STATE OF MICHIGAN
STATE OFFICE OF ADMINISTRATIVE HEARINGS AND RULES

In the matter of:	File Nos.:	GW1810162 and MP 01 2007
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. /	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. III

BEFORE RICHARD A. PATTERSON, ADMINISTRATIVE LAW JUDGE

Constitution Hall, 525 West Allegan, Lansing, Michigan

Wednesday, April 30, 2008, 8:30 a.m.

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Lansing, Michigan
Wednesday, April 30, 2008 - 8:36 a.m.

JUDGE PATTERSON: Good morning.
MR. HAYNES: Petitioner call Jack Parker.
JUDGE PATTERSON: Okay.
REPORTER: Do you solemnly swear or affirm the testimony you’re about to give will be the whole truth?
MR. PARKER: I do.

JACK PARKER

having been called by the Petitioners and sworn:

DIRECT EXAMINATION

BY MR. HAYNES:
Q Mr. Parker, would you say your name and spell your last name for the record, please?
A My name is Jack Parker, P-a-r-k-e-r.
Q Mr. Parker, where do you reside?
A In a small village called Baltic, Michigan, which is near Houghton.
Q Near Houghton? Which county is that in?
A Houghton County.
Q Thank you. And, Mr. Parker, could you give us a summary or your education starting with your bachelor degrees?
A That was at Michigan Tech. I took two bachelor's, one in geologic engineering and the other in mining engineering.
Q When did you receive those degrees?

A I forgot -- 1958, somewhere in there.
Q And --
JUDGE PATTERSON: Mr. Parker, could I ask you to speak up a little bit?
THE WITNESS: Not very much.
JUDGE PATTERSON: Okay. As best you can.
Q Mr. Parker, you will have to speak up, because we all have to hear you, including our opponents sitting across the aisle.
A Now, what?
Q It's not amplified. That's just for the -- the microphone is for the court reporter's purpose.
A Oh. Okay.
Q Mr. Parker, what were your -- I may have asked this already, but what were your degrees in?
A Mining engineering and geologic engineering.
Q And did you then take courses toward a master's degree?
A I did.
Q Did you receive a master's degree?
A I did.
Q From where?
A Michigan Tech.
Q What year?
A Around 1960, I think.
Q For your master's degree, did you prepare a thesis?

A I did.
Q What was the thesis on?
A The title was, "The Sublacustrine Geology of Lake Superior."
Q And for the benefit of the Judge and the rest of us, what is the -- generally what is the sublacustrine geology of Lake Superior?
A This is how it came about: The Corps of Engineers at that time was doing a detailed survey of the bottom of the lake, the eastern portion. And we were able to get ahold of that information and so map the bottom of the lake, and then my job was to interpret that topography in terms of geology.
Q Mr. Parker, we've already had marked and admitted your resume, which is Plaintiff's (sic) Exhibit 124, and the other details about your education are in your resume, are they not?
A Yes.
Q Now, during your career, have you studied the basic geology of the Upper Peninsula of Michigan?
A Yes.
Q And have you studied or do you have experience with the basic geological processes that shaped the Upper Peninsula?
A Yes.
Q Would that include matters relating to the creation of rock structures in the Upper Peninsula?
A Yes.

Q Would it include matters relating to glacial activity in the Upper Peninsula?
A Yes.
Q And can you describe for us what in geologic terms is meant by the word "dike" or "dikes"?
A In geology a dike would mean an intrusion of molten rock into what we call country rock, other rock. Usually it would be vertical. Usually it would be planar like this (indicating). Usually it would be straight. Usually it would be narrow.
Q And when you say "planar," you described with your hand what that looked like. Could you describe it in words?
A A flat plain standing on edge.
Q Thank you. Have you in your career studied dikes or patterns of dikes in the Upper Peninsula?
A Yes.
Q Now, what in geologic terms is meant by the word "fault" or the word -- or "faults"?
A In geology a fault would be a plain where the rocks broke and specifically on which there has been movement.
Q Okay. And have you studied faults or patterns of faults in the Upper Peninsula?
A Yes.
Q Now, have you studied or do you have experience with mine subsidence?

A Yes.
Q And where do you have experience with this issue?
A Well, the first seven years of my working life I was in England working at coal mines -- underground coal mines where surface subsidence was of concern, and so one of my jobs was to measure it.
Q And have you studied subsidence after you left England?
A Yes.
Q And in what locations?
A I worked for ten years at the White Pine Mine, and I was in charge of what we called a rock mechanics program, and one of our jobs was to monitor subsidence of the surface.
Q Where is the White Pine located -- White Pine Mine located? Excuse me.
A About 75 miles west of Houghton.
Q In the Upper Peninsula?
A Yes.
Q What kind of a mine is the White Pine Mine?
A Basically copper with a little bit of silver, the copper occurring as a copper sulfide.
Q Have you studied or do you have experience with lateral stress fields in mines?
A Yes.
Q And where do you have that experience from?
A It started at White Pine, where we had problems with it and

did not recognize it initially, but then we learned a lot about it at the White Pine Mine.

Q And what -- can you explain for the Court what a lateral stress field is?

A Yes. For a long time it was assumed that the weight of the rocks pressing down on an underground mine would exert a vertical load, which is roughly equal to the weight of the rocks. It was assumed for a long time that that would cause -- as you push downwards, there would be a tendency for rocks to expand sideways, and that would exert a lesser horizontal pressure. Then we found there were more stresses than that.

Q And what were those stresses that you found out?

A Usually somewhat complicated, but I think I heard it described best as a product of the history of the rock going back billions of years. The rocks had been deformed several times, and some of that stress which deformed them was locked into the rock.

Q And do the mining processes then affect those -- the stresses locked into the rocks?

A It works both ways, yes.

Q And could you describe how it works both ways?

A Well, if you make an opening in the rock structure in the ground, you create concentrations of stress around that opening. That changes the stress field, as we call it. And

the existing stress field is sometimes high enough to crush the rock. Sometimes it's just enough to hold the rock together, and sometimes there is not enough of this horizontal pressure to hold the rock together.
Q Have you studied or do you have experience with vertical stress fields in mines?
A Yes.
Q And where did you study this or do you have experience with vertical stress fields?
A Everywhere.
Q In all of the mines that you've been in?
A Yes.
Q Now, do you have experience with the designation of rock properties?
A Yes.
Q And where and when?
A Do you want me to tell you how I do and how I don't pay much attention to them?
Q We'll get to that.
A We're concerned with them everywhere.
Q I see. And by "everywhere," you mean in mines?
A Yes.
Q Okay. Do you have experience evaluating diamond drill rock cores?
A Yes.

Q And how long have you had this -- when did you start working with diamond drill rock cores?
A About 60 years ago, 6-0.
Q And that was in England?
A Yes.
Q And you've worked with diamond drill rock cores ever since?
A Off and on, yes.
Q Have you evaluated mining plans for various types of mines?
A Yes.
Q And how many, if you can give us an estimate?
A Well, every time I work at the mine, which means 4-, 500 different mines; every time we're concerned with those things.
Q And when you say 4- to 500 different kinds of mines, what -- different mines, what are the kinds of mines that you're talking about? Are they underground mines and aboveground mines?
A Mostly underground.
Q And are the underground mines for mining for a particular metal or substance?
A Well, all kinds. I started off in coal mines. When I came to Canada, I worked in copper, nickel, matter of fact, and coal mines and copper mines and limestone mines and salt mines and potash mines and trona mines; many different kinds.

Q Mr. Parker, do you have experience with drilling and blasting in mines?
A Yes.
Q And where did you gain your experience in that area?
A Well, in the old-fashioned coal mines, we could not use it, of course. I got most of the experience at White Pine, where for awhile there I was training miners in the use of explosives.
Q And have you studied the effects of mining -- excuse me -- of blasting in mines on fish in nearby streams?
A only in the literature.
Q And have you studied or do you have experience with ventilation plans and the operation of ventilation systems in underground mines?
A Yes.
Q And describe your experience for the Court.
A Well, when you're underground, of course you have to provide fresh air. You have to exhaust the bad stuff. And that's at every mine.
Q Can you describe for us what is meant by a crown pillar?
A I think that most people would understand crown pillar as being that rock above the mine and below the top of bedrock.
Q And do you have -- have you studied or do you have experience with evaluating crown pillars or studying crown pillars?

A Yes.
Q And have you studied the question of crown pillar stability?
A Yes, of course.
Q About how many times?
A That's a concern, of course, in every mine.
Q How is it a concern in every mine?
A You don't want the roof to fall on top of you. In most cases -- in some cases you do allow the roof to come down intentionally.
Q And what cases would those be?
A When you wanted to recover all of the reserves, for example.
Q Have you studied or do you have experience with the question of water influx into underground mines?
A Yes.
Q And where have you studied that, or where is your experience?
A Well, it's -- again, it's a concern in all mines. In salt mines, of course, it's a very bad thing, 'cause it dissolves the salt in the roof and the floor and the pillars. In some mines it's a nuisance. In some mines it's a problem because you have to pump it and dispose of it, and then some mines are flooded by too much water.
Q Have you studied or do you have experience with case studies of mining operations in the Upper Peninsula?
A Yes.

Q And could you describe your experience in that regard?
A Well, I had about ten years' experience at White Pine. That was the best, of course. That was an education. And then, as a matter of course, you look into all the old mining history. You can find -- see how they behaved.
Q And why would you look into the old mining operations to see how they behaved?
A Because I think that's the best way to learn, from experience. You're dealing with reality then.
Q Do those case histories of prior mines deal with issues of subsidence?
A Sometimes, yes.
Q Do they deal with issues of stress analysis?
A Not very much information is available on mines in the U.P. concerning stress analysis.
Q But you're familiar with that information?
A Yes.
Q And do those case histories also deal with mine safety?
A Naturally, yes.
Q And by "mine safety," what do you mean?
A You have to protect the mine and all the people who are in it or near it.
Q About how long, Mr. Parker, have you been working in or around mines?
A 1946 is when I started.

Q So that would be about --
A A long time.
Q -- 66 years -- no -- 62 years. My math is wrong. 62 years; is that right?
A 60-some years, yes; yes.
Q Okay. And can you estimate for us the number of times that you have studied or helped solve problems for mines?
A Sometimes, of course, you go back to the same mine many times; right? To answer your question, that would be thousands but at hundreds of different mines.
Q Mr. Parker, have you designed underground mining methods and layouts?
A Yes.
Q And what areas of mine design do you have experience in?
A Well, first of all, the coal mining and then ten years of experience at White Pine, which was not unlike a coal mine in that the ore was widespread like a blanket -- a think blanket, more or less horizontal. And then -- when I got into what people call consulting, then it was in a variety of mines, including hard rock mines.
Q And what kind of mining occurs at hard rock mines? I mean, what is being mined there at hard rock mines?
A Generally speaking, coal is considered to be soft rock. Salt might be -- the other salt such as trona potash would be soft, soft in the sense that you can cut them with

machinery. They behave differently from the other rocks, which have to be drilled and blasted. Then we start to talk about hard rock mining. They behave quite differently.
Q And does hard rock mining typically involve mining for metals?
A Usually, yes.
Q Have you studied or do you have experience with mine safety issues in general?
A Yes.
Q And could you describe your experience for the Judge and for us?
A Well, everything we did, of course, was concerned with safety. You have to design the mine so that it does not collapse before you want it to. You have to design it so that nobody gets hurt by drilling and by blasting, by transportation, by poor ventilation; all of those things.
Q Have you taught seminars dealing with mining at colleges or universities?
A Yes.
Q And in what subjects?
A At Michigan Tech it was concerned with mining directly. It was rock mechanics and rock fragmentation.
Q And describe for us what you mean by "rock mechanics."
A People define that in several different ways but, because of the kind of work that I've been involved in in the last 30

or 40 years, I call it -- I define it this way: It's an understanding of rock properties and rock behavior and what to do about it.

Q When you say "rock behavior," can you elaborate a little bit?

A Rocks deform in different ways. Soft rocks like coal, salt tend to squeeze, tend to actually flow, if I can use that words -- flow very slowly as ice flows. Sometimes it breaks violently -- suddenly and violently in a bursting fashion, sometimes unpredictably. Sometimes you can predict a long time ahead of time -- days or years ahead of time when that ceiling is going to fall down. Sometimes you can't. That's behavior.

Q And what do you mean by "rock fragmentation"?

A "Fragmentation" is breaking it into pieces, and there, of course, are many ways to do it. You can do it mechanically with a hammer or with explosives or with a machine. We can cut it, drill it. Those are different modes of fragmentation.

Q Have you given seminars to the mining industry?

A Yes.

Q About how many times, if you can estimate for the Judge?

A Dozens.

Q And what topics did those seminars cover?

A For about ten years I gave an annual seminar at White Pine

and took advantage of the workings. I have to show people the real thing. And that was called "Practical Rock Mechanics for Miners."
Q Have you given any other seminars to industry?
A Yes.
Q And what topics?
A Well, I've been asked to go and talk to the people at specific mines -- a coal mine, a salt mine, limestone mine and that sort of thing -- applying this practical rock mechanics to their particular environment.
Q Have you taught courses at the college level?
A Yes.
Q In what fields?
A The first were geomorphology.
Q And what is geomorphology?
A "Geo" meaning "earth" and "morphology" shape. You study geomorphology so that you can look at the topography as you drive by it or walk over it and can pretty well interpret what you're walking on; what's there and how it got there, how it got that shape. You interpret the shape of the rocks.
Q And what other courses have you taught?
A Glacial geology.
Q What is glacial geology?
A A study of how the glaciers -- the continental glaciers, in

particular, have affected the topography, especially in the Great Lakes region.
Q And what other courses have you taught?
A At a college level?
Q Yes, a college level.
A Rock mechanics and rock fragmentation.
Q Which you've already described?
A Yes.
Q Have you published any papers dealing with rock mechanics and mine stability?
A A dozen or so.
Q And are some of those papers listed in your resume?
A Yes.
Q And have you published any books dealing with rock mechanics?
A Engineering Mining Journal. EMJ it's called. I published a series of five articles, one a month, and then they reprinted them and bound them as a soft-cover book and sold them.
Q And what was the title of the book?
A Practical Rock Mechanics for Miners.
Q Have you published any papers dealing with mine pillar design?
A Yes.
Q Are those papers listed in your resume?

A Yes.
Q And are your other publications that you have listed in your resume?
A Would you say that question again, please?
Q Sure. Any other papers that you may have published, are they listed in your resume?
A Technical papers, yes.
Q Have you testified as an expert in court or administrative proceedings?
A Yes.
Q About how many times?
A Ten or a dozen.
Q And were you called in those proceedings by industry or by government or by others?
A Mostly by industry.

MR. HAYNES: Your Honor, at this time I move to qualify Mr. Parker as an expert in the fields of geology, geology of the Upper Peninsula, rock mechanics, mine design, mining practices and mine safety.

MR. LEWIS: It's not necessary to move to qualify the witness. I'm not willing to make a blanket stipulation as to his qualifications in those particular areas. I would suggest that, as questions come up as appropriate in those particular areas, I would reserve foundation objections until that time, your Honor.

MR. REICHEL: I have no objection to the witness' qualifications certainly in geology, geology of the Upper Peninsula and rock mechanics. Counsel, I didn't hear the remaining fields. There was --

MR. HAYNES: I may have gone too fast; mine design, mining practices and mine safety.

MR. REICHEL: Well, I think the -- there's a foundation that the witness has some specialized knowledge clearly in each of those areas.

MR. HAYNES: Before we move on, I'm going to give the witness a bottle of water since the rest of us have one.

A Is it Superior water?

Q I hope so. Can't vouch for the bottle.

A Thank you. It says it's been purified.

Q Mr. Parker, what kind of approach do you take to mining and geological problems; that is, is your approach aimed more toward computer modeling or toward the practical side of the mine -- of mining, or is there some other approach?

A When I first started in rock mechanics, we had to lean heavily on the work done by the U.S. Bureau of Mines and their publications. I'm telling you this so you understand how I came to be where I am.

Q That's fine.

A That was mostly theoretical work. I think most of it was done by mathematicians and physicists who were looking for a

way to apply their skills to the mining industry. And it worked out that way, and they had to make certain assumptions about rocks, as if rocks might behave in the same way as steel and concrete and other predictable materials. And that didn't sit very well with me, because I could see that those rocks were not like steel or concrete. They're vastly different. And so I had to do that work with tongue-in-cheek, so to speak. And I watched other people working in this field and publish and teach, and they would usually have a circular motion here like this: You teach, and you learn, and then you go back and you teach, and the same old stuff was repeated over and over again. And when we at White Pine got into a White -- a rock mechanics program, we found that that was all wrong.
Q That what was all wrong?
A The way that this rock mechanics stuff was being taught. We were taught, for example -- I'll give you an example -- that the roof in a mine in a room or something like this underground would behave like a beam, and the beam would sag under its own weight or perhaps under a superimposed load, and it would eventually fail in tension down the middle. It would go like this (indicating); crack in tension. And from that they did -- the signs would say that the narrower this room was, the more stable it would be, and the wider -- and wider you made it, the more likely it would be -- to become

unstable.

And we found that that's not true. And, you know, very soon it became obvious that, if you try -- if you're designing a beam and you've got -- going to pretend that it will eventually fail intentionally, you say, "That doesn't make sense, because this rock already has cracks in it." Natural rock has natural cracks in it, and it -- the rock mass itself has no tensile strength.

Q What do you mean by "tensile strength"?

A Resistance to pull apart. The cracks are already in it, so that beam-type design was all wrong for us. I mean, we tried it for a few years, and it didn't work, so we had to look for other reasons why the roof was stable or unstable, and that's when we got into this lateral stress situation.

Q And what do you mean by "lateral stress situation"?

A I'll give you an example. We were at a depth in one part of the mine of about 1,000 feet below surface, and we had to drive five parallel rooms -- headings, we call them -- straight east to develop another piece of ground for mining. And the roof kept failing in those headings, which were 28 feet wide; had a lot of trouble with the roof; had to keep patching it up and going back and patching it again, and it would fall and patch it again, and it wasn't working. So we did what the book recommended and made them narrower. Instead of 28, we went to 24, and that didn't help. And we made another move to go as narrow as the mining equipment would allow us to go, which was 18 feet, and the situation got much worse. We were doing what the book says. It should get better, but it got worse.

And about the same time a seminar was offered at Queens University in Kingston, Ontario, on lateral stresses. And those people were talking mostly about their experience, which is good in the uranium mines and Elliot Lake area of Ontario. And I was lucky enough to be sent there, and it was just as if somebody had turned a light on inside here (indicating). They talked about these horizontal stresses, which they had measured in a crude fashion. Then they found that, instead of the vertical stress being the weight of the rock, that's okay.

But instead of this horizontal stress being a third or a half of that value, there's much, much higher. The horizontal stresses in Elliot Lake were very, very high, like, thousands of pounds per square inch, not 500. And they varied in direction. They varied in magnitude, and they varied in direction. There was not a constant even in this one group of mines. And as I sat and listened to that, I said, "This is just what we're seeing at White Pine. I've got to get back and try some of these things." And they were able to overcome or at least control those horizontal stresses by, for example, making the rooms much wider -- not

narrower but wider, which was going against the book.
Q Counterintuitive?
A Yes, initially. But when you stop and think about it and when you stop to look at some of the old-timers, you found -- they find that they did it after awhile intuitively. They found that the narrow rooms didn't work, and so they went wider without having a theory, without talking about horizontal stresses. They just found it worked that way.
Q So can you tell us why, then, you take the more practical approach than the theoretical approach?
A Because it works.
Q And would you describe the basic principles of your practical approach, your creed, if you will?
A Yes. I like it, and I use it in all the seminars and courses. it came from a professor who taught geology, and he worked on the side for Cleveland-Cliffs Iron Mining, and he taught us this approach to mining problems or geologic problems. There are four steps. The first step was to observe, which for him and now for me, means, "Go take a look. Don't try and solve the problem without first looking at it. First go look and learn all you can about it while you're on the job. Talk to the people. Talk to miners in particular, because they're spent their lives working with that rock. Don't worry too much about the textbook. Go

there and take a look and see what's really there. Fill your head with as much of that information as you can.

Then the second step would be to analyze it. No. I'm sorry. The second step would be to measure. If -- some crude measurements -- at least some crude measurements. And so, for example, White Pine, we were faced with problems like this following reports that the conditions are deteriorating in a certain part of the mine, and it seems that the supports are falling apart, and your roof is coming down and cracking. So you go look at it, and you ask yourself, "Is this really a problem? Is it ongoing? At what rate is it moving?"

And the simplest approach that we had to start with was to take a stick -- a wooden stick and cut it to length and jam it in between the ceiling and the floor of the mine opening so it's tight and then come back next week, next month, next year and observe how much it had bowed. And we got some pretty good photographs of people standing beside bowed sticks like this. Obviously the roof had come down inches, and from there we got a little more precise. We're not worried about great precision, but without much trouble we could measure the convergence, as we called it, the coming together of roof and floor, to the nearest thousandth of an inch.

And you plot that on a graph, and you can see, if the graph is horizontal, a line like that (indicating); no movement, probably not a problem, not at this time anyway. But if it does start to move off of that horizontal line like this, you are forewarned something is going on even if you can't tell it by eyeball.

Q What other portions of your creed are there?

A Well, okay. That was start of measuring. We do a lot further with that. Once you've got some measurements, then you can start to analyze if you're sure that it is moving, for example, and at what rate. That's the third step. And once you've done enough of this, you have a grounding on which you can design. And I say, unfortunately, a lot of the modeling work, a lot of the theoretical work, it's okay. I don't mind if people do it, but I wouldn't want to pay for it, because it is founded on assumptions, not on the observations, not on the measurements. Or if there are measurements, they're not necessarily representative. So I like the practical approach based on those four steps.

Q Mr. Parker, what, in your view, is the best way to evaluate someone else's work dealing with geological issues?

A If I haven't already done it, I'd go take a look at what they're talking about; observe.

Q And by "observe," what do you mean? Does that include looking at the rocks?

A If it's a rock problem, that's essential that you know what

you're talking about. We go further than looking at it. You kick it. You hit it with a hammer. You lick it to see what it tastes like. You sniff it. You use all the senses you have to try to evaluate it.
Q In the absence of being able to do all of those physical touchings or observations of the rock, are photographs -- can photographs be used as a substitute for some of that evaluation?
A If they're good photographs, preferably in color, preferably clear, close-up, they can be very helpful, but they don't give you all the answers.
Q Mr. Parker, for your assignment in this matter, have you reviewed any technical reports that accompanied the mining application prepared by Kennecott Eagle Minerals Company?
A Yes.
Q And what technical reports were they?
A If you have a list, I'll tell you "yes" or "no."
Q All right. Did you review the Appendix C1 to the application, --
A I did.
Q -- which is entitled, "The Geology of Eagle-Nickel Copper Deposit" --
A Yes.
Q -- prepared by Rossell and Coombs?
A Yes.

MR. HAYNES: And for the Court's benefit, the items that I'm going through are part of the application, and we'll supply exhibit numbers later when we get all of those things sorted out.
Q Mr. Parker, did you review Appendix C2 to the application entitled, "Eagle Project Geotechnical Study" prepared by Golder Associates dated April 2005?
A Yes.
Q Did you review Appendix C3 labeled, "Eagle Project Additional Geotechnical Scope" dated February 2006?
A Yes.
Q Did you review the technical memorandum from Golder Associates to David Sainsbury regarding the clarification of -- on RMR classification systems dated April 2006?
A Yes.
Q Did you review the Golder Associates geotechnical memorandum dated July 7, 2006?
A I can't remember the date on it, but I did -- I think I reviewed all that were available.
Q And did you review two reports prepared by David Sainsbury?
A I thought there were four.
Q Did you review those reports?
A Yes.
Q And have you reviewed a document that has been listed as Kennecott Exhibit 592, which is -- if I can have that, I'll

give you the title. This is entitled, "A Report on the Evaluation of Possible Hydraulic Conductivity Changes Due to Mining-Induced Stress Effects Eagle Deposit Crown Pillar" prepared by Golder Associates.

A Yes.

Q Now, Mr. Parker, based on your knowledge and experience of the Upper Peninsula geology, I'd like you to describe how the orebody that is the subject matter of this hearing got where it is and in relation to other selected mines. And I put up on the screen a figure from page 7 of Appendix C1 of the application. And if -- this -- I think this shows the Mid-America Drift -- excuse me -- Mid-America Rift and the regional geology. Could you approach the screen and with a pointer give us an explanation of what the various features are on this chart?

A Yes.

Q And you'll have to speak up again, because the microphone is placed there.

MR. LEWIS: Excuse me, if I could, Mr. Haynes. Could we have a reference to exhibit number and page number for this, please?

MR. HAYNES: Again, this is Exhibit -- this is Appendix C1, so this is one of the unnumbered parts of the application. We'll have to fill this in.

MR. LEWIS: is it listed as an exhibit?

MR. HAYNES: It's part of the application.
MR. LEWIS: Is it listed as an exhibit?
MR. HAYNES: Is what --
MR. LEWIS: I just want a reference to the record and a page, if I might have one.
MR. HAYNES: It's MDEQ 26.
MR. LEWIS: Thank you, sir.
MR. HAYNES: It's one of those exhibits that we're going to provide the numbers for after we get all the stuff sorted out.
Q Mr. Parker, --
A Yes.
Q -- could you explain what's on this figure?
A This is a geologic map of the Lake Superior region, this (indicating) being Lake Superior. This is the area of interest in Yellow Dog Plains in particular. The general idea here is that there was at one time a great rift in the earth's crust, which starts down here somewhere in Texas and comes up around here and then goes back down this way like a great rift.
Q Mr. Parker, for the record; that is, when we get a transcript; when you say "here and goes down there," I'd like you to describe on the figure what it is you're talking about and describe where you're pointing.
A Well, starting down here in Texas, I believe this rift is

supposed to come up through the western arm of Lake Superior, to curve around and go down south in this (indicating) general area.

Q And by "this general area," do you mean, like, Michigan?

A More or less, yes.

Q Okay.

