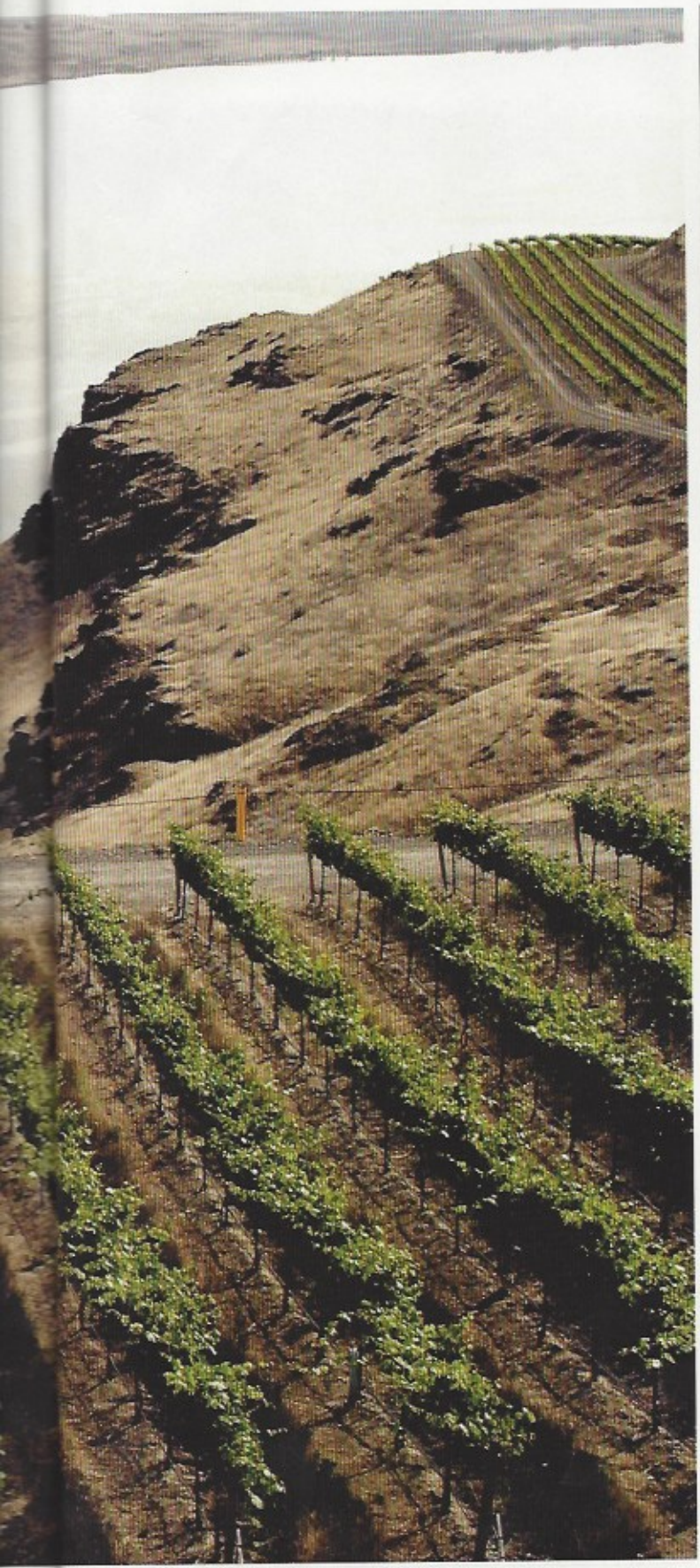
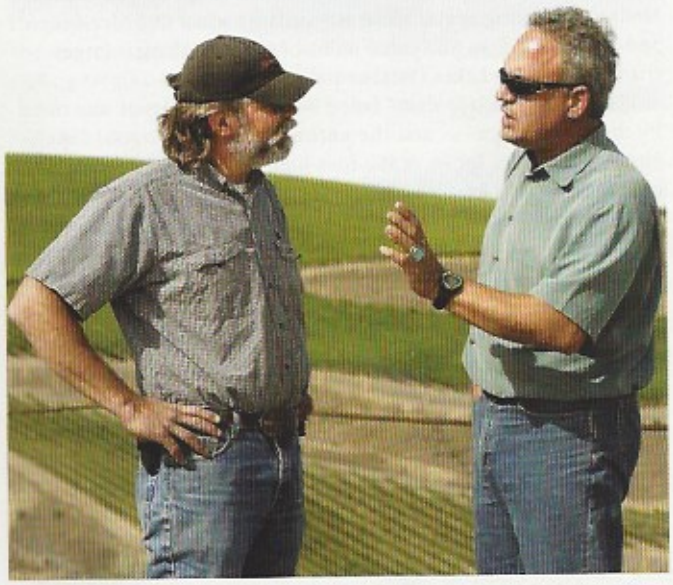
Wallula Vineyards is a series of terraced vineyards overlooking the Columbia River near the Wallula Gap. At top right, Wallula Vineyards owner Bill den Hoed, left, and vineyard consultant Alan Busacca discuss the location of a new block of grapes.





