STATE OF MICHIGAN

STATE OFFICE OF ADMINISTRATIVE HEARINGS AND RULES

In the matter of: The Petitions of the Keweenaw Bay Indian Community, Huron Mountain Club, National Wildlife Federation, and Yellow Dog Watershed Environmental Preserve, Inc., on permits issued to Kennecott Eagle Minerals Company. _______________________________/	File Nos.: GW1810162 and MP 01 2007 Part: 31, Groundwater Discharge 632, Nonferrous Metallic Mineral Mining Agency: Department of Environmental Quality Case Type: Water Bureau and Office of Geological Survey

D R A F T   T R A N S C R I P T

HEARING - VOLUME NO. XV

BEFORE RICHARD A. PATTERSON, ADMINISTRATIVE LAW JUDGE

Constitution Hall, 525 West Allegan, Lansing, Michigan

Friday, May 16, 2008, 8:30 a.m.

APPEARANCES:

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Intervenor's Exhibit 614. 3172
(metallurgical sample spreadsheet)
Intervenor's Exhibit 310. 3176
(lithology data)

NOTE: Page numbers may change on final transcript. Full exhibit list for today will be included in the final transcript.

Lansing, Michigan

Friday, May 16, 2008 - 8:33 a.m.

JUDGE PATTERSON: Mr. Haynes, you ready?

MR. HAYNES: Ready, your Honor.

ANDREW WARE

having been called by the Intervenor and previously sworn:

CROSS-EXAMINATION

BY MR. HAYNES: (continued)

Q Good morning, Mr. Ware.

A Good morning, sir.

Q Mr. Ware, I have on the screen a document which is Appendix C-1 to the mining permit application entitled "The Geology of the Eagle Nickel Copper Deposit Michigan USA." This is the report that you said yesterday that you helped prepared; is that right?

A That's correct.

Q All right. Mr. Ware, I've put up on the screen here page 10 from this report, which is entitled "Local Geology." And it has a map or a drawing of some of the geology of the area. Can you walk us through what the various features are here? And I'm particularly interested in the term the Baraga basin, which is in the description of this figure.

A First I'll start with the geology, and then I'll get to the Baraga basin. The geology is basically broken into three parts. This brown color here is the Jacobsville sandstone.

That's a later unit that lies on top of these pink and gray units. The Paleoproterozoic sediments here are set at 2.4 to 1.8 billion year old sediments. That's the Eagle deposit. This pink is Archean crystal lined basin. So that's very old rock. That's the oldest rock on that map. Baraga basin is essentially -- we classify that area as Baraga basin.
Q In the Paleoproterozoic sediments; right?
A That's correct, sir.
Q And the sediments are what we've been referring to in this proceeding a country rock?
A That's correct.
Q Now, Mr. Ware, I have had put up page 13 from Appendix C-1, which has a chart -- a figure called Eagle area geology. You've seen this before, haven't you?
A I have, sir.
Q Did you help prepare this?
A I did have some input into this map, yes, sir.
Q All right. And if you for Judge Patterson's benefit -- again this is for basic geology of the area -- explain the various labels on this figure?
A Okay. We sort of zoomed up from that last map and towards the Eagle deposit now. This is Eagle, this is Eagle East. And these features here, we call them mathic dikes from magnetics. We call these features false or from magnetics.

And these blue lines here are features called lineaments from resolved EM.
Q What is resolved EM?
A Resolved EM is a system you fly in an aircraft. Essentially it sends out a weak electrical field. That electrical field couples with the sediments, the till and the underlying bedrock in some cases. And you're recording essentially how resistive that material is.
Q And when it says a lineament, what does that mean?
A A lineament is a feature you would pick from a typical data set. If we had the entire data set on there, it would be a complete picture of colors. And you'd see what we like to class as lineaments, which would be a lineation of a feature in that data set.
Q And what kind of feature are we talking about? Is it a dike, a fault, some other structure?
A The resolved data set typically is mapping till. It doesn't have great penetration into the bedrock. So what we find from the resolve data is you're mapping thickness of till to a certain extent, and a lot of the till thickness has to do with the glaciation event from 10,000, 11,000 years ago. So if I was to draw a cross-section in the air and your bedrock was this shape and you had a big sandy unit in there, that sandy unit is going to make a feature in the resolve.
Q I see. And the resolve data set resides where?

A That resides in Negaunee.
Q That's something you have access to; correct?
A That's correct.
Q And the resolved data set has much more information than is shown on this particular figure?
A Yes, it does.
Q Did you ever offer that resolve data set to the DEQ?
A That data set was never offered to the DEQ, sir.
Q Did they ever ask for it?
A I don't believe they ever asked for it.
Q Continuing on this figure, we have -- and you've described it already, but I want some more detail on this. The feature is called mathic dikes. What's a mathic dike?
A A mathic -- mathic (pronouncing) dike is -- it's an intrusion. We call it mathic because it contains a lot of iron, magnesium and not much silica. So mathic dikes form these features that strike or trend this way across the map.
Q East/west?
A East/west. And Eagle and Eagle East essentially are mathic dikes as well.
Q I see. So that mathic dikes -- the intrusive then is a mathic dike?
A It's classified as a mathic dike.
Q I want to step back for -- go back for one moment. There's a lineament that appears to go right through the peridotite

at Eagle.
A Uh-huh (affirmative). That's correct.
Q And what is the nature of that lineament?
A Again we're referring to the resolve data here, which doesn't have great penetration. As I mentioned before, you're essentially marking till thickness. So at Eagle itself, the east end has a higher bedrock topography than what we have over on the west end. And it just simply appears that there's a thickening of till along that line.
Q And what does the thickening of till mean to you as a geologist?
A The thickening of till -- it's related here to the Paleo-topographic bedrock surface. I'm going to say that -- I'm talking about these sorts of features in the bedrock surface. Sorry. I lost track of the question.
Q The question was, what does the lineament that goes to Eagle -- the Eagle deposit mean to you as a geologist?
A In the resolve data, that, for me, is a thickening of till.
Q I see.
A I'm sorry. Can I just explain that? A thickening of till is based on bedrock topography in this case.
Q Mr. Ware, I've now gone to page 15 of Appendix C-1, which has two figures on it, one of which appears to be a representation of the Eagle deposit with a whole series of green and red and blue lines through it. And then there's

another figure below that with another series of green and red and blue lines. Would you explain what those two figures are?
A The top figure is a plan map of the outside limit of the intrusion at Eagle. We're looking down. It's on top of an aerial photo in this case. The green lines, these are projections of the drill hole to surface. It's called drill hole trace. And you'll see within those green lines that they change color. So I'm trying to find -- it's a little bit obvious. But if you look at this one here (indicating) --
Q The top one?
A Yes. I'm trying to point to a drill hole.
Q Yes. All right.
A Because it changes from green to yellow basically. So that's just a change in lithology down the drill hole.
Q So the legend in the top right portion of this figure shows green as the sedimentary rock, which is what we've been calling the country rock; correct?
A That's correct.
Q And then the bluish is the intrusive, which is the peridotite?
A Peridotites and gabbros, yes.
Q And gabbro?
A Yes, sir.

Q And then the orange is the semi-massive sulfide unit; correct?
A That's correct.
Q And then the red is the massive sulfide unit; correct?
A That's correct.
Q Who plotted all of these lines on the top figure there? Did you?
A Those lines would have been plotted from a geological modeling program. Steve Coombes probably would have plotted those lines, sir.
Q And the geological modeling program is GoCAD; is that correct?
A Not at this point. That map, I believe, was from 2004. That would have been generated in a program called Micromine.
Q And that's something that you generated in Negaunee?
A I generated the geological data that goes into those drill holes. Someone else takes that data and puts it into a model.
Q I see. So the geological data that is the basis for these two figures is in Negaunee?
A That's correct, sir.
Q And then the bottom figure is -- I take it that's a cross-section view of the same -- the same drill holes; correct?

A Yeah. That's a cross-section view, sir. If you're standing to the south of this area here and looking north, this is what you would see, all these drill holes obviously drilling down from the surface.
Q Mr. Ware, I've now put up page 17 from Appendix C-1. And I want to go through the paragraph that talks about dikes. Do you see that paragraph?
A I do, sir.
Q The first sentence says:
"A number of thin dikes ranging from less than a meter to a few meters in width have been noted in drilling in close proximity to the Yellow Dog intrusions."
Are those dikes the ones that were shown on the prior -- the mathic dikes, or are these something else?
A These are something else.
Q And you don't say in here which drill cores gave you the information to show where these dikes were present. But the dikes would be noted in some backup data somewhere; is that right?
A That's correct. In that paragraph, we're also referring to a dike that's actually underneath the Eagle ore deposit.
Q I see. And explain that dike for us.
A There's a thin --
THE WITNESS: Can I draw a diagram, your Honor?

JUDGE PATTERSON: Sure.
Q Sure; of course.
(Witness draws diagram)
A In a very generalized cross-section, we could say Eagle sort of looks like this.
Q Are you looking north or south in this cross-section?
A We're looking west.
Q West. All right.
A Because it doesn't pertain to that. This is the easiest way to explain it.
Q Go ahead.
A So we have these drill holes kind of like this, like this, from on top like this. So there's a thin dike that we can drill underneath Eagle and drill holes out here. It appears that this dike is what we call a feeder to Eagle. So we're assuming that most of the dike -- or most of the intrusion at Eagle including the massive sulfide and the semi-massive sulfide actually came out one of these feeders from depth.
Q So it was a dike next to the massive sulfide?
A I'm talking about the dike underneath.
Q So on your drawing here, where would the massive sulfide be?
A The massive sulfide would sort of sit like a blob like this.
Q And so the dike is underneath. Does it go to the surface?
A It comes into here (indicating). The composition of this dike is reflected in some portions of the orebody. The

problem with that, if you think of a slice of Swiss cheese, these dikes aren't often solid sheets of rock. I mean, they sort of come up through areas -- you could drill a hole through this dike like this and hit sediments or you could drill through here and hit the dike. But they're very complex structures.
Q Sure. And the 109 boreholes that were used to characterize the deposit would help us determine where those dikes are or not; correct?
A It could certainly help you define the dike underneath Eagle. And there appears to be a thin dike off the west end of Eagle as well.
Q The west end of the deposit?
A That's correct, sir.
Q Are you talking about the peridotite or the massive sulfide?
A What I was -- I'm just going to call it a mathic dike. I can -- there's various compositions. We have pyroxonite, gabbro, melagabbro, norites, dunites, lurzhotites. But we call them either gabbros or mathic peridotites or peridotites. So off the west end of Eagle there is a dike this is a pyroxonite that, from the drilling, appears to be a continuation of Eagle to the west, but it's thin.
Q And that information was obtained -- or that conclusion was obtained from all of the drill cores that you took; correct?
A That's correct.

Q Going down further in this paragraph, I'm reading a sentence that starts, "Thin dikes have been noted in the context of massive sulfide horizons peripheral to both Yellow Dog intrusions." Can you explain that sentence to us right here (indicating)?
A Yeah. That would be -- and I think we discussed this yesterday. Could you go back to the plan now that we looked at before?
Q This one?
A That's it.
MR. HAYNES: And we're now on page 15, Appendix C-1, just for the record.
A Yes. That statement would basically be referring to a dike, an intrusion that sits next to the massive sulfide right on the contact of the massive sulfide.
Q And when you say the "contact limit" -- when you say "contact," that's the contact between the massive sulfide and the peridotite?
A That's correct. A very important thing to note is that the massive sulfide and the semi-massive sulfide are intrusions themselves. They're just a very strange composition. And they also are the last intrusions to come into this area here (indicating).
Q Back to our paragraph on page 17, Mr. Ware, the next sentence reads, "These dikes may have formed barriers or

zones of weakness that played a role in localizing later massive sulfide mineralization external to the main intrusions." Do you see that?
A   Yes.
Q   And is that what you just described?
A   Yes. When I was -- I described to you a dike that came off the west end of Eagle. Okay. So we were considering that as a precursor to the main mineralization event at Eagle. So you have this dike running this way. It's exploiting a pathway or a conduit. Then you have the rest of the mineralization coming up that conduit. So that dike is essentially the first or one of the first intrusion phases. Then, as I mentioned before, the massive sulfide and the semi-massive sulfide are some the last intrusive phases.
Q   All right.
A   So you're getting contacts between preexisting dikes and the massive sulfide and semi-massive sulfide.
Q   All right. And all of this information is obtained from the bore holes that you took; correct?
A   That's correct.
Q   The cores that you extracted; right?
A   That's correct; that's correct.
Q   Mr. Ware, I've now gone to page 18 of Appendix C-1. The last full paragraph of that page has a sentence that reads, "Orientations of natural, open and cemented joints (veins)

were recorded as part of the geological logging." Do you see that sentence?
A   I do, sir.
Q   Yesterday you testified about the cemented joint table; do you recall that?
A   I do, sir.
Q   And the cemented joint table is what's referred to -- or the cemented joints in this sentence that I just read are the cemented joints in that table that you were talking about yesterday; correct?
A   That's correct.
Q   And it says here that there were orientations. So when the geologists were logging the cores, they orientated the cores; is that right?
A   As I described yesterday, yes. Can I put a clarifier on that?
Q   Sure.
A   The orientation of the core is very dependent on being able to get a continuous line, as I described yesterday, on the V rail. So we do have orientated core. We don't have complete coverage of orientated core.
Q   Mr. Ware, I've now put up page 21 of Appendix C-1, which has descriptions of three -- descriptions of pictures of three cores. Do you see this?
A   I do, sir.

Q Did you take these pictures?
A Dean Rossell took those pictures.
Q All right. But you know what they represent, don't you?
A Absolutely.
Q The first picture represents the semi-massive sulfide unit; correct?
A That's correct.
Q And the second and third are pictures of cores of the massive sulfide unit; correct?
A That's correct.
Q And these cores -- or these pictures were taken of cores that at the core shed in Negaunee; correct?
A Correct.
Q Now, Mr. Ware, in -- you recall our discussion yesterday -- do you recall our discussion yesterday about the major structures table in Appendix C-3?
A I do, sir.
Q I wish I had the ability to just flip back and forth between the images. But I want to read you the hole numbers in that table. And you may have to take this on faith. But here are the hole numbers if you could write them down; 55, 60, 62, 64, 67, 69, 99 and 101. Do you have those?
A I do.
Q Now, we have on the screen page 26 of Appendix C-1. And we've enlarged the cross-section at 431530E. Do you see

that?
A I do, sir.
Q Now, yesterday you said that the eight cores that were represented in Table 4 of Appendix C-3 were some of the worst rock, as I recall. Do you recall that?
A You're referring to the table from -- the major structure table?
Q Yes, the major structure table; right.
A Yes, I do.
Q The Table 4, which has the ten items from eight cores; correct?
A Yeah.
Q I'm sorry, Mr. Ware. We're going to have a technical glitch here. Now, Mr. Ware, I'm sorry about that little pause there. We have the cross-section of 43150 east. And this is a cross-section through the massive sulfide and the semi-massive sulfide; correct?
A That's correct.
Q And I see one of the -- the green lines on this figure represent drill holes; correct?
A In that particular section, that's a representation of a drill holes. And when it's green, it's in sediments.
Q But these are drill holes that intersect this cross-section?
A Yeah. There's a plane of -- a search plane either side of this section so that we're capturing drill holes that flow

basically in a rectangular block.
Q And how wide is that plane in this cross-section; that is, it will be going from the front of the screen to the back of the screen?
A Yes. If you could just show me the next one, I could probably tell you.
Q The next one down?
A Yeah. I just need to see the section number at the bottom.
Q Sure; of course.
A It's 53500. Now it appears it's 15 meters either side of a centerline. So any holes that fall 15 meters either side of that plane would be included in that section.
Q All right. And on this figure we have an inset in the lower right which appears to be a plan view of the orebody; correct?
A That's correct.
Q With a blue line vertically going through the orebody. That represents this cross-section; correct?
A That's the section of the plane, yes.
Q Approximately?
A Well, very accurately.
Q Very accurately. Thank you. Well, I notice on this cross-section that we have hole 04EA67. Do you see that?
A I do.
Q And that's one of the eight holes that's on Table 4;

correct?
A Yes. If it --
Q And it appears that this hole goes right through the orebody?
A Yes.
Q And so that's one of the worst holes in the area; correct? As you testified?
A Yeah.
Q Now, when you scroll down to the next figure on this page, and this cross-section is a little further west of the -- this is 431500 East; correct?
A That's correct.
Q And it's a little west of the one we just talked about; correct?
A Correct.
Q And we have on this cross-section hole 04EA064. Do you see that?
A Can you just point to precisely which one that is, sir?
Q Sure.
A My eyes aren't that good.
Q You can move up.
A Is the title next to what you've got there?
Q It's the one above the laser.
A Okay.
Q Okay. And that hole appears to go right through the

orebody; right?
A That's correct.
Q And that's one of the eight holes; correct?
A That's one of the eight holes, yes.
Q Now, Mr. Ware, I've put up on the screen a chart which is contained in the Appendix B to Appendix C-2 of the Eagle project geotechnical study. That's a study that's prepared by Golder, as you know.
A Correct.
Q And you've reviewed that, haven't you?
A Correct.
Q The Appendix B is an excerpt from an article by Trevor Carter. Do you know that?
A I do.
Q And Table 3, which is in this article, is a table called "Geomechanics System Rating Values." Do you see that?
A I do.
Q And you testified yesterday a little bit about this, didn't you?
A I did, sir.
Q All right. This is the RMR classifications; correct?
A That's correct.
Q And the table that we have on the screen is 1976 version of that; correct?
A That is correct.

Q And I notice that, on this table, we don't have the symbols A1, A2, A3, A4 and A5, do we?
A They're not listed.
Q But, in fact, A1 is the strength of intact rock?
A Correct.
Q And that's the first factor on this table; correct?
A Correct.
Q And then we do have RQD in the second group here, is the drill hole quality; correct?
A Correct.
Q That's A2; correct?
A Correct.
Q And then we have spacing of joints. That's A3?
A Correct.
Q And then next we have condition of joints; correct?
A Correct.
Q A4?
A A4.
Q And then below that we have groundwater which is A5?
A Correct.
Q And then below that we have adjustments for joint orientation. Do you see that title?
A I do, sir.
Q And that talks about strike and dip orientation of joints. Do you see that?

A I do, sir.
Q All right. You testified about -- yesterday about the various -- the five factors that were put into the Rock Mass Rating numbers for the various drill cores. Do you recall that?
A Yes, sir.
Q And those Rock Mass Ratings, the RMR's, are taken from the factors shown in this table; correct?
A That's correct.
Q What I didn't hear yesterday was who performed the calculations for the A1, A2, A3, A4 and A5. Did you do those?
A Again we collect the data in Negaunee. And we will ship off a database to Golder. And that database contains data that pertains to each one of those A1 through 5 ratings.
Q So the folks at Golder perform the calculations for A1 through A5; correct?
A Based on the standardized logging, yes.
Q But they did it; you didn't. Correct?
A That's correct.
Q So have you had an opportunity since they performed those calculations to look at their calculations to see if they're accurate or inaccurate?
A I have.
Q You have?

A Yes, sir.
Q And when did you do that?
A When the original reports came out, C-3, C-2 records.
Q The C-2 report was dated April 2005. So you looked at their calculations of the RMR factors and double-checked them?
A I looked at their conclusions on the RMR factors. I would have done a rough desktop review of what they came up with.
Q Did you take any notes?
A I didn't do that, sir, no.
Q So you looked at their conclusion and said, "That looks right"?
A I was checking to see if it was within what I would expect those numbers to be.
Q I see. And so their numbers are based upon the data that your staff get?
A That's correct.
Q And you didn't perform any of those calculations yourself before they were shipped off to Golder?
A No, sir.
Q So other than you sort of back-of-the-envelope checking of their numbers, you haven't actually verified the A1 through A5 numbers that were produced by Golder, have you?
A Only as I mentioned.
Q All right. On the A1 factor, which is the RQD, you testified yesterday that you had about 96 percent coverage

for their RQD; do you recall that?
A I do, sir.
Q What's the other 4 percent represent?
A When I calculate RQD coverage, I calculate complete number of intervals drilled which have RQD data versus the sum of the entire length of the drill holes. So I'll have a drill hole. I've had an entire set of drill holes and I have the entire length of all those drill holes. And then from the database I'm able to calculate or sum all the intervals that have RQD data.
Q All right. So for some of the boreholes -- are they called boreholes or drill holes?
A Drill holes.
Q Drill holes. For some of the drill holes, there is no RQD data; correct?
A Yeah. I'd like to explain that. As I just mentioned --
Q That was my next question. I'd like you to explain that.
A Okay. Because when I sum the entire depth of the hole, I'm including the till or the sandy unconsolidated sediments above the bedrock. So we don't have RQD data for that.
Q All right. So you're saying the 4 percent represents only the till or were there portions of drill holes that did not have RQD data?
A I'd say most of that 4 percent represents till.
Q I see. So there is some of the bedrock drill hole that

lacks RQD data?
A I would have to say 99.9 percent of the bedrock data has RQD data.
Q And what happened to the other one-tenth of 1 percent?
A It may have been at the top of the hole if we were drilling a broken zone, rubbly zone. Sometimes when you're drilling in a sandy, muddy layer, you're actually pulling out bedrock into the core tube and mixing it with the sand and mud you just drilled. So there are actually pieces of rock from the bedrock, but you've mixed it back into the till. So that would be one point where you would lose RQD data even though you're drilling bedrock.
Q And your staff when the drilling was being performed would log the RQD data at what point? When the cores were coming out of the ground or in the core shed?
A The RQD is measured in the core shed.
Q And those RQD data were then transferred to tables for each one of the drill holes; correct?
A The RQD data is transferred into a geotech table, that's correct.
Q And the A3 factor, which is the spacing of the joints, where is that logged? Is that logged in the core shed or in the field?
A That's logged in the core shed.
Q And is that also true for the A4, the condition of joints?

A Logged in the core shed.
Q Now, you testified yesterday -- let me back up. For the A3 and the A4 data, all of that data is in your databases in Negaunee; correct?
A That's correct.
Q So if someone wanted to check the data, they would have to go to Negaunee. You would have to assist them to get into the computer and then print out the data or look at it on the computer screen?
A That's correct.
Q Or you could bring the data here and we could look at it if that were allowable in this case; correct?
A That would be --
Q For instance, if our experts wanted to look at that data and compare the data to the actual drill cores, that could be done in Negaunee; correct?
A That could be done in Negaunee on the core that hasn't been cut.
Q How much of the core hasn't been cut?
A Well, all of the mineralized portions are cut for geochemical assay.
Q So for the cores, if we went back to the cross-section of those drill holes, all the cores that penetrated the massive sulfide or the semi-sulfide have all been cut?
A Yes, and beyond that as well. We'll sample out into the

sediments as well.

Q Do you have an estimate of the percentage of the drill cores that are now -- have been cut of the entire set of drill cores approximately?

A I'm just doing a little mental math.

Q Sure. Go ahead.

A It's approximately 35 percent.

Q And the 35 --

A 35 percent is mineralized and has been cut.

Q By "mineralized," you mean that it penetrated the semi-massive sulfide unit or the massive sulfide unit?

A Well, it penetrated -- be very clear on this. It's either sedimentary rock adjacent to the intrusion. It can be an un-mineralized intrusive portion within that intrusive envelope. It can be disseminated mineralization. It can be semi-massive sulfide mineralization. It can be massive sulfide mineralization.

Q I see. So just so the record is clear, if there is mineralization in the peridotite, those cores have been cut?

A That's correct.

Q So if someone were to today try to verify the RMR factors that you've testified to, you'd have to look at the photos in order to do that; is that correct?

A You would review the photos in conjunction with the drill core because we still --

Q In conjunction with the cut drill core?
A The cut drill core, yes.
Q I see. And you say, if you did that, you would be able to verify the calculations of the A3 and A4?
A Well, I'm saying it wouldn't be ideal, but that's the way you'd do it.
Q That's the best we would have right now; correct?
A That's correct.
Q Mr. Ware, you described yesterday in great detail the process of logging the drill cores into your database?
A That's correct.
Q And you mentioned at one point that there were driller's logs that were kept. Explain for Judge Patterson what a driller log is.
A Drillers maintain driller's logs. Each 12-hour shift has a separate page. They record the depth at which they start on that shift. And then on each line they record how far they drilled forward, how much core they returned. And they'll do that down to the end of their shift. And then they'll sum up and give us a summary of total core drilled. And from that log, you can see what the interval length was that they were drilling. So they'll note drilled forward 10 feet. They may say, "I drilled forward 5 feet." So they're giving you the run lengths. And each one of those run lengths corresponds to a block in the core box.

Q And the drilling process involves water going down the hole; is that right?
A That's correct.
Q And the water used to cool the drill bit; is that right?
A It's used to cool the drill bit and pull cuttings back up the hole.
Q All right. And you've -- you participated or observed drillers doing their work, haven't you?
A For 20 years I've been doing this.
Q The drillers when they're out there doing the work also note if water is lost during the drilling or it's gained, don't they?
A That's correct.
Q And when the drillers note -- and they would note this in their logs, wouldn't they?
A Yeah. They typically do note -- they'll call it lost circulation on the log.
MR. HAYNES: Your Honor, I have to do a technical.
Q And when a driller notices a water loss, what does that mean?
A It probably means that they're encountering a zone of higher permeability in the hole.
Q And that's significant, isn't it, for purposes of logging a hole?
A We take careful note of that.

Q All right. And where would those notes -- were those notes ever transcribed into some computer program?
A We have them in a series of binders by year. We also have an Excel table that notes that data from the driller's log.
Q I see. And if the driller notes that water is gained, what does that mean?
A Well, gains would indicate -- can I step back and just explain a little bit about the process of drilling?
Q Sure.
THE WITNESS: So I'm going to use my prop from yesterday, your Honor.
A If you can imagine that's the drill string sitting above the ground, and this is the ground and they're drilling a hole. So when they're pumping water down the hole to cool the bit and retrieve the cuttings, you're pumping water from up on this level (indicating). So you're creating a hydraulic head of approximately 10 feet. So you're pumping water down. And that water is at a higher pressure than what you may find in the subsurface. So what you can do is called over-pressuring the formation. You're pumping water down. And what will typically happen, if it gets over-pressured, that water will come back up of its own volition.
Q And can you gain water from, for instance, water that is hit by the drill bit that's at a higher pressure than the water in the hole?

A I think you're describing artesianal flow?
Q Perhaps.
A If you hit a aquifer that is over-pressured, you can generate water coming back up the hole, yes.
Q And the drillers would note that if that occurred; is that correct?
A That's correct.
Q And all of that, if it occurred, would be in the driller's logs that kept in Negaunee; correct?
A That's correct.
Q The logs are still there, aren't they?
A Absolutely.
Q Now, turning back to our RMR table, Mr. Ware, we have a groundwater factor. This is A5; correct?
A That's correct.
Q Now, it's true, isn't it, that the A5 factor was given the maximum values in the reports of initially 15; is that right?
A I think I testified yesterday that I wasn't involved in any way with determining A5.
Q Oh, I see. That wasn't done in Negaunee?
A That was not done in Negaunee.
Q Who did that?
A Golder made the determination.
Q In Sudbury?

