قسم الهندسة المدنية
المرحلة الاولى

Civil Eng. Dept
1st. Stage

Engineering Geology

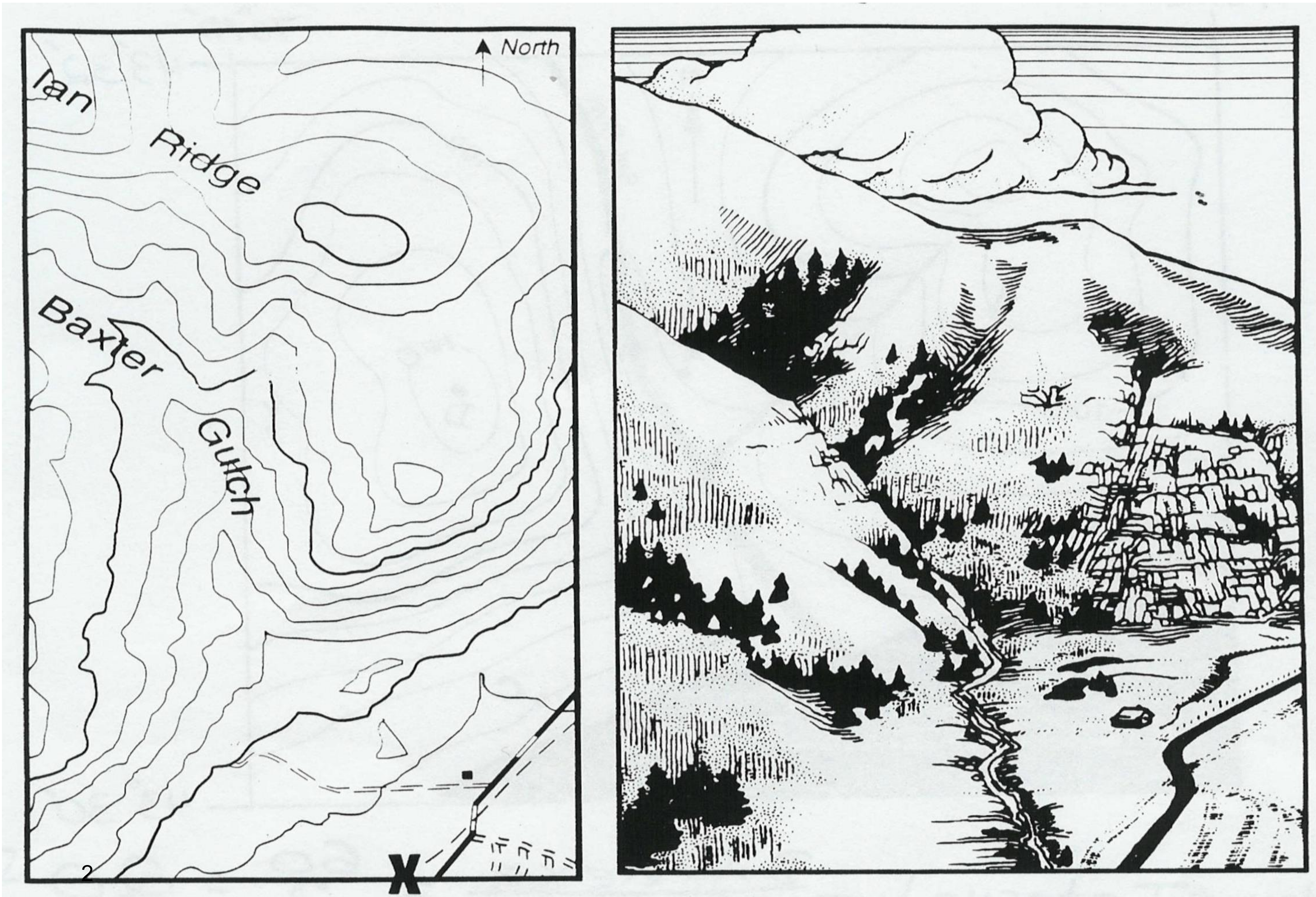
2022 - 2023

جيولوجيا

Lec.4

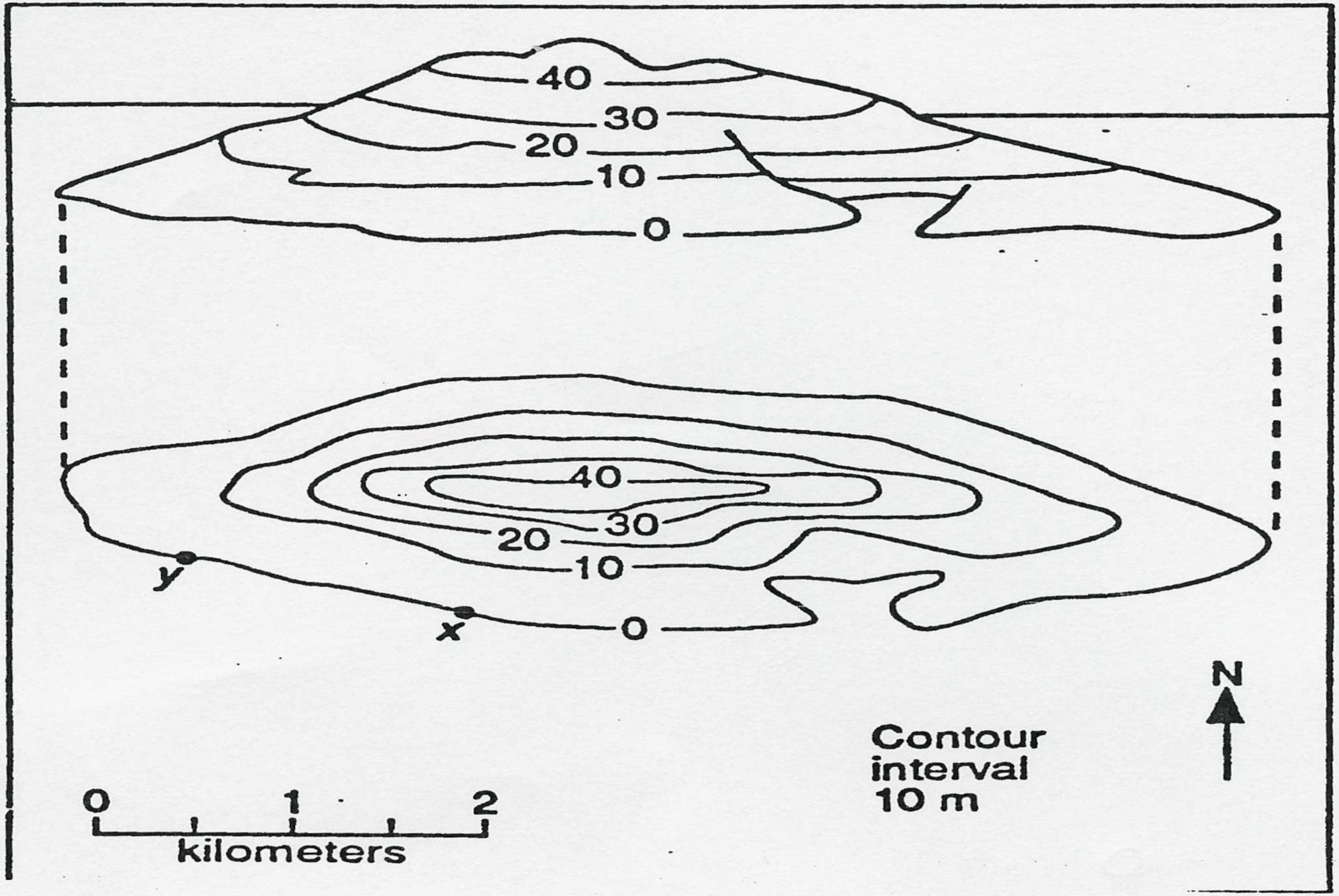
Haider Qais

Contour Lines



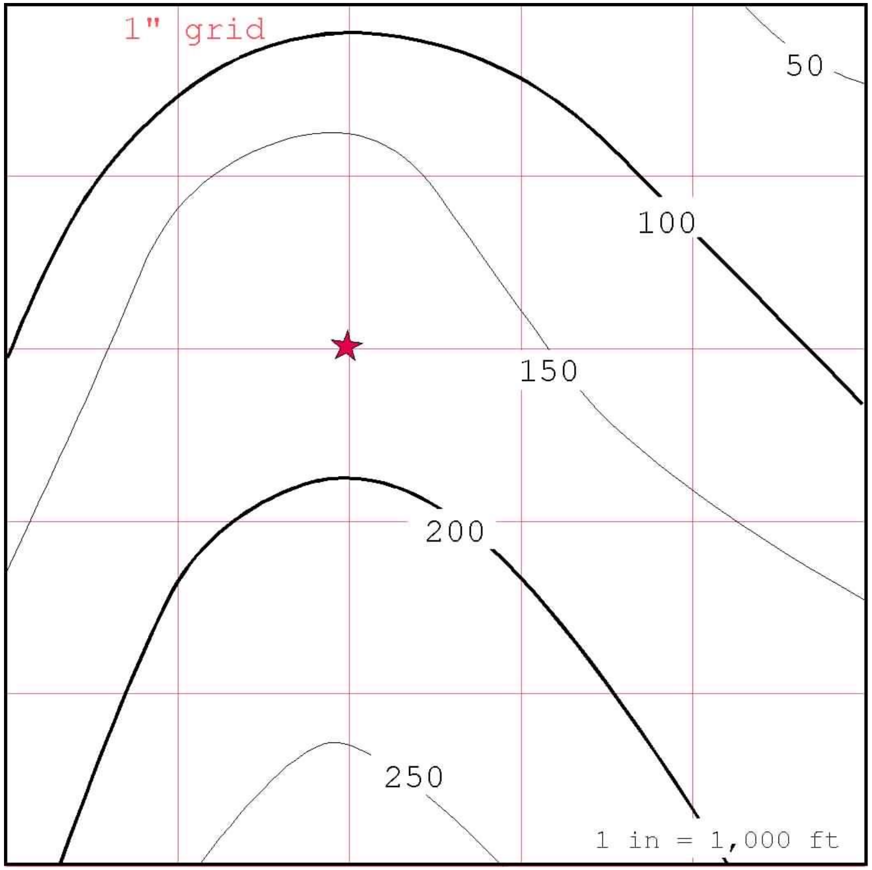
Definition

A contour line is a line that passes through points having the same elevation.*


40
30
20
10
0
40
30
20
10
0
y
x
N
Contour interval 10 m
0
1
2
kilometers

Elevation from Contours

$$\text{Elevation} = \text{High Contour} - \left[(\text{High Elevation} - \text{Low Elevation}) \times \left(\frac{\text{Distance to High}}{\text{Distance between}} \right) \right]$$



$$\text{Elevation} = 200 - \left[(200 - 150) \times \left(\frac{0.75}{2} \right) \right]$$

