STATE OF MICHIGAN

STATE OFFICE OF ADMINISTRATIVE HEARINGS AND RULES

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| 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. V

BEFORE RICHARD A. PATTERSON, ADMINISTRATIVE LAW JUDGE

Constitution Hall, 525 West Allegan, Lansing, Michigan

Friday, May 2, 2008, 8:30 a.m.

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

Lansing, Michigan

Friday, May 2, 2008 - 8:36 a.m.

JUDGE PATTERSON: Dr. Vitton, just a reminder you were sworn yesterday and still under oath.

THE WITNESS: Yes.

MR. LEWIS: Ready?

JUDGE PATTERSON: I'm ready.

MR. LEWIS: Good morning, Dr. Vitton.

THE WITNESS: Good morning.

MR. LEWIS: I have a few more questions.

STANLEY J. VITTON, PH.D.

having been recalled by the Petitioner and sworn:

CROSS-EXAMINATION

BY MR. LEWIS: (continued)

Q I'm looking at your resume. Tell me if I'm mistaken. But I believe -- let's see -- you moved into academia in -- what year was that?

A 1991.

Q 1991. And your last year working in industry was 1986?

A 1986; 1986.

Q And that was the Shell Oil Company job?

A Yeah, a subsidiary of Shell; the F&F Coal Company.

Q And you had some experience in the reclamation of abandoned coal mines before that?

A Yes, especially -- we specialized in mining abandoned mines.

And those were mostly underground working mines.

Q You talking yesterday -- offered some -- or you talked about you had some questions about the backfill. And you, in fact, looked at this article up here by David Stone. I believe it was Petitioner's Part 632 Exhibit 55. And you also discussed -- I think you had some concerns about blasting against the backfill; do you recall that?

A Yes.

Q I wanted to ask you, sir, I would assume, but you tell me if I'm wrong again, that you have had no personal experience blasting in underground mines against the kind of backfill that Kennecott plans to use here?

A That's correct.

Q And in this article you refer to as, I guess, having some relevance to your questions about the backfill, I think you've indicated that this David Stone was the author and you thought this was a quite -- well, I think you said you found this to be a good article, something to that effect?

A In general, yes. There's some mistakes in it, but I found it in general had some good points.

Q And are you aware, sir, that, in fact, David Stone is a consultant to Kennecott with the design and engineering of the backfill to this mining project?

A Yes.

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

MR. REICHEL: Good morning, Dr. Vitton.

THE WITNESS: Good morning.

MR. REICHEL: My name is Bob Reichel. I represent the Department of Environmental Quality. I just want to follow up on a few of the items that we touched on in direct and cross-examination.

CROSS-EXAMINATION

BY MR. REICHEL:

Q First going back to your Curriculum Vitae and you testified at some length yesterday about your professional experience. But I just want it to be clear about the nature of your experience in the industry before assuming an academic position. Do I understand correctly from reviewing your Vitae and your testimony that your experience with respect to operation and design of mining activities in the industry was primarily, if not exclusively, with respect to open pit coal mining; is that correct?

A That's correct.

Q So just to be clear, you've not had occasion to ever design in advance or assess the potential stability of an underground hard rock mine, have you?

A Yes, I have.

Q You have?

A Yes. In my testimony, I discussed the stability analysis of the old abandoned -- I'm sorry -- the Michigamme mine, which

are an iron ore mine, about 20 miles south of the Eagle project.

Q Right. But perhaps I didn't state my question clearly. Let me restate it again. My question is whether, during the course of your professional experience in the mining industry, you have ever been involved in the planning for and design of a new underground hard rock mine?

A That's correct.

Q You have not?

A I have not.

Q There was some testimony yesterday about --

MR. REICHEL: I'm sorry. The next one. There we go. Thank you.

Q Let's just take a moment here to look at this. It states, does it not:

"After review of the Eagle Project Mining Permit Application by MDEQ, the proposed mine plan was revised to allow for mine development to begin, limiting mining to an elevation of 327.5 meters, resulting in a substantial 87.5-meter thick crown pillar."

