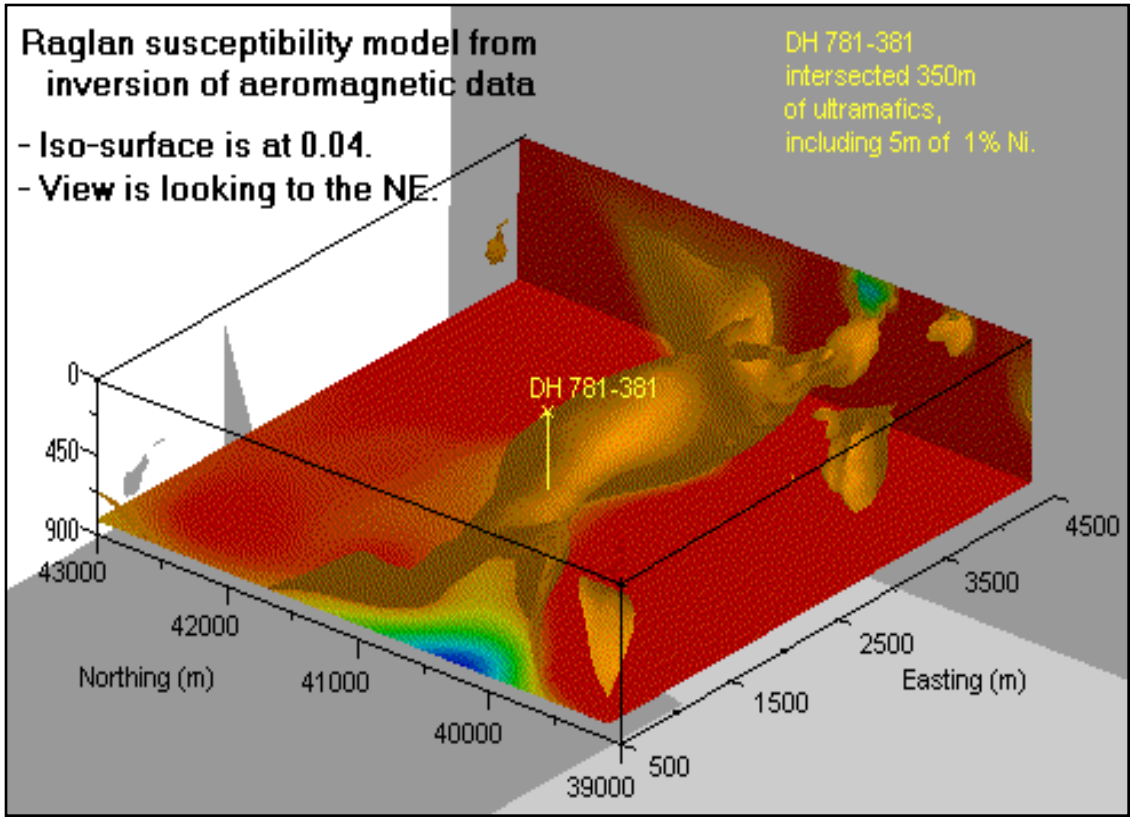
Exploration : Magnetics - Raglan deposit





Geological question:

"Are outcrops connected at depth?"



Upcoming activities

- Fri. Sept. 7
  - Lecture on physical properties
- Mon. Sept. 10
  - Lecture on the framework of applied geophysics
- Wed. Sept. 12
  - Quiz: foundations
  - TBL: “A geophysical journey around Ireland”
- Labs on Sept. 10, 11
  - Physical properties of rocks
  - Not a computer lab