

Introduction

Geology 1

G. Bertotti



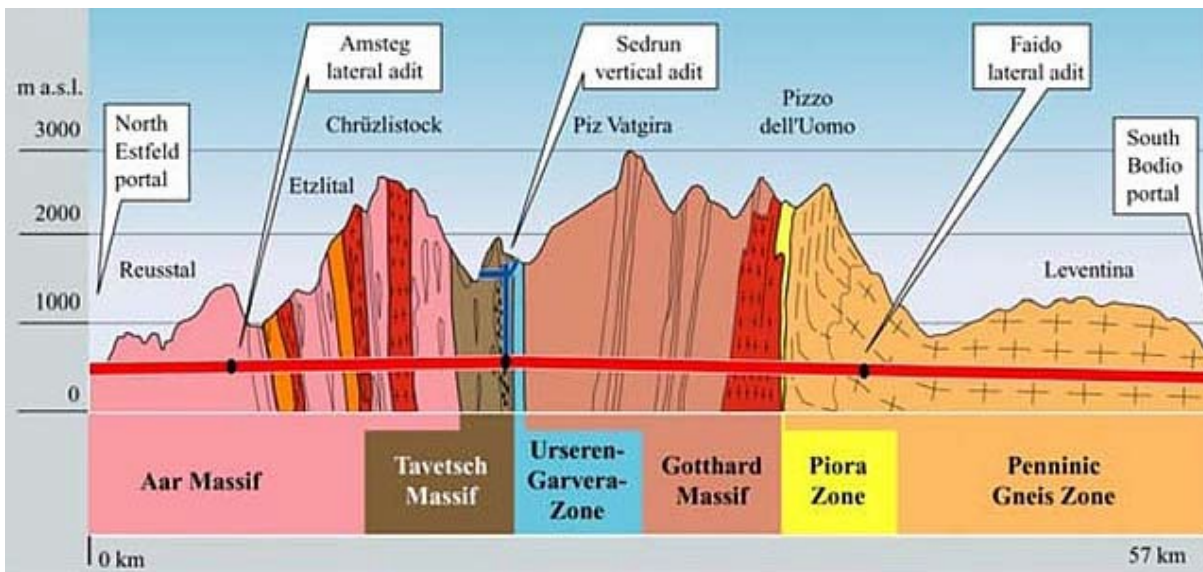
This course

The overall goal:
Make good **predictions** of the subsurface

Predictions: statements on space/time domains which you do not know

For instance, you need to decide:

