Extracts

Manure System Benefits Environment, & Noses

As the nation looks to agriculture for renewable fuels from crops and other sources, University of Florida researchers have developed a manure management system that produces energy, saves valuable nutrients for fertilizer, cuts greenhouse gas emissions and stops offensive odors.

"It's an environmentally friendly solution for an unpleasant housekeeping task," said Ann Wilkie, an associate research professor with UF's Institute of Food and Agricultural Sciences. "It's not often that one technology can solve several major problems, but our innovative animal manure management system is a sustainable option for dairies and other livestock operations that produces renewable energy and protects the environment."

She said the growing number of big dairy and swine livestock farms — along with urban sprawl in rural areas — has resulted in greater awareness and concern about the proper storage, treatment and utilization of manure. Without proper management, animal manure can get into groundwater supplies, and odor problems can irk nearby residents.

"The key to our waste management system is a natural biological process called anaerobic digestion that relies on microorganisms to transform animal manure into methane gas," Wilkie said. "Anaerobic digesters, which process waste under oxygen-free conditions, are different than conventional aerobic systems that use oxygen to treat the waste."

She said anaerobic digesters can process five to 10 times more waste than aerobic systems. Because the waste is enclosed to keep oxygen out, anaerobic digestion keeps odors in. Odors, flies and pathogens are reduced by as much as 95 percent.

With anaerobic digestion, the methane produced can be used to heat water or generate electricity, eliminating greenhouse gas emissions that contribute to global warming. Nutrients such as nitrogen and phosphorus can be recovered and used to fertilize crops.

To demonstrate the technology at a working dairy farm, a large-scale anaerobic digester at UF's 500-cow Dairy Research Unit in Hague is now generating biogas from manure flushed from animal barns and milking parlors.

About 40 cubic feet of methane per day can be produced from the waste of each dairy cow, Wilkie said. Each cubic foot of methane has about l,000 BTUs, which adds up to a huge amount of usable energy.

Art Darling, executive director of Sunshine State Milk Producers Inc. in Orlando, said although methane technology is not cheap, it can solve

Drake Passage Tied To Antarctic Cooling

Ancient fish teeth are yielding clues about when Antarctica became the icy continent it is today, highlighting how ocean currents affect climate change.

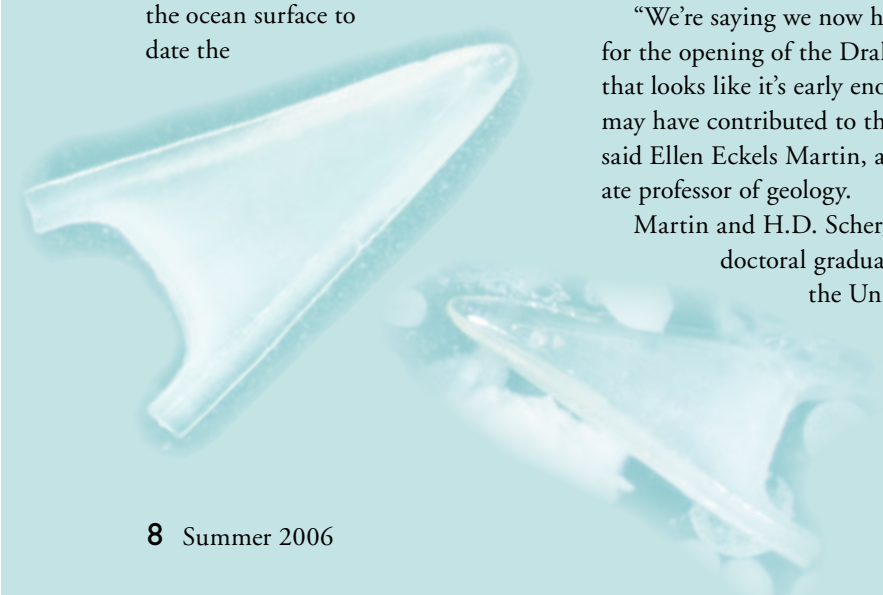
University of Florida geologists have used a rare element found in tiny fish teeth gathered from miles below the ocean surface to date the opening of a passage at the bottom of the globe between the Atlantic and Pacific. The opening, which occurred millions of years ago in a much warmer era, allowed the formation of an ocean current around the pole. That event preceded — and may even have brought about — Antarctica's transformation from a forested continent to an icy moonscape.