A We're interested in this rift because of a break -- a great break in the earth's crust -- between two plates of the earth's crust when they were shifting around a billion years or so ago, so they tell me. And minerals -- valuable minerals came up from deep in the earth's crust and gave us mineral deposits here (indicating) in copper country, native copper in the area of White Pine, here iron, up here right now copper, nickel, platinum.

Q And where you say "up here," are you pointing to around --

A Minnesota.

Q Okay. Thank you.

A And several copper and gold deposits here, gold up in Ontario; lots of valuable metallic deposits.

Q And were there such deposits in the Yellow Dog Plains as well?

A Right here (indicating). These were found more recently, yes.

Q All right.

MR. HAYNES: Could we then go to Department

Exhibit 26, Appendix C1, page 13?
Q Mr. Parker, this is another figure from Appendix C1, prepared by -- on behalf of Kennecott. And what does this figure show from a geological standpoint?
A Well, geomorphology shows that up he and to the north and east of this line there's a deposit of sand and mostly gravel that the glaciers, when they came down from the north, left in this area. And here, to the south of this plain -- the Yellow Dog Plains, a flat area, are the hills, mountains -- Huron Mountains, ancient rocks. The sand that washed out of that gravel was deposited here in a relatively flat plain -- first of all, a clay layer and then sand on top of it; relatively flat. Underneath that sand, hidden in most places but traceable by geophysical methods, are these dikes, planar deposits, almost vertical like this, like this, which go for miles across country here.
I think that they are indicative of stresses in the earth's crust a long, long time ago, which were tensile as if -- like my fingers, as if this area had been heaved up and, in being heaved up, was domed somewhat, I like to say. Or "arched" would be a better word -- arched -- and separated as my fingers are separating here as the earth's crust was stretched on top of that arch. And then these dikes were allowed to come up through the weakened zones, and they are oriented just about east/west.

Q Does this figure show any faults in geologic terms?
A It does.
Q Could you point those out for us?
A This one. These are fault finds interpreted from aeromagnetic measurements.
Q And the lines that you're pointing to trend in what direction?
A Northwesterly.
Q And do those dikes -- excuse me -- those faults go across the dike -- the dikes?
A In most places they cross them like this. In a few places they displaced them as is apparently being displaced on the fault here.
Q And when you say "the displaced fault" -- "the displaced dike," you're talking about the portion of the figure that's in the upper center portion?
A Yes.
Q Right there?
A Yes.
Q Are there any other geologic figures of interest or significance in this figure?
A Yes.
Q Could you point those out for us?
A Yes. In one place, which we call the Eagle Rock, some of this intrusive material, in the dike form, but a bigger --

sort of blob, poked up probably following one of these dikes out of these faults and formed what we call Eagle Rock. It's a type of rock which has intruded, and it came from great depth, and it just happens to have these valuable minerals in it.

Q Mr. Parker, when you say "intruded," could you explain that for us, please?

A I could do that better with the next figure when we're done with this.

Q Okay. Thank you. Mr. Parker, by the way, have you visited the area around Eagle Rock?

A Yes.

Q Have you looked at Eagle Rock?

A Yes.

Q Have you done all of those physical things that you talked about; chipping at it, touching it, tasting it?

A Yes; yes.

Q What was your impression when you did those -- when you examined Eagle Rock?

A Well, it was certainly intrusive. It certainly stuck up above the plains. It had not been eroded by the glaciers as other rocks had right here. It's harder, tougher than the rocks around it, which were ancient sedimentary rocks mostly. And there was another small outcrop on the bend of the river right here.

Q When you say "right here," where are you pointing?
A Towards what's now called the Eagle Deposit.
MR. HAYNES: All right. Let's go to Plaintiff's Exhibit 43.
A And if you wish to leave the --
Q Oh, sorry.
A There are other lineaments shown on here interpreted -- not actually observed but interpreted from the arrow in this case.
Q And what are those linear figures?
A They're called lineaments. For some reason there are -- the electromagnet survey shows something which could be traced from here to there, like this, so they call it a lineament but don't explain it.
Q What is a lineament?
A It's just that; how -- some things which are lined up.
Q I see. All right.
A Then these little dots here are some -- show the location of some of the exploration holes of diamond drillers.
Q I see.
MR. HAYNES: All right. Let's go to Petitioner's Exhibit 43, page 6.
Q All right.
A This came from --
Q Hold on a second. Mr. Parker, you have prepared certain

slides for your testimony today; is that right?
A I prepared some, and I was helped by other people.
Q Sure. And we have now on -- Petitioner's Exhibit 43, page 6, what is this figure that's on the screen right now?
A It came from a publication that was put out by Prime Meridian, another exploration company.
Q And what does this figure purport to portray, if --
A An --
Q Go ahead.
A An interpretation of the geology of the Yellow Dog Plains and how it may have got that way.
Q Do you think that the figure is accurate?
MR. LEWIS: Objection to foundation, your Honor.
A It's --
MR. LEWIS: He explained that somebody else prepared the figures. There's no foundation as to why he we don't know whether it's accurate or not.
A That's okay; that's okay. No, it's not accurate. It's just a general representation.
Q Mr. Parker, in your experience as a -- in the field of geology, does this figure portray a general representation of the processes and help you explain the processes that formed the metallic deposits at the Eagle area?
A In a general way, yes.
Q Okay. Thank you. Can you show us, then, and use the figure

to help you explain those processes?
A Okay. Most people accept that the world is more or less spherical, and most people believe that we live on a crust and that deep down there is molten material -- heavy molten material, quite often rich in such things as iron and nickel, uranium, uranium providing the heat, some people say. And I like this, because it illustrates what I think happened to the Yellow Dog Plains, and it's that the plume, as they call it, of molten material pushing up so it's domed the earth's crust a little bit, which caused these splits to open up. These are then the tension cracks that's between my fingers. And some of this molten material was squirted up, working its way up in those zones of weakness, which may have been opened, or found just weak ground. And then we are learning more and more about this recently. It seems that these are the ancient sediments --
Q When you say "these," what are you pointing to?
A This pinkish-brownish color. These are distorted a little bit, but this discolored material -- ancient sediments which underlie the Yellow Dog Plains. And at the bottom they are rich in sulfur as pyrite generally -- and some of that sulfur was picked up by these molten rocks as they came through it. And when it got to the basalt rocks up higher here, that sulfur picked up the metals which were in there -- the salt, the same basalt that the Keweenaw

Peninsula is made up of and the copper mines are in. It picked up the copper, nickel, few other things and concentrated it in this molten rock which is coming up here. In a few places that was segregated, being heavier and of different properties -- segregated and formed blobs of enriched rock, which we now call ore. And there are some samples, some examples here that this is the kind of deposit that the Eagle is believed to be in. That intrusive that we talked about coming up, not in dike form, but as something thicker in a dark, heavy rock, which is generally called peridotite, peridotite (pronouncing).

Q Could you spell that for the record, please?

A P-e-r-i-d-o-t-i-t-e. And that is the host rock which contains the orebody, and that might be left in a place like this, a blob of it, and within it the sulfites might be concentrated into sufficiently rich proportions to constitute ore. Ore is something that we can mine as a profit.

Q All right. Is there anything else about this figure that helps you explain the geologic processes for the orebody at Eagle -- at the Eagle site?

A Well, it's an encouraging sort of a thing, because it shows that this has happened before elsewhere in the world. Sometimes the values are concentrated in a sill, as you'd call it, more or less horizontal streak of enriched rock as

in South Africa and on the Bush Velt, where the copper, nickel, platinum comes from, and in Russia and in Siberia at a placed called Norilsk, Russia. A very rich deposit in rocks like this shows up at Sudbury in Ontario; same general idea; picking up sulfur. The sulfur picks up metals, and it concentrates them into orebodies of many different kinds. They don't have to be great filled dikes. They can be -- sills or -- be fracture filled, a funnel-shaped thing like this. This is encouraging for exploration in the Yellow Dog Plains. There may be several others.
Q All right.
MR. HAYNES: Could we then turn to Petitioner's Exhibit 43, page 7?
Q Mr. Parker, in preparing this exhibit, did you search for examples of what we've been referring to as dikes?
A Well, this came up -- this particular one came up by coincidence. This gentleman here, James Wark, was at Michigan Tech about the same time as I was. He was in mining. So was I while I was -- now he has his own plane, and he flies around the country -- around the world too taking air photos from unusual low altitudes, not the high-altitude stuff that we normally think of as air photos. And he has published several books of them, and they're on the web, and they're beautiful. I was looking at them; beautiful pictures, beautiful examples of geology. And

this, I think, was what Yellow Dog Plains would look like if you scraped all the sand off it. That's in the desert. The sand has been blown away here, leaving a dike exposed, vertical, hard rock which survived while the softer rock was worn away, and you see that going across the country, another one going across here, another one going across here, radiating from what we call a volcanic plug, where a massive molten rock came up like a plug. And that to me would be much like the Eagle Rock with these dikes moving out from it. In our case, there are all these -- in this case, they are radiating from that plug as if that plug came up and split the rock in several directions.

Q And what geologic feature does this photograph on page 7 of Exhibit 43 show?

A Well, mountains on one side, a plain here, and -- that's a road cutting across it -- and dikes and the plug.

Q And what is the plug called, if you know?

A Oh, that particular rock is called Ship, S-h-i-p, Rock.

Q And what state is that located in?

A New Mexico.

Q New Mexico. Thank you.

MR. HAYNES: Would you go to page 8?

A There are two photographs that are put together. I don't know why. But obviously the lighting is different, but it's the same rock, the same dikes.

Q So page 8 also shows Ship Rock in New Mexico?
A Yes.
Q And it shows a closer view of the dikes that you mentioned on page 7; is that right?
A It does, yes.
MR. HAYNES: Let's go to page 11.
A I have one more thing.
Q Yes, sir.
A If this were on the Yellow Dog Plains, that would have been rounded off by glaciation.
Q Like Eagle Rock?
A Yes.
Q Thank you.
MR. HAYNES: Page 11.
Q Mr. Parker, we've turned to page 11 of Exhibit 43. What is shown in this figure?
A Stanley -- Professor Vitton was working on a project in western Baraga County in Watton area, W-a-t-t-o-n, and came up with this old geologic map showing that the dikes, which we have over there in Yellow Dog Plains, extend all the way across here into Baraga County, and he had that buried by lighter rocks. But you may be able to see dotted or broken lines there, telling us that they do continue underneath the lighter rock.
Q And, Mr. Parker, is this figured prepared by -- I'm sorry.

Who was it prepared by?
A The U.S. Geologic Survey.
Q Is that a document that reasonably prudent-minded consultants would rely on in the ordinary course of their affairs?
A Yes. I think the primary, again, is looking for copper nickel in this area too.
MR. HAYNES: Can we now turn to Petitioner's 38, page 50?
Q Mr. Parker, I've put up on the -- I've had put up on the screen a figure from Petitioner's Exhibit 38, page 50. What does this figure purport to represent?
A A drawing, a cross-section looking west across part of the Athens Mine, which is near Negaunee, an old mine.
Q And for purposes of explaining your testimony, what is the relevance of the Athens Mine?
A Well, we mentioned earlier that, one of the first things that we'd want to do if we were concerned about the stability of a mine in the Yellow Dog Plains would be to look for examples of the mines in the general area, in similar geology, and this is one of the most striking -- a lot of people know about it. It's no secret. It was written up in Mining Engineering in the 1930's, I believe. Mining iron ore down here (indicating), this is elevation 1600 feet, 1200, 800, 400, zero, sea level and down 400

below sea level, down 800 below sea level. So they were mining a couple of thousand feet below surface and taking out the iron ore over an area about the same size as the Eagle Mine would be, 3-, 4-, 500 feet. What's special about the geology there is that another one of these dikes -- that's what this (indicating) is.

Q And you're pointing to what when you say "this" on the figure? Just describe in words what you're pointing to.

A Something which is labeled "Main east-west diorite dike," which tapers upward from a couple hundred feet thick up to zero near surface. That bounded the mine on that side which would be the north side. The orebody was bounded on this (indicating) side by what they call a truss, some people call a -- it's faulting; the dark lines are faults. This was a small dike.

Q You mean on the south side of the mine?

A Yes, of the deposit; yes. They mined this by a method they call top slicing. They mined up on top of the pile and blasted the roof down and blasted some more roof down and blasted it down, working their way upwards. They hadn't gone very far before they ran into trouble. They had water in the mine, and an unfortunate set of circumstances caused this to collapse. It's been written up several times. It's available in the literature, but this is generally what's believed to have happened.

This is a strong, hard rock. There's some things -- another surface over here, either a fault or a dike. They taper like (indicating)so it's in a cone-shaped mass of rock. And when it was undermined it broke loose with the help of some water on these plains. And a plug of rock about 1800 feet thick came down, collapsed, leaving a crater at surface about a couple hundred feet deep. The crater is still there.
Q Mr. Parker, is this figure one that reasonably prudent mining consultants would rely on in the course of their work?
A Yes, definitely. It would be like somebody flashed a warning flag at you and had said, "Hey. This is what happened. Is this anything like your deposit?" And I'd say, "Well, it is." The geology is vertical like this (indicating), and there are hard dikes and softer materials. There is a chance that there would be slippage on plains like this especially -- especially now if there was not very much of this horizontal stress available to prevent it sliding.
Q Excuse me, Mr. Parker. I may have misheard you. Did you say that the Athens Mine geology is similar to what we're talking about at the Eagle deposit?
A I did say that. It's similar. We know it's not exactly the same. It's similar.

Q Similar enough to apply the lessons from the Athens mine?
A To take warning from it, yes. Are we coming back to that probably?
Q Well, we're going to go the Athens mine now, Mr. Parker. Mr. Parker, I'm back at Petitioner's Exhibit 43. This is page 12, which is an aerial photograph. Do you know what this depicts?
A I do. Stanley noted that, but you can talk to him later?
Q Somebody will talk to him later. What do you know -- what do you know about what's depicted in this photograph?
A This is Negaunee and a string of iron mine -- underground iron mines running more or less in this (indicating) direction. And this is the Athens mine crater, circular now is what -- and the other -- well, it looks like potholes, but they are craters formed by collapse of the underground mines.
Q So this shows from the air what we saw previously in the cross-section view of the circumference of the Athens mine; correct?
A That's the same crater, yes.
Q And, Mr. Parker, we now have page 14 of Petitioner's Exhibit 43. And is this another view of the Athens mine crater?
A It is the same crater. It's distorted here, I think, by the way the print has been made. This is part of Negaunee.
Q And would these photographs of the Athens mine crater as it

presently exists be used by reasonably prudent mining consultants in the conduct of their affairs?
A I'd say of course.
Q Mr. Parker, we've put up a photograph of what appears to be a land form with certain equipment on it. Have you seen this photograph before?
A Yes.
Q This is page 4 of Petitioner's Exhibit 43. What does this photograph portray, if you can?
A The collapse of the surface above the Ropes Gold Mine.
Q And where is the Ropes Gold Mine?
A Just north of Ishpeming, not too far from the Yellow Dog Plains.
Q And when did this collapse occur, if you know?
A In the 1980's.
Q Have you visited this site?
A I was in the mine before it collapsed. I've been here since the collapse, but I believe it's all been filled in with sand.
Q Does this photograph, to your understanding, accurately portray what happened after the -- or what the condition of the land was after the collapse?
A I think so. Stories were in the newspaper at the time. They're available. I would add that this was certainly not expected because a delivery truck was driving over the road

when it collapsed and the truck went down the hole. The driver had to climb out.

Q The photograph that we now put up which is page 5 of Petitioner's Exhibit 43, is this also a picture of the Ropes Mine?

A Same thing. This (indicating) would be the head frame from the shaft which is over there.

Q What is a head frame?

A A structure put up above the shaft so that the hoist can be down here where my hand is, and the ropes go up over the head frame over a wheel -- it's called a shieve -- and down the shaft. That supports the shieve.

Q Thank you, Mr. Parker. You can take your seat.

MR. HAYNES: At this time, your Honor, we'd move admission of portions of Petitioner's Exhibit 43 and, in particular, page 7 and 8 which are the Ship Rock photographs, page 11, which is the east-west dikes in Baraga County, pages 12 and 14 which are the Athens Mine aerial photographs and pages 4 and 5 which is the Ropes Mine photographs.

JUDGE PATTERSON: I'm sorry. The exhibit number was what?

MR. HAYNES: 43.

JUDGE PATTERSON: 43. Okay.

MR. LEWIS: For the record, I believe that's

Petitioner's Part 632 Exhibit 43; is that --

MR. HAYNES: That's correct.

MR. LEWIS: I'd like to place an objection on the record, your Honor, as to the relevancy of this evidence as to other mines and, in particular, it would apply to Petitioner's Exhibit 43, the last series of photographs, which as I understand it are Exhibits 43, page 12, page 14, page 4 and page 5. And the basis of my objection is relevancy. And I handed this morning a bench memorandum to Petitioners' counsel and also to the court, supplied the court with some pretty good authority, I believe, under Michigan law that to present such evidence for its bearing on what may or may not happen to the Eagle Mine at issue in this case, that before that can occur and before such evidence can be admissible, the proponents have the initial obligation to lay a foundation showing that the circumstances and particulars of the other occasions, in this case the other mines, are, in fact, so substantially similar to the condition and circumstances of the Eagle Mine as to make such examples as what may have happened at other mines relevant in this proceeding. In particular, we cited a Michigan Supreme Court case, Royal Mink Ranch, which fairly clearly says that:

"In order that evidence may be admissible as to a similar but distinct fact the relation or similarity of which is not apparent, for an order that the admission of such evidence may not be held to be erroneous, foundation evidence is required for the purpose of showing that the seemingly extraneous fact as to which evidence is sought to be introduced or as to which evidence has already been admitted is connected with the controversy or an issue therein, that it is the same as or similar to a fact in dispute or that the circumstances or conditions were identical or at least similar."

We also cited to you a Michigan Supreme Court case which, in fact, involved evidence of the subsidence of mines other than the mine at issue in the case, the O'Donnell v Oliver Iron Mining Company case in which our Michigan Supreme Court excluded evidence of the subsidence of soils in a neighborhood far away from plaintiff's house because the excavation in those areas was far more extensive and took place under different conditions.

Now, your Honor, I submit in this circumstance that the Petitioners have laid a very much lacking foundation to meet the stringent Supreme Court requirements for demonstrating similarity between these mines and the Eagle Mine and that it ought -- these pictures and such evidence ought not be allowed for the purpose of showing the likelihood of some subsidence event at the Eagle Mine.

Relevant factors, it seems to me, for which a foundation ought to be laid is the timing.

Now, we already heard some testimony from Mr. Parker that some of these events in the Athens Mine occurred a long time ago and the Ropes Mine he suggests in 1980 sometime. He did suggest that the geology is similar; however, there's been very little foundation or specifics to establish that fact. He also mentioned in the course of his testimony that as to the Athens Mine, it was a type of mining called top slicing which he said involved blasting the roof down. As is reflected in the mine permit applications, that is a very much different method of mining than will be used in this mine, the Eagle Mine, which is going to be a sequential stope-by-stope mining with backfill after each stope.

Secondly, I believe part of the necessary foundation would be the regulatory framework in which these various mines were undertaken. We've had no foundation as to whether there were any regulations in place as to the Ropes Mine, the Athens Mine; if so, whether they compare at all to the regulations and the permit conditions that will govern this Eagle Mine -- which, as the court already knows, is a new set of statutes, new set of regulations particularly for this type of mining and which we saw yesterday in the Petitioners' exhibits in a letter from

Governor Granholm, what she believes to be the strictest mining regulations in any state in this country.

There are no references in the foundation for this evidence as to any reclamation requirements, as to any bonding requirements, as to any monitoring for subsidence requirements, as to any requirements that additional characterization be taken once underground in the Eagle Mine as are in our permit conditions. And ultimately, your Honor, I think such evidence that the Petitioners attempt to utilize to -- again for the proposition that there is some likelihood of subsidence of the Eagle Mine is ultimately not relevant and further is prejudicial under our Michigan Rule of Evidence 403 and ought not be admitted.

MR. REICHEL: Your Honor, the Department joins in the objection as to relevance.

JUDGE PATTERSON: Mr. Haynes?

MR. HAYNES: Your Honor, I have a couple of responses. First, I think the fact that -- or from Mr. Parker's testimony that there was a different mining technique is not at issue here. The question is the similarity of geology. And that foundation was laid. As to the different regulatory regime, I'm glad that Mr. Lewis brought that up because Part 632 requires the applicant to consider certain aspects of mine safety. And in particular, I cite 63205(2)(c) which says that:

"The application must be accompanied by a mining reclamation and environmental protection plan for the proposed mining operation including beneficiation operations that will reasonably minimize the actual and potential adverse impacts on natural resources, the environment and public health and safety."

So certainly mine safety is at issue in this case, and our contention is that the fact that other mines in similar geology in the similar -- in the nearby area have collapsed is relevant to mine safety. The statute also requires in 63205(2)(d) that:

"The mining plan" -- excuse me. "The mining application include a contingency plan that includes an assessment of the risk to the environment or public health and safety associated with potential significant incidents or failures."

So the application has to include a contingency plan for failures of the mine. Certainly the fact that mines in the Upper Peninsula in similar geology have failed is relevant to that question and hardly prejudicial. Next the statute says in Section 63207(2)(b)(2)(i) that for the mining permit, the permittee can -- that's right. Excuse me. Sorry.

"The DEQ can terminate the permit if the permittee has otherwise fulfilled all conditions determined to be

necessary by the Department to protect the public
health, safety and welfare."

So again the DEQ has the ability under the statute to terminate the permit if the public safety is not being protected by the permittee. Fourth, in Section 63207(6)(b):

"The Department may require that a mining permit
be amended if the Department determines that the terms
and conditions of the mining permit are not providing
the intended reasonable protection of the environment,
natural resources or public health and safety."

So public safety is part and parcel of this regulatory regime. It is important, we think, for the Department to understand and for the -- and for Kennecott to understand that other mines in the Upper Peninsula in the same geology have failed, that the crown pillars have failed. That's an important fact that should be taken into account in this application and in this proceeding.

Furthermore, reports from Dr. Sainsbury which are Department Exhibits 57 and 64 that will be used later on in this proceeding, specifically mention the relevance of and the need for considering other mines in the area and the causes of their collapse. So this regulatory regime, in fact, demands that mine safety and other mines be considered in the application. And to supplement that, your Honor, we suggest that under MRE 404(b)(1) that mine collapses in other mines are evidence of other acts that are information -- that are relevant to this proceeding.

MR. WALLACE: May I comment briefly, your Honor?

JUDGE PATTERSON: Sure.

MR. WALLACE: From the standpoint of Huron Mountain Club, this really goes to the heart of why we're here. Our concern is -- you know, one of two principal concerns is a plug failure or similar kind of collapse that will drain the headwaters of the Salmon Trout River. And we have a witness here of unparalleled credentials who has talked to us now for more than an hour about his approach to predicting the future geologically of a mining operation, and his approach is grounded in looking at and observing other situations, the 500 mines he's looked at. Unlike the two cases that were cited -- and they only cited two cases -- a Mink case -- Mink Farm case and a neighborhood subsidence case, where no expertise was -- and certainly not the expertise of somebody of Mr. Parker's stature, was brought to bear as foundation for admission of the evidence.

In our case Mr. Parker has fully informed us of the similarity, the relevant similarity of these mines and the collapses of these mines. In fact, Sainsbury himself refers specifically to the Athens Mine, and he's the consultant that the MDEQ brought into this case. So I think that, with all due respect, Mr. Lewis' opinion of whether this is sufficiently and relevantly similar does not compare to Mr. Parker's opinion on that subject which is the record upon which these exhibits should be admitted.

MR. HAYNES: Your Honor, if I may just supplement my remarks.

JUDGE PATTERSON: Sure.

MR. HAYNES: I was handed the memorandum prepared by Mr. Lewis this morning at about 8:25, and I have not had a chance to fully review the cases or the memorandum, but I join in Mr. Wallace's view the cases are easily distinguishable because we aren't dealing here with a property damage case; we're dealing with a regulatory regime that demands that the public safety be taken into account. And that includes the fact that other mines nearby have collapsed. So we think that it's entirely admissible and entirely relevant.

MR. EGGAN: Your Honor, I too -- and this is Eric Eggan, for the record, on the Part 31 part of this case. One of the obligations that both the DEQ and Kennecott had in this matter was to characterize the geology and characterize the hydrogeology, all of which relates directly to what Mr. Parker is testifying about right now. And so from our perspective, this is a simple matter of 404(b), an evidentiary issue that relates to their knowledge, what they should have known and what they did know, as they submitted all these reports and documentation on groundwater, on the mining permit, on all of these issues. I know it hurts them and that's why they don't want it in. But, your Honor, this is clearly evidence that would be admitted in a civil court. And under the relaxed standard in these proceedings, it's surely admissible.

MR. LEWIS: If I may, your Honor, number one, it's surely not evidence that would be admitted in any state or federal court in Michigan. And I think that's abundantly clear. I've cited to you two Michigan Supreme Court opinions to that effect. I think they're directly on point, and I've given you a list of factors which bear on the relevance of this evidence of other mines. And I submit that the Petitioners as far as their foundation have satisfied perhaps one percent of those foundational requirements. Again, clearly according to the Supreme Court, it's the plaintiff's burden to satisfy that foundation before such evidence may be submitted.

Secondly, Mr. Wallace's comments I believe confirm the point of this objection; that is, it is very much the intention of the Petitioners to use such evidence as having some bearing on their opinions about the likelihood of the subsidence of the Eagle Mine. And let's keep in mind that this case includes NEPA, and that the Petitioners bear the burden of showing by preponderance of the evidence that, in fact, the crown pillar will likely collapse. This is very much evidence they intend to use for that proposition.

As to the comments that these mines are in a nearby area, according to Mr. Haynes, once again there was no foundation about proximity of these mines among all the other lacking foundational issues. As to comments about relevancy to mine safety, I think, and the reclamation plan, the safety plan, the contingency plan, proves my point, your Honor. One of the variables here, one of the necessary parts of the foundation I believe would be to show that the regulatory statutory guidelines in place for these other mines are, in fact, substantially similar to those for the Eagle Mine; the point being, that our strict new regulations and statutes in this state provide severe and very emphatic incentives to the owners who wish to do this kind of mining to make 100 percent sure that this kind of thing does not happen. And my point is, they have not shown any foundation that for these mines there were any such similar or substantial penalties, bonding requirements, reclamation requirements and so forth, one more reason there is no foundation of similarity here. Thank you, your Honor.

