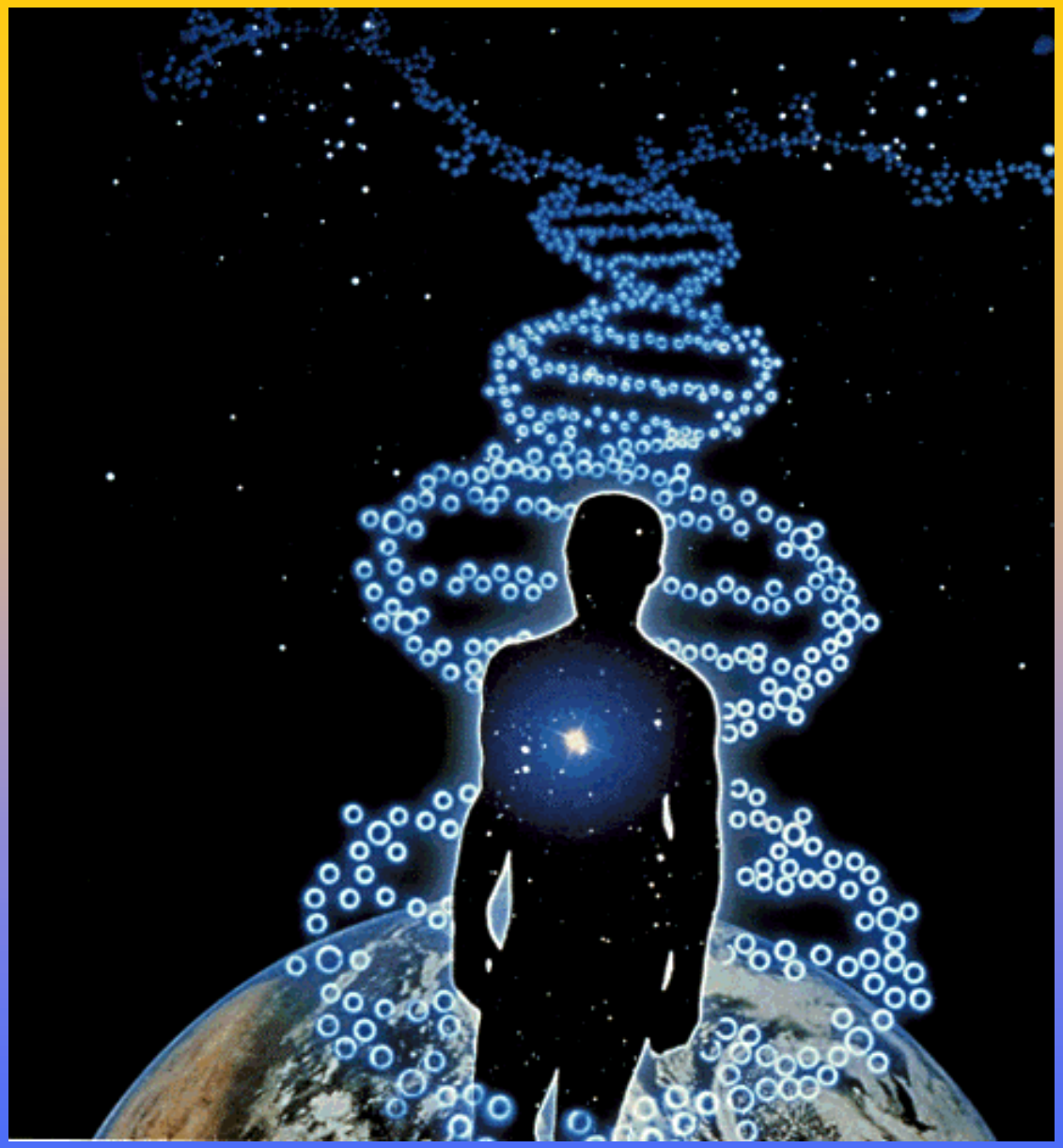


La Vita ….
prima della vita:
La chimica prebiotica

Sondrio, 19 dicembre 2008

Associazione Astrofili Valtellinesi

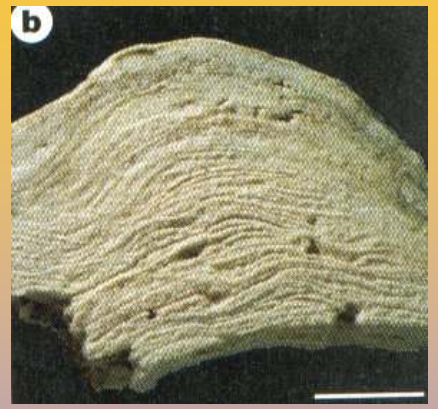
La nascita del sistema solare

5 miliardi di anni fa

La giovane Terra

4,5 – 4 miliardi di anni fa

Le stromatoliti



Fossili databili
a 3,5 – 3,8 miliardi
di anni fa

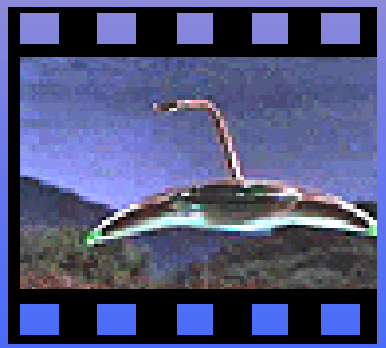
200 milioni di anni sono un tempo sufficiente perché emerga un organismo così complesso come una cellula batterica, dotata di DNA e di sintesi proteica?

La teoria della Panspermia

Svante Arrhenius

Fred Hoyle

Francis Crick



Gli elementi biogeni

Carboneum

Oxygenium

Hydrogenium

Phosphorus

Nitrogenium

Sulfur

Fattori fisici

Atmosfera

CH_4, NH_3, H_2, H_2O (Miller)

CO_2, N_2 (NO_x), H_2O (più probabile)

Fosforo

$Ca_3(PO_4)_2$, acidità

Temperatura

Alta, Pressione elevata

Luce e radiazione

Meno energia, effetto serra, intensa radiazione

Assenza di. . . vita

"Si dice spesso che oggi siano presenti tutte le condizioni per la produzione di un organismo vivente che possono essere state presenti in passato. Ma se (oh, quale grande se) potessimo concepire che in qualche piccolo stagno caldo, in presenza di ogni sorta di ammoniaca e di sali fosforici, luce, calore, elettricità ecc., si sia formato un qualche componente proteico già pronto a subire mutamenti ancora più complessi, oggi una tale sostanza verrebbe istantaneamente divorata o assorbita, cosa che non sarebbe accaduto prima della formazione di esseri viventi."

Charles Darwin

L'ambiente

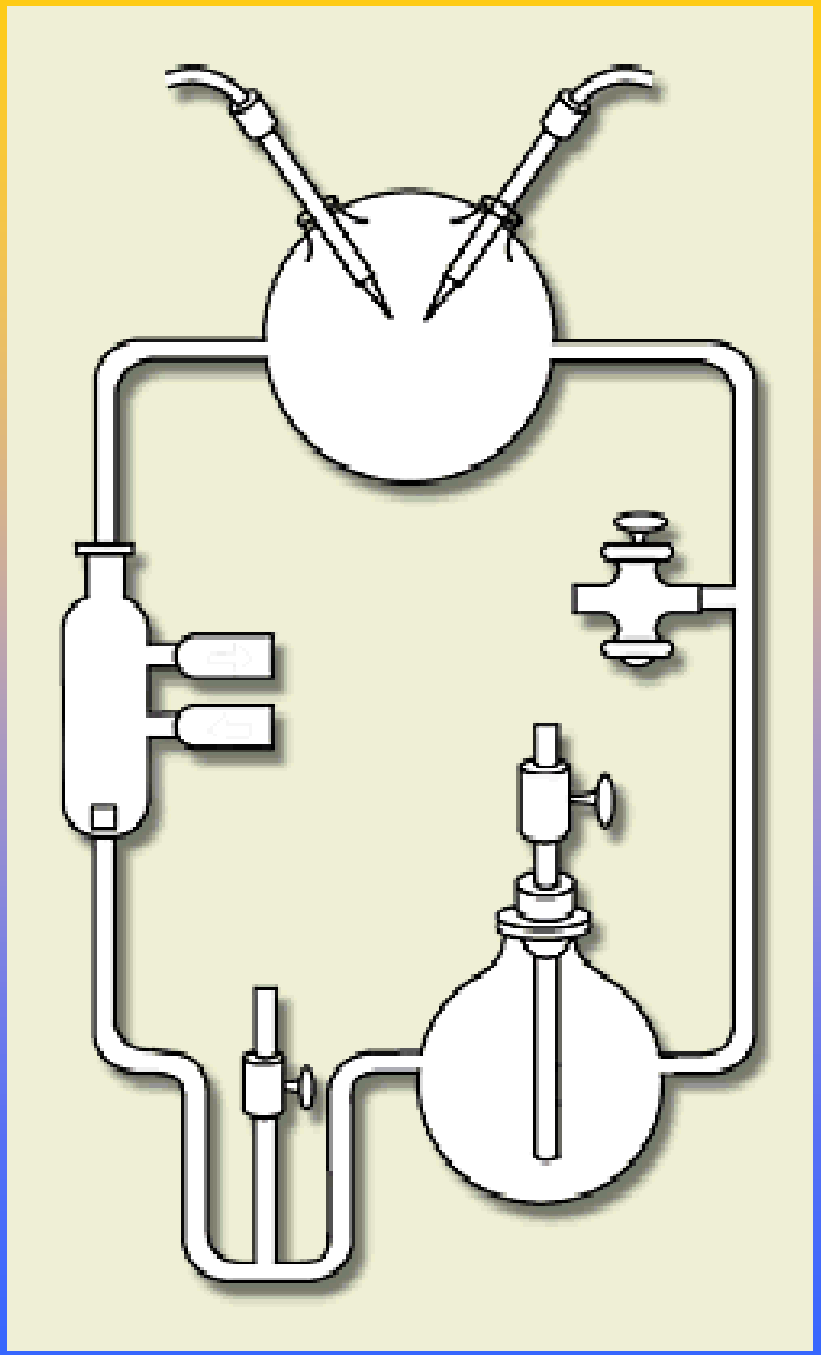
I Pionieri

Oparin (1924)

Haldane (1929)

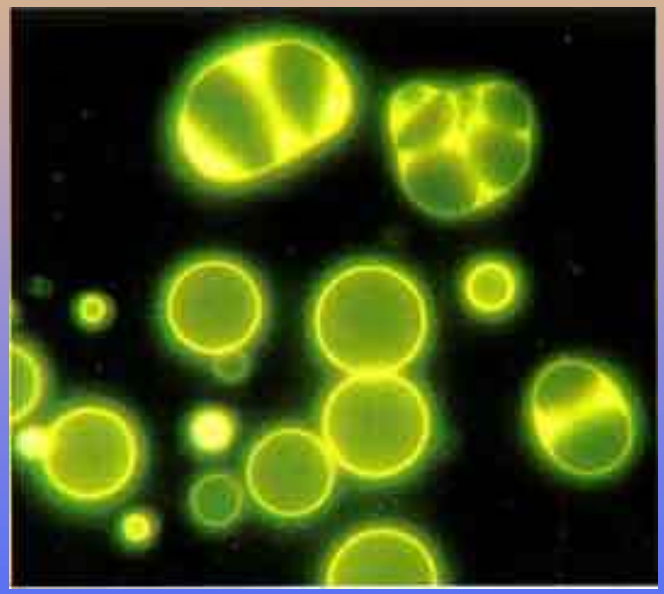
Watson e Crick (1953)