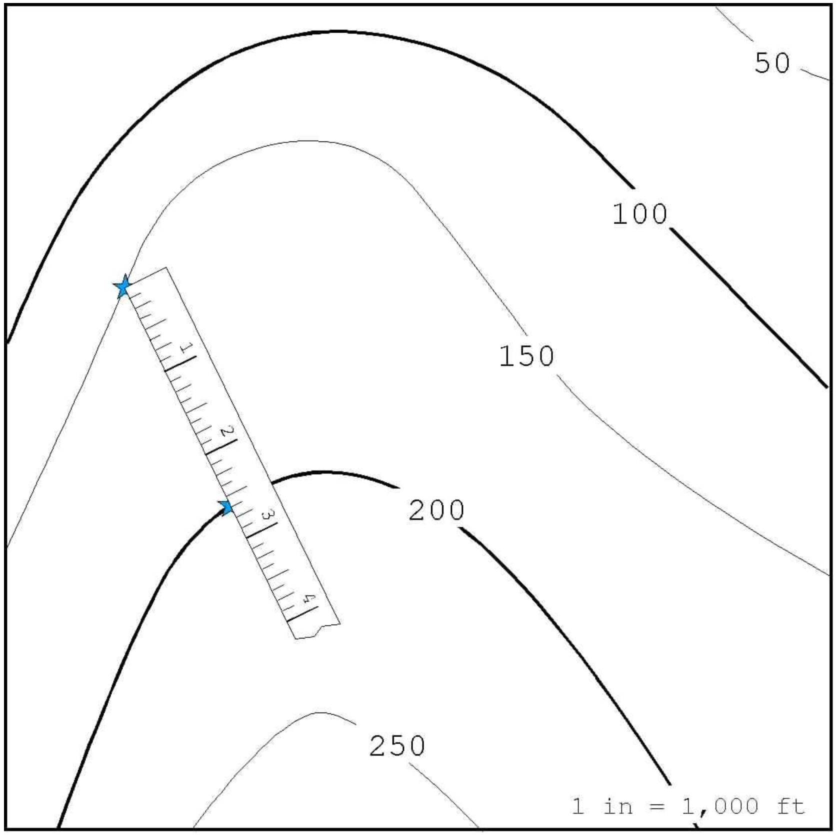
$$= 200 - (50 \times 0.375)$$

$$= 200 - 18.75$$

$$= 181.25 \text{ or } 181 \text{ ft}$$

Slope from Contours

The percent slope can also be determined from the contour lines on a topo map.



Determine the slope between the two points on the map.

$$\%\ \text{slope} = \left(\frac{\text{Rise}}{\text{Run}}\right) \text{x}\ 100$$

$$\text{Rise} = 200 - 150 = 50\ \text{ft}$$

$$\text{Run} = 2.625\ \text{in x}\ 1{,}000\ \text{ft/in}$$

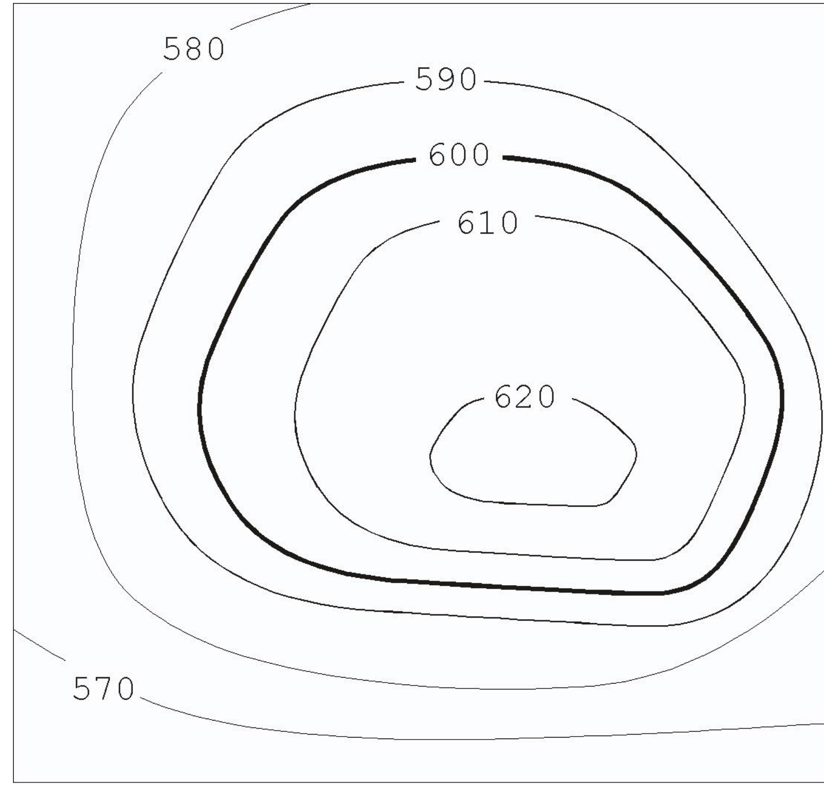
$$\%\ \text{slope} = \left(\frac{200\ \text{ft} - 250\ \text{ft}}{2625\ \text{ft}}\right) \text{x}\ 100$$

