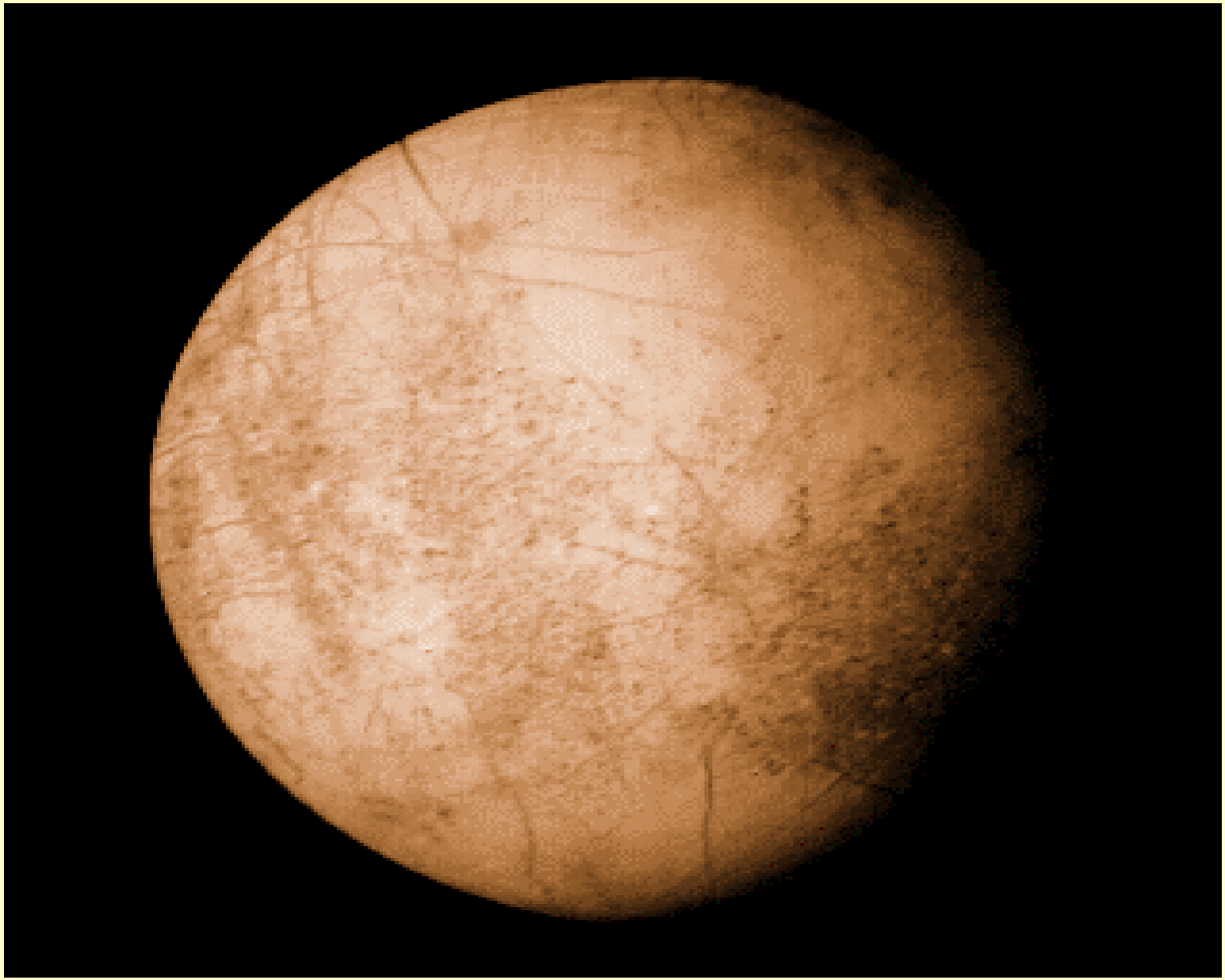
Is There Life on Europa?

