Winning the

How a company started by a UM researcher brought home one of the most coveted awards in science

By Cary Shimek

Chemistry Professor Mike DeGrandpre poses in his UM lab with several versions of the sensors he developed with Sunburst Sensors LLC, including a new titanium version that can function at 3,000 meters underwater.

XPRIZE®

Young XPRIZE winners: ***When Mike Degrandpre*** *(far left)* ***and Jim Beck*** *(white shirt)* ***were seniors at Capital High School in Helena in 1981, they had no idea where their shared future would lead them.***

Some friendships can change the world. So can some 20-year high school reunions.

In 2001, the Capital High School Class of 1981 converged on Helena for the sacred rite of discovering who had gained weight, lost hair, reproduced or become completely unrecognizable. At the reunion, Jim Beck, a towering 6-foot-7 mechanical engineer from Seattle, chatted with a classmate and learned another old friend, Mike DeGrandpre, now worked at the University of Montana and had started a company, Sunburst Sensors LLC.

Somewhat intrigued, Beck sought out DeGrandpre, a buddy he had known since junior high. They hadn't been best friends in high school, but they had moved in the same circles, taken the same classes, shared the same dry sense of humor and served as class officers together. (DeGrandpre was president, Beck treasurer.) Once they had camped together in the Pintler Mountains – an adventure aborted after waking to 4 inches of August snow.

The two soon learned their post-high school lives included a shared professional interest: sensors. DeGrandpre and UM had patented a device for analyzing marine and fresh water in 1999, and he had created Sunburst Sensors to market what became known as SAMIs: Submersible Autonomous Moored Instruments. Beck was running a small company that produced a high-tech pedometer, a sort of early Fitbit for scientists, but he itched to return home to Montana. Could Sunburst get him back to Big Sky Country?

After the reunion, the two friends kept in touch. Beck learned Sunburst wasn't selling many SAMIs in the early 2000s, and the company needed a fresh infusion of cash to remain viable. DeGrandpre had put up $25,000 or so of his own money to keep Sunburst afloat. He and Beck worked together on grant proposals to continue improving the SAMI technology, but nothing was funded. Beck couldn't risk returning to Montana unless Sunburst became a better bet.

They worked together on one last grant proposal in 2005. If that proposal failed, Beck was staying put and there was a chance Sunburst would fold. But this time they landed a sizable National Oceanographic Partnership Program grant to make the SAMIs more user-friendly.

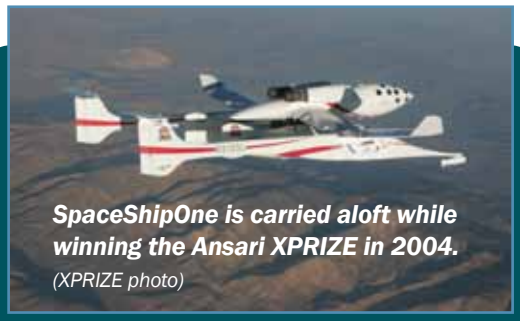
DeGrandpre now could offer his high school buddy three years of guaranteed salary, as well as half ownership of Sunburst. Beck made the jump to Missoula.

"That was a critical moment," DeGrandpre says. "I was the idea guy that came up with these products. But Jim has these skills like programming and mechanical design, and he actually can make a manufacturable product and run a business. He was the perfect guy."

A few years after that high school reunion, the tide had turned for Sunburst Sensors.

Jump ahead a decade to July 20, 2015. DeGrandpre, Beck and Beck's wife, Katherine (a Sunburst employee and another Capital Class of '81 graduate), found themselves in New York City's Harold Pratt Mansion for a lavish awards ceremony. Sunburst Sensors was one of five finalists for the $2 million Wendy Schmidt Ocean Health XPRIZE. The elaborate stage and well-dressed announcers and researchers gave the room an Academy-Awards-of-Science feel.

XPRIZE is a nonprofit organization that designs and manages public competitions



SpaceShipOne is carried aloft while winning the Ansari XPRIZE in 2004.
(XPRIZE photo)

XPRIZE Foundation Has Given Five Awards

In 1714, the British government offered 20,000 pounds to anyone who could solve the greatest scientific challenge of the 18th century: pinpointing a ship's location at sea by knowing its longitude. This challenge produced two solutions. Then in 1919, New York hotelier Raymond Orteig offered $25,000 to anyone who flew nonstop between New York and Paris. Charles Lindbergh collected that prize in 1927.

