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Bell Copper is a mineral exploration company focused on the identification, exploration and discovery of large copper deposits located in a region responsible for 10% of the world's copper production: Arizona.

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Peter Bell's

Patient Speculator

Deep Dives with the Most Interesting Executives

Drilling Past the Oxidation Boundary at Kabba

In this short interview, I ask Dr. Tim Marsh, President and CEO Bell Copper (TSXV:BCU), about the approach to drilling at Kabba. Specifically, why does the company drill past the oxidation boundary in every hole?

Peter Bell: One thing I'd like to clarify from our first rounds of conversations was about the number of your holes that have reached the oxidation boundary. You've told me that, “it's a critical feature that constitutes the most basic test of our drill target." I believe you also said that every hole had intercepted the oxidation boundary, but I wanted to ask if was every hole that did so or just many of the holes. Let's talk about hole K-1, for example. My impression is that hole really just stayed in the gravel there, did it reach the boundary?

Tim Marsh: Yes, it did. Hole K-1 went through the gravel, through the fault, and into unoxidized rocks beneath the fault.

Peter Bell: Okay. So my assumption was incorrect. Thanks for correcting me there, Tim.

Tim Marsh: Sure, Peter. The oxidation boundary coincided precisely with the fault.

Peter Bell: Really? Okay, that would seem to suggest it was not the paleo boundary you would be expecting at the cupola of the porphyry we discussed before.

Tim Marsh: Two things of great significance came out of K-1. For background information, we were a mile from the range front and drilled 600-plus meters of gravel before we hit the fault and then got into the footwall. We never hit the hangingwall in K-1. That was, in fact, the first major point from the first hole: we missed the hanging wall entirely. We believe that was because the slip on the fault was so great that a window opened up where the hangingwall wasn't even present. It had slid east entirely past the position of K-1.

Peter Bell: Right. That window you're referring to is the trough that we discussed before. The one that shows evidence of stratigraphic inversion.

Tim Marsh: Yes. When we drilled into that trough, we didn't see any of the basalt. That volcanic unit that had coated the surface after the porphyry formed had slid so far past the position of K-1 that we never saw it in that hole. The hole just cut the fault and encountered the footwall that I like to refer to as "Church" because it's so important for my faith in this exploration story.

We saw the fault plainly in the core – it went straight from gravel through fault. The fault was about two meters thick and very thoroughly ground up, with lots of striations on the fault surface.

The second major piece of information we got from K-1 was about the dip of the fault. The fault dips at 30 or 35 degrees from the horizontal, not 60 degrees like a standard gravity fault.

Peter Bell: Right. And this slip fault has to do with the space created by the Basin and Range Extension in North America. You've alluded to the academic controversy over the angle of these slip faults and I'd love to get into the details of that with you someday. Discuss some of the papers and compare the theories with what you're seeing on the ground at Kabba.

Tim Marsh: We made some very big step-outs after K-1. We knew it was necessary if we were ever going to catch up to the hangingwall. Instead of just taking another short stab off a little further to the east, we had to move a long ways to start finding the hanging wall because the fault was tipping so gently.

Peter Bell: Well, let's talk about hole number two shortly here. To ask again about the oxidation boundary that you saw in hole one. Was that the paleo boundary or the more modern boundary, post-slip?

Tim Marsh: It would have been post-slip. Since K-1 didn't even hit the hangingwall, it gave us no information about the position of the paleo oxidation boundary.

Peter Bell: You've come a long way since then. And when you say that "every hole hit the oxidation boundary", I guess that was typically the paleo boundary. Have there been other instances where it was the modern post-slip boundary?

Tim Marsh: Our third hole was one other hole that drilled through the fault and went into unoxidized rocks relatively quickly. The fault in K-3 coincided with the oxidation boundary, the more modern one. As in K-1, we didn't hit the hangingwall in K-3.

Peter Bell: Sounds like K-1 and K-3 were similar in those ways but differed in the amount of gravel you drilled through to get into the footwall!

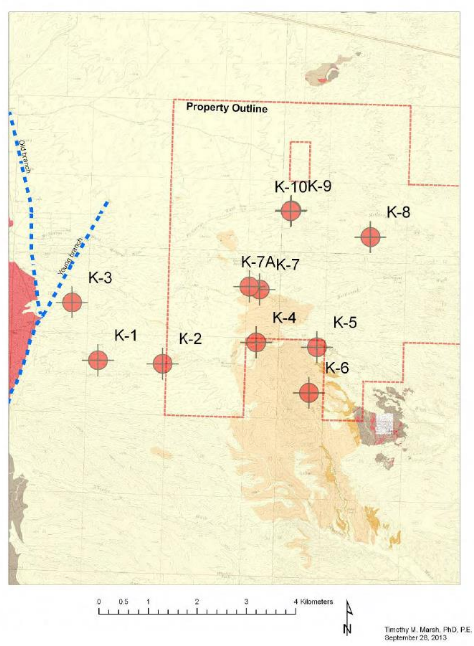


Figure 13. Drill hole map of the Kabba Property.

Peter Bell: The 43-101 shows a plan map with locations of these early holes. I had been surprised by the location of K-3. It seemed to step out to the west, closer to where that fault and the mountain range, away from where you're now looking for the porphyry. Any comments on why you went all the way over there?

Tim Marsh: Well, that hole was permitted. We permitted four sites with the Bureau of Land Management and the initial holes were on public land. All the way from K-1 through K-6, we were drilling on public land administered by the BLM. That is, unpatented mining claims. As is typical, it took a couple of months to get them permitted. We had four drill sites planned along the range front, K-1 to K-3, and then sites to the south around the Kabba Mine.

At the time we drilled K-1, it became very clear that slip on the fault was great. When we were doing this drilling in 2007, rigs were next to impossible to get so we had to either lose our rig to somebody else and wait for some much later date or move the rig to a site that we had permitted to get some information about the orientation of the fault and whatever else we could. We moved over and drilled K-2. When we got done with K-2, we had found the hanging wall in K-2, but we found fresh Precambrian rocks, no sign of a giant porphyry copper deposit. Then, I moved the rig to K-3. While K-3 was being drilled, I rapidly permitted the site for K-4 through the BLM.

Peter Bell: Did you learn much from K-3 itself?

Tim Marsh: It has been our only foot wall sampling through part of the system. K-3 is our only intersection of that part of the system, which is helpful in terms of being able to match the footwall and the hangingwall from assays of drill core.

At the time, it was our only encouraging drill hole to show the public we had an intersection. I've forgotten it now, but I think it was approximately 70 meters of .015 moly. It is typical of footwall mineralization with good potassic alteration, nice looking porphyry quartz veins, and quartz magnetite veins. It gave us a good look at the unoxidized part of the footwall.