$$= 1.9\ \%$$

Characteristics of contour lines

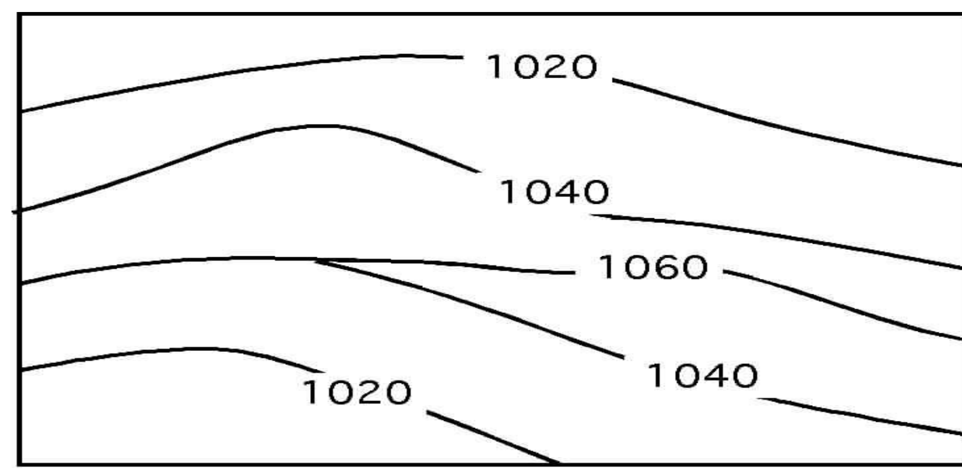
1. **Contour lines are continuous.**
2. **Contour lines are relatively parallel unless one of two conditions exists.**
3. **A series of V-shape indicates a valley and the V's point to higher elevation.**
4. **A series U shape indicates a ridge. The U shapes will point to lower elevation.**
5. **Evenly spaced lines indicate an area of uniform slope.**
6. **A series of closed contours with increasing elevation indicates a hill and a series of closed contours with decreasing elevation indicates a depression.**
7. **Closed contours may be identified with a +, hill, or -, depression.**
8. **Closed contours may include hachure marks. Hachures are short lines perpendicular to the contour line. They point to lower elevation.**
9. **The distance between contour lines indicates the steepness of the slope. The greater the distance between two contours the less the slope. The opposite is also true.**

1. Contours are Continuous



- **Some contour lines may close within the map, but others will not.**
- **In this case, they will start at a boundary line and end at a boundary line.**
- **Contours must either close or extend from boundary to boundary.**

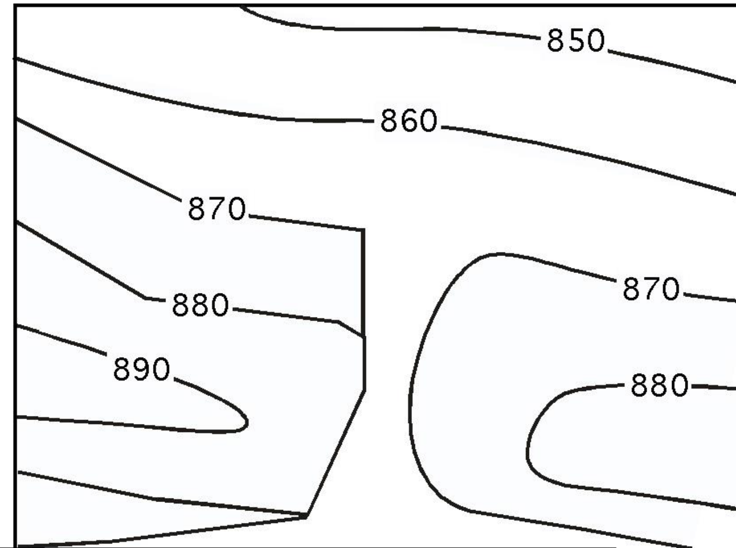
Is the map correct?

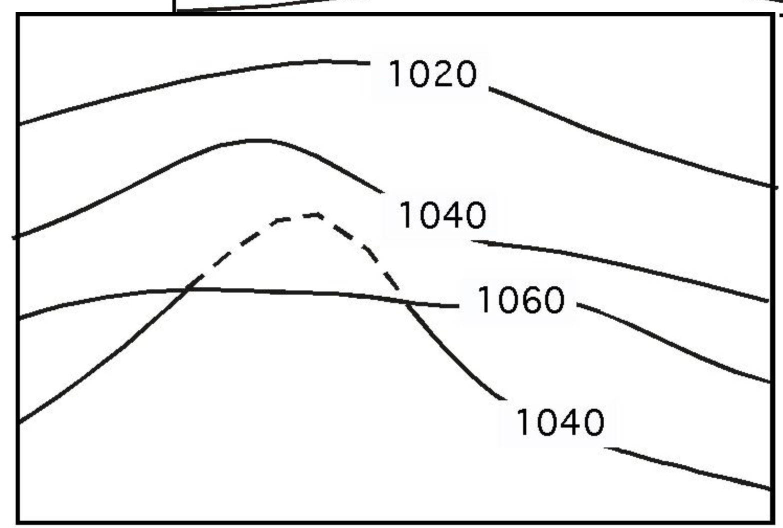


- No
- Contour 1040 is very unlikely
- This would only occur if there were a long vertical wall.