Started in 1995, the nonprofit XPRIZE Foundation emulates these examples by offering rewards to those who produce "radical breakthroughs for the benefit of humanity." The foundation has awarded five prizes:

- **$10 Million Ansari XPRIZE for Suborbital Flight (2004). A challenge to build a private spaceship that carries three people to space twice in two weeks.**
- **$2 Million Northrup Grumman Lunar Lander XCHALLENGE (2009). A challenge to build precise, efficient small rocket systems.**
- **$10 Million Progressive Insurance Automotive XPRIZE (2010). A challenge to design and race vehicles that get 100 mpg for the mass market.**
- **$1 Million Wendy Schmidt Oil Cleanup XCHALLENGE (2011). A challenge to speed the pace of cleaning surface oil spills on the ocean.**
- **$2 Million Wendy Schmidt Ocean Health XPRIZE (2015). A challenge to develop better tools to understand ocean acidification.**

Other challenges are ongoing, and the foundation cancels contests that are not successful. Visit http://www.xprize.org/ for more information.

A diver works on a SAMI deployed near a coral reef in the Bahamas.
(Photo by Jim Hendee)

to encourage technological developments that benefit humankind. Since 2004, the foundation has completed five XPRIZE competitions. The first was the $10 million Ansari XPRIZE that created the first private-industry-produced reusable spacecraft.

The ocean health XPRIZE competition challenged teams of engineers, scientists and innovators worldwide to create a precise pH sensor that would measure ocean chemistry from its shallowest waters to deepest depths. The aim of the competition was to provide incentive for the development of accurate, affordable instruments to measure ocean acidification. The oceans absorb about a third of the carbon dioxide pumped into the atmosphere by humans, which makes the seas more acidic and may lead to calamitous results. More accurate and affordable instruments may help scientists understand and possibly solve the problem.

Team Sunburst from landlocked Missoula had some serious competition in the room. The other finalists from around the globe included Team ANB (Cambridge, England), Team XYLEM (Bergen, Norway), Team DuraFET (USA) and HpHS (Tokyo). When Team DuraFET was introduced, about 15 people walked on stage. Nervous about the resources they were up against, Jim Beck whispered to his colleagues, "They are legion."

The XPRIZE actually was broken into two $750,000 grand prizes – one for affordability and one for accuracy – and then two $250,000 second-place awards in the same categories.

XPRIZE did a short film on each finalist team. In the Sunburst clip, DeGrandpre says, "I call myself an inland oceanographer because we don't have an ocean here in Montana." Beck continued: "One of the challenges of doing chemical oceanography 480 miles from the ocean is getting seawater.

Last time I was in Seattle, I ended up wading out to Pudget Sound with this jug." He also said, "We are competing against some teams that have a lot of resources, and we've made it a long way. So it feels good that we've proven that with a small team we can do something this big."

The night got bigger for Sunburst. After Team ANB won second place for affordability, the Missoula team won the grand prize. DeGrandpre and Beck took the stage amid applause, and the presenter had to reach high to put a medallion depicting a "sea butterfly" pteropod around Beck's neck. (The shells of such pteropods are eroded by ocean acidification.) For accuracy, second place went to Team DuraFET, and then Sunburst won another grand prize. A grinning DeGrandpre held aloft an XPRIZE trophy depicting a wave and coral reef.

Sunburst had experienced the best possible outcome: two grand prizes for a total purse of $1.5 million.

"I was smiling much more than normal," DeGrandpre says with a laugh. "It was exciting, and I was relieved."

Presenter Paul Bunje, senior director of the ocean health XPRIZE, said, "You have proven XPRIZE right that innovation can come from anywhere and it can make the impossible possible. You all are heroes for stepping up and attempting to do something that most of the world thought was unsolvable. You are true ocean heroes."

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DeGrandpre seemed destined for a career in science even back at Capital High, where he did an award-winning aquatics project on Helena's water quality. He did his undergraduate work in Montana and attended grad school at the University of Washington. Beck left Montana for the Massachusetts Institute of Technology, where he played basketball his sophomore year and studied mechanical engineering. He also attended graduate school at UW.

DeGrandpre studied sensor technology in grad school. "Using fiber-optics to probe matter was a big thing to do then," he says. "You would configure fiber-optics to take light down and back, and then you look at the signal to understand what is going on with the stuff you shine light on."

He sometimes became frustrated with researchers who developed fiber-optic technology – stick a fiber in a beaker of solution, record a signal, write a paper – but then nothing ever came of it.

