Discovery in Action

Captivating. Enchanting. Vivid, vibrant hues twisted, jagged, and contorted into something that only Mother Nature could conceive. This image was created by researchers at the Pacific Northwest National Laboratory on their quest to unravel the mysteries of science and solve complex problems. They apply their knowledge to address our nation's most intractable problems in energy, the environment and national security. Fueled by a passionate desire to make a difference in science and humanity, at PNNL we're transforming the world through courageous discovery and innovation—making the world safer, cleaner, better.

From breakthroughs in fundamental and computational sciences that help our understanding of the world around us . . . to exploring the possibility of storing carbon dioxide in deep geologic formations . . . to stopping contaminants from reaching the water table . . . at PNNL we have dedicated our life's work to putting discovery into action.

Pacific Northwest
NATIONAL LABORATORY

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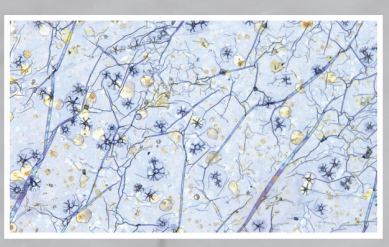
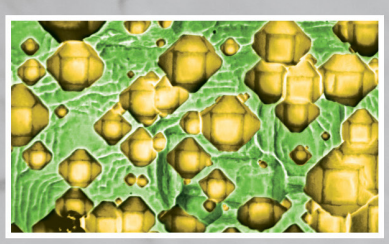


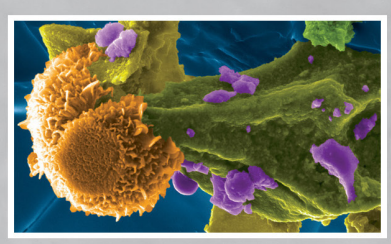
JANUARY

FEBRUARY

MARCH

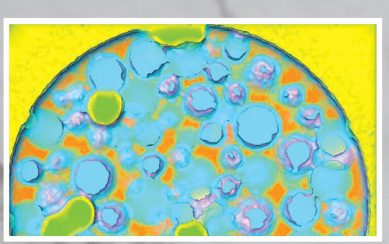


APRIL

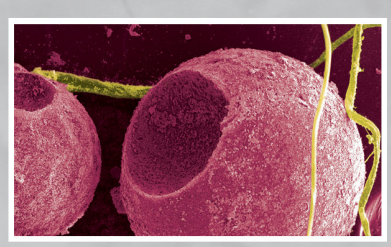


MAY

JUNE

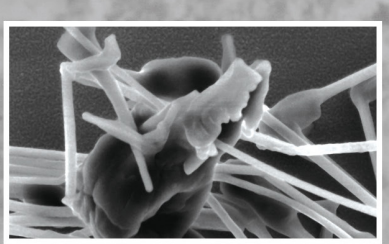


JULY

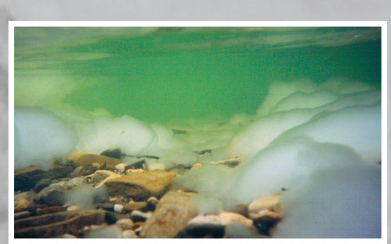


AUGUST

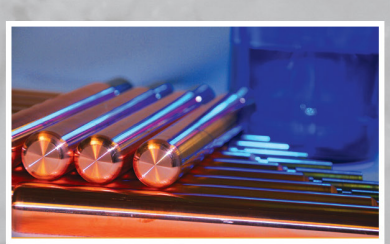
SEPTEMBER



OCTOBER



NOVEMBER



DECEMBER

** Images shown were selected during PNNL's Science as Art competition.*

Pacific Northwest National Laboratory is a U.S. Department of Energy Office of Science national laboratory. At PNNL, we are driven to respond to change and to make a difference in the world. The passion to build solutions derived from our scientific innovation is founded on our unique approach of empowering our teams to work in an interdisciplinary model that creates results. The collaborative nature of our discovery energizes leadership, science and technology to catalyze solutions with performance certainty. Our approach, propelled by our leadership in chemistry and molecular science, impacts the world—making it safer, cleaner, better. We employ nearly 5,000 and have an annual business volume of about $1.1 billion. PNNL has been managed by Ohio-based Battelle since the Lab's inception in 1965.

Pacific Northwest
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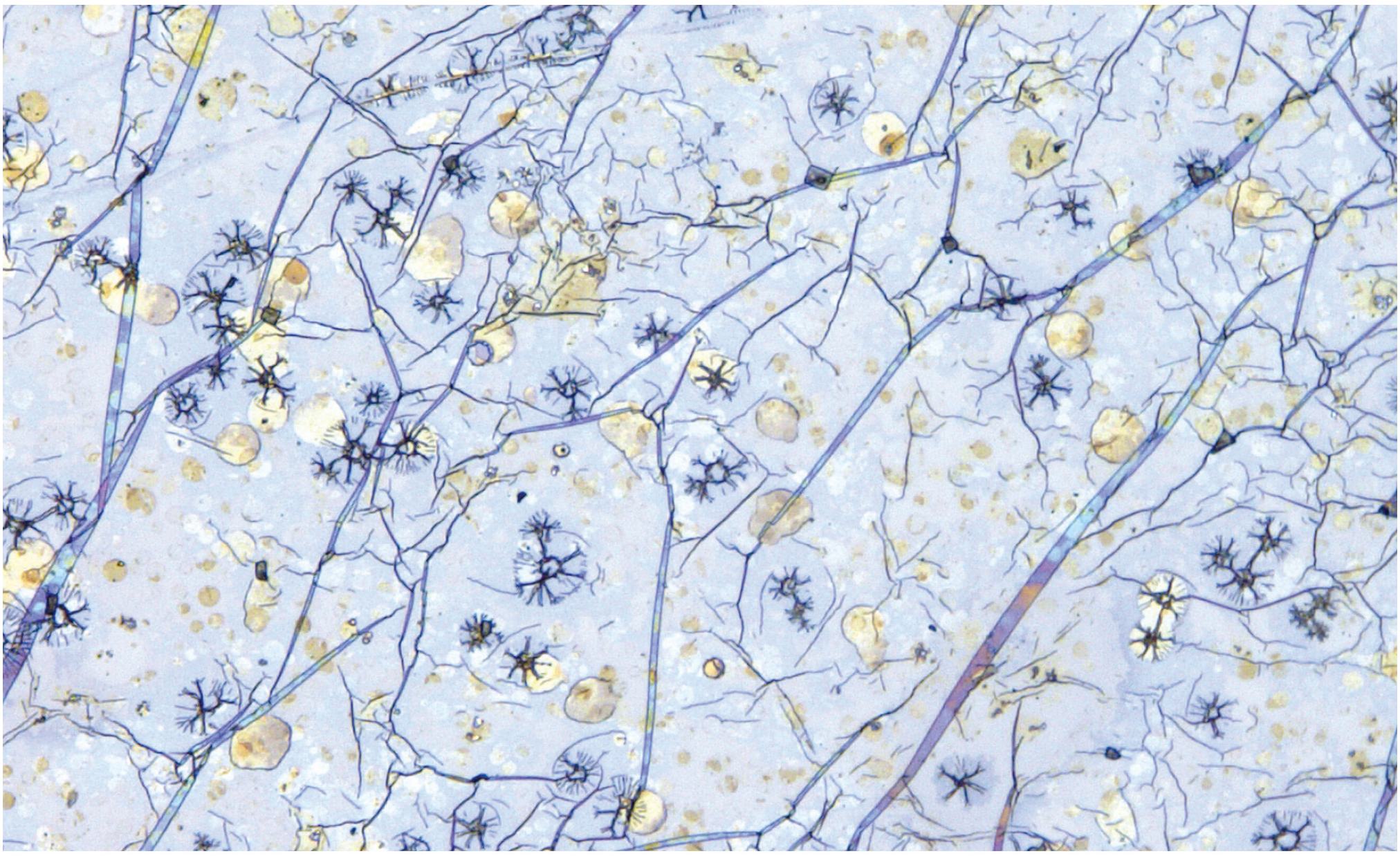

