



# Measuring Earth Review

# Models

- Models are small copies of an object or a system used for closer studies.
- Types of models include:
  - Physical (a globe)
  - Laboratory (an experiment) - simulations
  - Mental (the solar system, in your mind)
  - Mathematical (formulas or equations)
  - Graphic (graphs and charts)



What is the shape of the  
Earth?



It is almost perfectly round.

# How Do We Know the Earth is Round?

Photographs of  
Earth from space

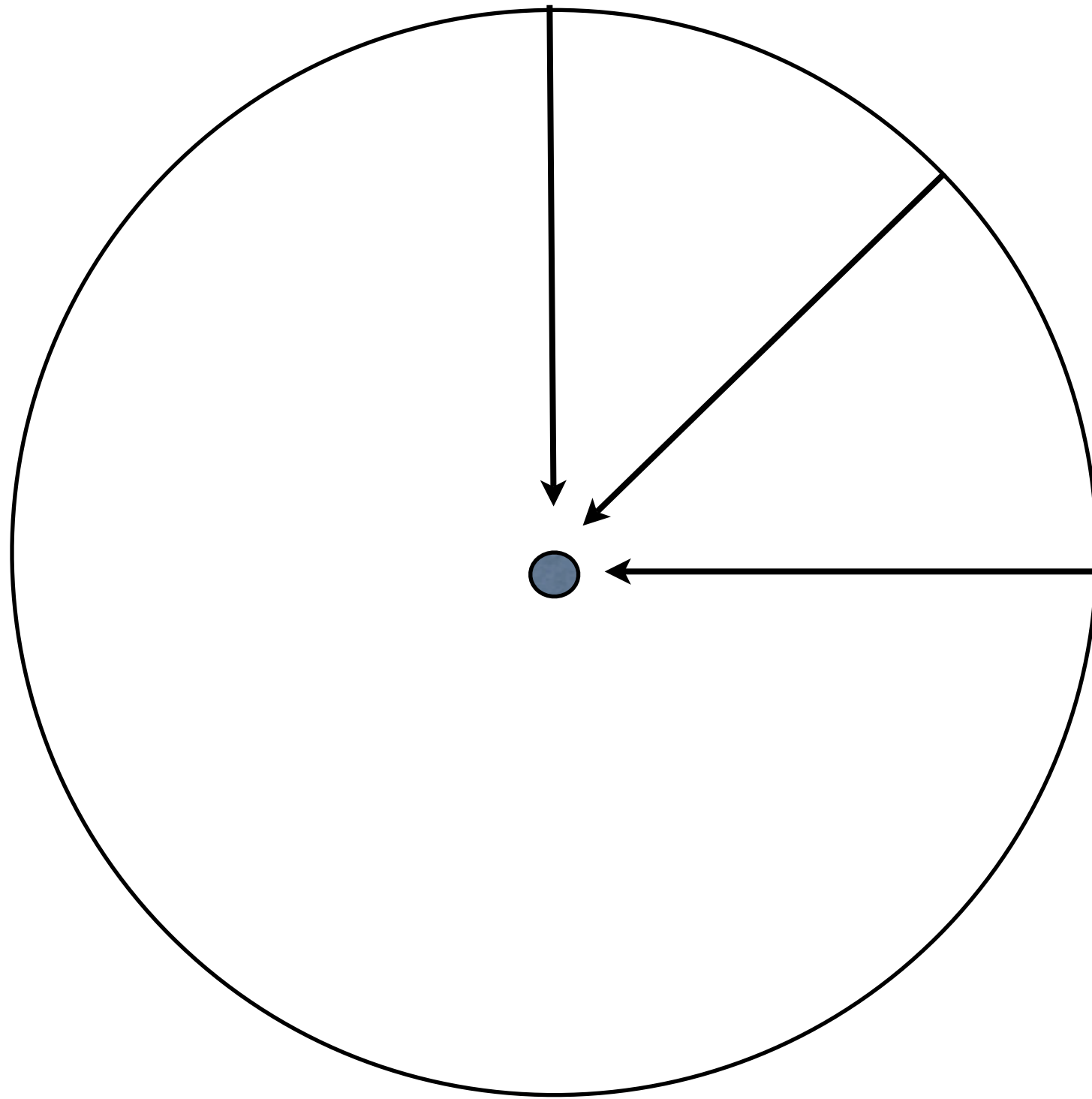


# The “Sinking Ship Illusion”

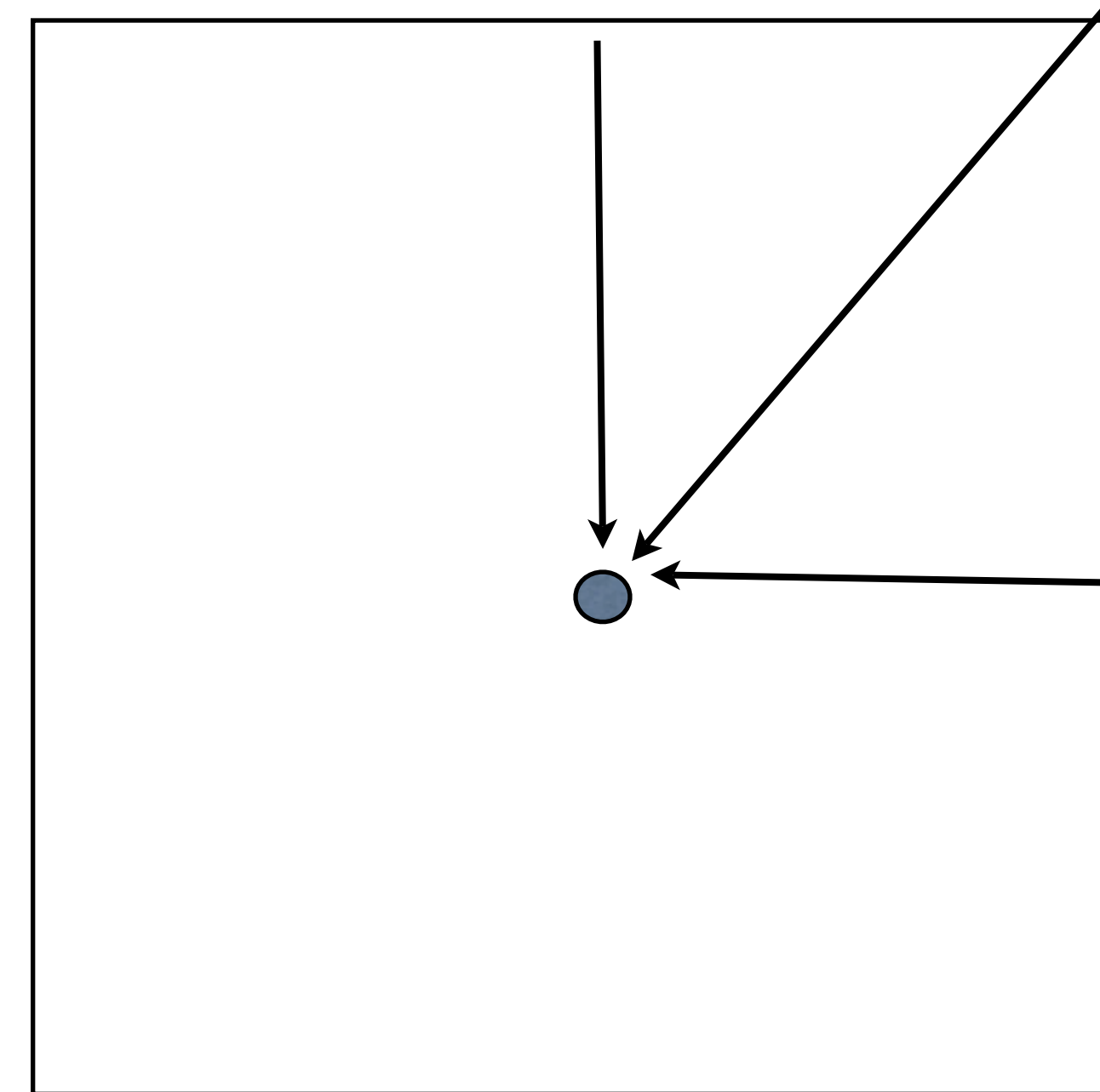
The observation of ships sinking in the distance as they travel past the horizon



# The similarity of the pull of gravity at all points on the Earth's surface



Equal pull (force) in all directions.

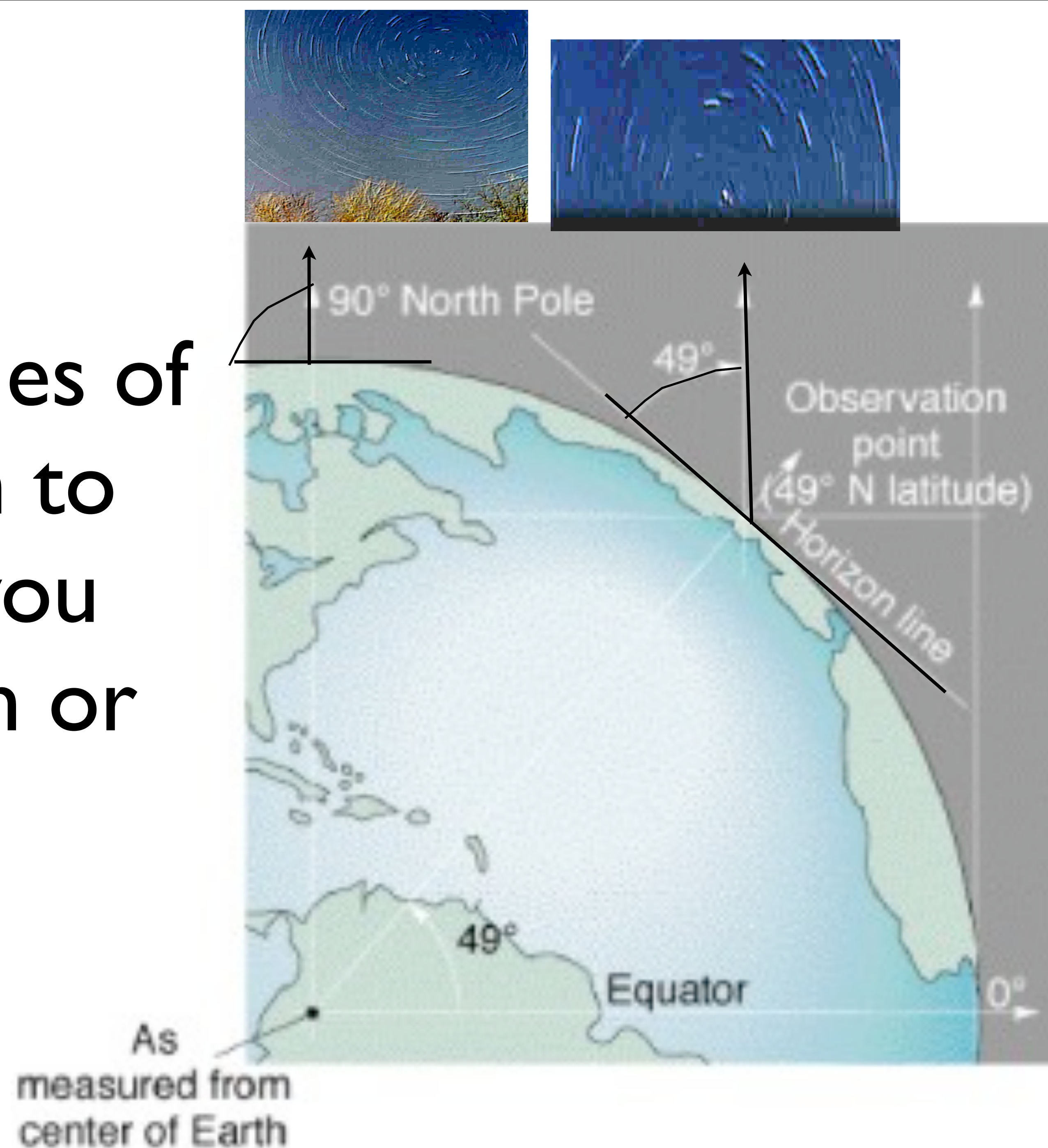


Unequal pull (force).

# The shadow of the Earth on the moon during Lunar Eclipses



Different angles of  
the horizon to  
Polaris as you  
travel North or  
South



# Sunrise and Sunset

**AM** The sun hits the tops of mountains first and the valleys last.

**PM** The Sun will hit your roof top while the first story can't see the sun any more.



# Best Scale Model of Earth

The earth is almost perfectly round; and almost perfectly smooth.

So the **best model** would be like a  
**billiard ball** or a **ping pong ball**.



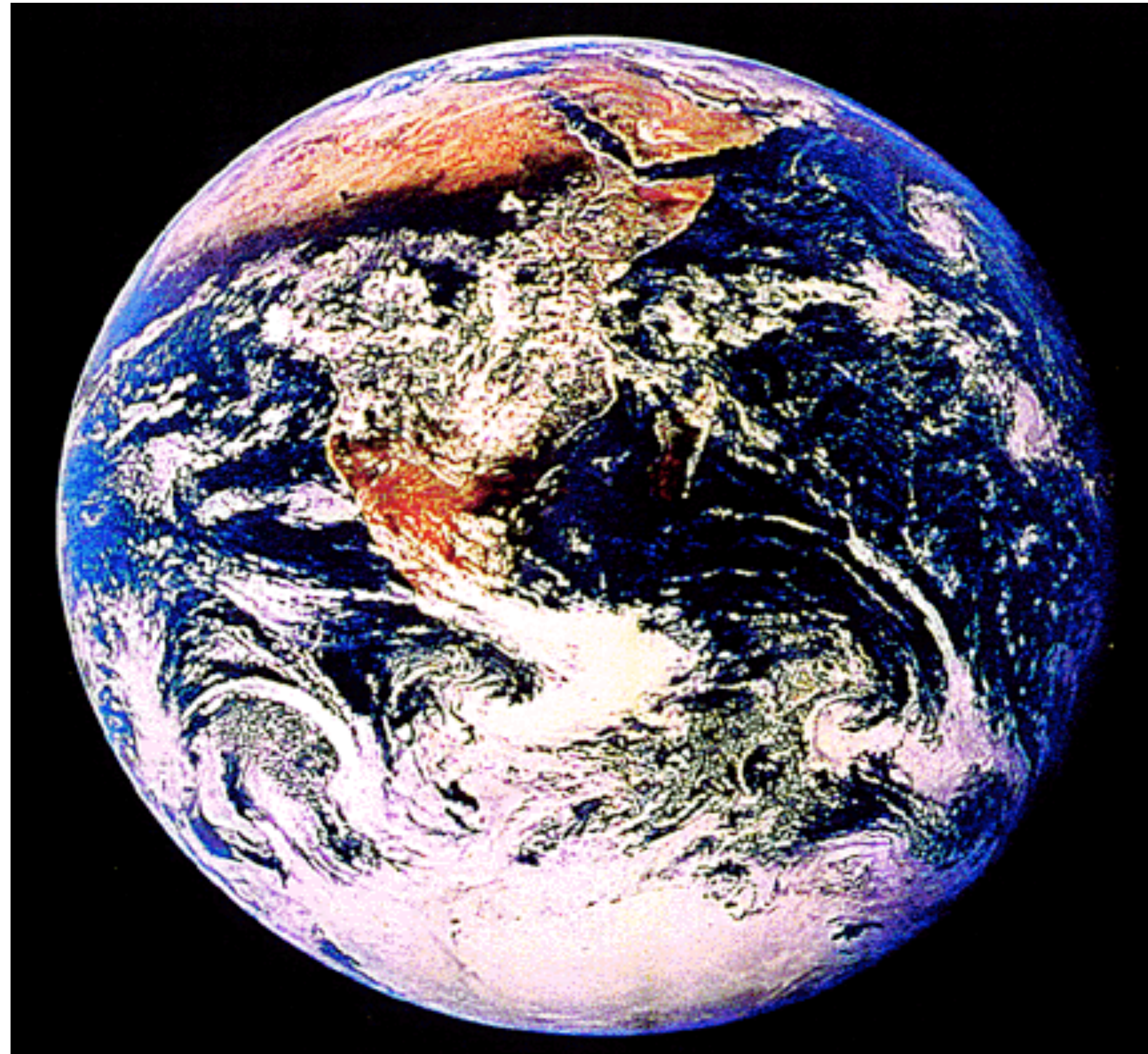
# What is wrong with these models?

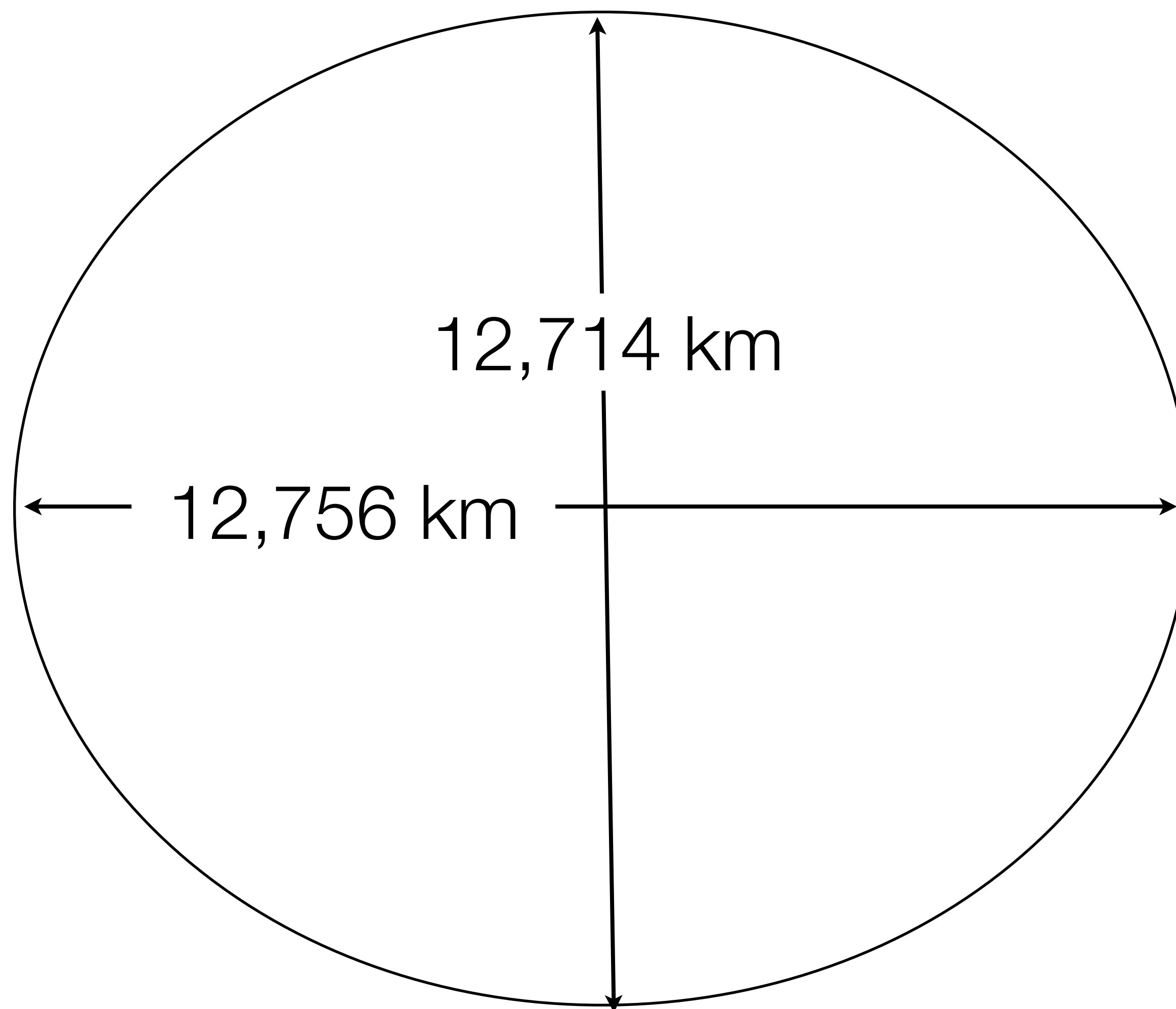


Bumps are too BIG



On an Earth Model - Oceans have no depth and  
Mountains have no height compared to the diameter of  
the Earth





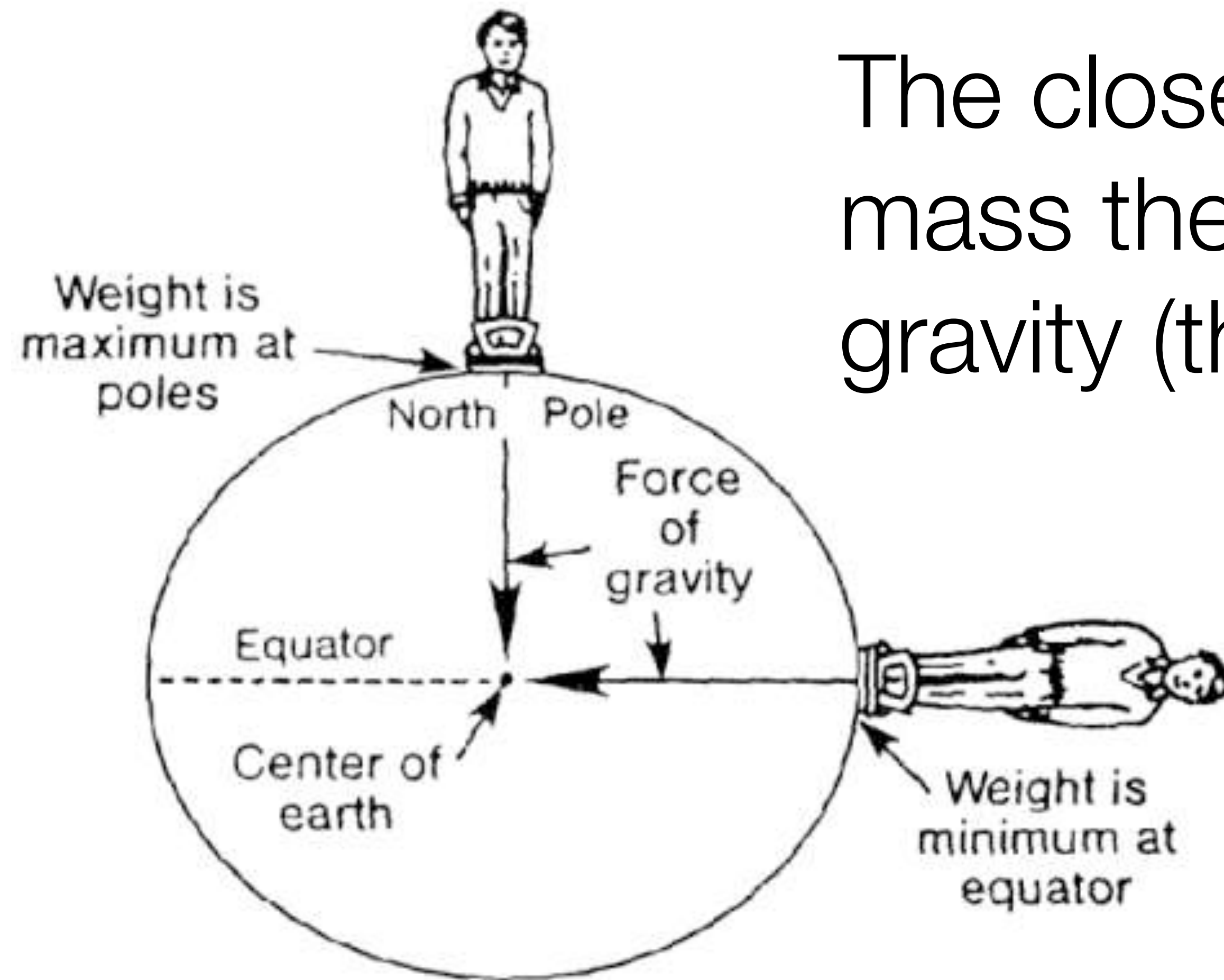
The **true shape** of the earth is an ***oblate spheroid***. Slightly wider at the equator.

