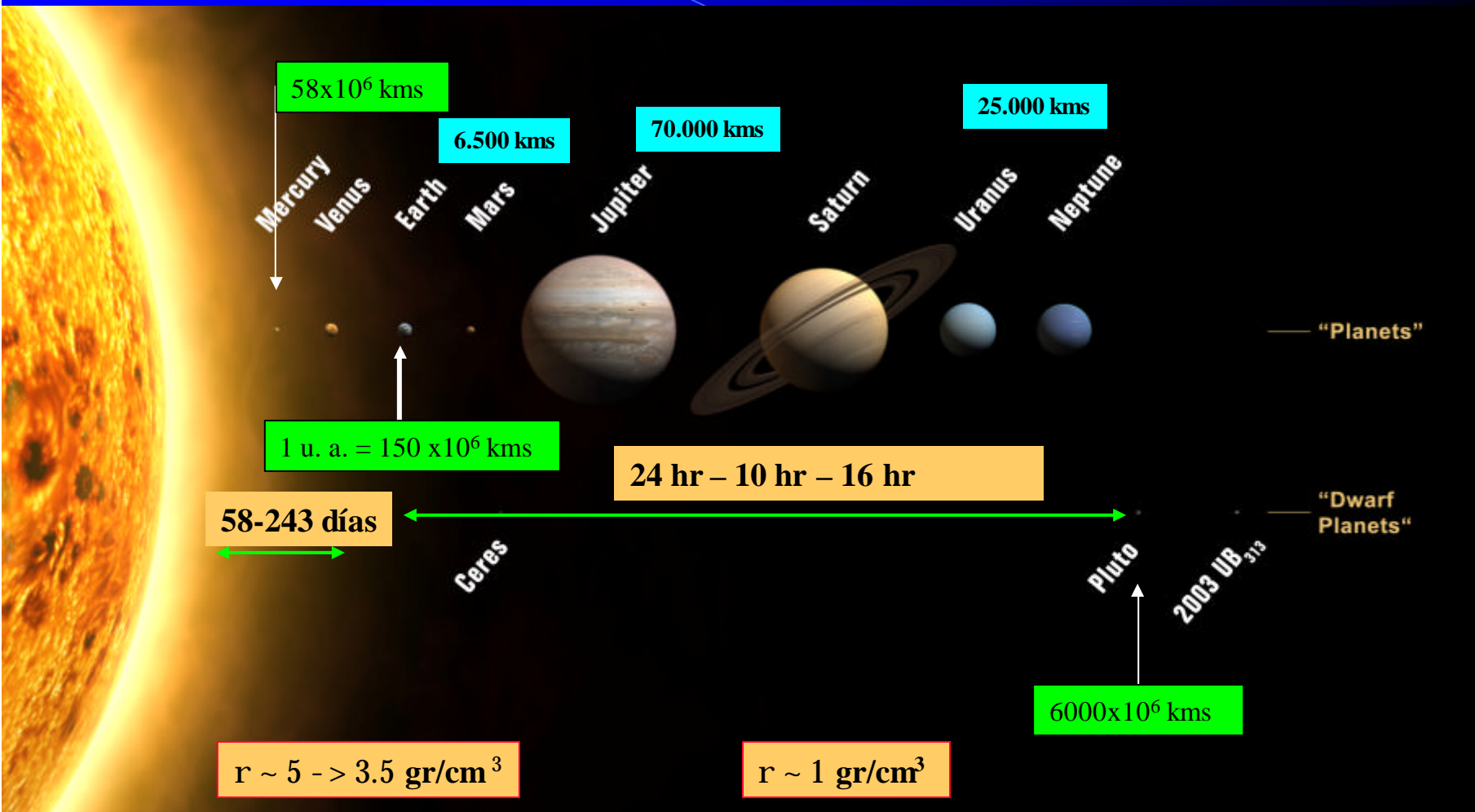


# PLANETAS Y VIDA EN EL UNIVERSO

*Agustín Sánchez Lavega*

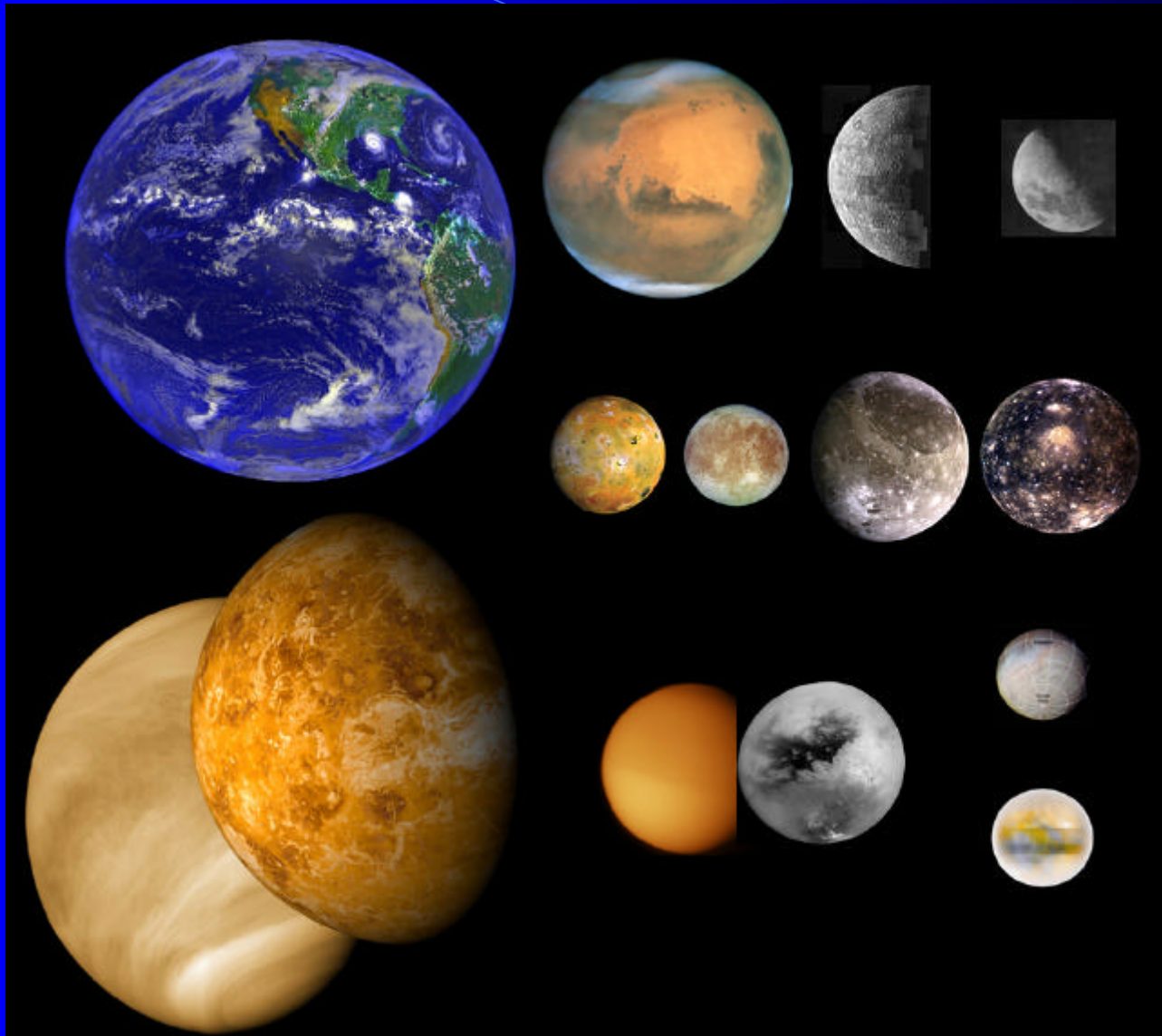
Grupo Ciencias Planetarias  
Universidad del País Vasco

# Planetas del Sistema Solar



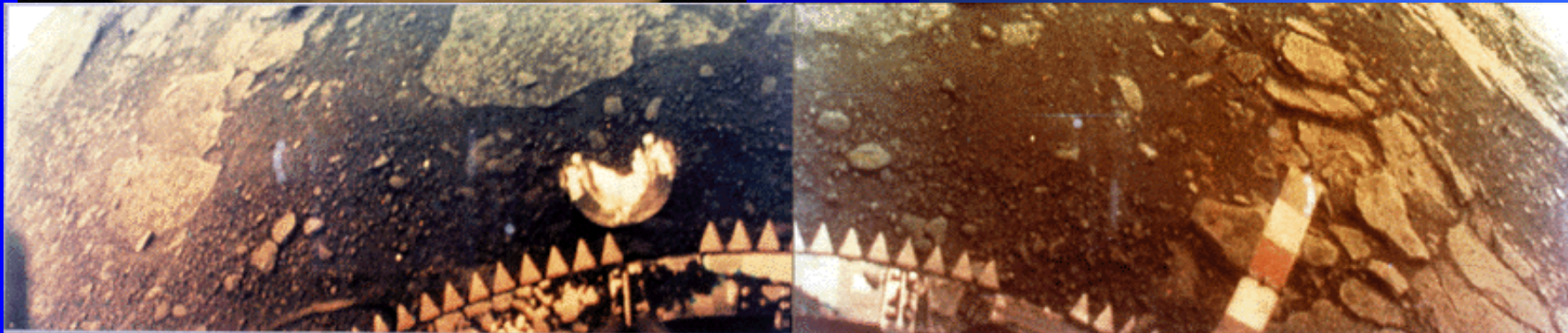
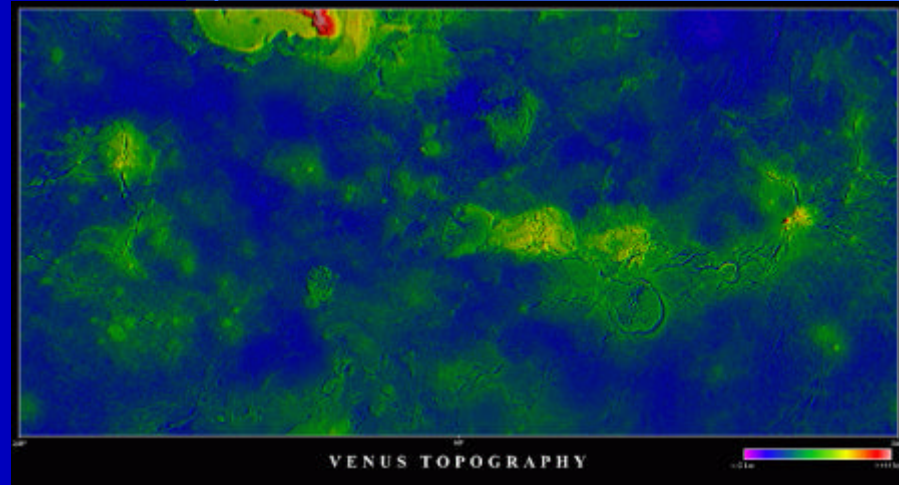
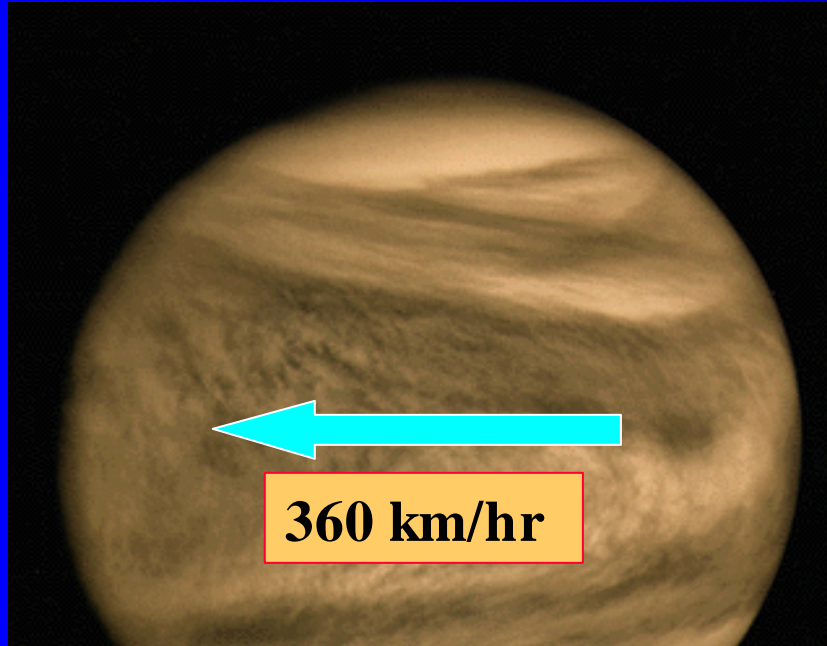
# Planetas Terrestres, Planetas Enanos, Satélites Mayores:

## “Planetodiversidad”



# Venus: Atmósfera única

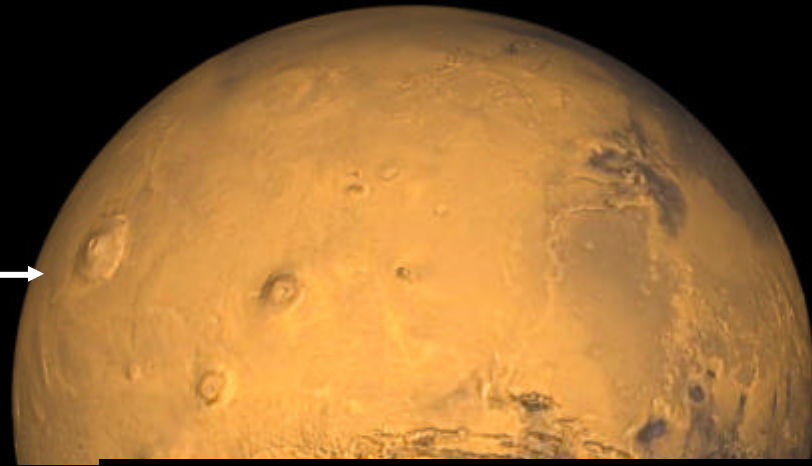
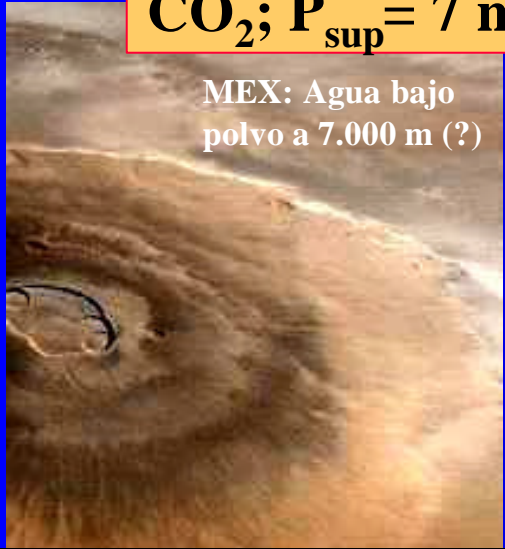
$\text{CO}_2$ ; Nubes:  $\text{SO}_4\text{H}_2$ ;  $P_{\text{sup}} = 90 \text{ bar}$ ;  $T_{\text{sup}} = 450^\circ\text{C}$



# Marte: Un mundo frío y seco ...

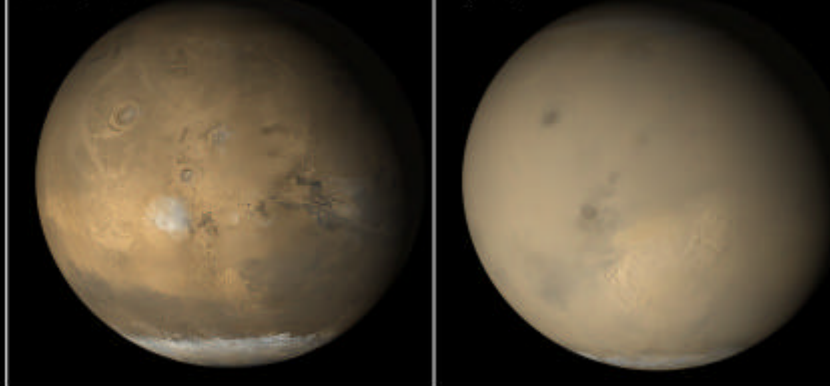
$\text{CO}_2$ ;  $P_{\text{sup}} = 7 \text{ mbar}$ ;  $T_{\text{sup}} = -100^\circ \text{ a } -50^\circ \text{ C}$ ; Nubes:  $\text{CO}_2\text{-H}_2\text{O}$

MEX: Agua bajo  
polvo a 7.000 m (?)

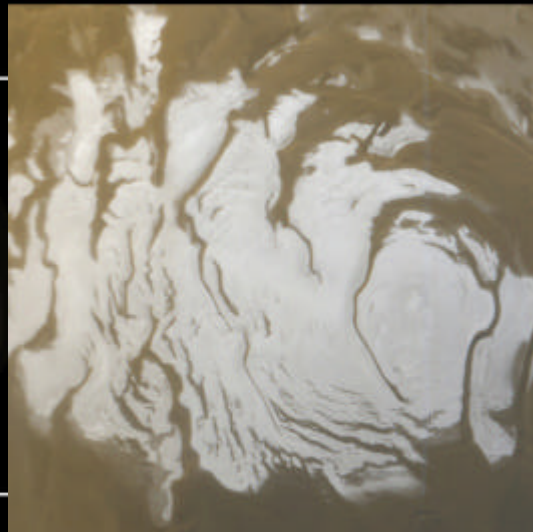


June 10, 2001

July 31, 2001



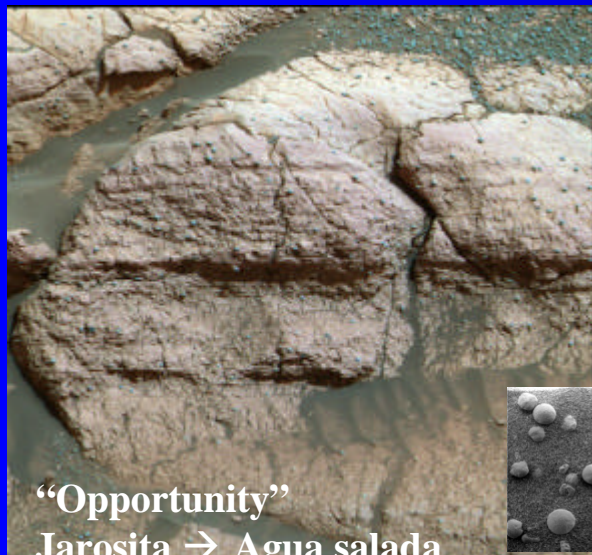
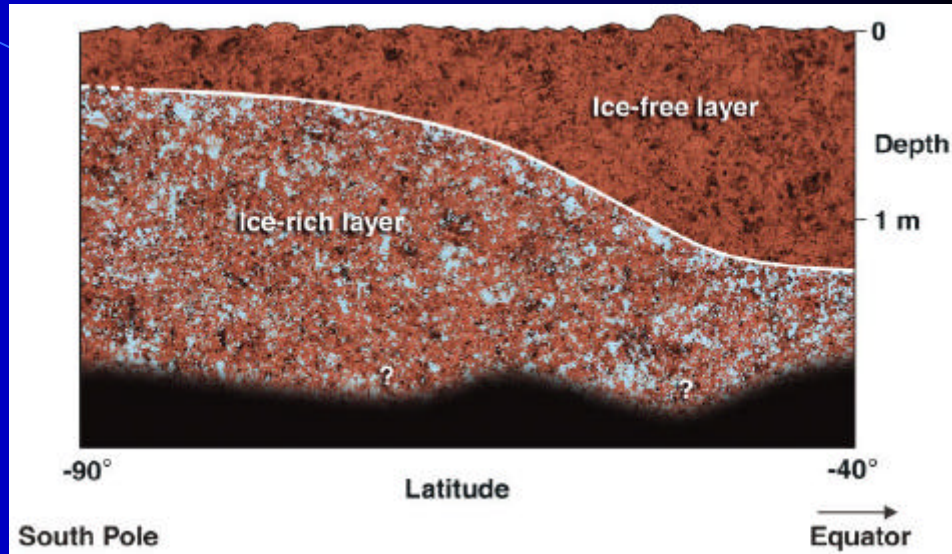
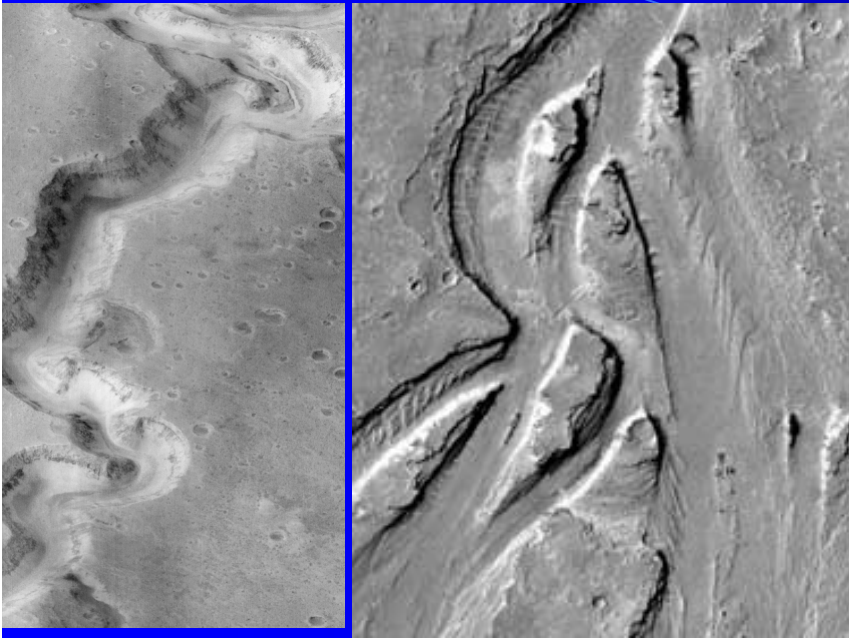
POLO SUR



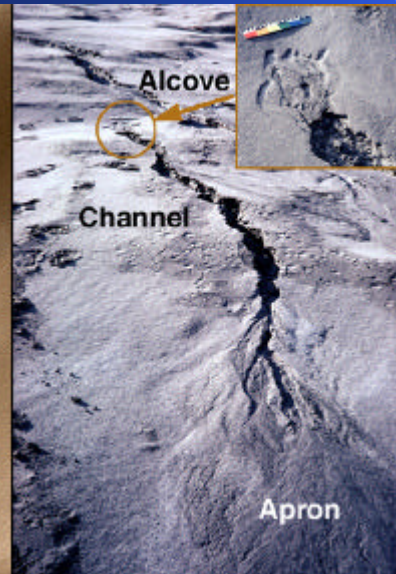
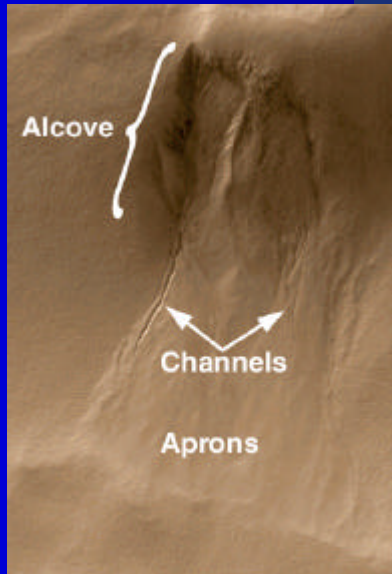
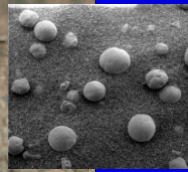
South Polar Cap