Organizations like the U.S. Environmental Protection Agency rely on field sensors that can detect traces of anionic water-soluble pollutants, like arsenate, chromate, perchlorate and pertechnetate. At PNNL, scientists are experimenting with modified polymer films that can recognize—and therefore be used—to detect pollutants. These polymers could potentially be incorporated into devices that would make detection rapid and economic. Shown here is a microscopic image of a polymer film generated through electro-polymerization of pyrrole from a water solution. Dev Chatterjee, Thao Bui and Sam Bryan are working on this project.

JULY 2013

S	M	T	W	T	F	S
	1	2	3	4	5	6
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AUGUST 2013

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SEPTEMBER 2013

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29	30					

OCTOBER 2013

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NOVEMBER 2013

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DECEMBER 2013

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22	23	24	25	26	27	28
29	30	31				

Pacific Northwest
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2013 CALENDAR

JANUARY 2013

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

FEBRUARY 2013

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3	4	5	6	7	8	9
10	11	12	13	14	15	16
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24	25	26	27	28		

MARCH 2013

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3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

APRIL 2013

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

MAY 2013

S	M	T	W	T	F	S
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5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

JUNE 2013

S	M	T	W	T	F	S
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9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

JANUARY 2012

Pacific Northwest NATIONAL LABORATORY
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SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1 *New Year's Day*	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16 *Martin Luther King Jr.'s Birthday*	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

DECEMBER 2011

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

FEBRUARY 2012

S	M	T	W	T	F	S
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5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29			

At PNNL, we are driven to respond to change and anticipate change to make a difference in the world—helping to prevent terrorist attacks from ever happening again on our homeland. Through federally funded research, scientists are developing radiation detection systems. The systems scan vehicles and cargo for unauthorized shipments of radiological materials. In this image, a scientist tests a scintillating plastic slab used in the detection system. When examined under cross-polarized light, a slab exhibits color banding. Imagery provided by Duane Balvage. Subject material provided by Mary Bliss and Jean Stave.

DECEMBER 2012

Pacific Northwest NATIONAL LABORATORY
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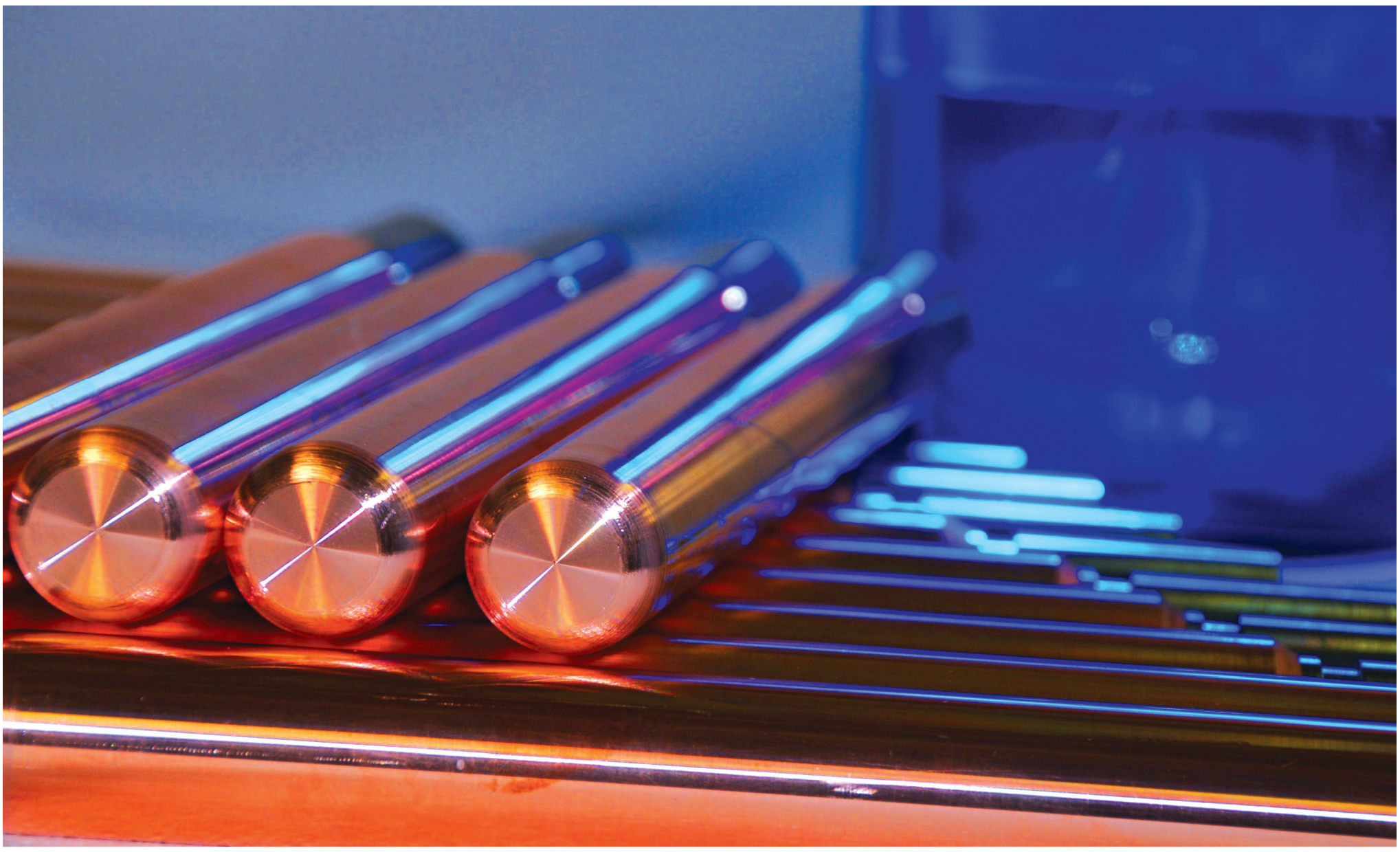
SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
NOVEMBER 2012 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	JANUARY 2013 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31					1
2	3	4	5	6	7 Pearl Harbor Remembrance Day	8 Hanukkah Begins
9	10	11	12	13	14	15
16 Hanukkah Ends	17	18	19	20	21	22 First Day of Winter
23 30	24 Christmas Eve New Year's Eve 31	25 Christmas	26	27	28	29