# Oblate Sphere

This is caused by the earth's rotation.



# Gravity on an Oblate Sphere

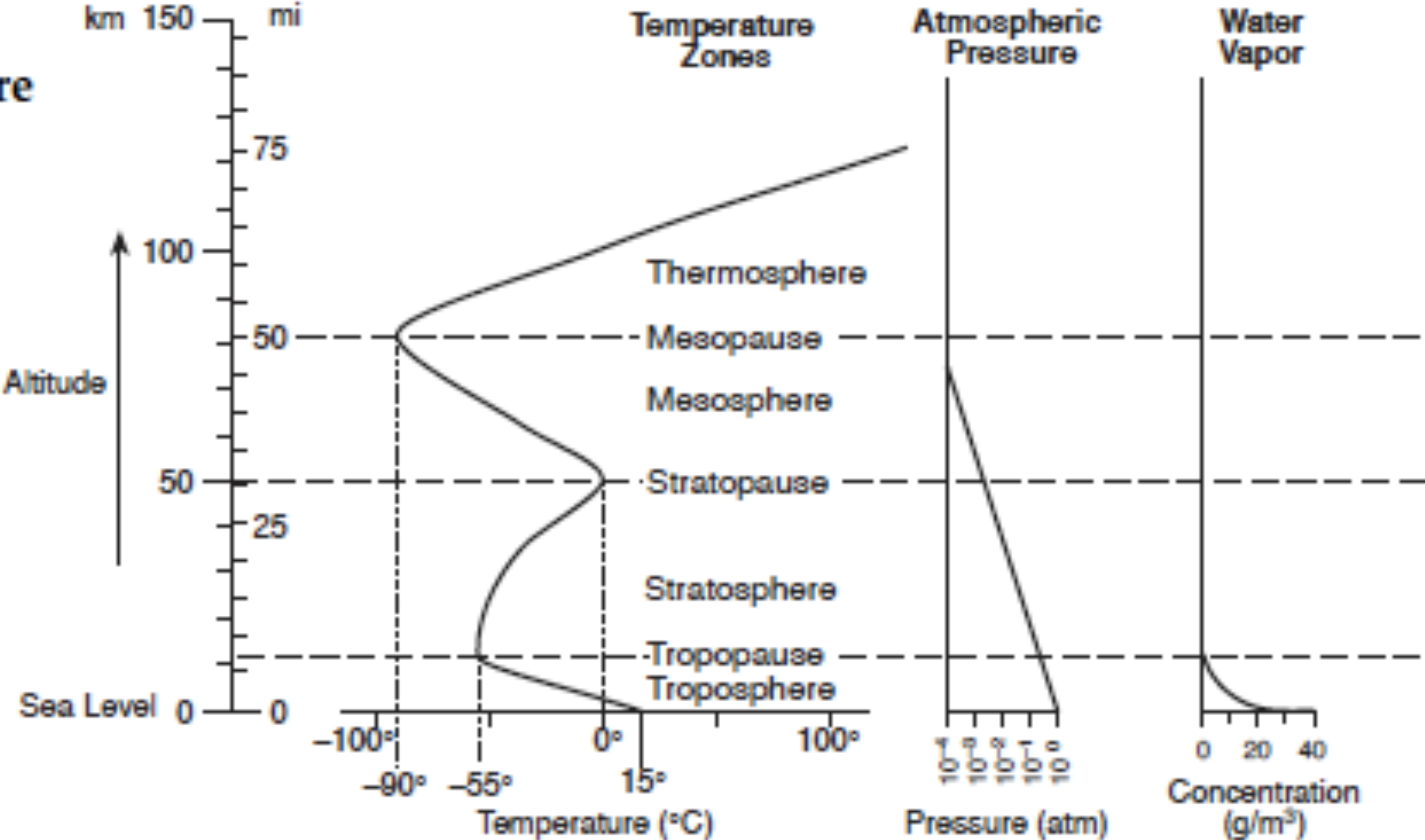


The closer to the center of the mass the greater the pull of gravity (the more you weigh)

## Average Chemical Composition of Earth's Crust, Hydrosphere, and Troposphere

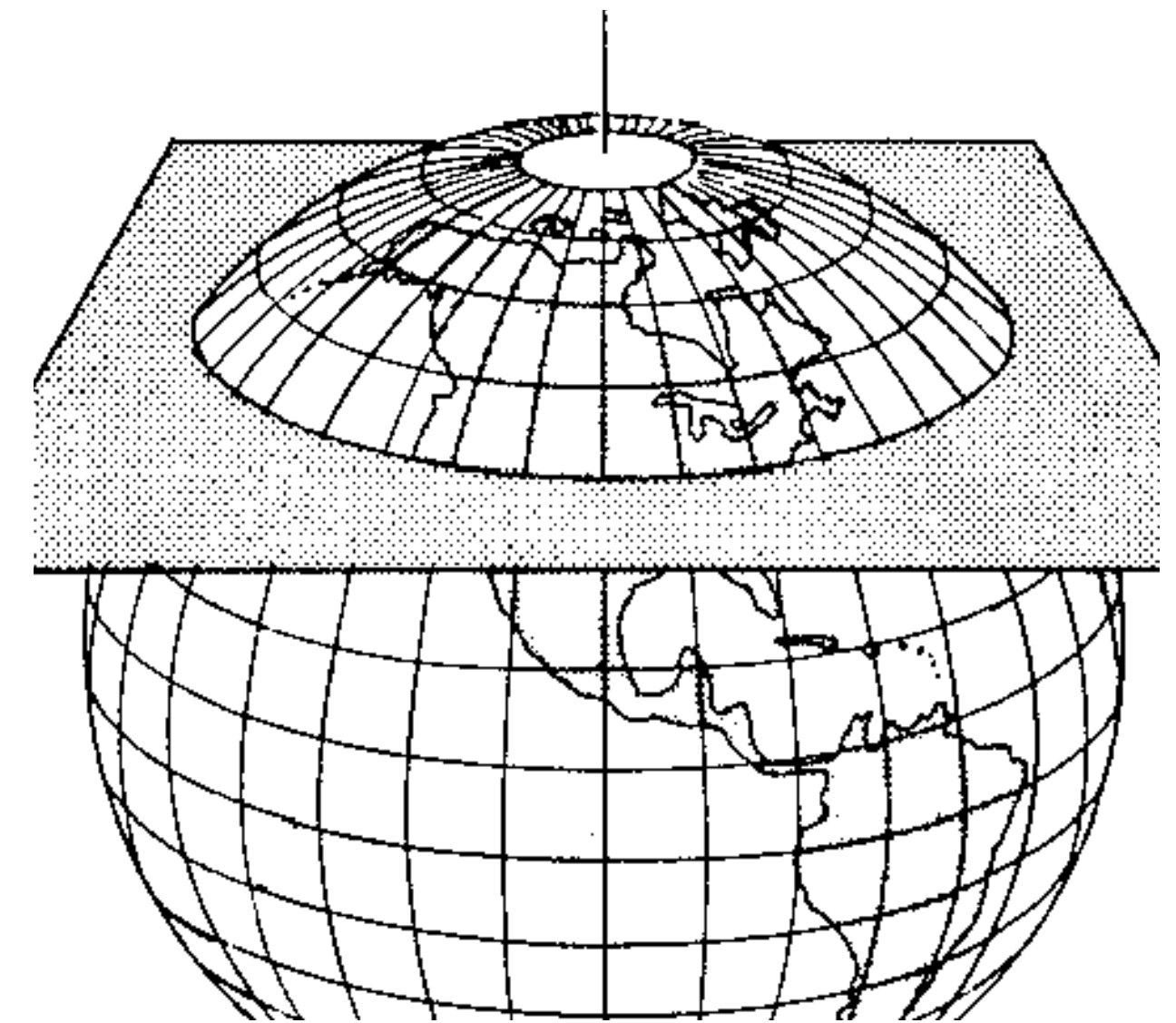
| ELEMENT<br>(symbol) | CRUST              |                      | HYDROSPHERE          | TROPOSPHERE          |
|---------------------|--------------------|----------------------|----------------------|----------------------|
|                     | Percent by<br>Mass | Percent by<br>Volume | Percent by<br>Volume | Percent by<br>Volume |
| Oxygen (O)          | 46.40              | 94.04                | 33.0                 | 21.0                 |
| Silicon (Si)        | 28.15              | 0.88                 |                      |                      |
| Aluminum (Al)       | 8.23               | 0.48                 |                      |                      |
| Iron (Fe)           | 5.63               | 0.49                 |                      |                      |
| Calcium (Ca)        | 4.15               | 1.18                 |                      |                      |
| Sodium (Na)         | 2.36               | 1.11                 |                      |                      |
| Magnesium (Mg)      | 2.33               | 0.33                 |                      |                      |
| Potassium (K)       | 2.09               | 1.42                 |                      |                      |
| Nitrogen (N)        |                    |                      |                      | 78.0                 |
| Hydrogen (H)        |                    |                      | 66.0                 |                      |
| Other               | 0.66               | 0.07                 | 1.0                  | 1.0                  |

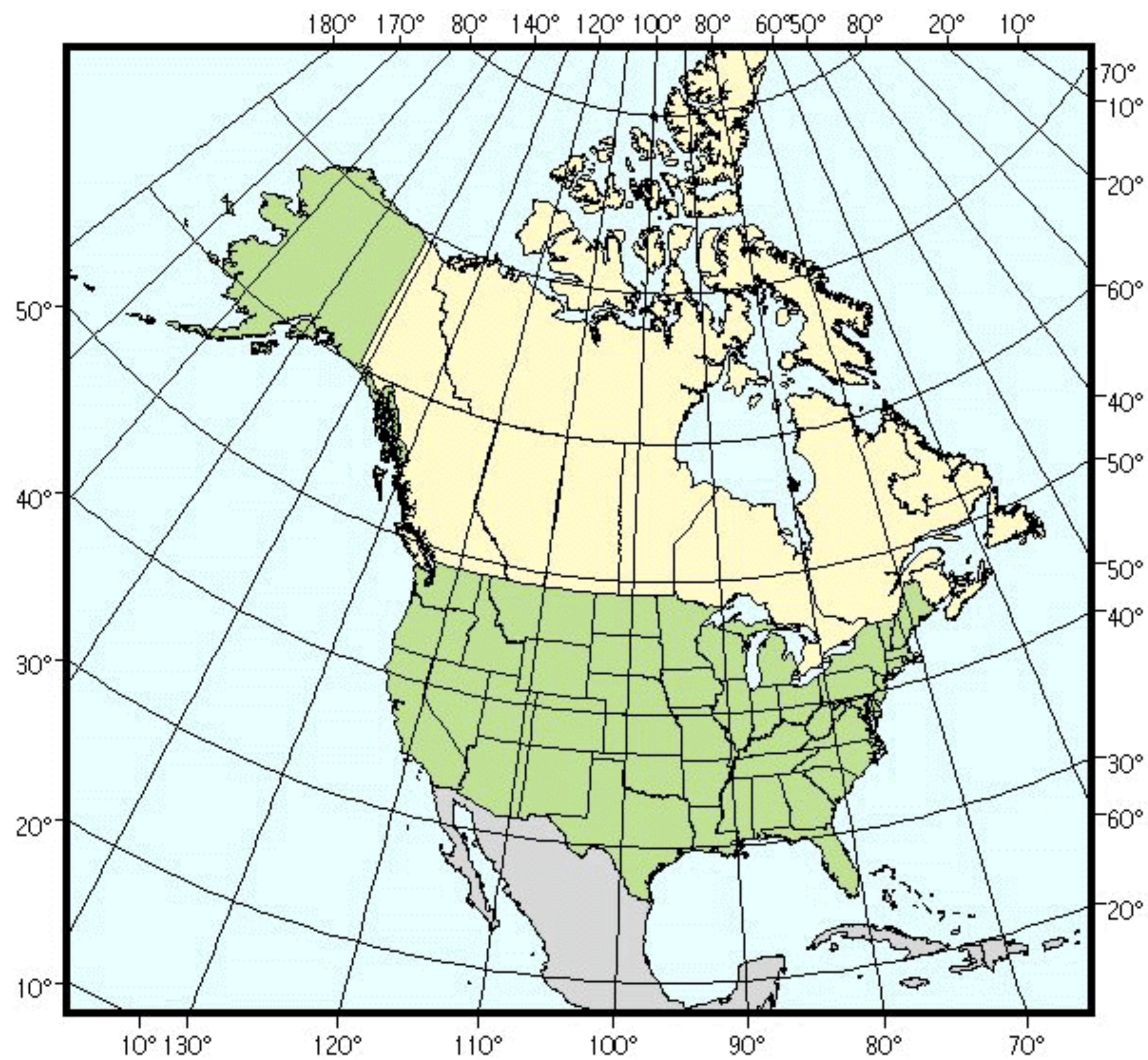
# Selected Properties of Earth's Atmosphere



# Coordinate System

- Grid system of imaginary lines
- Allows us to find specific locations on Earth.
- Based on the Earth's rotation.
- Latitude, then Longitude (**alphabetically**).
- Expressed in degrees, minutes (60 to a degree), seconds.

