



L to R: Kevin Dorrington, Shane Mogenson, Chris Wallace, and Jared Harris on the tablet rock of Granite Peak, Montana.
Photo by Kevin Dorrington.

Measuring Granite Peak

or How We Got Our Picture on the Wall at Angry Hank's

It's official now, or is it just more official? The tallest mountain in Montana—Granite Peak—is 12,807.09 feet high, give or take a half a foot, according to a Billings crew's Global Positioning System survey on Aug. 16, 2008. The peak's exact location is latitude 45 degrees, 9 minutes, 48.34170 seconds and longitude 109 degrees, 48 minutes, 26.85554 seconds (W).

We submitted the data into the Online Positioning User Service (OPUS) and received a solution with pretty good peak to peak error tolerances, I think the data turned out excellent.

I was one of seven people to climb to Froze-to-Death Plateau, near the peak, for the survey. Only four of our team members were physically up to continuing on to measure Granite's height.

>> By Barron Parks, LSIT

"I've done a lot of backpacking, but I've never done anything that extreme," said Jared Harris, one of four to reach the peak. "It was fun. It was exciting. It's still amazing that we made it."

Granite is considered one of the toughest high points to reach in the lower 48 states because of the long approach, 21 to 25 miles depending on the route, along with some class 3 and 4 rock climbing. The Custer National Forest, upon which Granite protrudes, warns on its website that climbing the peak entails a risk of injury or death. Granite Peak was the last of the lower 48 State high points to be occupied and wasn't occupied until September 1, 1923 when the first team of climbers found a passable route after five previous unsuccessful attempts.

History of Height

The measurement made by our group is a gain from Granite Peak's original height surveyed in the 1920s at 12,799, which is shown on topographic maps and quoted as the mountain's official height in most publications.

It's also an on-site verification of a recalculation of a 1953 survey. The 1953 survey monumented the peak and calculated a new elevation of 12,801 using the NGVD 29 model. In January of 1997, when NGS changed to the NAVD 88 model, the recalculation of the 1953 survey added six more feet to raise the mountain's elevation to 12,807.

"The height of the mountain hasn't changed, we just changed our reference surface," said Dave Doyle, chief geodetic surveyor of the National Geodetic Survey.

It was Doyle who, in a 2007 *Billings Gazette* story, threw down the gauntlet to readers challenging someone to measure Granite Peak with modern, professional-level GPS devices at the site of the 1953 mountaintop marker. That's where we got the idea for the excursion.

Shane Mogensen, Kevin Dorrington, Chris Wallace, Karen Schneider, Shawn Brown, Harris and myself—two geophysicists and five engineers—(all with survey experience) were discussing the article over pints of beer at Angry Hank's Brewery when the trip took shape. The biggest hurdles were acquiring the \$12,000 survey equipment and paying the \$500-plus insurance policy to cover the gear against damage.

I had been working with Neal Grey at Selby's, a Billings survey supply busi-



Leaving the Parking Lot on Day 1. L to R: Jared, Chris, Shane, Karen Schneider, Barron Parks, Shawn Brown, and Kevin. Photo by Jared Harris.



L to R: Chris, Karen, Shane, Jared, Shawn, Barron, and Kevin. It couldn't have happened without the help of Neil Grey and Selby's donating the use of the GPS equipment. Photo by Chris Wallace.

ness, renting Leica GPS survey equipment for various projects. I pitched the idea of Selby's donating the use of their equipment for a weekend excursion to survey Granite Peak. Grey agreed to

donate the use of the equipment since it would be on a weekend and the group was trying to getting insurance to cover the replacement costs in case of an accident. Selby's would consider as



The USGS Granite Peak tablet placed in 1953. Montana's highest elevation. *Photo by Kevin Dorrington.*

payment, pictures of the unit set up on Granite Peak for marketing, which was easily agreed. Later I learned that NGS allows collapsible tripods when using Leica equipment since a calibrated measuring tape for antennae height is included. For other types of GPS equipment, NGS recommends the use of fixed height tripods. Angry Hank's, a local microbrewery, stepped forward at the last minute to provide money for the insurance policy. The group figured corporate sponsorship by beer brewers is nearly every facet sports and media, why not surveying?

Dizzying Heights

The four-day trip started out rainy and wet as we took the route up the West Rosebud drainage to Mystic Lake and set up camp. The sloshy weather continued the next day, further

dampening spirits, especially considering they needed clear weather to get a good GPS reading. But by 2:00 p.m., the rain and clouds were burning off and the sun was trying to break through. A couple hours later, the sun came out to stay and we settled on a camp site spreading out our soaked gear to dry.