An overview



- Orbit 670,000 km from Jupiter
- Diameter 3,138 km
- Mass 4.80e22 kg
- Europa was a Phoenician Princess
- Discovered in 1610 by Galileo and Marius

Geology 1

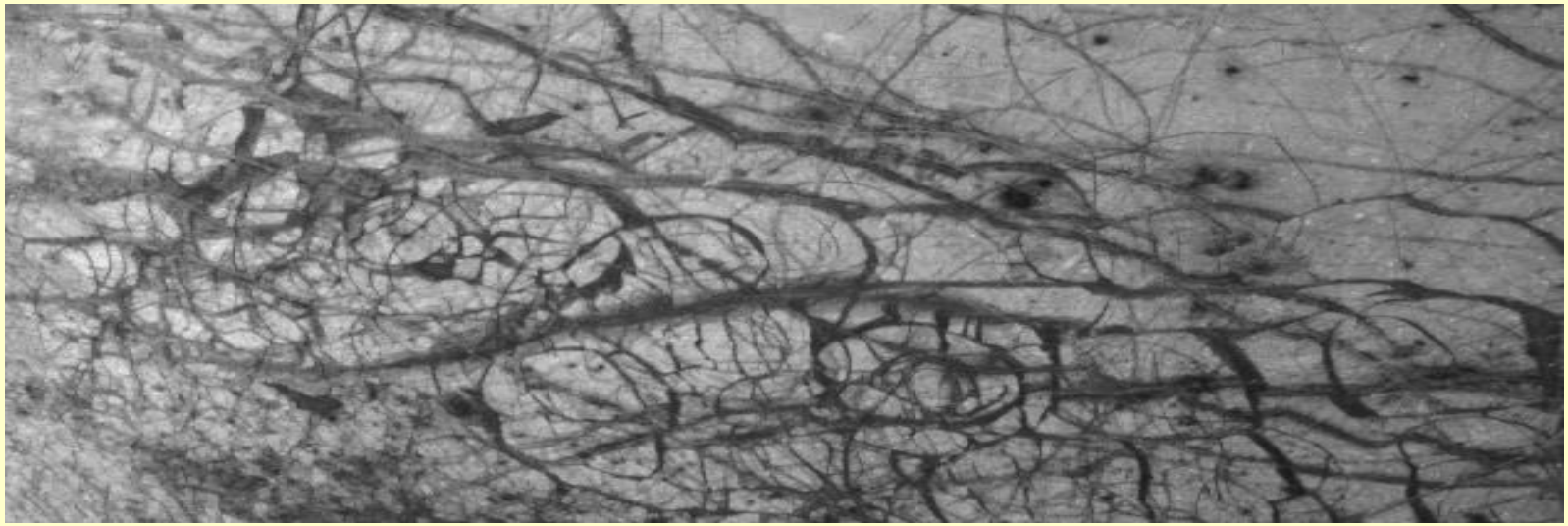
- Similar in bulk composition to terrestrial planets.
- Primary Compound composed of silicate rock
- Europa has a layer of ice
- Recent data from a mission Galileo indicates a layered internal structure, with a small metallic core
- Surface is smooth
- Few Craters
- Striking features are dark streaks crisscrossing the globe roughly 20km across

Geology 2

- Images of Europa's surface strongly resemble images of sea ice on Earth
- Possibility that below surface ice there is liquid water
- Recent observations indicate a tenuous atmosphere composed of oxygen.
- Only 4 other moons are know to have atmospheres