# ... agua hace 3.000 millones de años

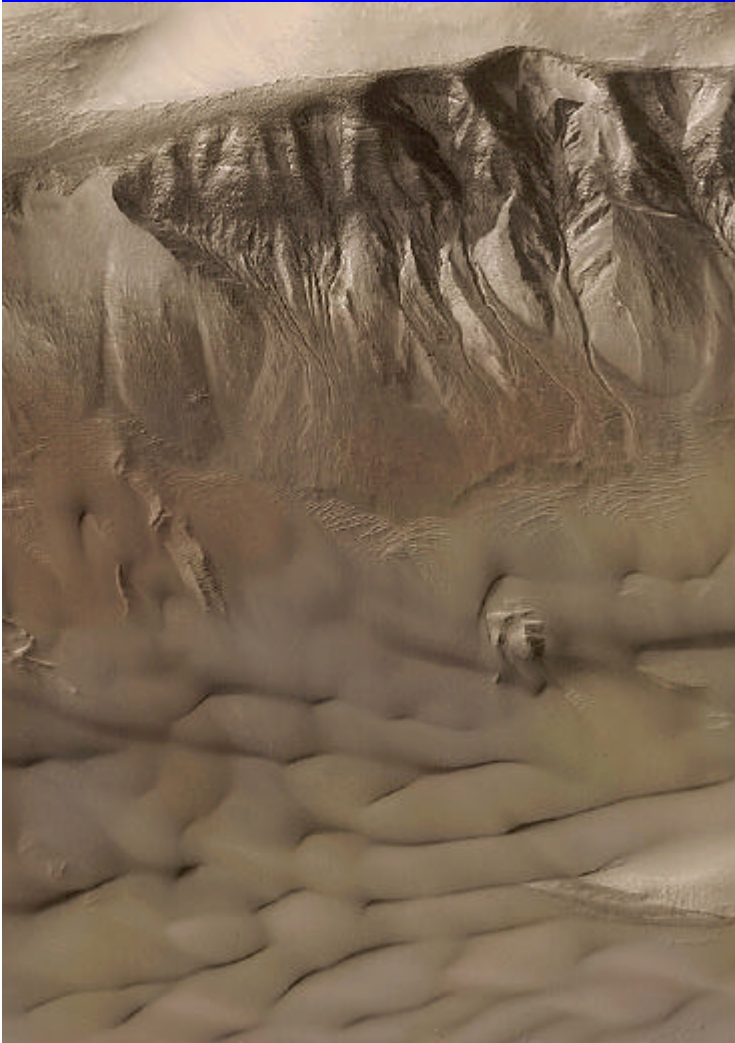


“Opportunity”  
Jarosita → Agua salada

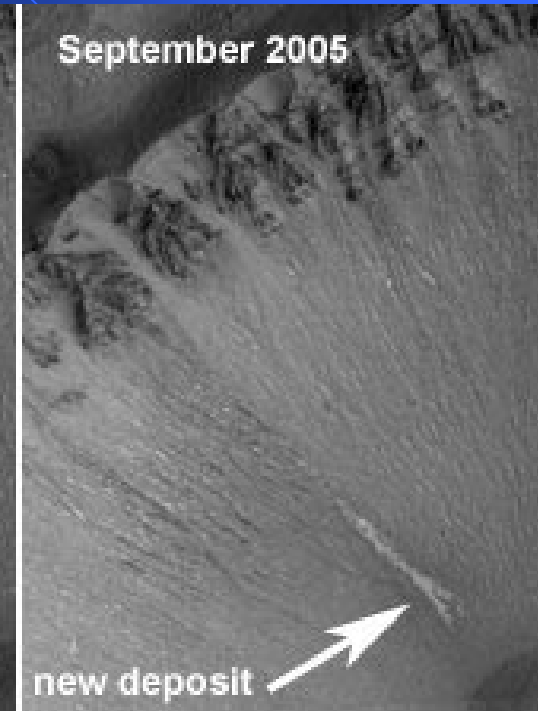
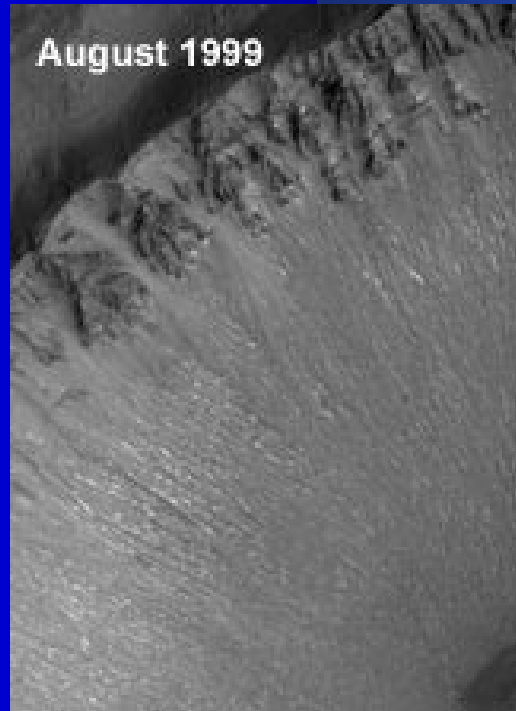


¿O solo  
10  
millones  
de años ?

# ¿O solo unos pocos años?



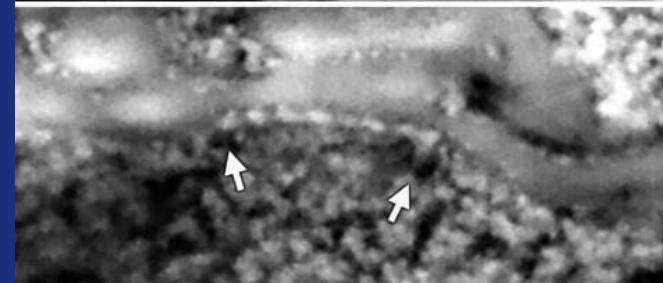
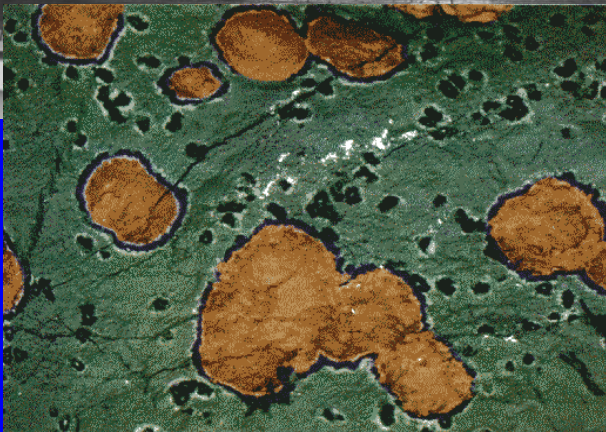
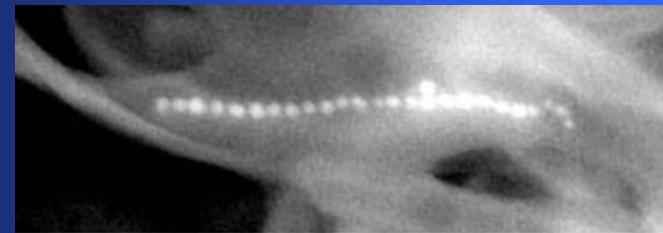
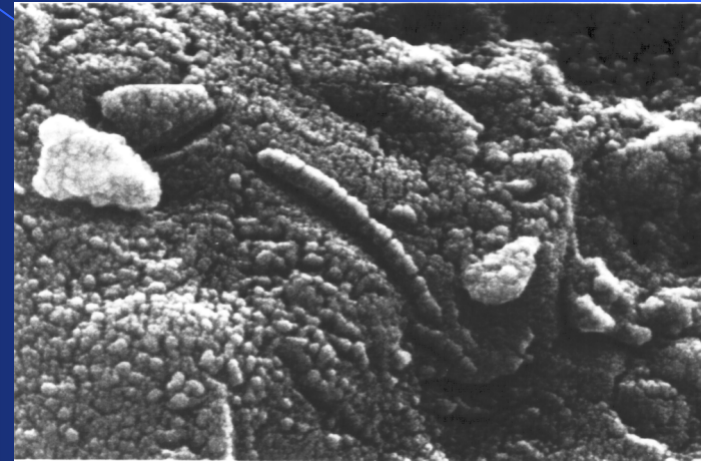
**Imágenes de la “Mars Global Surveyor”  
(paredes de cráteres)**



# ¿Microbios marcianos?

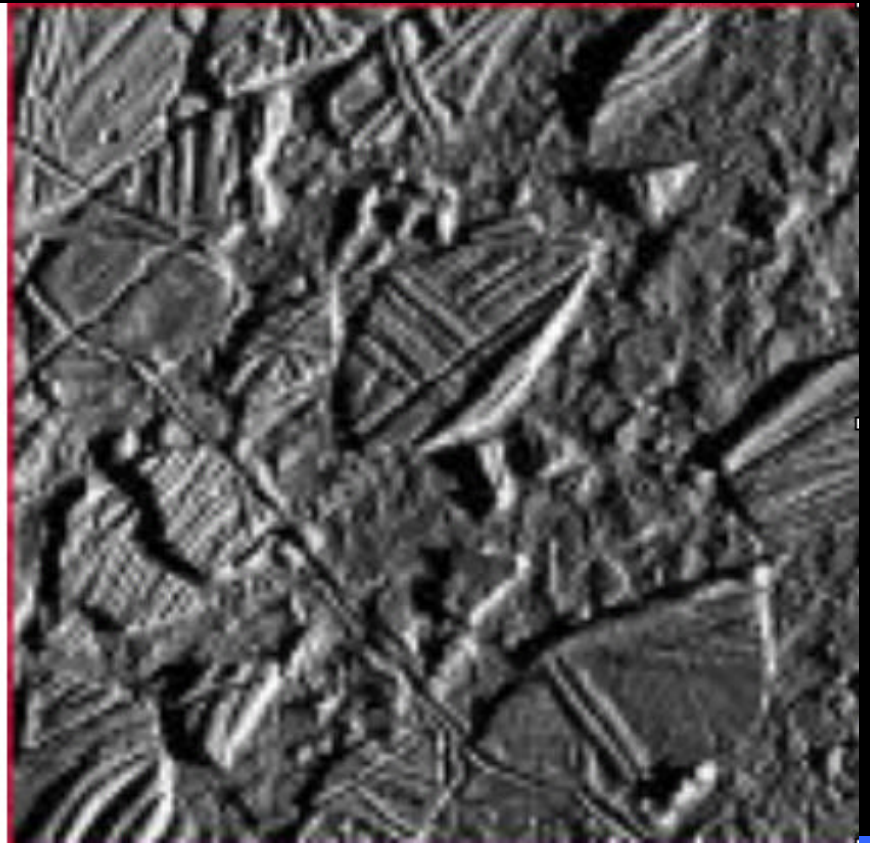
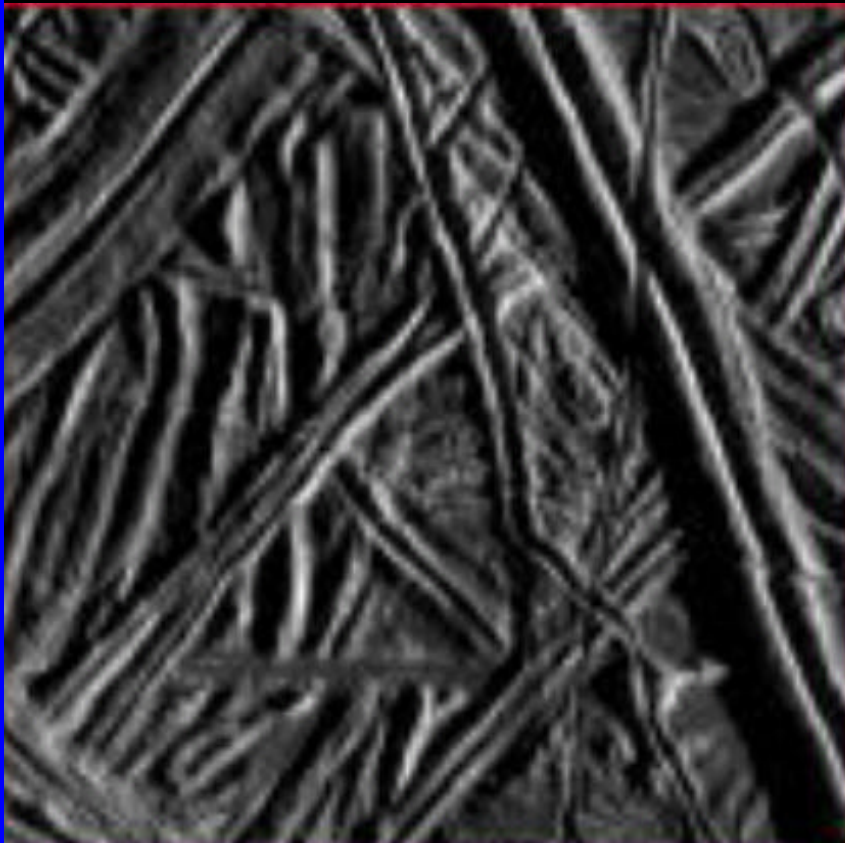