JUDGE PATTERSON: Anything --

MR. WALLACE: Well, I mean, there's no solace to my client that were a collapse to occur, that there could be reclamation later. And I think that it's a little bit terrifying to hear that this statute is being used as a sword against us in this argument. Our concern is that this not happen. And we have a witness here who's laid a very strong foundation as to the relevance. I mean, the court can take judicial notice of where Negaunee is if we didn't make the point of entering that geography into evidence. This is a nearby relevant mine looked to by all the experts. And to the extent it wasn't looked to by Respondent's experts, that's a major part of our case.

MR. HAYNES: One last thing, your Honor. In terms of the burden, certainly the Petitioners have the burden of going forward in this case, but the statute squarely places the burden of proving mine safety and the protection of the environment on the applicant. That's where the burden lies in this case. It lies on the applicant to prove that the environment will not be polluted, impaired or destroyed and that the mine will be safe.

JUDGE PATTERSON: Mr. Eggan?

MR. EGGAN: Nothing further, your Honor.

JUDGE PATTERSON: Oh, you looked at me. I thought maybe you had something to add.

MR. EGGAN: I was nodding in agreement.

JUDGE PATTERSON: Okay. Well, Mr. Parker I think has laid a proper foundation for utilizing these exhibits in formulating what I suspect will ultimately be his opinion regarding the mine safety. The fact that these mines may have been operating under different regulatory schemes or arguably remote from proposed Eagle Mine can certainly go to the argument and perhaps the underlying credibility of Mr. Parker's opinions, but I am going to admit the exhibits as proffered. And again, that's Petitioner's 43 -- 632-43-7, -8, -11, -12, -14, -4 and -5?

MR. HAYNES: That's correct, your Honor.

(Petitioner's Exhibits 632-43-7, -8, -11, -12, -14, -4 and -5 received)

JUDGE PATTERSON: Can we take a break?

MR. HAYNES: Yeah, I was going to suggest that, your Honor.

(Off the record)

Q Mr. Parker, continuing, from a geologist's point of view, did the glaciers affect the geology of the Upper Peninsula?

A Yes, of course.

Q And in what way generally?

A They swept in generally from the northeast, probably Labrador, and they scraped away broken rocks and weathered rocks and any loose rocks and dragged them, carried them south, some of it, into this area. And they're deposited as gravel, sand.

Q And in what way specifically, in your view, did the glaciers affect the Yellow Dog Plains?

A I would think -- of course, I wasn't there, but I would think that they, in part, excavated that valley, scraped away some of the softer sedimentary rocks and later blocked the north side with what we call a glacial moraine, a great big heap of gravel and sand and clay. As the ice melted, it washed a lot of the sand out of that gravel mess in what we call outwash sand. There was a plain developed between the moraine, the big pile of gravel on the north side, and the hills on the south side.

Q So are you saying that the Yellow Dog Plains is a glacial outwash plain?

A Generally that's correct; yes.

Q And can you describe the effect, if any, of the glaciers on the intrusives in the Yellow Dog Plains like Eagle Rock that we've talked about before?

A Yes. It much depended on the thickness of the ice where it was passing over the rocks. In some parts of the country, the ice carried in the bottom layer some other rocks which it used to grind away the big rock, scrape, grind and sometimes pluck off large chunks of loose rock and carry them away. The soft rocks would be eroded first, of course, and the harder rocks would remain, generally rounded off a little.

Q Like Eagle Rock?

A Eagle Rock is outstanding, yes.

Q In contrast to the figures that we showed before -- the photographs that we showed before of Ship Rock in New Mexico?
A Which was not glaciated.
Q Right.
A Yes.
Q And can you describe the effect, if any, of the glaciers on the dikes that you've described before on the Yellow Dog Plains?
A The same way. The dikes are generally harder, denser rocks, and they would resist erosion, so they would stand up above the other soft rocks.
Q Now, Mr. Parker, were you asked by the Petitioners in this case to evaluate the mining application submitted by Kennecott?
A The Petitioners?
Q Yes, by National Wildlife Federation and others?
A Yes.
Q And what was your first task with respect to your review of the application?
A Stanley Vitton over there (indicating) was approached first at Michigan Tech, and he asked me to come in on it and help him. We were to evaluate the application and the appendices, in particular the mining, the geology and the rock mechanics and the possibility of collapse of a crown

pillar and the possibility of subsidence. I think that covers it.
Q And so you've reviewed the application, and, as we've discussed before, appendices C-1, C-2 and C-3, which were the geology and the geotechnical analyses --
A Yes.
Q -- attached to the application?
A Yes.
Q And were these documents similar to other mining proposals that you have reviewed in the past?
A They're a lot thicker.
Q And upon your review of the appendices, Mr. Parker, what was your initial reaction after your initial review of those appendices?
A Of the appendices, not the application?
Q Yes, the appendices.
A I was pleased for the geologic, C-1. I thought this was written by somebody who has been out in the field and knows what his rocks look like. I was pleased by that. And the other stuff, the geotechnical stuff, I shake my head like this (indicating). This is far out but not realistic.
Q I'm sorry. I didn't hear the last.
A I said it's not realistic.
Q Not realistic. In what way wasn't it realistic?
A I believe that most of that work was based on assumptions

which are not valid.
Q And what assumptions specifically are you referring to?
A How much time do you have?
Q Well, let's start with the first one that you can recall.
A Well, the one that bothers me right from the start when we get into this technical approach is that those who are promoting it have to make assumptions about the properties of the rock right off the bat. They have to assume. And what they used to write in the textbook was, assuming that the rocks are isotropic, homogeneous and -- no, elastic and homogeneous, yeah, those three things; isotropic, homogeneous and elastic, and they're not -- the basic assumption is wrong.
Q And could you explain for the judge and for the rest of us what you mean by "homogeneous" when it refers to rock?
A The word is used more in something like homogenized milk. It's mixed up, and therefore the fat and the rest of the milk are thoroughly mixed. It's the same in composition throughout, homogeneous.
Q And what do you mean by the word "isotropic"?
A In a similar way it is assumed the properties of the rock will be the same in all directions.
Q What do you mean by "properties of the rock"?
A I think I could illustrate that best by pointing to a piece of wood, chunk of wood, and saying, "That's definitely not

isotropic." You try and split it across the grain and you'll find out that the properties are different in this direction and that direction.
Q I see. And what do you mean by the word "elastic"?
A Generally speaking it means that the rock will respond to pressure or stress with a straight-line relationship. You double the pressure and you get double the compression, that sort of thing more or less; also elastic in the sense that if you release the pressure, it will rebound as a rubber ball might rebound.
Q And you just said, I think, that these assumptions were incorrect. And what do you base that on?
A I think it's rather obvious that experience will show that it's not -- when you look at the rock that -- the most obvious in this case would be there were sediments which were laid down in layers like this (indicating), more or less horizontal; therefore, the layers differ from top to bottom of a layer, and there's a tendency for the rock to split, especially between layers. That's true in the horizontal direction but not in a vertical direction. If you sample a rock this (indicating) way, take a core out this way or this way, it would be quite different.
Q That is, if you take a core, you were motioning either vertically or horizontally, you would have -- you would have different -- you would show differences in the rock. Is

that what you're saying?
A Different properties, yes.
Q Did the appendices talk about the designation of rock strengths, either compressive or tensile?
A They used those terms.
Q And what do those terms mean to you?
A To determine what they call the tensile strength, they make a model -- usually make a model beam like this (indicating) and support it at the ends and apply a load in the center because it can bend and then break, fail in tension. And that load gives you some idea of the resistance, the tensile strength. That's one way of arriving at tensile strength. There are other ways.
Q And what about compressive strength?
A Similarly they -- typically they take a sample, which would be slice of a core. Could we see a core, please? Behind Peter, I think.
Q Mr. Parker, I'm handing you, for demonstrative purposes, --
A Thank you.
Q -- a rather long tube of what appears to be rock. What is that?
A It's not really a tube 'cause it's not hollow.
Q Thank you for that correction.
A All right. This is a piece of good core. If we found this when we were exploring, we'd say, "That looks like pretty

good rock." It's hard. I learn something when I hit it; right? The tone I get from it tells me something about its properties. I'm not going to lick this one, but that tells me something useful. But anyway, this is a core. And to get the -- what we call the compressive strength, we'd probably saw off a piece which was twice as high as the diameter, so it would be about three, four inches high.

And the normal lab testing you would square the ends, grind them flat and smooth and dry them from perhaps oven dry, but more likely to be room dry, a constant -- more or less constant room humidity. And then you put it in a hydraulic machine between two flat steel platens. They're called platens, plates, and squeeze it until it failed and note the load at which it failed, and then divide that load by the cross-sectional area and conclude that it took so many pounds per square inch to break it. And we call that the unconfined compressive strength. Unconfined is important because if we put a jacket around this, it would appear to be stronger. It would be less likely to fall apart. So the usual cut-right test is unconfined compressive strength done this way.

Q Mr. Parker, in the field of rock mechanics, what does RQD stand for?

A Do you want me to tell you first why those measurements are no good, or are you saving that?

Q Sure. Let's back up. The measurements that we're talking about, the compressive and tensile strength measurements, why are they no good?
A Because they're not representative. I mean, they're okay to play with in a lab and make models with if you wish, but just look at this piece of core. You see there are veins of another material in it, this white stuff, calcite, and a rock which we call siltstone. It's not coarse enough to be sandstone and it's not fine enough to be shale or mudstone. This is siltstone. This is from the White Pine Mine, by the way, from well above the orebody. But anyway, you see, if I took a sample from here (indicating), it would be quite different from a sample taken here.
Q Why is that?
A It's obviously different, different material. There are holes in it, flaws of different kinds, planes. This (indicating) is called a joint, this inclined plane here, with some calcite in it. Those could cause premature, should we say, failures in a test. And if you had an area, let's say, the same as this room, you could not get an average strength, not a meaningful average strength. You would make some calculations. What we'd normally do if we were in the business would be to take enough samples to get what you'd think would be a good average, let's say a dozen. And you'd get them -- you're now selecting the most perfect

rock you can find 'cause you don't want to test one that's going to break before you've half loaded it.

So you get the most perfect little piece of rock you can find, and you prepare it very, very carefully. You test it under very precisely controlled conditions. How fast you apply the load, how dry the air is, that sort of thing, that's all carefully controlled. And you still get a spread of results. Some will be very, very strong, and some will be very, very weak, and a bunch of them in the middle will be perhaps representative. But you throw out the high ones; you throw out the low ones, 'cause they screw up the average, and all through this process you've been selective about getting the best possible results.

Q And did the application appendices talk about compressive and tensile strength in those terms?

A They used them as if they were acceptable results.

Q And you believe they are not acceptable results?

A I wouldn't accept them as meaningful. I'd say they're okay for a start. Take a look. This (indicating) rock is much stronger than that rock.

Q And if those tests results in the application, as you say, were good for a start, what other kinds of tests would you perform in order to determine rock strength?

A Would I perform?

Q Yes.

A I'd hit it with a hammer.
Q And what would that show you?
A I don't have a hammer, but if it was easy to break, if it crumbled easily like coal would, I'd have some idea it's going to behave like coal. If it was brittle (indicating) I'd get a high note out of the more brittle stuff. Some rocks actually ring almost like a bell. Most often when they're fine grained like glass and stiff, strong, more or less elastic and usually those are the rocks which store the highest stresses.
Q Did you find, Mr. Parker, in reviewing the appendices to the application that there was any indication of such kinds of tests were performed on the rock at Eagle Rock as part of the geological investigation?
MR. LEWIS: Objection as to form of the question. I'm not sure which types of tests he's -- Mr. Haynes is referring to, whether it's hitting it with a hammer or uniform compressive strength testing or something else.
Q Well, the field tests, Mr. Parker. Hitting with a hammer and the other kinds of tests you --
A I'm sure the geologists did it.
Q Did you see any evidence in the application appendices that such tests were performed?
MR. LEWIS: Same objection, your Honor.
JUDGE PATTERSON: If you can clarify what tests.

MR. HAYNES: Sure.
Q Mr. Parker, you talked about the compressive strength test done labs; correct?
A Yes.
Q And you testified about tests in the field where you would actually go out and hit the rock that came out of -- came out of the drill hole. Do you see -- did you see evidence, for instance, in the application, the appendices of any tests that were performed that actually -- where someone actually hit the rock to determine its vibration or its -- the sound when it was hit, such as you've just performed here?
A Vaguely I remember seeing something like that in one of the exhibits when somebody else was trying to classify rocks, suggested hitting them with a hammer, but not on this specifically no. But there were other tests that were done in the field like that point load test.
Q And what's a point load test?
A That's supposed to be a cheap, quick way of determining -- or arriving at the compressive strength of the rock. And not a little gadget is used to push two points into the rock from opposites sides like this (indicating), like my fingers, and see how much pressure is required to cause the rock to fail.
Q Are point load tests in your view appropriate for testing

rock?
A If you've got nothing better to do.
Q Would you use point load tests in your evaluation of rock strength?
A Only out of curiosity I guess.
Q And why is that?
A Well, if I give you an example, especially now on those sediments which underlie the plain or -- and surround the ore body, the ancient sediments which are horizontally laminated. You can imagine that if the laminations go like this (indicating) and you put the two points in on the core like this and push it'll split readily along the planes of weakness.
Q Like splitting wood with an axe?
A Yeah, along with the grain sort of. Whereas if you turned it the other direction and used the point load this way down the axis of the core, across those bedding planes you get a different answer. And if the planes were inclined to the core, somehow or other you get intermediate answers. And then -- I don't like to -- is that the gentlemen who used this approach have to apply a formula of some kind to change the point load strength to what they called unconfined compressive strength, which I say is something like the doctor measuring your blood pressure and applying a formula to get your corpuscle count.

Q So you're saying, Mr. Parker, that the unconfined compressive strength test really doesn't tell us very much about the rock strength?
A More recently I was talking about the point load stress test being even worse.
Q All right. Mr. Parker, in rock mechanics, what does "RQD" stand for?
A Okay. Those three letters, "RQD," stand for "rock quality designation."
Q And is the rock quality designation a designation that is used in your field of geology?
A It is used.
Q And what does it -- what is it supposed to measure?
A It was developed a long time ago, 40, 50 years ago as an attempt to put numbers on rock quality, and then you could put them in a formula, see?
Q Do you have experience with the RQD measure -- the RQD -- I don't want to call it a calculation, but the RQD designation?
A The approach? Yes.
Q And tell us how it works. How does one determine an RQD?
A Well, typically the diamond driller would pull the core up the hole and then lay -- slide it out of the tube so that this comes up in a tube and you'd slide it out of the tube into boxes or trays, like that (indicating). And then to

get -- to arrive at the RQD you are supposed to measure the lengths of the pieces of core, because almost certainly it will break. And you ignore fractures which have been caused by the drilling process or by the driller. For example, if he has to get a core into this box like that he has to break it; right? And then the driller would normally put a couple of "X's" to show that this was a man-made break; right? So you'd know that when you're after RQD. But you measure the lengths of the broken pieces and you take the total of the lengths of those pieces which are greater than two times the diameter. So let's say that if that was two inches, then you say, okay, we're going to add up everything that is greater than four inches in length and then change that into a percentage of the total length. That percentage number is the RQD.
Q So RQD's are expressed in a percentage?
A A percentage of the core which is in lengths greater than two diameters, yes.
Q And in rock mechanics, Mr. Parker, what is an RMR?
A Well, we're going to come back to RQD's I hope.
Q Oh, we will.
A All right. It's fairly obvious and most people realize that RQD will vary with direction. For example, in laminated rock if you take your core this (indicate') way or that way, this way you might have many, many breaks at the

laminations; this way you just might stay in one bed and get out long pieces of core.

Q And you're describing -- Mr. Parker, just for the -- so the record is clear, you're describing either a vertical core going through the laminations or a horizontal core going parallel with the laminations?

A Yes. Okay. So we realize that there are shortcomings to the RQD approach. And people then try to improve on it by taking these variables into account and adjusting the RQD to come up with an RMR which is the rock mass rating. I'm not talking about what we call "intact core," perfect samples, but the mass, the size of this room. We try to get -- put a number on it, the properties of it.

Q And you have -- are you familiar with the technique of arriving at an RMR?

A Yes.

Q You've done that in the past?

A Yes.

Q I may have asked this already, Mr. Parker, but let me just clarify. What is the purpose of obtaining an RQD?

A Eventually to put a number of the properties of the rocks so you can plug that number and RMR into design formally.

Q And so the purpose of an RMR is to -- is for the purpose of designing mines?

A In part, yes; not just mines.

Q What other things would RMR's be used for?
A Foundations, dams.
Q So it's a recognized technique in the field of geology?
A It is.
Q Now, Mr. Parker, does the application and its appendices -- let me rephrase that. Do the application and its appendices predict the stability of the crown pillar over the proposed mine?
A They do.
Q Now, Mr. Parker, at some point in your review of the application and its appendices did you obtain photos or photographs of some of the core samples from the crown pillar area?
A We did.
Q And when you obtained those photos did you look at the photographs of those core samples?
A Of course.
Q And how many holes were represented by the photographs that you reviewed?
A There were two stages when we first asked to see cores. I'm going to have to say this clearly. I don't believe that anybody can evaluate an application such as this without seeing the rocks. If he accepts data which have been prepared from somebody else's observation then he is dependent on that and his conclusions ought to come out the

same as theirs. If he wants to be independent he's got to go back to the rocks. Okay? So we did our best to insist on that and the initial response was that Kennecott or their agent sent us a core which came from a hole which was drilled 50 miles from the project.

Q And did you find that core useful in your evaluation?

A We found it useful to -- we learned a lot from it, yes, but not about the stability of the Eagle.

Q Because the core was from a spot 40 to 50 miles away?

A Yes. And then --

Q And that was the first aspect; what about the second aspect?

A Yes. And then in response to an FOI, Freedom of Information request we did get additional data and photographs.

Q And again, going back to my question, Mr. Parker; how many holes were represented by the core photos that you received?

A The second time around we got eight cores.

Q Okay. And do you recall how many cores actually were drilled in the crown pillar area?

A I did see a number. And of course, addition cores were taken at later dates. I think initially there were about 60 and later that went up to over a hundred.

Q A hundred cores?

A In and around the crown pillar.

Q When you reviewed the core photos what was your general impression based upon your experience in reviewing such core

photos of the quality of the rock as compared to the descriptions of the quality of the rock in the application and the appendices?
A I remember very clearly that we thought that -- I thought there must have been a mistake.
Q In what way?
A Are we going to show photographs later?
Q We will. I'm setting out that all up. Remember we talked about foundation before? This is all foundational stuff.
A Okay. Well, so you'll see for yourself that this is what we call good rock. This is approaching a hundred percent RQD, even though it's got flaws in it. The photographs showed us rock which appeared to be much -- of much lower quality than this (indicating). Much. And lower quality than we saw just in the descriptions of it. We thought there was a mistake.
Q Mr. Parker, we're going to pull up Exhibit 116, which is the core photographs. This is Petitioner's Exhibit 116 in the 632 case.
A Let me add that we realized that the rocks had probably been handled a lot after the first RQD evaluation and there could have been additional fractures. But even so, it looked bad.
MR. HAYNES: Let's go to the first -- yeah, that's right.
A Can I talk -- do a thumbnail first, very quickly so we know

what they are?
Q I thought first we'd go to the core photo, Mr. Parker.
A Okay.
Q What we have here is the first slide on Claimant's Exhibit 116 which appears to be hole 05EA099. Do you see that at the top left of the photograph?
A Yes.
Q And by the way, the court reporter very nicely pointed out there's a laser pointer in front of you that can be used to point to various portions of the photograph if you don't want to get up and get down.
A Let's stand up.
Q Okay. If you would approach the screen then.
A Yes.
Q If we look in this photograph at the --
A There's the first mistake. It says "wet" and that says "dry."
Q And how is that a -- what do you mean that's a mistake?
A That shouldn't have been there. We asked for and I think that they were doing it anyway -- we asked if we would be able to see the cores wet and dry, because when they're wetted it's like spitting on an agate, if you're a local; you see the details when they're wetted. So we asked for wet and dry. This particular one, this designation "05," that was the year in which the hole was drilled. "EA" tells

you that it was drilled at the Eagle site. That's how we knew that fresco was not an Eagle core. And then this is the number of the actual hole, 099. This core, broken as it is, comes from a depth of zero to 17.98 meters. Sometimes they were in feet; sometimes they were in meters. Here is meters.

Q Mr. Parker, what is the meaning, if you understand, of the scale that says "centimeters" at the top right-hand portion of this photograph?

A This is a bit of a mystery. We could only speculate because we couldn't talk to anybody about it. Remember that the general idea is to pick out any pieces which might have a length greater than two diameters. This one almost certainly does.

Q And you're point to the upper right-hand -- the top row, right-hand side; correct?

A Yes; yes. And this one perhaps would pass, and that one perhaps would pass, but you'd have to measure them. This is obviously a zero RQD. But anyway, one of the first things that came to mind here was that they may have --

JUDGE PATTERSON: Mr. Parker, can you try to speak up. The court reporter is not picking up your --

THE WITNESS: Okay.

A One of the --

Q Actually, Mr. Parker, it might help if you come around to the other side of the photograph and that way you'll be speaking back toward us. Can we do that?

A Okay. One of the first things that came to mind was that when the gentlemen who evaluated this in terms of RQD might have used a wrong length -- remember, we're looking for two diameters -- and we figured that it should have been about ten centimeters. When we saw this here we thought, gee, maybe they used eight and then they would have been able to count more of this good rock. Right? That's certainly ten. That is not -- probably not ten, but you can count it if you were counting eight as the good rock. It would have obtained much higher RQD. It would have made the rock look a lot better.

Q I see. And in this photograph, Mr. Parker, we have what appear to be white labels between --

A I'll move.

Q Okay. But you'll to speak up now. Between portions of the rock we have white labels. We have three of them in the -- I'm sorry. On the top row we seem to have three labels. In the next row there seem to be four labels. In the third row there appear to be two and there appear to be one -- appears to be one in the fourth row. What do those labels represent?

A Okay. These boxes were designed to hold roughly ten feet of core; five two-foot lengths. Or when you're working in meters that would be roughly 3.3 meters. Now, when the drillers start that's a depth of zero. They were not able to recover very much of the rock because it was weathered. Perhaps it might been what we call over-burdened, loose material.

Q And when you say the drillers weren't able to recover much of the rock, what do you mean by "recover much of the rock"?

A Bring it out of the hole in the core barrel.

Q And that is because why; that is, it wasn't in the core barrel because what happened to it?

A It broke into little pieces or it wasn't -- this may have been rock which broke and that's from zero to 3.95 is about 12 feet. This is the only rock they were able to recover in that first 12 feet. And so they marked the depth and then they went back in the hole and got some more and they got between this depth, 3.95 and 8.53 meters; this is what they were able to recover. So responsible drillers keep doing that and put these markers in to tell at what depths.

Q All right. Mr. Parker, I want you to pause for just a second. I think --

MR. HAYNES: Could we go off the record?

JUDGE PATTERSON: Yeah.

(Off the record - switch microphones)

Q Mr. Parker, you were describing the labels and what they -- and how they got there and what they were relate to. Would

you continue?
A Yeah. Here's an example of two ways of measuring it: 11.58 meters and that particular driller says, "No, it isn't. It's 38 feet." And the same here. He liked to work in feet and this guy liked to work in meters. That's one of the confusion factors thrown in here. Anyway, in this one box, which is supposed to hold 3.3 meters of core, they got down to a depth of just about 18 meters, which is 55, 60 feet.
Q All right. Mr. Parker, we also see on some of these cores some red writing in the fourth and fifth rows here?
A Yes; yes.
Q What do you understand that red writing to be?
A Again, the responsible driller would -- he knows how deep his hole is because he knows how many pieces of drill steel he has added to get down there; right? He knows his depth. And if he stopped drilling and then pulled a core out he'd say, "Okay. At this point I have 17.98"; that's a pretty precise measurement of depth. He writes that on the core and then he puts this block in there to say the same thing.
Q Your earlier testified, Mr. Parker, that when you reviewed the core photos in relation to the designation of the rock and the application and the appendices you said there must have been a mistake. Can you elaborate on that?
A If anybody tried to put an RQD, a quality measurement on this particular box of rock higher than zero I'd question

it. I would not want this to be a roof over my head. Would you?
Q Sorry; I can't answer that question, rhetorical as it is.
A No, it's a -- that's very poor rock. And if you're talking about the thickness, it's as important. If you're talking about the thickness of a crown pillar -- this is the roof over the head of the mine -- you're talking about the rock between top of bedrock and top of mine. That's our crown pillar. And this stuff then -- there are special names for this kind of rock. This stuff represents the upper part of the crown pillar.
Q And how is that significant?
A Well, I'll give you another one of those questions. If you have to contract a building, a concrete roof over your structure and the upper part of the concrete roof looked like that, would you accept it? No. No. Something's wrong; something's badly wrong.
Q All right.
A You can go deeper if you want. Now, --
Q No, I wanted to use this photo as an illustration of what we're going to go to next.
A Okay.
Q And you can take a seat.
A Thank you.
Q Now, during your review, Mr. Parker, did you obtain and

review tables that relate to these eight cores that show the RQD's and the RMR's as calculated by others?
A We did.
(Pause in dialogue)
Q All right. Mr. Parker, you reviewed tables of these cores. Did you also review the application -- the location of the core -- of the eight cores that you had photographs of?
A To the best of our ability we did.
Q All right. And the figure that's shown now, which is page one of Exhibit -- Petitioner's Exhibit 41; did you prepared this?
A I put the red ink on it.
Q All right. And what is this figure from?
A That shows the -- a plan view of the upper part of the ore body.
Q And where is the figure from with this plan view?
A Somewhere in the application, maybe the first appendix.
Q All right. Mr. Parker, when you say it's a "plan view," can you describe the various features in this plan view of the upper part of the ore body?
A Yes. If we're trying to interpret those cores and what they mean to the stability of the mine we have to know where they are. Nobody told us where they were and nobody told us whether they were vertical or inclined, and if they were inclined which way they were inclined. We didn't know that;

we just got the tables with numbers on. But we went to the drawings which were in the report and we found some of them, for example, and you read that tiny writing there -- printing rather -- it looks as if hole 60 and hole 62 are drilled there. And it looks as -- to us as if on the edge, the outer edge of this blue stuff, which is the peridotite, the intrusive rock, this yellowish orange color depicts the sulfides, semi -- what they call semi-massive sulfides; that's pretty good rock -- pretty good ore, I mean. And then this reddish stuff is a really high grade massive sulfides. So when we look at this we say, "Okay. This is the dimensions of this square from here (indicating) to here; there to there." That square is roughly 300 meters, which is roughly 330 feet, so now we know how big this blob is near the top of the ore deposit. So this would be the crown pillar. This is a horizontal slice through the top of the mine near the crown pillar.
Q Mr. Parker, let me interrupt you for a moment. At the bottom right of this figure we see some writing that says "plan view at" -- it appears to say "350 meters elevation"?
A Yes.
Q And then there's a writing there that says "near the top." Did you place the writing there?
A Yes.
Q And when you say "near the top," can you give us a depth

from the surface that we're talking about here?
A The "top of bedrock" number which appears in the report is questionable, debatable. They usually use this number. The top of the intrusive, which is top of bedrock, is at elevation 415 meters, 415 meters, which would be 65 meters above this slice, which would be roughly 200 feet.
Q So this slice is about 200 feet below the top of the bedrock?
A Yes.
Q Okay. All right. I'm sorry. I interrupted you. Could you continue explaining the hole designations that are on this figure?
A Well, I just skipped the "05" or the year they were drilled and the "EA" and just use this number. We presume that the holes were drilled in sequence of 55 before 60 and so forth as they explored the ore body.
Q So we have hole 60; you talked about that. That's in the upper left of this figure. And also hole 62 in the upper left of the figure?
A Yes.
Q And hole 55; the designation -- or the writing there says, "Incline 45 degrees." What does that mean?
A The dot, the small dot which is hard to find in some places -- there's one -- the small dot shows you where the hole was colored -- this is a word -- started as the color

of the hole; that's where it was colored. And this line going down shows where the hole went and where it ended up, so obviously it was inclined; right?