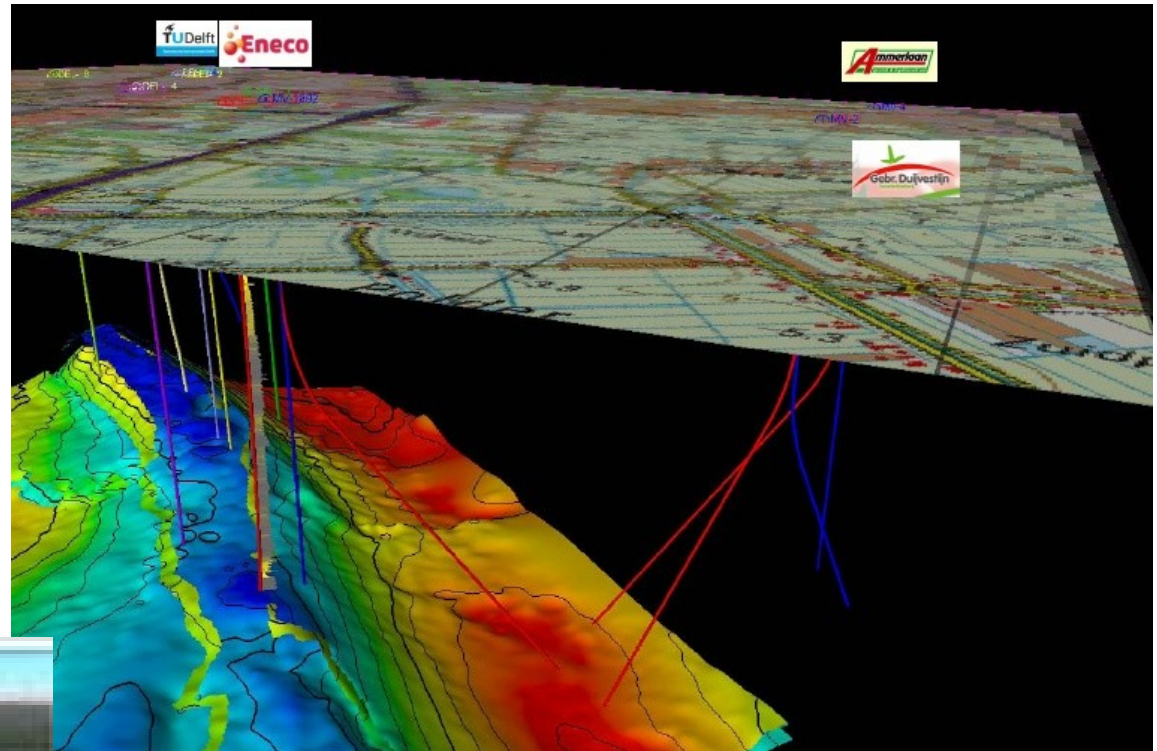
The trace of a tunnel



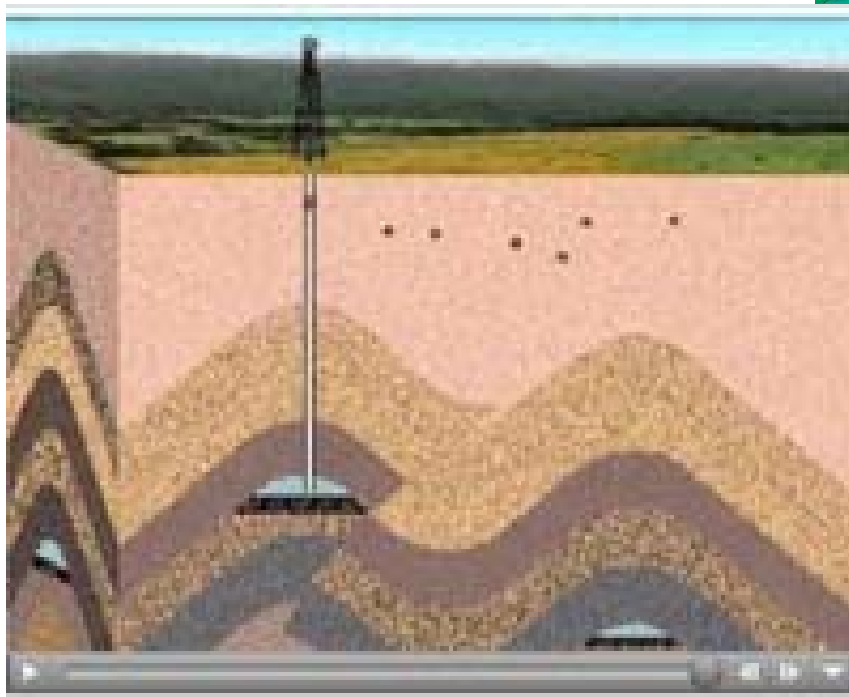
The tunnel under the English Channel

The Gotthard base tunnel

Decide on boring for geothermal energy



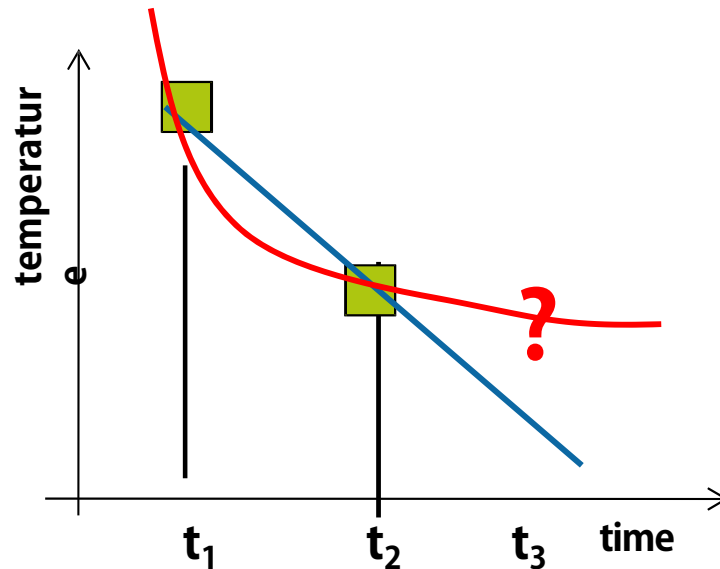
The Delft Aardwarmte Project



And, obviously,
hydrocarbons

The essence of prediction making:

You start from data points and use a bridge (=process) to go in an unknown region



What will be the value of T at t_3 ?

This depends on

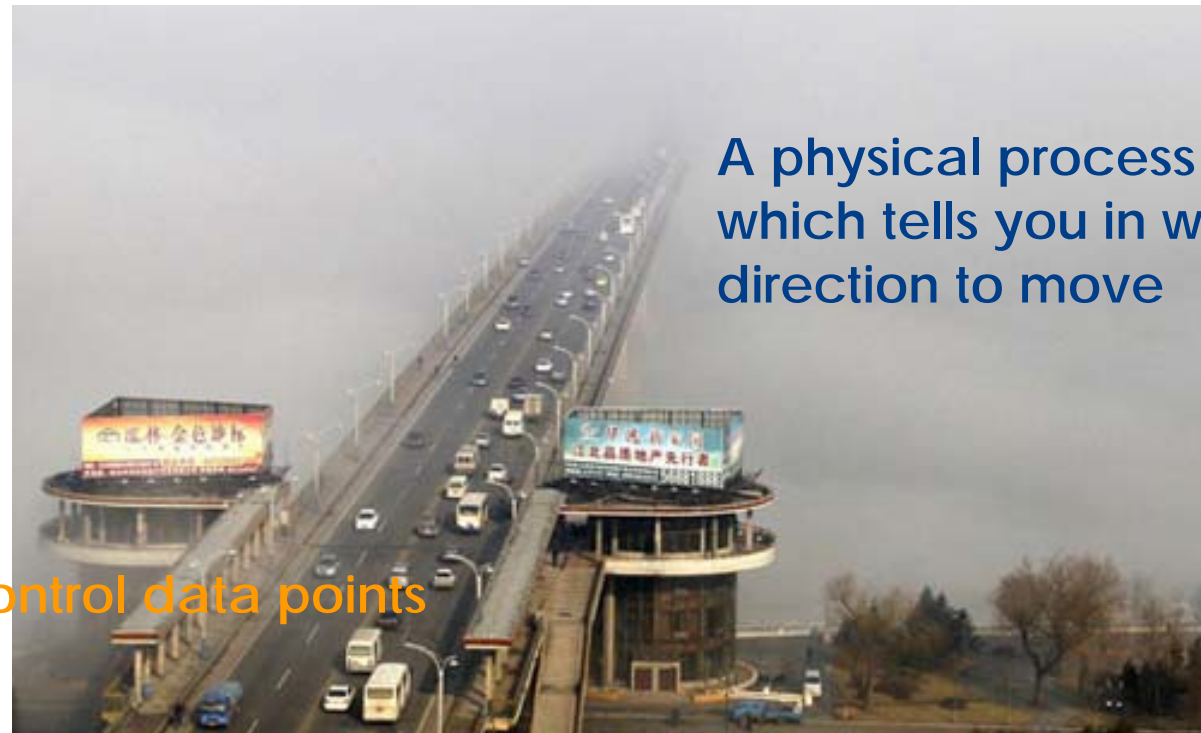
- 1) The data points you have
- 2) The process you envisage (the describing equation)

