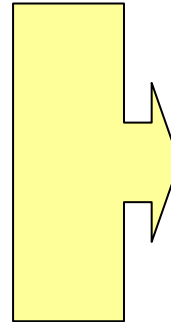


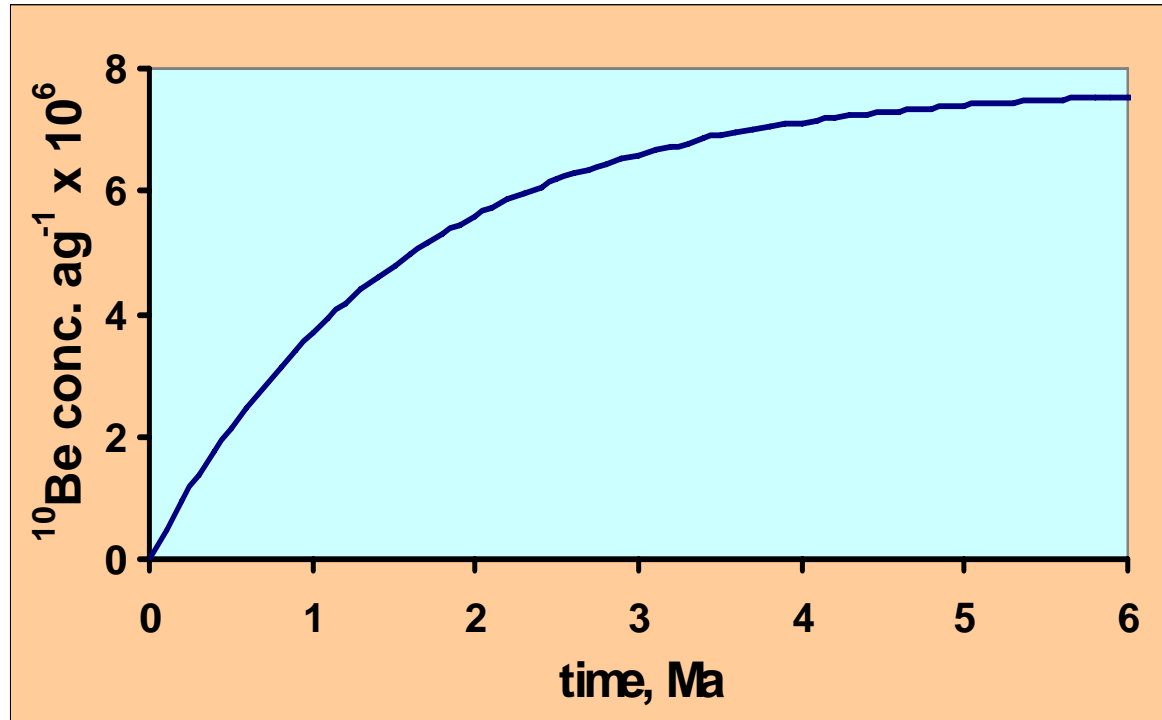
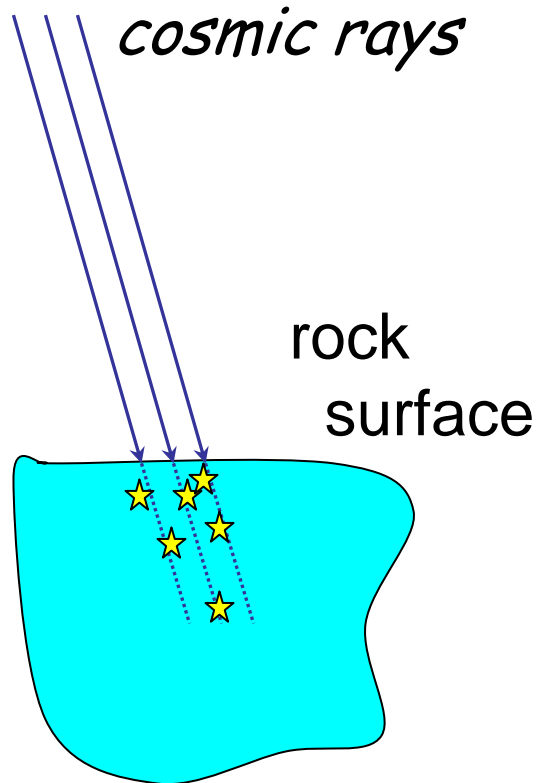
# Applications 1/2

