Spruce Ridge
WASHINGTON

by Bob Jackson

"Bivouacked with a box of dynamite, three intrepid geology students found crystal treasures near Snoqualmie Pass this summer."

--*Seattle Times,* Sept. 26, 1979

Stan Esbenshade, Neil Pfaff, and I were those "students," a bit of literary license taken by the reporter since none of us were in school at the time and we didn't exactly sleep with the dynamite, although it was always close at hand---used daily to help separate hard granite from valuable specimens.

We were all twenty-somethings and had worked for What on Earth (WOE), a collector shop based in Ohio, which had run a successful operation collecting world class quartz and pyrite specimens at Spruce in 1977. John Medici, one of partners in the shop, was lucky to have survived a helicopter crash near Spruce Ridge the previous season. This woeful episode caused WOE to say "Whoa!" to Washington collecting, and they turned the operation over to us. What seemed like a summer lark in 1978 became the one constant in the next 29 years of my life.

LOCATION

The ridge for which Spruce is named is at 900 meters elevation in the central Cascade Range of Washington State, roughly 100 kilometers east of Seattle. The deposit is 10 kilometers north of Snoqualmie Pass, as the crow flies. If the crow has to drive, it is a 2-hour long, bone-jarring, 38-kilometer jaunt on a rocky logging road. Because of the difficult access, the collectors live on site, often for months at a time.

Spruce is a beautiful place to live. Located in a dense forest of old growth fir and cedar, the locality echoes the sound of Nellie Falls, a 45 meter high waterfall on the glacier-fed Middle Fork of the Snoqualmie River. Initially, the only places to pitch a tent were on rocky outcrops above vertical cliffs. Now, 27 years later, a comfy but Spartan cabin keeps the rain off our sleeping bags.

Spruce has produced thousands of museum-quality specimens over the last 30 years. The deposit is an outgassing breccia within the Oligocene Snoqualmie granodiorite. Outgassing breccias develop when a rising body of magma creates cracks in the surrounding country rock. Violent explosive venting of gases fragments the rock, releasing pressure and causing temperatures in fluids and gases surrounding the magma to drop. The fractured rock (breccia) provides open space in which crystals may form as the fluids cool.

Oval in cross section, the Spruce breccia grades into country rock on the north, east, and south and is bounded by a high-angle, normal fault on the west. At the longest transect (04 bench), it is 48 meters in diameter. The deposit looks like a sponge, but in this case, the open spaces are vugs. Consisting of up to 30 percent open space, the breccia is an excellent conduit for ground water, which produces artesian springs in most of the vugs.

Spruce is one of 19 breccia pipes that crop out within approximately 6 square kilometers centered on the Middle Fork of the Snoqualmie River. The breccias were explored by Bear Creek Mining Co. in the 1950s. Bear Creek geologists core-drilled a deep-seated copper/gold porphyry and filed 250 mining claims on the surrounding mountains. The Spruce breccia is on one of the peripheral claims that saw little exploration because there was no surface showing of chalcopyrite, the main ore mineral.

COLLECTING METHODS

Collecting an outgassing breccia is like being a kid in a candy store. Initially, there were so many pockets open at once that it was difficult to keep track of what was found where. In 1979, we collected hundreds of pockets in a rather haphazard manner. There were exposed vug systems everywhere. Finding a new vug was as simple as scaling the cliffs and removing the natural bonsai vegetation that had used the vug as a foothold and source of water. The crystals in the exposed portions of these vugs were usually damaged beyond hope by soil acids and freeze/thaw stresses, but often another chamber of the vug system continued deeper into the rock where crystals had been protected from the elements.

Our blasting method was simply to follow the pocket systems, using small charges to improve access. Many of these early pockets were large enough to crawl into. By the end of the first summer's collecting, we had pretty well exhausted the exposed surface of the breccia. We were working with 2-cycle Skil® drills---underpowered roto-hammers in a tubular aluminum frame. The drill bits were carbide-tipped twist drills; so the rock chips generated by drilling tended to bog the drill in the hole. Clearing the drill hole required frequent stops to blow into the hole through a piece of copper tubing, resulting in a face full of rock dust---a slow and unpleasant way to drill. Everyone who used the Skil drill has a scar on their left forearm from the hot exhaust pipe. Any time the drill jammed in the hole, the frame started to spin. Unless you grabbed it within a split second of jamming, the exhaust pipe rotated onto your arm.

The next summer, we invested in a Cobra® drill. Cobras are

also gasoline powered, but blow air down the hollow shank of the drill steel, self-clearing the drill hole. Other than being a pain to carry (the Skil weighed under 20 pounds, the Cobra over 80), the Cobra vastly improved our drilling. Cobras enabled us to bench the breccia, working it as a normal quarry.