What kind of behaviour do you expect in the case of the cooling of a magma chamber?



Yellowstone caldera

Visualizing the essence of prediction



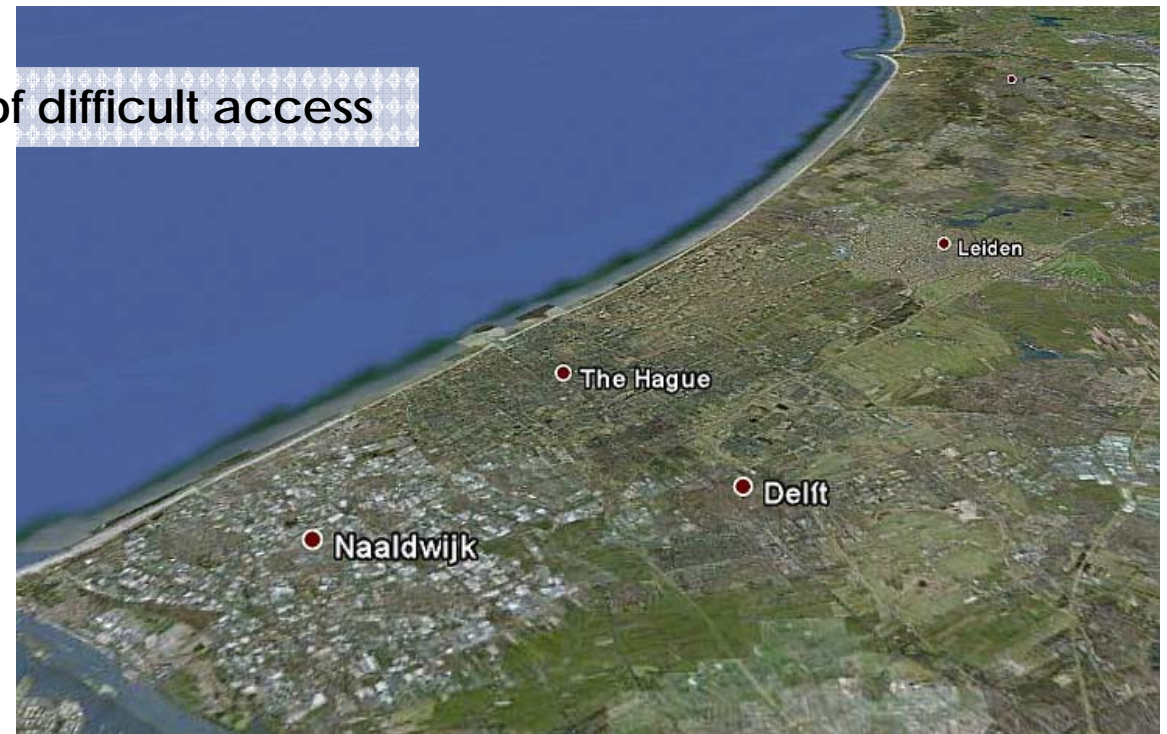
A physical process which tells you in which direction to move

good control data points

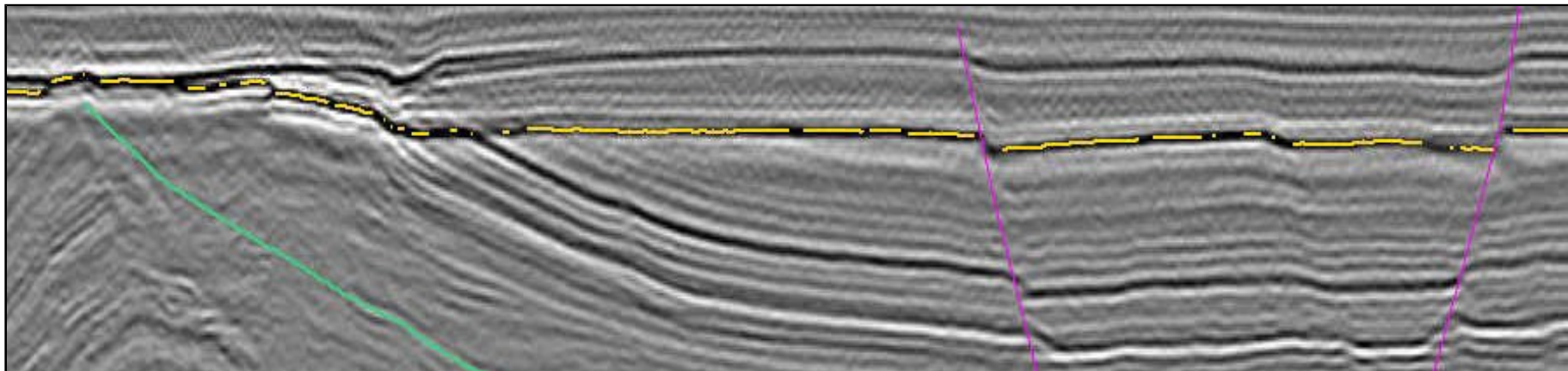
A geologist does this for the **subsurface**