1. Dating Quaternary basalt volcanism
2. Timing of landslides
3. Tectonic displacement
4. Glaciers and ice-sheets
5. Meteorite impacts
6. Sedimentation rates
7. (Ground) water dating
8. Sea water dating
9. Crustal recycling processes
10. Age of landscapes
11. Erosion rates



Exposure age  
dating

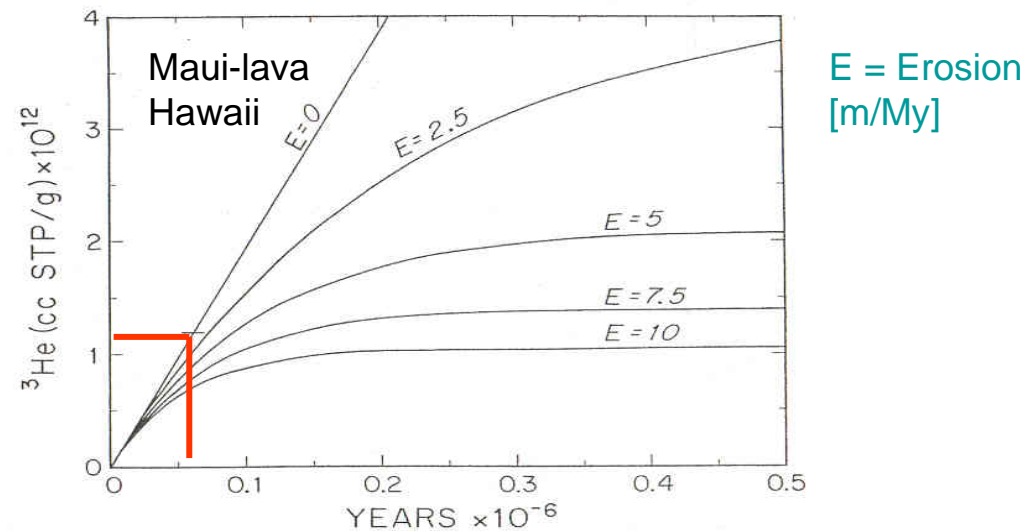
# Exposure age dating



ROCK SURFACE RAPIDLY CUT AND EXPOSED AT TIME  $t$ :  
