

## Bergy bit



photo: bergy bit (Environment Canada)

A large piece of floating Glacier ice\*, generally showing less than 5 m above sea-level but more than 1 m and normally about 100-300 sq. m in area.

\*Ice in, or originating from, a Glacier, whether on land or floating on the sea as Icebergs, Bergy bits or Growlers.

**Beset**

Situation of a vessel surrounded by ice and unable to move.

## Brash ice



photo: brash (Environment Canada)

Accumulations of Floating ice\* made up of fragments not more than 2 m across, the wreckage of other forms of ice.

\*Any form of ice found floating in water. The principal kinds of floating ice are lake ice, river ice and sea ice, which form by the freezing of water at the surface, and glacier ice (ice of land origin) formed on land or in an ice shelf. The concept includes ice that is stranded or grounded.

**Close pack ice**

Pack ice in which the ice Concentration is 7/10 to 8/10, composed of Floes\* mostly in contact.

\*Any relatively flat piece of sea ice 20 m or more across.

## **Crack**

Any fracture of Fast ice\*, consolidated ice or a single Floe\*\* which may have been followed by separation ranging from a few centimeters to 1 m.

\*Sea ice which forms and remains fast along the coast, where it is attached to the shore, to an Ice wall, to an Ice front, between shoals or grounded icebergs. Vertical fluctuations may be observed during changes of sea-level. Fast ice may be formed in situ from sea water or by freezing of Pack ice of any age to the shore, and it may extend a few meters or several hundred kilometers from the coast. Fast ice may be more than one year old and may then be prefixed with the appropriate age category (old, second-year, or multi-year). If it is thicker than about 2 m above sea-level it is called an Ice shelf.

\*\*Any relatively flat piece of sea ice 20 m or more across.

## Decay of sea ice



photo (300 ft): decaying thick first-year ice; puddles (Environment Canada)

During the winter, the ice usually becomes covered with snow which insulates the ice from the air above and tends to slow down its rate of growth. The thickness of snow cover varies considerably from region to region as a result of differing climatic conditions. Its depth may also vary widely within very short distances in response to variable winds and ice topography.

While this snow cover persists, almost 90 per cent of incoming radiation is reflected back to space. Eventually, however, the snow begins to melt as air temperatures rise above 0°C in early summer and the resulting freshwater forms puddles on the surface. These Puddles\* absorb about 90 per cent of the incoming radiation and rapidly enlarge as they melt the surrounding snow or ice. Eventually the puddles penetrate to the bottom surface of the Floes\*\* and are known as Thaw holes\*\*\*. This slow decay process is characteristic of ice in the Arctic Ocean and seas where movement is restricted by the coastline or islands. Where ice is free to drift into warmer waters (e.g., the Antarctic, East Greenland, and the Labrador Sea) decay is accelerated in response to wave erosion as well as warmer air and sea temperatures.

\*An accumulation on ice of meltwater, mainly due to melting snow, but in the more advanced stages also to the melting of ice. Initial stage consists of patches of melted snow.

\*\*Any relatively flat piece of sea ice 20 m or more across.

\*\*\*Vertical holes in sea ice formed when surface Puddles melt through to the underlying water.

## Deformation of sea ice



photo (50 ft): second-year ice under pressure; numerous ridges\*; snow (Environment Canada)

Where the ice is subjected to pressure its surface becomes deformed. In New ice\*\* and Young ice\*\*\* this may result in rafting as one ice floe over-rides its neighbor; in thicker ice it directs to the formation of Ridges and Hummocks\*\*\*\* according to the pattern of the convergent forces causing the pressure. During the process of ridging and hummocking, when pieces of ice are piled up above the general ice level, large quantities of ice are also forced downward to support the weight of the ice in the ridge or hummock. The draught of a ridge can be three to five times as great as its height and these deformations are thus major impediments to navigation. Freshly formed ridges are normally less difficult to navigate than older Weathered and consolidated ridges.

\*A line or wall of broken ice forced up by pressure. May be fresh or weathered. The submerged volume of broken ice under a ridge, forced downwards by pressure, is termed an ice keel.

\*\*A general term for recently formed ice which includes Frazil ice, Grease ice, Slush and Shuga. These types of ice are composed of ice crystals which are only weakly frozen together (if at all) and have a definite form only while they are afloat.

\*\*\*Ice in the transition stage between Nilas and First year ice, 10-30 cm in thickness. May be subdivided into Grey ice and Grey white ice.

\*\*\*\*A hillock of broken ice which has been forced upwards by pressure. May be fresh or Weathered. The submerged volume of broken ice under the hummock, forced downwards by pressure, is termed a Bummock.

