

# Amazing Antarctica

## 奇異南極



VW122015

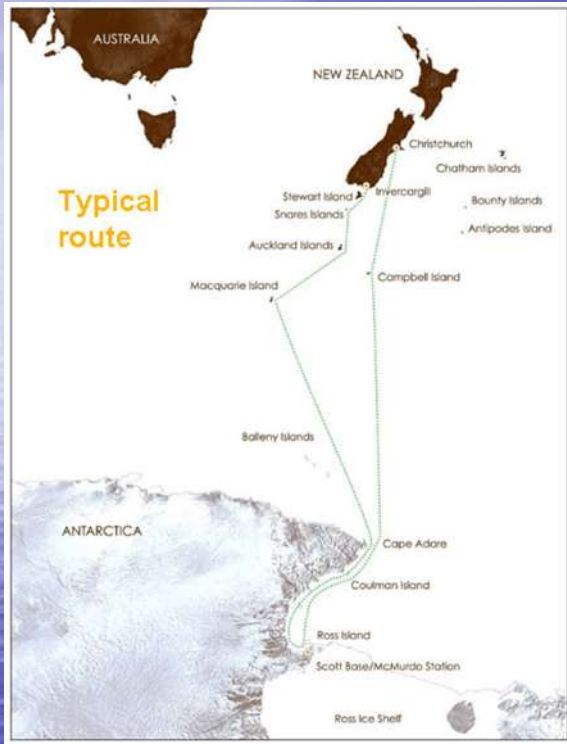
# Content

- Our voyage 航程
- Antarctica One Two Three 認識南極 :  
  
Geography, Climate, Currents, Aurora, Ozone hole,  
Geology, the Poles & Meteorites
- Key Exploration Timeline 探險簡史
- Ice, Ice, Ice 陸冰與海冰
- Fauna & Flora 動植物
- Snap shots of our destinations 上陸剪影



# Layman's choices to Antarctica

All water, no landing; All water, landing; Air /Air with landing; Air/Sea with landing; Air/Land ( Currently 46 registered ships from 14 to 3,000 passengers)



# Our choice – The M S FRAM

- The 26 day trip includes a 19 day Cruise of up to 3,500 nautical miles by the M. S. FRAM visited the Falkland Islands, Sub Antarctica 亞南極 (46 to 60S-South Georgia); Maritime Antarctica 南極海島(South Orkney, Elephant Island, South Shetland Islands) & the Antarctica Peninsula 南極半島





The vessel is operated by a Norwegian shipping company called the Hurtigrunten Group. Built 2006 at 11,640 tons it is named after the ship used by the famous Norwegian explorer Roald Engelbregt Gravning Amundsen 亞蒙森 who was the first man to have arrived at the South Pole on 16<sup>th</sup> December 1914. FRAM in Norwegian language means "FORWARD". Maximum capacity 318 passengers. Our voyage had 230 passengers





## Room 350, Deck 3 - our home at sea for 19 days





The food was good. We even have congee for breakfast !





Basically 2 landings per day, all "Wet Landings" except a Dry one at Port Stanley. Activities include snow shoes hiking, PolarCirkel boat cruising, camping, kayaking as well as lectures by geologist, ornithologist, marine biologist & documentary movie shows





# The Expedition Team on M S FRAM

Geologist, Climatologist, Marine Biologist, Botanist, Ornithologist, Historian



© Dominic Barrington

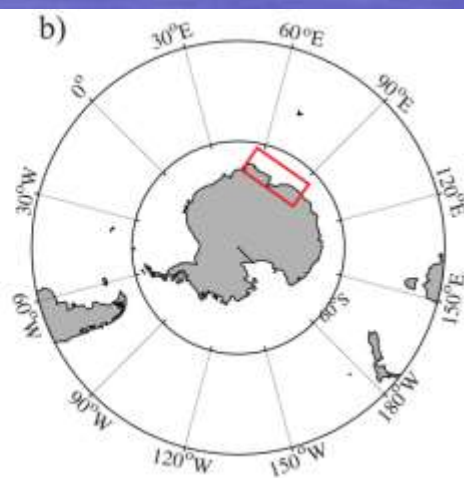
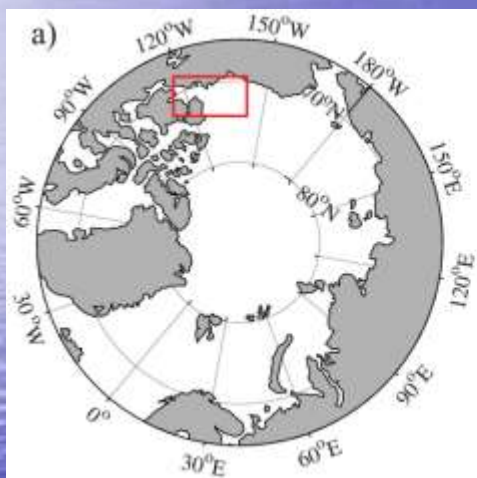
A background image of a vast, deep blue ocean under a bright blue sky with wispy white clouds. The sun is visible on the left side, creating a bright reflection on the water's surface.

Antarctica One Two Three



# Structure & Size

Structurally Antarctic is land & Arctic is ocean. Size wise at 14 million km<sup>2</sup>, it is the fifth largest continent in the world which is 1.4 times larger than of USA, 1.45 times that of China & 1.8 times larger than Australia



# Geographical Division

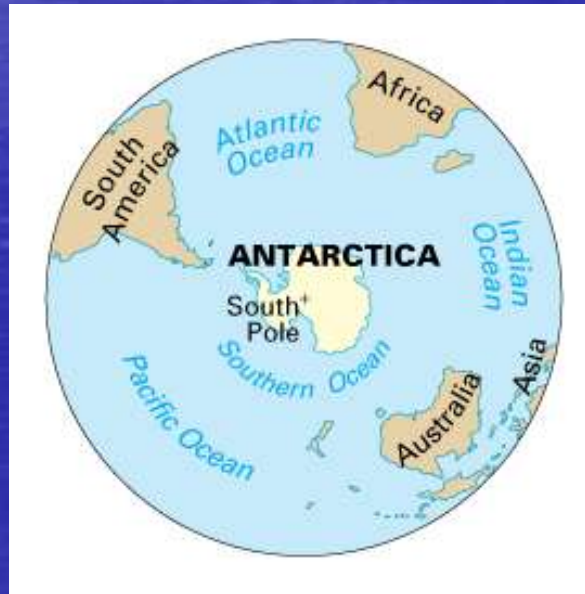
The continent is divided by the 4,000 km long Transantarctic Mountains into East Antarctica (Greater Antarctica) & West Antarctica (Lesser Antarctica) the latter includes the Antarctica Peninsular which is accessible to most tourists





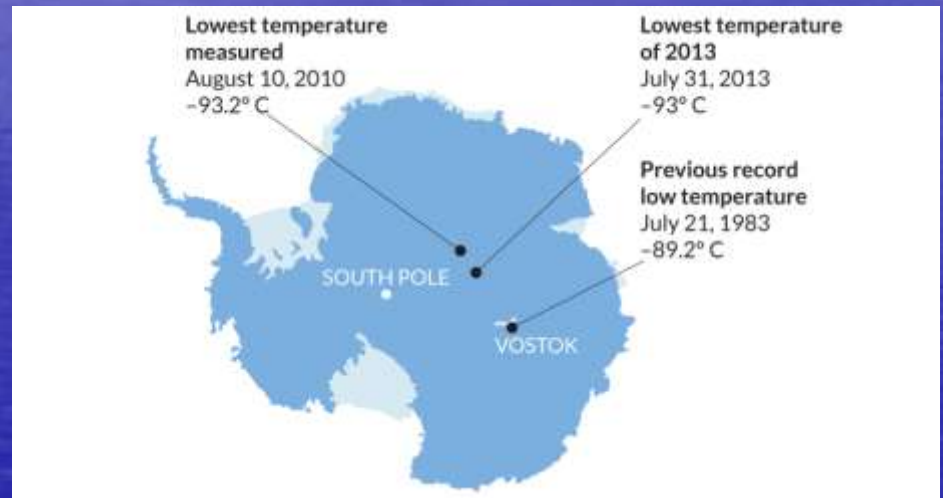
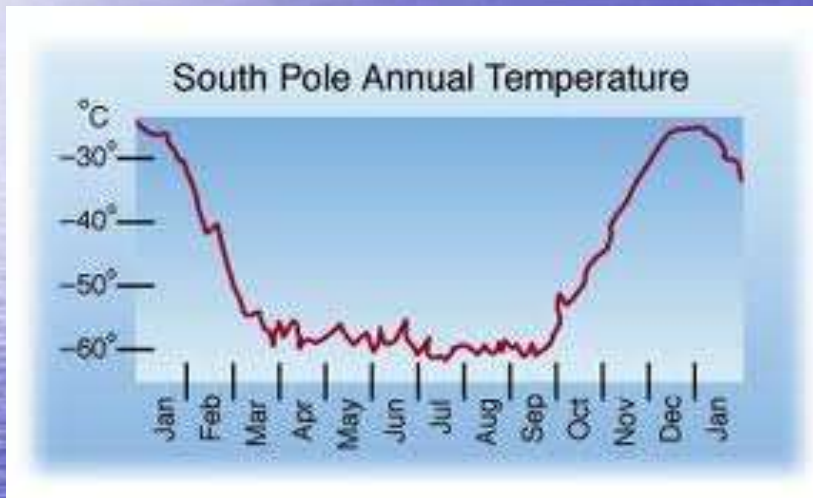
# The Six Extremes 六極端

1. The continent is situated at the southern most part of the globe
2. Surrounded by the Southern Oceans 南大洋, Antarctica is the most isolated continent in the world being 1,000 km from the top of South America, 3,500 km from Australia & 4,000 km from Africa
3. It is also the highest with average height at 2,350 m ( Europe is 300 m, Australia 330m, Asia 950 m). The highest point is at Vinson Massif at 4,897m which is near the Weddell Sea.



Climatically Antarctica is the coldest, driest & windiest place on Earth

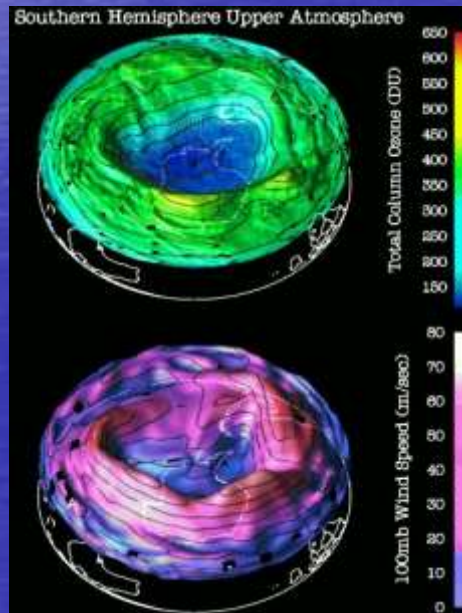
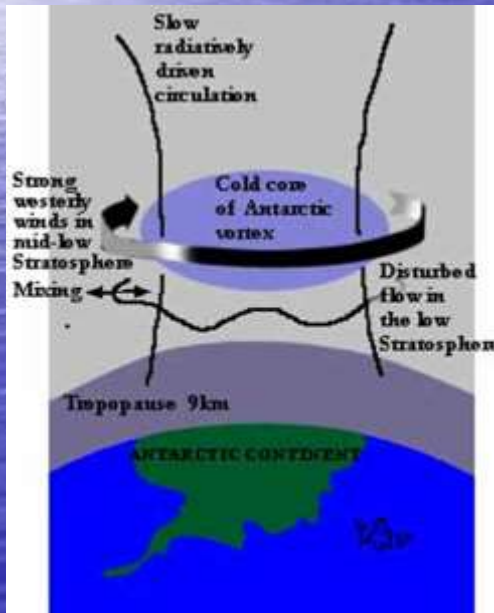
4. Temperature : with lowest winter temperature ever recorded was at **-89.2 C** at Vostok and highest summer temperature at -12.3 C & average at -25 C ( NASA satellite record 2010 was at **-93.2 C !** )



The temperature is so low because the Angle of the sun is very low ( highest only at 23.5 degrees ) and the sun's Albedo 反照率 is as much as 80-84% because 98% of the continent is covered by ice with average thickness of more than 2,000 meters & in winter the sea ice can double the size of the continent itself

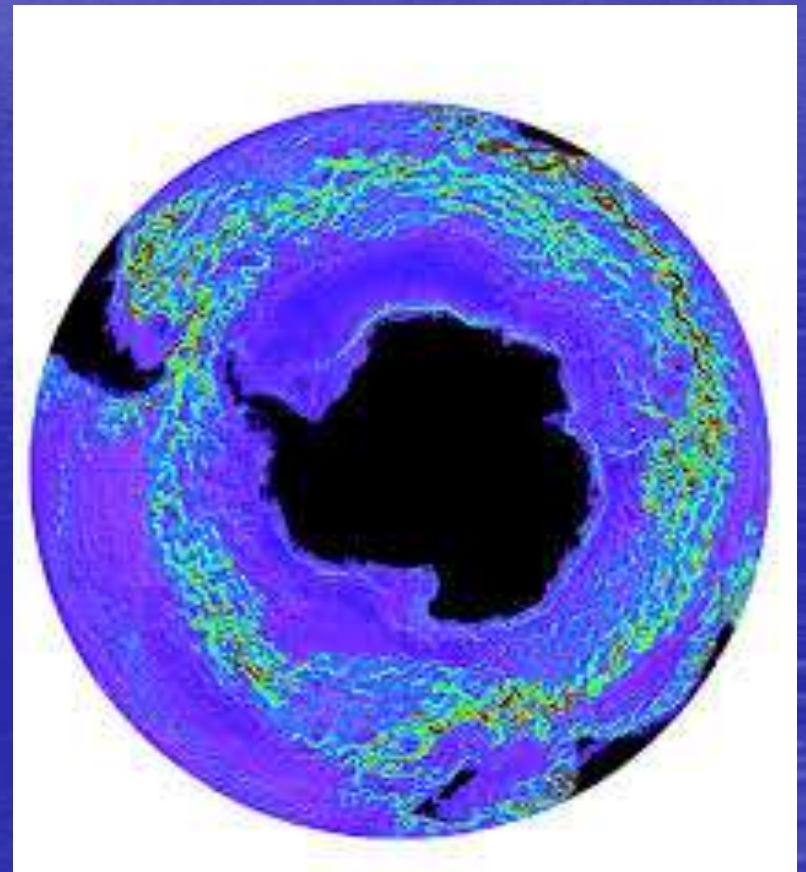
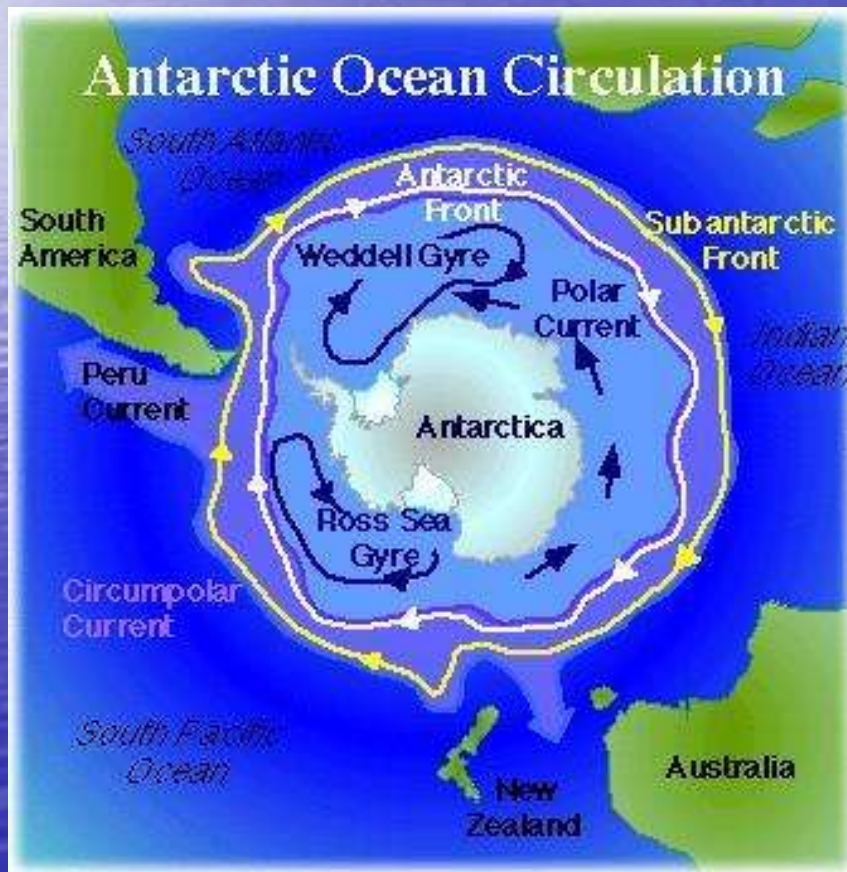


The persistent low temperature in Antarctica is also due to the existence of the “Circumpolar Vortex” 環極漩渦 which is a strong Westerly circulation of winds like a large scale cyclone that builds up during the winter months in the upper layer of the atmosphere over Antarctica. They cut off the central Antarctic weather from the rest of the world causing temperature to fall and stay low. It also adds to the breakdown of the Ozone Layer by trapping clouds called “Polar Stratospheric Clouds” that cause ozone depletion by chlorine containing compounds such as CFCs (Chlorofluorocarbons) . These clouds are called “Nacreous” 珍珠雲 as they look like nacre of shells or mother-of-pearl





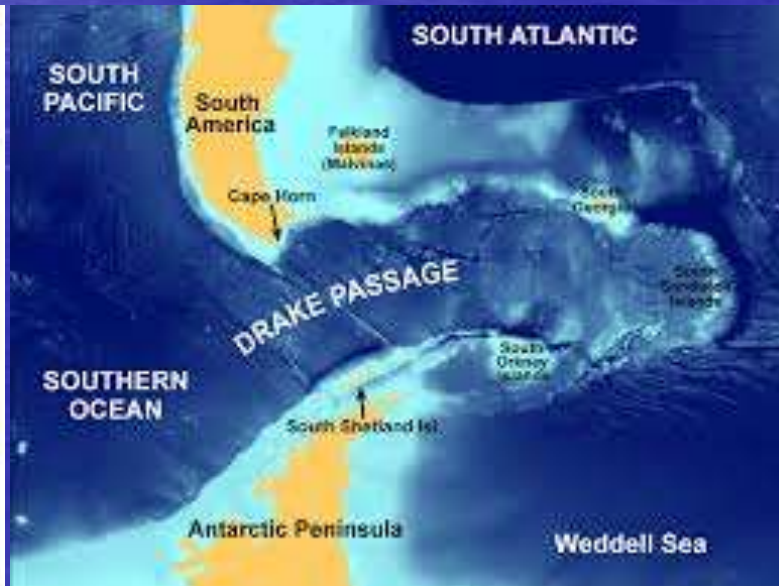
The Antarctic Circumpolar Current (ACC) 南極環流 : Also known as the West Wind Drift & formed around 30 My it is the largest & strongest wind driven current on Earth moving huge volume of water which is 600 times that of the Amazon. Driven by the westerly, it flows clockwise from west to east around Antarctica between 47-60 S & keeping the warm water away & keeps the continent cold. ACC contains the coldest & densest sea water in the world and often creates some of the roughest seas which are notorious to sailors particularly at the Drake Passage



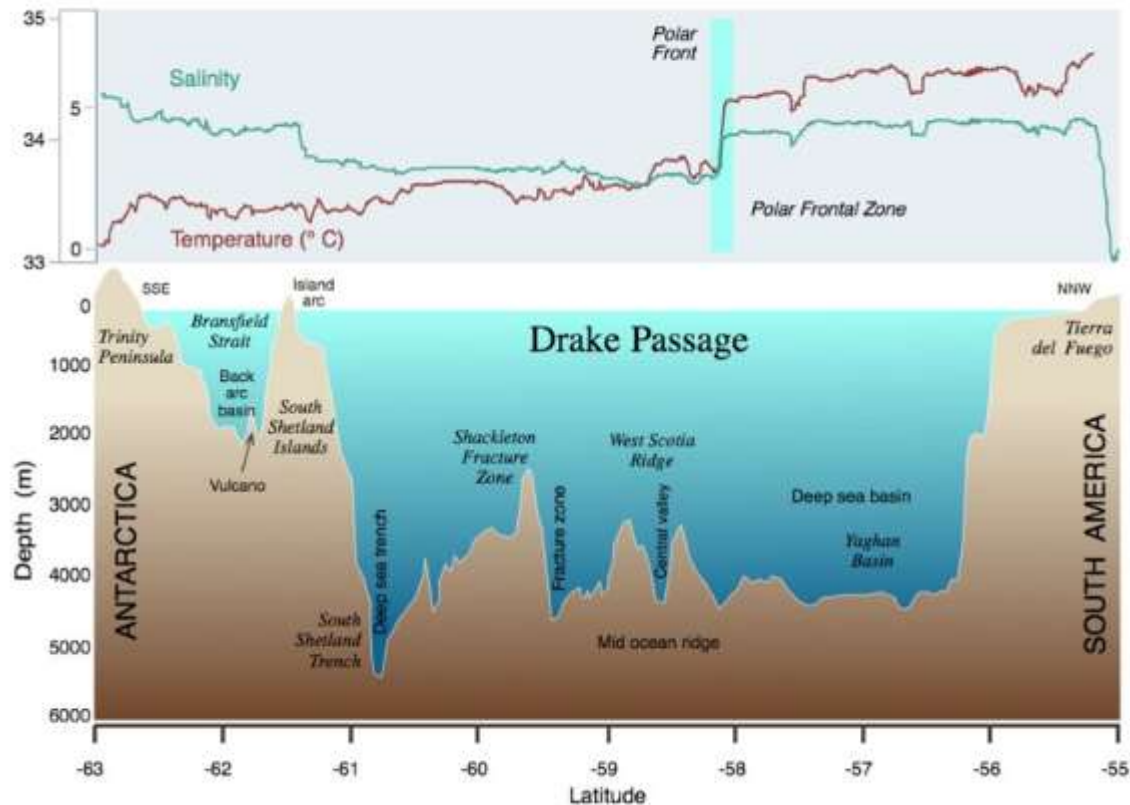


# The Drake Passage 德瑞克海峽

- The opening up of the Drake Passage is estimated to be around 23 Ma
- At 950 km wide & 5,840 m deep the Passage lies between Argentina & the Antarctic Peninsula & located within the Westerly Wind Belt. Stretching between 30 & 60S the Belt is driven by the earth's rotation. As it is surrounding Antarctica with no obstacles in between, wind speed can easily reach Beaufort Scale 5 to 7 generating 4/5 m high waves & up to 15 m during a storm. The sea condition is often worsen by the presence of the Antarctic Circumpolar Current (ACC) 南極環流 resulting in the infamous "Drake Shake"

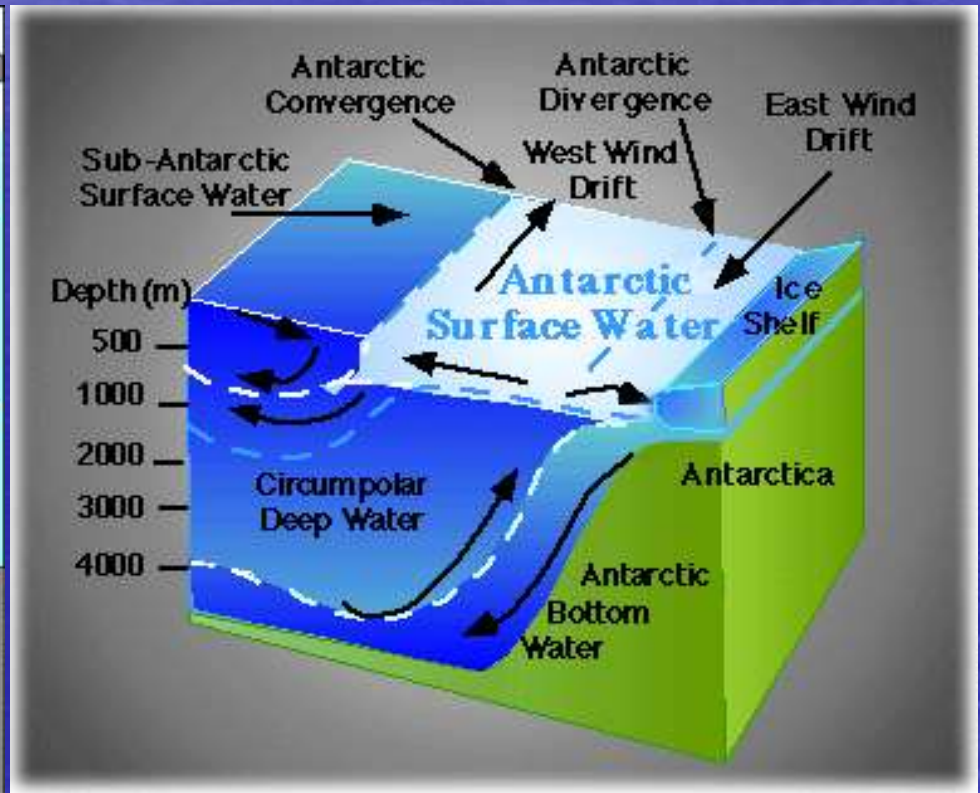


Crossing the Drake passage takes 40 hours & December is the calmest month to do it

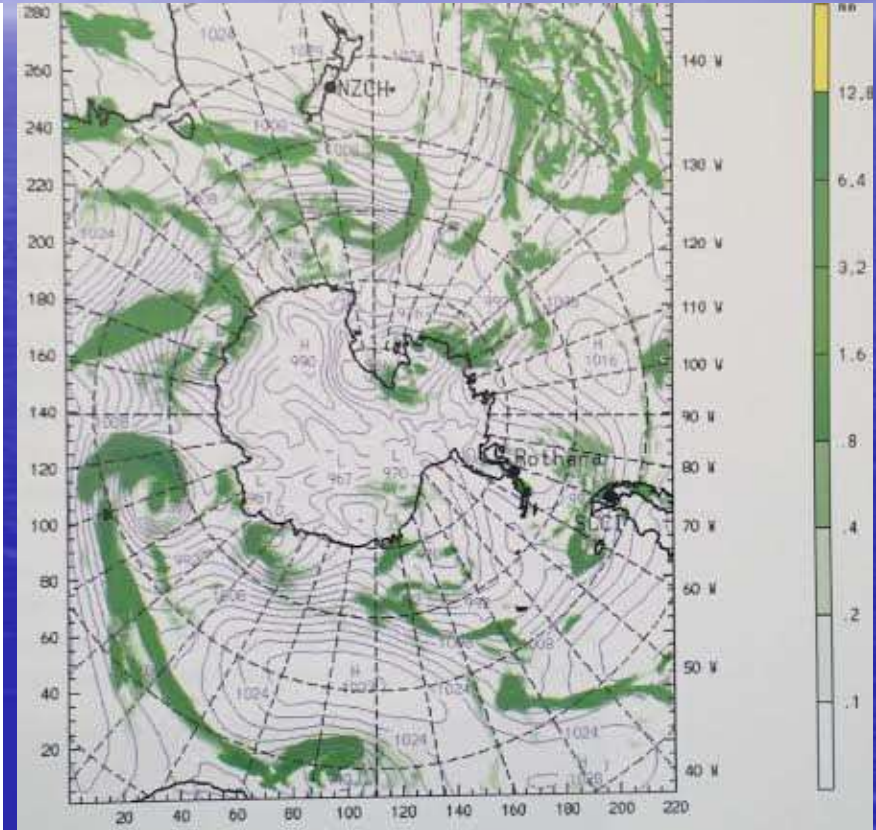
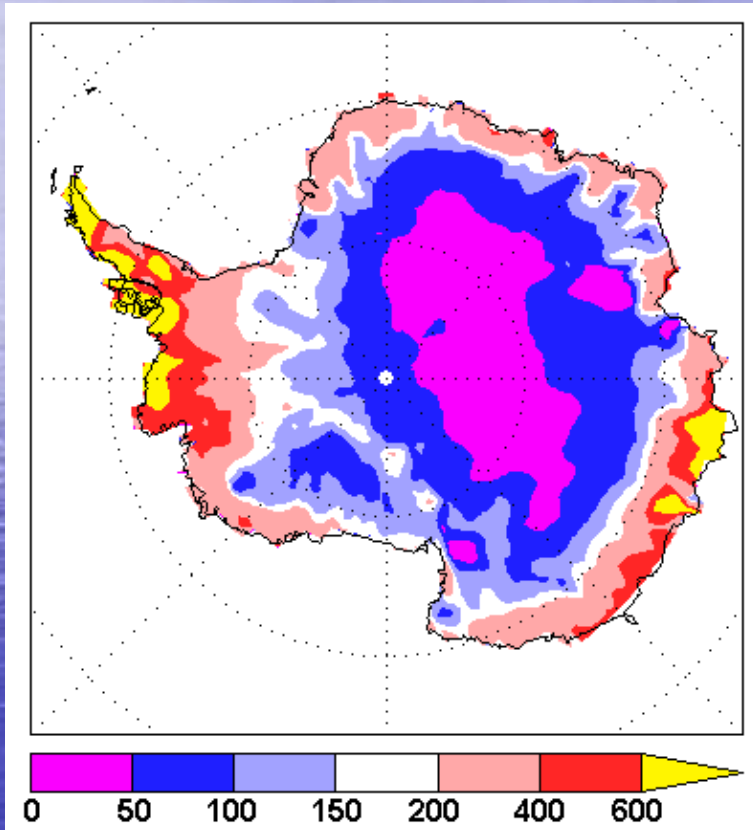




- Antarctic Convergence or the Antarctic Polar Front** 南極幅合帶 :  
 refers to the region where colder Antarctic Seas meet warm waters to the north. The two waters have marked differences in salinity, density and temperature (2-3 C) & when mixed creates a highly productive area for algae, krill & plankton forming the bases of the Antarctic food web as well as a Biological Boundary between Antarctic & Sub Antarctic life forms



5. Precipitation : Almost all precipitation falls as snow. Averaging 166 mm per year, Only 20 mm in the interior. Antarctica is so dry that it is actually the world's largest desert ( desert classification less than 250 mm ) !



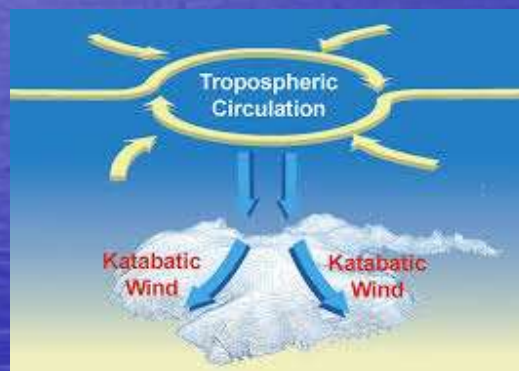
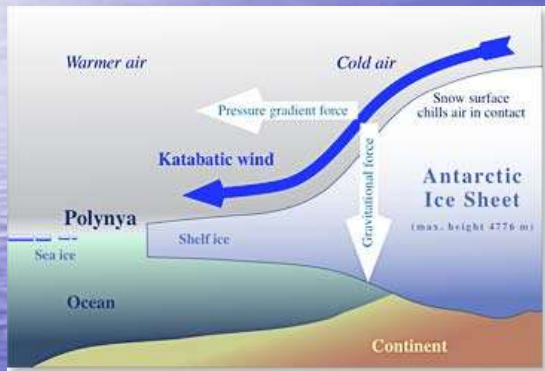
Green bands are storm clouds



Although precipitation is low, snow blizzards 暴風雪 do occur when wind speed reaches gale force (above 10 m per second) and can be very dangerous. Whiteout 白矇天 is an optical Phenomenon caused by blizzard in which uniform light conditions effectively make it impossible to distinguish shadows, landmarks or the horizon which is again hazardous. Snow cairns are being erected to mark the route and prevent people from getting lost



6. Wind : Antarctica is the windiest continent on earth. Storm with wind speed of 100 km per hour is common. Below 60 S Katabatic wind 下坡風 / 重力風 is even more severe. Katabatic in Greek means “going down hill”. It is the technical name for drainage wind which carries high density air from higher elevation down a slope by gravity. The wind can blow very suddenly & well over hurricane force reaching 300 km per hour & last for days & weeks which is killing. In some areas it scoured the snow away creating Dry Valleys or Antarctic Oasis such as the McMurdo Dry Valley

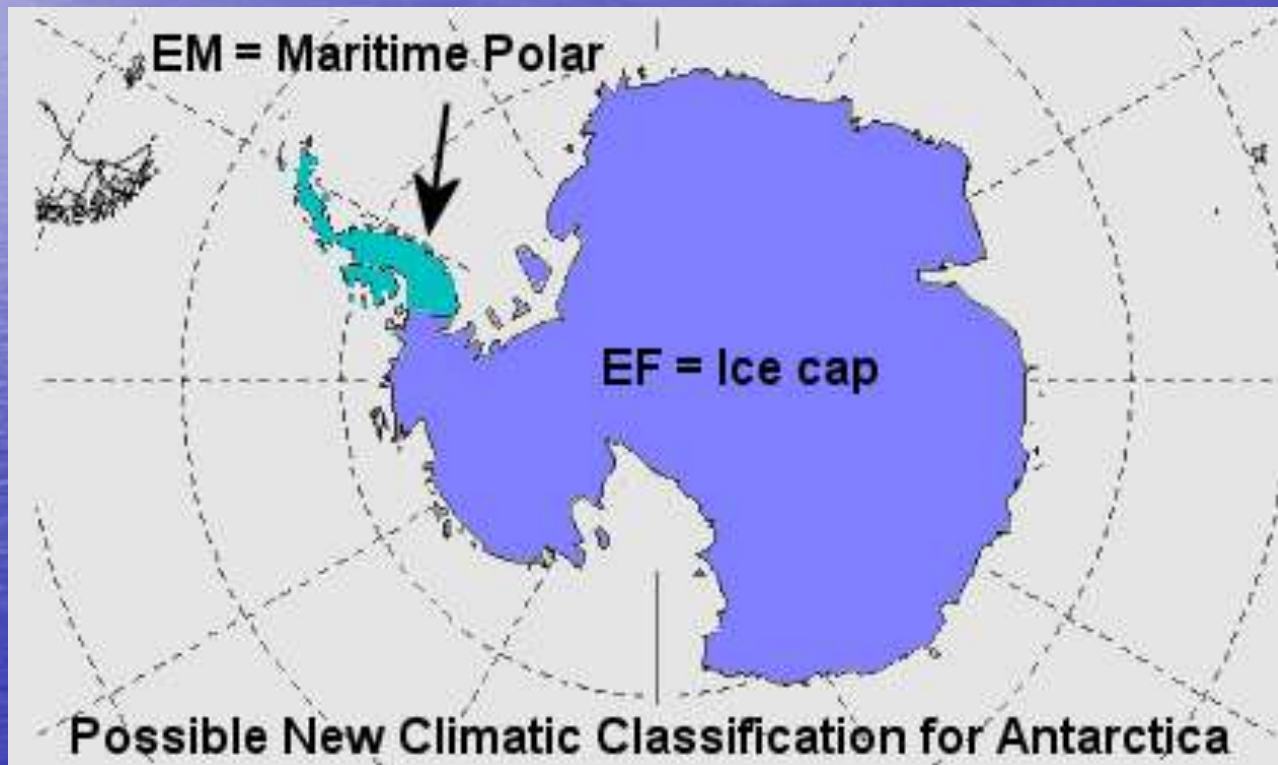




## More pictures of the McMurdo Deglaciating or dry glacial valleys



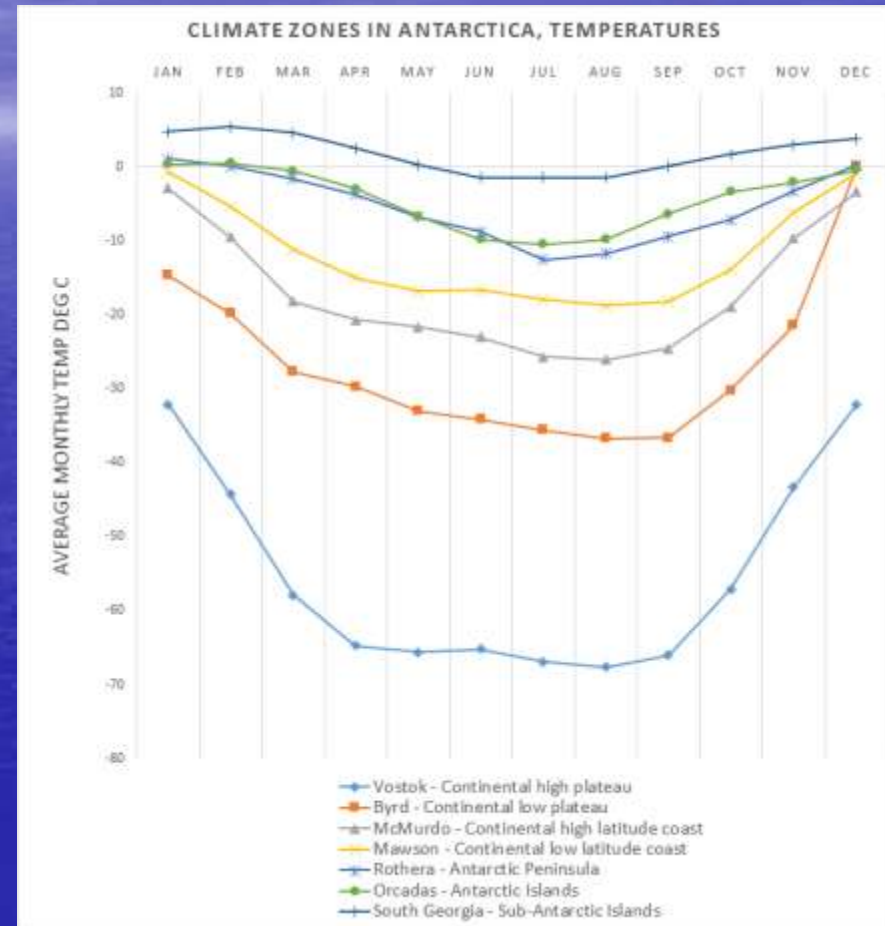
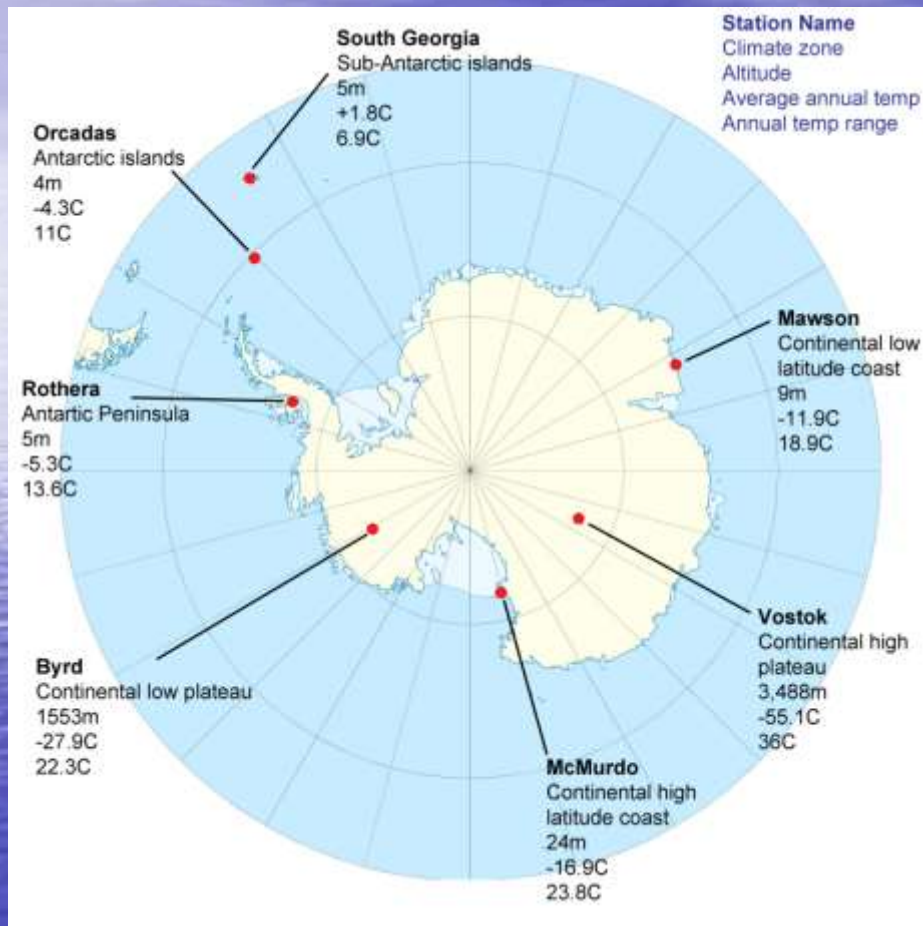
- Classification wise most of the continent is Ice Cap Climate (EF) 冰帽氣候 with average temperature never exceed 0 degree C whereas the coastal areas is classified as Tundra Climate (ET) 苔原氣候 with a very short summer with average temperature above freezing. Some scientists now proposed that the Antarctic Peninsular should be classified as Maritime Polar (EM) 極地海洋氣候 as it is cool & moist due to the extensive ocean influence.



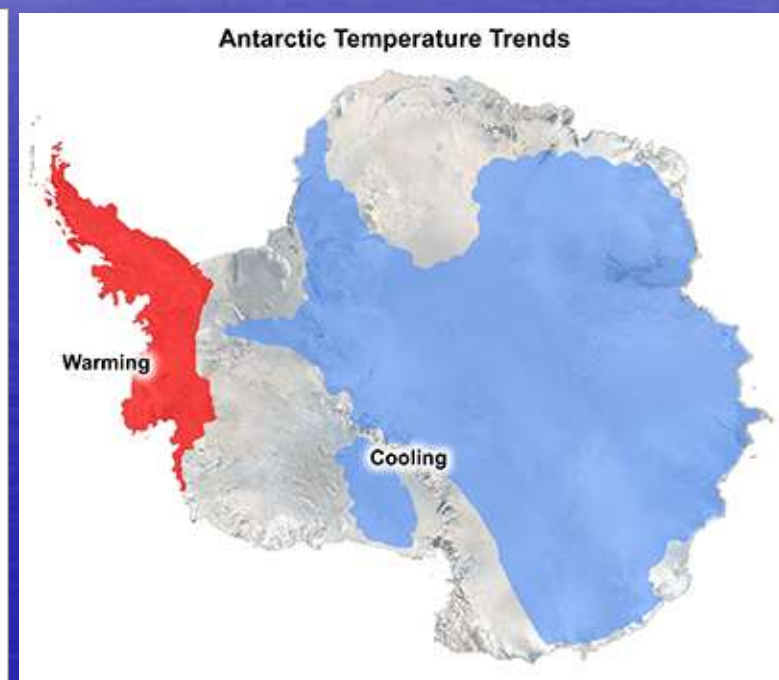
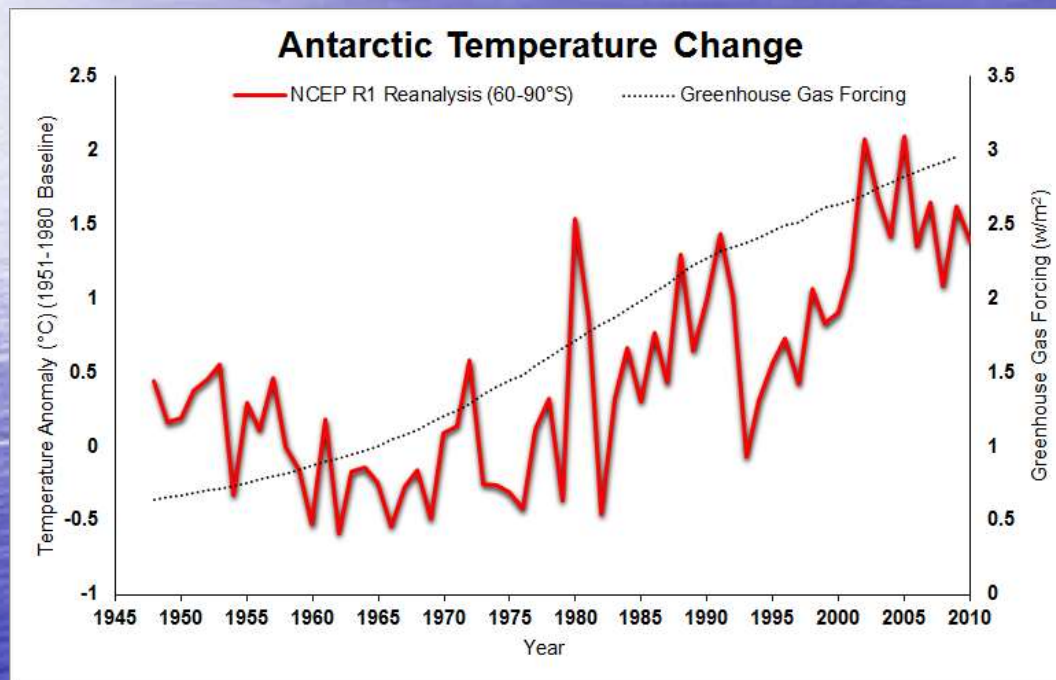
( **E** stands for Polar climate with extremely cold winter & summer  
Koppen Climate classification system)



# Climate Zones of Antarctica

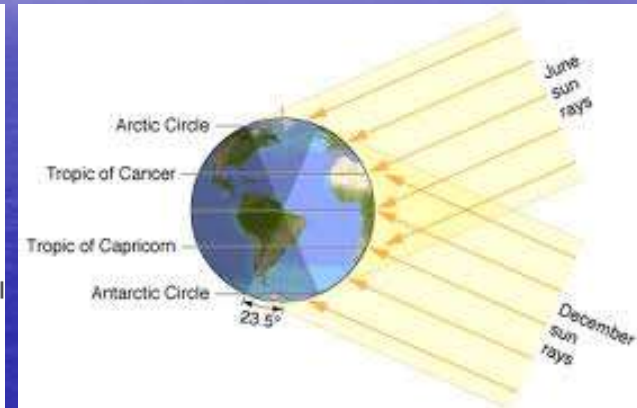
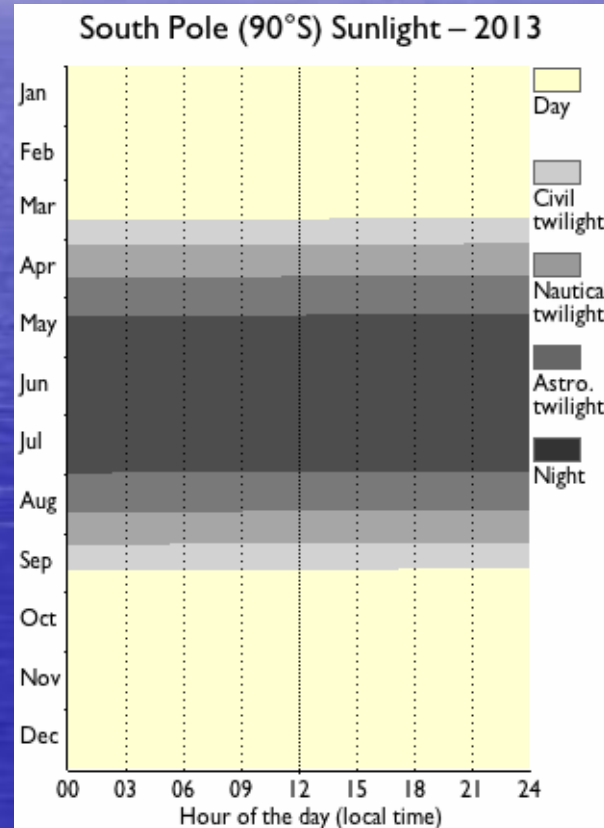


- Antarctica has a very volatile climate record. Its average temperature has risen by 2.5 C in the last 50 years due to global warming !