Tricky because the subsurface is of difficult access

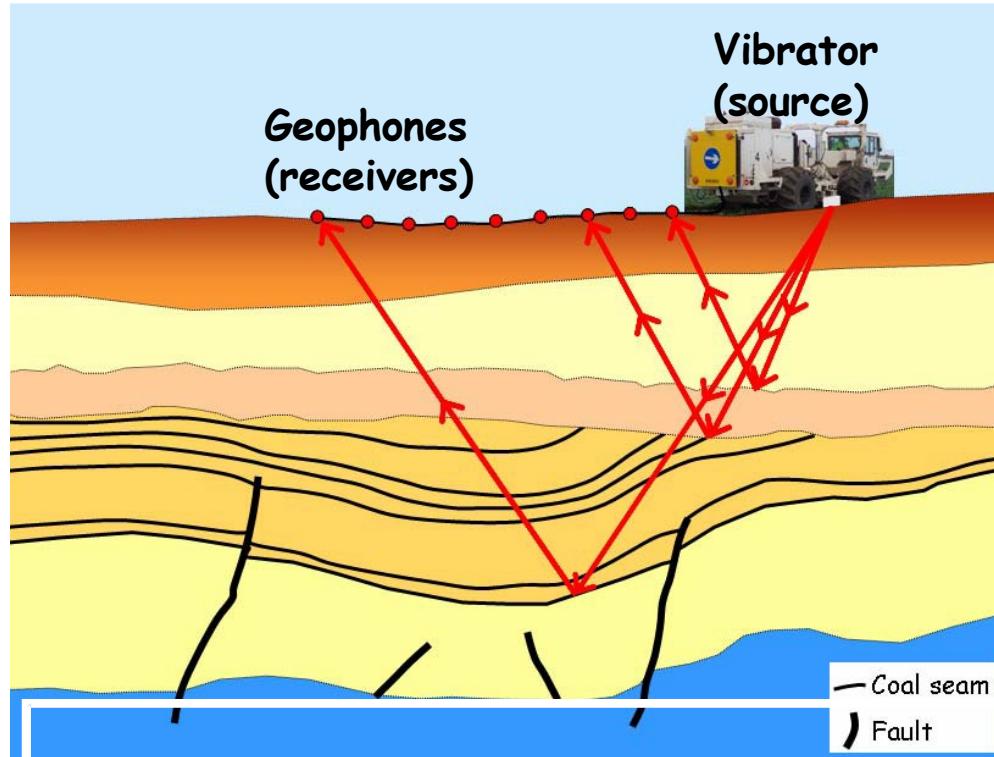
Direct methods such as boreholes give excellent but very limited information



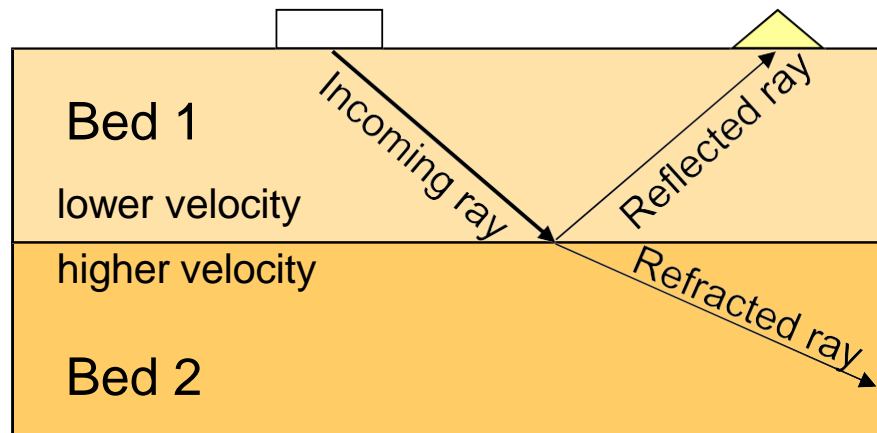
An indirect technique is **seismics** : provides “blurred” images of the subsurface