NUCLIDE CONCENTRATION AT SURFACE -

$$C_{(0)} = P_{(0)}/\lambda(1-e^{-\lambda t})$$

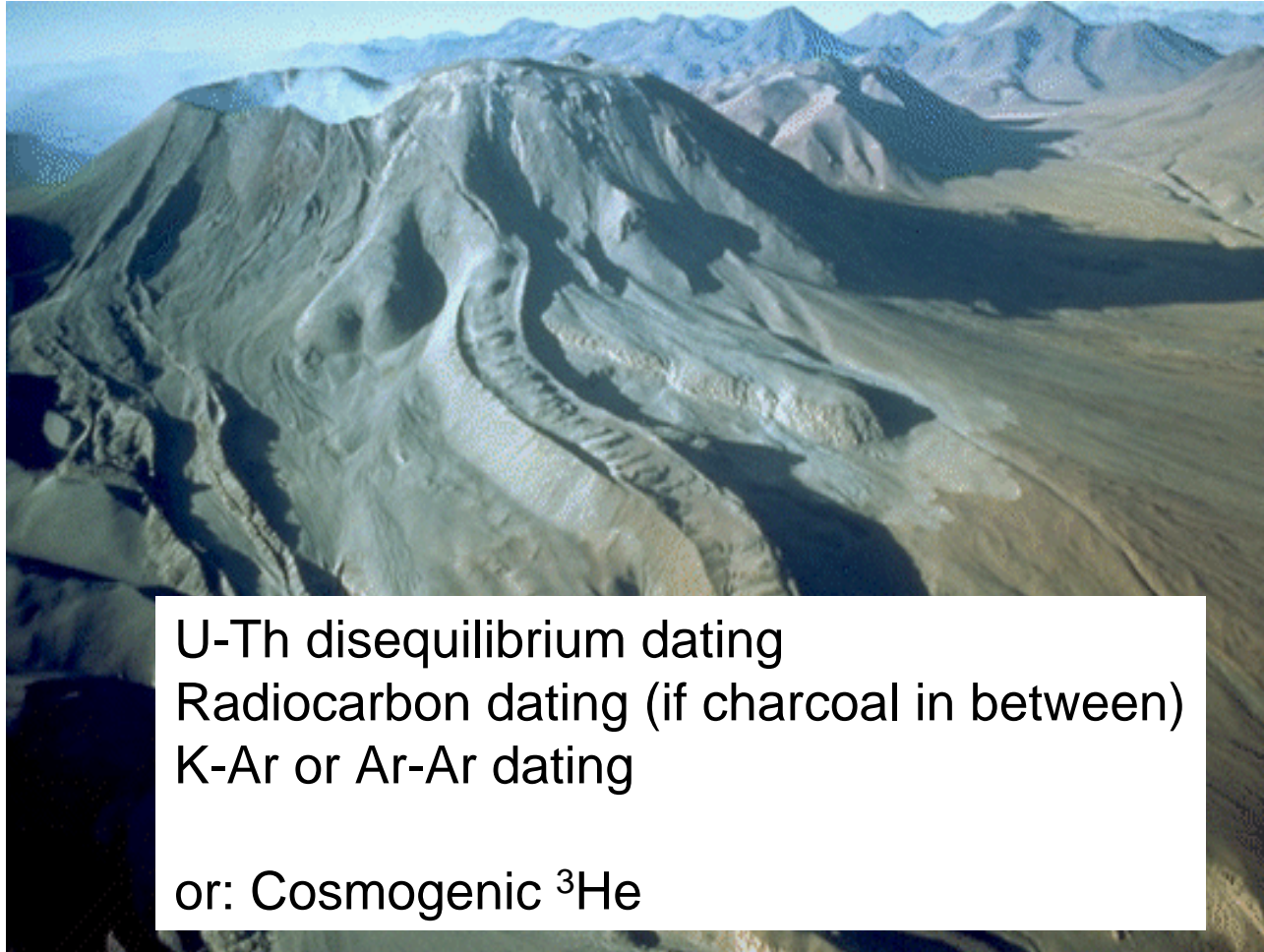
# 1. Dating Quaternary volcanism



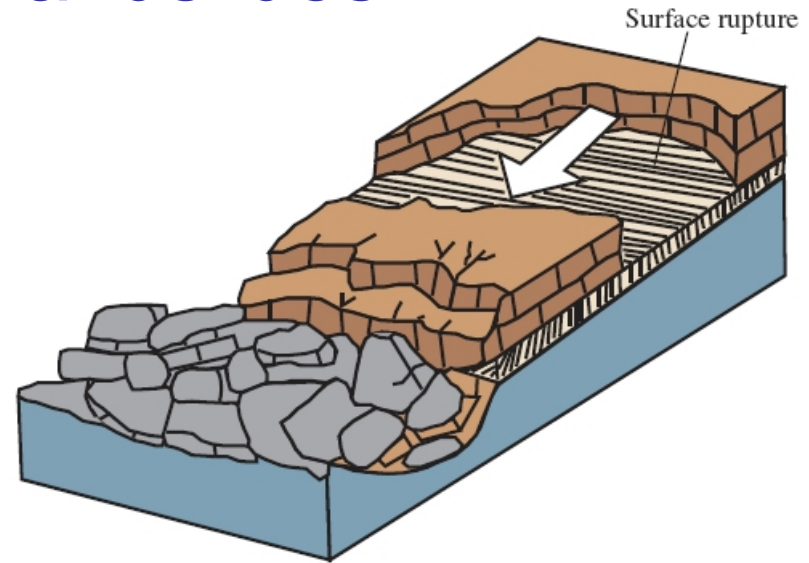
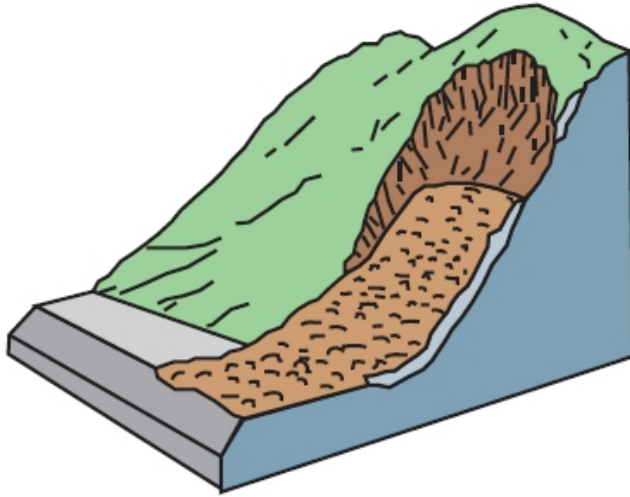
Cosmogenic  $^3\text{He}$  as a function of time and erosion rate (from Craig & Poreda 1986).

For  $E = 0$  (no erosion) the exposure age is 64.000 ys, whereas the maximum erosion rate = 8.6 m/My.