Table 4. Drill holes on the Kabba Property

Hole	Easting NAD27	Northing NAD27	Depth to Bedrock	Total Depth	Observations and Interpretation
K-1	245682	3887963	645 m	914 m	Footwall block – Hualapai Fault at top of bedrock. Widespread potassic alteration. Sparse chalcopyrite and pyrite. Ended in quartz monzonite porphyry.
K-2	246989	3887893	610 m	837 m	Hangingwall block - postmineral basalt capping widespread weak fluorite-pyrite mineralization disseminated in Precambrian Hualapai granite.
K-3	245157	3889143	506 m	826 m	Footwall block - common low grade molybdenite, common intense sericitic alteration, ended in quartz monzonite porphyry. Intersected 90 meters averaging 0.014% Mo.

Peter Bell: I've found it in the 43-101 here: 90 meters averaging 0.014 molybdenum. Sounds like a bit of serendipity there if the hole you didn't want to drill ended up being useful for providing some fresh samples from the footwall. Did you use those in some of the mineralogy with the Master's thesis?

Tim Marsh: It was available, but I think he mainly used surface outcrops that he was able to gather on his own time. He did use samples from holes K-9, K-10 and some from K-8.

Peter Bell: Looking at this old diagram, I see how hole K4 jumped to the other side of that property outline. Why did you stick to the outside of that property outline at that time?

Tim Marsh: The property outline has changed considerably over the years. It use to extend all the way to the dotted blue line on the West side, so holes K-1, K-3, K4, K5, and K6, were all on unpatented mining claims. We've dropped some of those claims since, but we held them when we were there drilling.

Peter Bell: Okay. Have you guys ever had any patented claims?

Tim Marsh: No. Bell Copper has never had any patented ground.

There's a small patch to the east at the Kabba Mine window with four patents covering about 70 acres, but we've never succeeded in dealing with the owners there. We've completely lost interest in that area with recent exploration. We're working a couple of miles to the north now.

Peter Bell: How about the little block above K-9 and K-10? There's a little carve-out that looks like someone's patented claim?

Tim Marsh: That piece of ground was purchased by a lawyer. When he bought some ground in the area, he bought the mineral rights. We don't have the mineral rights for that area. We actually drove K17 right on the south boundary of that block and it's now pretty clear that the little rectangle is not materially interesting to Bell Copper.

Peter Bell: And that's because K-17 hit the gold that is presumably distal to the main part of the porphyry.

Tim Marsh: That's right.

Peter Bell: Is there even a road out there in the desert? The highway to the north is one thing, but I wonder about local roads.

Tim Marsh: Yes, there is a well-graded county road that goes diagonally east-southeast. It gives us good access into the project and it's the main road that people that live out that way use.

Peter Bell: The access out here it's amazing. I've had a visit to the Moss mine and it's pretty impressive how quickly you can get around and how much you are smack in the middle of the USA. These are pretty good conditions to be exploring and developing mines, although there may be concerns about local resistance and NIMBY attitudes. Maybe we can talk about that one day.

Tim Marsh: The Kennecott people who work at site were able to stay in Kingman and drive back-forth every day. Every now and then they'd actually drive into town just for lunch! It's close enough that you can do that at Kabba.

Peter Bell: The town of Kingman, Arizona is pretty neat. And to repeat it for myself: when you say you've intercepted the oxidation boundary in the drilling that we're talking about now, you're talking about that paleo boundary that could be at depths that are much greater than where the water table is today.

Tim Marsh: That's exactly right. We hit the modern water table around 700-800 feet below surface and we've been hitting the paleo oxidation boundary at around 1,200-1,300 feet below surface.

Peter Bell: And I wonder about the significance of keeping going until you hit that boundary. It may seem obvious enough to a porphyry expert that you have to drill through that boundary to see if you're in the right part of the stratigraphy, but an outsider may not appreciate just how important it is to keep drilling even if you're not sure what you're going to find or when you're going to find it!

Is Rock Quality a Fatal Flaw at Kabba?

In prior interviews, Dr. Tim Marsh, President and CEO Bell Copper (TSXV:BCU), mentioned that core samples from Kabba are heavily broken up so I had to ask him if this could potentially be a fatal flaw for underground development. Read on as we discuss the RQD at Kabba and more.

Peter Bell: Please can I ask about something you mentioned before, Tim. The core you've recovered from the hangingwall is all very broken up. You said that goes beyond what is typical for a porphyry caused by the forces created on the rock as it slid. I have a couple questions around that. One hole was abandoned, K-9, and I wonder what happened there, specifically. But let's start with a general question first. If the rocks aren't competent then that could be a problem for underground development – could the fact that the rock is broken up so much be a fatal flaw down the line in a mining scenario?

Tim Marsh: The short answer is no, Peter. Nothing has happened at Kabba that hasn't happened throughout the Carlin Trend and the precedent of underground mining throughout the area shows that it is possible to make it work. The rocks in Nevada are notoriously busted. When they drill core in the Carlin District, you could sprinkled seeds in the core boxes and grow tomatoes if it weren't for the arsenic content of the rocks.

The rocks are very broken, but it's certainly not a fatal flaw. There's nothing fatal that we've encountered yet at Kabba or I would have moved along somewhere else.

We measure the RQD or rock quality designation, which is a geotechnical parameter, on every run of core that comes out of the ground. That is, every 5 or 10 feet of core. We measure the RQD and it helps us determine what sort of support you need in an underground opening to keep it open. There's nothing extraordinary about the broken nature of the Kabba rock. It is mineable. It'll crush like corn flakes in a crushing circuit.

Peter Bell: Right. Getting the rock out isn't going to be the hard part. It's the geotechnical concerns of the underground developments. Good to hear that this is fairly typical in the area.

Tim Marsh: Yes. Arizona and Nevada generally have broken-up ground. The Miami district comes to mind, as it has quite bad rock but the engineers handled it. A lot of ore has been mined underground there.

We're not sure yet what mining method might be used at Kabba but whatever particular style of underground mining is used, I think it will be okay. It's pretty easy to envision a block cave mine and that would require some heavy reinforcement on the ground at the haulage level, but the cave itself will flow real nicely because of the broken nature of the ground at Kabba.

Peter Bell: And this “broken-up rock” that is typical of this broad region is really driven by that movement in the North American continent – the Basin and Range Extension.

Tim Marsh: Yes. As the hangingwall was transported a great distance across the footwall, the stresses related to that transport process have jiggled the hangingwall and broken it up substantially but not to the degree that it isn't mineable.

intruding dacite porphyry dikes.

