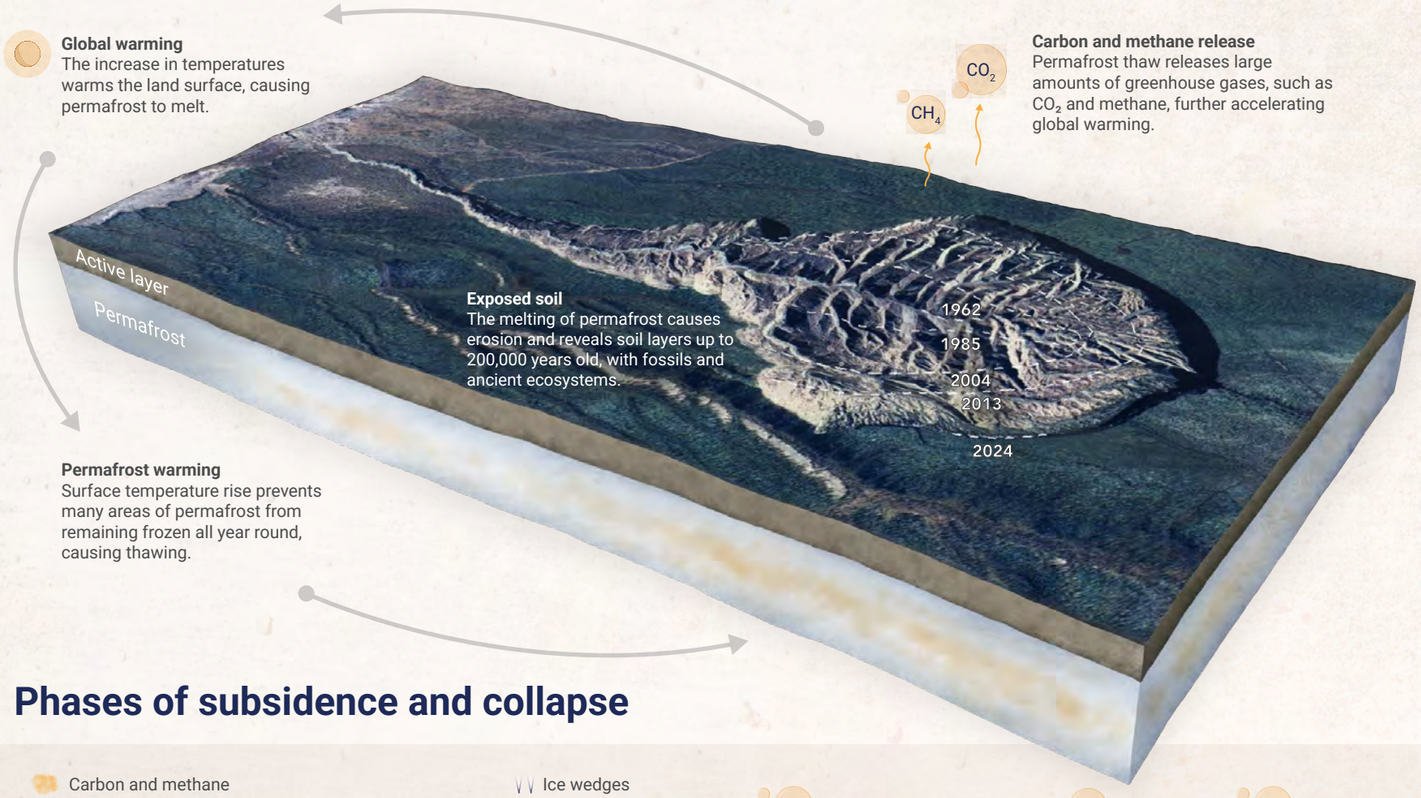
Batagaika: the scar of permafrost

The world’s largest crater formed by climate collapse

The Batagaika crater, located in Siberia, is a massive ground subsidence caused by permafrost thaw. Permafrost is a layer of soil that remains permanently frozen for at least two consecutive years. It forms when cold temperatures prevent the ground from completely thawing in summer, leading to the accumulation of frozen organic matter, like plants and roots, over thousands of years. With global warming, permafrost is melting at an accelerated pace, destabilizing the ground and causing depressions like the Batagaika crater.

