EOSC 350: Environmental, Geotechnical and Exploration Geophysics I

Geophysics for geoscience students & professionals.

Introductions

- Geologists?
- Engineers?
- Other EOS?
- Other?
- Professionals?

Instructor: Doug Oldenburg, Professor, Director of Geophysical Inversion Facility (GIF)

Room 5194 ESB doug@eos.ubc.ca

Experience: application of geophysics to help solve mineral/oil exploration, environmental , and geotechnical problems.

Introduction

- What is geophysics?
- Who has had experiences?

The A++Team

Dom Fournier

Thibaut Astic

Patrick Belliveau

Devin Cowan

Seogi Kang

Lindsey Heagy

Applied Geophysics

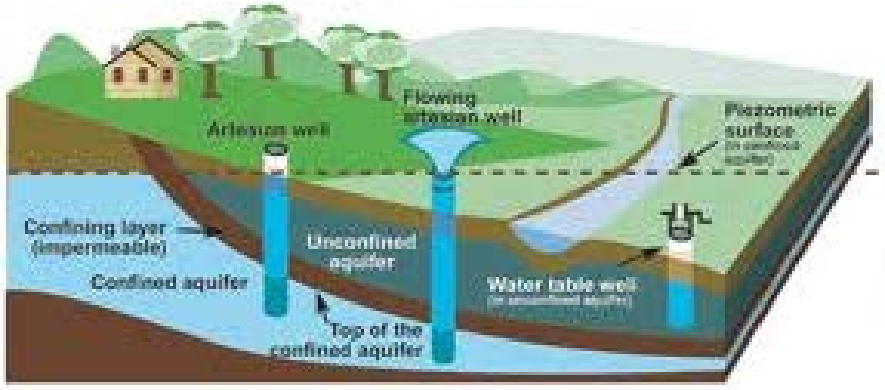
First some problems of Relevance