The geology that has been intersected in K-9 so far is consistent with a position near the western edge of a major magmatic-hydrothermal vent that has been subjected to alteration and mineralization typical of porphyry-copper systems.

If the fault model continues to hold, further drilling in K-9 is expected to encounter primary copper mineralization underlain by stock work quartz veinlets identical to those found over 15 square kilometers in the footwall block of the fault. The thickness of this interval is estimated to be about 1,200 meters, extending below the current bottom of the hole down to the Hualapai fault, beneath which unmineralized rocks of the footwall block are anticipated.

In June 2010, the Company announced that drilling and mechanical problems on hole K-9 had required wedging out of this hole into a new hole designated K-9A. At that date wedging and drilling of K-9A had retained the ultimate depth of K-9 and K-9A was advancing well in intensely sericitized diatreme breccia carry about five percent disseminated pyrite. After attaining a depth of 1065 meters, K-9A was lost due to severely altered caving ground between 910 and 950 meters depth.

On August 11, 2010, the Company announced that Major Drilling of Salt Lake City, Utah had been engaged to advance drill hole K-9. Following four unsuccessful attempts to penetrate the severely altered, caving ground below 910 meters depth, the Company announced on November 30, 2011, that drill hole K-9 had been terminated. Intense hydrothermal alteration typical of the upper parts of porphyry copper systems had produced the very weak rock encountered in K-9.

Encouraged by the extent of this alteration along with trace amounts of the sulphide minerals chalcopyrite, bornite, digenite, and molybdenite, the Company announced that it would be redrilling the same site as K-10 using large diameter mud rotary equipment to advance past the altered ground into the most prospective part of the target.

Table 4. Drill holes on the Kabba Property

Peter Bell: Okay, thanks Tim. And the specific question about hole K-9. I'm reading the 43-101 report here and I see that hole 9 was terminated at 900 meters depth after hitting severally-altered caving ground in June 2010. What does that mean – any sense for what was happening underground there?

Tim Marsh: To start with, Peter, I will point out that there's no copper there so we don't have to worry about mining there. As you read, that particular spot was very altered and broken. It resembled the type of alteration that you have in the middle ring around the copper shell. Not the type of alteration you'd generally have in the core of the porphyry copper deposit with sericitic and clay sericite alteration. This rock was flowing in almost a sandy condition.

Peter Bell: Really?

Tim Marsh: Yes, indeed. We made six attempts, K-9 through K-9E, to get that hole down through the interesting rocks without success. We brought on two drilling companies to attempt it. Brown Drilling first got the deepest penetration with an old Longyear 44 drill, but they lost the hole around 1,000 meters. So, we brought Major Drilling in – thinking that an outfit like Major Drilling could handle it. They had a brand-new rig, a Longyear LF230. They tried four times and failed when the hole collapsed on them.

Peter Bell: Wow.

Tim Marsh: The fourth time, I came out to the rig in the morning and, lo and behold, they had packed up and left in the night. They were so disgusted with the rock there.

Peter Bell: Hence, the retry with K10 and the large diameter mud rotary.

Tim Marsh: That's right. All the variants of K-9 and K-10 were really the same hole. For K-10, we moved over a little bit and brought in a big mud rotary rig. It wasn't quite oilfield equipment, but certainly the biggest water well rig you'd ever encounter. It had an oil rig sized mud pump and mud shaker system. It was a pretty big operation. It got down through the first thousand meters, and then we shifted over to coring. The coring was done I think within a week with no hole problems whatsoever.

Peter Bell: Great.

Tim Marsh: We found that Brown Drilling, with their old Longyear 44, actually got quite close to the target horizon. They were within 10 feet of the breccia that I felt I had to see the bottom of before I could stop that hole and walk away from it.

Peter Bell: Right. And this ties back to the whole "drilling until you pass the oxidation boundary" that we discussed at length elsewhere. I'm gathering that it's a critical part of the exploration for a porphyry to get to the right level of stratigraphy, regardless of what you find along the way, to situate yourself in the system.

Tim Marsh: That's right, Peter. And hole K-10 gave us the answer that we needed to be somewhere else.

Peter Bell: Wonderful. Lots of questions come up for me with that. Could the sandy section of stratigraphy that was so difficult for hole K-9 be associated with any tilting in the system?

Tim Marsh: Probably not. As I said, this type of heavily broken-up rock is typical of the outer part of a porphyry system. It wasn't particularly surprising to see it, especially after we saw how the hangingwall looked in K-10.

We don't have a lot of good indicators of tilting. Where we do have them is either immediately underneath young post-mineral basalt or immediately above it. There are some thin silty or clay sections that are usually well bedded, and they're only slightly inclined with respect to the horizontal. We drill vertically, which makes it very clear if the beds are flat in place depending if they cross the axis of the core at a perpendicular angle. We see bedding that might dip 20-degrees, but we're not seeing strongly tilted fabrics.

Deeper down in the Laramide part of the system, where we're drilling porphyry dykes in breccia, we see flow-banded porphyry dykes where the flow-banding is nearly parallel to the core axis.

Peter Bell: Sounds like a feeder system!

Tim Marsh: That's right. These porphyries are being squirted out of the earth roughly straight up and down, like a carrot growing in the ground. The flow-bands are the cracks that the magma is moving through, and they are vertical or parallel to our drill core.

We see some angle in the K-10 and K-9 core axes, but not more than 10- or 15-degrees from the core axis. 60-70 million years ago, it was squirting up more-or-less straight up out of the ground and is still oriented in that way.

We entered breccia right as soon as we got underneath basalt in K-9 and stayed in it for 500 meters. The fact that we were able to stay in the breccia for so long was quite significant. To stay in the same carrot-shaped mass for 500 meters means it probably isn't strongly off of a vertical angle. It could be 20-degrees off a vertical, but that's still mainly vertical rather than laying on its side.

Peter Bell: And a basic question for you – is the breccia associated with breaking up of the rock as the magma moved upwards or more as the rocks collapsed back in on themselves as the fluids cooled and condensed?

Tim Marsh: It's more the latter, Peter. Keep in mind that there is a vapor phase associated with the magma. As the magma moves up, the magma releases a vapor phase that travels roughly along the same path but that vapor phase doesn't do a good job of supporting the overlying rock. The overlying rock and surrounding rock tends to implode into the vapor bubble. It pops off the walls and leaves you a rubble-ized mass of broken wall rocks. As that thing propagates through the overlying rocks, it leaves a trail of broken rock behind it and that's the diatreme breccia. It's really caused by the magmatic gas accompanying the emplacement of porphyry dikes.