## Fast ice



photo (50 ft): thin first-year fast ice; snow; ice foot (Environment Canada)



photo (50 ft): fast ice; brash in channel; ice cakes floes are detached from the fast ice; snow (Environment Canada)

Sea ice\* which forms and remains fast along the coast, where it is attached to the shore, to an Ice wall, to an Ice front, between shoals or grounded icebergs. Vertical fluctuations may be observed during changes of sea-level. Fast ice\*\* may be formed in situ from sea water or by freezing of Pack ice\*\* of any age to the shore, and it may extend a few meters or several hundred kilometers from the coast. Fast ice may be more than one year old and may then be prefixed with the appropriate age category (old, second-year, or multi-year). If it is thicker than about 2 m above sea-level it is called an Ice shelf\*\*\*.

\*Any form of ice found at sea which has originated from the freezing of sea water.

\*\*Term used in a wide sense to include any area of Sea ice, other than Fast ice, no matter what form it takes or how it is disposed.

\*\*\*A floating ice sheet of considerable thickness showing 2 - 50 m or more above sea-level, attached to the coast. Usually of great horizontal extent and with a level or gently undulating surface. Nourished by annual snow accumulation and often also by the seaward extension of land Glaciers. Limited areas may be aground. The seaward edge is termed an Ice front.



## First year ice



photo: thin first-year ice or grey-white fast ice; note the wave in ice ahead of the ship, this is due to the ship's mass and deep draft (32 ft) (Environment Canada)



photo: medium first-year ice; frozen puddles; ridges; snow (Environment Canada)



photo (150 ft): thick first-year ice; blind lead behind; puddles (Environment Canada)

Sea ice\* of not more than one winter's growth, developing from Young ice\*\*; thickness 30 cm - 2 m. May be subdivided into 'Thin First year ice'\*\*\* / white ice, 'Medium first year ice'\*\*\*\* and 'Thick first year ice'\*\*\*\*\*.

\*Any form of ice found at sea which has originated from the freezing of sea water.

\*\*Ice in the transition stage between Nilas and First year ice, 10-30 cm in thickness. May be subdivided into Grey ice and Grey white ice.

\*\*\*First-year ice 30 -70 cm thick

\*\*\*\*First-year ice 70 -120 cm thick

\*\*\*\*\*First-year ice > 120 cm thick

## **Flaw lead**

A passageway between Pack ice\* and Fast ice\*\* which is navigable by surface vessels.

\*Term used in a wide sense to include any area of Sea ice, other than Fast ice, no matter what form it takes or how it is disposed.

\*\*Sea ice which forms and remains fast along the coast, where it is attached to the shore, to an Ice wall, to an Ice front, between shoals or grounded icebergs. Vertical fluctuations may be observed during changes of sea-level. Fast ice may be formed in situ from sea water or by freezing of Pack ice of any age to the shore, and it may extend a few meters or several hundred kilometers from the coast. Fast ice may be more than one year old and may then be prefixed with the appropriate age category (old, second-year, or multi-year). If it is thicker than about 2 m above sea-level it is called an Ice shelf.

## **Flaw**

A narrow separation zone between Pack ice\* and Fast ice\*\*, where the pieces of ice are in chaotic state; it forms when pack ice shears under the effect of a strong wind or current along the fast ice boundary.

\*Term used in a wide sense to include any area of Sea ice, other than Fast ice, no matter what form it takes or how it is disposed.

\*\*Sea ice which forms and remains fast along the coast, where it is attached to the shore, to an Ice wall, to an Ice front, between shoals or grounded icebergs. Vertical fluctuations may be observed during changes of sea-level. Fast ice may be formed in situ from sea water or by freezing of Pack ice of any age to the shore, and it may extend a few meters or several hundred kilometers from the coast. Fast ice may be more than one year old and may then be prefixed with the appropriate age category (old, second-year, or multi-year). If it is thicker than about 2 m above sea-level it is called an Ice shelf.

## Floating ice



photo: floating ice (by B. Muehr)

Any form of ice found floating in water. The principal kinds of floating ice are lake ice, river ice and sea ice, which form by the freezing of water at the surface, and glacier ice (ice of land origin) formed on land or in an ice shelf. The concept includes ice that is stranded or grounded.

## Floe



photo (60 ft): small floes; medium first-year (Environment Canada)



photo (5000 ft): giant floes; thick first-year (Environment Canada)

Any relatively flat piece of sea ice 20 m or more across.

*Floes are subdivided to horizontal extent as follows:*

GIANT: Over 10 km across.

VAST: 2 - 10 km across.

BIG: 500 - 2,000 m across.

MEDIUM: 100 - 500 m across.

SMALL: 20 - 100 m across.