**PAH**

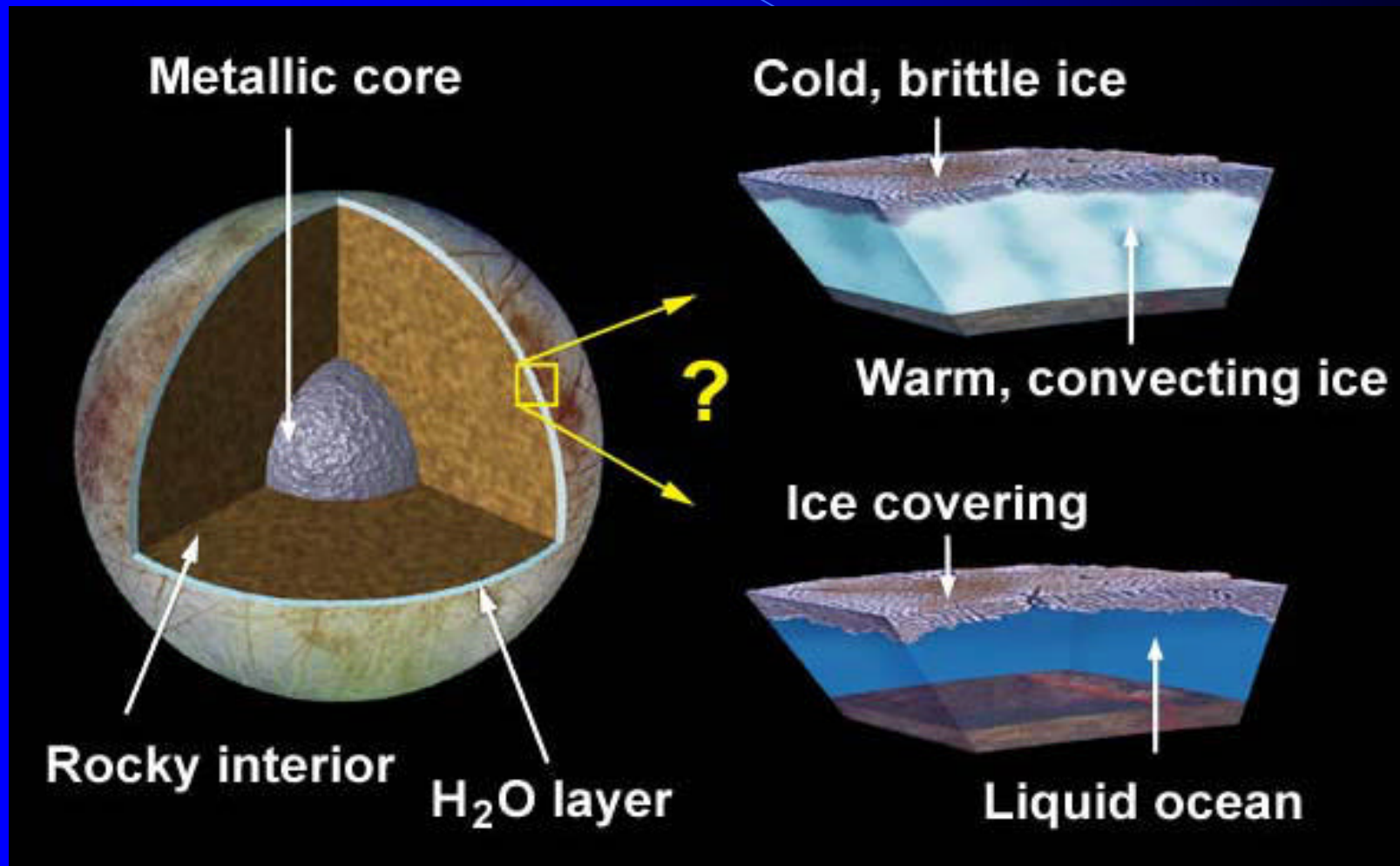




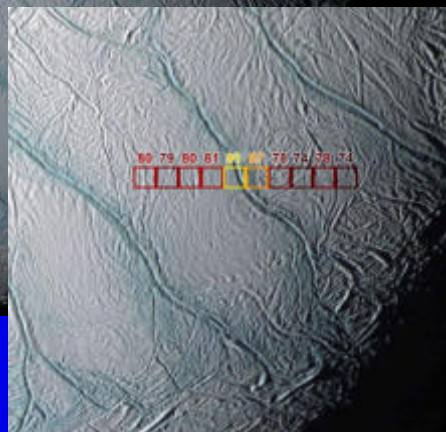
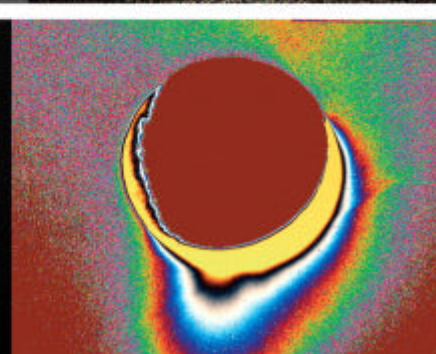
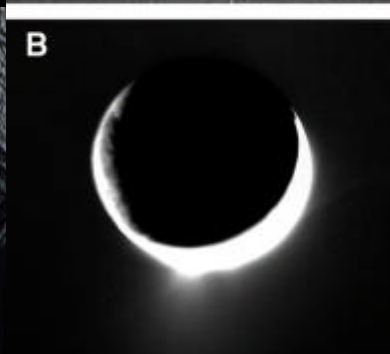
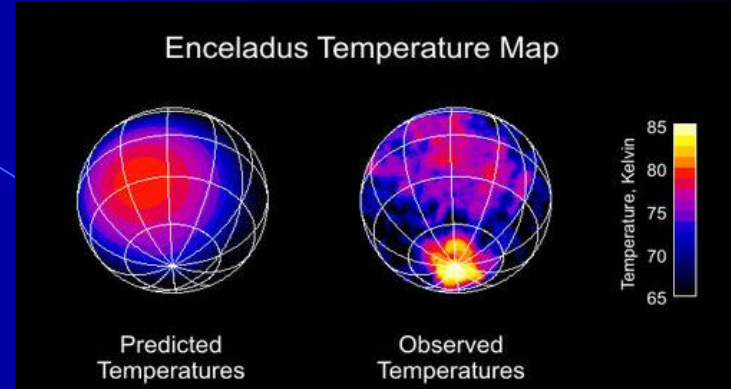
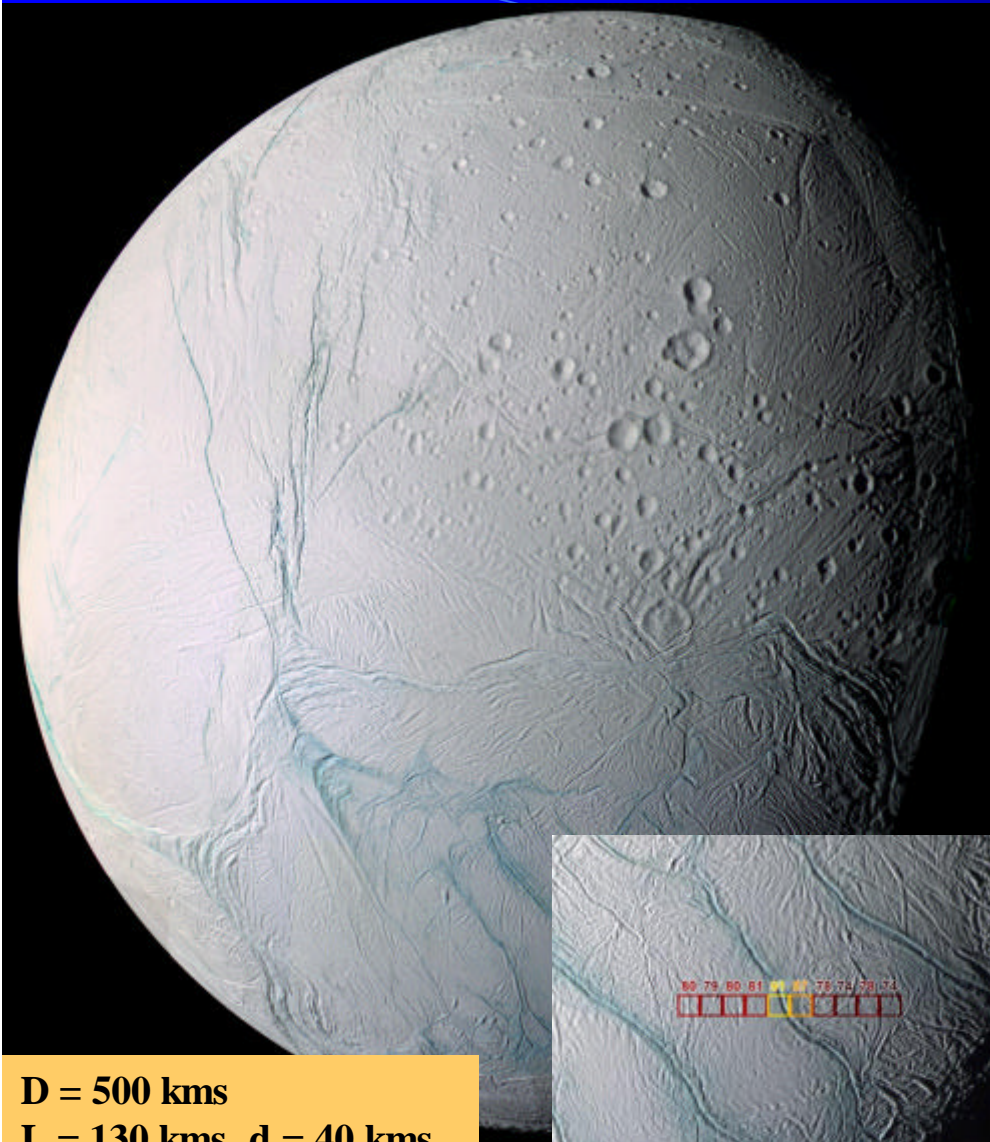
# Europa: agrietado y oculto bajo el hielo...



# ¿Un océano subsuperficial?



# Enceladus

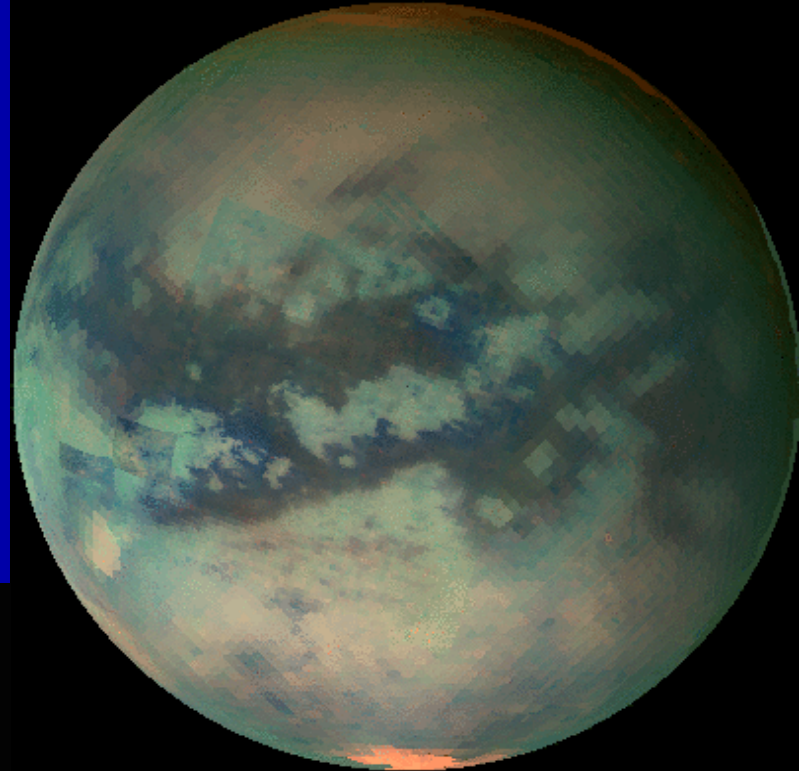
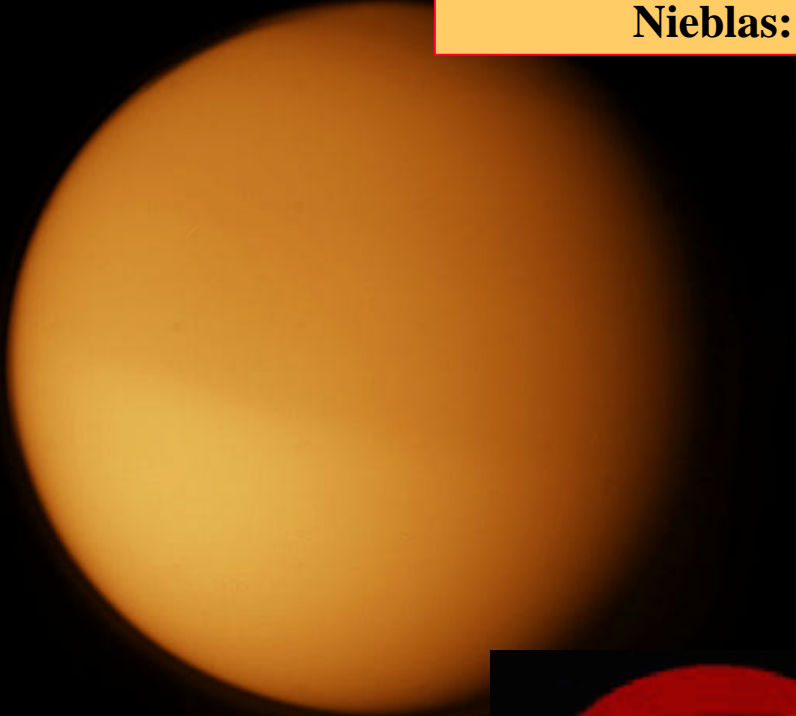