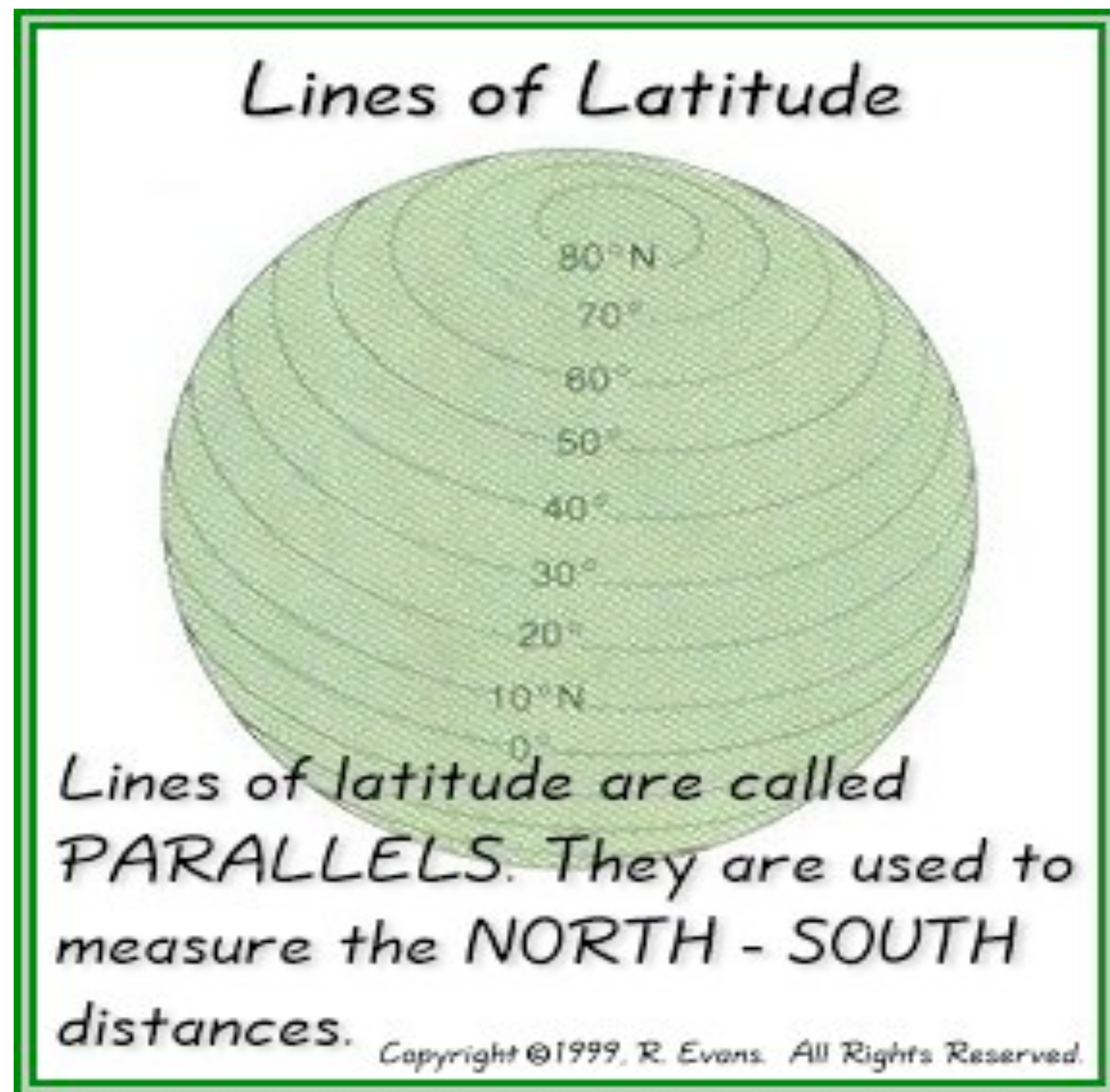




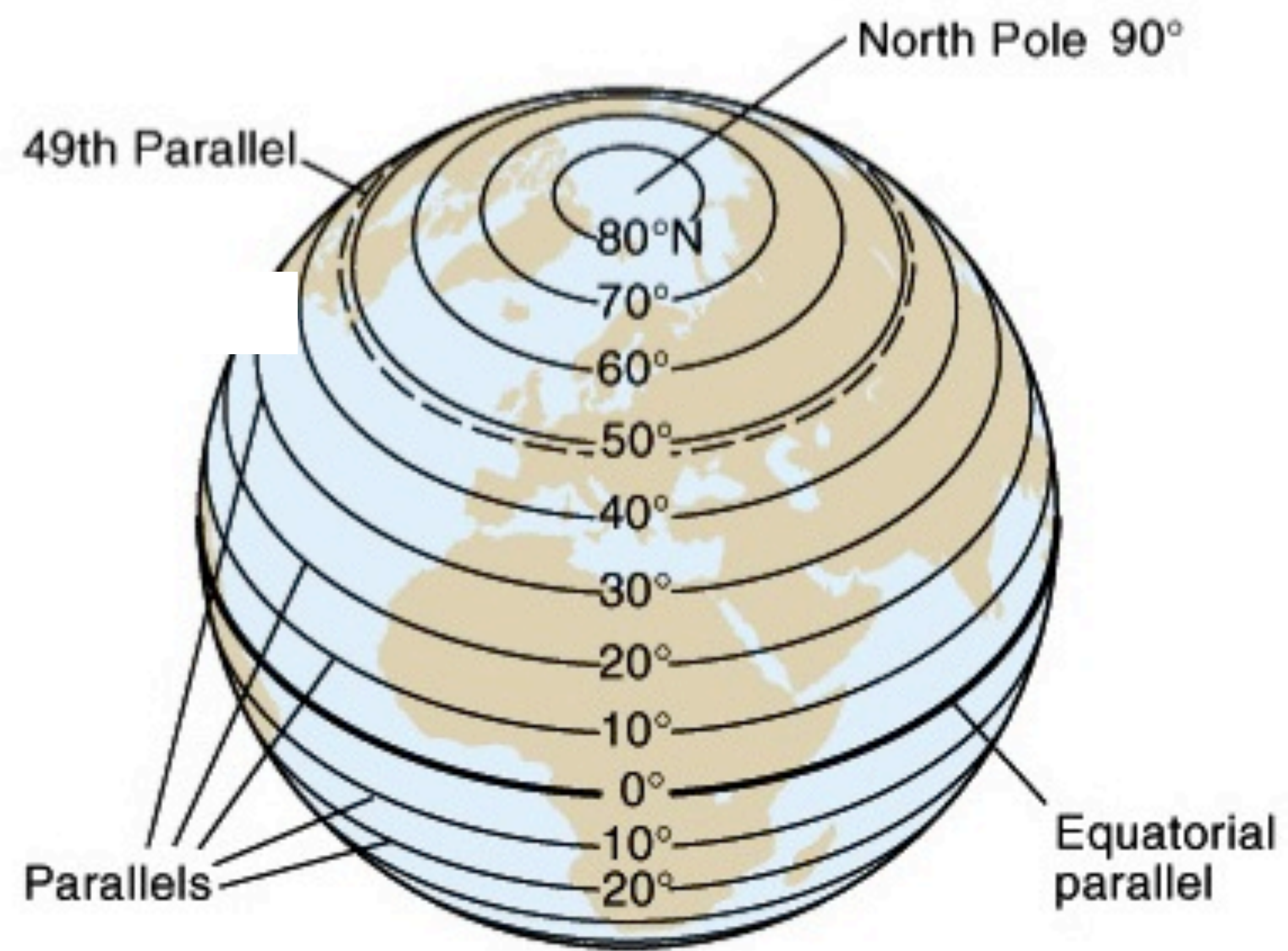
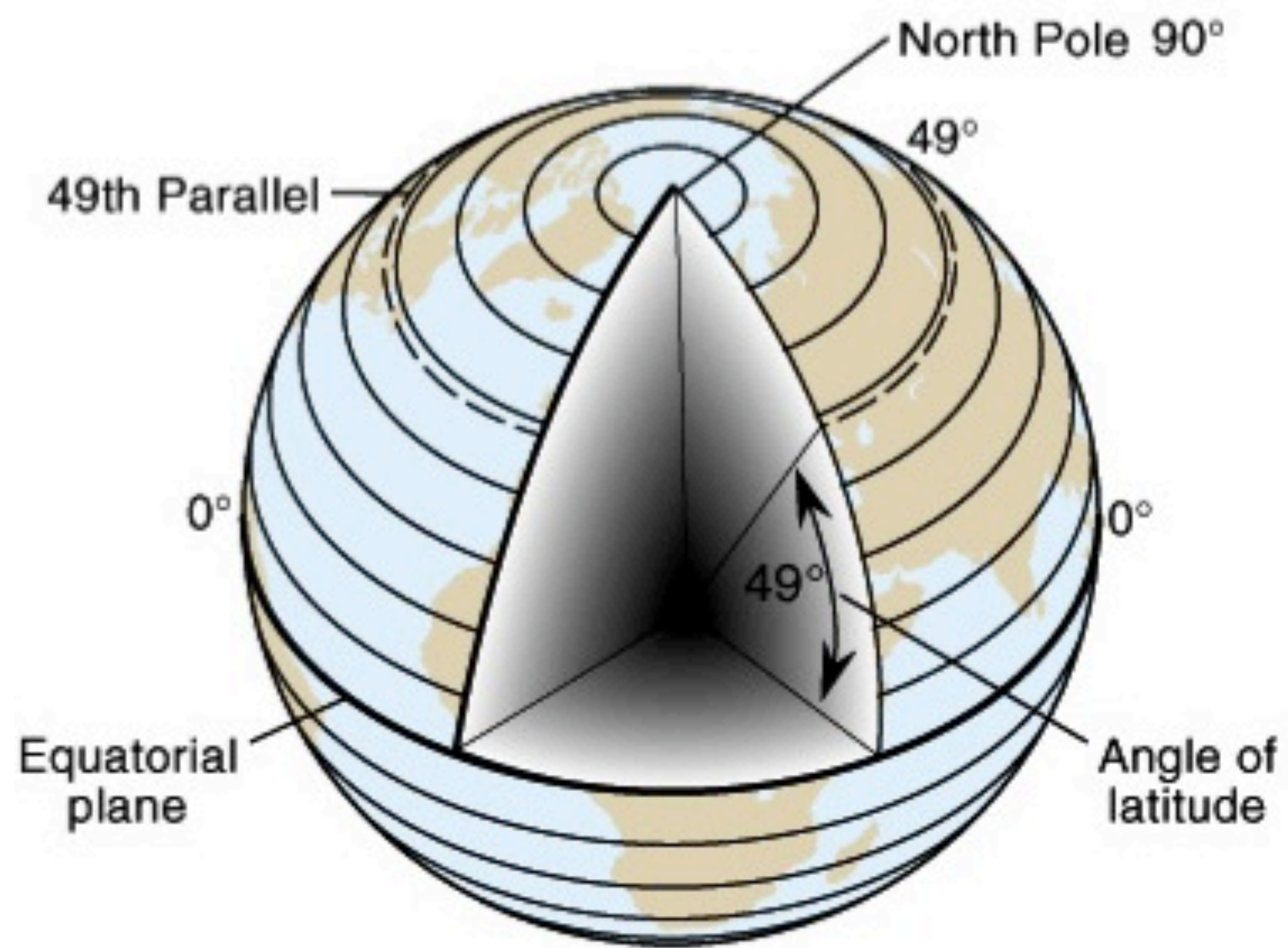
# Latitude

(side to side, like the rungs of a ladder)

NEVER INTERSECT = called PARALLELS

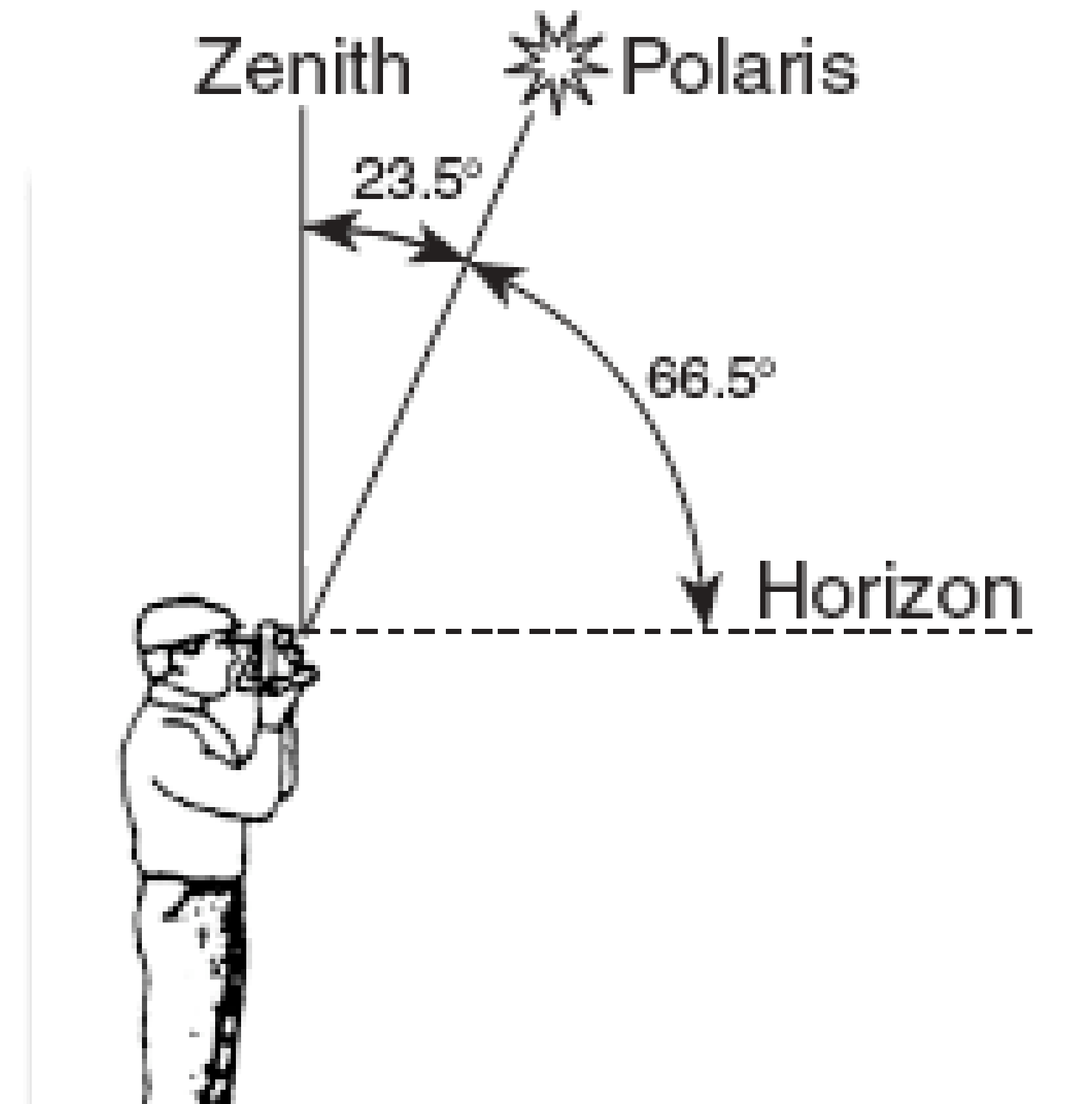


- The distance, in degrees, **north** or **south** of the equator
- Equator =  $0^{\circ}$  latitude
- North Pole =  $90^{\circ}$  north latitude
- South Pole =  $90^{\circ}$  south latitude



# Measuring Latitude

- In the northern hemisphere (north of the equator), we can determine our latitude by measuring the altitude of the star Polaris (the North Star).

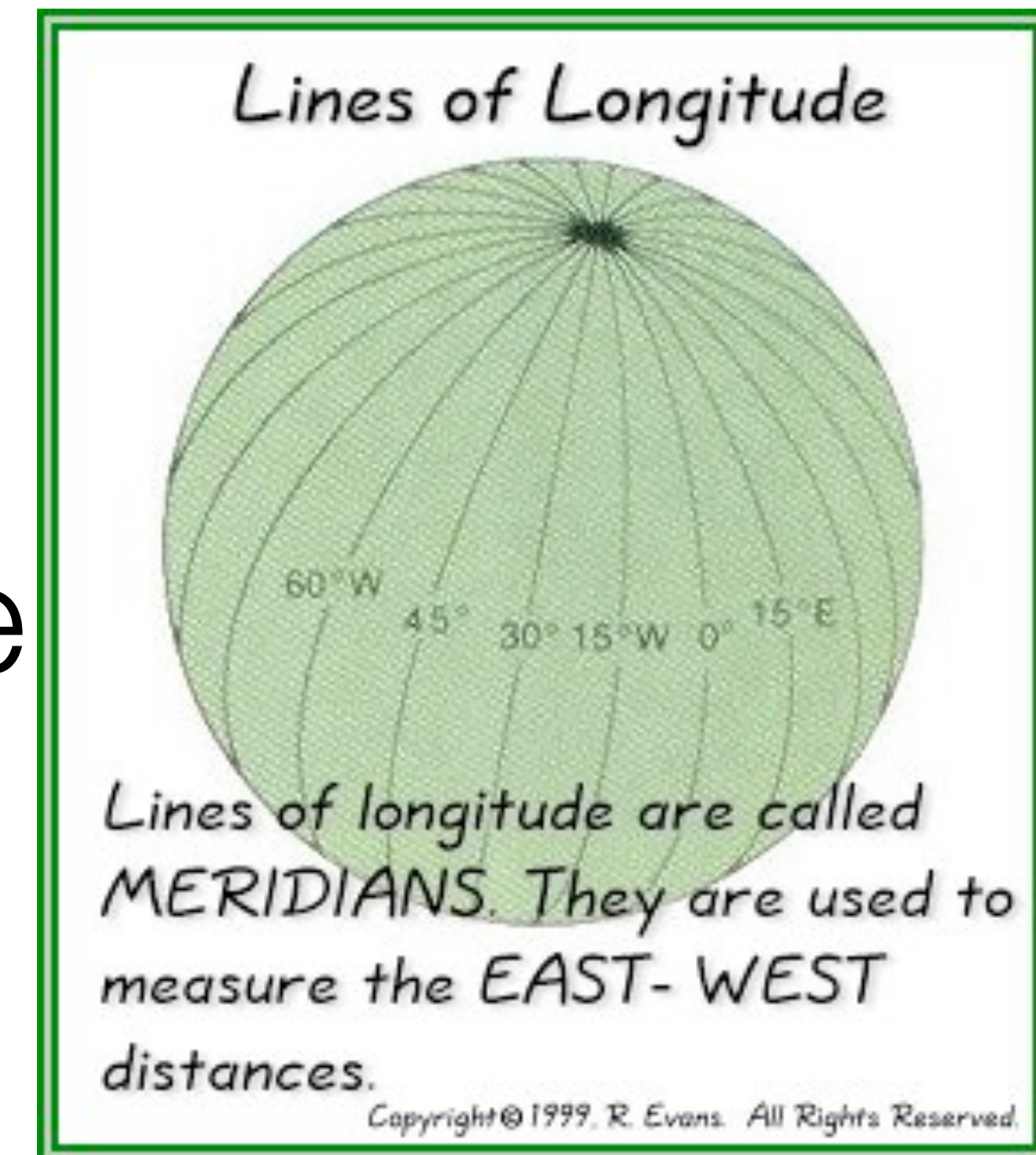


$$\text{ALTITUDE} = \text{LATITUDE}$$

# Longitude

(Pole to Pole, “Long Lines”)

- ▶ The distance, in degrees, **east** or **west** of the Prime Meridian, which passes through Greenwich, England
- ▶ Prime Meridian =  $0^{\circ}$  longitude
- ▶ Increases to  $180^{\circ}$  to the east and west
- ▶ The International Dateline =  $180^{\circ}$  longitude



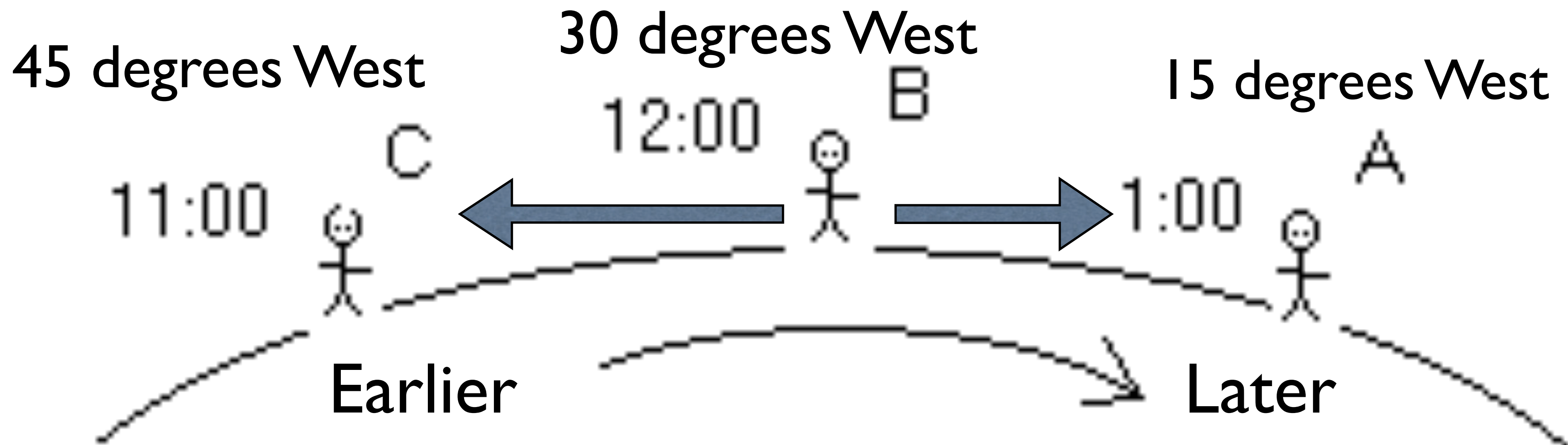


# Measuring Longitude

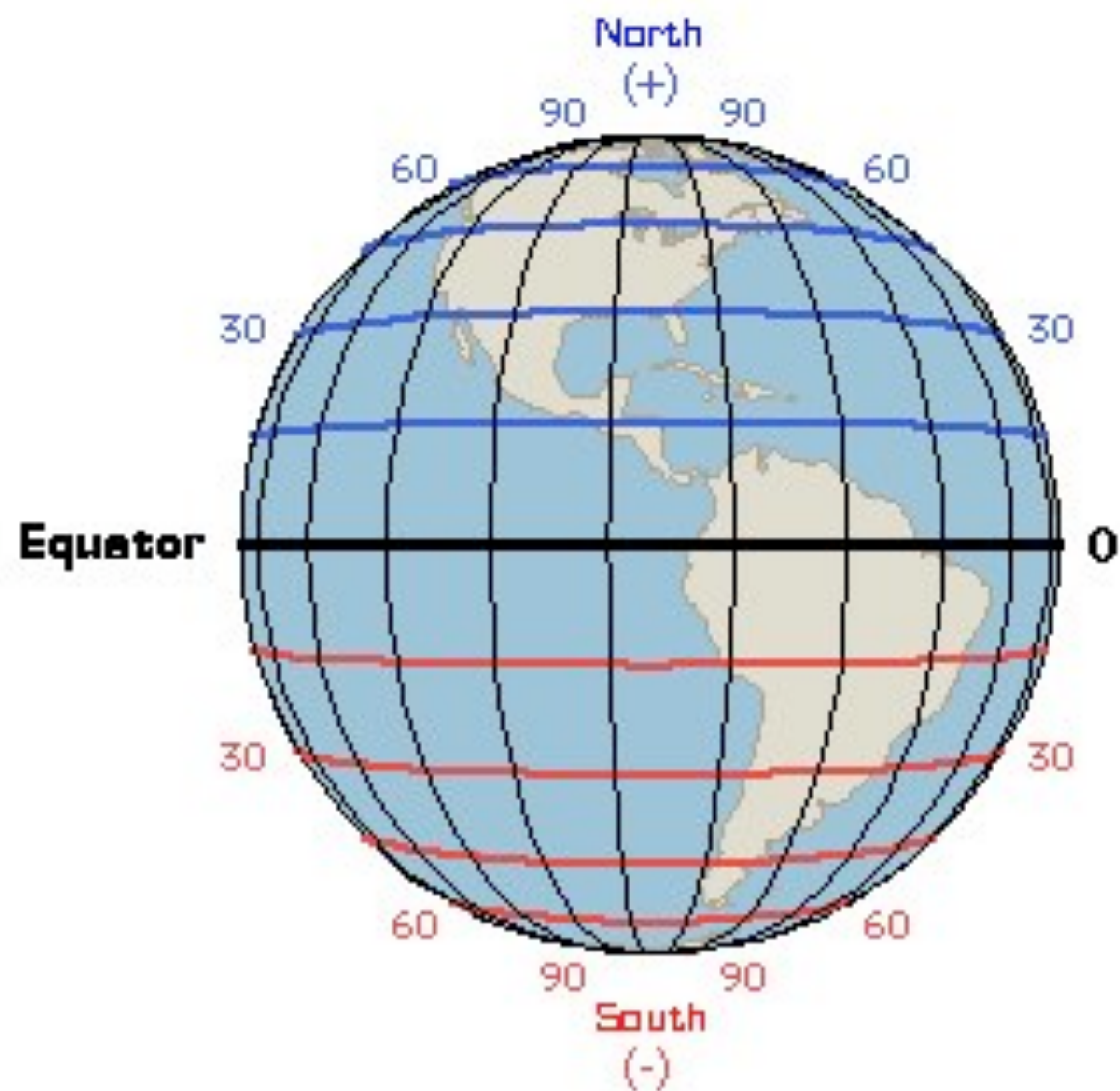
- Use a ***chronometer***, a very accurate clock displaying the time at the Prime Meridian.
- Earth spins at  $360^\circ$  every 24 hours, which is equal to  **$15^\circ$  per hour**.
- By comparing the time where you are to the time at the Prime meridian, you can determine how far east or west of the Primer Meridian you are.