## Floeberg



photo (30 ft): floeberg (Environment Canada)

A massive piece of sea ice composed of a Hummock\* or a group of hummocks, frozen together and separated from any ice surroundings. It may typically protrude up to 5 m above sea level.

\*A hillock of broken ice which has been forced upwards by pressure. May be fresh or weathered. The submerged volume of broken ice under the hummock, forced downwards by pressure, is termed a Bummock.

## Fracture

Any break or rupture through Very close pack ice, compact pack ice, Consolidated pack ice, Fast ice, or a single Floe\* resulting from deformation processes. Fractures may contain Brash ice\*\* and/or be covered with Nilas\*\*\* and/or Young ice\*\*\*\*. Length may vary from a few meters to many kilometers.

\*Any relatively flat piece of sea ice 20 m or more across.

\*\*Accumulations of floating ice made up of fragments not more than 2 m across, the wreckage of other forms of ice.

\*\*\*A thin elastic crust of ice, easily bending on waves and swell and under pressure, thrusting in a pattern of interlocking "fingers" (finger rafting). Has a matt surface and is up to 10 cm in thickness.

\*\*\*\*Ice in the transition stage between Nilas and First year ice, 10-30 cm in thickness



**Frazil ice**

Fine spicules or plates of ice, suspended in water.

## **Glacier berg**

An irregularly shaped iceberg.

## Glacier ice

Ice in, or originating from, a Glacier\*, whether on land or floating on the sea as Icebergs\*\*, Bergy bits\*\*\* or Growlers\*\*\*\*.

\*A mass of snow and ice continuously moving from higher to lower ground or, if afloat, continuously spreading. The principal forms of glacier are inland ice sheets, ice shelves, ice streams, ice caps, ice piedmonts, cirque glaciers and various types of mountain (valley) glaciers.

\*\*Icebergs are large masses of floating ice derived from Glaciers, including ice shelves. The depth of a berg under water, compared with its height above, varies widely with different shapes of bergs. The underwater mass of an Antarctic iceberg derived from a floating ice shelf is usually less than the underwater mass of icebergs derived from Greenland glaciers. A typical Antarctic Tabular berg, of which the uppermost 10-20 m is composed of old snow, will show one part of its mass above the water to five parts below but the ratio for an Arctic berg, composed almost wholly of ice with much less snow, is typically 1:8.

\*\*\*A large piece of floating Glacier ice, generally showing less than 5 m above sea-level but more than 1 m and normally about 100-300 sq. m in area.

\*\*\*\*Smaller piece of ice than Bergy bit or Floeberg, often transparent but appearing green or almost black in color, extending less than 1 m above the surface and normally occupying an area of about 20 sq. m.

## Glacier



photo: glacier; ice stream; calving; ice front; ice bergs (Environment Canada)

A mass of snow and ice continuously moving from higher to lower ground or, if afloat, continuously spreading. The principal forms of glacier are inland ice sheets, ice shelves, Ice streams\*, ice caps, ice piedmonts, cirque glaciers and various types of mountain (valley) glaciers.

\*Part of an inland ice sheet which the ice flows more rapidly and not necessarily in the same direction as the surrounding ice. The margins are sometimes clearly marked by a change in direction of the surface slope but may be indistinct.

## Grease ice



photo: grease ice and fast ice in the background (Environment Canada)



photo (50 ft): grease ice undulating under water; possibly ice foot in the background (Environment Canada)

A later stage of freezing than Frazil ice\* when the crystals have coagulated to form a soupy layer on the surface. Grease ice reflects little light, giving the sea a matt appearance.

\*Fine spicules or plates of ice, suspended in water.

## Grey ice



photo (150 ft): grey ice; note the convection holes also known as seal holes and typical of grey ice (Environment Canada)

Young ice\* 10 - 15 cm thick. Less elastic than Nilas\*\* and breaks on swell. Usually rafts under pressure.

\*Ice in the transition stage between Nilas and First year ice, 10-30 cm in thickness. May be subdivided into Grey ice and Grey white ice.

\*\*A thin elastic crust of ice, easily bending on waves and swell and under pressure, thrusting in a pattern of interlocking "fingers" (finger rafting). Has a matt surface and is up to 10 cm in thickness.

## Grey white ice



photo: grey-white fast ice; snow; small ridges (Environment Canada)



photo: grey-white ice; snow; ridges (Environment Canada)

Young ice\* 15 - 30 cm thick. Under pressure more likely to ridge than to raft.

\*Ice in the transition stage between Nilas and First year ice, 10-30 cm in thickness. May be subdivided into Grey ice and Grey white ice.

## Growler



photo: growler; bergy water (Environment Canada)

Smaller piece of ice than 'Bergy bit'\* or Floeberg\*, often transparent but appearing green or almost black in color, extending less than 1 m above the surface and normally occupying an area of about 20 sq. m.