Forces of Nature

How the last Ice Age shaped the Northwest wine industry

STORY BY **ANDY PERDUE**
PHOTOS BY **JACKIE JOHNSTON**

When Alan Busacca gazes across the arid landscape of Eastern Washington, he doesn't necessarily see sand, sagebrush and vineyards.

He sees water. Not just the Columbia, Yakima and Snake rivers, but walls of floods hundreds of feet high.

Everywhere he looks, Busacca sees the effects of the Ice Age floods, a series of cataclysmic events that occurred some 20,000 to 15,000 years ago.

"It was equal to 10 times the instantaneous flows of all the rivers in the world combined," says Busacca, as he stands in a vineyard along the Columbia River. "Absolutely unimaginable! I've been working for the past 25 years on the geology of this story and the soils that resulted, and it boggles my mind to think about it."

Busacca, a soil science and geology professor at Washington State University in Pullman, is the world's leading authority on the Ice Age floods and their effects on the wine industry. He has spent much of the past decade studying the soils and resulting wines in the Walla Walla Valley, Red Mountain, Horse Heaven Hills and other parts of the Northwest. His articles on the Walla Walla Valley and Red Mountain AVAs have appeared in the scientific journal GeoScience Canada. Anyone wanting to plant a vineyard in Washington probably should consider turning to Busacca first.

Here is what the experts tell us happened:

At the end of the last Ice Age, part of the Cordilleran ice sheet crept down into the Idaho Panhandle near what is now the city of Sandpoint. This lobe of glacial ice blocked the Clark Fork River,

and the water backed up and filled all the valleys of western Montana, creating Glacial Lake Missoula. It was 2,000 feet deep and held more than 500 cubic miles of water, making it larger than modern-day Lakes Ontario and Erie combined.

Eventually, the "ice dam" failed — it either broke or was lifted by the rising waters — and the entire contents of Glacial Lake Missoula were let loose. A 500-foot-high wall of water swept southwest across Eastern Washington at 60 mph. It carved out what now are known as the Grand Coulee and Channeled Scablands. As it reached the Pasco Basin at the current site of the Tri-Cities, the Wallula Gap in the Horse Heaven Hills temporarily held back the water. Glacial Lake Lewis, as it is known, was some 1,000 feet deep and backed up all the way past the city of Yakima to the west and to Lewiston, Idaho, to the east. Over the course of about a week, experts believe, the water roared out through the Wallula Gap, a dramatic canyon in the Horse Heaven Hills through which the Columbia River flows today.

From there, the flood headed down the Columbia Gorge. At times, it was more than 1,000 feet high. Here and there, the waters backed up as they reached narrow openings. When the waters reached Portland, they flooded the Willamette Valley as far south as Eugene before continuing west to the mouth of the Columbia River at Astoria, Ore., and dumping into the Pacific Ocean.

And this didn't happen just one time.

After the first dam broke, the glacier continued its march south, blocking up the Clark Fork River again, and the entire process repeated itself. Experts believe this occurred 80 to 100 times and each lake took 50 to 75 years to form. Each time, more sediment and soil was washed south and the landscape continued to change, shaping today's Washington wine country.

