Astrobiology & Lunar Exploration

Ariel D. Anbar

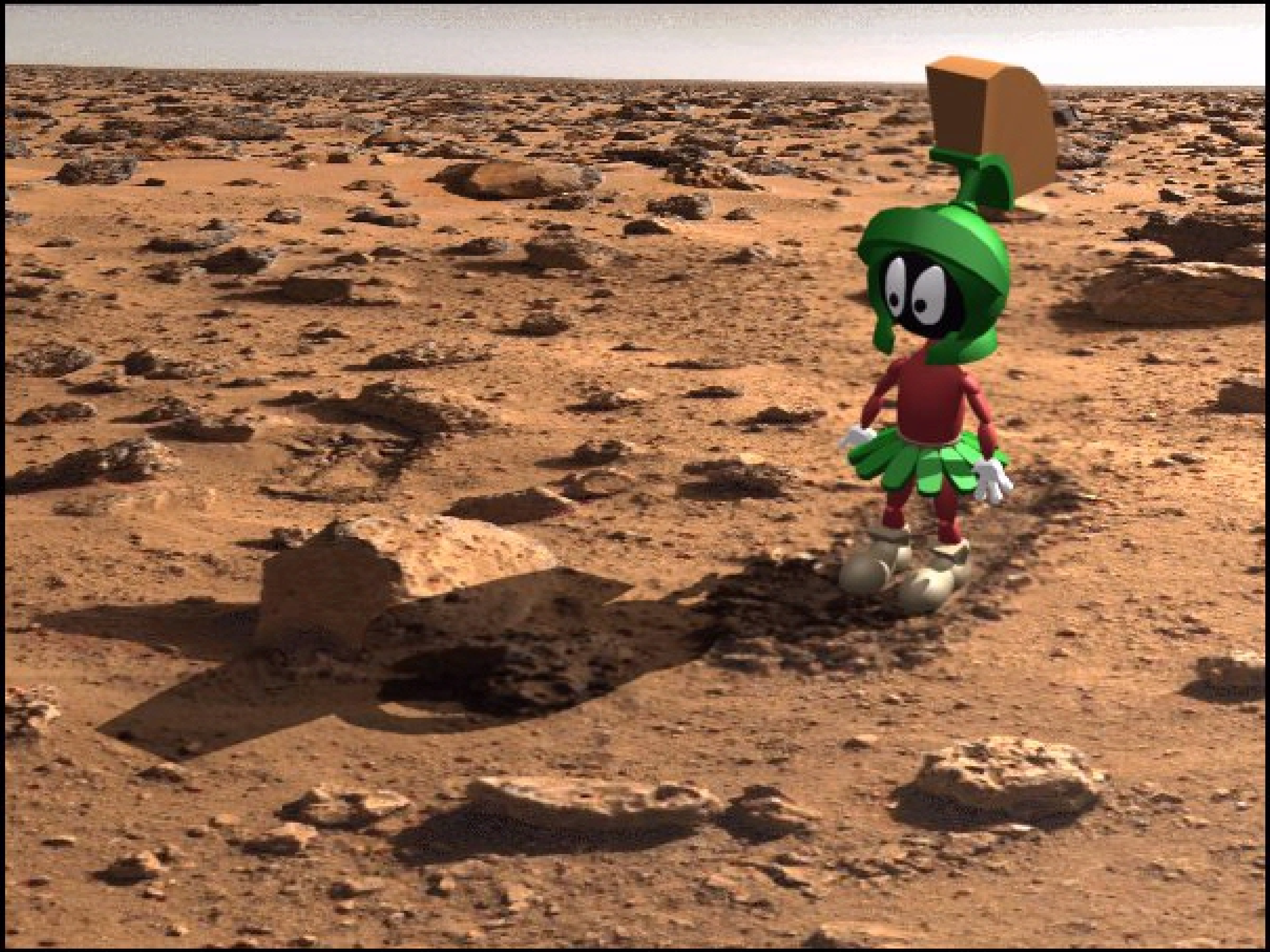
School of Earth & Space Exploration

and Dept. of Chemistry & Biochemistry

Arizona State University

Presentation to NAC Workshop on Science Associated with the Lunar Exploration Architecture

March 1, 2007




Astrobiology ≠ bug-hunt!