\*A large piece of floating Glacier ice, generally showing less than 5 m above sea-level but more than 1 m and normally about 100-300 sq. m in area.

\*\*A massive piece of sea ice composed of a Hummock or a group of hummocks, frozen together and separated from any ice surroundings. It may typically protrude up to 5 m above sea level.



## Hummock



photo: hummock; tormented Arctic ice; thick first-year; snow

A hillock of broken ice which has been forced upwards by pressure. May be fresh or Weathered. The submerged volume of broken ice under the hummock, forced downwards by pressure, is termed a Bummock.

## Hummocked ice



photo: hummocked ice; thick first-year (Environment Canada)

Sea ice piled haphazardly one piece over another to form an uneven surface. When weathered, has the appearance of smooth hillocks.

## **Ice boundary**

The demarcation at any given time between Fast ice\* and Pack ice\*\* or between areas of pack ice of different concentrations

\*Sea ice which forms and remains fast along the coast, where it is attached to the shore, to an Ice wall, to an Ice front, between shoals or grounded icebergs. Vertical fluctuations may be observed during changes of sea-level. Fast ice may be formed in situ from sea water or by freezing of Pack ice of any age to the shore, and it may extend a few meters or several hundred kilometers from the coast. Fast ice may be more than one year old and may then be prefixed with the appropriate age category (old, second-year, or multi-year). If it is thicker than about 2 m above sea-level it is called an Ice shelf.

\*\*Term used in a wide sense to include any area of Sea ice, other than Fast ice, no matter what form it takes or how it is disposed.

## Ice cake



photo (20 ft): medium first-year ice cakes (Environment Canada)

Any relatively flat piece of Sea ice\* less than 20 m across

\*Any form of ice found at sea which has originated from the freezing of sea water.

## Ice edge



photo (2000 ft): ice edge; medium first-year ice in small floes; brash (Environment Canada)

The boundary at any given time between open water and sea, river or lake ice of any kind, whether drifting or fast; may be termed compacted when it is clear-cut, or open when it forms the indefinite edge of an area of dispersed ice.

**Ice foot**

A narrow fringe of ice attached to the coast, unmoved by tides and remaining after the Fast ice\* has moved away.

\*Sea ice which forms and remains fast along the coast, where it is attached to the shore, to an Ice wall, to an Ice front, between shoals or grounded icebergs. Vertical fluctuations may be observed during changes of sea-level. Fast ice may be formed in situ from sea water or by freezing of Pack ice of any age to the shore, and it may extend a few meters or several hundred kilometers from the coast. Fast ice may be more than one year old and may then be prefixed with the appropriate age category (old, second-year, or multi-year). If it is thicker than about 2 m above sea-level it is called an Ice shelf.

**Ice front**

The vertical cliff forming the seaward face of an Ice shelf\* or other floating glacier varying in height from 2 - 50 m or more above sea-level.

\*A floating ice sheet of considerable thickness showing 2 - 50 m or more above sea-level, attached to the coast. Usually of great horizontal extent and with a level or gently undulating surface. Nourished by annual snow accumulation and often also by the seaward extension of land Glaciers. Limited areas may be aground. The seaward edge is termed an Ice front.

## **Ice of land origin**

Ice formed on land or in an Ice shelf\*, found floating in water. The concept includes ice stranded or grounded.

\*A floating ice sheet of considerable thickness showing 2 - 50 m or more above sea-level, attached to the coast. Usually of great horizontal extent and with a level or gently undulating surface. Nourished by annual snow accumulation and often also by the seaward extension of land Glaciers. Limited areas may be aground. The seaward edge is termed an Ice front.



**Ice rind (ice crust)**

A brittle shiny crust of ice formed on a quiet surface by direct freezing or from Grease ice\*, usually in water of low salinity. Thickness to about 5 cm. Easily broken by wind or swell, commonly breaking in rectangular pieces.

\*A later stage of freezing than Frazil ice when the crystals have coagulated to form a soupy layer on the surface. Grease ice reflects little light, giving the sea a matt appearance.