2. Contour lines are parallel

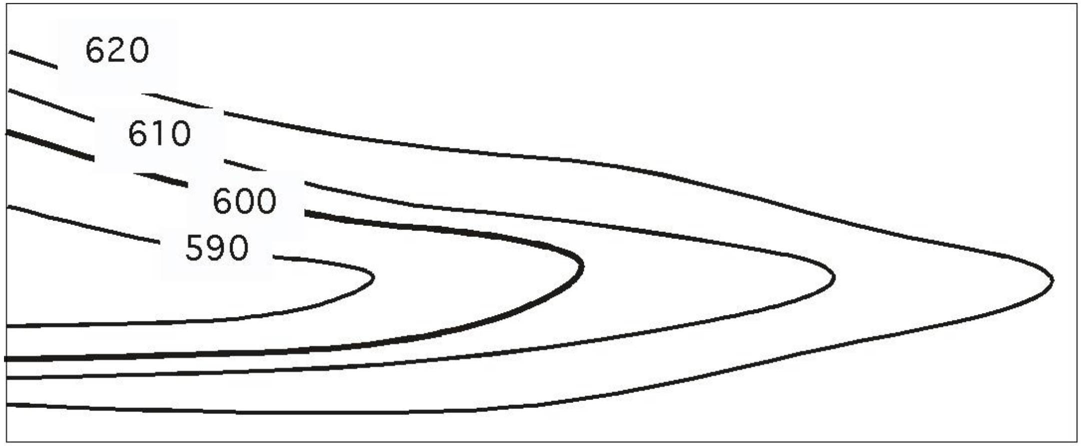
3. **Two exceptions:**
    1. **They will meet at a vertical cliff**
    2. **They will overlap at a cave or overhang.**
    3.

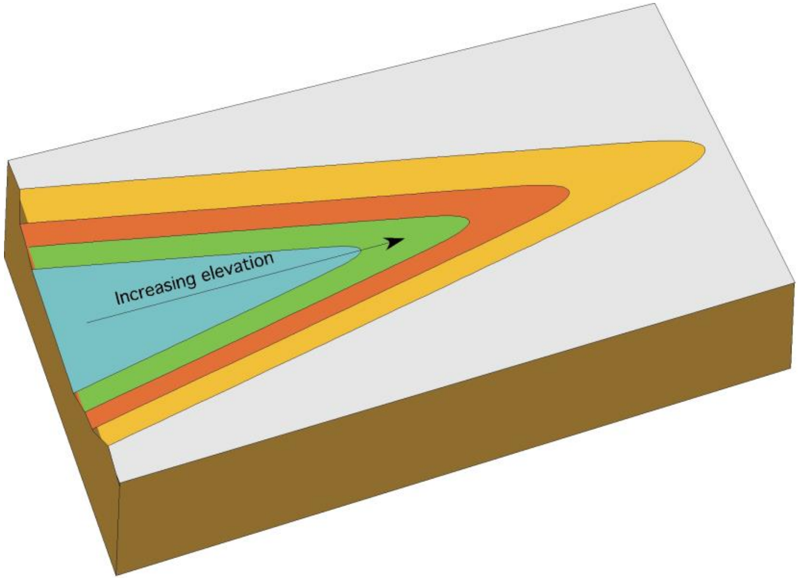




3. Valleys and higher elevation

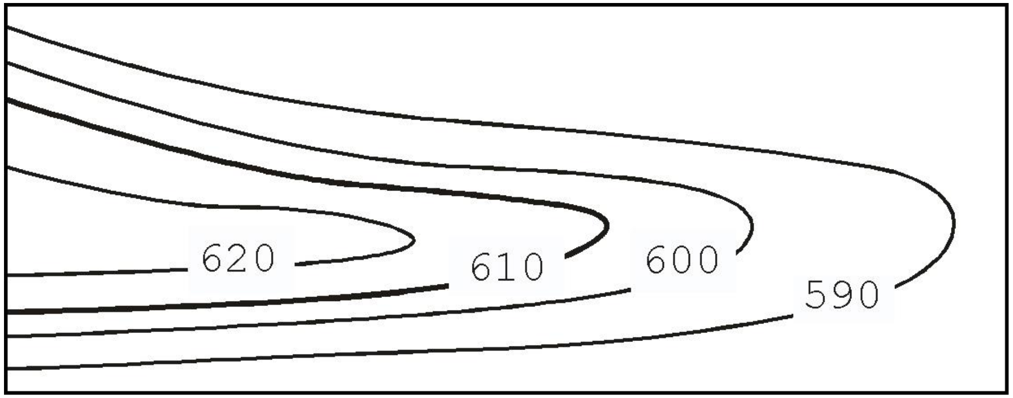
A series of V-shapes indicates a valley and the V's point to higher elevation.