Peter Bell: Okay, thanks. When you had said "rubble-ized rock", I wondered if it was more due to that collapse associated with the vapors or if it was the stresses as the whole cupola of the porphyry slid horizontally along that slip fault.

Tim Marsh: You can tell the difference very easily. The more recent cracks related to normal faulting, based on normal faulting with Basin and Range Extension are generally open cracks. The earlier cracks are generally re-cemented with pyrite or quartz and other hot mineral products. A lack of hydrothermal products is a key indicator that the crack formed after the mineralizing event.

Peter Bell: Of course. It seems amazing to think that you would see open cracks at these depths. Are they generally hairline fractures or more substantial voids?

Tim Marsh: They are generally hairline fractures, but as soon as you core it the rock falls apart on those hairline fractures.

Peter Bell: Amazing. I guess that provides an answer to my question about what kind of stresses the horizontal movement caused in the rock unit. It's really associated with small fractures that allow the rock to fall apart easily if it's given space to fall apart, but are not associated with any change in the chemical composition of the rock that would cause it to start turning to sand or anything like that. That's not what we're talking about.

Tim Marsh: A thin layer of shotcrete over fractures like that will keep the rock mass in place. It'll keep it from collapsing in on a reasonably-sized underground opening for access purposes. If you drive a drift five meters by five meters through this material and shotcrete it, put in some mesh, and some rock bolts within a day or so of first driving the drift then it will stand indefinitely. If you let it sit or try to make something substantially bigger, say 30 meters across, then you would have trouble.

Peter Bell: And that makes it clear to me why the rock falls apart when you get it in the core trays – it's the same thing. When the rock is under pressure, those fractures don't mean much but when you take it out and give it some volume to expand it to, it'll do just that.

Tim Marsh: It will, that's right.

Peter Bell: Okay, thanks Tim. I can check that off the list here too.

Revisiting Past Predictions with Tim Marsh for Kabba

Read on as Dr. Tim Marsh, President and CEO Bell Copper (TSXV:BCU) and I discuss how his understanding of Kabba has changed over time.

Peter Bell: I'd like to ask about some of the things in the 43-101 report about hole K-9 and K-10 before the results were known, I believe. It says, "if the fault model continues to hold, then further drilling is expected to encounter primary copper mineralization underlain by stockwork quartz veinlets." Did you see what you expected to see there and, if not, any ideas what happened?

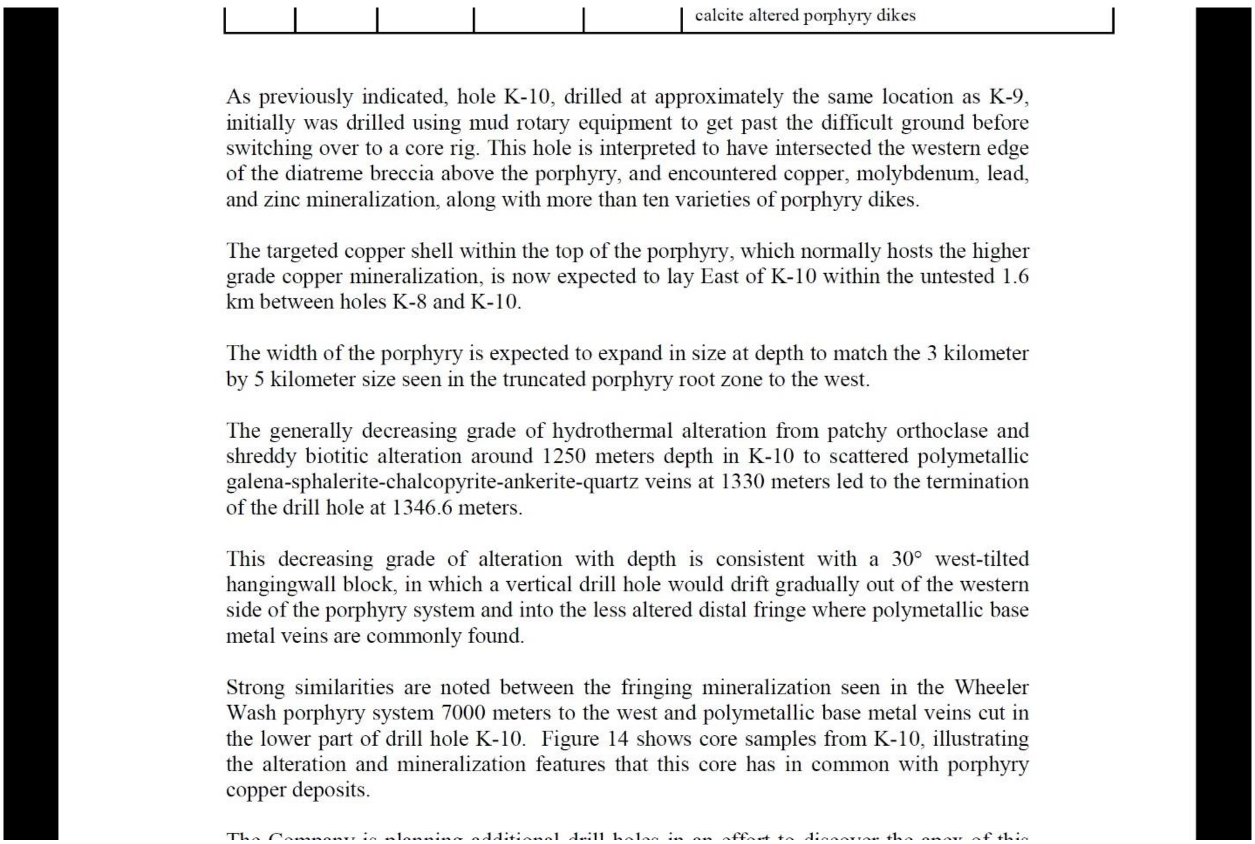
Tim Marsh: We did not ever encounter a zone of stockwork quartz veinlets. We saw some encouraging quartz molybdenite veinlets, which was good because molybdenite is scarce as anything – even in Arizona. The Laramide dykes, the breccia, the quartz-pyrite-molybdenite veinlets, the little bit of chalcopyrite, and little bit of bornite that we saw all gave us encouragement we were seeing the system that we were looking for, but it was clear we hadn't found it yet. There was an awful lot of carbonate mineralization and K-9 and K-10, which is generally something that you see in the margins of a porphyry system, not the core.

Peter Bell: I always wonder about the carbonate. Where is that coming from?