## Ice shelf

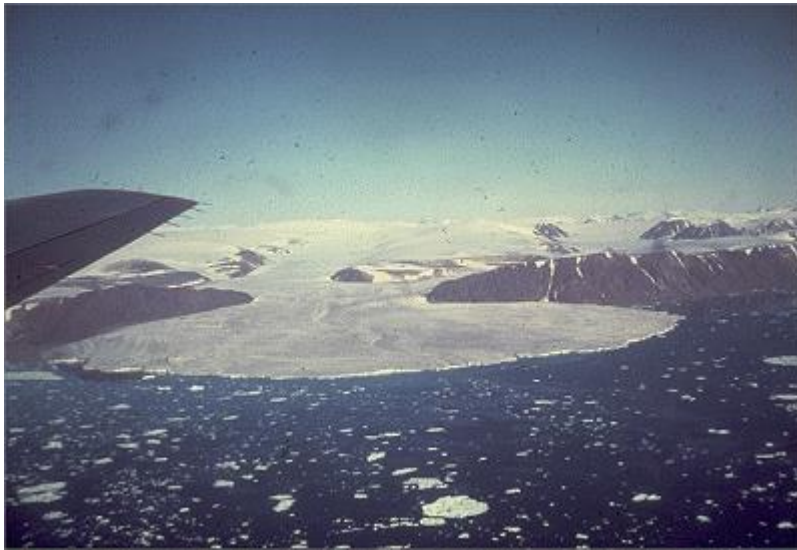


photo: ice shelf with ice front; glacier (Environment Canada)

A floating ice sheet of considerable thickness showing 2 - 50 m or more above sea-level, attached to the coast. Usually of great horizontal extent and with a level or gently undulating surface. Nourished by annual snow accumulation and often also by the seaward extension of land Glaciers\*. Limited areas may be aground. The seaward edge is termed an Ice front\*\*.

\*A mass of snow and ice continuously moving from higher to lower ground or, if afloat, continuously spreading. The principal forms of glacier are: inland ice sheets, ice shelves, ice streams, ice caps, ice piedmonts, cirque glaciers and various types of mountain (valley) glaciers.

\*\*The vertical cliff forming the seaward face of an Ice shelf or other floating glacier varying in height from 2 - 50 m or more above sea-level.

## Ice wall



photo: ice wall (by B. Muehr)

An ice cliff forming the seaward margin of a Glacier\* which is not afloat. An ice wall is aground, the rock basement being at or below sea-level.

\*A mass of snow and ice continuously moving from higher to lower ground or, if afloat, continuously spreading. The principal forms of glacier are inland ice sheets, ice shelves, ice streams, ice caps, ice piedmonts, cirque glaciers and various types of mountain (valley) glaciers.

## Iceberg



photo (30 ft): iceberg (Environment Canada)



photo (45 ft): icebergs (Environment Canada)

Icebergs are large masses of floating ice derived from Glaciers\*, including ice shelves. The depth of a berg under water, compared with its height above, varies widely with different shapes of bergs. The underwater mass of an Antarctic iceberg derived from a floating ice shelf is usually less than the underwater mass of icebergs derived from Greenland glaciers. A typical Antarctic Tabular berg\*\*, of which the uppermost 10-20 m is composed of old snow, will show one part of its mass above the water to five parts below but the ratio for an Arctic berg, composed almost wholly of ice with much less snow, is typically 1:8.

\*A mass of snow and ice continuously moving from higher to lower ground or, if afloat, continuously spreading. The principal forms of glacier are inland ice sheets, ice shelves, ice streams, ice caps, ice piedmonts, cirque glaciers and various types of mountain (valley) glaciers.

\*\*A flat-topped iceberg. Most tabular bergs form by calving from an ice shelf and show horizontal banding.

## Lead



photo (200 ft): lead with new ice; thick first-year; snow; ridges (Environment Canada)

Any fracture or passageway through Sea ice\* which is navigable by surface vessels.

\*Any form of ice found at sea which has originated from the freezing of sea water.

## Medium first year ice



photo (50 ft) medium first-year ice; ridges; snow (Environment Canada)

First-year ice 70 -120 cm thick

## **Movement of sea ice**

Sea ice is divided into two main types according to its mobility. One type is Pack ice\*, which is continually in motion under the action of wind and current stresses; the other is Fast ice\*\*, attached to the coast or islands, which does not move.

Wind stress in the pack ice causes the Floes\*\*\* to move in an approximately downwind direction. The deflecting force due to the Earth's rotation (Coriolis force) causes the floes to deviate about 30° to the right of the surface wind direction in the northern hemisphere and to the left in the southern hemisphere. Since the surface wind itself is deviated by a similar amount but in the opposite sense from the geostrophic wind (measured directly from isobars) the direction of movement of the ice floes, due to the wind drift alone, can be considered to be parallel to the isobars.

The rate of movement due to wind drift varies not only with the wind speed, but also with the concentration of the pack ice and the extent of deformation (see below). In very open pack ice (1/10-3/10) there is much more freedom to respond to the wind than in close pack ice (7/10-8/10) where free space is very limited. Two per cent of the wind speed is a reasonable average for the rate of ice drift caused by the wind in close pack ice, but much higher rates of ice drift may be encountered in open pack ice. Since it is afloat, a force is exerted on pack ice by currents that are present in the upper layers of the water, whether these are tidal in nature or have a more consistent direction due to other forces. It is usually very difficult to differentiate between wind- and current-induced ice drift, but in any case, where both are present the resultant motion is always the vector sum of the two. Wind stress normally predominates, particularly in offshore areas.