"I call that proof-of-concept technology," he says. "You make something work, but then you never pursue a true application. I wanted to take that technology and really use it for something."

In 1990, DeGrandpre landed a postdoctoral position with the Woods Hole Oceanographic Institution in Massachusetts. In his application, he wrote he wanted to develop an ocean carbon dioxide sensor using fiber-optic indicator technology. He later learned his application literally went into the garbage because he was an analytical chemist and not an oceanographer. But Craig Dorman, the Woods Hole director at that time, overruled the search committee because he believed the institution needed more sensor development.

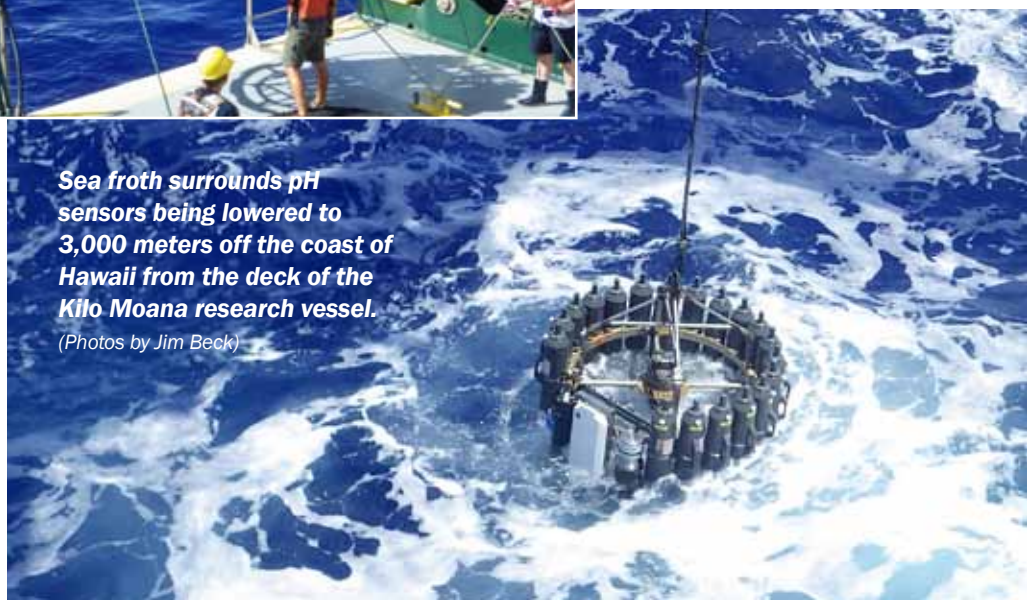
DeGrandpre stayed at Woods Hole nearly five years, and it was a productive time for him. He met his future wife, Kate Lindner, a grad student in the Boston University marine program, while she worked at a deli. He also wrote several papers, landed grant money and transitioned into more of an environmental chemist.

In 1992, he took a sensor prototype on its first ocean cruise. This version had to stay with a ship, but he soon started working on a proto-SAMI unit that could function on its own buoy. In 1993, he joined forces with an engineer named Terry Hammar to upgrade the sensor, and in 1994 it was deployed at the Woods Hole testing dock.

During one test, a failed pump caused water to flood a work station on the dock. Without thinking, DeGrandpre rushed into the flooding room to unplug some equipment. That room was a dangerous mix of electricity and conductive seawater.

"I was lucky I wasn't electrocuted," he says. "I realized then the development of new technology involves a lot of risks – sometimes even death!"

DeGrandpre says his wife came up with the catchy SAMI acronym, and over the next few years six more were deployed. Though his career was going well, he didn't plan to stay at Woods Hole, where he needed to earn grants and pay



Sea froth surrounds pH sensors being lowered to 3,000 meters off the coast of Hawaii from the deck of the Kilo Moana research vessel.
(Photos by Jim Beck)

his own way or lose his job. When he tried for a permanent position and didn't get it, he started looking for jobs on the West Coast closer to Montana. In 1995, a job opened in the UM chemistry department, and he got to come home.

Now an oceanographer far from the sea, DeGrandpre taught college chemistry classes while continuing to work on his sensors and garner research awards. At one point he tested a SAMI in Montana's Placid Lake. In 1999, he and UM patented the sensor method, and Sunburst was born.

"We sold our first SAMI for $20,000 to a well-known carbon-cycle scientist in Canada," he says. "Since he had the only one in the world, we think he got a good deal on it. We offered the first product you could put on a buoy, and we were the only company selling these for at least six or seven years. We were the first."