Tim Marsh: It's carbon dioxide coming out of the mantle. The mantle is loaded with carbon dioxide and it's dissolved in the mafic volcanics, which are iron- and magnesium-rich types of volcanic rocks that come up from the earth's mantle. When the magma moves, it carries a lot of carbon dioxide dissolved in it. As the pressure decreases and the magma gets closer to the surface, the carbon dioxide begins to bubble out just like a soda pop. If it encounters calcium, magnesium, or iron in solution, which means dissolved in water, then it will precipitate the calcium, magnesium, or iron carbonate minerals inside the cracks and those minerals are part of what glues this diatreme breccia together.

Peter Bell: And that is why you can tell the difference between cracks created by stress as the Kabba porphyry slid eastward. The sequence of everything is clear there.

Tim Marsh: This porphyry moved 40 million years after it was first formed. When it moved, there wasn't a heat source in the area so the rock would have been at an ambient temperature around 115-degrees Fahrenheit. At that time, it wouldn't have precipitated a lot of hydrothermal minerals.


calcite altered porphyry dikes

As previously indicated, hole K-10, drilled at approximately the same location as K-9, initially was drilled using mud rotary equipment to get past the difficult ground before switching over to a core rig. This hole is interpreted to have intersected the western edge of the diatreme breccia above the porphyry, and encountered copper, molybdenum, lead, and zinc mineralization, along with more than ten varieties of porphyry dikes.

The targeted copper shell within the top of the porphyry, which normally hosts the higher grade copper mineralization, is now expected to lay East of K-10 within the untested 1.6 km between holes K-8 and K-10.

The width of the porphyry is expected to expand in size at depth to match the 3 kilometer by 5 kilometer size seen in the truncated porphyry root zone to the west.

The generally decreasing grade of hydrothermal alteration from patchy orthoclase and shreddy biotitic alteration around 1250 meters depth in K-10 to scattered polymetallic galena-sphalerite-chalcopyrite-ankerite-quartz veins at 1330 meters led to the termination of the drill hole at 1346.6 meters.

This decreasing grade of alteration with depth is consistent with a 30° west-tilted hangingwall block, in which a vertical drill hole would drift gradually out of the western side of the porphyry system and into the less altered distal fringe where polymetallic base metal veins are commonly found.

Strong similarities are noted between the fringing mineralization seen in the Wheeler Wash porphyry system 7000 meters to the west and polymetallic base metal veins cut in the lower part of drill hole K-10. Figure 14 shows core samples from K-10, illustrating the alteration and mineralization features that this core has in common with porphyry copper deposits.

The Company is planning additional drill holes in an effort to discover the apex of this

Peter Bell: You mentioned that the carbonate is typically seen in the periphery of the porphyry. How about the molybdenite, is that typically seen in the periphery as well? And why haven't I heard much about the typical lead-zinc zonation?

Tim Marsh: Well, we did hit pretty good lead and zinc in K-9 and K-10. The molybdenite is kind of fickle. It is almost always present right in the middle of a porphyry, underneath where the copper forms, but it also moves out beyond where the copper is in many systems. The molybdenite can be both internal and external to the copper shell. In the case of K-9 and K-10, we saw it external to the copper shell.

Peter Bell: Right. And that is similar to the gold that you've recently hit in hole K-17 external to the copper part of the system.

Tim Marsh: We actually started seeing encouraging gold numbers in K-9 and K-10, but we didn't assay for it immediately. We did assay part of K-10 for gold and other elements, but Kennecott actually assayed more of it for the full suite when they got involved.

Peter Bell: The technical report also says, "Further drilling is expected to encounter primary copper underlain by the stockwork quart veinlets." Is it correct that you encountered quartz dykes, but not the veinlets in K-10?

Tim Marsh: Yes. What's more, the kind of quartz veins that we hit are quartz veins typically found off in the cool parts of the system where cracks lead out away from the core of the system. They're very much like the same kinds of veins you see in the footwall when you're a kilometer or more away from the porphyry and the heat source responsible for filling those cracks with hydrothermal minerals as we discussed. The quartz and other things we saw in K-10 were part of the porphyry, but they were distal cracks.

These types of veins are actually called polymetallic base metal veins. They commonly have chalcopyrite, sphalerite, which is zinc sulphide, and galena, which is lead sulfide, silver and gold. They can have pretty good silver values. These polymetallic veins are typically seen external to a lot of porphyries – external to the footwall, in fact. Some of the mines that operated 100 years ago in the footwall were mining the kind of polymetallic veins that we hit in the bottom of K-10. I am thinking of the Enterprise Mine or the Century Mine located back in the footwall block. In that way, K-10 gave us a correlation back to the footwall.

Peter Bell: Great, thanks Tim. I had wondered about that with the gold mentioned in hole K-17 recently. I wondered if there was any evidence of gold mines back in the footwall that you could correlate vertically to the hangingwall. It's interesting to hear that you made that connection with these polymetallic veins in K-10. If you could start to connect points in the footwall to your exploration area in the hangingwall, then that would be a big step in the right direction. If you had a particularly nice spot in the footwall that you wanted to test, then you would have a good sense for where it might be located.

Tim Marsh: Yes, indeed. I'll just mention that the silver and gold numbers in K-10 were really encouraging.

Peter Bell: Okay, so we've got all the stuff that we expect to see distal to the source with gold, silver, lead, zinc all showing that you're in the ballpark but haven't quite found it yet. I wonder what it was like for you when you drilled K-10. Was it a bit of a surprise – like, "This thing moved further than I thought again!"

Tim Marsh: That's about right, Peter. Every single hole is a surprise and a learning process and some are a disappointment. My energy ebbs pretty close to zero when I have to cut the hole off. It's terribly disappointing, but I pick myself up and I go back to the footwall to reconvince myself that I can't let up until I understand where the upper part of that footwall is located. The footwall is so spectacular – so intensely veined and altered that I can't let off the gas until I find where all the fluid that created that footwall went. It's just extraordinary.

Peter Bell: And to see it over 15 square kilometers in the footwall. It's a little hard to understand quite how large that is.

Tim Marsh: You can spend a couple of days on a quad just riding the trails in that 15 square kilometer area and not see the whole thing. It's a big patch of ground.

Peter Bell: Just banging rocks the whole time and seeing different things of interest – wow.

The Illite Crystallinity Index at Kabba with Tim Marsh

An important part of the Kabba exploration story is the use of sophisticated exploration techniques. Read on as Dr. Tim Marsh, President and CEO Bell Copper (TSXV:BCU) and I discuss one important example of his scientific approach here.

Peter Bell: We've been talking about the zonation across the porphyry at one level, but you've also made a point about the zonation vertically across a porphyry system. That was something I hadn't really heard before, which makes sense because most exploration geologists don't get to see the roots of the porphyry cut across like that. They're usually buried at depth, far below what you would be looking for as the economic area of interest in the porphyry. It's an interesting situation.