Finding Resources

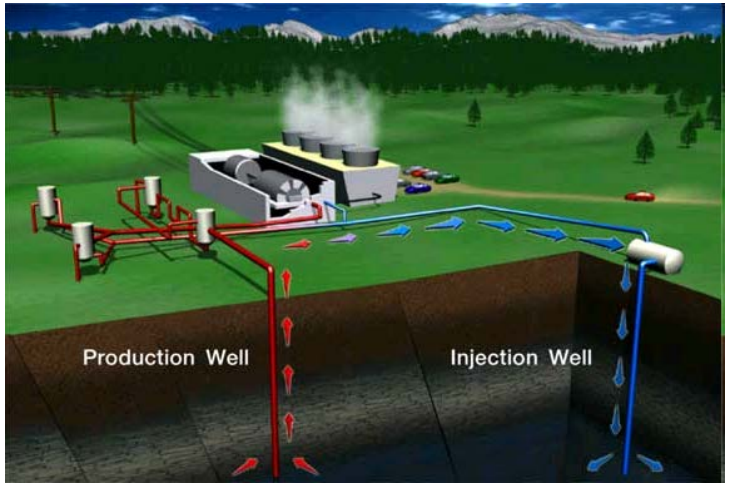
Minerals

Hydrocarbons

Ground Water



Geothermal Energy



Natural Hazards

Volcanoes

Tsunami

Earthquakes

Geotechnical engineering

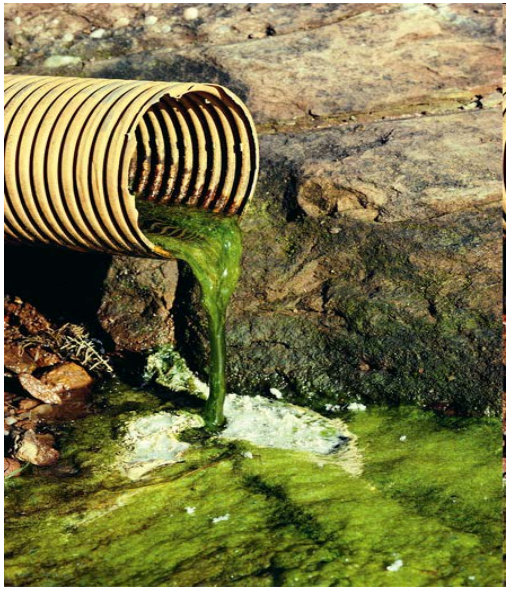
Tunnels

Slope stability

In-mine safety

Environmental

Water contamination



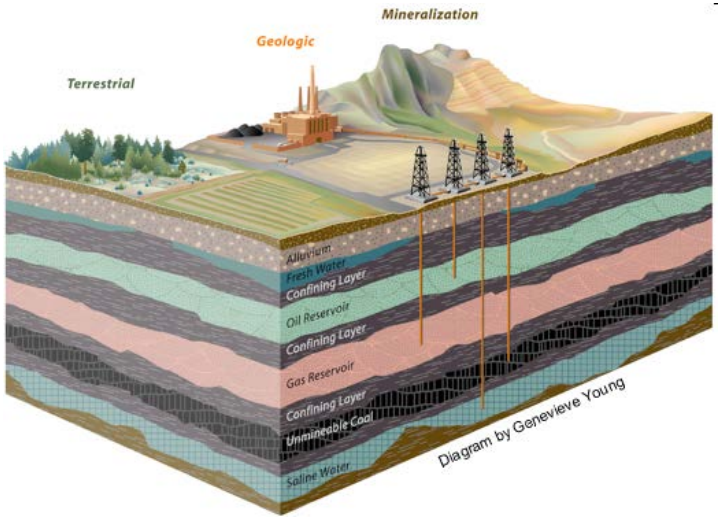
Salt water intrusion

UXO

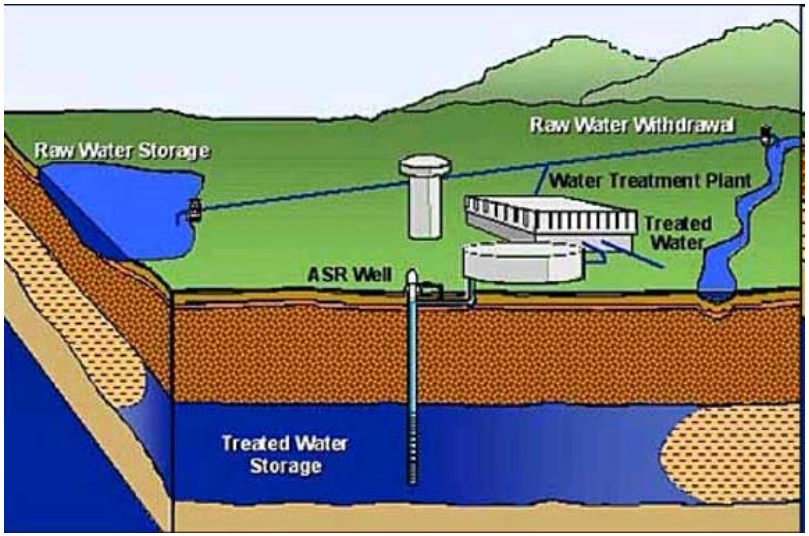
http://www.centennialofflight.gov

Surface or Underground Storage

CO2 sequestration



Aquifer Storage and Recover



Industrial Waste Disposal

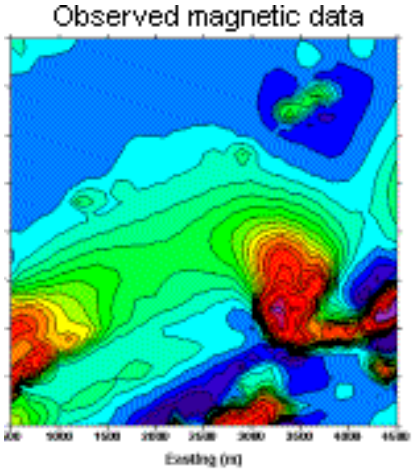
Radioactive Waste

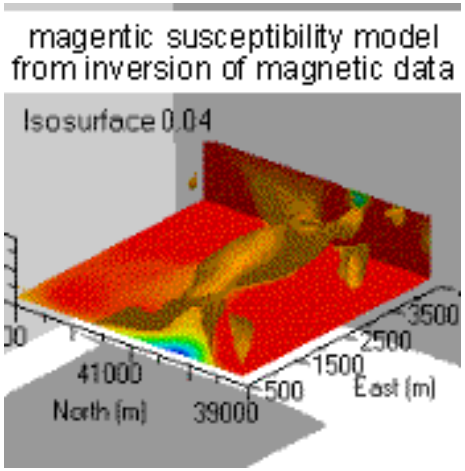
What do all these problems have in common?

