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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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Patient Speculator

Deep Dives with the Most Interesting Executives

Hydrogeochemistry for Dave Lowell & Tim Marsh $BCU

In this short interview, I ask Dr. Tim Marsh, President and CEO Bell Copper (TSXV:BCU), if there are any close comparables for what he is seeking to do at the Kabba project in Arizona. There's only one that is close for him and it's a good one. See more on the legendary Dave Lowell in this 2013 article by Tommy Humphreys here.

6.4 Bell Copper Involvement

Dr. Timothy Marsh, Bell Copper Corporation's CEO, became interested in the area on December 30, 2000, during a field inspection of the Kabba Mine.

His interest in the mine stemmed from the fact that it carried molybdenum, vanadium, and gold at a location that was six kilometers from the nearest mapped bedrock exposures in the Hualapai Mountains.

Dr. Marsh recognized that features common to porphyry copper deposits were present in the 100-hectare bedrock window into the valley-filling gravels.

Though the mine is not part of the Kabba Property, it is regarded as distal, fringing mineralization to a porphyry system centered four kilometers to the North.

Bell's initial work on the Property focussed on the Kabba Mine window and a large group of several hundred unpatented mining claims were staked in and around the window extending westward to the faulted base of the porphyry system in the Maynard Mining District.

Drilling efforts based on the concept of due-eastward slip of the hanging wall fault block demonstrated that concept to be erroneous (K-1, K-2, K-3, K-4, K-5, K-6).

New surface geological work combined with the discovery of public aeromagnetic data covering the Kabba Property led to a revised model of faulting.

That revised model involved 7 kilometers of east-north-eastward offset of the hanging wall fault block.

Drill testing of this revised model (K-8, K-9, K-10) has returned the favourable results indicated later in this report.

Peter Bell: The mining history in Arizona is just stunning. The old-timers looked all over these mountains – scratching all around.

Tim Marsh: By finding this, we've produced an entire new porphyry district in Arizona under 200-400 meters of gravel.

Peter Bell: Is there a precedent for any kind of discovery quite like that?

Tim Marsh: There's not much, Peter. The closest is some of the work that Dave Lowell did in the early 1970s out around Casa Grande. He was actually led out there by finding pieces of copper oxide ore in water-well cuttings in the middle of a valley. There was a farmer out there who said, "I've got some green rocks in my water-well cuttings, can you please go take a look?" Turns out it was a piece of a porphyry copper deposit.

Peter Bell: What's it doing out here?

Tim Marsh: Which way did it come from? His problem as a geologist was to figure out where the old stream was flowing that deposited that pebble with the copper in it and he eventually figured it out. He looked at some other water wells, deduced which way the ground used to tilt, and went to that spot. I think it took him six or seven holes before he found the deposit that ended up being half a billion tonnes of 1% copper, which was a tremendous discovery.

Peter Bell: That's something like 11 billion pounds of copper. What a surprise.

Tim Marsh: They found it out there with nothing to look at but the gravel. It's an interesting comparison as there are quite a few water wells in our area and they are useful for telling us how thick the gravel is at various points.

Peter Bell: And maybe for some hydrogeochemistry, too?

Tim Marsh: Absolutely. I sample any place I can where there's water. The state of Arizona has done some well sampling just for their own purposes and this area up here is fundamentally toxic. It is loaded with arsenic, antimony, molybdenum, manganese, iron, sulphate content, fluorine, and uranium daughter products, which are good pathfinders. The Arizona Department of Environmental Quality flagged one well right in this copper shell as "Do not drink" because it exceeds safe levels for so many elements.

Peter Bell: Wow. I bet that was a surprise. I suspect that most wells in the foothills don't have that problem, which is just another indication that something interesting is going on in this area. Well, there's been a lot to digest. Thanks for introducing me to the story, Tim. I look forward to taking another run at it all with you.

Tim Marsh: You're welcome, Peter. It's been a treat to talk with you. Until next time.

8 Kilometers of Displacement for Bell Copper $BCU at Kabba, AZ

I am new to the exploration story unfolding at Kabba in Arizona, but I am very excited by the depth of it. There is lots to understand and Dr. Tim Marsh, President and CEO Bell Copper (TSXV:BCU) is an experienced geologist and engineer who is capable of helping communicate this story in rich technical detail.

Peter Bell: The mining history in Arizona is just stunning. The old-timers looked all over these mountains – scratching all around.

Tim Marsh: A lot of the majors have been to Kabba. At different times in the past four years or so, we've been very close to agreements with Anglo American, BHP, and Groupo Mexico before we finally closed a deal with Rio Tinto in 2016. Groupo Mexico said it was too far from their smelter. Anglo American said they were going to focus on Peru, instead.

Peter Bell: Well, the last four years have been a tough period to be approaching majors for projects.

Tim Marsh: It sure was. BHP probably came out to Kabba three different times. The last time they visited, they were ready to sign and the person who was working on it thought it was a sure thing, but he had a pink slip on his desk when he got back from the last site visit!

Peter Bell: Sounds like this project might be better known amongst the majors than retail.

Tim Marsh: Yes, I think that's fair. Those are the people I know. I can call up influential people at those companies and they know who I am since we've talked before.

Peter Bell: Have you done scientific presentations on this or is it really just the business development community that knows you?

Tim Marsh: I've done a number of scientific presentations at places like the Arizona Geological Society and Society of Mining Engineers -- presentations to technical audiences.

Peter Bell: Okay, great. Please can you walk me through some of the materials on Kabba?