A century ago, nobody knew about the Ice Age floods. But in the early 1920s, a scientist named J Harlen Bretz formed a theory about the Channeled Scablands. He was almost universally scorned by the American scientific community as he decided the moonlike landscapes around Grand Coulee must have been carved by a catastrophic event, not millennia of river flows. He didn't understand where and what the water's source was until Joseph Pardee, another geologist, began to theorize about an ancient lake in Montana. Together, their research showed the true story, and the events started to be generally accepted some five decades ago.

So, you might ask, what does this have to do with wine?

Everything, says Busacca, who is retiring this winter from WSU to focus full time on his own company, Vinitas Vineyard Consulting, which analyzes where to plant vineyards based on soil, landscape shapes and climate. He also researches and writes applications for new American Viticultural Areas, or appellations. Busacca assisted with the applications for the recently approved Horse Heaven Hills AVA and the proposed Rattlesnake Hills AVA, and he wrote the entire petition for the proposed Wahluke Slope AVA.

"The history of Glacial Lake Missoula and the Channeled Scablands is a fabulous geologic story and one that really sets the Northwest apart from any other place on Earth," Busacca says. "The entire agricultural potential of Eastern Washington was created by these events."

On a windy spring day, Busacca stands in Wallula Vineyard, a stunning operation just south of the Wallula Gap near the town of Finley. The main vineyard is typical of Eastern Washington with rolling hills, but the most fascinating part of the vineyard is the plantings on flood-sculpted terraces that stretch down the steep cliffs toward the Columbia River.

"It's a microcosm of the beauty and violence of the floods

McIntyre Bluff, a 1,600-foot-high cliff near Oliver, B.C., is believed to have been carved out of solid rock from the force of moving glaciers during the Ice Ages. At right: A detailed view of the cliff face of McIntyre Bluff shows horizontal abbrasions in the rock that are a glacier's legacy.

because just upstream is the famous Wallula Gap," he says. "All the water had to gather just upstream of this narrow opening in the canyon. That water then had to funnel through and come right past us — in fact over our heads."

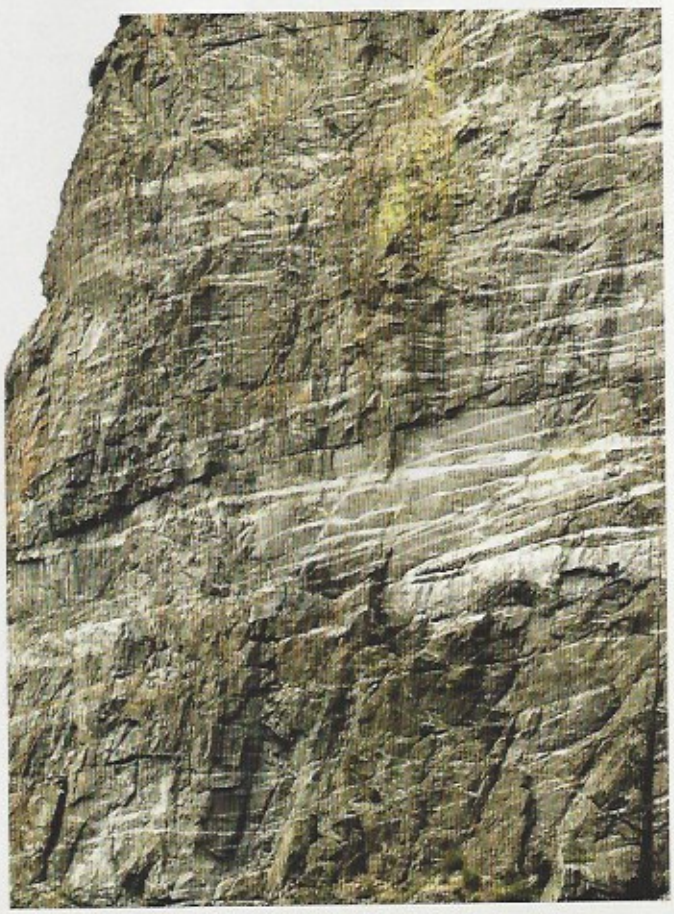
Busacca is standing on a cliff some 300 feet above the Columbia River, and the floodwaters that flowed past probably were 200 feet higher.