- They 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?
- What does geophysical data look like?
- 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

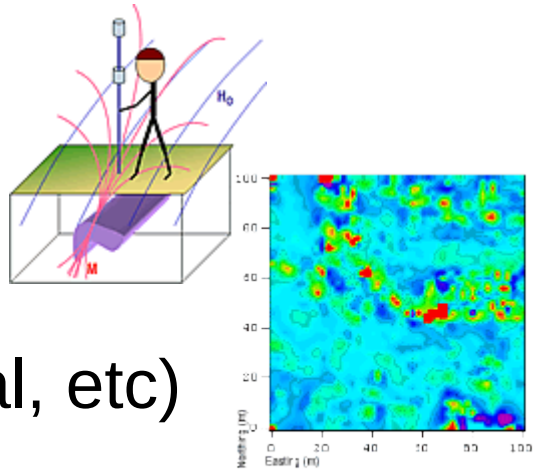
- **What the course is not**:

  A rigorous mathematical treatment of geophysical methods

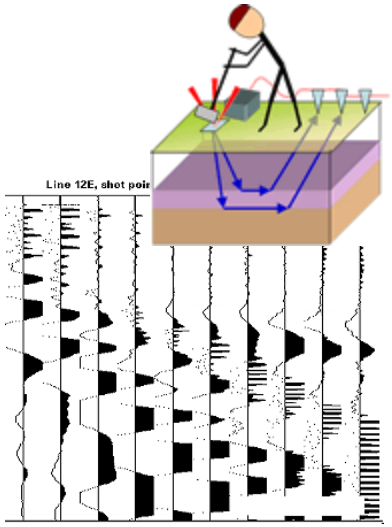
- **Goal** is to help you understand how to use and apply geophysics in your professional careers, not turn you into a geophysicist!

Your expectations for this course?

1. New knowledge?
   - Basics of geophysics
   - Some physics, a little math
   - Applications (Geologic, geotechnical, etc)



2. New skills?
   - Using geophysical information to make decisions



3. Attitudes?
   - Geophysics is not intellectually scary.

Outline of topics

1. **Background**
   - A framework for applying geophysics.
   - Physical properties.

2. **Physical properties and surveys**:
   - Magnetic susceptibility (magnetic)
   - Density (gravity, seismic surveys)
   - Elastic parameters (seismic surveys)
   - Electrical permittivity (Ground Penetrating Radar)
   - Electrical Conductivity (DC-IP, electromagnetic)

3. **Emphasis throughout:**
   - Understand the basics of the surveys.
   - Have reasonable expectations for when and a survey should be used and information provided.

Course Goals

1. Role of applied geophysics: Key concepts

   Physical properties, geophysical surveys, **data, interpretations**

2. Practical facility with geophysical methods

   Magnetics, seismic, GPR, EM

3. Professional skills
   - Teams, assessment of accomplishments (self & peers)
   - **Employers** want universities to help develop these skills.

4. Become excited about what geophysics can do for your profession.

See syllabus

Learning geophysics

- Individual work
  - Readings
  - Lab exercises
  - Midterm and final
  - Quizzes

- Team-based learning activities
  - In-Class work
  - Team-based quizzes

Emphasis: learning, engagement and fun

We don't want this!

And no watching movies, using Facebook or engaging in other non-scholastic activities during class.

Materials

- Course website http://eosc350.geosci.xyz

Course Schedule: Contains information about daily activities

- Geophysics for Practicing Geoscientists http://gpg.geosci.xyz

- Labs instructions via web
  - Who has NOT registered in a lab?

- EOS Computing facilities; get ID at main office.