# Longitude & Telling Time

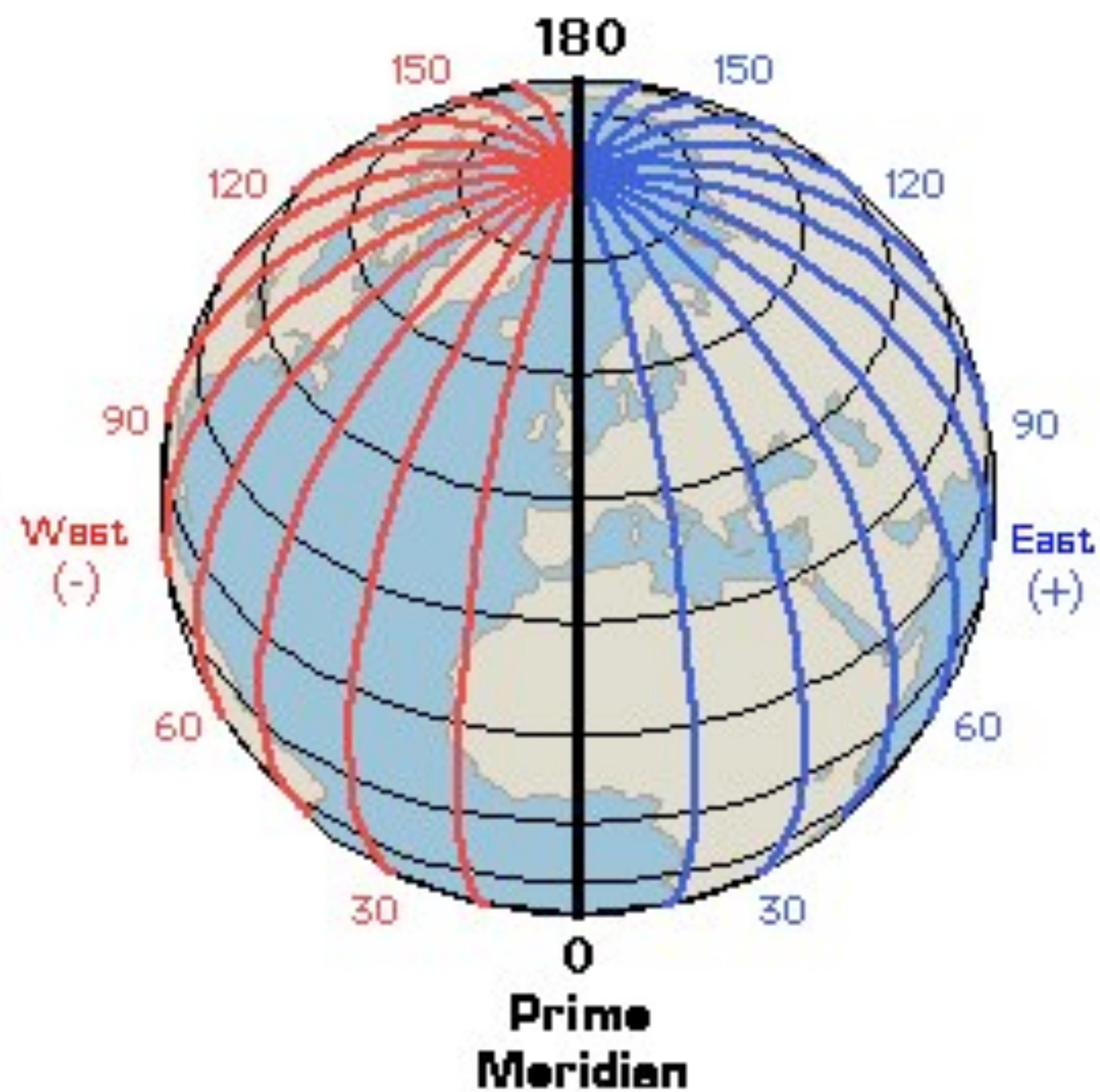
- ▶ All points along the same longitude line are the same time.
- ▶ Every 15 degrees = 1 hour.
- ▶ As you go **East** Time does **increase** (later in the day).
- ▶ As you go **West** Time does become **less** (earlier).



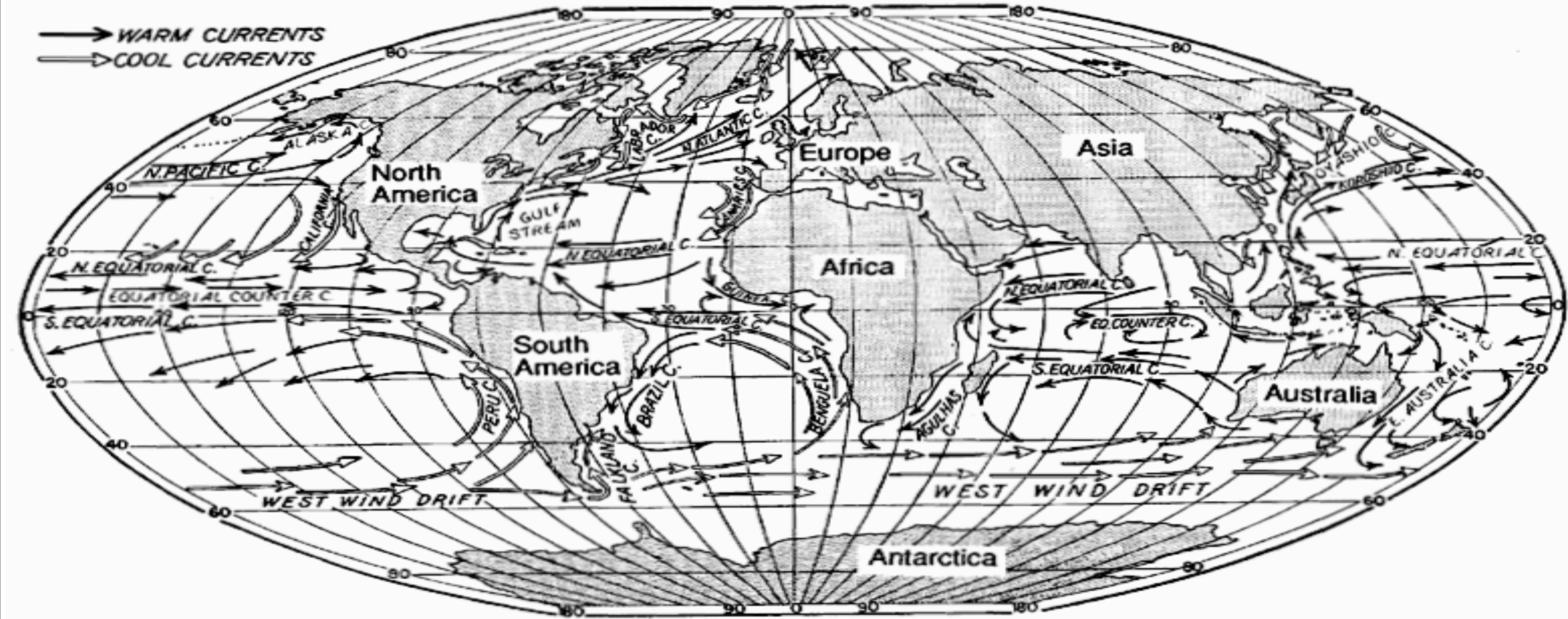
## Latitude

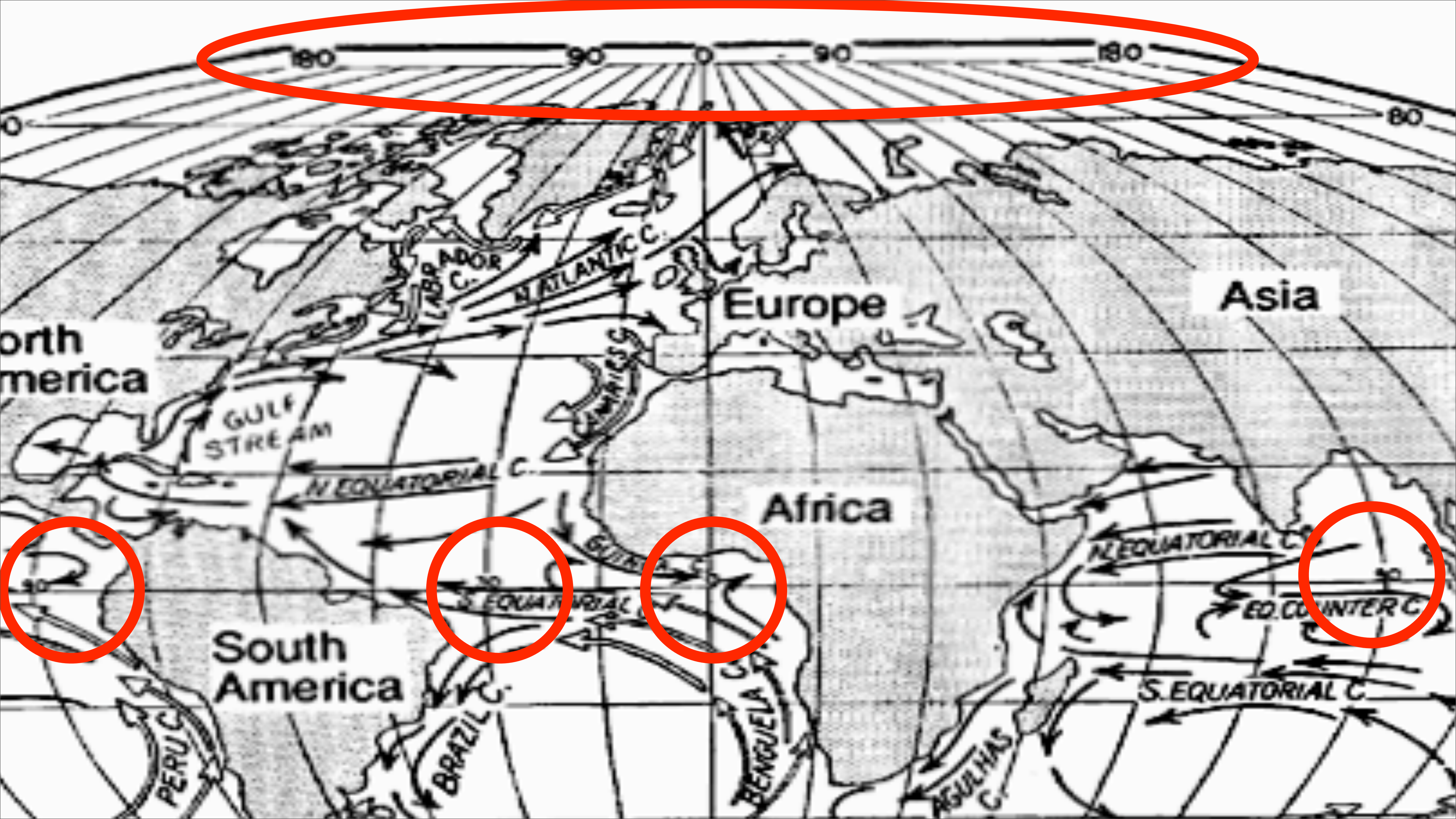


## Longitude

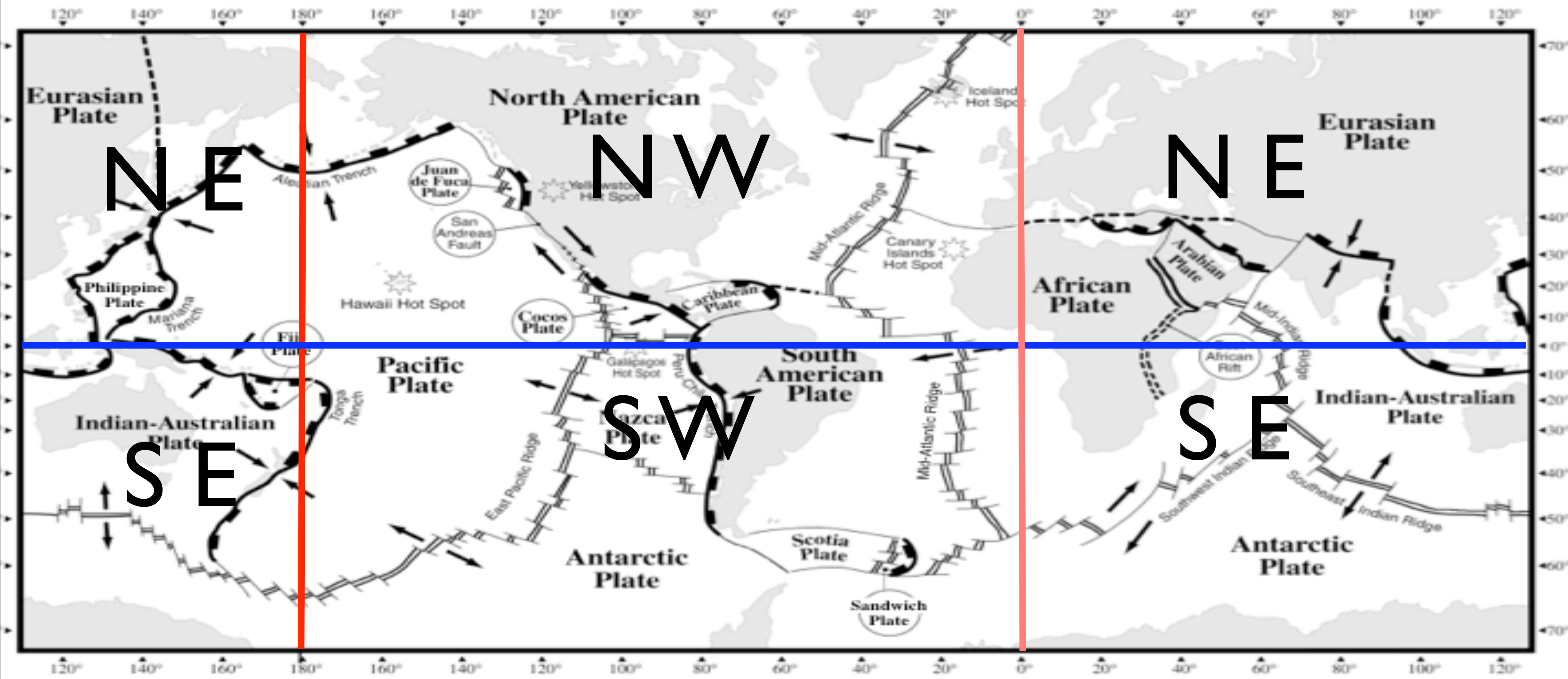


## Surface Ocean Currents





# Tectonic Plates



Divergent Plate Boundary  
(usually broken by transform  
faults along mid-ocean ridges)

overriding plate  
subducting plate  
Convergent Plate Boundary  
(Subduction Zone)

Transform Plate Boundary  
(Transform Fault)

Complex or Uncertain  
Plate Boundary

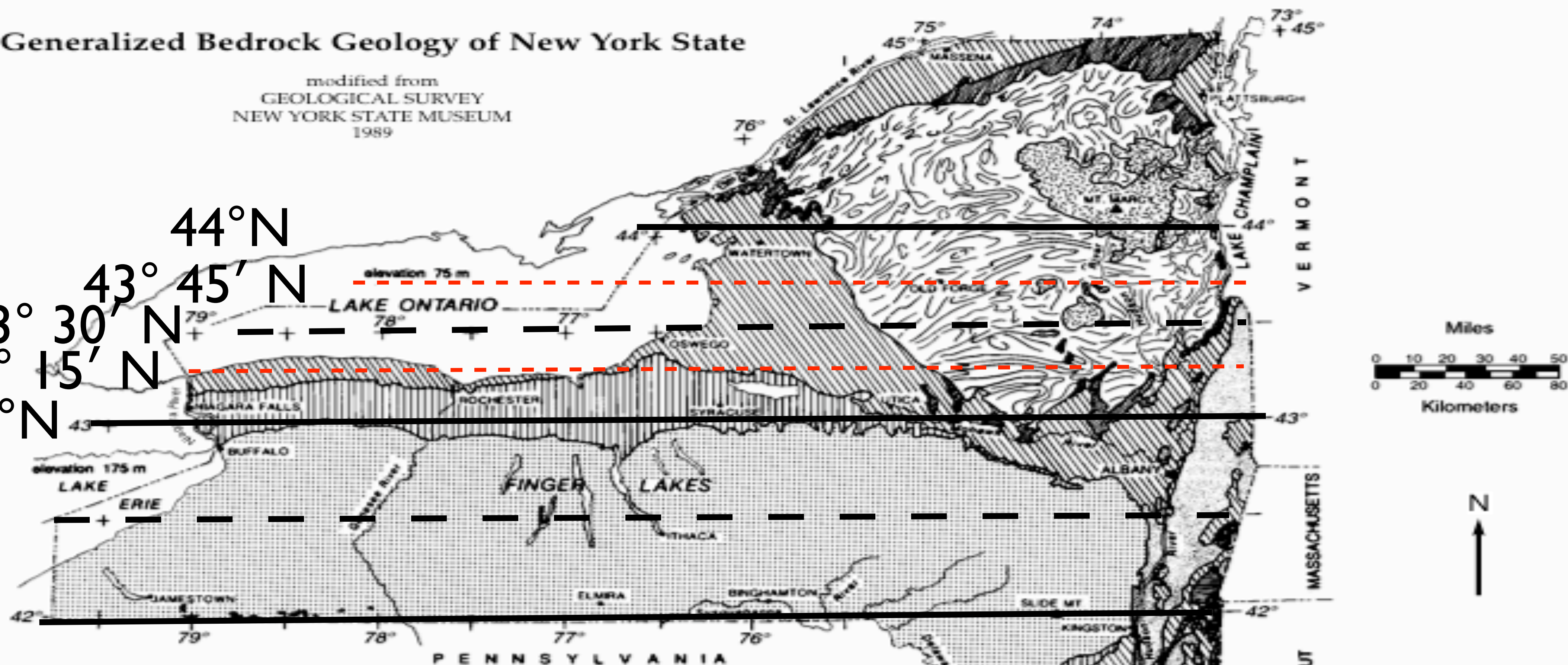
Relative Motion  
at Plate Boundary

Mantle  
Hot Spot

# Generalized Bedrock Geology of New York State

modified from  
GEOLOGICAL SURVEY  
NEW YORK STATE MUSEUM  
1989

44°N  
43° 45' N  
43° 30' N  
43° 15' N  
43°N



## GEOLOGIC PERIODS AND ERAS IN NEW YORK

|  |                                                                                                                |
|--|----------------------------------------------------------------------------------------------------------------|
|  | CRETACEOUS, PALEOCENE, and NEOGENE (weakly consolidated to unconsolidated gravels, sands, and clays)           |
|  | LATE TRIASSIC to JURASSIC (conglomerates, red sandstones, red shales, and a diabase (in the Plattsburgh Sill)) |
|  | PENNSYLVANIAN and MISSISSIPPIAN (conglomerates, sandstones, and shales)                                        |
|  | DEVONIAN (limestones, shales, sandstones, and conglomerates)                                                   |
|  | SILURIAN (limestones, shales, and sandstones)                                                                  |
|  | ORDOVICIAN (limestones, shales, sandstones, and dolostones)                                                    |
|  | CAMBRIAN (limestones, shales, sandstones, and dolostones)                                                      |
|  | CAMBRIAN and EARLY ORDOVICIAN (limestones and dolostones)                                                      |
|  | CAMBRIAN and ORDOVICIAN (undifferentiated) (quartzites, dolostones, marbles, and schists)                      |
|  | TACONIC SEQUENCE (sandstones, shales, and slates)                                                              |
|  | MIDDLE PROTEROZOIC (gneisses, quartzites, and marbles)                                                         |
|  | MIDDLE PROTEROZOIC anorthositic rocks                                                                          |

Dominantly  
Sedimentary  
Origin

Dominantly  
Metamorphosed  
Rocks

**Intensely Metamorphosed Rocks**  
(regional metamorphism about 1,000 m.y.a.)

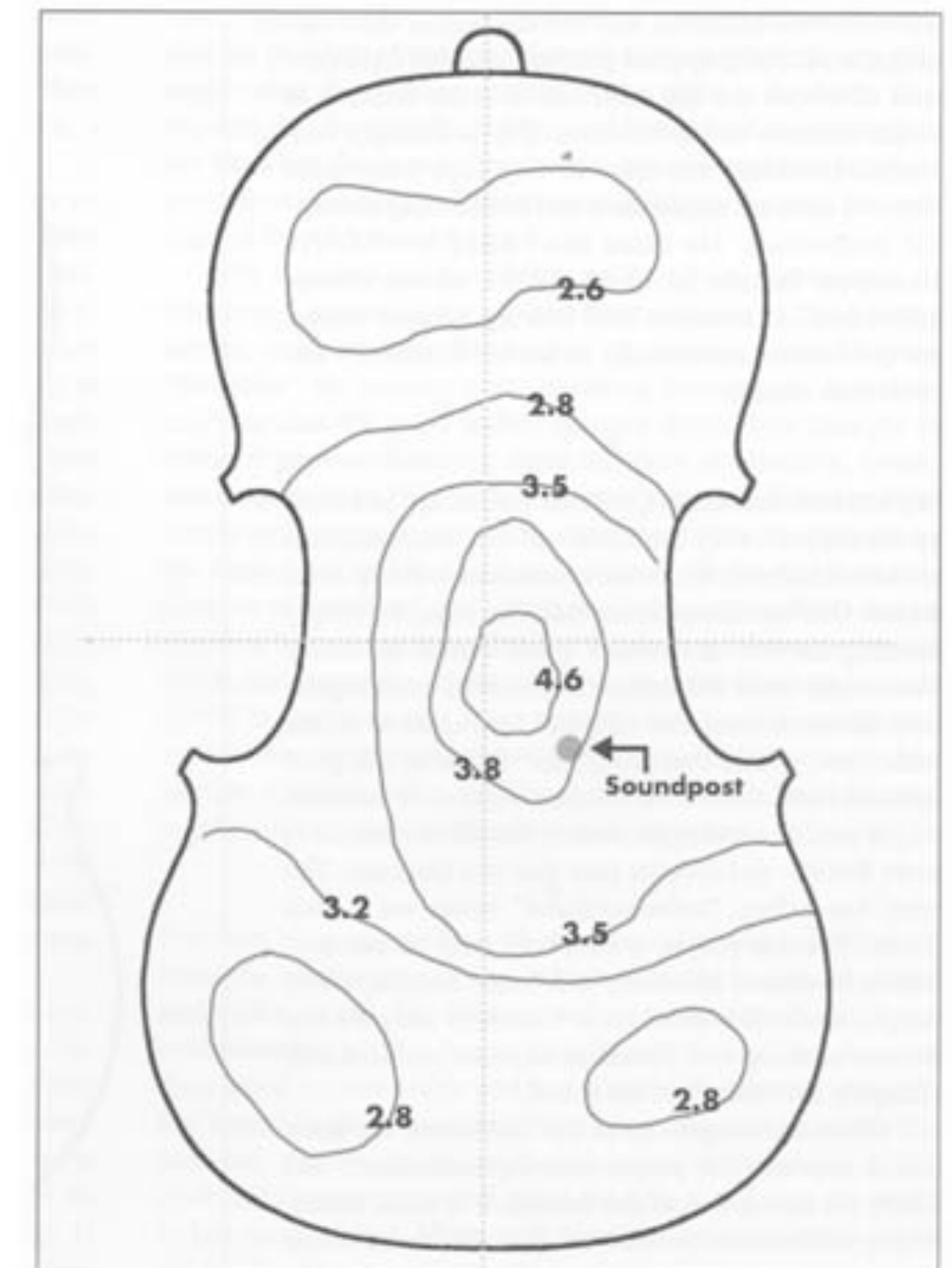
# Review- How To Determine Latitude and Longitude