"What the flood did in many places in Eastern Washington, which gives us one of the foundations of our wine grape vineyard locations, is it gave us lots of benches or terraces, high table-like surfaces upon which we can plant the wine grapes and have good air and water drainage and where cold air can drop away."

Since the end of the Ice Age, wind has continued to shape the landscapes of the Columbia Valley, providing unique soil types that, it turns out, are nearly perfect for growing wine grapes. As anyone who lives in or around the cities of Kennewick, Pasco and Richland, Wash., knows, wind is an issue. During the past 15,000 years, winds that blow southwest to northeast have brought in sand, creating huge sand dunes in south-central Washington, and finer silt called loess, creating the famous Palouse Hills.

"The soils we plant our wine grapes in are formed in soil materials that were brought in by the floods. But in most cases, these soil materials have a covering over the top of wind-blown sand or silt that is blown by the strong regional winds," he says as he struggles to stand against a 30 mph breeze. "The wind that is blowing today is exactly the kind of wind that moves the sediment that has created the amazing soil resources we have here."

Within the industry, winemakers are beginning to learn about and embrace the floods. Earlier this year, Columbia Crest released



The vineyards of Nk'Mip Cellars near Osoyoos, B.C., are on the Black Sage Bench, which is composed of sand from glacial runoff during the last Ice Age.

At top right: Bruce Bjornstad, a geologist at Pacific Northwest National Laboratory, says this granite boulder, an "erratic," was deposited in Badger Canyon, near Kennewick, Wash., during the big flood at the end of the last Ice Age.

two new wines under the "Torrent" label, a Riesling and a Shiraz. The back label tells the story of the floods and how the waters rampaged in a "torrent," adding, "This epic event sculpted the unique topography of the Columbia Valley to create the perfect *terroir* for premium wine grapes."

Farther east in the Walla Walla Valley, winemaker Chuck Reininger of Reininger Winery is a fan and student of the geologic wonders of the region. The former mountain-climbing guide even sells the book *Cataclysms on the Columbia* by John Eliot Allen and Marjorie Burns — the most important book on the floods — in his tasting room.

"I have always had a curiosity about geology and natural sciences," Reininger said. "No matter where I go, I'm absorbing the landscape and finding why it is the way it is."

And when he drives through the Walla Walla Valley, he sees the floods' direct results.

"In the Walla Walla Valley, it was backflooding of the water moving through the Wallula Gap," he said. "There was such a volume of water, it picked up material, so when it got into the Walla Walla Valley, the velocity slowed down and that material settled out."

That sediment is known as the Touchet Beds, and layer upon layer settled in Walla Walla. In some areas of the valley, the soils are heavier than others because of the ebb and flow of the backflooding, and Reininger says he can taste the difference in wines.

"The heavier the soil, which tends to be more toward the eastern end of the valley, we get a little more earthiness and minerality," he said. "At Ash Hollow Vineyard on the western end, for example, there's more purity of fruit because of the sandy soils."

"It's such a cool story," Reininger says with enthusiasm. "We definitely have unique soils because of it."

Evidence of the floods is everywhere in wine country. The Wahluke Slope, a region north of the Yakima Valley, is planted with 5,000 acres of grapes, about 20 percent of the entire Washington wine industry. Much of the 85,000-acre bench was created by the floods as they burst through Sentinel Gap near Mattawa to the north. Today, the Columbia River lazily drifts through the gap in the Saddle Mountains and around the Wahluke Slope. The region is, essentially, a giant gravel bar that was created when the floods came through. Sheets of wind-blown sand that has covered the area since the floods and the dry, warm conditions make this one of the best places in Washington to grow grapes.