Urey e Miller (1953)



L'esperimento di Urey-Miller

Amminoacidi
Idrocarburi
Purine
Pirimidine



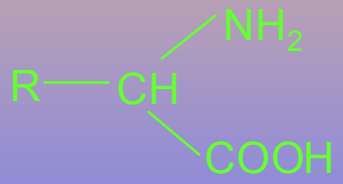
Il meteorite Murchison

S. Miller (1953)

CH_4, NH_3, H_2, H_2O

↓

Miscela complessa, da cui si isolano



R=H *Glicina*

R=CH3 *d,l-Alanina*

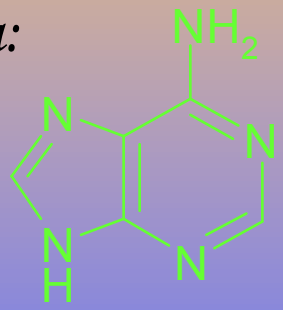
R=CH2COOH *d,l-acido aspartico*

J. Oro (1960)

HCN, NH_3, H_2O

↓

Miscela complessa, da cui si isola:



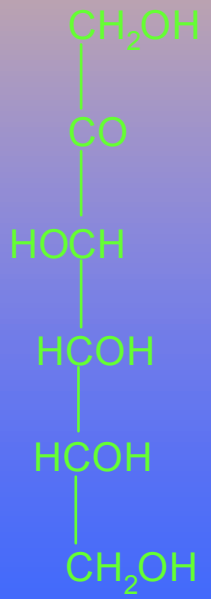
Adenina

E. Fischer (1890)

CH_2O, H_2O

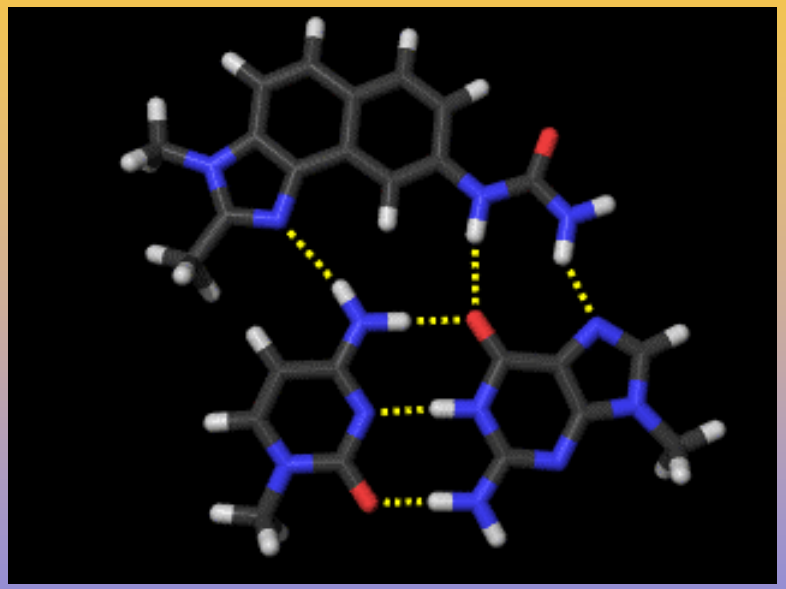
↓

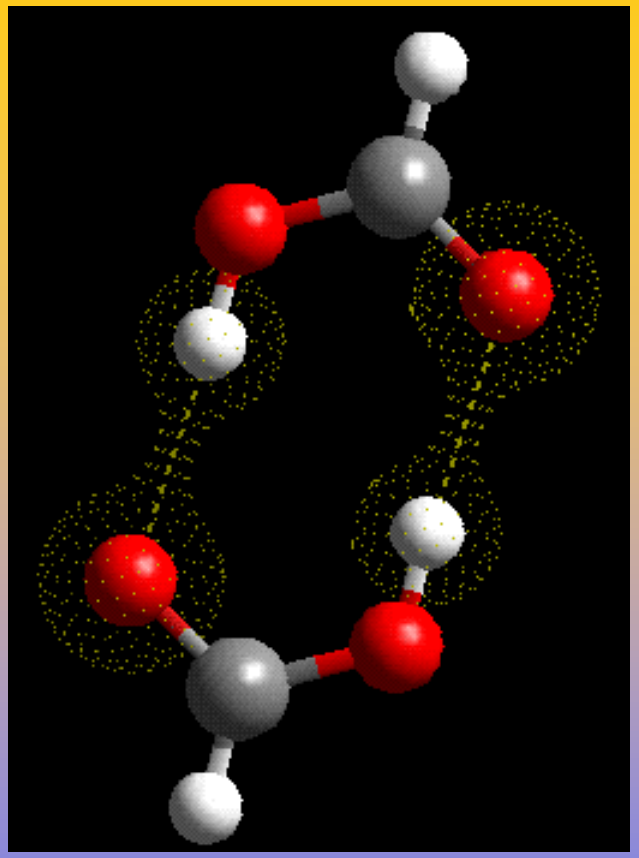
Miscela complessa, da cui si isola:

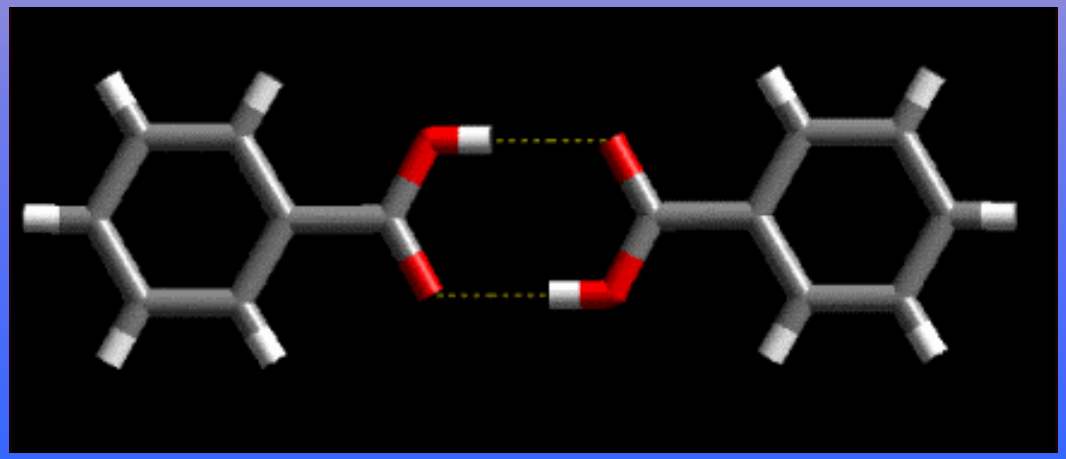


d,l-levulosio

Legame a idrogeno



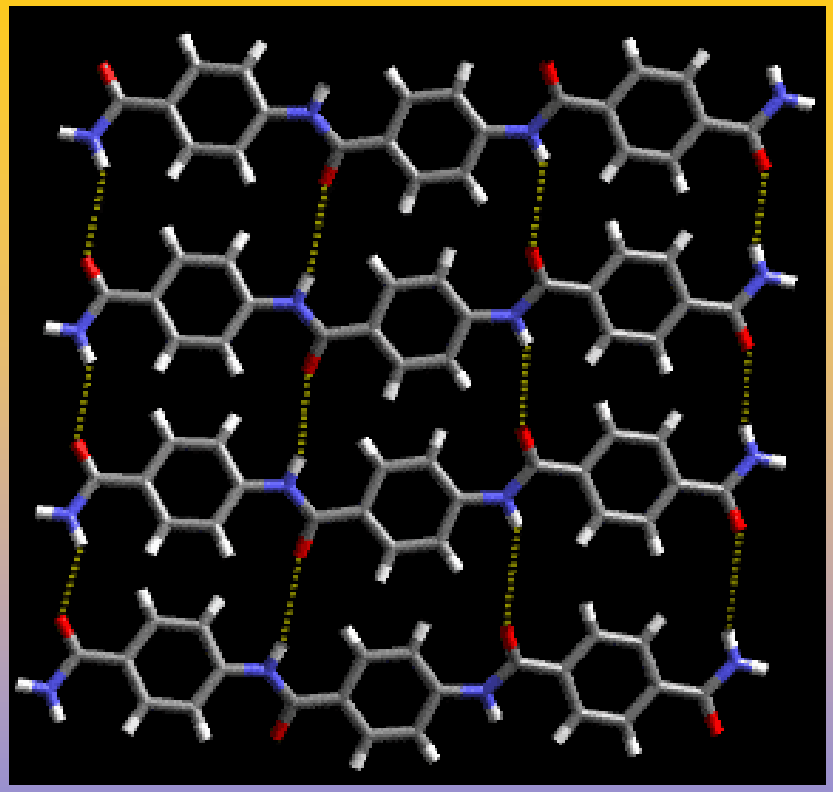


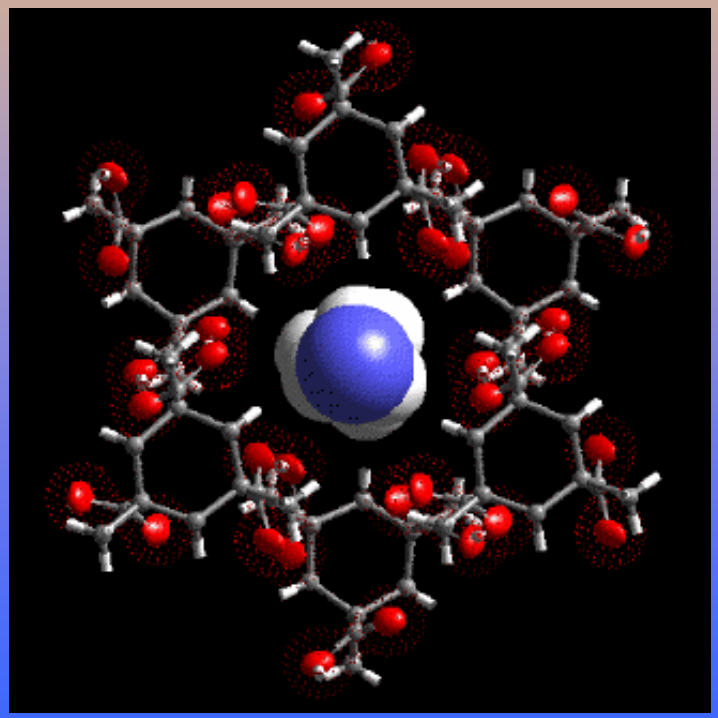


Riconoscimento

molecolare

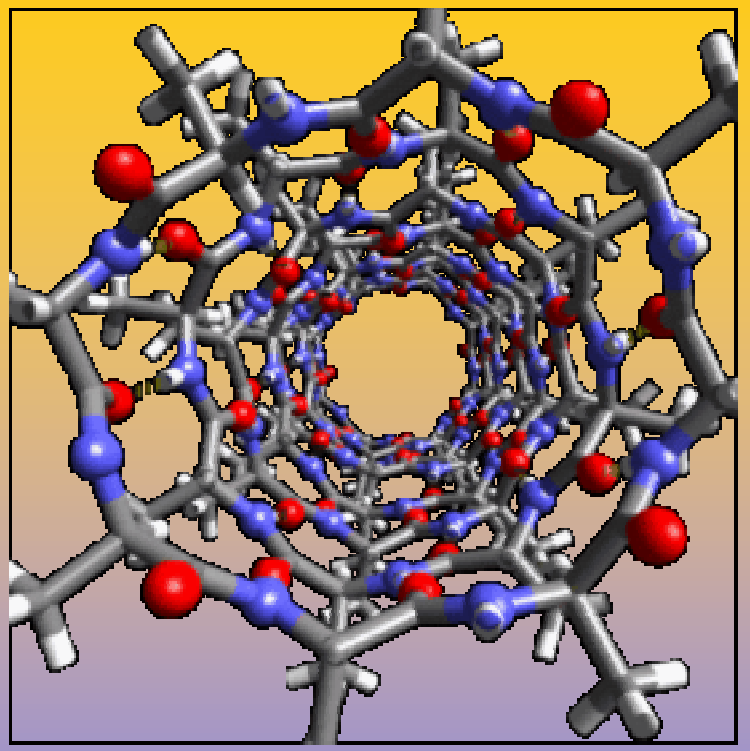
(informazione!)

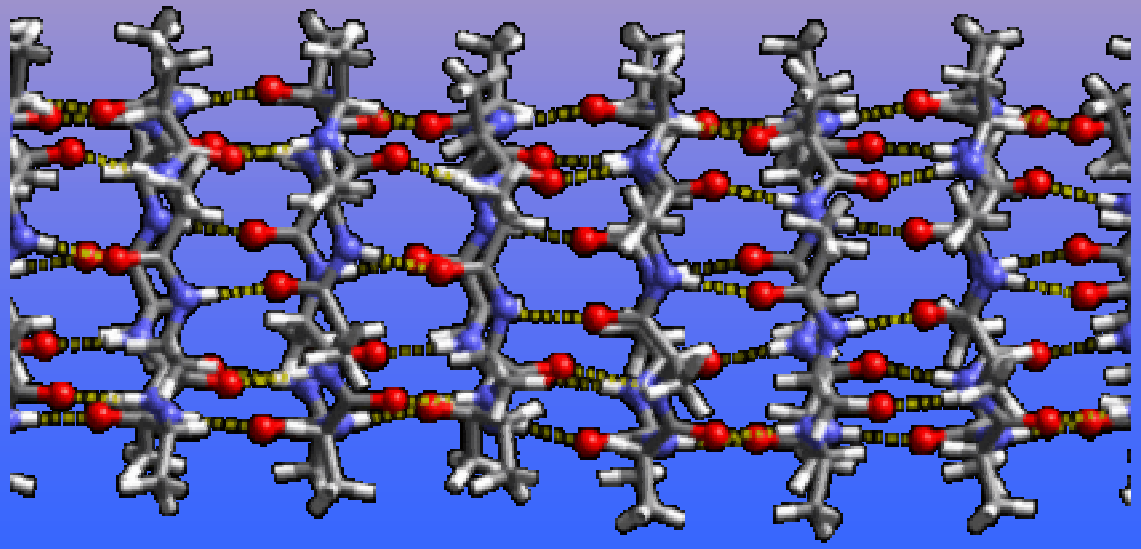




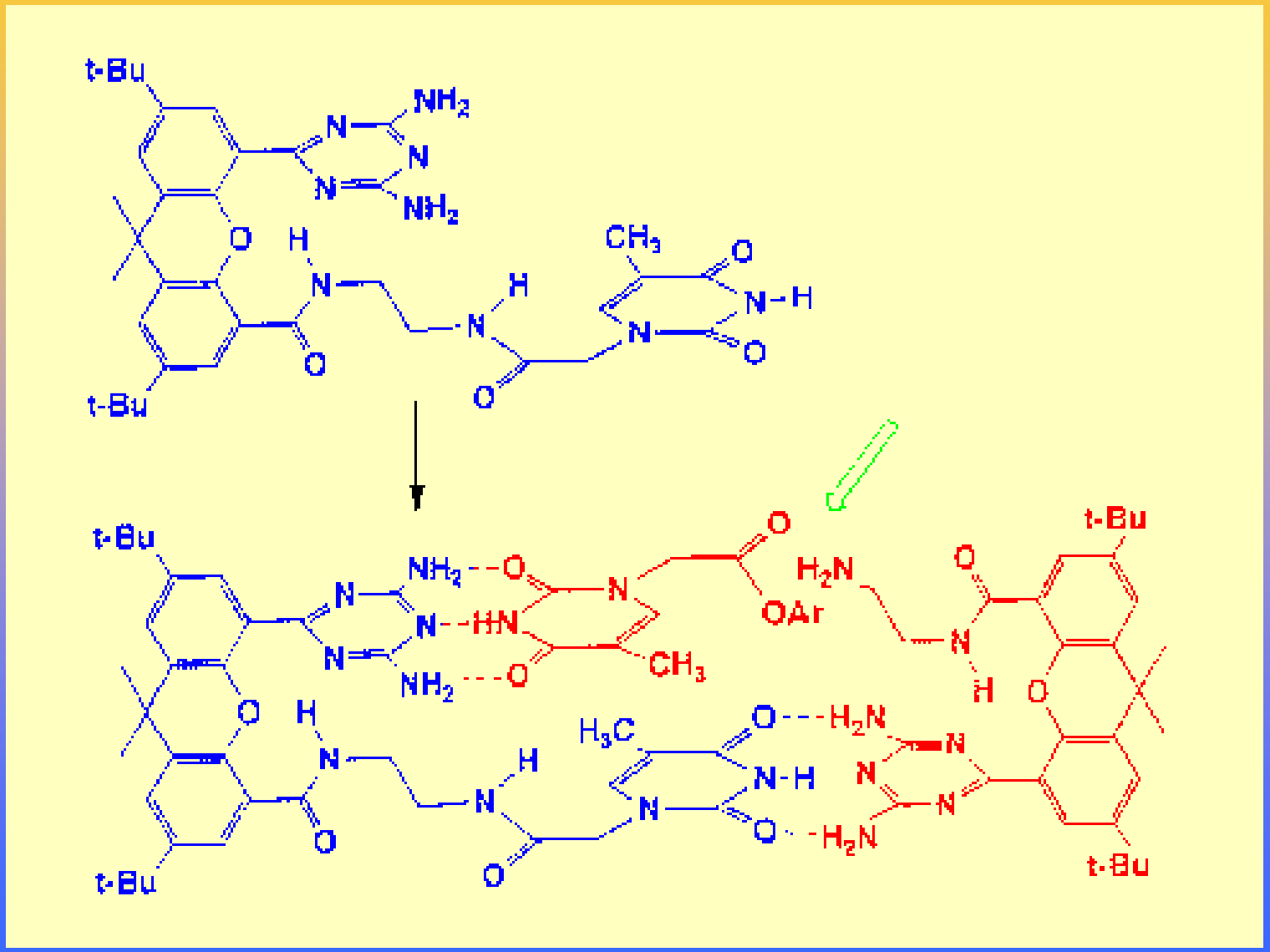
Interazioni ospite-ospite

Auto assemblaggio e auto organizzazione (ancora maggiore informazione!)

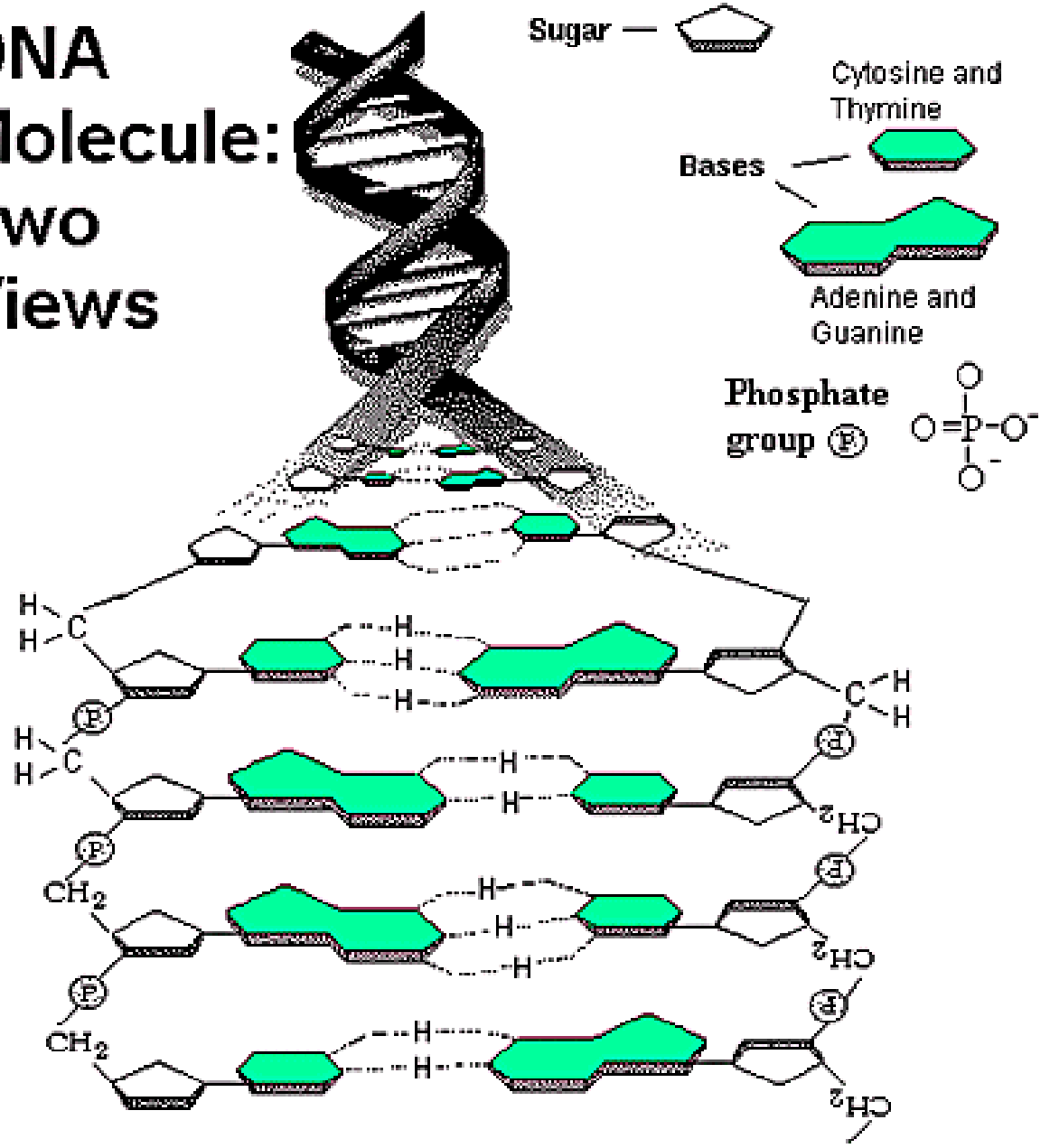




Auto replicazione (massima informazione!)