Q So hole 55 started above the semi-massive?

A Yes.

Q And then was inclined south at a 45 degree angle?

A Roughly, yes.

Q Roughly. All right. And then we have another writing here that -- in the upper right-hand portion of the figure that says "hole 64." What is that?

A Colored here. I believe that one was near vertical and it started in -- above the high grade rock; that's of special interest.

Q Why is that of special interest?

A That's the closest that the high grade rock came to surface, the uppermost -- the most desirable rock. And these are of interest to me too when I'm trying to evaluate it. And these holes are on the perimeter of the intrusive rock and I expect that there will be some rough conditions where that intrusive shoved its way up through the sediments.

Q Why would you expect there would be such rough conditions?

A Because of the way the intrusive comes in; it is shoved up from below in a molten form and so it must be pushing the rocks aside in some places, pushing the rocks up in some places, and melting and assimilating the rocks in other

places. So it's disturbed here and those two holes did show unusual disturbances. This (indicating) one was of special interest because it went down in that high grade rock.
Q "This one"; you mean hole 64?
A 64, yes. And it appeared to go down the hole like this, (indicating), into high grade and out of it and into it and out of it like this. It went in and out several times, so we -- in that hole I think we had a chance to look at that contact between the ore and the country rock.
Q And why is the contact between the ore and the country rock important?
A We want to know the condition of it; because, obviously, the general idea is to mine this stuff, leave the other stuff, and we want to know what's the condition going to be at this wall, if you will, where you stop mining. Is it possible that that would be a plane of slippage like the Athens mine, that sort of thing.
Q All right. And then we also have two other holes here, on the right-hand side of this figure, hole 67 and hole 69. What do those represent?
A It's hard to read the numbers so we're not sure of this, but it looks as if one of them is vertical and one of them goes from here to here, which would indicate that it was inclined and they'd be on the east side of the ore body.
Q And hole that is vertical is hole 67 -- is that right? -- or

that appears to be vertical?
A I'm not sure which was which.
Q I see. But one of them was vertical and one of them was -- between hole 67, 69 one was vertical and one was inclined?
A Yup. And we also I can tell you we also were provided in the application with cross sections, slices through here, vertical slices through there where in some cases we could see these holes cutting across the drawing like this (indicating).
Q I see.
A In cross section that was helpful.
Q You can have a seat now.
A Let me say something about this. I said that the top of bedrock was assumed to be at 415 meters.
Q Correct.
A I thought when I looked at those cross sections that I saw places where it was more like 405, which is a difference of ten meters, which is a difference of 30 feet in the thickness of your example.
Q Thank you.
A I may be wrong, but that's what it looked like.
Q Mr. Parker, does the application and its appendices describe the relationship of the RMR's as calculated in the application appendices and the crown pillar?
A I believe that all of the design work and all of the

evaluation was based on the RMR's values.
Q And RMR values, did the application say in relation -- describe in relation to the crown pillar?
A It's hard to give you a direct answer to that because there was more than one way of evaluating, for example, the stability of the crown pillar. But in general I think it's fair to say that they concluded and based their conclusions or recommendations on this assumption that if the RMR number was 70 or better it would probably be stable, and if the RMR was 60 or less it was questionable.
Q What was questionable?
A The stability of the structure as planned.
Q And when you say the "stability of the structure," you mean whether the crown pillar would stay intact during and after mining?
A Well, that's what I'm talking about, yes.
Q Now, as part of your review of these materials did you review tables that were provided along with the core photographs that contained RTD and RMR data?
A Yes; yes.
Q Mr. Parker, you say you reviewed tables. Were you provided tables or did you review tables that related to all eight of the core photos that you obtained?
A All eight.
Q And did you annotate those tables with various computations

or calculations after your review?
A Oh, yeah, many times.
Q All right. I'd like to now ask you about these tables. We put upon the screen a table that appears to relate to hole 04EA055 that's in the column labeled "Hole ID." Do you see that?
A That was the inclined hole.
Q That's the inclined hole. And in the next column to the right it says "from M." What does that mean?
A Beginning at a depth of so many meters, 13.11 for example.
Q And let me just stop you for a second. The tables that you reviewed; you did not prepare those tables, did you?
A I did not.
Q And you assumed that they were prepared by Kennecott or its consultants; correct?
A Or by their agents, yes.
Q Okay. So this is their data; correct?
A Yes.
Q All right. I'm sorry for the interruption, but just continuing on the columns, the next column over says, "To M." What does that mean?
A The same thing, to a depth of 15.24 meters. So we're talking about a section of rock from depth 13 to 15.
Q And this tabular format; this is a format that you're familiar with for describing rocks based upon the four

quotas that we looked at before?
A Yes.
Q And then the next column over or the next heading over in the left-hand column says, "RQD percentage." Do you see that?
A Yes.
Q What does that represent?
A That is the number that was assigned to that segment of core as the RQD rock quality.
Q You didn't assign the number, did you?
A I did not.
Q You assumed that the number was assigned by Kennecott or its agents or consultants; correct?
A Yes.
Q Now, in the right-hand column we have four headings. We have another heading called, "Hole ID" and it appears to contain rows that are 04EA055 which relates to the same hole we're taking about, the inclined hole; correct?
A Yes.
Q And then we have two column headings; one says, "From M" and the other says, "To M"?
A Yes.
Q Are those designations the same as before?
A The meanings are the same; the numbers are different.
Q Right. The meaning or the headings relate to the distance

at the start of the measurement to the distance at the end
of the measurement -- correct? -- or the depth?
A 10.67 to 13.11 refer to the top and bottom of that segment
of core.
Q All right. And then we have the last column says, "RMR 76."
What does that mean to you?
A That they applied certain corrections, modifications to the
RQD to arrive an RMR of 66.
Q And that would be for the first row?
A For the first?
Q Well, you said 66; that item would -- or that number would
only be for the first row?
A For that first segment of core.
Q First segment.
A Yes.
Q When it says, "RMR 76," is that significant?
A They're referring to the system which was developed by a
gentleman by the name of Bieniawski and he modified it at a
later date, 1976. And what was the other? '85, I think.
It was either his '76 or his '85 method.
Q All right. And when you annotated these tables, Mr. Parker,
the writing in red is your writing?
A Yes.
Q All right. I'd like to walk through these page by page to
have you explain your annotations to these tables. For this

table, which is for hole 55, you indicated here at the top, the top row.

A Bedrock --

Q Top of bedrock and what does it say there?

A 10.67.

Q And what does that mean?

A I looked at the core photos and decided where the dirt stopped and the bedrock started.

Q And is there any reason that you can see from these tables why in this first row, if we read across the table, on the column dealing with RQD's we start at 13.11 and on the -- in the same row with the column for RMR's we start at 10.67. Can you explain that?

A Not very well; it's a bit of a mystery. You may remember that the RQD's would normally be calculated from -- or for each "core run" as they call it. They go down the hole, they drill and they pull the rod up like this and they recover that much core and that's called a "drill run." If everything is going fine they get a full ten feet. If something goes wrong and they lose the water or it gets stuck or something, they pull out early and you end up a shorter segment. But normally you would calculate the RQD for a drill run. There's another exception to that. If there's a significant change in rock, say you went from ore to sediments, you would probably draw a line there and have

an RQD for this piece and a different RQD for that.
Q But for calculating -- Mr. Parker, for calculating the RMR on this first row?
A Yes.
Q On the run from 10.67 to 13.11 -- do you see that row?
A Yes.
Q Would you expect that if there's an RMR that's 66 that you would have an RQD for the corresponding run?
A Well, you see it's not the corresponding run really. This refers to that interval right --
Q So at the very beginning of this table, Mr. Parker, we seem to have a missing run for the RQD percentage; correct?
A Yes. And you -- well, --
Q All right. Now, let's go down to the next annotation which says -- which appears to say, "a hundred feet of crown pillar at 40.97 meters." What does that mean?
A Okay. What I'm really after is the condition of the rock in the crown pillar. And I have to have some kind of an average if I'm going to look at that. If I don't like that average, there's obviously averages tell stories. But to improve it a little bit I used what we call a "weighted average" whereby each one of these numbers would be multiplied by the length of core involved. You can see that that's about three meters right -- 3.05 meters from there to there multiplied by a hundred. Okay. Put that in your

machine and take this distance, which is also three feet, but let's look at this one. 15.24; that one's only a little over one meter. That length; I multiplied that by 50. Now, I'm taking into account not only the RQD but the length of the sample and I multiplied one by the other, then I add then all up, then I divide by the total depth to get weighted average.
Q And for the weighted average, Mr. Parker, did you do the same process for the RMR's?
A Yes.
Q And so your annotation here that says, "weighted average RMR" it says "15.65." Is that what that says? Oh, it is 65. Thank you.
A Yes, that's correct.
Q Maybe I need better glasses. It is 65. So, Mr. Parker, the calculation that you just described to take the weighted average based upon the length of the cores and the RMR. For the first 100 feet of crown pillar in this hole, the weighted average for the RMR is 65; is that what you're saying?
A That's what I ended up with, yes.
Q All right. we see here on the next portion of this slide two other annotations at 200 feet and at 300 feet; is there a reason why you picked those depths?
A Yes.

Q Why?
A Because those are the approximate thicknesses of the first guess at crown pillar and then it was modified, say not a hundred feet -- no. Let's see. There's 30 meters. And then they said, "Okay. Well, then we'll add another 30 meters and now let's look at 200 feet," and eventually got around to talking about 300 feet which is 90 meters.
Q And when you say "they"; this refers to the technical memoranda prepared for the application?
A Yes.
Q All right. For the 200-foot crown that depth reads at -- what depth is it?
A Roughly 71 meters.
Q Roughly 71 meters. And your weighted average, that's what "WA" stands for; is that right?
A Yes.
Q Weighted average RMR is 67?
A Right.
Q Okay. Performing the same calculation as you did before?
A Yes. So this includes everything up to top of bedrock.
Q All right. Then your next annotation relates to 300-foot crown pillar at 101.47 meters depth; is that correct?
A Yes.
Q And your weighted average there for the RMR is 67?
A Yes.

Q And this, again, is for hole 55 which is the inclined hole; correct?
A Yes; yes.
Q All right.
MR. HAYNES: Can we have the next annotation?
Q Mr. Parker, now we have turned in the next table to what appears to be hole 60?
A Yes.
Q In looking at the table for hole 60, Mr. Parker, we see we have on the left-hand side for the RQD percentage, at least for the first four rows on this page, an RQD that says zero. What does that mean?
A That means that the gentlemen who were assessing the RQD's as they looked at the cores say, "That's pretty crummy stuff; I'll give it an RQD of zero."
Q And --
A Excuse me. What it means essentially, no strength contributed to the structure.
Q Okay. Now, for the -- next to the RMR column you've annotated this to say, "Top of bedrock at 12.9 meters." Do you see that?
A 12.19, yes.
Q 12.19. Excuse me. And then you say, "But no RMR's before 23.01 meters"?
A That's right.

MR. HAYNES: And if we could move up just a bit to show the 23.01 row? Down; right.

(Off the record comments)

Q Mr. Parker, on the left-hand side in the RQD column we have in the third row on this page a run that goes to 21.03 meters.

MR. HAYNES: If we can go back up to -- there we go.

Q You annotated this to say that there are no RMR's before 23.01 on the right-hand side, so does it appear then that the RQD's that are in pretty low numbers on the left-hand side to 21.03 meters were just not included in the calculation on these tables?

A That's right. That rock, that very bad rock did not show up in the RMR's; it was ignored.

Q Is that standard practice?

A I would hope not. This, again, is the upper part of our crown pillar.

Q And so in your annotation you say this first 35 feet are rated RMR equals zero. Do you see that?

A Yes.

Q And why did you designate the RMR for the first 35 feet as zero?

A 35 feet -- well, bedrock starts here. I can tell that by looking at the core, 12.19, so that's not even bedrock. But

it starts here (indicating) and down to probably here. I get roughly 35 feet. And because it's so bad, it's broken up rubble. Like I said, it's worth about zero but I'm going to count it in my averages.
Q Mr. Parker, just so that the record is clear, when we're talking about feet and you're translating to meters we just have to be clear that we're using the right units whenever we are talking about the particular unit. So with that understanding let's go down to the next annotation. Now, still in hole 60, you've now annotated it at a hundred feet for the crown pillar at the depth of 42.67 meters; is that correct?
A Yes.
Q And the weighted average you calculated for the RMR is 37?
A That's right.
Q And that RMR appears to be much lower than we had in hole 55. Is that because the RMR weighted of zero that you gave the top portion of the crown pillar?
A Yes, that's what did it. You might just run your eyeball up and down this column too and see how many suitable rocks you find. 60 is not very good; 70 is acceptable for a crown pillar. These are Kennecott's own numbers. You don't see much good rock anywhere there.
Q All right. Then we go to the 200-foot crown pillar at 73.15 meters and you calculated -- what did you calculate the

weighted average to be there?
A 5-0; 50.
Q So for the top 200 feet of the crown pillar, for hole 60 the RMR is 50?
A That's right. And then we get to the bottom of the hole; we don't actually get 300 feet out of this hole.
Q So at the bottom of this hole about 280 feet down the weighted RMR is what?
A 5-8, 58.
Q Now, the next table shows hole 62; is that correct?
A That's right.
Q And for hole 62 we appear to have on the left-hand side a series of RQD runs at zero. Do you see those?
A Yes.
Q And were those translated into RMR's on the right-hand side?
A No. They're missing.
Q They're missing. Is that standard practice?
A Apparently it was here, but not normally.
Q Now, for the top of bedrock for hole 62 you listed that as 14.94 meters; is that right?
A Yes.
Q And then you say similar to hole 60 that there are no RMR's before the -- before 23.01 meters and then could you read your annotation after that?
A The first 27 feet I rated zero.

Q The first 27 feet, which would be the first nine or so meters; correct?
A Right. Some tougher bedrock -- yeah.
Q So for the 14.94 meter run to -- where would 27 feet be on the RQD side?
A That's a little under nine meters; it'd be around 23.
Q So for hole number 62, for the run from 14.94 to 23.01, you're assigning an RMR of zero?
A Yes.
Q Okay. Now, dropping down to the hundred foot level for the crown pillar at 45.42 meters, what is your weighted average there?
A 4-3, 43.
Q And that's the weighted average for the RMRs at a hundred foot?
A Yes. I should tell you every now and then that I'm not recommending this approach. But if you want to it with averages, I think that it should be weighted and I think that those poor rocks should be included. I'm not recommending doing that.
Q What would you recommend doing?
A Personally, and I think most mining people would forget The RQD RMR and go look at the cores and say, "That one looks pretty good. That's where we'll stop."
Q All right. Now, the next annotation on hole 62 talks about

230 foot of crown at 69.95 meters. Do you see that?
A Yes.
Q And you have a weighted average figure there for the RMRs, and what is that figure?
A 5-8.
Q and what is the further annotation below your weighted RMR for -- weighted average RMR for the crown pillar at this depth?
A I'll read it to you. "But below that is a 111-foot gap in the RMRs."
Q And would you show that and tell us where you found this 111-foot gap?
A Right there; that's roughly 70 meters all the way down to 103 meters but no RMRs.
Q And did you see in any of the documentation, then, an explanation as to why this 40-meter gap existed?
A No.
Q Is that standard practice to just simply omit 40 meters from these calculations?
A I would hope not, but it happened several times.
Q Your annotation further says, "Because of low RQDs." What does that mean?
A Well, I'd go back to the core boxes and look, and it's all crummy rock, either crumbly or missing.
Q That is when you looked at the photos of the cores?

A Yes.
Q On the left-hand side of the screen right now we have some red lines as well. What do those red lines signify?
A This gap from there (indicating) to there.
Q Wait; wait; wait. So the record is clear, when you say "from there to there," from where to where?
A From roughly 70 meters to 103 meters. There's roughly 70 meters and it goes down to 103 meters. That was the gap. It included these very low figures and some other low figures.
Q Very low figures for the RQD; correct?
A Yes; so not good looking rock.
Q All right. As we continue down in hole 62, on the right-hand side we see another one of your stairstep red lines. And next to it, could you read that annotation, please?
A I said there are other gaps. This one is nine and a half feet in there. That's rather strange, because in here then we've got some -- one -- well, a couple, three bad ones and then these 169.
Q I'm sorry. Mr. Parker, you're going to have to raise your voice just a bit.
A Oh, no. Actually, I have to go further down. Let's say 170 meters is off of the -- we're going to lose this, but there's another 27-foot gap.

Q We're at 170 meters, Mr. Parker?
A Yes.
Q And what's the RQD for that depth?
A I forget the exact number, but it looks like a 100 or 97 or 100. For some reason or other, that core was missing, or at least RMR was missing. Now we're beyond the crown pillar, but, of course, this will affect the mining.
Q How will it affect the mining?
A We've got this bedrock in there where we're supposed to be stoping, supposed to be mining.
Q And explain the concept of stoping.
A Extracting the ore, making a big hole.
Q And how will the bedrock affect the ability to extract the ore?
A I don't know where exactly this is going to be in the orebody. I don't have all the details there. But if, for example, this were the mine opening, the stope, and we had very bad rock in that wall, we'd expect it to cave in as we added money and supports, the same with the roof.
Q I see. Now, on the right-hand side now, going back to the hole 62, we're now on the RMR side. We're at 204.82 and there seems to be a gap going to 213.05. Do you see that?
A Yes.
Q Again, that gap, to your knowledge, is unexplained?
A Well, we can look -- we could look down here and might find

an explanation. 204 to 213.
Q On the RQD side now for hole 62 and the 204 to 213 range, what do you see?
A What looks like high RQDs. Why is there no RMR there, I don't know. Somebody may have taken that core and used it for testing. I don't know. I speculate. A tentative conclusion is that these are showing that the crown pillar will not be stable.
Q All right. Now we're going to turn to hole 64. And your annotation for hole 64 for the top of bedrock says what?
A 8.84 at 25 feet thereabouts.
Q And what does your annotation say about the RMRs at that level?
A Well, the no RMRs are presented here until you get down to 38 meters, way down here somewhere. For some reason or other they did not give an RMR to this.
Q And so you've assigned an RMR of zero for that range; is that correct?
A After looking at the photographs, yes.
Q So when you -- generally when you're assigning an RMR where there is no RMR in the table, you've done that after looking at the photographs and evaluating the rock from the photographs; correct?
A Just by looking at it, yes.
Q Okay.

A When you see that, that amounts to the first 97, close to a hundred feet of crown pillar.
Q An RMR for the first 97 feet of the crown pillar for hole -- at least for hole 64 is zero?
A Yeah, if that's a vertical hole. If that was inclined, of course, the depth is less.
Q Understood. Now, Mr. Parker, the next annotation deals with the first 230 feet of bedrock. Is that what that says?
A Yes.
Q And you've given that weighted average what?
A 6-9.
Q And your next annotation for hole 64 for 38.25 meters to 100.29 meters is also 69; is that correct?
A Yes; yes.
Q Okay. Now we turn to hole 67.
A That's over on the right-hand side of the opening.
Q You mean the east side?
A Yes.
Q Thank you. And your annotation for the top of bedrock says what for hole 67?
A 9.14 meters.
Q And could you -- on the left-hand side the RQDs for the -- what appear to be the first 12.5 meters are what?
A Zero.
Q Which means it's pretty bad rock?

A That's the way they look at it, yes.
Q Now, for the -- for the RMRs for that first 12.5 meters, what RMR average did you assign for that?
A Just 11 feet of it with RMR of zero.
Q And why did you say the 11 feet of it rates an RMR of zero?
A After looking at the core photos.
Q Now, your next annotation deals with the hundred foot depth of hole 67. And that's at -- does that say 37 to 47? Oh, 39 to 47. And what's your weighted average there?
A 4-6, 46.
Q 46 for the RMR?
A Yes.
Q Thank you. Let's go down. And at the 200 foot depth at 69.8 meters, what is your weighted average RMR?
A 5-5. Let me add a comment here. Without even going through this RMR business and arguing about it, just tell me how many 70's you see in the crown pillar.
Q And you're pointing to the RMRs for hole 67, at least at this portion of the slide?
A Yeah. Now, we're -- and I come back with a little caveat that this is on the right-hand side, east side, of the orebody right close to the contact. And who knows what kind of rocks were in there. But anyway --
Q All right. Let's go down. At the 300 foot depth of the crown pillar at 100.58 meters for hole 67, what is your

weighted average?
A It's been brought up a little bit by some 70's, but it's 58, still below the 60. And if you made it thicker, you'd still be below 70.
Q I'm sorry. Repeat that.
A I'll go back down here, please. I said if you made the crown pillar even thicker than 300 feet, you don't have very many 70's to help you, do you?
Q So does that suggest at least for this hole the thickness of the crown pillar really doesn't increase necessarily the depth -- Im sorry -- the strength of the crown pillar does not increase necessarily with depth?
A If you're using this technique to evaluate it, yes.
Q Right. Okay.
MR. HAYNES: Your Honor, maybe we could take a break now.
JUDGE PATTERSON: Yeah. It's noon.
(Off the record)
JUDGE PATTERSON: Mr. Haynes, whenever you're ready.
MR. HAYNES: Thank you, Your Honor. At this time Petitioners move the admission of Exhibit 41 in the Part 632 case.
JUDGE PATTERSON: And that is?
MR. HAYNES: That is the exhibit we've just been

going through --

JUDGE PATTERSON: Okay. But the --

MR. HAYNES: -- with the tables and the drawing at the very beginning.

JUDGE PATTERSON: Okay.

MR. LEWIS: Just one clarification. Did we see all of that?

MR. HAYNES: Yes.

MR. LEWIS: I have no objection.

MR. REICHEL: No objection.

JUDGE PATTERSON: Okay. No objection. That will be entered.

(Petitioner's Exhibit 632-41 received)

Q Mr. Parker, we're going to resume where we left off before lunch. We're now in Exhibit 42, which is a continuation of the tables that we were talking about before lunch. And we appear to be in hole 69; is that right?

A Yes.

Q And where is hole 69 in relation to the orebody, if you recall?

A I don't remember.

Q Okay. It's on your chart, though; correct?

A Yes. I think so.

Q The first annotation for hole 69 says, "Top of bedrock at 12.19 meters." And then it says, "Weighted averages of

RMR," but I don't see a figure there. Could you explain that for us? I'm looking right here (indicating).
A No; no. I don't see any reason for that being there. We should erase it.
Q Okay. Let's go down to the hundred foot annotation which says, "The hundred foot of crown pillar at 42.67 meters." And you have a weighted average figure of what?
A 6-3.
Q Let's go down. The next annotation for hole 69 is at the 200 foot crown pillar depth of 73.15 meters. And what is the weighted average RMR that you calculated?
A 6-5.
Q And again for hole 69 the 300 foot crown pillar depth at 105.46 meters is what is your weighted average there?
A 6-2.
Q And what's the next annotation say?
A It says that below 300 feet from 100 to 131 that is a 68-foot gap in RMRs.
Q Did you see any explanation in either these tables or any other document as to why that gap existed?
A We can look further down, 110 to 131. That's odd.
Q What's odd?
A Zero.
Q And what level is that at, what depth?
A From 110 ½ to 111. But that's a very short interval; right?

It's not a full 3.3. This one is also low.
Q Which one?
A 112 to 113 at 33. But I believe that interval, that gap went down here somewhere, 131. So there are a couple of other low ones, but not a lot.
Q All right.
A So they skipped them.
Q And is that best practice is to skip those intervals, as far as you're concerned?
A No.
Q All right. Now we're at hole 99. Mr. Parker, were you able to plot or determine where hole 99 was based upon your review of the application and its appendices?
A No. I think it's probably because it was drilled later than the application was provided.
Q I see. Do you have any reason to believe that hole 99 doesn't relate to this proposal?
A We were told that the eight holes were in and around the crown pillar.
Q I see. Including hole 99?
A That's one of the eight.
Q Now, for the -- for hole 99 your initial annotation indicates the top of bedrock at 3.35 meters. Do you see that?
A Yes.