Our tiny quarry started by following the fault scarp. Every blast produced multiple pockets; so Stan, Neil, and I would take turns drilling and collecting. There is no doubt which was the preferred task; drilling with a Cobra is akin to hanging on to a paint mixer while roped to a cliff. When the Cobra's steel jammed in a hole, the top-heavy end of the unit spun, creating a force strong enough to knock the driller off the cliff face. Cobras have powerful engines, which is wonderful when drilling but dangerous when in a free rappel, bouncing along the cliff face with a wildly spinning drill in your hands. The kill button is under the air cleaner, in an inconvenient spot to reach, especially while busy bouncing on a rope. When the engine screamed, meaning the drill had left the hole, whoever wasn't drilling would dash across the bench to assist in turning it off.

Our final upgrade for drilling (1996) was the helicopter installation of an air compressor. Drilling is now fast and efficient with CP air drills. While just as heavy as Cobras, they are quicker and safer.

Visiting collectors often comment that blasting must make collecting easy. To be sure, blasting cracks the rock, but collecting is done the same way as at localities where blasting is not possible: hard work with hammers, chisels, and bars. A running joke among the crew is that if we piled newspapers on the bench as we loaded the dynamite, specimens would wrap themselves as they jumped out of the vugs!

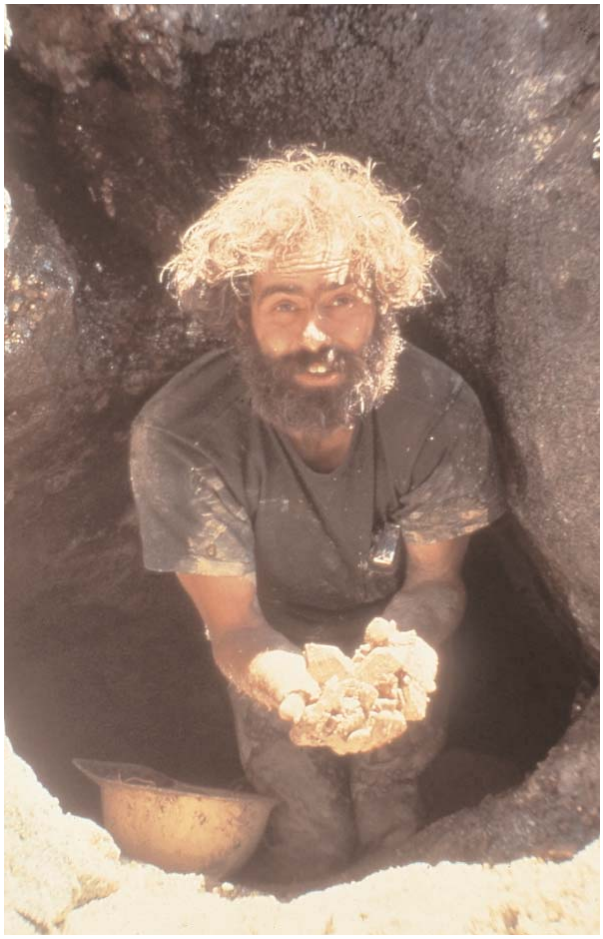
NOTABLE VUGS

Stan found the first pocket system of note in 1979. He hit it high on the face of the breccia and quickly opened the vug to collect better than half a square meter of specimens from a pristine chamber of small, brilliant quartz and pyrites. Once Stan had cleared the rubble and clay from the bottom of his pocket, the

artesian spring water drained away. This was a very good sign, as it meant there had to be a deeper chamber below. Each time the first chamber refilled with water, there would be a whooshing sound and it would drain again. This cycle of pooling, whoosh, and drain was nearly continuous; so Stan called his pocket the Toilet vug. Early in our careers as mineral dealers, we had not recognized that unattractive pocket names did not contribute to lively specimen sales.

The breccia along the fault was benched until it became too steep for us to stand and drill. A second bench (02) was started about 8 meters higher on the wall. Our next 2 years of collecting followed the contour of the exposed wall, including the section above our original cut along the fault scarp. The original cut channeled a constant flow of spring water, which streamed from the cliff face and thus came to be called "the canyon." In August of 1981, I opened our second pocket of note while drilling on a ledge above the canyon. The best way to find a pocket is to drill through 5 or so centimeters of solid rock (our Cobra drill steels were 66 centimeters long), and then have the steel fall into the open space of a vug. Ideally, the driller will catch the Cobra before the tip of the steel impacts the specimens on the pocket bottom, which is exactly what happened with the Louie vug.