- Seasons : Southern Winter is from March to Sept when there is no sunlight. Southern Summer is from Sept to March when the sun is continuously above the horizon & appears to move in an anticlockwise direction. The short summer months are critical to Antarctica wildlife to feed & breed in order to survive & thrive



## The bedazzling Midnight Sun in Antarctica 1





## The bedazzling Midnight Sun in Antarctica 2



## The bedazzling Midnight Sun in Antarctica 3





## The bedazzling Midnight Sun in Antarctica 4



- \*Lenticular or Wave Clouds ( altocumulus lenticularis ) 筭狀雲

Looking like almonds and even space ships they are formed when air saturated in separate layers combined with turbulence in the lee of the mountains

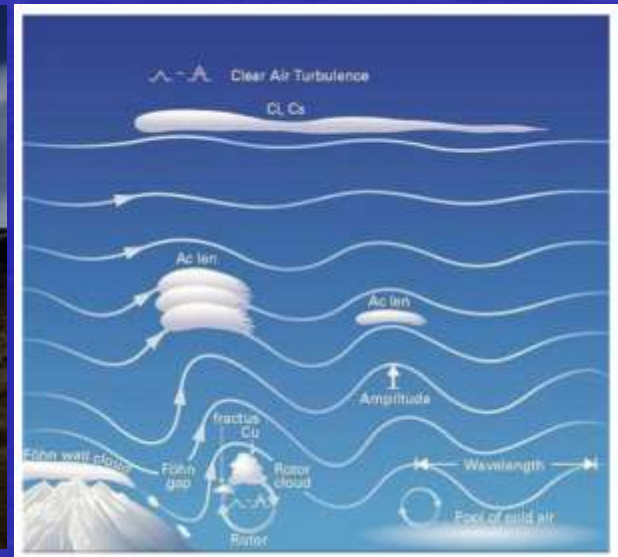




Photo of Wave Clouds taken near Hercules Bay South Georgia



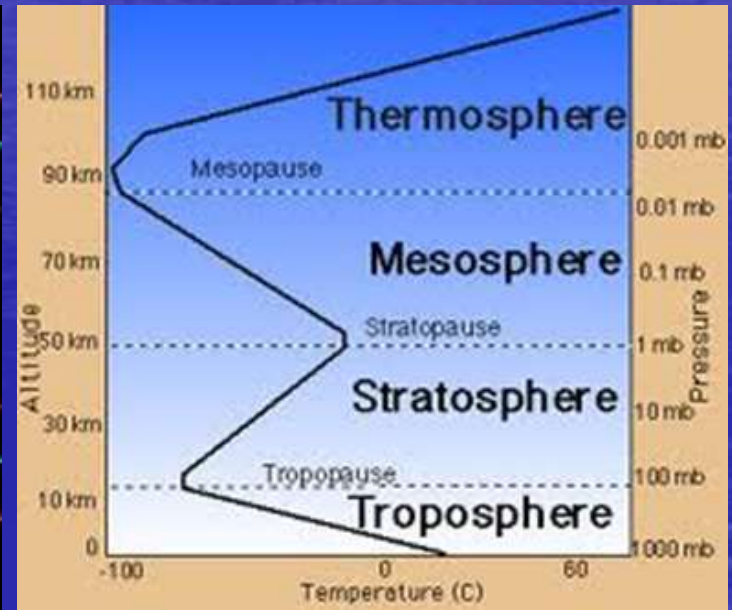
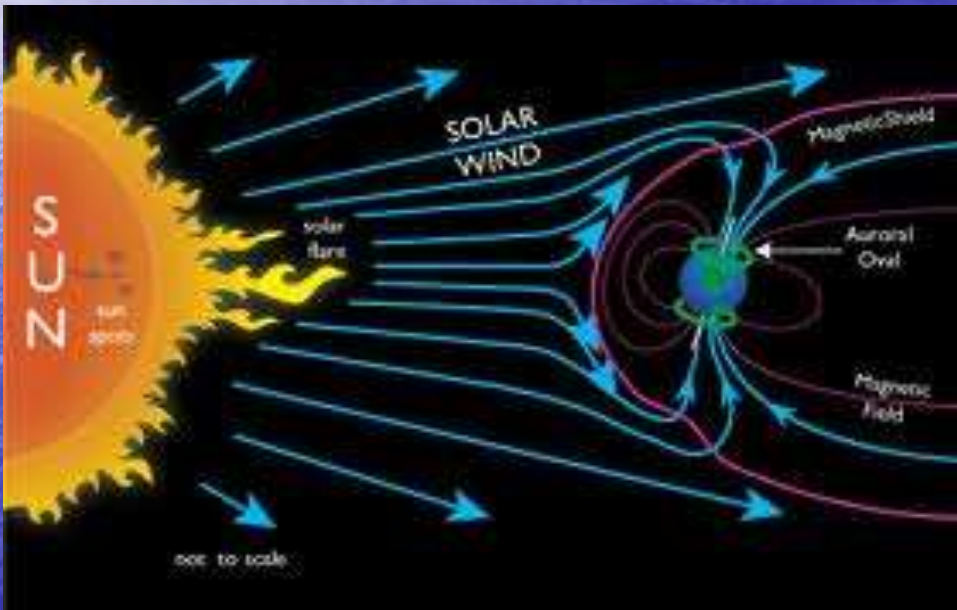
A photograph of a vast, deep blue ocean under a bright blue sky with wispy white clouds. A bright, horizontal line of light, likely the sun's reflection, stretches across the horizon. The word "AURORA" is centered in the middle of the image in a white, bold, sans-serif font with a subtle drop shadow.

**AURORA**

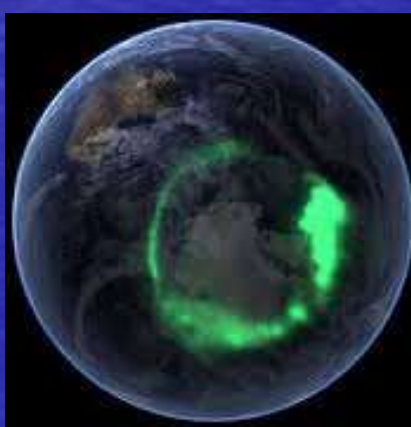


## Aurora Australis or Southern Lights 南極光

The Earth's solid inner core & liquid outer core together with its own rotation work like a dynamo creating a strong magnetic field which serves as a protective shield against solar wind. Aurora australis occurred when charged particles of proton & electron carried by the Solar Wind enter the Earth's Thermosphere. Green color appears when they collided with oxygen. Red & purple occurred when collided with nitrogen & are more rare



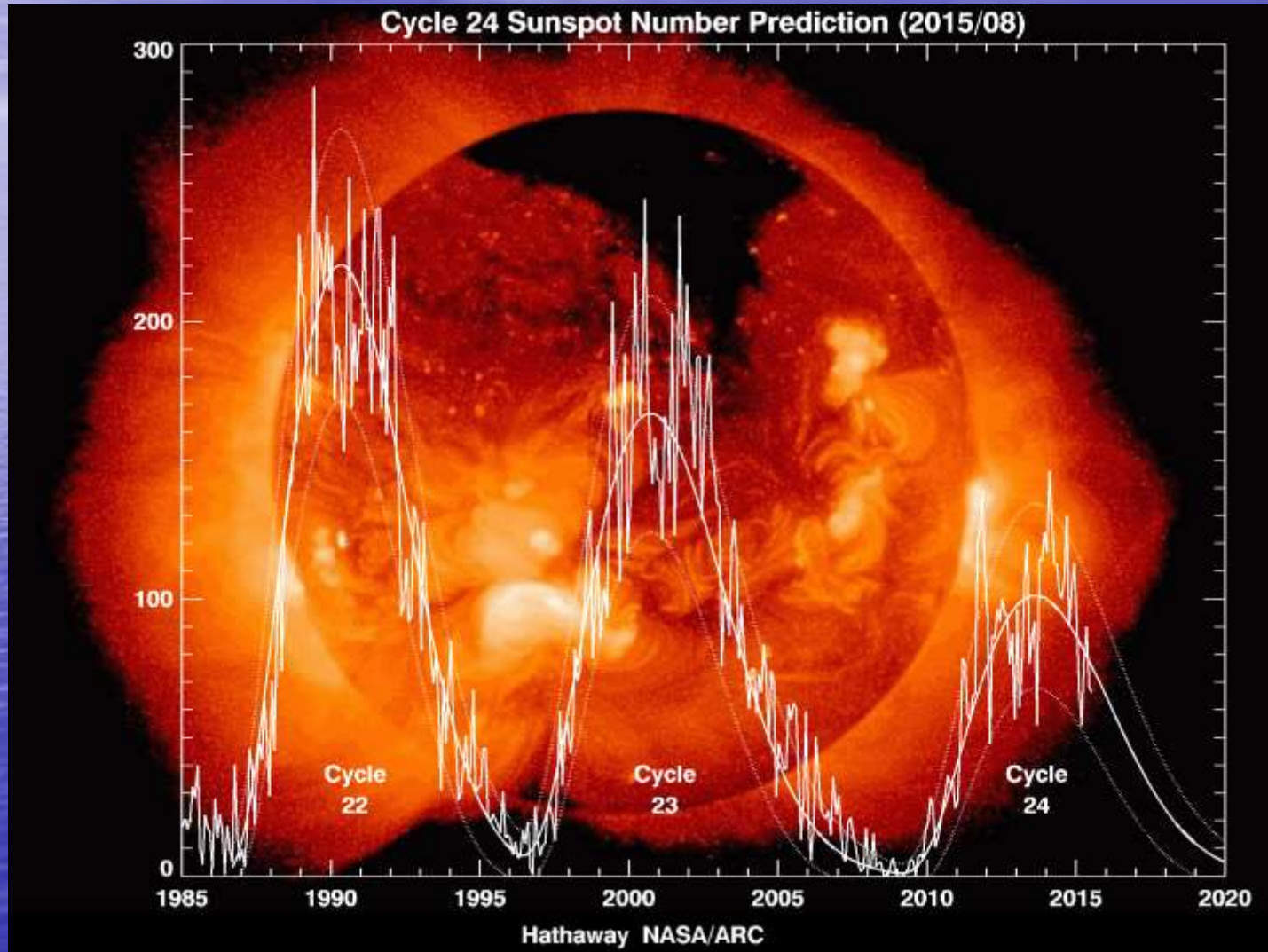
Aurora is the name for the "Goddess of Dawn" in Roman mythology . Can be of curtain shape or appears as pulse aurora. The North & the South Lights occur simultaneously & are almost identical mirror images of each other appearing between latitude 65 to 80S known as the aurora oval 極光卵形帶





# 11 Years Solar cycle

2015 is a weak year & at a down cycle



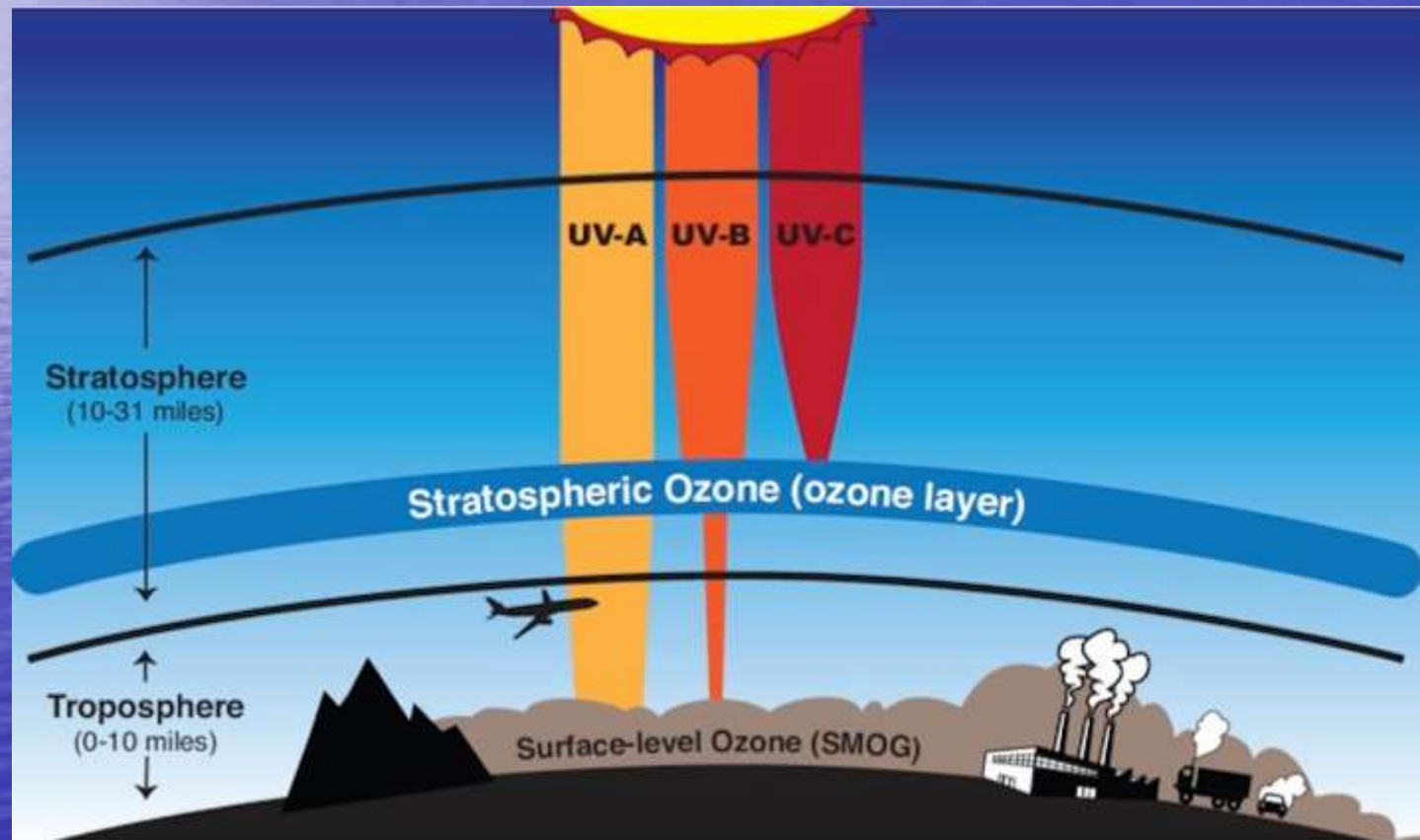


# THE OZON HOLE

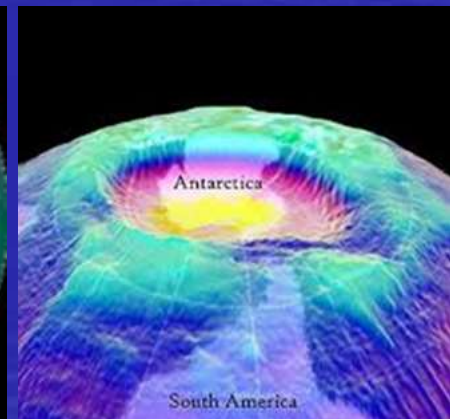
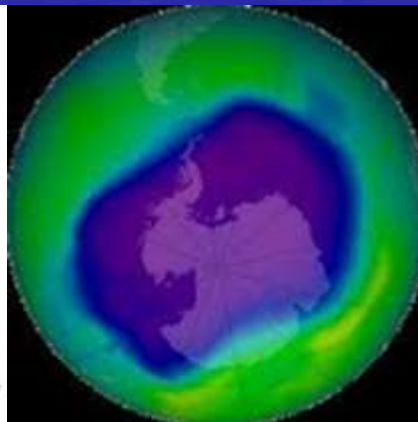
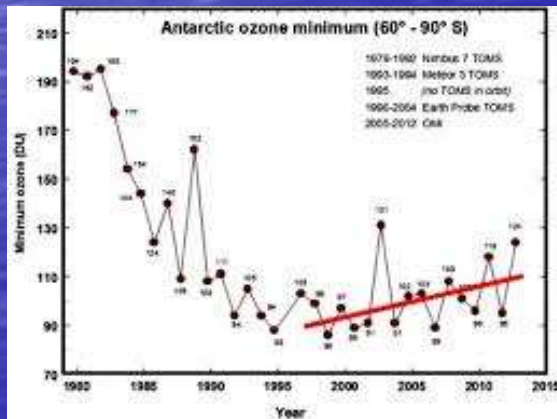
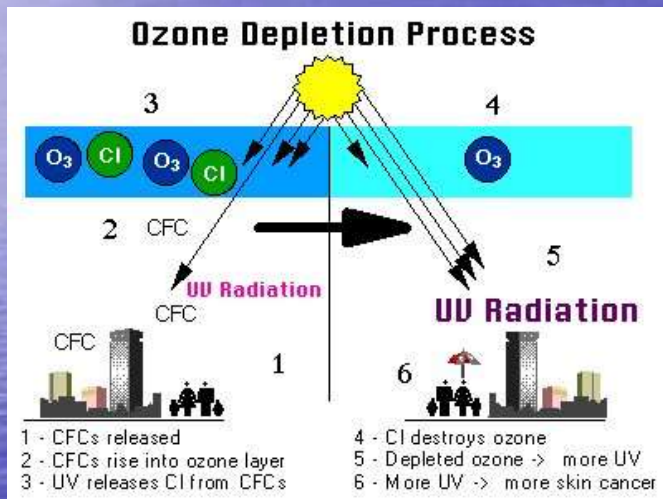


# Ozone Hole 臭氧層/臭氧洞

- Ultra violet rays from the sun breaks down the atmosphere's oxygen naturally into ozone (O<sub>3</sub>) 三價氧 which forms a layer some 10-30 km above the Earth's surface & in turn protecting it from the Sun's live damaging Ultra violet radiation ( UV-B & UV-C) which can cause skin cancer



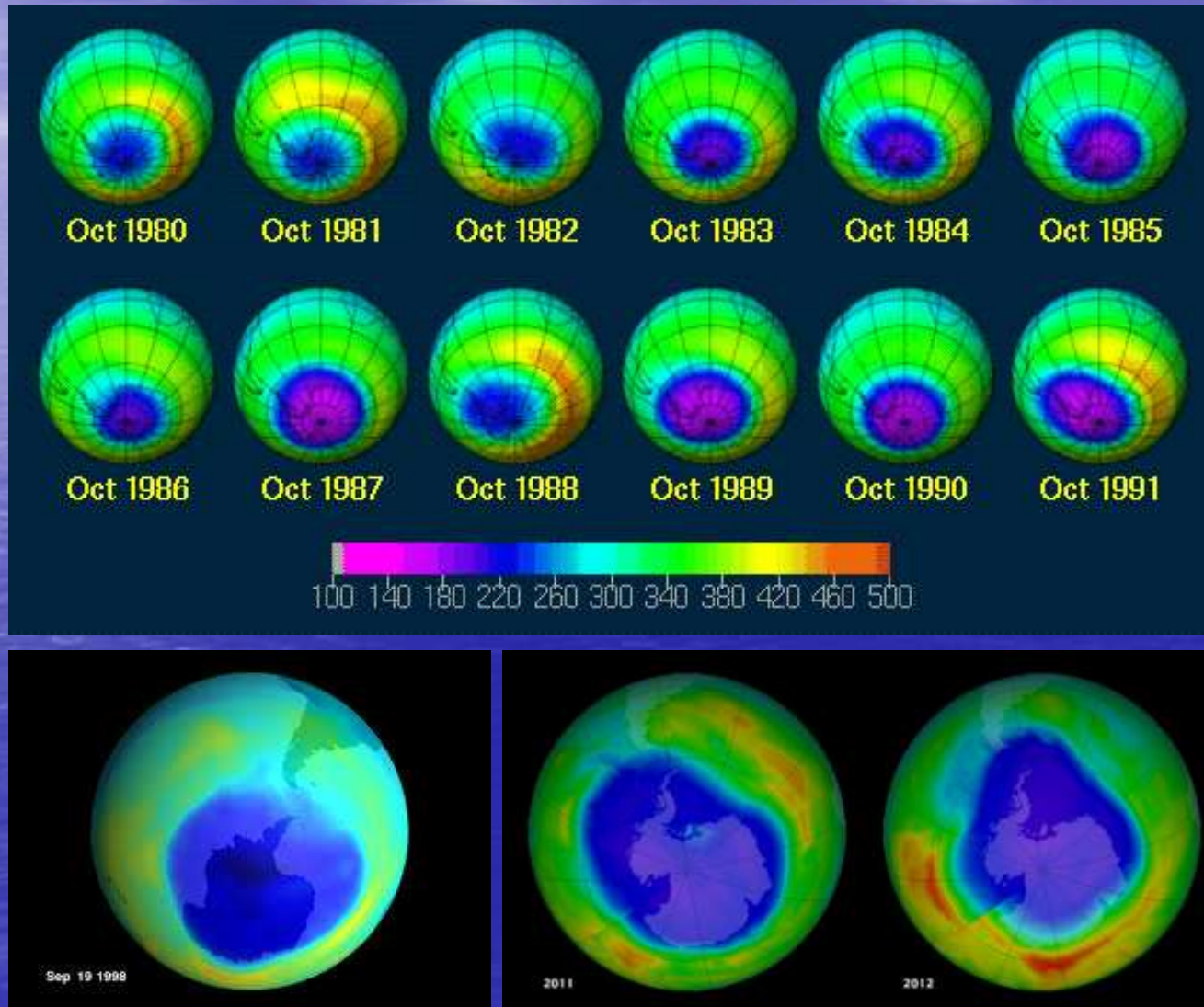
- A 30-50% reduction was discovered above the South pole during the 80s forming a Hole between August & November each year. It is largely due to the emission of ozone depletion substances such as CFCs 氟氯化炭 (chlorine, fluorine & carbon), HCFCs (R22), freons & halon used as refrigerant & various kinds of foam & spray products which were banded in 1987 by the Montreal Agreement but expect recovery to the 1980 level only by 2050



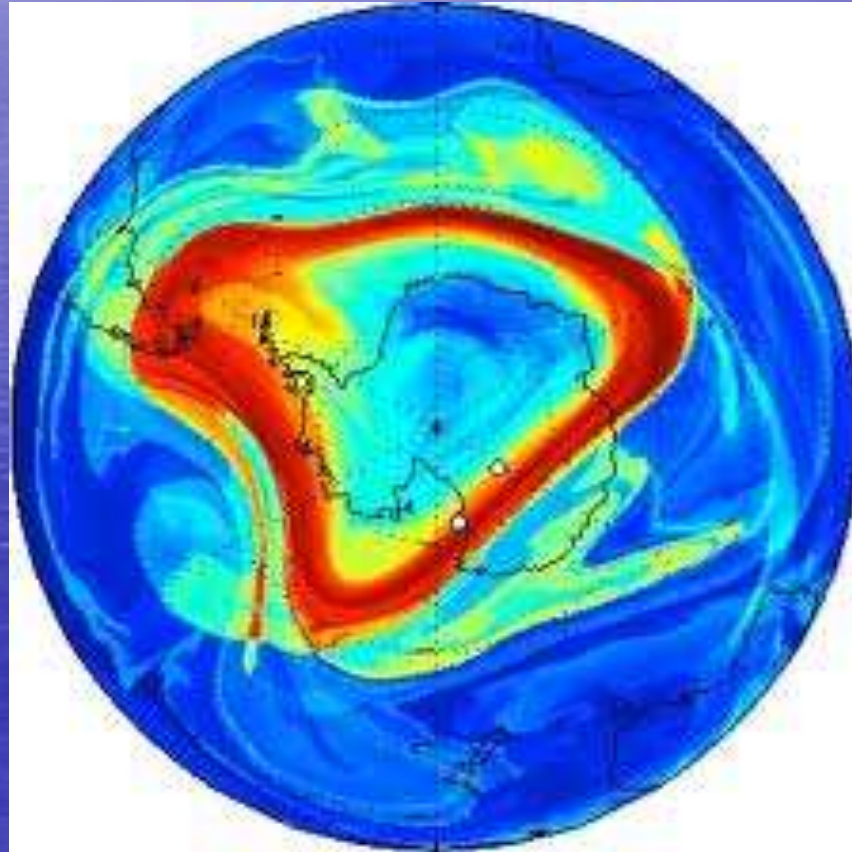


# Thickness of the Ozone Column 1980 to 2012

At 27 m KM2, the hole was the largest in 1998 & stopped expanded in 2012



Ozone depletion over Antarctica can cause a cooling of around 6 C in the lower stratosphere. The cooling has the effect of intensifying the westerly winds flowing around in the Antarctica Polar Vortex by 15% thus further prevent the outflow of the cold air near the South Pole. As a result apart from the Antarctic Peninsula there is very little change in temperature & snowfall for the last 30 years





# GEOLOGY



- Geologically 250 Ma the continent was part of Gondwana which was itself the southern portion of the Super Continent Pangaea . It finally broke away around 100 Ma by plate tectonic & Antarctica as we know today was formed around 35 Ma. The continent is actually still drifting at about 10 mm per year towards the west !



140 million years ago



110 million years ago



50 million years ago



35 million years ago



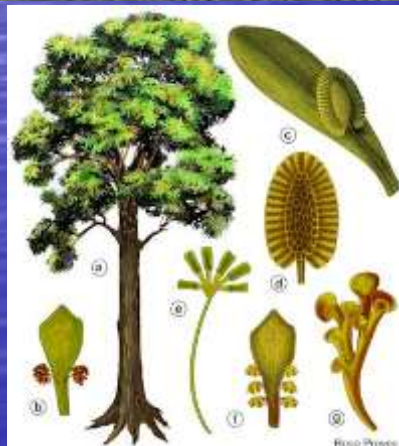
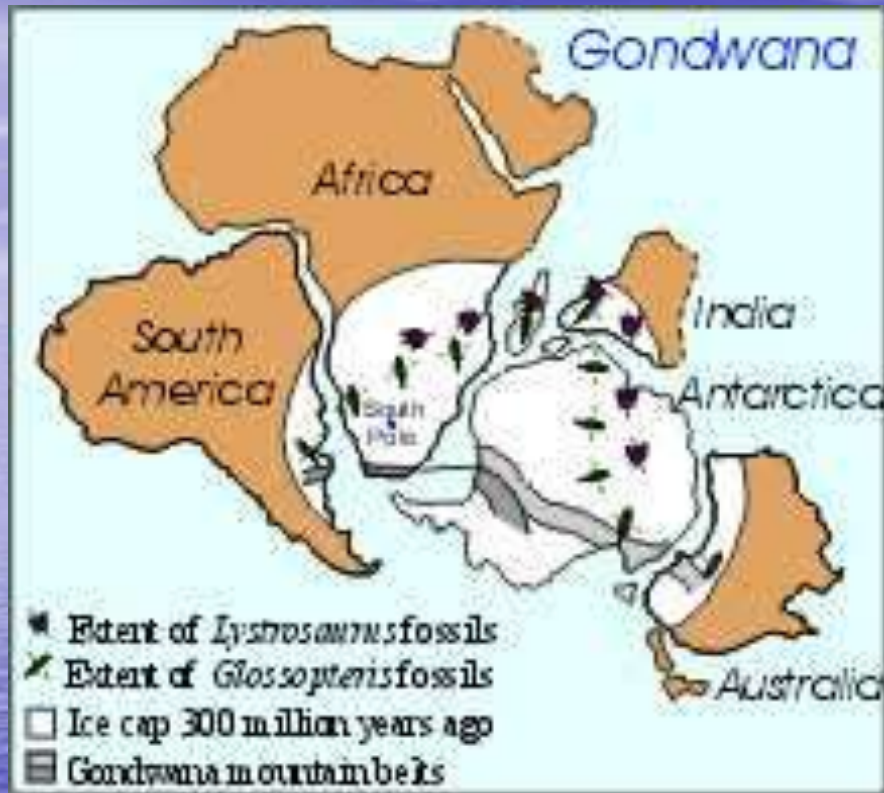
15 million years ago



Today

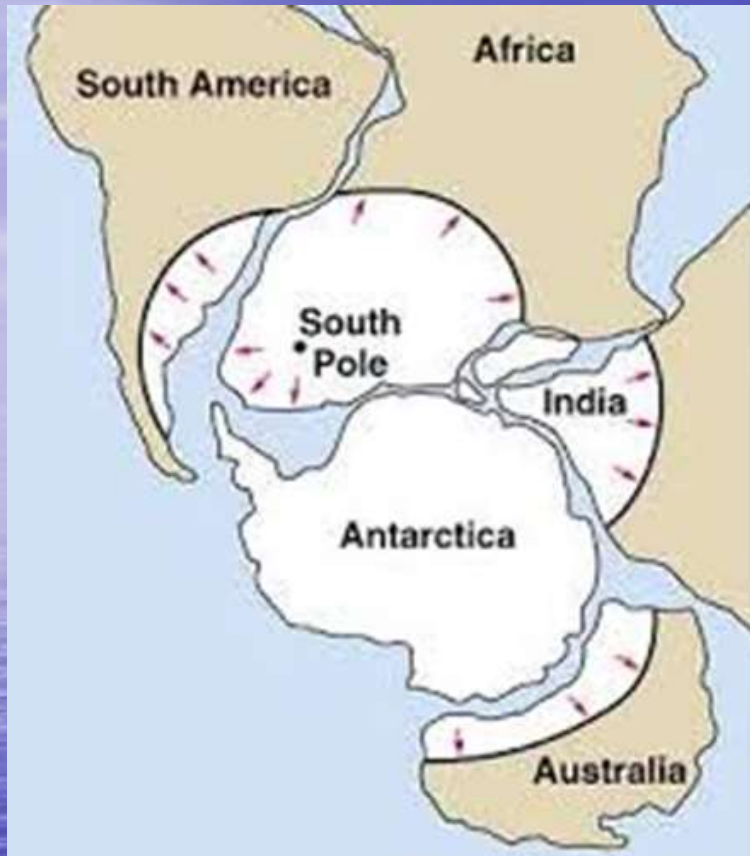


# Evidence of Plate Tectonic & breaking up of Gondwana



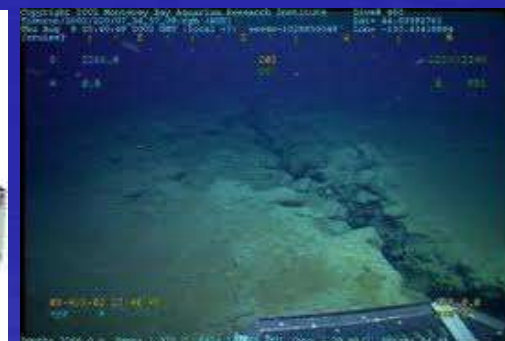
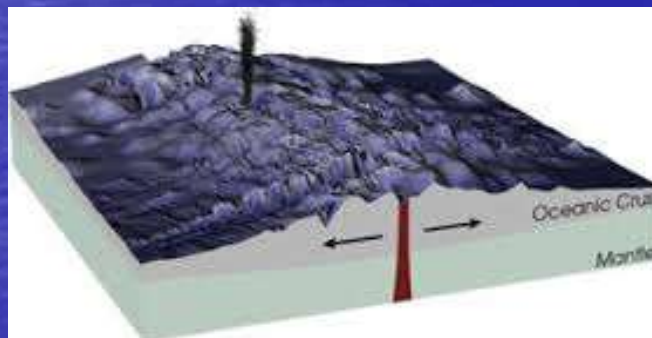
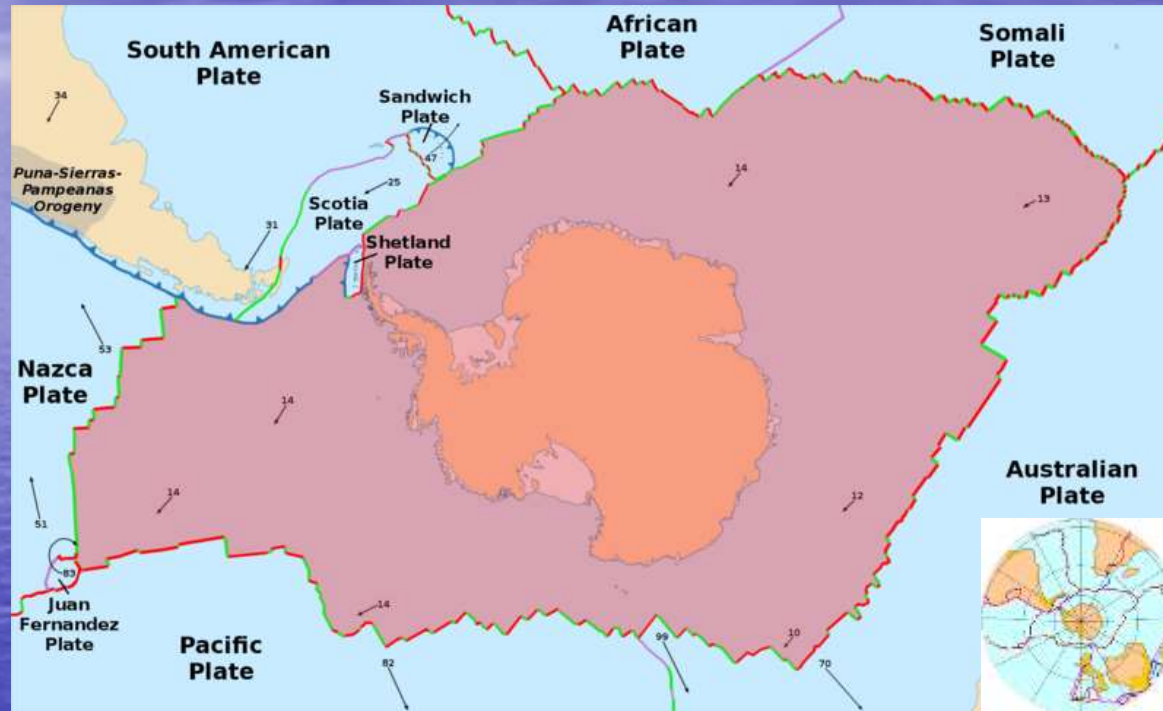


## Evidence of glaciation – moraines, striation, drop stones





- The Antarctic Plate is a tectonic plate containing the Antarctic continent & extending outward under the surrounding oceans. At 60.6 million sq. kilometer, it is the earth's 5<sup>th</sup> biggest plate which is bounded almost entirely by mid-ocean ridge systems. The plate is estimated to be moving one cm per year towards the Atlantic Ocean



- West Antarctica

Geologically closely resembles the Andes. The Antarctic Peninsula was formed by uplift & metamorphism of seabed sediment during the late Paleozoic & early Mesozoic. This uplift was accompanied with igneous intrusion & volcanism. The most common rocks are andesite 安山岩 & rhyolite 流紋岩 formed during the Jurassic

- East Antarctica

Is geologically very old dating from the Precambrian with some rocks older than 3.8 billion years. It is composed of a metamorphic & igneous platform or \*Craton 陸台/克拉通 which is the basis of the continental shield 地盾. On top of this granitic gneisses are modern rocks such as sandstone, limestone, shale & coal laid down during the Devonian to Jurassic to form the Transantarctic Mountain

### Transantarctic Mountains (TAM)

Formed 65 Ma during the opening of the West Antarctic Rift. Consist of sedimentary layers lying upon a basement of granites & gneisses and intruded by dikes and sills

( \* A craton 克拉通/陸台 is an old & stable part of the continental lithosphere having survived cycles of merging & rifting )



- Antarctic rock : Garnet gneiss 石榴石片麻岩 formed at depth of 20km at formation of 700C. Active tectonic movements subsequently exposed them on the Earth's surface and subject to intense weathering

( Jockey Club Climate Change Museum CUHK Shatin)





- The West Antarctic Rift System 西南極裂谷 : lying between West & East Antarctica it was formed 90 Ma (Cretaceous) & is still very active moving away from the East Antarctic craton on a NNE direction at 2 mm per year ( approximately the direction of South Georgia ) & also responsible for all the recent volcanic activities within Antarctica



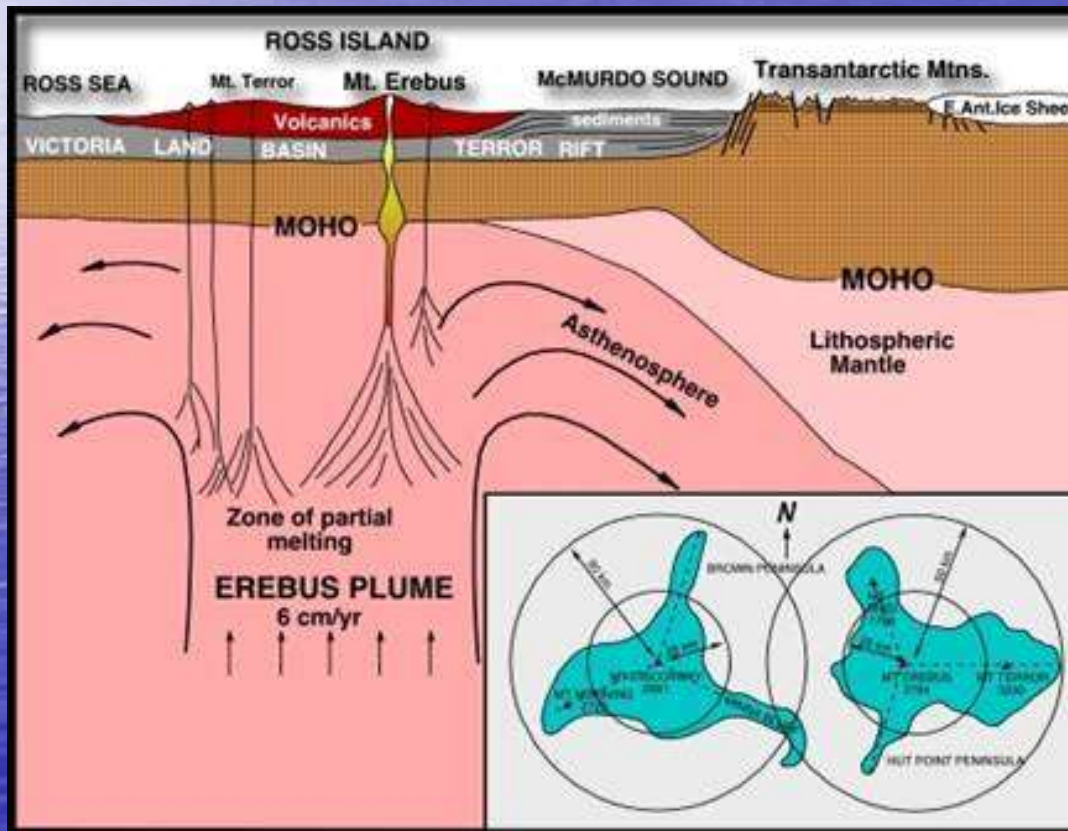


# Volcanic activities

- At one time there were as many as 70 volcanos but now only 36 left and they are located mainly along the west coast with many being subglacial. Only a few have recently exploded. Famous ones include Mt. Erebus (3,794m), Mt. Melbourne, Mt. Terror & Mt. Berlin. Seismic activity in the continent is rare & weak with Mt. Melbourne being the only recently active one on the mainland

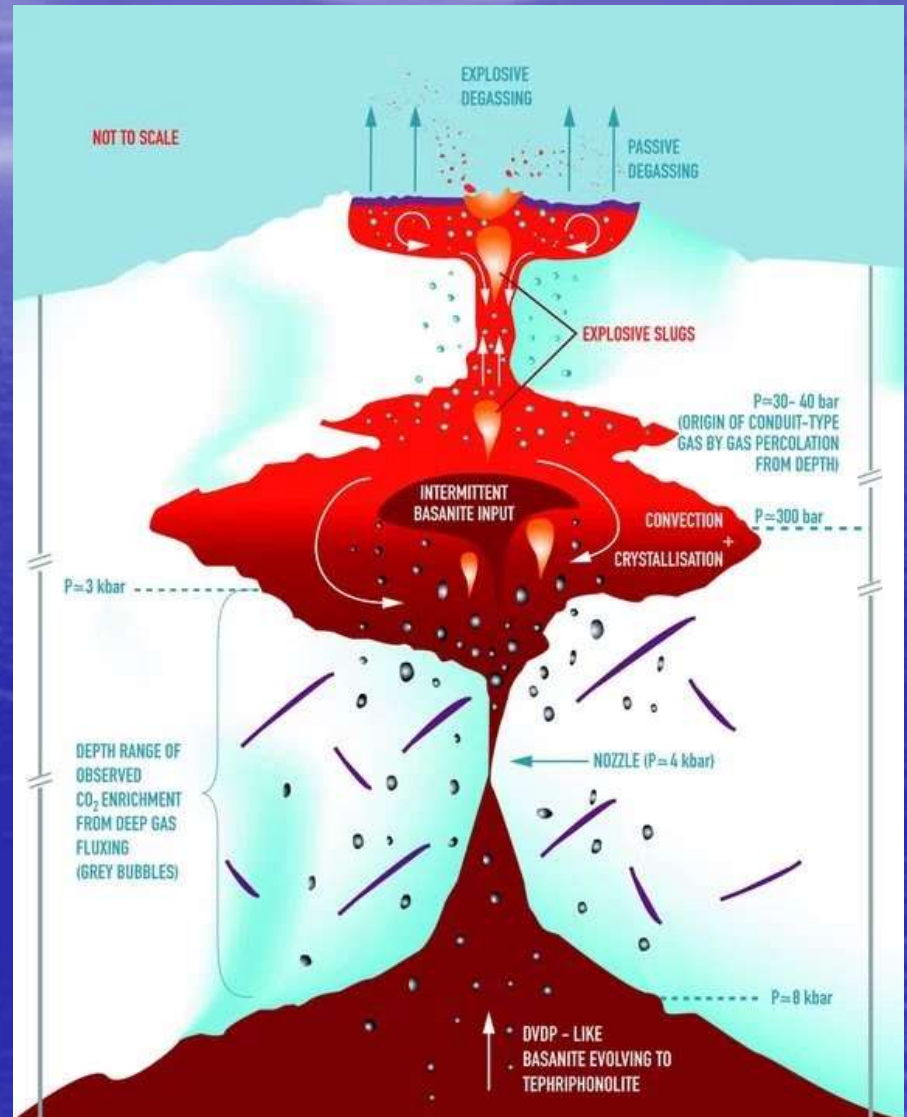


- Mt. Erebus : located on Ross Island is the world's most southerly active volcano & the largest in Antarctica. At 3,794 m it last erupted in 2010 ejecting large quantity of volcanic bombs from its lava lake in its summit crater. Having the bottom half being a shield volcano and the top half a stratocone, it is classified as a polygenetic stratovolcano. Note the "Tower of Ice" 火山煙囪 formed by steam emerges from a vent





The lava lake at Mount Erebus is one of only four found on earth



## Geological Milestone & fossils

- 540 Ma Cambrian 寒武纪 W. Antarctica located in the north hemisphere. E. Antarctica at the equator
- 416 Ma Devonian 泥盤纪 more southerly location and much cooler
- 299 Ma Permian 二叠纪 dominated by seed plants like Glossopteris 舌羊齒 which later became coal
- 250 Ma Mesozoic dinosaurs lived
- 100 Ma vast forest cover largely ferns & conifers
- 96 Ma Split with Australia & New Zealand
- 70 Ma enjoyed semi tropical climate while continuously drifting south
- 60 Ma Antarctica developed a cool temperate climate
- 50 Ma Transantarctic Mountain formed by uplift
- 35 Ma whole continent covered with ice
- 23 Ma Drake Passage opened
- 12 Ma seals all over
- 2-5 Ma Ice sheets advanced & melted many times





At left an 80 million year old leaf fossil from a flowering plant. At right is a leaf mat of Southern beech *Nothofagus* 櫟木 which is 3 million years old. The one on lower left is coal deposit. Next to it is a leaf from a tropical plant





# Antarctic dinosaurs

- Early Triassic : dominated by synapsid e.g. 水龍獸 *Lystrosaurus*, also found in South Africa, evidence of the Continental drift theory



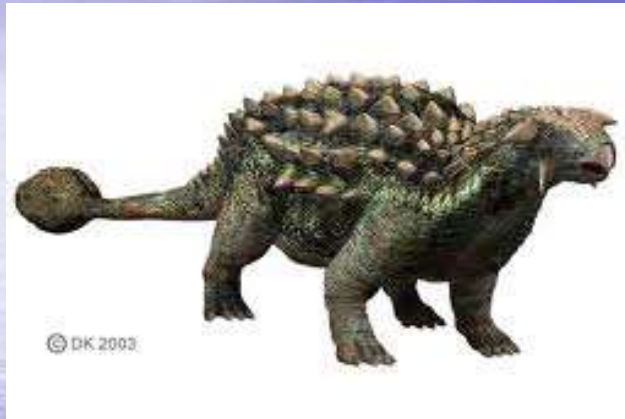
- Middle Triassic : *Cynognathus*



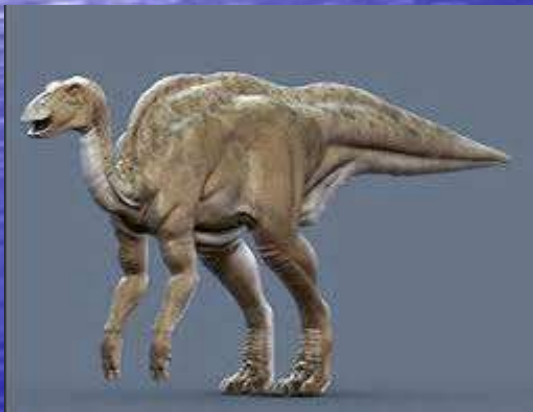


- Early Cretaceous (145 -100 Mya) : the appearance of “true dinosaurs”

Ankylosaurus 甲龍



Hadrosaurus 鴨嘴龍



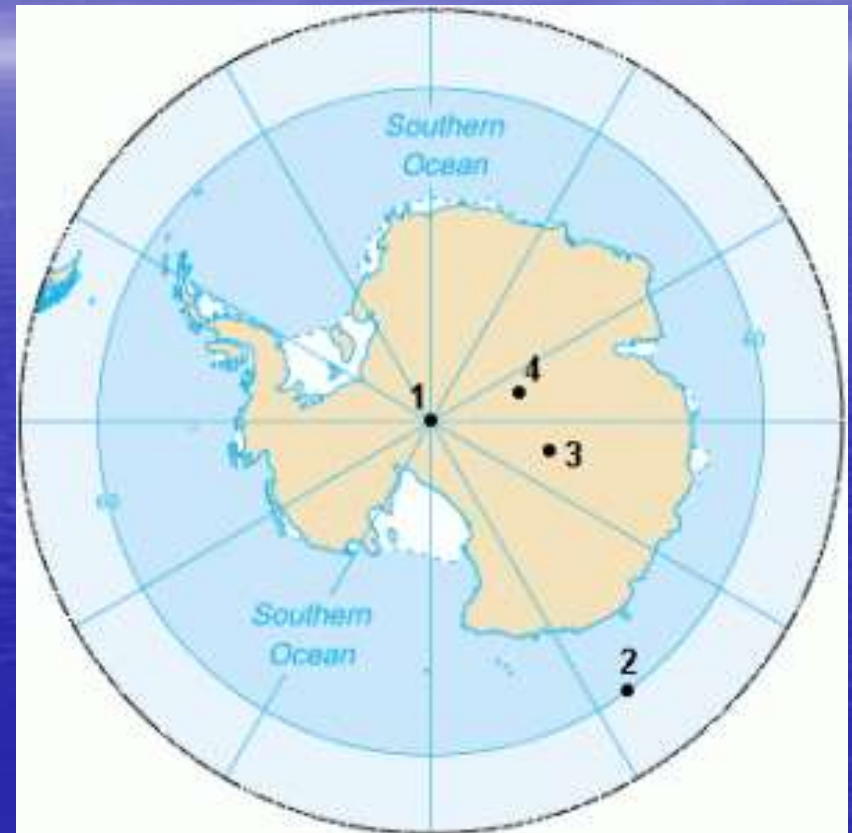
- Jurassic : *Cryolophosaurus ellioti* ("frozen crest reptile") 冰脊龍 : a carnivorous dinosaur which was unique to Antarctica, length 7 m weigh 460 kilogram





## Which “South Pole” ? 六極點

- 1. South Geographical Pole
- 2. South Magnetic Pole
- 3. South Geomagnetic Pole
- 4. South Pole of Inaccessibility
- 5. Ceremonial South Pole
- 6. The Pole of Cold



- 1. South Geographical Pole 南極點 or Terrestrial South Pole : is one of the 2 points where the Earth's axis of rotation intersects its surface which is at 90 S 0 W. The marker needs to be adjusted each year as it is located on a glacier which is moving 10 km per year towards 43 W. It is also the site of USA's Amundsen-Scott South Pole Station which is on top of 2,835 m of snow



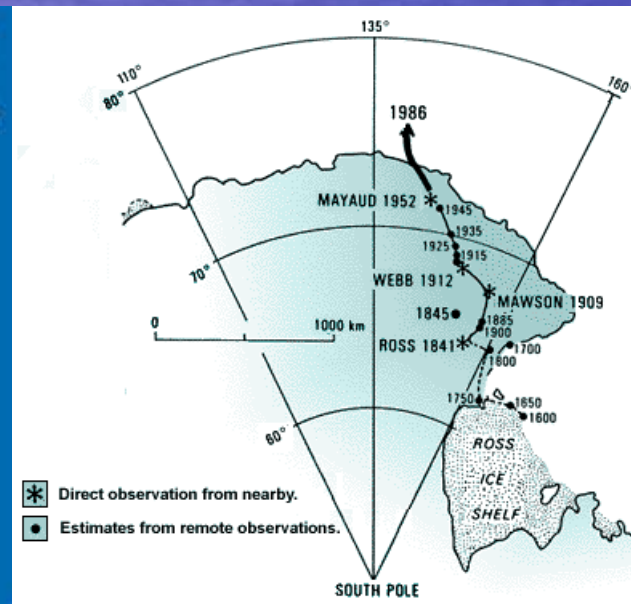
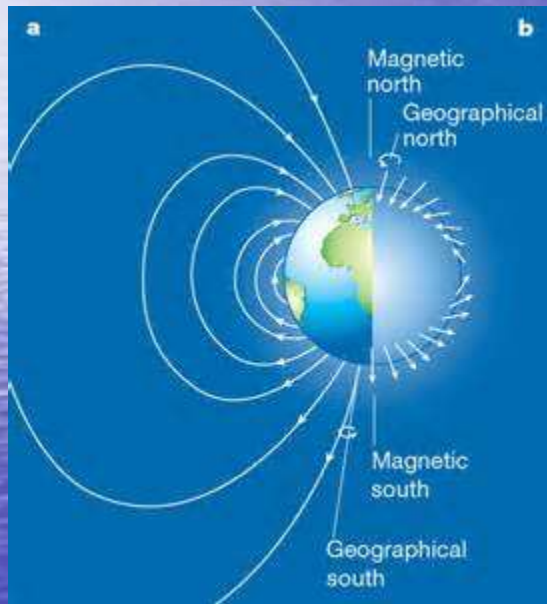
Apparent wandering of the geographic South Pole in the last 65 million years.