- 1 Latitude and Longitude is measured in degrees and minutes
- 2 1 degree equals 60 minutes
- 3 On maps, 60 minutes are divided into increments of 15, 30, 45 minutes
- 4 Latitude value is written first and Longitude value is written second
- 5 Example: 42 degrees North, 77 degrees 30 minutes West

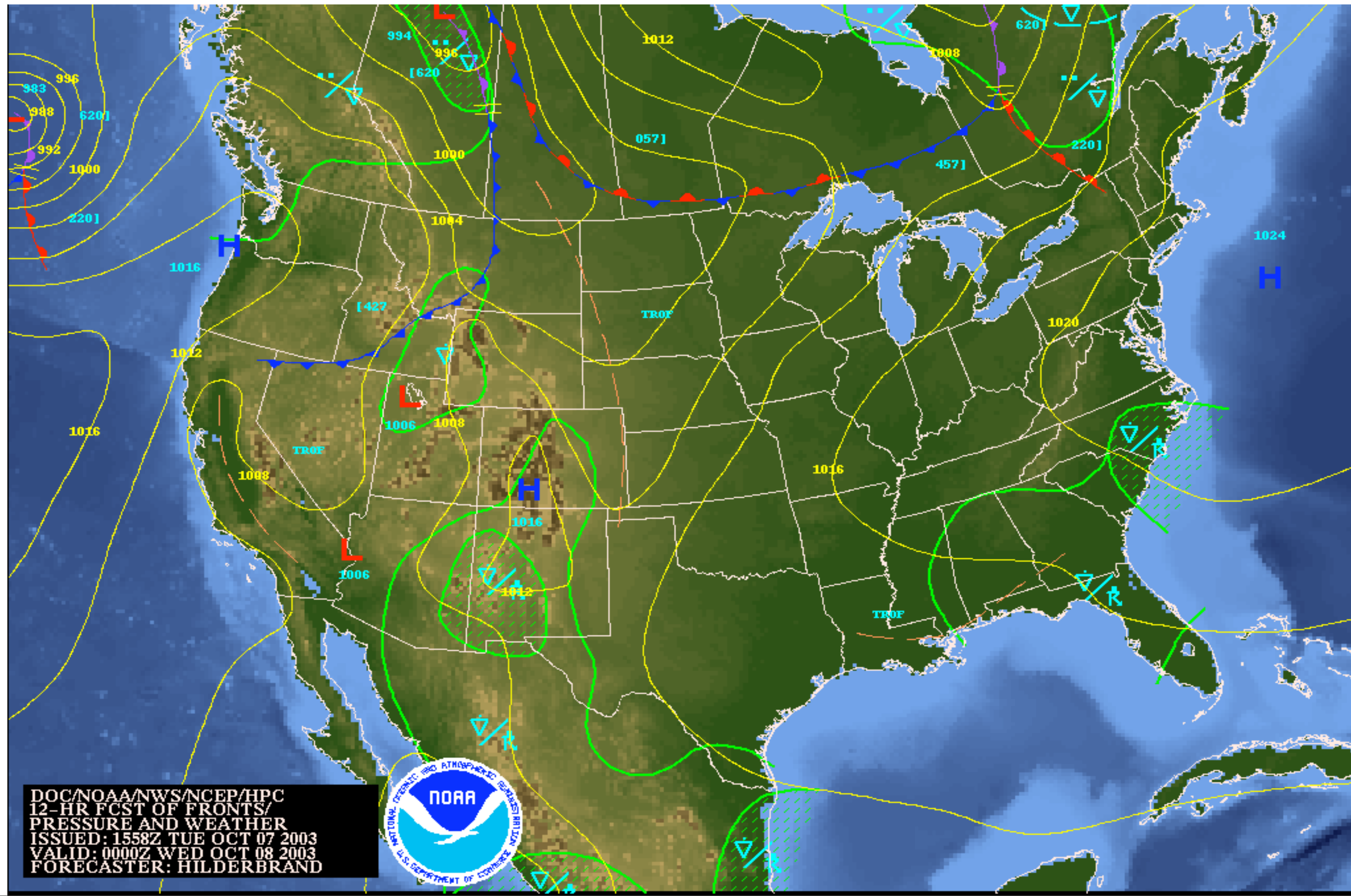
# Mapping Fields and Topographic Maps

# Fields

- A field is a map upon which something is measured
- **Isolines** connect points of equal value on a map
  - equal temperature- **isotherms**
  - equal pressure- **isobars**
  - equal elevation- **contour lines**
- Concentration of chemicals
- Anything else for which you can get a value.

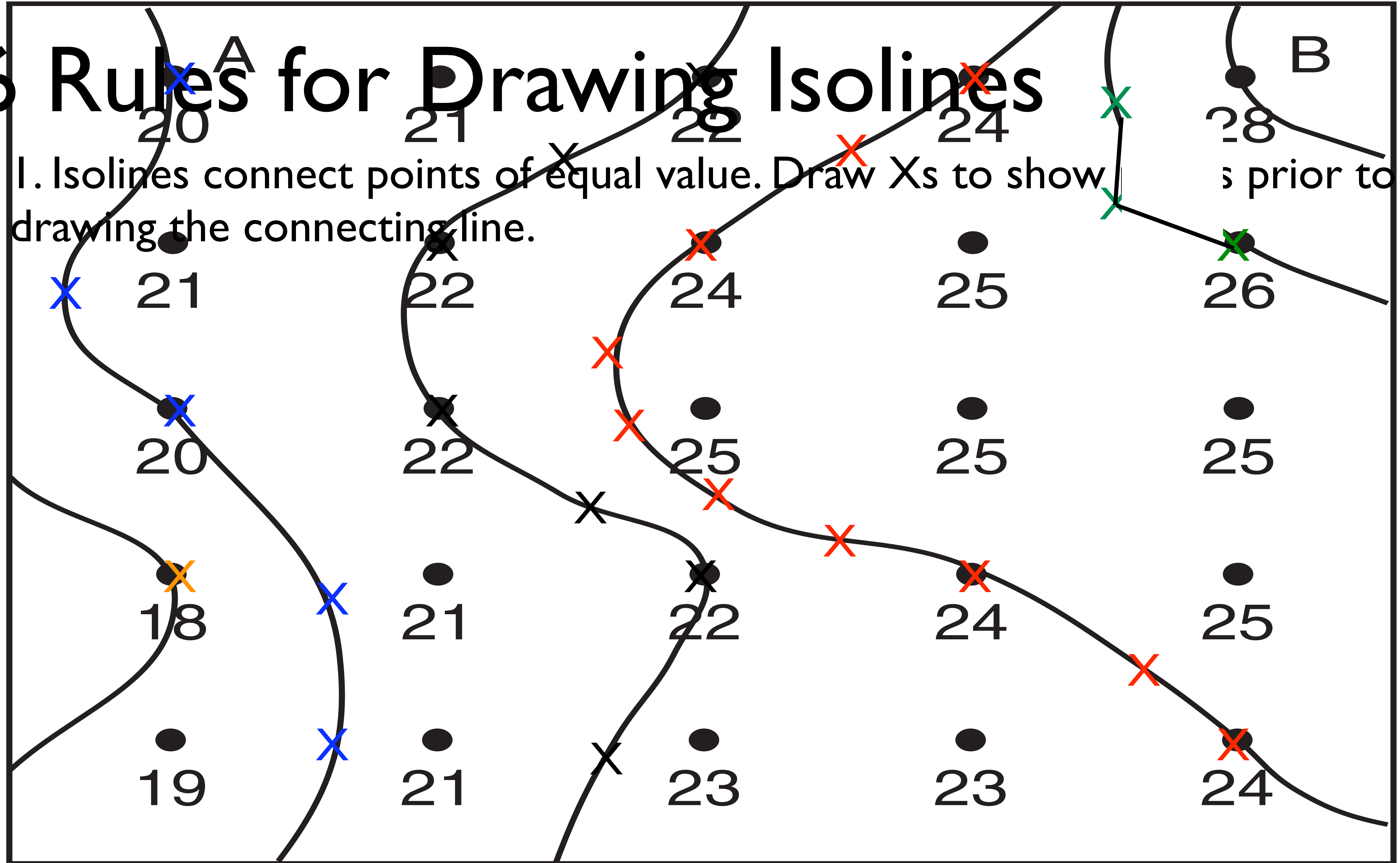


# Isobars measure Pressure



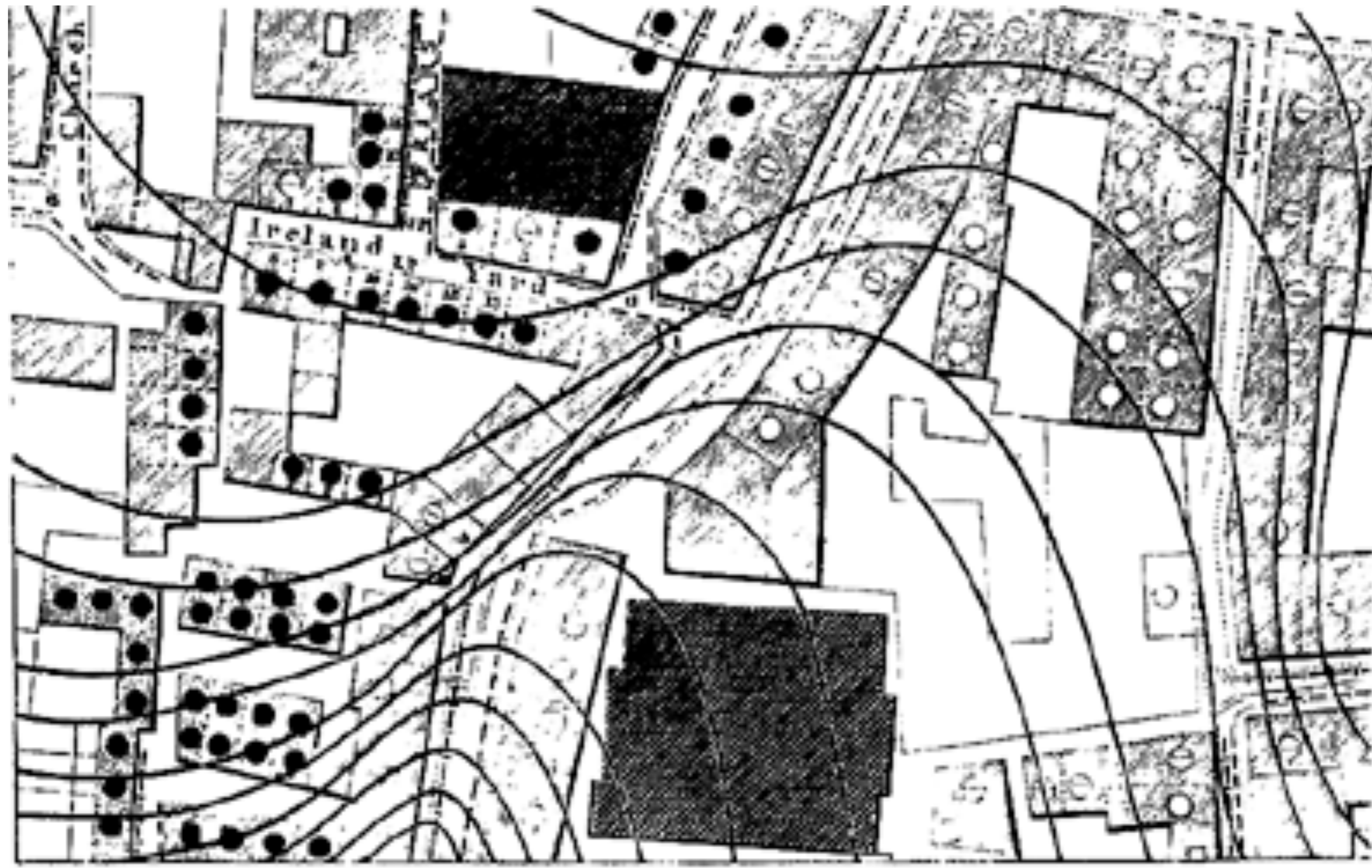
# 6 Rules for Drawing Isolines

I. Isolines connect points of equal value. Draw Xs to show points prior to drawing the connecting line.



# 6 Rules for Drawing Isolines

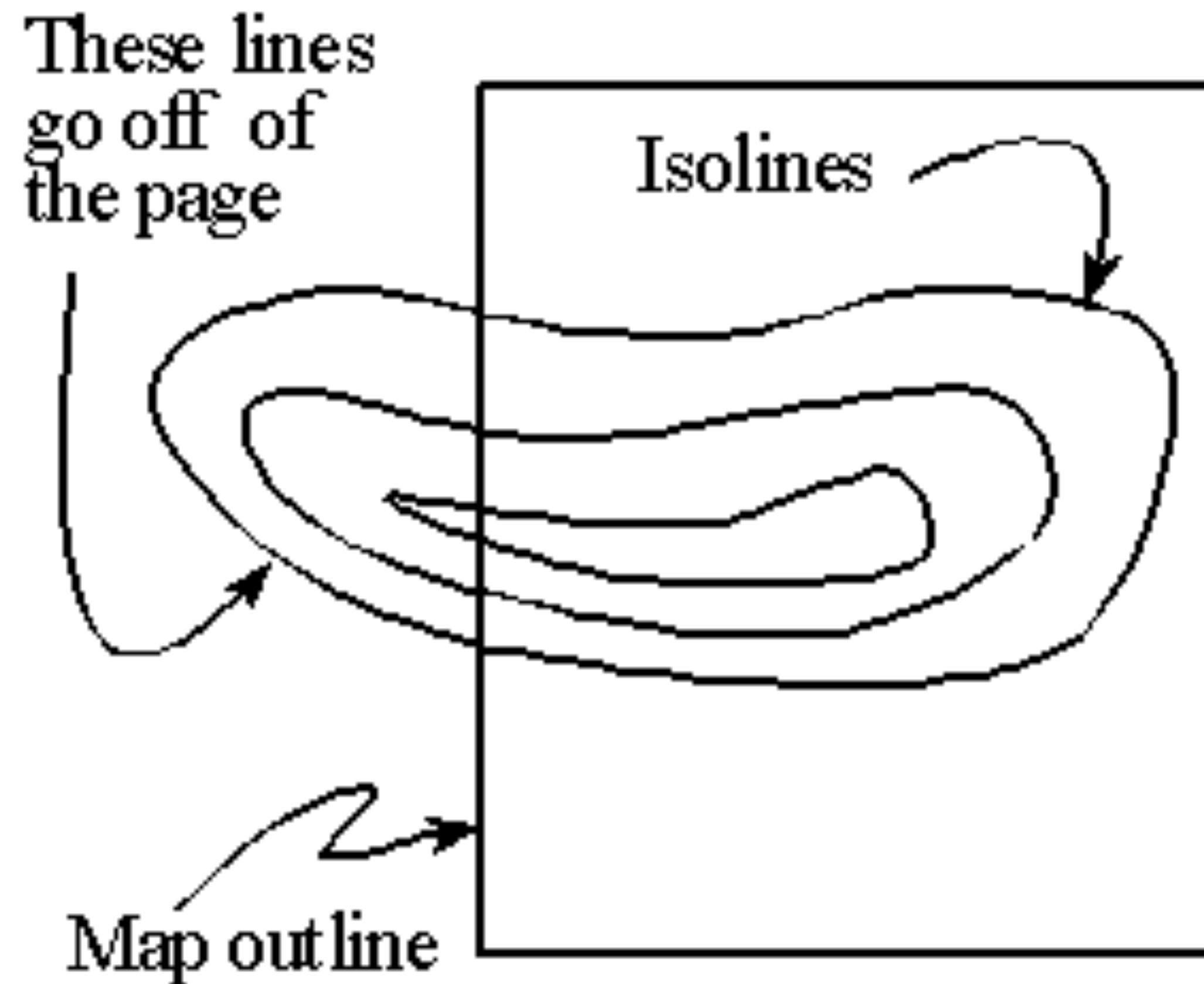
2. Isolines are gentle, curving lines - no sharp corners.



# 6 Rules for Drawing Isolines

3. Isolines are always closed curves even though the map might only show part of it.

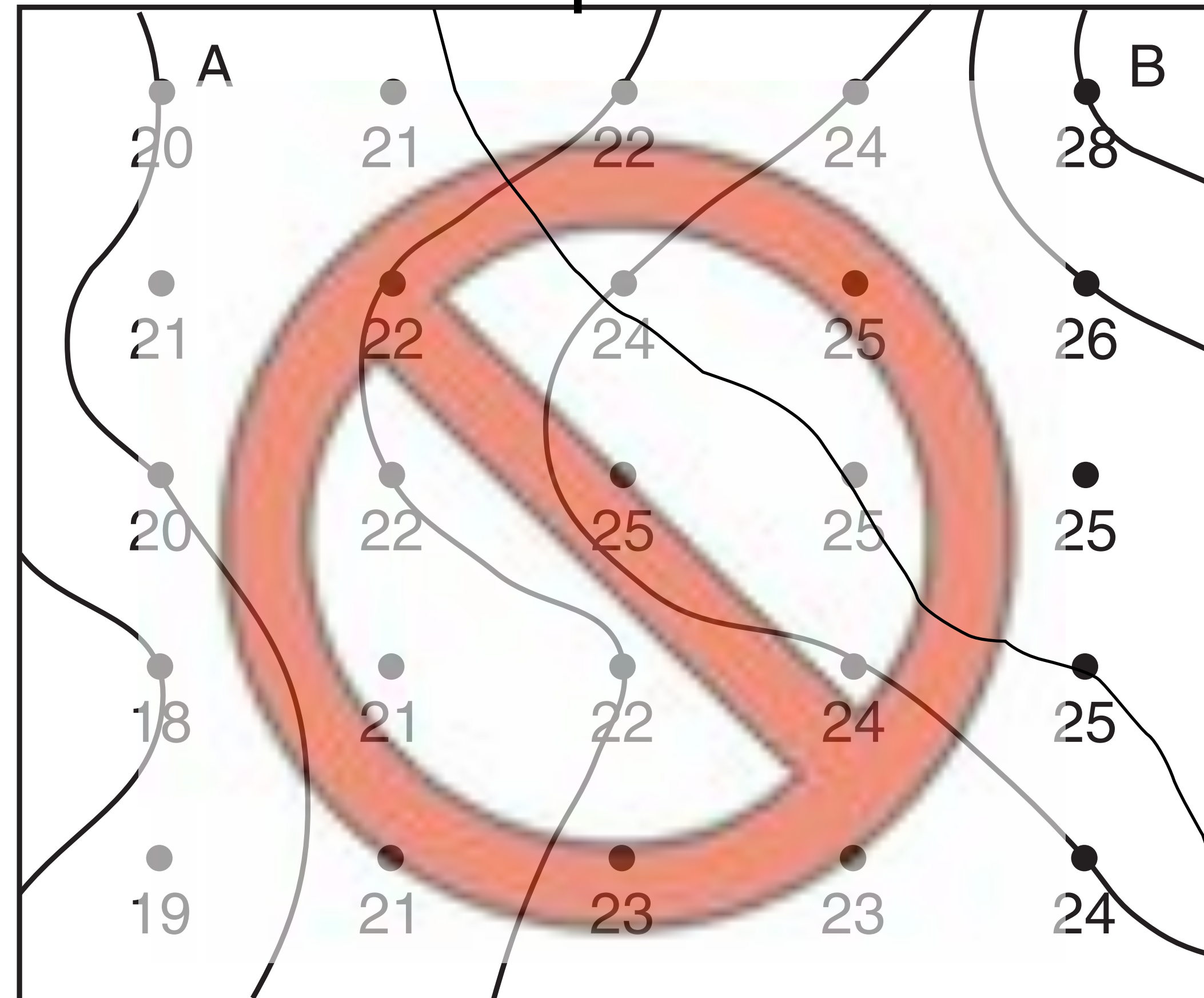
Isolines must connect back to themselves or run-off the map