A Where the reports were written.
Q In Sudbury?
A Uh-huh (affirmative).
Q "Yes"?
A That's correct.
Q Do you know how they did it in Sudbury, how they determined that the groundwater was going to be given a maximum value?
A That's a question more properly directed to Golder.
Q I see. Is that something that would have been done -- or that could have been done in the field to determine the groundwater factor for the RMR?
A No.
Q I see. And what is -- do you know what goes into determining the A5 factor?
A It's a -- as it's described there, it's a level of water inflow per 10 liters of tunnel length in that particular case. It includes joint water pressure and major principal stress.
Q And I see that was done not in the field and not in the core shed but in an office in Sudbury?
A That's correct.
Q How about joint water pressure and major principal stress?
A That's correct.
Q And the general conditions of the drill hole, completely dry, moist, water under moderate pressure and severe water

problems; right?
A No. You're talking about specifically referring to tunnel, not drill hole, sir.
Q That's the general conditions; right?
A Inflow per 10 meters of tunnel length.
Q Right. But part of the groundwater deals with general conditions of the drill hole; correct?
A Again I would suggest you direct that question to Golder.
Q That's fine. Now, so you can't testify today whether or not that A5 factor that was given is correct or not?
A I can't testify to the A5 factor.
Q Now, I notice that there is on this RMR chart an item called adjustments for joint orientation. Do you see that?
A I do.
Q And the adjustments are from zero to a negative number of -- depending on the type of use of the rock from a negative 12 to a negative 60. Do you see that?
A I do, sir.
Q And the RMR calculations that are in Appendix C-2 and C-3 did not consider these adjustments, did they?
A The RMR calculations in C-2 and C-3 were used in the consideration of crown pillar stability. And again we're talking about tunnels, foundations and slopes in those rating there.
Q And you're saying those don't apply to the crown pillar

stability?
A I'm saying they apply to tunnels, foundations and slopes.
Q I see. So the strike and dip orientation of joints is irrelevant to the crown pillar stability?
A I would ask that question to Golder.
MR. HAYNES: Your Honor, could we take a short break? I have to do a technical thing. I'm sorry. I apologize.
JUDGE PATTERSON: Yeah; sure.
(Off the record)
MR. HAYNES: Thank you, your Honor. We found what we were looking for.
JUDGE PATTERSON: Good.
Q Mr. Ware, yesterday you brought out a box that you brought here from the coreshed in Negaunee that contains some drill cores?
A That's correct.
Q The box as I recall was from hole 62; correct?
A That's correct.
Q And the box was for the run from 148.34 meters to 151.05 meters; correct?
A That's correct.
Q We have on the screen a photograph of that box from Petitioner's Exhibit 116 and do you recognize this picture as --

A That's the box, yes.
Q That's the box?
A Correct.
Q The drill core that's in this box -- or the cores in this box except for perhaps the top row looks pretty good, doesn't it?
A That's pretty good rock.
Q Pretty good rock, pretty solid?
A Yes, sir.
Q And the top row, however, is broken up a little more than the other four rows, isn't it?
A That has some breakage up there, yes.
Q Yes. All right.
(Pause in dialogue)
Q Now, Mr. Ware, I've put up on the screen a page out of Petitioner's Exhibit 41, which that exhibit was one that was prepared by Jack Parker and he -- this is the exhibit where he took the RQD and RMR calculations for the eight holes that are listed in Table 4 of C-2. You've seen this table before, haven't you?
A I have, sir.
Q You have? All right. So if we look at -- on the left-hand side we have the RQD percentages; correct?
A That's correct.
Q And on the right-hand side we have the RMR; correct?

A We have RMR's on the right-hand side.
Q So if we look at the hole -- or the run that's represented in the box that you brought yesterday -- the box that you brought yesterday goes -- it looks -- on this page appears to be the fourth line on the RQD side going down to the sixth line -- about the sixth line; correct? We have 148.34 to 151.05. 140- -- I'm sorry. I was up -- I was too far out. It's the sixth line which starts 148.43 and then it goes to 151.48. Do you see that?
A I see that.
Q All right. So the box that you have contains that line, the sixth line on page five of this exhibit; correct?
A It contains most of that.
Q Most of that, yes. And the RQD for that is listed as a hundred; correct?
A Correct.
Q A hundred percent; that means it's the best quality rock?
A It means that there's no pieces of core in there shorter than ten centimeters.
Q Shorter than ten centimeters. Fine. And so the rock that we saw -- well, it's given a hundred percent RQD; correct?
A It's given a hundred percent RQD.
Q Which is the highest that you can get; correct?
A That's correct in the RQD measure.
Q Right. And so the box that you showed us is in fact as good

as any other rock found in the drill cores -- correct? -- because it's given an RQD of a hundred?
A You're only considering RQD there?
Q Right. The best that can be found considering RQD.
A A hundred is the best you can find.
Q You testified yesterday that your -- that the RMR calculations extrapolated to a safe crown pillar. Do you recall that?
A Sorry. Could you rephrase the question?
Q Maybe my notes aren't correct here, but I -- my notes say that you testified yesterday that the RMR calculations in the Golder reports showed a safe crown pillar.
A I don't recall using that term of phrase, but the RMR calculations used by Golder suggest a safe crown pillar of 87.5 meters.
Q 87.5 meters; right. But you don't have a way of independently verifying those calculations, do you?
A I depend on Golder.
Q So your testimony depends on what they say?
A It depends on what I send them, so it's interrelational.
Q But your testimony that the Golder report shows a safe crown pillar of 87.5 meters thickness is wholly dependent on what they calculated?
A Yes, it is.
Q Yesterday you brought up -- or you testified about Kennecott

Exhibit 596, which was the geophysical work on the dikes south of the intrusive. Do you recall that?
A I do, sir.
Q And your testimony concerning those dikes related or was based upon the geophysical work; correct?
A And drilling.
Q Oh, and drilling?
A Correct.
Q And which drill cores did you use for the purposes of your testimony?
A As to the location of the dike; is that what you're referring to?
Q Yes.
A Okay. I would refer to hole 111, 163, YD02607 or 8 I believe, one of those holes.
Q So hole 111 you -- that's a hole that was drilled after the July 7, 2006 Golder memorandum; correct? Because that only goes through hole 109.
A Yeah, that would be in the first hole in 2006, I believe.
Q All right. But the Golder memorandum of July 7, 2006 only goes up through hole 109; correct?
A Yes.
Q All right. So hole 111 wasn't taken into account in that memorandum; correct?
A That's correct.

Q And the data that you're -- the data from the hole 111 and 163 and the -- at least from those two holes, that data that you testified about yesterday has never been transmitted to the DEQ, has it?
A It is transmitted to the DNR but not the DEQ.
Q Did you send the information to the DNR?
A We sent a well completion log to the DNR.
Q What division of the DNR?
A Ray Vugrinovich.
Q And when did you send that data?
A That data goes in on a periodic basis.
JUDGE PATTERSON: I'm sorry. Did you say Ray Vugrinovich?
THE WITNESS: That's correct, sir.
Q And how long have you been sending this completion data to Ray Vugrinovich?
A That's part of a reporting requirement. It's on a yearly by yearly basis.
Q When was the last time you sent the data to Mr. Vugrinovich?
A I believe I sent him some data this year, earlier this year.
Q And you say you send on a year-by-year basis?
A Or more frequently.
Q I see. But to your knowledge that -- the data from holes 11 and 163 haven't gone to the DEQ directly?
A Not the DEQ directly; that's right.

Q Okay. So if we wanted to check your testimony about the existence or nonexistence of those dikes we could check -- if we had the opportunity we would go to those drill holes and check the driller's logs and check the photos and look at the drill cores; correct?
A That would be a way to do it, yes.
(Pause in dialogue)
Q Mr. Ware, I've put up on the screen Kennecott Exhibit 214, which is a series of drawings. Have you seen this before?
A I have.
Q Do you know who prepared this?
A That was an internal report through Kennecott that was actually prepared in conjunction with Dr. Alasdaire Pope and myself.
Q I see. And what's the purpose of this -- of these drawings?
A We're trying to define a possible structural environment to Eagle and if we can do that we can take to other places where you have information -- geophysical information or mapping information. What we're basically trying to do here is essentially map a fold and see if there's any theoretical controls on the boundaries of the orebody.
Q And the boundaries of the orebody, and that would include potential faults around the orebody?
A That would include potential faults around the orebody as a model, yes.

Q So the purpose of this exercise in Kennecott Exhibit 214 was to prepare a model?
A To prepare a model that may possibly apply to Eagle-like orebodies.
Q Oh, you mean other orebodies?
A Correct.
Q Where?
A We don't know yet.
Q I see. And for this exhibit, Kennecott Exhibit 214, we have at least on the first figure here some writing. Who put the writing on that. Did you or did Mr. --
A Which writing?
Q Well, let's say where it says, "Where another fault?"
A Alasdaire would have put that writing on there; Alasdaire Pope.
Q And how much of the -- let me back up for a second. How much of this exhibit did you prepare?
A I prepared the plans for him. We reviewed the drill holes, pulled out core, logged the core together, relogged the core together.
Q All right. So did you put any of the writing on this exhibit, or is that all Mr. Pope's?
A That's all Mr. Pope's.
Q All right. By the way, the first slide appears to be level 375. Do you see that?

A I do, sir.
Q And so these slides on this -- figures on this exhibit are at different levels of the orebody; correct?
A That's correct.
Q Now we're looking at level 325. You prepared the --
A The base plan map.
Q The base plan map. All right. On the second page of this exhibit we have a level 275. Do you see that?
A I do.
Q And you prepared the base map here?
A That's correct.
Q And Mr. Pope put the writing on here?
A The annotations, yes.
Q The annotations. Did he discuss these with you?
A Yes.
Q And what was the purpose of -- for instance, on level 275 where it says, "Suggestion of another north/northeast fault." Do you see that?
A I do.
Q What does that mean to you?
A North/northeast fault; that would be something trending just to the right of north obviously.
Q Going through the orebody?
A I'm actually not sure where he drew that line. If you could point that to me that would be fine.

Q Well, I'm not sure what the line is either. I haven't had a chance to talk to Mr. Pope.
A Okay. I don't see a line that he's drawn on there referring to that annotation.
Q So for the annotations it would be better to talk to Mr. Pope about these; correct?
A Yes.
Q All right.
(Pause in dialogue)
Q Mr. Ware, I want to go back to Petitioner's Exhibit 41, which is the table that Jack Parker annotated. We were -- we talked earlier about the photograph of the box of hole 62 that you brought in; correct? Do you remember that?
A That's correct.
Q We're looking now at page three of Exhibit 41 and this -- and I'm looking here at the beginning tables for hole 62. Do you see those?
A I do, sir.
Q I notice here -- Jack Parker said that the top of bedrock is at 14.94 meters for this hole. Does that sound about right to you?
A That's correct.
Q That's correct? And I notice on the RQD column where it says "RQD percentage" from 14.94 to 20.27 meters we have a zero reading for RQD. Do you see that?

A That's correct.
Q What does that mean for that rock?
A No pieces of core longer than ten centimeters in those runs.
Q So it's pretty broken rock, isn't it?
A It is broken rock.
Q And here we note that on the RMR side of this table there's nothing -- there's no RMR rating for anywhere from the top of bedrock at 14.94 meters down to 23.01. Do you see that?
A I do, sir.
Q And in fact from 14.94 meters down to 23.01 we have zeroes or else one figure of 27; right?
A Uh-huh; that's correct.
Q Can you explain why there's no RMR rating for that?
A The RMR ratings depend on being able to log the A-3, A-4 features. In this particular zone as the RQD suggests it's extremely broken rock; there's very poor advance and the drillers were having a significant problem advancing the hole as you can see by the short runs there. So the way we approached that, if the geologist is unsure of whether the rock in the box is in an intact state they will not try and generate -- what can I say? -- they're not going to try and generate data that pertains to A-3 and A-4. So we've recorded an RQD of zero, which indicates very poor rock. Okay? But the geologist is at that point unsure which of those fractures can be classified as natural or unnatural

breaks. So essentially that's a pretty conservative way to go forward, because when you're comparing your RMR and RQD level plans, for example, you can see a bright red dot on your RQD, and that's an alert that there's some very poor rock in that area.
Q I see. And so the conservative way to log the RMR for this very broken rock is to not do an RMR?
A The conservative way is to try and avoid -- I don't know that this is the correct term, but try and avoid inventing data. The RQD is reflecting extremely poor rock; the RMR is absent, so you have a -- what you would call a target in your database where you know there's a structural zone there.
Q Where there's a structure?
A That would be right.
Q All right. And so the structure isn't reflected in the RMR side of this table; correct?
A The absence of RMR is an alert.
Q Is an alert. I see. So for instance, for hole 62 we're simply missing RMR's for a good -- for some portion of the hole?
A There's some portion of the hole that doesn't have RMR.
Q All right. I mean, it's not even a zero; it's just missing?
A That's correct.
Q And that's best industry practices?

A I think that is best industry practices not to invent data or try and fill data for the point of filling an interval. If you've got the RQD you've -- as I said, you can call it an alert. I mean, that really is broken rock there.
Q And so the data that you sent to Golder relating to the holes, the drill holes at Eagle for Golder to construct the RMR's included -- or rather did not include any RMR data for hole 62 and, in fact, anything above 23.01 meters; correct? It's just missing.
A Remember, we've got to -- what we're sending them, essentially data pertaining to A-1, A-2, which is RQD, and then A-3, A-4. So if there's absent RMR data they're still plotting the RQD data.
Q But you said that the geologist --
A That's correct; there's no --
Q -- in this situation where there's an RQD of zero would not give an A-3 or A-4.
A Not always. I mean, it really -- it's a little subjective. You've got to be very careful in what you're doing there. If you're inducing breaks in background through the drilling, through the extraction of the core from the core barrel, you've got to be careful about what you're doing.
Q Sure; that's understand. But you're saying that for -- when the RQD's were zero the drill -- the geologist wouldn't log the A-3 and A-4 data; correct?

A They would feel that they were inventing data; that's my point. So can I just recap? If you've got zero RQD, you know you have --
Q Bad rock?
A -- bad rock.
Q Okay. And so when Golder then took the data to construct their RMR figures, they wouldn't have necessarily data from the entire core run; correct? There'd be some missing; there'd be some gaps.
A There's some intervals where they would not be able to calculate the RMR value, but those intervals would be covered by RQD data.
Q Right.
(Pause in dialogue)
Q Mr. Ware, on this same exhibit I'm on page four, and again, the red annotations are by Jack Parker. We have on the left of -- for hole 62 starting at 70.87 down to 103.48 we have some RQD figures that range from zero to, it looks like about 88. Do you see that?
A I do, sir.
Q And on the right-hand side we have -- on the RMR side we have a gap here from 69.95 to 103.48. Do you see that?
A I do, sir.
Q Can you explain why there's no RMR calculation for this run from 70.87 -- actually, it's from 69.95 to 104.85?

A Maybe with checking that table, but I believe that is logged as a major structure within that hole.
Q A major structure. And define for us again what a major structure is.
A It could be a broken rock gouge or shear material.
Q And don't major structures have RMR's?
A Depending on the quality of the rock in the major structure.
Q By the way, the RMR figures that are on this table; those are the figures that were generated by Golder; is that right?
A That would be correct.
Q So the process of producing this table involved your taking the data from the -- you and your staff taking the data from the cores, putting them in your computer database, shipping them to Golder, and then getting the figures back to produce the right-hand column of this table; is that right?
A That's how it operates.
Q So the RMR figures here are from Golder; correct?
A That's correct.
Q So we should ask Golder why there's a gap there, shouldn't we?
A You could ask Golder and they would say there's incomplete A-1 through 5 variables available.
Q Oh, I see. And that's best industry practices?
A Again, this -- I mentioned before zero RQD is an alert.

Golder specifically takes and maps in three-dimensional space significant structures and I think in all of their reports they've noticed an area of lower quality rock on the north side of the orebody, which is precisely where this drill hole is located. So you have an RMR model; you have an RQD model; you have a major structure model. So through that you're able to define, as we have for that rock to the north of the intrusion, a zone of lower weakness which is a lower quality rock, which is something you'd want to know about before you go underground.

Q And for that lower quality rock where these major structures are, those weren't included in the RMR calculations by Golder; correct?

A That's correct. And again, I'm saying it's sort of a double backup here; not ideal, but if you're logging a major structure, you have low RQD's, then those do come out in the review of the drill core database. And especially when you're plotting material plans and sections. As noted by Golder, these things can line up and then you have an idea that you may have a zone of lower quality rock.

Q And you're saying it's best industry practices to not include the major structures?

A The major structures are included.

Q In the RMR calculations.

A In the major structure table.

Q But not in the RMR calculations?
A We would have to go back and check that. I think in the report we mentioned, I think it was 40 major structures. You would check those against the RMR for that database. I can't tell you off the top of my head whether the RMR of those major structures is included. I'm sure in some cases it was, in which case you have RMR, a major structure logged, and if you have low RQD then you have data that suggests that there's a point of interest out there before you go underground.
Q Point of interest being low quality rock?
A Exactly.
Q Weak rock?
A Low quality rock.
Q Possibly rock that would allow water to flow to --
A Lower quality rock.
Q Low quality rock. You mean broken rock; correct? Broken, sheared, gouged?
A Correct.
Q The kind of rock that would allow water to flow through more easily?
A Possibly, yes, depending on what was above it.
(Pause in dialogue)
Q Mr. Ware, we put up on the screen page two of Appendix C-2, the Eagle project geotechnical study, DEQ Exhibit 26. This

is a report prepared by Golder that you've reviewed; correct?
A (No verbal response)
Q Appendix C-2?
A Oh, sorry. Yes.
Q Yes. First paragraph of this section called "Data Review" describes the data being organized into two Microsoft access databases when they were drilled 2004 and 2004. Do you see that?
A Yes.
Q That's correct, isn't it?
A Yes.
Q And the next sentence says, "The databases were created using custom entry forms and consist of tables including those describing cemented joints, open joints, basic geotechnical measurements, major structures and point load tests." Do you see that?
A That's correct.
Q And that's what you testified about yesterday, the various tables in your database in Negaunee; correct?
A That's correct.
Q The next sentence says, "Some entries were found to be deficient in information." Do you see that?
A That's correct.
Q Would you agree with that?

A That's a QAQC process, yes.
Q But that statement's correct, isn't it?
A Yes.
Q So if the entries were found to be deficient, that's not best industry practices, is it?
A I would suggest it is, because we're doing QAQC whereupon if there is deficient data you can go back and determine why it's not there and correct it if you can.
Q Was it corrected?
A I can't talk to that point, sir. We don't have the piece of information for it.
Q So for the -- do you know which entries Golder's talking about here? Let me back up.
A I'm sorry.
Q The next sentence: "A list of deficient data has been formulated and communicated to KEX personnel on site." Do you see that sentence?
A Can you point to it, sir? Yes.
Q And did you see that list?
A I would have seen that list, yes.
Q Do you have the list somewhere in your files in Negaunee?
A It would be accessible in Negaunee, yes.
Q And did you review the list?
A I would have reviewed the list, yes.
Q Did you fix the deficient data?

A The data that was able to be -- I hate to use the word "fix" but from the QAQC done by Golder we would check their points and if there was a problem we would fix them.
Q And was that done?
A Yes, it is.
Q And where is that reflected?
A That would be reflected -- I believe in the old access database logging files you can see a variable that has date of entry then a modified date.
Q I see. So all right. Let's go down to the next paragraph that talks about geotechnical logging. In the fourth sentence of that paragraph it says -- and I'm interpolating from the previous -- well, let's start with the third sentence. "Logging procedures have been formulated and revised from 2001 to present." Do you see that?
A That's correct.
Q The next sentence: "This has resulted in a marked improvement in the quality and the completeness of the data over this period." Do you see that?
A I do.
Q That sentence suggests that there was poor quality and poor completeness of data before logging procedures were improved. Is that a -- is that an accurate statement?
A Can I expand on that, sir?
Q Is that an accurate statement?

A That is an accurate statement.
Q Thank you. Mr. Ware, were you at your office last week in Negaunee?
A I was there for a part of it, yes.
Q All right. Were you at a seminar called "The Institute of Lake Superior Geology"?
A I attended part of that seminar, yes.
Q All right. That was last week held in Marquette?
A Yes.
Q How many days did that cover?
A There was a field trip Wednesday; talks and presentations Thursday, Friday; then another field trip on Saturday.
Q And were the participants at that institute invited to come to this coreshed in Negaunee?
A They were part of the tour of the coreshed in Negaunee, yes.
Q So there was a -- as part of this institute, which is -- by the say, this institute is given -- what? -- every year or on --
A Every year, yeah.
Q Around Lake Superior?
A Around Lake Superior.
Q And this year it just happened to be in Marquette?
A It moves around every year, yes.
Q Right. This year it was in Marquette?
A Correct.

Q And as part of the -- part of the proceedings there was an invitation from Kennecott for the participants to visit the coreshed in Negaunee; correct?
A Kennecott offered a tour of the coreshed in Negaunee as part of the tour of the Eagle project, yes.
Q Yes. And how many participants -- were you at -- did you participate in the tour?
A I was tour guide on the first one; I was in Lansing for the second one.
Q All right. And for the first one how many participants went to the coreshed?
A I think I counted 44 people.
Q Forty-four people.

MR. HAYNES: Thank you, Mr. Ware. I have nothing further.

MR. WALLACE: Your Honor, I could benefit by a very short break.

JUDGE PATTERSON: Okay.

(Off the record)

MR. WALLACE: Mr. Ware, my name is Bruce Wallace. I'm representing Huron Mountain Club. I have a few questions.

CROSS-EXAMINATION

BY MR. WALLACE:

Q When did you first set foot out in the Yellow Dog Plains?

A That would have been October 2002.
Q And at that time were there personnel already working out there?
A Yeah. At that time we were wrapping up a drill program that we'd basically just completed, so there were people on the project, yes.
Q And what had been that drill program?
A In October 2002 we'd finished drilling up to hole 02YD28 so essentially hole 28.
Q So 28 holes had been drilled before you first arrived in the Yellow Dog Plains?
A That's correct.
Q And who was in charge of that?
A The first 28 holes?
Q Yeah.
A That would have been a combination of Steve Coombes and during the early days, when it was an exploration program, Mr. Dean Rossell.
Q And did Mr. Coombes continue to work out there after you arrived?
A I continue to work with Mr. Coombes to this day.
Q Was he living up there?
A No. He -- well, he's up there, like, six weeks, things like that, so he's flying in and out of Vancouver.
Q I'm trying to get a feeling --

A Yes.
Q -- for how many people were there and who was in charge of what in the early stages.
A Yeah. Okay. In summary, Steve was basically in charge of the project, looking after a crew of maybe three to five people. They were doing a geotechnical logging in the early stages when it was an exploration project. So Steve plus, let's say, four people would have been approximately five people in 2000.
Q And were some of the cores that were taken before you got there cores that went right into the orebody?
A Yeah. Hole 2 was the discovery hole. At that stage we didn't have the wetland road drilled, so we were really hard-pressed -- we were drilling mineralization, but we couldn't drill the crown pillar in those sets of holes.
Q Because you didn't have a way to get to it?
A We didn't have a wetland road in there, which we later permitted.
Q So you're saying the very second hole that they did hit the orebody?
A Well, there's a little bit more history behind that. They're out there drilling first in 1995 with two holes -- two diamond core holes. And in 2001 I believe they drilled six diamond core holes, and 2002 was the discovery hole. So that's about the way it went.

Q And after the discovery holes but before you got there, another 20-some-odd holes were drilled?
A Between the discovery hole and the time I got there -- I recall this actually pretty well -- I got there at hole 18.
Q Were the cores that were obtained before you got there recorded and made part of the overall dataset of the -- that we've been talking about?
A To a certain point. The reason I went up there was to take the program from an exploration program essentially through the -- what we call an order-of-magnitude program. So in exploration you're typically looking for signs of very decent mineralization, and you get excited. You'll drill a few more holes just to confirm in very broad -- 80 percent, 100 percent errors where there is something of interest there. So during that period of time, it's still an exploration, and typically you'll collect less geotechnical data, for example, than a full-blown order-of-magnitude study. So what really was the turning point was hole YD0202, and from that point on we basically essentially ramped it up to a point where we're getting to more of an industry standard geotechnical logging program.
Q Okay. When we talk about -- one figure that's been used was 109 holes; is that --
A Yes.
Q And that was 109 holes drilled up until what point in time

roughly?
A I think that was the end of '05, I believe.
Q End of 2005?
A I -- yeah.
Q And those 109 holes include these -- the first 28?
A Yeah, the first 28. Not all of them were drilled on Eagle either. We should be clear about that.
Q Are you looking around other places?
A Principally Eagle East. We weren't sure at that stage which one of those two intrusive bodies were of interest essentially.
Q Do you know which was the biggest?
A I didn't know which one was the best.
Q The best. And then, for another time frame, the holes you're drilling are basically what you call order-of-magnitude holes?
A Yes.
Q And how many of those holes were drilled until you had a sense of the size of the orebody?
A We kicked off a much higher level geotechnical logging program in 2003. And we made the formal decision to go forward with an order-of-magnitude study in the same year, and that was completed, I'm suggesting, in April 2004 when the project was actually taken out of exploration and handed over to the copper group.

Q In April of 2004 the period officially thought of as exploration was brought to an end. Is that what you're saying?
A Yeah, exploration was -- at Eagle essentially we'd gone from an exploration program more to a delineation drilling program.
Q And about how many holes had been drilled by then, sir?
A Are you talking about the end of 2004?
Q The end of exploration as you've just defined it now.
A Oh. I'd like to think about that just for a second, sir. It isn't a fairly precise point in time. We made a decision to go forward with an order-of-magnitude study essentially after the last -- I'd say around about hole 32 we sort of moved from a typical -- it may have been a little earlier -- a typical exploration-type project and programs we were doing. "Okay. Let's do an order-of-magnitude study."
Q Well, I'm just asking now, approximately how many holes have been drilled by this benchmark you mentioned of April 2004?
A At the end of 2004, I think we got up to -- the last hole in 2004 I believe was 92.
Q 92?
A So you subtract the first 20 or -- it's actually less than that, because there's holes other ways.
Q And at what point did you begin improving the geotechnical aspects of the drilling program because you knew that you

were going to be doing something serious here?
A As soon as they drilled hole 2 -- YD002, it became apparent that we've got to move it out of an exploration-type scenario where you typically collect less data. Then through 2002 and 2003, you know, we're developing basically geotechnical acquisition programs, and in 2003 we went over to a fully digital and geological and geotechnical logging program.
Q There was some testimony earlier about a period of time where you didn't have all your protocols in place for the geotechnical drilling program that you eventually arrived at?
A That's correct; that's correct.
Q And I'm still a little bit confused. I thought this April 2004 was when you told us was the end of exploration.
A No. That was the handover. We'd been conducting an order-of-magnitude study prior to that date, so I probably phrased it a little fuzzily. Between the time of drilling 2000 -- sorry -- YD0202 in 2000, we essentially moved from what was an exploration program into an order-of-magnitude study. And I'm going to say, by the end of 2003, we had everything set up to start generating data of a standard sufficient for an order-of-magnitude study moving forward.
Q So by the end of 2003, your drilling program was established at the level of sophistication that you've continued ever

since?
A We have made some minor modifications after that, but at that point we we're sort of getting onto the plateau of where we needed to be.
Q And what are the minor modifications since the beginning of 2004?
A We added -- I think we called it a microfracture-intensity variable, microfracture-intensity strength, things like that.
Q What does that measure, sir?
A It's just if you see a zone in the core, that -- if it's not a -- for example, if it's not a cemented joint -- it has to be less than 1 millimeter -- sorry -- a cemented joint has to be greater than 1 millimeter in width, so these things are very, very fine hairline fractures with some sort of fill on those surfaces. So typically they're not complete, but we will log those as well.
Q In any event, the program that you described yesterday with the collection of data pursuant to input forms for modeling that you'd send the data up to Golder that we thought were somewhat incomprehensible forms that we talked about for awhile that's --
A Correct.
Q -- when did the program that used all of that data and collected all that data fully get established?

