

## Physical Properties of Moon

- Average distance from Earth = 384,404 km
- Range of distances (elliptical orbit) 356,400 - 406,700 km
- Orbital inclination to Earth's orbit =  $5^{\circ} 8'$
- Average radius = 1738 km =  $0.2725 R_{\oplus}$
- Mass =  $7.35 \times 10^{22}$  kgm =  $M_{\oplus} / 81.33$
- Average density = 3.34 x water (Earth 5.52)
- Density of surface rocks ~ 3 x water (Earth 2.64)
- "Captured" rotation.
- Surface temperature - daytime max  $+270^{\circ}\text{F}$   
nighttime min  $-280^{\circ}\text{F}$



# Surface of the Moon

## ● General

75% LIGHT-COLOURED HEAVILY-CRATERED HIGHLANDS

25% SMOOTH, DARK, LESS-CRATERED "MARIA"

"RAY CRATERS" — impacts?

VOLCANIC-LOOKING CONES, LAVA FLOWS (?)

## Detail

FINE-GRAINED SOIL, DEPTH ~ FEW CM. ON HIGHLANDS

~ FEW M. ON MARIA

● CONTAINS GLASSY SPHERES ~  $\frac{1}{20,000}$  CM.

IGNEOUS ROCKS (condensed from melts), FRACTURED

CHUNKS OF CONGLOMERATES (BRECCIAS)

BEDROCK EXPOSED ON CRATER FLOORS, LARGE

ROCKS NEAR CRATERS

SOIL + ROCK FRAGMENTS + BRECCIAS → "REGOLITH"

Bedrock basalts resemble Earth lavas.

● Maria av. density ~ 3.3, rich in Fe, Co, Ni

Highlands . . . — ~ 2.9, rich in Al

No water, fossils, or obvious living organisms



# LUNAR CRATERS

## ● 1. MARIA

Roughly circular outlines, average ~ 300 miles across  
Mainly on side of Moon facing Earth.

Dark "smooth" floors with small craters, boulder fields and wrinkled ridges.

## 2. SMALLER CRATERS

100-mile to microscopic diameters

Similar to impact craters on Earth, but not eroded.

Many more small craters than large.

Small craters fresher in appearance.

● Craters a few miles across ~ 10 times more common in highlands than on floors of maria, where craters generally smaller.

Craters in or near maria may be filled in with smooth dark material, or have depressed floors and raised rims.

## Interpretation

Impacts of large bodies in past → maria?

Heaving by impact → flows, vulcanism?

Size of impacting bodies decreasing with time?

But what is time scale associated with this?



# Weathering and Erosion of Earth Surface

## ● MECHANICAL WEATHERING

Frost wedging - cavities and fissures in rocks fill with water - freeze/thaw disrupts rocks.

## CHEMICAL WEATHERING

Surface waters slightly acidic due to dissolved  $CO_2$  from atmosphere, and to dead/decaying organisms.

## WATER FLOWS

Surface - lakes, streams  
Underground.

## ● SLIDES

## WINDS

Transport of fine particles, bombardment

## GLACIERS AND ICE SHEETS

## TIDES

But Moon has negligible atmosphere  
no surface water

Erosion on Moon caused by  
BOMBARDMENT  
LAVA FLOWS  
THERMAL SHOCKS

● Moon's surface expected to represent older conditions than Earth's.