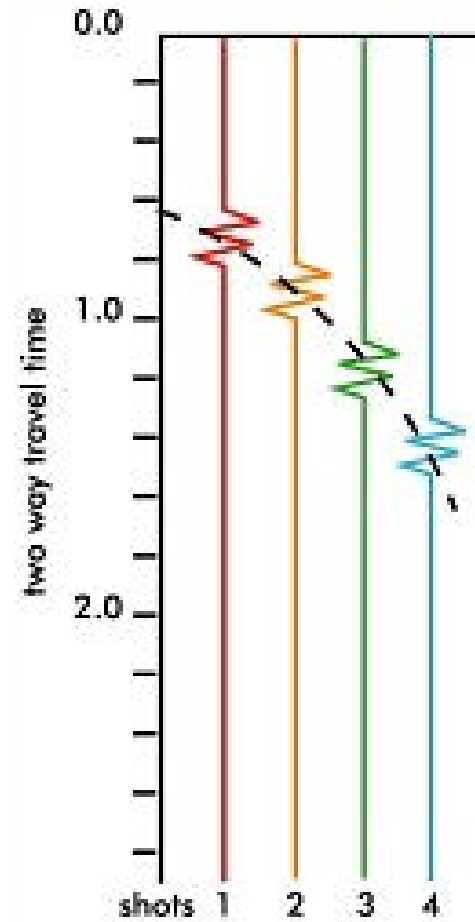
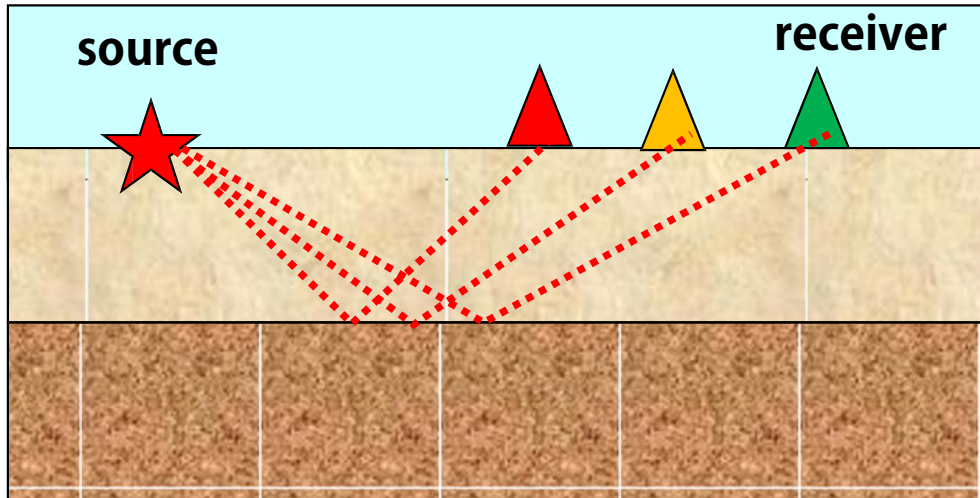
Seismics: very powerful tool to acquire (2D and 3D) **images** of the subsurface



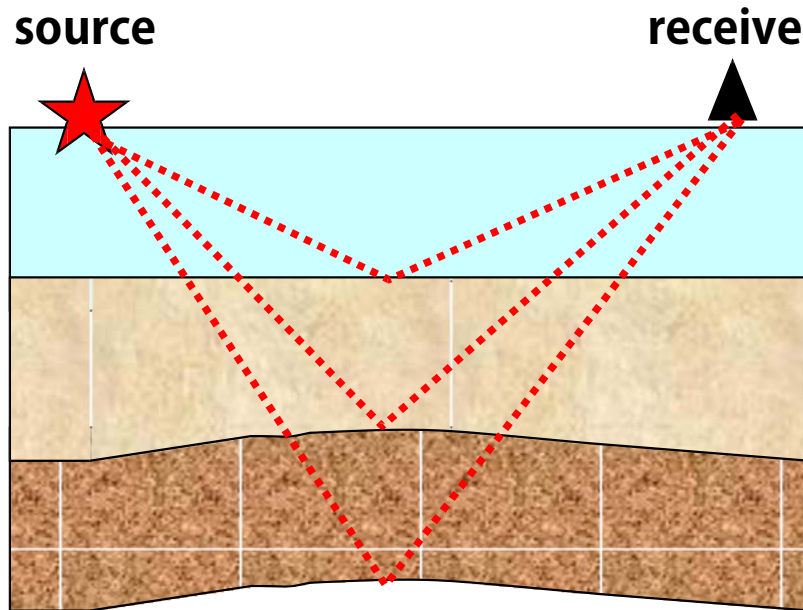
- the source generates sonic waves
- waves through geologic bodies with different physical properties.
- At interfaces energy is reflected and refracted
- geophones (receivers) receive and record the signal bouncing back