D = 500 kms  
L = 130 kms, d = 40 kms  
DT (grietas) = 12° C  
Edad superficie ~ 10 años

65% H<sub>2</sub>O, 20% N<sub>2</sub>, CO<sub>2</sub>, CO, CH<sub>4</sub>

# Titán

$D = 5.150 \text{ km}$ ,  $N_2$ ,  $P_s = 1.6 \text{ bar}$ ,  $T_s = -180^\circ\text{C}$   
Nieblas:  $C_nH_n$ , Nubes bajas:  $CH_4$



Titan

$\lambda \sim 1 - 1.575 \mu\text{m}$   
Superficie

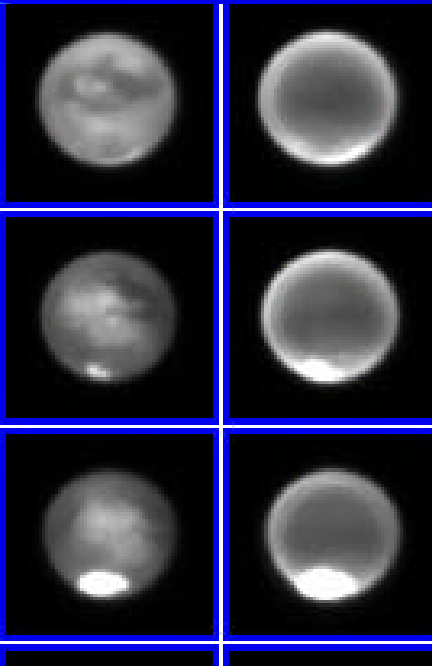
HST (& Telescopios Tierra)

2004-10-28

Keck &  
Gemini

2004-10-23

2004-10-08



# ¿"Sirimiri" y lluvias torrenciales de metano?



¿Lago Polar Sur?

3D Storm Structure  
time = 2h 40 min

43 km

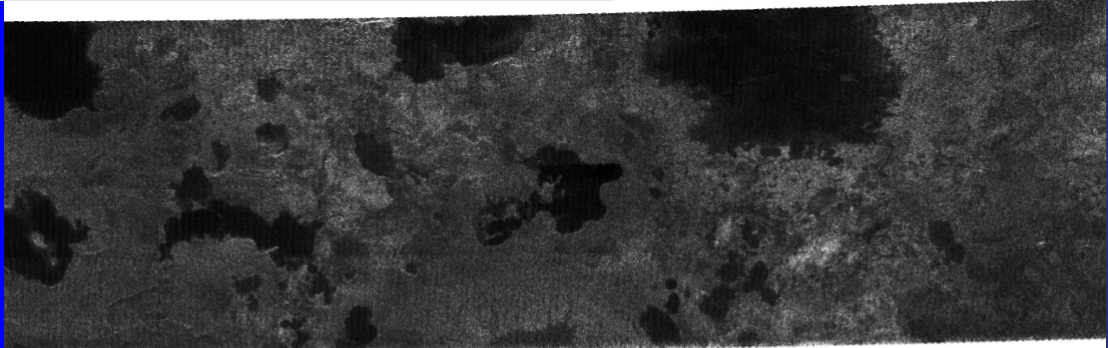
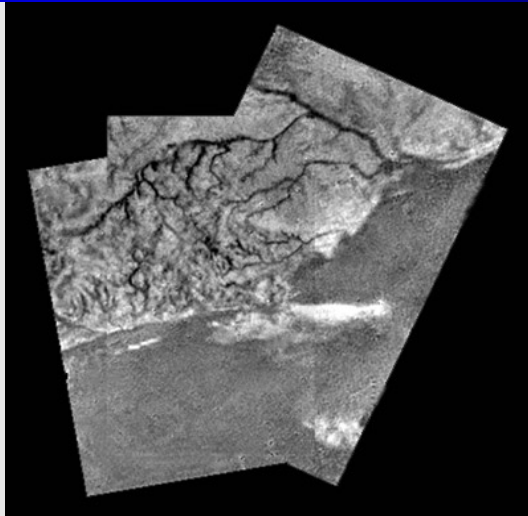
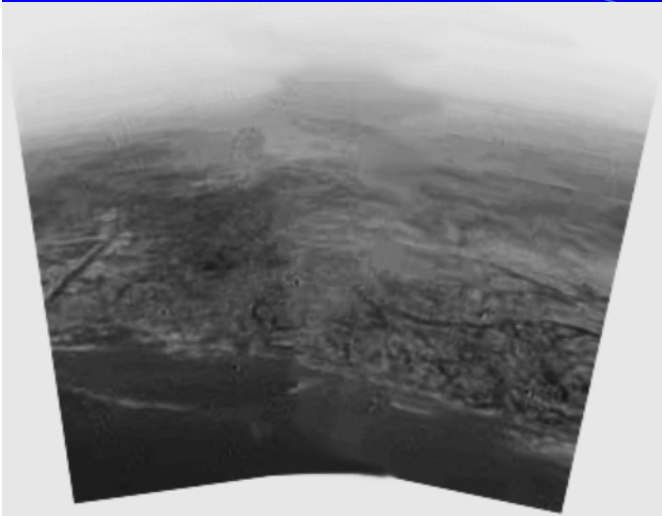
57 km

57 km

Precipitation  
120 kg/m<sup>2</sup>

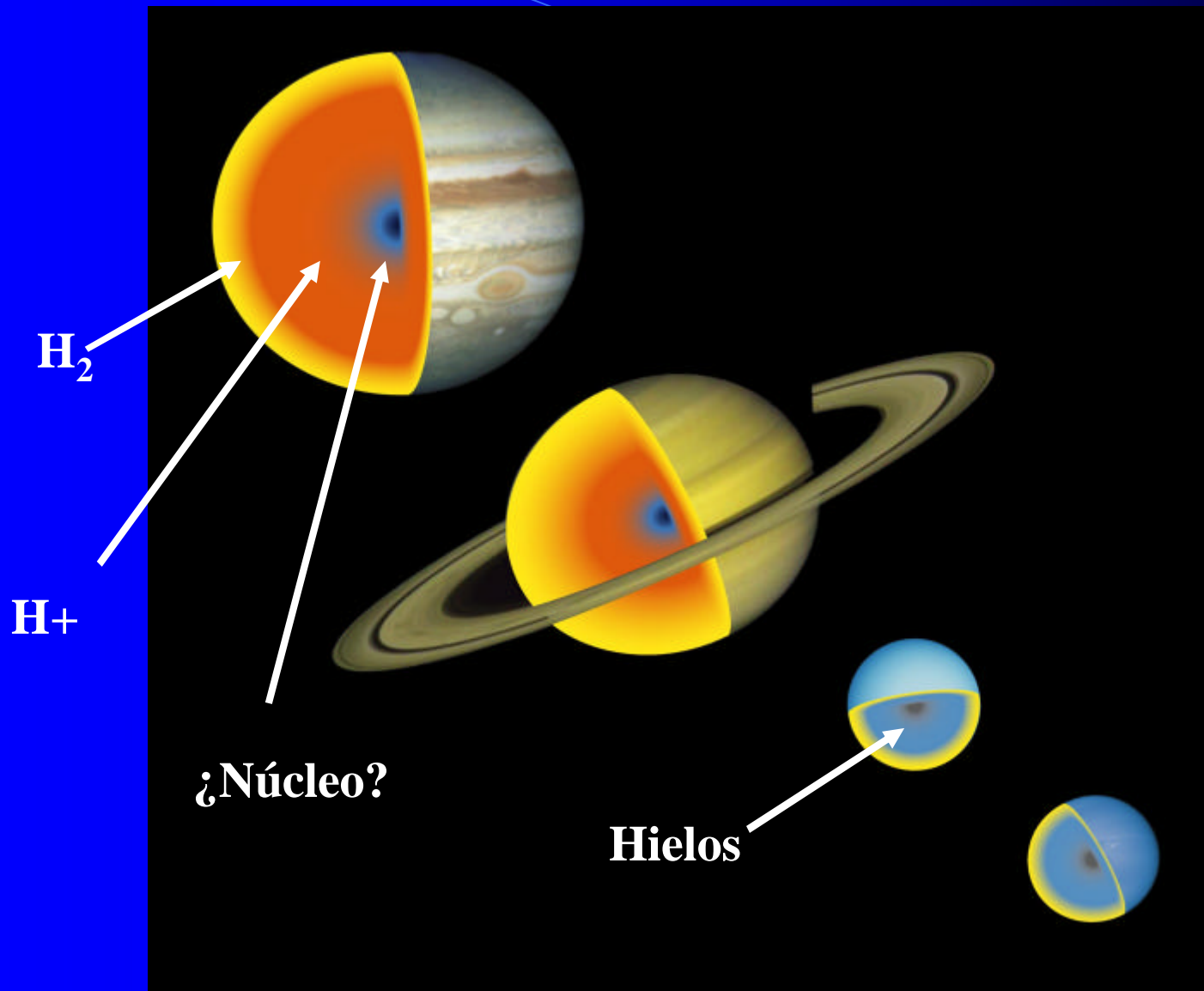


# Superficie: Radar Cassini – Descenso Huygens (14 Enero 2005)



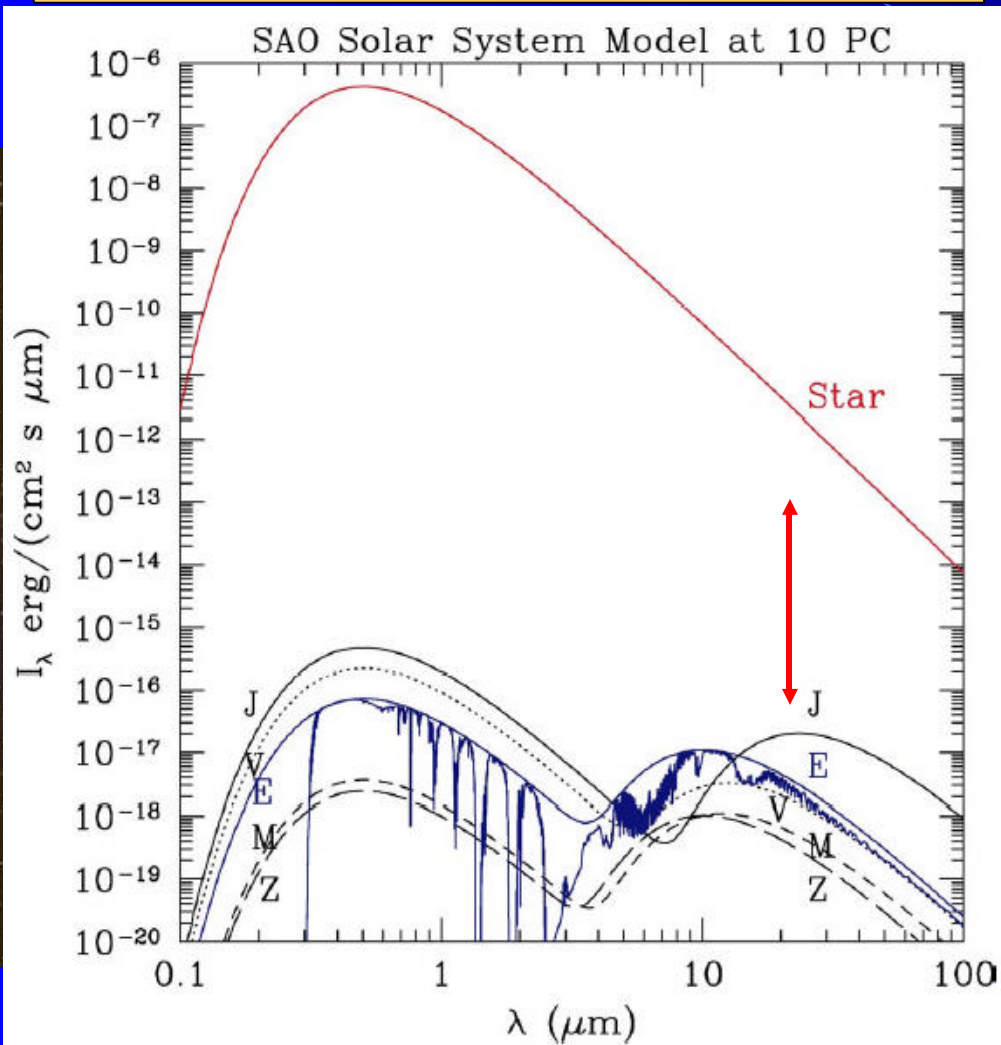
**Centenares de Lagos de hidrocarburos  
(Área polar Norte)**