# 1. Dating Quaternary volcanism



## 2. Timing of landslides



La Conchita landslide (1995) California



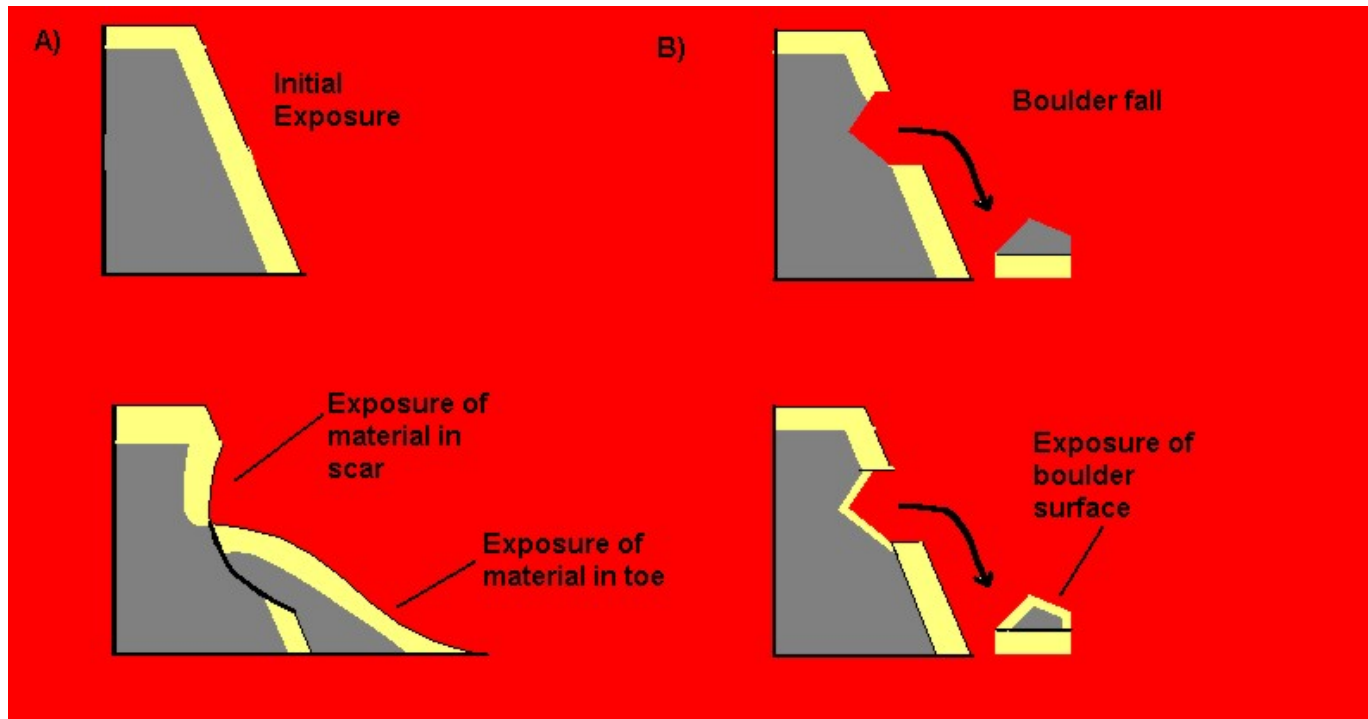
Panoche Hills, California



## 2. Timing of landslides

**A:** After landslide, cosmic rays build up in the rocks exposed in the landslide scar and on the surface of the deposit

**B:** after boulder fall, cosmogenic isotopes build up on the upper surface of the boulder and in the scar left behind



# 3. Tectonic