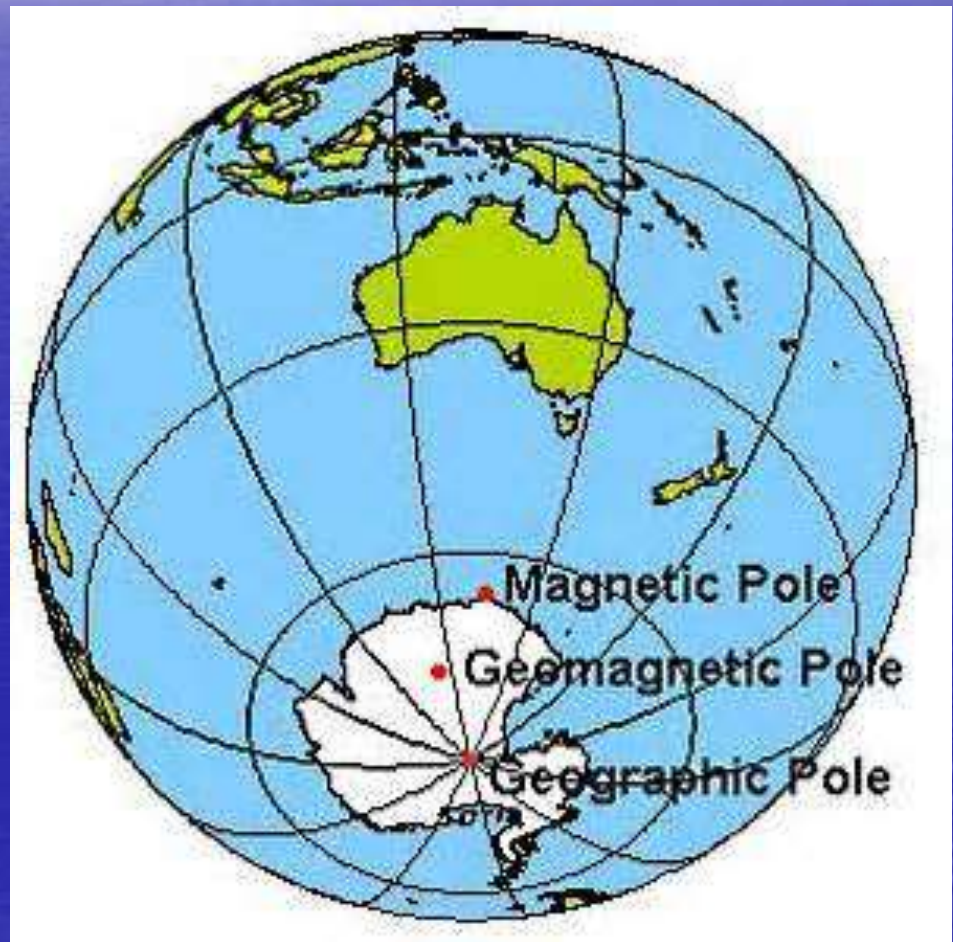
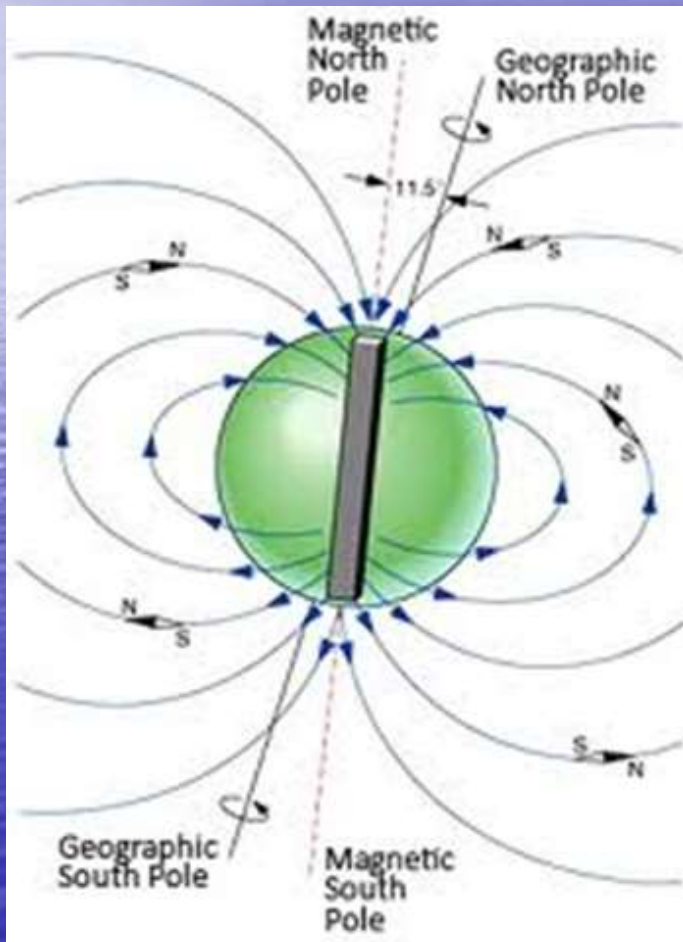
Wegener proposed that the poles remained fixed and that the continents moved over time.



- 2. South Magnetic Pole 南磁極 : is where the magnetic field lines are oriented vertically & come out of the surface of the Earth. It is constantly shifting due to changes in the earth's magnetic field. At 2015 it is located at 64.28S 136.59E approximately 1,800 miles from the Geographical South Pole



- 3. South Geomagnetic Pole 南磁軸極 : At 78 30'S & 111E it is one of the two points of intersection of the surface of the Earth's extended axis of a magnetic dipole 雙極磁場 which is assumed to be located at the center of the Earth & approximates the source of the Earth's magnetic field





- 4. South Pole of Inaccessibility 難抵極 : is the furthest point from any Antarctic coast. At 3,718 m high it is located at 83 S & 55 E approximately 870 km from the geographical South Pole & was first reached by the Russians in 1958



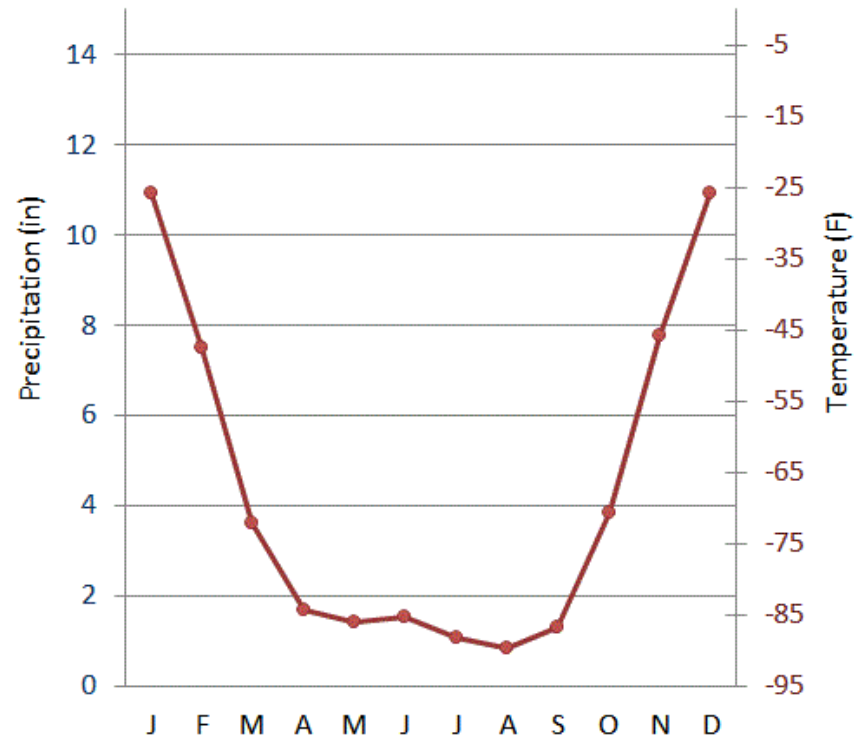
- 5. Ceremonial South Pole 禮儀南極 : it is located near the Amundsen – Scott South Pole Station



- 6. Pole of Cold 冷極 : is the place in the south hemisphere where the lowest temperature have been recorded. It is currently located at the Russian Antarctic station Vostok 東方站 at 78.28 S & 106.48 E which recorded -89.2C on July 21<sup>st</sup> 1983



## Vostok Station, Antarctica



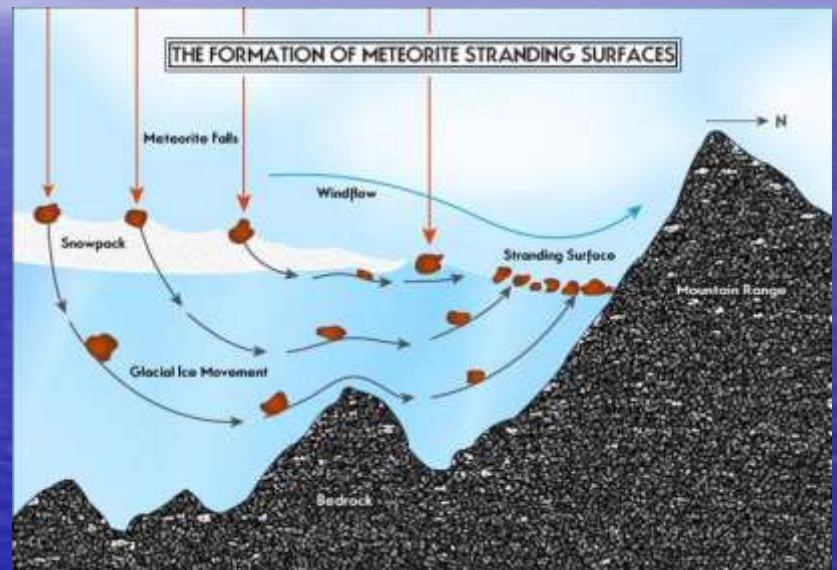
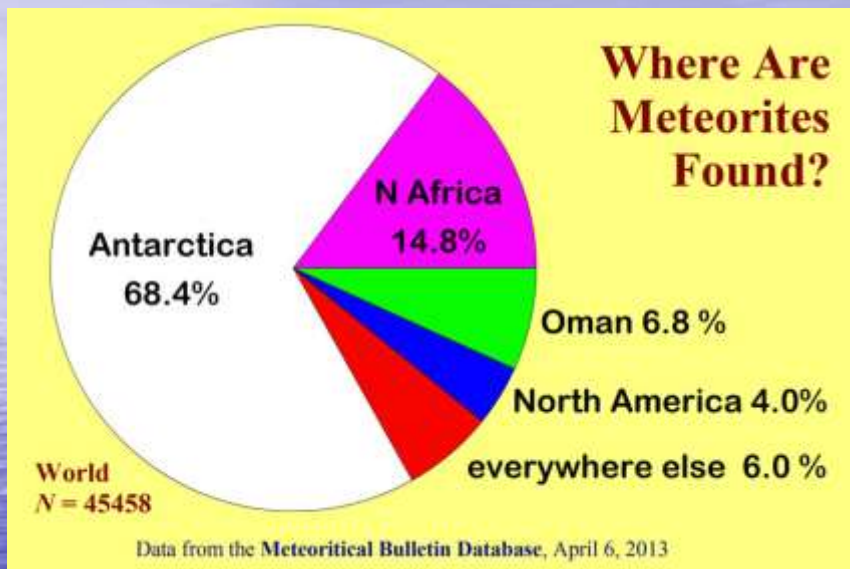
Average annual temperature: -67.1

Annual precipitation total: 0.2



# METEORITE 隕石

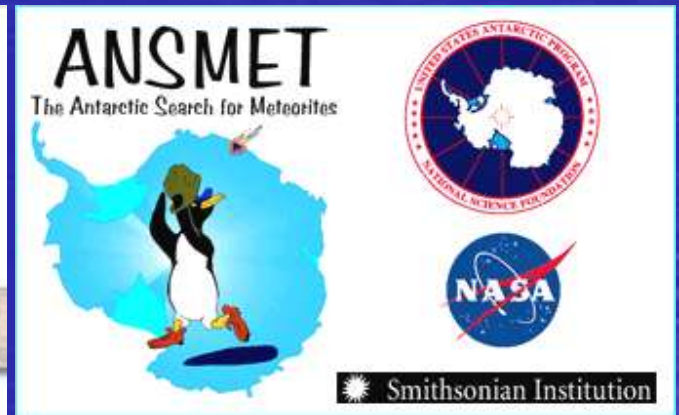
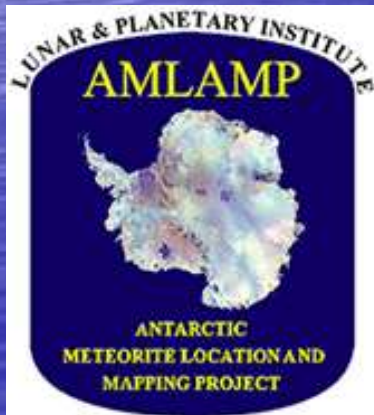
- Meteorites are most valuable for the study of the origin and structure of the universe. Up to 68.4% of all meteorites collected totaling 35,000 pieces were from Antarctica with the Japanese National Institute of Polar research (NIPR) having the largest collection totaling 16,000 pieces





# Project AMLAMP & ANSMET

Meteorite collecting in Antarctica is a major operation

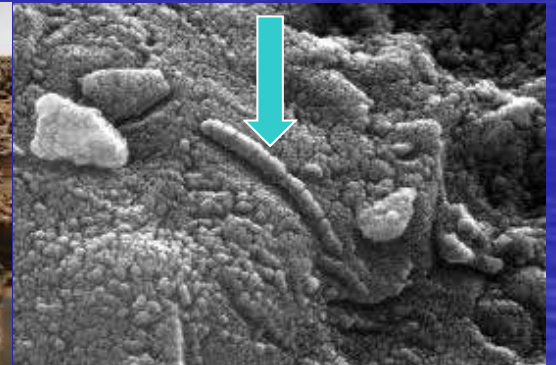




- Jan 2013 located a 18 kilo meteorite which is the 5<sup>th</sup> largest ever discovered & biggest found in 25 years



- AH84001.0 – a meteorite from the Mars surface found in Antarctica alleged to contain fossilized bacteria life form !







# KEY EXPLORATION TIMELINE

- BC : The ancient Greek philosopher Aristotle was the first to postulate the existence of a vast undiscovered southern continent, the counterpart of the lands in the northern hemisphere explored by the Greeks



- 650 AD : according to Polynesian legend an iceberg discovered after a storm in the sea near Rarotonga, northeast of New Zealand suggested the existence of Antarctica. Maori legend believed that Ui-te-Rangiora actually visited the South Ocean in the 7<sup>th</sup> Century





- 1578 : Sir Francis Drake discovered the Drake Passage



- 1642 : Dutch adventurer Abel Tasman discovered Tasmania & thought that it was the northernmost tip of Aristotle's great southern continent





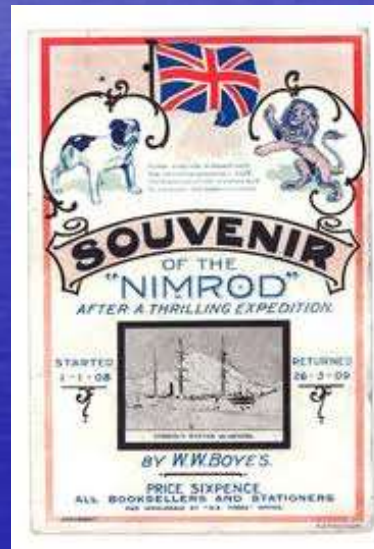
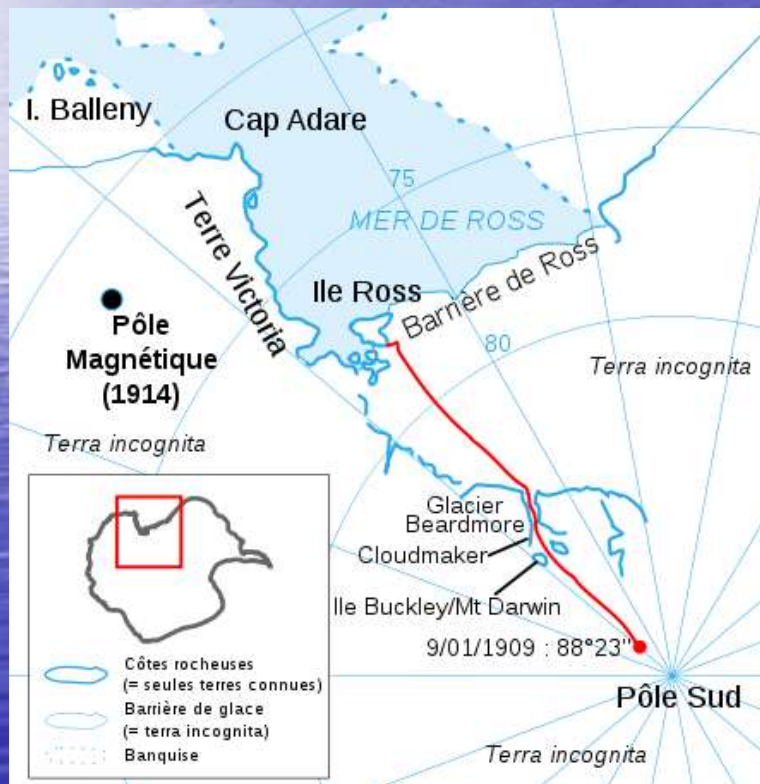
- The continent was originally to be named "Terra Australis Incognita" but this name was taken away by the present day Australia. The name Antarctica comes from "Anti - arktos" with arktos referring to the Great Bear Pointer Star at the North Pole
- 1772-75 : Captain James Cook's HMS Resolution & HMS Adventure crossed the Antarctic circle 3 times & came within 121 km of Antarctica



- 1820 : Adventurer Edward Bransfield led a British expedition & discovered Trinity Peninsula. It was the first official record of discovery of the Antarctic mainland



- 1908 : Ernest Henry Shackleton led the first winter scientific expedition to Antarctica & were the first men to scale the summit of Mount Erebus
- 1909 : Nimrod Expedition by Shackleton reached 88°23' which was only 160 km from the Pole but for the safety of the team he decided to turn back to base camp



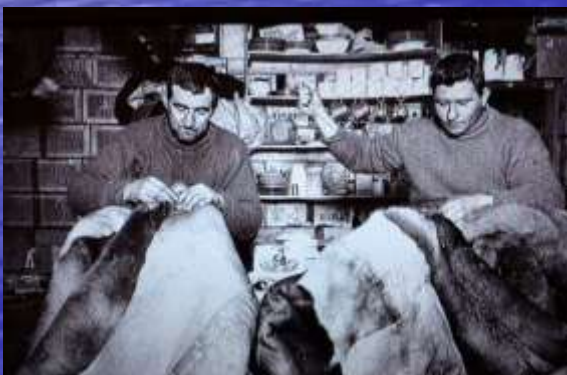
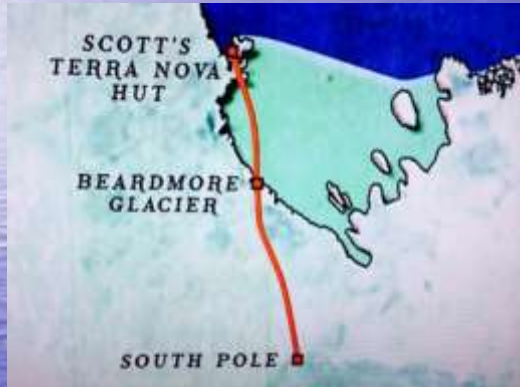


- 1911 : British explorer Captain Robert Falcon Scott lost the competition to Norwegian explorer Roald Amundsen who arrived at the geological South Pole on 14<sup>th</sup> December some 34 days earlier. Sadly Scott's 5 men team later lost their lives on the return trip





# Captain Robert Scott's expedition





## Their Equipment – rather crude in today's standard

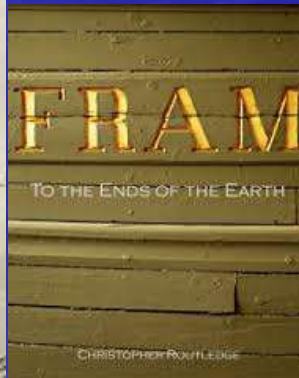




The three fresh emperor penguin eggs collected by Captain Robert Scott's last expedition to Antarctica. It was hoped that the embryo inside would confirm a link between reptiles and birds. One specimen is now being exhibited in London's Natural History Museum

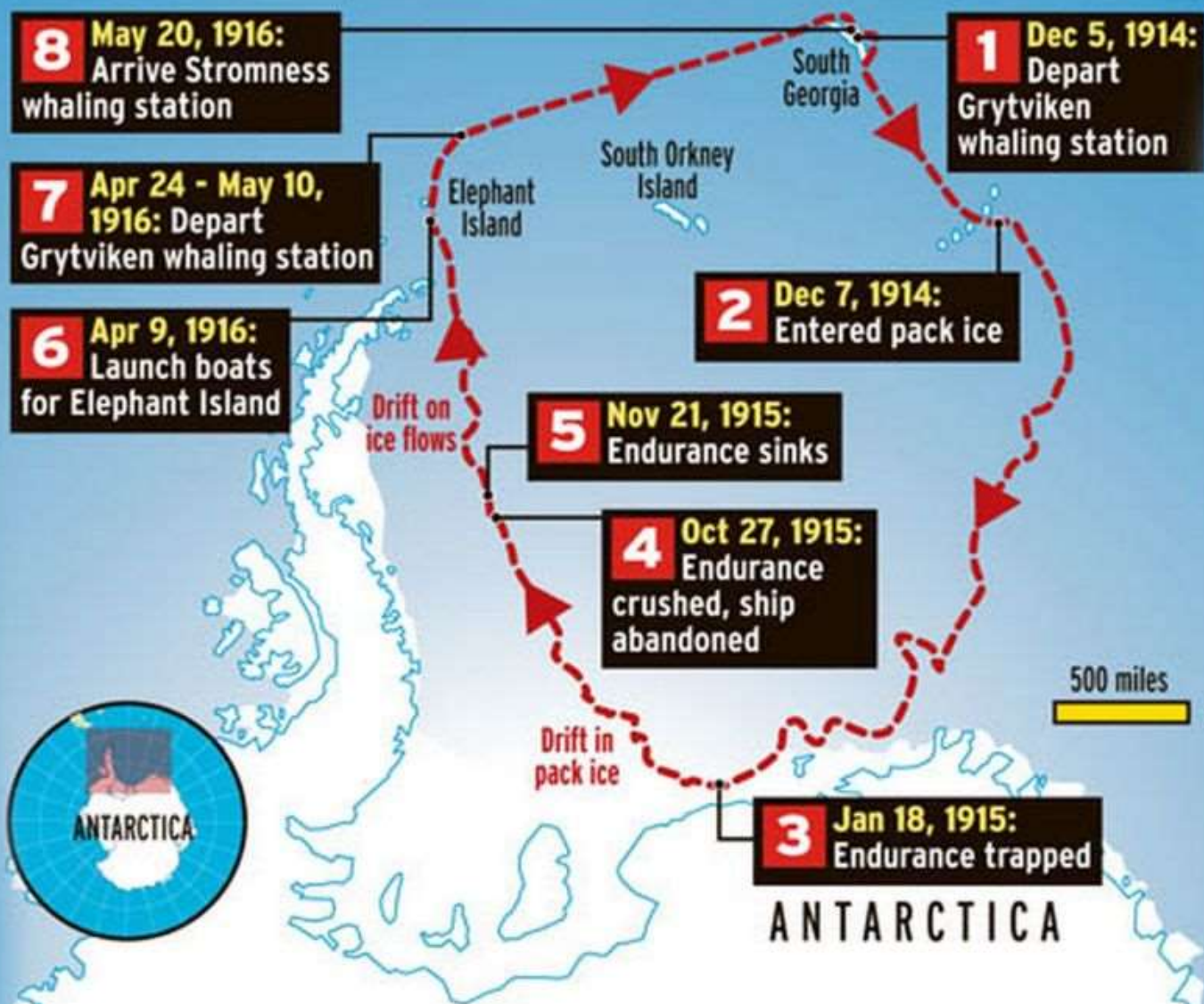


Voyage of the Fram by Amundsen. Using dogs instead of horses was a key reason for his success. See the first "FRAM"



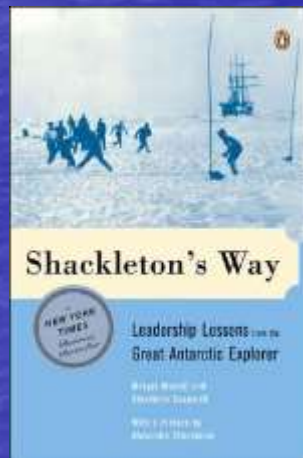
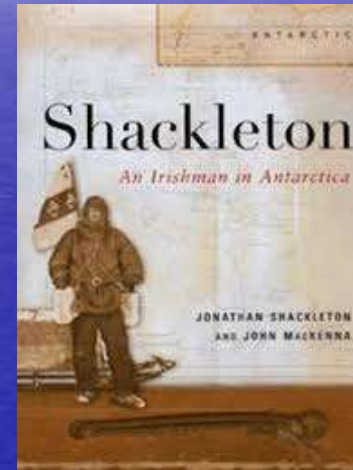






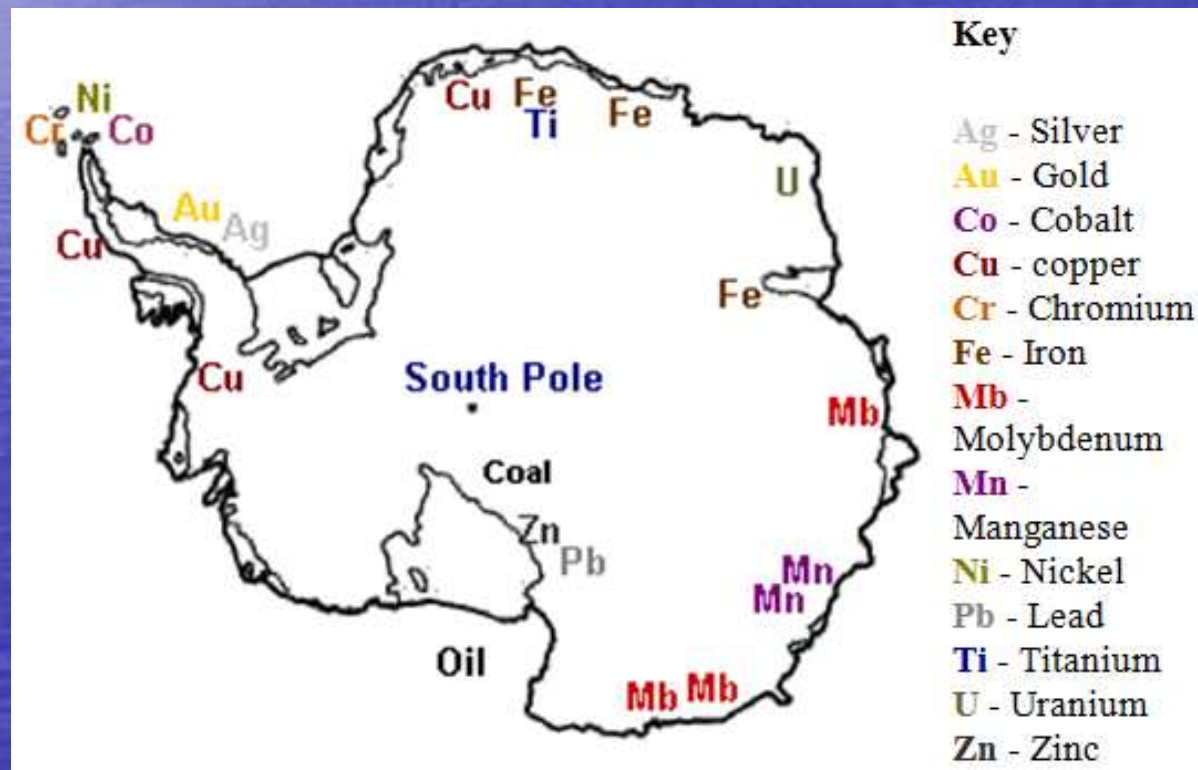


- To seek help Shackleton & his 3 men team managed to arrive at the whaling station in South Georgia after battling a stormy sea in a small life boat & climbing over the snow covered mountains. He then returned on a Chilean tug boat to pick up his stranded crew. Every one survived



## Resources & Territorial Claim

- Known minerals include iron, chromium, copper, silver, gold, nickel & platinum. 72% of the earth's fresh water is in Antarctica. Reserve of oil & coal are respectively at 200 billion barrels & 500 billion ton (=50% of world total reserve). Recent discovery of kimberlite strongly indicates diamond deposits

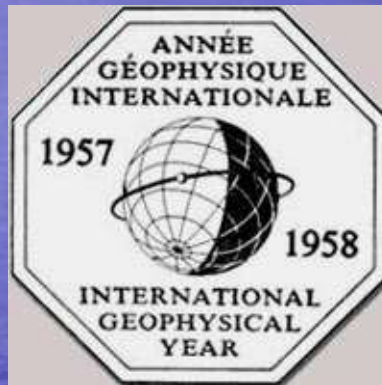




- Antarctica is defined politically as land south of 60 south. However the entire continent of Antarctica has no official political boundary although many nations claim land which include Argentina, Australia, Chile, France, New Zealand & the United Kingdom. USA & Russia disagreed



- 1957 : US Navy set up the Amundsen Scott South Pole station & became the first group of people who spent winter in the South Pole
- 1957-58 : International Geophysical Year (IGY)– more scientific explorations



- 1958 : Expedition by New Zealand mountaineer Sir Edmund Hillary
- 1959 : Antarctica Treaty signed by 12 nations & in force in 1961 calling for Antarctica to be used for peaceful purpose only. China signed in 1983. Now have 50 members with 28 having the right to vote in the annual Antarctic Treaty Consultative Meeting (ATCM). The protocol will be open for review after 50 years in 2048



- 1959 : Antarctica Treaty signed by 12 nations & in force in 1961 calling for Antarctica to be used for peaceful purpose only. China signed in 1983. Now have 52 members with 28 having the right to vote in the annual Antarctic Treaty Consultative Meeting (ATCM). The protocol will be open for review after 50 years in 2048



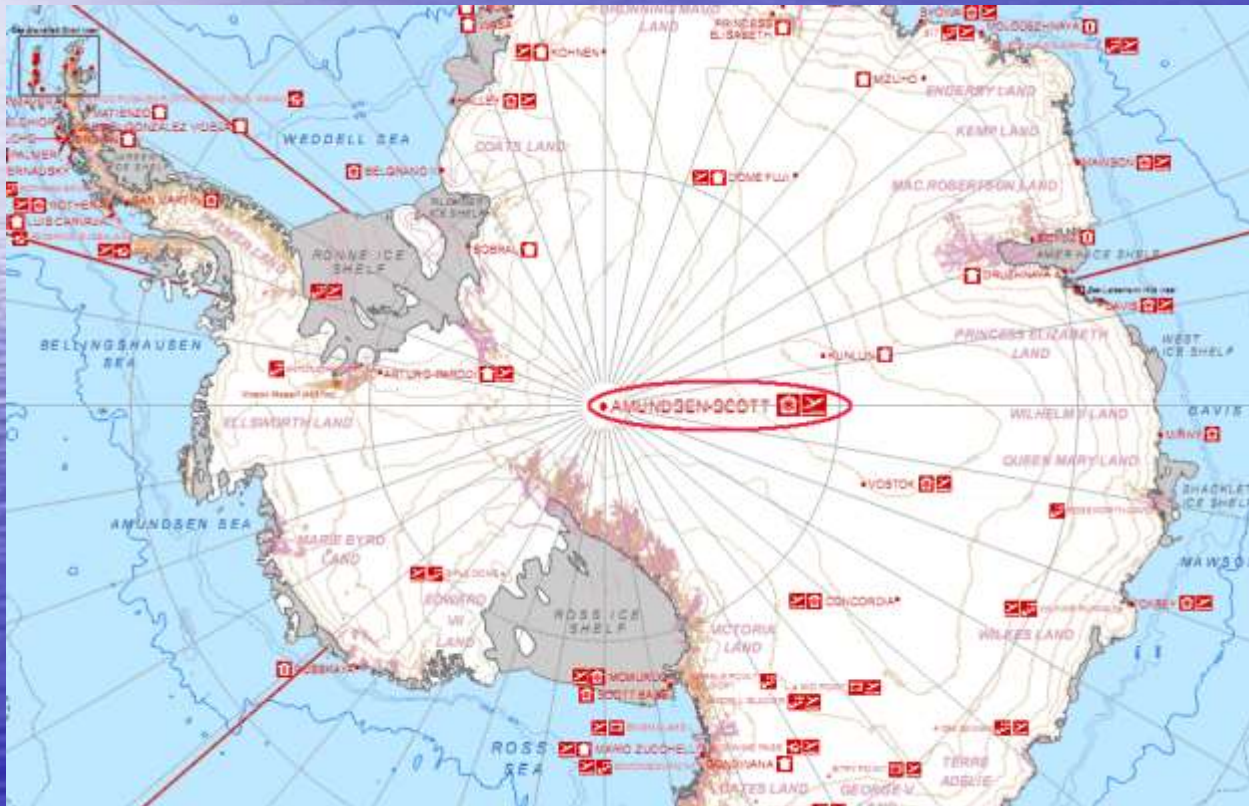
- 1991 : Protocol on environmental protection to the Treaty designated Antarctica as a natural reserve
- 1994 : Recommendation XVIII-1 adopted at the Antarctic Treaty Meeting Kyoto covering :
  - Protect Antarctic Wildlife
  - Respect Protected Areas
  - Respect Scientific Research
  - Be Safe
  - Keep Antarctica Pristine
- 2007-9 : International Polar Year (IPY) carried out many research initiatives





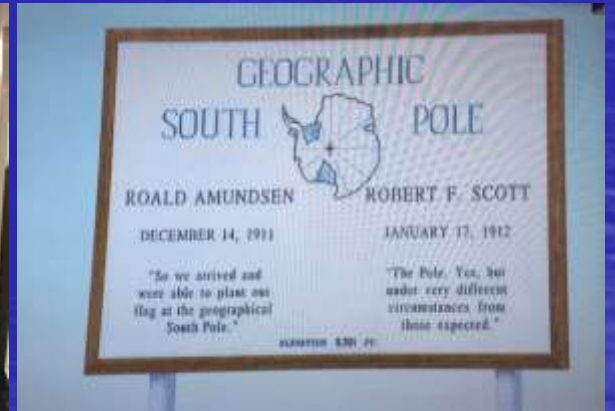
# Scientific Stations

- There are now 100 scientific stations operated by 31 countries with Argentina having the most at 13; USA the biggest & China just increased to four (長城 1985, 中山 1989, 崑崙 2009, 泰山 2014) at a budget of US\$55m launching a project to drill 2.5 km into Antarctica's highest ice dome



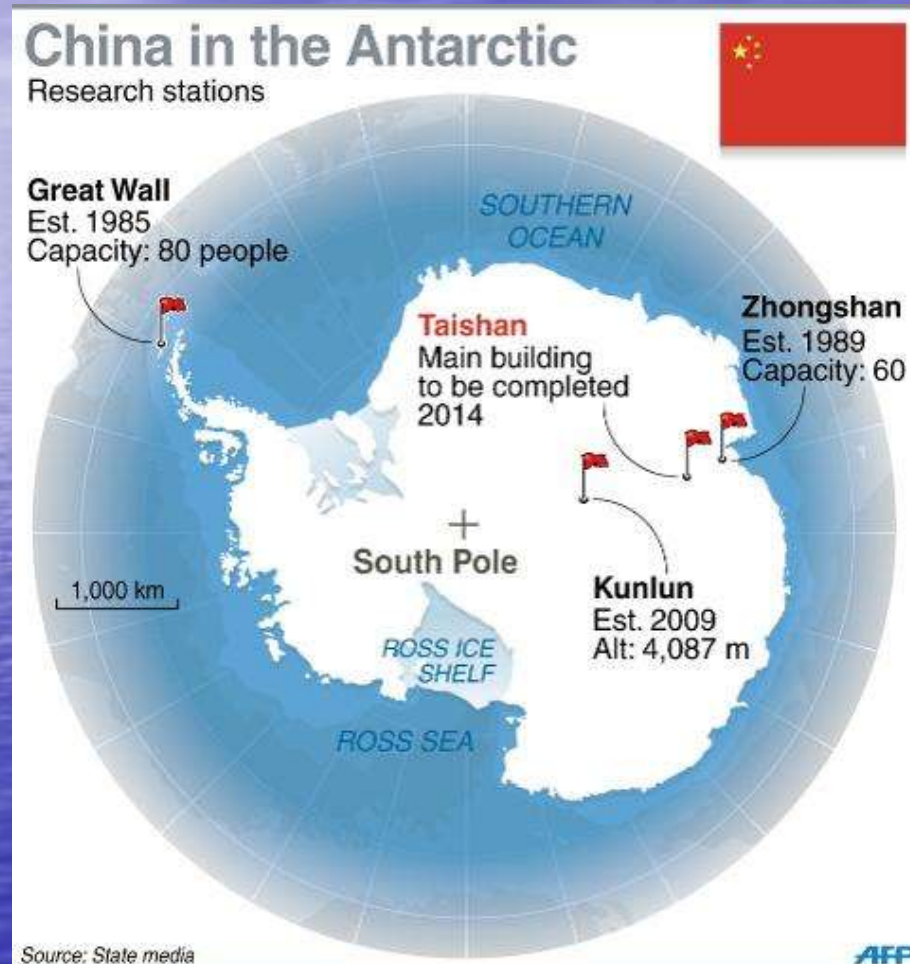


- Amundsen & Scott Station (USA) : a brand new one open in 2008 replacing the old geodesic dome built in 1975





- China: 4 stations operated by the Polar Research Institute of China & affiliated to the Chinese Arctic & Antarctic Administration (CAA)



- 1. Great Wall Station open 1985 operating the whole year round



- 2. Chungshan Station open 1989 focus on marine, glaciology, atmospheric sciences & base for inland expeditions. Also permanent

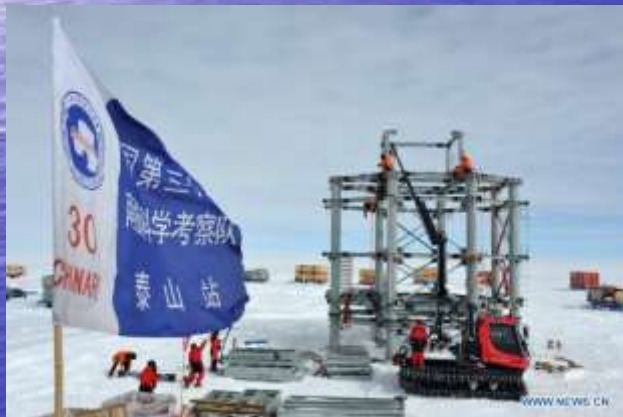




- 3. Kunlun Station 2000 is situated at Dome A an area with the lowest surface temperature. Only operational in the summer



- 4. Taishan Station 2014 also only operational in the summer



- 5. China is now planning to construct an additional station & as well as an air port



- Xue Long 雪龍 : China's Ukraine built icebreaker. Will be joined by a new one in 2016

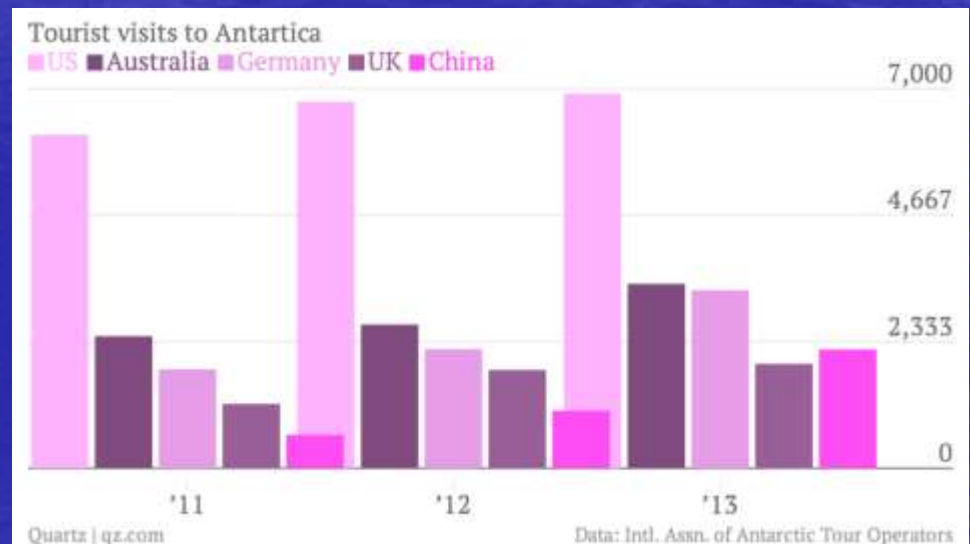






## International Association of Antarctica Tour Operators ( IAATO ) 南極旅遊組織行業協會

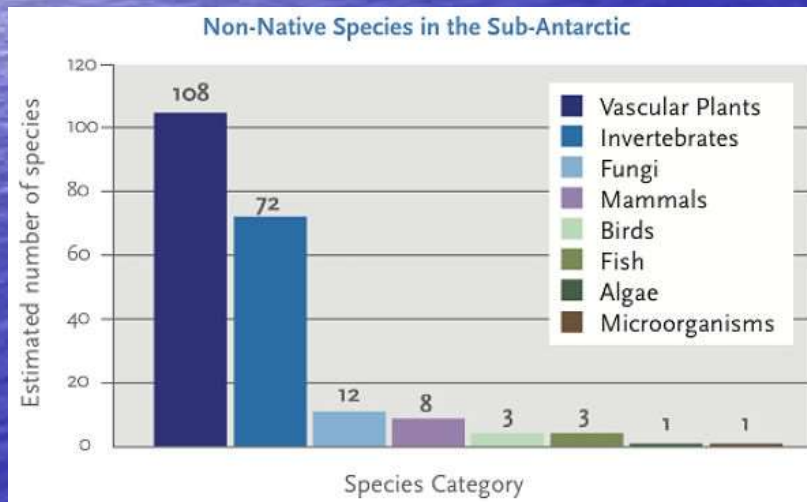
- The number of tourist have increased from 6,000 in 1990 to over 36,702 in 2014/15. Traditional tourist US, Australia, Germany & UK. Chinese tourist alone has tripled since 2011 to 4,123. The increase is adding heavy pressure to the environment & led to the formation of IAATO





## International Association of Antarctica Tour Operators ( IAATO )

Human activities in the sub Antarctic islands have contributed to a large number of introductions of non-native species both intentionally (rabbits & reindeer for food) and unintentionally (mice, rats, worms & grasses). Approximately 200 non-native species existed on the islands causing alterations to the ecosystems through extinction & decreased abundance of native species



### What types of non-native species have already arrived in Antarctica?



- seeds
- grasses
- algae
- fruit flies
- worms
- spiders
- midges
- microorganisms





- The IAATO was established in 1991 to advocate, promote & practice safe & environmental responsible private sector travel to Antarctica. Total member over 100
- One ship one site at one time
- Vessels with capacity over 500 passengers can only cruise around Antarctica
- Vessels carrying 200 to 500 passengers can land at certain sites only
- Vessel carrying less than 200 passengers can land at more sites
- Maximum 100 passengers for every landing



No littering. No alien plant & animal. No food. Do not take anything away.  
Keep 5 m away from local wildlife. Do not step on vegetation. Do not damage historical relic



**IAATO**  
**Guidance for Visitors to the Antarctic**

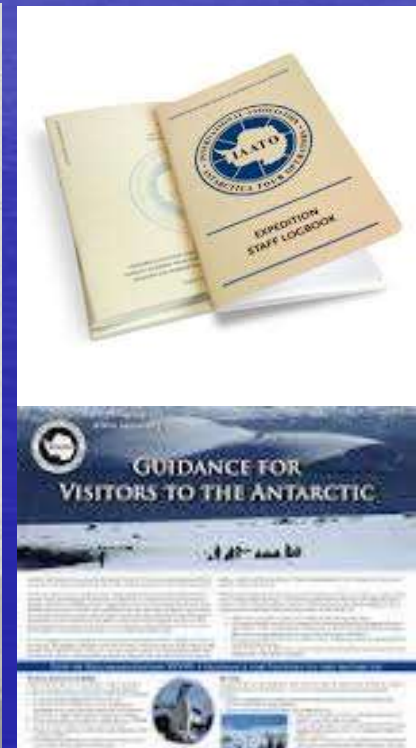
Protect Antarctic Wildlife

Respect Protected Areas

Respect Scientific Research

Be Safe

Keep Antarctica Pristine





# ICE, ICE, ICE

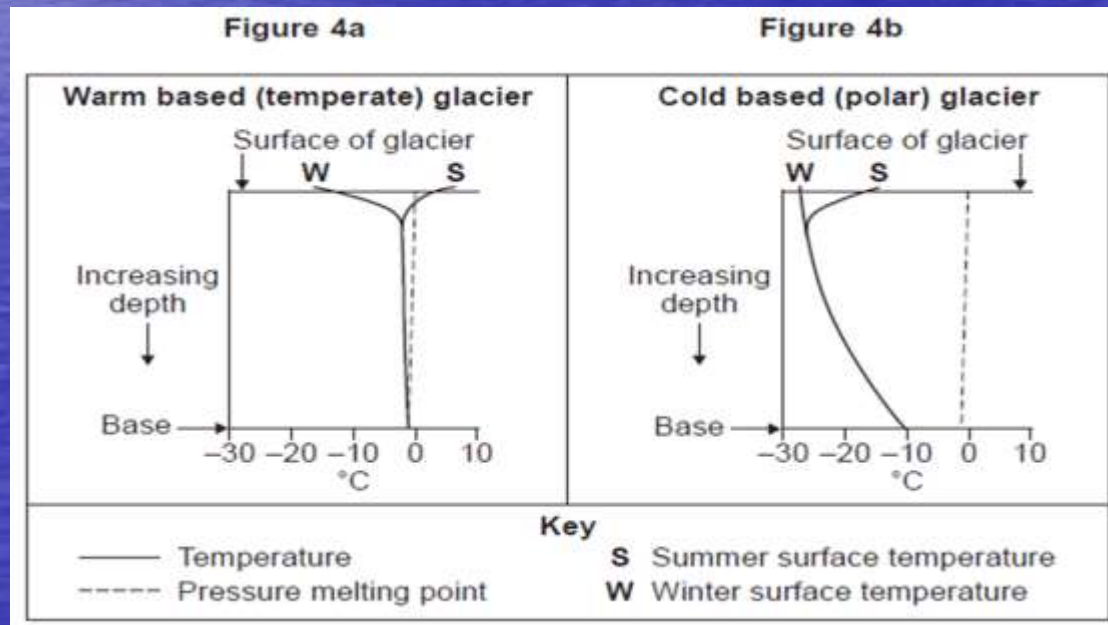
Ice is a mineral as it is an inorganic solid formed naturally with defined chemical composition and crystal structure



Space Ice/Atmospheric Ice/Land Ice/Sea Ice

# Land Ice 陸冰

- Mountain/Alpine Glacier 高山冰川
- Continental glacier/Ice Sheet 冰床 : size over 50,000km<sup>2</sup> e.g. Greenland & Antarctica
- Ice Cap 冰帽: size less than 50,000km<sup>2</sup> e.g. Iceland
- Outlet glacier
- Temperate/Polar Glacier : A Temperate glacier is at the melting point throughout the year from its surface to its base. Iceland glaciers are Temperate glaciers 溫帶冰川. A Polar Glacier 極帶冰川 is always below freezing point from surface to base

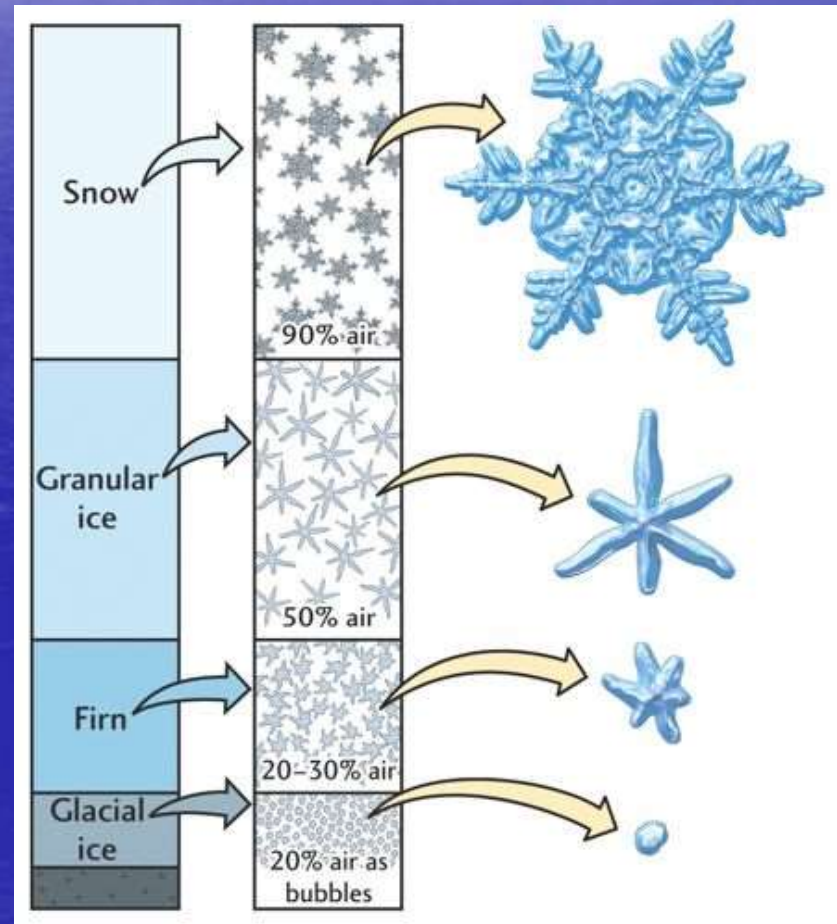




# Glacial Ice

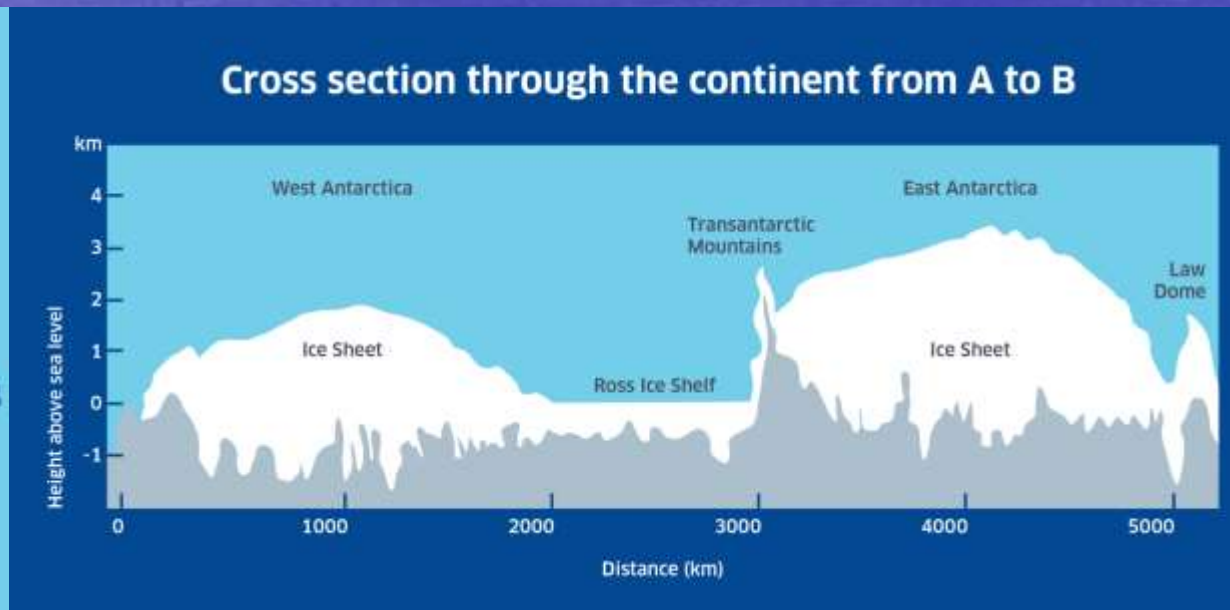
Glacial Ice is formed above sea level where the snow precipitation is high & the mean annual temperature falls to below 0 degrees C. The snow eventually transform into ice by compression

- Snow flake 雪花 : 90% air
- Granular snow 粒雪 : 50% air
- Firn 雪冰/萬年雪 : 20-30% air
- Glacial ice 冰川雪 : >20% air



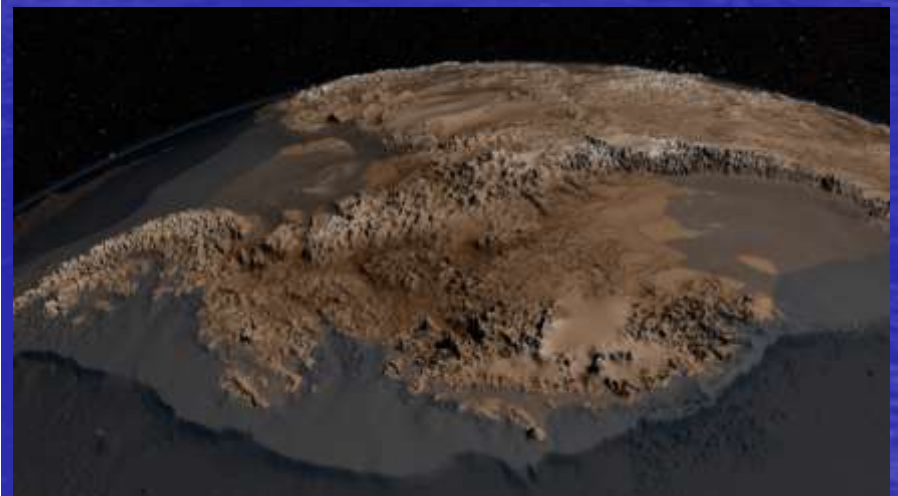
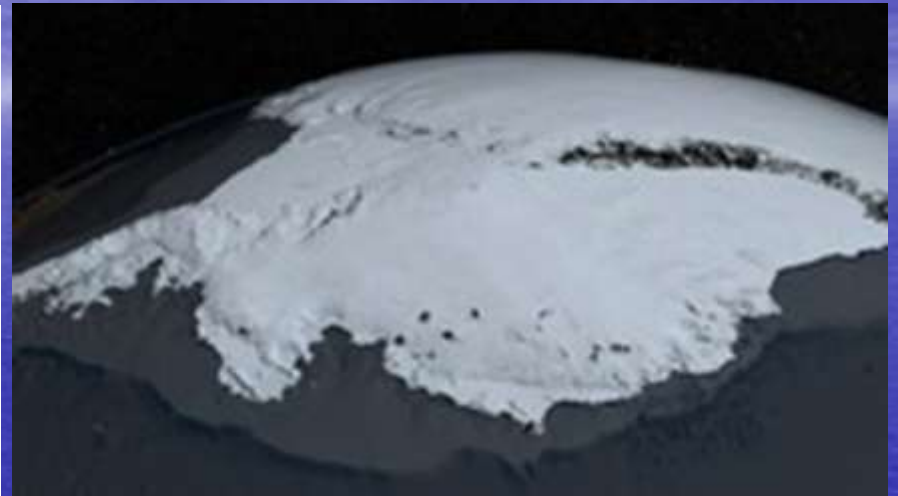
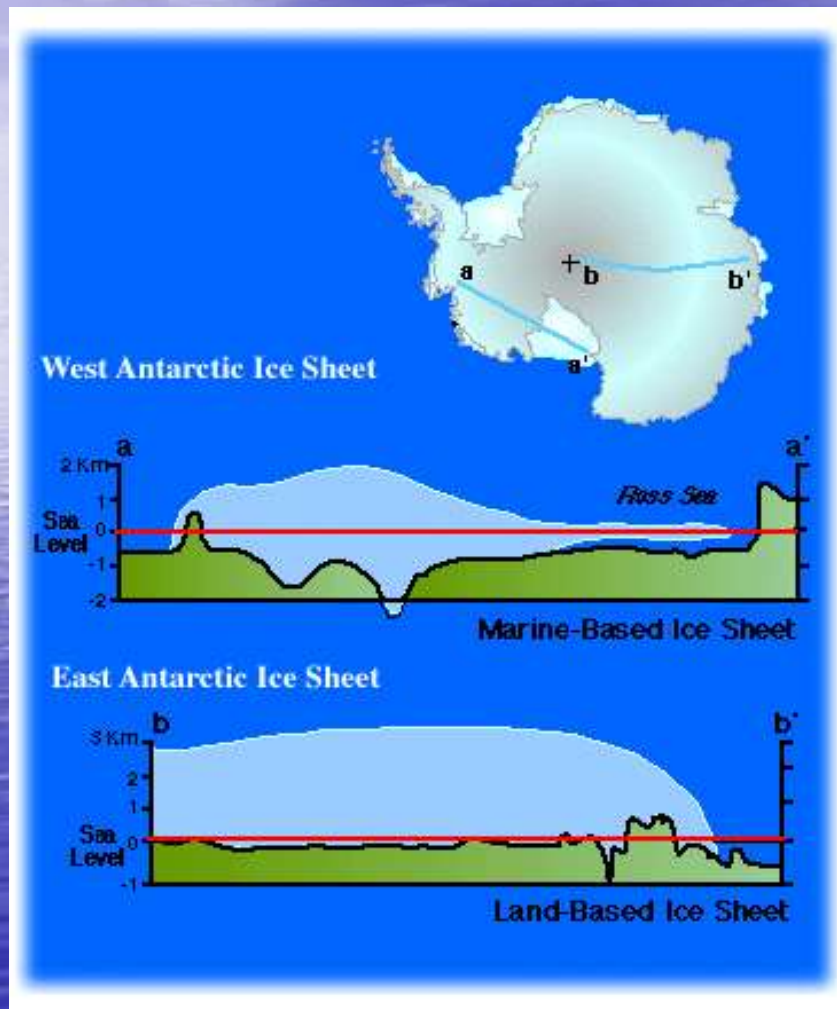
# Antarctica Ice Sheet 南極冰床

95% of Antarctica is covered with ice & the oldest ice core is dated at 100 Ma. The average thickness of the Antarctica Ice Sheet is 1,880 m & the thickest part is at 4,750 m. This represents 70% of the earth's fresh water. If all this Ice is melted the sea level will rise by 65-70 m !



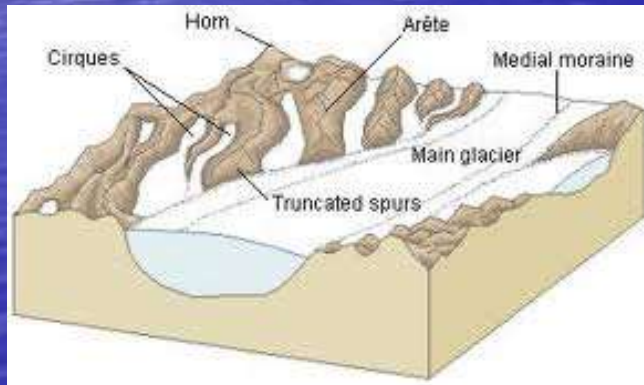


The West & the East Antarctica Ice Sheet East is land based, the west is marine based. The Ice sheet on the continent is so thick & heavy that it is pushing it down by as much as 1,000 m !



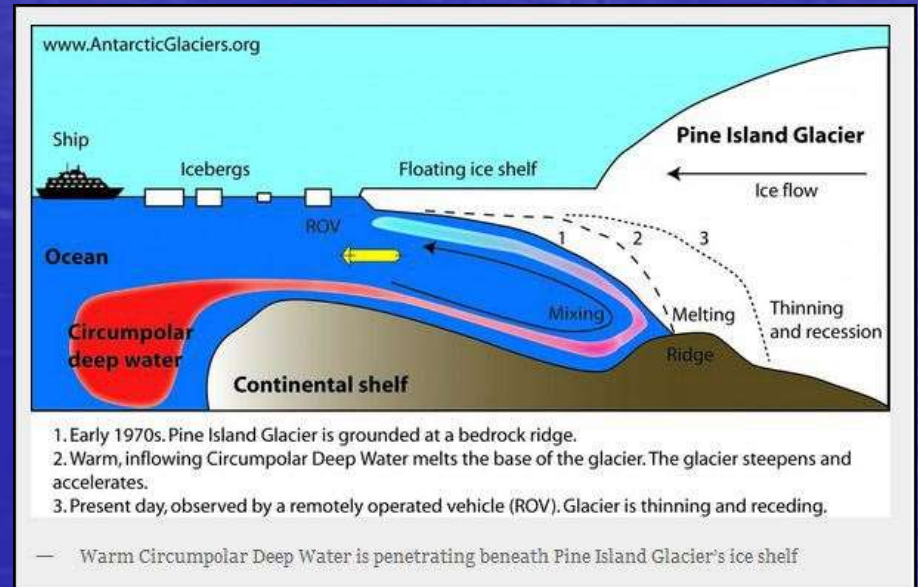
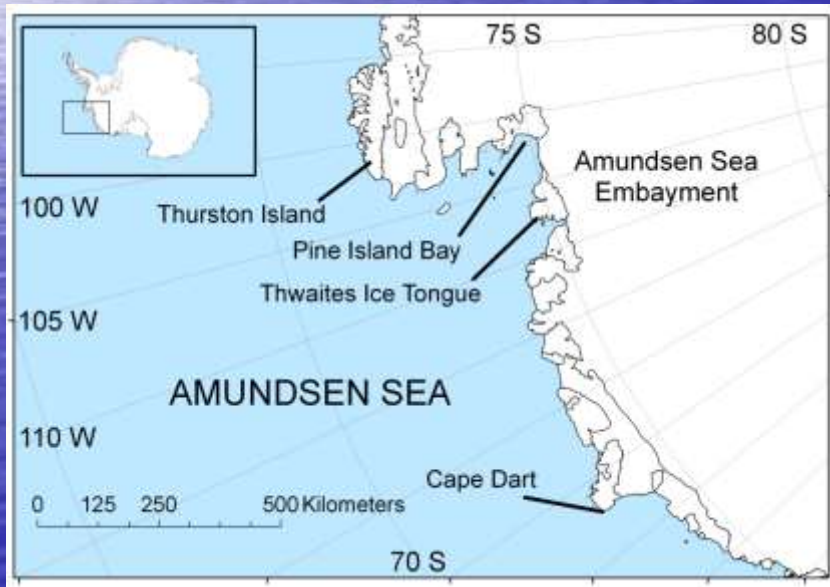
# Glaciers 冰川

A glacier is defined as an area of ice in which the ice itself is moving from an area of accumulation to an area of loss (ablation). In Antarctica the weight of the Ice Sheet itself is pressing the ice to move outward at 10 to 30 m per year forming glaciers which run all the way into the sea. Antarctica glaciers originated some 35 My. Famous ones include Pine Island, Beandmore, Lambert, Talor, Byrd & Axel Heiberg. At 563 km long, 100 km wide & 2,500 m thick, Lambert Glacier is the largest glacier in the world

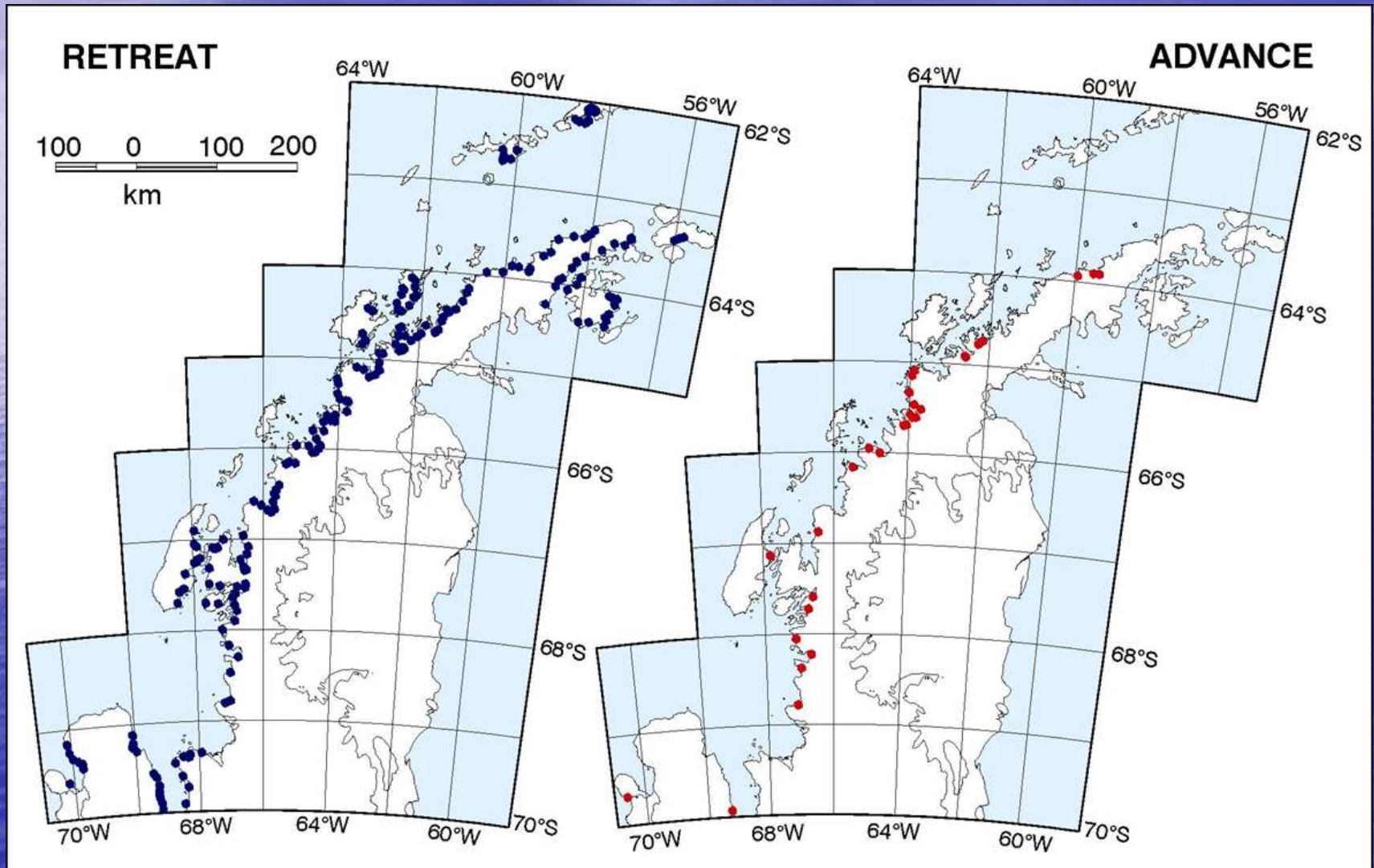




Latest study indicate warming water is washing up against large swaths of the Antarctic ice sheet accelerating the melting of glaciers. Per 2014 report all 6 West Antarctic glaciers located at the Amundsen Sea namely Pine Island, Thwaites, Haynes, Pope, Smith & Kohler are melting much faster than previously predicted & has passed the “point of no return”. It is estimated that at the end of this century the global sea level will rise by 26 to 82 cm & within the next 200 to 1,000 years just the melting of these glaciers will cause the sea level to rise 1.2 m !

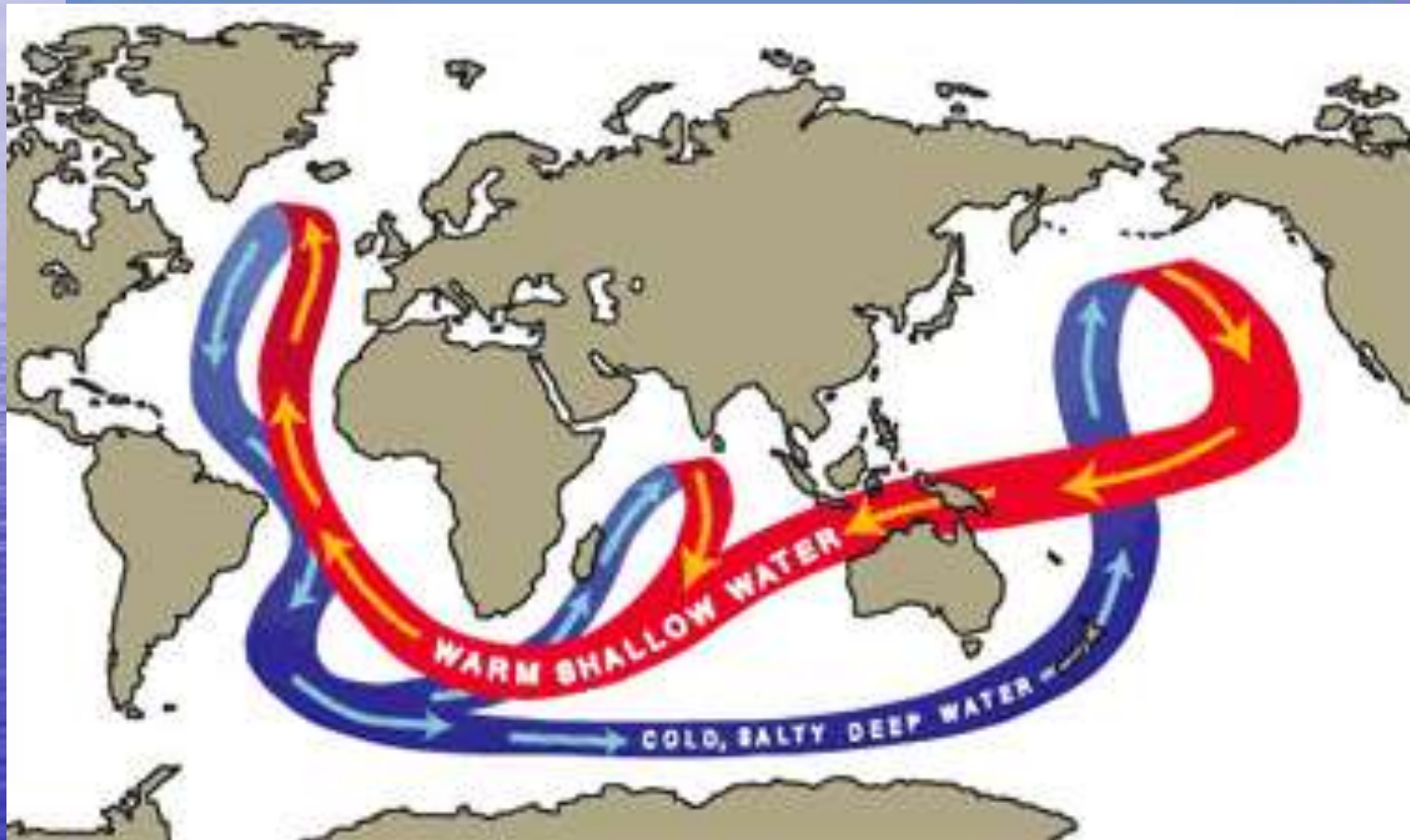


- Of 244 glaciers located in the Antarctica peninsula 87% have retreated over the past 50 years

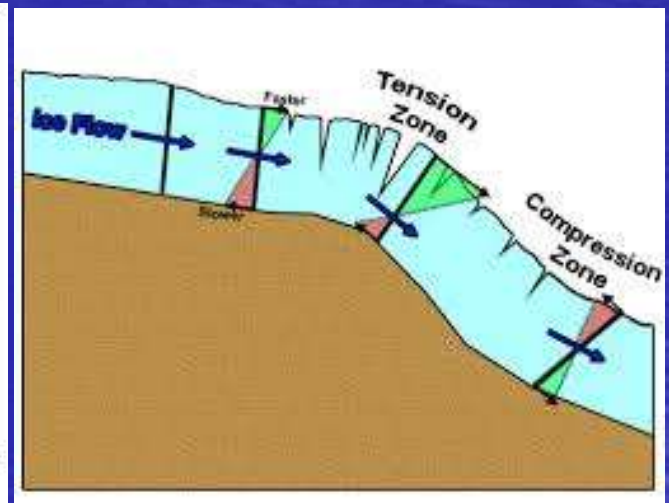
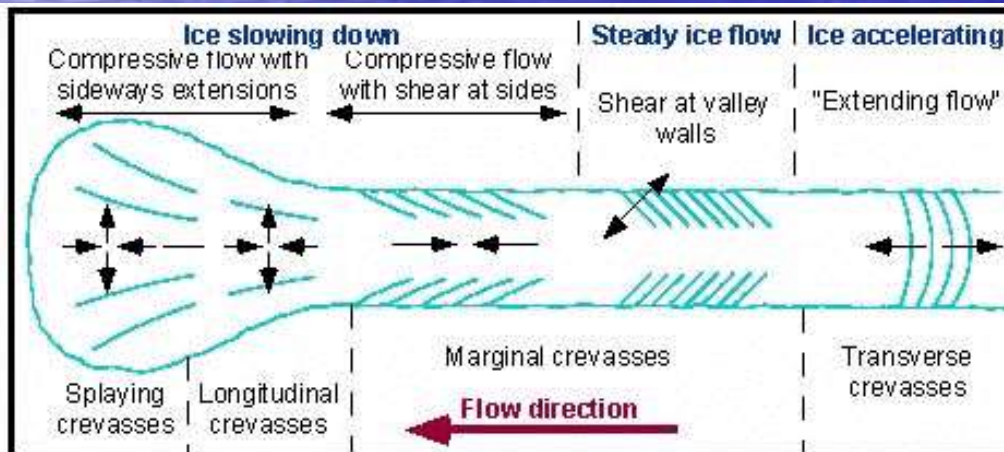




Melting of glaciers will also affect the Ocean Conveyor Belt ( Thermohaline circulation ) by produce a layer of fresh water that would slow or prevent normal saline mixing, weakening the circulation & even shutting it down leading to drastic global climatic changes



- Crevasses 冰縫 / 冰隙 : A crevasse is a deep crack in an ice sheet or glacier formed by shear stress. It can be spraying, longitudinal, marginal or traverse depending on the speed of the ice flow. Some can reach 50-100 m deep & often cover by a thin layer of snow bridge making them lethal hazards



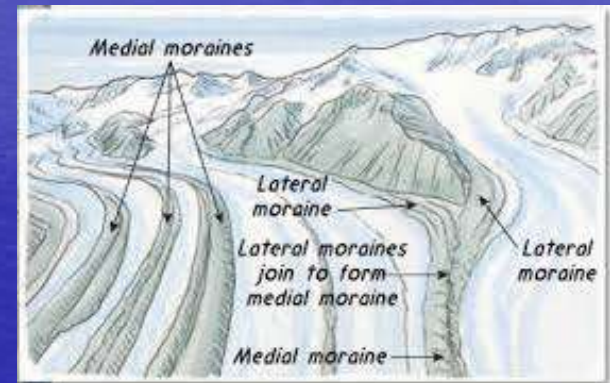


- Crevasses and Ice tunnels can be 150 m long 5 m high





- Moraines 冰積石 : a moraine is any glacially formed accumulation of unconsolidated glacier debris ( soil & rock ) that occurs in currently glaciated or formerly glaciated regions through geomorphological processes. Lateral moraine, medial moraine, ground moraine, ice cored moraine, terminal moraine





- Sastrugi 雪攏/冰浪 : sharp & hard irregular groves or ridges formed on a snow surface by wind erosion, saltation of snow particles & deposition. The ridges can be as high as 1.8 m & very difficult to cross

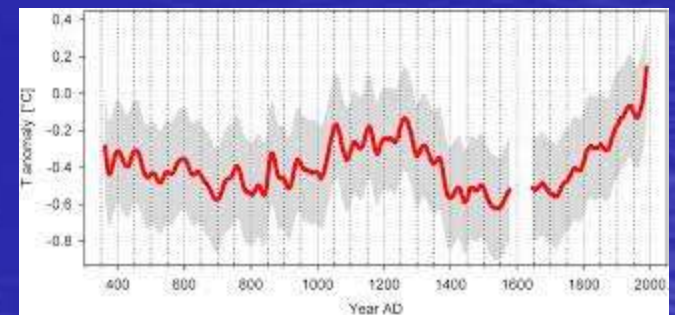
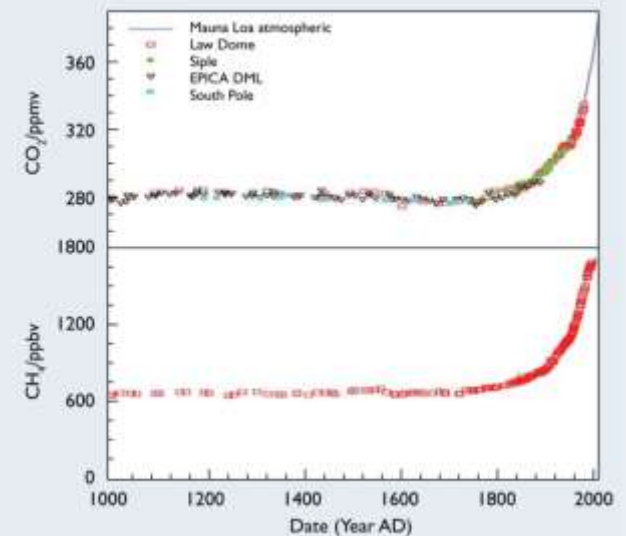




- Ice Core Study 冰芯研究 : Ice core are cylinders of ice drilled out of an ice sheet or glacier. Ice core contain a lot of information about the past climate conditions particularly through the analysis of the CO<sub>2</sub> & methane (CH<sub>4</sub>) 甲烷 contained in the small air bubbles as well as studying the historical temperature pattern by measuring the relative amount of <sup>16</sup>O & <sup>18</sup>O in the water

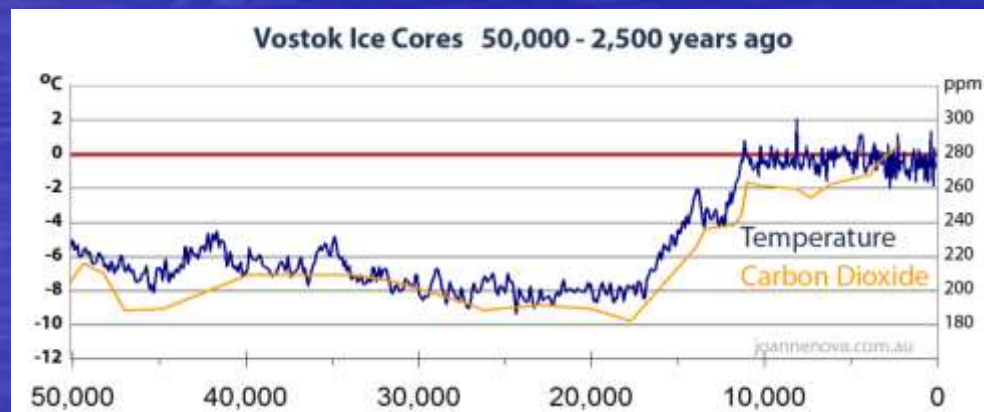
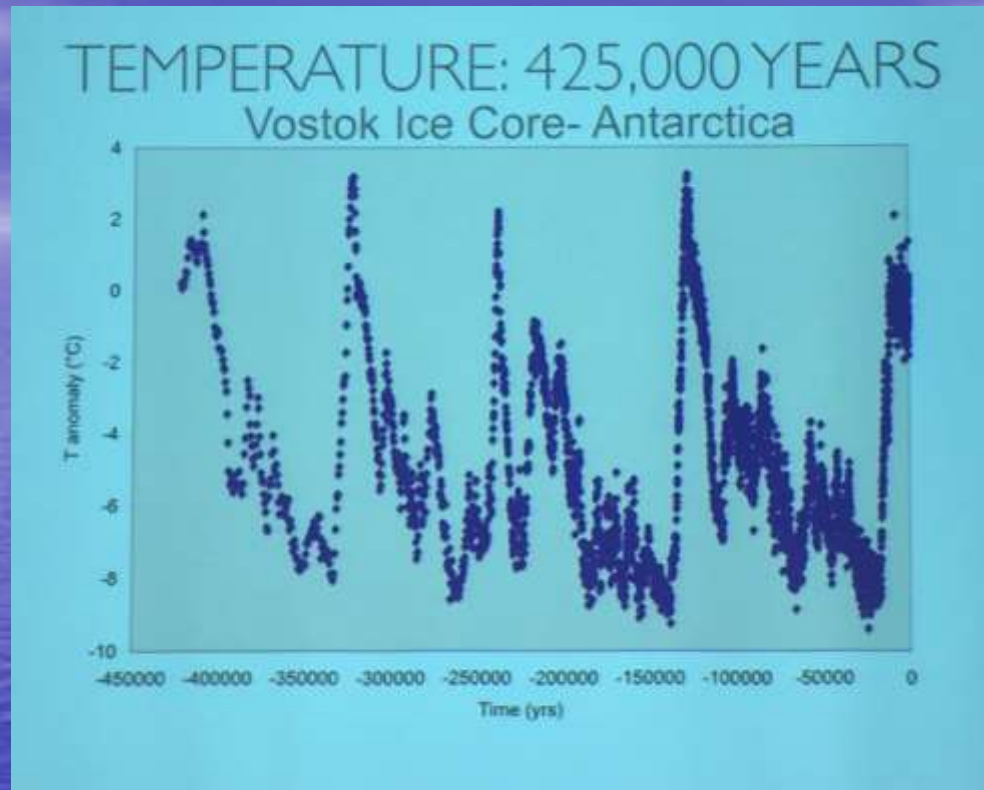


Fig. 2: CO<sub>2</sub> and CH<sub>4</sub> over the last 1,000 years<sup>[14]</sup>



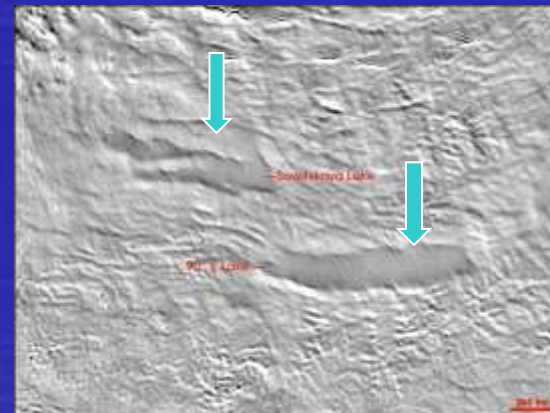
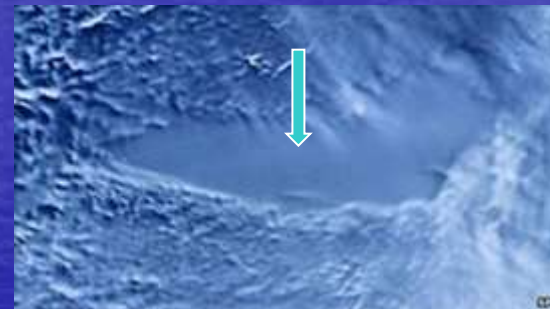


Vostok Ice Core analysis indicates we should be in an interglacial period with temperature falling but in reality both CO<sub>2</sub> & temperature are rising



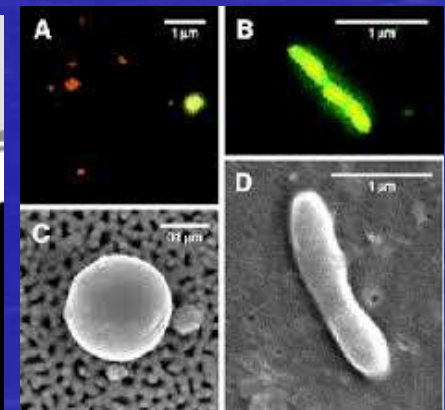
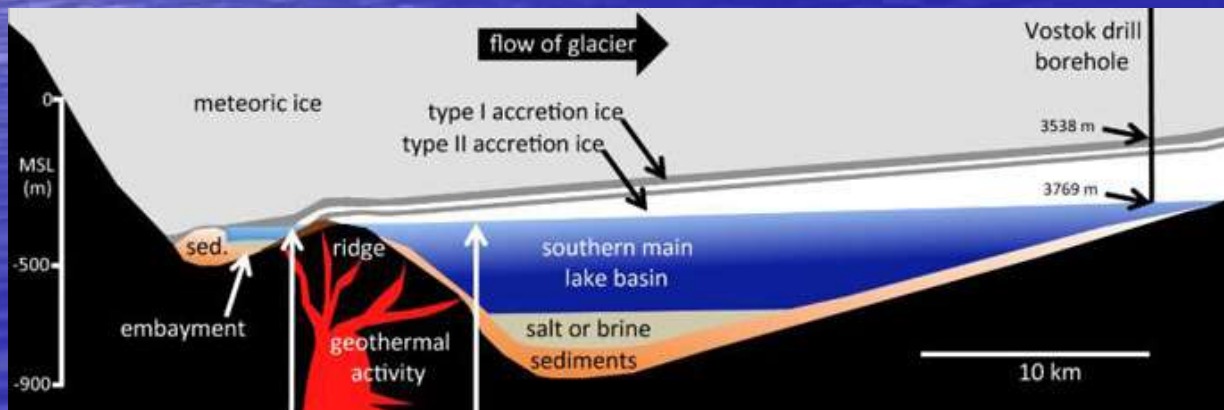
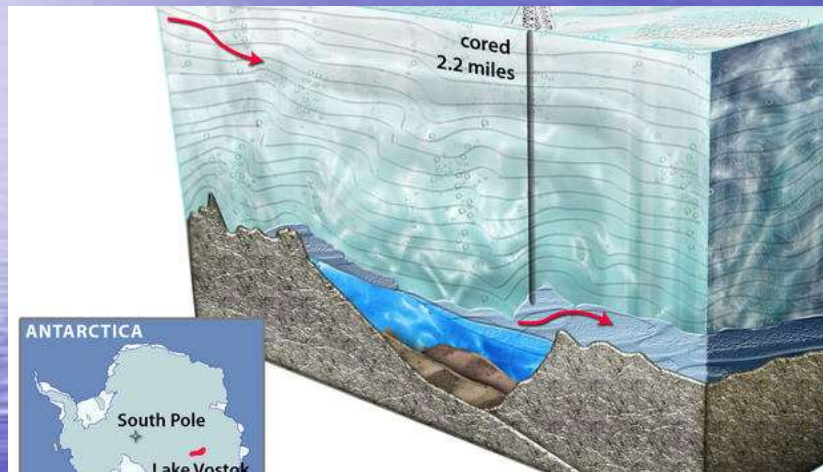
## Subglacial Lakes 冰底湖

- They are formed by geothermal heating plus the insulation effect & enormous pressure exerted by the overlying ice
- There are 400 known subglacial lakes in Antarctica most are between 3 -5 km in length & many are linked. At 4,000 m below the ice & 500m below sea level, Lake Vostok (Lake East 東方湖 ) is the largest
- Subglacial lakes actually serve as very effective lubricant for the ice sheet on top to move forward



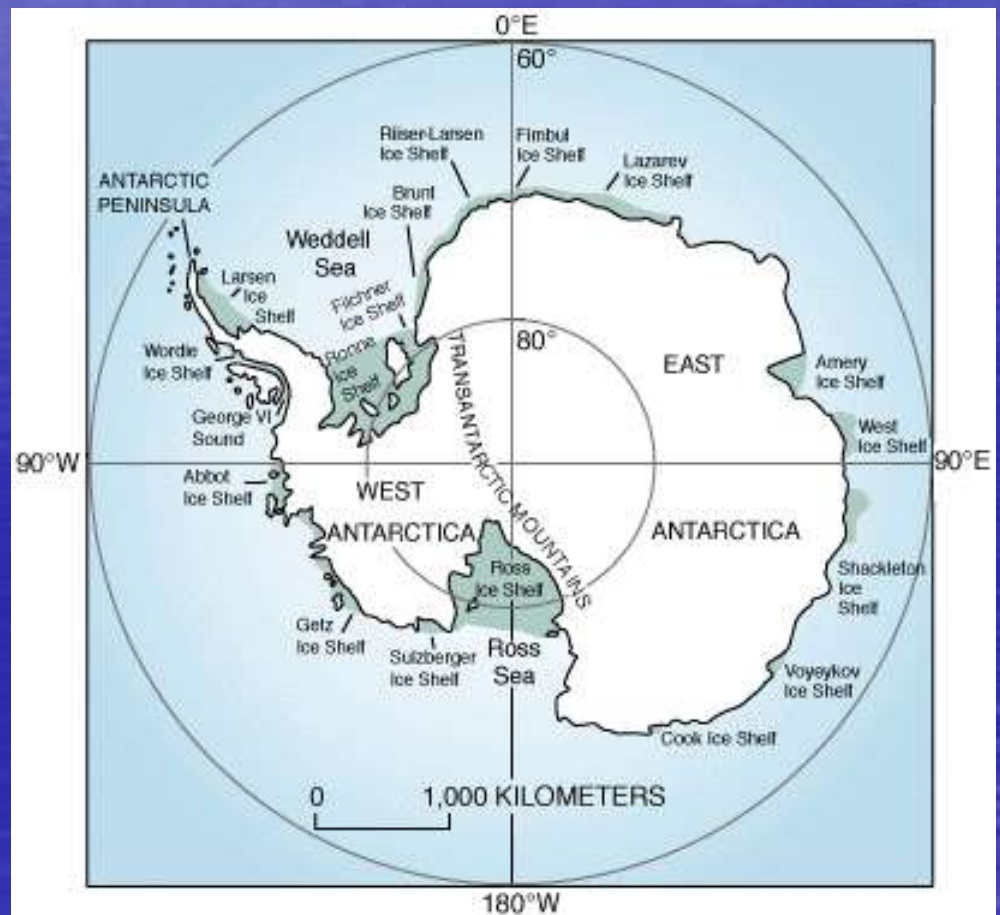
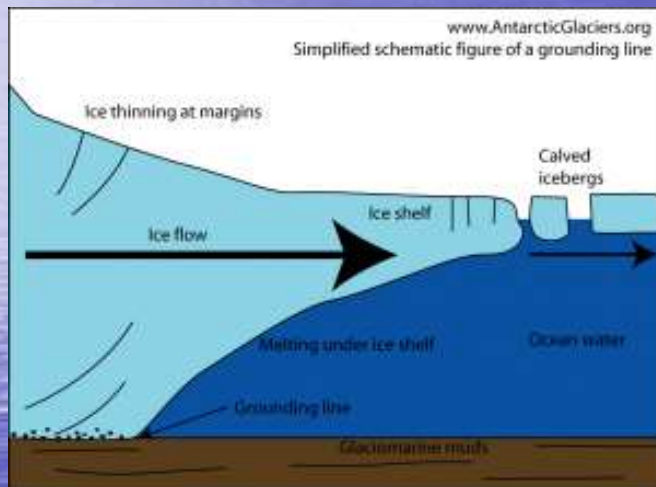


- The water at Lake Vostok has probably been isolated for 15-25 million years which can provide a lot of palaeoclimatic record to scientists. The first core drilling was completed in 2012 by the Russians down to 3,786 m. A special type of hot water drilling is used to prevent contamination. Over 3,500 life forms were discovered by biologists



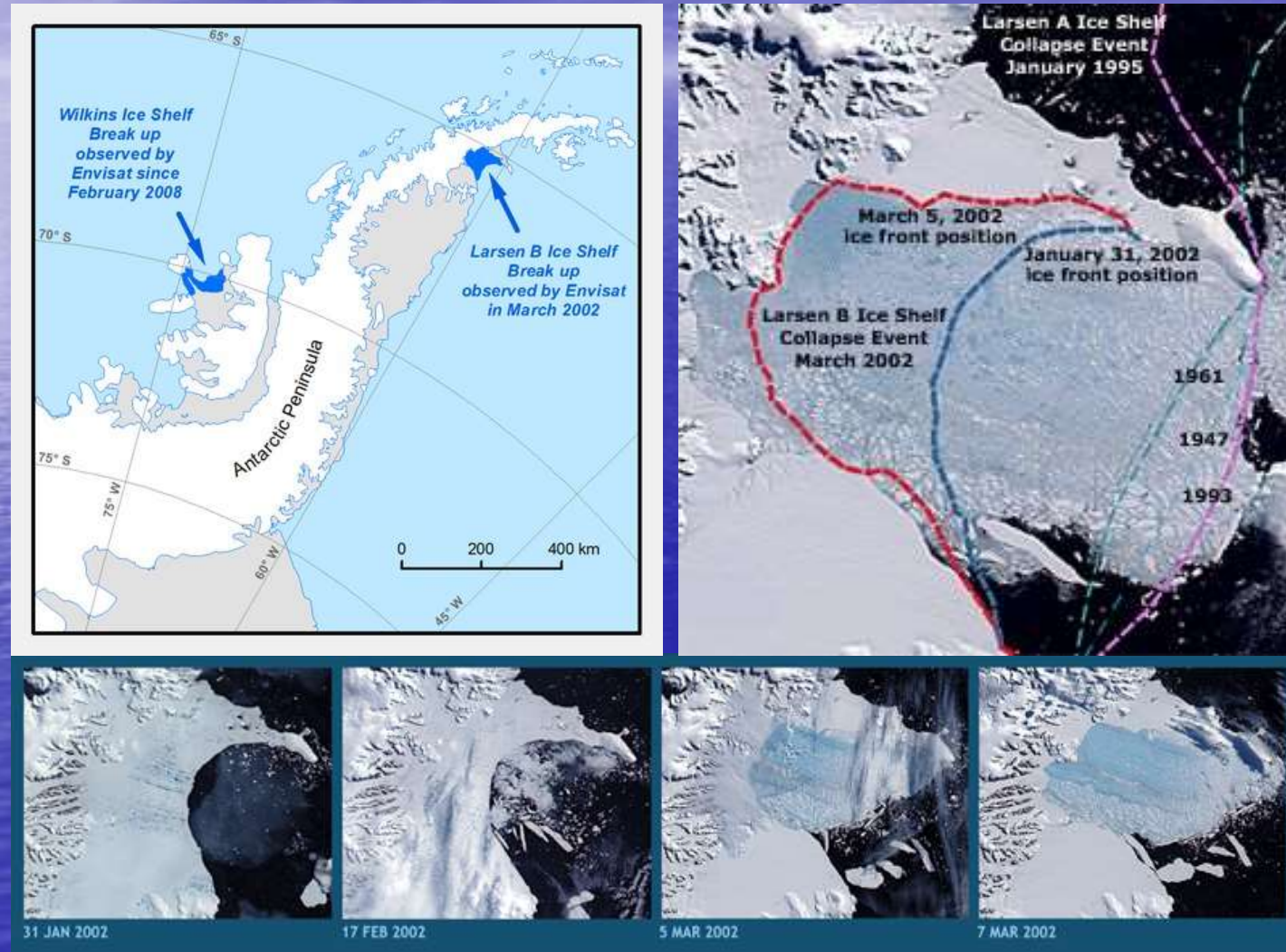
# Ice Shelf 冰棚/冰架

This is floating ice front only found in Antarctica, Greenland & Canada. Ice shelf can extend from land from 100 to 1,000 km out at sea. In Antarctica, ice shelves are attached to 45% of the coastline totaling 1.5 million km<sup>2</sup>. At 500,000 km<sup>2</sup> which is the size of France, the Ross Ice Shelf is the largest in the world being fed by 30 glaciers. Its vertical face is between 15-50 m above sea level





Due to global warming, the Larsen A Ice Shelf already collapsed in 1995. Formed 10,000 years ago, the Larsen B Ice Shelf is fast reducing in size from 11,500 km<sup>2</sup> in 1995 to 6,600 km<sup>2</sup> in 2002 and now only 1,600 km<sup>2</sup> which is roughly the size of London. It will probably disappear by 2020 . Larsen C Ice Shelf is also cracking up





# Ice Carving & Ice Fall

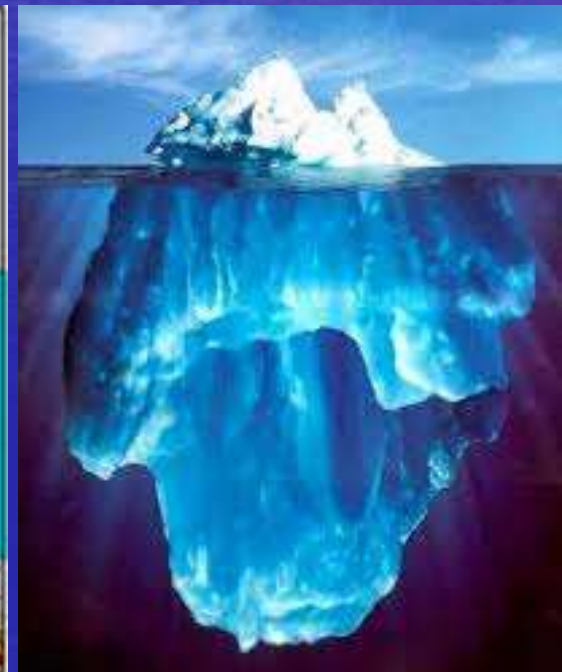
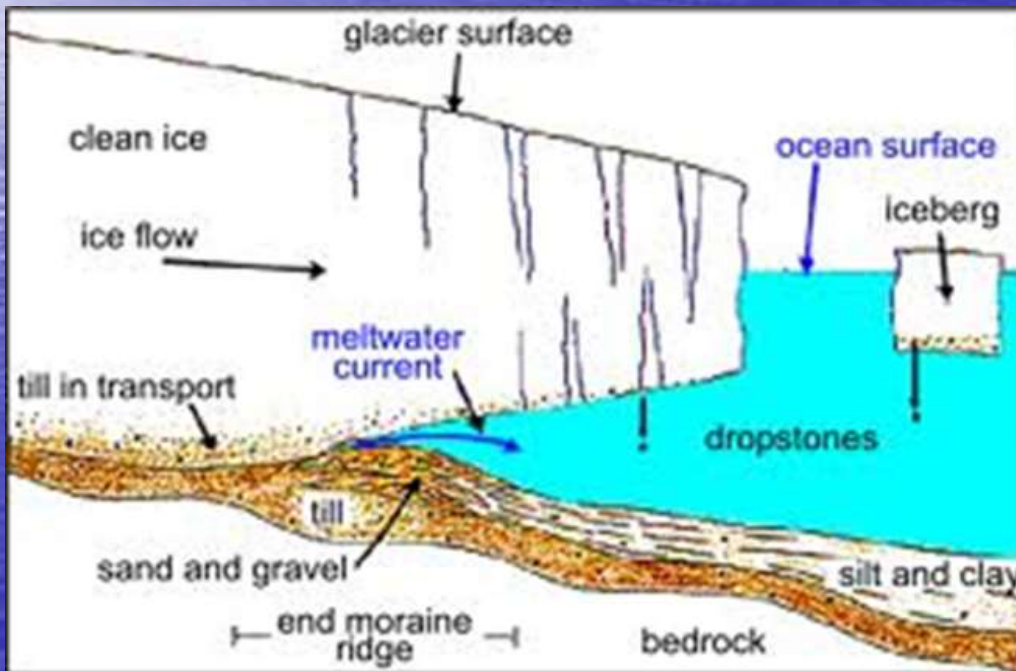
As air bubbles trapped in the glacier are being compressed, internal carving will begin with loud bands which sounds like a drum. Ultimately the front of the ice shelf breaks off once there is no bedrock support forming spectacular ice fall called "ice or glacier carving". Carving can create mini Tsunami which is still dangerous to life ashore











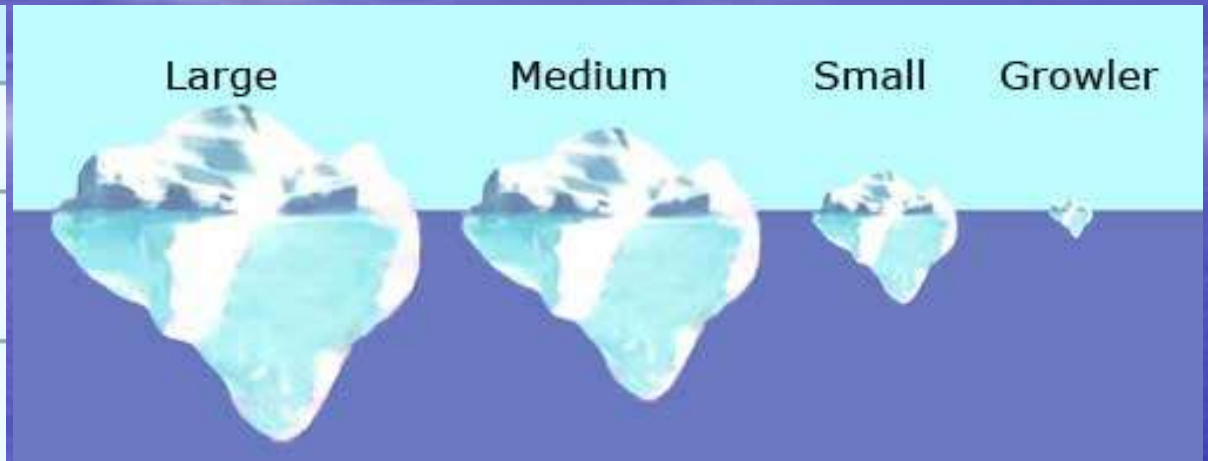
# Icebergs 冰山

They are formed when the glacier reaches the ocean and pieces of it eventually broke away & floating in open water. Since it is made of fresh water with lower density than sea water (0.9168 kg/l versus 1), only 1/9 of it is above the sea surface. Icebergs can last 10 years before melting & can be of very different shape & size. Small ones are called Flouting Ice. Those displaying beautiful blue color are million years old as they are so compact that they can absorb most of the light



## Iceberg classification by shape & size

| Shape    | Sketch  |
|----------|---|
| Tabular  |    |
| Blocky   |    |
| Wedged   |    |
| Dome     |    |
| Pinnacle |   |
| Dry Dock |  |



| Size Category | Height                     | Length                      |
|---------------|----------------------------|-----------------------------|
| Growler       | Less than 1 metre (3.3 ft) | Less than 5 metres (16 ft)  |
| Bergy Bit     | 1–5 metres (3.3–16 ft)     | 5–15 metres (16–49 ft)      |
| Small         | 5–15 metres (16–49 ft)     | 15–60 metres (49–200 ft)    |
| Medium        | 15–45 metres (49–148 ft)   | 60–120 metres (200–390 ft)  |
| Large         | 45–75 metres (148–246 ft)  | 120–200 metres (390–660 ft) |
| Very Large    | Over 75 metres (246 ft)    | Over 200 metres (660 ft)    |

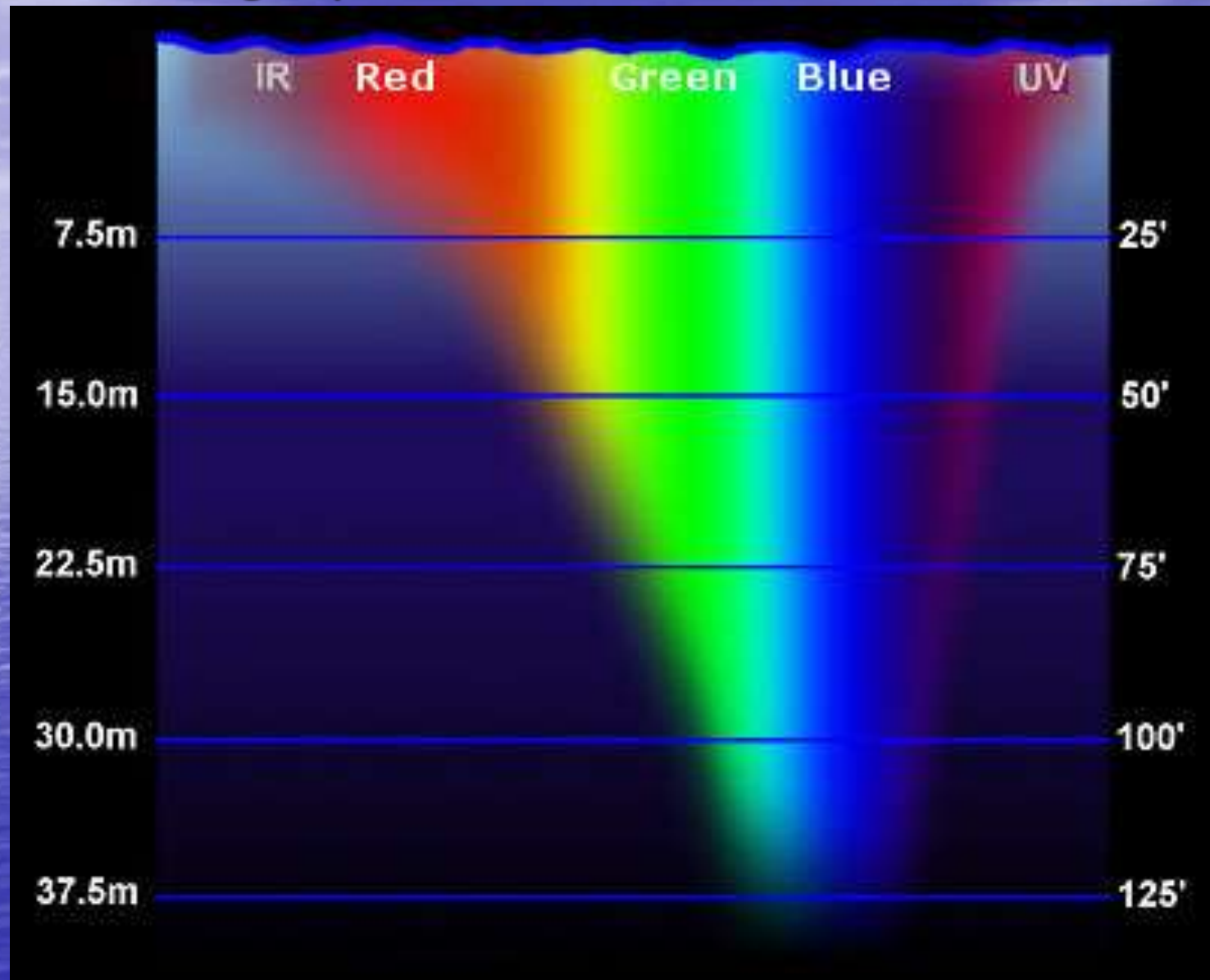


# Color of Iceberg

Iceberg itself is colorless. Some appeared white because 85% of the daylight has been reflected by the ice crystals acting like a mirror. Old compact Icebergs with little air appears blue because the ice is so compact that all the colors have been absorbed except blue which has the shortest wavelength. Some icebergs can be tinted pink, red, orange, green, yellow & gray due to the presence of single celled Snow Algae. Dark bands in iceberg represent rock deposit or deposit of volcanic ash collected when the ice sheet grinds downhill towards the sea



# Light penetration in the water column

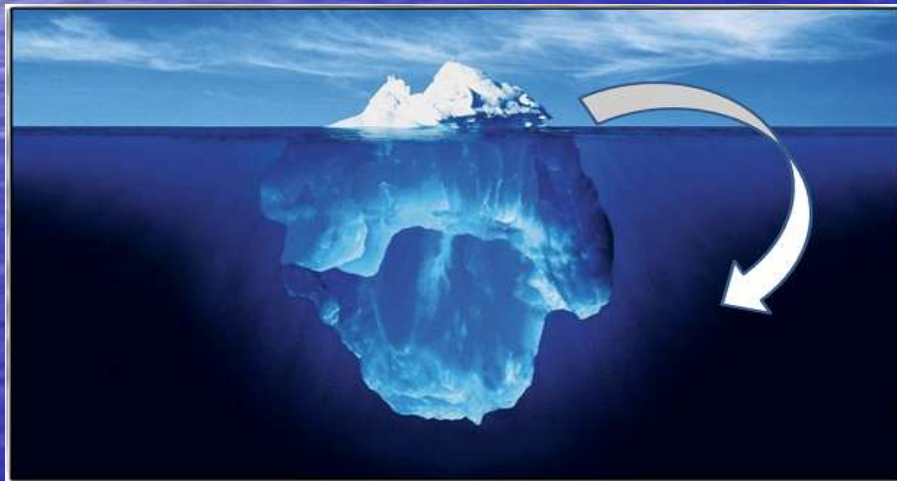




At any one time there are 300,000 icebergs big & small floating in the Southern Ocean  
many being shaped beautifully by nature – melt tunnels, ripple marks



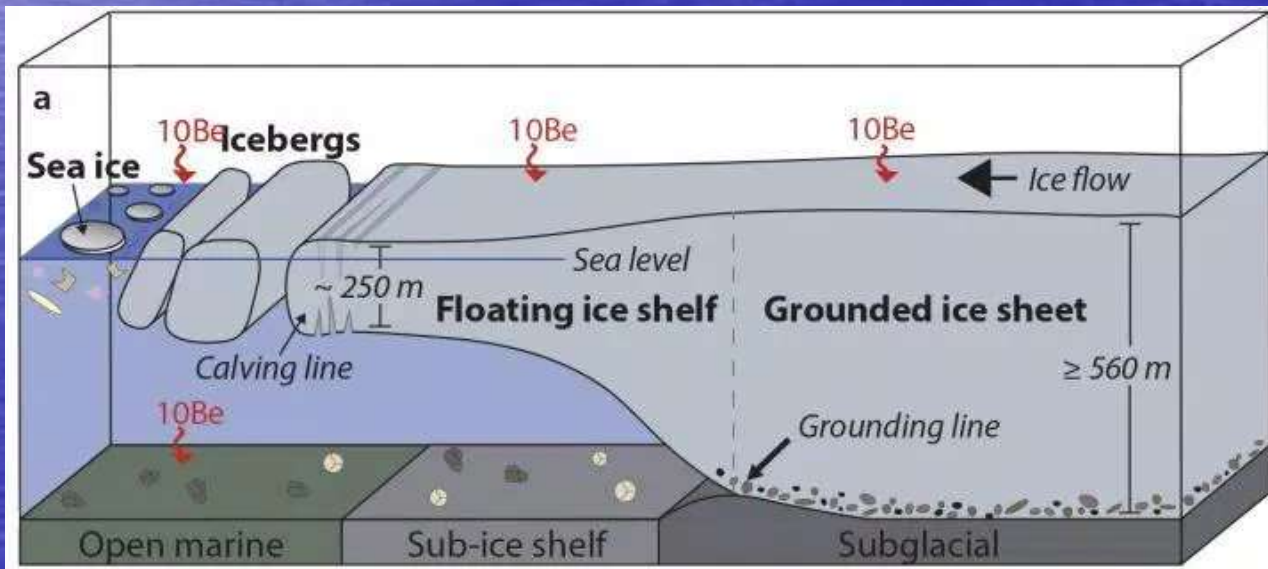
A huge iceberg grounded & eroded by tide & melt water. When afloat an iceberg even up to the size of a mountain can flip over suddenly when sea water eroded the bottom & altered its center of gravity





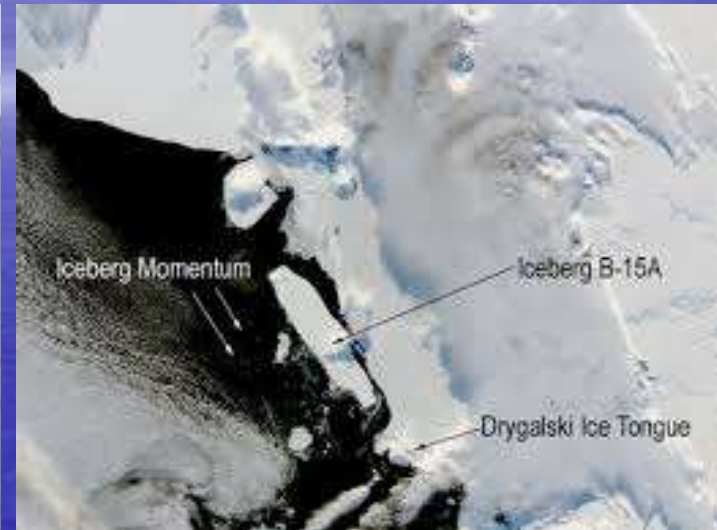
# Tabular icebergs 桌狀冰山

Formed by breaking up of Ice Shelf



## Iceberg B15

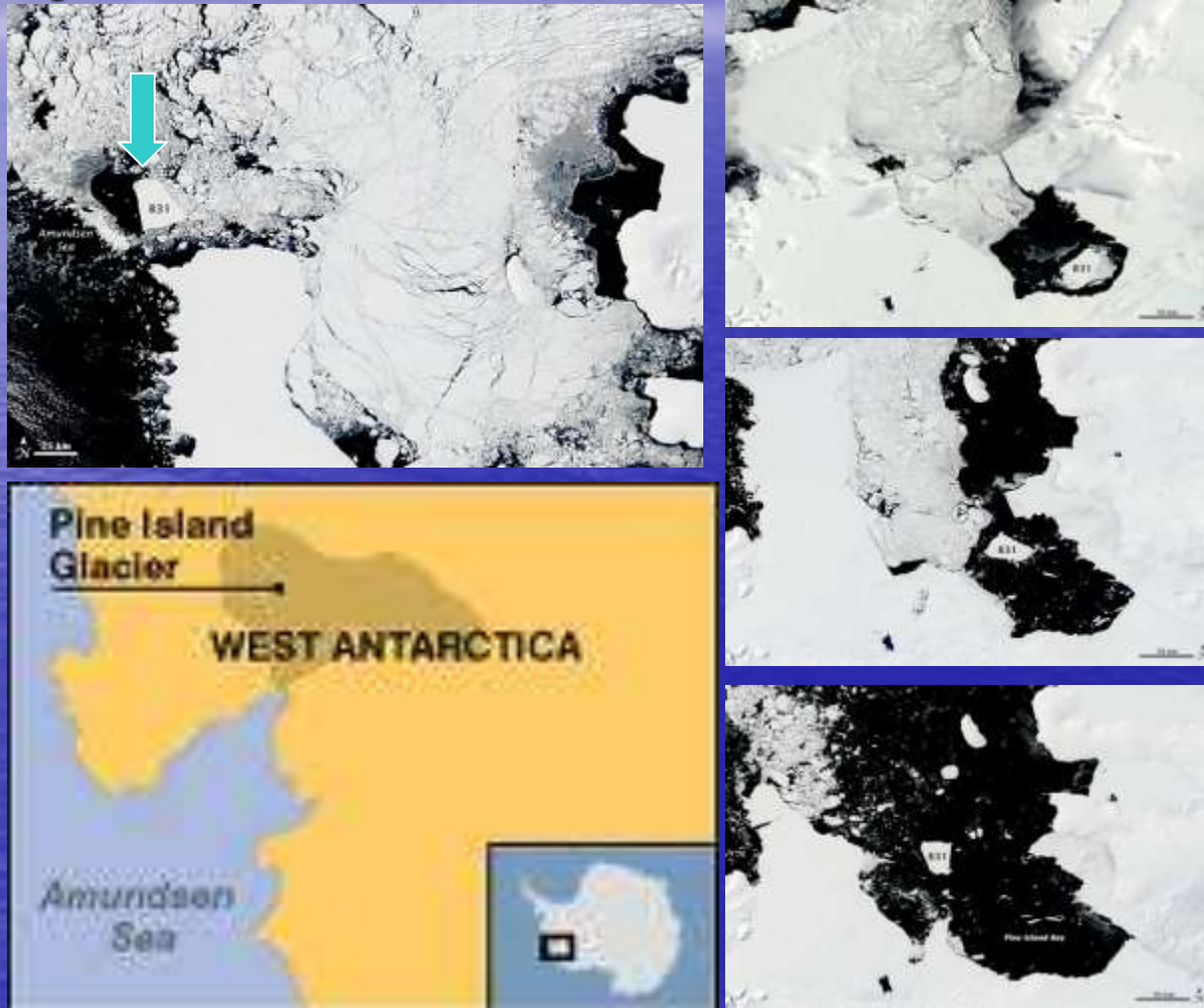
It is the largest Tabular Iceberg formed in 2000 with a surface area of 11,000 km<sup>2</sup>. Shaped like a tube it broke lose from the Ross Ice Sheet measuring 295 km X 37 km X 200m. It then broken up into several pieces





## Iceberg B31

In Nov 2013, a massive city size iceberg B31 of 700 km<sup>2</sup> & 487 m thick which is 6 times Manhattan and same size of Singapore broke away from the Pine Island Glacier & is now floating towards the Southern Ocean southward



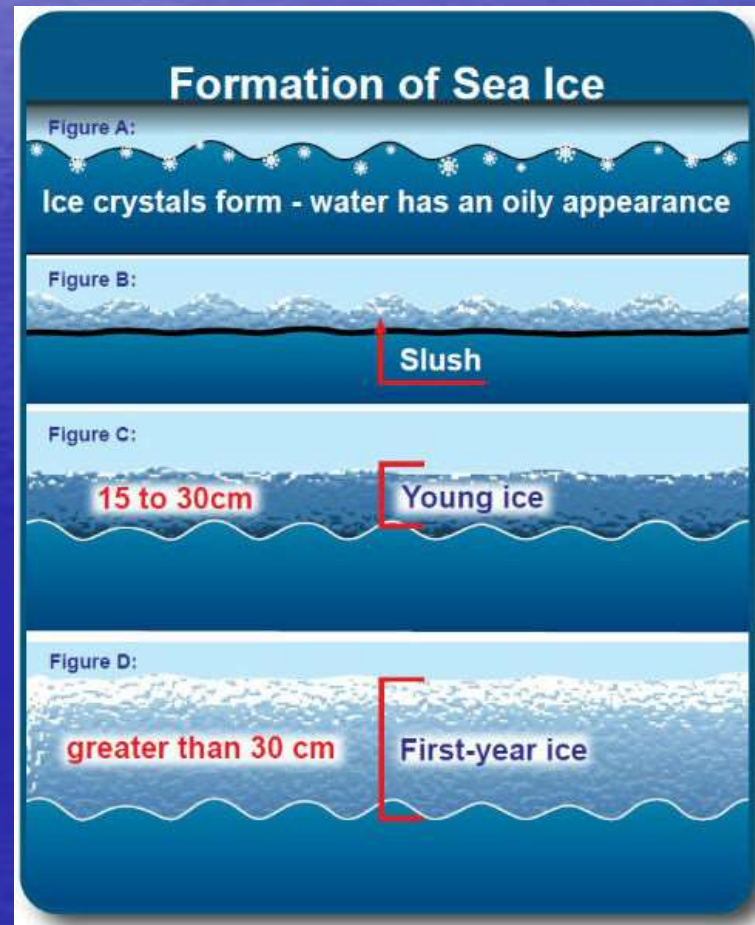
# Sea Ice 海冰

- Sea ice is frozen sea water formed when the temperature reached approximately -1.8 C depending on the salinity. It is usually 2 to 3 m thick & called Fast Ice 固定冰 if it is attached to land & Pack/Drift/Floe ice 浮冰 if it is not. Sea Ice can also be classified by age into Young Ice, First Year Ice & Old Ice

Fast Ice

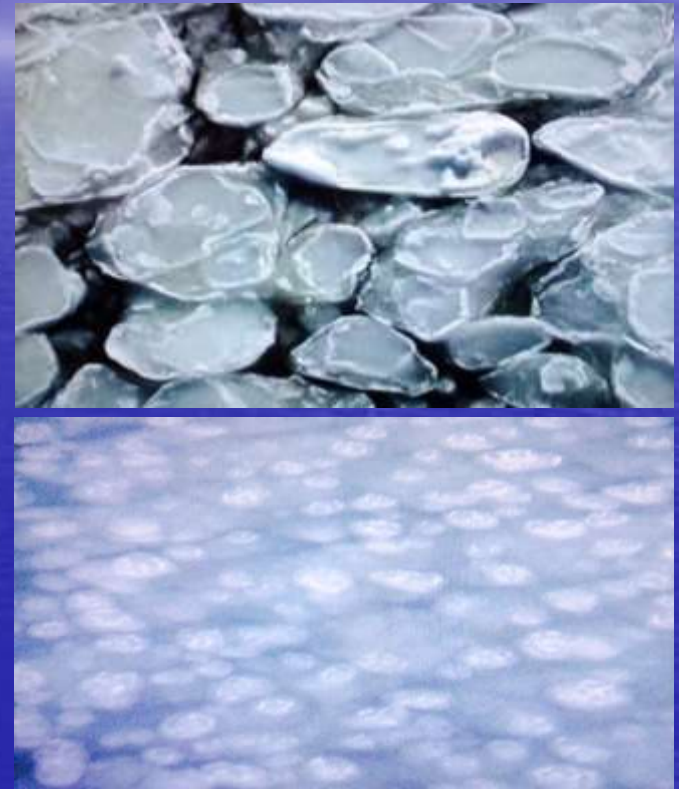


Pack Ice





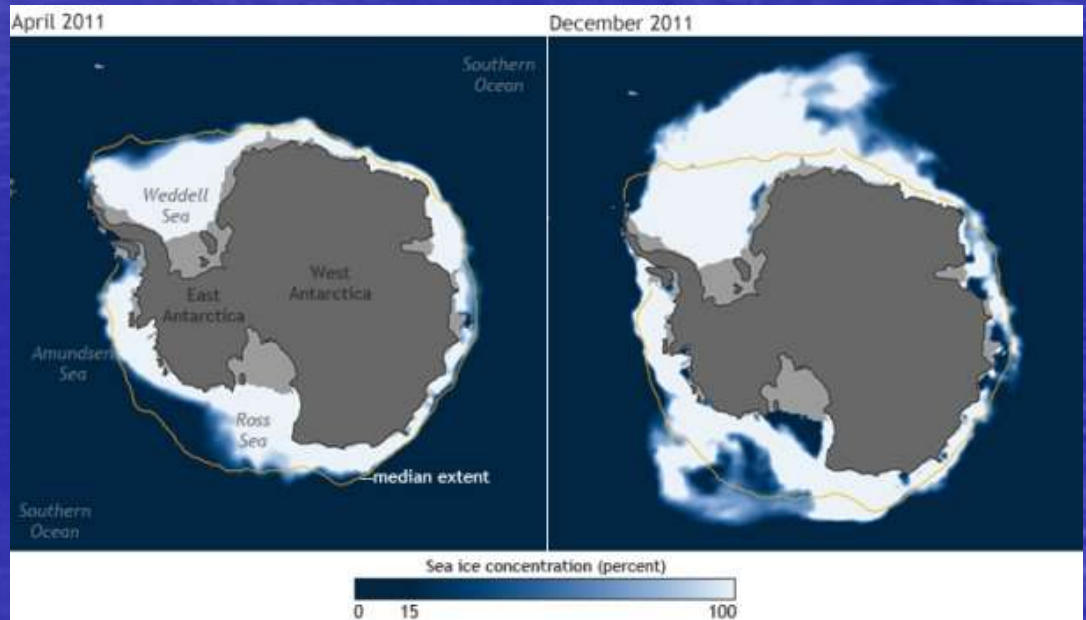
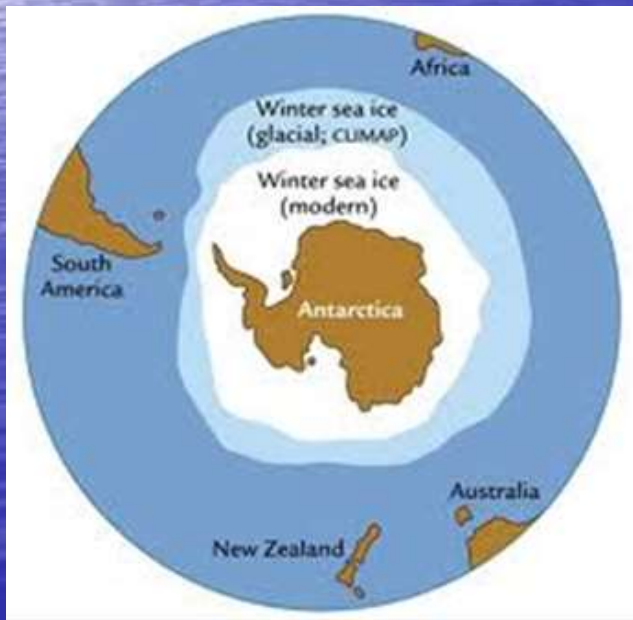
Appearance wise Sea Ice can be in many different forms depending very much on the sea condition – Pancake Ice is formed under rough ocean & Grease Ice is formed under calm ocean



When ice form in sea water, salt accumulates into brine & is expelled back into the sea making it denser. The ice floats on it thus creating a barrier between the ocean and the atmosphere which prevents heat exchange & keeps it cool

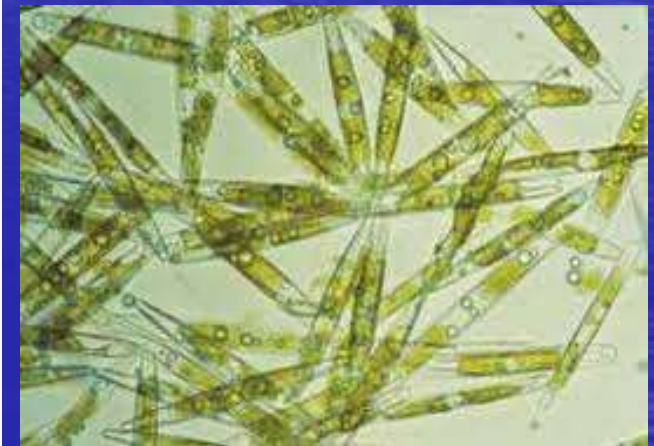
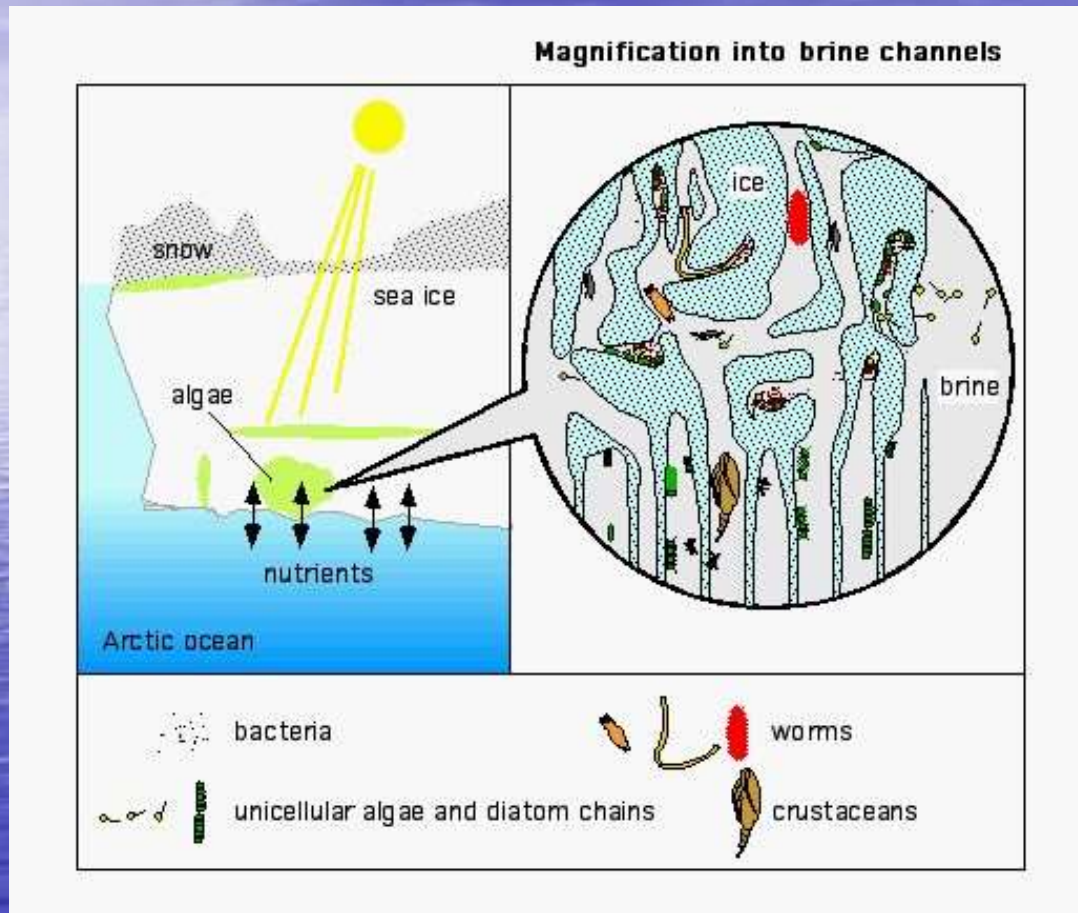
Sea Ice undergo a significant yearly cycling in surface extend. In winter Antarctic sea ice has a coverage up 5 million square miles. When Sea Ice melted in the Summer, it can reduce the size of Antarctica by up to 50%. Sea Ice is extremely important for the Antarctic Ecosystem as it provides :

1. The habitat for seals & penguins
2. Sheltering the phytoplankton (Diatoms) & krill population from predators
3. Keep the coastal temperature cool as it reflects up to 80% of the sun's ray compared to only 2% by unfrozen sea surface





## Relationship between Sea Ice & phytoplankton



Sea Ice is very dynamic. Driven by wind & current Pack ice can come & go at short notice & dangerous to ship's passage. Two of our crafts were stuck for hours and needed to be rescued by the mother ship





## Sea Ice 1/8



## Sea Ice 2/8





## Sea Ice 3/8



## Sea Ice 4/8





## Sea Ice 5/8



## Sea Ice 6/8





## Sea Ice 7/8

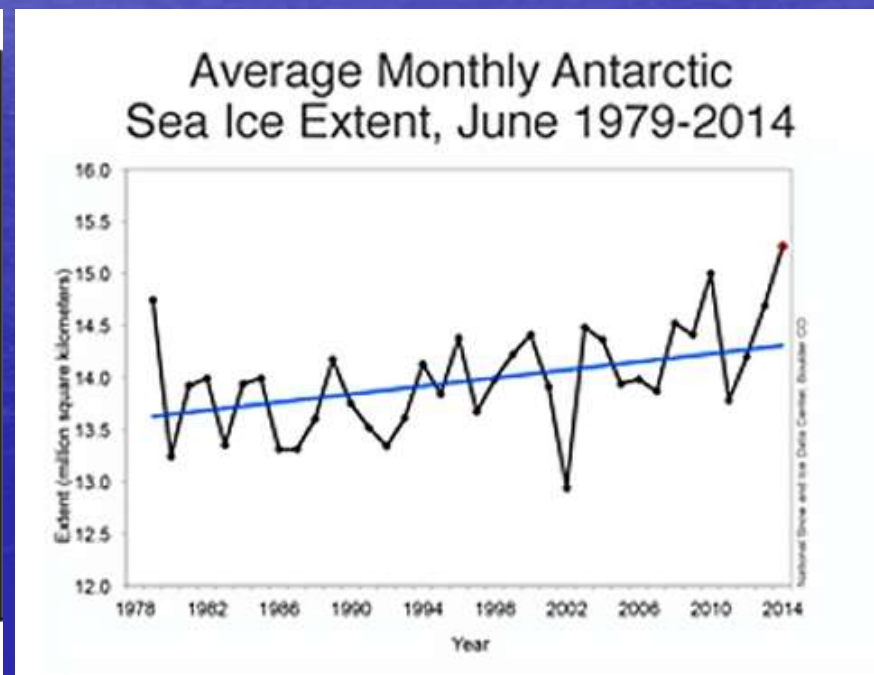
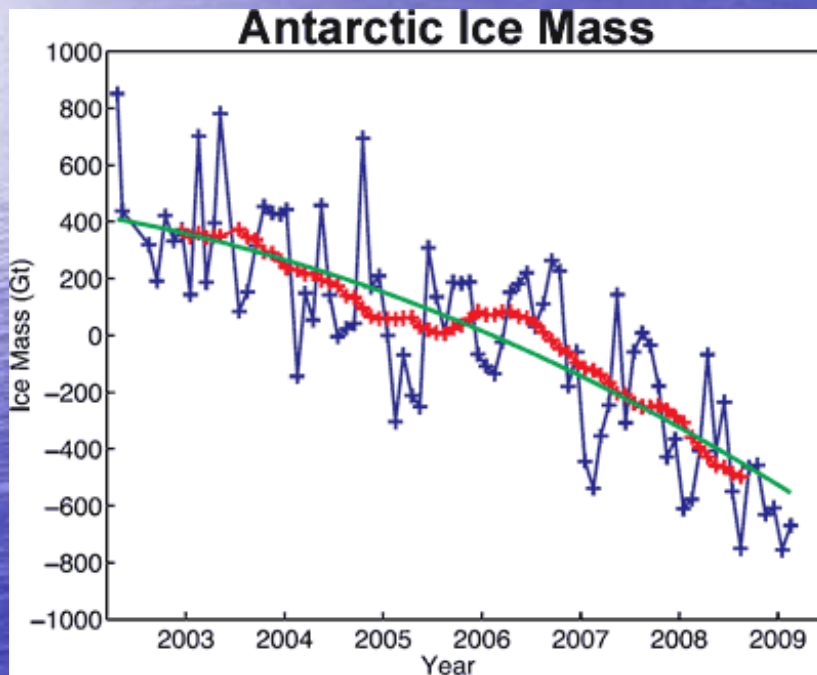


## Sea Ice 8/8





- In the last 50 years temperature has risen by 2.5 C. As a result the Antarctic Ice Mass on the continent is shrinking especially in the west & fastest in the Antarctic Peninsula. Antarctic land ice is losing more than \*100 km<sup>2</sup>/year since 2002. However sea ice around Antarctica is **growing** & exceeding 20 million km<sup>2</sup> for the first time in 2014 despite the fact that the Southern Ocean is actually warming at 0.17 C per decade (\* total mass of Antarctic land ice is at 25-30 million km<sup>2</sup>)



The loss of Ice from West Antarctica between 2009 and 2012 caused a dip in the gravity field over the region

2015 was the warmest year for 150 years. Latest climate model by US scientists predict that ice in Antarctica could melt much more rapidly than earlier estimate made by the United Nation's Intergovernmental Panel on Climate Change (IPCC). This is due to two previous ignored phenomenon namely hydrofracturing & ice carving which particularly affected the West Antarctica Ice Sheet as most of it is below sea level. Their revised estimate is for sea level to rise by 1 meter at the end of this century & 15 meters by 2500 !

Red line shows current ice sheet extend





A wide-angle photograph of the Antarctic ocean under a blue sky with wispy clouds. The sun is visible on the left side, creating a bright reflection on the water's surface. The text "ANTARCTIC FLORA & FAUNA" is centered in the middle of the image.