Tim Marsh: One of the things I tried to do in K-9 was some clay crystallinity measurements to see if we could measure a paleo temperature gradient. We had a pretty good vertical sampling of core, roughly 500 meters underneath the basalt. These temperature gradients can be very useful for understanding these types of systems and the vertical sampling allowed us to do some good work with that.

The mineral illite is a clay mineral similar to mica. In fact, it changes and becomes mica at high temperatures and that is part of the reason it is useful for estimating a temperature gradient. At low temperature, illite is quite disordered and gives an almost amorphous pattern when you do an x-ray diffraction measurement on it. As illite is exposed to higher temperatures for longer times, it becomes more crystalline. There is one peak on the x-ray diffraction pattern, in particular, that becomes sharper as the illite is exposed to higher temperatures, which is called the "Illite Crystallinity Index". It's something that can be measured in active geothermal systems today and compared with the measurements from mineral deposits like Kabba.

I sampled illite down K-9 and K-9A, and the guys at the University of Arizona x-rayed them for me. I developed a paleo geothermal gradient that showed a few things. For one, the paleo geothermal gradient at Kabba was much higher than a typical geothermal gradient. There was clearly something hot down there cooking things at Kabba. It was very encouraging to see that the illite became more crystalline as we went down deeper. Just seeing that things were heating up 5-times faster than a typical average geothermal gradient really drove me to get K-10 drilled down to 1300 meters.

Peter Bell: The depth on that hole is amazing. You encountered bedrock around 540 meters, so you are talking about 800 meters through different rock units.

Tim Marsh: If we were in the right spot, then we would expect to see a transition from whatever is underneath the basalt down into quartz stockwork and quartz magnetite veins – the types of things we see back in the footwall. That's the key condition, it should be a continuous monotonic transition. We haven't found that place yet.

In K-19 we're getting awfully close as we've seen some thin quartz magnetite veins and patchy, thin potassic alteration, which are things that begin to resemble the footwall. Until we've tested that on a coarse grid in some untested areas, we can't walk away. There is a big patch of ground out there where we need to see a lot of stockwork quartz veins and intense high temperature hydrothermal alteration with high-temperature sericitic alteration, but we haven't found that patch of ground yet.

Peter Bell: QSP – quartz sericite pyrite, right?

Tim Marsh: Yes, that’s right.

Peter Bell: It's tough – if you drill into that with a vertical hole, then you'll probably see some nice copper grades above that area that matches the footwall. That makes it tough as an exploration geologist. When you hit that thing that ties the footwall and hangingwall together, you'll also hit the economic thing of interest! That makes it an all-or-nothing outcome for this part of the exploration story, whereas some of your earlier stages were a little more sequential. For example, there were a few ways to determine the angle of the slip fault. You did that successfully and now you're onto the bigger challenge of finding the cupola of the porphyry and the only way to do that is to find it! Tough.

And you also have to keep in mind that this is a business, not an academic exercise. The academic exercise might be to drill in the footwall to compare the temperature gradient there and compare it with what you saw in the illite from K-10, but that would probably be a waste from the Board's perspective.

Tim Marsh: And Wyatt Bain took care of that for us in his Master's thesis. He measured paleo temperatures in the quartz veins back in the footwall and compared them what we were seeing in those drill holes.

He had a heating stage on his microscope and could heat the samples up to 350-400 centigrade to homogenize the microscopic bubbles trapped in the quartz veins. At those sorts of temperatures, all the components in the bubbles would homogenize into a single fluid. Usually, the bubble would disappear. Some of them have salt crystals and things like that, which would dissolve and leave a homogenous fluid that would be the equivalent of the fluid that actually got trapped in these little bubble spaces. He's constrained that the foot wall was pretty darn hot.

Peter Bell: You speak of this monotonic transfer and I wonder if you have evidence to suggest that the illite you were seeing at depth in K-10 corresponds to stuff seen in the foot wall at surface?

Tim Marsh: It was getting close to the foot wall, but we haven't found the spot in the hangingwall that sat above the best of the footwall yet.

At that spot, the fluids would have been rising out of the earth at a tremendous rate. We haven't seen any evidence yet to say that all those fluids erupted out to the atmosphere and were disbursed over the earth surface at that time. Everything we've seen so far at the pyrite shell at surface in the footwall gives evidence of sulfur infusion, molybdenum, and copper mineralization on a small degree brought a zoning of lead and zinc and fluorine, suggests that that batch of fluid stalled. It got stuck, and it is still there to be found.

If it had vented, we wouldn't see anything. There would be a hole in the ground, and there wouldn't be this big multiple kilometer square geochemical stain on the earth.

Peter Bell: To come up with a one-one mapping of what you're seeing at depth in hole K-10 to what you see in the footwall is very exciting. Good to see that you're in the ballpark, because that's often enough for exploration geologist. The academics require a greater degree of certainty and rigour but the explorationist gets to come along and say, "Good enough."

I think it's very important to consider that distinction since a lot of the exploration story at Kabba is relatively sophisticated. Many investors may be afraid that this is an academic exercise for you, but this is not an academic exercise – this is business. The fact that you've been able to work with academics to answer important questions is great, but it's even more important that it's allowed you to focus on the bigger picture at Kabba and put the whole thing together.

Discussing Core Samples from Kabba with Tim Marsh

In this interview Dr. Tim Marsh, President and CEO Bell Copper (TSXV:BCU), and I discuss several core samples that Bell Copper recovered from Kabba. These show hallmark indications of a copper porphyry system, although not the rich chalcopyrite mineralization that the company is looking for. Read on to find out why Dr. Marsh believes they are still on the right track with exploration at Kabba.

Peter Bell: Alright, we've got some pictures of core from hole K-10 as in the 2013 technical report.