# 6 Rules for Drawing Isolines

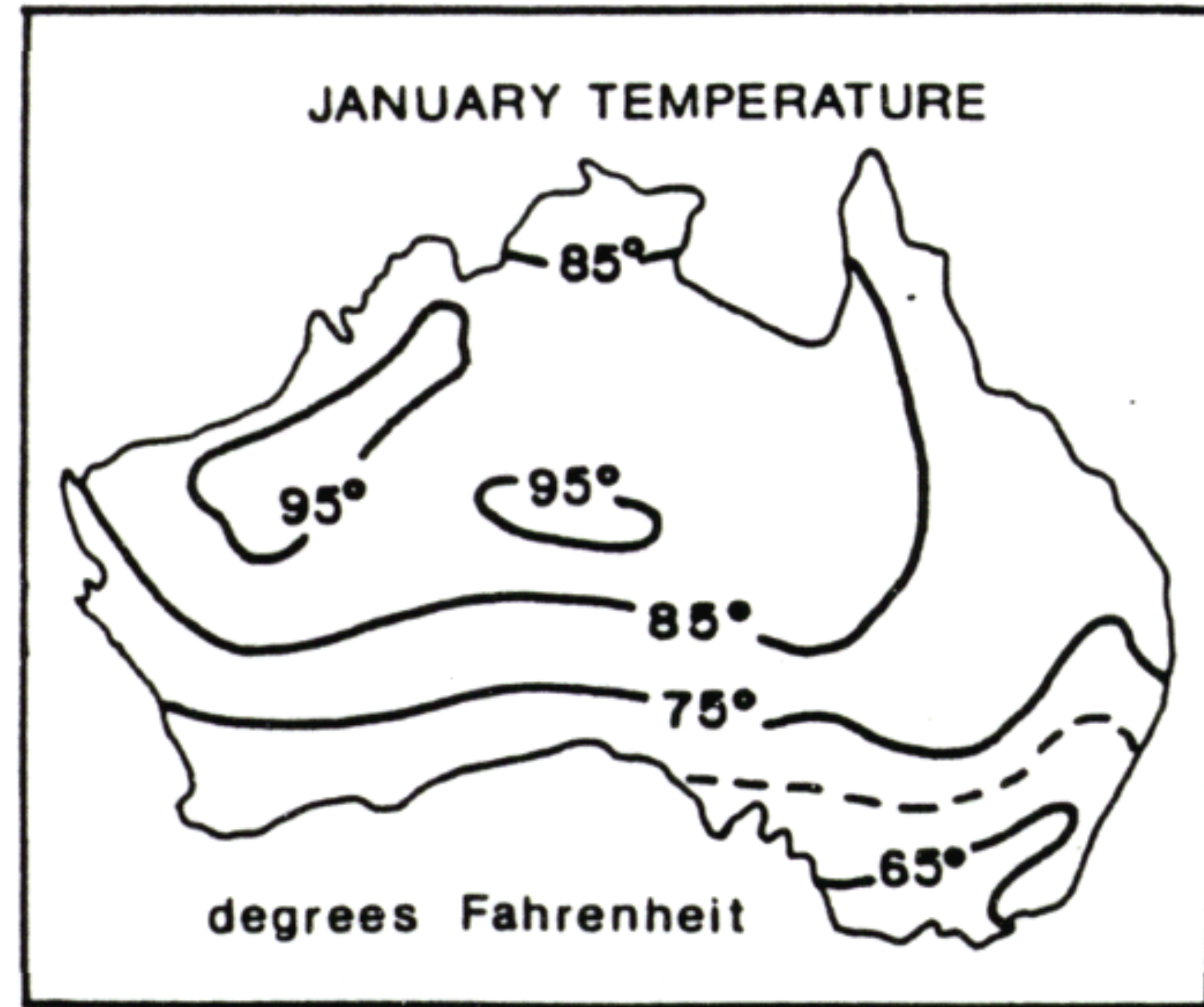
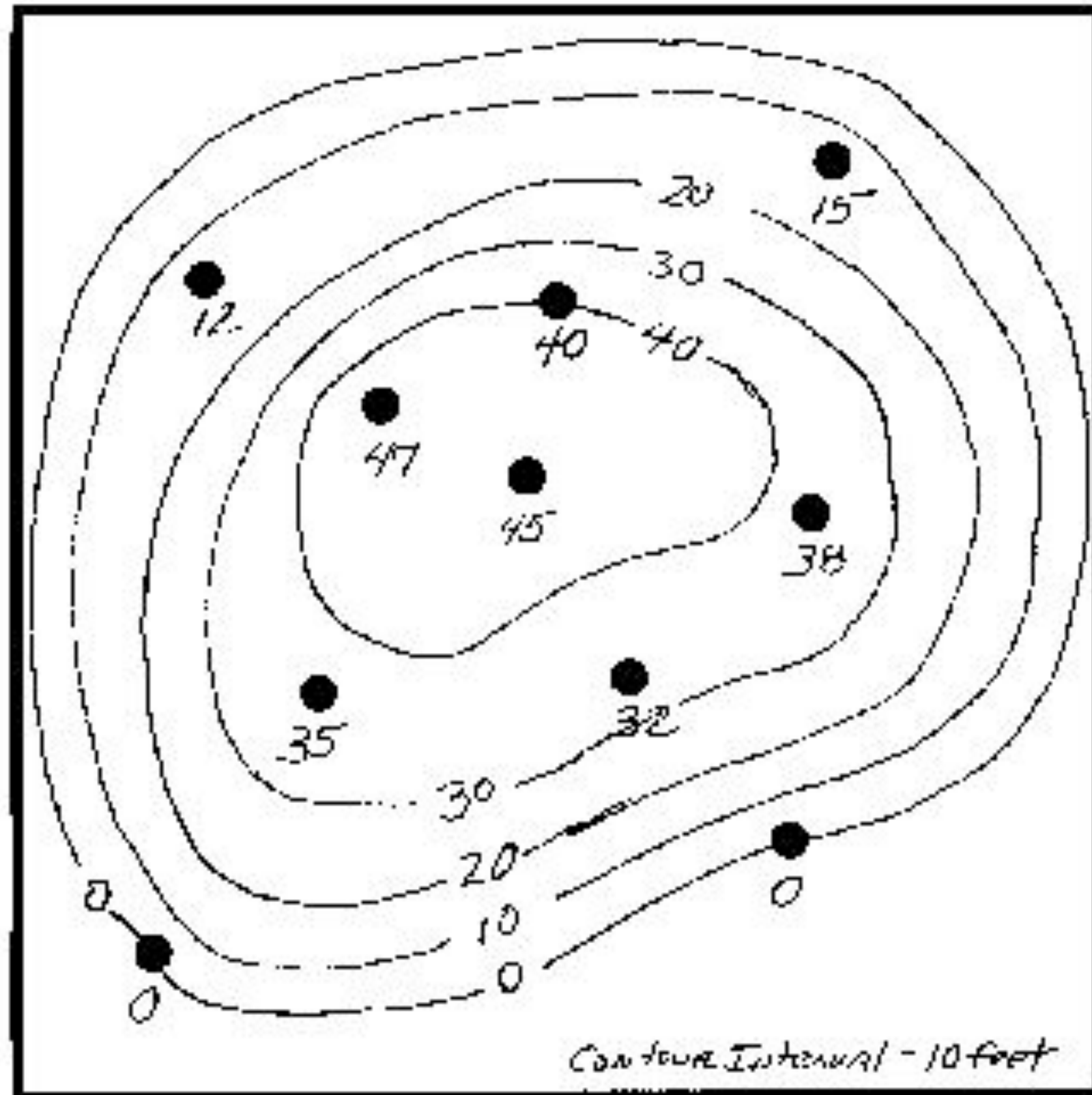
## 4. Isolines NEVER cross!

(This would mean that one point has two different values.)



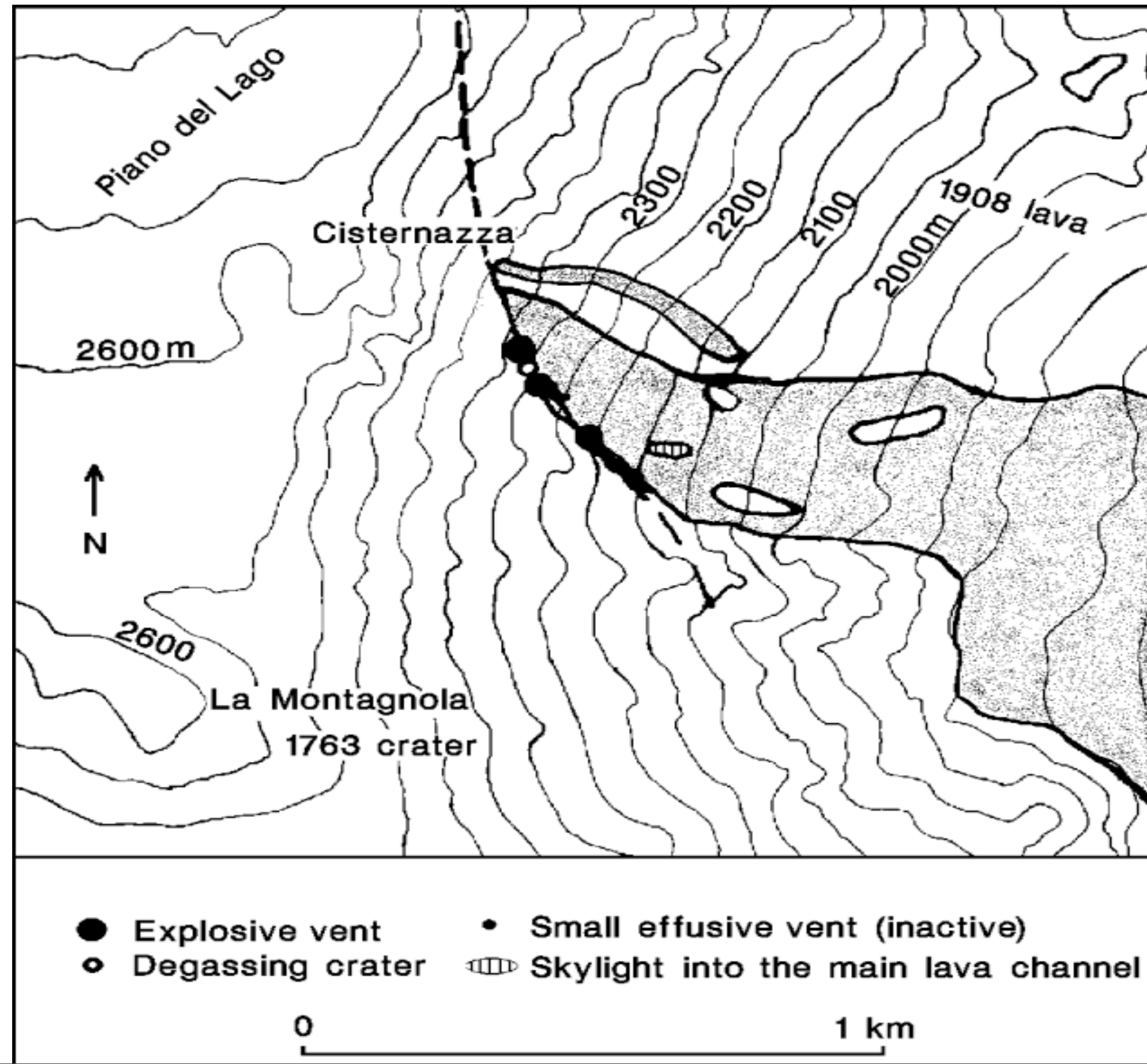
# 6 Rules for Drawing Isolines

5. Isolines usually are parallel.



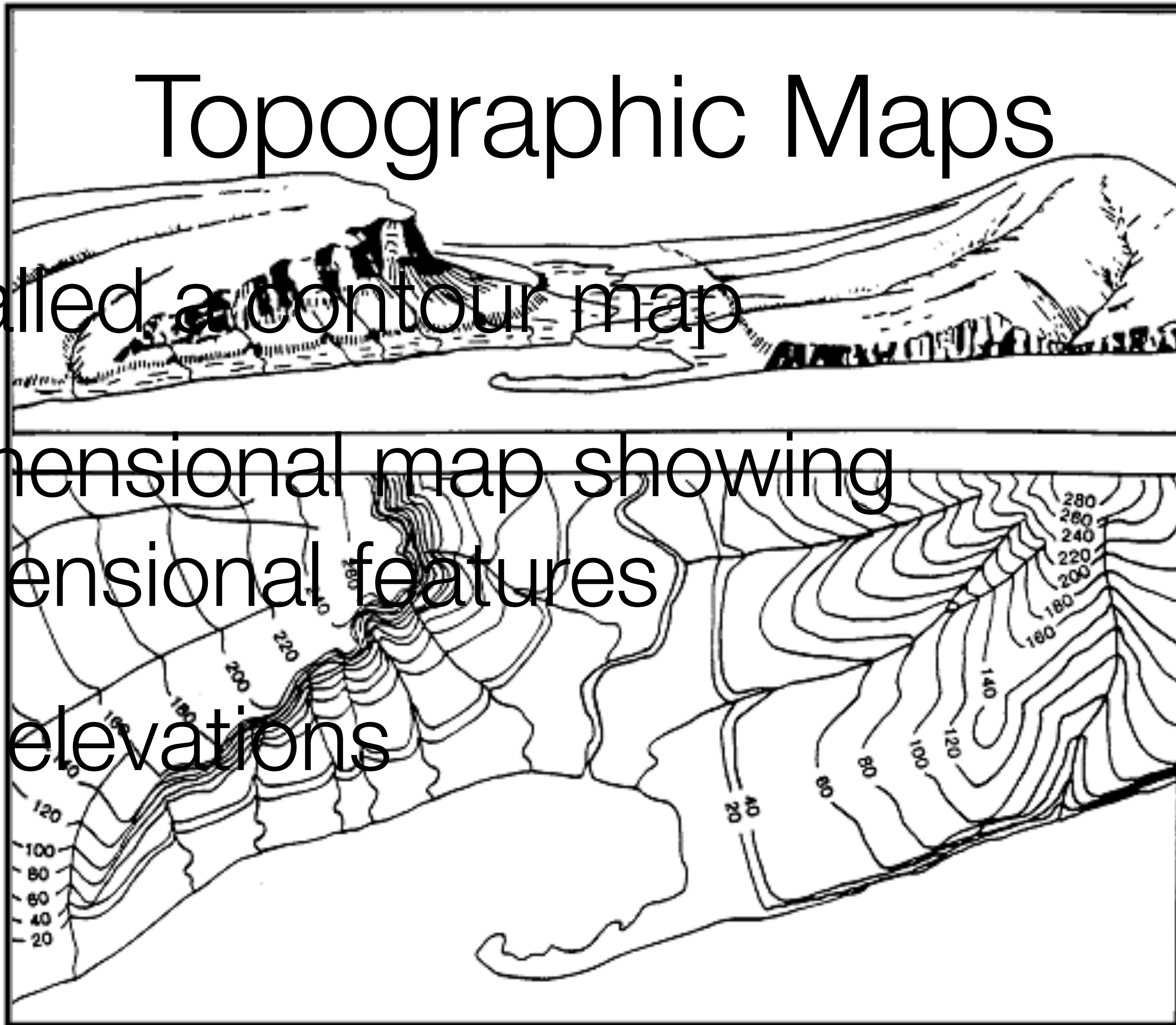
# 6 Rules for Drawing Isolines

6. They must always maintain the same interval between them.



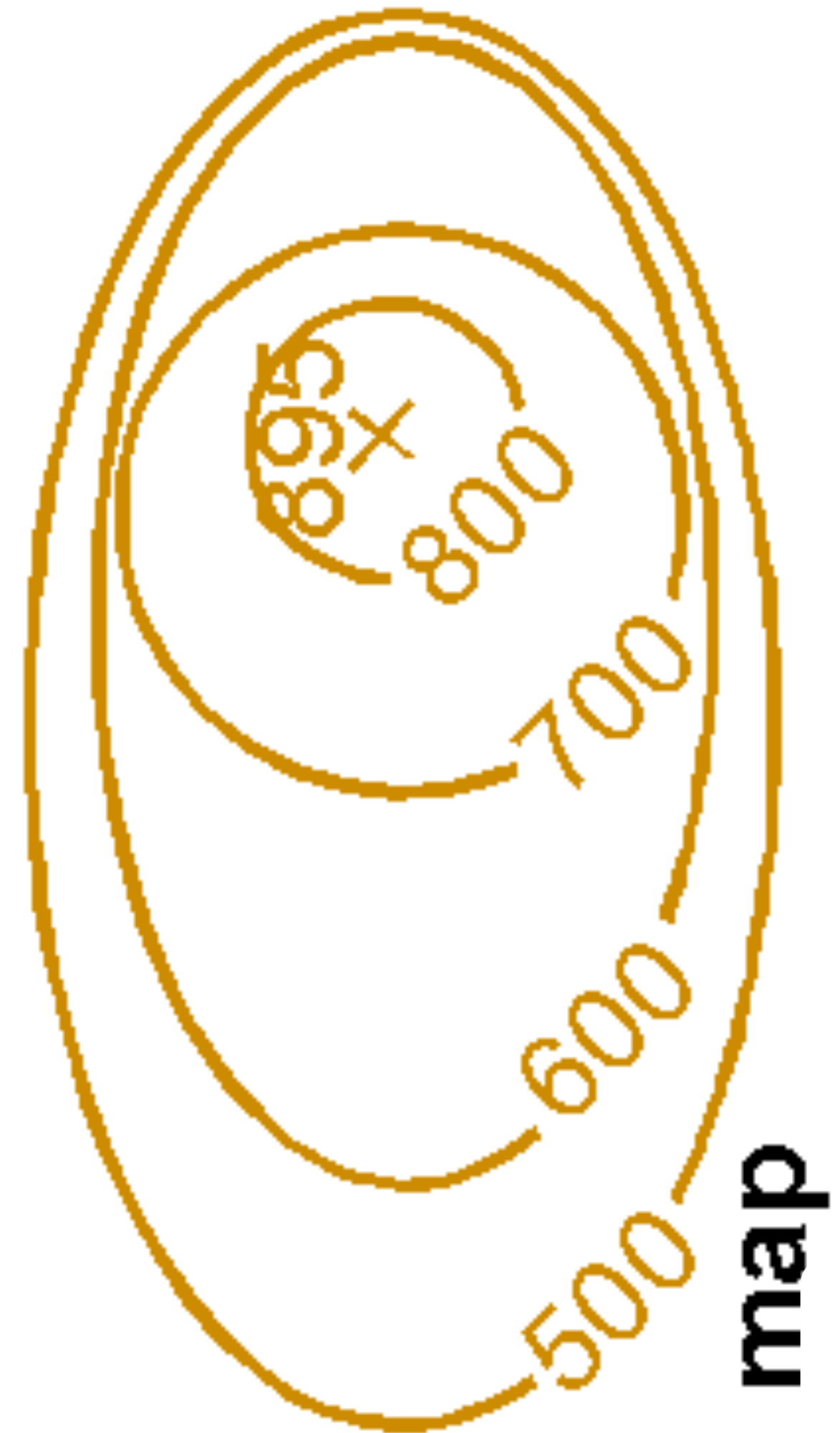
# Topographic Maps

- Also called a contour map
- a 2-dimensional map showing 3-dimensional features
- shows elevations