Business was slow but showed some promise. Sunburst added two or three employees, and in 2002 a new SAMI was developed to measure pH instead of CO2. For a time the firm was housed in MonTEC, a UM-affiliated technology incubator.

Beck says about 70 of the original sensors were sold in the first nine years of the company's existence, but after redesigned units were released in 2009, Sunburst has sold more than 300. In 2012, the company was hired to produce 145 units for the Ocean Observatory Network. A new unit today sells for about $17,000.

"The first year I was there, I think we sold three instruments," Beck says. "I know our sales were under $100,000. But last year we sold over $1 million. So things have picked up."

A SAMI-pH draws in sea water, puts in a dye that changes color depending on the water's acidity – much like litmus paper – and then shines a light through the dye. The resulting color of the water reveals the pH.

"It doesn't seem like much, but the machining of this is actually quite complicated," DeGrandpre says. "We have some manufacturing techniques and designs that keep us special, and we designed this thing in a way that nobody else does – and that's where the real innovation is."

He says Sunburst works with Montana companies whenever possible. Big Sky Machining of Superior and Diversified Plastics of Missoula are key partners.

***Sunburst CEO Jim Beck** (left) **recovers his company's tSAMI device after its return from 3,000 meters underwater off the coast of Hawaii during Phase 4 of the ocean health XPRIZE competition.** (XPRIZE photo)*

Presently located in adjacent, nondescript Missoula storefronts near Broadway Street, Sunburst employs nine people. It seems an unlikely place to produce an XPRIZE, but the interior is packed with workspaces to assemble, test and repair SAMIs.

Beck largely runs Sunburst, but he and DeGrandpre email frequently and meet every two weeks or so to discuss company business. DeGrandpre's UM lab also teems with SAMIs in various states of assembly that he uses in his research, and he often sends students to Sunburst to become employees. And it's interesting to note that Todd Martz, a former doctoral student of DeGrandpre's, was on Team DuraFET, which won a second-place XPRIZE during the competition.

So UM helped win two XPRIZE grand prizes and also helped educate a team that came in second.

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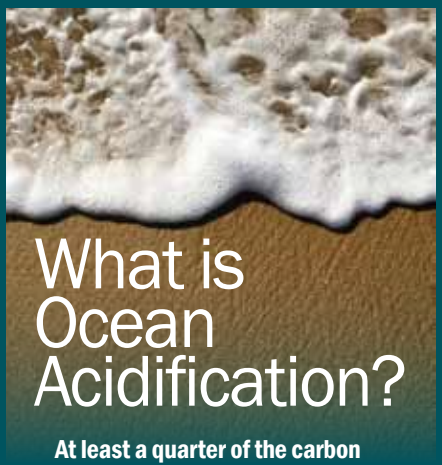
DeGrandpre says Sunburst has long been a leader in ocean sensor technology, so when the XPRIZE was announced in September 2013, they knew they had to defend their turf. The sensors have been deployed in locations worldwide on buoys, and they recently had a SAMI-CO2 and SAMI-pH deployed under the ice in the Arctic. The sensors hung on a line – one above the other – and transmitted their data via satellite.

The XPRIZE affordability purse called for the creation of a sensor costing less than $1,000, and that meant a major redesign of the Sunburst product. Beck says just one pump and valve in their regular SAMI costs $640, and the housing for those two items increases the cost to well over $1,000 – and there are many parts beyond these. So a much simpler design was required, but eventually they created the "inexpensive" iSAMI. DeGrandpre says they already had a head start to create a cheaper sensor from a Small Business Innovation Research Program grant. (The idea for that grant is to produce great research results by seeding the world's oceans with inexpensive sensors on disposable drifters.)

To compete for the XPRIZE accuracy purse the team needed a sensor that would work at 3,000 meters. The deepest a Sunburst sensor had been tested before was 900 meters. So they created a slightly slimmer (and more expensive) SAMI in a titanium housing called the tSAMI.

Seventy-seven teams from around the globe expressed interest in seeking the prize, but only 24 eventually registered for the competition. The contest was divided into several phases. Only 18 teams competed with sensors at the Monterrey Bay Aquarium Research Institute in California. Fourteen teams then advanced to coastal trials at the Seattle Aquarium, and then five finalists sent sensors down to 3,000 meters using a research vessel near Hawaii.

Breanna Roy photo



What is Ocean Acidification?