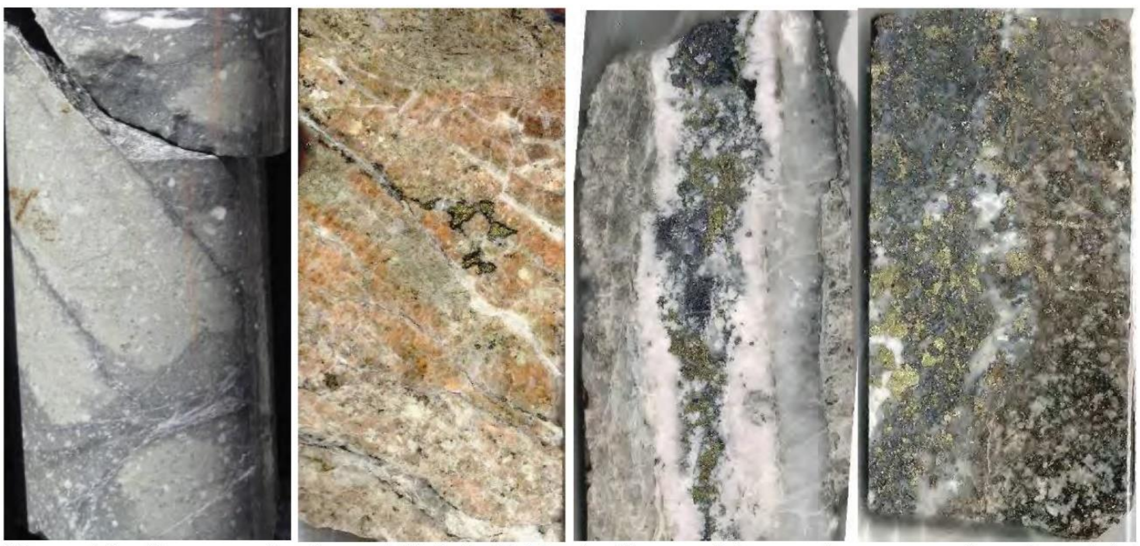


Figure 14. Core samples from drill hole K-10. A. Gray sericite envelopes around pyrite veinlets cutting illite-altered dacite porphyry, 1160 m, B. Pink orthoclase alteration with blebby chalcopyrite rimmed by transparent, greisenous muscovite, overprinted by pale green sericitic alteration and cut by late white ankerite veinlets, 1219 m, C. Polymetallic base metal vein carrying abundant chalcopyrite and argentiferous galena, hosted in gangue of ankerite and quartz, 1234 m, D. Polymetallic base metal vein carrying abundant black sphalerite, chalcopyrite, and lesser galena and tetrahedrite, with elevated gold and silver, 1329 m.

Tim Marsh: These are all extraordinary specimens, Peter.

The one on the left shows D-veins, which are a type of veins seen all over the world in porphyry copper deposits. They were first described back in 1975 by Lew Gustafson and John Hunt, two American geologists working for the Anaconda Company down in Chile on the El Salvador porphyry deposit. Their paper was published in 1975 in Economic Geology as a landmark porphyry copper paper. These D-veins consist of a center line where the crack is filled with pyrite. You can see in the lower left of that picture on the left that there's a kind of a real dark center line and then a broad gray region around that center line.

The dark green in the center is pyrite or fool's gold, and the dark gray around it is sericite or illite that has replaced the rock around that crack. Just to find D-veins at Kabba under several hundred meters of gravel and basalt tells me that we're finding the things that we went looking for.

We went looking for porphyry and the host rock is porphyry. There it is in that photo. What’s more, it has pyrite and D-veins in it!

The D veins form late in the high-temperature alteration. It's a late stage of the event that over-prints earlier, higher temperature phases of veining. The presence of D-veins there tells me that the whole system is present. It didn't vent to the atmosphere. All that sulphur didn't erupt out into the atmosphere – it was trapped in the subsurface and cooked the rocks. Those D veins are good evidence that happened.

Peter Bell: And you said that these rocks are porphyry, but they don’t really look like porphyry to me here.

Tim Marsh: It's severely altered. The little specks in there are feldspar phenocrysts, but most of the texture of that rock has been destroyed by hydrothermal alteration, by illite-sericite alteration.

Peter Bell: Ah, okay. I was at a museum in London recently, and they showed all different types of porphyry that looked pretty. I thought, "these look nice, but this isn't what we want!"

Tim Marsh: This one has been through hell and back. Once you have an eye for porphyry, then things get interesting when you start looking at altered porphyries! All kinds of bad things that happen to a porphyry when hot water flows through it and this one at Kabba had a lot of hot water flowing through it.

Peter Bell: Wonderful. And how about this crack up here in the top of that core? Is that one of those hairline fractures associated with the stresses from the movement that we were talking about earlier?

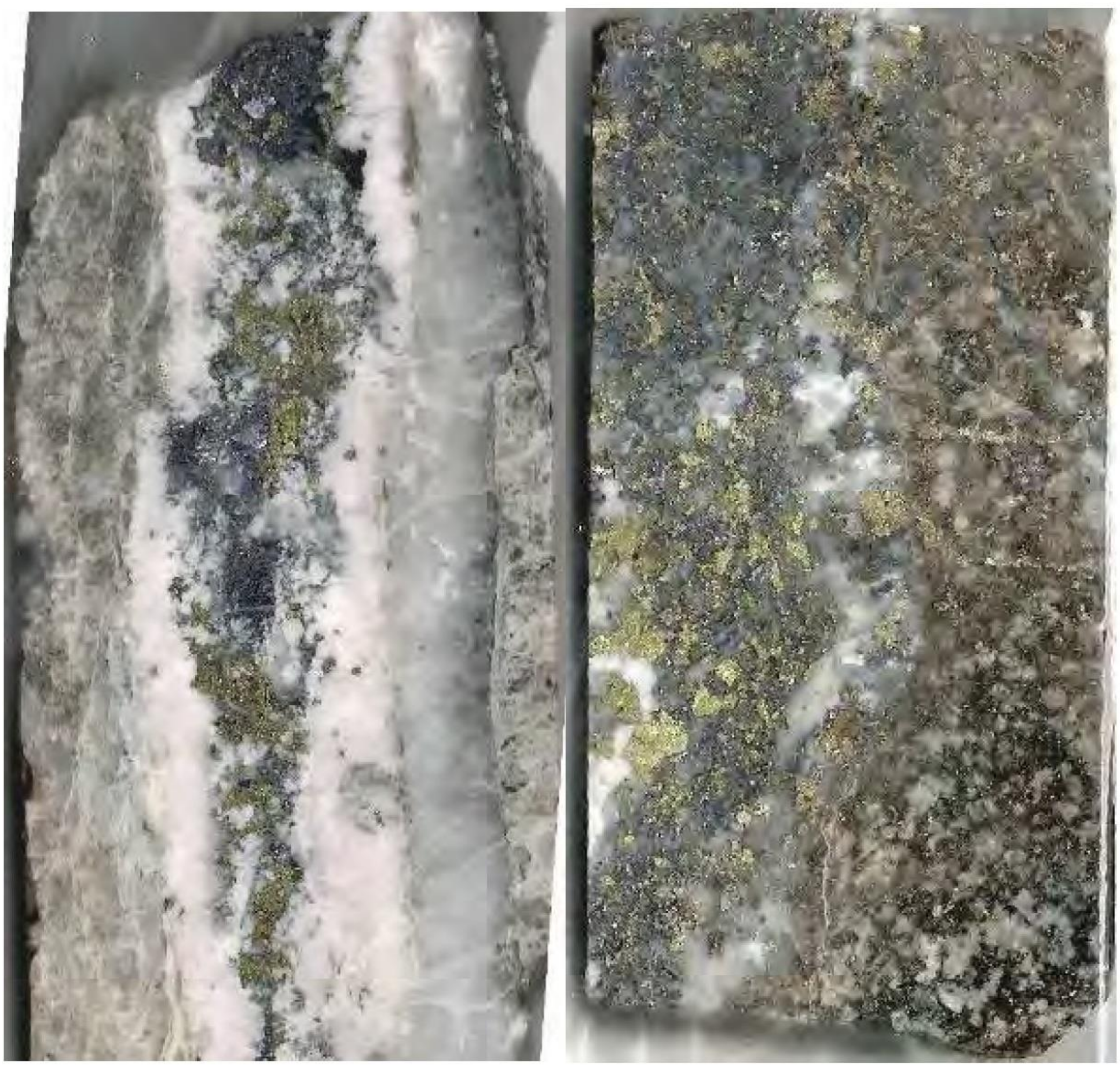
Tim Marsh: You bet, Peter. That crack is a lot more like what the Basin and Range Extension would create after the mineralizing event. The older cracks in the Laramide that occurred as part of the mineralizing event were re-healed with pyrite or white carbonate.