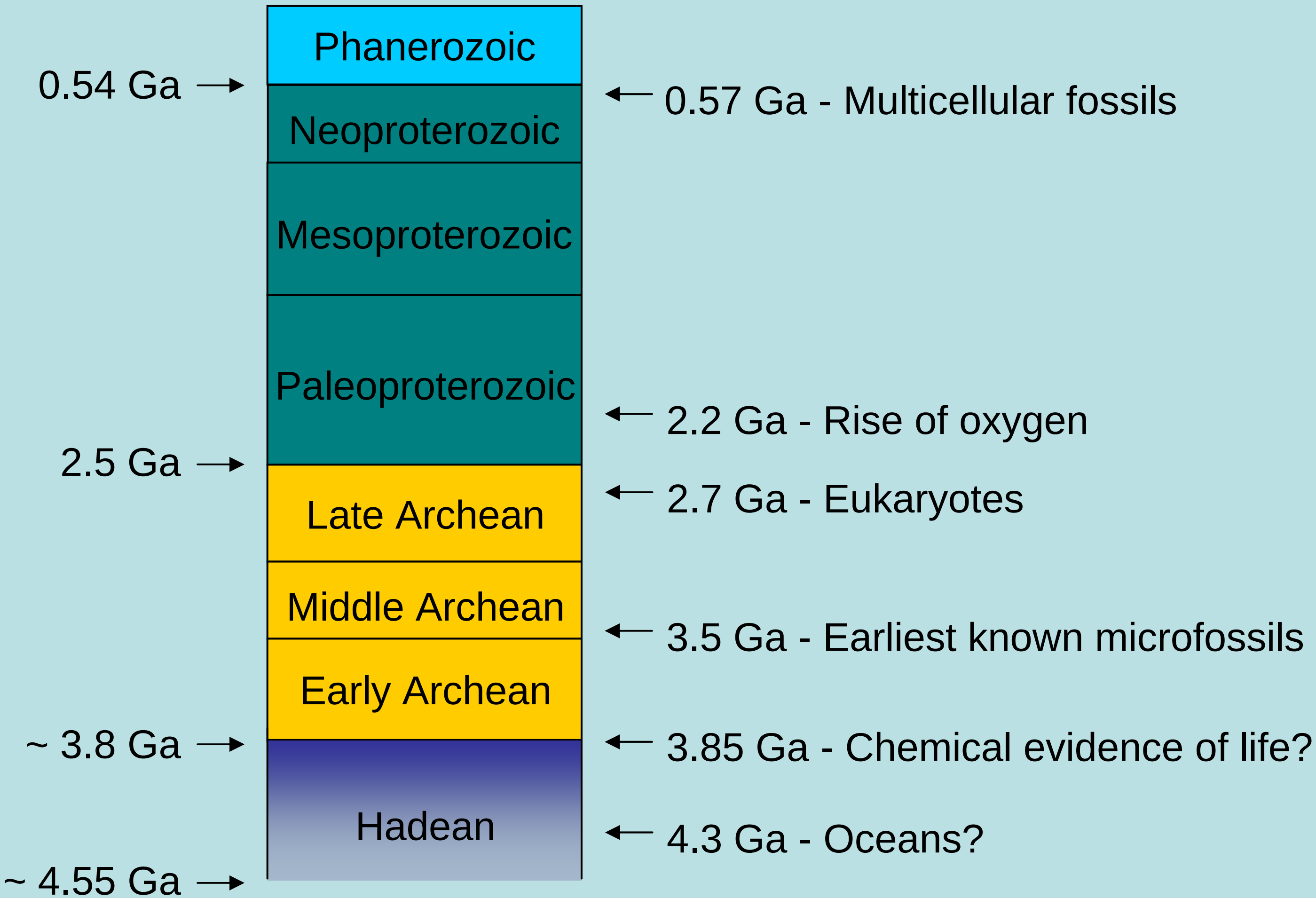
Astrobiology aims to...

...determine the distribution of life in the Universe *and understand how this distribution relates to the occurrence of different planetary environments.*

Early Bombardment

Massive impacts on the young Earth profoundly affected habitability at the time of life's origin and early evolution

Geologic Timeline
Ga = billions of years ago



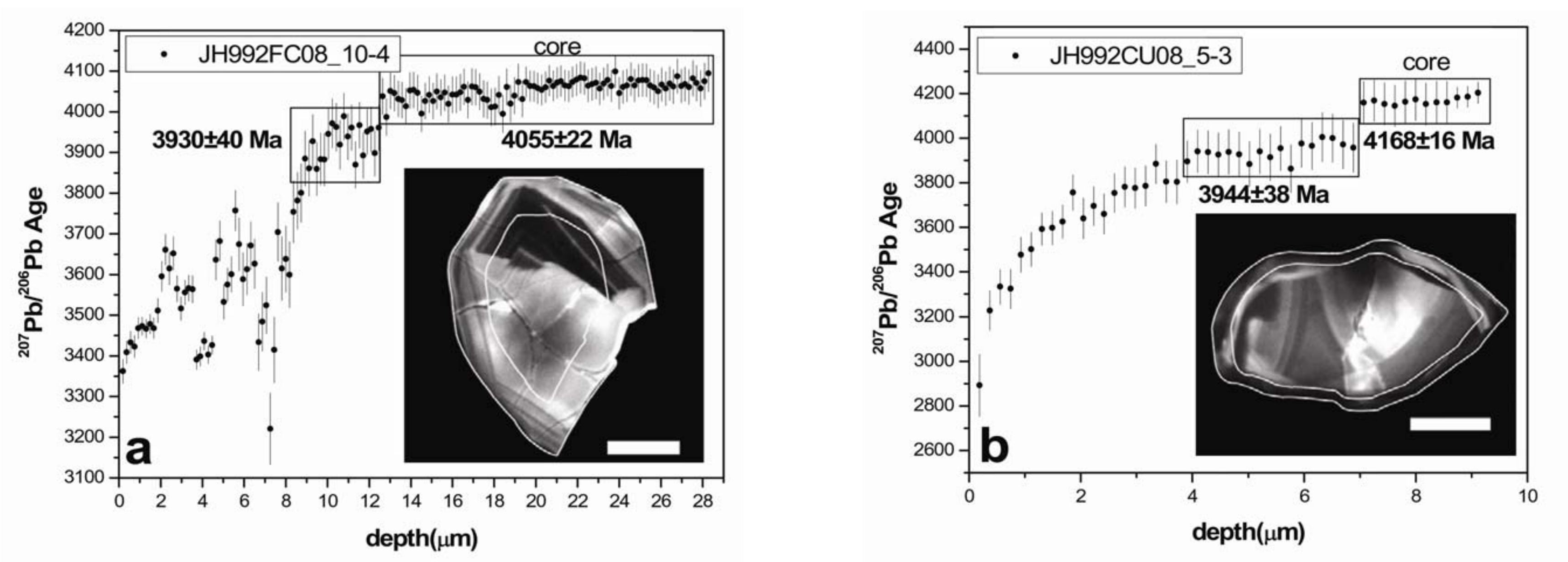
2.5 Ga: Rocks!


Hamersley Basin, W. Australia

> 3.8 Ga: Fragments!

Age Profiles in Zircons

S. Mojzsis, personal communication



NAI White Paper, 2004

Astrobiology Science Goals and Lunar Exploration

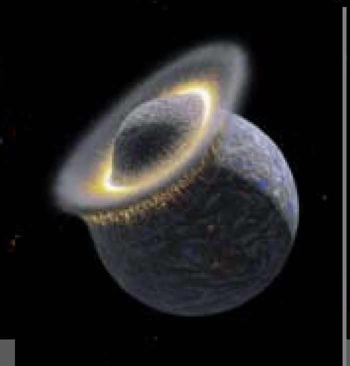
Key Themes:

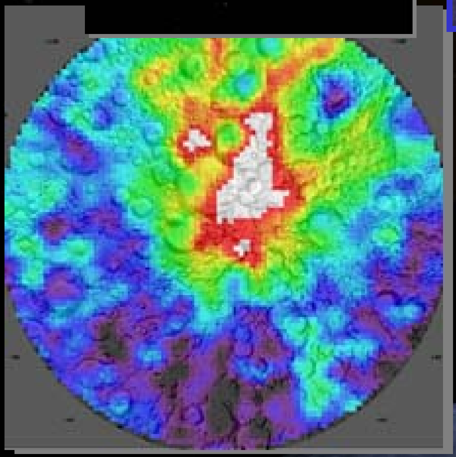
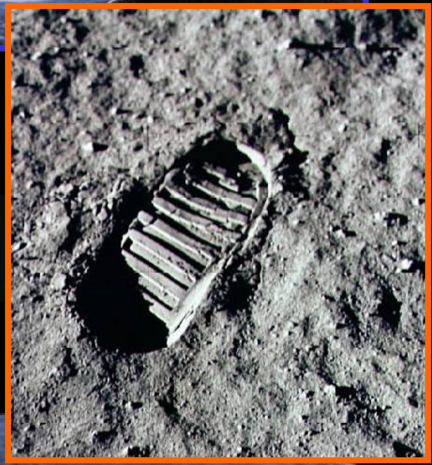
- Bombardment history
- Solar history recorded in regolith
- Origin of the Moon
- Volatiles (sources and prebiotic chemistry)

http://nai.arc.nasa.gov/about/lunar_astrobiology.cfm

The Moon Presents Compelling Science Opportunities

- Bombardment of the Earth-Moon system: Consequences for the emergence of life
- Lunar surface and interior processes and history
- Scientific treasure in the permanently shadowed polar environment
- Regolith as a recorder of the Sun's history
- The Moon as a Science Platform: Astronomy, Earth and Solar Activity Observations
- Testing Planetary Protection protocols

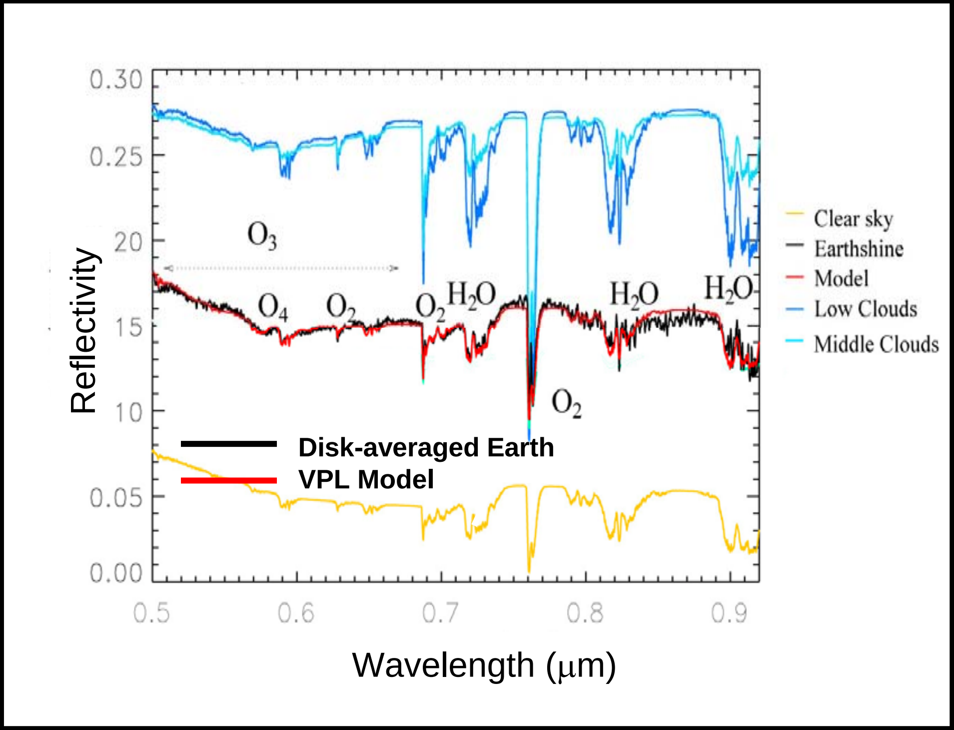


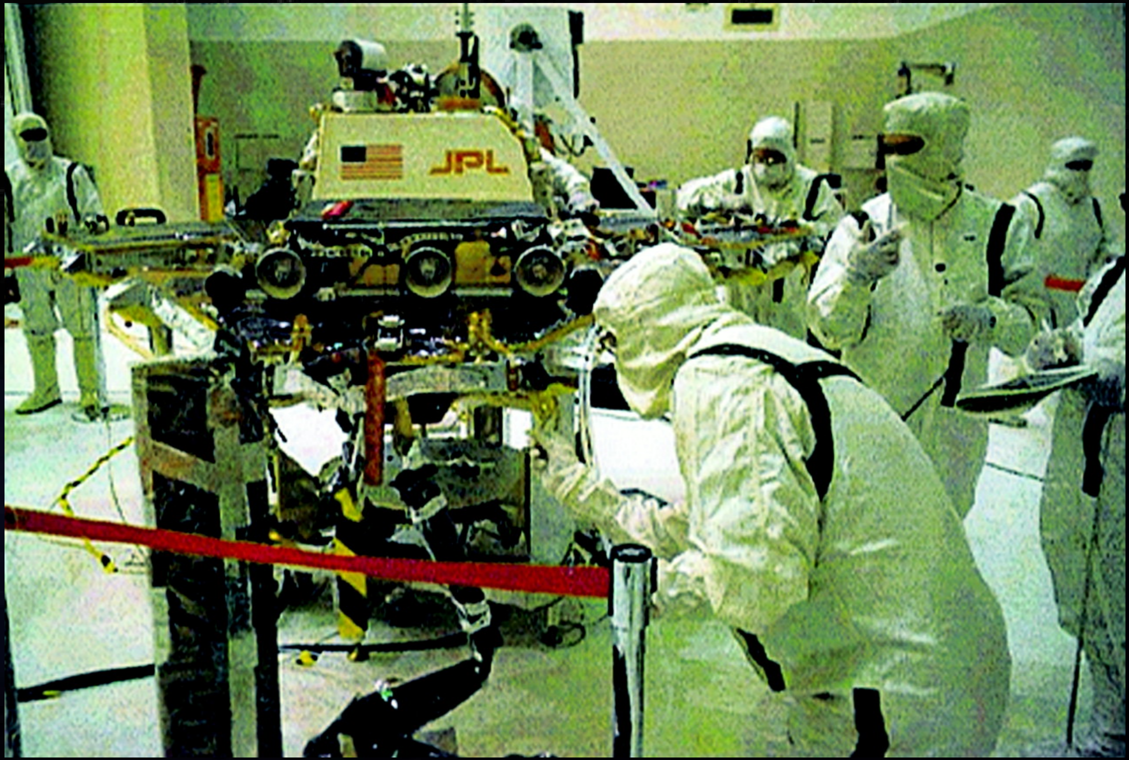
Take-home Message #1

Some of the identified major science themes for lunar exploration *are important astrobiology themes*

Planetary-Scale Biosignatures

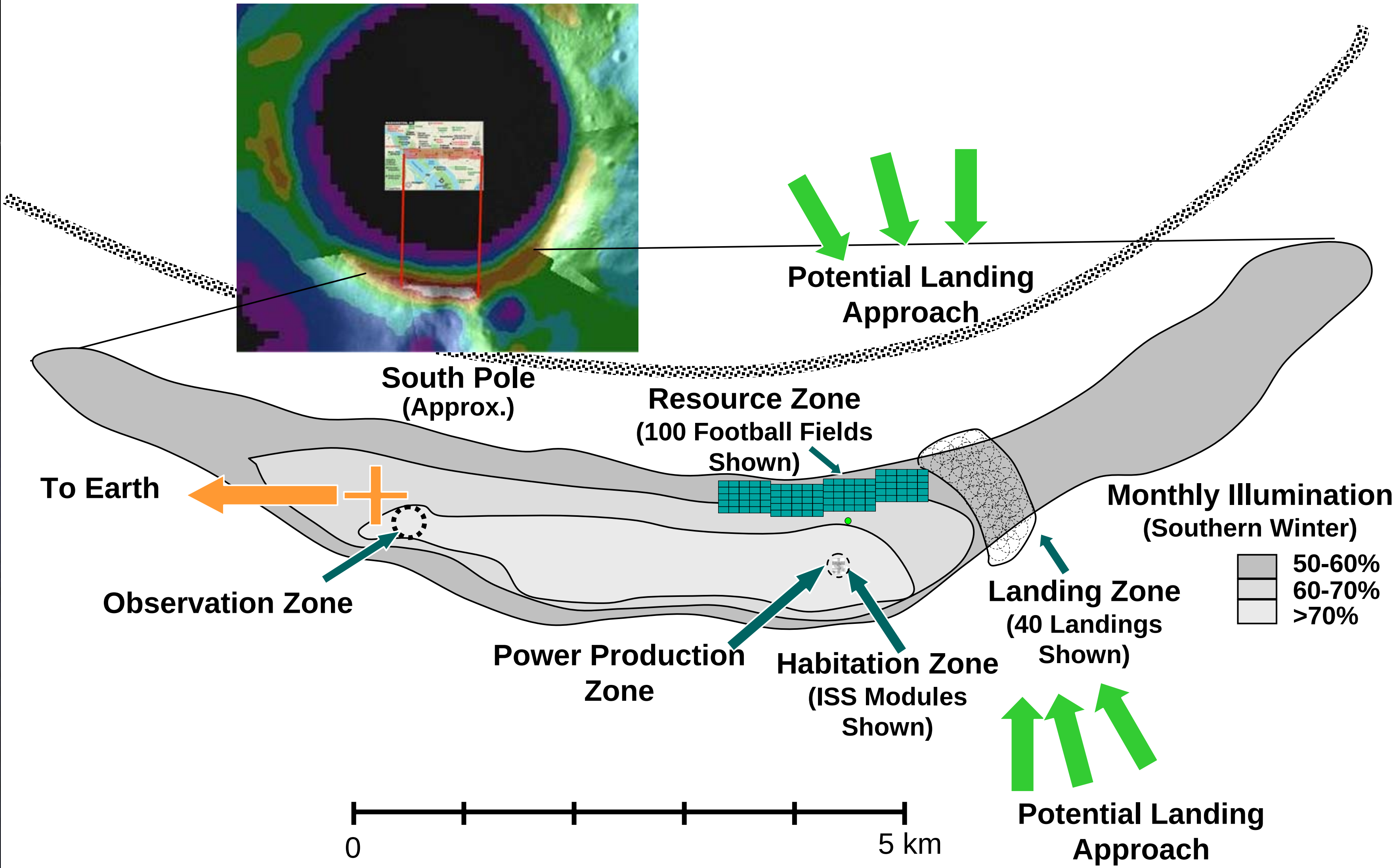


Planetary Protection

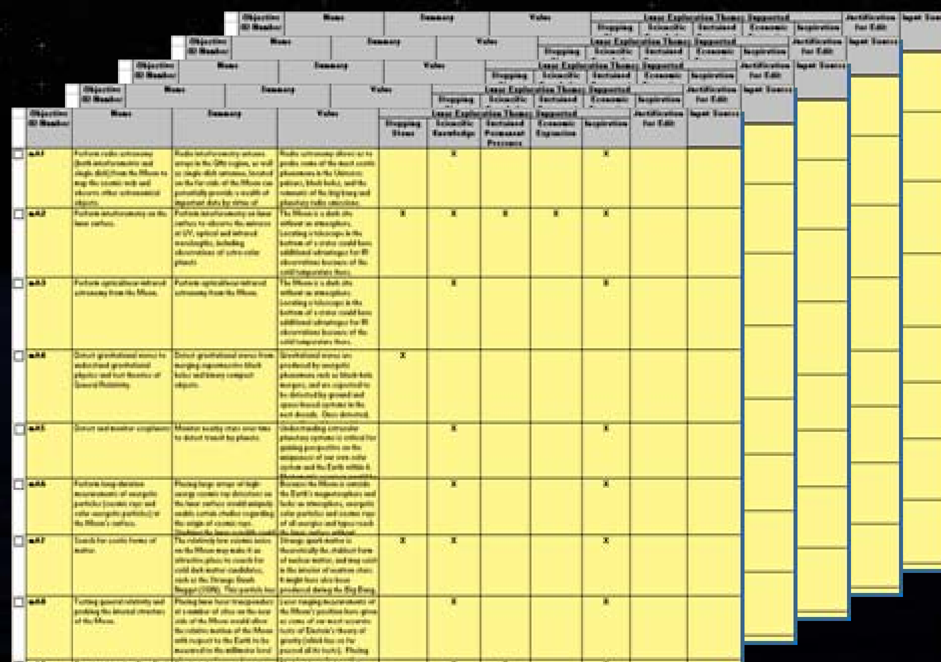


S. Polar Outpost

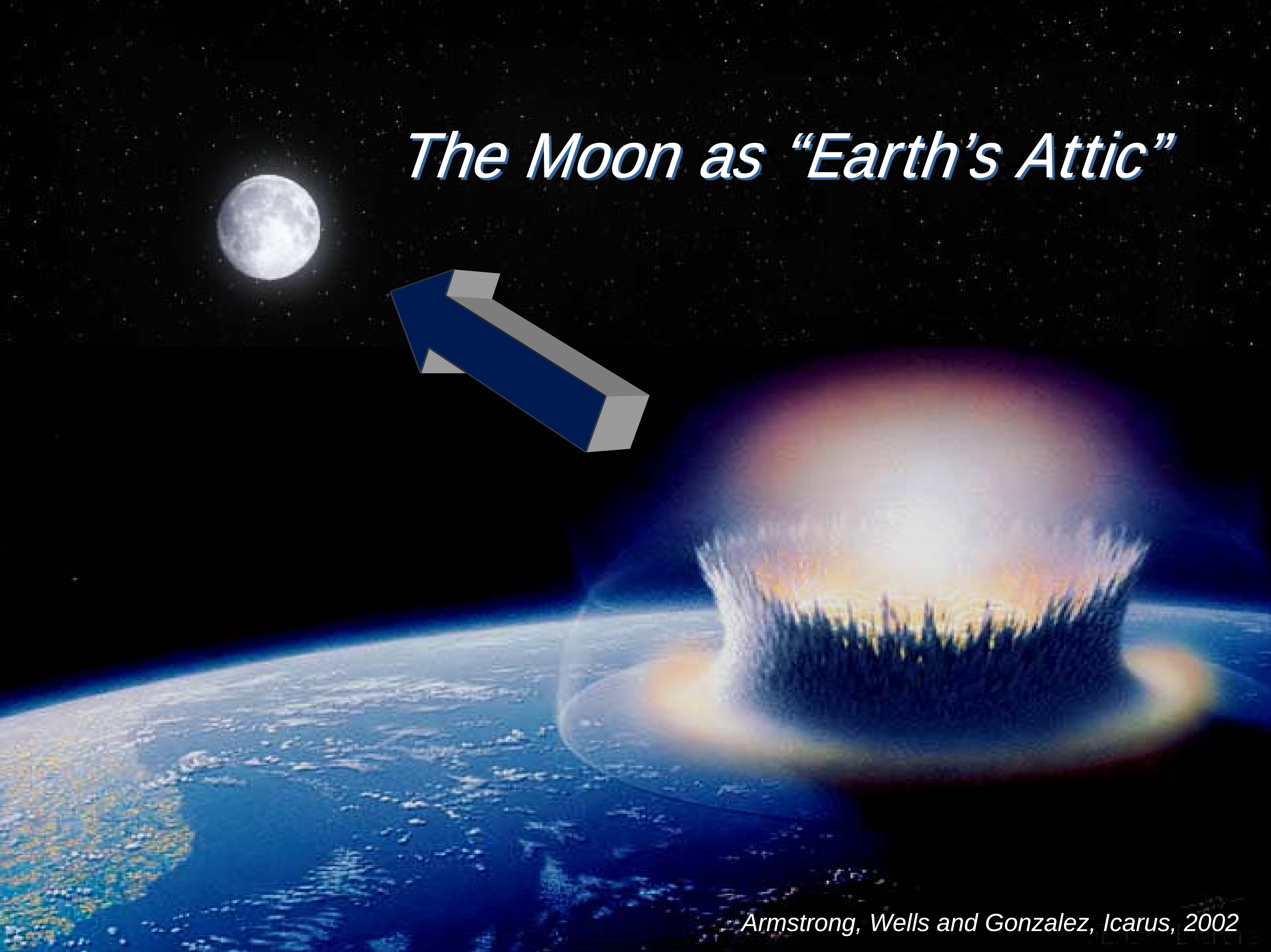
Not ideal but could signifiantly advance astrobiology



What's Missing?



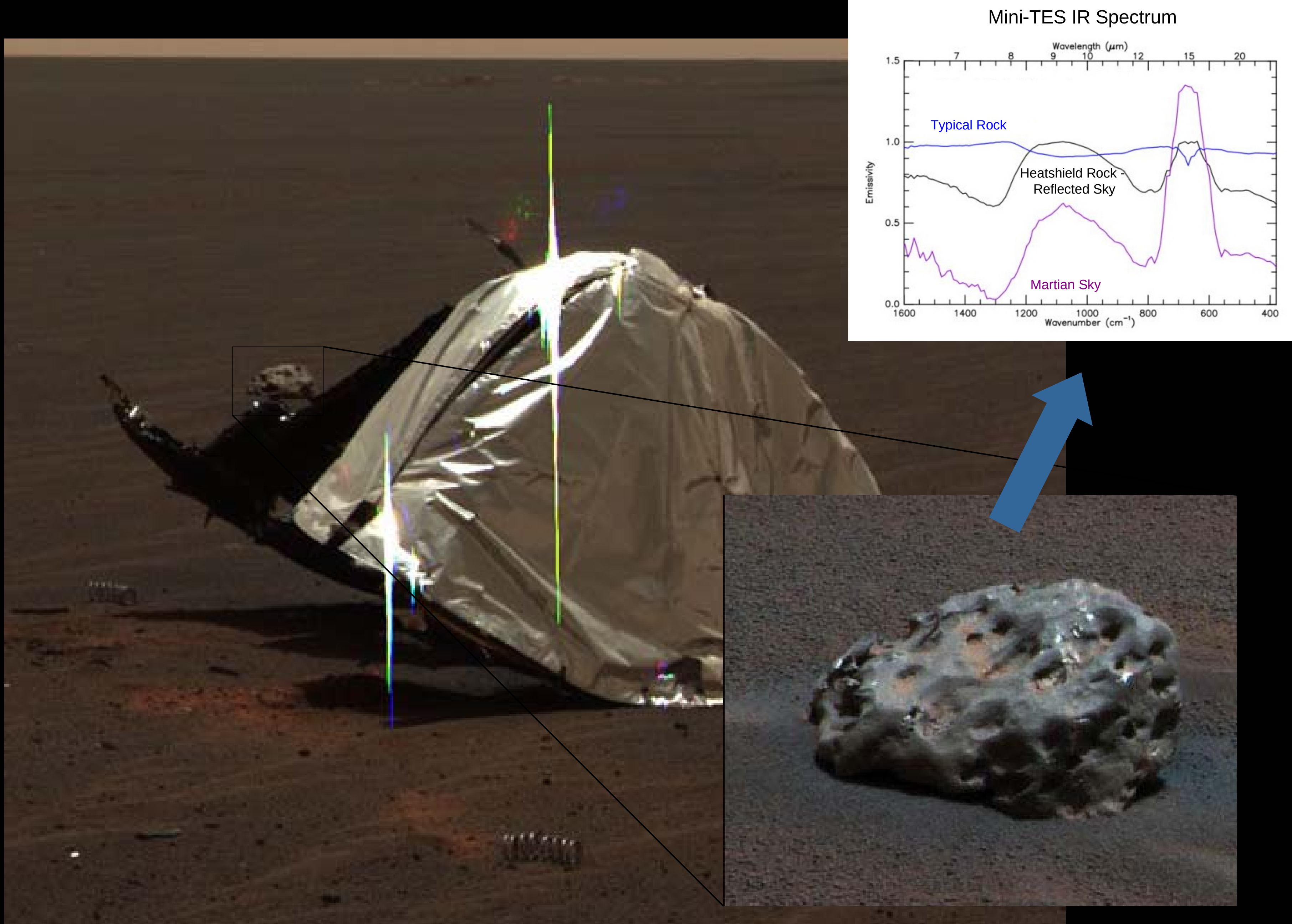
The Moon as “Earth’s Attic”



Armstrong, Wells and Gonzalez, Icarus, 2002

How Much Stuff? How Hard to Find?

- 7 parts per million
- About 200 kg of material in 1 sq. km.
- Size distribution *unknown*



Credit: P. Christensen, ASU

Take-home Message #2

On the Moon (eventually):

- *Keep eyes (and options) open!*

On Earth (until we return, and beyond):

- *Support development of NEW ideas.*
- *Integrate into mission plans.*
- *Iterate. Then do it again!*