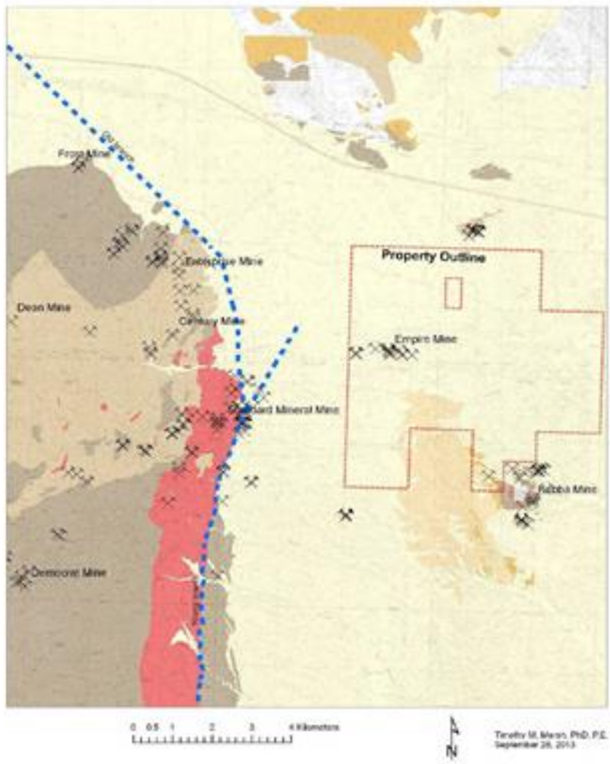


Figure 3 Map showing district mines and prospects. The Maynard Mining District includes the mines and prospects located West of the Kabba Property outline, while the Kabba mining district includes the mines located in the southeast corner of the Kabba Property outline.

Tim Marsh: Sure. Let's start with a plan view, geologic map of the area around the project.

Peter Bell: The version of the map I have here is from the 2013 technical report.

Tim Marsh: We have expanded the land package prior with Rio Tinto in 2017. There's still a bit of prospective ground out there that is owned by Newmont, but we have not pursued it as there are two different four-lane highways that come together out there.

In this map, you see a couple types of brown rock on the western side and those are Precambrian age rocks, which are very old rocks capped by some very young volcanic rocks like icing on a cake. The older rocks are a billion years old and the younger ones are about 20 million years old.

The rocks marked in red in the middle of the geologic map are the Laramide age rocks, which are 65 to 70 million year old igneous rock. They are a porphyry that intrudes into the Precambrian rocks. At some point in time, the volcano that probably existed on the surface above that Laramide porphyry intrusion was beveled down by erosion to a flat plain. Then, a lot of rain fell on that flat plain and leached copper down out of the porphyry into the underlying rocks over approximately 40 million years. Finally, the area was paved over with a basalt flow.

The basalt flow is found throughout the Kingman area and quite far east of us. Since it is a nice laterally extensive flow, it is distinctive and fairly easy to recognize. It forms an excellent strain gauge for assessing how much slip has happened on the fault, which provides a way to determine the vertical component of the slip on the fault. We can also estimate the horizontal slip in the fault from an aero-magnetics survey that shows two rocks at surface that were separated by the slippage. When you undo the slip, the target area we've identified for the copper shell slides up over the top of the exposed root zone.

When cross-sectioned, the cupola or upper tip of the porphyry system has been decapitated and shifted laterally, more than vertically, to the east-northeast. As it slipped and slid down, the intervening trench was filled up with the gravel derived from the Hualapai Mountains. The gravel shows evidence of stratigraphic inversion, with the young basalt at the bottom of the gravel and deeper components at more shallow levels of the trench. Finally, the very youngest gravel that we see in this sequence of gravels is gravel that was derived from the root zone. We actually see quartz veins and coarse Muscovite alteration as a thin gravel capping out across that entire fan.

When geologists from a lot of the majors come in and study this, they have pre-conceived notions and try very hard to avoid making mistakes. They rightfully try to poke as many holes into the ideas as they can.

One common response is "How do you know it just wasn't eroded?" Everybody can see the root zone and there is generally agreement about what was above it, but I couldn't answer that question early on. Now I can answer it very well because I've drilled this pile of gravel off to the east, which was deposited as this mountain range to the west eroded. If you project the fault up into the air, then you can determine where the rocks that would have formed that very crest of the range as this fault started moving 20 million years ago or so and those rocks were well outside of the footprint of the root zone. They were back in fresh Precambrian rocks, which is what we see along with the basalt or the icing on the cake that was the first to erode and deposit into this basin.

We see basalt clasts and fresh Precambrian clasts, but no evidence of an eroded porphyry copper system. It is not until we get to the very top of that pile, literally, the top 10 meters of gravel in that pile that we begin to see pieces of a porphyry copper deposit and even those pieces are from the root zone! They look very much like what sticks out in the hill, which was subject to much drilling in the past.

I encounter that comment again and again with the majors. How do you know it didn't erode and was destroyed? I know that because I've now drilled in several places. The leftovers of that erosion aren't there in the gravel pile, which means that everything laid above the plain of that fault is intact and is captured in the hangingwall block of the fault. Based on the slippage of the fault, that hangingwall block is now 8-10 kilometers east of the range front. That's where we have drilled and where we are finding it. We're finding porphyry dykes of all varieties with intense alteration, quartz veins, and copper mineralization.

If you project the fault up into the air, then it would have eroded basalt from this capping early on. Those basalt fragments are now down in the trough sitting on basalt, but they were derived from the hillside. It is only when you get to the top of the pile that you get this stippled alteration zone as fragments in the gravels. However, they are very distinctive fragments coating the top of this big alluvial fan. Those fragments extend 15 kilometers out from the range front. If you get out there picking up rocks, then you can find some neat stuff way out there. If you understand the fault story, it leads you right back out to the area we're drilling now.