"We're saying we now have a date for the opening of the Drake Passage that looks like it's early enough that it may have contributed to the cooling," said Ellen Eckels Martin, a UF associate professor of geology.

Martin and H.D. Scher, a UF doctoral graduate now at the University of Rochester in New York, co-authored a paper on the research that appeared in the journal *Science* in April.

Scientists have long puzzled over the rapid cooling that seemed to sweep over Antarctica more than 30 million years ago, replacing boreal pine forests with ice and snow. The cooling occurred in a very warm era when levels of carbon dioxide, the gas responsible for the greenhouse warming effect, were three to four times today's levels.

Theorists had suggested the plummeting temperatures could be related to the opening of the Drake Passage, a connection between the Atlantic and Pacific named after Sir Francis Drake, the English captain who circumnavigated the globe in the 16th century. But there has been a longstanding debate over when that passage opened.



important energy and environmental problems on Florida dairy farms.

Darling said the UF system takes advantage of the fact that it is less expensive to move liquid containing manure than dry manure solids. The anaerobic digester processes manure from the large volumes of water used to flush waste from animal holding areas at the dairy.

Because manure flushed from these areas is so diluted by water, only two types of anaerobic digesters are practical for Florida dairies – covered lagoons and fixed-film digesters, Wilkie said. Covered lagoons require large land areas, gas-tight covers and careful sealing to prevent nutrients from leaching into groundwater. By contrast, the fixed-film anaerobic digester at Hague is a 100,000-gallon tank that has a relatively small footprint, which can be a real plus when local land-planning issues are a concern, she said.

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Ann Wilkie records data at the waste treatment system at UF's Dairy Research Unit in Hague. The fixed-film anaerobic digester tank produces methane gas from flushed manure

That's a key point because Antarctica is known to have been covered with ice by about 33.6 million years ago, meaning the circumpolar current would have had to be established before that event if it could be considered a cause of the cooling.

Estimates for the passage's opening have ranged from 15 million years to 49 million years ago. Martin and Scher's research confirms the older dates.

The scientists' source: neodymium isotopes retrieved from fish teeth the size of grains of sand — teeth themselves retrieved from sediment cores recovered from the deep ocean bottom more than two miles beneath the surface.

Martin said neodymium has a chemical signature that varies depending on whether it came from the Atlantic or Pacific. Once the element erodes from rocks into the ocean, it becomes trapped in clays and minerals, which settle on the seabed. That means scientists can use it to determine the origin and movement of ocean currents, Martin said.

Fish teeth are composed of a mineral called apatite, which takes up neodymium on the seafloor. This is why the UF researchers focused on the teeth.

The geologists obtained the teeth from sedimentary cores retrieved from the South Atlantic ocean. The sediments were dated to more than 40 million years ago. Measurements using a technique called thermal ionization mass spectrometry revealed the teeth neodymium had a signature of the Pacific, indicating at least a surface connection between the oceans.

The presence of neodymium with a Pacific signature in the deep Atlantic suggests that Pacific surface waters flowed into the South Atlantic, where they cooled and sank.

Martin said the opening of the Drake Passage could have precipitated the plunge in temperatures because the newly developed circumpolar current would have isolated Antarctica from warm subtropical water carrying heat from the tropics. In addition, the circumpolar current sets up conditions leading to upwelling of cold, nutrient-rich water. This in turn may have spurred the growth of algae and higher forms of biological life, which consumed carbon dioxide, reducing levels and contributing to cooling the continent's climate, she said.

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