PNNL scientists are searching for a rare form of radioactive decay—never before detected—called neutrinoless double-beta decay. Drawing upon the Lab's signature capability in ultra-low-level counting, their research could help determine the mass and properties of neutrinos, one of Nature's fundamental sub-atomic particles. The copper used to build and shield the experiment will be manufactured underground in an ultra-pure form using a PNNL-developed technology to protect against naturally occurring radioactive impurities. Shown here, copper is deposited on stainless steel mandrels, machined and used for construction of gas proportional counters. The blue solution in the background is copper sulfate from the electroforming bath in which these copper pieces were grown. Image provided by Eric Hoppe, Brian LaFerriere, Jason Merriman and Nicole Overman.

FEBRUARY 2012

Pacific Northwest NATIONAL LABORATORY
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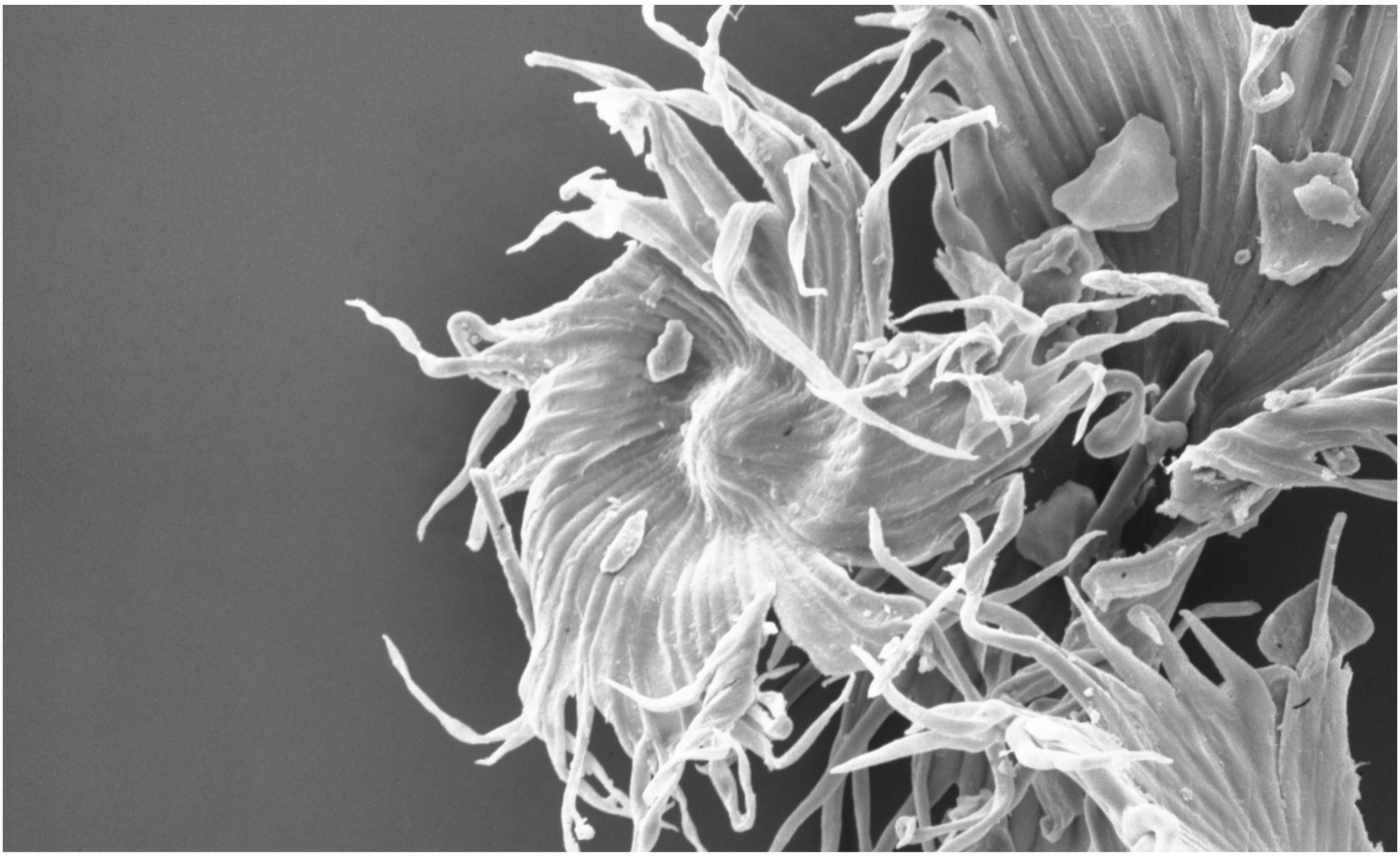
SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
JANUARY 2012 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	MARCH 2012 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31		1	2 Groundhog Day	3	4
5	6	7	8	9	10	11
12 Abraham Lincoln's Birthday	13	14 St. Valentine's Day	15	16	17	18
19	20 Presidents Day	21 Mardi Gras	22 George Washington's Birthday	23	24	25
26	27	28	29			