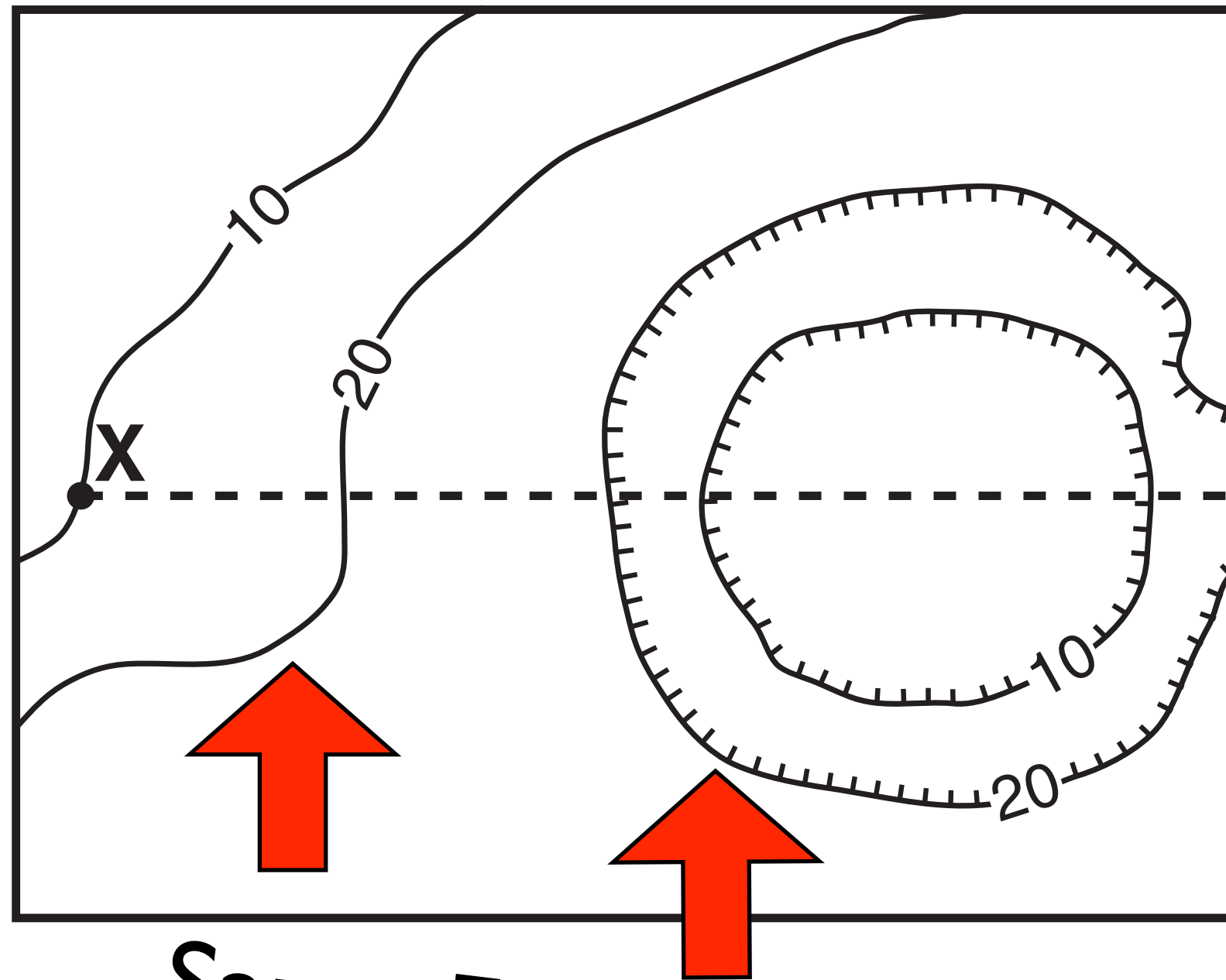
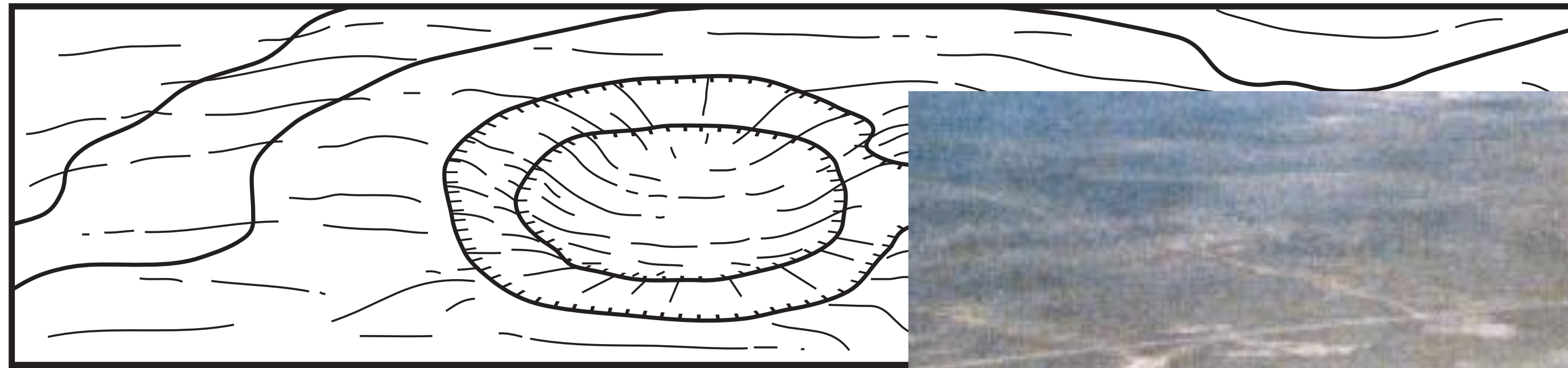


# Contour Interval

- › Contour Interval - the difference in elevation between adjacent contours.
- › Each contour line must maintain the same difference from the line before and after (with the exception of a depression).

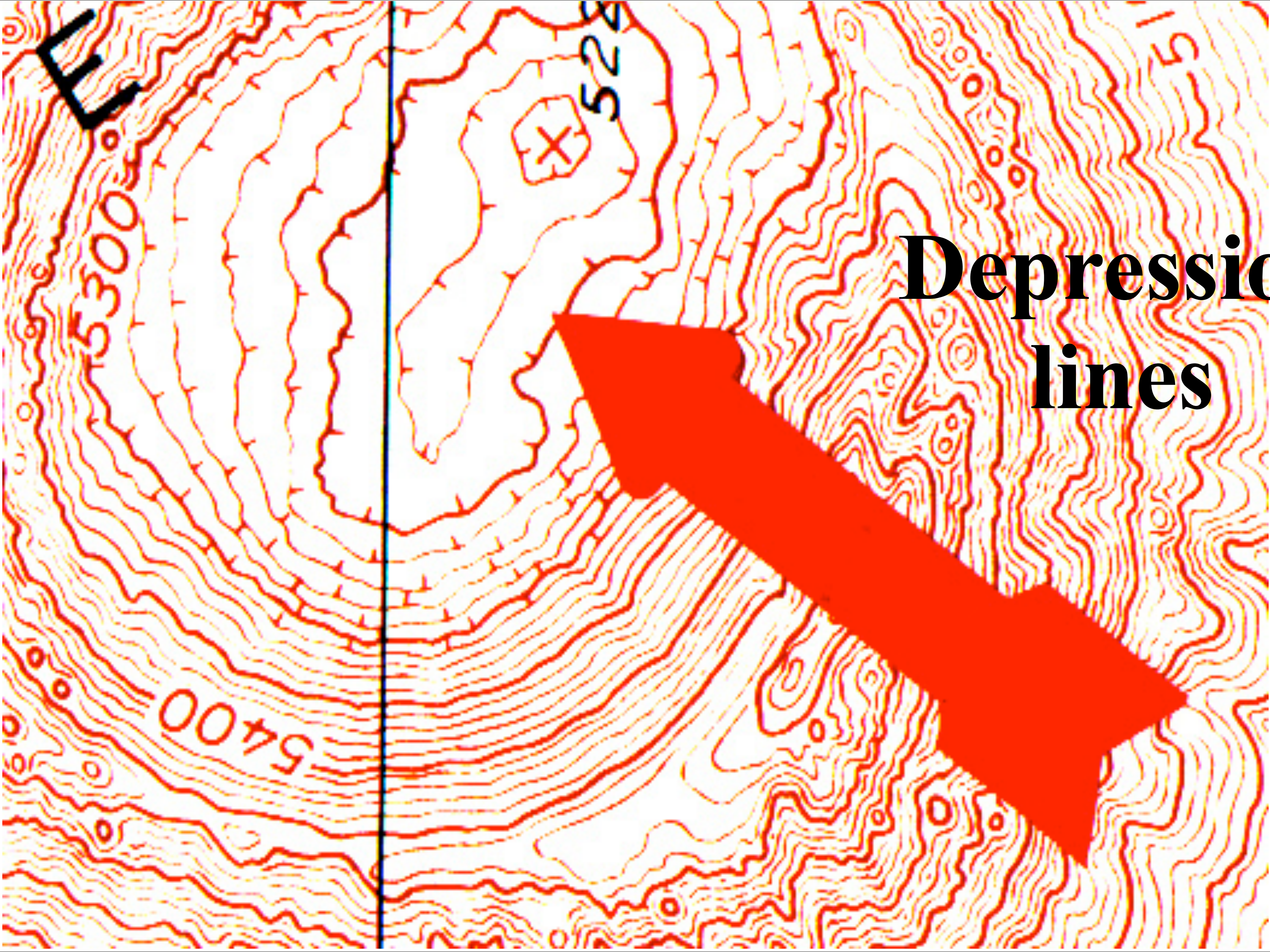


Depressions - holes in the Earth's surface, shown with hachured lines and are equal to the last contour line.



Same Elevation

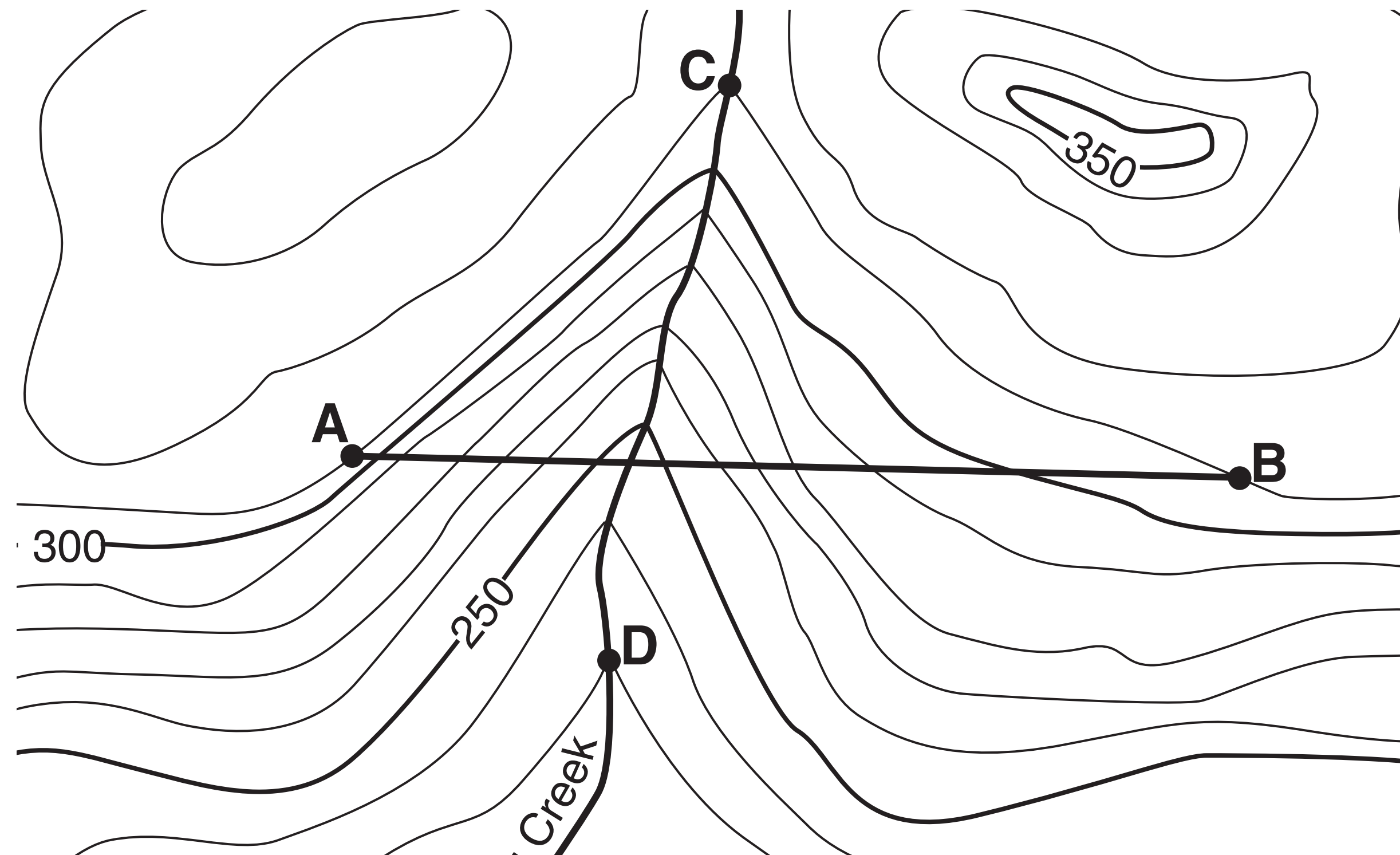


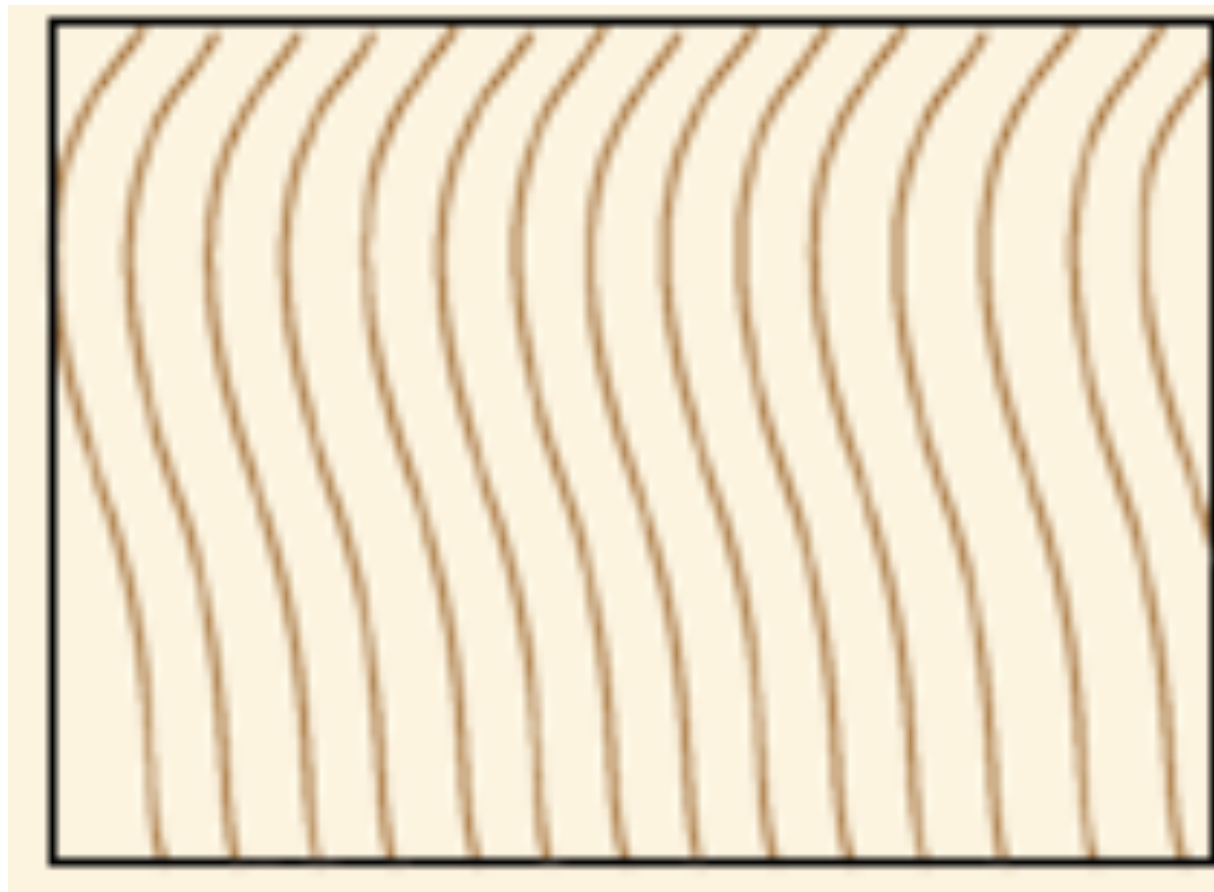


**Depression  
lines**

# Stream Flow

- Always downhill
- When contours cross a stream they form a "V" shape where they cross. The bottom of the "V" points to higher elevations and the source of the stream.





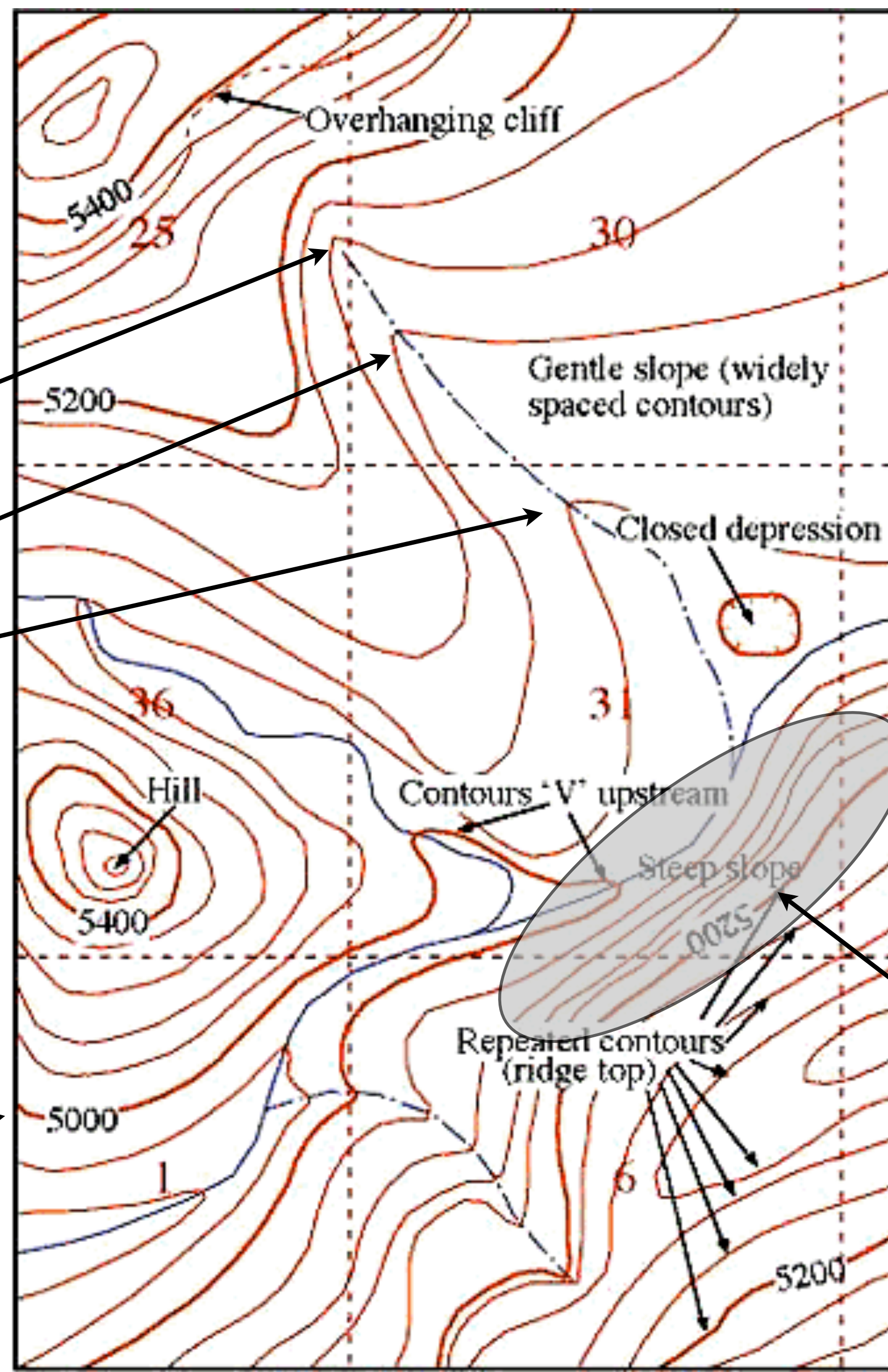
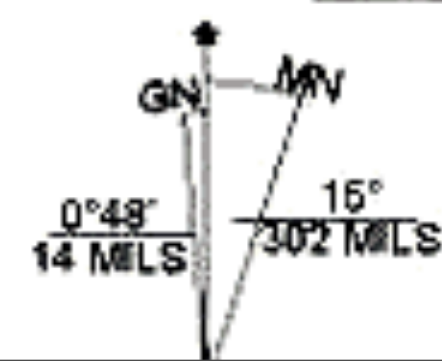
The closer contours are together,  
the steeper the slope.

The further apart contours are,  
the flatter the terrain.