The seismic reflection really confirms the kind of slightly back-tilted half graben orientation and very flat dip of the slip fault. The fault is plainly visible in the seismic reflection based on whatever impedance contrast there is between the gravels on top and the Precambrian rocks under the bottom. That fault is a very nice reflector and what it suggested was confirmed in our drill holes. The fault is flat. The lateral component of slip on the fault was very great relative to the vertical. We need to move east significantly rather than just drill deeper.

As we moved out to the equivalent position in the hangingwall, we begin to find the noteworthy minerals in our drill holes. If you just started randomly drilling holes in gravel in Arizona, then you would never find molybdenite or chalcopyrite or sphalerite galena. The reason we're having success finding these minerals is because we understand what nature did here. There is nothing we can do from surface to say, " drill here" or "drill there", but the geometry of undoing this fault pattern demands that it's out there.

Peter Bell: Wow. Thanks, Tim. You covered a lot of ground there, let's try and unpack some of the stuff you just said. The most important part to me sounds like the horizontal slippage caused by the fault. Let's go through that again.

Tim Marsh: The aero-magnetic data from the US Geological Survey is pretty helpful for that, Peter. It is publicly available, and it got a couple of the majors really excited. My target is non-magnetic, but this aero-mag survey shows how this piece translated in the same vector as the magnetic. It basically provides a good strain gauge.

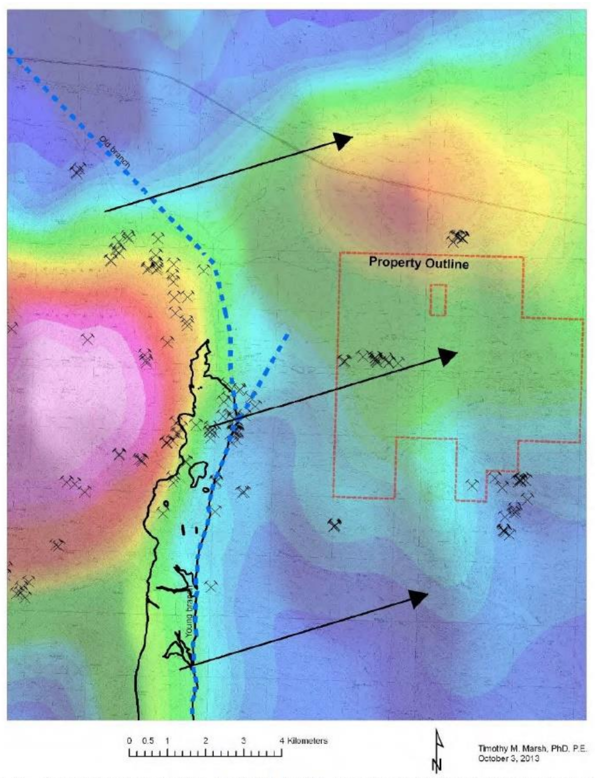


Figure 12. Aeromagnetic map of the Maynard District, showing the 7000 meter displacement of anomalies across the Hualapai Fault. Wheeler Wash quartz monzonite stock is outlined in black. USGS aeromagnetic data from Sweeney and Hill (2001).

Peter Bell: I don't quite know what that means but it helps that we're still looking at the same map as before. The scope and scale of this map is the same, but this one is showing some geophysics rather than geological units. I'm with you. I see the arrows and the two highs, I'm guessing they are related.

Tim Marsh: Yes they are, Peter. Neither of the highs are my targets, but they show a common rock unit that was separated by this slip fault. Both these rocks are magnetic and that makes them trackable along an east-west gradient. This is an uneconomic rock, just some old granite that is magnetic. It's a good tracer, but it is not my target. My target is non-magnetic and it's a bit to the south.

Peter Bell: Right, you're looking at the Laramide porphyry. That should be conductive, if you can get an electrical current deep enough to reach the mineralized body, but not magnetic.

Tim Marsh: Right. But this magnetic survey was still very useful to us because the geophysics suggests that the one magnetic high to the east actually used to sit right on top of the other one. The type of fault required to make this pattern is the same as what we saw with our seismic reflection. If you slice this magnetic unit it with that kind of fault, then you can take the top piece and slide it right over to the east.

Peter Bell: Cool. I'm a big fan of the seismic reflection work you did and can't wait to talk about that. For now, is there anything else you'd like to say about the magnetics?

Tim Marsh: Yes, there are a few things more to add. For one, you can actually see evidence of this at surface on the property where the rocks are beat up rock and gouged by eastward movement of the rocks above. There are scratch marks that point to the east.

Peter Bell: That's not glaciation.

Tim Marsh: Certainly not. The rocks in the east are generally buried by gravels, but we do get a little window where the magnetic rocks are showing at surface. We have done geochemical fingerprinting there and found that the rocks to the east and west are the same, which shows how the thing fell apart. It gives me a slip vector. It wasn't quite due east-west, but it went more in an east-northeasterly direction.

Peter Bell: As is indicated by the arrows. Now, I've got to ask about these field pictures with the handgun Tim.

Figure 11. Correlation of a porphyritic phase of the Peacock Mountain granite across 7700 meters between footwall outcrops (left) and hangingwall outcrops (right).

Tim Marsh: Once I began to get my head around that USGS aero-mag data, I took a hike with this sort of north-eastern orientation. Previously, my traverses had been east-west but when I started walking more east-northeasterly I began to find patches in the hangingwall that matched rock types in the footwall. These photos were taken the first day when I made a strong correlation like that and the gun is simply what I had for scale that day when I took the hike.

Peter Bell: These photos were taken the first day you went all the way out there to this magnetic anomaly and started to piece together the horizontal displacement of the whole thing?

Tim Marsh: Yes, that's right. These photos were taken eight kilometers apart. It's the same rock and you can see these distinctive potassium feldspar phenocrysts. They weather to a chalky white on the outer surface and are more of a gray on fresher surfaces. It's the same rock, and they're eight kilometers apart at a heading of 69-degrees north east. That vector was critical for me. I thought that if I start at the best-looking spot in the footwall and apply that vector, then I should drill at that patch of gravel. The IP didn't tell me where to drill, it was this vector that told me where to drill. I drilled K-9 based on that vector and we got a pretty darn good hole.