At PNNL, we are committed to fostering the next generation of scientists and engineers. Our researchers collaborate with teachers in the classroom to build students' critical thinking skills, cultivate their curiosity, give them the confidence to take intellectual risks, and encourage them to fearlessly explore their ideas. Shown here are the lepidote scales that impart Russian Olive leaf surfaces with a silvery sheen. Images like these are used as teaching tools to help young scientists visualize the vocabulary used to describe our natural world. Robin Durham captured this image using a Scanning Electron Microscope.

NOVEMBER 2012

Pacific Northwest NATIONAL LABORATORY
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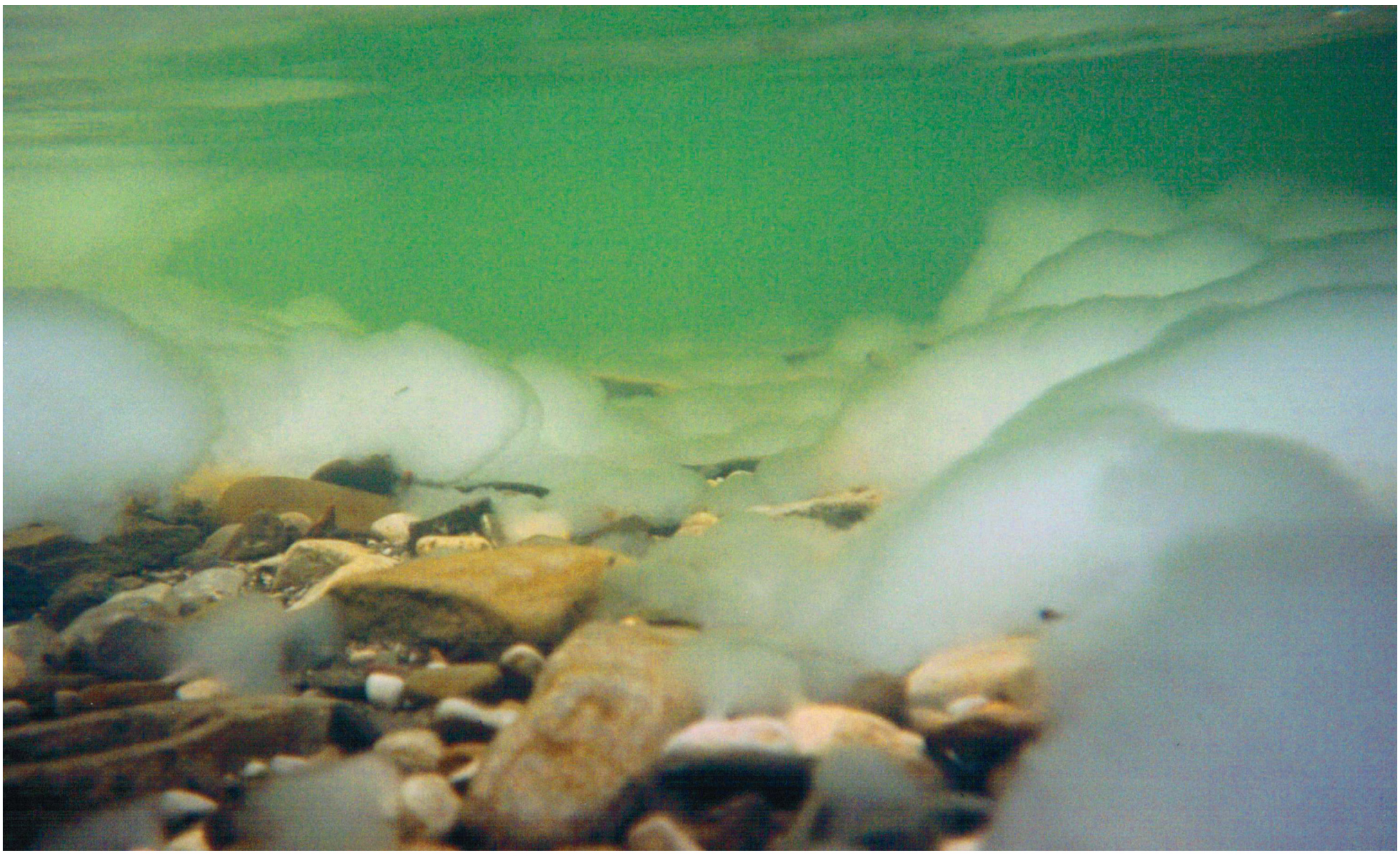
SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
OCTOBER 2012 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	DECEMBER 2012 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31			1	2	3
4 Daylight Savings Time Ends	5	6	7	8	9	10
11 Veteran's Day	12	13	14	15	16	17
18	19	20	21	22 Thanksgiving Day	23	24
25	26	27	28	29	30	



Stream-dwelling fish such as salmonids and trout face highly variable environmental conditions from fall to winter due to fluctuations in water temperatures, discharge and ice conditions. A clearer understanding of these habitats will help fisheries managers make better decisions about habitat management. Richard Brown provided this underwater image of anchor ice clinging to the bottom of Dutch Creek located in Alberta, Canada.