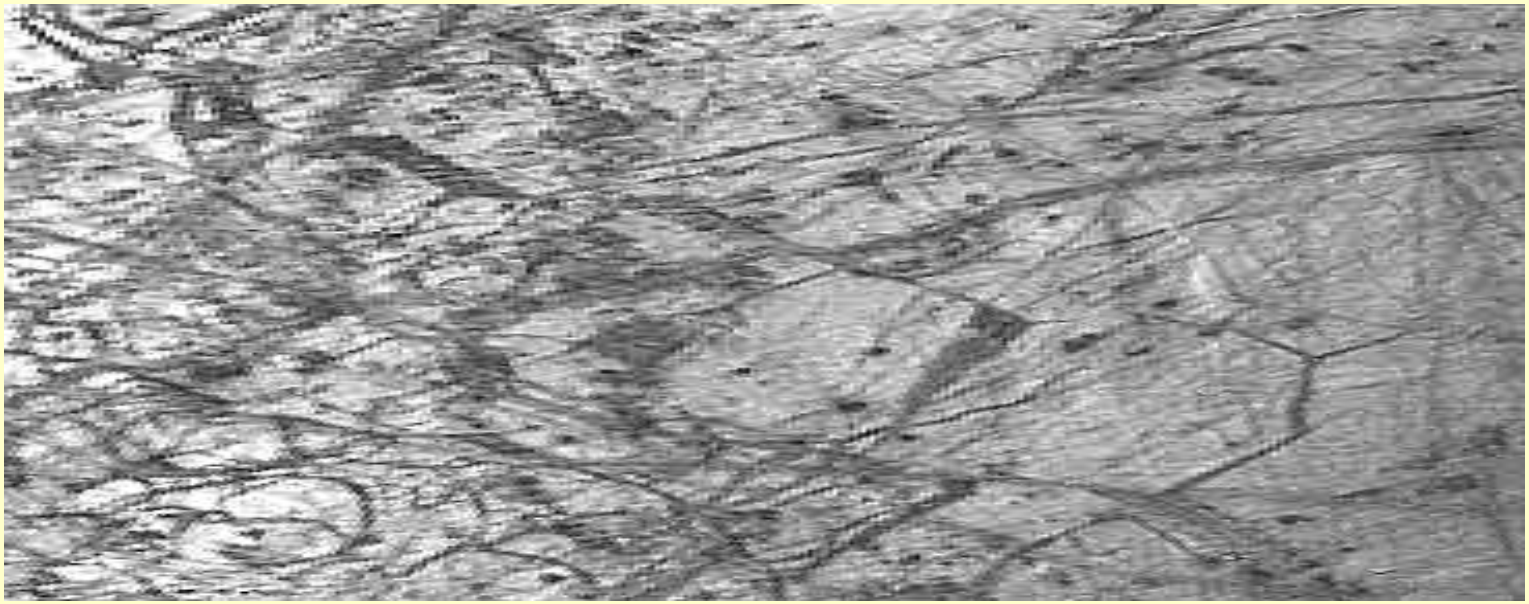
Geological Units

- The Plains



Geological Units

- Bands