A In 2003.
Q And how many holes had been drilled before that program was established?
A I'd like to talk specifically about the Eagle orebody, how many holes they had drilled in that, if I may. Give me a minute, and I can count them.
Q Okay.
(Witness calculating)
A I'm thinking off my head -- off the top of my head, it's probably on the order of 12 holes, not all of which penetrated the mineralization. YD02 obviously did. Some of them we were testing down deep in the mineralizations in deep holes, so they're drilled at Eagle but actually missed the mineralization if you --
Q When you talk about 12 holes that weren't in the final program with the improved protocols, is that 12 out of 109?
A It would be on that order, I believe.
Q I'm just having trouble with the numbers here. Are -- the 109, it sounds from your testimony as if that doesn't -- that's not all the Eagle deposit, the 109. That does include holes from elsewhere?
A We'll take a step back. At the Eagle deposit right now we have 200 holes drilled. I think we're talking at slightly different odds. If I drill a hole off the west end of Eagle and it misses, that's an important hole that is drilled at

Eagle. Holes that hit mineralization obviously are drilled at Eagle. So I think a more -- you know, I'm going to stick with that number. I'm going to say 10 to 15 holes were logged under the pre-2003 protocols.
Q But out of the 109 holes we've talked about, some substantial number were looking for ore elsewhere or characterizing ore that had been found elsewhere such as at Eagle East; is that correct?
A They're trying to find extensions to Eagle. And I'll get back again to that point I made. If I drill a hole off the end of Eagle and I miss it, to me that's still a hole drilled at Eagle. And that may be 50 meters or even 100 or 200 meters out from Eagle. So it's very important holes obviously, so I include them in Eagle so --
Q But they're not important to the crown pillar stability of the Eagle?
A I wouldn't think, if you're 200 meters out, from my point of view, it would be important, but Golder considers all those holes as well.
Q And then by 2004 how many permanent employees -- full-time employees were out at the site, and what were they doing -- I mean, out at the site in Negaunee or otherwise working for Kennecott on the project?
A Can you give me a month within 2004?
Q Well, let's --

A January?

Q Let's say January.

A Yeah. I was located up there. We had a safety officer and a field tech at Eagle as Kennecott employees, and we also had a contract logging crew. At that point we had one, two, three, four contract loggers typically as a minimum.

Q Were you logging the site where the improvements will be for the mine operation? Did you say --

A Not logging trees.

Q Yeah. Well, okay. You're logging cores.

A Logging cores.

Q Okay. And those are not actually Kennecott employees, then?

A They're long-term contractors. One of the ladies is still with us from 2004.

Q But they don't work for Kennecott, these loggers?

A They work for Kennecott as contract geologists.

Q And what company are they employed by?

A They're independent contractors.

Q Do they work for a company?

A They work for themselves.

Q I see. Each one individually?

A Yeah. They working on daily rates contracts.

Q And where are they based? Where do they live?

A Are you referring to at that point in time or right now?

Q Yeah. I'm talking 2004.

A Two of them -- three of them, actually, of the geologists actually -- two of the geologists lived in the Marquette/Negaunee area. At that time two or three of the others were flying in and out of Colorado, I believe it was, or Tucson -- and/or Tucson, I should say. At that point in time we were also still utilizing the services of exploration geologists from Kennecott, and they were flying in and flying out.
Q And were the exploration geologists doing some of the logging?
A Yes, they were.
Q Was there a company called the Mine Members -- Mappers?
A Mine Mappers, yes.
Q Mine Mappers?
A That's correct.
Q And what did they do?
A They're an interesting group of people. They're guys with 20 to 30 -- well, actually, 30 to 40 years' experience. They do geotechnical and geological evaluations of existing mines or mines that are being temporarily abandoned, and they develop geotechnical and geological models for those things. And we brought them up to Eagle to help us out in the geotech logging.
Q From where did they come?
A I believe one of the gentlemen is actually based in Iron

Mountain, and he's -- actually, his brother is based out of Tucson, I believe. I mentioned Colorado before but based out of Tucson.
Q And are all the loggers degreed geologists? Sounds like they're not.
A Yeah; yes.
Q They are?
A The logger degreed geologists will have field techs who will do the point load testing, the actually physical breakages of the rock. The field techs will cut core. The field techs will retrieve the core from the drill site, that sort of thing. So we have technical assistants to the geologists.
Q Are you familiar with projects or have you worked on projects where the logging was done on site as the cores were taken out?
A I've done that.
Q And one of the advantages of that is that it answers the moisture question, doesn't it, sir?
A No, it doesn't. The advantage of that is you don't induce any further damage to the core through transport.
Q Well, how do you answer this moisture question which went unanswered with respect to all of these cores?
A Well, again, I would refer that question to Golder, who have done some groundwater hydrogeological modeling.

Q Well, I'm asking in the data collection. I mean, Golder does the analysis, but they can only analyze what you send them, and you don't send them cores; right?
A No. We send them core -- data based off of logging cores. But again, A5 is truly not my area. I don't opine on A5.
Q I'm not asking for an opinion. I'm just asking for, physically among the people that you employ, the drillers and the loggers, --
A Uh-huh (affirmative).
Q -- what steps were taken to determine moisture content at the time at the site or back at the shed?
A On the job that we do, which is the drilling, you know, we're drilling a hole in the ground and using water to lubricate the bit. So every time you pull a core barrel, the core comes up wet. So I'm not sure where -- well, I know you can't make a determination based -- well, you can't make an A5 determination based on that.
Q Based on the outside surface of the core, because you've already put your own water in it?
A Because it's already wet, yeah; more properly done through pump tests and modelings.
Q And nobody ever asked you to gather data -- moisture content data?
A No, because I can't do it from the drill core. I can't do it from the drill core.

Q Okay. But it can only be done on site; correct?
A Yeah, it can only be done on site; yes.
Q And you were in charge of the operation on site collecting the data, so only you could have collected this data; correct?
A No. When we're doing pump tests, for example, we had Golder personnel out there supervising the collection of pump test data.
Q And when was the pump testing program begun?
A I believe we were doing modeling in 2004 or -5.
Q Was any effort made to correlate the pump testing data collection with the analysis of A5 in the cores that you obtained?
A Could you repeat that question again, please?
Q Were any steps taken to coordinate the pump testing data collection with the core drilling and logging in order to arrive at this A5 data point?
A When Golder conducted the -- when Golder designed the pump testing program, they took into consideration zones of poor quality rock as a way of indicating that may be a permeable barrier within the orebody.
Q Well, let me ask you this: Did any data get collected or generated on site under your direction that addressed the A5 criterion of RMR that you know of?
A If you're referring specifically to the logging of core --

is that correct?
Q Well, if that's specifically the area in which this data should have been collected, then, yes.
A No. You cannot collect A5 data from the core. You can locate zones that you suspect have higher permeability from the core, but you're not making a determination of A5 just based on that. Is that --
Q No. I understand what you're saying. And you say it has to be coordinate with pump test results or some other --
A That's correct.
Q And the pump test results -- the pump testing started after much of this core drilling had gone on for a long time; right?
A I would have to check the record, sir. I can't remember if it was 2004 or 2005.
Q Is it safe to say, sir, that you are pro mining?
A I'm pro mining in an environmentally responsible manner.
Q You've prepared a resume; correct?
A That's correct.
Q And I don't think we need to put it up on the screen, but one of the points in your resume was that you had conducted your part of your work under budget; is that correct?
A That's correct.
Q What costs have you cut to come in under budget, if I may ask?

A Typically haggling on contract drilling process. That's where we spend most of their money. I'm not trying to suggest that we lowball the contractor, but we have good contract meterage prices right now. That helps us a lot.
Q But you considered this an accomplishment worth putting in your resume that you had kept costs down; correct?
A Keeping costs down is very important.
Q I have a few questions, sir, about the basic geology that you observed in the course of your data collection and specifically with respect to the development rock. Can you tell us if the development rock included -- includes siltstones?
A It would include siltstones.
Q How about sandstones?
A In addition to sandstones.
Q Shale?
A Shale would be in there.
Q Slate?
A Slate is another rock type.
Q And I'm going to pronounce this wrong, but turbidite greywacke?
A Greywackes, yes.
Q Greywack?
A Greywackes, yes.
Q Is that one of the constituents of the development rock?

A Yeah; uh-huh.
Q And do all of these different components of the development rock have different traits?
A That's why they're logged separately, yes.
Q Yeah. It would have been more efficient if I'd done this a different way, but what's the basic relevant trait of siltstone to you in analyzing the development rock?
A Well, I think you're asking me to go somewhere where I'm -- you're asking me characteristics of the rock. I can answer that it's a fine-grained rock. It has a variable sulfide percentage in it. That's the way I would describe it.
Q Yeah, and that's the kind of description I'm asking for.
A Yes; exactly.
Q Can we do this list, then, quickly that same way? How about sandstone?
A Sandstone is a slightly coarser-trained rock than a siltstone. Again, typically sandstone has a lower sulfide percentage in the rock in the Baraga Basin.
Q Lower sulfide percentage?
A (Nodding head in affirmative)
Q Siltstones, would you call them strong rock?
A We should be calling them metasilstones. Most of the rock out there is slightly metamorphosed, and they can be an extremely strong rock.
Q Okay. How about sandstone? That's not strong?

A Again, that can be an extremely strong rock.
Q It can be?
A Yup.
Q Is it out there? Is that --
A I believe it is, yeah. That's a good characterization.
Q And shale?
A Shale can be variably sulfidic out there. I'd probably class it as a lower-strength rock than the first two you mentioned but still very strong in that area.
Q And how about the slate?
A Slate is a metamorphic equivalent of a shale. It's just gone through one more level of metamorphism. They start to --
Q Does that mean it's stronger, though?
A Not necessarily. Again, if you were talking about a tunneling operation, it will strongly depend on which way you were going through the slate. Slate by definition --
Q Is striated or whatever?
A Well, it has a layering in it, for lack of a better term. So again, it's a pretty good rock out there.
Q It's strong in some planes and could be shattered in other planes?
A That's a good way to describe it, yeah.
Q Turbidite greywacke, what -- is that -- how would you describe that?

A That's a pretty solid rock. That's a massive featureless sort of a variably grained sandstone.
Q And this may be in the record multiple times, but what is the -- what are you saying when you're "mineralized" or "mineralization"?
A As a geologist, I get excited when I see economic mineralization, be that as copper or nickel or lead or zinc. So when we say "mineralized," you're referring to a component of the rock that may be of some economic value.
Q Such as copper or nickel?
A That would be an example.
Q When you said you discovered mineralization here, was that the discovery of this copper and nickel and sulfide?
A I'm sorry. You're going to have to rephrase that. Can you ask that again, sir?
Q Yeah. And maybe I'm using the wrong terminology. But at some point in the exploration process, YD2, I think it was, --
A Uh-huh (affirmative).
Q -- you discovered mineralization?
A We discovered significant amounts of mineralization, yeah.
Q And that was copper and nickel in this sulfide ore?
A Correct.
Q Do you happen to know -- and maybe we should ask somebody else -- but where the aggregates coming from in this

operation?
A I actually don't, really, sir.
Q You don't know that?
A I believe it's from -- no, I'm not even going to comment on that.
Q Is it anyplace nearby?
A I would assume it would be, yes.
Q Who knows that?
A I believe one of our witnesses can testify to that, sir.
Q Anyone in particular? You don't know?
A Probably several.
Q I think we looked yesterday at this but, in any event, I will tell you that in Appendix C-1, talking about the geology of the Eagle deposit, there's a statement, and I'm quoting:

> "A number of think dikes ranging from less than a meter to a few meters in width have been noted in drilling in close proximity to the Yellow Dog intrusions. Little is known about the extent, orientation or composition of these predominantly fine-grained dikes."

A Uh-huh (affirmative).
Q Do you know what that refers to?
A I think we were discussing that earlier this morning, and I'll say it again. There are dikes that appear to extend

east and west of Eagle, thin, fine-grained dikes. There's definitely one underneath Eagle. That would be, I believe, what we were talking about in that particular --
Q Okay. And what is it about the extent, orientation or composition of these dikes that has not yet been determined?
A The extent isn't -- we haven't purposely gone out and tried to drill holes falling -- pulling a small dike, for example, so we may hit in a hole off the end of Eagle to the west, for example. It would be unmineralized. So we're not going to purposely go out further to the west and drill that same --
Q And waste a lot of time looking at it?
A Well, yeah, exactly.
Q Do these dikes have any bearing on stability issues to the mine?
A Are you talking about the fine, small-scale dikes?
Q Yes.
A No.
Q Are there larger dikes proximate to the ore deposit that do have stabilization or stability relevance?
A I don't believe so. The dike that we discussed that's apparent in the geophysics to the south of Eagle that we drilled, the contact between that particular dike and the sediments is extremely solid. It's a welded contact, basically.

Q And that shows up in a particular core?
A Yeah. It would show up in hole 111.
Q Hole 111?
A Yeah.
Q I guess I was trying to get at this earlier, but can you give us a number that constitutes, as of the time of the filing of this application, the number of drill holes that were relevant to stability of the mine?
A At the time of filing of the application?
Q Yeah. I mean directly relevant.
A Well, we can quote the number 26 in the crown pillar.
Q Have you ever been involved in mining under a body of water before, sir?
A Under a body of water, no.
Q Do you know of any of your colleagues who have worked on this project to date, if any of them, have experience drilling under a body of water like the Salmon Trout River?
A Are we talking about drilling now? Drilling under the water body or mining?
Q I mean mining; mining.
A Okay. Actually, the gentleman on the front of Exhibit 303, I think it is, Jim Finch, he's a geotechnician -- geological engineer now in charge of the underground development of Diavik, which is a diamond mine.
Q Do you know, is he going to testify for us in this case?

A I don't believe he's on the list.
Q Now, this may be outside your area, but when you look at -- when you see core drillings with areas -- substantial areas sometimes of bad rock or weak rock, aren't those areas of bad or weak rock highly relevant for the overall strength of -- or stability of the body that's being mined? Isn't it the -- it's like the weakest-link-in-the-chain concept? Doesn't that apply to mining?
A It depends how you approach those features in the mining plan. And again, you are right when you say it's out of my area of expertise. But typically you want to hit those things at right angles, for example. If you have a large plane of feature, you don't want to mine along it or down it or up it. You'd want to cross it. I'm not going to elaborate more than that on that particular point.
Q You said, with respect to the drill run that you brought into court here, that it was pretty good rock?
A In that particular box, it was pretty good rock.
Q Yeah. What kind of RQD would you give it?
A It would be in the high 90's, perhaps 100. I'd have to look at that again.
Q If not 100, what features would bring it down from 100 and put it in the high 90's?
A If it was a 3-meter run, for example, and you measured a piece of core less than 10 centimeters. So you'd -- round

numbers you'd have 2.9 meters on 300, so you'd be looking at, say, 97 percent RQD.
Q When you were demonstrating yesterday, you picked up some of the rock, and it looked like you looked at it with a magnifying glass?
A That's correct.
Q And you opened up fractures and studied them for roughness and other characteristics?
A Uh-huh; that's correct.
Q Isn't it true, sir, that the ability to pick up the core and study it closely like that gives you a greater opportunity to find indicia of weakness in the rock than if you're just taking a photograph?
A No. It gives you the ability to qualify and quantify exactly what you're looking at. I wouldn't agree with you on that one.
Q I guess what I'm asking, then -- I'd be interest in your answer. If you're limited, for whatever reasons, to looking only at photographs of core samples, isn't that going to buy us the results that you get for assigning RQD's upwards because you'll miss things that are relevant to lower RQD's? Isn't that the way it works, actually?
A I would state again that logging core from photos is not industry practice, and I've never seen it done before.
Q But the disadvantage of it is you miss things; right? You

don't see things that give you a higher RQD rating. You miss things that might give you a lower RQD rating; isn't that true?
A I'm sorry. Just run that question past me again.
Q Yeah. The disadvantage of being stuck with only photos to look at of core samples is that you're going to have -- you're likely to miss things or you may miss things, the kind of things you pointed out yesterday, that would make the RQD rating that you had to assign higher than it would be for somebody who looked directly at the rock?
A I don't think -- and if you're referring to Dr. Vitton and Dr. Bjornerud's report, they have set the RQD values that we generated, so there wasn't any variation in that.
Q Okay. Well what aspect of their looking at -- merely at photographs would have skewed their -- any of their conclusions in the direction of lesser rock strength than greater rock strength?
A Well, that gets right back to the heart of the matter of the source of the dataset. They were reviewing core photos from 8 holes that displayed or had recorded major structures in the rock. So right from that point, they're starting with a dataset of lower quality rock. And I can't attest as to how Dr. Bjornerud determined A3 or A4, for that matter. I can only conclude -- I can only indicate that I would find it extremely difficult to do that off the core and --

Q Okay.
A -- photos; sorry. I left the important word off.
Q Well, were you saying -- first of all, they did just accept your RQD's; right? They used them?
A They made --
Q They used your RQD's?
A Yeah. They made commentary that they thought it was overdone, but they accepted it and --
Q They accepted those numbers?
A That's correct.
Q So your RQD's that you got from picking up and looking at the rock -- or your people did -- are the same RQD's that they incorporated into their analysis; correct?
A That's correct; that's correct.
Q Is there some respect in which you are specifically critical of the review of Dr. Bjornerud or Jack Parker that you think would have given them a final analysis lower than your final analysis or Golder's?
A Specifically I would suggest that, in the definition -- sorry -- the logging of A3 and A4, that they're limited in their ability to make a full and complete characterization of those features and -- so they're just looking at one-half of the core in a box. They can't turn it over. They can't see if that feature is actually a complete feature in the core. And again, I think I'm being repetitive here, but

they can't pull it apart. They can't look at the roughness of the surface. So I'm assuming they're making assumptions on the roughness of the surface, the joint conditions, without the physical contact of the core, and I would suggest that they were probably pushing the envelope a little bit on trying to use that methodology to determine A3 and A4.

Q Okay. Well, as you full well know, this was not their choice. This is what they -- you look at drill cores with the army you've got or whatever the term is. But I'm just asking you if you specifically know any respect in which that skewed their results against Kennecott somehow.

A I'm not implying that they did. I'm just saying their methodology was not correct. It's not industry standard. That's all I can really say about that.

Q But not adversely to Kennecott in the final analysis?

A I'm not sure, sir. I'm just saying that they can't do it off core photos.

Q You used the term again a couple minutes ago "major structures." What are major structures, sir?

A Major structures are features that the geologists will note in the core, and it can be a broken zone of core. It can be a gouge, which is a zone of soft ground-up rock. It can be a shear, which can be actually a plane of very little on it, but it's a long, continuous feature in the core. So they're

sort of broken out on length and characterized in those categories. So a major structure is something we capture and put in the major structure tables for a reason, you know. We want to know what they are and where they are.
Q And because they're significant for bedrock stability; correct?
A That's correct.
Q And I guess my question is, do you know -- once you've got the major structure data -- and there's some 40 major structures in the proposed crown pillar; is that right?
A I believe that's what was logged in the crown pillar, yes.
Q Do you know how these get translated into an analysis of crown pillar stability? Do you put numbers on them?
A Where it's possible. You are collecting the A1 through A4 parameters on those structures. As we saw in hole 62, there was a zone there where you couldn't. Okay? So the major structures are located 3-dimension in space. You know where they are. And one method is to physically pluck them in space and then physically rotate those things around and see if there's any lineation of features that you've logged. And again, it comes back to the zone of lower quality rock that's being identified off to the north of the Eagle ore deposit. That's a very good example of how we use that table in conjunction with the RMR and in conjunction with the RQD.

Q When you located major structures and logged them, did you -- you located evidence of a major structure in a given core; correct?
A That's correct.
Q Did you attempt to orient that discovery of one of these 40 major structures to other cores nearby?
A Yeah. I think I was just trying to get at that. Maybe I didn't explain it very well.
Q I didn't get it.
A Yeah.
Q But it could be me. Do you want to draw something? Because that --
A No, I can't draw it three-dimensionally.
Q Okay.
A These are drill holes, and what we're doing is we're plotting features, major structures in this case, in a various set of drill holes. Okay? You can plot that one there (indicating). I don't want to draw on my fingers. Let's call it this knuckle and this knuckle and one of these knuckles. So you can take that with your drill hole trace and physically spin that thing around in three dimensions. Okay? So, you know, all of a sudden we see, as we did at Eagle, that there appears a concentration of lower quality rock, again, inconsistent with the RMR, RQD and major structure table. But there's a zone over here. So when I'm

turning this thing, I'm not going to see it from, you know, underneath. But when I'm looking at it east to west or west to east or from above or below on that plane, we've got to notice that there is a lower -- a zone of lower quality rock.
Q Okay. You made reference yesterday -- and I think we -- you had a diagram up that showed a fault that had been located by Klasner some years ago -- right? -- or two -- was it two fault lines?
A That's correct.
Q Okay. And the two fault lines created a fault zone?
A That's correct.
Q And you said that you hadn't yet found any evidence of that specific fault zone; is that right? Or is that right?
A The 13 holes that we have drilled in and on the edges of that zone don't appear to indicate that there's a very large 500-meter fault zone through there, nor does --
Q I mean, there is evidence of faults intersecting the orebody; correct?
A I wouldn't say that there's conclusive evidence, and I'll go back to that structure that we were talking about. We originally had a fault -- and I'm assuming that you're talking about this one drilling across Eagle way back in 2003, 2004. That was defined through geophysics essentially. And then, as the years have gone past, we

drilled four or five holes perpendicular to that plane and numerous holes fairly acutely to that plane, and I just haven't seen the evidence for that fault in existence. What the original origin of that was was the shape of the body itself. It's a dumbbell shape, and the magnetic response sort of lit up two big circles like that (indicating). And the original interpretation was there must be some sort of structure through there, but I haven't seen that in the drilling, and I doubt there was --
Q Okay. Well, it sounded like you're saying that Klasner's fault zone you don't think is as large as Klasner drew it, and that's saying it doesn't exist?
A Well, I'm saying the evidence is just that it doesn't exist.
Q And the faults that Golder found, what about them?
A The faults that Golder found in reference --
Q Do you know what I'm referring to?
A Do you have a table or --
Q Yeah, we can take a look.

MR. WALLACE: Could you put up our Exhibit 7? And I'm looking at Exhibit 4 to that exhibit. And this is also DEQ 97, I believe. These are Sainsbury exhibits. If you could, scroll down to the bottom of that page.

Q We'll get to this issue of faults in a minute, but I want to cover a couple of other things. This is Deposition Exhibit 4 to the Sainsbury deposition, sir, which is Petitioner's

Exhibit -- the overall Deposition Exhibit -- Petitioner's Exhibit 7. All right? And this is a May 22nd, 2006, memorandum from David Sainsbury to the -- to Mr. Maki. And the first point is critical of the fact that only point load tests were initially used without using the UCS to calibrate. Do you see that?
A Yes.
Q And was that criticism accurate?
A No. I think we did uniaxial compressive strength tests with Golder back in 2003.
Q Do you have any idea of why the UCS results didn't turn up in the Golder data and Dr. Strand criticized this?
A No, I couldn't -- I'm sorry.
Q Did anybody bring to your attention the Sainsbury criticisms?
A Eventually, yes, I read these.
Q I mean, much of it had to do with data collection, did it not, sir?
A Yes.
Q So do you have any explanation why, if you had done UCS testing, you were being criticized for having not done so and using only an outmoded point load test?
A The point load test is not outmoded. The point load test is always used in conjunction with uniaxial compressive strength tests.

Q Has to be done with them?
A That's correct.
Q And is this kind of on a one-to-one?
A No, not at all. You want a database of your rock types. We have UCS tests. That gives you the uniaxial compression strength. And you want to correlate your point load tests, and there's a factor of conversion there that will give you a comparative MPA value, compressive strength of the rock.
Q And do you know whether the mine application reflected that you've done these UCS tests?
A I'm not sure, sir.
Q Did you send the data to Golder so they could use it?
A Golder performed the tests.
Q Oh, they performed the -- did they perform point load and UCS?
A No. We performed the point load tests in the Negaunee facility. Cores were sent to Golder for performing the UCS tests.
Q And who selected the cores?
A Back in 2003 that would have been probably myself.
Q Probably you?
A Yeah.
Q And how many pieces of core did you send to Golder for UCS testing?
A I think it was a represent sample of the geology. I can't

quite remember -- a representative sample of the rock types.
Q So Sainsbury goes on to say:

"Laboratory testing of the unconfined compressive strength (UCS) of representative intact rock specimens is required to determine the intact rock strength of the rock mass units surrounding the proposed Eagle Mine."

Correct?
A Correct.
Q Did you ever have any conversations after you learned of this criticism and saying to Golder, "I thought you were going to do this testing. Why are we being criticized for not including it"?
A I did not.
Q And you don't have an explanation for this, then?
A I do not.
Q Do you know who would at Golder or elsewhere?
A I would have to check who the data was sent to or who the specimens were sent to for UCS testing.
Q When you first arrived in the Upper Peninsula, were you the first geologist on behalf of Kennecott to arrive there?
A No, I wasn't.
Q Who preceded you there?
A Steve Coombes would have preceded me. Prior to Steve problem would have been Mr. Dean Rossell, who's spent a good

part of the last 20 years on and off in the U.P.
Q Who was in charge of observing, analyzing and documenting local and regional geology at the outset of this project?
A I'll ask you to clarify that. Are you talking about just mapping geology?
Q Well, I'm talking an overall assessment of local and regional geology. Well, let me ask you this: Is an understanding of local geology and regional geology important to predictions about, for example, crown pillar stability?
A I would say a good understanding of your local geology is very important to your crown pillar.
Q And who was in charge of assessing that among the first geologists out there -- assessing the local geology?
A You would say Mr. Dean Rossell.
Q It wasn't you?
A Dean did most of the mapping, and I refer specifically to mapping in the Baraga Basin.
Q Was there any other assessment of local geology undertaken besides mapping?
A Geophysical surveys; very extensive coverage of geophysical surveys as part of the exploration program.
Q And by that are you referring to at the site?
A The site and the entire area. If you recall, that map we saw earlier, Baraga Basin, and I explained it went east/west

essentially out of that and to the south a little bit.
Q Was there an effort made to understand horizontal stresses in the area or region?
A As a task to specifically understand them? No.
Q Would you agree, sir, with Sainsbury statement that:

"Pre-mining in situ stress regime has a significant effect on the behavior of underground excavations. The horizontal stresses assumed throughout the ability and subsidence analyses have been underestimated"?