MARCH 2012

Pacific Northwest NATIONAL LABORATORY
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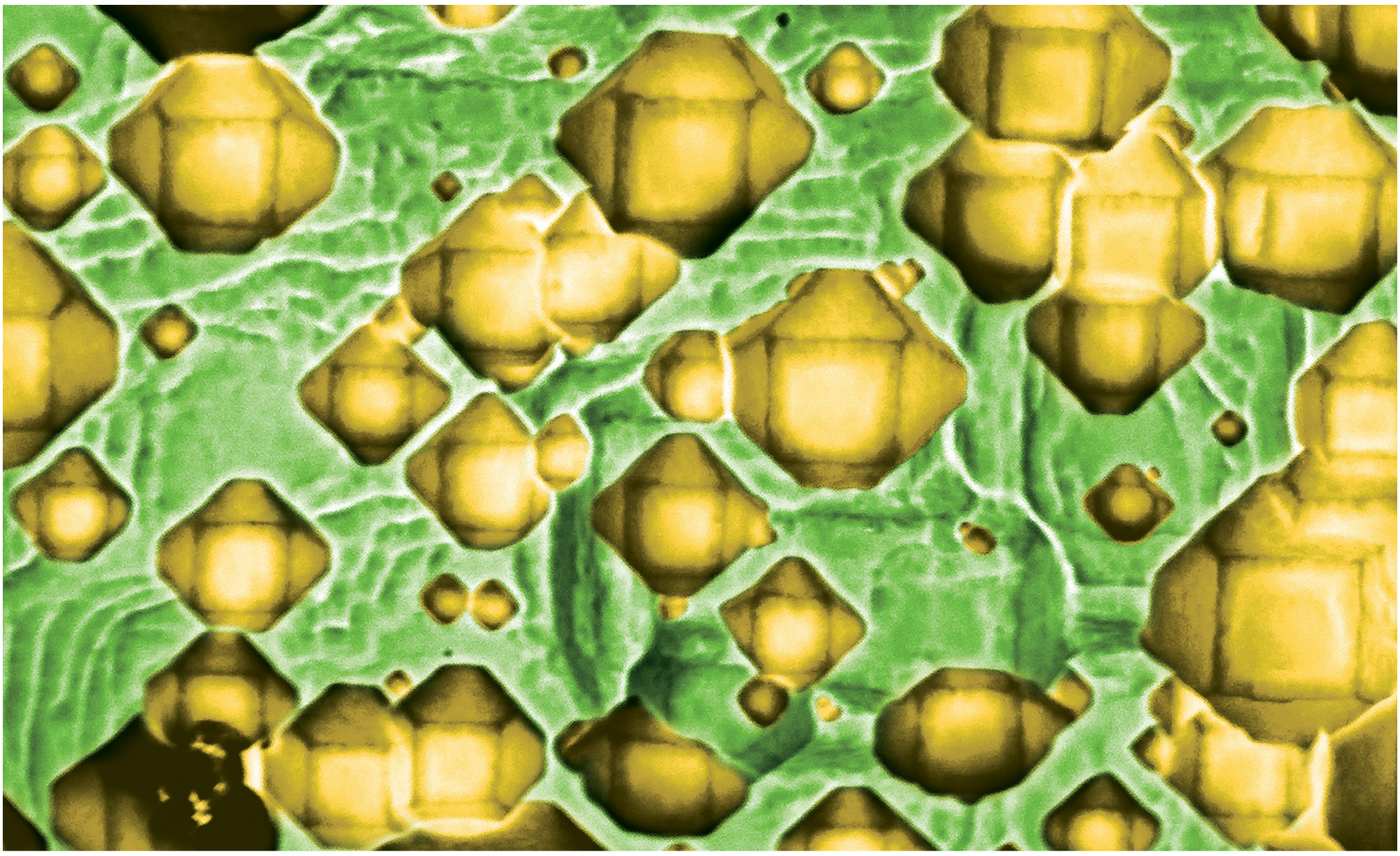
SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
FEBRUARY 2012 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29	APRIL 2012 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30			1	2	3
4	5	6	7	8	9	10
11 Daylight Savings Begins at 2 a.m.	12	13	14	15	16	17 St. Patrick's Day
18	19	20 First Day of Spring	21	22	23	24
25	26	27	28	29	30	31



A paramount issue impacting the performance, safety, and life extension of current light-water reactors is the environment-induced cracking of metallic structural components. Understanding their structure and chemistry, as well as how they react to various aqueous environments, is important to determining their real-world behavior. Metallography is one of the tools in determining microstructure. Using a light etching technique, the crystallographic orientation of the metal can easily be observed. This scanning electron microscopy image taken in backscatter mode illustrates how crystallographic pits are formed on the metal surface when exposed to acid. Imagery provided by Matthew Olszta. Other contributors are Robert Seffens, Clyde Chamberlin, Mychailo Toloczko and Stephen Bruemmer. Image colored by graphic designer Jeff London.

OCTOBER 2012

Pacific Northwest NATIONAL LABORATORY
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SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
	1	2	3	4	5	6
7	8 Columbus Day	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31 Halloween			