Contribution to final Grade

- Final …… 35%
- Midterm …….. 18%
- Labs …….. 22%
- Individual quizzes 8%
- Individual TBL … . .. 7%
- Team exercises ….. 10%

Marking Labs and TBL

- The grade assigned to the various categories is:
- ✓+ 95 %
- ✓ 80 %
- ✓ - 65 %
- - 50 %
- - - 0 %

Office hours and contact

- Email: doug@eos.ubc.ca
- Office: Room 5194 ESB
- Office hours: none prescribed
  - email ahead to make an appointment
  - Open door policy, come by anytime, but…
  - Make use of the TA's when possible
- TA's:

  Dom Fournier: fourndo@gmail.com, Office: ESB

  Patrick Belliveau: patrick.t.belliveau@gmail.com, Office:3031

  Thibaut Astic: thast@eos.ubc.ca, Office: ESB 4037

  Devin Cowan: devinccowan@gmail.com, Office: ESB

  Seogi Kang: skang@eos.ubc.ca, Office: ESB 4037

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Geophysics = Information

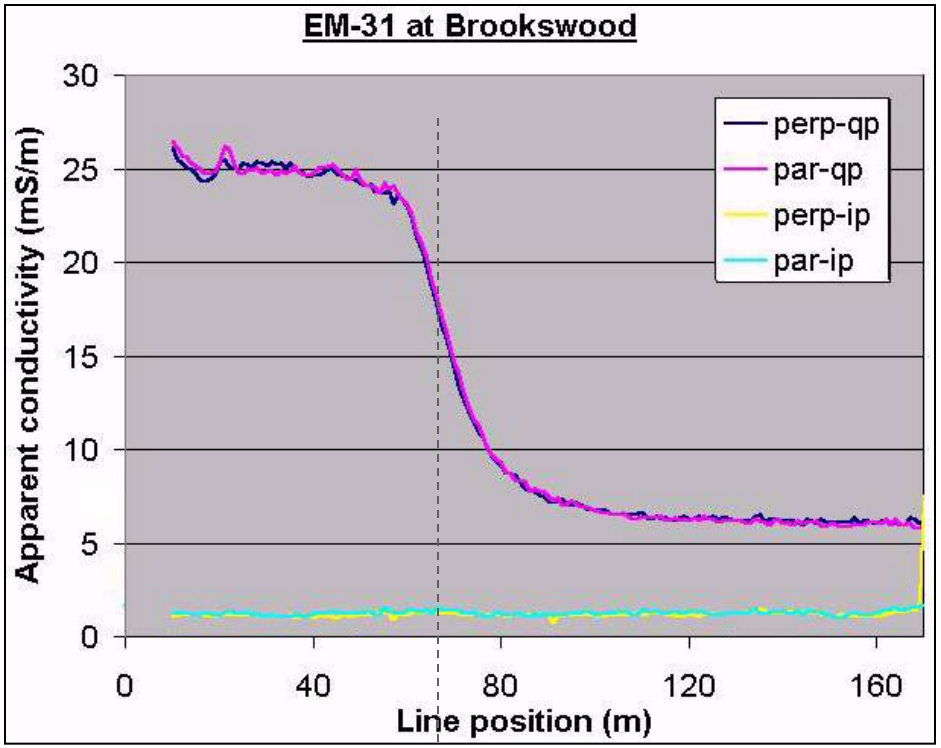
- Physical measurements to produce “data” Data are displayed as:
  - Maps
  - Profiles
  - A series of “time-traces”
  - Some other forms of graph

- Interpretation of data is always in terms of
  1. First: physical properties …
  2. Then: physical property values yield geologic / geotechnical information.