Q And then read the rest of your annotation for us, if you could, please?
A "But no RMRs before 1737, thus the upper 14 meters, 46 feet, rates an RMR of zero."
Q And would your weighted average of RMR here or your indication of an RMR of zero, be consistent with the RQD numbers that you see on the left-hand side?
A Well, this has been logged to 1737. There's a 100, there's a 100 above 1706 is very low. This is odd. Well, just a minute. That's a very short interval, only sixteen-hundredths of a meter. This is another short interval, only fifteen-hundredths. And that is -- yeah. So these are very short intervals of core.
Q All right. For the hundred foot depth of the crown pillar in hole 99 at 34.74 meters, what is your weighted average RMR?
A 2-9.
Q Let's go down. Your next annotation relates to a gap. Can you read that for us, please?
A Well, this segment ends at 57.75. The next one starts at 60.5. So there's a nine-foot gap in here somewhere.
Q And let's then go down to the RQD for that 60.5 level. And, Mr. Parker, if you can look at the RQDs for the 54.71 through 60.5, what are the RQDs in that range?
A Apart from this short one, very poor; zero.

Q The next annotation talks about a three-foot gap in RMRs with RQD 86, and you say which is questionable. Why do you say that on your annotation?
A Well, from that to that, roughly 88. Let's look at 88. There's a couple of low ones, but not very low, so that's -- I can't explain it from this.
Q All right. Let's go back up. Now, at the 300 foot level for hole 99 with the crown pillar at 96.01 meters depth, what is your weighted average RMR?
A 43. This is all because of that really bad stuff at the top.
Q All right. Mr. Parker, we're now at hole 101. Were you able to determine the location of hole 101 in the proposed Eagle Mine area?
A No.
Q You have no reason to doubt that hole 101 relates to this project, though?
A I have reason to doubt everything, including that. But I was told that it was part of that.
Q All right. For hole 101, you have an annotation that says the top of bedrock is at 16.5 meters?
A Yes.
Q And then would you continue the annotation?
A But at no RMRs before 17 and a bit, just the upper two feet in this case. Just the upper two feet were given an RMR of

zero.
Q Okay. Thank you. All right. In hole 101 at the hundred foot depth for the crown pillar at 47.55 meters, what weighted average did you give the RMRs?
A 6-3.
Q Now, the next annotation for hole 101 shows gaps in the RMRs. Do you see that?
A Yes.
Q Did you see any explanation for those gaps?
A Apparently I saw high RQDs in that region, 69 plus. So who knows?
Q Now, at the 200 foot crown pillar depth of 78.84 -- or 64 meters, what's the weighted average of the RMR?
A 62. In this particular hole we're being helped by a few in the 70's.
Q Your next annotation talks about a one-foot gap in the RMRs.
A Yes.
Q And that's at the 87.78 level. Now, on the RQD side, at that level, you have an annotation that says, "See box 28."
A Yeah. This is a peculiar thing. The length chosen was only from 87.48 to 87.78, which is about five inches; right? And they rated that with an RQD of a hundred. That's an odd thing to do for a short length. So I said, "Let's take a look at the box."
Q That's on the next page?

A 87.48; 87.48. This is a good time to compare what most folks would call good rock, RQD 100 with the real thing.

Q All right. And for purposes of comparison, Mr. Parker, we've got box 28 here. And can you show us on this slide the portion of the rock that was graded an RQD of 100?

A Somewhere around 87.48. So I would guess it was this piece over here, which would be a continuation of this right there.

Q All right. I'm having a little trouble following you, Mr. Parker, when you say "this piece."

A If we go down the core like this, we have to stop here and start again over there.

Q I see. And so what portion of this core that's in this photograph would have been rated an RQD of a hundred?

A This piece.

Q And do you think that's appropriate?

A I can't see the rest of it. Can we -- can we move that over?

Q That's the end of the box.

A Oh, that's the end of the photograph?

Q Right.

MR. REICHEL: Excuse me. Counsel, just for clarity of the record, could you more specifically identify which exhibit and which slide this is?

MR. HAYNES: Yes. This is Exhibit 42. And this box is -- it's a photograph of box 28, hole 101, slide eight. And it's the run from 85.83 to 88.12.

MR. REICHEL: Thank you.

A And this must be near the bottom of it, a 300 foot crown pillar, this box.

Q And just for illustration purposes, Mr. Parker, on the fourth portion of the box from the top, how would you characterize the rock that's in that portion of the box?

A Should we take a poll --

Q No. I'd like you to --

A -- so we know what people would think?

Q What would you think? What's your characterization of it?

A Zero. It's terrible structurally.

Q All right. Now, you're circling, Mr. Parker, some of the RQD numbers for the depths at 87 meters or so. What's the significant of those RQDs?

A In that box that's where I said it appeared to me when we just looked at the pictures that there was something wrong. The appearance of the rock didn't appear to warrant numbers like this.

Q You mean numbers such as 60, 56 and 72?

A In this case, somewhere in there; 84 to 87.

Q Oh, sorry. 80, 56 and 72. My eyes are getting bad. All right. In box -- excuse me. In hole 101 at the 300 foot crown pillar depth of 109 -- no -- 105 -- 109.42. What's

your weighted average for the RMR?
A 5-9.
Q 59? Thank you.
A Yeah.
Q Thank you, Mr. Parker. You can have a seat.
MR. HAYNES: Petitioners move the admission of Exhibit 42 in the Part 632 case.
MR. LEWIS: We've seen, I believe, a series of tables of data we've gone through, and then I saw as apparently part of this same Exhibit 42 a slide eight. And that's, I guess, I assume that's not the entirety of this Exhibit 42?
MR. HAYNES: That is the entirety of Exhibit 42.
MR. LEWIS: All right. So Exhibit 42 has the tables we looked at and only slide eight photograph?
MR. HAYNES: Yes.
MR. LEWIS: Then I have no objections.
MR. REICHEL: No objection, Your Honor.
JUDGE PATTERSON: Okay. No objection. It will be entered.
(Petitioner's Exhibit 632-42 received)
Q Mr. Parker, based on your corrected RMRs as annotated on Exhibits 41 and 42, do the RMRs for the eight cores that you analyzed predict a stable crown pillar or a crown pillar failure?

MR. LEWIS: Objection; foundation. I don't believe the witness has testified as to whether or how he made any calculations or predictions of subsidence or crown pillar failure based on these RMR values that he's talked about.

MR. HAYNES: I'll rephrase.

MR. LEWIS: Okay.

Q Mr. Parker, based upon the predictions in the application in which the application used a figure of RMR at 70 for a stable crown pillar and an RMR of 60 for an unstable crown pillar, and then based upon your corrected RMRs as shown in Exhibits 41 and 42, do those RMRs predict a stable or a failed crown pillar?

MR. LEWIS: Objection; foundation, relevance, Your Honor. Number one, I don't believe we've looked at provisions in the mine permit application materials which verifies Mr. Haynes' indicates an RMR of 60 representing unstable and an RMR of 70 representing stable. And the second part, the relevance part, would be that I don't know that we've identified any particular parts of the Golder reports which equate a 60 RMR as unstable with in fact the current permitted conditions of the crown pillar. So I think we have a problem with both foundation and relevance at this point.

JUDGE PATTERSON: Mr. Haynes?

MR. HAYNES: As to foundation, the witness testified without objection that the application and its appendices predicted a stable crown pillar at 70 and a failed crown pillar at 60. So a foundation has already been laid. As to relevance, the witness is using the figures that came out of Kennecott's documents. So it's clearly relevant. All we're doing is basing the opinion here on their documents. So it's clearly relevant.

MR. LEWIS: If I could explain a bit further, Your Honor?

JUDGE PATTERSON: Sure.

MR. LEWIS: It's my understanding that the documentation concerning potential crown pillar stability went through various permutations and preliminary steps culminating in a report which recommended a final thickness of crown pillar and also that there were some final design plans made as to, for instance, the width of the stopes, which equates to the potential dimensions of the open void for the mine. And I believe the questions that Mr. Haynes is posing to this witness do not account for those changes from the initial preliminary Golder reports to the final recommendations by Golder and importantly what is in fact in the mine permit application now. So I believe the testimony Mr. Haynes is soliciting at this point is not relevant, because it relates to earlier preliminary discussions about potential heights of the crown pillar, which are no longer the case.

MR. HAYNES: As to that, Your Honor, the witness testified that the hundred foot crown pillar height was the initial application proposal. The 200 foot crown pillar height was the first modification. And the 300 foot height was the last modification. So we've covered that as well.

JUDGE PATTERSON: I'll overrule the objection.

Q Mr. Parker, let me ask it again. Based upon your corrected RMRs, using the Golder estimates of a stable crown pillar at 70 and a crown pillar failure at 60, what do the RMRs of these eight cores as you have adjusted them predict for either a stable crown pillar or a crown pillar failure?

A I don't want to own this approach to estimating or predict instability. But I say that based on their figures, those adjusted numbers would indicate that the crown pillar would be unstable.

Q And by "unstable," what do you mean?

A Likely to collapse.

Q Mr. Parker, you're familiar with best practices for preparing mining plans for review by agencies and others?

A I'm not quite sure what you mean by that.

Q All right. Best practices -- I'll rephrase it. Are you familiar with best practices for preparing applications to mine so that those applications can be reviewed by others

for completeness or sufficiency?
A I'd say I know how it's normally done.
Q All right. And in your review of the tables that we've just gone through for Exhibits 41 and 42, would you say that the way that the RMRs were calculated is the way that it's normally done?
A It would not normally be done the way that it was done.
Q And how would it normally be done?
A You wouldn't omit those bad rocks and pretend they weren't there.
Q Mr. Parker, earlier when we went through the list of documents that you reviewed, I asked you if you had reviewed what has been proposed as Kennecott Exhibit 592, which is entitled Evaluation of Possible Hydraulic Conductivity Changes Due to Mining-Induced Stress Effects, Eagle Deposit Crown Pillar, prepared by Golder Associates, dated April 2008. And you said you reviewed that document?
A Yes.
Q Did this document contain any new core logging or geotechnical logging?
A I'm not sure how to answer that. At about the same time we did get some additional information about core logging. I'm not sure if they were related or not.
Q All right. And was that additional information helpful for your analysis and your opinions, or not?

A It was somewhat confusing, but was helpful, yes.
Q And was there anything that was included in Exhibit -- Kennecott Exhibit 592 that would cause you to change your opinion of crown pillar failure?
A No. I'd like to add a little bit to that, just one more point. Again, there was no new information of the magnitude and orientation of any lateral stresses in the rock mass. And I consider that crucial to prediction of stability of crown pillars.
Q Explain to us why the information about lateral stress is crucial to the stability of the crown pillar.
A Because that is what holds a massive broken rock in place.
Q Is there a common example that you might use to show the effective lateral stress on a crown pillar?
A A common example, you mean, like a model?
Q Like a model.
A Yeah; yes. I could if somebody would lend me half a dozen fat books, I could hold them up like this (indicating) by pressing inwards on those books. And I could relax or have to relax and eventually my hand would come apart and it would collapse, just as a rock would. And that appears to be what happened at the Athens Mine.
Q Mr. Parker, do you recall in reviewing the application and its appendices any discussion of the relationship between vertical stress and horizontal stress -- excuse me --

lateral stress?
A Yes.
Q And what was the discussion in the documents about those concepts?
A In general, they admitted that nobody knows what the stress field, as we call it -- the stress field is in that area. Nobody knows. And the best that they could offer was to take a stab at it by going to documentation of stresses generally speaking over what they call the Canadian shield.
Q What is the Canadian shield?
A That is a very, very large area, like, thousands and thousands of square miles of ancient what we call Precambrian rock, which is present in Huron Mountains and up parts of Keweenaw and in the Iron range and over a large part of southern Canada, the Canadian shield.
Q Yes. I'm sorry I interrupted you. You were discussing -- a discussion about the Canadian shield.
A That is called the Canadian shield. They took from the publications some averages and concluded or at least told us that the lateral stress would be somewhere around one and a half to two times the vertical stress. That was their basic assumption.
Q And do you view that assumption as valid?
A No.
Q Why not?

A You can't give one representative number to -- for an area that large. I likened it to giving an average air temperature for Canada today.
Q And is that because the relationship between lateral stress and vertical stress has to be localized?
A I'm not sure what you meant by that, but I think that -- well, how should I put it? It's going to vary a lot from place to place from one corner of this room to the other corner of the room. If I take a measurement here and I move over five feet, odds are I've got a different measurement. It varies a lot in magnitude and direction over short areas, short -- small distances.
Q And in terms of the relationship between lateral and vertical stress, is there a relationship? Strike that. Let me start over. If lateral stress is low, in your example of the books being held together, and the lateral stress is low, what would likely happen in a mine with a crown pillar if the lateral stress field in that regime is low?
A If there were a mass of fractured rock which was constituting the crown pillar and you had, say, 1,000 pounds per square inch or a pretty substantial horizontal stress, it would probably hold it in place. If that diminished or in some way was released, the rocks would probably start to fall a few at a time and the roof rocks would unravel, as we say, like that and find their way to surface or to a very

strong horizon.
Q Now, from the information that you've reviewed in the application relating to lateral stress, including this assumption from the Canadian shield, is it possible to determine from the application what the lateral stress regime is at the area of the proposed mine?
A Not possible.
Q And why is that?
A Nobody has measured it or studied it, as far as I know.
Q And in your view, it would be important for purposes of determining the stability of the crown pillar here to study the lateral stress?
A I don't think that you could predict the stability or instability reliably without determining the lateral stress field.
Q Is it possible to determine the lateral stress field before mining begins?
A It's possible.
Q And how would that be done?
A I would guess that the first approach -- well, first go take a look at the rocks, look at the cores and see if there's any evidence of high stress or low stress, the extremes by looking at the cores, talk to the drillers or look at their logs and find out what they encountered. Did they find rubbley stuff down there which apparently was not held

together? Did they find gaps which suggests that the joints were not closed? Look for that evidence first and then move on to the next step, which would be measurement and probably the first would be to use a technique called hydrofracking.
Q What is hydrofracking?
A Hydro, water, and fracking, fracture. The general idea is to close off a portion of a borehole by putting a plug here and a plug there and then introducing water or some other juice under high pressure into that interval and pumping the pressure up until it split the rock. And there you have a measure of the direction of the stress and an approximation of the magnitude.
Q And is hydrofracking a test that is commonly used in the mining industry?
A Not commonly. Commonly in oil well drilling and that sort of thing simply to break the rock.
Q But it is used in the mining industry?
A It has been for 30, 40 years that I know of. And then there are other techniques, too.
Q And what other techniques are there?
A Well, another one for deep holes would be something like this (indicating). You could drill a hole and put a different bit on your drill and flatten and smooth the bottom of the hole and then glue in effect some kind of an instrument, string gauges perhaps, to the bottom of the hole

and then use a normal diamond bit and over core it, as we say; that is, drill around it and relieve it of stress. And the stub of core that is broken off then will be relieved of stress and it would expand or perhaps contract and you could calculate the approximate stresses.
Q And did you see that any of these techniques for -- by the way, would these techniques be called in situ stress measurements?
A In situ, just means in place; yes.
Q Okay. And did you see any evidence in the application or any documents related to the application of the use of such techniques to predict lateral stresses?
A Not in the original documents, no.
Q Have you seen any since?
A I'm not sure. There's somebody might have mentioned it. It should be done. But before mining, no. I think what I've seen in the documents is a proposal which everybody now jumps on and says, "Yes, we'll measure the stresses when we get underground where it's easier to do."
Q Mr. Parker, in your opinion, could in situ stress measurements have been performed as part of the geologic characterization of the rock formations or conditions near or above the proposed mine?
A It could have been, yes.
Q Should it have been?

A Naturally wanting to not waste any money, we look at the cores and look at the outcrop and get any other evidence first. If we could determine it then, I think it would be worthwhile to get measurements. Again, with this proviso that we realize that if we did one of these rather expensive measurements it's not representative of the whole mine. I think that -- I'll finish up that. I think that that would lead me to -- if I were in a position to be planning a mine, it would lead me to set aside the stability of the crown pillar for awhile and do what most people, go underground and start mining and then find out as you go along.
Ideally, you do it first.
Q Mr. Parker, have you described the mining plans proposed use of explosives in the mine?
A How they proposal to drill and blast?
Q Yes.
A I think I can.
Q Go ahead.
A Okay. The original plans said that they would probably use four-inch diameter blast holes, which they would drill about a hundred feet deep and put explosives into them and blast them together or in a sequence to break the rock.
Q And what would the -- let me back up. I want to establish some foundation here. What is your understanding after reviewing the mining application of the method of mining?

And I think you referred earlier to stopes. Could you explain that for us?

A The stope is a big hole in the ground from which they extract the ore.

Q All right. And what's your understanding of how the stopes would be mined at this proposed mine?

A It's a little bit involved. But starting at the bottom, which is what they did at the Athens Mine too, starting at the bottom they would drill and blast a stope, which would be a hundred feet high. And the most commonly used number in their report is ten meters wide. Elsewhere it's different. Anyway, ten meters wide and a hundred feet high. They would break that primary stope and haul the rock out and then they'd move over ten meters leaving a pillar of ore and mine another stope the same way. There would be two primary stopes and a secondary stope to be mined later. They would backfill those two primary stopes with what they called cemented rock fill and then mine the middle secondary stope in a similar manner and repeat that up, up, up until they get to the top of the orebody.

Q Now, in your view, Mr. Parker, after the primary stopes have been mined and the mining occurs in the secondary stopes with a blasting -- the drilling and blasting, do you have a view about the effect on the backfill primary stopes from blast -- drilling and blasting a secondary stopes?

MR. LEWIS: Objection; foundation. Your Honor, I haven't heard any indication this witness has ever had any experience with stope mining and backfilling.
Q Mr. Parker, --
A Yes, I --
Q -- do you have any experience with --
A Yes.
Q -- stope mining and backfilling?
A Yes.
Q Describe your experience.
A Canadian gold mines, same general idea.
Q When was that?
A There were several times. I've been doing this traveling consulting-type business for 40 years or so and scattered around in there several times.
Q So you have experience with stope -- the method of stope and backfill; correct?
A Yes.
Q All right. Back to my question. Do you have a view about the effect on the secondary -- excuse me -- on the primary backfilled stopes from blasting in the secondary stopes?
A Okay. Even before that I'd be concerned that those holes filled with that explosive would break the rock on both sides of the stope to a significant distance, thereby weakening what we're calling a pillar between two stopes.

Q So in other words, the drilling and blasting in the primary stopes would weaken the rocks in the secondary stopes?
A Yes; yes.
Q And then what about the blasting in the secondary stopes once the primary stopes have been backfilled? What would be the likely effect?
A If we go with the original application, we're going to have four-inch holes with a standard explosive, which would probably be ammonium nitrate, because it's cheap -- relatively cheap. 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. Most of the damage would be close to the hole, of course, and then it would diminish to about 30 diameters there would be not much damage. And that 30 times four inches is ten feet. So what I'm looking at right off the bat is that the pillar is going to be damaged to some extent to a depth of about ten feet on that side and ten feet on that side leaving only ten feet in the middle of this pillar undamaged. Okay. That's before we get around to mining that middle pillar. Okay. Now we put in backfill which itself is as described in the application as very weak, very little strength to it, which somebody else will address, I suppose. The situation gets worse when you blast that middle pillar which is already damaged and the concussion goes out into the

backfill, which is very weak stuff. And you're likely to destroy it.
Q Do the application and its appendices or subsequent documents discuss the possibility of going to six-inch holes rather than four-inch holes?
A That is in the original application that to improve productivity and lower costs they might go to holes as big as six inches in diameter.
Q And what would be the likely effect of going to six-inch holes based upon your previous testimony?
A Well, just take 30 times six inches and you've got 15 feet of damage on both sides of a 30-foot pillar. There's nothing left; right?
Q I'm sorry. You said there's nothing left?
A 15 feet, 15 feet, and it's only 30 feet wide in the beginning, so there would be nothing left theoretically. That would be an effect. And that was apparently not considered, which, you know, suggested to me that it hadn't been thought through very well.
Q Does the application discuss the possibility of using high velocity explosives?
A Yes; same height.
Q What's a high velocity explosive?
A Well, the energy content of explosives is related in a hole to the amount that you put in the hole, of course. And

that's something to do with the density, how much it weighs per cubic inch or whatever. It's also directly related to the velocity squared. And we're talking about velocity as the rate at which an explosion propagates through that explosive. With a cheap ammonium nitrate, that might be 11,000 feet per second, which is pretty quick. With a high velocity emulsion, say, it might not be 11,000 but 18,000, much, much faster. And it's velocity squared that counts, so a very significant amount of damage done. Apparently it was not considered at the time.

Q In the documents you've reviewed, have there been changes to the type of explosive that may be used, switching from a high velocity to a low velocity or low density explosive?

A One of the Kennecott exhibits concerns a low density emulsion, which is being used in gold mines in California and Nevada to help them avoid this excessive damage.

Q And would your views about the explosives be changed if a low density emulsion were used in this case?

A It should help. It's not a new idea, by the way. It's the idea of making low density explosives is a hundred years old.

Q Mr. Parker, if we turn now to the topic of the ventilation of the mine, is fire a concern for underground mines?

A Yes, of course.

Q And what are the potential sources of fires in underground mines?

A Well, although the application makes light of it and says there's nothing down there to burn, that's not true.

Q How is it not true?

A Well, they do recognize that one of the minerals, peridotite, tends to oxidize and get hot. They recognize that, but they do not address the idea that one of the fairly common things to happen underground is that on a piece of machinery, say a big truck or a front-end loader, a hydraulic hose may burst with too much pressure on it and hydraulic oil spray onto the engine or an exhaust, burst into flame, tires catch fire, black smoke is immediately filling the mine openings. And since the air is traveling at something like 1,000 feet per second in their ventilation system, very soon that thick black smoke which won't allow you to see a hand in front of your nose, fills the mine. And as I say, probably kill everybody in the mine except the driver who would walk back up the hill in fresh air.

Q And what does the application say about the fire risk at this proposed mine?

A Negligible.

Q Do you find that conclusion credible?

A Ridiculous. That was only possible cause of fire. And then there's electrical, explosives. A significant one which should not be overlooked is arson, the disgruntled employee.

They say it will never happen, but it does. Therefore, you've got to do something different about that ventilation plan and escape plans.
Q Mr. Parker, is the influx of water into a mine a concern for the design of the mine?
A Yes.
Q Do you have any experience with water flowing into mines?
A Yes.
Q Can you give us the benefit of your experience, please?
A Yeah, quite a few. Limestone mine in Kansas City everything was going fine and all of a sudden a fountain erupted under the floor. The floor heaved up with enough water to flood a good part of the mine. That was a quick one. At White Pine, as they approached a major fault and which was called White Pine Fault, they drilled holes into the fault and high pressure water shot across the room like that, lots of water. A lot of mines -- several mines have been completely flooded when they encountered water unexpectedly.
Q And describe for us generally how the water gets into the mine.
A What do you mean by that?
Q Well, from the very general terms, how does the water get to the mine?
A I would think that most commonly -- I just thought of another one in Kentucky where they hit water with a lot of

sulfur in it, toxic stuff. And in that case too the water shot across the room, hit the other side there. It was very high pressure. And they had to get rid of it, and they had to find a place to put it, the Ohio River.
Q That's a whole other state and a whole other regulatory regime, Mr. Parker.
A Anyway, that's what commonly happens. You run into a fracture, not expected, and there's a lot of high pressure water in it and it floods the mine.
Q Is there any way before the mining starts at a particular mine, Mr. Parker, to study the likelihood that the mining will encounter water such as you have described?
A Yes.
Q How is that?
A Well, if I were looking at a proposed mine like this one, I think the first place I'd look for information would be from the drillers and their logs.
Q And what would the drillers logs show you?
A If we had responsible drillers on the job, I think that they would record every instance when they lost water. They have to pump water down the hole to wash the cuttings out as they drill and to prevent the bit at the front end from plugging. Okay. So they're continuously pumping water down the hole and watching it come back out of the hole. If that suddenly stops, they say they've lost water. Right. Either the pump

quit or they hit a void underground and they're losing their water. And they would normally record that. And that would be a warning to someone who was thinking about the possibility of making or losing a lot of water. They might on the other hand encounter excessive water pressure which would push extra water out of the hole. They'd say they were making water in their records. That's where I'd look.
Q And did you find any discussion in the application or its appendices or subsequent documents relating to this mine that discuss the review of any drillers' logs in relation to the losing or gaining water?
A No. I looked for it. I asked for it. I have nothing.
Q Do you find that unusual?
A Yes.
Q Do you think that's best practices for purposes of designing this mine --
A Of course.
Q -- or to ask for drillers' logs?
A Talk to the drillers all the time. "What do you find? Did you make any water? Did you make -- lose water? Let me look at your logs." And then I might have some special holes drilled into suspect areas to define the problem better.
Q And did you see any of that in this application?
A I think that inclined holes are more likely to hit vertical

fracture than if you have a vertical hole; therefore, I think the inclined holes are going to give you the indications, and I might ask to have some drilled specifically if I thought it had a fault or something underground. But I saw no indication of that.

Q Mr. Parker, is it accurate to say that application and the appendices that you reviewed approached the mine design from a computer-design standpoint rather than from a practical standpoint?

A I think so.

Q And in your opinion, what would be a better way to evaluate the design of this mine? From a computer-modeling standpoint or from a practical standpoint?

A Practical. I want to deal with reality, not assumptions.

Q And how, from a practical standpoint, would you go about that task?

A Are you asking us now to redesign the mine?

Q No, I'm not asking you to redesign the mine. But from a practical standpoint, what would you do to at least begin the mining design?

A Go back to the basics. Look at the rocks; look at the cores; study the geology on the surface; look at case histories.