# Gigantes gaseosos y helados

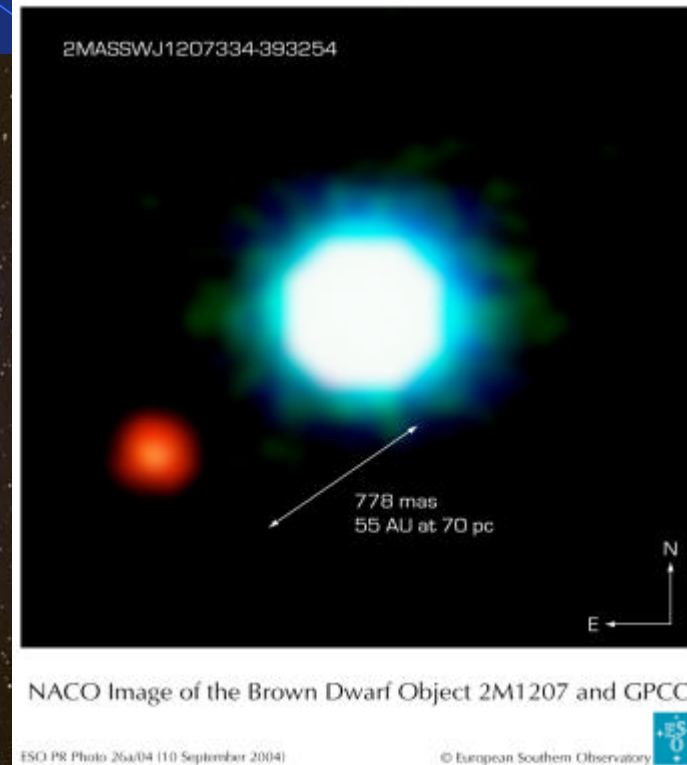


# Planetas Extrasolares

**Brillo (Estrella / Planeta)  $\sim 10^6$ - $10^{10}$**

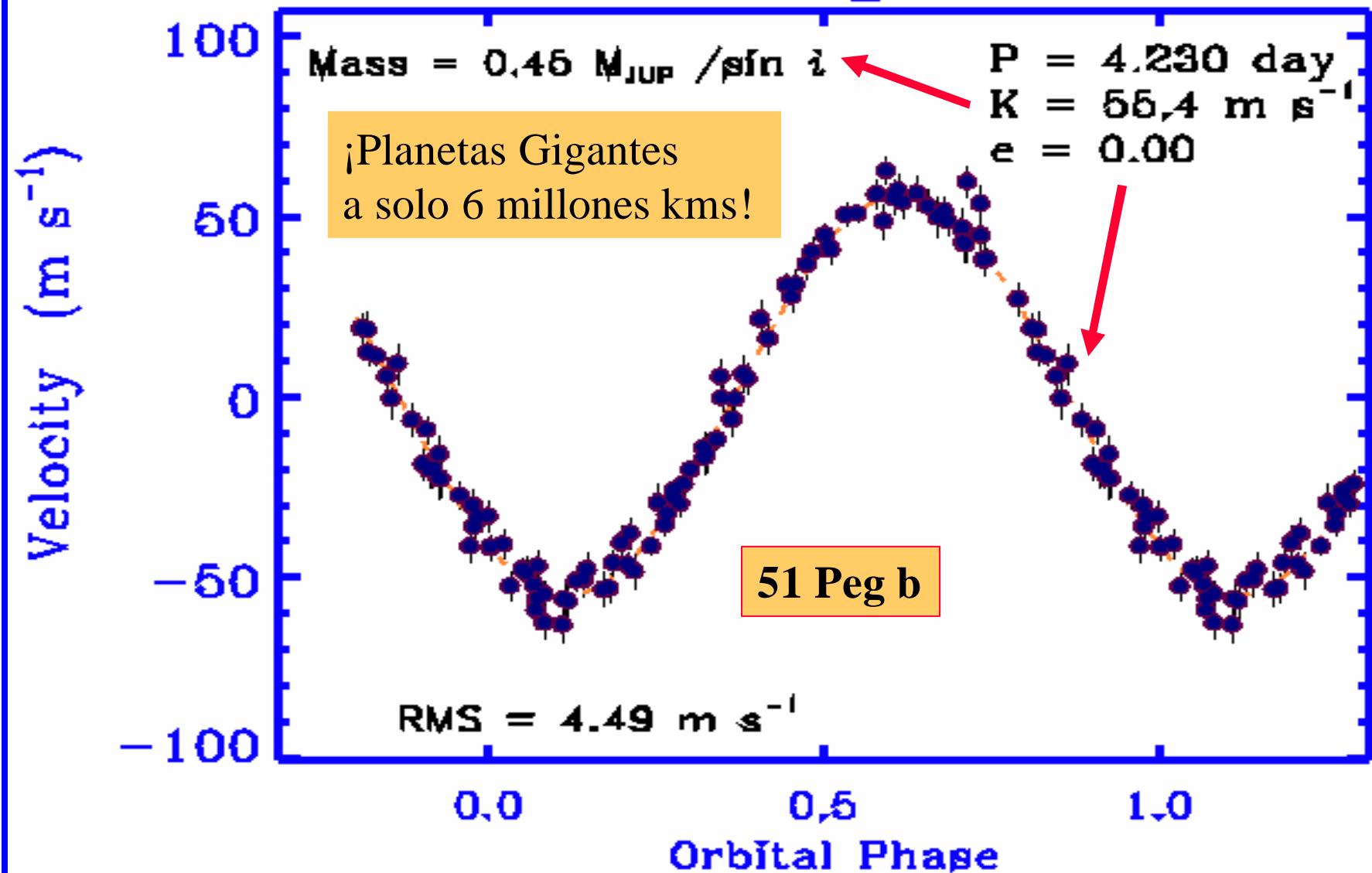


**Brillo Planetas Jóvenes (My)  
 $\sim 10$ - $10^3$  Planetas Viejos (Gy)**

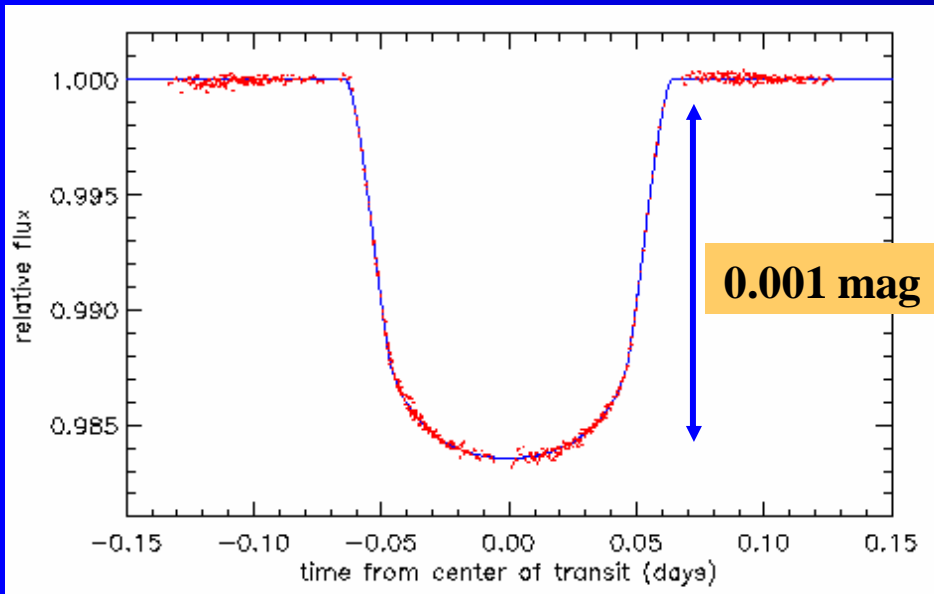
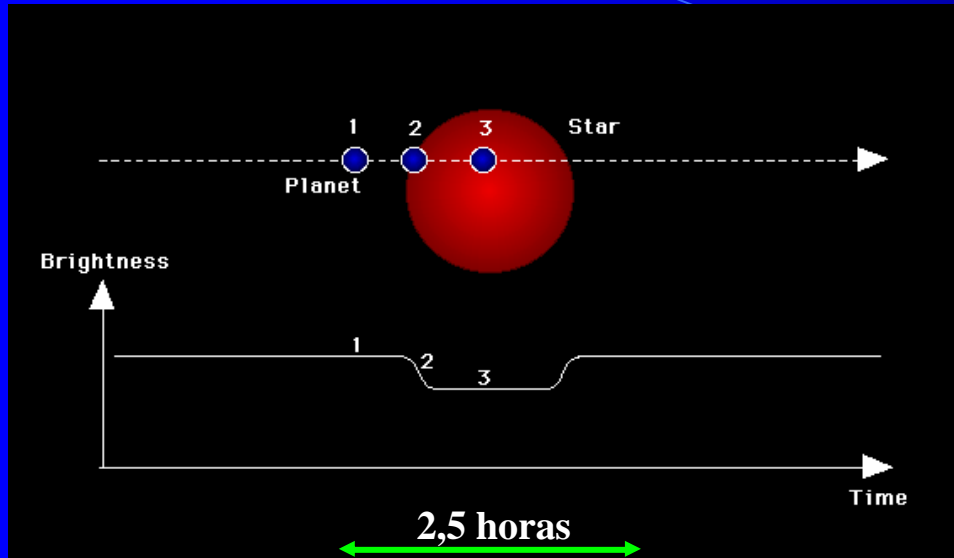


**“Planetas”**  
 **$M < 13 M_J$  ( $1 M_J = 300 M_{\text{Earth}}$ )**





# Planetas eclipsantes y en tránsito



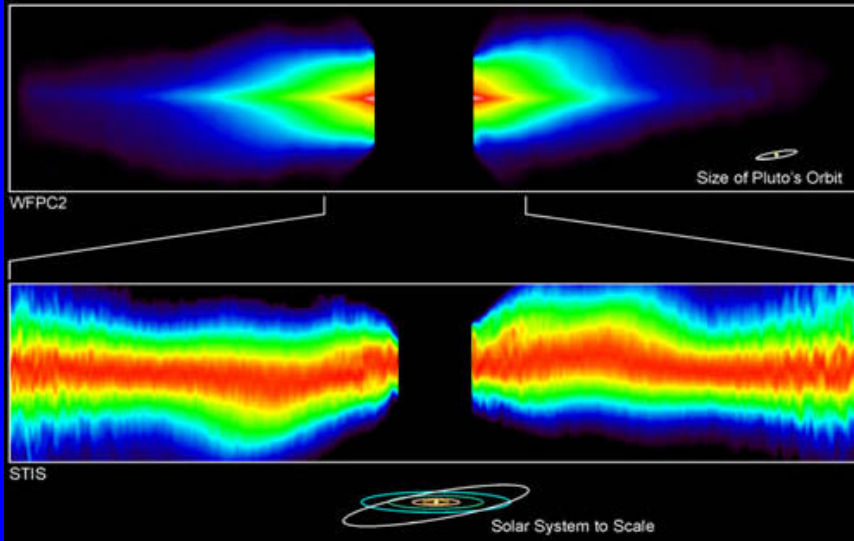
## • 16 Planetas en tránsito:

- “Hot Jupiters”  
(6-7 mill km)  
(P = 3-9 días)

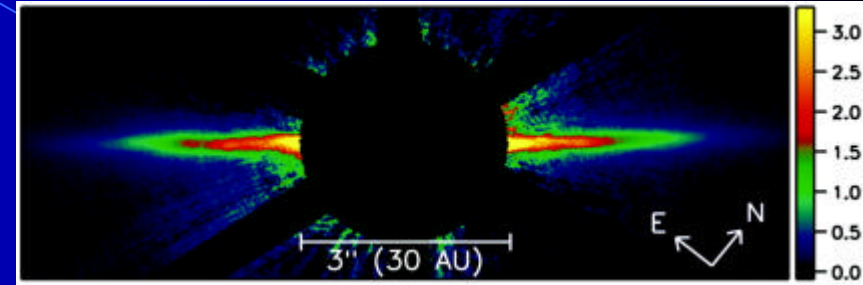
- “Very Hot Jupiters”  
(3-4 mill km)  
[1/17 Mercurio]  
(P = 1-3 días)

→ T ~ 1500 – 1800 K

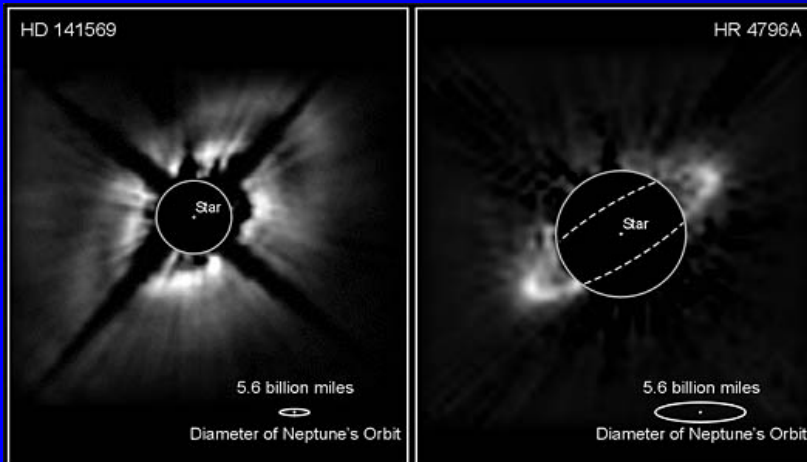
# Discos protoplanetarios por doquier



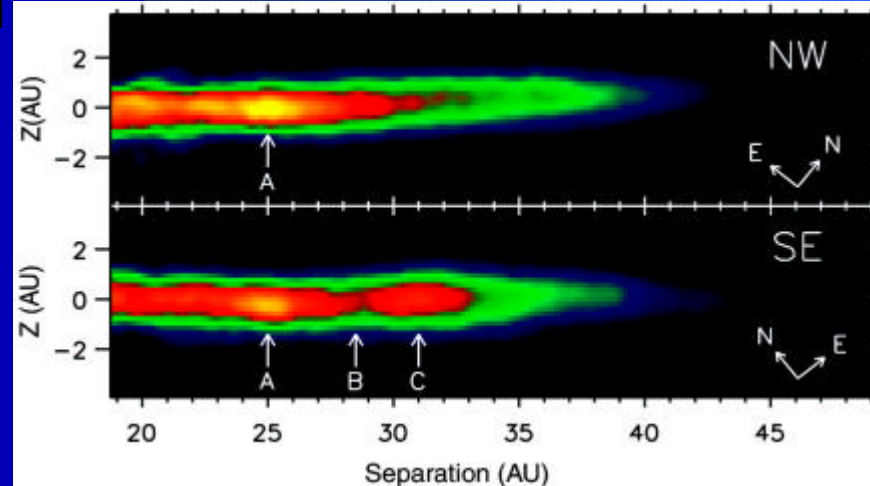
**Beta Pictoris**  
 HST • WFPC2 • STIS  
 PRC98-03 • January 8, 1998 • ST ScI OPO  
 A. Schultz (Computer Sciences Corp.), S. Heap (NASA Goddard Space Flight Center) and NASA



**Au Microscopi:**  
**¿Planetas gigantes en Formación?**



**Dust Disks around Stars**  
 HST • NICMOS  
 PRC99-03 • STScI OPO • January 8, 1999  
 B. Smith (University of Hawaii), G. Schneider (University of Arizona),  
 E. Becklin and A. Weinberger (UCLA) and NASA



# En busca de la vida

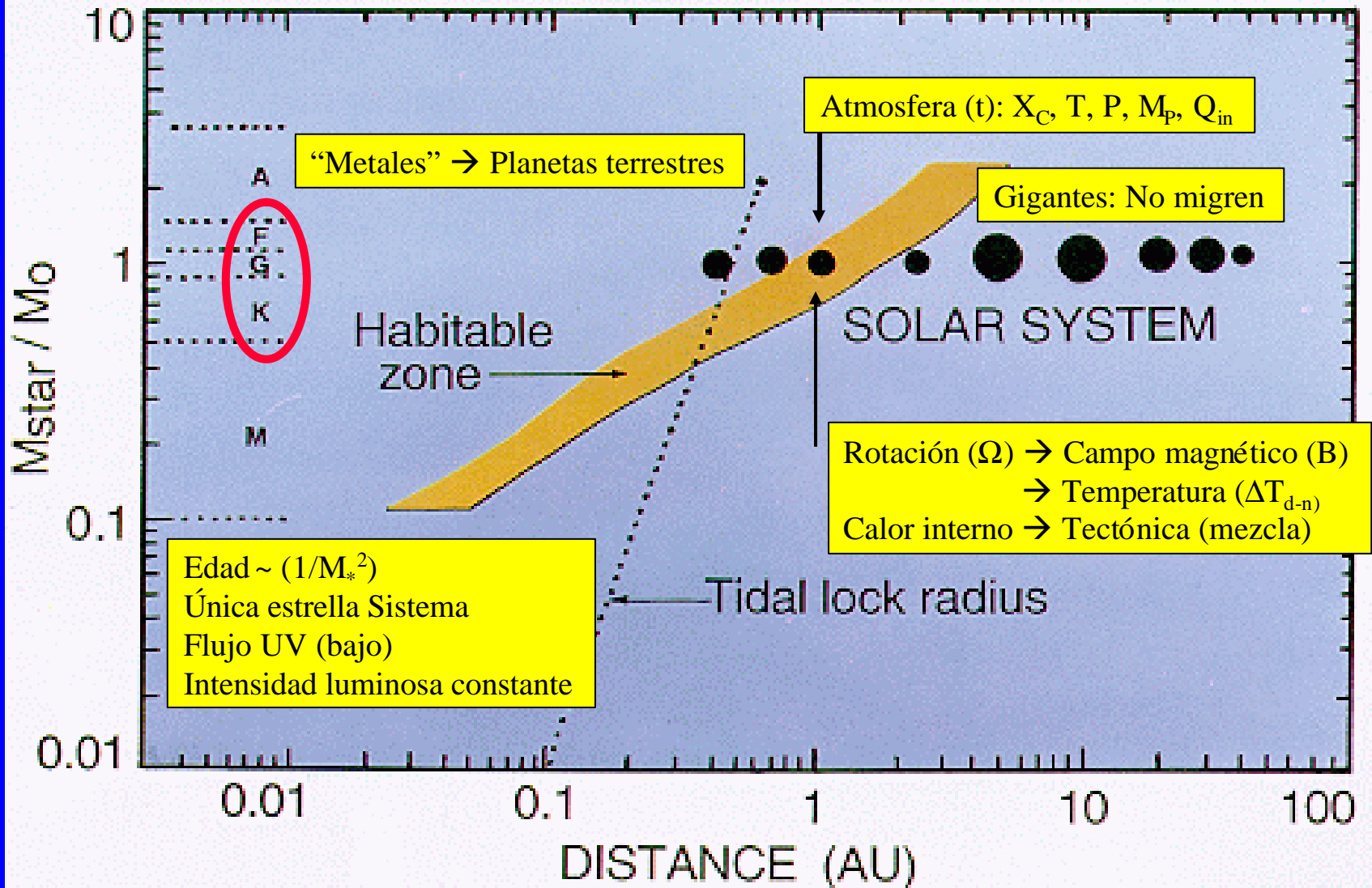
**Fuente de energía + Agua líquida + Carbono  
(N, P, S)**