At least a quarter of the carbon dioxide released by the burning of fossil fuels dissolves in Earth's oceans and lakes. Over time this has lowered the pH of the oceans and made them more acidic. To achieve chemical equilibrium, CO2 reacts with water to form carbonic acid.

In the past 200 years, the ocean has become 30 percent more acidic, which is faster than any known change in ocean chemistry in the past 50 million years. This rapid change doesn't give ocean life much time to adapt, and scientists worry about major negative impacts to ocean ecosystems. The shells of some animals already are starting to dissolve in more acidic seawater.

"We used to think the ocean had infinite capacity to accept abuse," says Paul Bunje, the senior director of the ocean health XPRIZE competition. "We now know that isn't true. Down the road I would like us to do an ocean pH forecast, much the way we do a weather forecast."

The latest XPRIZE produced better instruments to help scientists more accurately measure and understand ocean acidification.

Beck** (white shirt) **and Paul Bunje, senior director of the Wendy Schmidt Ocean Health XPRIZE** (far right)**, meet with Weather Channel celebrities after UM and Sunburst's big win.

Beck went on the cruise that tested the tSAMI. He and DeGrandpre were not sure if they or their creation could take the pressure.

"And on the fifth day of a six-day cruise, Mike sends me an email that says the reagent we use in our device has pressure sensitivity and that we need to correct for it," Beck says. "I had already processed all this data, and I had to rewrite a bunch of code at the last minute to deal with this. We weren't certain of our approach, but what we did must have worked."

When the tSAMI emerged from the ocean depths on its seventh deployment, Beck put his ear against it to hear the telltale click of a pump working. His heart lurched when all was silent, but when the instrument downloaded he knew things were OK ... and the XPRIZE was won.

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DeGrandpre says a big chunk of the XPRIZE winnings will go to taxes. A portion also will go to employee bonuses and rewarding loyal business partners. And they will try to speed innovation of core Sunburst products. Improving the Sunburst facilities or adding employees are other options.

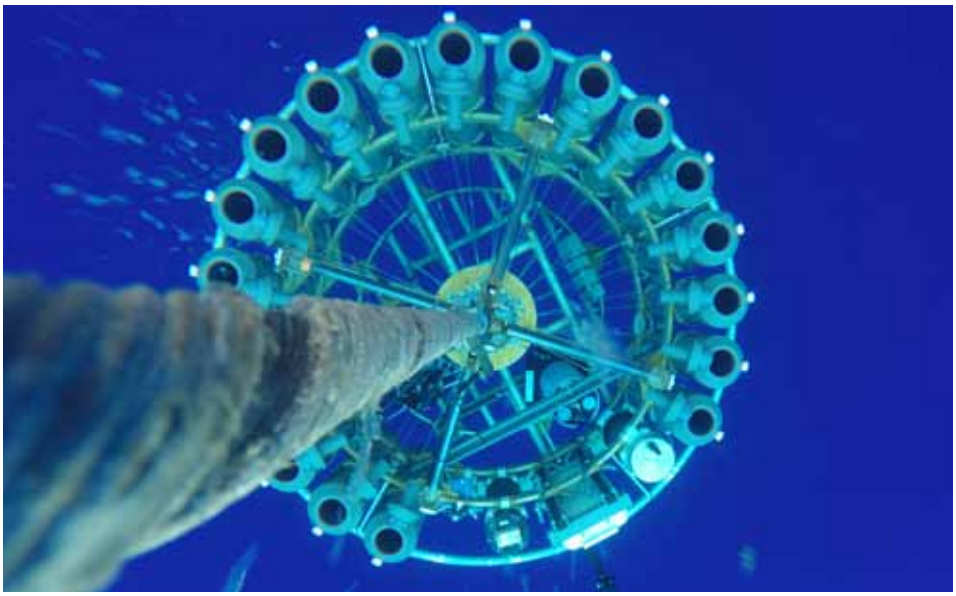
"The iSAMI we entered in the XPRIZE competition was a prototype," Beck says. "Now it's time to turn it into real products that we can get into the hands of the scientific community. We've had a lot of interest."