Geological Units

- Crater Material

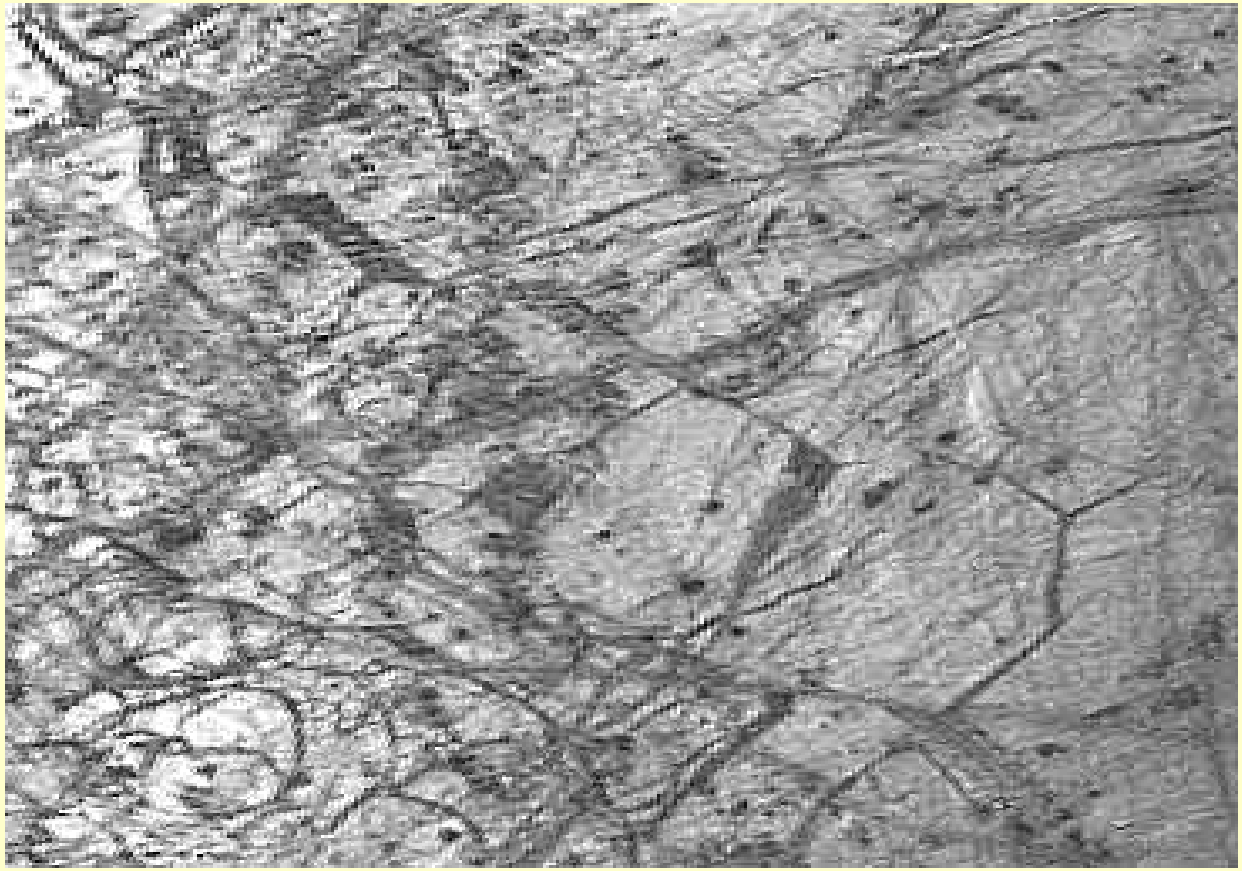
Evidence for Life?