Peter Bell: Interesting to hear you say that because you actually had to abandon that hole, Tim! Back on November 30, 2011 the company announced that hole K-9 had been terminated at 910 meters because it encountered very weak rock, which is actually a good thing because it's indicative of "intense hydrothermal alteration typical of the upper parts of porphyry copper systems" as in your technical report. Then, you drilled hole K-10 in the same location using "large diameter mud rotary equipment to advance past the altered ground into the most prospective part of the target" and the assays from that hole were pretty good.

Tim Marsh: Yes, that's right.

Peter Bell: Then you drilled hole 11 right between K-8 and K-10. I'd love to discuss that one and all the others with you in detail sometime, but let me go back to those rocks from the footwall and hangingwall. What brought these rocks to surface eight kilometers apart?

Tim Marsh: Terrible days on planet earth, Peter. There were probably hurricanes drifting out of the Sea of Cortez across Arizona and terrible rainstorms that absolutely unloaded on the Hualapai Mountains causing mud flows that washed the boulders out. The biggest boulders are found out in this area about six meters across.

Peter Bell: Wow. Those are big.

Figure 8 Giant boulder of Hualapai Granite having a maximum width of approximately 5 meters. Similar giant boulders of Hualapai Granite and Boriana Granodiorite form a 500-meter-thick, west-dipping alluvial fan deposit located 7000 meters east of the nearest source for such clasts in the Haulapai Mountains. Normal slip along the Hualapai Fault is believed to have transported the giant boulder stratum within the hangingwall block of the fault. Man is about 1.8 meters tall.

Tim Marsh: They're 50-tonne boulders. Or more! They're giant boulders that were transported by mud, not by water. They were actually floating in a slurry of mud when they were transported that far.

Peter Bell: Right. In the desert like this, big rains can cause a lot of erosion and mudslides. These rocks weren't coming up through the gravel at the porphyry target?

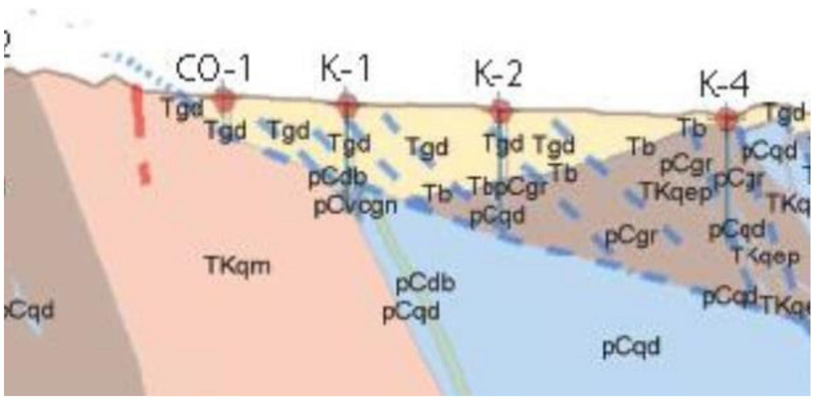
Tim Marsh: No. These are an old, pre-Cambrian porphyry. Just like the magnetic anomaly, these aren't the things I'm looking for, but they're an excellent strain gauge that allows me to relate the hangingwall back to the footwall. It gave evidence to suggest the same arrow as on the magnetic map.

Peter Bell: Okay. Thank you for introducing me to things here. That's a good start. Let's pause and come back for more in a bit.

Tim Marsh, Bell Copper $BCU and the Hualapai Slip Fault

Read on as Dr. Tim Marsh, President and CEO Bell Copper (TSXV:BCU), and I continue to unpack this unique exploration story where a copper porphyry in Arizona appears to have been cut in the middle and slid 8 kilometers to the east. The roots of the system are exposed at surface and show a pyrite shell measuring 3 kilometers by 5 kilometers, which is very encouraging for the size of the prize.

Peter Bell: One of the things you said the first time we talked, Tim, that really struck me was that the relief underneath the valleys can be similar to what's seen in the mountains above. It occurs to me that a good example of that relief is the trough that formed as the upper part of the system slid eastwards.



Tim Marsh: That's right, Peter. There are many square miles of nothing but gravel, but if you could peel that gravel away and see the relief down in this basin then you would see that it is just as rugged as what you see sticking up by the mountains. There are a couple thousand feet of relief down there.

Peter Bell: I had thought that your comment was focused on the flat parts of the valleys further away from the mountains, but you are talking about what is more like the foothills here. Thanks for clarifying that for me. I am surprised to hear that there is that much gravel below these foothills with the washes, I would have thought the bedrock would be closer to surface there.

Tim Marsh: There is a bedrock horst that comes to surface in a little patch out to the north of us, but it is a tiny patch of about 300 acres. Still, it's quite important for supporting the slip vector I described to you before.

As you said at the start, Peter, the gravels are filling in a very deep trough between our Kabba property and the mountain. There are multiple bedrock ridges underneath all that gravel, which is associated with the stretching of the western part of North America.

Peter Bell: Are we talking a couple hundred meters of gravel in this trough?

Tim Marsh: The trough has more than 700 meters of gravel there.

Peter Bell: Really?

Tim Marsh: Yes, indeed Peter. That's where I first thought the target was located. I thought the slip on the fault was at a steep angle, so I started looking about a mile off of the range front after seeing the footwall exposure of a giant porphyry copper system.