The vug opened with a couple taps of a 3-pound hammer. My flashlight beam did not reach the back of the chamber. Within an hour of our first glimpse of the pocket, the entire bench was covered with easily-collected plates. Each was coated with carbonates, primarily ankerite. We have a love-hate relationship with carbonate minerals at Spruce. The carbonates form last, providing a protective layer for the quartz and pyrite underneath, particularly the sharp and easily-damaged pyrite edges. But thick carbonate coverings can obscure those forms entirely, resulting in specimens that resemble cauliflower. What On Earth had done an excellent job of promoting Spruce as THE North American quartz and pyrite locality, not the quartz and pyrite covered by ankerite locality; so most of our customers for high-end specimens wanted the carbonates etched off. Not a problem; carbonates etch easily but occasionally the etching process reveals pits in the otherwise lus-



trous quartz.

The Louie vug took over a week to collect. The initial plates were loose in clay, but the bottom of the pocket was thickly encrusted with ankerite. For days, we took turns chiseling out thick floor plates. Entry to the pocket involved traversing a narrow ledge, dropping to our knees, and then crawling into the meter-wide pocket opening. At the opening, we ignored a large mound of ankerite. It was a convenient spot to prop tools and a good handhold for entry and exit. Stan finished collecting the pocket floor and asked, "Hey, does anyone care if I pry this lump out?" We didn't, it was just an ugly lump of ankerite. A quick pop with a heavy pry bar and it rolled over the edge, landing with a thud on a mound of dirt in the canyon. The impact popped the top off the ankerite mound, revealing a fine quartz and pyrite specimen inside. We promptly named it "Louie the Lump." Louie, with very little preparation other than dropping it over a cliff, now resides in the Pacific Museum of the Earth at the University of British Columbia. The story of our unusual collecting method is displayed with the specimen.

There was one small scepter plate left on the roof of the vug for which a contortionist was required. I lay on my back, my head in a puddle, chiseling straight upward at arm's length, while holding a flashlight between my teeth. At the first solid blow, the entire roof of the vug collapsed onto my chest. Fortunately, the roof was composed of rotten granite and was only about 5 centimeters thick. Once I recovered from the shock of having been buried alive, my flashlight revealed a new vertical chamber filled with glistening quartz and pyrite and with small scalenohedral calcite crystals perched on many of the quartz crystals. It was a marvelous sight. Stan and I took turns collecting delicate plates, which had formed on the walls, then detached as the granite weathered. But instead of falling, they stayed in place, supported by the calcites, which spanned from plate to plate. We collected the pocket until well after dark. As I passed plates out to Stan, he kept up a running commentary about values: "Nice! … $800 at least … OK, $200 … Super perched pyrite …$1,200 … I know who'll buy this one." When we climbed down to camp, the bench was again covered in plates.

Bruce Stanford joined the Spruce operation in the early 1990s. After collecting there several seasons, he recalls the he had dulled, chipped, bent or broken just about every tool known to man (not to mention body parts), trying to collect quality specimens without causing them damage:

I was beginning to believe it just wasn't possible. Then, on the last shot of the 1993 season, a fist-sized hole opened in the canyon wall. It was full of ice-cold water, which needed to be siphoned. Siphoning normally just took a few minutes, but this time the hose ran for 45 minutes, signaling a large vug.

Bob and I spent most of the day with chisels, a Cobra, and powder trying to access the vug before Bob needed to leave for a show. I then had the pleasure of collecting this amazing pocket. A large percentage of the vug walls were decomposed. Two thirds of the ceiling plates had dropped into cushy muck on the floor and had suffered almost no damage from the 2 to 3 foot drop! The first piece I lifted out took my breath away, leaving me so weak and shaky that I could only sit and stare. With a racing heart, I got back to work and pulled out plate after plate for a few hours. Once the floor was collected, I was able to crawl inside for a look. The sight was stunning. Pyrites several inches across, dazzlingly bright and clean, nested in spiky clusters of quartz topped with snow-white ankerite and minute calcites, winking at my flashlight. It looked like an ancient night sky covering the walls, ribs, and parts of the ceiling.

I don't know how long I was lying there just looking. I thought of how reluctantly Spruce gave up her treasures and almost decided to wait to let Bob collect the rest when a dinner plate-sized piece slid off the wall, pinning my arm to the floor. As my blood turned the white mud red, my only thought was that more decomposed granite equaled more plates to collect.

Once the blood flow had been stemmed, I sat back to look at the bench I'd covered with incredible plates, most not even requiring cleaning. It was the most exhilarating, adrenaline-filled day of collecting I've ever experienced.

Mining claim ownership is subject to the vagaries of politics. Since the value of mineral specimens is not well documented in mining literature, claims based on specimen value have been challenged by the BLM or Forest Service. One way to protect a claim is to patent it. Patenting gives the claimant absolute title to the land; so I filed a patent application on Spruce in the early 1990s. Patenting requires an examination by a government geologist, and Jerry Capps, a BLM geologist visited in 1998. Jerry watched as I loaded a shot, calculating the cost of drilling and explosives. It was a small shot, aimed at producing a bench wide enough to walk across without need of a rope. After clearing the blast rubble, Jerry and I were eating lunch on a newly created flat spot. Idly tapping the rock with a hammer, I heard the distinctive hollow "clunk" of a vug. The flat spot on which we were sitting was the roof of a large pocket! Many taps and much gentle chiseling later, I lifted off the roof plate, and gasped at the sight of a dramatic burst of amethyst scepters! (Fig __) Jerry asked what it was worth, and I quoted a very conservative price.