# ANTARCTIC FLORA & FAUNA

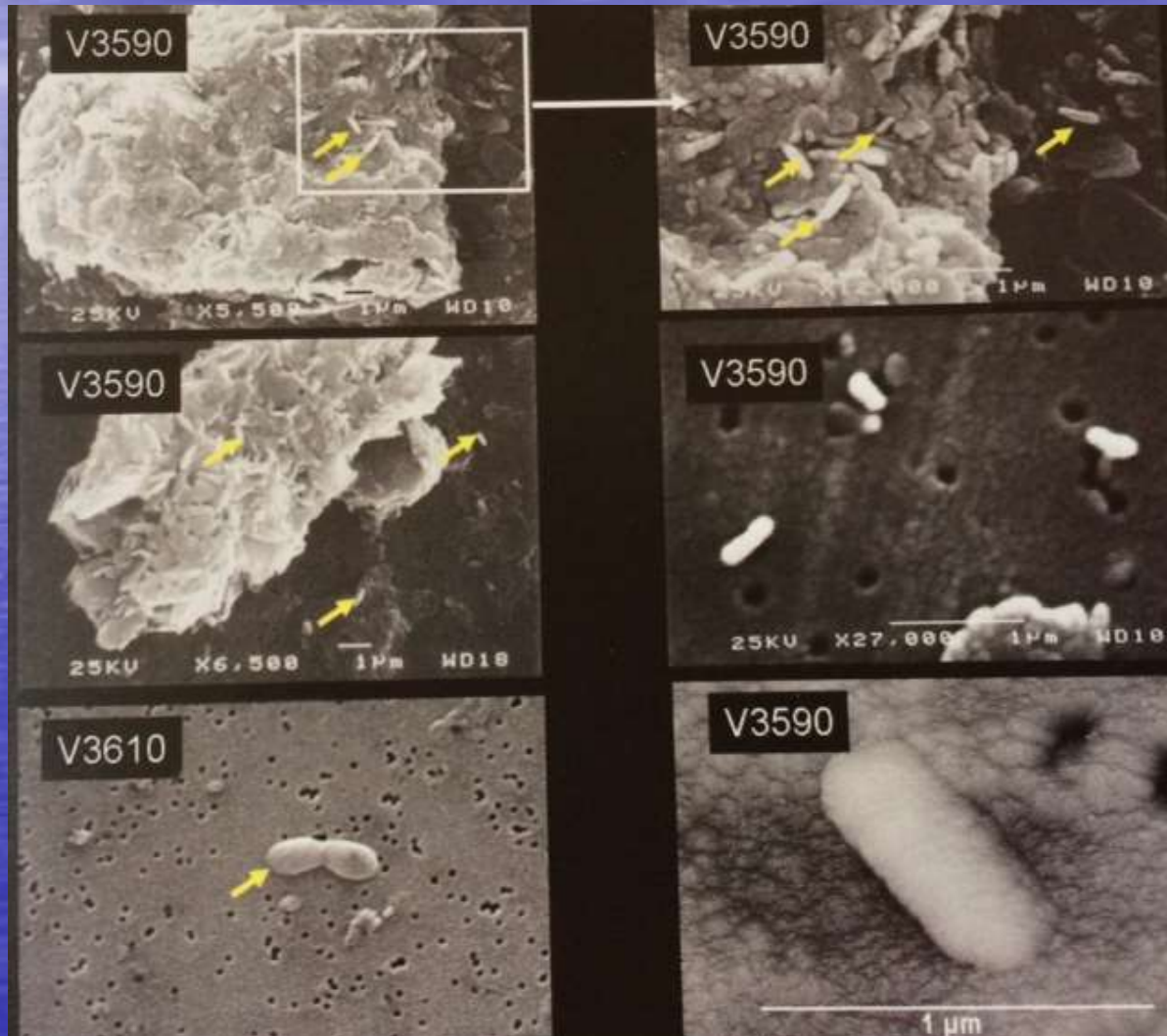
# Characteristics

- Compared to the North Pole, life in Antarctica is very sparse
- No trees - only mosses, lichens & grass
- No naturally occurred mammals, reptiles or amphibians at all on land
- Terrestrial animals are arthropod – 130 species most insects are parasites
- 10 species of birds
- Compared to land animals, Marine animals have more varieties with some of them huge in quantity



# Microorganisms

Microorganisms (bacteria & fungal) recovered from a depth of 3,590 m above the subglacial lake Vostok





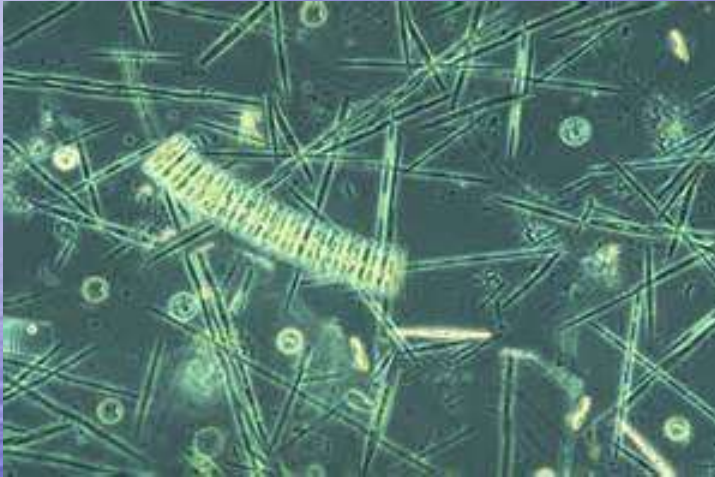
# Antarctic plant life

- No soil, no habitable perma frost (too cold & too dry). Very few species have been recorded in the 1% of the continent which is ice free
- They include 300 species of algae 藻, 100 species of mosses 苔蘚, 300-400 species of lichens 地衣, 27 species of liverwort 地錢, 28 species of fungi 真菌 & 2 species of grass





- Antarctic algae 藻: 300 species of terrestrial & aquatic algae have been identified. Most important are the marine phytoplankton which forms the base of the Antarctic food web. Algae also plays a significant role in global climate by absorbing carbon dioxide which is the most important green house gas





- Antarctic lichen 地衣 : 300-400 species divided into 3 main types – crustose lichen which forms a thin crust on the surface of the substrate they grow on; foliose lichen which have lobe like leaf and fruticose lichen which have shrubby growth. They all grow very slowly – can be only 1 cm per 100 years even in the most favorable conditions

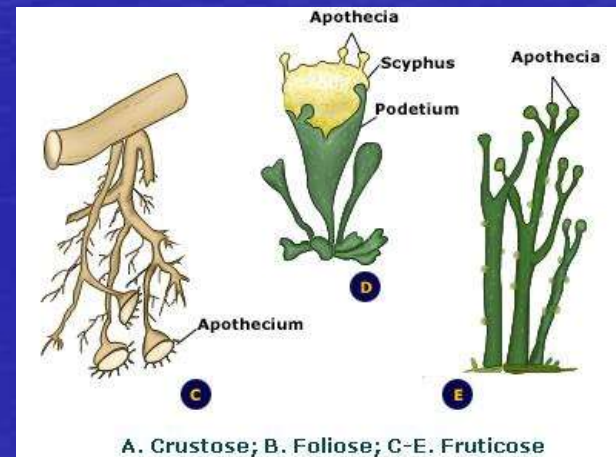
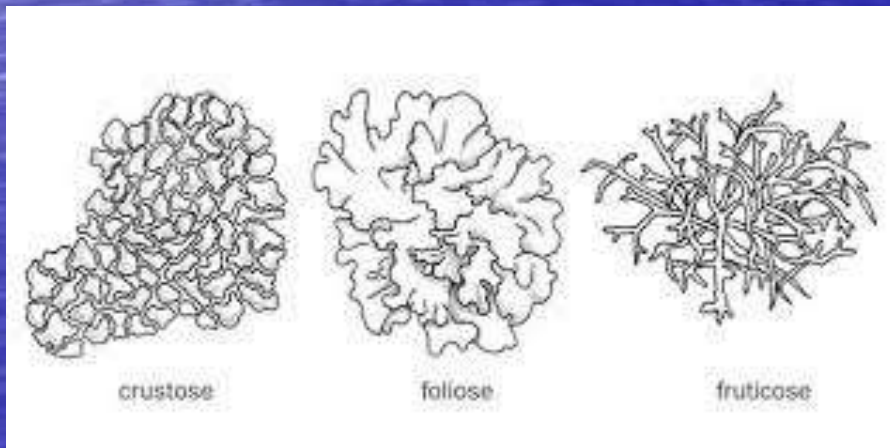
crustose lichen



foliose lichen



fruticose lichen





*Usnea antarctica* 南極松蘿 is a fruticose lichen that grows like leafless shrubs and acts like a “nurse” species to other Antarctica flora





- Liverwort 地錢 : 27 species of this nonvascular land plant have been identified in Antarctica





- \*Antarctic hair grass 南極髮草 : ( *Deschampsia antarctica* ) & Antarctic Pearlwort 南極漆姑草 ( *Colobanthus quitensis* ) are the only two native flowering plants ( vascular plant )



- It is estimated that each year visitors brought with them some 70,000 seeds to Antarctica & some non native plants like Poa annua 早熟禾 has already taken root & became a resident plant





## Antarctic arthropods

- Mainly tiny ones like lice 虱, fleas 跳虱, midges 蚊蚋 & mites 蟎. All have natural antifreeze. Mites can survive very cold temperature down to -30 C. Many are parasites of seals & birds. At 1.3 cm long, a flightless midge called *Belgica antarctica* 南極百吉卡蚊蚋 Photo at left shows a mating pair. It is endemic & also the largest animal in the continent ! Live one week





- Mites (*Alaskozetes antarcticus*) 蟎 : Black ones are herbivores, the “elephant” of the ecosystem. The smaller orange ones (*Gamasellus racovitzai*) are the predators, the “lion” feeding mainly on Spring tails

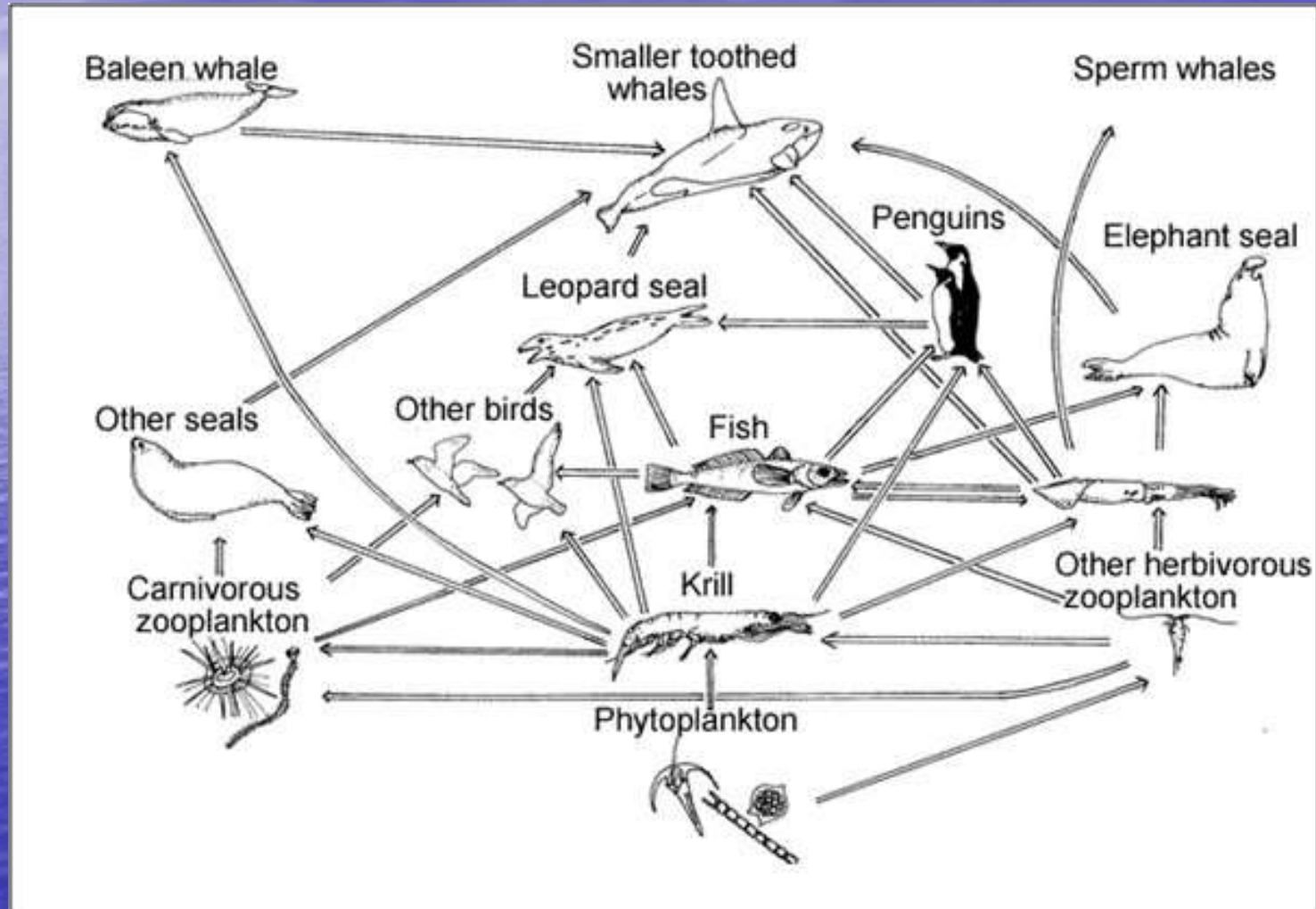


- Spring tails (*Cryptopygus antarcticus*) : a terrestriil invertebrate 1-2 mm long feed on lichen, algae & fungus. Life span 3 years



# Antarctic Marine Life & the Food Web

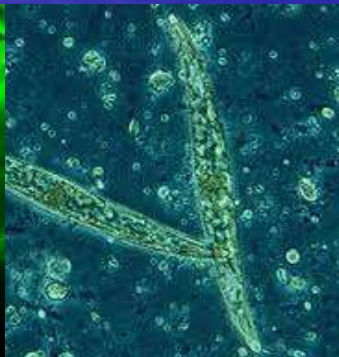
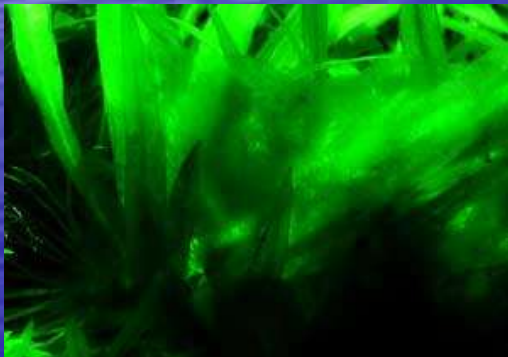
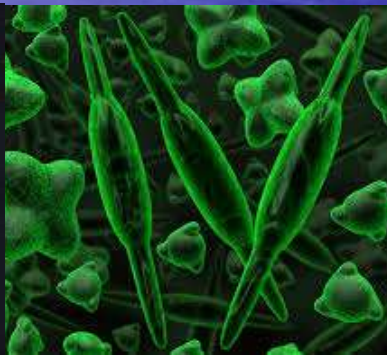
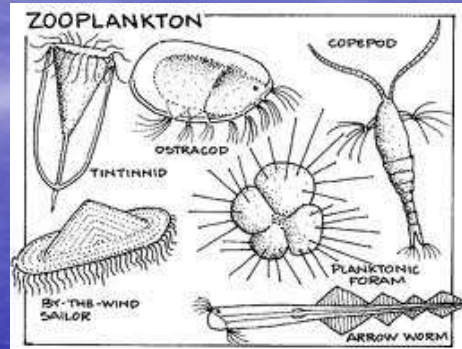
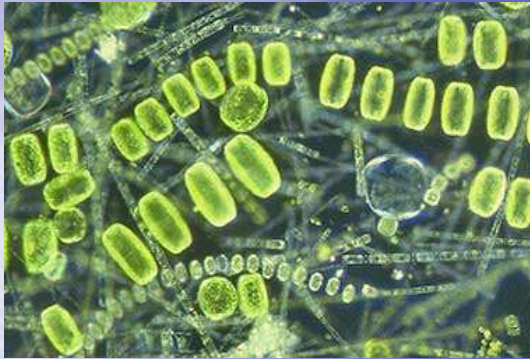
From phytoplankton & zooplankton to krill, fish, squids, seabirds, seals, penguins & whales



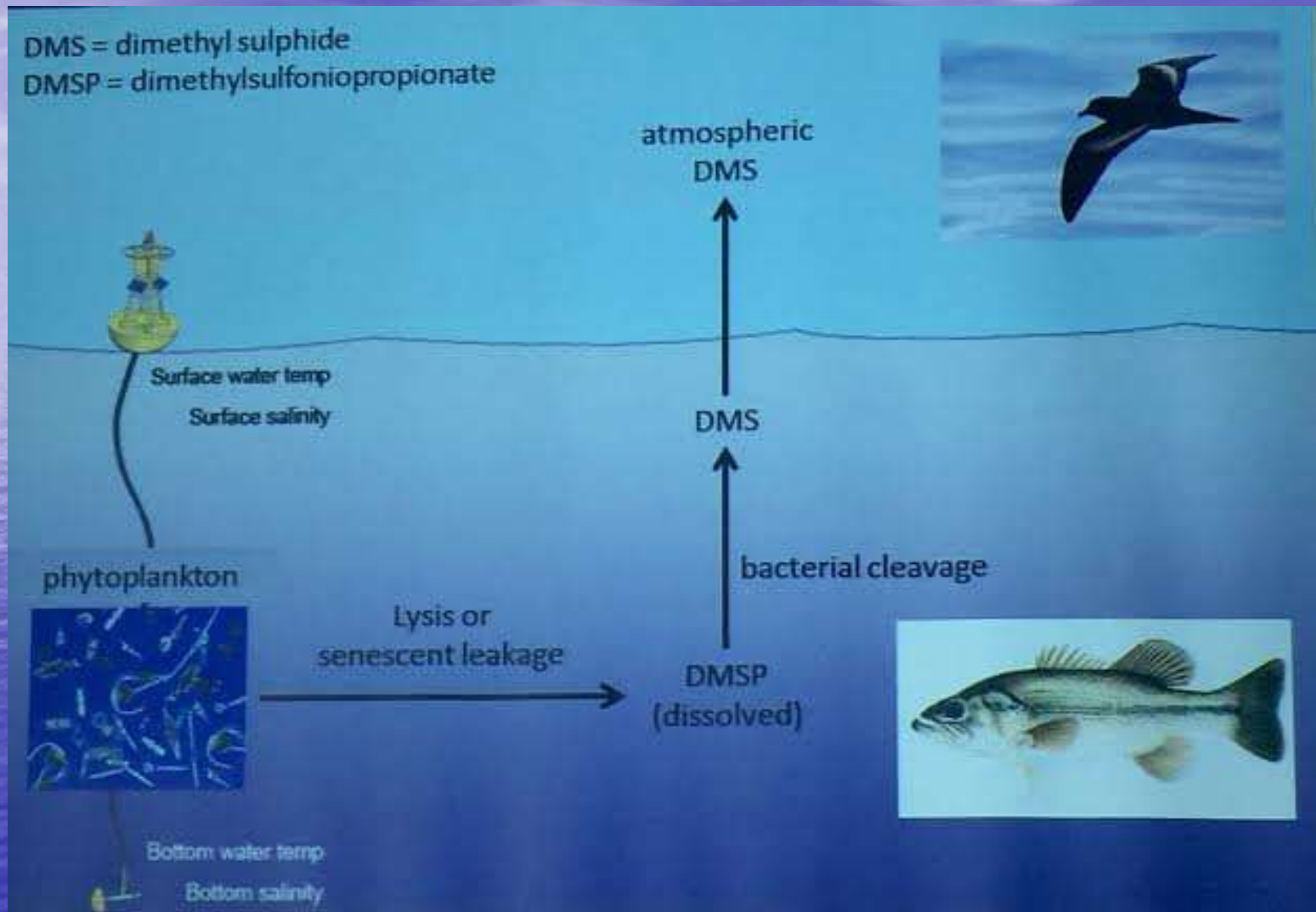


# Phytoplankton & Zooplankton 浮游生物

Only 3 % of the total global volume form the base of the Antarctic Ecosystem



# Phytoplankton & DMSP – plants SOS





## Life at the bottom

Scientists recently discovered that the Antarctic ocean floor is rich in life including sponges, worms, clams & starfish especially around hydrothermal





# Coral, Sea urchins & Star fish





The starfish main food source is the excrement from seals !





## Medusa's bell jellyfish & others



## A Sun Star





## A bizarre "Lost World" under the Ice Shelf

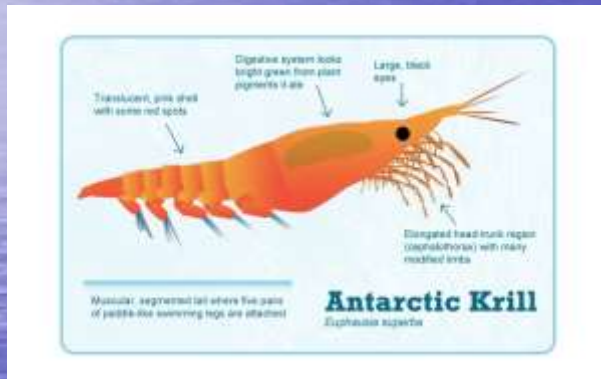
In 2015 scientists drilled through 740 m deep Ross Ice Shelf & by using a ROV discovered a huge quantity of strange looking fish, amphipods & unknown creatures living in the dark -2C water. Chemical energy rather than sun light could be sustaining bacteria & other microbes for the fish to feed on





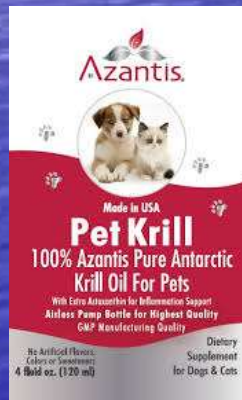
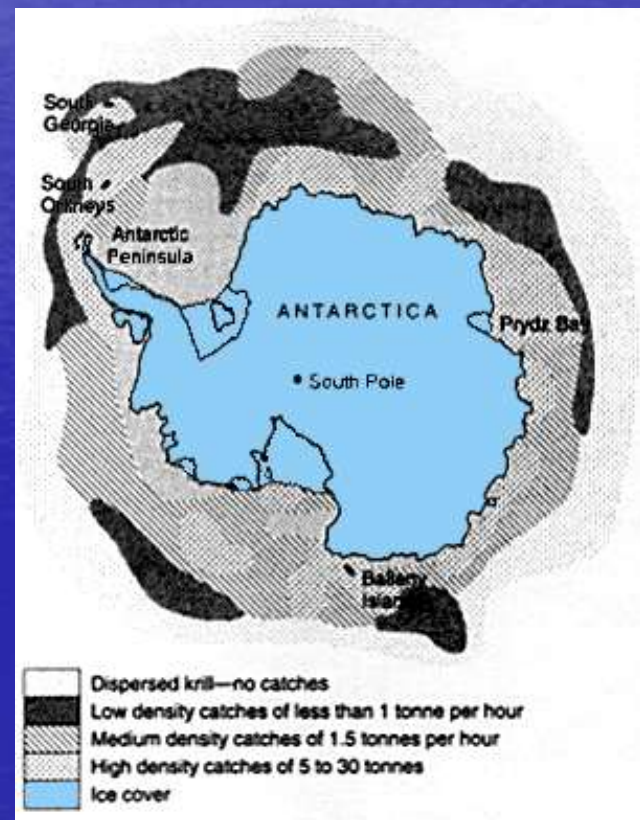
## Antarctic krill (*Euphausia superba*) 磷蝦

Small crustaceans that are dinner for so many. 8 species. Size 1 to 6 cm life span up to 5 years consume algae & plankton for food. Day time in deep water & surface at night. The Antarctica krill has a biomass of 600,000 billion strong weighing 500 million tons making it the most abundant animal in the world !





Antarctic krill can be found in water not deeper than 100 m located south of the 50 degrees Latitude. About 55% of its body is protein. Each year around 115 million tons are being eaten by seabirds. Another 200,000 tons of Krill is being harvested by 9 countries including China for fish feed as well as making krill oil which is rich in two nutrients namely Omega-3 & phospholipids ( antioxidant marketed as Astaxanthin 蝦青素 ). Expanding commercial harvesting is now being managed by quotas



# SEA BIRDS

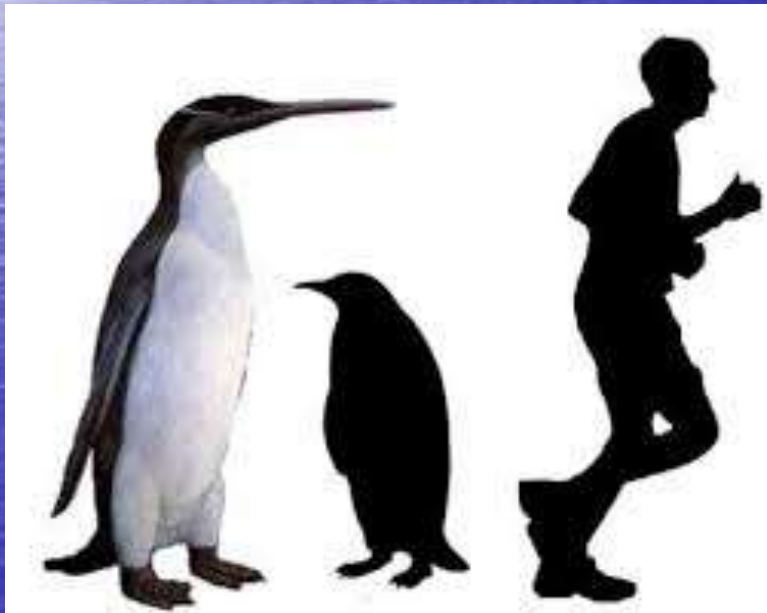
Sea birds spent most of their life time at sea & only return to land for breeding. Of 100,000 bird species only 300 are sea birds. Main challenges :

1. Cool wet environment – special feather structure
2. No fresh water – special nasal/salt glands to excrete salt
3. Adaptation for food – grab, dive, steal
4. Mobility – dive & “fly” in water, Dynamic soaring is very energy efficient
5. Breeding ground – must be close to food source



# PENGUINS (*Sphenisciformes*)

Penguins in Portuguese is “Pingus” meaning fat. They are aquatic flightless birds living exclusively in the Southern Hemisphere probably evolved from petrel 海燕 & albatross 信天翁 60 million years ago then developed into different species we see today some 23 million years ago. In 2014 scientists have discovered an ancient penguin *Palaeudyptes klekowskii* 卡氏古冠企鵝 which lived 37 million years ago. At 2 m high weighed 115 kilos it was taller than the Emperor penguin by 90 cm & weighed twice as much & able to stay in water for over 40 minutes !



Having webbed feet and wings reduced to flippers, penguins are extremely powerful swimmers. Some species can dive to a depth of 565 m & swim for 10 km. Adapting to the Antarctic waters they also have short legs, thick & dense insulating feathers (X4) lacking barbs and hefty store of body fat & nictitating membrane to protect the eyes. These restrict them living in warmer places. They are also monomorphic

Gentoo



Macaroni



Magellanic



Rock hopper





## Proposing

At sea proposing is common for breathing or to confuse predators. On land penguins move by waddling or toboggan meaning sliding over the ice on their bellies which is a faster way than waddling



## Waddling



## Toboggan

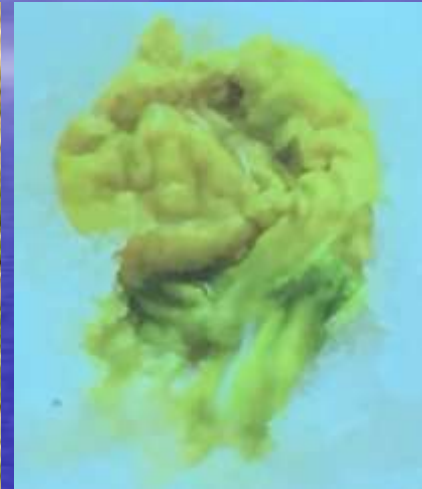


Penguin's taste buds are underdeveloped & can only differentiate sour & saltiness but not sweet, bitter & freshness probably due to the extreme cold temperature in Antarctica. That penguins swallow their food whole & their tongues are laden with sharp spike like papillae may have some relationship with this unusual trait

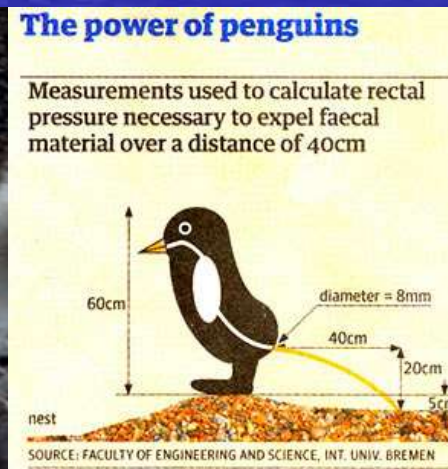




Penguin eats a lot of krill which contains an exceptionally high amount of phosphite which is poisonous. The way penguins protect themselves is by digesting the krill very quickly. The poison is also being kept on the gut lining which is then excreted from the body



Extreme PHD research – How penguins pooh pooh !





Their main diet includes fish, crustacean & squid. Average life span in the wild is 12 to 20 years. Large penguins lay one egg each year whereas small ones have two eggs. Penguins also go through moulting





Baby penguins molt & so are adults to replace damaged feathers due to wear & tear. Molting needs a lot of energy & takes 2 to 5 weeks with the old feathers being pushed out & replaced by new ones so that at all time the penguin has insulation to keep warm





There are 3 families : King/Emperor (*Aptenodytes*), Brush or Bristle tail (*Pygoscelis*) & Crested (*Eudyptes*) covering 18 species 7 of which live in Antarctica totaling 120 million (87%). They are the Emperor, King, Adelie, Gentoo, Chinstrap, Macaroni & Rock hopper. Only 4 namely the Emperor, Adelie, Chinstrap and Gentoo breed in the continent

| Penguin Species             | Scientific Name                |
|-----------------------------|--------------------------------|
| Emperor Penguin             | <i>Aptenodytes forsteri</i>    |
| Adélie Penguin              | <i>Pygoscelis adeliae</i>      |
| Chinstrap Penguin           | <i>Pygoscelis antarcticus</i>  |
| Gentoo Penguin              | <i>Pygoscelis papua</i>        |
| King Penguin                | <i>Aptenodytes patagonicus</i> |
| Southern Rockhopper Penguin | <i>Eudyptes chrysocome</i>     |
| Northern Rockhopper Penguin | <i>Eudyptes moseleyi</i>       |
| Macaroni Penguin            | <i>Eudyptes chrysolophus</i>   |
| Royal Penguin               | <i>Eudyptes schlegeli</i>      |
| Little Blue Penguin         | <i>Eudyptula minor</i>         |
| Snares Crested Penguin      | <i>Eudyptes robustus</i>       |
| Erect Crested Penguin       | <i>Eudyptes sclateri</i>       |
| Fiordland Crested Penguin   | <i>Eudyptes pachyrhynchus</i>  |
| Yellow-eyed Penguin         | <i>Megadyptes antipodes</i>    |
| Humboldt Penguin            | <i>Spheniscus humboldti</i>    |
| Magellanic Penguin          | <i>Spheniscus magellanicus</i> |
| Galápagos Penguin           | <i>Spheniscus mendiculus</i>   |
| African Penguin             | <i>Spheniscus demersus</i>     |





## Penguins of the world showing their relative sizes

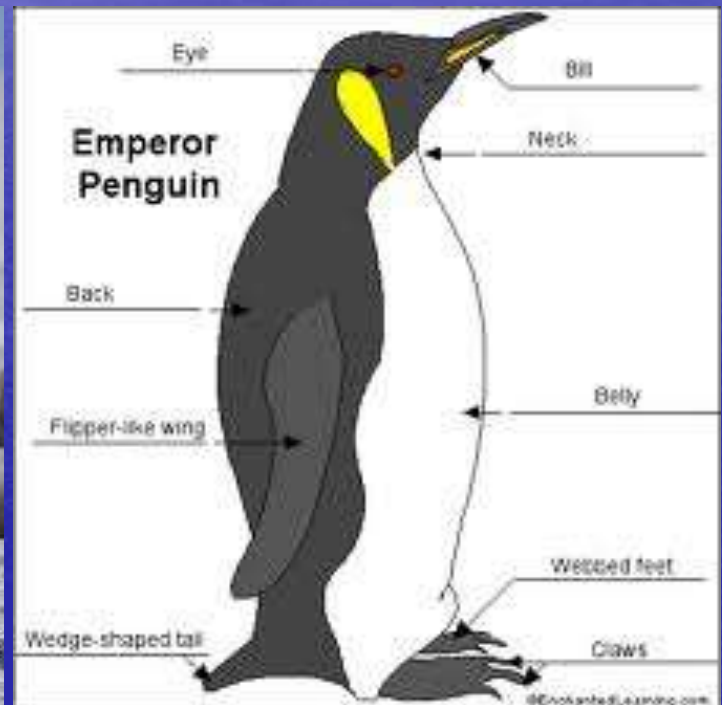


1. Emperor 2. King 3. \*Gentoo 4. \*Chinstrap 5. \*Adelle 6. Yellow eyed  
7. Royal 8. Macaroni 9. Erect crested 10. Snare 11. Fiordland 12. Rock  
hopper 13. Magellanic 14. Humboldt 15. African 16. Galapagos 17. Fairy

(\* Bristle tail penguins 硬尾企鵝 )

- Emperor penguin (*Aptenodytes forsteri*) 帝企鵝

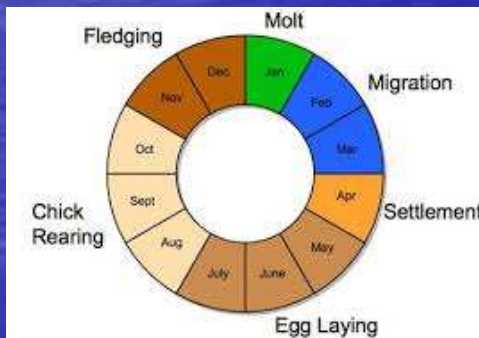
The largest of all penguins with male & female of the same size being 1.3 m tall weighing 45 kg. Rather rare totaling only 570,000. They are the one of the two species of penguin that breed in Antarctica.





# Emperor Penguin Annual Life Cycle

Every year the mating pairs trek 50-120 kilometers across the Antarctic wasteland to their ancestral breeding grounds on sea ice & laid only one egg. The male is responsible for incubation which takes 2 months standing up without food & water in the cold winter (-70 C) under total darkness until being relieved by the female. Note the nursing sag 抱卵囊 on the feet





- \*King penguins (*Aptenodytes patagonicus*) 王/國王企鵝

World's second largest penguins 90 cm tall weighing 1 kilo totaling 1.5 million pairs. Their dive can last 15 minutes. Note the solid yellow orange patch at the back of the neck. Chicks are being look after for 14 months so they give birth of 2 chicks in 3 years. Parents identify their chicks by their distinct individual call. The chicks started molting at 12 to 13 months



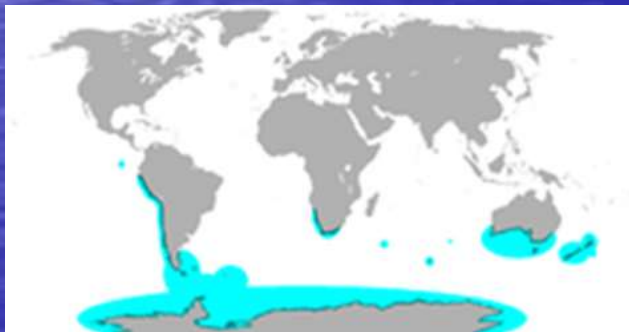


Unlike Emperor Penguin, incubation for King Penguin is the job of both the male & the female. During winter the chicks are left alone & rely on their fat reserves to survive. The parents undertake extended foraging trips, returning only rarely to feed the chicks. Adult birds have been tracked to make 50 days round trips covering 1,800 km ! King penguins favorite food is lantern fish



- \*Gentoo Penguins (*Pygoscelis papua*) 紳士/金圖/巴布亞企鵝

3<sup>rd</sup> largest penguin totaling 320,000 pairs . They are the fastest swimmer with speed up to 36 km per hour & dive to 100m. They breed in Antarctica but are residents of the Falklands. 76 cm tall weight 6 kg they built their nest on rock. Note the white triangular patch over eyes and long stiff tail for balancing when walking on ice





Gentoo is one of the "Brush tail" penguins which also include the Adeline & the Chinstrap. Note the nest they built with small pieces of rocks



Gentoo lives together in sizeable colonies. Note the hook shaped tongue





- \*Adelie Penguins (*Pygocellis adeliae*) 阿德利企鵝

45-55 cm tall weighing 4.5 kilos this tuxedoed penguin is the smallest penguin living only in Antarctica totaling 2.5 million pairs. Very good swimmer, can jump directly from the sea to shore. They spend 5 months at sea and go ashore for breeding building their nests with pebbles, produce two eggs but raise only one chick. Note the distinctive white ring around the eyes & feeding its young by regurgitation





Adelie penguins built their nests with pebbles they picked up with their mouths. Some lazy ones steal from the other's nests





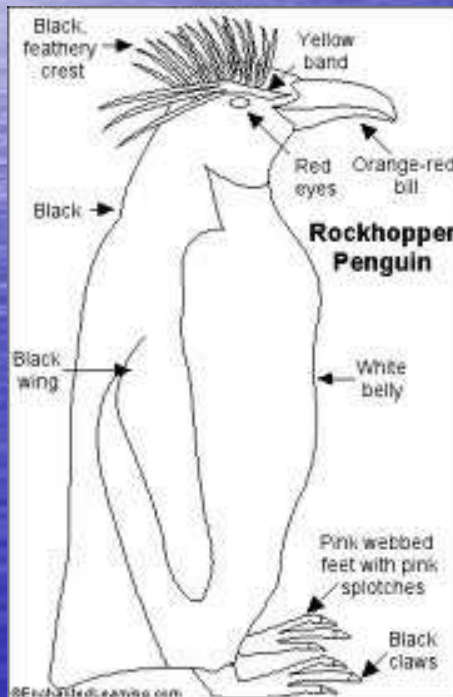
- \*Chinstrap Penguins (*Pygocellis antarctica*) 帽帶/頰帶/白眉企鵝  
Also called ringed or bearded penguin. Most common species totaling 7.5 million pairs. Weigh 6 kg & 68 cm high. Fast swimmer can dive down to 70 m & scoot quickly on its belly. Main diet krills & like to nest on hill tops of volcanic ash





- \*Rockhopper Penguins (*Eudyptes chrysolophus*)

跳岩/喜石企鵝 The smallest of the crested penguins 58 cm high weighing 3-4 kilos. Normally lays two eggs but the first one is smaller & seldom survive. Very sociable animal often seen preening one another. Two species the Northern & the Southern totaling 3.5 million pairs mainly living in Sub Antarctic islands especially in the Falklands where they nest among albatross & called "Rockies" by the local people Note the spike yellow feathers dropping from side of head.





- \*Macaroni Penguins (*Eudyptes chrysolophus*)

馬克羅尼企鵝 One of 6 crested penguins found in the sub Antarctic to the Antarctic Peninsular weighing 5.5 kg & 70 cm in length. Nest on slopes. Very noisy & aggressive. With 12 million pairs they are the world's most abundant penguin but now classified as vulnerable









# A tale of three penguin species



Climate change “winner”



Gentoo

- expanding population + range
- opportunistic colonizer
- less specialized diet
- more likely to re-lay

Climate change “losers”



Adélie

- populations declining, disappearing
- colonial, minimal “pioneering”
- krill specialists
- unlikely to re-lay



Chinstrap

Source: Antarctic Site Inventory data & analysis

Slide courtesy of Ron Naveen, 2012

# Penguin populations near palmer station

Adélies declining, Gentoos and Chinstraps invading and increasing



PAL-  
LTER





**Palmer 2001-02 Heavy spring snowstorms: near- total penguin breeding failure** (as air warms, more evaporation and greater water content – more snow!)



**2013 Giant Iceberg B09B killed 150,000 Adelie penguins  
by blocking their way to feed with 10,000 survivors now  
struggling for life at Cape Denison**





- \*Wandering Albatross (*Diomedea exulans*)

Also called snowy, white winged albatross or Mollymawk, it is a large sea bird of the albatross family. The bird mates for life and start breeding at the age of 10 giving one egg in two years. Nest in colonies on islands in the South Ocean the largest of which is in South Georgia. Their numbers have declined drastically to only 6,000 pairs due to long line fishing for Patagonia tooth fish. See slide on Patagonia fish for more details



- \*Black-Browed Albatross ( *Thalassarche melanophris* )

Also known as black-browed mollymawk, it is the most common member of the family. Wingspan 200-240 cm, 70 years lifespan. 75% are breeding in the Falkland islands. Shaped like a cup, the nest is built on the ground with mud





A Black-browed albatross colony in the Falkland Island. Note the eggs





## SKUAS 賊鷗

- \*South Polar Skuas 賊鷗 : A scavenger & an aggressive hunter, skuas is the world's most southerly bird. Note baby penguin taken by a skua



- \*Brown Skuas 褐鷗 : just as aggressive





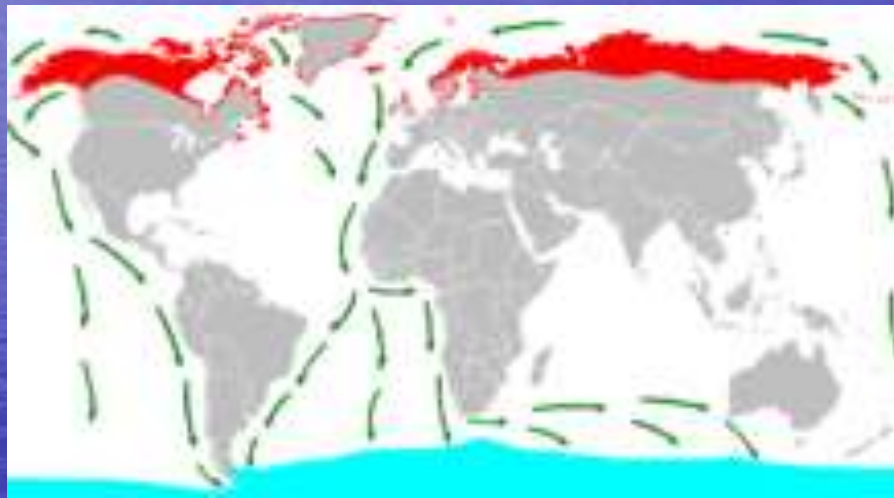
This brown Skuas was very curios as well as destructive





## \*Arctic Terns 北極燕鷗 (*Sterna paradisiac*)

They are migratory birds that travel every year between the North Pole & the South Pole. The average flight distance in its life time will be more than 2.4 million km which equals to 3 return journeys to the moon. They feed on fish & large zooplankton





## \*Antarctic Terns 南極燕鷗 (*Sterna vittata*)

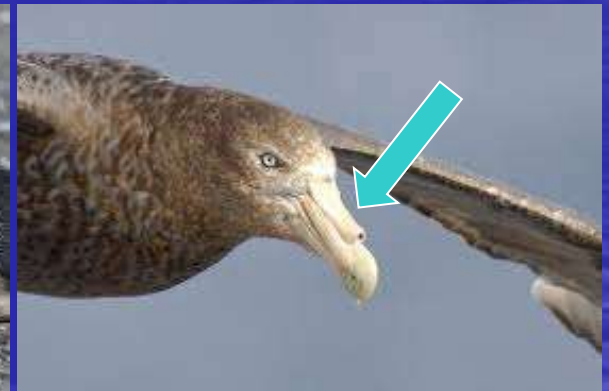
They live extensively in the Southern Oceans. Looks very similar to the Arctic tern but stockier feeding primarily on fish plus some Mollusca, insects & algae.





# Petrel 海燕

- \*Giant Petrel (*Macronectes halli*) 大海燕 : The “vulture of Antarctica”. Forage on both land & sea killing penguins & scavenge in seal colonies eating fish & squid. Note the tube noise





## Giant petrel played the role of vulture in Antarctica



- \*Antarctic Petrel (*Thalassoica Antarctica.*) most commonly found in the Ross & Weddell Sea. They eat krill, fish & small squid





- \*Cape Petrel 岬海燕 (*Daption capense*)

Also called Cape Pigeon or Pintado Petrel, it is a very common sea bird of the Southern Ocean & can only duck dive to shallow depth for krill as well as small fish & squid



Cape petrels followed our ship every where





- \*Storm petrels

Smallest & lightest seabird in the world weighs only 35g feed on planktonic crustaceans & small fish picked from the surface while hovering. Strictly pelagic they only land when breeding



- \*Snow Petrel (*Pachyptila spp.*) 雪錨 they breed exclusively on the bare Antarctic mountain tops in the summer which can be as high as 3,000 m and keep themselves clean by bathing in the snow !





\*Blue Eyed Shag/Antarctica shag/Imperial Cormorant/

King Cormorant 藍眼鸬鶚

8-14 species which are closely related to the cormorant. The inside of the mouth is red in color



## \*Kelp Gull (*Larus dominicanas*) 海帶海鷗

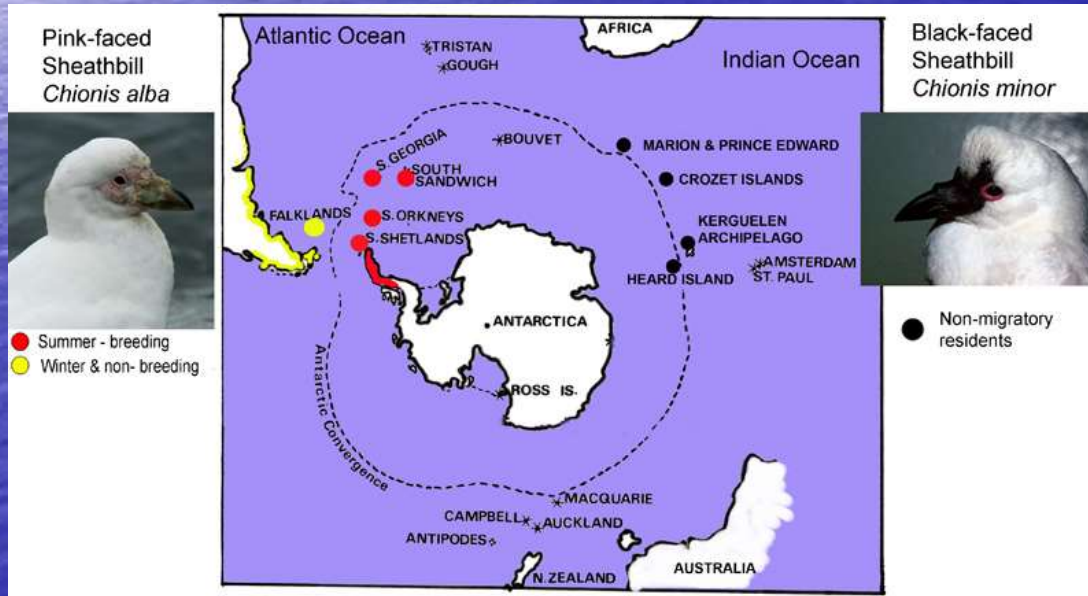
Also called the Dominican gull, it breeds on coast and islands throughout the Southern hemisphere





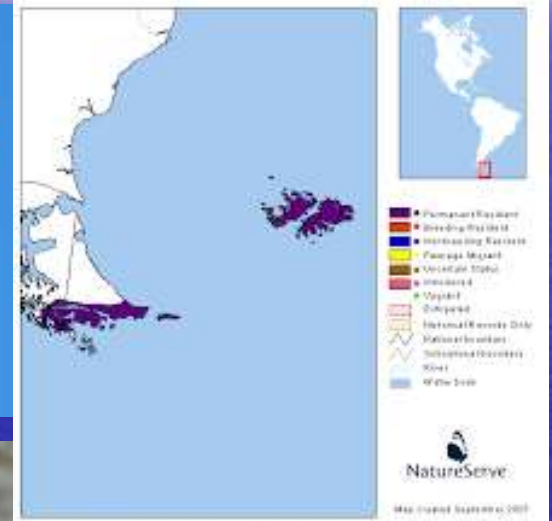
## \*Sheathbill (*Chinois*)

Two species – pink faced Snowy Sheathbill (*Chinois albus*) & Black-faced Sheathbill (*Chinois minor*). They are omnivore & scavenger and the only land bird native to Antarctica & also the only Antarctica bird without webbed feet



## \*Striated caracara 長腿兀鷹

A bird of prey living in several island & particularly common in the Falkland.  
Primarily a scavenger feeding on dead birds & dead sheep but also attack at small albatross and penguins





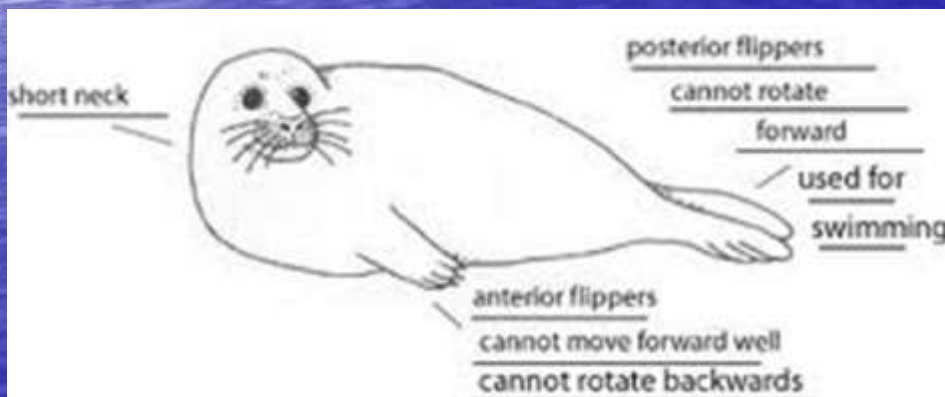
The background of the slide is a photograph of a vast blue ocean meeting a blue sky at a distant horizon. The sky is filled with soft, wispy white clouds. On the far left, a bright sun is partially visible, creating a strong lens flare and illuminating the water's surface with a shimmering effect. The water is a deep blue with subtle ripples.