\*Term used in a wide sense to include any area of Sea ice, other than Fast ice, no matter what form it takes or how it is disposed.

\*\*Sea ice which forms and remains fast along the coast, where it is attached to the shore, to an Ice wall, to an Ice front, between shoals or grounded icebergs.

\*\*\*Any relatively flat piece of sea ice 20 m or more across.

## Multi year ice



photo: multi-year ice; note puddles color; eroded surface; numerous puddles; thaw holes in the background (Environment Canada)

Old ice up to 3 m or more thick which has survived at least two summers' melt. Hummocks even smoother than Second year ice\*, and the ice is almost salt-free. Color, where bare, is usually blue. Melt pattern consists of large interconnecting irregular Puddles\*\* and a well- developed drainage system

\*Old ice which has survived only one summer's melt.

\*\*An accumulation on ice of meltwater, mainly due to melting snow, but in the more advanced stages also to the melting of ice. Initial stage consists of patches of melted snow.



## New ice



photo (50 ft): new ice; one tabular and numerous bergs in the back (Environment Canada)

A general term for recently formed ice which includes Frazil ice\*, Grease ice\*\*, Slush\*\*\* and Shuga\*\*\*\*. These types of ice are composed of ice crystals which are only weakly frozen together (if at all) and have a definite form only while they are afloat.

\*Fine spicules or plates of ice, suspended in water.

\*\*A later stage of freezing than Frazil ice when the crystals have coagulated to form a soupy layer on the surface.

\*\*\*Snow which is saturated and mixed with water on land or ice surfaces, or as a viscous floating mass in water after a heavy snowfall.

\*\*\*\*An accumulation of spongy white ice lumps, a few centimeters across; they are formed from Grease ice or Slush and sometimes from Anchor ice rising to the surface.

## Nilas



photo (80 ft): light nilas; considerable rafting; grey-white ice or first-year ice in the background (Environment Canada)



photo (200 ft): dark nilas near the shore; light nilas and grey ice in foreground; finger rafting (Environment Canada)

A thin elastic crust of ice, easily bending on waves and swell and under pressure, thrusting in a pattern of interlocking "fingers" (finger rafting). Has a matt surface and is up to 10 cm in thickness. May be subdivided into Dark nilas (Nilas which is under 5 cm in thickness and is very dark in color) and Light nilas (Nilas which is more than 5 cm in thickness and rather lighter in color than dark nilas).

## Old ice



photo (50 ft): old ice (Environment Canada)

'Thick first year ice'\* may survive the summer melt season and is then classified as old ice. This category is subdivided into Second year ice or Multi year ice depending on whether the Floes\*\* have survived one or more summers. The thickness of old ice is normally in the range 1.2 m to 3 m or more prior to the onset of the melt season. Towards the end of the summer melt season old ice may be considerably reduced in thickness. Old ice may often be recognized by a bluish surface colour in contrast to the greenish tint of First year ice.

\*First-year ice > 120 cm thick

\*\* Any relatively flat piece of sea ice 20 m or more across.

## **Open pack ice**

Pack ice\* in which the ice concentration is 4/10 to 6/10, with many leads and Polynyas\*\*, and the Floes\*\*\* are generally not in contact with one another.

\*Term used in a wide sense to include any area of Sea ice, other than Fast ice, no matter what form it takes or how it is disposed.

\*\*Any non-linear shaped opening enclosed in ice.

\*\*\*Any relatively flat piece of sea ice 20 m or more across.

## Open water



photo (30 ft): open water; 25 ft high hummock or floeberg (Environment Canada)

A large area of freely navigable water in which 'Sea ice'\* is present in Concentrations less than 1/10. No 'Ice of land origin'\*\* is present.

\*Any form of ice found at sea which has originated from the freezing of sea water.

\*\*Ice formed on land or in an Ice shelf, found floating in water. The concept includes ice stranded or grounded.

**Pack ice**

Term used in a wide sense to include any area of Sea ice\*, other than Fast ice\*\*, no matter what form it takes or how it is disposed.

\*Any form of ice found at sea which has originated from the freezing of sea water.

\*\*Sea ice which forms and remains fast along the coast, where it is attached to the shore, to an Ice wall, to an Ice front, between shoals or grounded icebergs.