The older timers in the 1950's, 60's, 70's and 80's saw that footwall, so they drilled down into the bedrock at the root of the porphyry system where you have a lot of quartz veins with spectacular alteration. There is a lot of molybdenite and a little bit of copper, but the copper shell was located above that when the system formed. Porphyries are generally shaped like a carrot and they were drilling into the bottom parts of the carrot. The bigger part of the carrot with better mineralization would have been above them, but it has been chopped off and slid out into the valley. Now, it's hidden under this gravel.

Early on, we wanted to test the idea and find out what's underneath all this gravel so we ran some seismic reflection. Hard rock geologists rarely do seismic reflection, but oil geologists do it all the time.

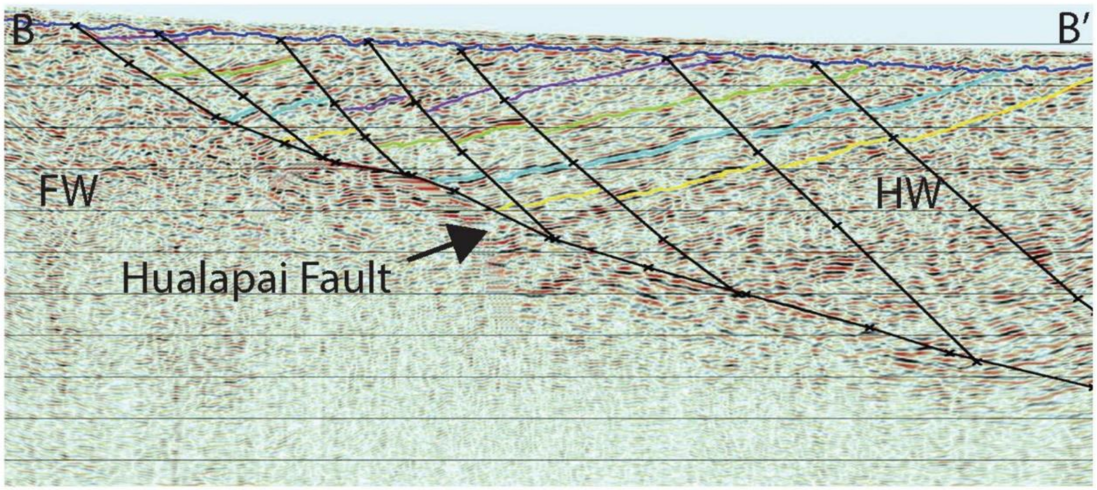


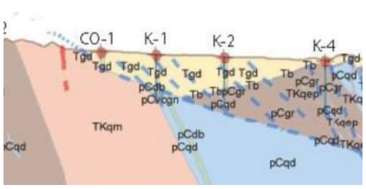
Figure 11. A) Seismic reflection data from the Kabba prospect. The survey line used to gather this seismic data is roughly parallel to the B-B' cross-section line shown in Figure 7 and this is denoted by the B and B' lettering on the top left and right-hand corners of this image. B) The same seismic reflection data shown in A, but with the Hualapai normal fault, as well as other smaller unnamed faults, traced in black. The purple, green, and yellow lines trace the contacts between layers of Quaternary sediments.

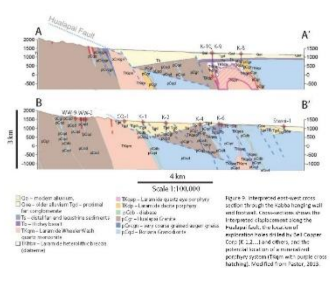
Tim Marsh: Around the same time we got this seismic reflection data, we drilled some holes that really confirmed that the upper part of the porphyry really came down quite a bit as this thing stretched apart. That movement created a big trough that was subsequently filled with erosion from the mountains. When we drilled the gravels in that trough, we see what is called stratigraphic inversion. Whatever the layering was going up the side of the hill, you see the opposite in the gravels. The pieces on the top of the mountain are on the bottom of the trough. The whole sequence was inverted as it filled that basin.

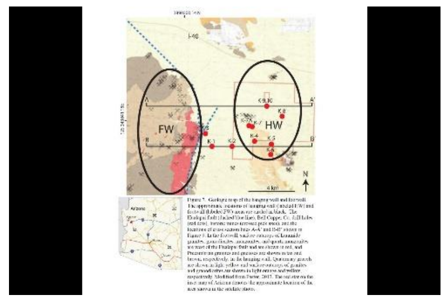
Peter Bell: Right, you mentioned this before. You could literally see that in your holes?

Tim Marsh: Peter, we saw it in our first hole. K1 was drilled into this trough because I thought the upper part of the porphyry went down very steeply. We drilled the fault going through here in that K1 hole and it was dipping at a much shallower angle than we thought.

Once we got underneath the fault, the rock was too fresh and it was clear that the top of the carrot had moved a lot further at a much flatter angle than I ever would have guessed. My next hole was one mile step out from the first. And then we started seeing porphyry dykes – Laramide porphyry dykes that were 70 million years old with a little molybdenite and a little pyrite.







Peter Bell: And since then you've kept moving eastwards and northwards.

Tim Marsh: Generally, yes. The thing I didn't appreciate early on was the lateral slip. However, I know the system hasn't slid too far east because I can walk around and see some bedrock far off to the east that has a bit of alteration but not much.

Peter Bell: And you mentioned the stretching of the western part of North America -- that must have been a large-scale geological phenomenon. Was the slip fault that moved this porphyry related to the extension?

Tim Marsh: Yes, I believe so.

Peter Bell: Any sense of the sequencing for that mineralizing event versus the continental extension and the creation of that trough with the gravels?

Tim Marsh: The extension came around 40 million years after the mineralizing event.