displacement

## dating of ancient earthquakes

Movement along fault planes usually occurs during earthquakes.

Exposure ages increase from bottom to top, and can cluster into discrete groups or steps representing the episodic nature of faulting events.

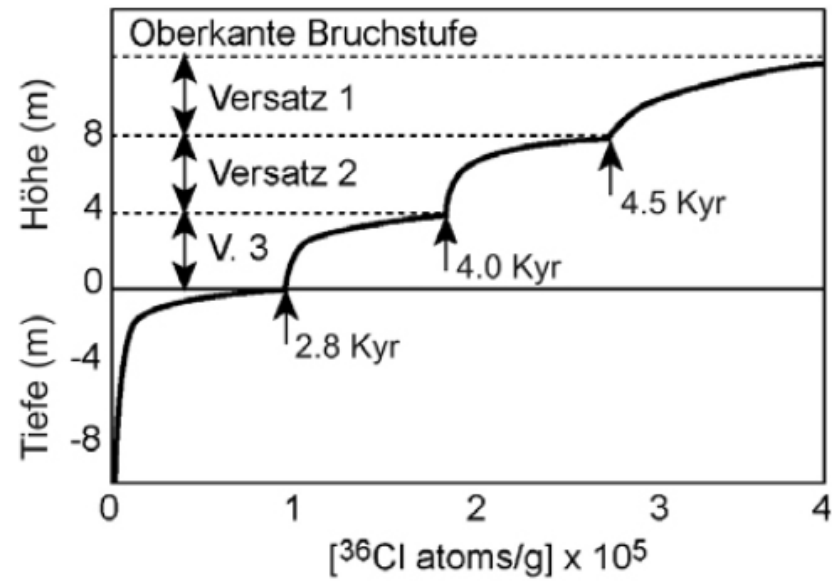
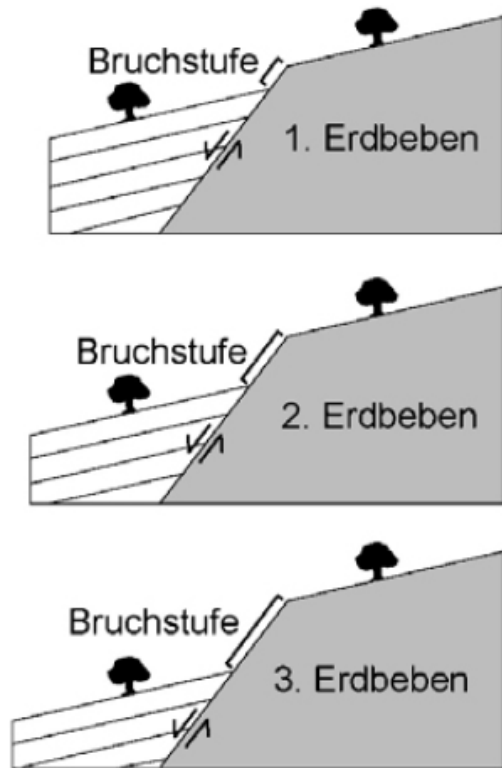
The number and magnitude and recurrence interval of the faulting events which produced the scarp can be determined.