Do you agree with that?
A You're talking to a geologist. That's a mining engineer making that statement.
Q Isn't there a relationship between local and regional geology and horizontal stress?
A In the big picture there is, yes.
Q Well, who did estimate the local horizontal stresses?
A There's a lot of literature just regarding -- trying to characterize -- I'll use the term "orogenic events," which are very significant events in the earth's crust that may impact an isotropic or stress regimes that aren't all nice and even. And for me to go beyond that into the mining, up-close part, that's not my field of expertise.
Q And really I don't mean to be trying to take you outside your field. I'm really talking about initial data collection at the site, and I'm trying to find out -- here

we have a criticism that the stability and subsidence analyses have been underestimated. Who collected that data and why was there this underestimation if you know?
A Which paragraph are you referring to?
Q It's right below "Pre-mining in situ stress."
(Witness reviews document)
Q If you know. I mean, somebody --
A No, I can't -- I can't explain to you why he would say that or what data he's basing that statement on.
Q You, yourself, didn't --
A As a geologist I can't explain to you why he's saying that.
Q Did you, yourself, do any analysis of regional or local geology -- you, yourself?
A Yes.
Q And what steps did you take to gather data about local and regional geology?
A Typically mapping and interpretation of geophysical surveys. That would be a very big part of it.
Q Do you know who did the estimating of horizontal stresses?
A There's a -- as someone mentioned previously, there's an abundance of public data out there that does pertain to very broad-scale, broad-brush approaches as trying to plot out horizontal stress regimes all over the US. We sort of live out there on the Canadian shield which has a particular horizontal stress. And again I'm talking from a geological

perspective and absolutely nothing to do with the mining perspective. So he's referring to in situ stress measurements. I believe the permit condition requires us to collect in situ stress measurements once we begin mining down there. That's an appropriate place to collect them. Since we don't have outcrop in the crown pillar, for example, we can get that from underground development as required by the permit.

Q As of now, as of the time this application was filed, or as of the time you were out in the beginning analyzing this site for mining, there are two ways that you can -- two basic ways you can understand stress regimes. One is to look at local and regional geology; correct?

A To a point, yes.

Q And you can't tell us who did that -- besides mapping, who did that to form an estimation of the local stress regime, can you?

A As I said before, that's public, filed data.

Q But who did it? You were in charge out there. Who gathered this data and made the estimate, if you know?

A Right back to the point that there's public, filed data out there that's applicable to the Canadian Shield as a starting point. I didn't do it. But Golder, with their extensive experience in the Canadian Shield and those types of rocks, presumably apply a factor to start with for their modeling

process.
Q So you think the estimation was done by Golder?
A In their modeling it definitely was done by Golder, yes.
Q And the other way, if you're not satisfied with the local geological information, is to do actual in situ stress testing; right?
A That's one option, yes.
Q And you did none of that; right?
A We've done no actual in situ stress measurements at Eagle. We have drilled a lot of holes and we've done some disking out there, which is an indicator of high, horizontal stress. So indirectly we have that information.
Q You have information from what source?
A Indirectly we have information on the horizontal stress indicated by the absence of disking in the core.
Q Well, disking occurs when the stress is so great that rock starts breaking; right?
A It's a high horizontal-to-vertical stress ratio in that particular piece of rock.
Q Rock actually breaks up into little --
A It turns into poker chips.
Q -- pieces? It turns into poker chips? Okay. But you can have high stress that doesn't -- that hasn't yet resulted in that; correct?
A Generally that's pretty much an instantaneous occurrence

when you drill it. You drill it and it will turn to poker chips either before you get it out of the hole or very soon after. Once that stress -- in-built stress in that core is released, it starts to --
Q   Does it give you any measurement?
A   If you're able to have an orientated core on the disking of that core you could make some bold assumptions as to a -- orientation for the maximum principal stress.
Q   You don't know how close to disking any particular rock that you --
A   No, I don't.
Q   You can't tell that?
A   It's not disking now.
Q   If it's not disking you don't know if it's close to disking? You don't know if you're --
A   I'm sure there's some study probably being done precisely on that question.
Q   If you know, sir, why would you not have -- I mean, you've done now 200 drill cores. Why would you not have over-cored a few of these to get some in situ stress information?
A   It's -- I would suggest that in situ stress measurements are very typically corrected during the onset or the start of mining.
Q   But here in a situation where you're filing an application that's supposed to talk about the stability of the mine

among other things, why would you have not? I mean, is it prohibitively expensive to do over-coring? Or are there other views?
A The best place to collect it is in the mine.
Q But if there were some advantage to knowing something about the stress regime through in situ testing before you start mining; for example, if you're going to be asked about that; why would you not do some over-coring? And again I ask is it prohibitively expensive?
A There is a way to deal with a lack of that stress data in the way that consultants at Golder placed those variables into their calculations. The absence of a stress measurement on our behalf can be easily reconciled or anticipated by simply bumping up your stress values in your modeling. We could make it horizontal-to-vertical stress of ten to one if you wanted to. I mean, that's the point. I couldn't -- this line of questioning is a good one for Golder to explain.
Q Okay. I'll take your advice on that. Let's look at the bottom of this page if we could, because I think it addresses what you just mentioned. When you say you could use a variety of stress values up a model to see what results you got, is that what a sensitivity study is, sir? First of all, let me just read this for the record. A sensitivity study is required to determine crown pillar

behavior under a variety of possible horizontal stress conditions. That's what it says; right?
A That's what it says, yes.
Q Okay. And a sensitivity study is just that, isn't it? Try different values in the same situation?
A Yeah. You can -- very many of the variables that go into that, not just stress.
Q And Sainsbury is critical that this was never done; right?
A He would seem to be suggesting that in the last --
Q And are you aware that it's ever been done to this day?
A I believe it has by Golder.
Q And have you seen those results?
A I have read the report, sir.
Q Do you know where that is or what it's called?
A I'm sorry. I couldn't point you in the right direction.
Q Were you ever asked to gather data that would be used to support sensitivity studies of horizontal stress?
A I would submit that the point of the sensitivity analysis is, in the absence of data you can assume a range. So you can put a worst-case scenario or best-case scenario into that.
Q Without gathering data?
A If that's what you are required to do, yes.
Q We're looking under, again, the Sainsbury "Modeling of Subsidence, Modeling Methodology." And do you see that

first point, sir?
A I do.
Q And he says, "No analyses were conducted using plasticity theory to predict shear and tensile failure of the rock mass"; correct?
A So you're getting further and further away from my field of expertise.
Q Well, here's you question: Were you asked to collect data that would support a study of plasticity?
A Sir, I'm not even sure what data I would collect to support that study.
Q Okay. Fine. And if we can put it a different way, were you asked to collect data that you understood would be used to predict shear and tensile failure of the rock mass? And if you don't know what that data would be, that's fine. I'm just asking.
A We've spent quite awhile, and I've explained what data I collect.
Q So as far as you know, you weren't specifically asked to collect data to predict shear or tensile failure; correct?
A Shear or tensile failure? No.
Q Sainsbury's next point is "Long-term -- the long-term time-dependent behavior of the Eagle crown pillar was not considered," et cetera. Again, were you asked to collect any data that you understood to address time-dependent

behavior?
A No, I was not.
Q And do you know whether this has ever been done?
A (No verbal response)
Q If you know.
A The calculation of time-dependent behavior of the crown pillar is a function of the rock; the quality of the rock, the type of the rock. And that's what we're collecting geotechnical data to help quantify. I collect geotechnical data. I do not make interpretations.
Q At the top of the page -- earlier I think I asked you about a Golder Report about sub-vertical fault?
A That's correct.
Q Here we -- here Sainsbury is telling us "A discrete sub-vertical fault plane that intersects the Eagle deposit has not been considered in any of the stability or subsidence analyses." Do you see that?
A I do.
Q So do you agree, sir, that a sub-vertical fault plane intersecting the Eagle deposit was located?
A The one he's referring to -- the one he's referring to is the one we discussed earlier that originated from the geophysical data from the very beginning of the project; a description of the dumbbell shape orebody in the magnetics. I replied -- I think it was to Mr. Haynes -- that we have

now five, six, seven, eight, nine, ten drill holes through that plane. And I don't find good evidence that there is a significant structure through there. But to be conservative, we've included it in there. We leave it on the plane.

Q And I guess that was my question. Because I'll represent to you that the last that I've seen from Golder on this subject is that this plane exists and it intersects the orebody?

A It intersects the orebody as it's plotted. I don't believe it would intersect the crown pillar as designed.

Q Are you saying as a geologist you think this fault plane is irrelevant to crown pillar stability?

A No, not at all. I'm saying as time goes on and we collect more data in that area, there appears to be less and less evidence that supports the existence of that plane, either as a fault or anything else.

Q Sir, we had testimony a couple days ago about -- from a gentleman who's a water chemist, an environmental chemist who collected water samples out on the Yellow Dog Plains for a four-year period. And he report that in 2004 he collected water from a substantial hole in the ground on the future mine site --

A Uh-huh (affirmative).

Q -- and sampled it for contaminants. Do you know what this hole would be full of water out there that -- I guess he

testified there were a number of such holes full of water. What were they -- what were they from?
A Okay.
MR. LEWIS: Just an objection to the form of the question, your Honor. As I recall, Mr. Coleman is certainly no water chemist.
MR. WALLACE: No, this was Dr. Ejnik.
MR. LEWIS: Who?
MR. WALLACE: Dr. Ejnik gave his testimony.
MR. LEWIS: Oh, I'm sorry. I missed that testimony.
Q Do you know what those holes were, sir?
A They're probably -- well, if you can tell me where they're located, I might probably be able to give you an answer.
Q He just said the mine site, and he said there were a number of them.
A Close to anywhere or --
Q I happen to know, but I can't bring that to bear. I don't recall exactly what his testimony was. Are you recalling that there were holes a variety of places? Where do you remember seeing holes full of water?
A Under Part 625 when we're drilling a hole we're required to use a sump to capture cuttings. Sometimes those sumps remain open prior to reclamation. Sometimes they accumulate water in them.

Q And are those holes lined? He said the one he looked at was not lined.
A What year was that?
Q 2004.
A Prior to 2005, August 1, the requirement by the DEQ, I believe was not -- the requirement wasn't that you needed to use a PVC HD liner, which is a large plastic sheet inside the holes. So at that stage we were using a combination of bentonite to line those holes.
Q Later you started using PVC?
A It's 20-mil HD PVC.
Q And do you know, sir, that even after starting to line those with PVC, the liners were allowed to fall down into the the bottom of the hole and continue to allow drainage from the holes? Did you ever see that?
A If I did, they are fixed immediately.

MR. WALLACE: I'll pass the witness.

MR. EGGAN: Your Honor, I probably have ten or 15 minutes. The witness has indicate he would like to be able to leave after his testimony. I don't have a problem with going on, but I want to be sure that you're okay with it.

JUDGE PATTERSON: I'm okay.

MR. EGGAN: Okay. Very good.

JUDGE PATTERSON: Mr. Lewis, do you have any substantial redirect you're anticipating at this point?

MR. LEWIS: We are going to have to cover the documents that we discussed yesterday on the exhibits. There was some discussion about the -- the word's escaping me. It's not "key code," but there's another word.

MR. HAYNES: Picklists.

MR. LEWIS: Picklists. So I do want to take that up with Mr. Ware after lunch if we could. If we could complete the cross, that would be good.

MR. WALLACE: I actually quit early hoping you could go -- leave.

JUDGE PATTERSON: So what you're saying is, you want to finish the cross and then break for lunch?

MR. LEWIS: That would be my preference. I do have to organize some of those things.

JUDGE PATTERSON: All right.

MR. EGGAN: Mr. Ware, I don't have very much, and I just want to cover a couple of issues.

CROSS-EXAMINATION

BY MR. EGGAN:

Q You've talked about faulting --

A Correct.

Q -- and the faults that have been seen or not seen in the area. And I just want to cover a couple of issues with you. One is, we can agree, I think, you and I, that faults are water-conductive features or can be water-conductive

features?
A Faults can be water-conductive features.
Q In other words, water can use a fault or a fault zone as a highway or as a roadway to move along?
A Water-saturated bedrock, yeah.
Q Very good. I'd like to show you again Exhibit 214. And you'll forgive me as I get up, because I have a hard time seeing it and I want to make sure that we're communicating. Now, this is KEMC Exhibit 214. Now, this I believe as you testified was a series of snapshots, if you will, of various levels as you look at them -- as you looked at them in the zone of the orebody; am I right?
A They're level planes through the orebody.
Q Good; good. Now, I believe you indicated that you were working with a Dr. Alasdaire Pope on this?
A That's correct.
Q And you indicated that Dr. Pope identified or was responsible for the black -- this black writing on Exhibit 214?
A That's correct.
Q And what we see here on Exhibit 214, at least at level 375, is a note from Dr. Pope indicating "fault separating steep and shallow limb misfit," question mark. So he's asking whether there is a fault in that area; am I right?
A With his question mark that's what he's indicating.

Q He doesn't say that there is, but he is questioning it?
A That's correct.
Q And here is another notation -- and again, this is at level 375 -- another notation where it says "another fault," question mark; am I right?
A That's what it says.
Q And it looks to me like his note has an arrow pointing at this black line that goes through this area; am I right?
A That's correct.
Q And what is the -- is the shaded area here with -- that appears to be bordered in brown?
A That is mineralization, either semi-massive or massive mineralization as I recall.
Q Does that indicate that we're talking about the area of the orebody, then?
A That would be above the level of the crown pillar base, that particular plane.
Q Very good. And then I think that we have another notation here on the left-hand side, down here (indicating) where it says "another fault," question mark, and he's got a line drawn up, it looks like, toward the northeast; is that right?
A That's correct.
Q So at least at level 375 Dr. Pope is asking about three potential faults that exist at that level?

A Dr. Pope is --
Q Sir, just listen to my question. At least as of level 375, Dr. Pope is asking -- or questioning the existence of three separate faults in this zone; am I right?
A That's correct.
Q Can we move down slightly? And I'll tell you when to stop. We're going to go down now through level 325. And then we'll continue on down. It's going to flip right over to another page, and that's okay. Again, we're still on Exhibit 214. Okay. Let's continue on down. I don't need to -- well, we do need to stop there. Let's stop at level 275. Okay? And again, this is -- these are more snapshots. And this is the report, or this is -- these are the snapshots that you, I believe, and Dr. Pope worked together to create?
A That's correct.
Q And Dr. Pope, here at level 275, has indicated another notation: "Suggestion of another north/northeast fault"? That's what he says?
A With a question mark, yes.
Q With a question mark. I am not disagreeing with you. Question mark; am I right?
A That's correct.
Q So he's questioning whether or not these faults exist?
A Yes.

Q And bringing them to the attention, as he should, of Kennecott; am I right? Bringing them to the attention of Kennecott, at least with a question mark?
A With a question mark he's bringing them to the attention of Kennecott.
Q Good. Let's move -- let's move down slightly. Bear with us, because the technology is a little slower. Okay. Now, what we have here is a drillhole plan; am I right?
A With some of the drillholes on it, yes.
Q Okay. Showing some of the drillholes?
A That's correct.
Q And the notation at the bottom of Exhibit 14 says, "As per Dr. Pope's 275-level map"?
A That's correct.
Q "The drill holes shown in the above intercept" -- and we're talking about this particular snapshot; am I right?
A Shown above intercept, yes.
Q Okay. What appear -- I'm going to make sure I read it -- "what are possible water-conductive features"; am I right?
A That's correct.
Q And again, we're agreeing, you and I, that faults are water-conductive features? You've said it a little while ago; we agreed faults are water-conductive.
A If you are sure on their existence, yes, they could be water-conductive features.

Q Understood; understood. Okay. So at least Exhibit 214 is calling into question the possibility of some faults, and those faults are water-conductive features. We can agree on that?
A Sorry? Repeat that question, please?
Q Sure. As to Exhibit 214, we can agree that there is clearly a question in Dr. Pope's mind about the existence of faults and water-conductive features. And here are the drill holes that are showing the interception of water-conductive features; am I right?
A In Dr. Pope's interpretation it was an attempt to place a structural model on Eagle.
Q Understood. Now, let's talk for just a second about Dr. Pope, because I want to make sure that the hearing officer has an understanding who Dr. Pope is. Dr. Pope is a Rio Tinto consultant geologist, isn't he?
A Dr. Pope is a Rio Tinto employee.
Q Okay. But he's also a consultant geologist, isn't he?
A He consults to various groups within Rio Tinto, hence the name "consultant."
Q Understood. He certainly has knowledge of structural geology?
A Yes, he does.
Q He is a real Kennecott Exploration Company employee; am I right?

A That's correct.
Q In fact his offices are in Salt Lake City, Utah?
A Yes, they are.
Q And you've consulted with him on other projects, haven't you? This isn't the only time you know Dr. Pope?
A That's correct.
Q Okay. In fact, Dr. Pope has been an employee of Rio Tinto Mining and Exploration since about 1992; am I right?
A That's correct.
Q And has also been an employee of the Kennecott Exploration Company since about 1999; am I right?
A That's correct.
Q And in fact if you look among Dr. Pope's publications, you would see that this is a gentleman that has some advanced knowledge in faults; am I right?
A Correct.
Q So we're not dealing with a guy who really doesn't know very much about faults. This is a guy who's written articles about faults and their presence and their impact on a site like this; am I right?
A That's correct.
Q For example, in 1996 he wrote an article titled, "Geometry and Evolution of a Fault Bend/Fold"?
A Sorry? What?
Q He wrote an article titled "Geometry and Evolution of a

Fault Bend/Fold, Mount Bertha Antic Line"? He wrote that article?
A Very good; yes.
Q And in 1996 he also wrote an article titled"Mesozoic Fault Systems: Deformation and Fault Block Rotation in the Andean Forearc." He wrote that article too, didn't he?
A He did.
Q So this is a guy who knows something about faults?
A He knows some about faults.
Q I'll bet he knows something more than maybe you do? Or maybe you know more about faults than he does. I don't know. Do you?
A In relation to this particular deposit, given that I've seen every drill hole, I would suggest --
Q Well, you and he --
A -- I would know a little more about it than he does.
Q But you and he collaborated on this particular report?
A We argued together on this report, yes.
Q On Exhibit 214?
A We certainly argued together on this report.
Q Okay. And maybe you disagreed with him?
A We had our differences.
Q We also know that Klasner found faulting in this area, didn't he?
A No. he inferred it.

Q Okay. Inferred it or not. But Dr. Klasner certainly found evidence to suggest that there was faulting through this area?
A We found evidence in geophysical data of faulting.
Q Very good. And from the documents we saw this morning, Dr. Sainsbury found evidence of faulting through this area. In fact, I think what he said was, he found evidence of a substantial fault through the zone we're talking about?
A I don't recall that particular wording, sir.
Q Well, we can go back to Exhibit 4 if you wish, but I think that's what you and Mr. Wallace talked about a few minutes ago.
A I'll take your word on that one, sir, if he said it's substantial.
Q Let me ask you this: You've indicated that you did some geophysical work and some drilling. I think you said you drilled 13 holes in the area where the -- south of the intrusive?
A 13 drill holes in between the lines or on the lines drawn by Klasner.
Q Correct. Okay.
A That's not south of the intrusion. That's in between Eagle and Eagle East.
Q Okay. My mistake. Let me ask you, did you have test results from those boreholes showing hydrologic or -- well,

hydrologic characterization from those boreholes?
A No.
Q "No"?
A "No."
Q Did the logging that you did or the data that you have presented -- did that include -- from those boreholes, did that include flow data metering -- flow metering from those boreholes?
A Flow metering water?
Q Yes.
A No, it didn't.
Q They did not?
A No.
Q Okay. It sounds to me like you really did no testing in that zone to identify conductivity testing -- am I right? -- for water conductivity?
A On the log's drill core there's no testing.
Q Likewise no reactivity or resistivity testing?
A Again, on the logging of the core that's the only data we have in that area.
Q So I'm right? You don't have that data?
A That's correct.
Q Very good. Just a couple of questions about some of the things that Mr. Haynes asked you this morning. The drill logs that you and he talked about this morning, were those

reviewed by the Michigan Department of Environmental Quality?
A They're summary logs. They have a start depth and an end depth and a summary geology that says "sediment, intrusive, mineralization" -- it could be semi-massive, massive -- "sediment, end of hole." That's what they're designed to be, summary logs.
Q So I guess what I'm wondering is, in terms of the drill logs you indicated that a driller has the ability to write notations and memoranda right there on the drill log itself?
A I'm sorry. We're talking about two different things here. The driller produces his shift reports which we call a driller's log. And then you're talking about a drill log, which is a summary geology. And that's not done by the driller; it's done by the geologist.
Q By the geologist that's there, standing there?
A No. It's done by the geologist based on the core as it comes into Negaunee.
Q I see. Okay. What I'm wondering is, were either of those documents requested? Or documents for the boreholes that we have, were they requested by the Department of Environmental Quality? Did they ask to look at those materials?
A I would say yes. I believe Melanie Humphries certainly does ask me to get those things in a timely fashion.
Q And they were provided to MDEQ when?

A They go directly to Ray Vugrinovich.
Q That's the person from the Department of Natural Resources?
A I believe so, yeah. And I think the way it works -- and perhaps some other people here could correct me -- is that a copy is distributed within the governmental agencies.
Q Okay.
MR. EGGAN: I don't have anything more. Thank you.
JUDGE PATTERSON: Is everybody done with cross?
MR. HAYNES: I think we're done with cross, your Honor.
JUDGE PATTERSON: Do you have redirect?
MR. LEWIS: Yeah, I do have some limited redirect, and then I wanted to talk about those documents. I can do some of the redirect now if you prefer or do it after lunch.
JUDGE PATTERSON: It's up to you. I think the mission is to get Mr. Ware on his way. So however we can expedite that --
MR. LEWIS: Well, I guess my suggestion might be that we take a short lunch period. But I don't know if everybody can deal with that or not. Barring that --
JUDGE PATTERSON: Well, --
MR. HAYNES: Your Honor, why don't we break for lunch and come back that 1:00 o'clock and get at it then? It's about 10 after 12:00 now.

JUDGE PATTERSON: Does that work?

MR. LEWIS: Yes.

JUDGE PATTERSON: Is that short enough?

MR. LEWIS: Yes.

JUDGE PATTERSON: Okay. 1:00 o'clock.

(Off the record)

JUDGE PATTERSON: Ready?

MR. LEWIS: As ready as I'm going to be. Mr. Ware, a few questions on the prior examination.

REDIRECT EXAMINATION

BY MR. LEWIS:

Q First of all, toward the end, I think it was with Mr. Eggan, you were looking at, I think, what were called geological level plans again that you indicated that you and Mr. Pope had prepared; do you recall that?

A I do recall that.

Q And I wanted to ask you, what was the point of you and Dr. Pope preparing those figures and going through that exercise?

A The point of that exercise was to try and determine what the contacts of the intrusion and the host sedimentary rocks and their distribution -- how could that be explained by structure. It wasn't -- the idea wasn't to infer in structures; is was how to explain it by structure. If we could figure that out, then we could take that model

elsewhere within the Baraga basin and especially in the areas where we have outcrop and we can map the features that Alasdaire was generating through his interpretation of the shape of the orebody.
Q And did the creation of the figure itself have any meaning as to whether the so-called faults actually exist or not?
A As per the annotations on those plans with the question marks, it was simply an attempt to try and explain the shape of the orebody such as we know it from drilling. If there was a fault here, if there was a fault question mark, this might explain the shape. The drilling indicates and our databases indicate that those are just simple contacts, for the most part. Again I'll go back to what we know as a zone of weaker rock on the north side. So the idea wasn't to say that every contact in that orebody is a fault. The idea is to say this is the shape of the orebody; how might it be explained by a set of structures.
Q Mr. Ware, when you gave the data you described earlier to Golder that was referenced in their C-2 and C-3 reports, was any of the data that you had gathered excluded?
A No, it was not excluded. They got a snapshot of the database at a point in time. Up to that point in time, all the data resides in the database. We don't have separate subdatabases holding data. All of the data that was generated up to that point in time when we send the database

has all the data that we have. That's what send to Golder.
Q Now, back just for a moment to the so-called Klasner faults. You indicated earlier in your testimony that you had, in fact, had drilled a number of holes in the area shown on the Klasner map between the east outcrop and the west outcrop. Do you recall that?
A I do.
Q And what, in fact, did you see as a result of that drilling as to the quality of the rock in that area?
A The quality of that rock in the area was no different from other holes we drilled in the Eagle orbit where we drilled sedimentary rocks. The rock was good quality. In addition to that -- and we went through this earlier regards the aeromagnetic interpretation -- the drill holes that we drilled didn't show a sign of faulting. And the aeromagnetic interpretation that we did and I think fairly clearly showed that there could be no offset on those two structures that Klasner indicated as faults simply because the dikes to the south weren't moved. The sedimentary package to the south of the dike wasn't moved. There was no notch in the data. The dikes that Klasner drilled -- drew were based on his geophysical interpretation. We have 13 holes in that area now that indicate there's no 500-meter wide faults or even on the edge are faults that may just represent that line.

Q You were also asked earlier about a chance in the core logging program at some point in time; do you recall that testimony?
A I do.
Q And do you have in Intervenor Exhibit 303, which is the Eagle project ore drilling data collection and analysis procedures, a description of the changes in the ore drilling program, Mr. Ware?
A I do.
Q And is that page 4?
A It is.
Q In the introduction section there; is that right?
A That's correct.
Q And could you review that in terms of what was said in the procedures manual about the core drilling program?
A Basically the introduction highlights the evolution of the drilling program out of Eagle from one, which is a pretty typical grassroots exploration program where you're testing your target with one or two holes, how it evolved into a program where we got to the point where we thought we had -- may have an economic accumulation of minerialization. It's essentially highlighting the changes that were necessarily taking place in our data collection procedures to accommodate the possibility that we may have an economic orebody. Once you get an economic indices, you need to

start ramping up your geotechnical program to be able to capture all the data required for what might go into a future mine plan. If you're just drilling holes and not collecting all the data, then you're not taking full advantage of your drill core.
Q And is that evolution explained in this section of that document?
A It is. In paragraph two, we can see that the data was acquired at a grassroots exploration level. Again that's just a testing of targets and maybe one or two drill holes. And there was no geotechnical data on those holes. All the logging was done on paper and transferred to a digital base in 2002. The discovery hole, as we call it, was drilled in 2002. So, you know, we go from 2002. We've moved from actually recording on paper logs. And we've gone into a full digital storage for all of our geotechnical and geological and geochemical data. So it's very much an evolution that was common throughout the industry. That's basically what you have to do once you have a hole there. In 2003 we moved to tablet computers. We acquired software specifically for the project. Geotechnical data improved significantly because we were cognizant of the fact that we've gone from an exploration program into a program where we're drilling what might possibly be an economic orebody. As it says there, in 2003, "Quality control measures were

increased and sampling systems were standardized. We collected orientated core for several holes." It's a logical progression for any company in the mineral exploration industry.