- Water or Ice?
- Liquid or slushy or frozen?
- Since Voyagers pass in 1979 these have been the questions.
- The surface make it one the brightest objects in our solar system.
- Its believed moons surface is -260°F enough to freeze ocean.
- Warming may occur by a tidal tug from Jupiter and neighbouring moons
- This could be keeping large parts of ocean liquid

Liquid Water

- Craters, Chaos and Wedges support hypothesis of liquid water in recent history
- It has been suggested that the ice crust is several kilometres thick, below a liquid sub-ocean exists.

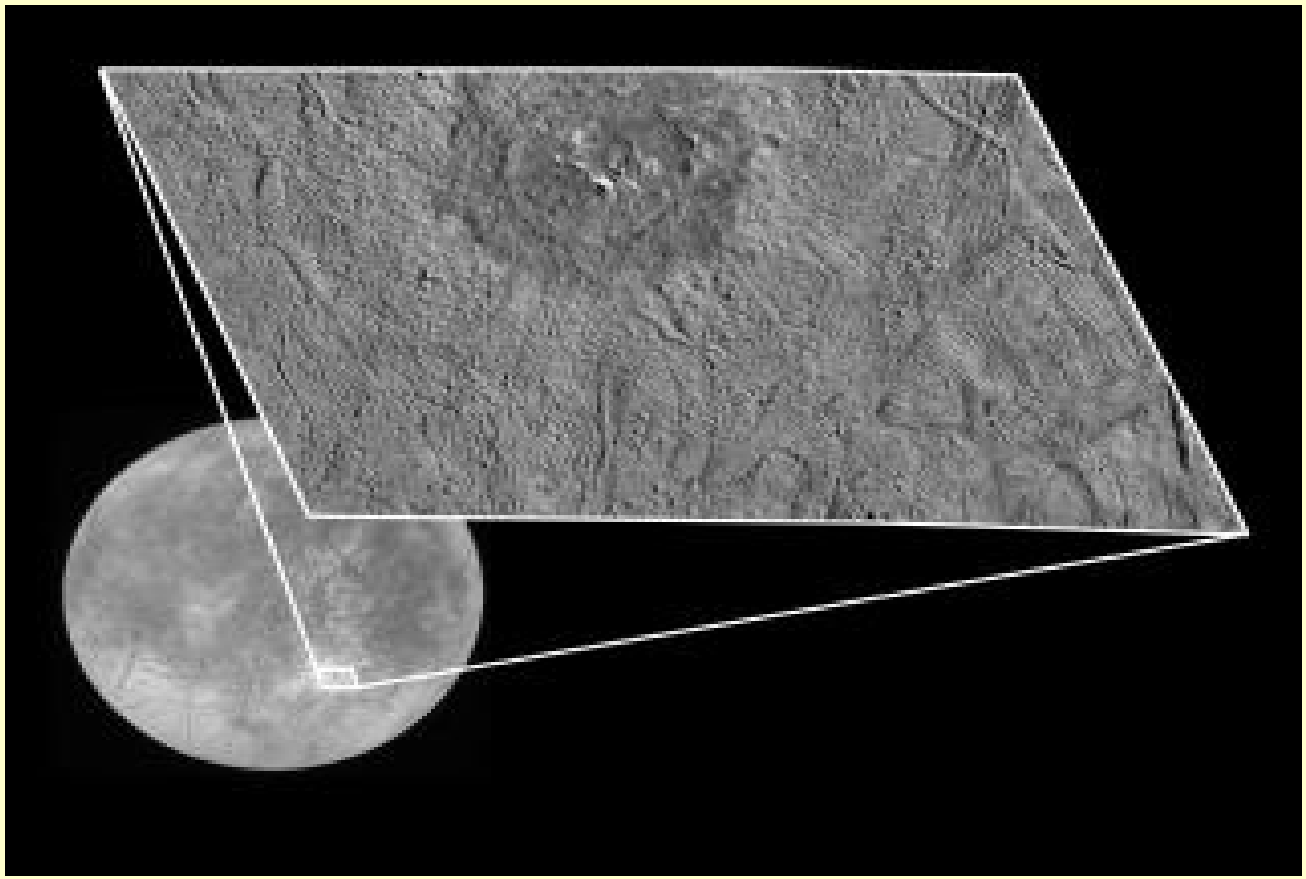
Wedges



Wedges

- Looking at this image it suggests by darker areas were once joined
- This may suggest a thinner area of solid ice fracture.
- Where they have moved apart from one another, the top base may have more liquid properties may be slush
- Wedges suggest tectonic activity

