Hills point to catastrophic Ice Age floods

Fields of low hills that cover parts of inland Canada and the northern United States may seem quite distant from the watery world of Atlantis. Yet a Canadian geologist proposes these hills formed from huge Ice Age floods that sharply raised global sea levels and could have spawned myths of a swamped continent.

"There's nothing in recorded history that matches the size of these floods," says John Shaw of Queen's University in Kingston, Ontario, who has estimated the extent of the floods from the size of the ridges.

Called drumlins – a word derived from Old Irish – these hills appear in concentrated fields in North America, Scandinavia, Britain and other areas once covered by ice. When seen from above, the aligned knolls sometimes look like a basket of eggs lying on their sides and pointing in the same direction. Some drumlins are made of sediments deposited onto bedrock; others are ridges carved out of the rock.

Most geologists believe drumlins developed gradually from the grinding action of heavy ice sheets as they moved over the land. But in the last several years, Shaw and others have proposed the controversial idea that floods of water flowing beneath the ice created many of the North American drumlins and possibly others around the world. They base this hypothesis on the shapes drumlins share with other land forms sculpted by meltwater.

According to Shaw, heat from the Earth formed huge lakes of meltwater that remained trapped beneath the North American ice sheet. As the sheet began to retreat near the end of the glacial age, the water broke through and flowed in torrents down to the Gulf of Mexico and Atlantic Ocean. While flowing under the ice cap, water would have surged in vast, turbulent sheets that sculpted and scoured drumlins. Each flood lasted until the weight of the ice cap once again shut off the outlet of the covered lake, Shaw says.

Through simple calculations described in the September GEOLOGY, Shaw estimates that 84,000 cubic kilometers of water must have discharged during the creation of one large drumlin field in northern Saskatchewan. Upon reaching the ocean, this flood would have raised global sea levels by 23 centimeters during a few days or weeks, he says.

In some ways, Shaw's hypothesis echoes ideas raised 14 years ago by a group of oceanographers who studied the ancient remains of one-celled animals buried under sediment on the floor of the Gulf of Mexico. The ratios of oxygen isotopes in these organisms suggested that sometime around 11,500 years ago, a large amount of freshwater entered the gulf, says Cesare Emiliani of the University of Miami in Coral Gables. On the basis of the isotope studies, Emiliani and his colleagues theorized that a sudden influx of meltwater from the ice sheet could have rapidly raised sea levels, sparking myths of a great deluge.

When Emiliani's group proposed the theory, glacial experts responded that the sun could not melt the ice sheet fast enough to create such a sea-level rise. Shaw's hypothesis relieves this problem by proposing that vast amounts of meltwater were stored under the ice.

Yet many other geologists contend the drumlin-flood connection doesn't hold water. "Several of us are strongly opposed to this idea," says John Menzies of Brock University in St. Catharines, Ontario.

Menzies says the ice sheet could not have remained stable if large sections of it rested on huge lakes instead of on rock. Moreover, he says, studies of rock under the ice in Antarctica show that moving ice can shape drumlins. – *R. Monastersky*

Soil nitrogen leaves methane up in the air

Increased soil nitrogen, from acid rain or fertilizers, may lead to higher levels of methane in the atmosphere, a new study indicates. But researchers disagree on whether such an increase can significantly accelerate global warming.

Atmospheric concentrations of methane – a colorless, odorless "greenhouse" gas produced mainly by rice paddies, ruminant animals, termites, wetlands and burning vegetation – are increasing by about 1.1 percent per year, according to previous studies. While hydroxyl radicals (charged molecules produced by sunlight, water and ozone) remove much methane from the lower atmosphere, certain soil microbes are the predominant biological scavengers of the gas.

Working in an experimental forest in central Massachusetts, Paul A. Steudler of the Marine Biological Laboratory at Woods Hole, Mass., and his co-workers exposed soils to high and low levels of ammonium nitrate fertilizer. They recorded methane changes in the air trapped by plastic boxes over plot sections. After six months, methane emissions in the highly fertilized plots were 33 percent higher than in unfertilized plots, the researchers report in the Sept. 28 NATURE.

Microbes exposed to the fertilizer apparently feast more on it and consume less methane, Steudler says. He and his colleagues strongly suspect that decades of exposure to acid rain and nitrogen fertilizers significantly reduce a soil's role as a "sink" for removing methane.

Using data from this and other studies, the group also estimates that soils in temperate and boreal forests – the largely coniferous woodlands running from the Arctic treeline into the northern United States – consume 3.7 times more methane than do tropical forest soils.

M. Aslam K. Khalil of the Oregon Graduate Center in Beaverton, who studies methane sources and fluctuations, calls the report interesting "but nothing that's spectacularly new." Since roughly 550 trillion grams of methane now enter the atmosphere each year, and Steudler's group estimates that temperate and boreal forest soils worldwide remove about 12.5 trillion grams, Khalil says a decrease in methane consumption by forest soils won't dramatically increase atmospheric methane and global warming. In fact, "cows are doing more [to increase] the greenhouse effect than the soils are doing to prevent it," he told SCIENCE NEWS.

Steudler argues that "you may not need large changes in the rate of the [methane] sink" to trigger important changes in global methane. Since nitrogen depositions worldwide have increased substantially, scientists ought to learn whether that will affect global greenhouse gases, he says.

William S. Reeburgh, a geochemist at the Institute of Marine Science at the University of Alaska at Fairbanks, says he's observed significant methane uptake by microbes in the soils of tundra and high-latitude spruce-birch forests. But other tundra microbes and plants efficiently *release* methane, he says, at an estimated rate of 30 to 50 trillion grams per year, or about half the methane emission rate of the world's wetlands.

Steudler's new findings bolster other research suggesting that controlling nitrogen is important in improving air quality (SN: 9/17/88, p.180). President Bush's proposed Clean Air Act revision calls for halving sulfur dioxide emissions – a reduction of 10 million tons per year from 1980 levels – but proposes a reduction of only 10 percent from the estimated 20.4 million tons of nitrogen oxides emitted into the atmosphere in 1980 (SN: 6/17/89, p.375). "We feel there should be as much attention paid to nitrogen oxide emissions as to sulfur dioxide emissions," Steudler says.

His group has begun research in the same forest to learn whether the nitrogen and sulfur in acid rain increase soil releases of carbon dioxide and nitrous oxide. – *D.E. Loupe*