*(Zreda & Noller 1998, Science 282)*

### 3. Tectonic displacement

#### Sparta fault- Greece



*Benedetti et al. 2002 Geophys. Res. Lett.*



## 4. Glaciers and ice sheets



*Courtsey H. Hann*



## 4. Glaciers and ice sheets

Pasterzenzunge and Großglockner (3798 m)



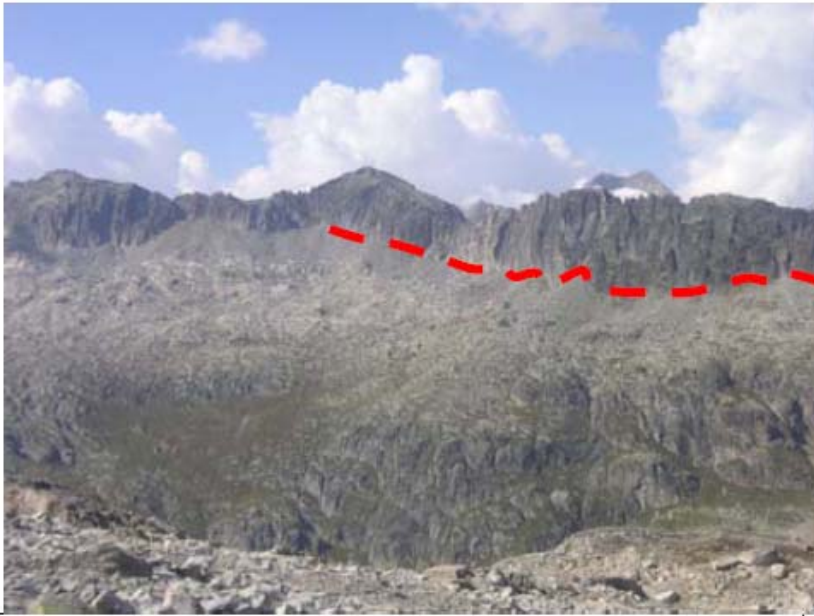
1900



2000

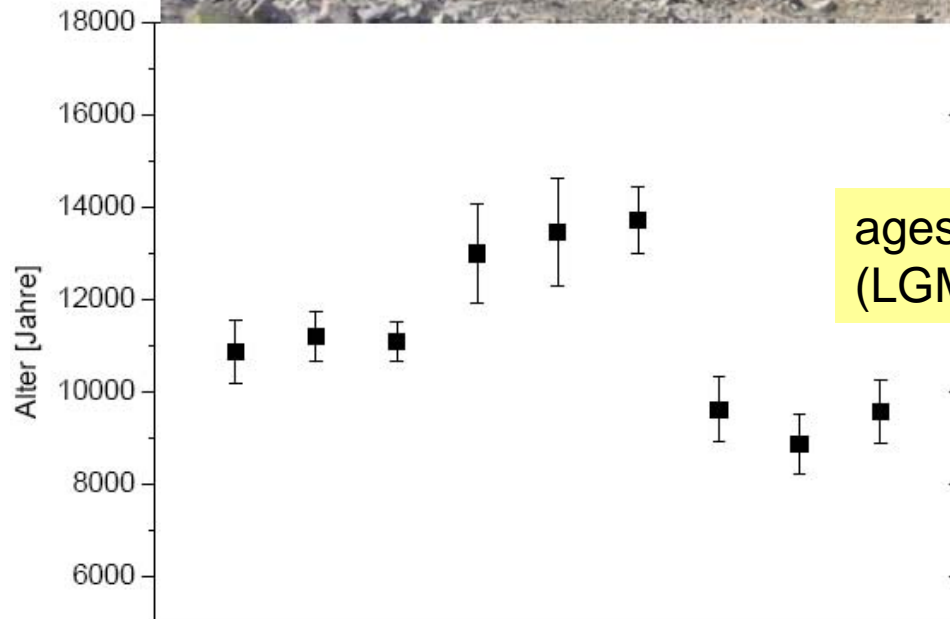
Assuming that boulders have been exposed continuously since the retreat of the ice, the glacial retreats can be dated

## 4. Glaciers and ice sheets



Grimselpass, Schweiz

← former active ice surface



ages correspond to the last glacial maximum (LGM) → Younger Dryas