Q And for this mine what case histories would be relevant for purposes of designing this proposed mine? Are there any

that are local or nearby or in the Upper Peninsula?
A Yeah. I would look at all the mine histories that I could get ahold of in the area and -- let's say 100 miles or in similar rocks. Keweenaw Peninsula did -- some of those mines -- some of those residents of mines in Keweenaw Peninsula, did they run into large quantities of water as they went under Lake Superior or not? Iron mines, not many miles away, they're in Precambrian geology. What was their experience? When did they have the -- one of the biggest pumps in the world in one of those iron mines, a Cornish pump.
Q And which iron mine was that; do you recall?
A Iron River --
THE WITNESS: Stanley, could you fill me in on that?
Q Sorry. He can't help you right now.
A Okay. Maybe at Chapin mine.
Q At which mine?
A Maybe Chapin mine, C-h-a-p-i-n. They --
Q And what's significant about the Chapin mine?
A I saw a photograph where three hairy, old miners were standing, grinning underground as three jets of water came out of the wall like this (indicating), and we hit water bodies.
Q And what about -- as we discussed before, Mr. Parker, what

about the Athens mine? Would that be relevant to your inquiry?

A Yes, of course.

Q And what about the Ropes gold mine that you discussed before? Would that be relevant to your inquiry?

A Yes; yes. I could say a word or two about the geology there. It's been studied several times, and there have been various theories. But I think that the most recent and the most probable is that there was a massive rock, which they call Schist, which is a little -- made up of sort of flaky minerals all aligned parallel to each other with a blob, if you will, of peridotite on both sides of it, so it was, like, a sliver of this permeable rock between two peridotites, and the gold-bearing juices went from the peridotites into that. And so there was a sliver of a somewhat weaker rock between two stronger rocks. All of this sat vertically. Again, that sort of rings a bell when we've got a possibility of a plug-like collapse because of the vertical geology.

Q Are there differences in geology at these other mines that you've just described that would preclude them from being used as examples of nearby mines for purposes of evaluating this mining design or even design it?

A No two mines are alike in detail. But in general, I think that these could be -- they could provide useful information of these local mines being Precambrian ancient, what we call hard rocks. I would not use a salt mine or a coal mine for a comparison, 'cause their rocks are quite different.

Q And, Mr. Parker, in your review of the application and the other materials that accompanied it, did you find any discussion of any of these mines or these mine events in those materials?

A In -- on the first Sainsbury report -- I think it was the first, maybe the second, he mentioned the Athens mine. It was not mentioned in the later reports.

Q And the Sainsbury report is of course a report by a consultant for the DEQ; is that correct?

A I think he was chosen by another company, an intermediary, MFG, for the DEQ.

Q Yes. Okay. But in the application and its accompanying documents, you didn't find -- did you find any reference to any other nearby mines for purposes of designing this mine?

A I think there was mention of the White Pine mine as having high stresses. That was just as an example. Somebody else mentioned another one in Minnesota, Long Miser Way. A long time ago one set of measurements was made in an iron mine. I think those are the only things that might be called case histories.

MR. HAYNES: Thank you. No further questions at this time.

MR. LEWIS: Your Honor, I'm going to do a technology switch. I'm told it takes a couple minutes.

JUDGE PATTERSON: Take a break?

MR. LEWIS: All right.

MR. DYKEMA: Actually, your Honor, before the break, can Huron Mountain Club ask just a couple of quick questions?

THE WITNESS: Oh. Okay.

JUDGE PATTERSON: Oh. Okay.

MR. DYKEMA: Thank you.

DIRECT EXAMINATION

BY MR. DYKEMA:

Q Mr. Parker, am I right that, when this operation starts, if it starts, the first thing they'll have to do is blast into and under the Eagle Rock itself?

A That's what the proposal says.

Q And do you have experience with blasting -- initial blasting operations to open up an underground mine?

A That would be just like a quarry in the beginning, yes.

Q Can you give the Court a sense of how far away the blasting noises are likely to be audible?

A It would depend on how much explosive you detonated at one time and what kind of explosive. But to answer your question a little better, you can hear a shotgun from one end of the plains to the other, I imagine -- a 12-gauge.

You can hear it. So you'd hear a "boom" and some rumbles, I think from a normal mine blast which was opening up a tunnel or cleaning up the face prior to opening a tunnel. You'd hear it, and for a long distance you'd feel it too underfoot. There would be waves through the air and some underfoot.

Q Have you in your capacity as a mining expert and mining consultant ever been asked to conduct an analysis relevant to the effect that underground blasting on fish living in surface waters?

A I have not been asked to do that specifically, no.

Q Are you aware of any state that regulates underground mine blasting in order to protect surface fish?

A I don't think it's specifically aimed at mining, but Alaska and Oregon, at least those two states, have regulations which regulate the -- any blasting near bodies of water containing fish.

Q And have you conducted any review or any analysis of issues related to that question?

A I read the Alaskan and the State of Washington regulations and what I could find in the federal regulations, which lean on Alaska for information.

MR. DYKEMA: Look at Exhibit 38-6.

Q Mr. Parker, we're now looking at Exhibit 36, which is a document prepared by the Alaska Department of Fish and Game relating to blasting standards for the protection of fish. Are you familiar with this document?

A Yes.

Q And have you undertaken an analysis to determine, based on the standards set forth by the Alaska Department of Fish and Game as to the effect that the blasting of the Eagle mine is likely to have on fish living at the surface?

A That was a very crude evaluation. I plugged dollar numbers into that formula, yes.

Q And what conclusions did this analysis give you?

MR. LEWIS: Objection; foundation, your Honor. Number one, I haven't heard anything about what our numbers are. I don't know that Mr. Parker knows the details about the plan for blasting that will be used in the mine, the amount of explosives, type of explosives, location of explosives and so on. And I haven't heard any foundation by which he could draw any comparisons between the actual mine plan of what will actually be done to regulations from Alaska, nor, of course, have I heard any foundation or qualifications from this witness as to talk about the effects of anything on fish, let alone blasting.

MR. REICHEL: I join in the objection.

MR. DYKEMA: Your Honor, he has testified as to the kinds and sizes and velocities of the explosives that have been discussed in the application. There is a range, and I expect his answer will take into account that there is a range and -- what was the other basis? And he is -- we're not offering him as an expert on fish. He is simply applying the data that the Alaska Department of Fish and Game have formulated to test the -- at what impacts a fish's swim bladder will rupture or burst. He's simply using the likely explosives in this mine under the -- using the formula that the Alaska Department of Fish and Game have established as setting parameters for killing fish, so I think he has an adequate foundation.

MR. LEWIS: Your Honor, if I might add further, my understanding that to attempt to apply what may happen in this mining, number one, again, detailed, specific information about the types of charges, amount of charges, location and so forth would have to be known. At best this witness has testified that he has some general idea about what may be used, and that's the extent of what we've heard. Secondly, it's further my understanding that, for any attempt to compute effects on fish under this Alaska standard, one would have to first be able to derive by some mathematical calculation some reflection of sound waves and so forth, and I don't believe he has the qualifications to do it, nor have I heard any foundation that he has done it. So I think there is simply no foundation for him to be able to ask the question posed by counsel.

JUDGE PATTERSON: By his own admission Mr. Parker has stated it was a crude analysis. For what's it's worth, I'll allow him to testify, but I understand, Counsel, there may be argument as to the -- again, the credibility of the assessment. But I'll allow him to opine what he can.

Q Mr. Parker, what conclusions, if any, did you reach from applying the standards for fish safety that Alaska proposed in Exhibit 36 to the operations of the Eagle mine and likely effects on trout living at the surface?

A The analysis was relatively simple. I didn't need a lot of input. I just did what most mining engineers would want to do if they had to predict what damage would be done to a sensitive structure by blasting nearby. That's common practice; nothing very difficult about that. And to put it briefly, what you need to know is how much explosive you're going to detonate at any one time. They don't even specify which explosive, because they will all behave in much the same way. You have to know the distance from the point of explosive to the point where the fish is, and you have to know something about the media through which the blast waves will travel.

Is it going to be air? Is it going to be water? Is it going to be, as in our case, more less vertically rock? And you just plug those things into the formula, and it tells you either the safe distance or the amount of explosives detonated at any one time which will be safe. And I was surprised at the results. As Peter said, the initial damage done to most fish would be that their swim bladder would be damaged. That's what keeps them right-way upwards, allows them to live.

And even more sensitive to that is the damage which would be done to spawn just before it hatches out, and that would be in a trout stream. That would be in the gravel and up-welling water at the bottom of the creek. So it's not a difficult computation. And I found that, if I used the numbers which were given to us in the application and the application that I was to evaluate, not recent additions -- I used the original numbers, there would be a four-inch hole. It would be filled with explosive.

And I took a simple explosive, which is not the most devastating. And I said, "Okay. A four-inch hole would contain roughly 4-1/2 pounds of ammonium nitrate per foot of hole. And if we multiply that by the tight -- the depth of hole which would be filled -- that would be the simplest way to do it. And a 100-foot hole you might put -- I don't know -- 60, 70 feet of explosive. And I multiplied that out, and I come out with a total amount of explosive which would be detonated if you only blasted one hole at a time. Now, not many people would blast one hole at a time, because you get more efficient fragmentation if you blast several together.

But let's suppose they did that for only just one; not the most efficient way to blast. Well, 4-1/2 times 60 is -- you figure it out. 84, 90 pounds of powder, something like that, would go of, "bang." That's a big "bang." And I plugged that into the formula and find that you have to be several-hundred feet away from the fish, in fact. Then I tried different combinations and found out that, if we were to blast as proposed in the proposal and only blasted one hole at a time, we'd be damaging brook trout in a creek which was running almost directly over the orebody at a distance something like 1,000 feet.

MR. DYKEMA: May I have one moment, your Honor?

JUDGE PATTERSON: Sure.

MR. DYKEMA: That's all I have, your Honor. Thank you, Mr. Parker.

MR. LEWIS: Now the Petitioner's counsel are finished.

JUDGE PATTERSON: I was waiting to hear from Mr. Haynes. Do you have any follow-up?

MR. HAYNES: Oh, no, I have nothing further at this time.

JUDGE PATTERSON: Let's take a break.

(Off the record)

JUDGE PATTERSON: Mr. Lewis, are you taking it away?

MR. LEWIS: Yes, your Honor; yes. Hello, Mr. Parker. I'm Rod Lewis. I represent Kennecott in this matter. I'll be asking you some questions.

CROSS-EXAMINATION

BY MR. LEWIS:

Q First of all, Mr. Parker -- and can you hear me all right?

A Yes.

Q -- I have a few questions about your resume I believe that's been marked as Petitioner's Part 631, Exhibit Number 124. I understand from your resume that since 1971 you've been what you called self-employed; is that correct?

A Yes.

Q And that's as a consultant?

A I don't like to use that word, but most people do call me a consultant.

Q All right. And just judging from your resume, it looks like the last time you actually worked in the mining industry, not as a consultant but as someone working for a mining company, would have been the years 1961 to 1971 when you worked in the White Pine mine; is that right?

A That's right.

Q And prior to your experience in the White Pine mine, you had about one year with a company called RL Loofbourow, L-o-of-b-o-u-r-o-w. That was one year as a mining

consultant out of Minneapolis; is that correct?
A That's right.
Q And prior to that you were at Michigan Tech for a number of years?
A Yes.
Q And prior to that you worked on -- as a surveyor engineer on mine shafts sinking and development projects between 1953 and 1954?
A Yes.
Q And prior to that you were in England, and you worked in some coal mines in England; is that correct?
A That's right.
Q You also have listed in your resume a number of articles. It looks to me like -- and tell me if this is not true. I did not see listed here any articles that would have been published in a peer-reviewed, refereed scientific journal?
A In a what?
Q A peer-reviewed refereed scientific journal.
A I think there were some in mining engineering.
Q You think there were some?
A I think so.
Q Okay.
A And one in a Canadian mining journal.
Q I did not see any of your articles listed that appeared -- for which it appeared the subject matter was the computation

and prediction of crown pillar stability prior to mining. Would that be correct?
A I didn't write about such a thing specifically, no. But of course, in many mines the roof is the crown pillar.
Q Pardon me?
A I say, but in many mines the roof is the crown pillar.
Q You've indicated that you have testified in some law cases; is that right?
A Yes.
Q And was one of those some litigation involving the White Pine mine?
A Yes.
Q And was that litigation involving the imposition of a penalty by the Federal Mine Safety and Health Agency?
A Can you tell me more about that? I don't remember.
Q Yes. Do you recall a penalty case in, I believe, 1983 brought against the owner of the White Pine mine?
A Was that -- could that have been a labor dispute?
Q No, sir. It appears to have been involved with safety issues and particularly the reinforcement that was done in the roofs of the rooms in that mine.
A That was a safety dispute, yeah. Yes, I remember it.
Q And do you recall testifying in that case?
A Yes.
Q And do you recall that the subject of the matter was

whether -- first of all, the White Pine mine used a method
of mining called room-and-pillar mining; is that correct?
A That's right.
Q And that is different than the stope mining that's going to
be used in the Eagle mine; is that correct?
A Probably, yes.
Q And is it true that in that type of mining, room-and-pillar
mining, that the coal, or the ore in this case, is mined in
rooms separated by narrow ribs or pillars; that the core or
ore in the pillars is won by subsequent working in which the
roof is caved in successive blocks?
A In general that's correct. The pillars were square, not
linear, and they took out enough ore to make some money but
not -- in that case not to collapse the roof.
Q And the issue in the case concerned the use of rock bolts or
roof bolts; is that correct?
A That's right.
Q And the issue, as I understand it, was whether the mining
company should have used roof bolts or rock bolts as part of
the mining as a general matter or whether, as the owner
contended, the use of roof bolts should only be used on an
as-needed basis, depending on the assessment of the
conditions?
A That's right.
Q And did you, in fact, testify in that case in favor of only

using rock bolts to stabilize the roof of the mine if the conditions you encountered as you mined, in your opinion, merited such steps?
A I did, yes.
Q And I believe that would be consistent with the opinions that you've offered today that you believe the best course is a practical approach, Mr. Parker?
A Yes; yes, it is.
Q And you don't put much stock in the more modern computerized modeling, I take it?
A That's right. Could I tell you how that case was resolved?
Q Pardon me?
A Could I tell you how that case was resolved?
Q Well, I got the decision here, so I think I know.
A It was against the company based on what the union steward said. He said that they always bolted under these conditions. And afterwards I said to him, "John, why did you say that? You know it's not true." And he says, "Well, I didn't know you were going to show up."
Q I see.
A That's the truth.
Q All right. But at any rate, you were in favor of only using the rock bolting as needed and as you thought conditions warranted?
A Yes, sir.

Q Now, earlier you testified, Mr. Parker, as to your opinions about the quality of the rock from the core samples from the crown pillar. And I believe you testified that your opinions were based solely on photographs of some of those samples; is that correct?
A Solely? I'd say mainly. When I found those, there was errors or omissions or something like that, and I felt that I was quite probably justified in doing that.
Q Okay. And you had -- what you had was photographs of eight core samples; is that correct?
A Yes.
Q Or eight drill holes, I should say.
A Eight cores.
Q Okay. And I believe you indicated earlier you have an understanding that there were many more drill holes which penetrated the crown pillar than the eight for which you had photographs; is that correct?
A That's right.
Q And you, therefore, do understand, don't you, Mr. Parker, that you had a small subset of the total number of drill holes through the crown pillar?
A Yes. And further, we realized that they were selected by Kennecott.
Q And what's the basis of that understanding, Mr. Parker?
A Well, we didn't select them.

Q Pardon me?
A We did not select them.
Q Oh, I understand that; I understand that. Is it -- I think you indicated that it's your understanding that those photographs of those eight boreholes were obtained from the Department of Environmental Quality via a FOIA request; is that true?
A I personally don't know where they came from, except that we -- a request was put in for them, and they did come through. Now, how they got into our hands, I'm not sure.
Q You do not know why those particular eight boreholes were selected by the DEQ, do you, sir?
A I don't. I'm curious, though.
Q And you do not know whether those eight boreholes were representative of the total boreholes from the crown pillar, do you, sir?

MR. HAYNES: Your Honor, I have to object here to this line of questioning. It's argumentative in the sense that those eight boreholes that the witness testified to were the only ones that we got. We have -- of course have asked both informally and in this proceeding for access to the borehole logs of all the other holes that were drilled here, and we've asked to see the actual rock, and we haven't been able to do that. So to -- for counsel to infer somehow that the witness is self-limited in his analysis of these core holes I think is prejudicial, because, of course, if he had a chance to look at more, he would have done more work.

MR. LEWIS: Your Honor, number one, it is very relevant that he's only looked at a very small subset of the data. Number two, it is my understanding that the Petitioners did not request any such data until after the contested case proceedings were filed; that they got the photographs and the other information pursuant to a FOIA to the DEQ; that the photographs, eight boreholes, were what the DEQ had and, therefore, what the Petitioners got. So I think I'm perfectly -- it's perfectly relevant to ask this question -- questions to this witness about the limitations of the data he had to review.

MR. HAYNES: Actually, your Honor, let me correct something counsel said. We requested from the DEQ through FOIA requests numerous times all of the information they had on the cores, on the core logs and on the -- on any photographs relating to those cores from this project. The DEQ consistently said, "We don't have any information." And so our FOIA request actually was to the DNR, and we got these photographs from the DNR, not from the DEQ. So we have requested them, and we've been stonewalled from the beginning.

MR. LEWIS: Well, there's no basis for that either, your Honor. They got what the Agency had.

JUDGE PATTERSON: All right. I think the specific objection was that it was argumentative. I don't see it as that. I think it's proper cross-examination. Counsel, if you -- you can certainly argue the reasons in -- if you have more or pursue that through rebuttal or redirect examination. But I think this Mr. Lewis is on a proper course of cross-examination.

MR. REICHEL: Again --

JUDGE PATTERSON: I'm sorry. I didn't mean to --

MR. REICHEL: No; no. That's fine. I just wanted to clarify. While Mr. Haynes correctly noted that the -- as I understand it, that the Petitioners obtained the photographs in question from the Department of Natural Resources, not the DEQ. And again, I would simply like to note for the record that, to the extent counsel has suggested or implied that the DEQ had this information in its possession and -- in its possession and refused to provide it, that's inaccurate. But again, that can be addressed separately.

MR. HAYNES: And I'm not implying that the DEQ withheld information that they had, because it's apparent that the DEQ didn't have the information that we requested that -- some of which we eventually got from the DNR. So I'm not making that implication at all.

JUDGE PATTERSON: Okay. All right.

Q Mr. Parker, again, just to review, you had photographs of eight drill holes through the crown pillar. You understand that there were many more than that. My question is, you have no reason to know whether those eight boreholes were representative of the entire database, do you, sir?
A I did not know. I assumed that they would not send the worst. I did not know.
Q Yes. But in fact, for all you know, those could have been eight of the worst samples of rock from the crown pillar; isn't that true?
MR. HAYNES: Objection; calls for speculation.
JUDGE PATTERSON: Overruled.
Q You may answer the question, Mr. Parker.
A It's possible.
Q Now, another thing I think you indicated earlier, Mr. Parker -- and in fact, you held up that core in your hands, and you testified as to how you would look at that core, how you would tap that core, how you would listen to that core and how that would tell you more information than these modern computers and modern calculations about the quality of that rock. Is that your opinion, Mr. Parker?
A It is.
Q Okay. And in fact, you were not able to touch, handle, tap on, listen to, taste any core here in forming your opinions, were you, sir?

A We were not given that opportunity, no.
Q You were limited to black-and-white photographs; is that correct?
A No.
Q Is that correct?
A No.
Q Did you have color photographs?
A You saw them.
Q I didn't see color. I'm sorry.
MR. HAYNES: They're color.
MR. LEWIS: Okay. All right.
Q All right. You had color photographs.
JUDGE PATTERSON: It's not colorful.
MR. LEWIS: Not colorful, yes. Okay. That's what it --
A I read -- can I make a comment here? I read in Steve Coombs' description of the logging procedures that photographs were taken of all the cores.
Q And you only had photographs of eight; is that correct?
A That's correct. Then who had the --
Q Now, you also indicated -- I think you acknowledged in your testimony that the core samples that were reflected in the photographs could have been handled. Other things could have been done to them before what you saw in the photographs; is that correct?

A I said that was a possibility, yes.
Q And I think you did indicate that you knew that these cores, whatever length they came out of the ground, would have to be broken to be put into the box. Is that also true?
A Of course.
Q And were you, in your evaluations, able to sort out the fractures and other discontinuities in the samples from manmade fractures versus natural fractures?
A I think I was able to do that well enough.
Q Did you in fact have access to Kennecott's core logging procedures? Did you know the details about those procedures, Mr. Parker?
A I have seen them, yes.
Q And do you know how long the length of drill cores extracted from the ground were?
A At best, ten feet.
Q Do you know that to be true?
A I didn't measure it.
Q And is it possible, in your opinion, Mr. Parker, based on your experience, that, to extract the rock core from the sleeves from which it's extracted from the ground, that sometimes the operator would need to knock on that sleeve with a hammer or other device to loosen the core?
A We would say tap.
Q Tap?

A Yes.
Q And is it not true that that tapping can also cause fractures in the core sample?
A Of course it could, yes.
Q And you were not able to distinguish from the photographs, were you, sir, whether a particular fracture or break was caused by tapping to remove the core?
A I can say this: well enough to evaluate length of core, yes.
Q So in your opinion, you could look at a fracture in a piece of core in the photograph and determine whether that was caused from tapping and removal of the core from the sleeve as opposed to a natural break within the ground?
A Some of them would be quite clear. Some of them would be debatable.
Q Now, I wanted to ask you -- you testified in -- about the length used for the RQD calculations -- do you recall that? -- the length of core? I believe you indicated that the rule of thumb is to use two times the diameter?
A Yeah; that's correct.
Q And in your view, two times the diameter in this case ought to have been ten centimeters?
A Or close to it.
Q And we looked at a photograph of a box of cores, I believe, that had a little rule at the top of the photograph that

went to eight centimeters; right?
A That's right.
Q And from that you assumed that the actual core logging procedures and the procedure used to calculate the RQD was based on an eight-centimeter length versus ten centimeters; is that right?
A No, that's not right. That's not what they said.
Q Okay. Did you not testify that you felt that an eight-centimeter standard was used and that was incorrect?
A I didn't testify to that, no.
Q So is it your testimony actually that you don't know whether Kennecott used either an eight-centimeter or ten-centimeter length?
A I personally do not know, but there was some speculation as people looked at these things that maybe that eight-centimeter scale in there was because somebody was using and eight-centimeter length as the standard.
Q Would you ascribe any more significance than speculation to that, Mr. Parker?
A Well, I asked around, say, "Who did it? Can't we find out?" And I found out that several people logged the cores in the early days of the Eagle Project; contractors. And even the contractors sent several different geologists to work on the cores, and so I couldn't pin it down.
Q Isn't it possible that someone put that rule on there just

to give the person who looked at the photographs some measure of scale?

MR. HAYNES: Objection to the form of the question as to the possibility. I think the witness might be able to testify to probabilities but not possibilities.

A In the sense about --

JUDGE PATTERSON: Well, wait 'til I -- I'll overrule the objection as to --

A In the sense that all things are possible, I'd agree with you, but I would expect there would be another reason.

Q I've carried in my pocket for several years this handy little booklet, Mr. Parker, and I wanted to show it to you, if I might. Common with these things I get kidded about it, but I carry it around. It has handy conversions and things like that. And you see here (indicating) it's got a little scale; right? You've seen those before, haven't you, in little pocket calendars and things?

A Yes.

Q And can you see that this scale in both inches, up to 5 inches, and it's in millimeters, 130 millimeters?

A Yes.

Q And I believe, if I recall my math correctly, that that 130 millimeters would be 13 centimeters; is that right?

A Yes.

Q Now, if you had seen that scale on the photograph, would you

have assumed that, in fact, Kennecott used a 13-meter scale for its procedures in calculating RQD?
A I wouldn't have assumed any such thing. But this was a -- looked like a hand-made scale, specially made and colored. But again, I did not draw that conclusion. I never went with the idea that it was an 8-centimeter standard. I left that open as a possibility, though.
Q All right. I understand. I believe, according to my notes, that this is Petitioner's Part 632 Exhibit 41, page 1. And do you recall, Mr. Parker, you talked about this diagram earlier?
A Yes.
Q And I believe you indicated that the red dots on this figure are the locations of some of the eight boreholes that you had data for; is that correct?
A That's as close as I could get, yes.
Q Okay. And I think you acknowledged that they may not be exactly in the right location?
A That is true; yes.
Q And I think you indicated -- and tell me if I'm wrong -- that what appears as tan or yellow in the figure I think you referred to as the semi-massive sulfide?
A Yes.
Q And the red blob, as you called it, in the upper right corner of the tan portion I think you referred to as the

massive sulfide?
A Yes.
Q And it is your understanding, is it not, Mr. Parker, that it is the semi-massive and massive sulfides which are the target of the mining?
A They were at the time of application, yes.
Q Good. And then the area that appears to be in blue outside of the orebody itself, is that the peridotite rock you referred to earlier?
A That's what the map was intended to show, yes.
Q Okay. So again, it may not be accurate in scale; is that what you're saying?
A Well, you see, there's no information around this left -- bottom left corner there, so there's some interpolation or guessing involved, but it's close.
Q Okay. Now, you don't have all eight of the boreholes located on this figure, do you, sir?
A One, two, three, four, five, six, seven. It looks like I have seven. One, two, three, four, five, six, seven. Okay.
Q Now, it looks to me like -- and again tell me if I'm wrong; I may have missed something. I see one hole within the semi-massive sulfide part of the orebody, and I see one within the massive sulfide part of the orebody. Is that correct or am I missing one?
A I think you are describing what's shown on that map, yes.