A few examples

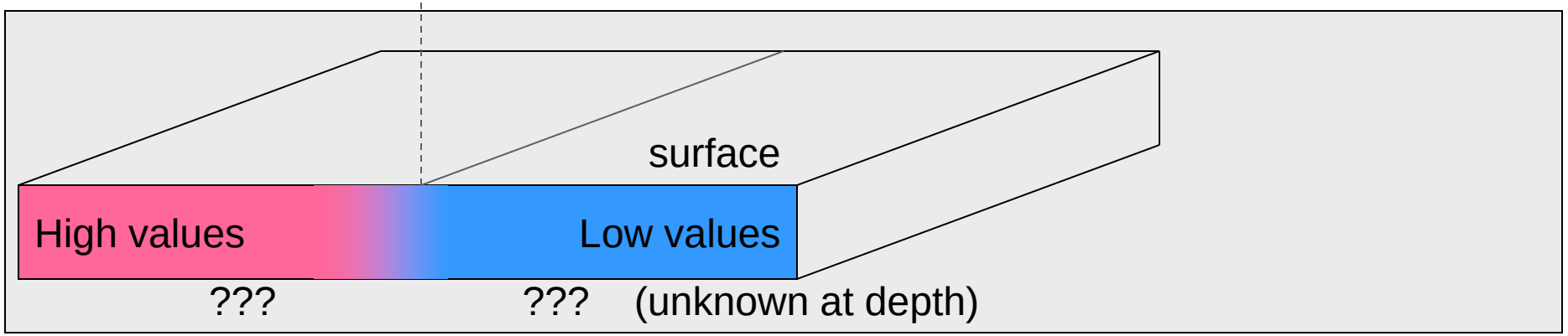
Examples

Measurements ➔ physical property ➔ geologic information



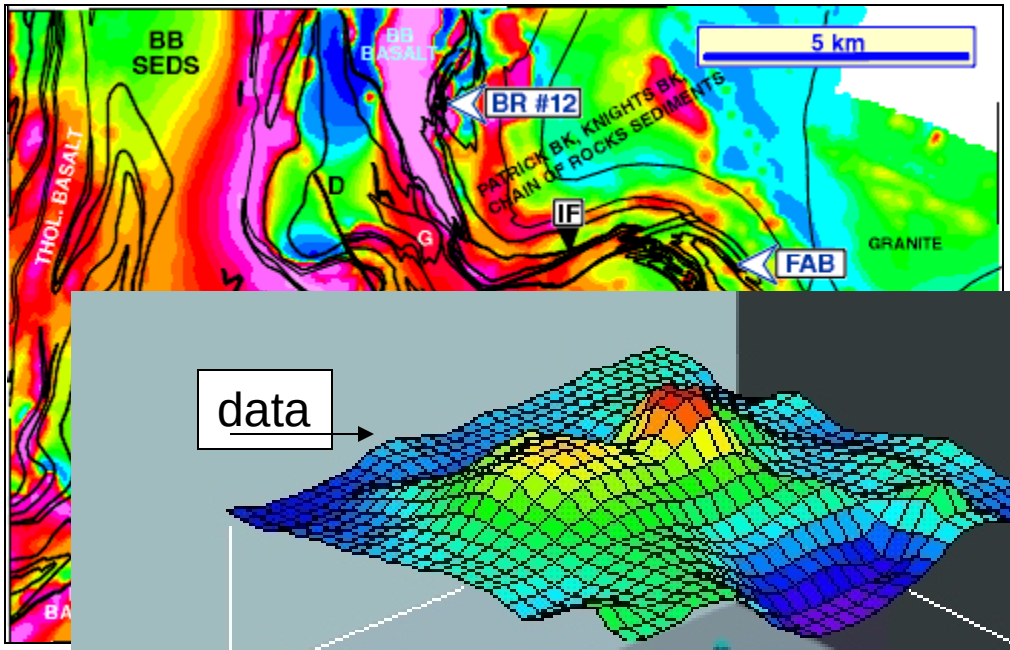
Profile of measured electrical conductivity over an aquifer

Outcome:
physical property values.



Examples

Measurements ➔ physical property ➔ geologic information



Map: magnetic response, NB

sible outcomes:

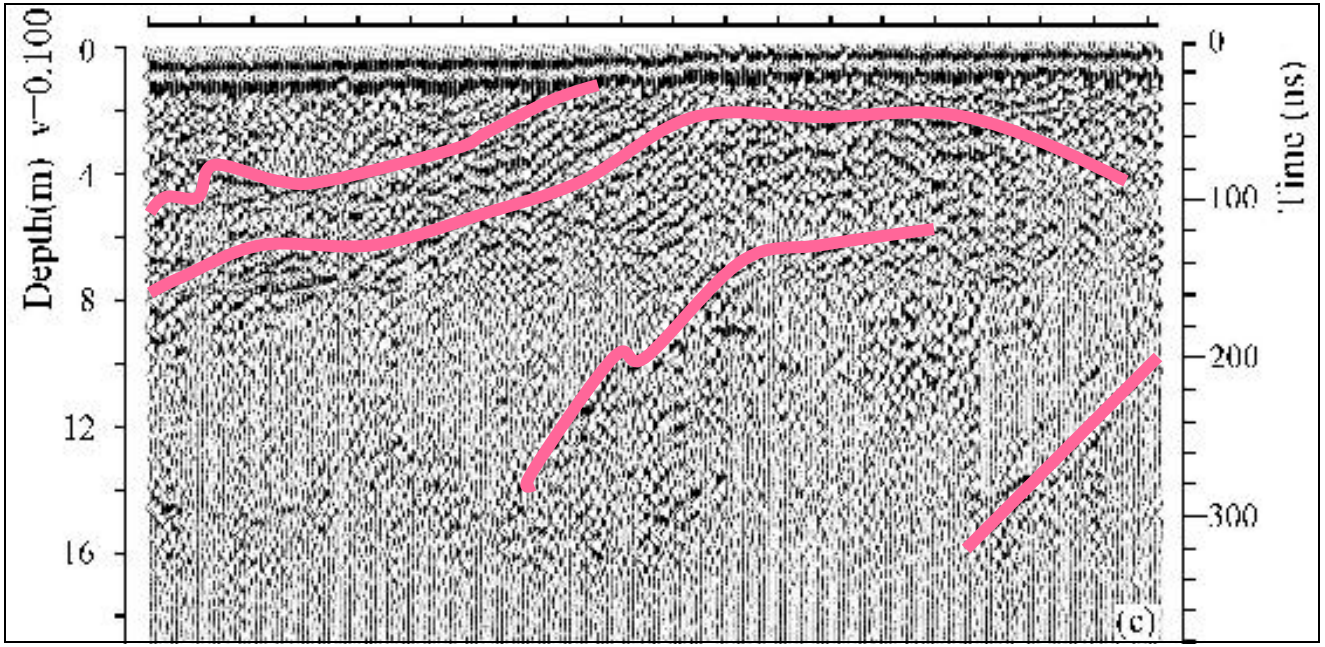
tructures on surface map.
tructures under surface.
hysical property distribution

Model of susceptibility:

Red=high values

Examples

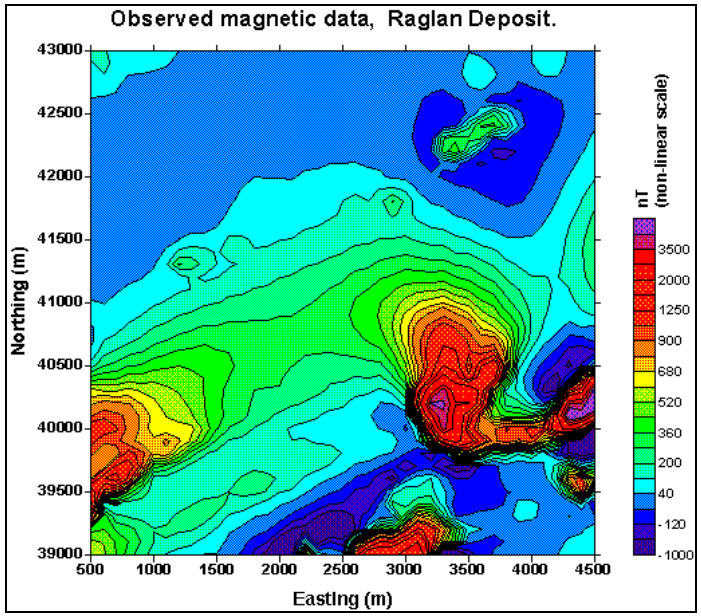
Measurements ➔ property models ➔ geologic information

