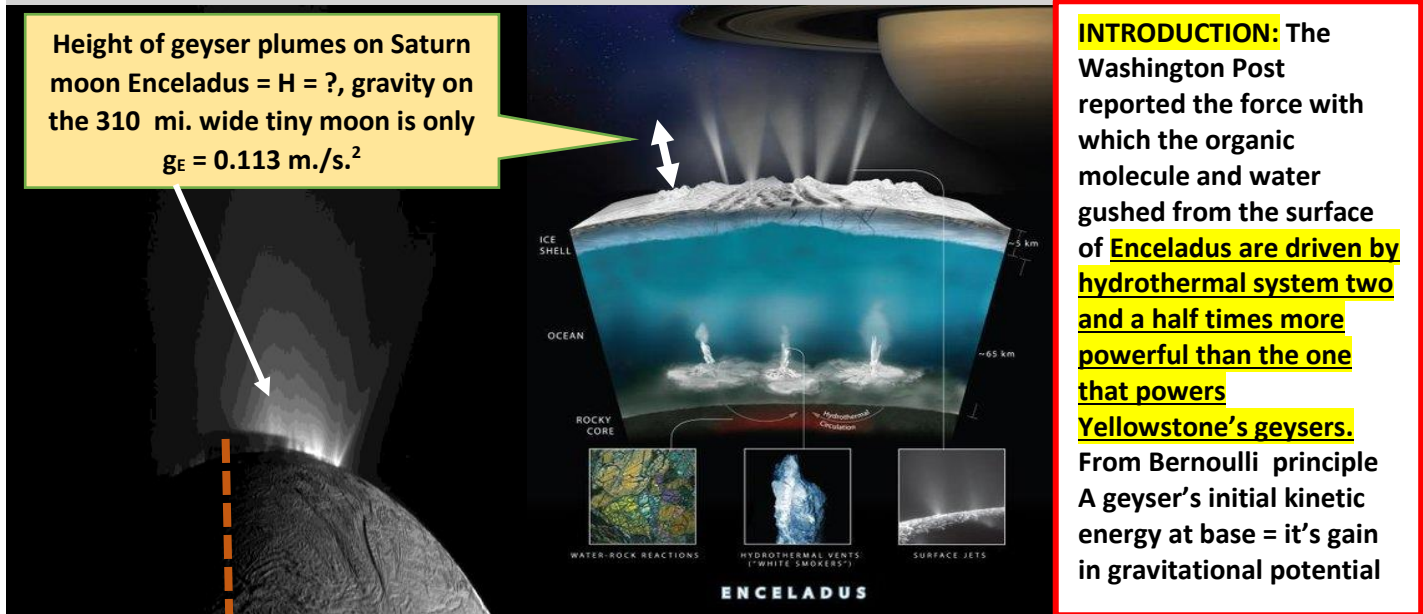


FLUIDS & ENERGY

Units 18 & 10 Dr. John P. Cise, Professor of Physics, Austin Com. College, 1212 Rio Grande St., Austin Tx. 78701, jpcise@austincc.edu & NY Times , April 14, 2017 by Kenneth Chang & Dennis Overbye

Plumes From Saturn's Moon Enceladus Hint That It Could Support Life.



INTRODUCTION: The Washington Post reported the force with which the organic molecule and water gushed from the surface of Enceladus are driven by hydrothermal system two and a half times more powerful than the one that powers Yellowstone's geysers. From Bernoulli principle A geyser's initial kinetic energy at base = it's gain in gravitational potential

Height of geyser plumes on Saturn moon Enceladus = $H = ?$, gravity on the 310 mi. wide tiny moon is only $g_E = 0.113 \text{ m./s.}^2$

plumes rise from ice fractures one surface of Enceladus

$R = 155 \text{ mi.}$

ANSWERS: (a) $H = \sim 39,027 \text{ feet}$, (b) $H = \sim 7.4 \text{ miles}$, **IS ANSWER PLAUSABLE?** (c) Looking at the picture above it can be seen that H being $\sim 7.4 \text{ miles}$ fits about right as $7.4/155$ the radius of Enceladus About $1/15$ to $1/20$ th. radius of Enceladus. H IS 180 FT. on earth and 39,027 ft. on Enceladus due to gravity being 100 times smaller on the moon + 2.5 the energy on earth.

Energy (U). Thus, $\frac{1}{2} \rho v^2 = \rho g h$. The purpose of this application is to find the height of the geyser plume (H) on Enceladus. The only difference between energy(power) flow at Yellowstone's old faithful geyser plumes and Enceladus plumes is Enceladus plumes Are 2.5 times more powerful(Energy/time). Thus,

$$[U]_{\text{ENCELADUS}} = 2.5 [U]_{\text{YELLOWSTONE OLD FAITHFUL}}$$

$$P g_E H = 2.5 (P g_{\text{EARTH}} h_{\text{EARTH OLD FAITHFUL}}) \quad \text{EQ. 1}$$

QUESTIONS: (a) Find H height of plumes on Enceladus in units of feet?, (b) Convert height in feet to miles?, (c) Does the answer seem plausible for H viewing picture in upper left taken by Cassini spacecraft as it flew past Saturn's moons?

HINTS: ρ = water density on earth & Encelades. $g_{\text{EARTH}} = 9.8 \text{ m/s}^2$
 $h_{\text{OLD FAITHFUL}} = \sim 180 \text{ ft.}$ (from Wikipedia)

Could icy moons like Saturn's Enceladus in the outer solar system be home to microbes or other forms of alien life? Intriguing new findings from data collected by [NASA's Cassini spacecraft](#) suggest the possibility.

Plumes of gas erupting out of Enceladus — a small moon with an ocean of liquid water beneath its icy crust — contain hydrogen. Scientists infer a lot from that: that there are hydrothermal chemical reactions similar to those that occur at hot fissures at the ocean bottoms on Earth. On Earth at least, hydrothermal vents thrive with microbial life, offering up the potential that icy moons far from Earth — called "ocean worlds" by NASA — could be habitable.

At a mere 310 miles wide, Enceladus was considered too small to be geologically interesting; scientists suspected that its interior had frozen solid long ago. But 11 years ago, Cassini spotted plumes rising from the south pole region, one of the biggest, most surprising discoveries of the mission. The tidal forces of Saturn pulling and squeezing Enceladus appear to generate enough heat to melt the ice. From additional Cassini observations, scientists concluded that not only is there a pool of water near the south pole of Enceladus to generate the plumes, but a global ocean that lies beneath the moon's ice. A NASA illustration shows how scientists studying the plumes at the south pole of Enceladus think water may be interacting with minerals in the moon's rock. Such hydrothermal chemical reactions are similar to those that occur at hot fissures at the ocean bottoms on Earth. On Earth, hydrothermal vents thrive with microbial life.