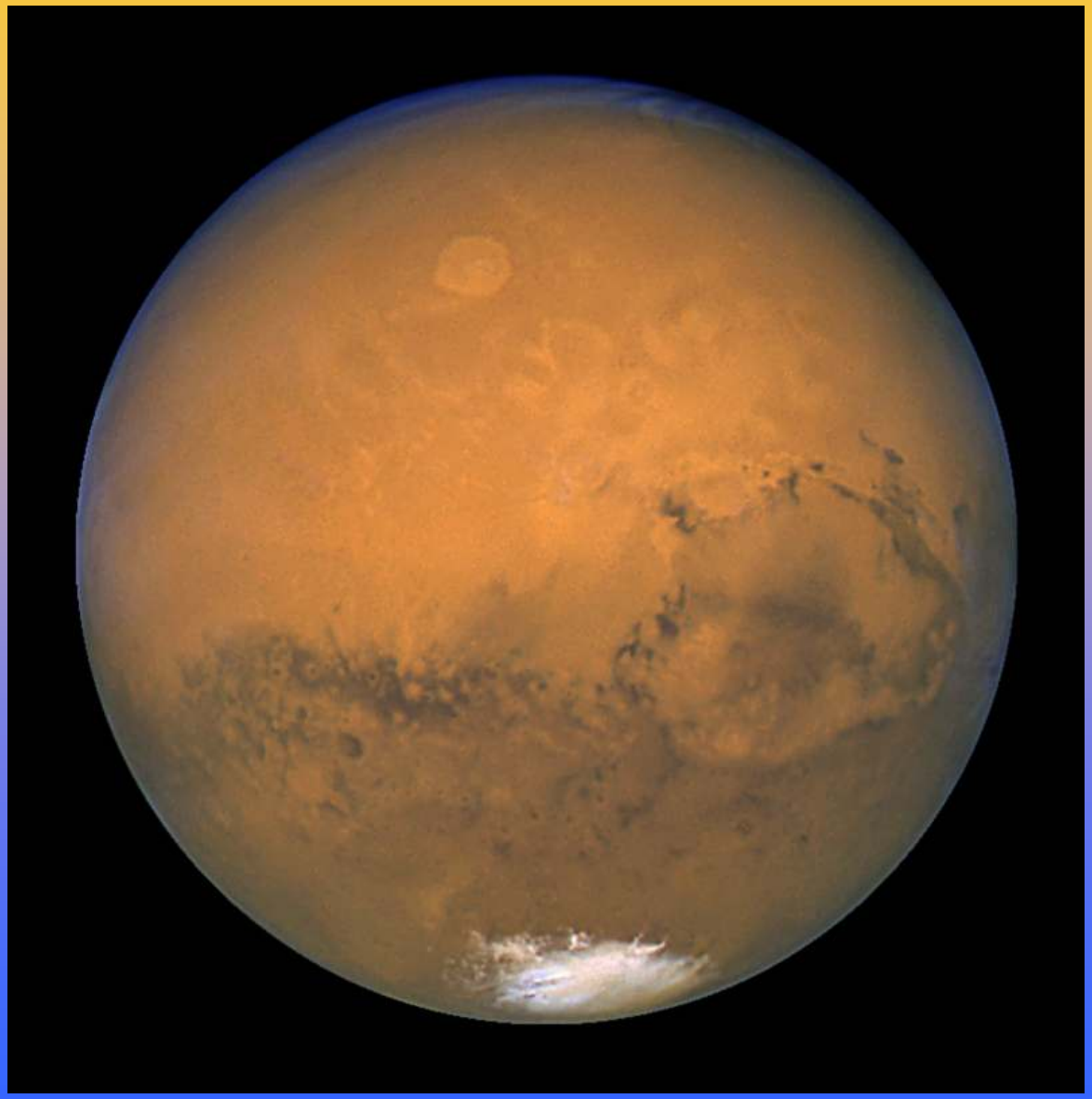
DNA Molecule: Two Views



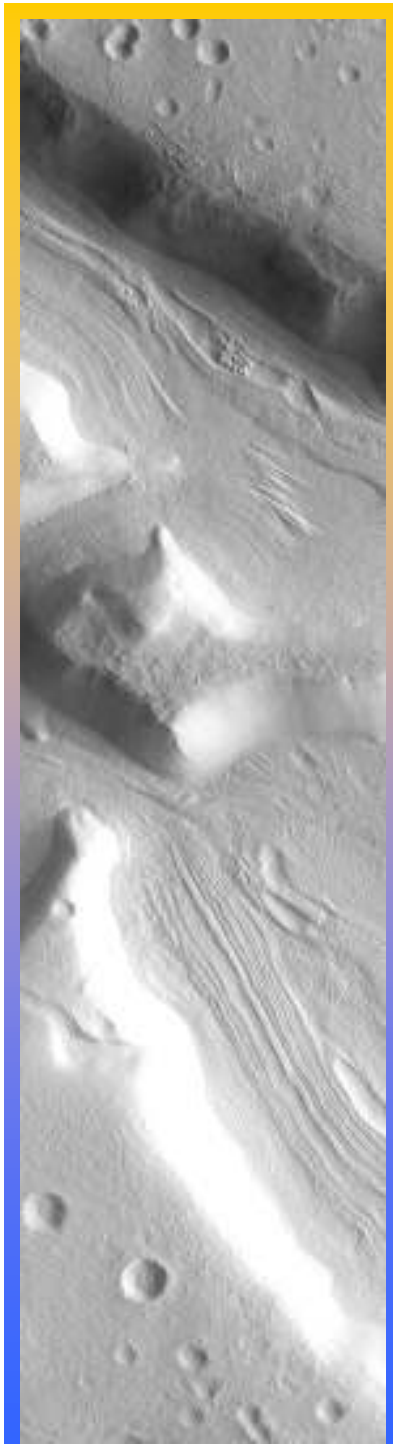
Dove può essersi sviluppata la vita?

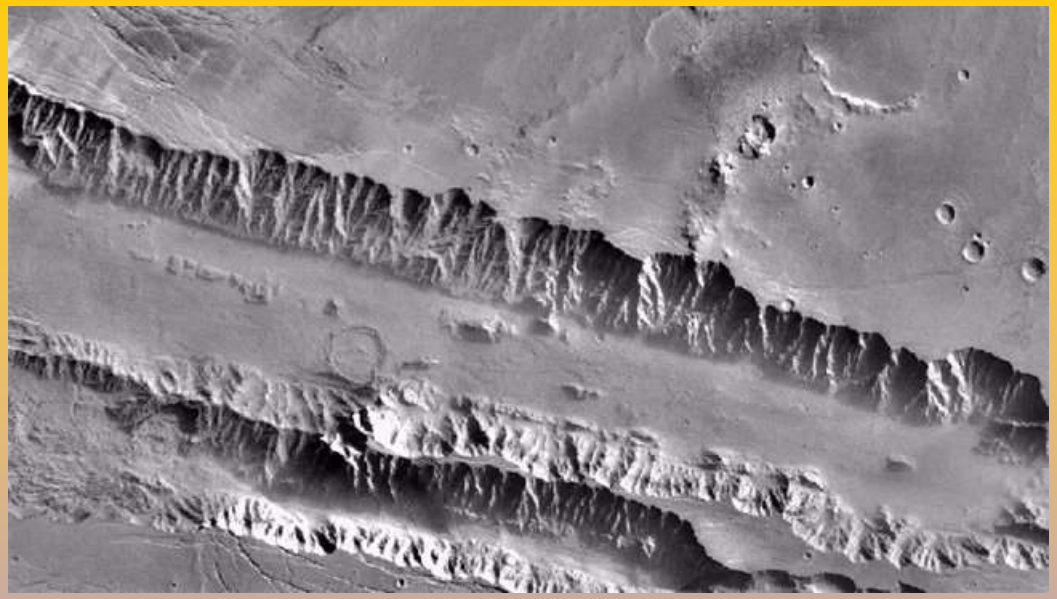
- *presenza di un solvente liquido*
- *presenza di molecole organiche*
- *disponibilità di energia*
- *presenza di uno "scudo" protettivo*

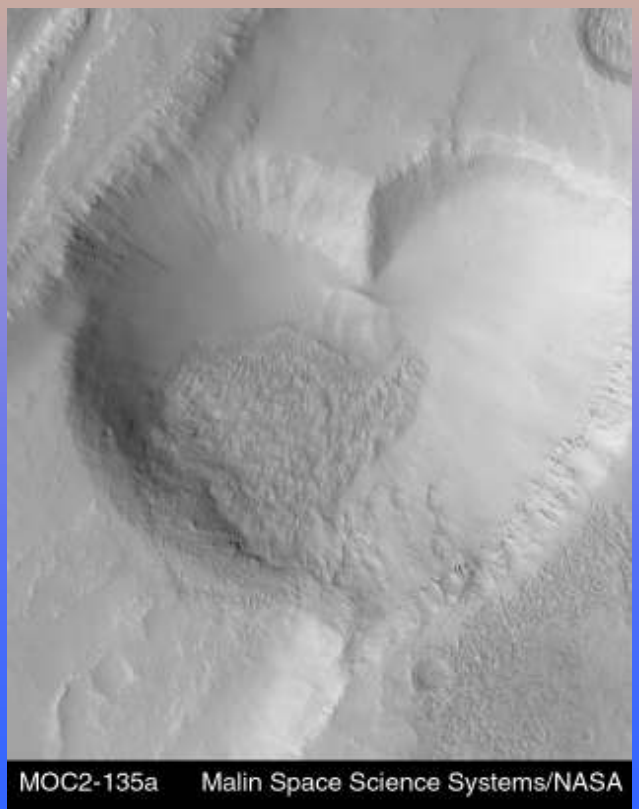
Dove può essersi sviluppata la vita?