## Pancake ice



photo: pancake ice; grey ice and nilas (Environment Canada)

Predominantly circular pieces of ice from 30 cm - 3 m in diameter, and up to about 10 cm in thickness, with raised rims due to the pieces striking against one other. It may be formed on a slight swell from Grease ice\*, Shuga\*\* or Slush\*\*\* or as a result of the breaking of Ice rind, Nilas\*\*\*\* or, under severe conditions of swell or waves, of Grey ice\*\*\*\*\*. It also sometimes forms at some depth, at an interface between water bodies of different physical characteristics, from where it floats to the surface; its appearance may rapidly cover wide areas of water.

\*A later stage of freezing than Frazil ice when the crystals have coagulated to form a soupy layer on the surface. Grease ice reflects little light, giving the sea a matt appearance.

\*\*An accumulation of spongy white ice lumps, a few centimeters across; they are formed from Grease ice or Slush and sometimes from Anchor ice rising to the surface.

\*\*\*Snow which is saturated and mixed with water on land or ice surfaces, or as a viscous floating mass in water after a heavy snowfall.

\*\*\*\*A thin elastic crust of ice, easily bending on waves and swell and under pressure, thrusting in a pattern of interlocking "fingers" (finger rafting). Has a matt surface and is up to 10 cm in thickness.

\*\*\*\*\*Young ice 10 - 15 cm thick. Less elastic than Nilas and breaks on swell. Usually rafts under pressure.

## **Polynya**

Any non-linear shaped opening enclosed in ice. Polynyas may contain brash ice and/or be covered with new ice, nilas or young ice; submariners refer to these as skylights. Sometimes the polynya is limited on one side by the coast and is called a shore polynya or by fast ice and is called a flaw polynya. If it recurs in the same position every year, it is called a recurring polynya.



## Sastrugi



photo (50 ft): sastrugi; thin first-year ice; bare ice; ridges; snow (Environment Canada)

Sharp, irregular ridges formed on a snow surface by wind erosion and deposition. On mobile floating ice the Ridges\* are parallel to the direction of the prevailing wind at the time they were formed.

\*A line or wall of broken ice forced up by pressure. May be fresh or weathered.

## Sea ice

Any form of ice found at sea which has originated from the freezing of sea water.

### *sea ice less than 30 cm thick*

The first indication of ice formation is the appearance of small ice spicules or plates in the top few centimeters of the water. These spicules, known as Frazil ice, form in large quantities and give the sea an oily appearance. As cooling continues the frazil ice coalesces to form Grease ice, which has a matt appearance. Under near-freezing but as yet ice-free conditions, snow falling on the surface may result in the sea surface becoming covered by a layer of Slush. These forms may be regrouped by the action of wind and waves to form Shuga and all are classified as New ice. With further cooling, sheets of Ice rind or Nilas are formed, depending on the rate of cooling and on the salinity of the water. Ice rind is formed when water of low salinity freezes into a thin layer of brittle ice which is almost free of slat, whereas when water of high salinity freezes, especially if the process is rapid and wind is very light, the ice has an elastic property which is characteristic of nilas. The latter form of ice is subdivided, according to its thickness, into dark and Light nilas; the second, more advanced form reaches a maximum thickness of ten centimeters.

The action of wind and waves may break up ice rind or nilas into Pancake ice, which can later freeze and thicken into Grey ice and Grey white ice, the latter attaining thicknesses up to 30 cm. These forms of ice are referred to collectively as Young ice. Rough weather may break this ice up into ice cakes or Floes of varying size.

### *sea ice 30 cm to 2 m thick*

The next stage of development (first stage see: "sea ice less than 30 cm thick") is known as First year ice and is subdivided into thin, medium and thick categories. Thin first year ice has a thickness of 30-70 cm. Medium first year ice has a range of thickness from 70 to 120 cm while in polar areas Thick first year ice (> 120 cm thick) may attain a thickness of approximately two meters at the end of the winter.

## Second year ice



photo: typical second-year ice; eroded surface; poorly connected puddles; puddles colors; thaw holes (Environment Canada)

Old ice which has survived only one summer's melt. Because it is thicker and less dense than 'First year ice'\*, it stands higher out of the water. In contrast to 'Multi year ice'\*\*, summer melting produces a regular pattern of numerous small Puddles\*\*\*. Bare patches and puddles are usually greenish-blue.

\*Sea ice of not more than one winter's growth, developing from Young ice; thickness 30 cm - 2 m

\*\*Old ice up to 3 m or more thick which has survived at least two summers' melt. Hummocks even smoother than Second year ice, and the ice is almost salt-free.

\*\*\*An accumulation on ice of meltwater, mainly due to melting snow, but in the more advanced stages also to the melting of ice. Initial stage consists of patches of melted snow.

## Shuga



photo (30 ft): shuga and grease ice; pancakes (Enironment Canada)

An accumulation of spongy white ice lumps, a few centimeters across; they are formed from Grease ice\* or Slush\* and sometimes from Anchor ice\* rising to the surface.