Peter Bell: And that's where the gas came up, created space for the rocks to collapse into, caused brecciation, and then the hydrothermal fluids came in to fill up those cracks. Thanks, Tim.

Tim Marsh: The next rock over is a little hint of the sort of thing that we're looking for – that magic zone where things could become economically significant. This is out of K-10 and there's a patch in the middle with chalcopyrite, which is a copper-iron sulfide. The chalcopyrite has a black rim around it that is actually muscovite or white mica, but it's so glassy and clear that the light penetrates down into the interior of the rock and causes it to look black because all the light gets absorbed.

Peter Bell: Really?

Tim Marsh: Yes, indeed. That coarse-grained, clear mica that rims the chalcopyrite, looks very much like the greisen or quartz-sericite alteration we see in the footwall. The orange or pinkish orange halos or streaks you see going through it are potassium feldspar, which is an alteration product related to the early mineralizing phase of a porphyry copper system. Then you see late, white carbonate-filled cracks. There's some molybdenite down there at the bottom of that thing and some gray streaks on the edge of a plane, which is all saying that the things I like to see in a porphyry copper are happening right there at K-10. Not enough of it to make an ore deposit, but the right processes were operating.



Tim Marsh: Then, the two samples on the right are both examples of these polymetallic base metal veins that you commonly find external to porphyry copper deposits. If you see some greenish chalcopyrite in the one on the right that has a yellow-green tinge to it – that's copper iron sulfide. A lot of the dark stuff in that rock is a zinc sulphide called sphalerite.

Peter Bell: And some silver in there, too?

Tim Marsh: The sample left of that has a lot of galena in it. You can see silver-gray galena and some chalcopyrite. The galena is very interesting in that case. Normally galena is cubic form, but this galena is all distorted with curved cubic faces. That curvature is a deformation of the galena structure that occurs when it incorporates significant silver into its cubic structure. Silver will dissolve in the galena, but it distorts the typical cubic cleavage of the galena and causes these strongly curved faces. I saw that as soon as it came out of the core. We made sure to check for silver because it was such a strongly distorted cubic cleavage and it turned out to run at 30 ounces per ton of silver in the galena.

Peter Bell: Do you need a hand lens to see that?

Tim Marsh: No, you can see it with your naked eye.

Peter Bell: I guess that would be indicative of some pretty juicy fluids?

Tim Marsh: That's right, Peter. It also indicates that we're not in the right place.

Peter Bell: Ha!

Tim Marsh: We've got fluids carrying a lot of metal, but it's too cool. We're out on the edges. We need to be somewhere else.

Peter Bell: Right – the silver and lead-zinc are typically seen on the edges of these systems. I don't know typology of porphyries, but I wonder if there are ever cases where you see rich mineralization in the distal zones but weak mineralization in the core of the system?

Tim Marsh: I would say it does happen, but any particular case where it does happen may offer more of an exploration opportunity. If base metals were so prolific, then maybe the high-temperature part of the system just hasn't been found yet. However, there are probably variations where the core is not as rich as the outer fringes. I think we are ensured against that sort of possibility at Kabba because we can walk around on the deeper part of the system and see that it's got the things that well-mineralized copper shells ought to have. For example, the laser ablation work done on the fluids in the footwall showed that they have the same chemistry as other very productive porphyries around the world.

Peter Bell: And how about the depths of these core samples? At 1,200-1,300 meters, you are getting down to the depths where you stopped drilling this hole. So you were seeing stuff like this and you still considered this to be not what you were looking for?

Tim Marsh: That's right. I'm looking for a very different style of mineralization.

Peter Bell: Wow. That's good to hear.

Tim Marsh: To me, they were outstanding geochemical anomalies and nothing more than that.

Peter Bell: That's a long hole to get a geochemical anomaly, Tim!

Tim Marsh: It sure is.

Peter Bell: And based on what you are seeing in the stuff in the footwall, do you have a sense for where the juiciest parts of the system would be when projected upwards?

Tim Marsh: Yes, I do. The area around the old Standard Minerals Mine or Telluride Chief Mine is what I consider to be the geometric or geothermal center of the footwall. And I've got a magic place picked out there in the gravel where that spot should be. It's undrilled to date and we need to get out there to drill a hole in it.

Peter Bell: Godspeed, Tim! I hear mention of Telluride, so I'll just ask briefly if that element is seen around this area and the geological significance of that?

Tim Marsh: Yes, we see tellurium. It's part of the mineralization suite that we see in the system. The old timers encountered it a bit in the Telluride Chief and we see it out in the hangingwall.

Peter Bell: And it indicates that these fluids are coming from great depth – directly from the mantle rather than splitting off from some other magmatic system.

Tim Marsh: Yes, that's right. The word tellurium actually refers to depth. There are other good examples where porphyry systems are related to tellurium mineralization in Arizona.

Disclaimers

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The technical content of this release has been reviewed and approved by Timothy Marsh, PhD, PEng., the Company's CEO, President, and Qualified Person. No mineral resource has yet been identified on the Kabba Project. There is no certainty that the present exploration effort will result in the identification of a mineral resource or that any mineral resource that might be discovered will prove to be economically recoverable.

Peter Bell has been compensated to prepare and distribute this promotional material.