Q Mr. Ware, I'd like to ask you about the geology report that you were asked some questions about earlier and that various other Petitioner's witnesses have relied on in their testimony. And it's identified as Intervenor's Exhibit 2. And it was in Bate stamp range 102383 through 102418 titled "The Geology of the Eagle Nickel Copper Deposit Michigan USA" prepared for Kennecott Minerals Company. And you talked about that report earlier again, Mr. Ware. And I wanted to ask you what kind of areas are covered in this report, first of all?

A This is a summary report basically discussing the local geology, physiography, regional geological setting. And then it moves into the discussion of the Eagle deposit itself. Within this report, we have a summary of the ore reserves as those were known at that stage. Those ore reserves were based on the data that I was responsible for collecting. The depiction of the orebody and the sections and plans, the result of the data I was collecting. Steve Coombes and Dean Rossell wrote the report, and it went through a full extensive peer review including myself before this became a document within our filing system.

MR. LEWIS: Your Honor, I would offer that exhibit at this time.
JUDGE PATTERSON: I'm sorry. The number of that again was?
MR. LEWIS: Intervenor Number 2 starting at Bates range 102383 ending at Bates range 102418.
MR. HAYNES: Just for clarification, is this -- is the offer Appendix C-1?
MR. LEWIS: No, I don't think so, Mr. Haynes. I'm not sure what Appendix C-1 is at this time.
MR. HAYNES: Well, I thought that's what the witness was talking about.
MR. LEWIS: Okay. I guess it is also referred to Appendix C-1.
MR. HAYNES: SO it's the full C-1 appendix?
MR. LEWIS: That's my understanding.
JUDGE PATTERSON: Okay.
MR. REICHEL: Yes, that's my understanding as well. For the record, I believe this has been previously been referred to Appendix C-1 to the permit application -- the mining permit application.
MR. HAYNES: I'm going to object on foundation. Because the witness has testified that he assisted in the preparation of portions of the report. But he also said that Mr. Coombes and Mr. --

MR. WALLACE: Rossell.

MR. HAYNES: -- Mr. Rossell also prepared portions of it. They aren't going to be here to testify. That's Mr. Rossell, R-o-s-s-e-l-l. They aren't going to be to testify. They're not on the current witness list. We don't know which portions they prepared, so we don't have a chance to cross-examine them on their portions of the report. So I object on that basis, your Honor.

MR. WALLACE: I join in the objection.

MR. REICHEL: No objection.

MR. LEWIS: Just in addition to that, let me ask a couple more questions, your Honor, if I may.

JUDGE PATTERSON: Okay.

Q Mr. Ware, you indicated that you, in fact, peer reviewed this article?
A That's correct.
Q And were you personally involved with the mapping information within this document?
A I was personally involved in the generation of level plan sections in this document, yes.
Q And the geophysical information stated in the document?
A The geophysical information stated in this document was collected under my supervision.
Q And does this document, this report, accurately summarize the data that was collected and presented within this

report?

A It does. The purpose of the peer review was to make sure that what was going into this report accurately reflected the data that was available to us.

Q And as I think your Honor has already heard in these proceedings, various of the Petitioner's witnesses, in fact, relied on this report. There's testimony offered and evidence offered from this report by the Petitioner's witnesses. I believe it falls in the category of a business record. And secondly certainly under the Rules applicable here that this is, in fact, evidence of a type commonly relied on by reasonably prudent men and, in fact, various experts in this case. So I offer it once again.

MR. WALLACE: Well, with the additional testimony of Mr. Ware about his role in this, I'll withdraw my objection.

MR. HAYNES: I'll withdraw mine, too, your Honor.

(Intervenor's Exhibit 2 received)

MR. LEWIS: Now I'd like to turn to the discussion or the exhibits we were talking about yesterday, your Honor, and try to first get us back to where we were again. I believe it started out with my offer of Intervenor Exhibits 269 through 302. And I believe we had established that that is various geotechnical data collected by Mr. Ware and his crew as to various drill holes. And we talked about which holes there were the other day. And in addition to that, I don't know if we discussed it or not, but in the same category is Intervenor Exhibit 598, which is that kind of geotechnical information for another hole. I believe it's 47.

Q Is that right, Mr. Ware?

A I believe it's 84.

Q 84.

MR. LEWIS: And I'd like to deal with those first. First of all, as I understand the nature of the objections and even your questions, your Honor, it was -- I think it finally got down to the fact that the information reflected in those exhibits had been transported by them into what was called Acquire database and that, in fact, the codes that Mr. Ware described and explained in Exhibit 303 pertain to what was called an Access database. And there was apparently some confusion as to how to read these codes and so forth. So what Mr. Ware has presented is -- first of all, it seemed the simplest way to deal with this was that he retrieved the same data but now re-exported into the original Access format with the Access headings so that the description he went through yesterday now applies to these exhibits. And we have then Exhibits 618 -- new Intervenor Exhibit 618, which covers the cemented joint parts of the data and the exhibits we looked at yesterday. And then

Exhibit 619, which covers the cemented joint areas --

MR. HAYNES: Just to clarify, my 619 says open joint.

MR. LEWIS: Excuse me. Did I misread it? So does mine. But 618 says cemented joints. 619 says open joint.

MR. HAYNES: That's what mine says.

MR. LEWIS: That's what mine says. So I guess we're in agreement.

MR. HAYNES: So far we're in agreement.

MR. LEWIS: Okay.

MR. HAYNES: Making progress.

MR. LEWIS: All right. Just little baby steps. 610 refers to the geotech, and then 621 is the density database, and 622 is the entire point load database. And so the other thing I have to offer with that is --

JUDGE PATTERSON: Are these contained in the box that I was handed this morning?

MR. LEWIS: No, your Honor, they're not. And just to complete the list then or where we are, Intervenor 615 is the codes list or the picklist for all the various joint codes. And Exhibit 616 is the picklist or so-called code list that corresponds to the geotech codes so that these lists cover all of the data reported in the tables in Exhibits 618 through 622. And I would like to, if I could, your Honor, approach and give you these copies. I neglected to give those to you.

JUDGE PATTERSON: Okay. I have 15 and 16.

MR. LEWIS: Oh, I'm sorry. Good. Because I only have one of those left.

JUDGE PATTERSON: I got 614, -15 and -16.

MR. LEWIS: All right. These the ones that --

MR. HAYNES: Which ones are those, Mr. Lewis.

MR. LEWIS: 618 through 622.

MR. HAYNES: I have a copy and I think Mr. Wallace has a copy.

MR. LEWIS: Could we retrieve one for the judge?

JUDGE PATTERSON: I'm not sure I need it right now.

MR. LEWIS: All right. We'll get them to you when we need to.

JUDGE PATTERSON: All right.

MR. LEWIS: So I would offer those exhibits at this time, your Honor.

MR. HAYNES: Your Honor, assuming the representations of counsel are correct, I don't have an objection to these exhibits. But I'd note just for purposes of completeness -- and maybe it's because I don't understand the codes that are in here -- we have the codes for cemented joints, density, geotech, open joints and front load. What we don't have or what I have not been given is the geology set and the structure set. Now, maybe those included in some of the others. Perhaps I could ask the witness about that.

THE WITNESS: Yeah. The geology within the geotech table there --

MR. HAYNES: I have a geotech table. This is Intervenor 620.

THE WITNESS: Okay. If you were to down to -- and I don't have a copy of that.

MR. HAYNES: I'll give you mine.

THE WITNESS: Okay. So your question is? Sorry. As to geology?

MR. HAYNES: Yeah. The question is as to the geology table, because there are a number of exhibits that relate to the geology table.

THE WITNESS: Okay.

MR. HAYNES: Is that a separate group of tables that that table can be extracted from a database?

THE WITNESS: It could be extracted from the database. You do have the data in -- the original list. I have that here. You do have the data in 269 in the list to 302. So you can the geology tables in here. This is just an attempt to make the tables clearer. As we noted before, they are CSV files.

MR. HAYNES: Right. I guess the question is, you produced the Access database for four out of the six types of tables. What I'm missing is the geology and the structure.

THE WITNESS: Okay.

MR. HAYNES: Could those be reproduced in this format?

Q Are they not in these exhibits, Mr. Ware?

A No. They're not in the previous set of exhibits.

Q Okay. So we would have to use those as well?

A We could reproduce those.

Q And this new coding now has been provided that would apply to that?

A That's correct.

MR. HAYNES: For purposes of getting the witness on his way, I don't have a problem with a conditional offer if we can get those tables later.

MR. LEWIS: We already have them here, I think, is what Mr. Ware is saying. They're in the exhibits we discussed yesterday.

MR. HAYNES: Oh, they're --

THE WITNESS: I'm sorry. I'm not making it clear. The data I provided you on these new exhibits is exactly the same data in the --

MR. HAYNES: Oh, I see, just in a different format?

THE WITNESS: I'm just trying to make the format clearer for you to be able to see. And as I repeated and I'll repeat again, there was a problem because the data was exported from our current database, which is Access. And that caused some confusion as to the headers in the database.

MR. HAYNES: Yes.

THE WITNESS: The data is the same. The headers are now the old Access headers that should have sat across the top of that data. So you have the data. It's just a clearer format. And if you would like the structure table, we could --

MR. LEWIS: The same data is repeated in these new exhibits?

THE WITNESS: Exactly.

MR. LEWIS: But we can put in the other exhibits as well, if you'd like, because you now have the keys for them -- the code keys that correspond.

MR. HAYNES: I'm just trying to see if we could -- and maybe this is just a matter of convenience -- to have the geology and the structure tables reproduced in the Access format. Can that be done?

THE WITNESS: Today is Thursday?

MR. HAYNES: Today is Friday.

THE WITNESS: Friday.

MR. HAYNES: I want to get you on your way.

THE WITNESS: That's fine. I'm just thinking of the date when I can actually get that data. It's a question of 15 minutes and we can get that data out to you.

MR. HAYNES: Well, I wouldn't object to a conditional offer if we can get those so you can get on your way and you don't have to delay getting back to Negaunee. Okay.

THE WITNESS: Appreciate that.

MR. HAYNES: If we can get them in the new format, would that be possible, Mr. Lewis?

MR. LEWIS: Yes. We'll get them before Mr. Ware leaves based on his representation as to how soon we can get them.

MR. HAYNES: Great.

MR. WALLACE: I have maybe an amended objection, which is perhaps a suggestion. You know, I'm looking at the documents that we've been provided. And I appreciate all this backup. I really don't understand much of it. And so my only concern -- I don't think there's any way to just look at whatever we got -- another 150 pages of paper in the past few minutes and understand it. But if the purpose of the exhibits originally offered now supported by these codes and backup data is what this witness has testified to -- if these exhibits have been offered in support of testimony we've received here in court, I don't object to their being used in that way. My concern is -- and this is probably not the intention -- that I'll learn, you know, at the end of this proceeding or in closing argument or something that contained within these documents is information that is being used to contradict some other theory or something we haven't heard about. And to that extent, I don't think they should be admitted. I think they should be admitted in support of the testimony that's occurred here in court. And I don't object to that because I think I've understood that testimony. Just that they don't have some other purpose that we don't any of us understand.

MR. LEWIS: I think, your Honor, number one, before -- I think that we've laid sufficient foundation that what we could do at this point rather than bringing Mr. Ware up here again, I think it's established that all the data represented in Exhibits 269 to 302 and 598 is represented in those exhibits. And it's clear now, I think, that the key codes for the picklists have now been provided that correspond with those codes, which is what we were talking about yesterday. In addition to that, we've offered just as an easier means, I guess, of looking at that data these new exhibits 618 through 622 and that so Mr. Ware doesn't have to stay here so we don't have to bring him back up on the stand again to talk about these things, I think there's sufficient foundation in the record at this point to have these exhibits admitted. We certainly would, as a matter of courtesy, also get to Mr. Haynes later the other kind of format that might be easier for him to use.

JUDGE PATTERSON: Mr. Wallace, I think the concern expressed yesterday by you and Mr. Haynes was about enabling you to understand this in the event that there was subsequent testimony as to any underlying data and its validity in accordance. And I understood at that point that Mr. Ware was not going to address that, and he hasn't, and that that testimony would come in through Golder representatives. So I think now you've been furnished with sufficient information to hopefully understand this. I'm not sure I do. But --

MR. LEWIS: So the offer at this point would be Intervenor Exhibit 269 to 302 and 598 and Intervenor 618 through 622, your Honor.

JUDGE PATTERSON: These are being entered only so far as to support Mr. Ware's testimony as to how, when and the date it was compiled and foundational.

MR. LEWIS: It's foundation; it's foundation. yes.

JUDGE PATTERSON: And forwarded to Golder who did the actual analysis.

MR. LEWIS: Yes; yes.

MR. HAYNES: With that understanding, I don't have an objection.

JUDGE PATTERSON: Mr. Wallace?

MR. WALLACE: With that understanding, yes, sir. Thank you.

MR. REICHEL: No objection.

(Intervenor's Exhibits 269 through 302 received)

(Intervenor's Exhibit 598 received)

(Intervenor's Exhibits 615, 616 and 618 through 622 received)

Q Now, Mr. Ware, I wanted to ask you about a couple more exhibits, the same kind of foundational matter, your Honor. This is Intervenor Exhibit 309 we're looking at entitled "Geochemical data and Intervenor's Exhibit List." Can you tell us what this data is, Mr. Ware?

A That is the first page of pretty much the current assay database as it pertains to drill holes at Eagle. On the left-hand side you have the hole number. You have a from and a to as it's indicated in the head list. Then just to be clear for everyone, it's copper percent, so we got CUPCT. The first two letters are the metal abbreviation according to the periodic table. So it's copper percent, nickel percent, then it's gold, grams per ton, platinum grams per ton, palladium grams per ton, cobalt grams per ton, sulfur percent -- that's percentage -- zinc percent, SG is specific gravity, ALT03 is aluminium oxide, COO is calcium oxide, crown percent, FE203 is iron oxide, MGO is magnesium oxide, NNO is manganese oxide, and we have a SI2 value, which is silica dioxide. And then we have titanium dioxide on the end. So in that exhibit that is the list of variables pertaining to the geochemistry from Eagle as obtained from the assay database.

Q	Now, you're responsible for the collection and reporting of this data?

A	I am responsible for the collection and reporting of this data.

Q	And do you review this data?

A	This data is very carefully reviewed both internally and externally. The laboratory we use is called ALS Chemics. They have a preparation lab in Thunder Bay. When I say "preparation," that's a place where they're actually taking in our split drill core samples. They crush them down to a certain size. They seal them in paper bags. Then those samples are shipped to Vancouver where the ALS Chemics lab in Vancouver performs the geochemical assays which gives us this database.

In terms of quality control, we have a very rigorous quality control program. We essentially submit a duplicate or a blank or a standard of varying types. At this point, we're using three standards. Every one in five

samples. So 20 percent of the data we get back from the lab -- 18 percent of the data we get back from the lab is a check on their performance, so to speak from are end that are our samples. Also the lab does their own internal QA/QC which they report to us as well.
Q Is that a certified laboratory?
A That is a certified laboratory. It's a worldwide outfit. Reviews them for the entirety of this project. We use them extensively throughout North America. And we conduct independence audits on their preparation facilities and their assay facilities whereby someone unknown to them will drop in and announce to them, "I am a representative of Kennecott. I want to review their lab." And they're obligated to show that person around. And he does an independent audit on their function -- on the way they do things basically and make sure everything is right. It's a very rigorous process. It has to be. This is very important data for the economic side of things. If you do not get this data right, then you may have a problem. So we take special care with this data.
Q What's this data used for then, Mr. Ware?
A This data is -- as you can see in the left-hand column, you have a from/to and the drill hole. Now, we take that from/to, and each one of those has a corresponding series of metal values. We'll place those drill holes in space so we

come up with the true orientation of the drill holes. And then you start to incorporate geochemical data into each one of those intervals in space. So you've got a lot of drill holes as we've seen on plans and sections. And each one of those intervals has a specific copper, nickel, cobalt, gold, platinum, platinum value. And those values are used to generate a resource grade for deposit. The SG value there, that's used to in part generate the tonnage so SG and geochemistry can figure out the copper and nickel grade of the deposit and we can figure out the tonnage of the deposit.

Q And is the rest of this exhibit -- is it more of this same kind of data and information?

A That's correct. I believe it goes down to hole 179.

MR. LEWIS: Offer Intervenor Exhibit 309, your Honor.

MR. HAYNES: Your Honor, may I voir dire the witness?

JUDGE PATTERSON: Sure.

VOIR DIRE EXAMINATION

BY MR. HAYNES:

Q Mr. Ware, on this exhibit, if we're at page 1 -- we're at page 1 here?

MR. LEWIS: Yes, we're on page 1.

Q All right. The first hole looks like 01YB003. Do you see that?

A I do.

Q If we could please scroll down to page 5, fifth page of this. On this page, we have the first hole. It looks like 02YD002. Do you see that?

A That's correct.

Q And then it goes 02 and I have a series of numbers for that hole and then we have 02YD004. Do you see that?

A I do.

Q Those are holes 2 and 4 from the year 2002; correct?

A That's correct.

Q What happened to hole 3?

A It didn't intercept any mineralization of economic interest or it didn't intercept anything of interest, so it wasn't assayed.

Q Oh, so the holes that are represented here -- the drill holes represented by this table are only drill holes that intercepted rock of economic interest?

A Yes.

Q And that's why there are gaps in the holes here; correct?

A That would be correct.

Q For instance, could we go to the last page of this 142-page exhibit, please? And then scroll up one page, please. Thank you. It appears we have hole number 171 here, do we not?

A You have part of hole 171 there.
Q Part of it. And then we have hole 169?
A That's correct.
Q I'm sorry. It's taking me longer to where I want to go than it is -- just bear with me one moment. By the way, was hole 171 drilled in Eagle Rock?
A No.
Q No?
A No.
Q Somewhere else?
A It's drilled from the south side of Eagle.
Q I'm sorry. South side of Eagle. I misspoke. So 171 is the Eagle formation; correct? Not just Eagle?
A No. That contains some information on the mineralization in hole 171 which was from 385 to -- sorry -- 339 to 357 meters.
Q All right. Could we go to -- go up one page, please. All right. On this page, which I show as page 141 of this exhibit, we have holes 104, 105, 107, 118, 137 and up to 169. Do you see that?
A That's correct.
Q There are lots of holes that are not included here; correct?
A Yeah. We don't have a 100 percent hit rate when we drill. So again there's -- we've talked about this concept of a snapshot of a database in time. Okay. So it's very

possible that there's holes that are not here because they're still being logged or assayed or they're low priority. So this gap that you're talking about here, 138 to 169, they're not holes at Eagle. They're away from the main Eagle orebody.
Q I see. Did you have, Mr. Ware, somewhere in your office available for us to look at the location of these boreholes? Are they plotted on something?
A I would have that in my office, yes.
Q That is the boreholes represented by this proposed exhibit?
A That's correct.
MR. HAYNES: Your Honor, I'm going to object to the admission of this exhibit to the extent that we don't know where these holes are. And we've got a list of selected holes. The witness has testified that they appear to be related to the Eagle deposit. But without knowing where the holes are, it is difficult to understand the relevance of these figures, the relevance of all of the numbers and all of the chemical sampling points and the sampling data and the results. So I'm going to object on the incompleteness of the exhibit and therefore the relevance.
MR. WALLACE: May I voir dire briefly?
JUDGE PATTERSON: Sure.

VOIR DIRE EXAMINATION

BY MR. WALLACE:

Q Is what's happened here, Mr. Ware, that you've included drill holes that have been done since 2005 and away from the main ore deposit that's on here?

A That's correct.

Q They're just -- they came out in this printout. You didn't intend them for this trial or us to see them necessarily; right?

A This is just an exhibit of the geochemical analysis we do at --

Q And that includes stuff from elsewhere that might be of value?

A That's -- anything with an EA prefix or YD prefix is in the Eagle ore bit.

Q Ore bit?

A Yeah. As I mentioned, we don't have 100 percent hit rate. So we don't necessarily assay our entire holes occasionally.

Q But this includes hits that are not in the ore deposit underneath the Salmon Trout River; right?

A Can you scroll up just a couple of pages? There are several holes that are outside of the Eagle ore deposit, yes.

Q What do you mean by "the Eagle ore deposit"?

A Let's just draw -- it's easy to describe on a map. But it would be, say, 500 meters around the Eagle intrusion itself.

Q Okay. And these percentages, are they -- of the copper percent, is that -- I can't tell from this page. But I'm looking at .02 under copper percent. Is that 2 percent or two-hundredths of a percent?
A .02 percent.
Q .02 percent?
A Yeah.
Q So it's two-thousandths?
A It's .02 percent.
JUDGE PATTERSON: Two-hundredths of a percent or .2 percent. No 200. You're right. Like I said, no math in law school.
Q And I assume from the numbers on these holes that many of them have been drilled since the application was filed?
A Can we scroll down? Yes.
Q Okay. And finally this exhibit -- I may have to make a relevancy objection and then Mr. Lewis would respond. But it may be faster just to ask you. Was the relevance of this exhibit that it shows the value of the mineralization?
A The relevance of this exhibit shows the coverage of the geochemical data.
Q This exhibit is not being offered to establish anything about the stability of the crown pillar or the environmental concerns we've raised?
A It's an exhibit to illustrate the coverage of assay data on

drill core.
Q Okay. Assay data being mineralization information?
A Or not.
Q Or not?
A Or not. So we assay stuff that is of no value, sir.

MR. WALLACE: Being offered for that purpose, I have no objection if it's limited to that purpose, except that I do object to -- just to be consistent in this trial to -- as a general matter including data collected since the application which has given rise to this permit. I don't want to seem to avoid that objection. I don't really care on this exhibit. But putting in test results that -- you know, on other matters that we haven't seen and come in after the permit procedure was over with would generally be objectionable. And I don't want to waive that objection.

JUDGE PATTERSON: Okay.

MR. REICHEL: I have no objection.

MR. LEWIS: Similar to the last series of exhibits, this is foundation for information that's being used in the geochemical studies, your Honor. And I think the purpose of the data does not require location of these -- the location that Mr. Haynes was referring to. It has a different purpose. So I don't think that goes to the relevance of this data.

MR. HAYNES: On the other hand, your Honor, it would be helpful certainly, I think, for this tribunal to understand if the geochemists are going to come in and talk about the geochemistry of the orebody or the surrounding area, where they're talking about. And so the location is, in fact, quite relevant. Because I don't understand if you're talking about geochemistry, you have to talk about geochemistry both in the aggregate but also discretely. So the location data is, in fact, quite relevant.

MR. LEWIS: Again, your Honor, I think that's a question better left to be taken up if necessary when the geochemist testifies. It really has nothing to do with the foundational requirements for this offer of this exhibit at this time.

JUDGE PATTERSON: Mr. Ware, did you testify you could or could not generate something that would show the location of these holes? I'm not sure I heard you.

THE WITNESS: I could generate a table with the location of the holes.

JUDGE PATTERSON: Would that be a time-consuming thing or --

THE WITNESS: No.

JUDGE PATTERSON: Would it be a problem to do that, then?

MR. LEWIS: I've got no problem with that. I'd like to avoid having to have Mr. Ware come back if we could offer it or have it admitted conditional on producing of the table you just referred at some later point.

JUDGE PATTERSON: I think I have his assurance to be done. I don't think he needs to be here to present that.

MR. WALLACE: Well, if it can be done and I suppose if we have questions about it, we could perhaps get Mr. Ware on the telephone and examine him at that point. But I don't want to have him come back either. That's silly.

JUDGE PATTERSON: All right.

MR. WALLACE: That's fine.

MR. LEWIS: Agreeable.

THE WITNESS: Can I just describe what the table will be?

JUDGE PATTERSON: Sure, please.

THE WITNESS: It's going to be a hole number, a UTM Eastern, a UTM Northern and a color elevation for the hole.

JUDGE PATTERSON: What's the color elevation?

THE WITNESS: That's the distance above sea level. We use above sea level, ASL. And it's going to be in meters.

MR. HAYNES: That's fine.

MR. WALLACE: This will be in a form that we can locate it on a map?

THE WITNESS: Yeah. It's a common measurement system. If you wish to use that database to plot them on a map, you can plot out the names of the holes on the map. SO I can produce that data.

MR. HAYNES: That's satisfactory.

MR. LEWIS: All right.

JUDGE PATTERSON: Mr. Eggan, you've been very quiet. Are you happy?

MR. EGGAN: I am, your Honor.

JUDGE PATTERSON: All right.

THE WITNESS: Your Honor, I just have one question. Do you want the holes up to the end of the permit application? Is that my understanding?

MR. HAYNES: Yes.

THE WITNESS: That form the basis of the permit application?

MR. HAYNES: I think that's 109. That's the figure that I have in the various reports.

(Intervenor's Exhibit 309 received)

MR. LEWIS: May I approach the witness, your Honor?

JUDGE PATTERSON: Sure.

REDIRECT EXAMINATION

BY MR. LEWIS: (continued)

Q Mr. Ware, I'm handing you what's been marked as Intervenor

Exhibit Number 614. Can you identify what that is?
A This is a complete listing of samples that were set aside for metallurgical testing.
Q Set aside for metallurgical testing by whom?
A Probably me.
Q You mean you set the samples aside?
A That's correct.
Q And what was the use of the samples and what was the purpose of doing that?
A Just a little background. We typically send either a half or quarter core away for assay. That's destructive testing. That's gone. We send -- we need to keep always a sample of the core in the core box. And when it's mineralized, we will take what is called a metallurgical sample. And those metallurgical samples will be packed in sealed buckets. And they're used for a number of purposes one being metallurgical testing obviously. Several of our consultants request samples that pertain to a various grade range. They may want to see samples from 2 to 3 percent copper with 5 percent nickel. And I can go through this list with this VR number, which is a sample number, and indicate to them, "Yes, I have samples of a sufficient weight to meet your request." And then we'll have someone go over there and physically extract those samples from the bucket or buckets as the case may be.

Q And what is done with those samples?
A The samples -- they can form the basis, again, for strict metallurgical testing, which is a very standard procedure in the design of the mine and you want to know how to recover the material out of the sample. Also going to things like static incanate testing for AID studies. Those samples are sent on per request to people like Geochimica. These samples are also sent to various educational institutions who request samples from Eagle, various useful things.
Q Does this Exhibit 614 represent a complete listing and description of those metallurgical samples?
A Yes, it does.
Q And what kind of information is shown on the exhibit for the samples; what types of information?
A You have a bucket number.
Q I'm sorry. We don't have it up there.
A That's all right. I can read it off this. It's a bucket number. Usually you can get four to five samples in a bucket, so we label the buckets. As you can see, there was a sequential numbering sequence to start with. We got much better organized after that. We were naming the buckets by "M" for "metallurgical"; 41, for example, for the hole; and then number of the bucket in that hole. So there might be ten buckets for a particular hole. In any case, also on the bucket what we call the "VR" numbers. Those VR numbers

pertain to the assay sample that we send to Kemex, so what we're doing is generating a split of the core for which we have an assay -- that's gone -- assay result: the copper lead, zinc -- I'm sorry -- copper, nickel, gold platinum plating. So that number correlates to one of the assay numbers. Date which it was sampled. The project here is Eagle. We have a drill hole list after that; that's just the drill hole. You can see it repeats itself: on the very first page, continues on the second page, continues on the third page and on the fourth page we've got 12 or 13 samples that were sampled from that hole. So start/finish is again an interval value where the sample starts down the hole and where the sample ends down the hole, and then you'll get an interval itself. And the remarks comment is basically very brief geological description of the sample as contained in that bucket.