There was a chain of volcanoes running from parts of Mexico up into Nevada with major stratovolcanoes every 40-50 miles. Like the whole chain of Mt. Baker, Mt. St. Helen's, Mt. Rainier, Mt. Hood up in the Pacific Northwest now, there was a similar chain located down in Arizona 70 million years ago. Underneath each one of these you have multiple pulses of magma. Some of them came up with a lot of juice but didn't make it to the surface. These ones that didn't erupt as volcanoes just stalled out and the juice was trapped in a small volume of rock. That's where you end up with porphyry deposits. One day, people will drill Mt. Rainier and Mt. St. Helen's to look for yet another generation of porphyries.

Peter Bell: I can just imagine that a hundred years from now. People often say Arizona is all broken up and it sounds like the continental extension could be a reason for that. How about the upper part of the porphyry you're looking for, is there reason to believe it's still intact?

Tim Marsh: What we see, so far, is that things are intact on a gross scale. We've got a hangingwall block and a footwall block. The hangingwall block, even in the places where it's extraordinary stretched, is internally coherent. We are not seeing little bits of a porphyry copper deposits appearing in several places. What we've defined as a good target for the copper shell is a big blob.

Peter Bell: And what's the basis for that copper shell?

Tim Marsh: Good question, Peter. The basis for it is a zone in the footwall where quartz magnetite veins are abundant. Quartz magnetite veins are, in my mind, the deep equivalent of what would be chalcopyrite veins at shallower depths. The difference has to do with temperatures, mainly. Lower temperatures at shallower depths. There were a lot of magmatic hydrothermal fluids streaming up through the rock in this area that left behind quartz magnetite veins. This blob out here translates to roughly where that copper shell ought to be. That puts us in the ballpark, but you still have to do more to figure out where the copper shell is located.

It's really quite important that I know where it isn't at a few points! If you get just outside of the copper shell in a few holes, then we see lead and zinc. Lots of galena, too.

Peter Bell: That's the typical zonation of a porphyry, right?

Tim Marsh: That's right.

Peter Bell: Okay. It's one thing to refer to the zonation of a porphyry at a one level of the system horizontally, where you get the typical zonation from copper to gold and then lead-zinc, but this point you just made about the quartz magnetite veins being the deeper equivalent of the chalcopyrite veins is not something I've heard before. You're talking about zonation horizontally and vertically, Tim. That's new to me, thank you very much.

A Shallow-Dipping Slip Fault for Tim Marsh, Bell Copper $BCU

A shallow-dipping slip fault may not sound like much, but that angle really matters if you're talking about 8 kilometers of horizontal movement. A shallower dipping fault means less overburden for your target, which is precisely what Dr. Tim Marsh, President and CEO of Bell Copper (TSXV:BCU), is looking for at the Kabba project. It may not be the standard theory in the textbooks today, but it may become a new chapter in the future!

Peter Bell: Okay, so you believe that the upper part of this porphyry system was preserved as it shifted to the east?

Tim Marsh: Yes, these units have been transported coherently out into their position now as a relatively intact block. I say relatively because it falls apart when you drill it. You can see the igneous contacts within the core and that sort of thing.

Peter Bell: Is it just the oxidized zone that falls apart?

Tim Marsh: No, it's everything.

Peter Bell: Really?

Tim Marsh: When you get down underneath the oxidation, the rock is still very strongly broken and that is not typical for a porphyry. It probably reflects the fact that the block slid for eight kilometers!

After a very small amount of slip on a fault, you generate gouge and clay-sized particles. As water gets into them, it just becomes more and more slippery. I think a lot of geologists don't appreciate just how slippery these faults can be. There's an important group of geologists who say that faults slip at 60 degrees and then flatten out to 30 degrees as you stretch them. Once they hit 30 degrees, the coefficient of friction on the fault is such that rather than continuing to slip, you form a new set at 60 degrees and start the process all over again.

Peter Bell: Sounds reasonable.

Tim Marsh: What I think these geologists don't deal with adequately is the extreme lowering of coefficient of friction on that fault as you move and drag rock across it. You comminute the rock, water gets in there and alters the ground-up rock into clay causing it to get more slippery. Brian Wernecke, a professor at Caltech, has found similar faults in southern Nevada where features have been transported during basin and range extension 12 kilometers between the hangingwall and the footwall.

Peter Bell: Wow. That range extension is the same event we're talking about here. What kind of an angle does he believe that 12 kilometers of slip happened at?

Tim Marsh: I'm not sure off the top of my head, Peter, but it has to be pretty flat for both pieces to still be at the surface of the earth. It's a very shallow scoop.

This idea of actively sliding flat faults is one that's been kind of shunned by geologists for a long time, but I can't escape it because I've drilled it. I've put the pieces back together.

The slip fault at Kabba is 30 degrees. It's not 50, it's not 60. And everything isn't rotated over on its side, which is typically what happens when you repeat this process with steeper faults. In that model, you can have rocks laying on their sides or even inverted if you do repeat it a few times. That's certainly not what we see here. The hangingwall has stayed relatively flat as it has extended.

Peter Bell: You don't expect any major changes in orientation then? I would have thought that the slipping might have led it to fall over a bit.

Tim Marsh: As far as I know, nothing has rotated it strongly as it pulled apart. I've got some pretty good controls out here in this valley to back that up. Other geologists believe there is a lot of rotation associated with the stretching, but we have got drill holes that show this block in here in the valley has not rotated strongly while that stretching happened. Things are pretty much straight up and down here. There might be 20 degrees of rotation, but I don't consider that a lot.

Peter Bell: Okay, that's pretty minimal. I wonder if that might even improve things a little bit when it comes to mining methods down the line.

Tim Marsh: We will see. For now, the best way to drill it is with vertical holes. If it were laid over strongly, then you would want to be drilling angle holes into it. The flow orientation of the porphyry as it was squirting out of the ground is nearly right down the core fractures. When we drill down into the 65-70 million-year-old rock, we see that the fabric isn't strongly tilted. We're drilling down the throat of a Laramide volcano.