The cycle of thawing and global warming



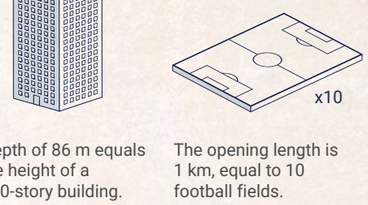
Location of the Batagaika crater

The Batagaika crater is located in eastern Siberia, in the remote Republic of Sakha, Yakutia. One of the coldest regions in the world, with the most extensive and deepest permafrost.

Crater expansion

- 1960s: First collapse after deforestation.
- 1980s: Accelerated expansion due to rising temperatures.
- 2000s: Massive landslides reshaped the landscape and led to lakes forming.
- Present: Grows up to 10 m per year, releasing carbon and methane.

Current dimensions



Its depth of 86 m equals to the height of a 25–30-story building.

The opening length is 1 km, equal to 10 football fields.

Climate solutions

- Monitor the crater’s expansion to better understand permafrost evolution.
- Significantly reduce global greenhouse gas emissions in order to slow down the warming that accelerates permafrost thawing.
- Research climate engineering methods to stabilize permafrost, such as using reflective ground materials to reduce heat absorption and maintain cooler ground temperatures.

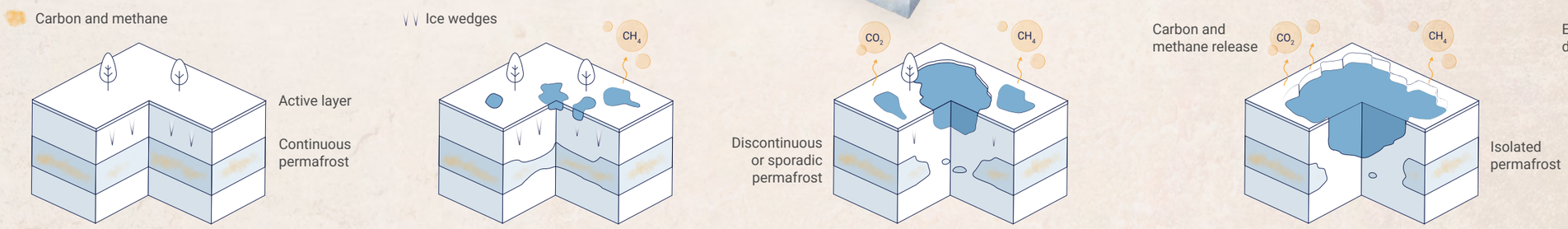
Permafrost in numbers

Global surface
Permafrost covers approx. 23 million km², around 15% of the Earth’s land surface.

Carbon stored
Contains ~1,700 gigatonnes (Gt) of carbon, almost double that in the atmosphere.

Depth
Can reach up to 1,500 meters in some Siberian regions.

Phases of subsidence and collapse



1. Long-term stable ground freezing

Permafrost remains solid, trapping organic matter and gases like methane and CO_2. In winter, water infiltrates cracks and freezes, forming ice wedges below the active layer.

2. Accelerated surface thawing due to heat

Seasonal heat melts the active layer, forming ponds on the surface. Beneath them, permafrost thins and ice wedges begin to melt, weakening soil stability.

3. Initial collapse and thermokarst formation

Deep thaw and loss of natural insulation cause the ground to fracture. Irregular depressions appear and the terrain begins to gradually subside.

4. Total collapse and crater formation

The collapse exposes permafrost, releasing large amounts of carbon and methane. This alters the surrounding ecosystem and accelerates regional climate change.

5. Crater desiccation (the case of Batagaika)

Unlike other craters, accumulated water in Batagaika evaporates or drains away. This prevents a lake from forming and leaves a dry depression that continues to expand.

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