MR. LEWIS: Okay. Offer Intervenor Exhibit 614, your Honor.

MR. HAYNES: Your Honor, for what purpose?

MR. LEWIS: Again, it's foundation for the geochemical analysis, your Honor.

MR. HAYNES: I understand the foundation, your Honor, but we were just handed this exhibit after the lunch hour and it's -- I don't know -- 50, 60 pages thick. So I -- it's untimely, therefore, prejudicial. And it also goes to hole -- appears to go to hole 175, so it contains data that were obtained after the permit application, which goes to Mr. Wallace's previous objection. It appears to be a database that was available to Kennecott well before today and could have been produced as part of their exhibits well before today, so I object because of the prejudicial nature of it.

JUDGE PATTERSON: Mr. Wallace, do you have anything to add?

MR. WALLACE: You know, I don't know -- I don't know what to make of this. I don't know what to say, except I guess it's foundational. I understand what Mr. Lewis is trying to do here. I guess when I see what it's being used for later in trial I'd like, you know, have the ruling reserved until then because we don't know where this is headed.

JUDGE PATTERSON: Yeah, I think --

MR. WALLACE: And I can't --

JUDGE PATTERSON: And I don't think Mr. Lewis's intention is anymore than foundational at this point, so --

MR. LEWIS: That's right.

MR. WALLACE: I feel this is akin to this testimony in the Sainsbury deposition, what we were just handed in the bio and asked him to identify it and he did. But I understand why that is what you want to do right now, so if you could just reserve.

MR. LEWIS: It would be admitted subject to a showing of relevance later; is that --

JUDGE PATTERSON: Yeah, that -- yeah, it will be admitted merely on the foundational basis to alleviate Mr. Ware further testifying or coming back.

(Intervenor's Exhibit 614 received)

MR. LEWIS: Thank you.

Q And finally, Mr. Ware, this is Intervenor Exhibit 310 and can you explain what information is shown in this exhibit?

A That is a very simple table describing the lithology of various intervals in the holes. Could you flip to the page, please? Okay. So it's an exhaustive list again. It's simply a description of the rock in the interval, hole number from/to down the hole. A very broad descriptor. If we look at -- where you see the zero next to "178" it says zero -- oop.

Q They like to do that to us, Mr. Ware.

A Zero to 219; it's approximately halfway down there, so that's a very broad description of what the rock was: silt stone and it's a sediment. Here is a Gabbro; it's an intrusion. Here it's hornfels and it's a sediment. So those lithological codes go to in part the geochemical assay database descriptor; it's a descriptor for the geochemical assay database is what I'm trying to say.

Q And are you responsible for collection of this data as well, Mr. Ware?
A That falls under my responsibility.
Q And do you review this data?
A I review that data constantly. That's pretty important data as we can rapidly -- very rapidly generate cross sections while we're drilling new holes. And if something doesn't work out right when we're drilling it we quickly look at that and say, "Why did we miss?" basically.
Q Good. And does the -- is the data in Intervenor Exhibit 310 accurately represented, Mr. Ware?
A Yes, it is.
MR. LEWIS: Offer Intervenor Exhibit 310 on the same -- for the same foundational purpose as the last exhibit, your Honor.
MR. HAYNES: And, your Honor, to the extent that the data shows -- the data relates to holes that were drilled after the application was submitted I think that's objectionable. But with the previous understandings with the prior exhibits, otherwise I don't have an objection.
MR. WALLACE: I just have a couple questions so I can understand this.

VOIR DIRE EXAMINATION

BY MR. WALLACE:
Q Could we look at for hole 178 -- see where it says next to

it, "307.2"? Could we look at that line?
A This one here?
Q Yeah. 307.2; what's that number?
A 307.2 to 321.9; it's a interval -- in that case it's some 14 meters of massive sulfide.
Q Okay. And is this massive sulfide unit in the Eagle deposit underneath the Salmon Trout River, or is it elsewhere?
A It's in the Eagle deposit to the north of the Salmon Trout River.
Q North of the Salmon Trout?
A It's at the bottom of the deposit on level one essentially.
Q It's part of the same ore deposit?
A It is part of the same ore deposit.
Q But deeper down than --
A Deeper down and a little further to the --
Q And has that been shown in some schematic that as the red blob at the bottom?
A It is the red blob at the bottom.
Q Okay. And the minus "1's"; what are they again?
A If you can flip to the top, first page, please. That's just a cave number. They're all minus 1. Oh, wait. What we're interested in doing is getting a way to very rapidly produce sections on an area where we're working.
Q What kind of value is that minus 1 is what I'm asking.
A We never use it. That's a good question. What we're

interested in is the from/to and the rock descriptor, so you've got lithology 1, peridotite and then that's an intrusion. So to be a -- to just explain that a little better, if I wanted to plot a plan of ore intrusions: peridotites, Gabbros -- if you can find a Gabbro -- I would just -- I'd select lithology 2. If I wanted to be very -- a little bit more specific -- and this is a summary table -- I'd select lithology 1 to make the plan. So lithology 1 is a -- in the intrusions, for example, it's a bit more detailed of just intrusion.
Q And is what you just said with reference to the minus 1 number?
A If you can just forget about the minus 1 number. It's just a way to plot --
Q All the samples are below average; is that what that means?
A No, it means they're very high quality. It has no relevance to the purpose of the table and that's just a very quick way to plot sections in geology.
MR. WALLACE: Okay. With the same understanding that this foundational for some later witness and this gentleman has identified it.
JUDGE PATTERSON: All rights reserved?
MR. WALLACE: All rights reserved.
MR. LEWIS: So it's admitted on the same basis --
MR. REICHEL: No objection.

MR. LEWIS: Oh, I'm sorry. Admitted on the same basis as the last exhibit?

JUDGE PATTERSON: Correct.

(Intervenor's Exhibit 310 received)

MR. LEWIS: Good. That's all I have, your Honor.

MR. REICHEL: I have no questions.

MR. HAYNES: Your Honor, a little bit of recross based upon some new material in the redirect.

JUDGE PATTERSON: Mr. Reichel, did you pass?

MR. REICHEL: I just did.

JUDGE PATTERSON: Oh, I didn't hear you.

MR. REICHEL: Yes.

MR. HAYNES: I did. I apologize if I jumped in.

JUDGE PATTERSON: That's all right.

RECROSS-EXAMINATION

BY MR. HAYNES:

Q Mr. Ware, on redirect examination you talked a bit about the Klasner data. Do you recall that?
A Yes.
Q That was about a half an hour ago?
A Yes.
Q After lunch with Mr. Lewis; right?
A Yes.
Q And you talked about drill holes that intercepted the dikes shown on the Klasner report?

A The dike -- are you talking about the dike --
Q The dikes shown on the Klasner report.
A The dikes shown on the Klasner report, yes.
Q And you said there were 13 drill holes?
A Are you talking about the fault or the dikes? The fault was the one that went north, the big zone.
Q I'm talking about dikes, but if you're talking about faults let's talk about those.
A The fault zone as inferred by Klasner ran between Eagle and Eagle East. We have 13 holes in that zone there.
(Pause in dialogue)
Q Can you identify the fault -- or the -- yeah, the fault that you're talking about on this page?
A That particular plan doesn't show the Klasner fault.
Q Okay. Just for the record, if we -- is there a figure that you prepared that shows the Klasner fault that's in the appendices?
A There is an exhibit, I believe, produced that shows the Klasner fault, I believe. I can --
Q Why don't you -- all right. Rather than playing with that exhibit, Mr. Ware, can you with your laser pointer --
A Yeah.
Q -- point out and then describe where the Klasner fault would be on this chart from page 13 of Appendix C-1 -- excuse me -- this figure?

A Klasner based on his interpretation of the magnetics had one side of a fault zone going through here (indicating).
Q Running from south of --
A Basically through there.
Q Between Eagle Rock and the Eagle deposit and moving in sort of a north/northwest direction?
A I think it might be better if I draw it.
Q That's fine.
JUDGE PATTERSON: Yeah, let's --
Q Here we go.
A Okay. I'm just going to draw Eagle and Eagle East on this piece of paper here very diagrammatically.
(Witness prepares diagram)
A Here's Eagle and there's Eagle East. So Klasner's proposed fault zone, he described it by two lines essentially running like that. I wish I hadn't -- he put the line this side of Eagle. Let me draw it again. He put a line here and there's a line over here. So --
Q Mr. Ware, let me stop you for just a moment. The Klasner proposed faults or the faults that he described were there before we knew of Eagle and East Eagle; correct? As we know those terms today.
A The faults that he proposed were derived from a part of a study they were doing on Eagle and East Eagle intrusions.
Q I understand. Go on.

A Okay. So Klasner suggested there was a fault between Eagle and Eagle East. Our magnetics indicated there was no displacement on that large magnetic feature to the south which is a dike. We've drilled it; we know it's a dike. And we know there's sediments to the south of that which dip essentially into the page like that. So if there was a fault, if there was movement like this (indicating) with side going that way or -- let's make it a big one -- this side going that way you would necessarily -- on that line you would need to see displacement. So this line here would be pushed to the south, or this line here would be pushed to the north. We don't see that displacement; that's my point. And the sediment doesn't -- the magnetic response from the sediment doesn't change in that area either. More to the point, we have holes drilled across it there (indicating). We have holes drilled across here; just recalling which way they go. We have one drilled here that goes right across there. We have one drilled over here. The point being that in the 13 odd holes that we've drilled on this area here and in between these two lines we just don't see very good evidence that the structure he's proposing exists there. It's --
Q All right. That's fine. And for those 13 holes for you to come to this conclusion, do you have some document somewhere, some table, some reference that describes this

conclusion based upon the 13 holes?
A Well, we have our geological logging. We have the core.
Q These are the cores in Negaunee and the logging for those cores; correct?
A That's correct.
Q So you're drawing that conclusion based upon your review of the cores and the driller's logs and your geologists' logs from their logging; correct?
A Yeah, I'm basing that conclusion on my revision of those holes.
Q I see. And so if we wanted to check your work we'd have to go look at the cores and look at the driller's logs and the core log; correct?
A The drill core is the best way to review that.
Q Sure. So to check your conclusion to see if your conclusion's correct we'd have to go look at the drill cores? "Yes"?
A That would be correct.
Q Okay. Did you ever convey your conclusion to the DEQ?
A Regarding Klasner's --
Q Yes, regarding Klasner.
A No, I did not.
Q "No"? Did they ever ask about it?
A No, they did not.
Q Looking at Kennecott Exhibit 309, which is the

mineralization asset -- assay data.

(Pause in dialogue)

Q Mr. Ware, this -- when was this particular document produced for the first time? Last week? Last month?

A I'm sorry. This particular document?

Q Yes.

MR. LEWIS: Which exhibit reference is it, Mr. Haynes?

MR. HAYNES: 309.

MR. LEWIS: That was submitted with our original exhibits, as I understand it.

MR. HAYNES: I know that.

MR. LEWIS: Okay.

MR. HAYNES: I know.

A If we could just check the bottom again, sir. Last page. Is that going to take a long time? I think I recall it was either 171 or 178 down there. So that -- this particular --

Q 171.

A Okay. Well, this particular document would have last been updated probably in March.

Q March of 2008?

A Correct.

Q Okay. And so this document is -- or versions of this document have been produced on periodic -- on a periodic basis?

A It's a living document in that we're adding data to it as data becomes available.

Q All right. Has any version of this document ever been offered to the DEQ?

A No.

Q To your knowledge has the DEQ ever asked for any version of this document?

A No.

Q Mr. Ware, on Exhibit 3- -- Kennecott Exhibit 310 could you just for the record explain the various abbreviations in the lithology?

A Certainly.

Q Maybe you said this and I'm sorry if I'm repeating what you said before, but I didn't understand the difference between lithology; lith 1 and lith 2 columns. Can you explain those for us?

A Sure. We've got -- there's two types of rock type out there. Rock type, not overburden. So you can call it overburden, which is the glacial till.

Q That's OB; right?

A OB. There's intrusive or there's sediments essentially. Okay? So within intrusion it's an internal breakdown; it just gives a little more detail for peridotite, Gabbro or pyroxonite. And that is just the intrusion rock types. If you were to flip down there you may see other ones:

felspathic peridotite. That would be f-per. So again, I'll get back to the options you have with this. If I use this database I can just plot the outline of the intrusion at Eagle. If I want to get a little more detailed I can use this (indicating) column then I'll get intrusive types in that plot.
Q By "this column" you mean lith 1?
A Lith 1.
Q Right. So lith 2 is more general than lith 1?
A That's correct.
Q And in general lith 2 deals with overburden, which is "OB"; intrusion -- intrusive, which is "INT"?
A "INT."
Q "SED" is sedimentary; correct?
A That's correct.
Q And then "MSU" would be massive sulfide?
A That's correct.
Q Okay. "SMSU" would be --
A Semi-massive sulfide.
Q All right. And that pretty well exhausts the categories in lith 2, doesn't it?
A Pretty much.
Q And then in lith 1 we've got, for instance -- let's go down to the end of 01YD006. Make sure that's right. Here (indicating): what's "SHLE"?

A Shale.
Q Shale? Oh, I see. Okay. "SLST" means what?
A Siltstone.
Q These are commonly used geological terms; correct?
A That's correct.
MR. HAYNES: All right. Thank you. Nothing further.
MR. WALLACE: Just very quickly.

RECROSS-EXAMINATION

BY MR. WALLACE:
Q On Exhibit 214 which -- let's see if we can do this without even waiting for it -- in the various figures there was an indication of cleavage rotated in the shear zone, cleavage rotating towards basic shear zone? Remember those notations?
A Yes.
Q Okay. What does that mean?
A That the Baraga Basin has a general cleavage in the rock that's caused through metamorphism. We try and plot cleavage orientations; that gives us some indication as to subtle folding or structural movement. Cleavage rotation into the plane is -- if that's what you are talking about?
Q It was into the shear zone.
A Oh, into the shear zone. Okay. You would be saying there if it's an orientated piece of core then the rotation of

that cleavage is slightly different from the pervasive cleavage through the Baraga Basin as we call it. You can use it to map folds and faults that are post-pernokerogy* (phonetic) which is 2.4 billion years basically.
Q and is cleavage a split?
A That's a good way to describe it. It's a feature within the typically sedimentary rocks, typically fine-grained sedimentary rocks that is generated when pressure is applied and it's slightly metamorphosed and it develops these -- what's called cleavage planes and --
Q Lines of separation?
A They can be lines of separation. They can be all sorts of -- there's all sorts of cleavage. That's one of them.
Q And when it's -- when the cleavage is rotating into the base of the shear zone it's not actually moving as we speak, is it, or not?
A No. No.
Q "No"? Okay. It means that the direction of it is rotational into the existing shear zone?
A That's an indication that the cleavage was rotated away from the average cleavage.
Q And who noted this, you or Dr. Pope?
A Dr. Pope would have made that observation.
Q And what was Dr. Pope's belief as to the relevance of the cleavage rotating into the shear zone?

A Well, he was using that as a piece of evidence that there may have been movement on that particular fracture or shear.
Q Relevant to stability?
A Well, relevant to the other side of it. It is right on the intrusive contact as I recall, sir. At one stage it had to have had fault -- I mean a structure that had to have had some movement on it and that could date back, as I said, 2.4 billion years.
Q Okay. And did he believe this should be looked at further?
A I'm sorry. What should be looked at further?
Q The possible significance of this cleavage rotating into the shear zone.
A I don't think he believed it should be looked at further; he certainly noted it.
Q Did you agree as to its relevance?
A I agreed it was there, but we also had another discussion as to the age of that particular feature.
Q And you thought its age -- what?
A I thought it was essentially an undeterminable age.
Q And would that make it less relevant to the analysis that was going on in Exhibit 214?
A No, it was relevant; for our argument it was relevant.
Q Okay. And the argument was?
A If it was -- we have an age on the intrusion itself, which is 1.1 billion years. My contention was that the rotation

could be anywhere from 1.1 billion years back to 2.- -- let's say 2.2 billion years. So it's all to do with the timing of the intrusion.

MR. WALLACE: Okay. I've nothing further. Thank you.

MR. EGGAN: Nothing for me, your Honor.

JUDGE PATTERSON: Redirect?

MR. LEWIS: No, your Honor.

MR. REICHEL: Nothing.

JUDGE PATTERSON: Mr. Ware.

(Witness excused)

MR. LEWIS: We have to make a shift change.

JUDGE PATTERSON: Okay.

(Off the record)

JUDGE PATTERSON: Are we ready?

MS. LINDSEY: Yes. Your Honor, Intervenor Kennecott Eagle Minerals Company calls Dr. David Stone.

MS. HALLEY: Your Honor, we object.

JUDGE PATTERSON: That was quick.

MS. LINDSEY: That must be some sort of record.

MS. HALLEY: It was quick. Well, Dr. Stone was listed in the intervenor's witness list; however, there were no reports listed and his expected testimony is simply a list of words. We have no idea, no way to prepare for what he's going to say here today. His expected testimony says, "Mine engineering, mining plan, mine backfill materials and methods, stability of mine and backfill and blasting against a backfill, potential for air de-degradation of backfill, and rebuttal as appropriate." That could be almost anything.

MR. WALLACE: Join in the objection.

MS. LINDSEY: I think the description is actually quite accurate, your Honor. And he's not going to talk about just anything; he's going to talk about mine backfill materials and methods, stability of mine and backfill -- and blasting against the backfill, potential for the air de-degradation and rebuttal to petitioners' expert's opinion within his areas of expertise, which is exactly what we said. As this court is aware, we exchanged our -- the witness list on the same date that the petitioners supplied us with their witness list and all we had to know whether this was even going to be an issue, whether the backfill was going to be an issue was a couple of reports where Mr. Parker and Dr. Vitton had in a cursory fashion discussed backfill. And while neither of them was terribly qualified in that area, they talked about it anyway. So we had no idea whether this was even going to come up, and so this area of testimony is purely rebuttal and purely appropriate as rebuttal to the petitioners' case that they've raise, the issues that they've raised through their witnesses. And so we're offering this entirely to rebut what was put forth.

MS. HALLEY: Your Honor, the backfill plan, the intervenors in their application insist that this backfill is a key component of their mining plan. For them to suggest that they wouldn't have talked about it in these proceedings, I just have a hard time believing that. And our -- your order required a recitation of testimony and we provided very detailed recitations of testimony. And in return -- and Ms. Lindsey is correct that we exchanged lists on the same day, as it should be, but we complied with your order about a recitation of the testimony. And what we got from them was just a list of items with no way to narrow it down, no way to understand anything about the scope of the testimony we would be dealing with. And Dr. Stone had no report. There's nothing listed here about anything he's ever had to do with the application until today. We have no idea.

MS. LINDSEY: You Honor, if I just may respond. Dr. Stone has not prepared a report and was not required to prepare a report. The argument about the recitation -- if I may just read what is described for Jack Parker with respect to backfill, which you may remember he talked about backfill. The recitation says that "the backfill plan is faulty and will not hold up to the proposed blasting." That's supposedly the entire extent of his testimony. He went far beyond that in his testimony. And more importantly, this argument that continues to come up about the recitation; your Honor, we've addressed this.

What we put forth -- they've at the last minute come up with what they think is a definition of "recitation"; we had our interpretation of that. We put forth what we thought was sufficient information for them to understand. They waited until literally the eve of trial to even bring this up. They had our witness weeks for weeks and didn't come and say, "your Honor," or come to us and say, "Kennecott, we more sufficient descriptions." Instead they waited until the eve of trial as a tactic and said, "No, exclude all their witnesses on the basis of our now new definition of 'recitation.'" So, your Honor, we believe at all times that we complied with that.

MS. HALLEY: Your Honor, the eve of trial was not a strategic move on our part; it was simply due to the very fast track of this whole proceeding. And, furthermore, the eve of trial was about three weeks ago at this point and certainly during those three weeks somebody from the intervenor could have provided us more appropriate recitation than just a bald list.

MR. EGGAN: If I may add something to that, your Honor. We certainly didn't wait until the eve of trial. We groused about the absence of a recitation in our discovery motions; that our recitation was a full disclosure of what our witnesses would have to say and that theirs was not. So it should be no surprise to them that we did not like their recitation and didn't think that it was fulsome explanation of what these witnesses had to say.

JUDGE PATTERSON: I'm not going to exclude him. What I will do though at the conclusion of his testimony, you know, if you need time to prepare for cross-examination I'll accommodate that.

MR. EGGAN: Thank you.

JUDGE PATTERSON: If anything comes up that is a surprise or in any way you feel prejudiced.

MS. LINDSEY: Thank you, your Honor.

REPORTER: Would you raise your right hand? Do you solemnly swear or affirm the testimony you are about to give will be the whole truth?

MR. STONE: I do.

MS. LINDSEY: Good afternoon, Dr. Stone.

DAVID MICHAEL RAYMOND STONE

having been called by the Intervenor and sworn:

DIRECT EXAMINATION

BY MS. LINDSEY:

Q Would you please state your full name and spell it for the record?

A David Michael Raymond Stone, S-t-o-n-e.

Q Thank you. Can you just give us a background, your educational background?
A Yes. I have an undergraduate degree from the University of British Columbia where I specialized in geotechnical engineering. I graduated in 1975 -- 1980 -- sorry -- and then went on to do a master's and a PhD; a combined master's/ PhD at Queens University in Canada where I studied under Dr. Robert Mitchell who was in the civil engineering department. But that degree it was a multiple-disciplinary degree between the mining engineering department and the civil engineering department. I was granted a PhD in civil engineering in 1985.
Q Okay. And who is Dr. Mitchell?
A Back in the 1980's he was very well known in the backfill engineering field as being one of the kind of leaders in analysis and design for the stability of mine backfills.
Q And what was your thesis in?
A My Ph.D. thesis was in the stability of mine backfills.
Q Is there some sort of formula that Mitchell created or --
A Yeah. I mean, just prior to me arriving at Queens he had put out what's probably one of the landmark papers in terms of designing mine backfills, on the stability of mine backfills and that formulation is now pretty well accepted in the industry as being the state of practice for design of the stability of mine backfills.

Q And do you have any publications?
A Yes, I do. I have a number of publications in both rock mechanics and mine backfills.
Q Okay. And I think we actually have a list of those. If we could put that up just for you to maybe help illustrate. Could you tell us a little bit about the ones that relate to backfill?
A Sure. Well, the top one obviously there is my PhD thesis on the model studies. In there we were doing physical model studies, which is what Bob Mitchell was investigating at that time to confirm these formulas that he had developed. And then that led to the paper that was published in 1987, which was kind of summarizing the results of my thesis in the Canadian Geotechnical Journal, which is a peer review journal in Canada. And then I wrote a paper in 1993 that was published in the Minefill 1993 Conference on the "Optimization of Mixed Designs for Cemented Fills." And people in the industry tell me that that's one of the most widely quoted papers that's out there in industry right now. I've had a number of people present it to me in a number of different formats not recognizing the name. In 1995 I published a paper with Bob Mitchell on the design of CRF brattices.
Q And what is "CRF"?
A Cemented Rockfill. And a brattice is where you have a very,

very thin cemented rockfill pillar holding back uncemented fill and that uncemented fill exerts a force on the cemented fill. In 1998 I published a paper on "Hydraulic Filling for Underground Disposal of Tailings in Peru" and that was published in the Minefill '98 Conference. And I had a couple of rock mechanics papers I published. And then in 2001 I was the chairman of the Seventh International Symposium Mining with Backfill, so-called Minefill 2001, which was held in Seattle on September the 11th of 2001, a very unfortunate date. And I edited that proceedings volume. So that's a -- again, it's all peer-reviewed papers and it's available -- that publication is available. And then more recently I just published a paper which kind of summarizes all of my experiences on consulting to mines in Nevada on talking about cemented rockfill quality control.

Q Is that -- the 2001 publication is that a book?

A Yes. It's a proceedings volume, so it's a book, yes.

Q Okay. And we actually had some discussion in this case. Have you reviewed the testimony of Mr. Parker and Dr. Vitton?

A I have, yes.

Q And I believe that he cited to one of your articles; is that the --

A Yeah, I believe he was referencing the 2007 paper on the rockfill quality in Nevada.

Q Okay. He referenced it for the discussion of some quality control problems and backfill?
A Yes.
Q Did you review that?
A I did review his testimony.
JUDGE PATTERSON: Whose testimony was he reviewing?
Q I'm sorry. This was Dr. Vitton?
A Dr. Vitton, yeah.
Q Did you agree with his summary of your article?
A Well, in general, yes, but there were some -- there were some facts that weren't in the paper that he wouldn't have been aware of. He attributed the paper to be a mining method that was similar to what's proposed for Eagle, namely an overhand long hole stoping type method; whereas, in fact all of the mines in Nevada that I was referencing are underhand cut-and-fill mines, which is a very, very different mining scenario and requires a backfill of much, much higher strength. And so he was drawing the parallel between the strengths in Nevada and he had some notes about the sizes of the stopes and the likes that -- again, the details weren't in the paper and he had made some guesses that weren't correct.
Q And we'll talk a little bit more in a few minutes about the different types of backfill and the different types of

mining. But if we could go back. You talked during your discussion of a publication you referenced "Minefill Conference"?
A Yes.
Q What is that generally?
A It's a -- it's kind of a meeting of peers that's held every -- normally every 40 years, and it's an international conference so it's held all around the world. The last conference in 2007 was held in Montreal, the previous one in 2004 was held in China. In 2001 we were in Seattle. In 1998 we were in Australia. And in 1993 it was held in South Africa. The next conference is scheduled to be held back in South Africa in 2010, I believe. And that conference bring together approximately 130 people who are actively involved in the mine backfill industry. About half of those people would be operators, so people coming from mining operations that are using mine backfills, and probably a quarter of the people are researchers, so mostly university researchers, some industry researchers, and then about a quarter is kind of a good cross section of the -- those of us that are in the backfill consulting field, that actively consult in mine backfills.
Q So is that approximately 25 or 30 people who actively consult in backfills?
A Yeah.

Q Would you say that that's the number of people who actively consult in backfills or just the number who attend that conference?
A Well, it's probably a pretty representative number of the number of people that would have been considered to be industry wide, like, internationally known experts in the field. There are obviously other people. Some of the major engineering companies have one or two people who might be represented as being capable of doing mine backfill designs. But most of the independents attend those conference and the people who are very well-known in the indicated.
Q Do you have a position on the MineFill concept?
A Yeah. I mean, I'm the U.S. representative on the International Minefill Council, which is made up of ten member countries, and that council is kind of the backbone of the conferences. So within the U.S. I'm responsible for kind of, you know, generating the interest of published papers and to -- and keeping all the researchers and everybody all connected together.
Q And when did you become a representative?
A That was at the '98 conference in Brisbane.
Q With respect to your publications, are any of those -- you said some were peer reviewed?
A Yeah, I think they're pretty well all peer reviewed. I mean, even the thesis is peer reviewed, so they're all peer

reviewed, yeah.
Q Now let's turn to your experience in the mining industry. Can you give us a general summary of that?
A Yeah. I mean, I've been a -- I've spent my entire career as a consultant in the mining industry since graduation in 1985. My career has been based around consulting in both rock mechanics and mine backfill. And, you know, the one thing you have to understand is that you can't understand mine backfills unless you understand rock mechanics. It's a -- it's kind of a very specialized extension of the rock mechanic consulting industry. And I consult to metal mines. All of my consulting is all hard rock metal mines and to -- consulting to mines all over the world. I think I -- last time I looked I'd worked in 35 countries or something and pretty well on every continent and --
Q Do you know how many mines you've consulted?
A I mean, I've done well over 100 projects. At least 60 of those projects would have been in backfills. And out of that I think we've guessed that somewhere around 20 was in cemented rockfill.
Q And cemented rockfill, is that what's proposed to be used at the Kennecott Mine?
A That's my understanding, yes.
Q You said these were all hard rock metal mining?
A Yes.