Pwyll Crater

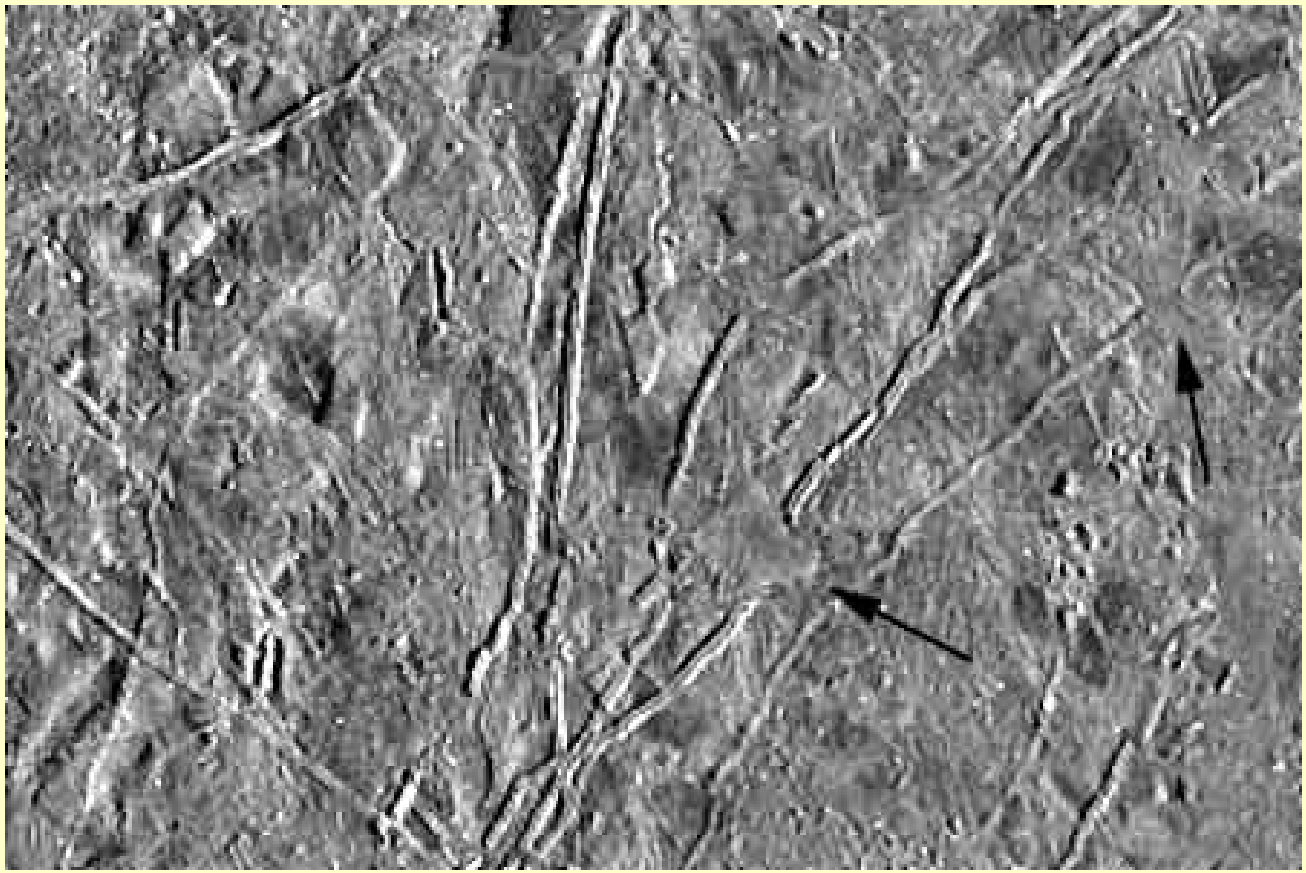


- Central Peaks are 2,000 feet high, higher than the outer rim
- Meaning that this young crater is warm and weak collapsed during meteorite strike in contrast to craters in cold
- Debris flowing from impact from dark suggests excavation of different material below surface.
- All this suggests water below surface was warm enough to be slushy.

Volcanism

- Ice-spewing volcanoes and grinding tectonic plates have reshaped surface of Europa

Ice Volcanism



Tidal Tug

- As stated earlier a suggested theory of tidal flexing, is that this is enough to melt ice crust at depth below the surface
- This leads to the possibility of hydrothermal vents where life may exist. More on this later.

Can Life Exits Here ?

Lets take some interesting examples

Life in Extreme Environments

Antarctica

Life in a Freezer!

- Earth's Last Great Frontiers
- Freezing Temperatures against biological metabolic functions
- Water is in a solid ice state making it the driest desert on Earth

Lake Vostok

- Discovery of huge amount of liquid water 4km under the ice in Russian controlled area.
- 250km long 40km wide and 400m deep
- Russian's used radar and artificial seismic waves, discovering a vast warm lake under 4000m of ice
- This Suggests this its warm enough to retain liquid
- May be caused by geothermic heat
- Ice samples analysed could be 420,000 years

Micro-organisms

- Researchers finding Antarctica not sterile
- Micro-organisms have been found in upper layer of ice
- Bacterial colonies survive long winters
- Small bits of ice melt during summer
- Algae have been discovered to co-exit
- Algae seeds in winter and sprout in summer
- Deep core samples of ice have found fossils

Micro-organisms (Fossils)

The Hydrobot

The Hydrobot

- JPL led project
- Send probe to Lake Vostok
- Developed a probe design to melt through ice and explore liquid water for life.
- Trial for a probe to Europa
- Evidence for life under Vostok is inconclusive.

Volcanic Vents

Vents

- Before 1998 life existing at extreme depths where its cold or in cold regions of the earth was unknown
- New discovery!
- Deep Ocean exploration by French scientists in South Pacific on vessel L'Atalante reveal volcanic vents where life exits

Crabs near vents

Volcanic Vent Video

Recent Discoveries

- Ganymede may also have a similar activity
- Titan may also support life, perhaps in the future as the sun becomes a Red Giant
- This will be short lived

So is there life on Europa?

Only time will tell