# MAMMALS

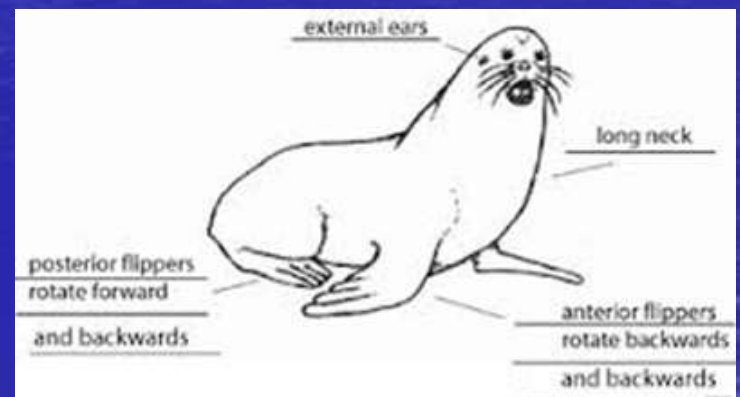
# SEAL ( Pinnipeds 鰭足類)

There are two natural groups of seals : True Seals ( f. *Phocidae* ) & Eared Seals ( f. *Otariidae*). The former is earless. The latter have ear flaps & long flippers enabling them to move rapidly on land & include fur seals & sea-lions. Six species of seal range from the sub-Antarctic to the continent totaling 32 million representing up to 90% of the world population. Seals can dive to 600 m deep and stayed under water for up to one hour. All Antarctica seals have a layer of fur & they leave the water to breed, rest & molt

## True Seals 海豹 (f. *phocidae*)



## Eared Seals 海獅 (f. *otariidae*)







皮肤层  
Skin layer

脂肪层：厚5-6厘米  
Fat layer: 5-6 cm thick

肌肉层  
Muscle layer

生活在南极的威德尔海豹的脂肪层较厚  
The fat layer of Weddell seal living in the Antarctic is thicker



皮肤层  
Skin layer

脂肪层：厚1-2厘米  
Fat layer: 1-2 cm thick

肌肉层  
Muscle layer

生活在热带的新加坡海豹的脂肪层较薄  
The fat layer of Hawaiian monk seal living in tropical is thinner



夏威夷僧海豹 *Monachus monk seal*  
Hawaiian monk seal



威德尔海豹 *Leptonychotes weddellii*  
Weddell seal

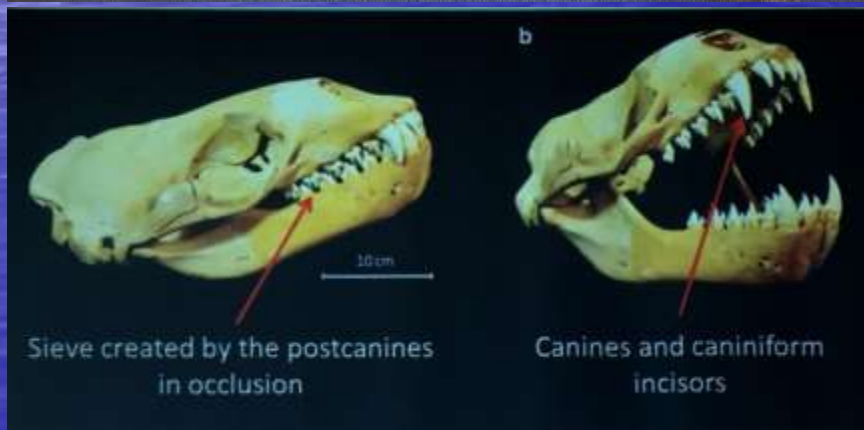
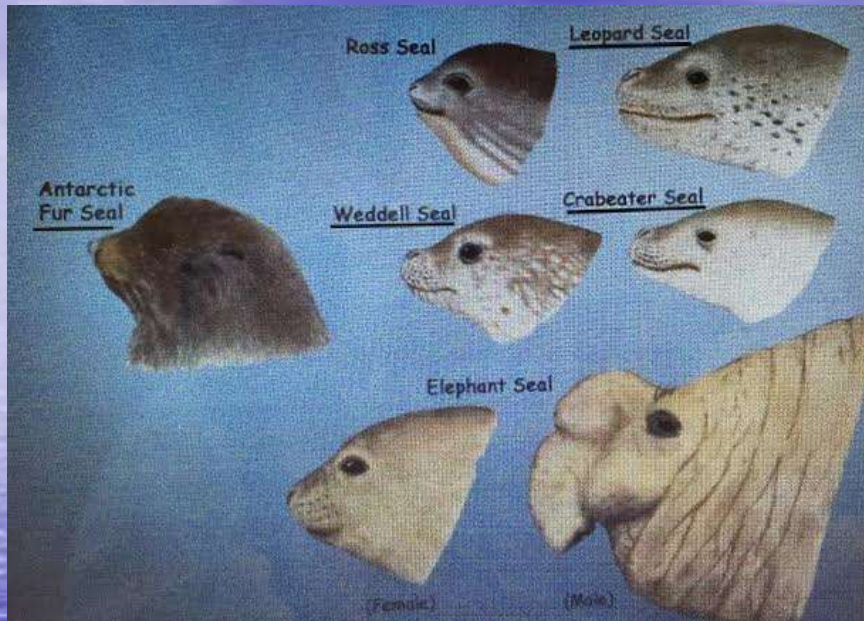
- \*Leopard Seals (*Hydrurga leptonyx*) 豹海豹

Endemic to Antarctica living on sea ice. The total population is between 200,000 to 400,000. Leopard seals are solitary carnivore measuring up to 4 meters & weighing 350 kilos making them the largest of all Antarctica seals. Not a fast swimmer but they can dive for 15- 20 minutes & down to 300m. Their favorite food is Adeline penguin but also eat krill & fish





Apart from penguins, Leopard seal also eats birds, fish, squids as well as krill. They have special tooth at the back of the mouth to sieve the smaller preys





- \*Southern Elephant Seals (*Mirounga leonina*) 南象海豹

Largest of all seals male 6m long weighing 3,600 kilos female 3.6 m long weighing 900 kilos, largest sexual dimorphism of all mammals. Once hunted for their blubber for oil extract, they can dive for 98 minutes & down to 2 km deep & remain submerged for 2 hours. In the summer they keep cool by paddling wet sand onto their bodies. A "Beach Master" male keeps a harem of as many 100 females & ready to fight to for them !





Huge Beach Master surrounded by his harem



Another giant elephant seal resting among fur seals & penguins





- \*Crabeater Seals (*Lobodon carcinophaga*) 鋸齒海豹

Endemic. 2m long weighing 227 kilos. Living on pack ice they have the largest population of all seals totaling 50 million\*. Despite its name the main diet is not crab but krill. They have specially adapted teeth with extra projections forming a sieve to strain out the krill which they consume about 20 kilos per day



\* probably the second largest animal population after human

A crabeater seal resting on sea ice





- \*Antarctic Fur Seals (*Arctocephalus gazella*) 南極毛皮海獅/海狗

Males are 2 m long weighing 200 kilos whereas females are 1.3 m long only weighs only 55 kilos. They can dive down to 100 m or more. Once being slaughtered for their fur at 1,000 per day, they have a remarkable recovery with total population of nearly 2 million. 95% of the world's population breeds in South Georgia & Orkney



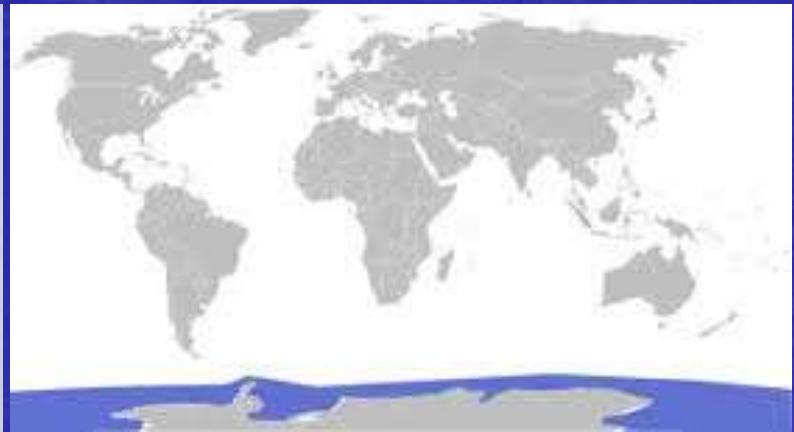


Male Fur seals are substantially larger & rules in an area of 30 square meters which can accommodate a harem composed of 10 to 12 females. Mating season is from November to February during which time they can be very aggressive



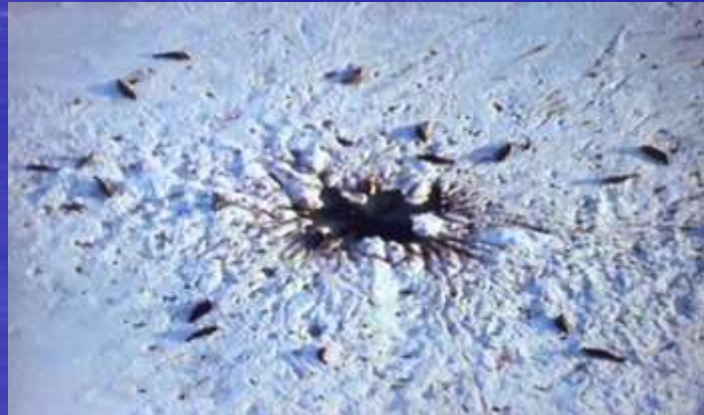
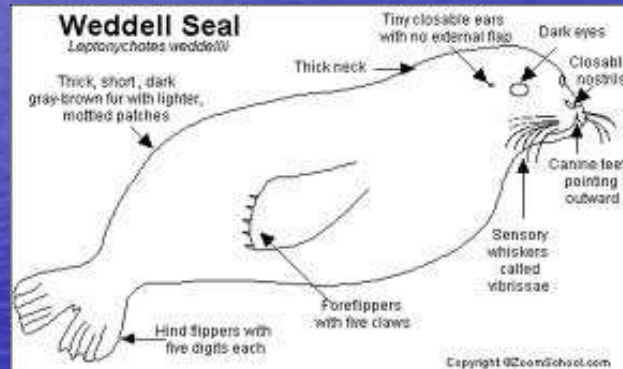


- Ross Seals (*Ommatophoca rossi*): 4 m long weighs 600 kg. Endemic. Known for its big eyes & siren like vocalizations. Confined to the Antarctica pack ice with population of 200,000, they are usually found alone or in pairs. Rarely seen in recent years



- Weddell seals (*Leptonychotes weddellii*) 威爾斯海豹

Endemic & most southerly breeding seal. 3 m long weighs 400-600 kg. Female is larger than the male (reverse dimorphism). Circumpolar distribution & live on fast ice all year round using their teeth to keep air holes in the ice open for diving down to 750 m & up to 1 hour ! Life span only 20 years as their teeth deteriorate by scrapping ice in order to keep the hole open & at the end can no longer eat anything. Total population 2 m



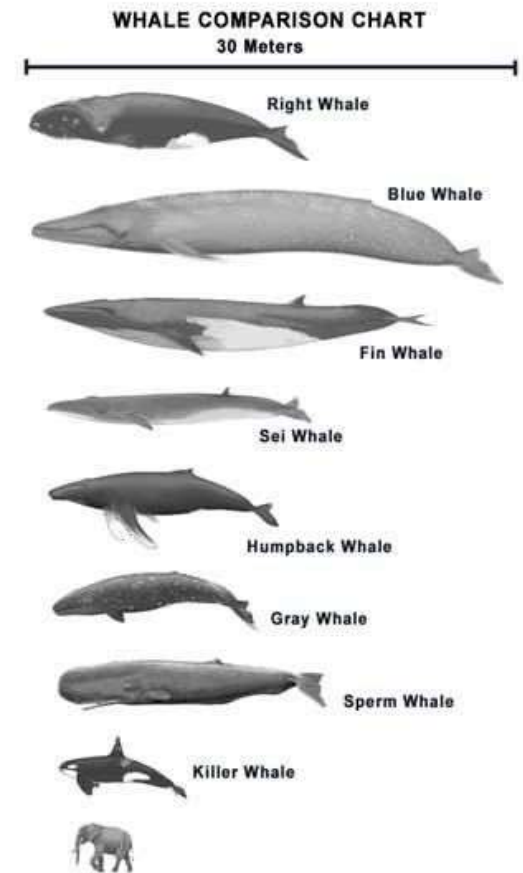
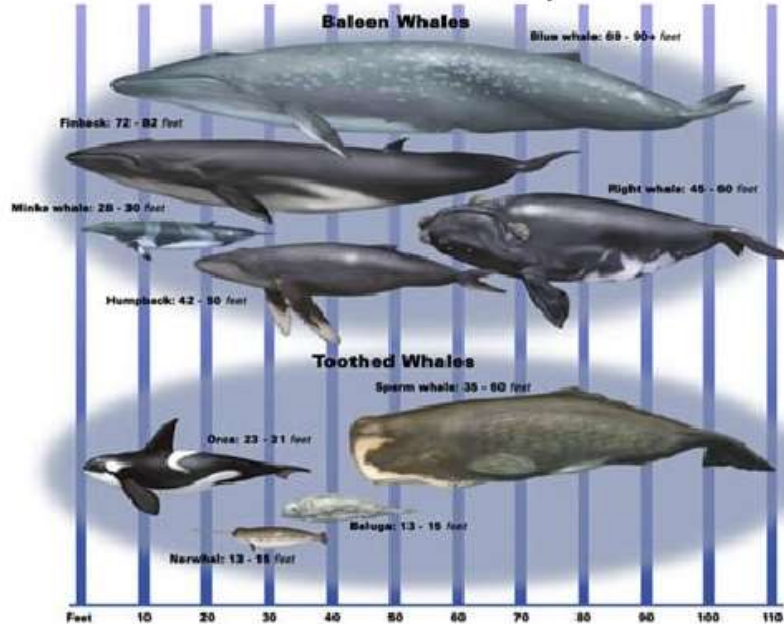


# WHALES (Cetacean)

About one million whales are living in Antarctica waters which include Right, Blue, Sei, Humpback, Minke, Fin, Sperm & Killer whales. When whaling stopped in the South Ocean in 1960, 175,000 had been slaughtered with only 1% of the Blue whale population remaining – one more year of whaling would mean total extinction for this species !

## Types of Whales

- Toothed whales – suborder Odontoceti
- Baleen whales – suborder Mysticeti



- Humpback whale Often called the “canaries of the sea” due to its mesmerizing songs, it is a species of baleen whale length 12-16 m weigh 3,600 kilos & likes to breach. The Southern Ocean Humpback population visits Antarctica during the summer months to feed on krill & small fish using the unusual bubble net feeding technique to round them up





We encountered many humpback as well as minke whale enroute



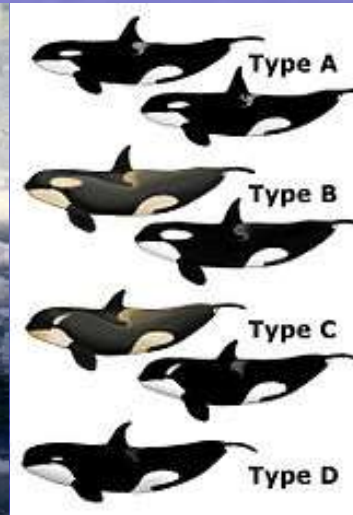


Note the double blowholes of the humpback whale



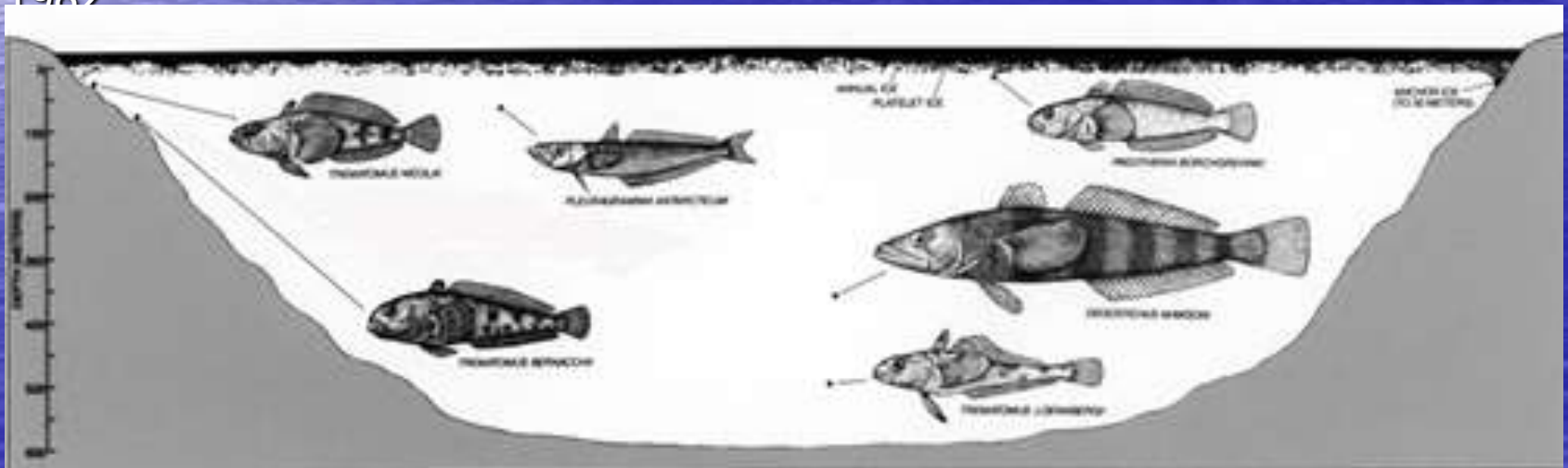


- \*Killer Whales (*Orcinus orcas*) 逆戟鯨/殺人鯨/虎鯨 : A main predator in Antarctica. Probably the largest population of around 25,000 lives here. They often hunt in schools or pods for seals & penguins with delicate team work to "swamp" or "wave washing" a seal resting on ice as well as by "grounding" on the beach. 4 Types of killer whales have been identified



# FISHES

Of the 40,000 of the known species of fish only 200 live South of the Antarctic Convergence of which 122 are notothenioid (Antarctic Icefish) 南極冰魚 which is a suborder of fish that contains glycoproteins 糖蛋白 in its blood acting as an antifreeze enabling them to live in very frigid water (-2 C to 4 C). They account for 95% of all fish biomass in the region. Some fish also hibernate to conserve energy. No fishing is allowed below 60 degree south except for scientific reason & fishing in the South Ocean is now monitored by the Convention on the conservation of Antarctic Marine Living Resources (CCAMLR) signed in 1982





- Antarctic Toothfish (*Dissostichus mawsoni*) 鱗犬牙南極魚

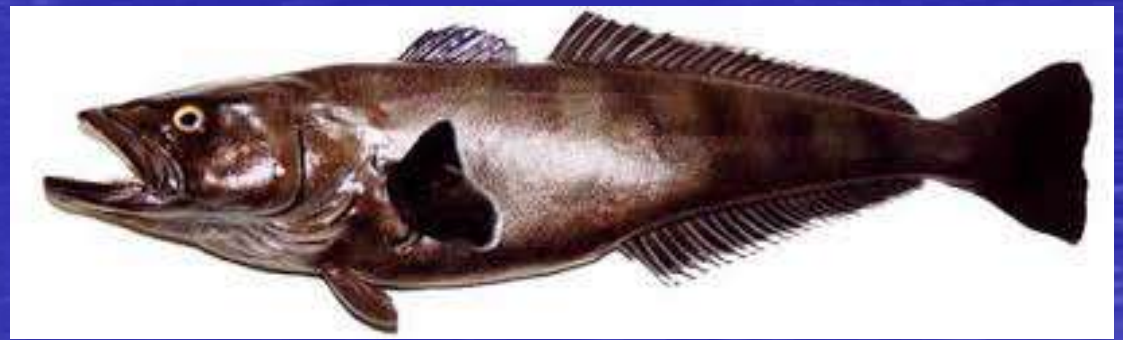
A species of Icefish native to the south ocean sometimes mistakenly referred to as Antarctic cod. Can grow to 2 m long & 135 kgs in weight & living at depth of 600 m in subzero water. They are favorite food of Weddell seals & also being commercially fished with population decreasing due to demersal long line fishing. Total catch 2011/12 around 3,800 tons





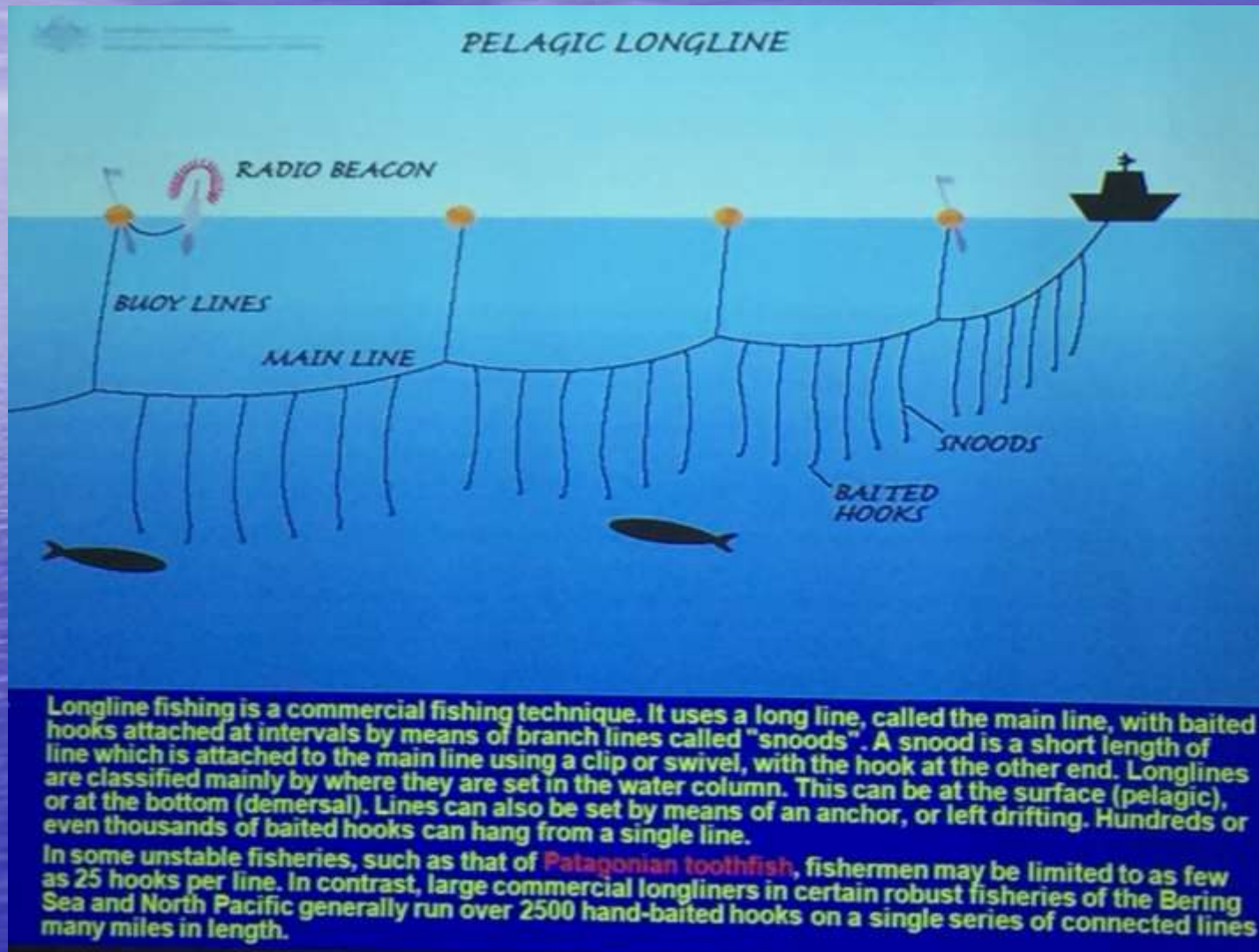
- \*Patagonia Toothfish (*Dissostichus eleginoides*) 小鱗犬牙南極魚

It is a species of cod Icefish found in very cold water 1 – 4C between depth of 45 to 3,850 m & a close relative of the Antarctic Toothfish. Can grow to 100 kg in weight and 2.3 m long living up to 45 years. Favorite food of albatross. Also being caught commercially under the name of Chilean Sea Bass with Far East & North America being the main markets

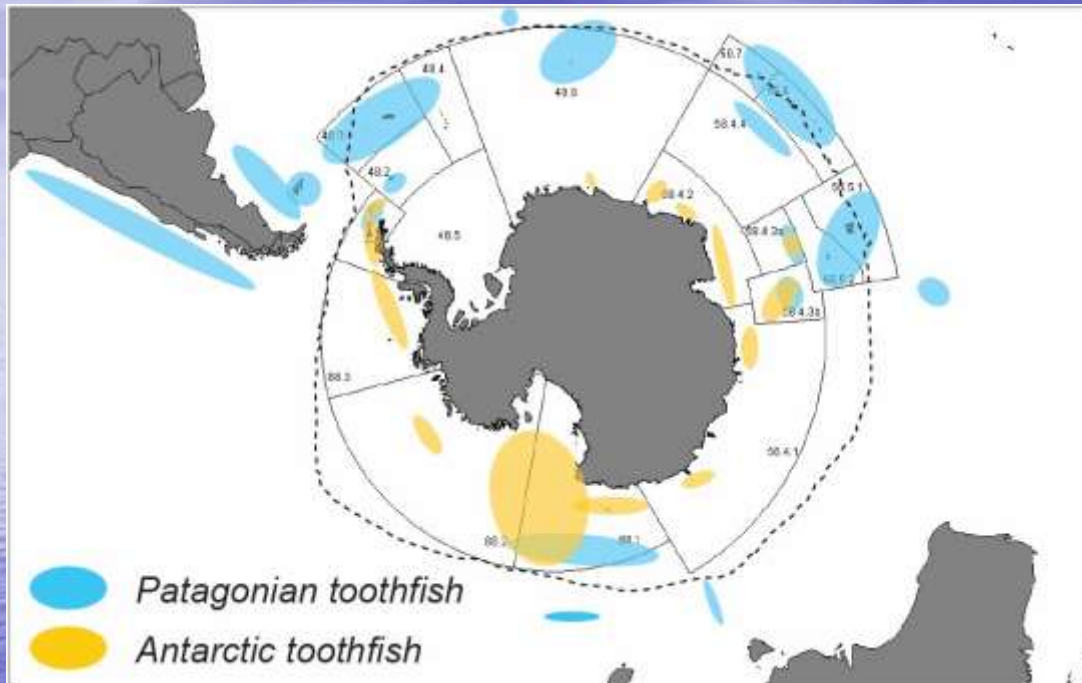




- Long line fishing for Tooth fish can be as long as 130 km with 40,000 hooks. Since 1994 it has killed as many as 300,000 sea birds especially albatrosses which takes 11 years to mature and breed

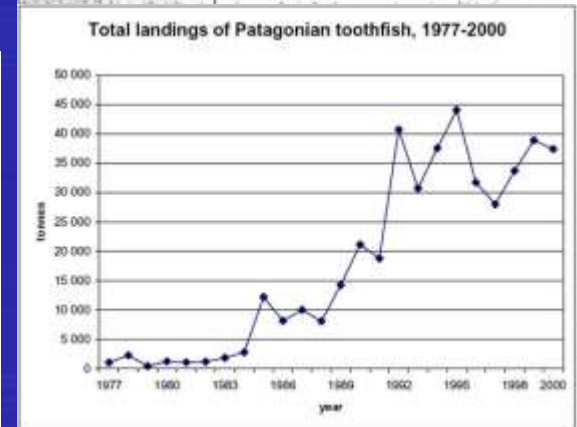


# The Royal Highness & the Patagonia Toothfish



Dear Mr. Morley,

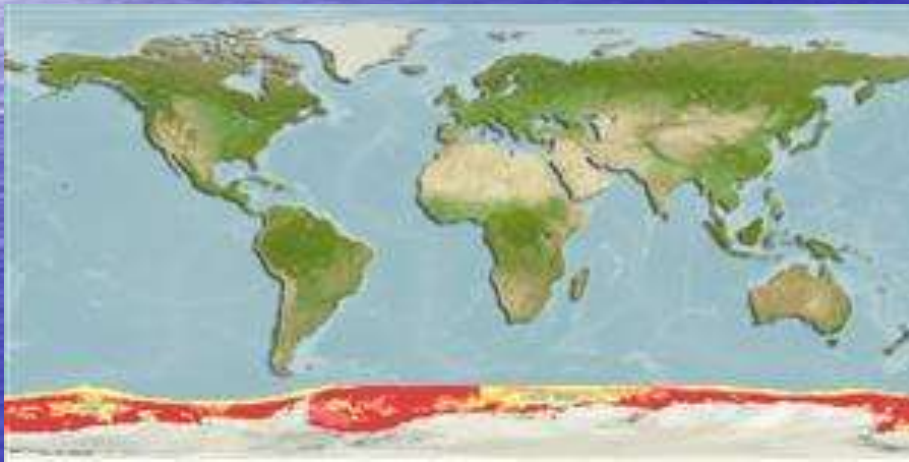
Thank you so much for your letter telling me about the High Seas Task Force. I must say that it is enormously encouraging to know of your efforts to try and bring to heel the recalcitrant countries who sanction, either directly or by turning a blind eye, pirate and illegal fishing and I do wish you well in your endeavours. You have certainly managed to bring together a powerful alliance of N.G.O.s and countries. I particularly hope that the illegal fishing of the Patagonian Toothfish will be high on your list of priorities because until that trade is stopped, there is little hope for the poor old albatross, for which I shall continue to campaign...





- Antarctic Silverfish (*Pleuragramma antarcticum*)

It is also a species of cod icefish native to the Southern Ocean & the only truly pelagic one in Antarctica waters which is of key importance to the ecosystem. Favored by Adelie penguins & Weddell seals

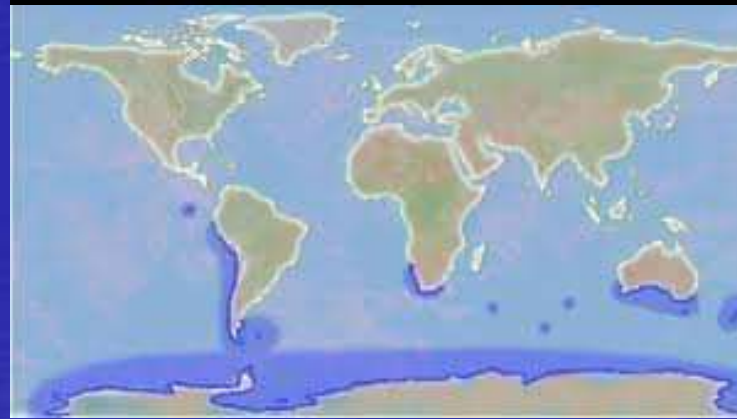


- Crocodile Icefish or White blooded fish (*Channichthyidae*)  
25 species with length between 25 and 75 cm. The blood of the fish is colorless because it contains no hemoglobin & red blood cells. This is possible because the fish has a very low metabolic rate and the high solubility of oxygen in water at low temperature





- Warty Squid ( *Moroteuthis ingens* ): there are around 70 species of cephalopod in the Southern Oceans with Warty squid being the most preyed upon one which makes it a very important part of the marine food chain



## Colossal Squid (*Mesonychoteus hamiltoni*) 大王酸漿魷

Also known as Antarctic squid or Giant cranch squid, it is 14 m long being the largest of all invertebrate & also has the world's largest eyes (diameter 35 cm) & 7.6 cm hooks which can rotate 360 degrees on its base. Has 3 hearts & its blood is blue ! First complete specimen only caught in 2003





A full-page background image of a vast, calm ocean under a bright blue sky. The sun is visible on the left side, creating a strong horizontal reflection across the water's surface. The sky is filled with soft, wispy white clouds. The overall color palette is dominated by various shades of blue and white.

Snap shots of places visited

# Argentinean Patagonia

Patagonia is a region in the southern part of South America covering some one million square kilometers which is shared between Argentina & Chile. The word Patagonia means the "Land of the big footed people". We stayed in El Calafate & visited Lake Argentino as well as the Upsala Glacier & the Perito Moreno Glacier





- Lake Argentino : It is the largest lake in Argentina between 200 to 700 m deep fed by glacial melt water of many rivers



- The Upsala Glacier at 5 km wide, it is the second largest compound valley glacier in Argentina. Feed by two other glaciers, it flows from the Southern Patagonia Ice Field located in the Andes which also feeding 24 glaciers including the nearby Perito Moreno Glacier. The Upsala Glacier is famous for its rapid retreat as evidence for global warming. Our visit included a boat trip passing Lake Argentina







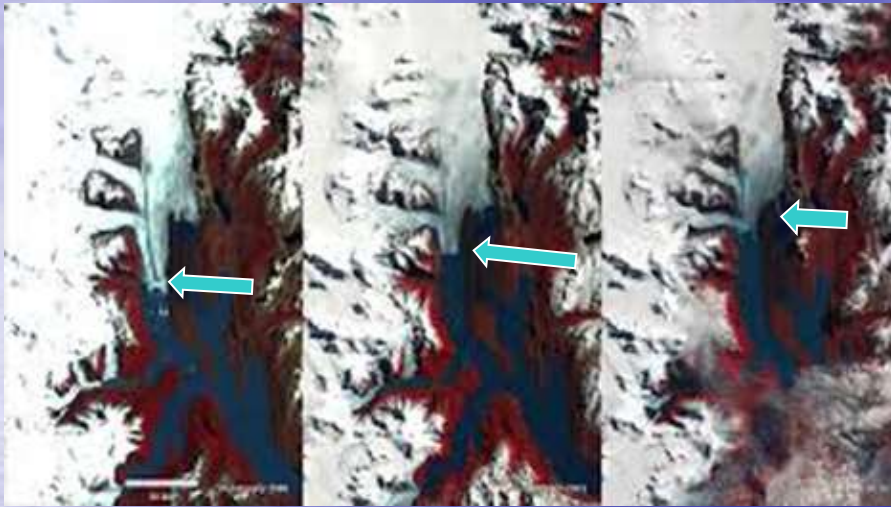


The terminus ( toe or snout ) & icebergs formed by the Upsala glacier





The Upsala Glacier has retreated more than 4 kilometers since late 1960's to mid 1990's and continues to retreat at 200 m per year



Glaciar Upsala - 1931



Glaciar Upsala - Nov.2006





## Retreated glacier exposed shattered & highly polished bedrock





## Retreated glacier exposed ammonite & belemnite fossils from the Andes





The "Hong Kong Team" in front of the Upsala Glacier





- The Perito Moreno Glacier : located in the Los Glaciares National Park, this Glacier is a 250 km<sup>2</sup> ice formation 30 km in length also fed by the Southern Patagonia Ice Field. Unlike Upsala this glacier is in equilibrium and therefore not retreating. It is one of the major tourist attraction in Patagonia to watch icebergs being formed as they break away with a big bang which is called "ice calving"





## Watching "Ice Carving" in action





## Formation of icebergs with "Fire bushes" found near the observation platform





# Ushuaia 烏蘇懷亞

We embarked the Frame at Ushuaia which is the capital of Tierra Del Fuego ( "The land of fire" ). It is the southern most city on Earth & also known as the end of the world city. The Argentina government eradicated the local tribes & operated a penitentiary here between 1902 & 1947 using convicts to clear the forest for building material and fire wood. Today there replica steam train for the transportation of wood are used by tourists. Charles Darwin visited Tierra Del Fuego onboard the Beagle in 1835. The city is also famous for its tasty "Centolla" ( King Crab or Snow Crab or Spider crab )





Ushuaia is now a thriving town with its economy based on tourism



Another view of Ushuaia City center







## Visiting the Parque Nacional





# The Voyage began





# Falkland Islands (Islas Malvinas)

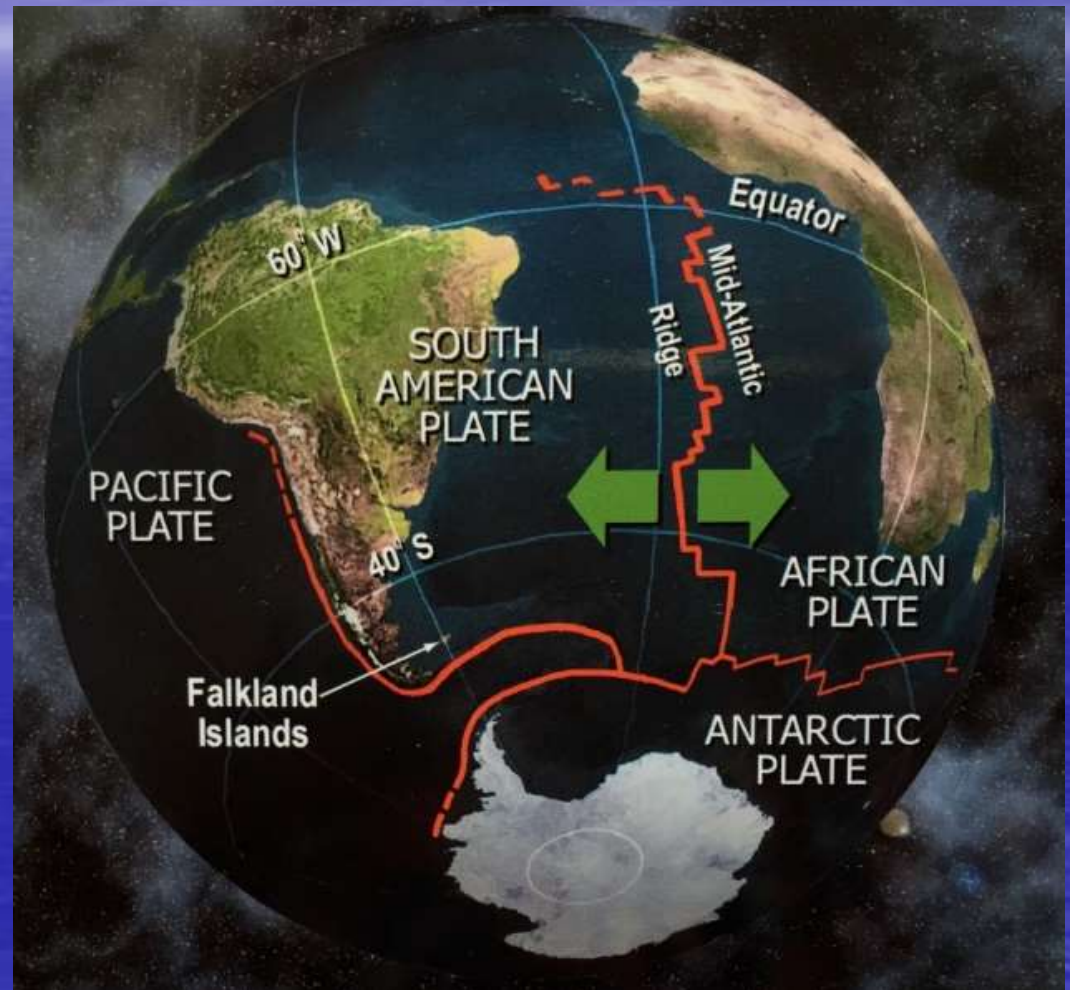
- A group of 700 islands largest being East Falkland & West Falkland lying 480 km from Argentina & 1,000 km from Antarctica total area 15,000 km<sup>2</sup>
- Controversial regarding its discovery. Claimed by France, Britain, Spain as well as Argentina between 16 & 18<sup>th</sup> Century
- It is now a British Overseas Territory
- Total population 3,060. Capital Port Stanley first settled in the 1840s current citizen 2,000
- Summer temp 24C Winter just above freezing. Annual rainfall 600 mm
- Main economy sheep farming, fishery & tourism. Falkland Patagonia tooth fish represents 6.5% of the world's total catch.
- Made famous by the war with Argentina in 1982



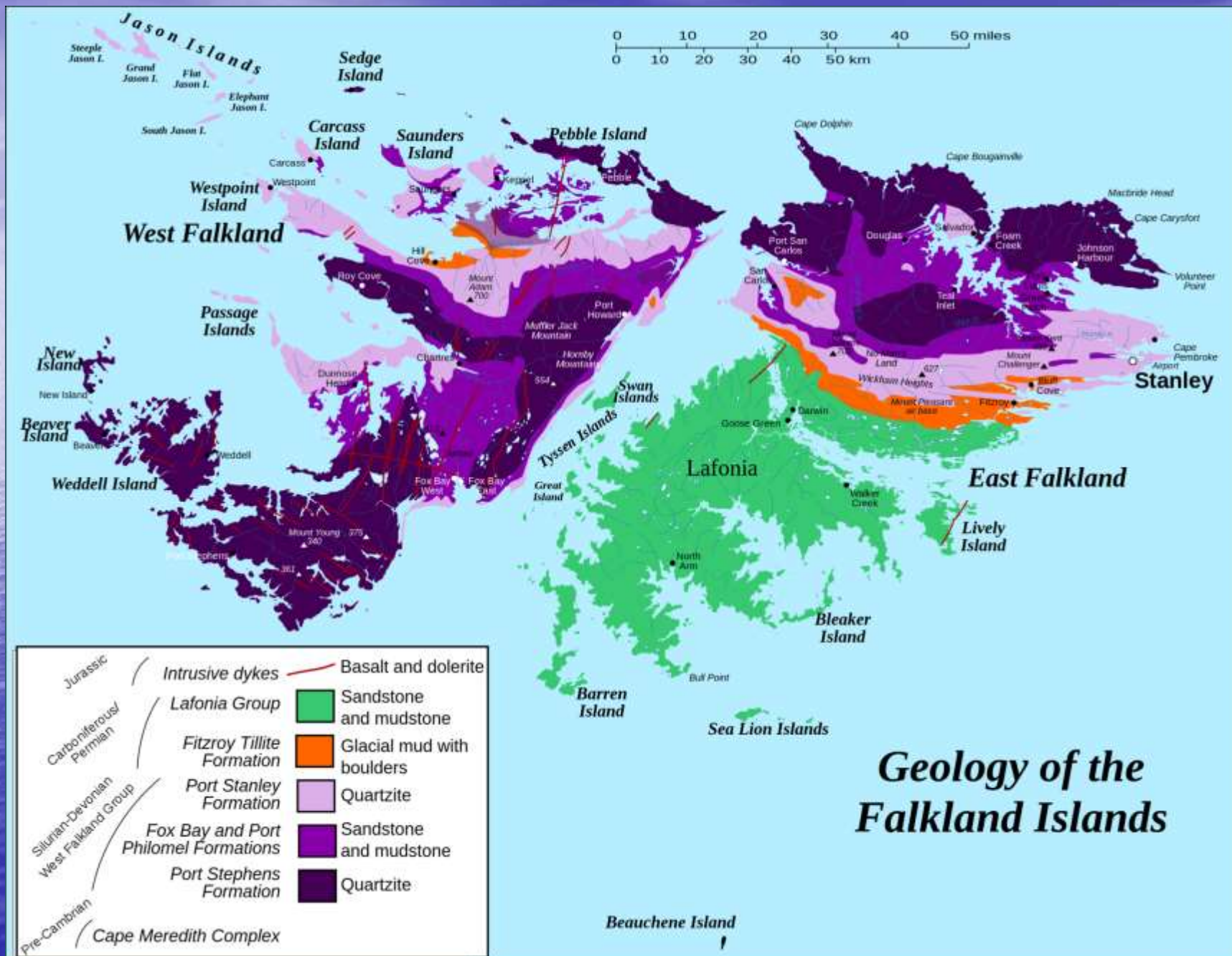


# Falkland Geology

- About 200 Ma Gondwana broke apart & the Falklands were detached from the south east side of South Africa. By 150 Ma it lay adjacent to the margin of the new South America continent. Geologically Falkland is very similar to that of Cape Town !