Q All right. And I think you indicated earlier -- and again tell me if I'm wrong -- for these holes that you've indicated with these red dots, you're not sure specifically whether they're vertical, whether they're on a slant one way or another; is that correct?
A I can tell that some of them are vertical 'cause there's a dot and no line connected to them. I can see "155" there which is rather clearly connected to a green line. That green is where it's in the sediments, so I'm pretty --
Q And that tells us that it's drilled on a slant?
A Yes. Now, some of those on the right-hand side, there's a bit of confusion there.
Q If we look at hole 55, the one you just identified, what would be the point of beginning of that drilling; do you know?
A Where the red dot is or approximately.
Q And, now, I see -- other than those two holes that you identified in the orebody, the rest of the holes appear to be outside the peridotite; is that correct?
A At this elevation, yes; at this elevation.
Q And, again, you don't know for sure whether those are vertical or on a slant; is that right?
A And I told you that in some cases we had cross-sections which allowed us to determine how they were oriented. It would have been nice if when somebody had provided us the

information, they would have provided all of it, including the location of the holes, the inclination and the orientation, what would be normal standard.

Q You also -- Mr. Parker, earlier we spent quite a lot of time looking at Petitioner's Part 632 Exhibit Number 42, which I believe was those tables of data where it had the RQD data, the borehole length information, then another chart that showed RMR data. Do you recall those tables?

A Yes; yes.

Q And as you went through that -- or as you went through those tables you indicated that in some cases you saw lengths of borehole for which there were RQD's very low or, for instance, zero; do you recall that?

A Yes.

Q And you noted in your testimony that in some cases there was no corresponding RMR values shown for those particular lengths of boreholes; do you recall that?

A Yes.

Q But I also believe you indicated on more than one occasion that there were also some lengths of boreholes which, in fact, had some very RQD values and again for which there was no corresponding RMR values shown in the tables; do you recall that?

A That's right.

Q And don't you think that if it was Kennecott's intention to

skew the data; in other words, make the RMR's look better than they really were; that they would also have included those higher RQD borehole data?
A First of all, did I say anything about skewing the data?
Q Well, I believe you indicated that the result was to skew the data, and that's why I'm asking this question.
MR. HAYNES: Objection. That's mischaracterizing the witnesses' testimony. He didn't say that the data were skewed. He said the data didn't conform to best practices.
JUDGE PATTERSON: I think that's a fair comment.
A There were a lot of things that I did not understand, and I pointed them out even though I didn't understand them.
Q All right. Do you think it's possible that there is, in fact, a reasonable explanation for why some of those sections of boreholes which had either high or low RQD values were not reflected in the tables for RMR values? Isn't that possible, Mr. Parker?
A I can't think of a good reason. Once you had the course, you should be able to do that.
Q You authored a report that was submitted with the public comments in this matter; is that right, Mr. Parker?
A It was submitted?
Q Pardon me?
A What was submitted how? What?
Q Did you submit a report earlier with comments about the

planned mine?

A Several.

Q Pardon me?

A Several of them.

Q Several. Okay. All right. I wanted to ask you about some things you said in some of that material.

MR. LEWIS: Counsel, I'm going to be looking at what you had marked Part 31, Exhibit 9-H. I think it was also listed as Part 632, Exhibit 3, that big exhibit.

MR. HAYNES: Comments?

MR. LEWIS: Pardon me?

MR. HAYNES: The comments?

MR. LEWIS: It is the comments. And I think I have an appendix reference if that helps you. Yes. It was NWF Appendix 9-B.

MR. HAYNES: Thank you.

Q I want to ask you about some things you said in your report which I believe are consistent with your testimony today, Mr. Parker. And specifically I have in my notes here that you said in your testimony that in this case as far as determining the stability of the crown pillar, that you would do what most people do, get underground and find out then. Is that pretty much your approach to this, Mr. Parker?

A I think that that's the way most people do it.

Q And in your report, Mr. Parker --
A Excuse me. Could I just add a little bit to that?
Q Yes, sir.
A That's the way they would do it rather than predict with a lot of confidence that everything would be right.
Q I understand. You take issue with the -- again, the mathematical and the computer modeling and the more modern use of predictive tools?
A And the confidence expressed in the fact that it would be stable and there would be no subsidence. Yes, I take issue with that.
Q And it's your position that, again, the old ways are still the best ways, that we need to look at the rock, kick the rock, get down underground and then see what we're going to encounter?
A That's my opinion.
Q Mr. Parker, I've seen the term -- and you may have used it; I'm not sure. But in the mining context I've seen the term "development" used in terms of mining. And I've seen -- it appears to me it means something different than actually mining the ore; is that correct?
A Yes.
Q And does it generally -- would it include, for instance, the process of making a tunnel and access places, for instance, so you can get ready to get to the ore and then mine it?

A Yes.
Q And are you familiar with the permit conditions for the mining project in this case?
A What do you mean by "permit conditions"?
Q Do you know that a mining permit has been issued by the Michigan Department of Environmental Quality for this mine?
A I would like to think that is not a certainty.
Q Okay. Okay. Well, let me assure you, Mr. Parker, that such a permit has been issued. Okay?
A I hear you.
Q All right. I take it since you -- well, let me ask you this: I'm assuming then that you have not read the conditions of the permit; is that correct?
A That's probably true.
MR. LEWIS: Looking at, Counsel, Intervenor Number 385, that's the Part 632 Mining Permit, and by the way, I would offer that at this time, your Honor.
JUDGE PATTERSON: I'm sorry. What was that number again, Mr. Lewis?
MR. LEWIS: Intervenor Number 385.
JUDGE PATTERSON: 385.
MR. HAYNES: I don't have an objection.
MR. REICHEL: No objection.
Q Mr. Parker, we just talked about --
JUDGE PATTERSON: No objection, it will be

entered.

(Intervenor Exhibit 385 received)

MR. LEWIS: I'm sorry, your Honor.

JUDGE PATTERSON: That's all right.

Q We just reviewed your opinion as to if it would be better to collect and develop this data once underground than rely on these other predictions. And I recall also that you talked earlier about the collection of what Mr. Haynes called in situ stress data; do you recall that?

A Yes.

Q And it had something to do, as I understand it, with some testing which might enable one to predict or gain some additional information about these so-called vertical or lateral stresses which might exist within a crown pillar?

A That's right.

Q And I believe you indicated that while it could be done perhaps before mining, that it's more typically done after mining commences once underground; is that true?

A More typically, yes, which is not the best way.

Q And are you aware, then, in the permit, Mr. Parker, that in page 6 condition E-8, again Intervenor Number 385, that the DEQ actually requires the following for this mining operation: "As each level is developed" -- and we just talked about that word, remember?

"As each level is developed starting with the lowest level, the permittee -- that's Kennecott -- "shall collect in situ stress data in standard geologic, geotechnical and hydrologic data to evaluate rock stability for the overlying level or levels. Supplemental diamond drilling shall be carried out if necessary to fill in any data gaps, and a 3D physical model shall be developed and maintained to accurately assess ground and hydrologic conditions."

You did not know that that was going to be a requirement for this mining; is that correct?

A I think I'd heard that, yes. But none of that appeared in the original application, which is what I was supposed to evaluate.

Q That's fine. I understand that, sir. Thank you. And do you recall also making this statement in your report, Mr. Parker?

MR. LEWIS: This is at page 14, Counsel, of the second of the papers in that appendix.

Q Do you recall saying in one of your --

MR. HAYNES: I'm sorry, Counsel. Second of which papers?

MR. LEWIS: It would be the same exhibit I referenced earlier. It's the Appendix 9-B-NWF. Okay?

MR. HAYNES: In which report?

MR. LEWIS: And then I believe it's his second report. It's titled "Comments on the KEMC Application, June 2006." These are all included together in my version. If you trust me, Mr. Haynes, I'll read it correctly.

MR. HAYNES: I'll trust you subject to verification.

MR. LEWIS: All right.

MR. HAYNES: Isn't that what President Reagan said?

MR. LEWIS: Trust but verify, yeah.

Q Do you recall saying this in your report, Mr. Parker, as soon as I find it again:

"My thinking is that surface stability could and probably would be ensured by careful mining during the early years so as not to lose the mine but could only be guaranteed if a penalty were imposed if subsidence did occur at any time." Do you recall that?

A Yes, I do.

MR. HAYNES: I'm sorry. Before you continue, what page was that on, Counsel?

MR. LEWIS: Page 14.

MR. HAYNES: Thank you.

Q And, again, you have not reviewed the permit application or materials, I think, beyond the Golder reports, but are you aware, sir, that, in fact, there is a bonding requirement for this mine project?

A Was that the 11 million?
Q I'm not sure of the amount.
A That's -- my comment was, "peanuts as compared to the value of the project."
Q And do you recall saying in that report on page 21, Mr. Parker, that:
"The proposed mine schedule will allow approximately 69 months to complete the data collection and crown pillar design prior to mining above the 327.5 limit. Good, but again a new approach"?
A Okay. That sounds familiar, again emphasizing that this is a change from the original application.
Q I understand. You've indicated that your assignment and initial comments were based on the application materials, and you had not reviewed the permit condition. Mr. Parker, you also offered some testimony earlier or some opinions about the potential performance of the backfill that's going to be used in the mine. Do you recall that?
A Yes.
Q And you indicated in response to my objection, I believe, that you had -- you had had experience in mines which used stope and backfill techniques. Do you recall that?
A Yes.
Q And did you indicate you'd had that experience in several mines?

A Yes.
Q And was it successful?
A Okay. There are several different kinds of backfill. When I've seen mine tailings sorted to get the coarse material and get rid of the fine material and lightly cemented and poured hydraulically into an enclosure, that works.
Q Also, in looking at your report --
MR. LEWIS: And this would be, I think, the third paper attached to that appendix, Mr. Haynes, the one entitled "Additional Thoughts on KEMC Backfill Plans," page 23 actually.
Q -- you indicate there, Mr. Parker, that you had discussed the prior day with Stanley, the proposed backfill. And you indicate that, "from Googling mine backfill practices, especially Canadian technical papers, in which I think I recognized the Golder approach." Is that correct, Mr. Parker?
A Is what part of it correct?
Q What you said there, that you, "learned quite a bit from the discussion with Stanley and from Googling mine backfill practices, especially Canadian technical papers"?
A That's correct.
MR. LEWIS: That's all I have, your Honor.
MR. REICHEL: Good afternoon, Mr. Parker. My name is Robert Reichel. I represent the DEQ in this proceeding.

I have very limited questions for you.

CROSS-EXAMINATION

BY MR. REICHEL:

Q On direct examination when Mr. Haynes was asking you the questions, one of the things you testified about was a situation at the Athens Mine, and do you recall that one of the slides you were asked to look at was from a publication.

MR. REICHEL: I believe, for the record, it was contained in Petitioner's Part 32 Exhibit -- 632 Exhibits Number 38.

Q I'm not hooked up here to project this, but as you may recall, sir, you were asked to look at a diagram and a paper that discussed the -- case studies at certain mines?

A Yes.

Q And depicted in that slide or that excerpt from the paper was a diagram that showed certain subsurface formation pattern with, I believe -- according to your testimony there were dikes present there. Do you recall that?

A Yes.

Q And I just want to make sure I understand your testimony. Is it your understanding that the situation at the Athens Mine, based upon your review of that paper, was that the area where the subsidence occurred was an area located in between two dikes; is that a fair statement?

A The one on the left of the sketch was described sometimes as

a dike, sometimes as a fault, sometimes as a combination. The one on the right was a dike clearly.
Q Is it your understanding, sir, in that situation that the subsidence did not occur in the actual area of the intrusion of the dike that you described?
A No, between dikes.
Q Correct. And isn't it true, sir, that at least based upon your review of the application for this particular mining project, the area where the target of the mining is is within a single intrusion that comes to the surface that's the so-called Eagle formation?
A I think it was -- it came in at least two stages, maybe three; first the dike and then the peridotite and then injection of ore, I think.
Q Well, wouldn't you agree, sir, that the situation that existed at the Athens Mine where the subsidence occurred between two features that were identified as dikes is not the same as exist at the proposed mining site at issue here?
A It's not exactly the same, but I see similar conditions in that there is a dike on one side and a questionable contact with the country rocks on the other side also almost vertical.
Q But, again, the situation is not the same?
A No; no. I said no two mines are alike.
MR. REICHEL: Could I have just a moment, Judge?

JUDGE PATTERSON: Sure.
Q Mr. Parker, you testified earlier about in situ stress testing; do you recall that?
A Yes.
Q And you were asked a series of questions by counsel on direct examination about the possible use of in situ stress testing from a surface location prior to the development of a mine. Do you recall being asked about that?
A Yes.
Q And I believe your testimony was that you had identified a couple of possible techniques. One I believe you testified was hydrofraccing; do you recall that?
A Yes.
Q In your professional experience, sir, do you know how many times that technique has been used; that is, in situ stress testing from a surface location in hard rock mining prior to the development or permitting of a mine?
A No.
Q You don't know if it's ever been done?
A Oh, I didn't say that. I don't know how many --
Q Okay. Do you know -- you don't know how many times?
A Right.
Q How many instances are you aware in which that has occurred under the circumstances I described?
A This was my connection: One of my jobs was to find

hydrofraccing sand, the oil people, and hydrofrac a hole and went to crack the rock to let the oil and gas permeate it more easily. And they like to pump in a special kind of sand to hold those fractures open so they don't close when you release the pressure. So I was chasing that hydrofraccing sand, and I knew there was a big demand for hydrofraccing. But that would be practically -- I'll guess practically all for oil, gas, and in some cases for in situ leaching of ores, crack the rock and put juice in there to dissolve the metals or whatever.
Q 'Cause of their mining technique?
A Yes.
Q But, of course, that's not being proposed here; correct?
A Pardon?
Q That's not being proposed at this site; correct? That is --
A No.
Q And I believe the other technique that you describe for in situ stress testing you said conceivably could be used or conducted from a surface location prior to the development of the mine involved doing additional borings. And I'm not sure I have the correct terminology, but over drilling?
A Overcoring.
Q Overcoring. Excuse me. Thank you, sir. And again, my question is, based on your professional knowledge in the hard rock mining industry, how many instances are you aware

of the use of this technique in advance of mine development to conduct in situ stress testing from a surface location? That is, how many times, to your knowledge, has that been done?

A I did not follow it closely, but I know that for quite a years the practice was used in South African gold mines. They promoted it. I never used it.

Q It's not a technique you used?

A As I look at Wilson Blake, I remember now that there's some hydrofraccing done in Idaho too in silver mines.

MR. BRACKEN: We hydrofrac --

MR. REICHEL: Sir. Mr. Blake will be testifying and if someone wants to ask him about that, that can be pursued, but just to explain to you, sir, only person can testify at a time.

Q But if I understand your testimony correctly, you're not aware of the use of this technique prior to the development or the permitting of an underground hard rock mine in the United States to determine these vertical -- excuse me -- in situ stress measurements?

A I cannot point to an instance. I used to read about it years ago, how it was done. And I shall say I don't remember any reason why it would not work here.

Q Okay. Let's just assume hypothetically, sir, that this were done.

A Yes.
Q Would you -- for example, let's just say hypothetically someone did this technique tomorrow and they conducted the stress -- this kind of test at a single boring. Would you consider a single test sufficient to -- reliable in your philosophy or your practical approach to mine engineering? Would you consider that sufficient to establish conclusively the probability or potential for subsidence?
A Not conclusively but better than nothing. And I'd be looking not for a very precise measurement of the level of stress but for a direction of maximum stress and for an approximation. Is it zero? Is it 10,000? Is it 2,000? Something like that. I'd be happy with that. And as I've --
Q Just a single measure?
A As I've said before, no one measurement is likely to be representative, but you could do several measurements in the same hole at different depths. We could figure it out.
Q But again, you wouldn't base it -- if I understand your testimony correctly, sir, it's your recommendation and your professional judgment is that the best and preferred way of addressing this kind of issue is to actually conduct these kinds of tests in situ once you're underground and as the mining progresses; correct?
A I didn't say that was the best but it would be the most

attractive, especially if, as in a lot of cases, you're sort of poor-boying an operation; you don't have much money in the beginning. Normally those people would wait. But if, as in this case, a very valuable project, it would be almost like a government project money that would be available, and I'd do it.
Q But, again, you can't give me a single instance that you're aware of the hard rock mining industry in the United States where this has been done prior to mine permit; correct?
A At this time I cannot do that, no. I think I could find it though. I've not looked into it.
Q And in any event, it's your testimony that this is not commonly done?
A That's true. This isn't a common mine. Remember?
MR. REICHEL: Nothing further at this time.
JUDGE PATTERSON: Redirect?
MR. HAYNES: I have a few questions.

REDIRECT EXAMINATION

BY MR. HAYNES:
Q Mr. Parker, Mr. Lewis questioned you about the availability of other core data in addition to the eight cores that you reviewed the photographs and the tables for. Do you remember that questioning?
A Not precisely, but I remember vaguely, yes.
Q In your review of the application and its appendices and

later information did you note in your review any discussion in those documents of the cores and the RMR analysis that you performed here, any discussion that looked like that in any of the application or its appendices?

A Wilson Blake commented on our report, including that stuff.

Q But did you see any in the application or its appendices or the later documents concerning an analysis like you performed?

A Only that I just mentioned.

Q Mr. Lewis also asked you -- strike that. In response to Mr. Lewis' questions about the semi-massive and the massive sulfide unit that were shown in Exhibit 41 as the orange and then the red portion of the deposit; do you remember those questions?

A Yes.

Q And the blue ring around the deposit, as you testified before, is the peridotite; correct? Well, a close approximation?

A Approx- -- yes.

Q And you testified in response to his questions about the proposal in the application is to mine the massive sulfide and the semi-massive sulfide; do you remember that?

A I heard him say that, yes.

Q And do you have a -- do you have a view different than that about what you believe will be mined at this site?

A Of course.

MR. LEWIS: Object other foundation, your Honor. The witness has testified that he has reviewed specifically -- if I can find it here, Appendix C-1 -- that was the geology report; Appendix C-2, that's the Golder report on rock characterization. Appendix C-3 was another Golder report on rock characterization and predictions of crown pillar stability, technical memo dated April 2006 by Golder, technical memo dated June 7, 2006 by Golder, Mr. Sainsbury's reports. There's no foundation laid as to why Mr. Parker would have some basis for some opinion that the mine plan will be different other than is reflected in those documents.

MR. HAYNES: Well, your Honor, I'm asking the witness to testify concerning his -- based upon his knowledge of the mining industry and based upon the likely value of the ore in this unit as well as in the peridotite as to whether or not the mining application correctly predicts what's going to be mined there. I can ask -- I can do one more foundational question.

JUDGE PATTERSON: All right.

Q Mr. Parker, did you also review the mining application itself as well as the appendices?

A Yes.

Q And are you aware of the price of nickel and copper in markets today as opposed to -- or in comparison with the prices at the time the mine application was submitted?

A I am well aware of that.

Q And based upon that knowledge do you have a view as to whether or not it would be feasible from a mining standpoint to mine more than the massive and the semi-massive units?

MR. LEWIS: Objection to relevance, your Honor. The permits sets forth the conditions for the mining. It specifically incorporates the mine permit application materials. That is what Kennecott is allowed to do. That is all it's allowed to do. Counsel is attempting to elicit this witness' speculation as to what might happen at some point in the future not allowed by the permit, and it's not relevant to these proceedings.

MR. REICHEL: Join in the objection.

MR. HAYNES: Well, I think, your Honor, that we can explore the basis of the application and also the permit and as to whether or not those actually reflect reality. That's what I'm asking the witness about.

JUDGE PATTERSON: I'll allow him to answer. I'm not sure where you're going with this exactly, but --

Q Mr. Parker, do you have a view as to whether or not the application and the permit set forth the probable extent of the mining for this site?

A I do.

Q What is your view?
A I believe quite strongly that the sudden and spectacular increase in prices of metals has brought a lot of that peridotite which had some sulfides in it up in value to a point at which it not only could be mined but almost has to be mined if we are to get responsible recovery of the resource, a lot more.
Q And if that were to occur, Mr. Parker, would that alter the analysis for the crown pillar stability that's been proposed for this mine?
MR. LEWIS: Objection; foundation; relevance, your Honor. First we start with speculation about mining that can't take place by law under the current permit. Now we're asking about speculation as to what the mining design would be in that speculative hypothetical scenario.
MR. HAYNES: All I'm asking was to infer based upon his knowledge of and his review of the RMR's for this site whether or not he'd have to revise those if the mining plan changes. It's a pretty simple question.
A Yes.
JUDGE PATTERSON: I'll allow him to answer.
Q Mr. Parker?
A Well, I've seen enough changes in the application already to believe that more will follow. And I can't prove that yet, but when the dollars are counted, I have to believe that the

State will require that ore to be mined, and then the mine will be more valuable. It will be larger. The dimensions will change. The duration of mining will change. Those things I believe, not to mention yet the additional orebodies which we suspect are laying around.

Q All right. Mr. Parker, in response to Mr. Lewis' questions about getting down underground to then -- once the mining begins to then take in situ stress measurements and to development a 3D mining plan, do you remember those questions?

A Yes, I do.

Q If the mine were to proceed as planned and that is the mining would start from the bottom up and this 3D plan were prepared, would those -- would that work change your view as expressed today that the crown pillar at 300 meters is nevertheless unstable based upon Kennecott's RMR's as you've analyzed them?

A If we just look at the numbers and accept their evaluation we see that the mine would be unstable.

MR. HAYNES: I have nothing further. Thank you.

MR. LEWIS: Nothing further, your Honor.

MR. REICHEL: Nothing further.

JUDGE PATTERSON: Thank you, sir.

MR. HAYNES: Your Honor, could we take just a short break?

JUDGE PATTERSON: Yeah. Good idea.

(Off the record)

JUDGE PATTERSON: Ready?

MR. HAYNES: Ready. Petitioners call Marcia Bjonerud.

REPORTER: Do you solemnly swear or affirm that the testimony you’re about to give will be the whole truth?

MS. BJORNERUD: I do.

MARCIA BJORNERUD

having been called by the Petitioners and sworn:

DIRECT EXAMINATION

BY MR. HAYNES:

Q Good afternoon. Would you say your name and spell both names for the record, please?

A My name is Marcia Bjornerud. The first name M-a-r-c-i-a; last name Bjornerud, B-j-o-r-n-e-r-u-d.

JUDGE PATTERSON: I'm sorry. Can do that one more time?

THE WITNESS: B-j-o-r-n-e-r-u-d.

JUDGE PATTERSON: Thank you.

Q Dr. Bjornerud, could you give us a brief recitation of your educational background, please?

A Yes, I have a bachelor's degree in -- a Bachelor of Science degree in geophysics from the University of Minnesota in 1983, and a master's in structural geology and rock

mechanics and a PhD in the same fields from the University of Wisconsin and those degrees in 1985 and 1987.
Q And what -- can you describe for us please what you mean by "rock mechanics"?
A The study of how rocks respond to stress both by brittle failure and ductile deformation.
Q And what do you mean by "structural geology"?
A Structural geology is the study of the architecture of the crust of the Earth. It can include plate tectonics but it can also include smaller scale features like fractures and joints. Anything that has to do, again, with the response of rocks to stresses and mapping the crust, defining its geometry.
Q And then could you give us then a brief history of your employment?
A Yes. After my bachelor's degree I had a short-term appointment with the U.S. Geological Survey in California doing work along the San Andreas Fault and also in the Mona Lake area where there was concern about a volcanic eruption about to happen. And then I had a postdoctoral -- then I went to graduate school and then I had a postdoctoral appointment at the Ohio State University and during that time I worked with Canadian Geological Survey geologists in Northern Ellesmere Island in Arctic Canada to map a large area of northernmost Canada that had not been mapped in

detail geologically. And then I had my first academic job at Miami University of Ohio where I was professor in a graduate program and I got tenured there but decided to move back to the north country and I took my current position at Lawrence University in Wisconsin in 1995.
Q And what is your position at Lawrence University?
A I'm professor and chair of the geology department and I teach but I also continue to do research, my own as well as research involving students.
Q What courses generally do you teach?
A I teach the hard rock geology courses primarily, including structural geology, igneous and metamorphic petrology, history of earthen life, the whole great story of all of the Earth's history, introductory geology, field geology, and occasional seminars on things like planetary geology.
Q And how would planetary geology be different from the -- as you described it, the whole big Earth that we live on? Or is it?
A It's very different and we learn actually a lot about Earth's geology by comparing it with that on Venus and Mars; for example, no water makes a big difference.
Q And what are the particular areas that you have an interest in research?
A I'm particularly interested in understanding rock fracture and faulting and being able to look at naturally fractured

rock and make inferences about ancient stress regimes and processes including seismicity of earthquakes.

Q Have you received any academic awards or others honors in your work?

A I have -- I'm a fellow of the Geological Society of America, a professional organization of geologists in the United States and Canada. And I think fewer than five percent of the members can become fellows, so it's and honor. I have received a Fulbright fellowship to study geology in Norway. I spent a year there. And I also was recently granted an endowed professorship at our university in recognition of my research.

Q Have you written any books concerning geology?

A I have. I've written a textbook in geology that's used in introductory geology classes and more recently I've written a book meant for lay people about the history of the Earth; a very broad-brush overview.

Q Have you participated in writing chapters of any books dealing with geology?

A Yeah, I've done that too in a number of edited volumes, technical as well as books for popular audiences.

Q Have you published anything in any peer review journals?

A Most of my publishing is in peer review journals and I've done a lot of that in my field, in structural geology.