Q About how many, if you know, are base metal mines?
A Oh, probably a half to two-thirds, something in that range.
Q And have you had any other types of consulting experience? I'm sorry. Let me back -- backfill; anything besides cemented rockfill?
A Well, I mean, I consult in all types of backfill, so I, you know, do a lot of work that's in hydraulic fills. I mean, hydraulic fill is probably one of the most popular methods that's used in the industry right now even today. And in the last ten years, of course, with the introduction of pace* backfills 3:05:00, we get more and more consulting work coming along that's in the pace backfill arena.*
Q What companies have you worked for or owned during this time that you've been doing this consulting?
A Well, all of my consulting is done through my own company called MineFill Services, again very -- internationally known. We get faxes and e-mails from all over the world on a regular basis. We work for both major as well as, you know, small producers.
Q You're the president, owner of that company?
A President and sole owner, yes.
Q How long have you owned that company?
A MineFill's been around for ten years now.
Q What did you do before that?
A Prior to MineFill I was consulting. I had two partners in

another consulting entity called Citricorp, and I did the same consulting then. My partners were involved in other aspects of mining.

MS. LINDSEY: And, your Honor, for reference, Dr. Stone's CV is Intervenor Exhibit 231, which I believe by stipulation with the parties is admitted.

JUDGE PATTERSON: Okay.

Q Your company, MineFill, in addition to doing the consulting where you go, does it -- do you do anything else besides consulting at on-site?

A Yeah. And I do a fair amount of teaching at universities. I'm asked a lot of times to do presentations and to present, you know, technical papers and provide training sessions and acting as session chairs and keynote speakers at conferences and the like. I'm very actively involved with other organizations in the mining business such as the Society of Mining Engineers here in the U.S., the Canadian Institute of Mining and Metalurgy in Canada.

Q Do you do any sort of testing at MineFill?

A Yeah. We have a lab in Seattle, and we do backfill testing there.

Q When you test it, what are you testing for?

A Well, we do two main types of testing in our lab. One is doing strength testing for rockfills, hydraulic fills and pace fills, and then the other part of our lab work is doing

pace mix designs for pace plants.*
Q And you said that you have done guest lecturing and teaching?
A Yes.
Q All right. I'd like to talk now a little bit about the different types of backfill. Can you give us an overview of the types of backfill?
A Sure. Okay. Well, basically, you know, mine backfilling has been in use in the world -- I think oldest recorded case that I know of is something around 1100, so it's been in use for almost 1,000 years. The cemented fills really is something that came about since about the 1930's. Prior to that most filling was done with uncemented fill. And the cemented rockfills that we know about today really were developed in the late 1960's by big base metal mines like Kidd Creek in -- up in Ontario in Canada and the Mount Isa Mine in Australia, where they had, you know, massive blasthole stopes.
They're beyond imagination compared to the size of Eagle. I mean, we're talking about stopes that are 500 meters high and, you know, 150, 160 feet wide, so huge operations. And those mines required a very high strength fill that couldn't be met with -- under the hydraulic fill that had been, you know, commonly in use up to then, and so they developed a cemented rockfill to do that. So, I mean,

cemented rockfill is -- basically it's a mix of an aggregate; you know, cement and water.

You have those three components. You mix it together, and it's either trucked or conveyored or sometimes dropped down a borehole directly into a stope. And it's the strongest and stiffest fill, and that's why it's very popular in large, you know, open stoping operations, blasthole stoping operations, very popular in Canada and Australia where we have those types of mines, both in base metal mines as well as in gold mines.

The other type of fill is hydraulic fill. I would say that -- hydraulic fill's been around for a long, long time -- is probably still the most common filling method that's around. And basically what that comprises is classified mill tailing, so you take the tailings that come out of the mill, and you run it through a cyclone to separate the sand fraction out. And you take all the material that's finer than sand, and that goes out to the tailings pond. And you take that sand fraction then. You mix it with cement, and you pump it into the mine, and you pump it into the stope, and it's poured as a liquid behind a bulkhead, and then with time that material will then solidify.

The third type of fill is a relatively new type of fill, and it's kind of an offshoot of the hydraulic filling, and that was -- instead of classifying the tailing, coming out and plant* 3:10:35 splitting into a coarse and a fine, they actually take the whole tailings product, and they add cement to that, and they dewater it down to the point where it's just about a solid. I mean, it would look like a pile of wet sand when it comes out of the filter cake plant. And you add just a little bit of water and a little bit of cement, and it makes what you call a paste.

And basically, the industry definition of paste is a non-segregating slurry. So if you take that stuff and you pile it up on a desk, there's no water bledg out of it. It actually retains the water, and it is a pumpable product. And that pumpable product is based on the viscosity and characteristics of pumping concrete, and it kind of looks a little bit like concrete but with no aggregate in it. And they pump that material to stopes. And the advantage with paste is that -- number one, is that it uses the highest proportion of mill tailings, and you don't have this problem with these residual slimes that you then have to deal with on the surface, which typically require that you have to build a big pond and keep the stuff under water.

So there's all kinds of environmental impacts on that side of it. But also, it's far stronger than hydraulic fill. It has about double the strength of hydraulic fill, but it's not as strong as cement or rockfill. But what you see now is that a lot of big cemented rockfill operations are -- slowly one by one they're all switching over to paste just because they'd rather get rid of the tailings underground.

Q And have you prepared some slides and some -- assembled some photographs to help illustrate this?

A Yeah. We -- I put together a little PowerPoint presentation with some actual photos of backfill being used underground, and these photos would be representative of what is being planned for Eagle.

Q Can you tell us, the first slide that's up here, first --

A Yeah. I mean, this slide -- is there a pointer here somewhere?

MR. WALLACE: Is this a second exhibit?

MS. LINDSEY: No. It's just purely demonstrative.

MS. HALLEY: Do you have a copy available for us?

A This is a tackardam* 3:12:47 in Nevada.

(Counsel reviews documents)

Q Okay. I'm sorry. Go ahead.

A Okay. This is a carden* 3:12:58 in Nevada. What's out of the photo is the actual mixer, but this truck is backed up underneath the mixer. And you dump the product out of the mixer into the back of the truck, which is what would be done -- planning to do at Eagle. And this is a close-up of what the cemented rockfill looks like. And basically, I think, you know, one of the kind of misconceptions that wasn't directly stated but maybe was implied in some of the other evidence is that -- you know, cemented rockfill is -- the finished product does not look like concrete. It's not a solid with very little void space like concrete.

Cemented rockfill is a very open-graded product, and basically you have coarse, you know, angular particles of rock that are coated in cement. And then, when you dump it into the stope, the material comes in a point-to-point contact, but it does form a solid block like a block of concrete would be. But anyway, these -- this product here that they're using in Nevada is for what they call jam fill,* which is the tight fill that they use for the underhand cut and filling.

Q And what's the scale, sir, in the lower left-hand corner of this --

A Yeah. I mean, that's a -- you know, field surveyor's books. That's a six-inch book there. So this product that they're using in Nevada I think is -- it's a 2-1/2-inch-minus product, so it's a material that's -- it's quarried nearby, and it's crushed and screened in order to come up with a product that's suitable for using it in cemented rockfill. And we have a specification that they have to adhere to, and they take regular samples of the aggregate, and they run it through a screening in the lab to make sure that it conforms

to the specification.
Q When you say "2-1/2-inch-minus," what does that mean?
A That means that the largest particle size is -- if you took a square of 2-1/2 inches by 2-1/2 inches, that's the largest particle that could go through that screen.
Q So all the particles are that size and smaller?
A Yeah.
Q You talked just a little bit about backfills being used as far back as 1100, you said?
A Yeah.
Q Have you visited any mines where backfill was in place from long ago?
A Yeah. I think the oldest backfill that I've seen personally and stood on top of was at a mine in Mexico called Natividad, and that mine was backfilled in the early 1500's -- early to mid 1500's by the Spanish Conquistidors when they were doing silver mining there. And it was -- we had to blast the backfill through it, it was so solid.
Q So the backfill was still there?
A Yeah. And that is a very high-sulfide-based metal mine, that mean.
Q So there was no settlement of the mine -- settlement of the backfill in the sense that it --
A Well, we didn't measure the actual settlement in the stope.
Q Sure.

A But we had to blast to get through it.
Q Can you tell us a little bit about the general design of backfill plant and how that would work?
A All right. What --
Q Actually, maybe we could put up a diagram for what's proposed at Kennecott, and maybe you could use that to illustrate?
A Sure.

MS. LINDSEY: This is figure 4-33 of the mine permit application, which is Intervenor Exhibit 1.

A So this is what I understand to be the basic flow sheet for the proposed plant for Eagle, and that's a fairly typical flow sheet for a modern CRF plant, where you have -- all the cement-handling facilities and aggregate facilities are on the surface. In this case we're bringing in quarried aggregate by truck and dumping it down a raise into an underground bin. And that product will have already been prepared, so it'll have already been crushed and screened in order to meet specification, and then it's dropped down the raise. And then you have your cement or binder-handling facilities on the surface, in this case a cement fly ash mix.

Some mines would actually take the cement and the fly ash down independent and mix it down below, but in this case we're actually premixing the product and sending a premixed product into a binder bin down underground at the backfill plant. Then, if you want to scroll down a little bit on the page there, at the backfill plant, then basically what you have is a colloidal mixer,* which is like a very high-speed centrifuge mixer, and it -- what it does -- the reason they use that is it breaks up any lumps in the cement, because a lot of times the cement will get lumps if it sits around for a long time or if there's any moisture or anything. So it breaks those lumps up, and you get a very, very good consistent mix.

It goes into a holding tank, and then you have the aggregate coming down, which has already been prescreened and preproportioned, and it goes onto a conveyor that takes a preprogrammed amount of weight and puts into a drum mixer. And then it takes a preprogrammed amount of slurry and puts it into the drum mixer and mixes it for about 45 seconds, and then it tips it onto the back of the truck. Then the truck will go out. The whole operation is all automated, so there's no human intervention in that, and all the recipes for the backfill are all preprogrammed into the plant.

There'll be -- an operator will have a control screen somewhere where he can -- the backfill truck driver can call and say, "Okay. I need you to switch to recipe number 6." And this remote operator would change the plant recipe, and it would actually change, you know, how much cement goes in or, you know, whatever. But they can play with the actual mix design that way and -- but the truck driver doesn't have -- he doesn't have any hands-on in terms of the operation of the plant. So very -- this is a very typical-type plant.

There's a plant that's very, very similar to this at the Deep Post Mine in Nevada. They just built one at the Levill* Mine in Nevada. It has exactly the same flow sheet, so a very popular plant flow sheet.

Q Have you reviewed the permit application and the appendices in this related to backfill?

A As it's related to the backfill, yes.

Q Could you generally describe for us the backfill plan that will be used, including the stoping method? And perhaps you could draw sort of what the -- you talked about primary and secondary stopes.

A Okay.

Q And you said backfill in those, and it might be useful to draw that.

(Witness draws diagram)

A All right. Well, as I understand it. It's a long-hole stoping-type operation where you have primary and secondary stopes, and it's what we call overhand mining. Overhand mining means that you always have a -- your * stopes 3:20:40 hurt your feet. Underhand mining means that you're mining from the top down. So this is overhand mining. And in this case you'd have a level where we're mining, and they'll take out the primary stopes first. And I'm exaggerating this by making the secondaries look small. But you take these primary stopes out first, and they'll take them out in a checkerboard fashion on one level.

And then, once the primary stopes are mined -- and it's done on a sequential basis, so you mine one stope at a time. And each stope is mined out, and then it's filled up with backfill. In this case they're planning on filling from the brow of the stope. So a truck will back up to the edge here, and he'll tip the material out of the truck, and it'll fall down, and it'll form a little pile that will build up in the stope.

Once they get it up to the point where it's level, they use a -- and I have a slide later that I can show you of how they actually are able to tight fill this right up so the fill is in contact with the back here. But they'll tight fill that stope. So once that stope is full then, then they'll come along and mine the secondary, and the mining scenario is the same. But in this case, the secondaries are going to be filled with uncemented fill.

And one of the things I'd like to clarify with respect to some of the previous testimony is all of the primaries are filled with cemented fill with imported aggregate. There's no development rock being used as aggregate in the primaries. It's all imported material; whereas, the development rock that's being used as backfill is only going into the secondaries, and it's going in as an amended fill product that's mixed with limestone. And any shortfall in the tonnages on the secondaries will be made up with imported material again, the same material that's going to be brought in from the primaries.

So once you've mined that level out, now you've got a floor of backfill. And you jump up another level, and you do the same thing again. And in this case what you're going to do is you're going to stack the primaries up on top of each other, and you'll do this in a sequential fashion, mining upwards until you get to the underside of the crown pillar. And then -- obviously, at the crown pillar, then the important thing is the tight-filling operation to make sure that the backfill is in contact with the crown pillar.

Q Okay. Thank you. You talked a little bit earlier, I believe, about quality control, and that's one of the things that you do and do consulting on?

A Yes.

Q And I believe you prepared some slides that will help illustrate kind of what is the typical quality control for a backfill -- cemented backfill plant?

A Yeah.

Q So let's go to the next slide. Actually, this was another -- we didn't talk about this slide. This is another --
A Yeah. Well, the part I was trying to show -- there's two points I was going to try and make with this one. One is that you can see the backfill is very glisteny and shiny compared to the previous shot, and that's because, even within cemented rockfills -- we'll play with the recipe a little bit in order to do different things. If you're johnfilling* for underhand cut and fill, you prefer the backfill to be a little bit dry, which is what that first slide showed you. And it's a very kind of sticky dry product, and it packs in, you know, very, very tight when you ram it into the stope, and it forms a very good, tight bond with the back for this underhand operation.
And they need that fill so that they can get the type of quality that they need so they can come in underneath, because it's a safety concern, mining underneath the backfill if you have poor quality fill up above you. So there's a lot of work that goes into the quality control. When you're mining in a long-hole situation, one of the concerns always is forming segregated bands like I showed here (indicating), because it's inevitable, when you're in a situation like this of tipping it over and into the stope, that you're going to get some degree of segregation.

And what you're trying to do is you're trying to control that segregation to the point where you don't impact the overall quality of the fill that's at the stope. And one of the ways that we achieve that is by adding a little bit more water to the backfill, and what that does is, instead of having individual rocks rolling when it gets to the bottom of the stope like you would if you tipped over dry, it actually -- the stuff all sticks together, and it goes down, and it kind of goes down like a big dough ball, and then it kind of flows down the slope.

And when you have that flow-type mechanism, it pretty much eliminates most of the segregation problems that you have. The other way we get around it is that a lot of the mines that -- you know, that are in the literature that reported severe segregation problems and were kind of the basis for all the fears about segregation and big stopes -- we're using basically a 6-inch-minus product, so they're using a product that's much, much closer than what you're -- we're using here.

And so that's one of the other ways that we minimize segregation, is by reducing the top size. We spend more time crushing and screening the product to get a more consistent product and get it down to a smaller size. And what you'll find, then, is that, even though you do get what you would call a visible banding in the backfill, it doesn't impair the strength of the backfill, and it doesn't reduce the stability of that fill then. What you see here in the background, then, is -- this is -- a operator is actually preparing the concrete test cylinder, so he's got a shovel here, and he'll take a couple of shovelfuls of this stuff and put it in these.

These are standard ASTMC-31 concrete test cylinders. It's a standard method of testing concrete. We use those same concrete tests for testing the quality of backfill. Obviously we don't get the strength that you do in concrete, because we're dealing with such low cement contents, but the test method is the same. And so the cylinders are prepared in the same manner. And the rule of thumb that we use in mines is that you take two cylinders on every shift, and every time you do a change in recipe, you take -- you have to take another two cylinders. So every shift has a minimum of two cylinders that's taken, and those cylinders then are all matched to the individual stope that the backfill went to and everything so we can trace it back.

Q Okay. And can we look at the next slide, and maybe you can illustrate this a little?

A Okay. This is at Olympic Dam in Australia, which, again, they use a form of cemented rockfill there. They're using a crushed and screened quarried limestone product for their backfill. They use so much backfill there that the quarry that they run for that plant is the largest open-pit quarry in the Southern Hemisphere, and all it does is supply aggregate to the backfill plant. But they go through -- I've forgotten the quantities now, but it's huge. But their stopes are over 500 feet high. And so they use this rockfill product.

So here what you see is he's standing on top of the mixer. And they use a very, very wet product, and they -- he has a bucket he lowers down, and he takes a sample of the stuff. And this is a standard ASTM concrete slump cone, and they actually produce a product that has a measurable slump in it. So what he's doing is checking to make sure that their product is within specification on the slumps, and then they fill the cylinders with product to do the strength testing later on.

Q And maybe we could look at the next slide, and you could tell us --

A So again, what we do when we're consulting to mines is we set them up with this standard backfill sample preparation poster. This is done up on a big, giant, you know, 24-by-36 poster that's laminated. We put it right in the backfill plant for the operators to see. And it just goes through a step-by-step procedure of sampling the material, putting it into the cylinders, you know, tamping it, you know, putting in a couple more of this, all in accordance with the ASTM

specification, which is said standard specification for testing concrete, and then topping the cylinder off and putting a cap on it and then labeling all the information on the heading, the formula, which we call the recipe, the batch number, the crew, the shift, the date and the operator's initials so, if we have any problems, we can go back and talk to the operator.
Q Now, you said that this would be done how frequently, this sort of --
A Every -- two of these concrete test cylinders every shift, so we'd probably have a change of shift. They'll take two more cylinders and then every time you change the recipe, because a lot of times different stopes have different recipes. You don't use the same mix through the whole mine. So you would actually prepare the backfill with a different recipe for each stope.
Q So if you could, what's the next slide real quickly?
A So here, the -- this is at Carlin* now, and so you see the truck with the backfill plant in the background here. Here's the box of the truck with the CRF sitting there, and there's the test zone there that he's filling. So he's just following the rules.
Q All right. And the next slide is further illustration of the --
A And there's -- so there's the lids that they put on them.

It's got the crew number, the formula number, the batch. It's got the -- that's the name of the stopes. It's on the 4570 level and, you know, some code for the stope. And it'll have -- it's got the date on it and then the test spec on it.

Q Now, Dr. Vitton testified that the method that we're using with cemented rockfill has very little quality control. Would you agree with that?

A No, I mean, I would differ to that statement. There's a lot of effort that goes into the quality control. Because you have to extend that thinking to, "What is the benefit to the mine to not doing quality control?" What happens is, if you don't do adequate quality control, you start to get more and more, you know, backfill failures, and backfill failures result in dilution, and dilution costs the mine money. So there's no point in having dilution and costing the mine money. It's -- so it comes down to an economic issue; that it doesn't make economic sense to have poor quality backfill. And in this type of a situation, it's not so much of a safety issue, because all of the stopes are non-entry. But if you're working in an underhand environment, for example, if you have backfill failures, you know, potentially you can -- they can be lethal. So the mines that we work at spend a lot of time and a lot of money on quality control, and the backfill is monitored very, very carefully.

Q And you mentioned dilution. Can you tell us, what does that mean?

A Well, in this case the dilution would be that, if you -- typically what would happen is that you would have a piece that was what we would call scab, but basically it's a thin junk of backfill would break off the face, and it would fall into the ore and get mixed in with the ore. So there's no way to separate it out. You have no choice but to muck that out with ore and send it to your plant. And so it's -- what you're doing is mining something that you've already mined once. Now you're mining it again. And the cement that's mixed in with the sierra * 3:32:46 can -- in some plants can have a metallurgical impact in terms of the operation of the mill. And it can cause problems, especially if you're using a flotation circuit in a base metal mine. The cement disrupts that flotation process. So most mines work very, very diligently to prevent dilution.

Q So what happens after you take in this sample? And I think, if we look at the next slide, maybe that would help illustrate it.

A Yes, it would. The rule of thumb is that you would -- it would cure at the backfill plant, so in this case it would cure, you know, underground at the batch plant for anywhere between 40 -- 24 and 48 hours, which allows the cylinder to solidify to the point where you can move it. After 48 hours you have the choice of moving it to a humid room at a lab up on service -- up on the surface, or some mines will actually have an underground lab, so the cylinders would get moved to this underground lab area. And they're set up on racks, which have a testate on them, and they cure for the 28 days that's required for that cylinder. At the end of 28 days, then you would -- you'd peel the mold off. And I think, if you go to the next slide, you can see --

MS. LINDSEY: Can we look at the next slide, please?

MS. HALLEY: I don't mean to interrupt you, Dr. Stone, but I'm -- I need to object to this line of questioning, because none of this quality control measure is described at all in the application. There's nothing about the cylinder tests in the application at all.

Q Dr. Stone, is this typical of most cemented rockfill plans in your experience?

A Well, it's not typical. It's mandatory.

Q Okay. So is this --

MS. HALLEY: It's what? I'm sorry.

THE WITNESS: Mandatory.

MS. HALLEY: Mandatory.

THE WITNESS: Yeah. I don't know anybody that would try and run a mine with cement rockfill and not do this.

MS. HALLEY: Your Honor, I don't disagree with Dr. Stone about that; however, none of this procedure is even referenced in the application or the permit or anywhere else, for that matter, except here today. I don't doubt Dr. Stone is right about his idea that this is what's done, but unfortunately, none of these procedures have been described in this particular case.

MS. LINDSEY: Your Honor, that may be the case that the mine permit application does not describe this operational procedure, but certainly the mine permit application was not meant to describe every operational -- everything that might take place in the operation of the mine. And this is simply meant to rebut testimony that Dr. Vitton put on about the lack of quality control with respect to cemented rockfill.

JUDGE PATTERSON: I think on that basis it's permissible, if nothing else. And Dr. Stone has also testified that, in his experience, these procedures are mandatory, which I assume somewhere on the application there was an allusion to backfilling in this method. And this is mandatory and presupposed and --

MS. HALLEY: Your Honor, I -- could we have somebody show us in the application where this is discussed, assuming that it is mandatory?

JUDGE PATTERSON: I think they're admitting it hasn't been discussed specifically.

MS. LINDSEY: I believe that this is an operational issue, which is not part of --

JUDGE PATTERSON: I'm going to overrule the objection.

Q And if we could just maybe look at the next slide to finish this off, what are we looking at here?

A Yes. Here you're looking at a test cylinder sitting in the loading frame ready to be loaded. What I wanted to show you in this slide was that it's not a solid. It doesn't look like a concrete cylinder. It's got lots of voids in it, and that's what it's intended to look like.

Q You've talked about testing of this backfill. What is the reason to test it?

A It's -- you're trying to get a measure of consistency, and so all of the testing that we do is to ensure that we have that measure of consistency. So what we do is we set what I would call, like, benchmark guidelines that are met or exceeded with the testing. And the point is that, because we need to do the testing so routinely and on such a frequent basis, that we're not so much worried about the actual members themselves but just making sure that it meets our benchmark guideline. And as long as we're meeting it, then we know that we're achieving out goals.

Q And what's the characteristic or quality that you're testing?
A In this particular case, we're measuring what's called the uniaxial compressive strength, the UCS, and so there will be a benchmark UCS that we're trying to exceed in those tests.
Q And there's been some discussion in this case about the strength of the backfill. Are you aware of the strength that is proposed to be used in Kennecott?
A Yes, I am; yes.
Q Okay. And what is that? What's the number given for that?
A Well, the strength test quoted in the Golder report is 1-1/2 MPA.
Q And we've also heard reference to 218 psi. Is that the same thing?
A 218 psi is the imperial equivalent of 1.5 MPA. And I think there was a comment by one of the others that it seemed like a very exact number, and I just want to point out that it's not. 218 is not intended to be an exact number. It's an exact conversion of a round number.
Q Okay. Do you know how 218 was calculated?
A In this particular case, the 218 psi is basically the stress from the self-weight of a 30-meter-high CRF-filled stope. So if you take the unit weight of this material and multiply it by 30 meters, you end up with a number that's around 1.4 MPA, and Golder has then just rounded that up to 1.5, which

is typical in the industry. Actually, I should correct that. There is a factor of safety of 2 in there. So the number is actually around 700 psi, with a factor of safety of 2 is 1.4, and then they rounded that up to 1.5.
Q Can you tell us why strength matters? And I believe there's another slide. What -- can you tell us what -- why strength matters for backfills in this type of mining?
A Well, obviously, you know, the primary concern in designing the fill is that you don't want this block of fill to fall into the secondary when you're mining the secondary. So kind of the strength requirement is to come up with a material to fill this stope out that will be stable and self-supporting when you expose the secondary. And you see that in this case here, where you have a primary and a secondary that's being filled. You fill the primary. You fill another primary, and then you come in, and you take the secondary out, and you're trying to make sure that these two faces are stable when you expose them. You don't want any of this material to end up in the secondary, because that is then a source of dilution in the secondary.
Q So are there formulas used? And you've -- I think you talked earlier when you talked about * 3:41:13 to estimate this?
A Yeah. The industry standard is what they call the Mitchell formula.

Q And if we could --

MS. LINDSEY: Well, actually, could we get the next slide?

Q And this is not Mitchell formula, is it?

A Well, these are based on the Mitchell formula. This is from my 1993 paper that's so widely quote. And what you see here is that, for a variety of widths and for a variety of heights, you need increasing strength of cemented rockfill. And this chart has a built-in factor of safety of 2. So in this case here where we have, you know, a 10- or a 20-meter-wide exposure -- if we say the 20-meter-wide exposure and we got a height of 30 meters -- that's the open circle -- that plots at that point right there, and it translates back to a uniaxial compressive strength of just over .6 MPA of 600 kPa, and that's the minimum strength that you can use in a stope of that size to prevent this material from falling into the stope next door.

Q And remind us what's being proposed from you here in MPA.

A We're using 1.5 MPA so, even though the -- it plots there, we're using a number that's -- well, it's right here (indicating). It's up at the top of the chart. So the number that's proposed for Eagle is -- by current design methods would be considered to be conservative.