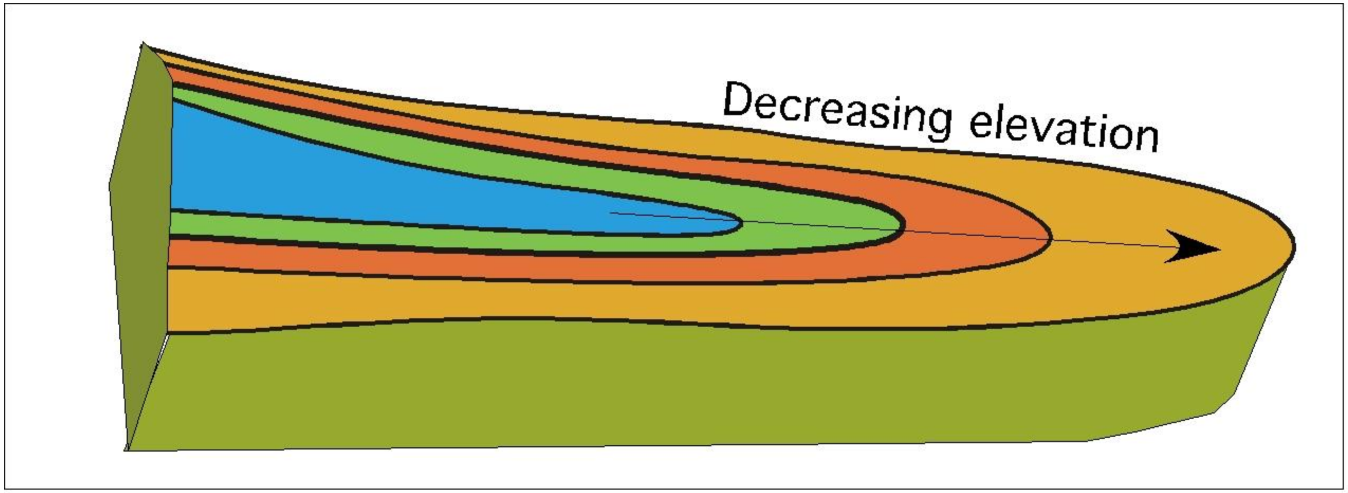




4. U shapes and ridge

A series of U shapes indicates a ridge. The U shapes will point to lower elevation.

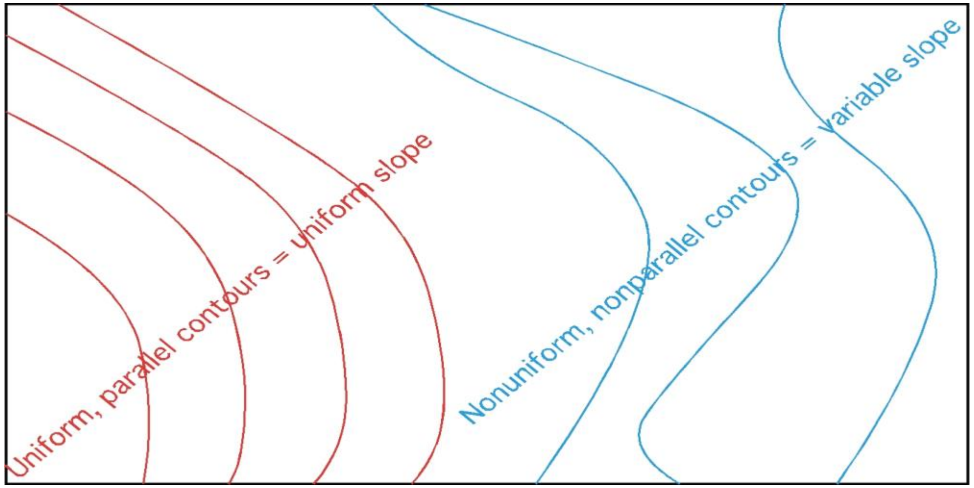




5. Contour Spacing

Evenly spaced contours indicate an area of uniform slope.

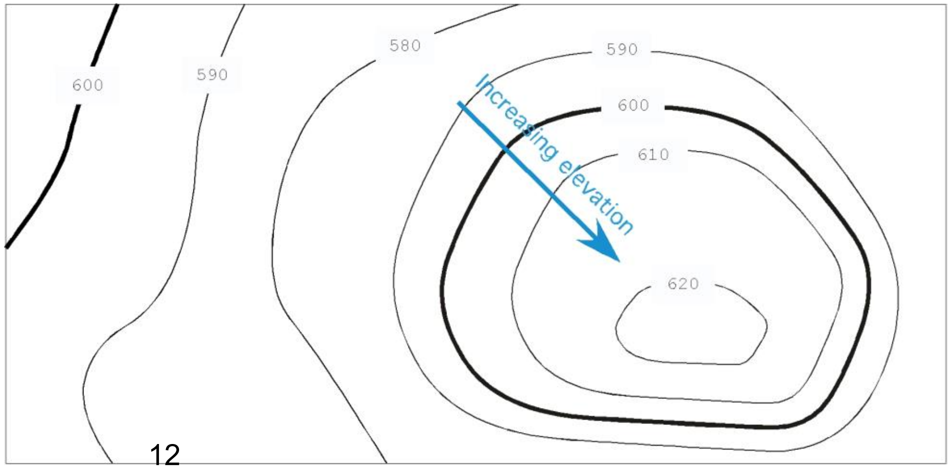
variable slope.



6. Hills and Depressions

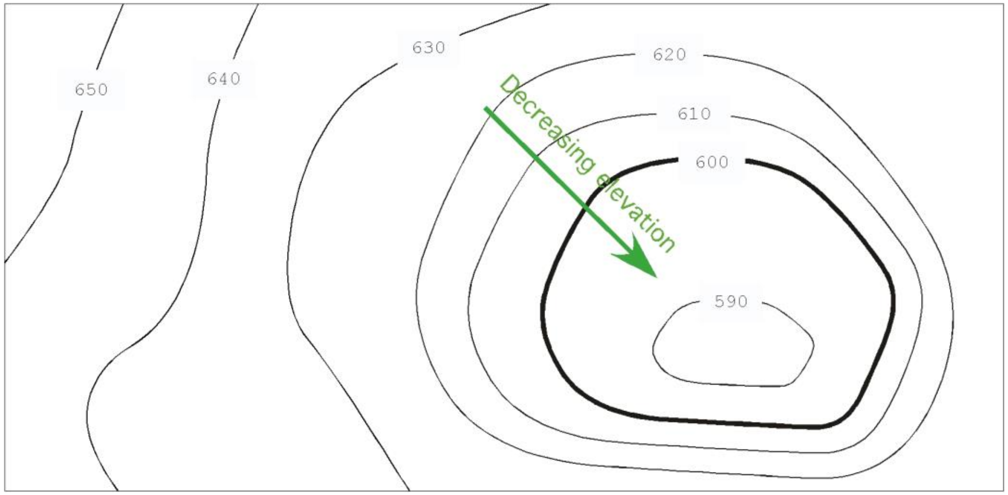
A series of closed contours with increasing elevation indicates a hill.