SEPTEMBER 2012

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NOVEMBER 2012

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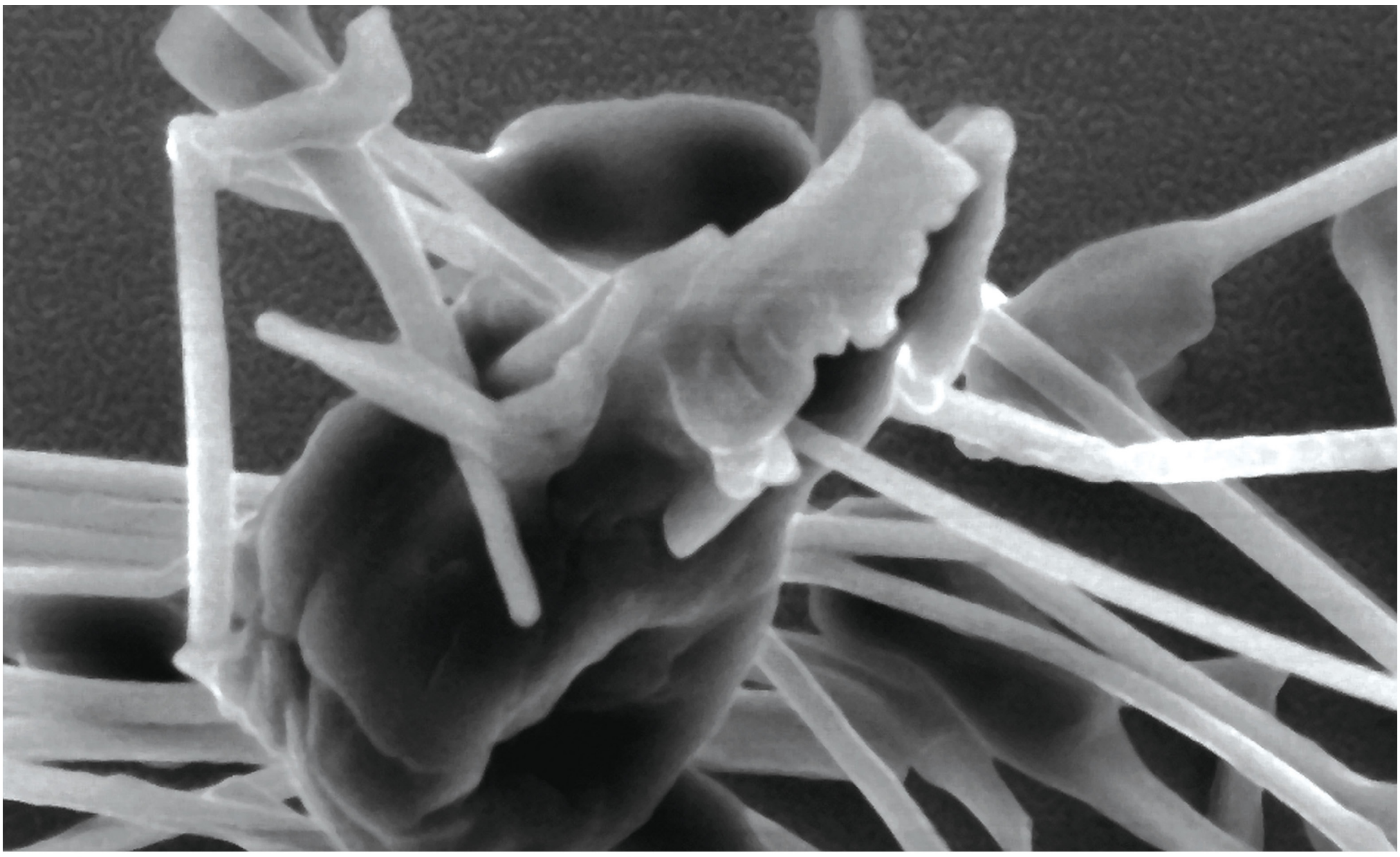

PNNL scientists have been investigating high-pressure hydrogen material compatibility and surface degradation of aluminum-coated lead zirconate titanate (PZT) surfaces for applications in clean-burning hydrogen internal combustion engines. This lead (Pb) spider-like formation was discovered during the research. It was imaged with the Environmental Molecular Sciences Laboratory's helium ion microscope and may have battery applications. Contributing to this project are Kyle Alvine, Vaithiyalingam Shutthanandan, Wendy Bennett and Stan Pitman.

APRIL 2012

Pacific Northwest NATIONAL LABORATORY
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SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1 *April Fool's Day*	2	3	4	5	6	7
8 *Easter*	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

MARCH 2012

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11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

MAY 2012

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20	21	22	23	24	25	26
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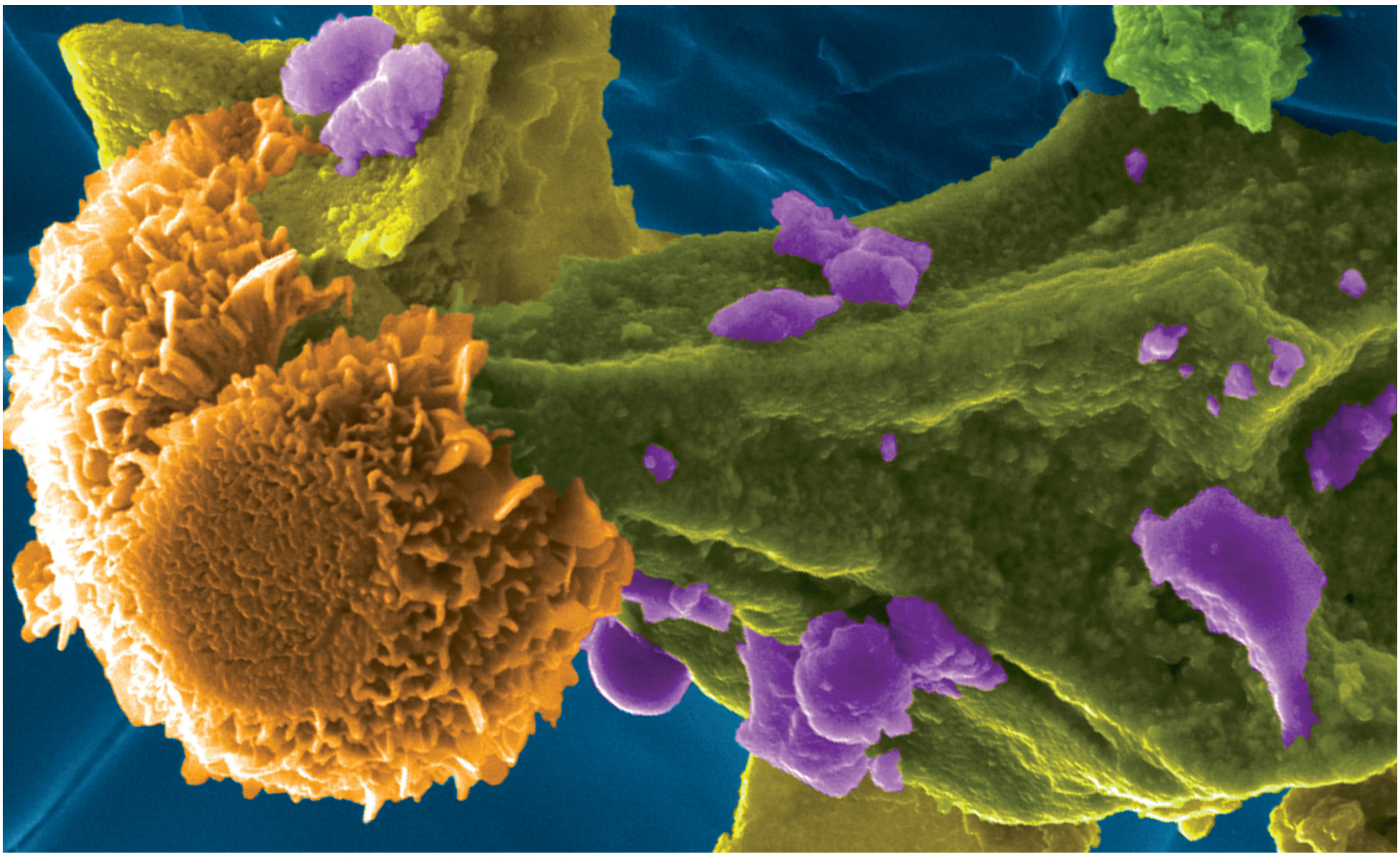