Q Well, there's been some testimony in this case that the number of 218 psi or, as you said, 1.5 MPA is overly

optimistic compared to other operations and that it's very low. Is that -- do you agree with that?
A   Not at all. There's -- just a very quick review of other operations, you can -- we can come up with a number of operations that have much larger stopes, much larger exposures that are using strengths that are at or below what's proposed for Eagle.
Q   Okay.
          MS. LINDSEY: If we can turn, to the next slide, please.
A   Why don't we go to the next one?
          MS. LINDSEY: Yeah. Go to the next one after that.
Q   So what does this slide show us?
A   Well, this is a -- part of the database that MineFill has been collecting over the years of different mines and what they're using. And in this case, what I was trying to show with this one was the relationship between the cement content and the uniaxial compressive strength. Because most of the designs are based on finding a target strength, but somehow you have to relate that back to the strength contents so you know what -- how to mix it. So that was what we were trying to show here. But if you go to the next slide, this is just a snapshot that I just put together very quickly taken from the Canadian Mining Sourcebook, which is

a journal that's published every year in Canada of surveys of underground mines in Canada -- of current practices of underground mines in Canada. And what you see here is length, width and height of stopes. So here you got 40 metes, 30 meters, 40 meters, 66 meters, 19 meters, 50 meters, 25 meters. So all of these mines are at or well above what's proposed for Eagle in terms of heights. And again, you know, widths, they're in the same order or bigger. And what you see is the target binder content. These are the actual design binder contents in those mines. And you see 4 percent, 4 percent, 4 percent, 5 percent, 4 percent, 5 percent, 5 percent. And again, you see most of these mines are using the same placement method as what's proposed for Eagle, is tipping it from a truck, so tipping it out the back of a truck. And my comment in this case, even though this doesn't actually relate directly to the UCS -- you have to go back to that previous chart to relate it to the UCS -- these mines are all using cement contents that are at or below what's proposed for Eagle, and most of them are much larger stopes and --
Q Now, could you -- I'm sorry. Could you explain to us what "binder content OPCFA" --
A That's ordinary Portland Cement and fly ash mix. So most of them you can see they're using a 50/50 mix, which is what's proposed for Eagle. Eagle it says a 6 percent binder; 3

percent ordinary Portland cement and 3 percent fly ash, so 6 percent on a 50/50 mix is what's proposed for Eagle. And there's none of these ones that are up as high as 6 percent, and here you got a 19-meter-high stopes. Here you got 66-meter-high stopes. So I mean, these are double, triple the sizes of stopes at Eagle, and they're using strengths that are lower than Eagle. And these are operating mines. These aren't theoretical. These are actual operations. And if you go to the next slide, there's more of them.

Q Yeah. Let's skip that.

A This is from Barrick, which is one of the largest mining companies in the world. This is taken from a paper that was published this year. "UCAF" is "underhand cut and fill," which is not we're doing. Underhand cut and fill is where you come in underneath, so you need a very, very high strength. So that's why you see 4 MPA, 4.1 and 2.8 for the underhand fill. But if you go down here, you see "overhand cut and fill." They're using .2 MPA there. These are long-hole stopes, so they're not coming underneath them. They're mining beside them, the same scenario as we have here. And here they're using .1 to .3, you know, .1 to .6, you know, .1 or .3 so, again, just trying to illustrate that these are actual operating mines using stope sizes that are -- these are 180-meter-high stopes, 135-meter-high stopes, much, much bigger stopes, operating mines using less cement than what's proposed at Eagle, and the inference, less cement is less strength.

Q So how would you describe Kennecott's proposal with respect to -- in comparison to the industry practice?

A In my experience, it's conservative.

Q We also had heard testimony in this case about blasting against backfill. Do you have any experience with the design of backfill programs that are subject to blasting?

A Well, absolutely, because that, you know, is obviously one of the design criteria that we must address in our designs, because we have to come up with a backfill design that will be stable under the forces of blasting.

Q Could you give us maybe a little bit of an overview of what happens in a blast in terms of the gases and how that -- just generally how it works?

A All right. Well, I mean, from -- looking at it from the cemented rockfill perspective, there's two elements to a blast in a stope adjacent to a cemented rockfill that can have an impact on that rockfill. The one is the release of the explosive blast gases themselves, so this would be the gases that expand out from the blast through the fractures and fissures in the rock. And in this case, there's a limitation obviously that you do not want to have your blastholes drilled into the fill, because if you do that, the expansion of those blast gases will damage the fill.

But I should emphasize that the damage that it does is very local, and basically what it does is it punches a -- like, a little pocket into the fill. It doesn't destroy the whole stope. It doesn't crush all the cement and make the whole -- render the whole cemented fill useless. It just knocks the hole out, and again that leads to dilution. So there are methods now that have been widely in use for at least ten years now called the Cavity Monitoring System or CMS system that's used to survey the outlines of the primary stopes after they've been blasted for the primaries and before you put the cemented rockfill so that, when you come along to mine the secondary, you know exactly where that line is, and it prevents you from accidentally drilling into that stope.

So if you had a -- let's say you have a chunk like that (indicating) that broke out of the primary and fell into the primary. When you fill it, of course then you have a little piece of cemented fill that would stick into the secondary. And what you don't want to do is you don't want to drill through that. Because if you do, you can have the scenario where you'll knock a hole in it with the blast gases. The other mechanism is the actual vibration from the blast itself, the blast vibrations in the P-wave and S-wave that's emanated from the blast.

But in this case, as much as some would believe, it really poses no risk to the fill, because the ground movements that are produced by a blast are intensely, intensely small. And when that blast vibration reaches this interface here, the vast majority of that vibration is knocked backwards and reflected back into the rockfill stope, into the back -- it's reflected back into the primary. There's a very small amount of the vibration energy that's actually transmitted into the fill.

And the fill itself has what we call a Young's modulous. And that modulous value is anywhere from 10 to 100 times what this fill is here. In other words, it's a lot more elastic, and it basically just absorbs the energies. And there's been a lot of work -- there's not a lot of stuff that's papered that's been published on, you know, the properties and mechanics of blasting up against backfills, but there was some work that was done by Kidd Creek early on the 1970's when they were doing all kind of the fundamental research of mining in this type of an environment.

And what they found was that, as long as you kept the vibrations below 300 millimeters per second -- you keep that velocity, blow 300 millimeters per second, you won't damage the cemented rockfill. By contrast, the civil engineering criteria, which I believe was actually quoted in some of the previous testimony, is in the order of, you

know, 2 inches per second or 50 millimeters per second. So we're using numbers that are, you know, one-sixth of what you would use in civil engineering criteria. So this material is extremely resistant to vibration, but it's not very resistant to drilling holes into and blasting it with explosive.
Q And you've told us that there was this cavity monitoring system used to avoid that?
A Yes.
Q Essentially does that, if I understand, map out what the primary was after --
A Yeah. It gives you a three-dimensional -- a very accurate three-dimensional rendering of the outline of the primary stope so that, when you go to design the blastholes for the secondary, you know to provide the necessary offset not to damage the fill in -- that's already in the primary.
Q When you do blast and get dilution, is that a problem -- why do mines want to avoid that?
A Well, again, it's an operational problem, you know. If you blast too close to the fill and you knock a hole in the fill, you know, you might knock 50 tons of rockfill out into the stope. The whole stope won't come tumbling down, but you might knock, you know, 10 or 20 or 50 tons of material out, and it just becomes dilution in the next stope. And again, it's an economic issue. So it's an operational

issue.

Q I'd like to actually read to you some testimony from Dr. Vitton, and he's talking about blasting against backfill. And if you could tell me afterwards, I'm going to ask you some questions about it, if my voice will hold out. He's talking about the strength, and he says --

MR. WALLACE: Excuse me. What page would this be?

MS. LINDSEY: Certainly. It's pages 674 through -75 of the draft transcript.

Q And he's talking about the primary and secondary stopes, and he says:

"The rock strengths that we're talking about here are around 10- to 20,000 psi on the right. That's the rock strength. And then you're going to put a cemented backfill strength at 218 psi and blast next to it? It seems difficult. In addition, you're relying on some interesting -- I believe some interesting things. For example, at the bottom of the mine on the first level, they've got three stopes, two cemented, one primary or secondary. When they fill the first one up with cemented rockfill, if they don't get a good bond with the host rock with the peridotite, they're going to be -- there's going to be openings. When that blast and vibration comes through, there's going to be essentially a free face, and you're going to get rebounding, which is going to cause fracturing in the cemented backfill. It seems by problematic to me in this when you look at other operations and what strengths you're using."

Can you tell me generally, do you agree with that testimony?

A No, I don't.

Q Why not?

A Well, on a number of grounds. Number one is that there's very few scenarios where you're going to end up with a void between the primary and the secondary. And it's almost impossible to envision that happening. But even if you did have that void, there's no way to transfer the blast energy from the secondary through a void and into the cemented rockfill. The physics don't allow it. As soon as --

Q And why is that?

A Because as soon as that energy hits that air gap, it's going to get reflected back into the secondary. And as I said, the actual vibration and the amplitude of vibrations in the rock mass itself with those kinds of strengths is thousands of a millimeter. So it's so small that you wouldn't even be able to see it. It would be absolutely inperceptible, and that's not enough to compress the air in that air gap. So the -- all the energy gets reflected back into the secondary slope, and there's no transmission into the primary.

Q Okay. He also concludes that it's problematic when looking

at other operations and the strengths you're using. You've given some testimony about this before, but could you just summarize?
A Well, if he could give me a list of operations that had that problem, I'd love to talk to him about it.
Q So in your experience in this industry --
A I've never heard of it happening. I mean, it's -- there's been -- the research work that was done was in the early 70's and late 70's, and since that time, since people began to recognize the mechanics of it, there's been nothing more published, which to me -- the way our industry works is that we love to publish it when things go wrong, because we want to learn from other people's mistakes. So when you see something like that disappear out of the literature, it means that nobody's having problems. Certainly within my consulting career, I've never come across anybody that's had that issue.
Q I'd like to read you just a little bit more testimony. This is from Mr. Parker.
MS. LINDSEY: And this is from pages 409 through 410.
Q And he says -- he's talking about the original application. He says, "We're going to have 4-inch holes" -- do you understand that 4-inch holes will be used?
A Yeah.

Q -- "with standard explosives, which would probably be ammonium nitrate because it's cheap." Do you understand that ammonium nitrate will be used in this?
A Either ammonium nitrate or emulsion, yeah.
Q "Some damage would be done to the rock to a distance -- rule of thumb, some damage would be done to the rock to a distance of about 30-, 3-0, hole -diameters." Do you agree with that?
A No. That's a civil engineering criteria. That's not a mining engineering criteria.
Q He also says that most of the damage would be close to the hole and that it would diminish to about 30 diameters and there would not be much damage at 30-hole diameters. Can you just describe for us what he's talking about? When he says "30-hole diameters," what does that mean?
A Well, if he's using a 400-millimeter hole, you know, 30-hole diameters would be 12 meters away; 12 times 400 -- 30 times 400.
Q So if he's 4-inch in this instance?
A So he's saying, on 12 meters on either side, you would be damaging the rock.
Q There's also been some testimony in this case about tight-back filling.
A Yes.
Q Are you familiar with this concept?

A Oh, absolutely, yeah.
Q Have you used it or seen it used?
A Yeah. Several of the operations that I consult to use tight fill, and I've been underground at a number of operations that use tight fill, both in Canada, the U.S. and in Australia.
Q So can it be accomplished?
A Oh, it's routine, yeah. It's done every day in Nevada.
Q So let's turn to the next slide. And can you just tell us generally how it's done?
A Yeah. Generally it's done with a piece of equipment with what they call a ram mounted on the front. In some cases it's a fixed bar like this (indicating) with a plate on the end that they use. It acts like a shovel, and you push the material up the slope and then tight up against the back. All the ones in Nevada use what's called an extendable boom, so it's actually a boom that's hydraulically extended. And so what he'll do is, he'll take the LHD up against the pile and then use this extension to push the material up a -- you know, up the slope and tight up against the back. Because when you're mining underhand cut-and-fill, you need that tight bond. Because when you take the stopes beside it, if you don't have that tight fill, if you have an air gap there, that means that you've got three times -- basically three times the span. Because you've got an air gap that

side, air gap that side, and then you take this one out. So now you've got three times the span that's open, and that's not safe. So that's why the tight filling is so critical in Nevada. These photos hr are actually taken at the Doe Run Mine in -- by Burnham, Missouri. And their stopes are roughly 20 to 25 meters high and filled with cement rockfill and then tight-filled against the back to prevent subsidence, because they're mining right underneath a town.
Q And they've been able to achieve the tight back filling?
A Yeah. As I say, it's a routine part of the operation.
Q Could we look at the next slide, please? What is this showing us?
A So here you see a tight-filled stope at the Doe Run Mine in Missouri. So here's a guy standing here for the scale. So this stops about 18 meters high, so it's getting up into the order of the size of stopes that you're looking at at Eagle, but it's filled right tight to the back. And that -- they do that on a routine basis, as I say, because they have to prevent subsidence of the ground surface.
Q There's been some testimony in addition about segregation of backfill?
A Yeah.
Q And I'm going to read to you again some testimony. This is from Dr. Vitton, and this is pages 675 through -76. We're talking about segregation. He says:

"This is a very large volume, and they're not going to have -- from what I've read -- I haven't done this type of mining. They're going to use an end dump. They're going to have a batch plat somewhere, either in the mine -- mix it up and then haul it up and then dump it down 100 feet. Problematic. Some of the problems you get is segregation of the materials." And then he also says that "There are two problems you have discussed in these types of papers. One is segregation of the particles. The big particles tend to work their way upward in the cement; at the bottom will get very strong, and the top will get very weak. The other thing, if a" -- and actually I'm going to stop there and ask you to comment and tell me first whether you agree with that description of segregation as you drop down with rockfill.

Q Well, as I mentioned before, in the early days of cement rockfilling segregation was an issue. And the mines learned to adapt to that, and they learned to modify the design of the mixes and the procedures -- the placement procedures, in order to minimize it. Nowadays segregation is a minor operational issue. It doesn't pose any threat to the bulk stability of all the stope because we understand the -- we understand the mechanics of that problem much better now, and we take actions to remediate against it. And I've talked about two of those actions being making the fill a little bit wetter if you're putting it into a long hole stopes is that you don't allow individual rocks to roll, and cutting down on the top size so you have a more consistent product that goes into the stope.

Q And continuing what he testified -- and this is at pages 676 through -77. He said:

"The other thing you can -- with the liquefaction problem -- and that's more of a soil mechanics. I had a paper on that, on the liquefaction issue, and they describe having liquefaction problems, meaning that it drops down. The pore pressure gets up so high that it just blows it out. It causes it to move and then heavily segregate."

Can you first tell us your understanding of "liquefaction"?

A I believe my understanding of liquefaction would be the same as Dr. Vitton's, is having a -- having energy imported into a granular media which is placed at a very, very loose density. And when that media is disturbed, it wants to repack to a tighter density. And in doing so, it pressurizes the water that's in the pore space. And when that water pressurizes, it actually effectively lifts all the soil particles and the soil strength goes to zero and it becomes a liquid. Liquefaction is an engineering -- civil engineering issue that has been studied absolutely to death.

It's not my area of expertise, but being an engineer it's been studied to death. And there are charts available that show liquefiable susceptible soils. And cemented rockfill would not even plot anywhere near on one of those charts. The materials themselves are not susceptible to liquefaction. The other thing that you need to appreciate is that these stopes don't get filled in one day. So the material that's at the bottom is not in the same state at the material at the top. It takes weeks to fill these stopes. And cemented rockfill cures to a solid within 24 hours. You could go out and drive on cemented rockfill after 24 hours and it -- and it's already -- just the same as when you pour a sidewalk in front of your house or pour yourself a new driveway. You know, the next morning you can go out and you can walk on it, you know, and you won't sink in it. It's not wet cement anymore. The cement hydrates to a -- that hydration process takes it to a solid within 24 hours. So by the time you get up a couple of lifts in that stope, the material on the bottom is already solidified.

And the other thing I should point out too is that the -- you remember from the very first slides I showed you it's a -- it looks like wet gravel, and it's not a -- if you tip it out on the ground, you don't get a bunch of water poured out of it. There is no free water in it, in the sense that you don't -- there's nothing there to drain down.

So there's nothing there that's going to -- this concept of the cement sinking down and the rocks floating up, it can't happen because there's not enough water. The water is already tied to the cement, and that cement is tied to the aggregate particles. And they're all just stuck together in this kind of gooey matrix. So I don't believe that liquefaction is even a credible risk in a cemented rockfill environment.
Q Have you ever heard of it happening in cemented rockfill?
A Never.
Q There was also some testimony about the settlement of the backfill?
A Yes.
Q And Dr. Vitton testified about his experience with the settlement of soils. And at page 680 he testified that in soil mechanics in surface mining, for example, "One of the first problems I encountered when we put our backfill -- our soil back in a surface mine, it settles over tens of 20, 30, 40, 50 years. So it's continually settling. Even when you compact it, it still settles." Does cemented rockfill behave the same way as soil put back into a surface mine?
A The mechanical properties of a cemented rockfill would follow more parallel with a very, very weak concrete. And you don't see concrete settling in that scenario. I mean, when you pour concrete tight, it stays tight. And my

experience and certainly with the operations that I consult to, I've ever known anybody that's ever experienced any short-term or long-term settlement within the cemented rockfill itself.

Q Dr. Vitton also testified that after the end of mining you could get as much as one to two percent settlement of the backfill. And he said that given 650 feet of backfill, he estimated you would have 12 to 15 feet of settlement. And he testified at page 750 on that. Do you agree with that conclusion?

A No. I would have -- I have trouble believing that. And the reason I have trouble believing that is because comparing the settlements of a pile of material out on the surface is a very different scenario in an engineering environment than putting it in a confined environment in an underground stope. And because of the mechanics of the confinement and the arching stresses that develop in these stopes, you're going to get a lot of self-support within that stope because of the -- because of the load shedding from arching. And that's why there's been a lot of mines that have put pressure meters and load cells at the bottoms of stopes. And you would never read this kind of worst-case scenario of a, you know, gamma H, the unit weight times the height of the stope. You'll never measure that stress at the bottom of the stope because of the arching forces that develop.

And therefore, you're not going to see those kinds of subsidence effects on that scale from a confined stope.

Q Can you explain to us -- you mentioned load-shedding and arching effect. What does that mean?

A Well, basically there's not interaction between the primaries and the secondaries. And that interaction is that when you -- in order to mobilize settlement, it -- the material has to drag down against this interface. And that interface has friction and a certain amount of cohesion in it. And those forces are going to counter-balance the forces that want to drag this material down in that settling environment. And we call that arching; that mechanism is called arching. And it will minimize the amount of settlement that you would actually witness in a confined environment. The other thing is, it's got no place to go. I mean, in order for it to settle, it has to fill a void somewhere. And there's no voids down there for it to fill. It's all grain-to-grain contact. And so the only way you can get it to settle is to put so much pressure on it that you actually crush the grains. And at this type of a shallow depth, personally I don't believe that you could put that much weight on it that you could actually crush the aggregate that's underneath it.

Q You did talk earlier about the fact that there were voids in the cemented rockfill.

A Yeah. But -- Are those the type of voids that could result in the settlement?
A Well, it -- but the voids aren't -- they're between grains. So you've got grains that are supported on each other. And when you have that grain-to-grain contact, you have very, very tiny voids that are in between the -- in between the grains. And in order to fill those voids you have to physically crush that material down to a powder to get rid of the void. And as I say, I don't believe in this shallow of an environment that you could put that much stress on it to crush it.
Q In your experience what kind of settlement might you expect from -- in a mine like this of the backfill?
A Well, as a -- as an off-the-cuff type of a worst-case scenario, I looked at a one-percent void ratio change in the secondaries, and that amounted to about two meters of settlement at the top of -- at the top of the secondaries.
Q And that's in the secondaries. What about in the primaries?
A In the primaries? There's no way you can generate settlement in the primaries. The only way you can get the primaries to settle is to put a load on it. And in that case I did a quick back-of-the-envelope calculation, assuming that somebody figured out how to cut the crown pillar out all the way around so that it became a free-floating block and drop it on top of the cemented rockfill.

And when you do that, the cemented rockfill would sink about one inch at the top.
Q There's also been testimony in this case about the ARD erosion and backfill. Did you review that testimony as well?
A I did, yeah.
Q Have you reveled the literature relating to backfill generally? I believe you've testified a lot about that?
A Yeah, I'm very familiar with it; yeah.
Q Have you seen any reference in this literature to anything related to acid attack on any types of backfills?
A Well, I should -- I should clarify that what's been testified to previously is a mixture of acid attack and sulfate attack. So are you asking me about the acid attack issue?
Q Well, we have actually heard both.
A But they've been mixed together, though, like interchangeably, --
Q That's right.
A -- not recognizing that those are two completely separate issues.
Q What do you understand the two different issues to be?
A Well, I mean, they're -- you can generate acid from ARD in the oxidation of sulfides and make the water acidic. But the only way that that water -- acidic water is going to

come into contact with cemented rockfill is when the mine floods. So in that sense, that issue is a post-mining issues in my view. The other issues that's been raised as being a deleterious issue is a sulfate attack of the backfill. But in that case the previous testimony was assuming that the backfill, the cemented rockfill, was made out of development rock and that there was sulfate in the cemented rockfill. We're using an imported granitic rock that has no sulfates in it, no sulfides in it. And therefore there's no source for the sulfates to attack that -- attack that material. So that issue in my mind is a non-issue.

Q So the sulfide attack, that's -- have you read any -- reviewed any literature about that issue in particular?

A Well, I mean, I'm very familiar with the literature that relates to sulfate attack of mine backfills. But sulfate attack is not an issue in cemented rockfill. It's never been reported, and I know of no case of anybody that's ever had issues with sulfate attacks and strength loss in cemented rockfills. All of the literature that relates to sulfate attack in mine backfills relates to hydraulic fills and poaste fills. And in that case the fill itself is the source of the sulfate, because they're putting the tailings back into the stope. And it's sulfide tailings that they're using. And if you go through that literature -- so it has

no relation to what we're doing here, because number one we're using rockfill, not tailings. And number two is, we're putting non-sulfide aggregate in there. So there's no source for the sulfates to attack the cement. But even then, the actual mechanism of sulfate attack -- and even though -- you get sulfate attack in concrete, but it's a surficial issue because it has to attack a free face. And the -- and it comes about because you have -- the sulfates react with the lime in the cement, and it produces a gypsum-like crystal that's called Heterogenite. Heterogenite requires a lot of volumetric expansion, and it causes expansion in that media. Well, you can imagine in cemented tailings if you've got gypsum crystals growing in there and the stuff starts to swell, it basically pulls itself apart. And in the very early days of poaste there were some operations that reported problems with the poaste falling apart after a few years because of the growth of these gypsum crystals. But they very quickly realized, you know, what that was. And if you read the literature and -- they talk about if you use clean-mix water as opposed to plant-mix water, the problem goes away, because the sulfates are in the water that's used to batch the backfill. All those issues are totally, totally unrelated to what we're doing here. So it's --
Q And do you -- when we talk about acid attack, have you

worked -- you told us about some base metal mines where you're worked?
A Yes.
Q That have used cemented rockfill?
A Yeah.
Q And do those have any issues with acid water?
A Oh, absolutely. I mean, it's -- in base metal mines where you have very high sulfide content, you know, ARD is an issue.
Q And in that have you had problems with degradation of the backfill in those types of mines?
A In my experience I have never run across a mine that had degradation in cemented rockfill due to acid degradation of the cement. And I have reached -- gone through my whole library that -- I have quite an extensive backfill paper library -- and gone through the research journals I can, and I can't find anything in those journals that talk about acid degradation of cemented rockfill. So again, like I said, generally if it's not published it means that nobody's experienced it before. And I've never heard of it.
Q What's the lowest pH water in a mine that you're familiar with that was using cemented rockfill?
A Well, after I replaced all my clothes from the one mine visit, it was -- it was about pH 1 ½, was the lowest I worked in.

Q And that was using cemented rockfill?
A That was using cemented fill but not cemented rockfill.
Q Did they have problems with acid attack on the rockfill?
A Not in the fill they don't, no.
Q Okay.

MS. LINDSEY: Your Honor, can I have just one minute?

JUDGE PATTERSON: Sure.

MS. LINDSEY: Thank you. I have no more questions.

MR. REICHEL: I have no questions.

MS. HALLEY: Your Honor, given the hour and your previous ruling that because there was no report provided and the recitation was sparse, I think we would like to defer our cross for now.

MS. LINDSEY: And, your Honor, I just would like to say that I thought your ruling was that if this came as a surprise and was not truly rebuttal, that you would allow that. I did speak to Ms. Halley before this and explained that we really wanted to get Dr. Stone out of here if at all possible. He's been waiting for three days given the testimony. He has to fly back to Seattle on a flight tomorrow, and he's very busy. And I would really like to try to get him done today if at all possible.

JUDGE PATTERSON: Are you saying you're not prepared to cross-examine him at this point?

MS. HALLEY: I'm saying that he testified about things that went beyond just rebutting our witnesses' testimony. And so given the nature of the recitation that we got, that's right.

JUDGE PATTERSON: I think most of his testimony is exactly rebuttal. Ms. Lindsey read from testimony.

MS. HALLEY: Your Honor, could I have a few minutes to go through with my notes?

JUDGE PATTERSON: Yeah, sure.

MS. HALLEY: And I could point out perhaps what was new.

JUDGE PATTERSON: Okay. But I think if we can accommodate this witness at all, we should get him done today. If you need some time to prepare cross-examination now, then that's fine.

MR. WALLACE: Is there another way to do this, your Honor?

JUDGE PATTERSON: I don't know. What would you suggest?

MR. WALLACE: Because the other thing is, you know, we're going to be late.

JUDGE PATTERSON: Right.

MS. LINDSEY: Well, and my understanding is, we have accommodated other witnesses in this case who had to travel and leave.

JUDGE PATTERSON: True.

MS. LINDSEY: And I did explain this at the beginning and understood that there would be maybe an hour of cross. So I thought I was perhaps conservatively hoping that we'd left enough time and could get this done.

MR. WALLACE: Well, I mean, I think it's clear he's testified to many, many points and issues in a compressed period of time that we need to look into. I mean, we're not particularly well-prepared to do that because we didn't anticipate this. But I'm just wondering if there's another way, such as doing a telephone deposition next week --

JUDGE PATTERSON: Well, we could do that.

MR. WALLACE: -- and presenting it to the court so we could b prepared; he can take his flight. Would that be --

MS. HALLEY: That's acceptable to me, certainly.

MS. LINDSEY: Your Honor, that seems highly prejudicial. Every witness in this case who's testified, the cross comes right afterwards. You don't get, you know, days to think about it and prepare. This is -- I was very careful to give all recitation of what we were talking about in rebuttal. And that should be of no surprise, that we were going to rebut that testimony, because it's exactly what we said. And his credentials and his CV were in this (indicating), and his credentials of talking about backfill, there should be no surprise here. And I would prefer to finish this today.

MS. HALLEY: Well, your Honor, I think in recognition of the limited recitation we got from the Intervenor -- you know, you offered to provide us --

JUDGE PATTERSON: Well, I guess people are willing to do it by telephone.

MS. HALLEY: I have no objection to that, your Honor.

JUDGE PATTERSON: Would you be ready to do that on Monday morning?

MS. HALLEY: Sure.

MS. LINDSEY: Dr. Stone, are you available Monday?

THE WITNESS: I can make myself available.

JUDGE PATTERSON: That way you'd get out of here at a decent hour today too, this being Friday. So maybe we can work that out. Let's call it a day. We can go off the record.

MS. HALLEY: Just a point of clarification. I understood that you were calling --

REPORTER: Are we off?

JUDGE PATTERSON: Yeah.

(Proceedings adjourned at 4:23 p.m.)

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