Peter Bell: How does that affect your sense for true widths?

Tim Marsh: Well, it takes a lot of drilling to understand the scale of these giant porphyries. However, we do already have a sense for the true thicknesses of the supergene cap where the rainwater leached the copper.

We're seeing dramatic leaching over nearly five hundred feet. The leaching is caused by pyrite in the rock. As the pyrite oxidized, it made sulfuric acid and leached down to the water table. We're seeing spotty concentrations of copper in several holes where there's chalcocite enrichment at the oxidation boundary, then we get into the primary sulfides underneath that.

Peter Bell: I recently learned that the water table is generally the oxidation boundary.

Tim Marsh: In this case, the relevant water table is the Paleo water table. All that leaching happened before the western part of North America was stretched and the upper part of this porphyry system slid downwards to the east and was buried by gravel.

Peter Bell: That sequence is very interesting in terms of the implications for where you see oxidation. You said 500 feet of oxidation, but that is from the start of the porphyry. There is also some gravel above that is not oxidized in the same way. Is the porphyry outcropping at surface, or are you seeing 500 feet of oxidation after getting through 100 feet of gravel, say?

Tim Marsh: The amount of gravel varies, but we have drilled through 800 feet or 240 meters of gravel before getting into rock that is brilliantly red from oxidation.

Peter Bell: And that's probably the hematite. It's interesting how the typical oxidation boundary in this area today is probably around 200 meters, but you actually start seeing oxidized material below that depth. It really tells you that this stuff was once much closer to surface.

Tim Marsh: That's right, Peter. It gives us confidence that the gravel came in over the top of the porphyry after it was all leached.

In microscopic photos of the core you can see that it is all chewed up, too. There are classic D-veins in some parts, which were originally described in classic paper on vein types for porphyry copper deposits by Gustafson and Hunt in 1975 on the El Salvador mine in Chile. These vein types are classic indicators of porphyry copper style alternation and we see them in this core. You can also see that the rock is brecciated, with rotated chunks of rock that happened while this porphyry was forming.

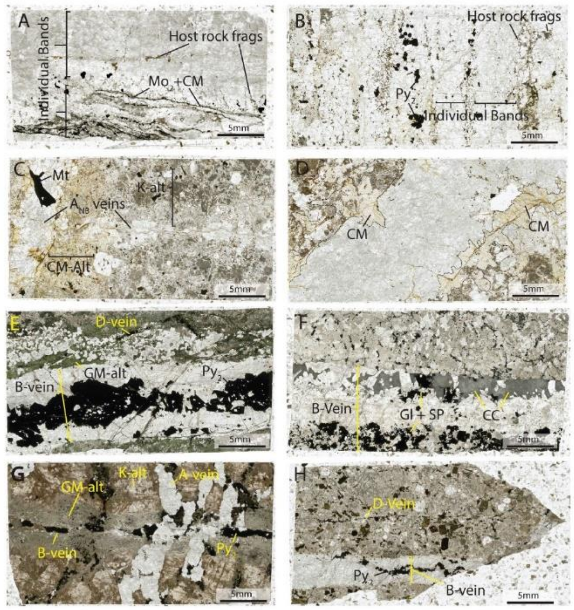


Figure 16. Scanned images of selected thick sections showing vein types from the footwall and hanging wall. A) A_B vein from footwall sample KF5E-2 showing host rock fragments and "wispy" bands of coarse mica (CM) + Molybdenite 2 (MO2). B) A_B vein from footwall sample KF3D-19 showing individual quartz bands separated by aligned host rock fragments. C) Two cross-cutting A_{NB} veins from footwall sample KF4B-5A showing potassic (K-alt) and coarse mica (CM) alteration selvedges and a mass of magnetite (Mt) crystals. D) A_{NB} veins from footwall sample KF1-13 showing well developed CM alteration selvedge along its outer margin (outlined with black dotted line). E) B and D veins from hanging wall sample 1343.9. The B vein in has a well-developed sulfide centerline and is rimed by a green mica (GM-alt) selvedge. F) Moderately sinuous B vein from sample 1279.9 showing calcite (CC) intergrown with CL-bright quartz along its margins. G) Hanging wall sample 1078.78 showing an A vein with potassic alteration selvedge being cross-cut by a B vein with a green mica alteration selvedge. H) B and D veins from sample 1201.1. A_{NB}=A "non-banded," A_B= A "banded."

Tim Marsh: This oxidation boundary is quite important. If there was copper present in the system, then this process will have concentrated it down at the boundary and we would see extraordinary grades.

Peter Bell: Good luck getting into that copper shell! What about the gold in the system? If there was gold, would it have been scavenged in this leaching process and moved down to that boundary as well?

Tim Marsh: In general, gold stays where it is. It's recalcitrant in that sense. Copper, on the other hand, is highly mobile and moves down with the leaching process. When the solution runs out of oxygen at the oxidation boundary, the pyrite in the rock consumes that oxygen and that's where the copper pops back up.

Peter Bell: Sounds like classical differences in chemical reactivities for Cu and Au. Have you hit that boundary?

Tim Marsh: Yes, many times.

Peter Bell: Have you gone through it?

Tim Marsh: Yes. We've gone through it many times.

Peter Bell: And you're getting fresh sulphides below it?

Tim Marsh: Yes. I can show you some pictures of some of those sulphides from the Master's thesis that was done on this.