Contour lines  
point upstream  
(bottom of "V")

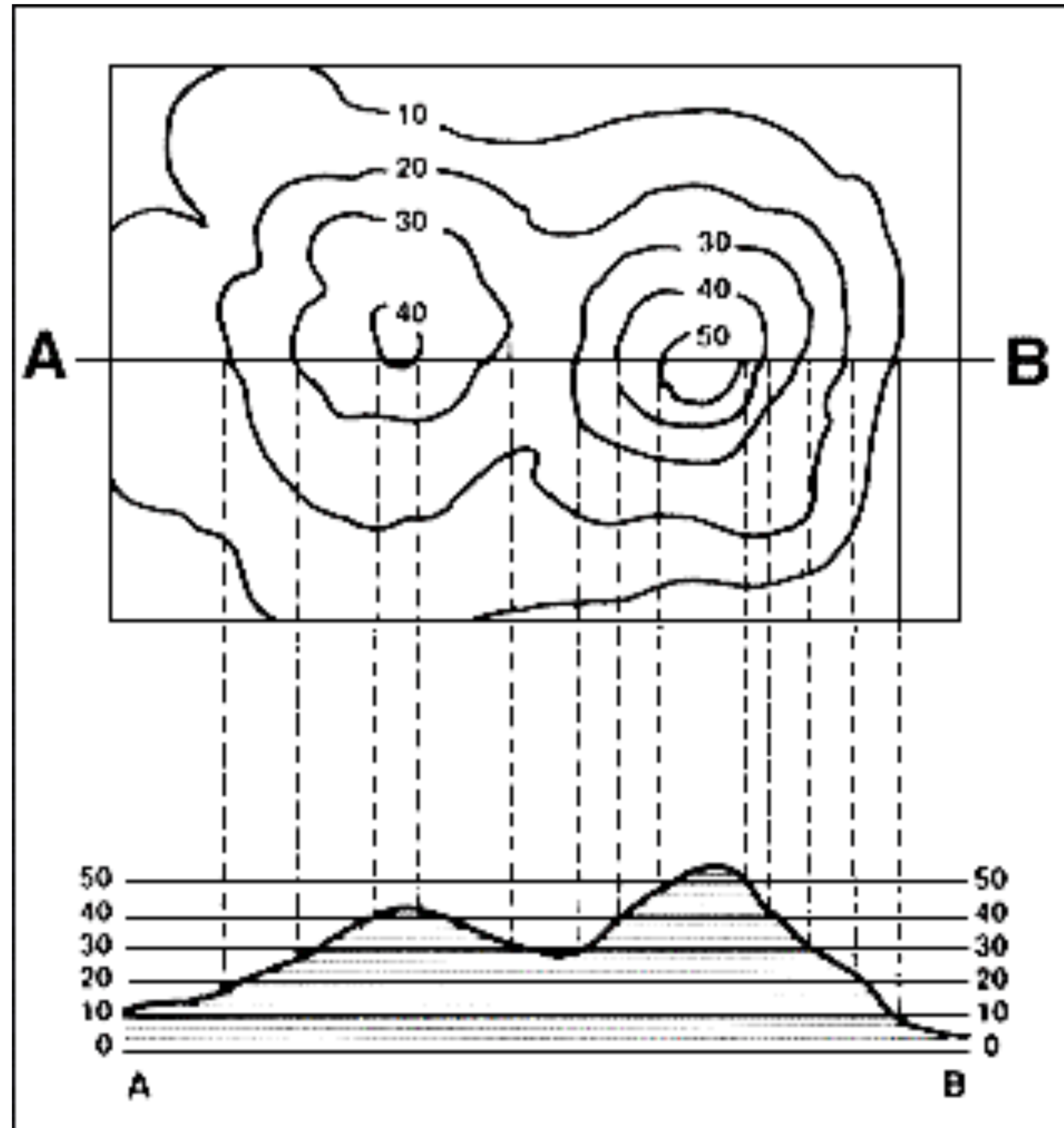
Index  
Contours  
(Every fifth line  
and it is darker)



Steep Slope  
(closer lines)

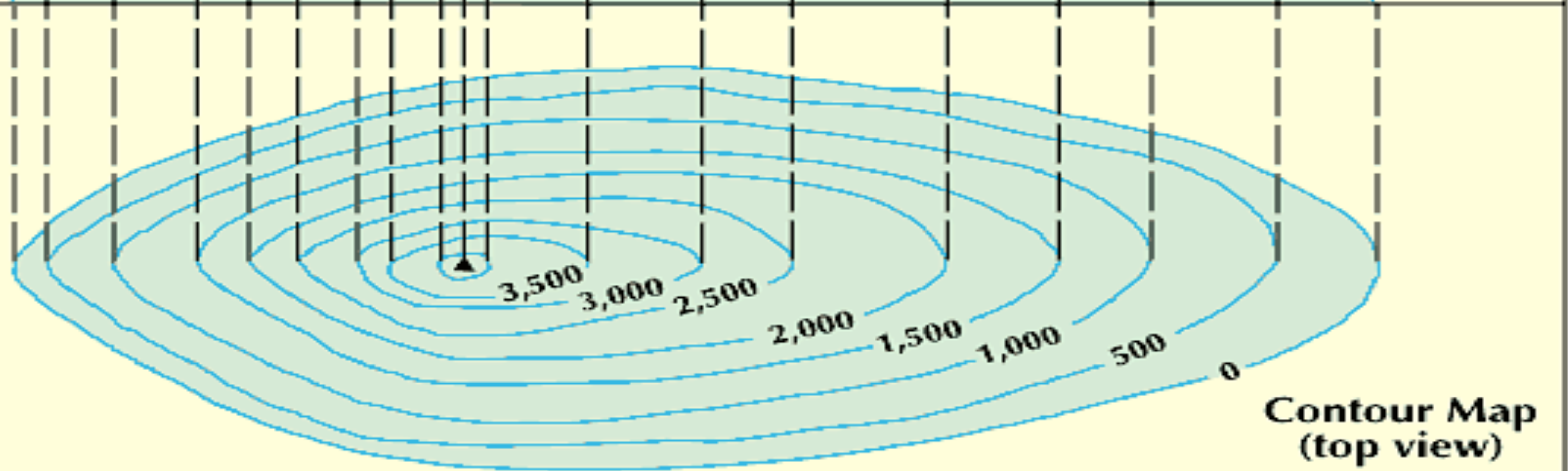
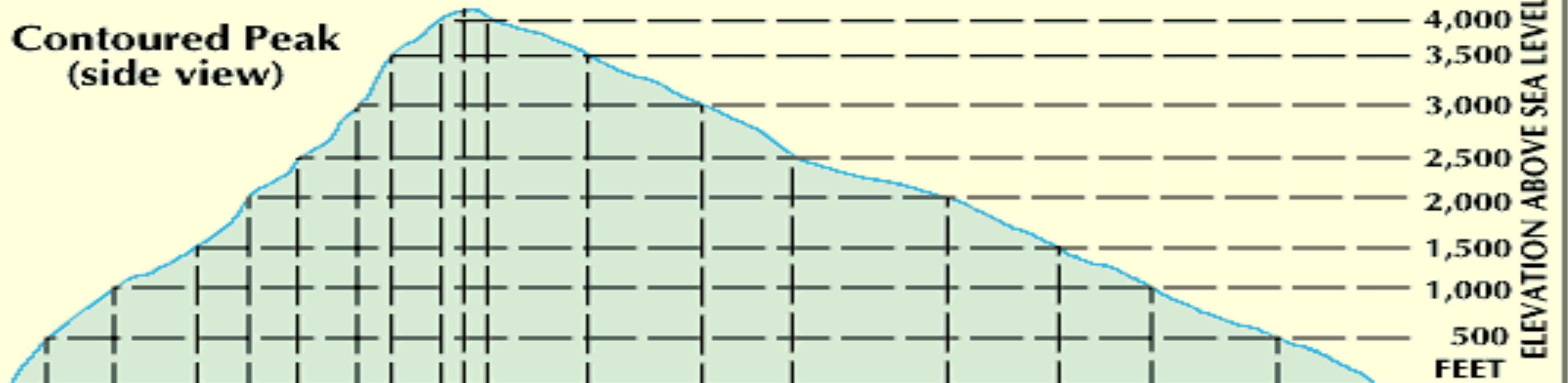
# Profiles

- A side-view or cross section of the features shown by the map.
- Can be constructed simply with any topographic map.

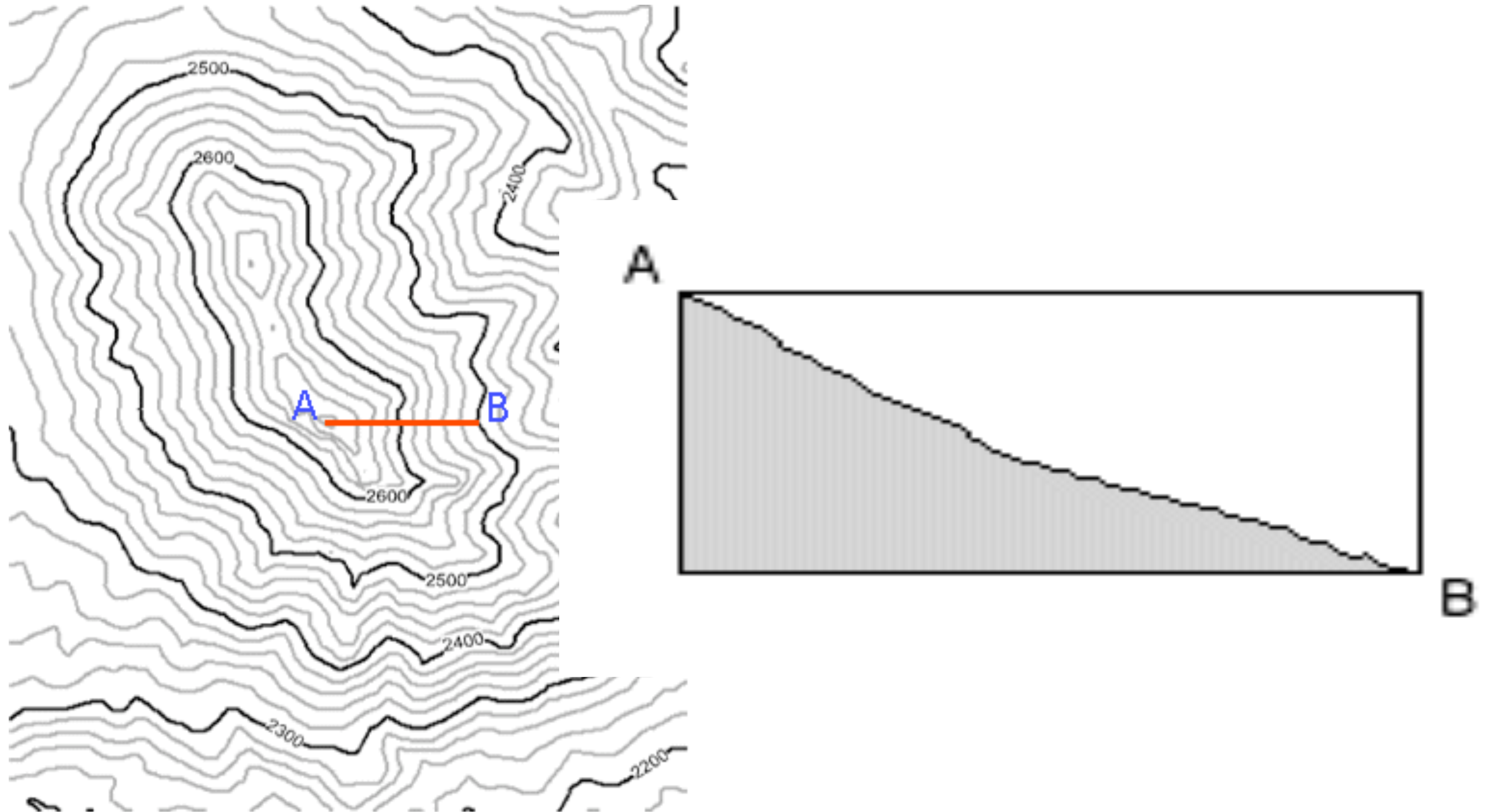


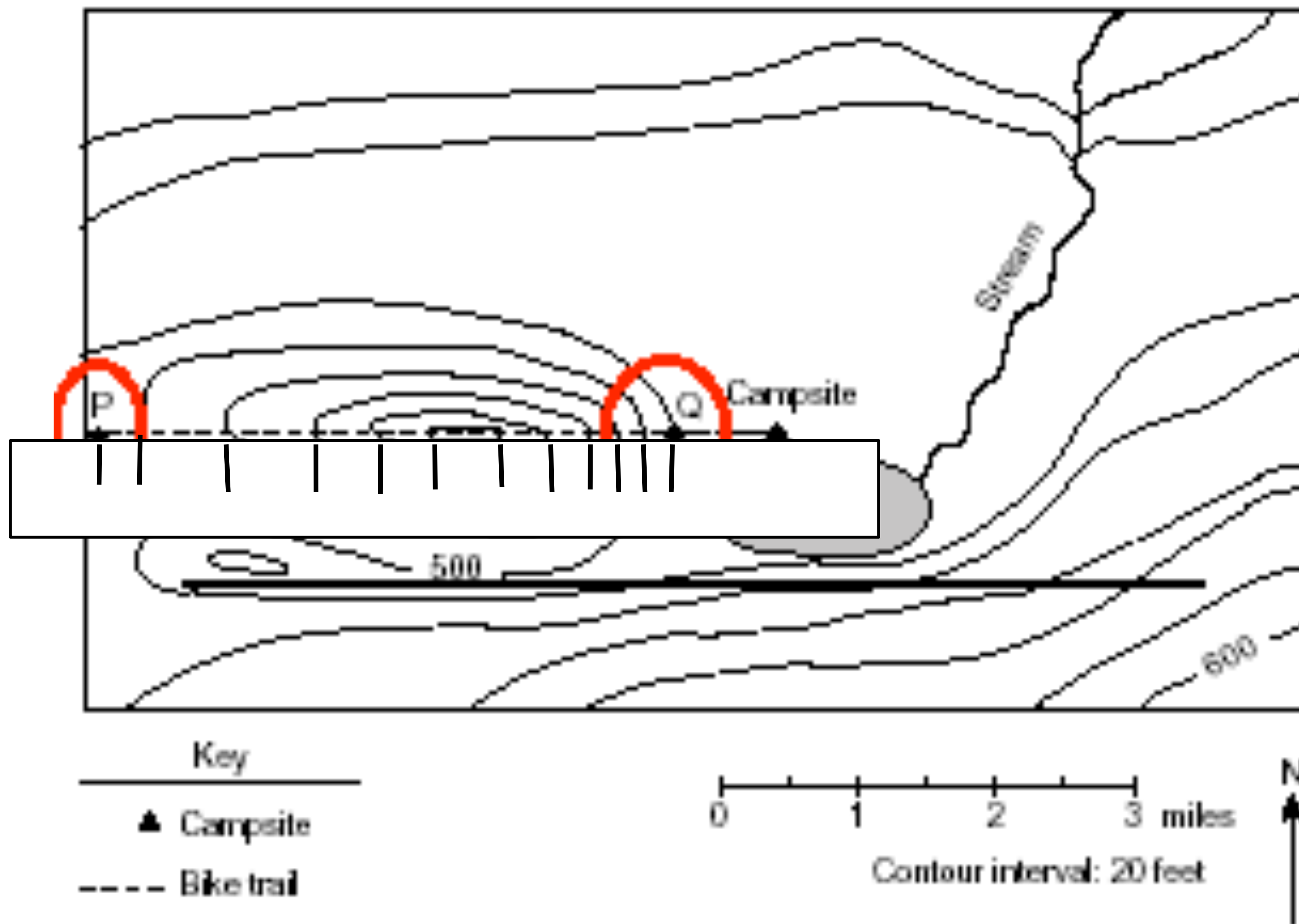


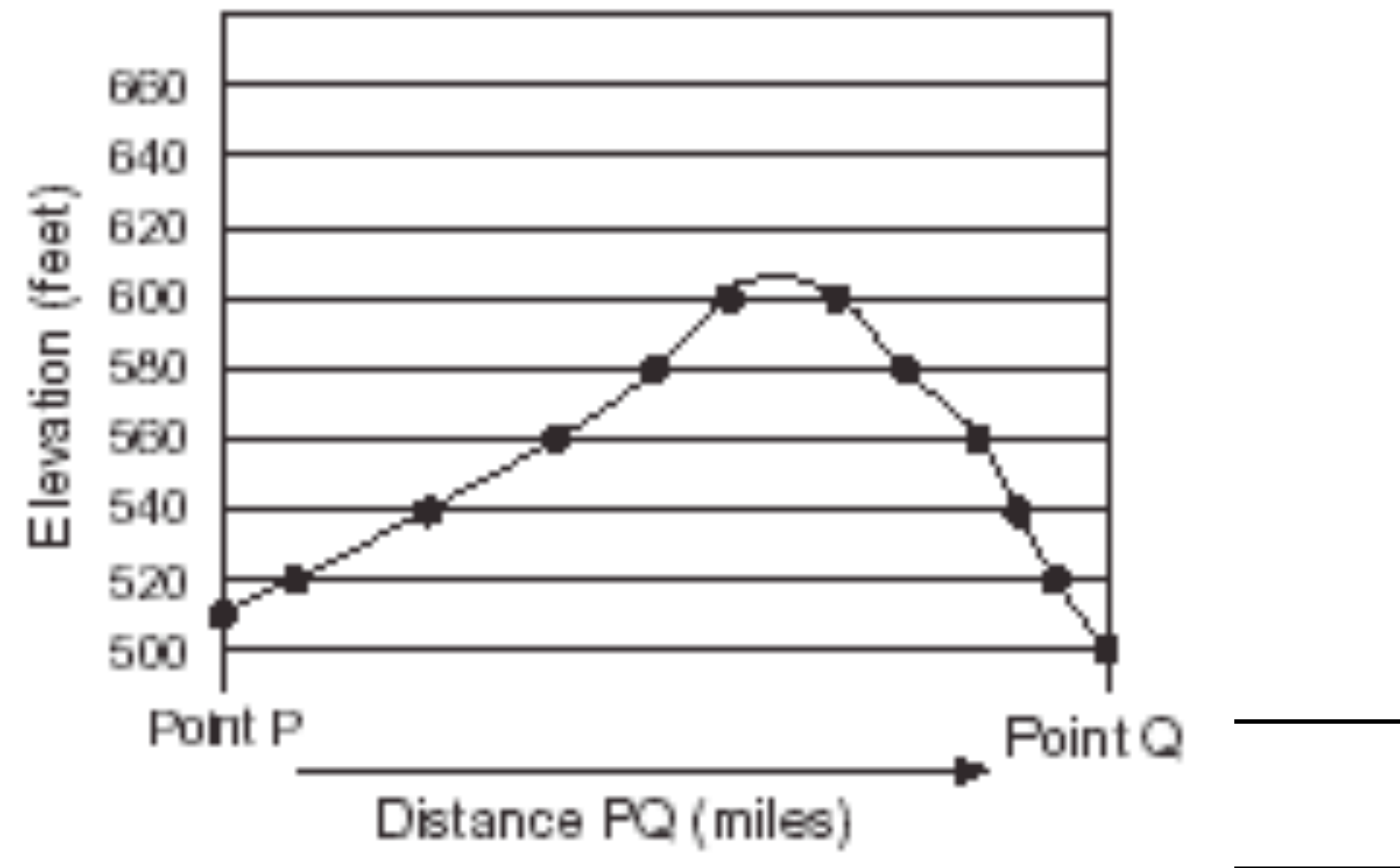
**Contoured Peak  
(side view)**



# Profile of A-B







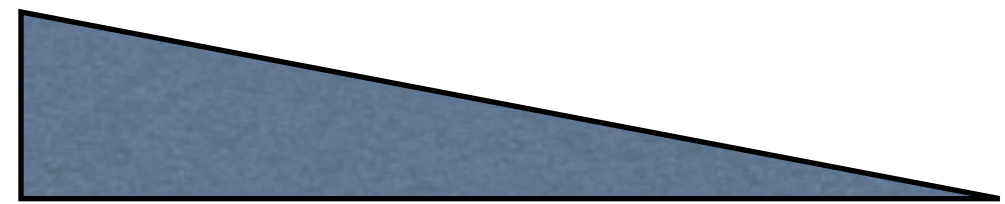
# Gradient

Gradient is slope (how steep is the hill?)

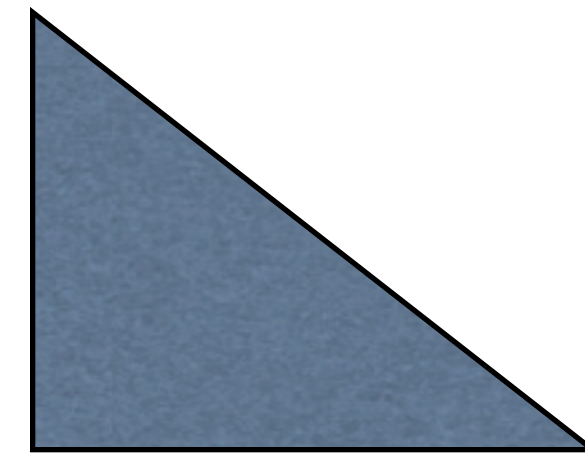
Gradient=(change in elevation between two points)

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(the distance between two points)



less gradient



more gradient

$$\textit{Gradient} = \frac{\Delta \textit{value}}{\textit{distance}}$$

## EQUATIONS

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Percent deviation  
from accepted value

$$\text{deviation (\%)} = \frac{\text{difference from accepted value}}{\text{accepted value}} \times 100$$

Eccentricity of an ellipse

$$\text{eccentricity} = \frac{\text{distance between foci}}{\text{length of major axis}}$$

Gradient

$$\text{gradient} = \frac{\text{change in field value}}{\text{distance}}$$

Rate of change

$$\text{rate of change} = \frac{\text{change in field value}}{\text{time}}$$

Density of a substance

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

# Gradient

Contour Interval = 20 m

Elevation of Y = 300 m

Elevation of X = 380 m

Difference (Change) = 80m

Distance between X & Y = 2 km

Grad. = 80 m/2 km = 40 m/km

$$\textit{Gradient} = \frac{\Delta \textit{value}}{\textit{distance}}$$