Q And those articles in your structural geology area in the

peer review journals are indicated in your résumé?
A Yes.
MR. HAYNES: For the record, Dr. Bjornerud's résumé is Petitioner's Exhibit 122 and it has already been admitted by stipulation.
Q Dr. Bjornerud, have you published abstracts also?
A Yes.
Q And what is a published abstract?
A They're usually a relatively short summary of a paper that's presented at a professional meeting. And I've published -- I'm not sure how many dozens.
Q Now, as part of your academic duties do you teach students who go into geotechnical consulting?
A Yeah, quite a few of our students with a bachelor's degree can find jobs in geotechnical consulting, and they do.
Q And as part of your work and your research, have you become familiar with best practices -- best professional practices for structural geology and rock mechanics?
A Yes.
Q And what are -- if you can generalize, what are those best professional practices?
A Well, in any project you gather as much germane data as possible and generally that starts with a literature search to find whether previous work has been done the area, and then it would certainly involve going to the outcrop. If

there's actually exposed rock available that is certainly the beginning point where you have an actual three-dimensional exposure of the rock that you're trying to study. It would also involve taking samples and bringing them back to the laboratory and perhaps making thin sections to look at them under the microscope so you could do a detailed mineralogical analysis. It would involve potentially collecting data in the field on the orientations of bedding planes or fractures of faults and then, again, bringing them back to the lab and plotting them. And then if there were any geophysical or bore hole data that tell -- give you information about the subsurface you would incorporate that as well. So trying to get information -- as much three-dimensional information as possible.
Q Now, in this matter what were you asked to do?
A I was asked to do a field study of the site of the Eagle outcrop and, secondly, to look in detail at the eight cores for which we had images and do rock mass ratings of all of that core based on the images.
Q You were here to listen to Jack Parker describe what rock mass ratings are. Do you have anything to add or subtract or clarify concerning his explanation of what RMR's are?
A Yeah, I think I do, and can I write something on the --
Q Of course.
A I think it would help everyone.

MR. HAYNES: Your Honor, I'll try not to have an equipment malfunction.

JUDGE PATTERSON: I appreciate that. Our high-tech easel.

(Witness prepares sketch)

A So what we call the rock mass rating, RMR, is actually the sum of five different components. There's a sixth one but we'll talk about that in a second. RQD, which Mr. Parker talked a lot about, is one of those components. And in the current version of the RMR system, which is called "RMR 89"; that has maximum possible value of 20. You do a conversion between the percents that Mr. Parker talked about and there's a correspondence between the percent and the different possible values for that. A1 is what's called "intact rock strength." That has a maximum possible value of 15. A3 is the spacing of discontinuities.

Q And what do you mean by "spacing of discontinuities"?

A The distance between fractures, faults and other things that break up the rock. And that has a value of -- maximum possible value of 20. A4 has to do with the condition of these discontinuities, which means are they -- do they fit back together like puzzle pieces or do they have a lot of loose rock between them or do they have evidence of slip. And that has a maximum possible value of 30. And the last one is groundwater conditions predicting how much flow of water could happen through the rock, and the maximum possible value of that is 15. Now, the reason I wrote this out is because it is hard to hold all these numbers in mind and there are protocols for each of these, descriptors of the quantitative rock strength and then more qualitative things that have to do with condition of the discontinuity that allow a person looking at the rocks to assign specific numerical values, again with these being the maximum possible ones.

In the Kennecott report all we had was the A2 values and then the total RMR values. We did not have specific independent information on these other parameters, except that there was a table that provided intact rock strength of different rock types and also there is a statement in the geotechnical report, C3, to the effect, or C2 -- excuse me -- to the effect that dry conditions were always assumed. And that we inferred then that they always gave this parameter a value 15. We had no independent information really meter by meter in the cores of anything but RQD's. So I was asked to go through the cores meter by meter and do an assessment of them, identify the rocks and then assign to the best of my ability values for A3, A4 and A5 and use the RQD values, which was the only independent component that we had information for.

Q All right. Now, if we can go back to the first portion of your assignment, and that was to visit the site. Did you visit the site?

A Yes.

Q And why is it important -- or is it important to visit a site like this to evaluate the structural geometry or the structural geology of this -- of a site?

A Right. As Mr. Parker indicated, these rocks are very heterogenous; it means from place to place you find different rock types and they're also not isotropic; they're not the same in all directions. And so it's important to get a sense of the three-dimensional picture. And when you have an actual outcrop, when rock is sticking out of the ground, that's the easiest place to start to get this three-dimensional picture. Bore holes are essentially one-dimensional peep holes down into the subsurface and it's difficult, if not impossible, to get a unique sense of the geometry of the rock from bore holes. Even many densely sampled bore holes aren't as good as three-dimensional exposure of rock.

Q And before you visited the site did you have a chance to look at the regional geology of the area?

A Yeah, I'm very familiar with the geology of the Marquette, Michigan area. I take students on field trips there and have had some student projects in that area, so I do know quite a bit about the area.

Q All right.

MR. HAYNES: Now, if we could put up on the screen.

Q This is appendix C1 of the application, page 13. And this is a figure that Mr. Parker also testified about, Dr. Bjornerud.

A Yes.

Q This figure says -- it's labeled "east area geology." Is there anything in this figure that would assist you in your assignment and would you point those things out to us?

A Okay. Again, most of this is based not on available outcrop. There's just two places where rock is actually sticking out of the ground: East Eagle, which is a place that I visited, and the smaller Eagle area. But this work that I think was done initially in the 1970's by the Michigan Geological Survey is very important because it shows us that there are very continuous dikes that are generally east/west striking that can be seen magnetically through the sand and gravel and glacial deposits that cover them up in general. And then also these faults tell us that these dikes are set by some later tectonic stress.

Q And what is the significance of that, of the faults here?

A Well, both the dikes and the faults constitute discontinuities in the rock; places that one should investigate because they can potentially be zones of

weakness.
Q All right.
MR. HAYNES: Could we then go to, on the screen, 3A?
Q All right. Dr. Bjornerud, you said that you visited the site; correct? "Yes"?
A Yes, I did.
Q Did you take any pictures of the site?
A Yes, this is one of the pictures I took at the site.
Q And what is this picture of?
A Okay. This is a view of one of the steep rock faces you can see at the site. There's my rock hammer for scale. And what we see is the peridotite body; it's an igneous body that was in -- placed in the subsurface, but close to the ancient ground surface. And we know that because one of the most dramatic features to a geologist visiting this site are all of the fractures -- or "joints" we say -- breaking the rock mass up into columns or pencils almost that are quite uniform in thickness. And this really is a lovely example of what we call "columnar jointing." And it's formed when a hot magma body cools quickly. And you see this, for example, in lava flows in other parts of the world.
Q All right.
MR. HAYNES: Can we go to the next slide, next picture?

MR. REICHEL: Excuse me. Counsel, I'm not sure the record is clear. Which exhibit is this?

MR. HAYNES: This is from Dr. Bjornerud's report in the comments from October 17 that when we -- when I move to admit it is going to be labeled Exhibit 3a.

MR. REICHEL: Thank you.

A This is another view, a picture I took at the East Eagle outcrop a little bit closer up showing how the rock mass is broken into these polygonal shapes that continue into the side of the hill.

Q And how is that significant to you as a structural geologist?

A Well, it's interesting because it does tell us something about the cooling history of the rock. Again, as the magma cools it actually contracts. It's a little like mud cracks in some sense of the word, because they're caused by -- they're cracks caused by something shrinking. And when you see something like this usually it continues right across the entire thickness of the magma body and it means that the rock is completely broken into these rod-like cylinders.

Q And what from a structural geology standpoint does it tell you that the -- this rock outcrop has these polygonal cracks and columnar structures?

A Well, it tells us that, again, the magma body was very hot and it was intruded into much colder rock. And the reason the cracks developed is because of that temperature contrast and the rapid cooling and shrinking. And again, we see these in other parts of the world.

Q Now, we've now put up on the screen what are figures 1C and 1D, and what are these?

A These are two pictures I took in Southern Iceland three years ago in the national park called Skaltafell National Park, and I included them because they're very analogous to what we can see in much older rocks at the East Eagle outcrop. This is a common method a geologist uses, compare modern and ancient features. So these are very much like what we see at that site. Except in this case these columns of rock -- these (indicating) are icicles here, but these are columns of rock. Here we see them much closer up, almost perfect hexagons. These are formed in a horizontal lava flow that cooled from the top down and the bottom up, and so they're in a different orientation. In our case at the Eagle outcrop they formed in a vertical dike and that dike cooled from the sides inward and formed these cracks. But in the lava flow they were cooling the other way and you form vertical columns. But they're the same feature. And again, even to a casual glance it's quite clear that's the same mechanism of formation as at East Eagle.

Q Thank you. Dr. Bjornerud, do you have experience in evaluating the stress regime of rocks underground?

A Much of my work, my academic work involves making inferences about ancient stresses. But we can't really measure them directly; we can only make inferences about them. As a graduate student I did do some in situ stress testing but it's not something that I do today as part of my work.
Q Is the stress -- are stress regimes something that you routinely describe as -- in your teaching and in your academic work?
A Yes.
Q And is that a fairly straightforward geological concept?
A Students find it difficult but, you know, it's -- I think at the undergraduate level it's possible for students to understand/
Q And is it important in your view to understand the stress regime of an area in order to evaluate a mining -- potential mining plan?
A Yes.
Q And why would that be?
A Because anytime you have preexisting fractures in rocks determining whether or not they are going to be reactivated as slip planes or just tensile cracks depends entirely on the stress regime that's acting on it.
Q Dr. Bjornerud, we put up on the screen figure 3A from your October 17 report. And this is a figure that you prepared, is it not?

A Yes.
Q And what is the purpose of this figure?
A What I was trying to do was convey the rather complicated three-dimensional geometry that we can infer, again, based on both the outcrop that is exposed at East Eagle as well as the drill cores that I looked at images of. And the two key points would be here's the dike, again like most of the structures in the area, trends east-west. And here's my attempt to draw these columns of rock that have formed this polygonal network breaking up the rock into these pencils again. And then the other important feature that is very clear is one looks at the drill cores, the eight that we have the images for, is anytime these drill cores have penetrated the contact between the dike rock and the host rock there's a very, very broken-up zone of sheered and almost rubblized rock that often has also a lot of mineralization along it, including a mineral that is an alteration product of olivine which is the main mineral that gives the peridotite its name. Peridot, the gemstone people have perhaps heard of, is olivine. When olivine gets hydrated it changes to a very weak mineral called serpentine and we see that especially developed along the margins of this. And I actually brought some serpentine. It's an extremely slippery rock. It's a bit like talc and is known for very low friction.

Q And, Dr. Bjornerud, did you in your review of the core photos notice or were you able to observe the occurrence of the -- give me the name again, the --
A Serpentine.
Q -- serpentine rock?
A I can infer that it's there, but in just an image of a rock it's hard to do a positive identification. However, in both the 1979 Michigan Geological Survey report by Klasner and others and in the C1 appendix by Rossell and Coombs both groups of geologists mentioned that much of the peridotite is -- has been changed to serpentine. So I wasn't the first to observe this. But it has a certain look even in a picture; it has a shiny sort of look.
Q And what is the significance of the serpentine rock?
A It has very low frictional properties; it's a very unusual rock. It's kind of notorious for being -- having much lower coefficient of friction than other silicate minerals.
Q And what is the significance of a low coefficient of friction?
A Well, it means for any particular state of stress that may be acting across a discontinuity like the edge of the dike here, you need more confining pressure to keep it from slipping.
Q And by confining pressures, that would -- is that what Mr. Parker referred to as the lateral stress?

A Lateral stress, yeah.

MR. HAYNES: Let's go to the next slide.

Q I'm sorry. Before we leave this one, Dr. Bjornerud, just below the north arrow we have writing that says "brecciated contacts between dike and country rock." What does that mean?

A Okay. That's what I was describing. This word "brecciated" means broken up, sheered rock. Certainly there's been a lot of deformation of that rock at the time that the dike was in place.

MR. HAYNES: Next slide.

Q Now, Dr. Bjornerud, we're looking at figure 3B from your report and what is figure 3B and what does it represent?

A Okay. I was trying to argue, as Mr. Parker was, how important it is to have some idea about the stress regime, because there are any number of relationships geometrically between these two sets of discontinuities: the broken zones between the dike rock and the country rock, those vertical walls. And then also the -- all of these thermal fractures that cut through the dike rock. Those are all potential zones of weakness and we need to know if we're going to make meaningful conclusions about the stability of the pillar what kinds of stresses are acting on them today. We know that when the dike was in-placed the stress regime might have been something like this, that the dike itself represented a tensile crack that opened up and magma was intruded into it. If that's true still now, that's a very bad scenario because that means there would be potential for tensile failure opening along that.

Q And what would be the consequence of tensile failure?

A I do have a model that I could share, or maybe defer that.

Q Let's -- can you bring the model up?

A Now?

Q Sure, to illustrate your point. We have some assistance coming.

A So I've tried to make a very, very simplified block model to show the stress situation. And it's rather like the picture in the middle, we have little pencils of loose rock that's just held together by the compression of these elastic bands. And if I remove the bottom of the model, so had some failure under this particular state of stress, but as we start removing the confining pressure -- that too -- we can have failure progressively or suddenly because nothing was holding these rods of rock.

Q Thank you.

A So that's one stress scenario, but we don't know what the stress is, either its direction or the relative magnitude. Stress is a three-dimensional quantity. You can't describe it by just one number.

MR. HAYNES: Could we go to the next slide?

Q Now, in figure 3B we're describing the maximum principle stress going I think longitudinally along the dike; is that right? Correct?
A Yes.
Q And then in this slide you have a different kind of stress?
A Here's the opposite scenario where again assuming as probably is true in this part of Michigan that the maximum principle stress lies somewhere in the horizontal plane. This is the opposite extreme where the stress is acting perpendicular to the walls of the dike. And that in some ways is the best case scenario and it seems to be what was assumed in the application and in the C2 and C3 geotechnical reports.
Q And when you say --
A But it is only one of possible -- one of several possible scenarios.
Q When you say it was assumed; can you describe that assumption for us?
A The assumption, which is again just one of many possibilities, was that the maximum principle stress was conveniently acting to keep the rock together.
Q And do you view that assumption as accurate?
A It's one of an almost infinite number of possibilities, it could be anywhere in the horizontal plane if the stresses in this part of Michigan are like those in other Precambrian

regions where the maximum principles stress does lie in the horizontal plane. It could be anywhere from north to south, so here it's acting north and south. In my other scenario it was east and west, but it could be any of those things. And the other thing that we don't know are the relative magnitudes of what we call sigma one versus sigma three, the maximum and minimum principle stresses. That makes a big difference too. Rocks tend to fail when those differences are larger, so we neither know the orientation nor the relative magnitudes of the stresses.

Q And you're saying the application and its appendices don't discuss those factors?

A No. The last -- the application and its appendices do not. The --

Q And do any subsequent documents that were submitted by Kennecott for purposes of this mine?

A Is it 592 -- does address that, but again, they have no -- even Michigan data, much less local data. So they speculate about other scenarios but don't have any data.

Q Dr. Bjornerud, we now have figure 3D from your October 17 report. And you seem to have a different set of -- different orientations for the red arrows here. Could you explain that?

A So this is the more general case where the maximum principle stress, the red arrow -- big red arrows is at some oblique angle both to the contact between the dike and the country rock and to these thermal joints. And in that case all of these features could be at risk of failing as faults rather than as tensile cracks.

Q All right. Could you explain in a little more detail what you mean by "failure as faults versus tensile cracks"?

A Okay. Neither being exactly shut nor just opened up, but instead there is a component of this stress acting parallel to the plane. It could cause them to slip in the plane. So the point of these three diagrams was simply to show -- we don't know what the state of stress is and the responses of this very broken rock depends on how the stresses are acting, both the magnitudes and the directions.

Q Is that, in your view, having reviewed the application and it's appendices and supplementary material -- is your view -- what is your view concerning the discussion in those documents for determining the local structure regime around this proposed mine?

A Well, in the original application as Mr. Parker, I think, said, the only information they had was based on regional Canadian shield stresses. And again that's, I don't think, professional best practice to use something that is not a local value. Because all of the crown pillar stability analysis, both the scanned scale span and the C pillar analysis, the stress magnitude and direction are inputs into those programs. And so you have to assume something to use those programs, so you should have some basis for the numbers that you enter when you use those programs.

Q And if you were to use such a program, Dr. Bjornerud, you would not from a professional best practice standpoint use such assumptions?

A No. Or you would run scenarios that represent the full range of possibilities.

Q And did you see in the application or its supporting documents or further documents any such estimation based upon those different variables?

A No.

Q Is there a way in your view from a structural geologist standpoint to estimate the stress locally in a spot such as the proposed Eagle Mine?

A Yes.

Q And how would that be done?

A Again, hydrofracturing is probably the quickest. If you already have bore holes you can do it that way and Mr. Parker has talked about that. There is one even less expensive method, which if you have bore holes that have been around for a while the regional stresses will actually start deforming them from circular to slightly elliptical and you can get at least qualitative information about the magnitudes and orientations of the stresses in the

horizontal plane just from bore hole deformation.
Q And are such in situ stress measurements a standard procedure for determining the stress regime?
A Yes.
Q And in your view could one obtain such stress measurements in situ before starting to mine?
A Yes.
Q And would you recommend that such things be done?
A Yes.
MR. REICHEL: Objection; leading.
MR. LEWIS: Also objection; foundation. There's no foundation that this witness is an expert on what kind of studies aught to be done for mining. Apparently she's talking about in situ stress testing and other context near as I can tell.
MR. HAYNES: Well, I think, your Honor, that she's testified already about using various inputs into the scale span and C pillar analysis which are, which it's what Kennecott did here. So she's qualified to answer those questions.
JUDGE PATTERSON: And I'll overrule the objections.
Q Dr. Bjornerud, would you recommend that such in situ stress measurements be -- had been done in this situation?
A I would.

Q Dr. Bjornerud, I think you testified that as part of your assignment here you were asked to perform some RMR calculations; is that right?
A Yes.
Q And is there a standard reference in the literature that structural geologists and other geologists use for determining how RMR be calculated?
A Yes.
MR. HAYNES: For the record, this is a chart from the Stanley Vitton report in the October 17 comments, is at page 15.
Q Dr. Bjornerud, you reviewed Dr. Vitton's report that was submitted as part of the comments in this project?
A Yes.
Q And the chart that we have up on the screen; is this chart the one that you recognize as one that is used ordinarily by geologists in determining RMR's?
A Yes.
Q Jack Parker talked about RQD percentages. Do you remember or did you hear that testimony?
A Yes.
Q And is that the technique that was used under the RMR 76 method?
A Yes. In the application apparently, at least initially, the RMR values were based on a slightly older version of this

called RMR 76. It's more common these days to use an updated version RMR 89 that is -- was changed; that's the one I drew here -- to make it more geologically relevant. They're not hugely different. There are slightly different maximum possible values of all these components.

Q I see. And could -- for our benefit could you point out in this chart that we have on the screen the method by which RMR's are calculated and tie that into your previous writing on the foot chart of the various A1 through A5?

A Yes. So here we have the parameters. Each one is numbered and this is the first part of the RMR system, A1, 2, 3, 4, and 5. The first one, as I mentioned before, is intact rock strength.

Q And could you define intact rock strength, please?

A So this is usually a laboratory test similar to what Mr. Parker was describing, some kind of standardized test to get a sense of how strong a particular rock type is under dry, uniform laboratory conditions. And there are different ways of measuring that, even at the point load or the uniaxiel unconfined compressive strength, both of those he described. And than if you do the point load test you use this group of numbers, if you do the other one you use this group of numbers. And than you change them to the A-1 rating, again, maximum value of 15 but if it falls in this range it's 15, this range 12 et cetera.

Q So there's a conversion that takes place from the actual test into the RMR system?
A Right. So all of these have no units, they've been converted from some units to just this RMR rating with its maximum value.
Q And the minimum value --
A Or minimum value.
Q Is zero; correct?
A Yes. For this particular parameter.
Q For the intact rock strength; correct?
A Yes.
Q All right. And than what is A-2?
A A-2 is the RQD and so you see the percent's here correspond to different RMR A-2 values but here the convention is even if it's very poor, it's actually three.
Q So for the RQD under the RMR 89 system the range of values is from three to 20; correct?
A Yes.
Q And just so that we can compare these values to the RQD percentages that were in the charts that Mr. Parker testified about. A 100 percent RQD would be 20; is that right?
A Yes.
Q And then the lower percentages have correspondently lower numbers in proportion; correct?

A Yes.
Q All right. Could you than describe the A-3 Doctor?
A The A-3 is trying to quantify the typical spacing of discontinuities including fractures, faults, veins that are actually breaking the rock up and --
Q And by spacing discontinuities; what do you mean by spacing?
A How far apart they are.
Q And that's based upon viewing the cores?
A Yes.
Q And give us an example for the spacing say for if you were to get a rating of 20?
A That means that you have long pieces of rock unbroken greater than two meters, six feet and would have to be unbroken to be a 20 there.
Q And if you have the core that Mr. Parker used; is there a way that you could for us today give us an A-3 rating for the core that you have in your hand?
A Well, it's not long enough really to be two meters.
Q Okay. Well, could you rate it?
A I mean, it's intact as long as it is assuming that it was broken, I suppose from a longer piece, I could give it a rating of 20.
Q That's fine. Now, if you go to A-4; could you describe A-4 for us, please?
A The A-4 is the condition of the discontinuities and it's

suppose to place a number on something that is inherently a descriptive thing. But it has to do with how much displacement and how much alteration has happened to the fracture. A fracture that's very fresh will just fit, the two pieces will fit right back together and that is one criteria by which you can tell fractures that might have happened during the drilling process from natural ones. But a fracture that has some separation between the surfaces and you can tell the pieces don't quite fit together. Or there's some kind of we call it gouge material, than it will get a lower rating if it has slickened sides. These are linear features on surfaces that indicate there's actually been slip, those would typical of fault surfaces. And again, this gouge means material, ground up rock that's been processed by faults slip.
Q And for A-4, you say that there's some judgement that's required in order to assign those numbers; correct?
A Yeah.
Q And that judgement is obviously professional judgement of the geologist; correct?
A Right.
Q And even if there is professional judgement is there a way to be consistent or inconsistent in such assignations on the A-4?
A Absolutely. I think the strength of this kind of approach

is if it used in a very consistent way. One person or a small group of people doing the work over a short period of time and at least it can give you relative assessments of rock quality. But it's not a precision kind of measurement.
Q All right. And for A4 the range of values is what?
A In the RMR 89 it's 30 to zero.
Q All right. And I'm sorry. I think I overlooked this on A3. Just for the record for A3 what is the range of values?
A Maximum 20 to 5 minimum.
Q And why do we have a minimum that is greater than zero?
A This is just the convention that is used; it's a standard that everyone has agreed is a workable thing.
Q All right. Now, Dr. Bjornerud, if you can look at the A5 portion of this chart and explain it for us, please.
A Okay. This is one that concerns groundwater flow through the rock or potential flow. And again, there is some subjectivity but 15 is the maximum value that is completely dry conditions either of rock that so tight it doesn't have any effective permeability or a situation where there is no water present. So that's the maximum. And the minimum value where groundwater could flow through the rock is zero.
Q and have you in your experience seen the various flow or conditions that -- the wet conditions of rock?
A Yes.
Q They correspond to these different values?

A yes. And again, in the application it seems that the assumption for the A5 value, although we didn't have it tabulated meter by meter in the core, was that all of the conditions were dry. And that was on page -- in appendix C2 on page 21.

Q So in other words, for the RMR's that were used in the application the assumption was that the A5 factor was going to be given a value of 15; correct?

A That's right. And can I say something about that?

Q Of course.

A Because in the application as I mentioned before, the RMR 76 method was used. And I don't have another color, but let me just put the different values. So this for RMR 89. And the 76 method, the first two parameters have the same maximum possible value.

Q Of what, just for the record?

A Of the -- A1 and A2 have the same possible maximum value, 15 and 20 respectively. A3 however, in the 76 scheme has a maximum possible value of 30. A4 had a maximum possible value of 25. And A5 had a maximum possible value of 10. If you look closely at the C2 geotechnical report what we found was that they used the RMR 89 value -- maximum possible value for A5 but the MRM 76 values for the other four components -- and if you add these up they actually add up to 105.

Q and would that be best professional practices?
A No, because --
Q Have you ever seen that happen in any other RMR work that you've reviewed?
A Well, if you're going to use one system you should use all of the parameters in that system.
Q And what is the effect of having a total RMR of 105 versus 100?
A well, it means that all of the values started out potentially too high, five points too high. And so I would -- my best judgment is that all of the values in the application should be shifted down by five at least. There's one other parameter.
Q Go ahead.
A Let's see where we are. One other parameter that was not mentioned at all in the report is this one, which is B, and it has to do with the orientation of the discontinuities in the rock. So we -- I mentioned before these joints that cut across the dike rock as well as the two bounding surfaces on either side of the dike, their orientation should be taken into consideration. And this parameter B ranges from maximum value of zero to negative 12
Q And why do we have zero to negative values for the parameter B?
A Because generally any major discontinuities are -- will

decrease the rock mass rating, and so in the best case scenario there's no effect, but they get worse depending on their orientation relative to the structures that's being developed.

Q And based upon your review of the application and the supporting documents can you tell whether or not the B factor was used in any of the RMR calculations?

A Does not seem have been used.

Q So would it be accurate to say that the RMR discussion in the application and its supporting documentation is first overstated by a factor of -- by a value of 5 and then it doesn't take into account probable negative ratings, or at least from zero to a negative rating on the B factor?

A Based on my reading of the application and the appendices, yes.

Q Dr. Bjornerud, in your view are RMR's a necessary and sufficient description of rock properties?

A I think they're an attempt to quantify and standardize what is inherently a very complex system, but the absolute numbers don't mean anything. I think they're useful in a relative sense and they can be useful as a first order approach to again try to quantify things and -- I think they're one approach, but I think that in the absence of a better understanding of geologic context they can be dangerous because the computer programs just require these

RMR's as inputs as well as the stress data. But you can get a kind of misleadingly precise result without actually having a good sense of the context of the rock mass. So I think that's -- in some ways they're a good solution to the problem of a very messy reality, but they have to be used with caution.

Q Now, Dr. Bjornerud, did you review the RQD and RMR values assigned by Kennecott to the several cores that you reviewed?

A Yes.

Q And how did you do so?

A Well, I had Excel spreadsheets that listed the RQD and RMR values. And actually I did not look at the total RMR's. I did my designations independently and then I compared them.

Q All right.

MR. HAYNES: Your Honor, I hesitate to break testimony here, except that we're going to get into a much larger area and I think since it's almost 5:00 o'clock it would be appropriate to take a break.

JUDGE PATTERSON: Thank you.

(Hearing adjourned at 4:51 p.m.)

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