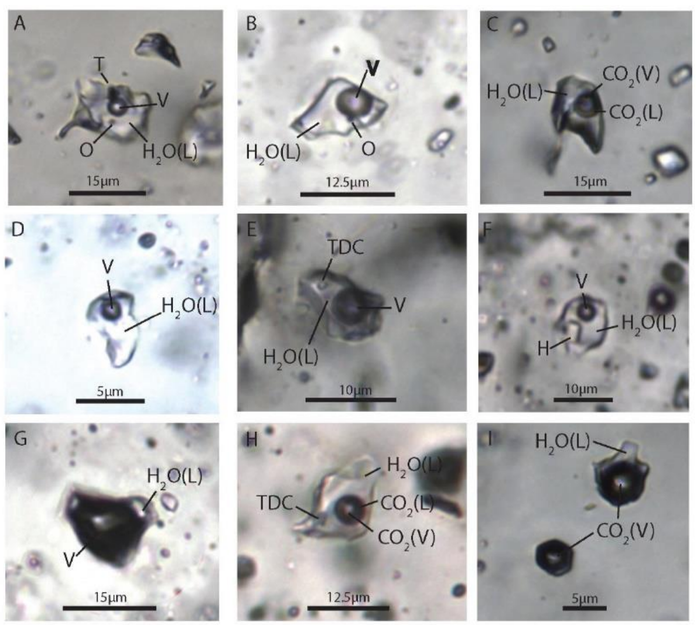


Figure 18. Photomicrographs of individual fluid inclusions from the nine inclusion groups found in the Kabba hanging wall and footwall. Abbreviations on micrograph labels are as follows: V=vapor, L=liquid, TDC=translucent daughter crystal, H=halite, T=triangular opaque crystal, and O=oval opaque crystal. Variation in the brightness and color between photomicrographs are due to the depth of the imaged inclusions from the surface of the thick sections that host them, and the level of magnification needed to resolve clear images. A) B15D inclusion in CL-bright quartz. B) B30 inclusion in CL-bright quartz. C) B15C inclusion in CL-dark quartz. D) B15 inclusion in CL-bright quartz. E) B30D inclusion in CL-bright quartz. F) B30H inclusion in CL-bright quartz. G) B75 inclusion in CL-bright quartz. H) B20C inclusion in CL-dark quartz. I) B75C inclusion in CL-dark quartz.

Peter Bell: I love this Master's thesis. Such a smart thing for you guys to do. This is an example of microscopic image of the sulfide?

Tim Marsh: Yes. We're down underneath where any chalcocite blanket would form and we see bornite 65% by weight with copper-rimming chalcopyrite at 33%.

Peter Bell: Any native copper at this point?

Tim Marsh: We've seen small amounts of native copper up in those red rocks that are oxidized.

Peter Bell: And within this sulphide zone, could there be problems with this being refractory ore?

Tim Marsh: A good rule of thumb is that if your minerals are highly recoverable if the grains are 75-100 microns or larger. That's pretty much always the case in a porphyry as these are easily recoverable by conventional milling and flotation.

Peter Bell: And these look to be around 0.3 millimeters from the diagram, which are a couple hundred microns.

Tim Marsh: Yes, this stuff should be easily recoverable.

Peter Bell: And this copper mineral – is it chalcopyrite?

Tim Marsh: This gold-looking stuff is chalcopyrite, which is a sulphide mineral, $CuFeS_2$. It's surrounded by a more copper-rich copper sulphide mineral called bornite. The fact that this thing started out at 33% copper mineral and was then enriched by a high-temperature process to produce a mineral with higher copper-concentrations is encouraging because there may well be a zone where bornite is the more abundant mineral. I expect that to be the case. When you mill that bornite-rich zone, you produce a concentrate that's 50-60% copper. When you send that to the smelter, you can ship half as many truckloads to produce the same amount of copper. The economics can really improve with higher grades.

Peter Bell: Is it typical to see bornite like that?

Tim Marsh: In some porphyries, yes. Resolution was a very bornite-rich system and that's one of the reasons that it's mineable. This hypogene upgrading from chalcopyrite to bornite can be something to watch for.

Peter Bell: Does that have to do with the oxidation?

Tim Marsh: No, it's associated with a later stage of period when the high-temperature mineralizing fluids came through the system. Long before the oxidation was happening.

Peter Bell: More like different stages of the same mineralizing event rather than different events?

Tim Marsh: I would say it is more like an evolution of the same event.

Peter Bell: And was this mineralizing event going on for 30-million years?

Tim Marsh: No, it was tens of thousands of years. Even though these fluids are at magmatic temperatures of 900-1,000 degrees centigrade when they're put in place, they cool relatively quickly. There are thermal models for how long it takes something that's three-by-five kilometers to cool off and it's not a million years, it's more like 50,000 years. Geologically, it's nearly instantaneous.

Peter Bell: And was the host rock prepped in the right way here?

Tim Marsh: Yes, it was terribly broken. The hydrothermal fluids have a density of 0.1 grams per cubic centimeter at these temperatures, so they are more like a gas than a liquid. When you take a gas at 0.1 grams per cubic centimeter and cool it one degree, it condenses dramatically. As it condenses, you end up with space underground that fill with more of these magmatic vapors or fluids.

As the rocks begin to collapse, a large column of rock overlying it starts to rubblize and that's how volcanoes erupt. Long before Mt. St. Helen's blows its top, the roof is caving in to a magmatic vapor chamber. When it breaches the surface, out comes 10 million tons of sulfur dioxide and metals that get blown all over the countryside.

Peter Bell: Right. And some of these volcanoes don't actually explode -- they get trapped underground and those are the ones that could be mineralized porphyries today. Thanks for all the geology here, Tim. I think I'm starting to get it!

Tim Marsh: My pleasure, Peter.

Disclaimers

This document contains statements that are forward looking statements and are subject to various risks and uncertainties concerning the specific factors disclosed under the heading "Risk Factors" and elsewhere in the Company's periodic filings with Canadian securities regulators. Such information contained herein represents management's best judgment as of the date hereof based on information currently available. The Company does not assume the obligation to update any forward-looking statement.

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.

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