"We would have been 600 to 800 feet underwater during the height of the largest outburst floods," Busacca says as he gazes over Clifton Vineyard on the Wahluke Slope. "Unimaginable volumes," he adds, shaking his head. Busacca has done most of the work on getting the Wahluke Slope approved as an AVA, and he points out that it will be one of the only appellations in the

Northwest that is on a single geological landform. Additionally, it was created almost entirely by the floods.

At one edge of the vineyard, near Highway 243 that sweeps past Clifton Vineyard, Busacca stands between boulders that are nearly six feet high. Such rocks are known as "erratics" because they don't belong there. In the case of the Ice Age floods, basalt and granite boulders were swept down along with the water and also were rafted down in icebergs that floated in Glacial Lake Missoula. Erratics are scattered all along the route of the floods, in Spokane, the Tri-Cities, along the Columbia Gorge and deep into the southern Willamette Valley. Some are small boulders that are a few hundred pounds, while others are the size of a small house.

"They give us a real visual clue as to the violence and the power of the forces that shaped these landscapes through the period of the Ice Ages," Busacca says.

To plant vineyards on the Wahluke Slope, erratics needed to be moved by bulldozers toward the highway. Some were so large, they had to be dynamited.

To the southeast is famed Red Mountain, the Northwest's smallest appellation at about 4,000 acres. As Busacca stands on a future vineyard above Hedges Family Estate, he looks west up the Yakima Valley and sees evidence of the floods.

"Red Mountain is another area where the outburst floods had quite a dramatic effect," he says. "Red Mountain stood in the way of the floods that were coming from the north. The water that washed in through here was at around 1,200 feet. We speculate that when the first waves of those floods came crashing in here, they came swirling in around this spine of Red Mountain, and this area — this bench that forms the main growing area — was on the downstream side and was a back eddy for the world's largest flows of water."

He said this brought in gravel, sand and silt and dropped it on Red Mountain. Those who have developed vineyards on the bench, including Jim Holmes of Ciel du Cheval Vineyard, have found huge variations of soil patterns.

But what would Washington wine country look like if there hadn't been the Ice Age floods? Busacca contemplates this as he stands in Horse Heaven Vineyard near Columbia Crest in Paterson, where flood waters would have flowed 600 feet over his head.

"The really startling thing is to think about what agriculture would be like in the Pacific Northwest if there hadn't been these big glacial events," he says. "The bedrock is the hard, black basalt lava rock from 10 to 15 million years ago. Without the floods bringing this fresh, ground glacial material in here, basically, we would have shallow, stony soils throughout Eastern Washington, and we *might* have cattle grazing. This soil came out of western Alberta and central British Columbia, down through Idaho and western Montana. So it's pretty exotic soil that came from a distant place."

To the west of Paterson, Mimi Nye oversees Chateau Ste. Michelle's Canoe Ridge Estate, a vineyard that overlooks the Columbia River. She sees the effects of the floods every day.

"Closer to the river, the soil is coarser, more gravel. Farther up the Horse Heavens, it's finer. Basically, the coarseness of the soil has to do with how fast the water was moving," she says. "Here, the floods were flowing pretty fast, so just heavy things like gravel could fall out. Farther up the hill, the fine silt could fall out."

Busacca adds that winds blowing eastward up the Columbia Gorge have mimicked and reinforced that pattern, spreading coarse sand sheets over the flood deposits near the river and finer silty loess up farther on the Horse Heavens.

Above the vineyard, at about 900 feet high, sits a small granite boulder. "The floods dropped that boulder," Nye says. "The floods

LEARN MORE

ABOUT ICE AGE FLOODS

IF YOU'RE INTERESTED in further exploring the Ice Age floods, start with these resources:

Books

➤ **Cataclysms on the Columbia,** by John Eliot Allen and Marjorie Burns, with Sam C. Sargent, 1986. This is the most popular and in-depth book on the ice age floods.

➤ **Glacial Lake Missoula and its Humongous Floods,** by David Alt, 2001. This is a good introductory book on the subject that serves as an Ice Age floods tour guide starting in Missoula, Mont., and ending at the mouth of the Columbia River near Astoria, Ore.

Columbia Crest has a new label, Torrent, named for the Ice Age floods.