*Kelly et al. 2004 J. Quaternary Sci. 19: 431*

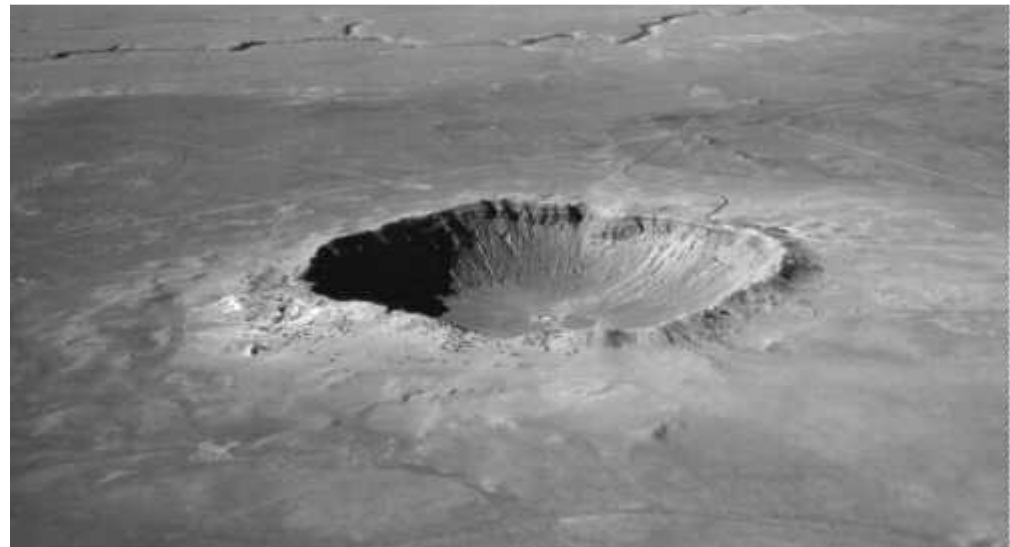


# 5. Meteorite impacts

## Dating a hole in the ground



The Barringer Meteorite Crater (also known as "Meteor Crater") is a gigantic hole in the middle of the arid sandstone of the Arizona desert.



## 5. Meteorite impacts

**When did it form?**



$49.2 \pm 1.7$  ka, based on  $^{10}\text{Be}$  and  $^{26}\text{Al}$  exposure age of samples from the crater walls and ejecta blocks at the crater rim (*Nishiizumi et al. 1991*).

$49 \pm 0.7$  ka, based on  $^{36}\text{Cl}$  exposure age of for dolomite ejecta on the crater rim (*Phillips et al. 1991*).