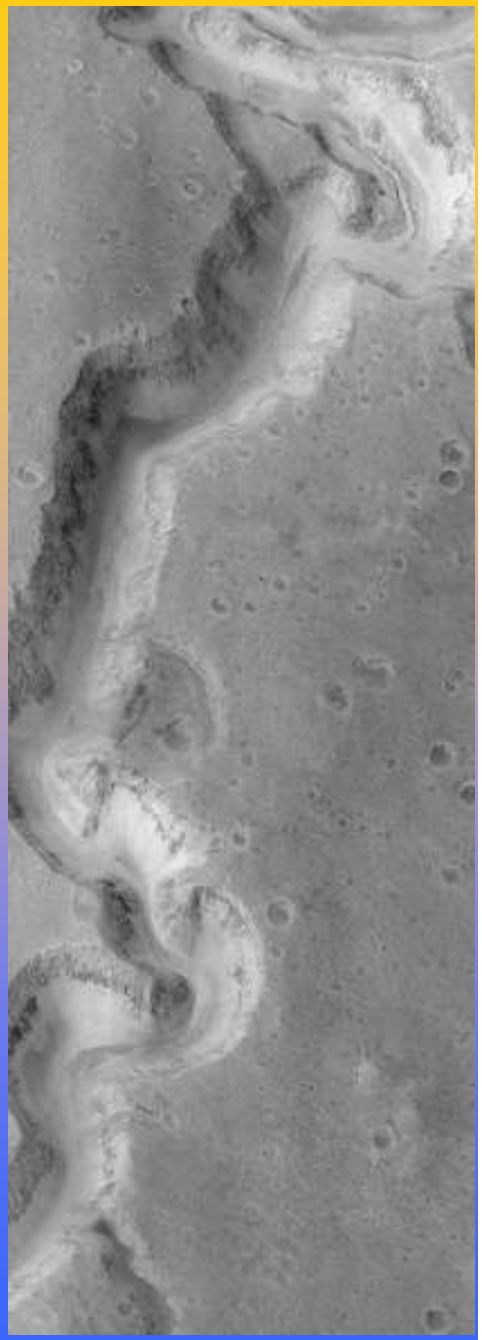
Marte





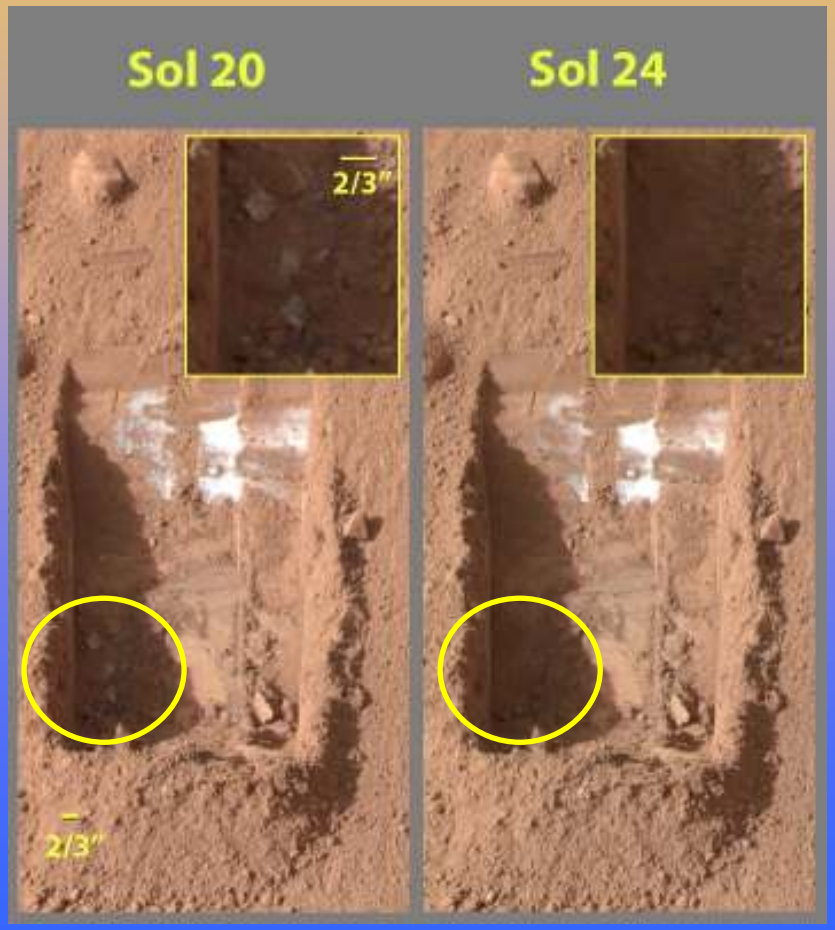


Marte: antichi letti di fiumi e laghi?



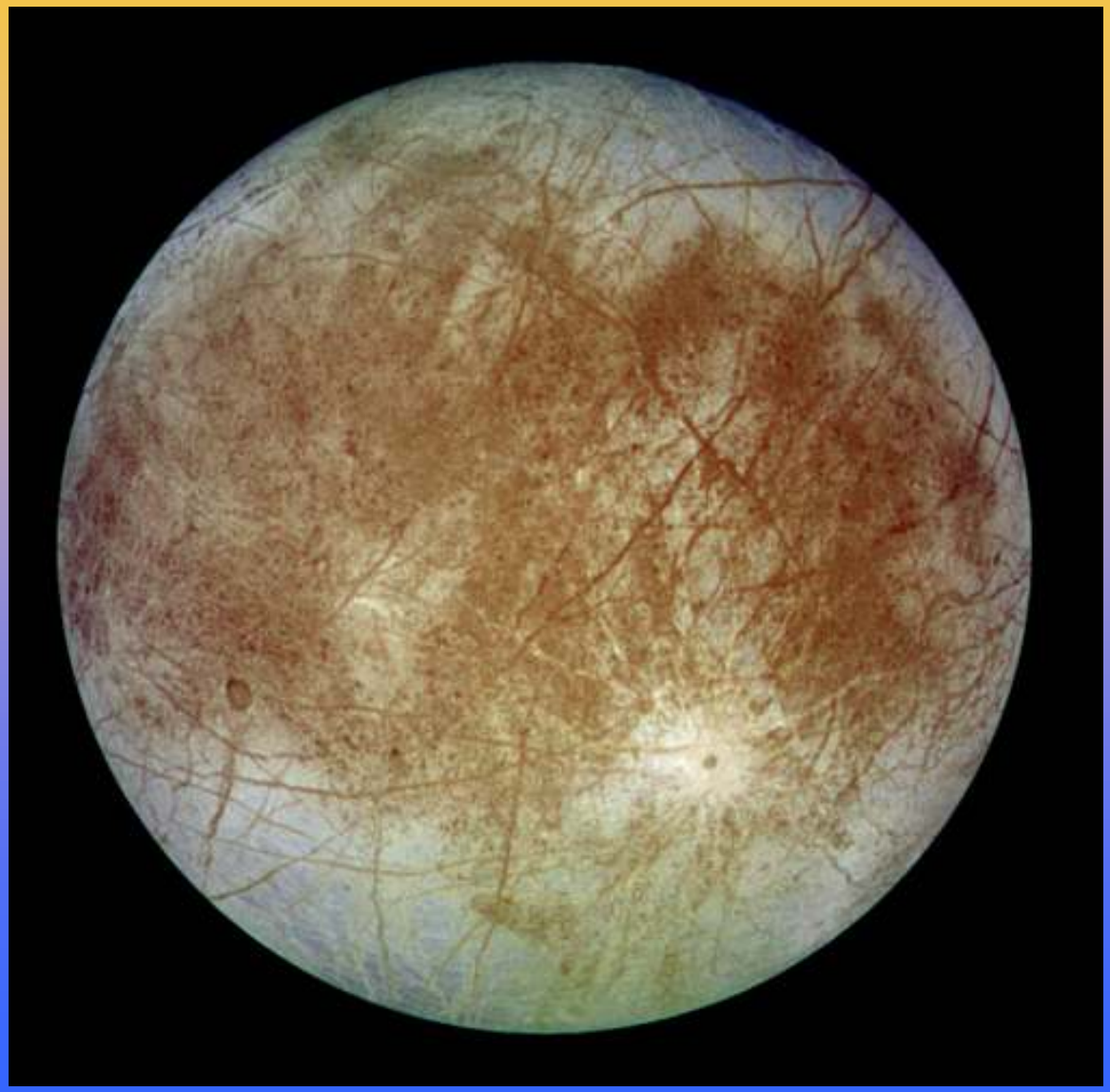

Phoenix
Mars Lander 2007

Depositi salini fotografati da Opportunity



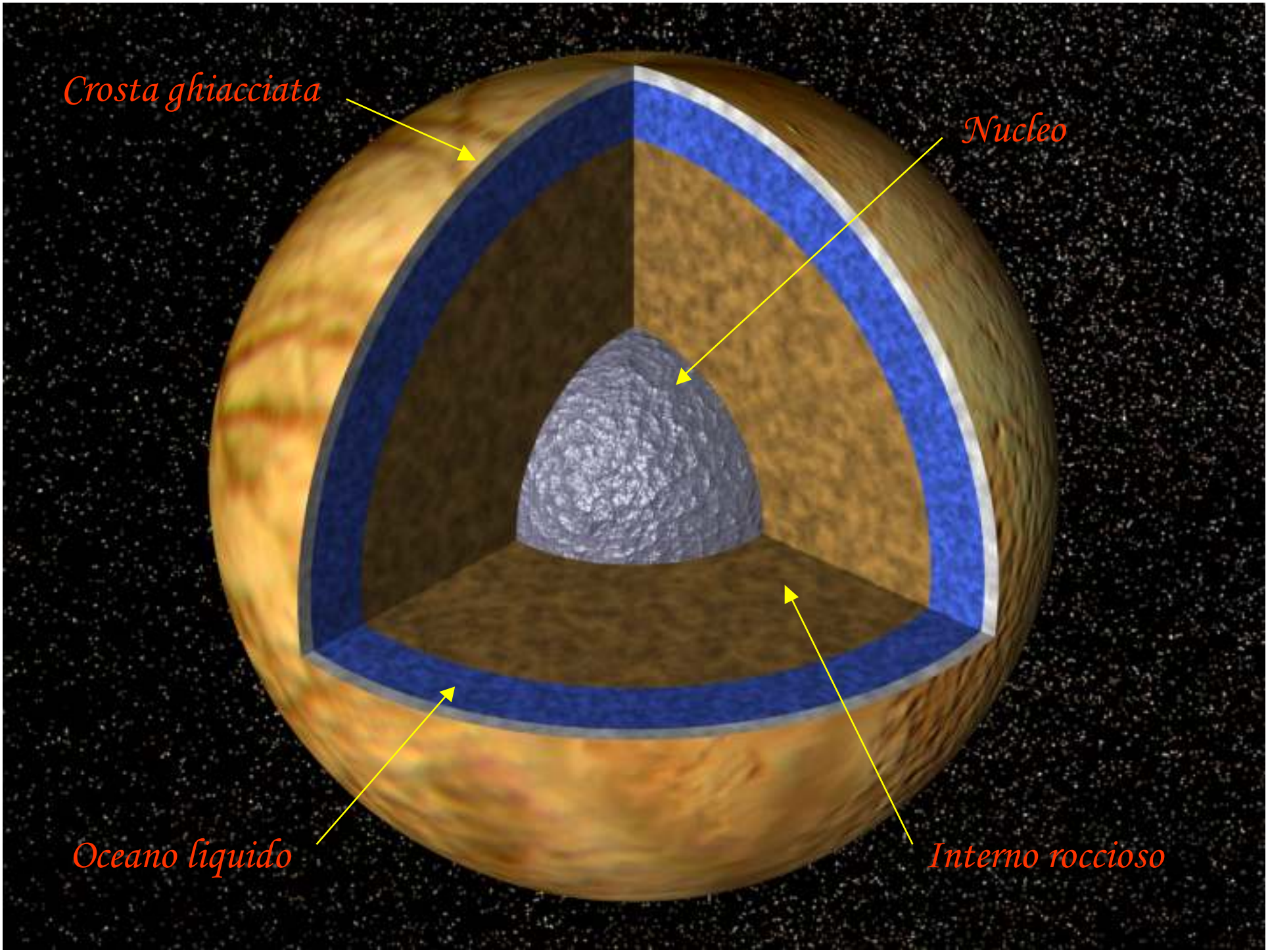
Sublimazione di ghiaccio d'acqua, ripreso dalla sonda Phoenix