**(“condiciones apropiadas”) = ¿Vida?**

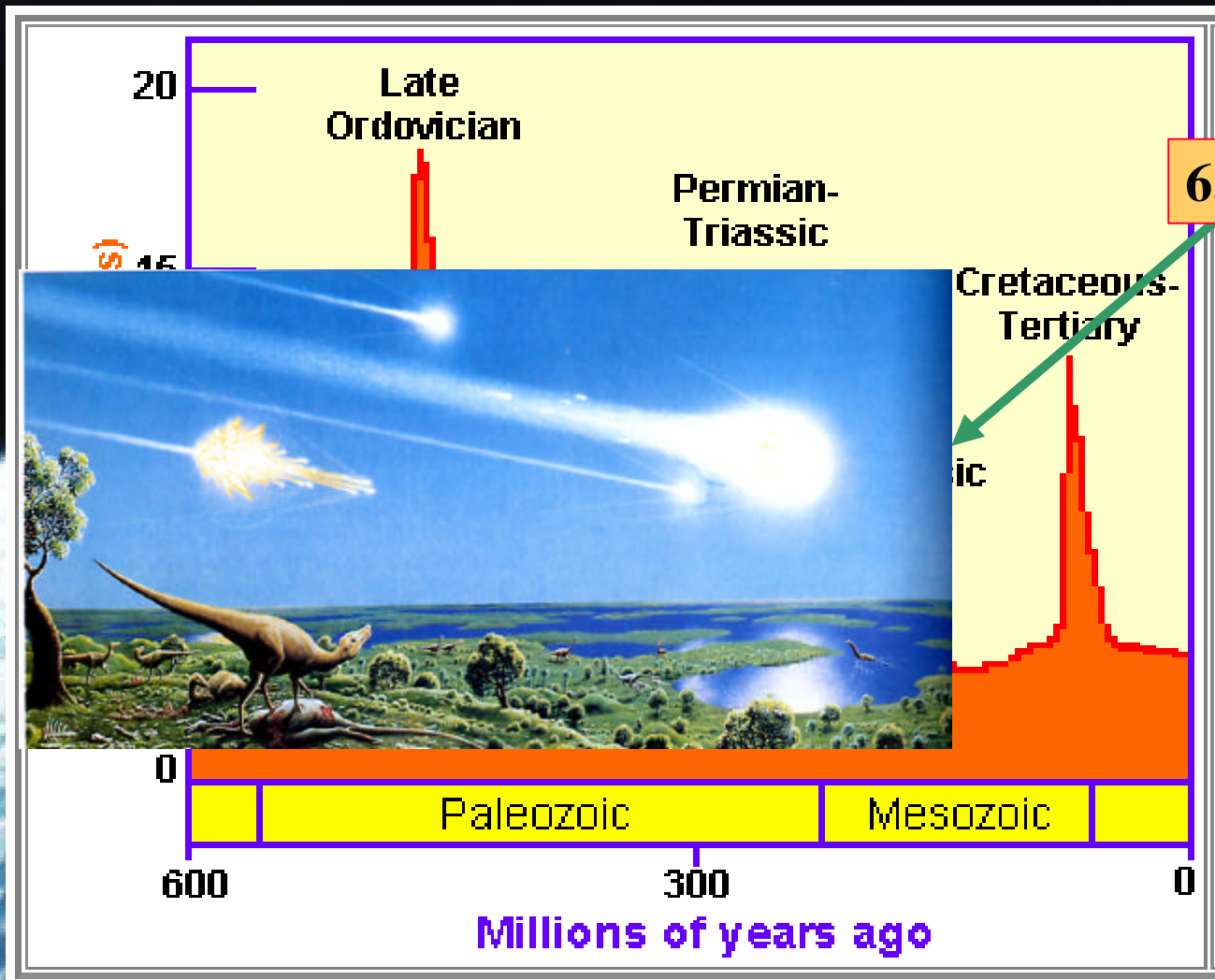
**Macromolécula orgánicas → célula**



# Zona de Habitabilidad

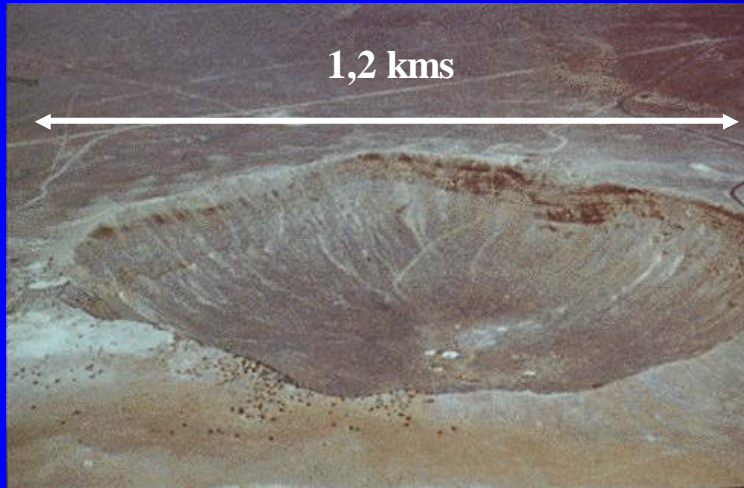


# Impactos → Cambios



# Impactos Recientes

**Crater Barringer  
(Arizona, USA) 49.000 años**



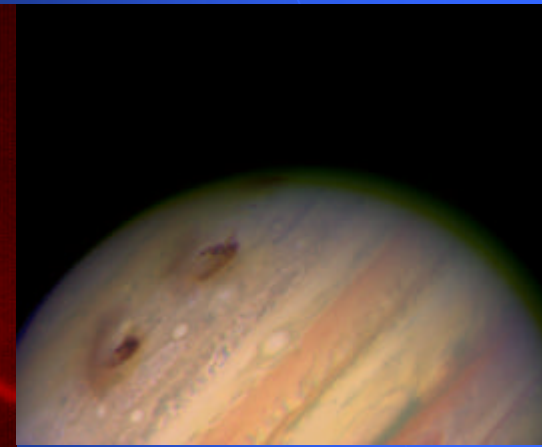
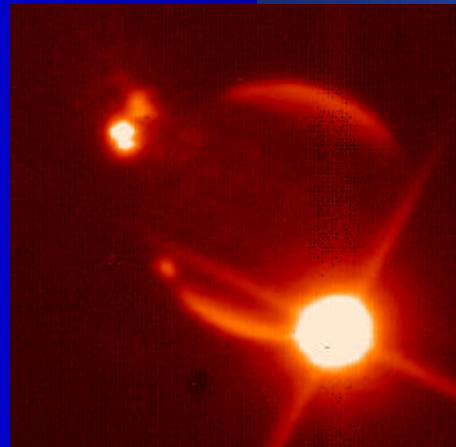
Energía cinética ( $v \sim 60 \text{ kms}^{-1}$ )  $\rightarrow$  Calor, luz, onda choque

**Tunguska (Siberia) Lat. 61°  
30 June 1908**



$D = 50 \text{ m}$ ,  $H = 8-10 \text{ km}$ ;  $E = 10-15 \text{ MTn}$   
(500 x Hiroshima), 2150 km<sup>2</sup> afectados

**Impacto SL9 con Júpiter  
(Julio 1994)**



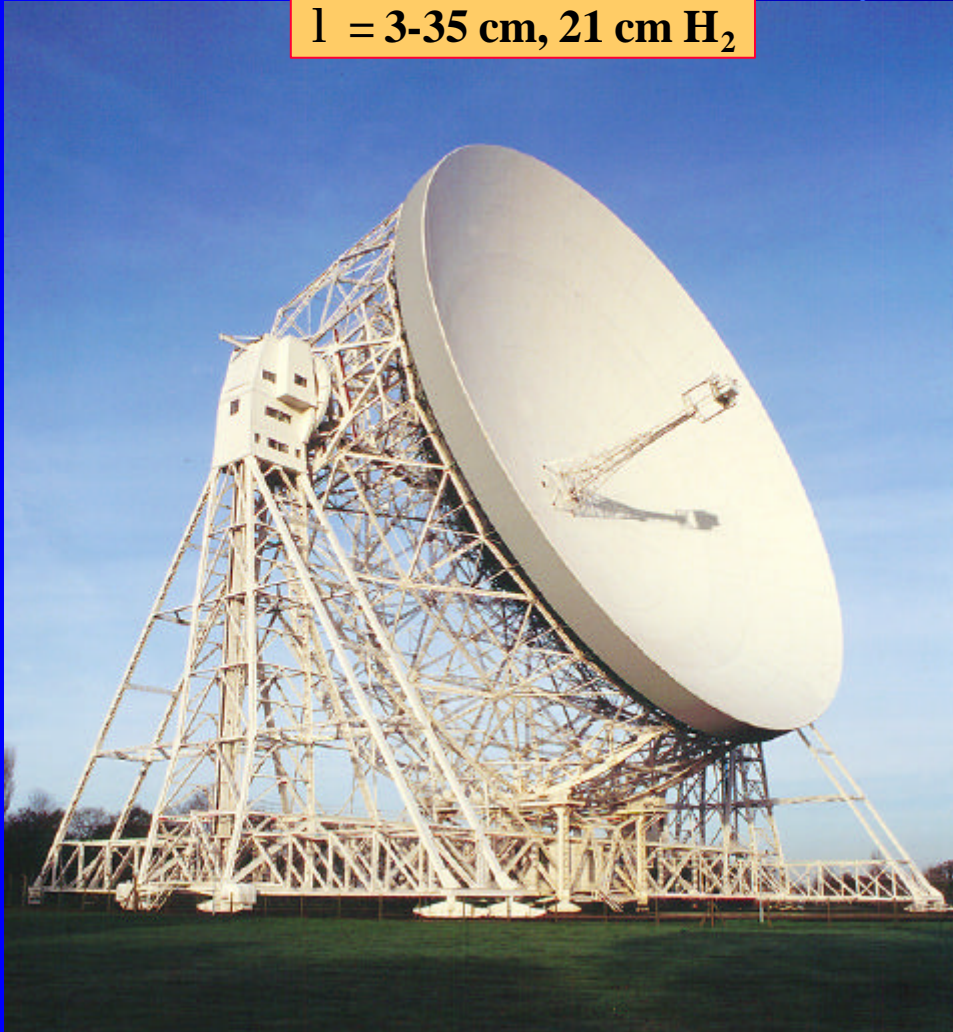
# Y cercanos ...





# ¿Hay alguien ahí?

$\lambda = 3-35 \text{ cm}, 21 \text{ cm H}_2$



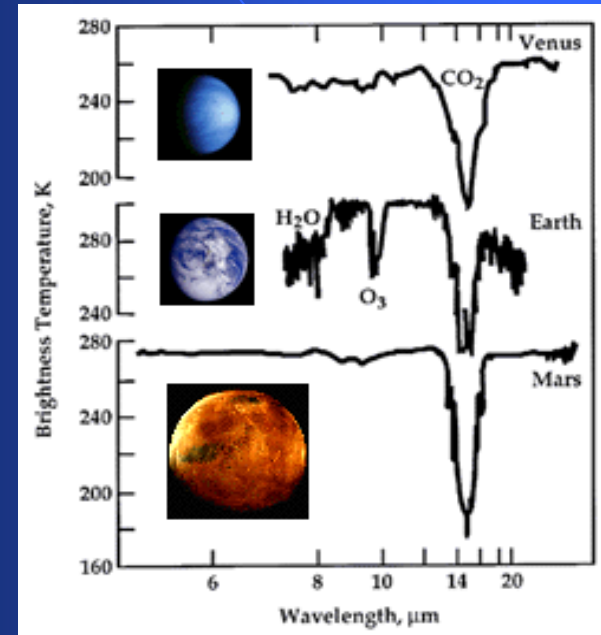
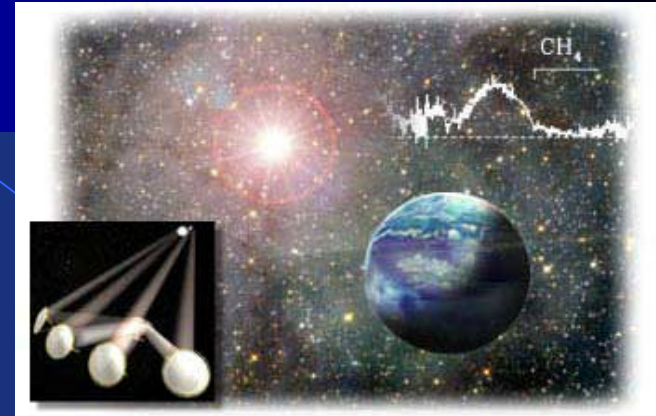
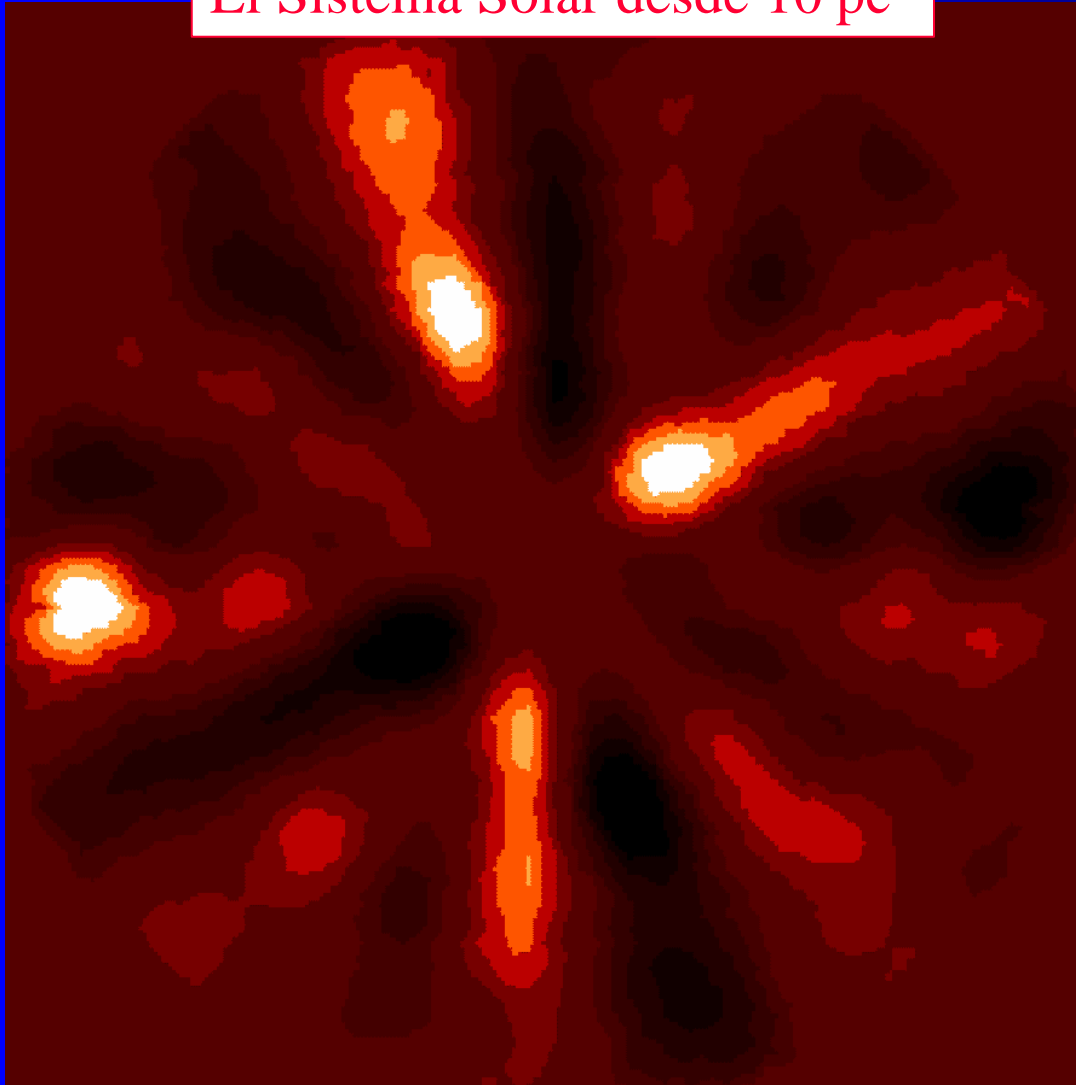
**SETI**



This 34-meter (about 98-foot)-wide telescope near Buenos Aires scans the southern hemisphere.  
*Photo: Argentine Institute of Radio Astronomy .*

# Buscando planetas y vida

El Sistema Solar desde 10 pc



# En un futuro lejano ...