\*A later stage of freezing than Frazil ice when the crystals have coagulated to form a soupy layer on the surface. Grease ice reflects little light, giving the sea a matt appearance.

\*\*Snow which is saturated and mixed with water on land or ice surfaces, or as a viscous floating mass in water after a heavy snowfall.

\*\*\*Submerged ice attached or anchored to the bottom, irrespective of the nature of its formation.

**Slush**

Snow which is saturated and mixed with water on land or ice surfaces, or as a viscous floating mass in water after a heavy snowfall.

## Snow cover related to ice



photo (30 ft): snow covered thin first-year ice (Environment Canada)

During the winter, the ice usually becomes covered with snow which insulates the ice from the air above and tends to slow down its rate of growth. The thickness of snow cover varies considerably from region to region as a result of differing climatic conditions. Its depth may also vary widely within very short distances in response to variable winds and ice topography.

## Strip



photo (20 ft): strip of medium first-year ice (Environment Canada)

Long narrow area of Pack ice\*, about 1 km or less in width, usually composed of small fragments detached from the main mass of ice, and run together under the influence of wind, swell or current

\*Term used in a wide sense to include any area of Sea ice, other than Fast ice, no matter what form it takes or how it is disposed.

## Tabular berg



photo: tabular berg; first-year ice cakes (Environment Canada)

A flat-topped iceberg. Most tabular bergs form by calving from an Ice shelf\* and show horizontal banding.

\*A floating ice sheet of considerable thickness showing 2 - 50 m or more above sea-level, attached to the coast.



## **Thaw holes**

Vertical holes in sea ice formed when surface Puddles\* melt through to the underlying water.

\*An accumulation on ice of meltwater, mainly due to melting snow, but in the more advanced stages also to the melting of ice. Initial stage consists of patches of melted snow.

## Thick first year ice



photo (30 ft): thick first-year ice (Environment Canada)

First-year ice > 120 cm thick

## Thin first year ice



photo: thin first-year ice (measured at 60 cm); snow; ridges (Environment Canada)

First-year ice 30 - 70 cm thick

**Very close pack ice**

Pack ice in which the Concentration is 9/10 to less than 10/10

## Young ice



photo (20 ft): young ice; consolidated pack ice; pancake ice under pressure (Environment Canada)

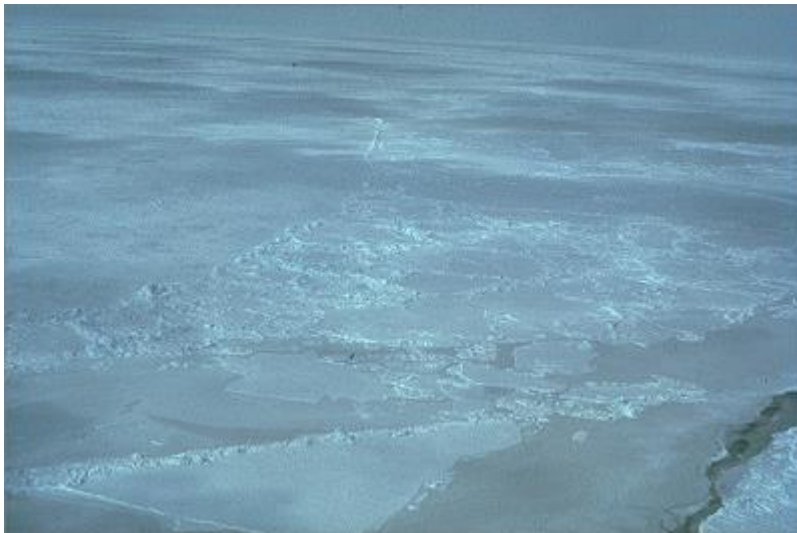


photo (500 ft): grey ice and grey-white ice; trace of nilas; ridges and snow (Environment Canada)

Ice in the transition stage between Nilas\* and First year ice\*\*, 10-30 cm in thickness. May be subdivided into Grey ice\*\*\* and Grey white ice\*\*\*\*.

\* A thin elastic crust of ice, easily bending on waves and swell and under pressure, thrusting in a pattern of interlocking "fingers" (finger rafting). Has a matt surface and is up to 10 cm in thickness.

\*\* Sea ice of not more than one winter's growth, developing from Young ice; thickness 30 cm - 2 m

\*\*\* Young ice 10 - 15 cm thick

\*\*\*\*Young ice 15 - 30 cm thick.

### Very open pack ice



photo: very open pack ice; medium first-year; icebergs (Environment Canada)

Pack ice in which the Concentration is  $1/10$  to  $3/10$  and water preponderates over ice.