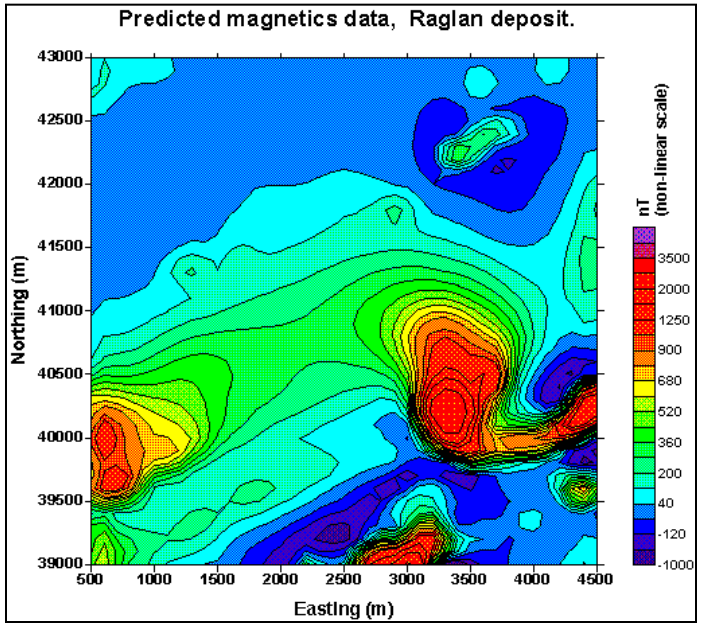


Seismic data:
Echoes of
sound energy

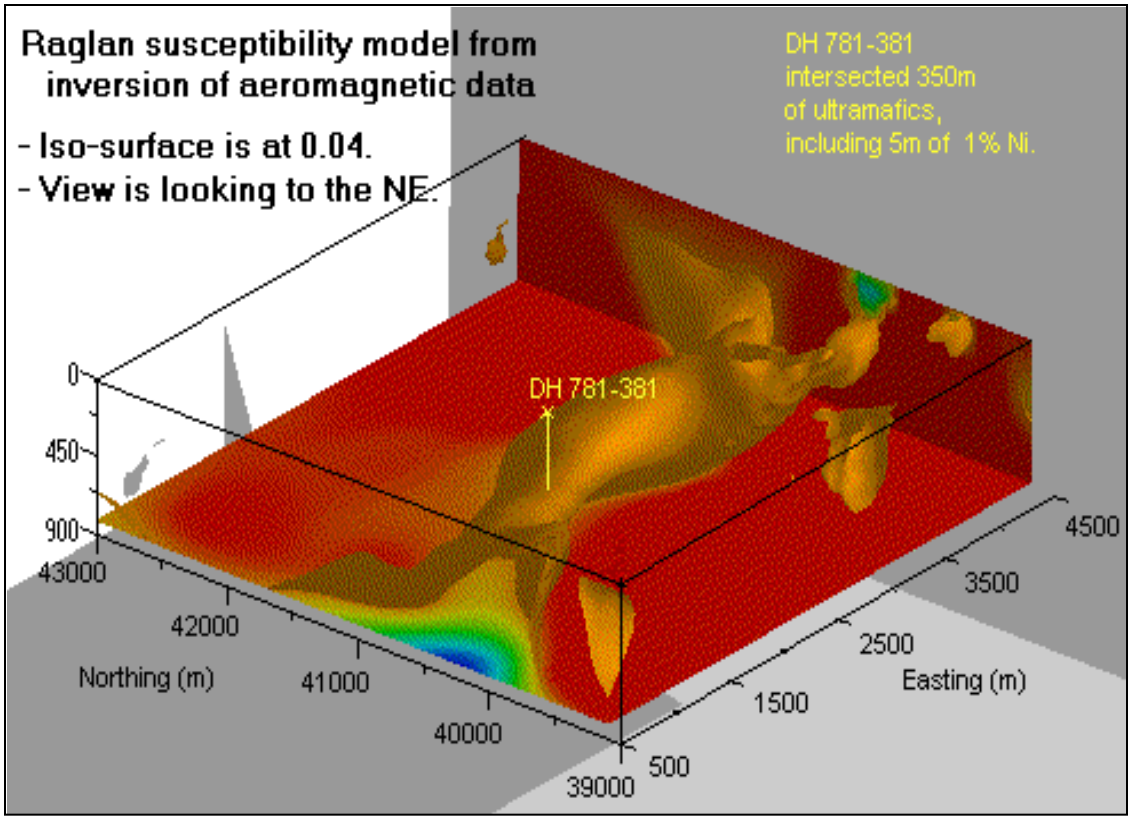
Model: locations of interfaces.
Property values less well known.

Exploration : Magnetics - Raglan deposit, Qué. (Flaconbridge)





Geological question: are outcrops connected at depth?



Homework

- Read the course syllabus
- http://eosc350.geosci.xyz

- On GPG (**http://gpg.geosci.xyz**) Read **Foundations**

Upcoming activities

- Team Assignments (Friday)
- Quiz and Team exercise #1 (Monday)