Effect of the ice age erosion during the Pleistocene glaciation between 25,000 to 15,000 years ago are visible in the form of glacial cirques, "stone runs/river", mud and boulders & tillite 冰磧岩 which are unsorted rock deposited by glaciers. Identical rocks are found in southern Africa





# The Falkland War

- The war lasted 74 days with Argentina invaded the Islands on 2<sup>nd</sup> April 1982. The British sent an armada on 5<sup>th</sup> April & the Argentine surrendered on 14<sup>th</sup> June 1982
- Casualty : death Argentina 649, British 255, locals 3





- Falkland is home to large colony of King penguins & Rockhopper penguins & also frequently visited by South elephant seals as well as S. Antarctica fur seals. We visited West Point Island, Carcass Island & Port Stanley





- West Point Island : covered with tussock grass & yellow goose bush, the island is home for black-browed albatross & rock hopper penguins. We landed on Port Pattison, had a 4 km walk to see a colony of black browed albatross living together with Rock hopper penguins & then visited a local sheep farm ( air temperature 16 C )





A very large colony of black-browed albatross nesting on a headland





## Black-brown albatross incubating eggs in their mud nests & rock hoppers





## More Black-brown albatross incubating eggs in their mud nest





A very large colony of black-browed albatross at a cape





The birds are not afraid at all with people





- A small colony of magellanic penguins can be seen out of their burrows homes





## Enjoying tea & tasty cookies in a local sheep farm – very British





- Carcass Island : Unlike West Point, this island is rat free after much effort eradicated them. We landed on Port Patterson & took a 7 km hike to Leopard beach to see magellanic & gentoo penguins. Very windy on the return leg. Also visited another local farm and were treated with tea, coffee and lots of cookies ! (air temperature 15 C)





# Falkland Island birds including upland geese, kelp goose, oyster catcher & heron





# Ashy headed geese, pipit & caracara





# Port Stanley





## Governor House, Pioneer Row, local residence & Post Office





# The Christ Church Cathedra & Royal Falkland Islands Police HQ





The Falkland Liberating monument, Battle memorial & Thatcher Drive. Some beaches are still closed due to live mines buried by the Argentinians during the last war



# The Falkland Museum – settlement history, natural history & the War





## Falkland street scene, no more whaling



- Bluff Cove, Port Stanley, a medium size king penguin colony with chicks





# The unnamed Rocks

Passing by from a distance it is a sanctuary for sea birds



A flock of shags landed on deck while we were at sea





# South Georgia

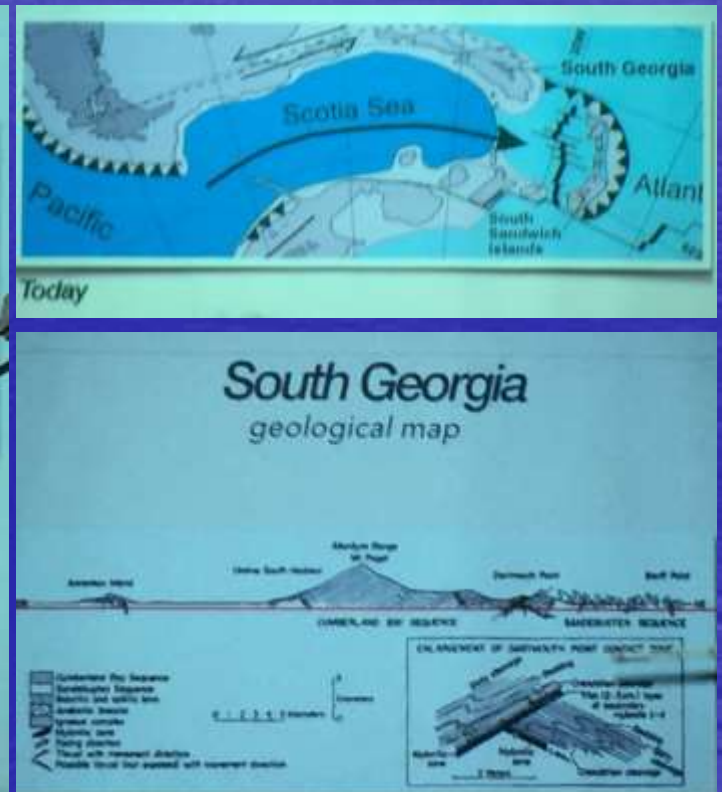
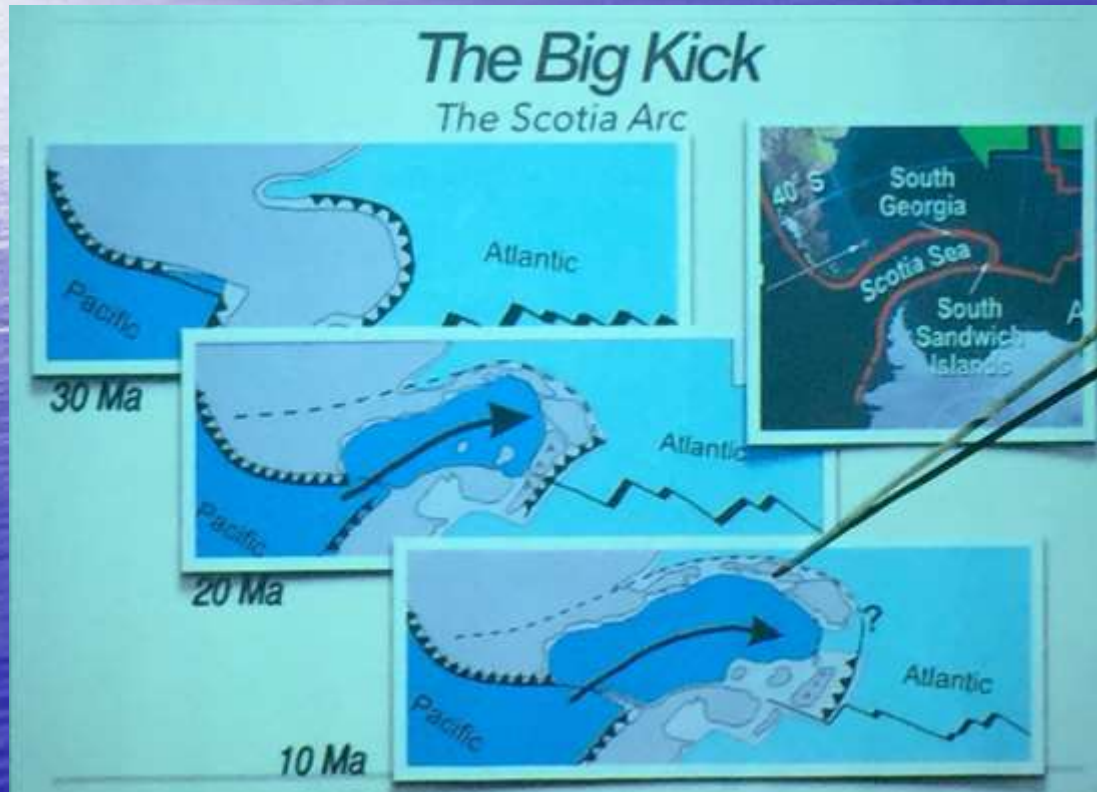


- SGSSI is a British Overseas Territory in the South Atlantic. Claimed sovereignty of South Georgia in 1775 by Captain Cook. A short battle took place in 1982 when the Argentinians invaded & was driven out as part of the Falkland War
- The 100 miles long island is remote & inhospitable with half of it covered by glaciers but the sea never freezes making it the island home to tens of millions of breeding penguins, seals & seabirds. Used as whaling station called Grytviken by the Norwegians until closed down in 1965 having slaughtered 175,250 whales since 1904



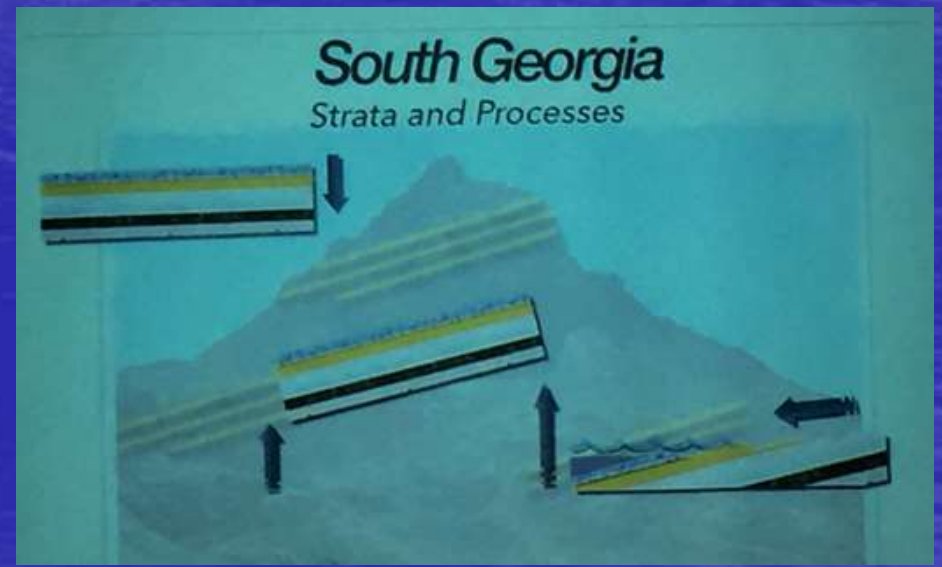
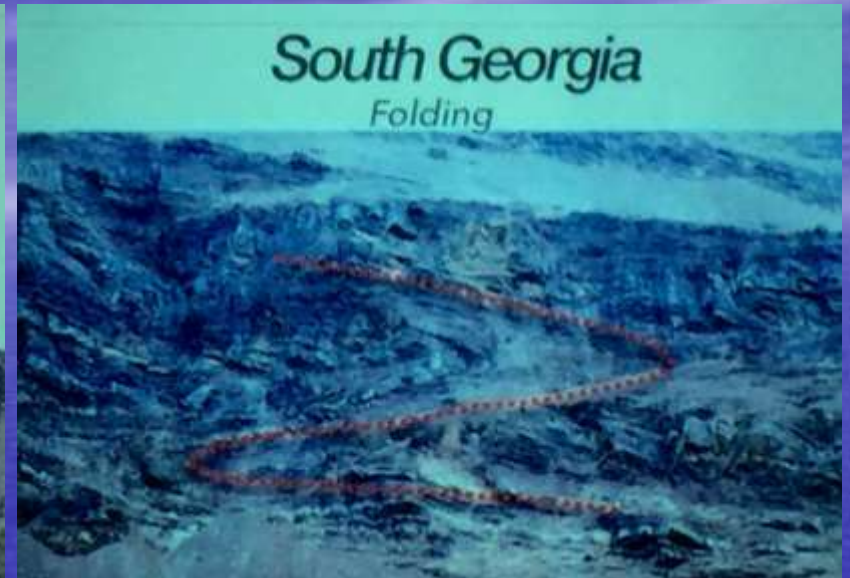
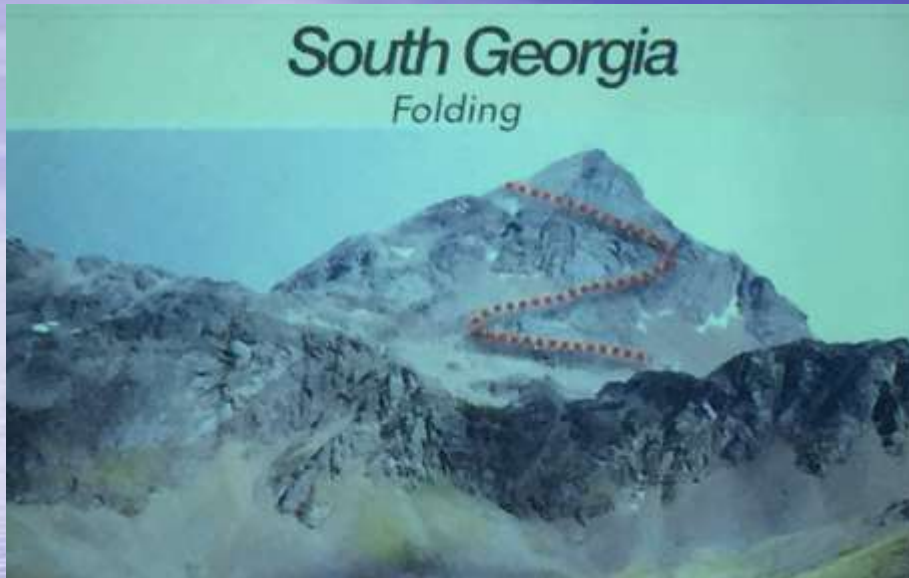
# South Georgia Geology

South Georgia was the child of a “Continental Divorce” result of a “Big Kick” which opened up the Drake passage between Patagonia & Antarctica & formed the Island with marine sediment during the late cretaceous. It is therefore relatively young compared to the Falkland with 13 mountains above 2,000 m. The Scotia Arc is still Active with earthquakes of magnitude 6/7 to 8.2. Folds and faults abound.





# Evidence of intensive folding is everywhere in South Georgia





Reindeers and Brown Rats ( *Rattus norvegicus* ) introduced by visiting ships caused havoc to the local wild life particularly birds. The South Georgia Pipit have lost 70% of their population & 13 species of petrels are also vulnerable. Now reindeers have been eradicated. Rats are still an issue with systematic eradication by using poison pellets since 2011. The project is managed by the South Georgia Heritage Trust (SGHT)





- Hercules Bay : named after a Norwegian whaler, it is rock hopper penguins country





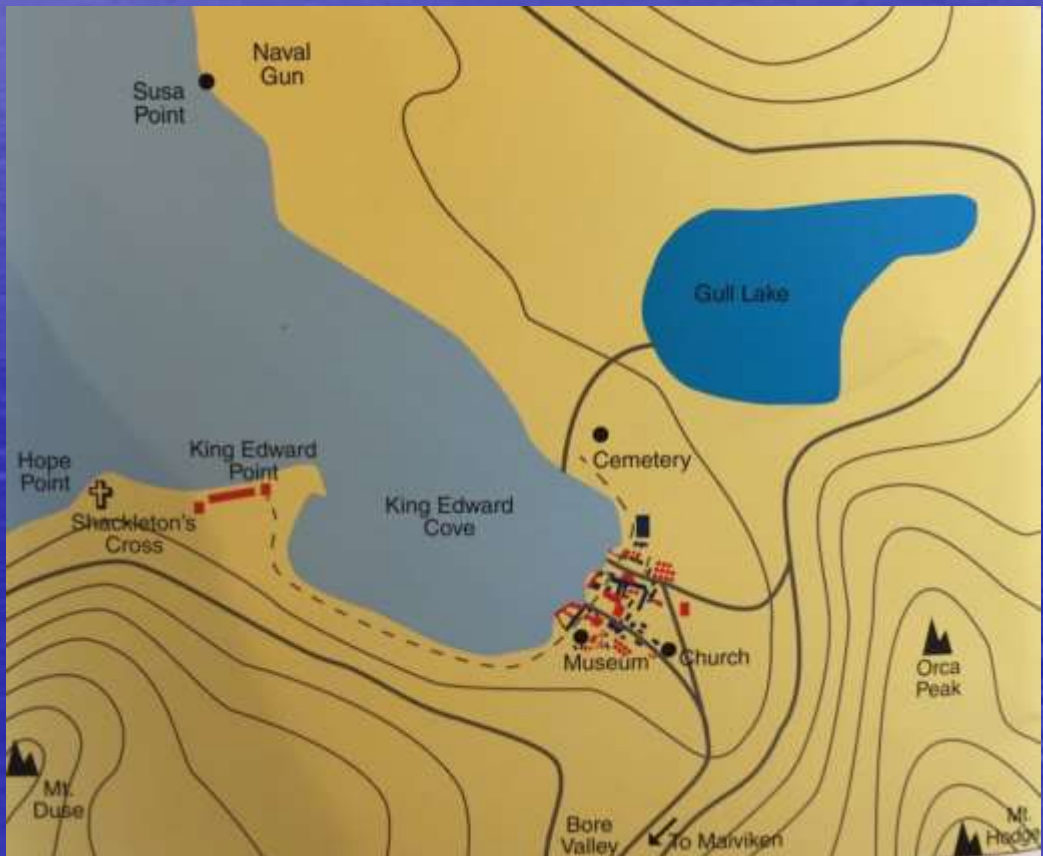




Rock hoppers at home, so very active



- Grytviken : It was the first whaling station in Antarctica water founded by Norwegian Carl Anton Larsen in 1904. We can still see the several examples of steam powered whale catcher like the Petrel lying on the beach. Within walking distance is a museum, & Shackleton's grave. Further to the left is King Edward Point which used to be the site for the former British Garrison and now home to a British Antarctic Survey as well as the Marine Officer, the government's sole representative. Up a small hill is Shackleton's Cross





# The old whaling station & what it was like in the hey days





A couple of Old "Whalers" now rusting away on the beach





King Edward Point on the left of the Bay where Shackleton's cross  
& the British Research Station are located





## The cemetery & Shackleton's grave, a traditional toast to honor the explorer





## The local Museum covering whaling history & Shackleton's expedition



## Replica of Shackleton's boat "James Caird", his gear & clothing





## Sunday sermon given by a fellow passenger in the Whalers Church

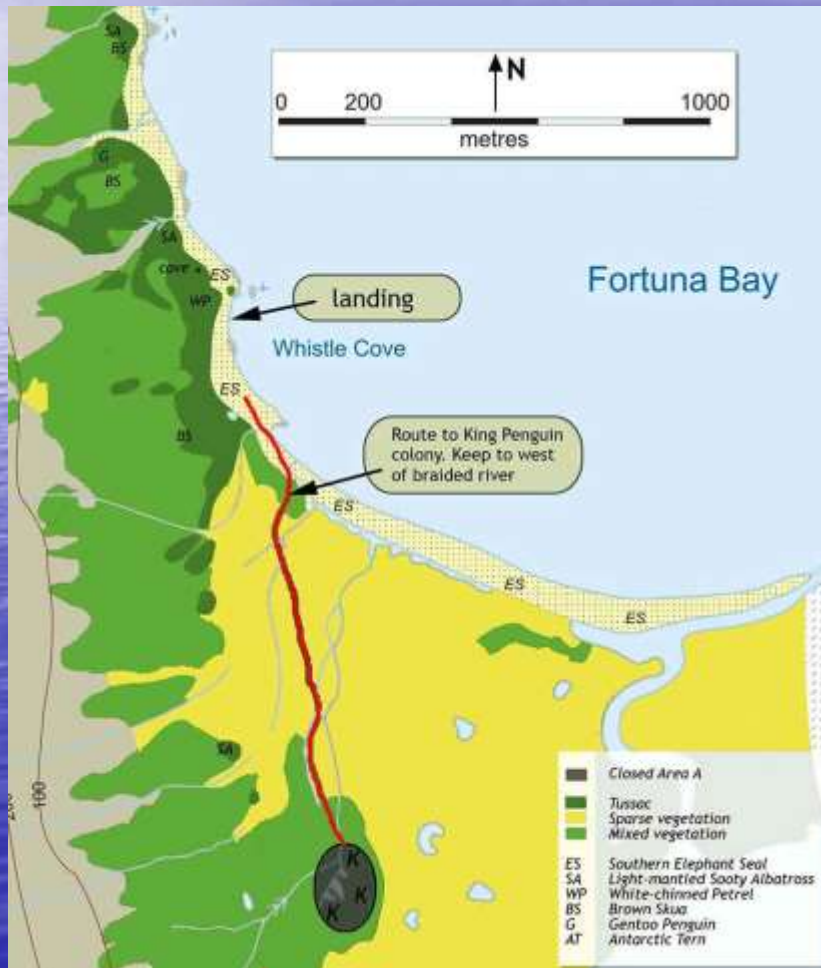


Seals at Grytriken. What a nice day !





- Fortuna Bay : named for one of the first whaling ships in the area which actually ran aground at Hope Point in 1916. Shackleton & his companion also started their 5.5 km hike from one side of South Georgia to the other to get help at Stromness. At Whistle Cove, saw King penguins, gentoos, fur seals, elephant seals, albatross and giant petrel ( air temperature 17 C which is exceptionally warm )













The old whaling station at Port Leith operated from 1909 to 1965





- Stromness Bay : home for three deserted whaling stations Stromness, Leith Harbor and Husvik. First attempt to save the Shackleton crew from Elephant island started from here but failed. Elephant seals and fur seals are found along the beach



















## Fur seal county, fierce at time





- Drygalski Fjord : a beautiful fiord named after Erich Dagobert von Drygalski a professor from Berlin University who led the German South Polar Expedition 1901-03. The fiord is fed by 3 glaciers & is actually at the boundary of a fault line. Rock formation on the starboard side is of Gondwana origin consisted of 1 billion years old rock including gneiss with marked basaltic intrusion & much older than those on the portside which is basaltic ( air Temp 9 C )







# Gondwana age rock formation, probably gneiss & granite



Another view of the fiord. Note the flat sea





- St. Andrew's Bay : Largest concentration of king penguin (200,000 breeding pairs & 100,000 babies totaling half a million ) & elephant seal. The bay is fully exposed to the open sea & the frequent occurring strong winds that plummets from the summits of the Allardyce Range which is up to 2,000 m high. The 3 km long fine dark sandy beach only gets interrupted by some rivers flowing from the Heaney, Buxton & Cook glaciers ( air temperature 9 C )





## Elephant seals & king penguins share the beach





## Peaceful coexistence





## Sunbathing elephant seals note one is molting





## St. Andrew's Bay is King Penguins paradise





All dressed up for a party ?





## Crossing several rivers to reach the big colony





St. Andrew's Bay is the home for half a million king penguins





Close up of the king penguin colony





Parents & chicks in their thousands





Another view of the large colony





Another corner of the same colony





Puffy Babies everywhere but global warming is taking its toll !





# South Orkneys Islands

Discovered in 1821 by American & British sealers, it is a group of 4 islands in the Scotia Sea claimed by both Argentina & the UK which is 600 km north east of the Antarctic Peninsula. The British naming it as part of British Antarctic Territory with a base established on Signy Island. The Argentina Naval base is called Base Orcadas which is located on Laurie Island





- Base Orcadas : it is an Argentinian naval base located on Laurie Island at 66.44 south & 44.44W. The base has over 200 days of fog per year & often very snowy. Home for Chinstrap and Adelie Penguins. ( air temperature – 2C). We were their first foreign visitor in nine months & we bought them some fresh produce







The navy carry out studies on ocean currents, northern lights, ice thickness, salinity, meteorology & magnetism





## Inside Base Orcadas





Base Orcadas, cold and snowing, no visitors for 9 months



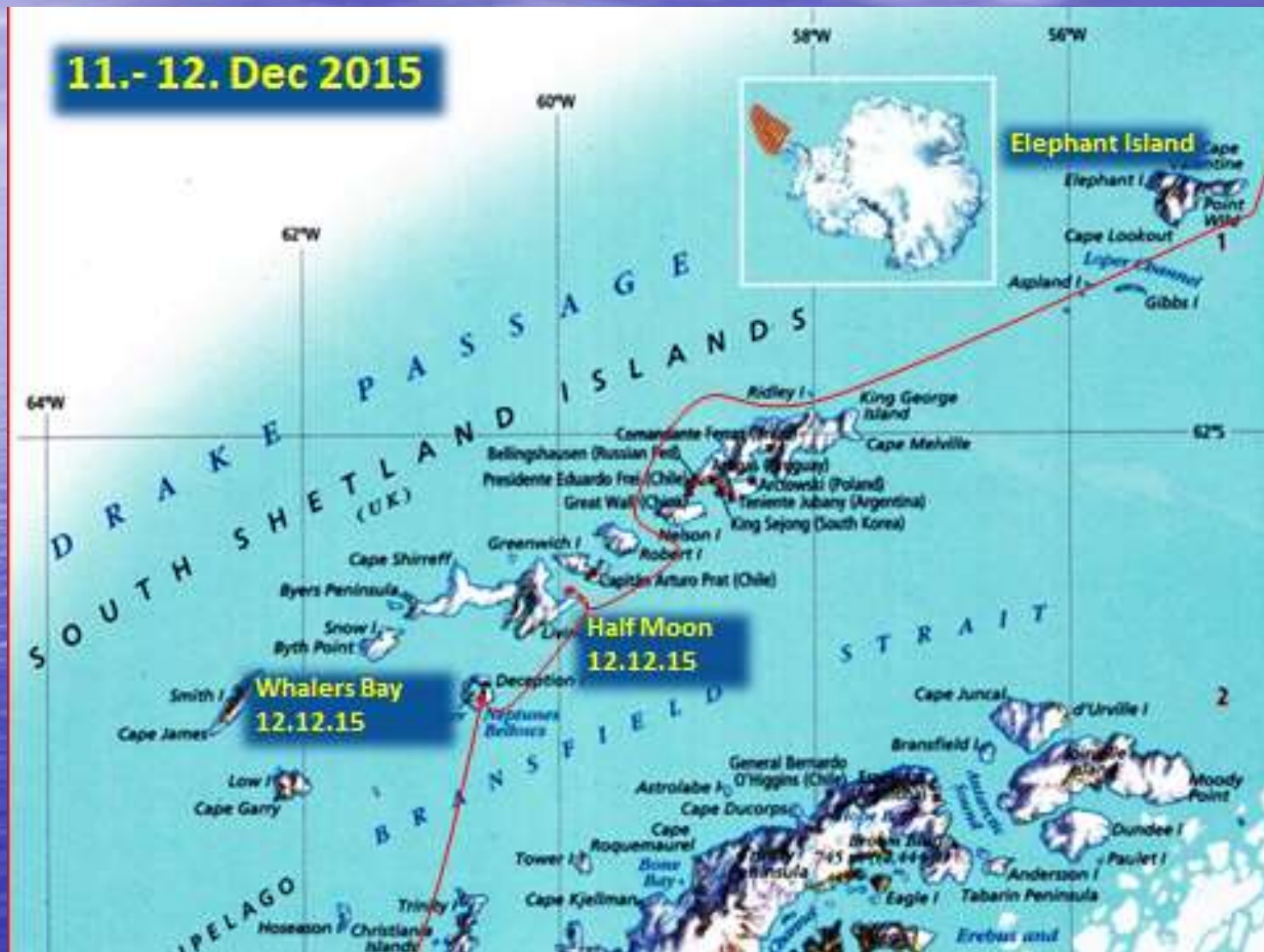
## The day of the hurricane

Strong wind up to hurricane force with 5 m waves followed by swells of up to 8 m pounded the vessel for 24 hours but most passengers took it well. An ideal timing also for showing a movie on Shackleton's Expedition in 4 D !





## Our voyage continued



# Elephant Island 象島

This desolate island was home to 22 marooned members of Shackleton's fabled 1914 Expedition for four & a half months while they awaited rescue. Led by John Robert Francis Wild the team barely survived living beneath two overturned lifeboats until being rescued by Captain Luis Pardo of the Chilean Navy. We passed by Point Wild which is named after Francis Wild but could not see much due to hurricane force wind & high sea ( air temperature -2 C )





Elephant Island from a distance – formed of old erosion resistant rocks



## Half Moon Island, South Shetland Islands (62.36 S 59.55 W)

A small island 2 km long island being classified as an “Important Bird Area” (IBA) by Birdlife International. Species include 2 colonies of Chinstrap penguins, Antarctic terns, kelp gulls, petrels, skuas, Imperial shags and sheathbills (air temperature – 2C)









## Chinstrap penguin colony



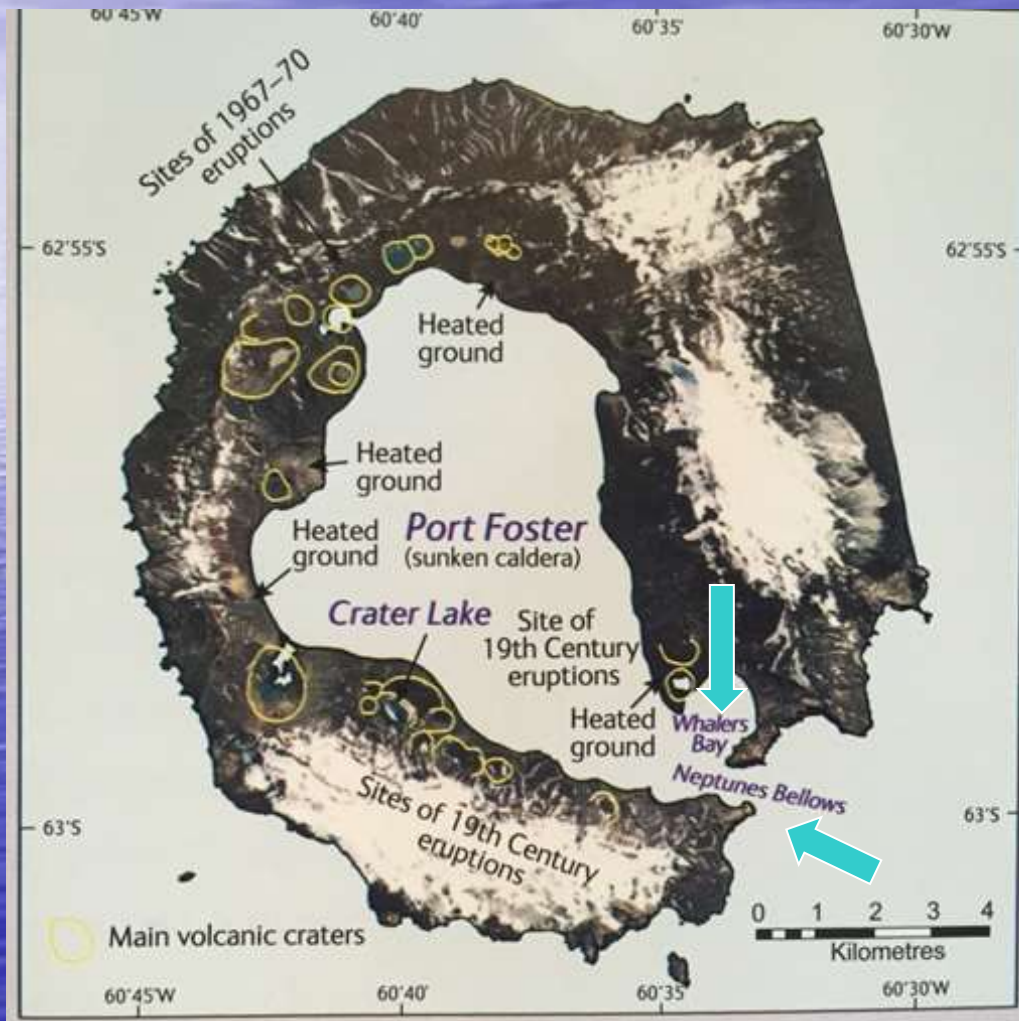


## Deception Island, South Shetland Islands 奇幻島

As part of South Shetland it is a live volcano recently erupted in 1967, 1968 & 1970. The last one destroyed two scientific stations operated respectively by Chile & the UK. The island contains an 8 km crater now flooded by the sea forming a central lagoon. Movements of the molten magma cause rises & falls in the sea floor & scientists predict another eruption is likely in the near future. Landing was at Whaler's Bay, a whaling station known as Hektor which was in operation between 1912 & 1931



The island is a distinctive ring-shaped caldera approximately 12 km in diameter. A portion of the caldera wall has collapsed & created a navigable opening into the flooded interior. We entered the caldera through the narrow Neptune's Bellows which is also called the Hell's Gate or Dragon's Mouth





Entrance to the caldera. Note the stack which is called "Neptune's needle"



# Remains of the once thriving Hektor Whaling Station







The caldera is now flooded by the sea





## Hiking to visit "Neptune's window"



Photo taken with Ornithologist – the “Bird Man”





The “Polar Plunge” - Swimming is possible in the bay area near to hot springs fed by water heated within the volcano. Part of the surface temperature on the beach can be as high as 50 C but the water is still very cold !





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## Snow shoeing in Half Moon Bay, pretty challenging



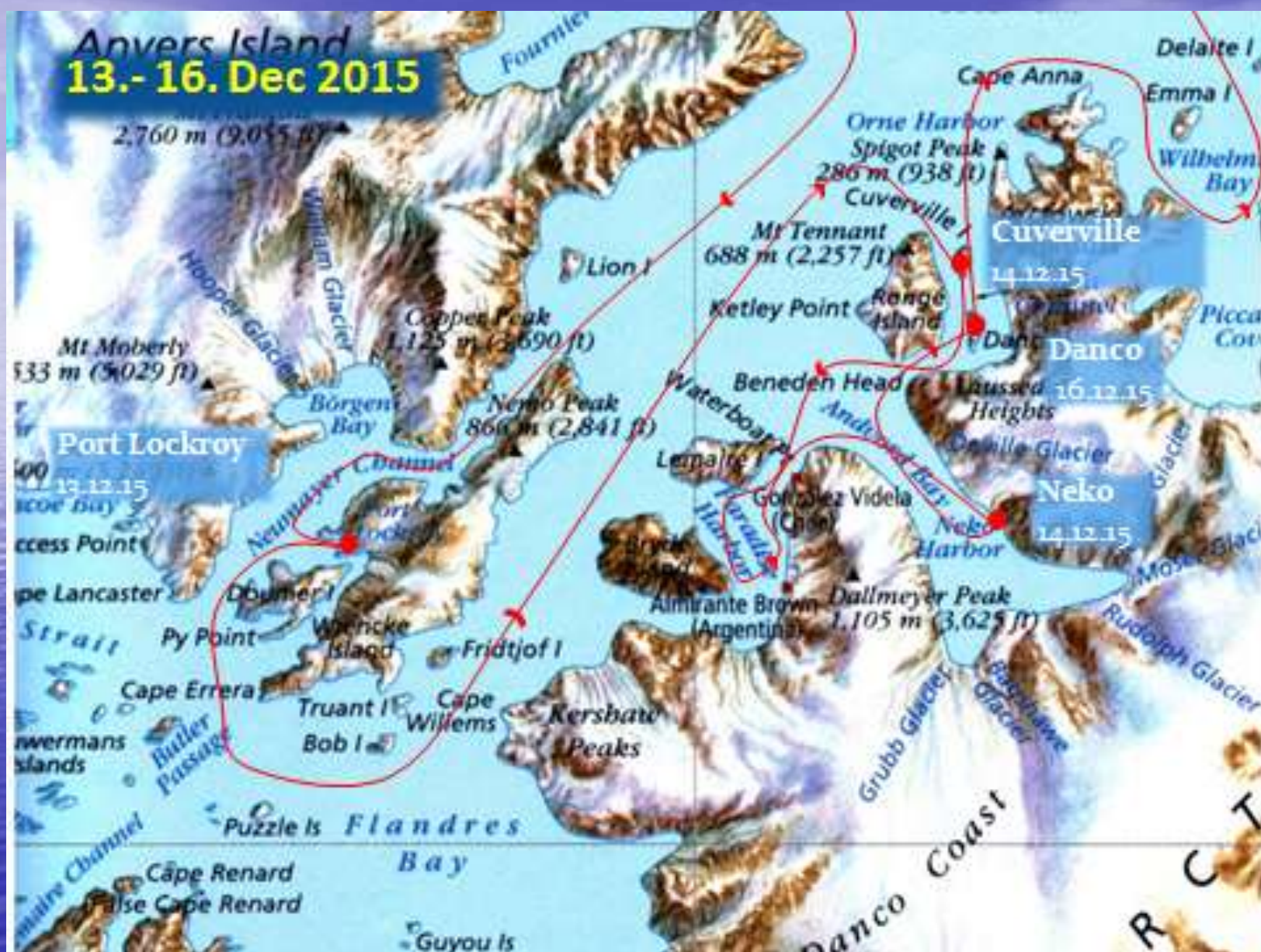
# The Antarctic Peninsula

The Antarctic Peninsula or Graham Land is a 1,800 km long mountain chain running from the Antarctic Continent towards South America which are the relics of a chain of volcanoes that were active between 183 & 4 million years ago. The coastline is very complex with peninsular separated by fiords & many islands lying between straits & narrow channels. Glaciers are everywhere. We visited Port Lockroy, Curville, Paradise Harbor, Lemaire Channel, Neko Harbor, Danco Island & Wilhelm Bay





# Anvers Island 13.- 16. Dec 2015



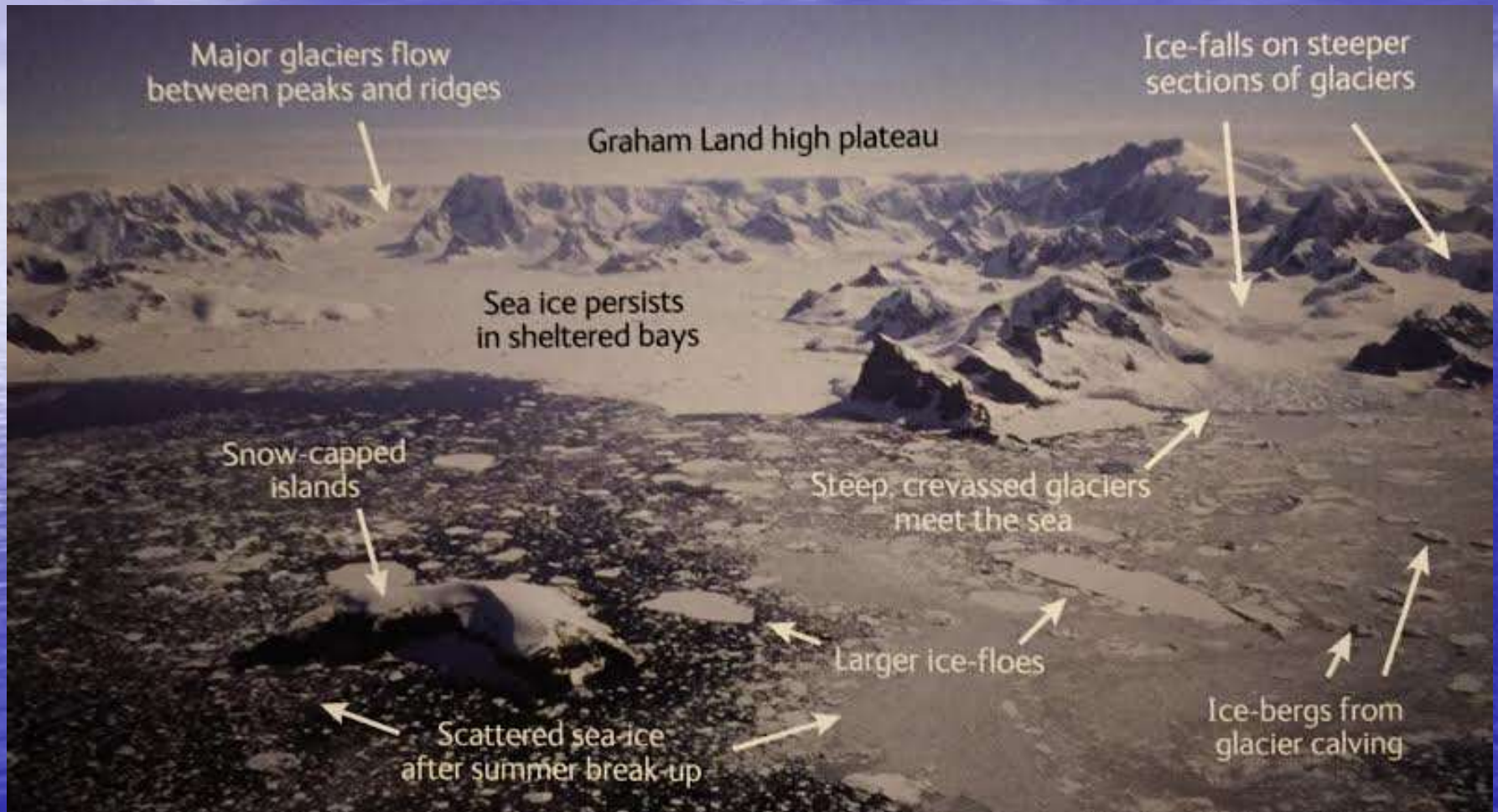


- The lack of any features such as trees & buildings to give scale together with the unlimited visibility in the clear air, makes it very difficult to judge distance & size

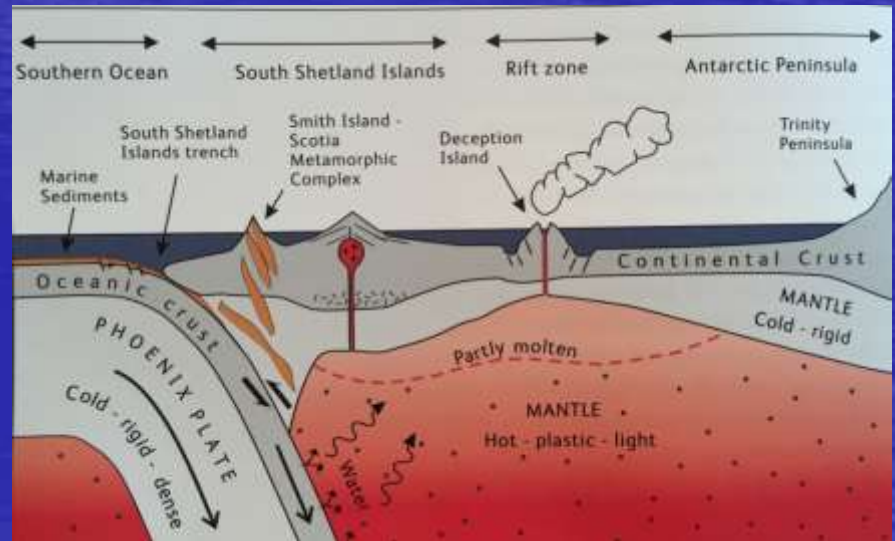
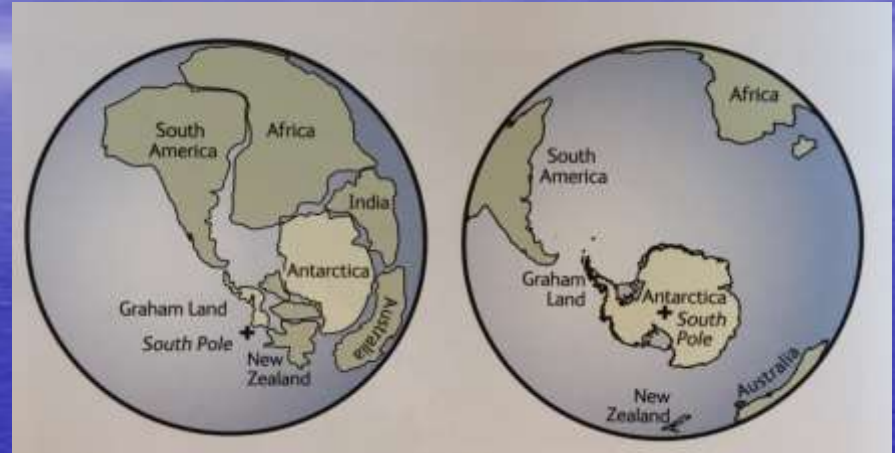
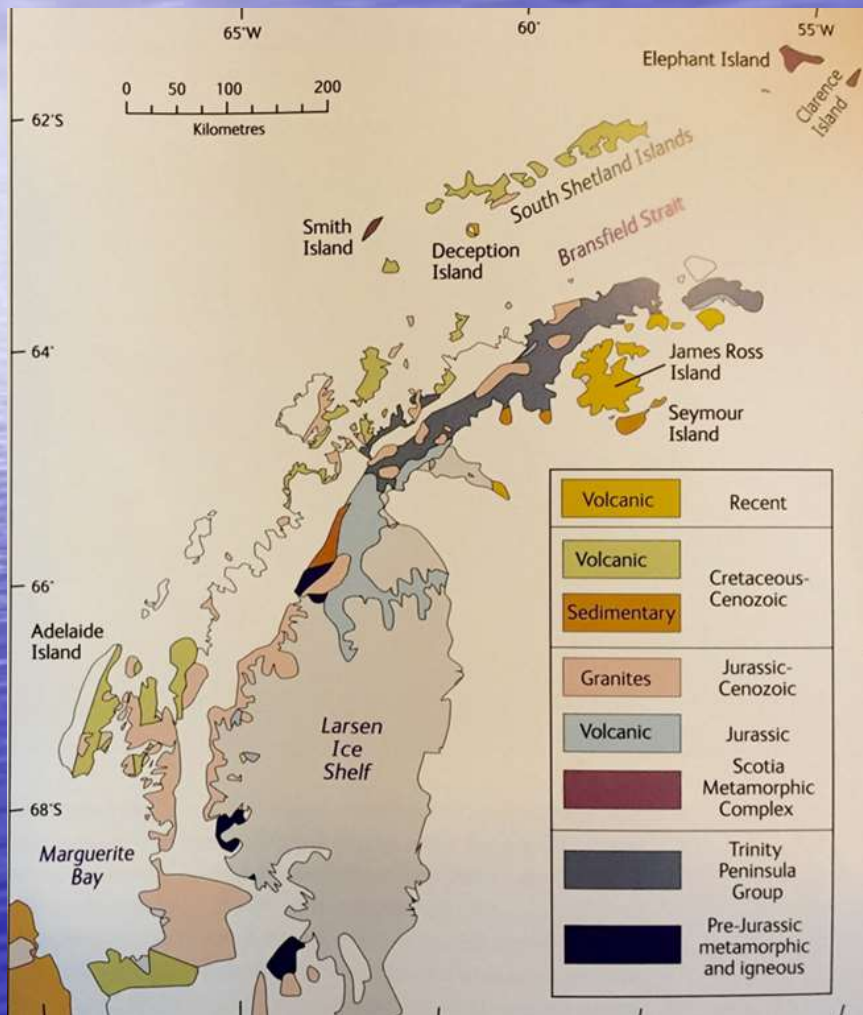




## Typical mountain & glacier landscape of Graham Land



Geologically Graham Land is a continuation of the Andes & also part of the Pacific Ring of Fire formed by subduction & separated from South America about 183 Ma.





## Volcanic rocks of the "ring of fire" exposed at the entrance of Lemaire channel



# Port Lockroy

- During Operation Tabarin in 1941, the British established two bases with Base A at Port Lockroy & Base B at Whalers Bay, Deception Island. The one at Port Lockroy was then converted into a research center until being closed in 1966. The place was restored in 1996 by the Antarctic Heritage Trust (AHT) & became a Historical Site & Monument (HSM) containing a museum, post office & souvenir shop. It is also home to a Gentoo colony





The station is also home for a colony of gentoo penguins





## The station & its cemetery





- The station facilities including a very popular souvenir shop





## Cuerville : (64.42 S 62.38 W)

The Errera Channel is a scenic, narrow waterway between Ronge Island & the Arctowski Peninsula on the mainland & home to Cuerville & Danco. Cuerville Island supports one of the largest known gentoo penguin colony totaling 5,000 breeding pairs. Snow covers impedes but does not stop penguins accessing their nest through "penguin highways" carved into the snow. The shallow waters between Cuerville & Ronge Islands often trap & grounded icebergs which makes for superb cruising through the channel (air temperature 7C )





The landing site in the bay close to a Gentoo colony





Hiking towards another Gentoo colony





“Penguin Highways” used by the Gentoo to reach their nests on exposed rock surface









- Kayaking around glaciers & icebergs at Cuverville 15.12





## Ice Cruising 1/14



## Ice Cruising 2/14





## Ice Cruising 3/14



## Ice Cruising 4/14





## Ice Cruising 5/14



## Ice Cruising 6/14





## Ice Cruising 7/14



Ice cruising 8/14





Ice cruising 9/14



## Ice cruising 10/14





## Ice cruising 11/14



## Ice cruising 12/14





## Ice cruising 13/14



## Ice cruising 14/14





# Paradise Bay

## Brown Station, Argentina



## Lemaire Channel 雷麥瑞水道

- Also known as the Kodak Gap, it is 11 km long & only 1,600 m wide. Famous for its scenic beauty with steep cliffs and iceberg filled passage on sheltered water. Crab eating seal and waddle seal can often be observed resting on the sea ice. We were unable to pass through this passage due to thick sea ice but even the entrance is beautiful !





The scene in the Lemaire Channel is surreal





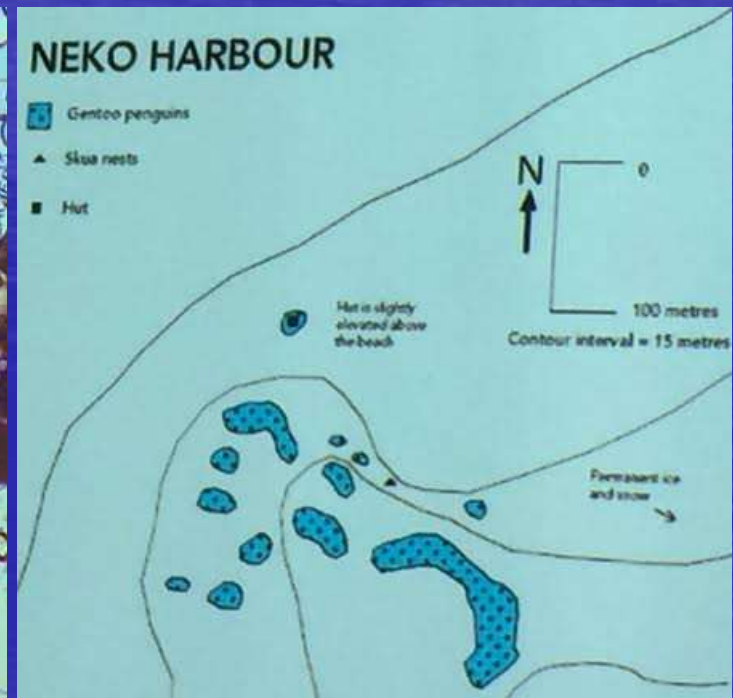






## Neko Harbour 尼可港 (64.50 S 62.33 W)

Andvord Bay penetrates deep into the Antarctic Peninsular from here the Weddell Sea is just 50 km away. The scenic Bay is surrounded on all sides by mountains & alpine glaciers & fills with castellated icebergs & wildlife. At the bottom of the Bay is Neko Harbor named after a whaling ship which anchored there in the early 1900's. Home for Weddell seals & Crab eater seals. We did a two and a half hour kayaking amidst icebergs & magnificent glaciers & came ashore on the Antarctica mainland on the 15<sup>th</sup> December which was the 140 years anniversary for Amundsen's successful trip to the South Pole ( air temperature 4 C )





One night Camping for the braves, cost US\$1,000 per person



- 2.5 hours Kayaking around glaciers & icebergs around Danko Island

























- Demco Island















## Wilhelmina Bay

The mountains and high glacier walls of the Antarctic Peninsula around Wilhelmina Bay are very scenic with frequent ice carving. The bay is a choice feeding place for whales. Weddell, crabeater, leopard seals & Antarctic terns can be found as well









## The Drake Passage

- The 40 hours crossing was unbelievably calm – wind 3 m/sec, air temperature -2 C, water temperature 1 C. The “Drake Lake” was the result of the presence of an anticyclone





# Cape Horn

One of the greatest graveyard for ships anywhere. Discovered by Dutchmen Jakob Le Maire & Willem Schouten in 1616 & named after their ship Hoorn. The Cape itself rises 424 m with striking black cliffs. We passed the Cape and turned north through the Beagles Channel to return to Ushuaia. We had a extremely smooth passing



## Dusky dolphins welcoming us back near Cape Horn





We made it - safely return to land without a scratch !





MS FRAM

## ANTARCTIC certificate

THIS CERTIFICATE IS AWARDED TO

**Wai Shing Vincent Wong**

*has followed the footprints of Roald Amundsen  
and explored pristine Antarctica.*

*This happened in the true spirit of Amundsen on an expedition  
MV FRAM*

30.11 – 18.12.2015

Date

*Line Overgaard*

Expedition leader

Captain, MS Fram

[hurtigruten.com](http://hurtigruten.com)



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## ANTARCTIC certificate

THIS CERTIFICATE IS AWARDED TO

**Yuet Ngor Lucie Chan**

*has followed the footprints of Roald Amundsen  
and explored pristine Antarctica.*

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## ANTARCTIC certificate

KAYAKING AT DANCO ISLAND

THIS CERTIFICATE IS AWARDED TO

**YUET NGOR LUCIE CHAN**

*for kayaking in the surrounding area of Danco Island, Antarctica*



MS FRAM

## ANTARCTIC certificate

KAYAKING AT DANCO ISLAND

THIS CERTIFICATE IS AWARDED TO

**WAI SHING VINCENT WONG**

*for kayaking in the surrounding area of Danco Island, Antarctica  
on the 15th of December, 2015*

15th December 2015

Date

*Line Overgaard*

Expedition leader

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100



A full-page background image of a vast blue ocean meeting a blue sky with wispy white clouds. A bright sun is visible on the far left, creating a shimmering reflection on the water's surface.

THE END