The capture and storage of carbon dioxide and other greenhouse gases in deep, underground geologic formations represents one of the most promising options for mitigating the impacts of greenhouse gases on global warming. In this study, PNNL researchers examine the interfacial reactions of the commonly found olivine forsterite mineral with supercritical carbon dioxide containing water. By using electron microscopy, scientists gain a better understanding of the reaction with carbon dioxide and minerals. The research shows promising results for the safe, long-term storage of greenhouse gases. Bruce Arey, Andy Felmy, Odeta Qafoku, Zheming Wang provided the image, which was colored by graphic designer Nathan Johnson.

SEPTEMBER 2012

Pacific Northwest NATIONAL LABORATORY
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SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
AUGUST 2012 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	OCTOBER 2012 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31					1
2	3 *Labor Day*	4	5	6	7	8
9	10	11 *Patriot Day*	12	13	14	15
16	17	18	19	20	21	22 *First Day of Autumn*
23 30	24	25	26	27	28	29

Diatoms, unicellular phytoplankton, are used by scientists to determine if a waterway is contaminated. Different species of diatoms can thrive or die depending on the quality of the waterway's condition. Scientists also study diatoms when researching potential remediation techniques and for climate change studies. Their hydrated silicon dioxide cell walls give them a unique, sculptural quality and longevity. Fossilized diatomaceous earth, for instance, can provide insight into prehistoric environmental conditions for climate change researchers. These diatoms, captured by Benjamin Miller, are from a drop of water along the Columbia River located in Richland, Washington. Others contributing to the project include Robert Mueller and Amoret Bunn.

MAY 2012

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SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
APRIL 2012 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	JUNE 2012 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	1	2	3 *National Day of Prayer*	4	5 *Cinco de Mayo*
6	7	8	9	10	11	12
13 *Mother's Day*	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28 *Memorial Day*	29	30	31		

How do you protect glass from degrading over millions of years so that it can play a critical role in the long-term storage of nuclear waste? To answer that question, scientists at PNNL are studying glasses that can precipitate a self-protecting layer on the glass surface. Early research focused on precipitating certain phases that would be stable over long periods of time. The samples studied have been designed to work with various environments, and research indicates that the glasses exhibit vastly different corrosion properties depending on the solution environment. This image is an optical micrograph of one of the glass samples. It is possible to see three distinct layers—light brown, tan and cream—forming on the glass surface, which is shown in the upper left corner in brown. Imagery provided by Dan Skorski, Joe Ryan, David Pierce and Dong-Sang Kim.

AUGUST 2012

Pacific Northwest NATIONAL LABORATORY
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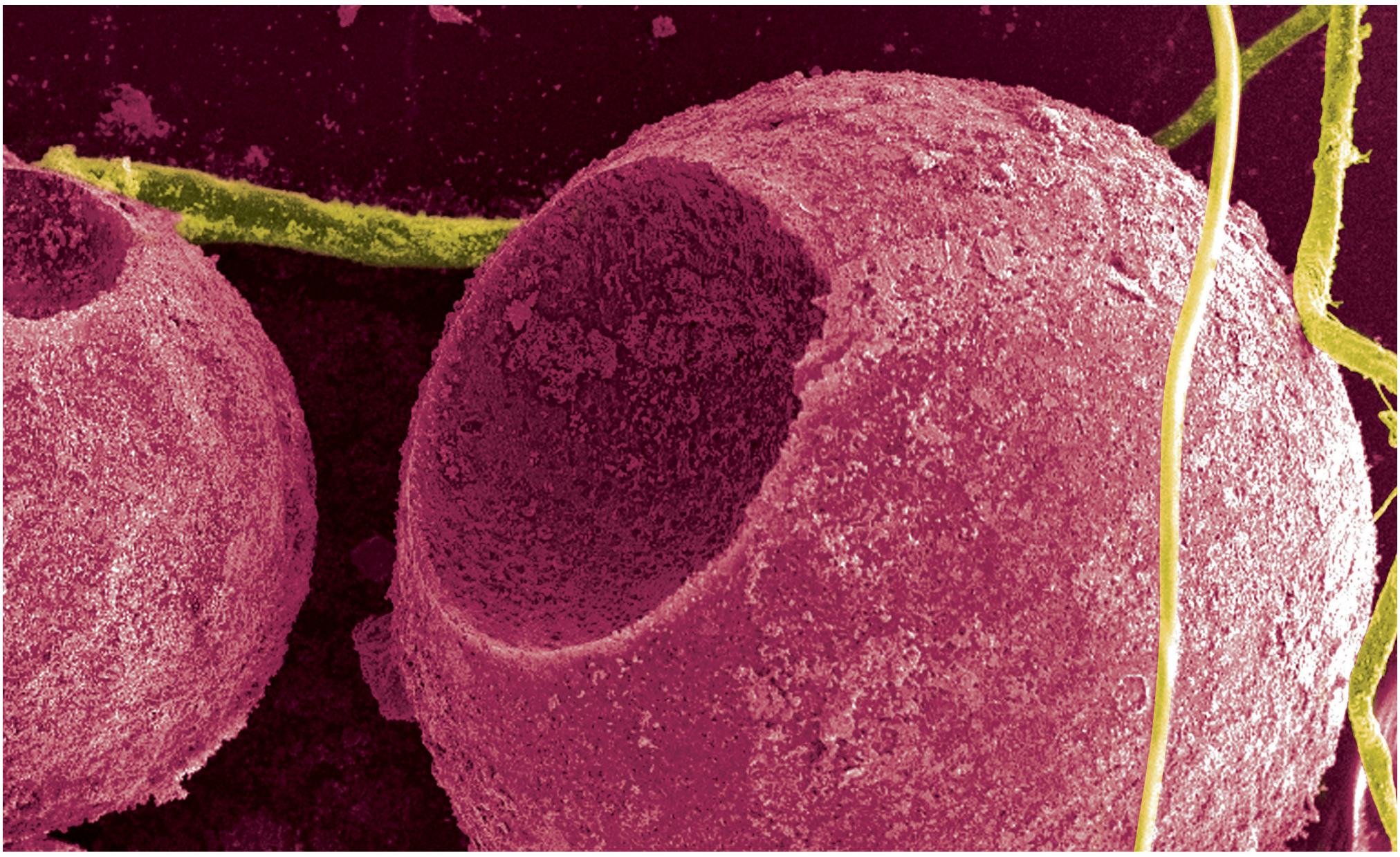
SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
JULY 2012 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	SEPTEMBER 2012 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30		1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18 *Ramadan Ends*
19	20	21	22	23	24	25
26	27	28	29	30	31	