Video

➤ **Sculpted by Floods: the Northwest's Ice Age Legacy.** This hour-long video was produced by KSPS, the public television station in Spokane and is a great primer on the floods.

Group

➤ **Ice Age Floods Institute.** This is a Northwest-wide group of Ice Age flood enthusiasts that meets regularly to discuss the floods, learn from scientists and take field trips to see the results of the events 15,000 years ago. The IAFI has chapters in the Wenatchee Valley, Tri-Cities and Spokane in Washington and Missoula in Montana.

Web site: www.iceagefloodsinstitute.org.
Phone: 509-754-2931.

would have been 600 feet over our heads right here."

While the Glacial Lake Missoula floods are the most violent examples of the Ice Age in the Northwest, no less dramatic is the landscape of British Columbia's Okanagan Valley, a 100-mile-long trough that was carved out by the succession of ice ages going back more than 1 million years.

The Okanagan Valley is a series of lakes and rivers, the largest of which is Okanagan Lake, which starts in Penticton in the south. Through time, glaciers carved out the lake so deeply, it is more than 2,000 feet below sea level at its lowest point.

Pat Bowen, a scientist at Pacific Agri-Food Research Centre in Summerland, B.C., has done some of the most serious work on the geology of the Okanagan Valley and how it relates to wine. For example, she says, receding glaciers during the most recent Ice Age created temporary lakes in the valley, such as Glacial Lake Penticton and Glacial Lake Skaha. When these lakes drained, benchlands formed along the valley walls, many of which are home to some of the province's finest vineyards. The Okanagan's soils are primarily a glacial mix that allow roots to run deep and water to drain.

Bowen and other scientists have put together a geographical information system (GIS) application that maps vineyards throughout the Okanagan and Similkameen valleys (the Similkameen is a smaller grape-growing region west of the southern Okanagan Valley). The system provides growers and researchers with a way to look at various vineyards' characteristics, such as "physical, soil and climactic attributes; varieties grown; and viticultural practices that determine grape and wine quality," she wrote in an article for an upcoming issue of GeoScience Canada, a scientific journal.

Just north of the town of Oliver, perhaps 30 miles from the U.S. border, is a formation known as McIntyre Bluff. On the west side of the highway, McIntyre Bluff is some 1,600 feet high and is a dramatic cliff. Geologists believe the force of glaciers sheared off the rock like a knife through soft butter. Today, visitors driving past the bluff can see scrapes high up the cliff, evidence of glaciers gouging through.

For winemakers, McIntyre Bluff holds deep importance. South of Oliver on the eastern side of the Okanagan River is the Black Sage Bench. With 2,000 acres of vineyards, it's the most-planted area in Canada — and its most important. The bench gets more heat during the growing season than Napa or Sonoma and more sunshine than anywhere else in North America. Most of the grapes grown on the bench are such warm-climate varieties as Cabernet Sauvignon, Merlot, Cabernet Franc and Syrah, and the resulting wines are garnering high praise around the world.

But the bench wouldn't likely be there if it weren't for the last Ice Age. As glaciers retreated north through the Okanagan Valley, they slowed at McIntyre Bluff. Glacial runoff dropped sediment on the Black Sage Bench, creating a sandbar that is hundreds of feet deep, perfect for growing wine grapes.

Just north of the bluff is Ian Mavety's famed Blue Mountain Vineyard, prized by wine lovers for its sultry Pinot Noirs. One wouldn't think Pinot Noir could grow well so close to Cabernet Sauvignon, but the difference in temperature puts Mavety's vineyard a week or two later than the Black Sage Bench. This slightly cooler climate turns out to be impeccable for the finicky Pinot Noir.

The Ice Age is an amazing geological story, one that circumnavigates the globe. The history it reveals in the Pacific Northwest is one of violence and drama, a tale that is told with every sip of wine.

ANDY PERDUE, is editor-in-chief of *Wine Press Northwest*.

JACKIE JOHNSTON, a freelance photojournalist, is a regular contributor and the page designer for *Wine Press Northwest*. Her Web site's at: WineCountryCreations.com