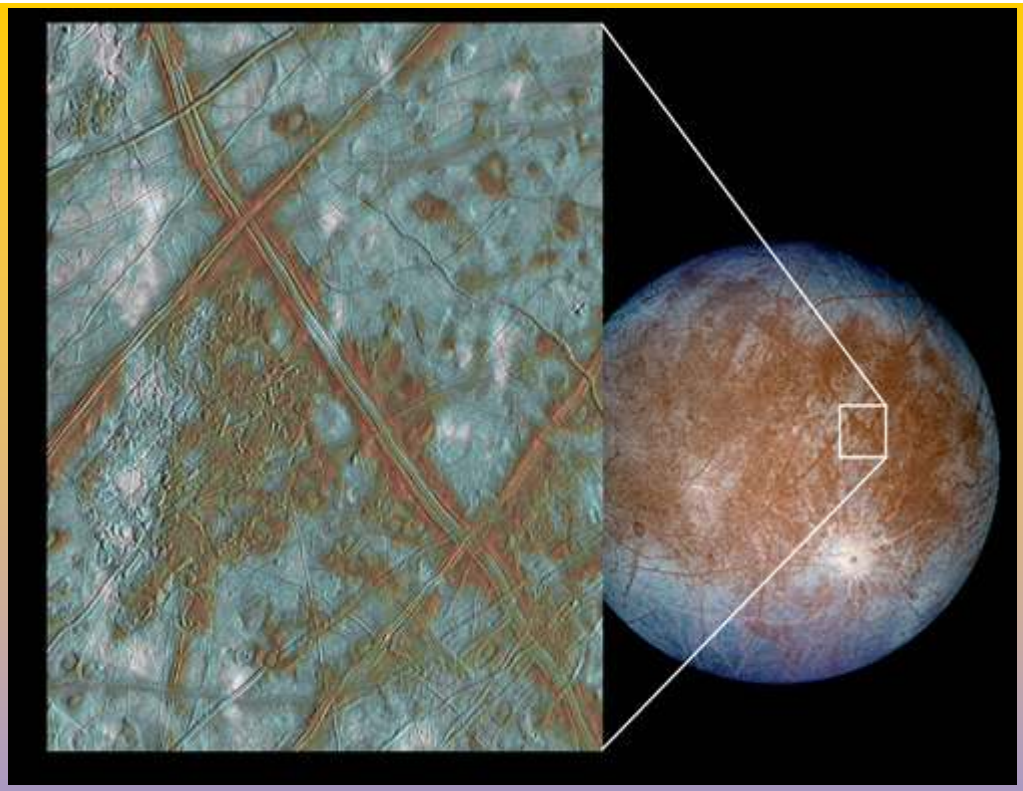
Dove può essersi sviluppata la vita?