Hills may be identified with a "+" with the elevations



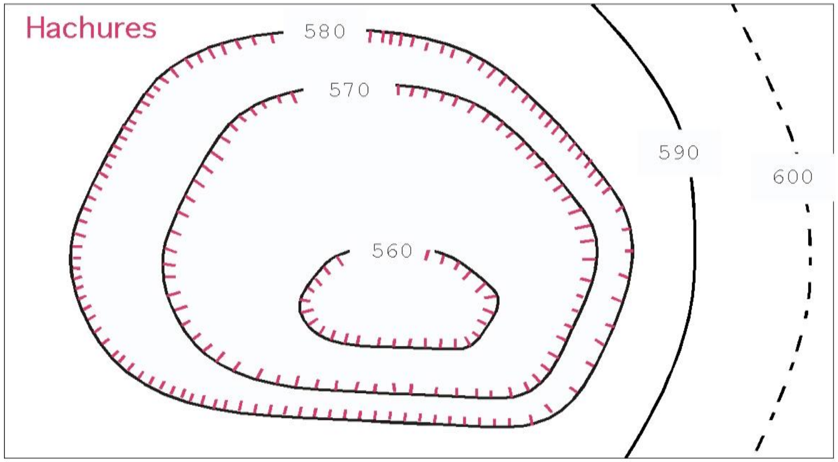
7. Hills and Depressions--cont.

- **A series of closed contours with decreasing elevation indicates a depression.**
- **Depressions may be identified with a "-".**

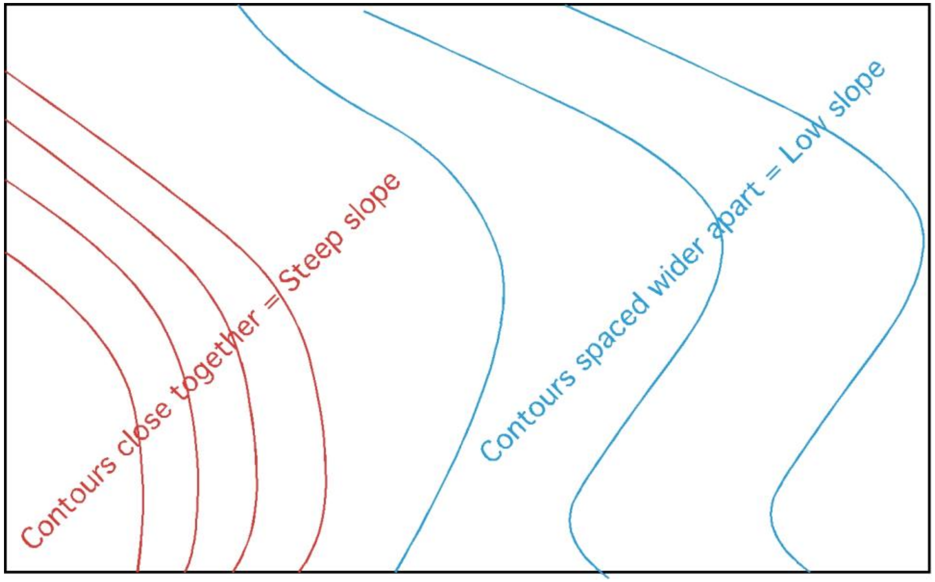


8. Hachures

- Hachures are short lines which are perpendicular to the contour line.
- Used to indicate a hill or a depression.
- Not used on modern maps.



9. Contour Spacing



- Contours spaced close together indicate a higher % slope.
- Contours spaced wider apart indicate lower % slope.

Contour Intervals--cont.

Types of topo map	Nature of terrain	Recommended interval (feet)
Large Scale	Flat	0.5 or 1
	Rolling	1 or 2
	Hilly	2 or 5
Intermediate scale	Flat	1, 2 or 5
	Rolling	2 or 5
	Hilly	5 or 10
Small scale	Flat	2, 5 or 10
	Rolling	10 or 20
	Hilly	20 or 50
	Mountainous	50, 100 or 200

كلية المنصور الجامعة
Al-Mansour University College

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جيولوجيا

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Geothermal energy

Introduction

The inner core of the earth reaches a maximum temperature of about 4000 C. Heat passes out through the solid submarine and land surface mostly by conduction – geothermal heat – and occasionally by active convective currents of molten magma or heated water. The average geothermal heat flow at the Earth's surface is only 006W m^{-2}, with a temperature gradient of <30 C km^{-1}. This continuous heat current is trivial compared with other renewable supplies in the above surface environment that in total average about 500W m^{-2};
However, at certain specific locations, increased temperature gradients occur, indicating significant geothermal resources. These may be harnessed over areas of the order of square kilometers and depths of ~5km at fluxes of 10–20W m^{-2} to produce ~100MW thermal km^{-2} in commercial supplies for at least 20 years of operation.