While camping on the plateau and discussing the next day's ascent, Schneider, Brown and I admitted fatigue and backed out of the summit attempt, leaving Mogensen, Wallace, Harris and Dorrington to complete the trek. The only problem was that I was the one trained in the use of the equipment. Grey of Selby's had set up the GPS unit with a configuration specific for this shot. All we had to do was type in the job name, the antennae height, and hit 'OCCUPY'. Neal did a

great job of eliminating configurations and keeping it simple, so anyone could run it if something happened on the hike. I was really nervous because I wasn't able to get up there. You never know what could go wrong. In the remaining sunlight of the second day, I conducted a crash course in GPS survey setup for the team members who would be continuing.

At 3:30 a.m. on Aug. 16, the four-person peak team set out for the summit. The Lord was smiling on us. The weather was absolutely perfect.

If anything, Harris said, it was too hot. The four ran out of water as they waited the two hours required to get an OPUS reading. NGS provided several forms, the group also had to take weather readings, snap photos of the survey setup from all four directions, and trace the existing monument.



Looking east from Granite Peak as the Leica unit gathers epochs. *Photo by Chris Wallace.*



Jared Harris working his way up Granite Peak's steep approach. *Photo by Chris Wallace.*

Sweating the Details

There were two “real big sweat moments” when Harris said he was worried that despite all their effort, the survey would fail. One was when Wallace asked Harris where the extension for the antenna was. Harris didn’t have it. Wallace looked through his pack once more and found it. Whew! The other moment was when the computer screen changed after an hour of collecting data. Mogensen pointed to the escape button and suggested they try that. As they all held their breath, the button was pushed. Luckily it worked. (I had forgotten to tell them about the screen change, but they held their cool and did a great job!)

The group also had to stake out the equipment over the top of the survey marker on a large, flat rock. They were concerned that other climbers would be mad that they couldn’t have their photo taken on the marker. Instead, most folks were friendly and interested in their

project, and also wanted to know what the “real” height of Granite was.

Around 1:00 pm, the tasks were completed and the team began their descent, which turned out to be more time consuming than the climb. Shane Mogensen had told Karen Schneider that he hoped the four would be back to camp around 5:30 p.m., no later than 7:30 p.m. The late deadline passed with no sign of the team. Schneider and Shawn Brown donned their hiking gear and began making their way towards Granite hoping to meet the team somewhere on the plateau or perhaps hear word from the other hikers in the area. At 8:00, the duo met the tired but happy foursome and all were back at camp by 8:30, the trek completed. “When will we know what the elevation is?” was the biggest question on everyone’s mind. I told them I still had to post-process the data, but that as soon as I knew, I would e-mail them all.

Curtis Smith with NGS was a huge help on this project. Smith told us tying down the elevation is going to be difficult, because gravity really plays with GPS, especially in mountainous terrain. Also, the remoteness of the shot and its relation to Continuously Operating Reference Stations (CORS) will affect the accuracy. The nearest CORS station is nearly 45 miles away at Mammoth, Wyoming.

Smith told us a single GPS shot, such as the team took, does not provide enough data to narrow the accuracy down. To obtain a fully accurate elevation, three different five-hour shots on three different days at different times of the day would be necessary and would have to run concurrently with at least four other GPS units occupying other known benchmarks. The acquisition of this amount data would be enough to secure a true and accurate elevation of Granite Peak.

“That’s a lot more than what we had in mind.” said Harris.



Shane and the friendly mountain goats of Froze to Death Plateau on the way home.
Photo by Jared Harris.

Smith did tell me that the OPUS shot would be useful to NGS for an upcoming lidar survey. NGS is looking to obtain and update information of their known benchmarks and this OPUS shot would be included in the NGS database. Even though the elevation may not be wholly accurate the latitude and longitude shot

by the team at Granite Peak can be considered accurate and could be used for reference by NGS.

But based on the reading, I thought, "They've got to get rid of that 12,799, at least in my mind."

After all, the reading corresponds with the NGS recalculation in 1997. Harris

agrees. "If you look at the elevation we got, that correlates to their reading," he said. "It wasn't all for naught. Even if it doesn't get on the map, it is 12,807."

NGS's Doyle commended the climbers for their difficult journey and praised their efforts. He also said their measurements were "well within the range of tolerances" that NGS anticipated.

"That's awesome," he said. "What it means is they have validated the current height that's published."

The excursion also had another benefit for Harris. A photo of the peak-bagging team atop Granite now hangs in Angry Hank's Brewery.

"That's the first time my picture's been in a bar, so I'm pretty excited," he said. *AS*

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