



Thawing Permafrost in Arctic and Industrial Contamination

For Prelims: [Thawing Permafrost in Arctic](#), [Industrial Contamination](#), [NASA](#), [Permafrost](#), [Mining](#), [Climate Change](#).

For Mains: Thawing Permafrost in Arctic and Industrial Contamination.

Why in News?

According to a New Study, “**Thawing Permafrost poses an environmental threat to thousands of sites with legacy industrial contamination**”, thawing of [Permafrost](#) may result in the spread of toxic substances in the [Arctic Region](#).

What is Permafrost?

- Permafrost is **essentially any ground that stays frozen** — 0 degree Celsius or lower — for at **least two years straight**.
- These permanently frozen grounds **are often found in Arctic regions** such as Greenland, Alaska (the United States), Canada, Russia and Eastern Europe.
- According to the [National Aeronautics and Space Administration \(NASA\)](#), permafrost is composed of “**a combination of soil, rocks and sand that are held together by ice**. The soil and ice in permafrost stay frozen all year long.
 - However, although the **ground remains perennially frozen**, permafrost regions aren't always covered with snow.

What are the Findings of the Study?

- **Contaminated Sites In the Region:**
 - 4,500 industrial facilities in the permafrost regions **have most likely produced between 13,000 and 20,000 contaminated sites**.
 - As of now, around 1,000 of the known industrial sites and 2,200 to 4,800 of the known contaminated sites are **already at risk of destabilising due to thawing permafrost**.
- **Industrial Waste in Arctic:**
 - Known industrial waste types in the region include **drilling and [Mining](#) wastes**, toxic substances like drilling muds and fluids, mine waste heaps, heavy metals, spilled fuels, and [Radioactive Waste](#).
- **Rapid Thawing and Destabilizing Industrial Site:**
 - The [Arctic is getting warmer nearly four times as fast as the rest](#) of the planet due to [Climate Change](#), and therefore permafrost is thawing rapidly, which could destabilize not only the industrial sites **but also the contaminated areas**.
 - Nearly 2,100 industrial sites and between **5,600 and 10,000 contaminated sites are under threat of destabilization** by the end of this century.

▪ Reasons for building Such Sites:

- Once believed to be perennially stable and reliable, the Arctic is far from an uninhabited and untouched region.
 - It's dotted with countless **industrial facilities such as oilfields and pipelines**, mines and military bases.
- All this infrastructure is built on permafrost, the toxic waste from these industrial facilities has been buried in the permafrost, on the assumption **that it would stay locked away permanently**.
 - But danger looms as the planet continues to heat up.
- The Arctic region experienced **increased development during the Cold War**, becoming a hub for **resource extraction and military operations**.
 - As a result, industrial and toxic waste accumulated on or within the permafrost, and no measures were taken to remove it.

What are the Implications of Thawing Permafrost?

- One of its most dangerous consequences is the **release of Greenhouse Gases (GHG)** into the atmosphere.
 - A 2022 report by NASA said, "Arctic permafrost alone holds an estimated 1,700 billion metric tons of carbon, **including methane and carbon dioxide**. That's **roughly 51 times the amount of carbon the world released as fossil fuel emissions in 2019**."
- Plant matter frozen in permafrost doesn't decay, but when permafrost thaws, microbes **within the dead plant material start to break the matter down**, releasing carbon into the atmosphere.
 - A 2022 study by Columbia University observed that **thawing permafrost would unleash thousands of dormant viruses and bacteria**.
 - Some of these "could be new viruses or ancient ones for which humans lack immunity and cures, or diseases that society has eliminated, such as **smallpox or Bubonic plague**."

UPSC Civil Services Examination, Previous Year Questions (PYQs)

Prelims

Q. Which of the following statements is/are correct about the deposits of 'methane hydrate'? (2019)

1. Global warming might trigger the release of methane gas from these deposits.
2. Large deposits of 'methane hydrate' are found in Arctic Tundra and under the sea floor.
3. Methane in atmosphere oxidizes to carbon dioxide after a decade or two.

Select the correct answer using the code given below.

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

Ans: (d)

Exp:

- **Methane hydrate is a crystalline solid that consists of a methane molecule** surrounded by a cage of interlocking water molecules. It is an "ice" that only occurs naturally in subsurface deposits where temperature and pressure conditions are favourable for its formation.
- Regions with suitable temperature and pressure conditions for the formation and stability of methane hydrate- **sediment and sedimentary rock units below the Arctic permafrost**; sedimentary deposits along continental margins; deep-water sediments of inland lakes and seas; and, under Antarctic ice. **Hence, statement 2 is correct.**
- Methane hydrates, the sensitive sediments, can rapidly dissociate with an increase in temperature or a decrease in pressure. The dissociation produces free methane and water, which can be

triggered by global warming. Hence, statement 1 is correct.

- Methane is removed from the atmosphere in about 9 to 12-year period by oxidation reaction where it is converted into Carbon Dioxide. Hence, statement 3 is correct.
- **Therefore, option (d) is the correct answer.**

Mains

Q. How do the melting of the Arctic ice and glaciers of the Antarctic differently affect the weather patterns and human activities on the Earth? Explain. **(2021)**

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