# Ages

light, low-density highland basalts

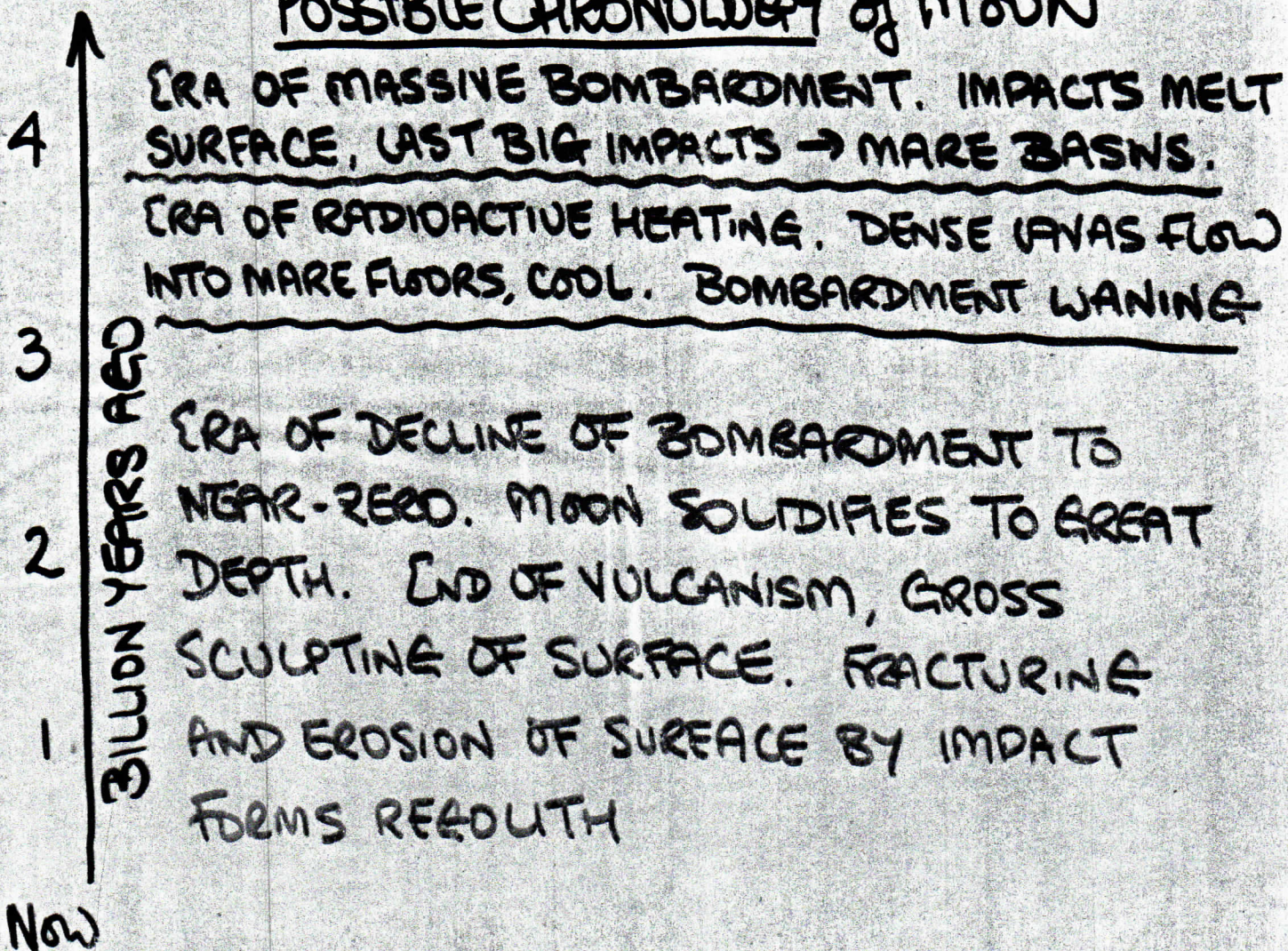
3.85 to 4.25 billion years

Dark, high-density maria basalts

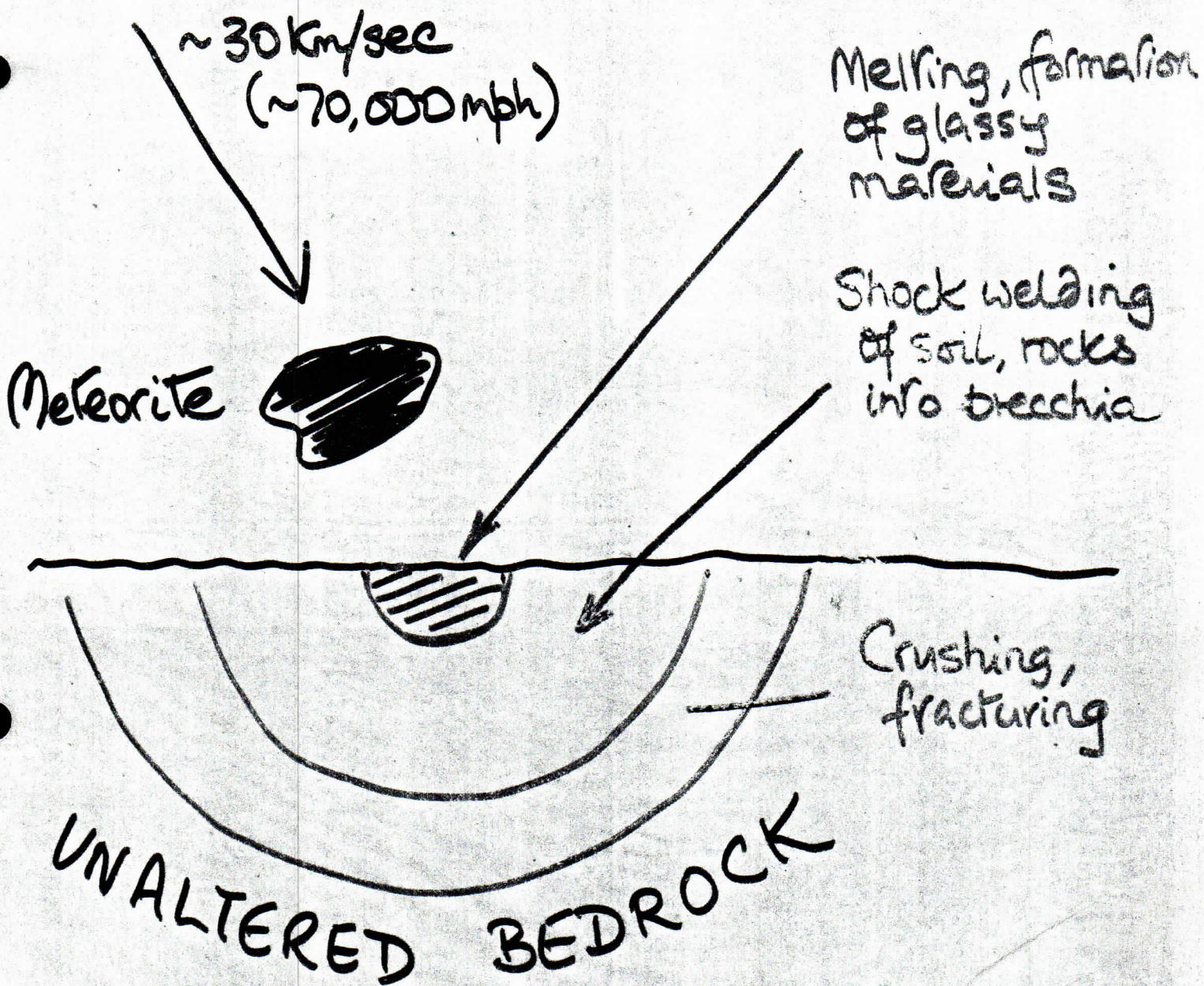
3.15 to 3.85 billion years

All of sampled surface molten 3 to ~ 4 1/4 billion yrs ago.

## POSSIBLE CHRONOLOGY of MOON







All of altered materials likely to be ejected to excavate crater, mixed  $\rightarrow$  regolith  
 1-ton meteorite  $\equiv$  100 tons of TNT exploding.