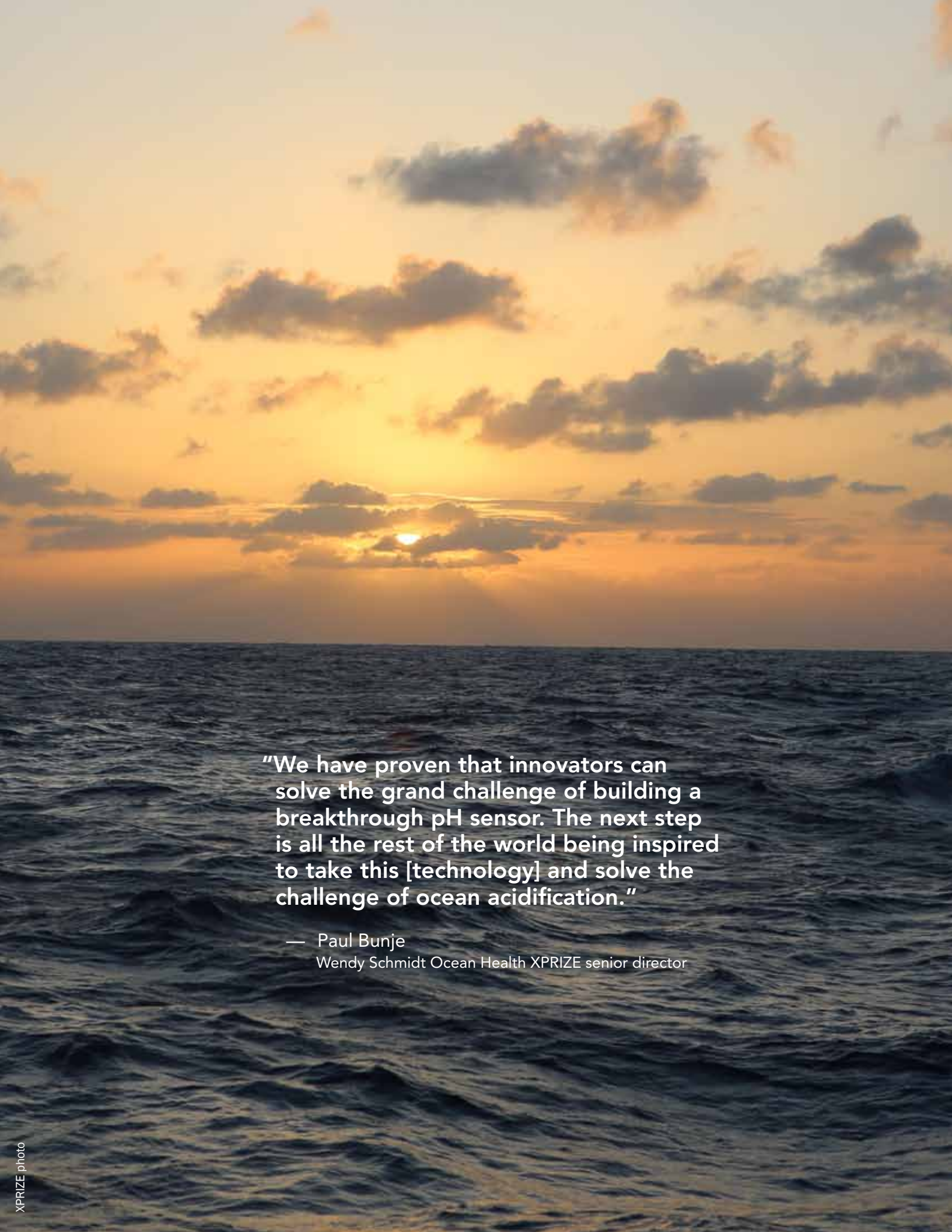
UM held a campus event in summer 2015 to celebrate Sunburst and the big XPRIZE win.

"To have a team from our University and our community win an XPRIZE is something I don't think will happen too often at the University of Montana or any other university," President Royce Engstrom said before leading the gathered dignitaries in a toast. "So this is a very special day for us to recognize the hard work, the creativity and just the tremendous expertise of our team from Sunburst."

Then-Lt. Gov. Angela McLean, a former high school teacher, represented the state of Montana at the event. "It's not lost on me that the two [Sunburst] leaders hail from Capital High School in Helena, Montana," she exclaimed. "Public school kids! It doesn't get any better than that."

For more information email **michael.degrandpre@umontana.edu** or **jim@sunburstsensors.com.**





"We have proven that innovators can solve the grand challenge of building a breakthrough pH sensor. The next step is all the rest of the world being inspired to take this [technology] and solve the challenge of ocean acidification."

— Paul Bunje
Wendy Schmidt Ocean Health XPRIZE senior director

XPRIZE photo

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Janet Seidel, a Sunburst employee and UM alumna, puts a reagent bag on a SAMI-pH unit as Sunburst CEO Jim Beck looks on at the company headquarters in Missoula.