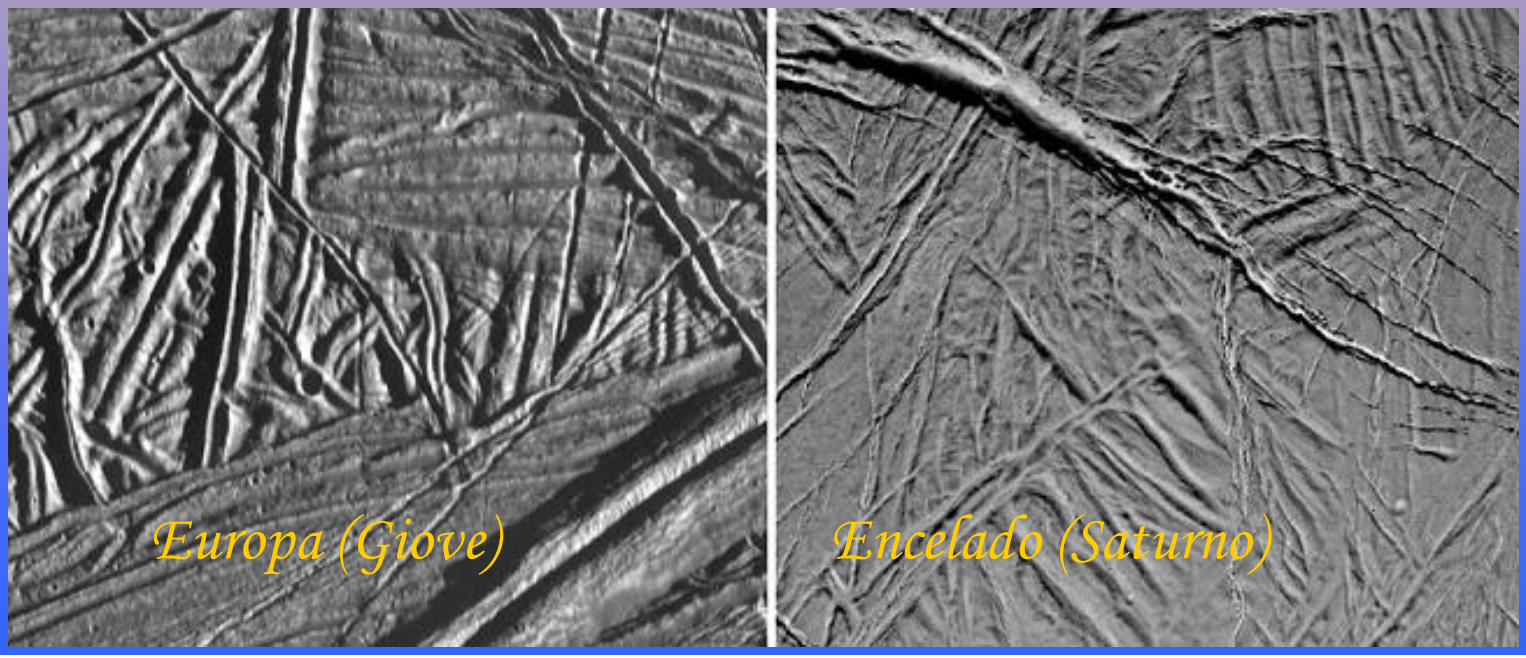


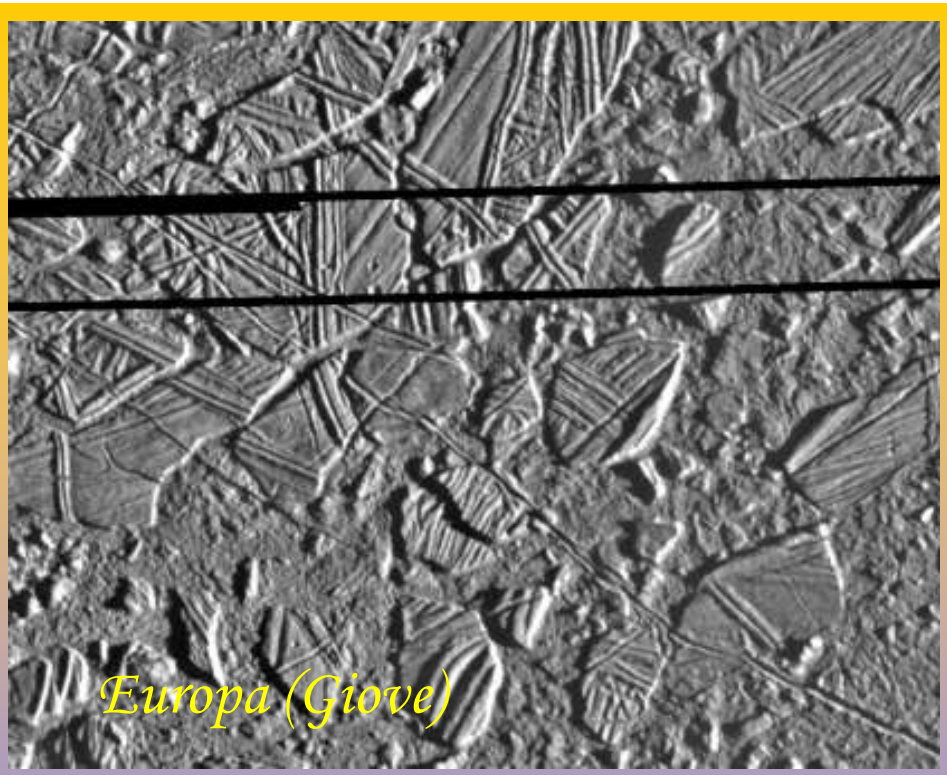
Europa

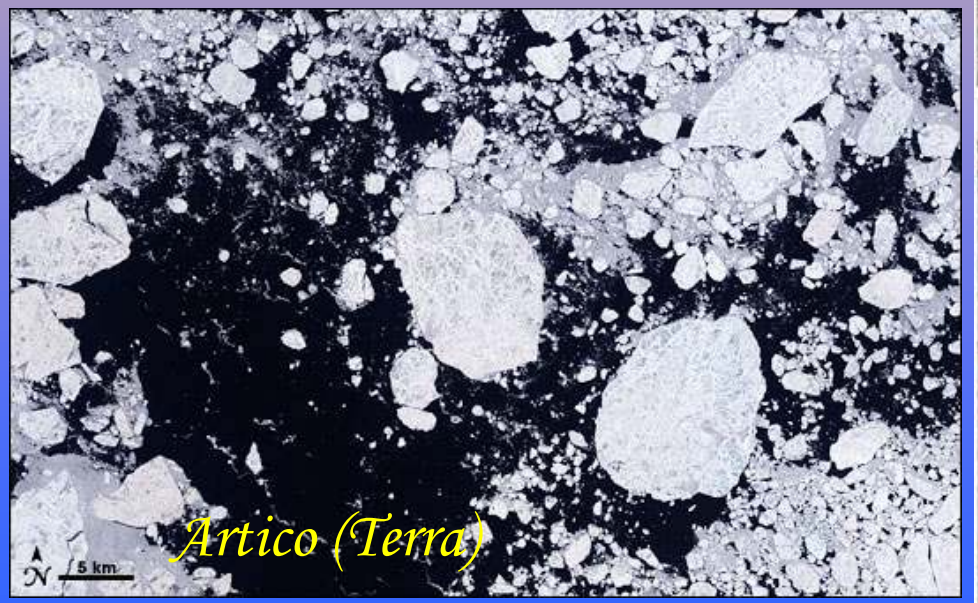
Luna di Giove

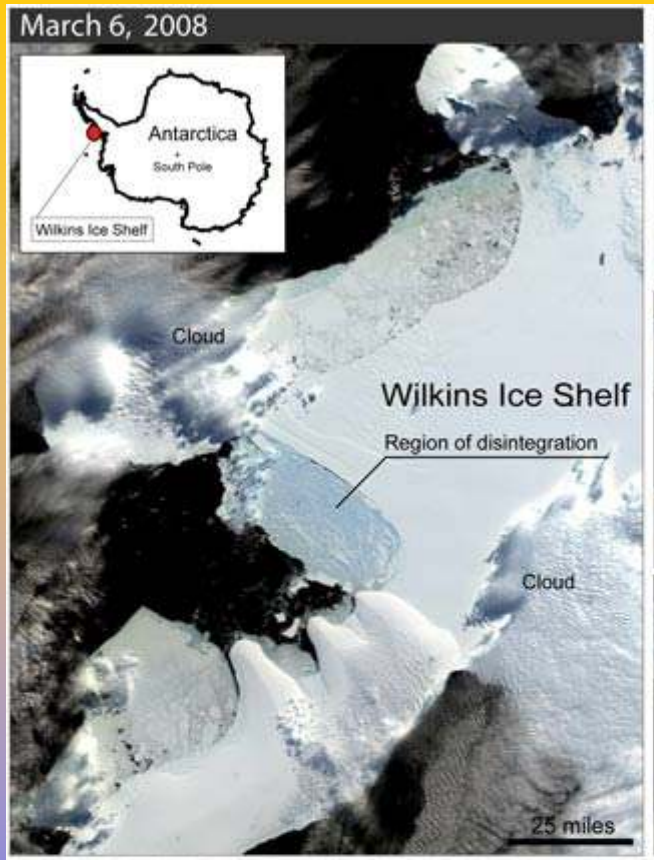

Crosta ghiacciata
Nucleo
Oceano liquido
Interno roccioso




Europa (Giove)
Encelado (Saturno)


Europa (Giove)


Artico (Terra)
5 km

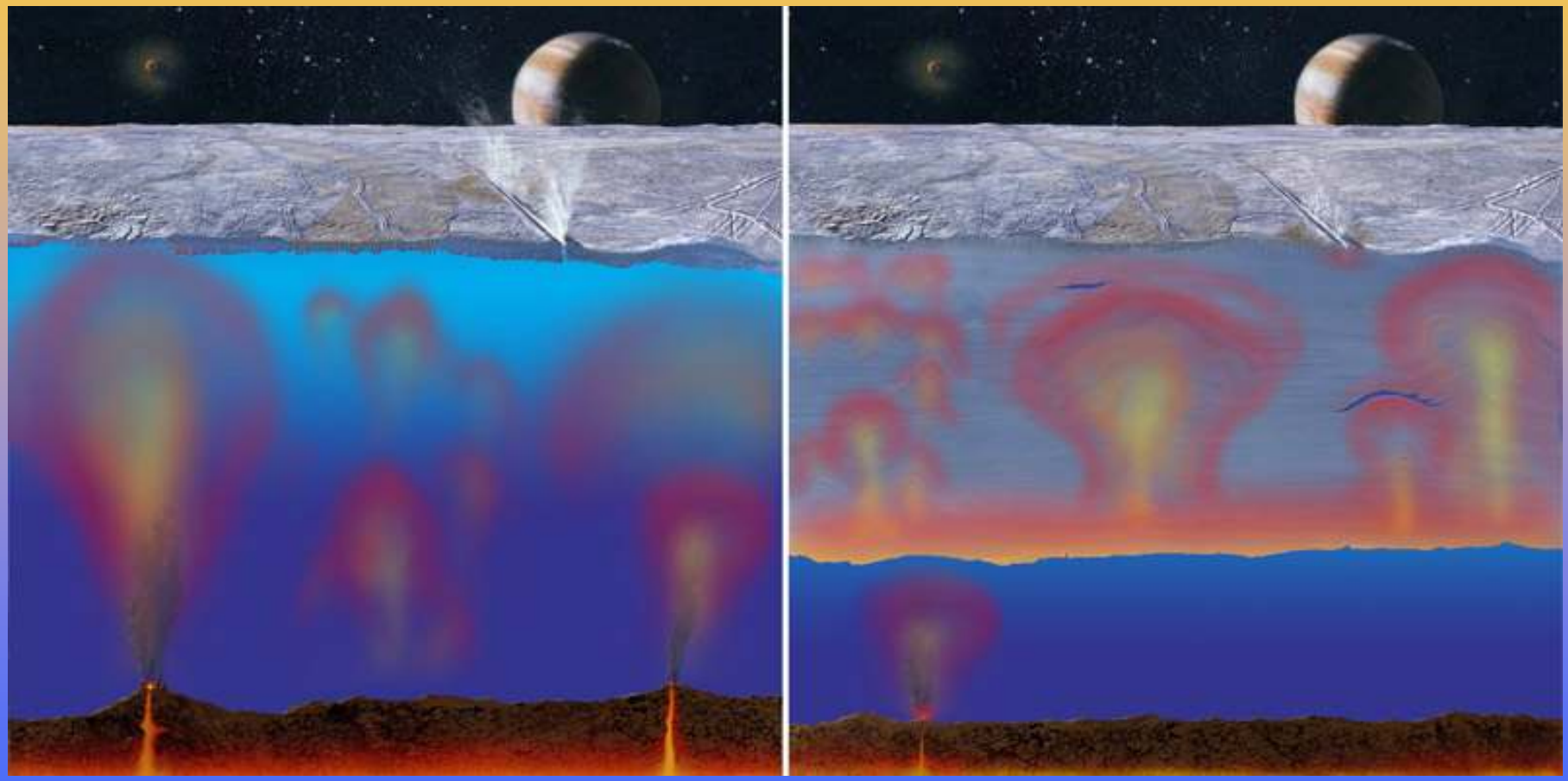

March 6, 2008
Antarctica
South Pole
Wilkins Ice Shelf
Cloud
Wilkins Ice Shelf
Region of disintegration
Cloud
25 miles