Geothermal heat is generally of low quality, and is best used directly for building or process heat at about 50–70 C, or for preheating of conventional high temperature energy supplies. Such supplies are established in several parts of the world and many more projects are planned. Occasionally geothermal heat is available at temperatures above about 150 C, so electrical power production from turbines can be contemplated. Several important geothermal electric power complexes are fully established, especially in Italy, New Zealand and the USA. It is common to use heat from the near-surface ground or from lakes, etc. as input to a *heat pump*. Although this may be interpreted as a 'geothermal' source, we do not include such systems as geothermal supplies for the purposes of this chapter. It is probably more meaningful to consider such sources as stored heat from sunshine, since replenishment will be more from the environment above than below. Renewable energy was defined as currents of energy occurring naturally

energy can be classed as renewable, because the energy would otherwise.

تم تعريف الطاقة المتجددة على أنها تيارات الطاقة التي تحدث بشكل طبيعي في البيئة. من خلال هذا التعريف ، يمكن تصنيف بعض مصادر الطاقة الحرارية الأرضية على أنها مصادر

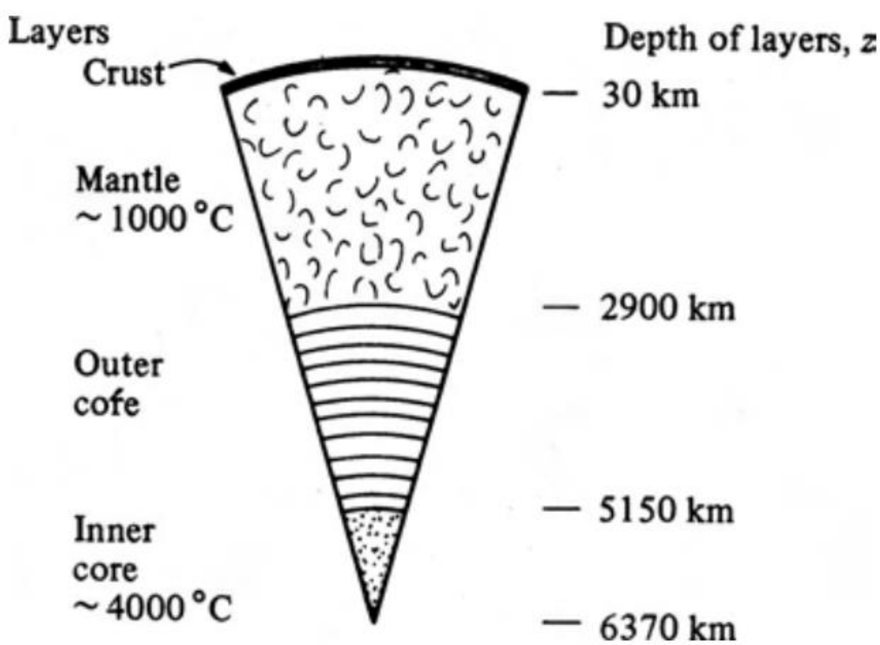
Geophysics

A section through the earth is shown in figure below. Heat transfer from the semi- fluid mantle maintains a temperature difference across the relatively thin crust of 1000 C, and a mean temperature gradient of ~30 Ckm^{-1}. The crust solid material has a mean density ~2700kg m^{-3}, specific heat capacity ~1000 J kg-1 K-1 and thermal conductivity ~2W m^{-1} K^{-1}. Therefore, the average geothermal flux is ~006W m^{-2}, with the heat stored in the crust at temperatures greater than surface temperature being ~1020 J km^{-2}. If just 0.1% of this heat was removed in 30 years, the heat power available would be 100MW km^{-2}. Such heat extraction would be replenished in time from the mantle below. These calculations give the order of magnitude of the quantities involved and show that geothermal sources are a large potential energy supply.

Heat passes from the crust by
(1)
(2) radioactive decay of elements such as uranium and thorium,
(3) chemical reactions.

The time constants of such processes over the whole Earth are so long that it is not possible to know whether the Earth's temperature is presently increasing or decreasing. The radioactive elements are concentrated in the crust by fractional recrystallisation from molten.

Section through the Earth, showing average lower depths of named layers. The crust has significant variation in composition and thickness over a local scale of several kilometers.



مقطع من خلال الأرض ، يظهر متوسط أعماق أقل من اسمه
طبقات. القشرة لها تباين كبير في التركيب والسماكة
على نطاق محلي يبلغ عدة كيلومترات

There are three classes of geothermal region

1- Hyperthermal. Temperature gradient ≥80 Ckm^{-1}. These regions are usually on tectonic plate boundaries. The first such region to be tapped for electricity generation was at Larderello in Tuscany, Italy in 1904. Nearly all geothermal power stations are in such areas.
2- Semithermal. Temperature gradient ~40–80 Ckm. Such regions are associated generally with anomalies away from plate boundaries. Heat extraction is from harnessing natural aquifers or fracturing dry rock. A well-known example is the geothermal district heating system for houses in Paris.
3- Normal. Temperature gradient <40 Ckm. These remaining regions are associated with average geothermal conductive heat flow at ~006W m-2. It is unlikely that these areas can ever supply geothermal heat at prices competitive to present (finite) or future (renewable) energy supplies