Geol 493
Subsurface Mapping

Representing a 3D surface on a map

The arrow points at …

A. A ridge.
B. A valley.

What is a contour line?

Describe this surface
**Simple Contouring Rules**

- A contour line separates points that are higher from points that are lower
- Contour lines cannot cross
- Contour lines cannot merge
- Contour lines must close on themselves or extend to the edge of the map
- Contour interval must remain constant for the entire map

**How do you make a contour map?**

- A contour lines separate points that are higher from points that are lower
- Space the contours between all the known points
- Honor all the data

Contour this data using 25m interval
Datum = 0 m
Problem: How to interpolate between the known points?

Methods of interpolation
- Least squares
- Tangential
- Spline
- Weighted average
- Minimum curvature
- Polynomial
- Hyperbolic
- Kriging
- Trend surface
- Etc., etc., etc.
Advantages of Computer Contouring

- Fast
- Objective and unbiased
- Easily updated
- Ready for later processing
- Only practical way if you have 1000s of data points

Advantages of Hand Contouring

- Allows you to impart your geologic knowledge to the interpretation

Depth Structure Maps

Dealing with multiple layers

- Isopach maps
- Plot the elevation difference between two maps

Mississippian Top

Pennsylvanian Top
Which well would encounter the thickest sand?

What about Unconformities?
What about mapping other parameters?

- Extensive Surfaces:
  - Tops and Bottoms of formations
  - Isopachs
  - Fault surfaces
  - Fluid contacts, i.e. Gas-Oil, Water-Oil
- Intensive Surfaces:
  - Porosity
  - Fluid Saturation
  - Production

**Black contours are structure**
**Colors are porosity**
**Circles are production**

**Porosity map from reservoir model**

**Mapping faults**
Contouring Faulted Surfaces

- Faults break the continuity of a surface

Describe the Structure

Faulted surfaces

Faulted surfaces

Making a map of a faulted structure
1. Contour the surface without faults
2. Contour the fault plane
3. Find the intersection of the two maps
4. Correct the contours for the vertical separation across the fault
5. Clean up
Faulted structure contour map

Faults from well data
- A normal fault can remove a piece of the stratigraphy in a well
- Missing section is a indicates faulting

Reverse Faults - cross section

Reverse Faulting Example
DEPI 85639 (047-055-00226) Gamma Ray Log

Thrust faults cause repetitions in the stratigraphy

Cross-section A - A'

Where is the highest point in the structure in this depth map?

A.  
B.  
C.  
D.  
E.  

Scale: