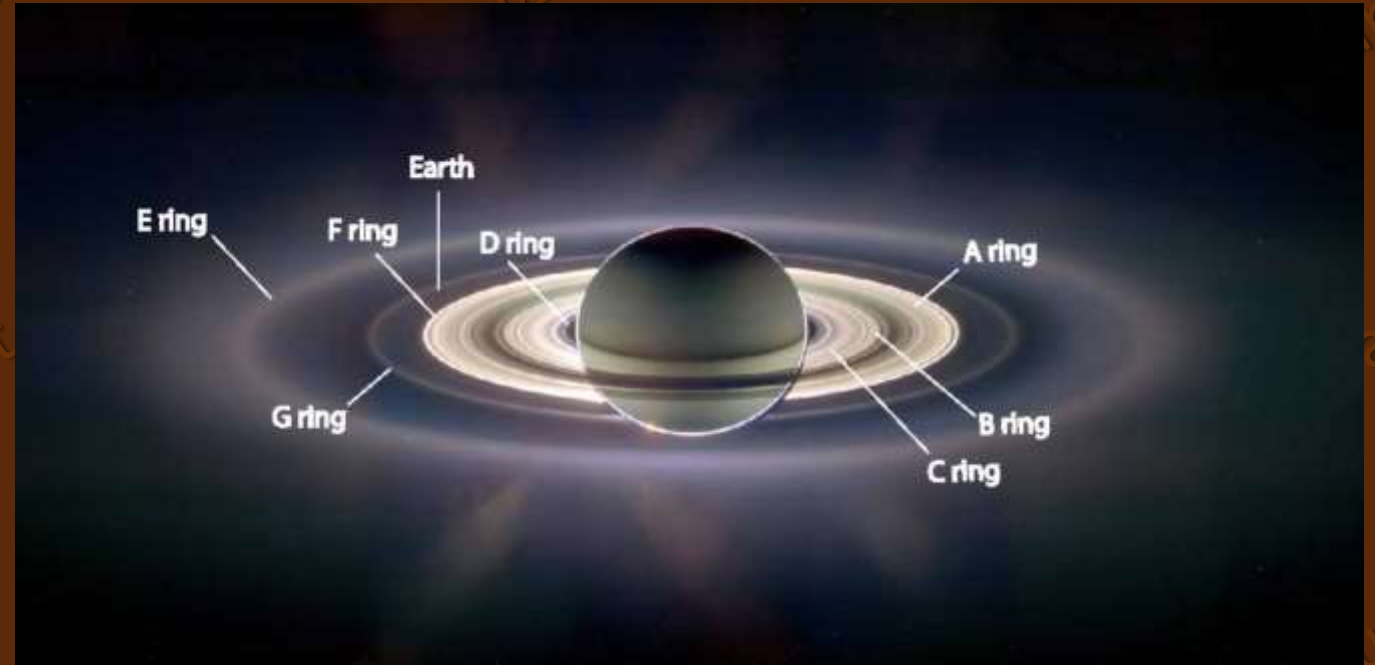


Summary of the Last Lecture

- ❑ Grand tour of the solar system
- ❑ Enormous diversity of planetary moons
- ❑ What does diversity indicate?
 - *Different origin*
 - *Different evolutionary paths*
 - *Accidents...*
- ❑ Earth's Moon
 - *Giant impact origin*
 - *Earth has a very chaotic past but survived*
 - *The Moon was much closer to Earth than today*



(Source: <https://caps.gsfc.nasa.gov/simpson/kingswood/rings/>)

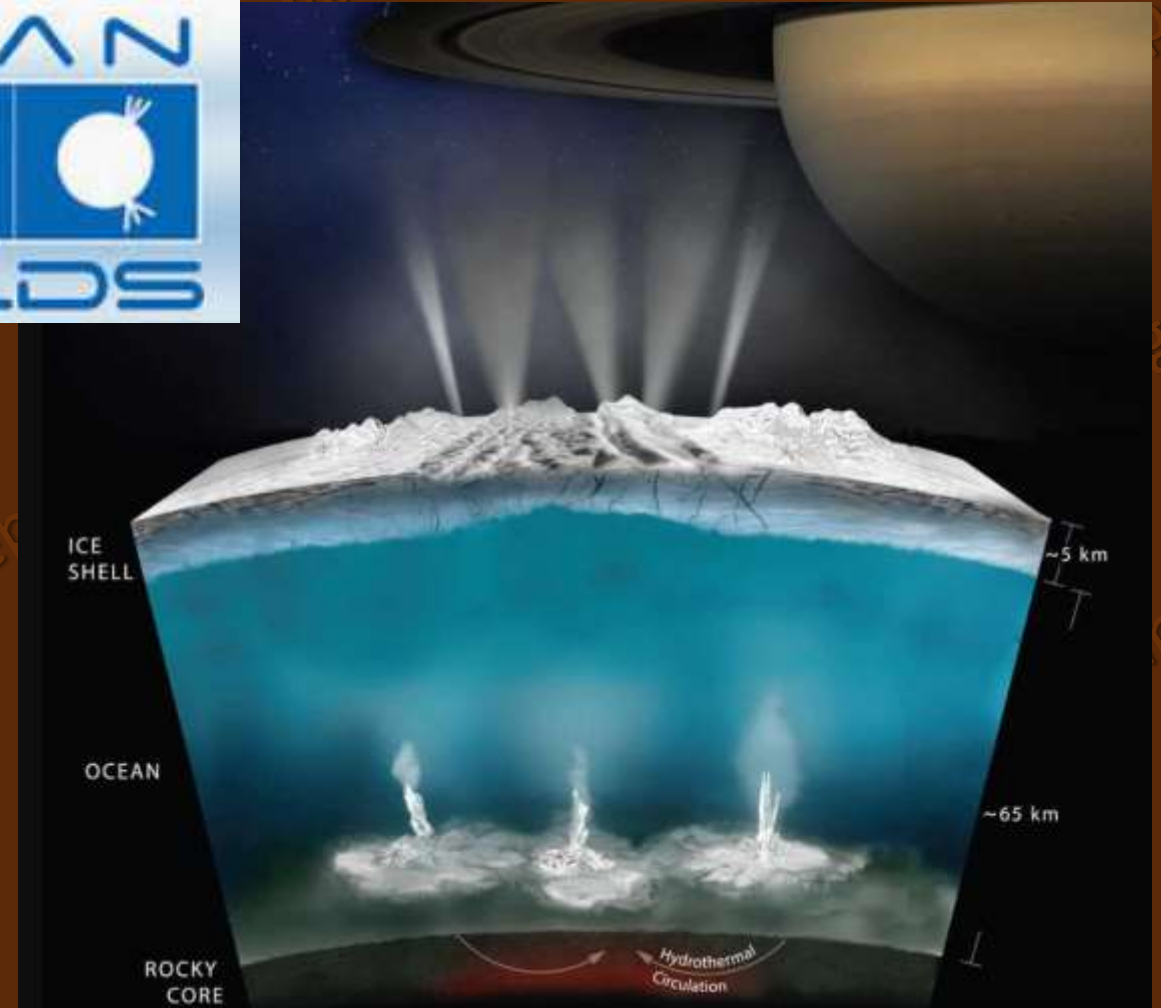


Can a moon tell us about the origin of life?

Enceladus



(Image Credit: NASA/JPL/Space Science Institute)



(Credit: NASA/JPL-Caltech/Southwest Research Institute)

(A mission to Enceladus: <https://vimeo.com/177182335>)

The Moon's Connection to Life!

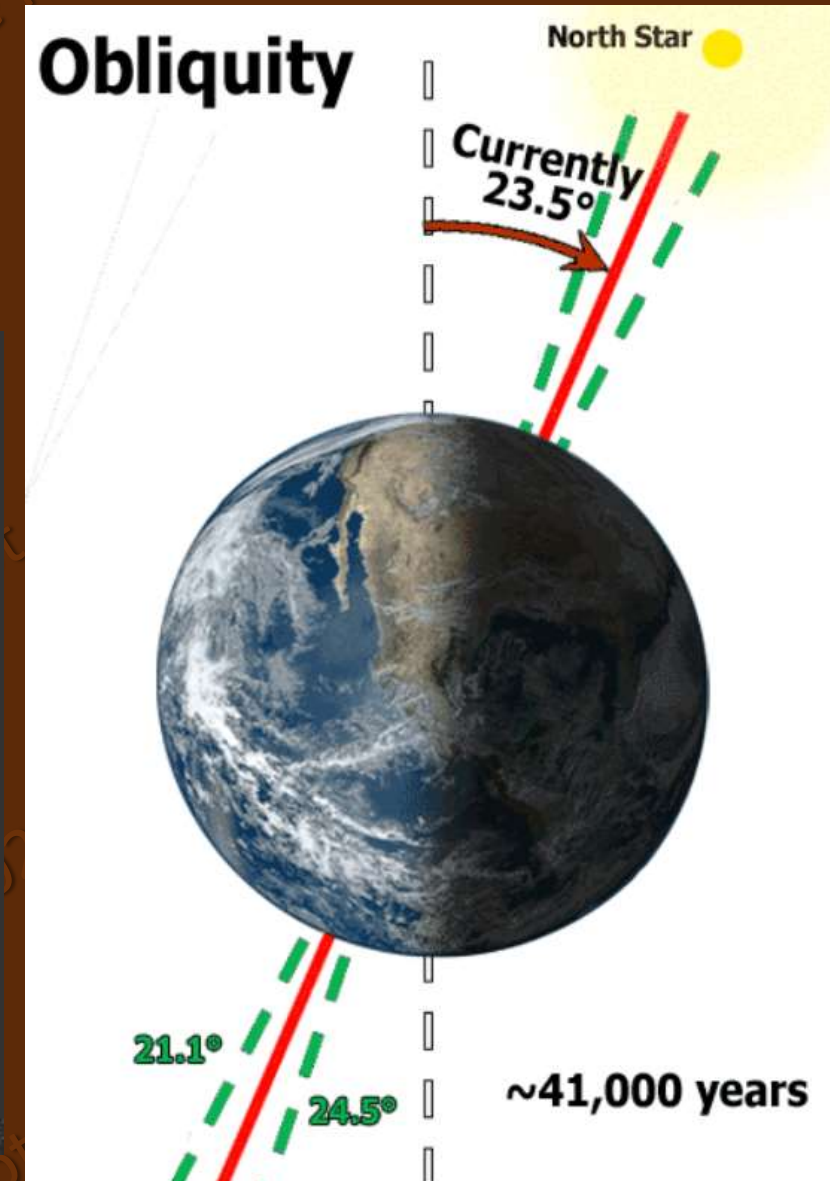
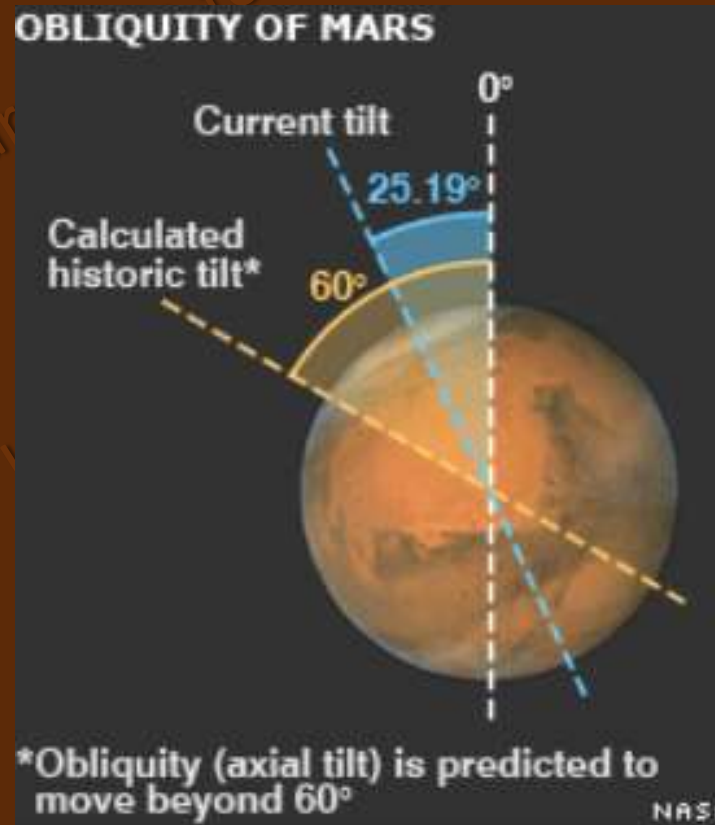
- ❑ Life started in water, land, tidal pools...
- ❑ The Water Problem: Prebiotic organic reactions → dehydration → long-chain organic polymers → Biotic life
- ❑ Tides – Stirrers of the Oceans
- ❑ Inter-Tidal Flats (Wet - Dry Cycling)



Implications for biological diversity

The Moon's Connection to Life!

- ❑ Stabilization of Earth's Orbital Dynamics
 - *Slowing down of Earth – Duration of the day*
 - *Obliquity - Climate extremes*



The Moon's Connection to Life!

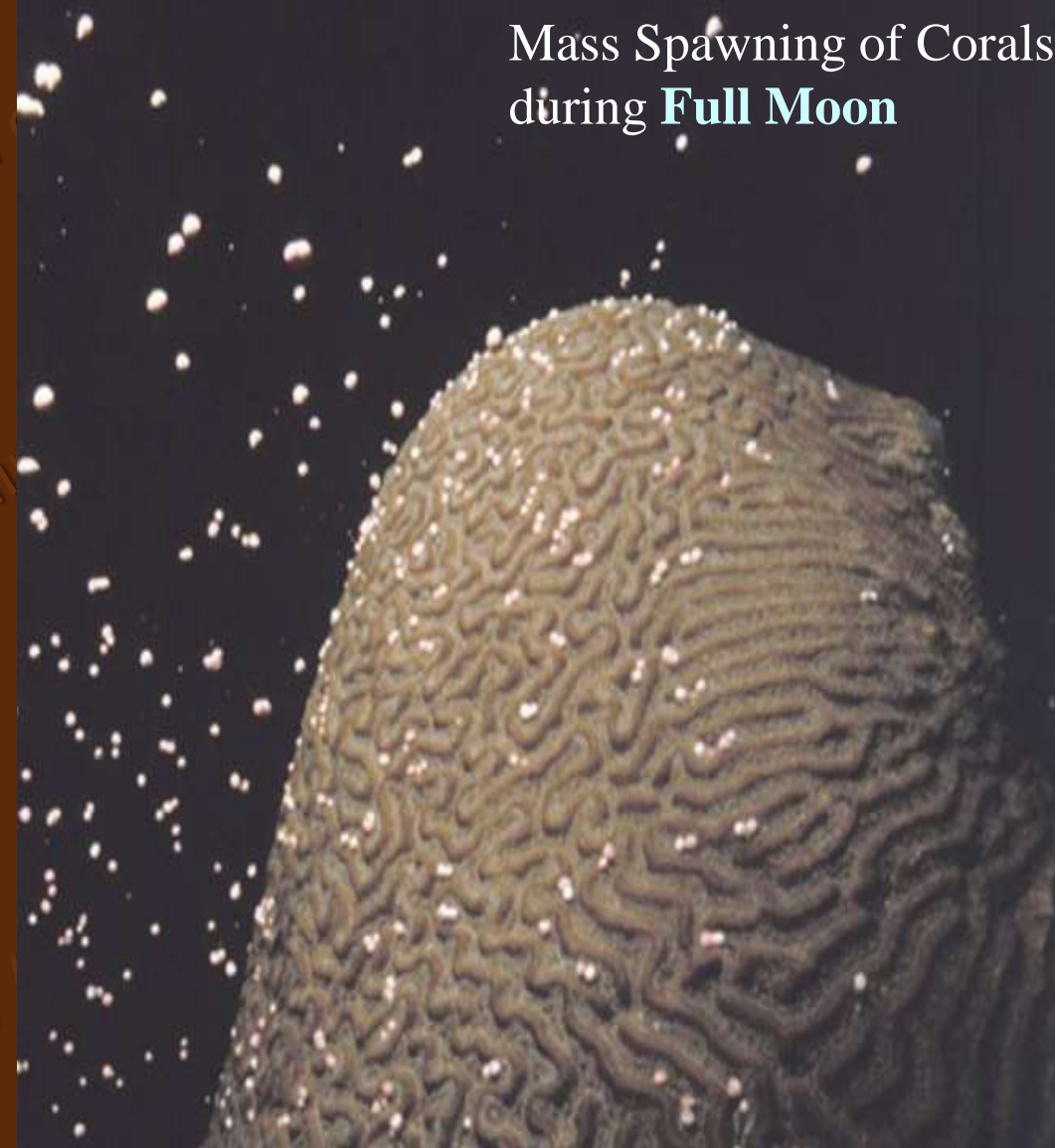
One-Way Romance on the Full Moon

July 05, 2018

Marine polychete Atlantic Clamworms (*Alitta succinea*)



Mass Spawning of Corals during **Full Moon**

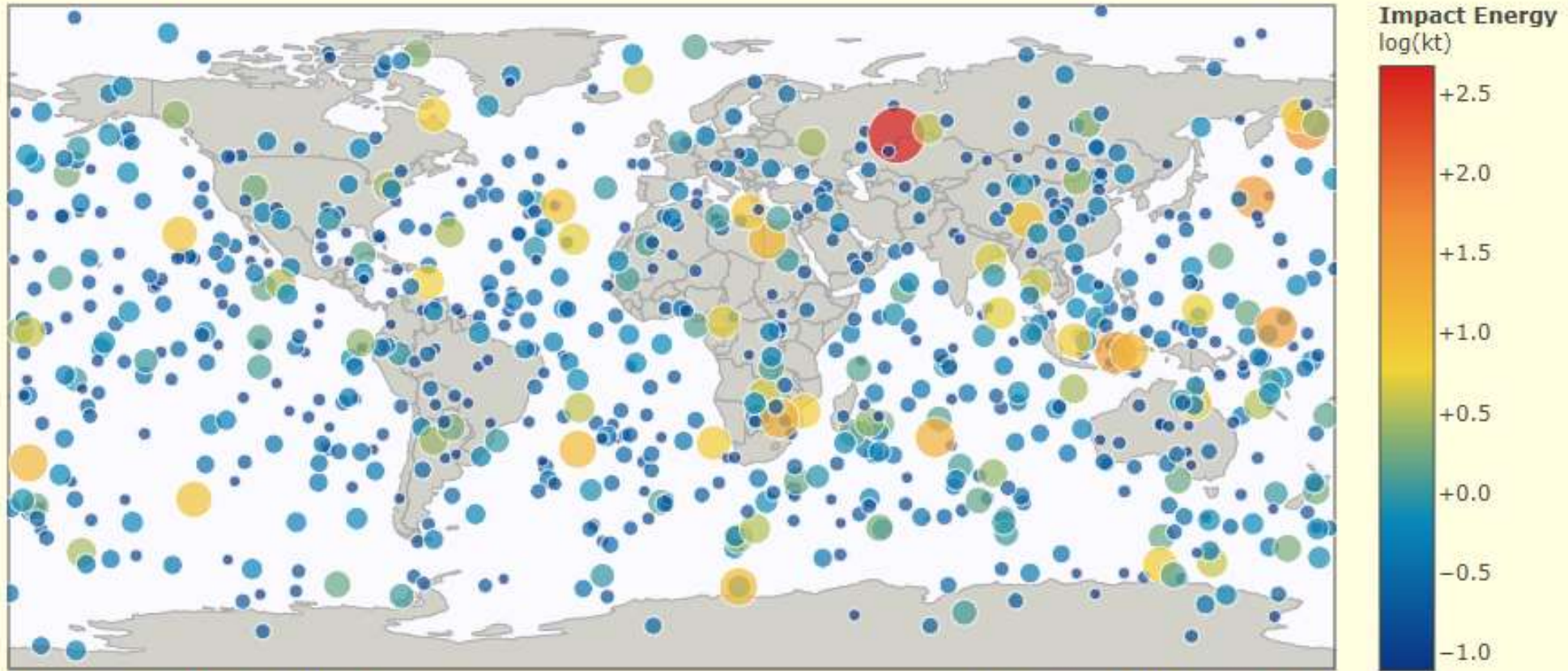


The story of our Earth and its Moon



Modern day impacts

Fireballs Reported by US Government Sensors
(1988-Apr-15 to 2023-Jul-26)



<https://cneos.jpl.nasa.gov/fireballs/>

Alan B. Chamberlin (JPL/Caltech)

Smoke/Dust trail of Chelyabinsk Meteoroid



Modern day impacts

Chelyabinsk event (2013)

Size: ~20 m (7-storey building)

Weight: ~ 10,000 Tons

Velocity: 20 km/s

People hurt: >1000

Largest recovered fragment : 650 kg

(Image credit: M. Ahmetvaleev)



(Video: Fall / Damage Video: <https://youtu.be/DsIqw60c9Hs>)



RESEARCH ARTICLE

Chelyabinsk Airburst, Damage Assessment, Meteorite Recovery, and Characterization

Olga P. Popova¹, Peter Jenniskens^{2,3,*}, Vacheslav Emel'yanenko⁴, Anna Kartashova⁴, Eugeny Biryukov⁵, Sergey Khaibrakhm...

+ See all authors and affiliations

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DOI: 10.1126/science.1242642

Fall 2023/ ESO213 / IIT Kanpur / Deepak Dhingra

(Meteorite Recovery: https://youtu.be/n1TL_jaVijY)