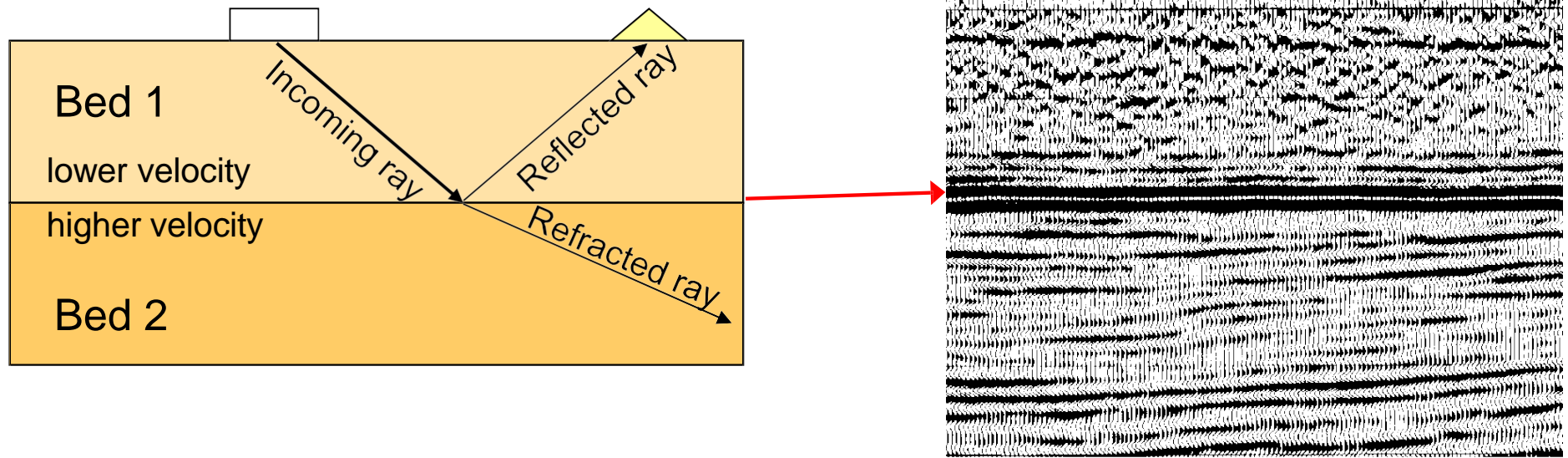
The same reflection on different receivers



Different reflections on the same receiver



Following processing, stronger or weaker horizons are traced which roughly correspond to changes in physical properties

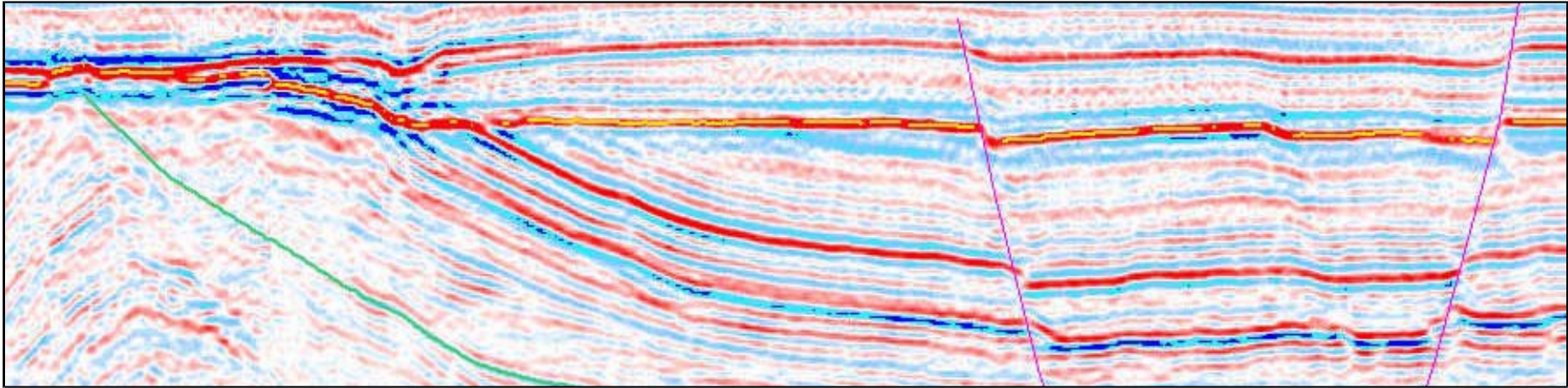


Reflections provide information on the **geometry** of the horizons and on their **spatial organization**

Reflections can be laterally (dis)continuous, they can be strong or weak, they can be organized in spatial patterns

These features do reflect the organization of the rocks producing the reflections (reflectors)

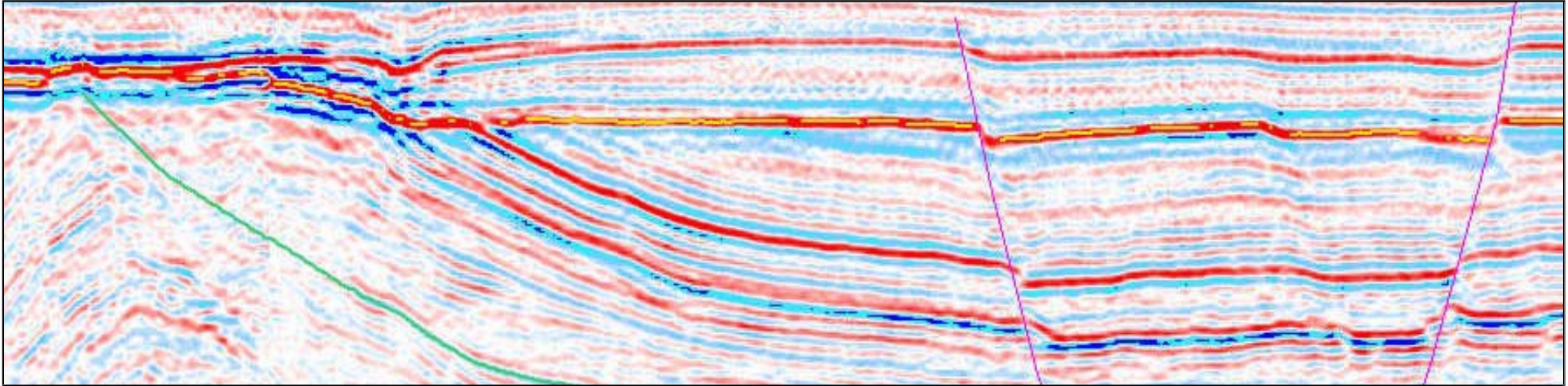
What you get



The image is however **not** the reality:

- only bundles of layers are visible (few 10s m)
- possible artifacts
- Section is in time and needs to be depth-converted

Back to the seismic data

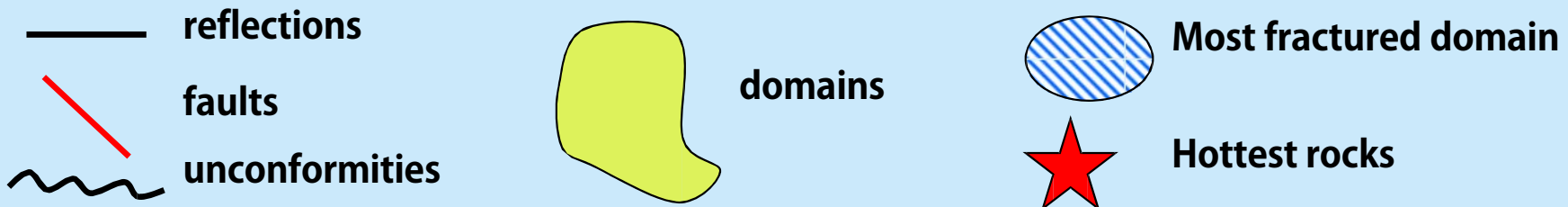


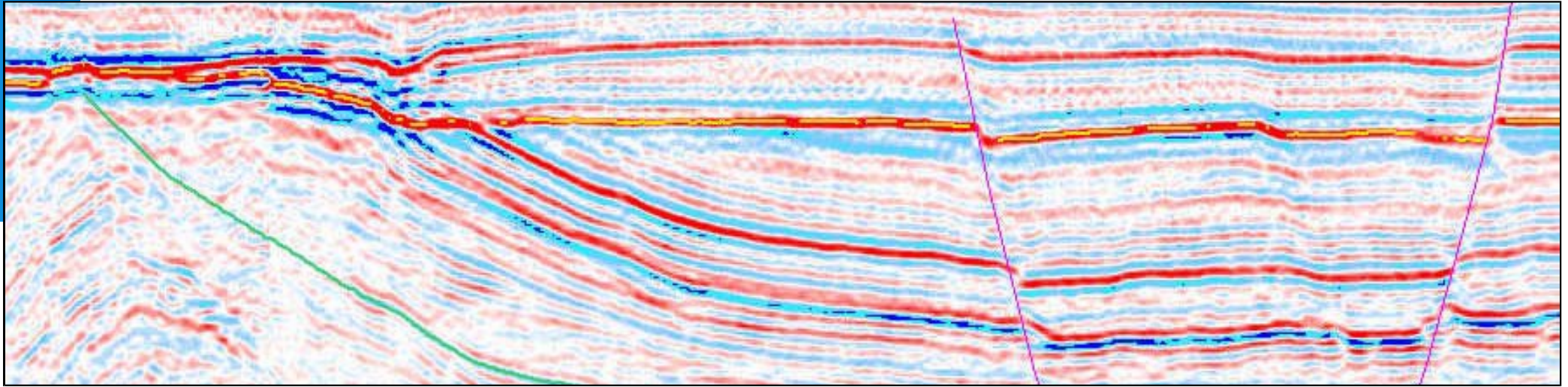
A warming up exercise

Your road map

- 1) Make a **line drawing** indicating the position of
 - Well developed reflections (bedding)
 - surfaces interrupting the lateral continuity of reflections (faults, for instance)
 - Surfaces separating domains with very different patterns (unconformities)
- 2) Define **domains** with different reflection patterns
- 3) Make a **history** of the section
- 4) Answer **applied questions**:
 - Where do you expect to have rocks with the highest degree of fracturing?
 - where are the rocks which have reached the highest temperatures?
 - Fluid flow