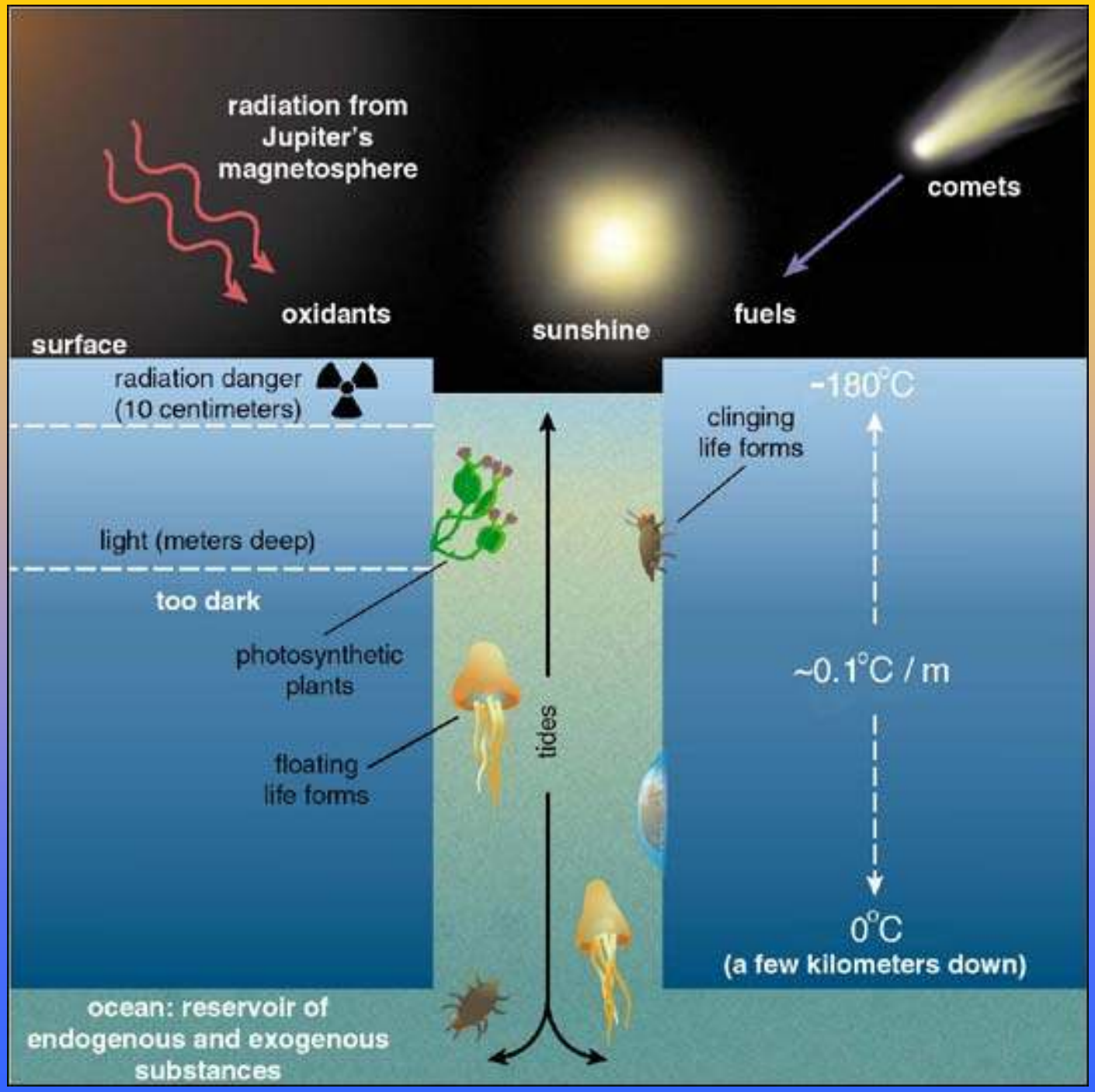

February 28, 2008


February 29, 2008

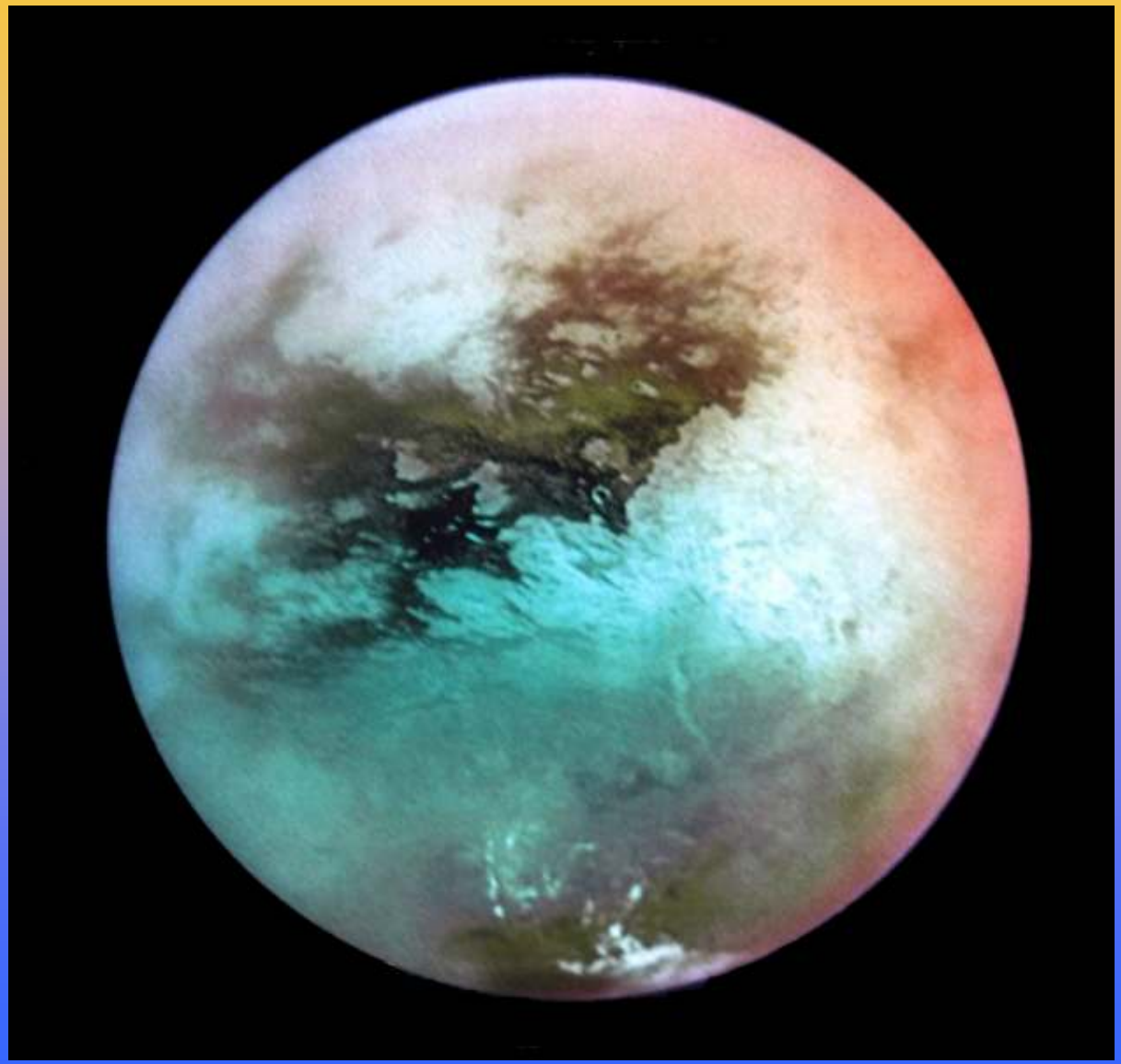

March 8, 2008


Antartico (Terra)



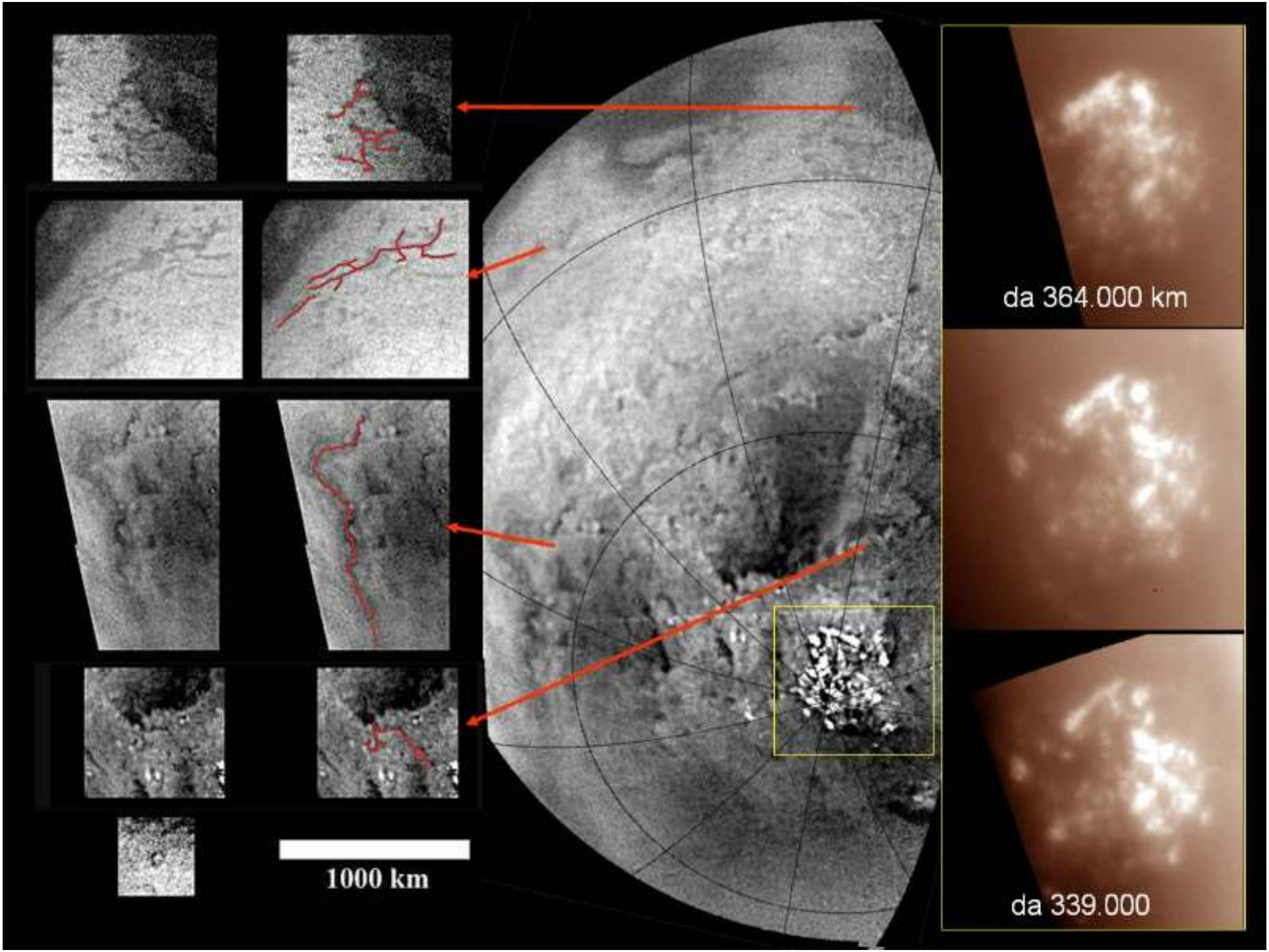

radiation from Jupiter's magnetosphere
comets
oxidants
sunshine
fuels
surface
radiation danger (10 centimeters)
-180°C
clinging life forms
light (meters deep)
too dark
photosynthetic plants
floating life forms
tides
~0.1°C / m
0°C
(a few kilometers down)
ocean: reservoir of endogenous and exogenous substances

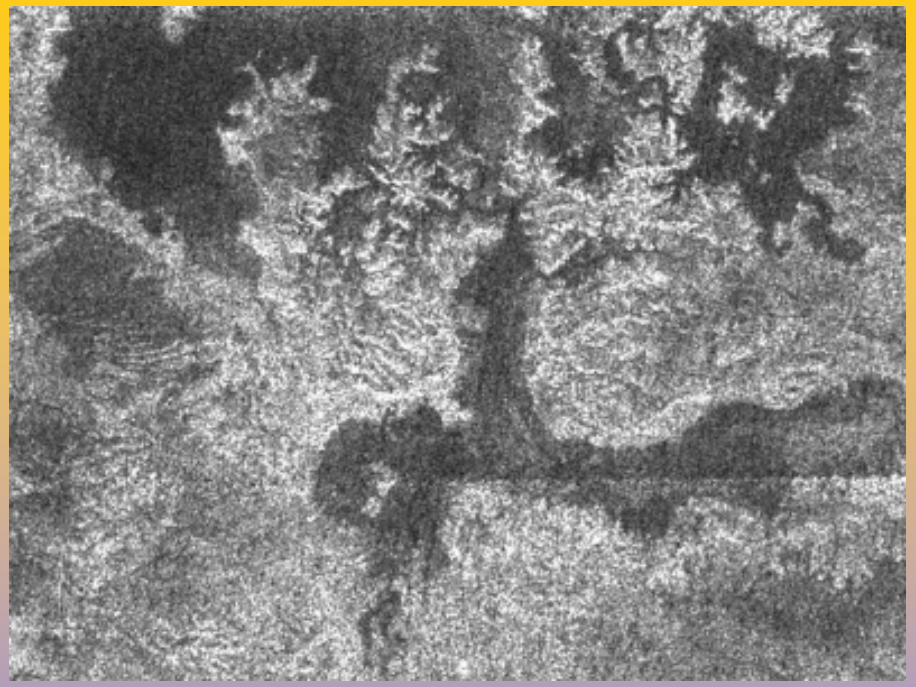
Dove può essersi sviluppata la vita?

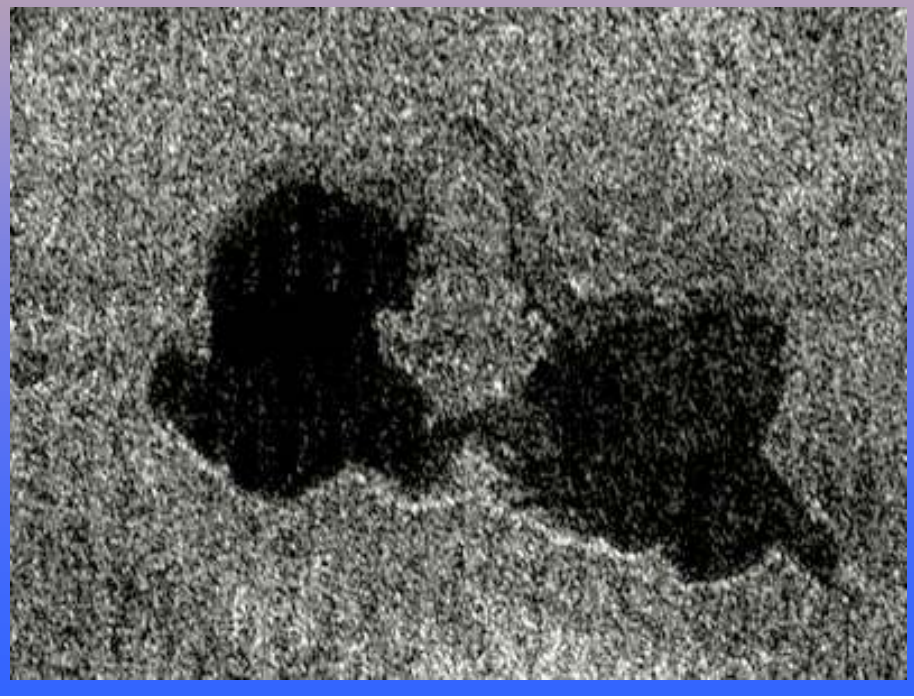


Titano

Luna di Saturno


da 364.000 km
da 339.000
1000 km





Per saperne di più