Imaging bio-molecules and cells over extended periods of time is critical to understanding cellular processes and the causes of pathogenic diseases. Cadmium sulfide quantum dots are widely used for highly sensitive cellular imaging. The extraordinary photostability of these probes are highly attractive for the real-time tracking of bio-molecules and cells over time. PNNL scientists are exploring quantum dots with varying morphologies and trying to understand the variation of their spectroscopy associated with the morphological changes. The goal is to design probes that can be used to monitor cellular processes over extended periods. Dev Chatterjee provided the image. Others who contribute to the project include Matthew Edwards, Paul MacFarlan, Samuel Bryan and Jason Hoki. Image colored by graphic designer Jeff London.

JUNE 2012

Pacific Northwest NATIONAL LABORATORY
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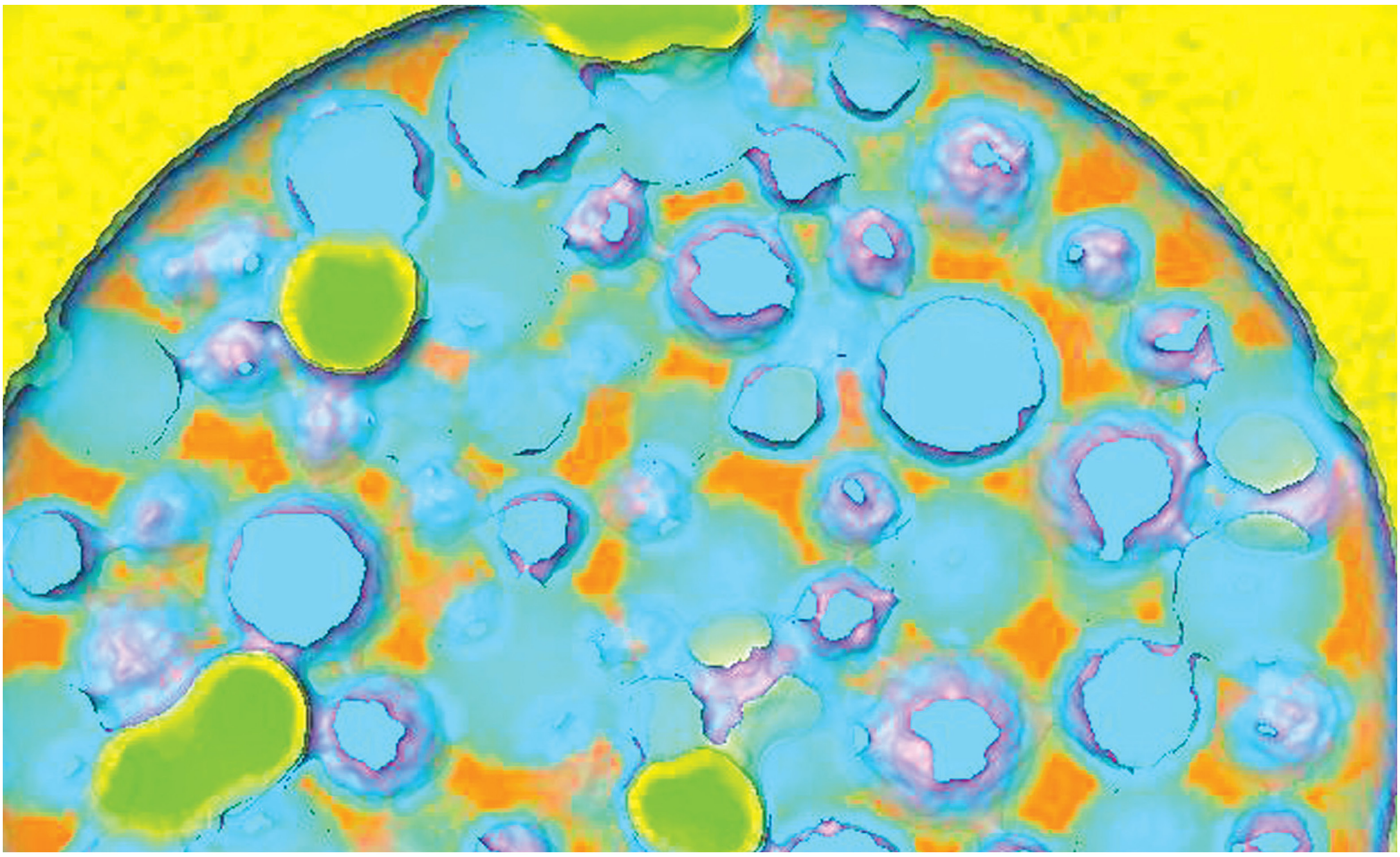
SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
MAY 2012 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31	JULY 2012 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31				1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17 *Father's Day*	18	19	20 *First Day of Summer*	21	22	23
24	25	26	27	28	29	30



PNNL empowers, leads and promises to make the world a safer, cleaner and better place. That commitment led our scientists to explore how contaminants move in soil. The region between the soil surface and above the water table is of great interest to PNNL researchers, because it can act as a source for groundwater contamination—contaminants of concern include organic materials (oil), metals, and radionuclides. Here scientists imaged air and water distribution in idealized sediment to evaluate their impact on how contaminants travel underground. Imagery provided by Danielle Jansik, Dawn Wellman and Antoinette Owen.

JULY 2012

Pacific Northwest NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1	2	3	4 *Independence Day*	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20 *Ramadan Begins*	21
22	23	24	25	26	27	28
29	30	31				

JUNE 2012

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

AUGUST 2012

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	