"No way!"

His astonishment surprised me. The patenting report contained values substantially in excess of what I'd quoted, but Jerry didn't really believe "rocks" could be that valuable even when he witnessed my popping one out of the ground.

"I think I could sell it at that price with a phone call, but if you'd like, you can meet me at the Tucson show next February and watch me sell it."

BLM sent Jerry to the next Tucson show, where he observed the contents of the BLM vug being sold to collectors from around the globe. Spruce was patented in April, 2000.

Spruce has entertained many collectors since What on Earth left in 1978. We opened the locality for public collecting in 1988. Tour clients have included well-known collectors and dealers, as well as people who had never seen a vug before. Trying to describe the experience of opening a vug to someone who has never experienced this is akin to describing the pleasure of biting into a juicy steak to a life-long vegetarian. There is simply no way to convey the concept.

MINERALOGY

The mineralogy of the Spruce breccia is exceedingly simple. Only six mineral species---pyrite, quartz, barite, calcite, siderite, and ankerite---produce aesthetic specimens. The impossibly pleasing pyrite and quartz combinations are what have made the locality famous.

Ninety-nine percent of the pyrite occurs as crystals. Pyrite crystals often make up the entire floor of vugs. On the 02 and 03 benches, pyrite crystal production exceeded 2.7 tonnes per year. Individual crystals range from 2 to 20 centimeters on edge---among the largest in North America. Pyrite crystals under 1 centimeter are actually rare at Spruce. The two dominant crystal forms are the cube and pyritohedron and were commonly modified by octahedra, trisoctohedra, and diploids. Pyritohedra are far more prevalent in the upper portions of the breccia; cubes dominated in the lower benches. By far the most common crystallization is a cube-pyritohedron combination, which results in a slightly curved, rectangular shape.

Most Spruce pyrites larger than 2.5 centimeters have a hoppered center. In crystals larger than 7 centimeters, the hoppering

is quite distinctive, with the center of the crystal frequently depressed 6 or so millimeters from the adjacent faces. The hoppered area contains cube faces in stair-step patterns, regardless of whether the adjacent faces are cubes or pyritohedrons. In weathered vugs, the hoppered centers are the most etched or corroded, perhaps because these sites offered better opportunities for bacterial growth. Oddly shaped and "floater" pyrites are extremely common in vugs that had several episodes of crystallization and collapse.

Other than scepters and Japan-law twins, the quartz crystals at Spruce are unremarkable. Many other quartz localities produce crystals that are larger, clearer, and more lustrous. However, Spruce produces fine quartz in conjunction with large, fine pyrites. Quartz crystals formed throughout the paragenesis of the breccia. They range from 5 millimeters to 15 centimeters in length, with aspect ratios (length: width) from 1:1 to 10:1. Scepters are extremely common. In some vug systems, 80 percent of the crystals are sceptered. Japan-law twins are present, but not abundant. During most seasons, only 5 to 10 twins are collected. The largest collected thus far has equally sized "ears," 15 centimeters long. Most Japan-law twins at Spruce are flattened. Both equal and unequally sized ears occur, and a few sceptered twins have been found.

Quartz and pyrite formed contemporaneously; so quartz crystals commonly pierce pyrite crystals or pyrite crystals may perch on quartz crystals. Pyrite-included quartz is very abundant. Pyrite floaters (perfect crystals without any point of attachment), with a terminated quartz crystal or quartz scepter sticking out, are particularly prized. These presumably formed when a quartz crystal that supported a perched pyrite broke off the vug wall and then grew a new termination. Many vugs show episodic collapse and recrystallization, resulting in pyrite crystals completely surrounded by doubly terminated quartz crystals.

ACCESS AND COLLECTING

Ray Lasmanis, Washington State Geologist, wrote in 1991: "Few mining properties have been operated exclusively for mineral specimens. It is even more unusual to have such properties produce specimens for more than 10 years. This ... describes the Spruce 16 claim, whose world-class pyrite and quartz groups grace (museum collections worldwide)."

The breccias at Spruce have continued to produce world-class specimens for the ensuing 15 years and will for the foreseeable future. Specimen collecting occurs each summer, but the season has been shortened by the presence of nesting Spotted Owls (an endangered species) in the valley. According to the US Fish & Wildlife Service, blasting noise could cause the owls to abandon their nests. Public collecting is only available on guided tours. A live-in caretaker protects the property at all other times.