Legend for your exercise



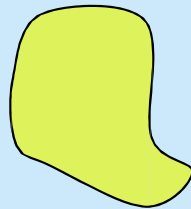


Legend for your exercise

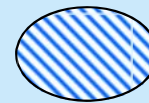
— reflections

— faults

~ unconformities



domains

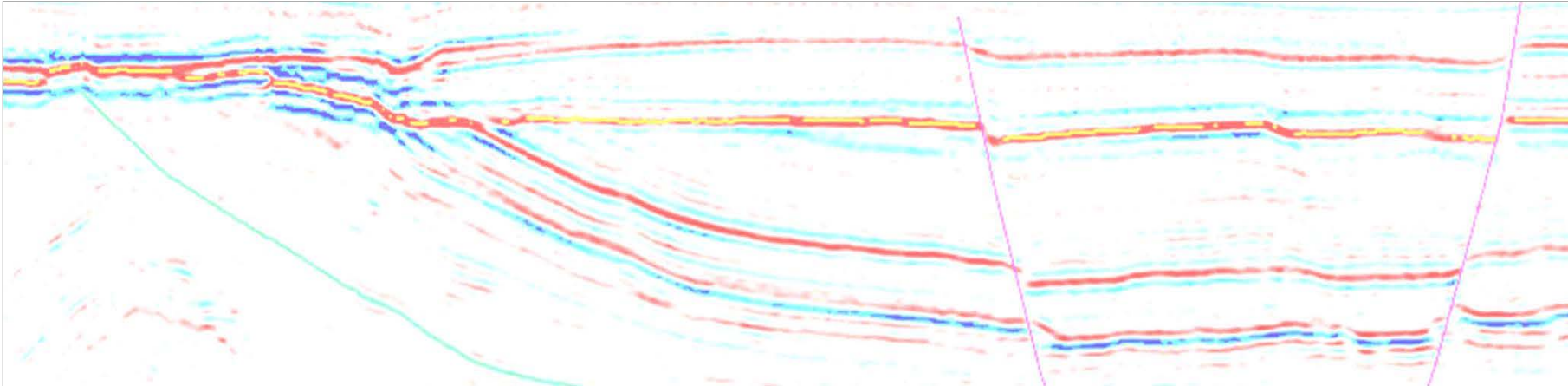


Most fractured domain



Hottest rocks

The course **General Geology**

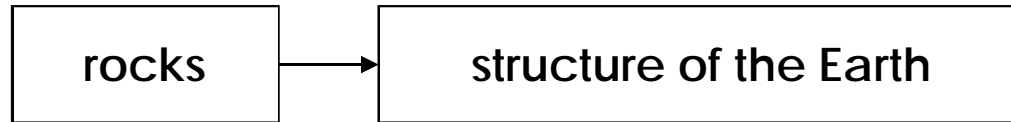


Most of the processes we are interested in can be grouped in

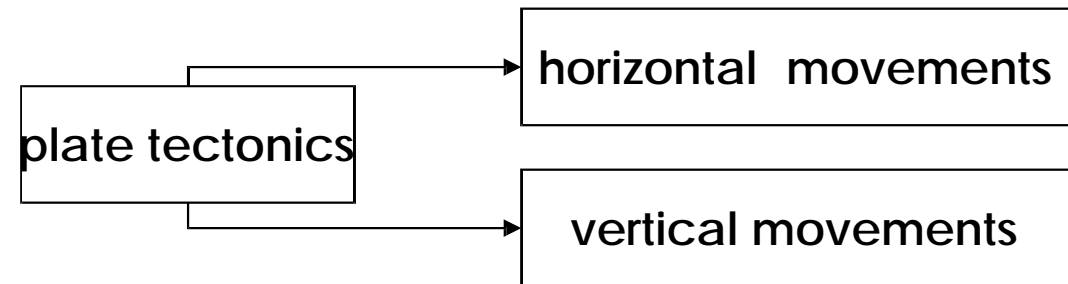
1. horizontal and vertical movements (tectonics)
2. erosion, transport and deposition processes

Our road map

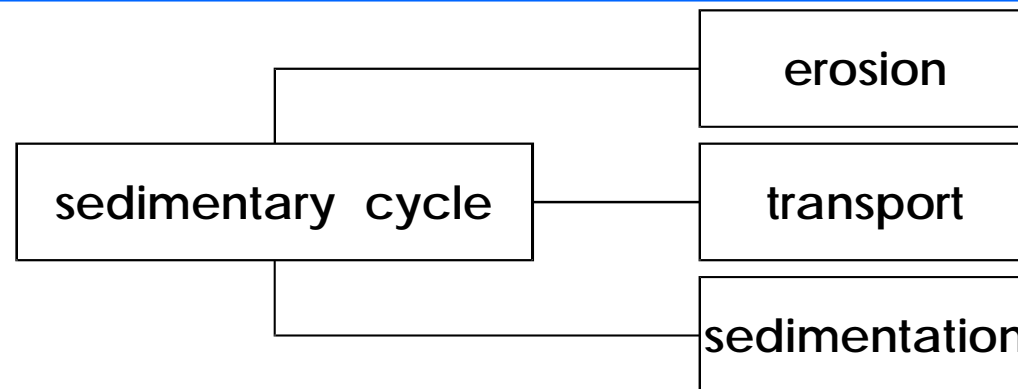
Part 1: the materials



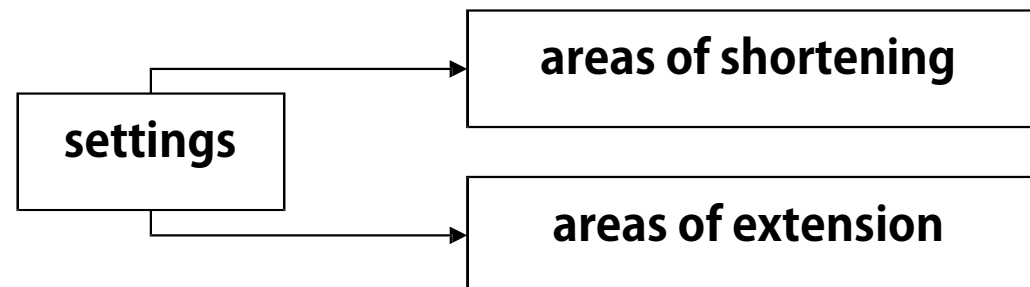
Part 2 The accommodation space



Part 3: The infill



Part 4: the integrated analysis



Sources of figures

http://www.dierengedrag.be/?page_id=107

<http://www.abovetopsecret.com/forum/thread672665/pg688>

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