It goes on to state:

"This approach will allow further field investigation and analysis to be conducted prior to mining above elevation 327.5 meters ensuring greater understanding of the actual rock mass response to

mining prior to development of the final crown pillar. Based upon the geotechnical information provided in the Eagle Project Mining Permit Application, a crown pillar thickness of 87.5 meters is considered sufficient to prevent any significant surface subsidence."

So is that conclusion reflected in this document consistent with the conclusion that you saw in the November 2006 document?

A My understanding of November 9th, 2006, document was a letter, just a one-page letter. And I think that basically is consistent with it.

Q Could you please call up -- before we get that -- Respondent's Exhibit 26? Yesterday in your testimony, sir -- and you testified at some length about different aspects of Appendices C2 and C3 to the mining permit application; do you recall that?

A Yes.

Q And those were contained -- the C2, which has been projected here, is the geotechnical study; is that correct? And C3 was a subsequently prepared document dealing specifically with stability and potential subsidence issues; is that --

A It was titled "Subsidence," I believe. C3 was the subsidence report.

Q Thank you. And I just want to make sure I'm clear on this. I understood your testimony yesterday, sir, to be that,

based upon your review of those documents, you could not ascertain whether or not the borehole log data and associated RMR for Rock Mass Rating calculations for the eight boreholes that you've had an opportunity to look at were, in fact, included in the GoCAD modeling exercise that was done. Is that -- did I understand your testimony?

A Yes. My understanding and the statements in those reports that stated that they were not included in the GoCAD modeling. So the discrete features section was discussed at length which represents -- is represented by those eight boreholes. That information was not included in the RMR calculations that subsequently David Sainsbury -- Dr. Sainsbury did not have a chance to review to make a -- what I would believe would be a different opinion.

Q Okay. Thank you.

MR. REICHEL: Could you please in that document go to Appendix C3. I'm sorry. Stay in C2, please, and scroll to -- I'm sorry. Let's go to C3 and specifically to page 5 as it appears in the top. And there's a Table 1. I'm sorry. That's C3, page 5. Thank you. If you'd stop right there. Could you enlarge that Table 1, please? Thank you.

Q Dr. Vitton, this is part of the document that you reviewed; correct?

A Yes.

Q And I'm going to direct your attention specifically to Table

1, boreholes used in GoCAD model. Do you see that? Is that correct?

A Yes.

Q In the left-hand column, there's a heading that says, "RMR calculated for entire hole." Do you see that?

A Yes.

Q And at the bottom of that table is a notation 04EA044 to 05EA109 as part of the information contained in.

A Yes.

Q Do you understand from your review of this document and work on this project that that refers to a series of boreholes designed 44 through 109?

A Yes.

Q And with --

MR. REICHEL: If you could scroll down to Table 4. Thank you. If you stop there.

Q This is this Table 4, major structures in crown pillar area, that you discussed yesterday; correct?

A That's correct.

Q And looking at the left column hole ID number, it lists the eight boreholes from which you and your colleagues looked at photographs of cores; correct?

A That's correct.

Q All right. And if you look at the sequence of numbers -- and they appear to be sequential, do they not? The one at

the top if 55 and the last is 101. Do you see that?
A Yes.
Q So all of those numbers would be included in the range of 44 to 109, would they not?
A Yes.
MR. REICHEL: That's all I have at this time, sir. Thank you.
MS. HALLEY: Can we have just a moment, your Honor?
JUDGE PATTERSON: Sure.
(Off the record)

REDIRECT EXAMINATION

BY MS. HALLEY:
Q Dr. Vitton, does backfill settle?
A Yes.
Q Do you remember from looking at the application what the intact rock strength is of the rock that would be removed from the mine?
A The uniaxial compressive strength of the rock on average was about 14,000 pounds per square inch.
Q Okay. And how does that compare to the rock strength of the proposed backfill?
A Well, there's two proposed backfills. There's the cemented rock fill backfill that's going to be put in the primary stopes, and then they're going to use soils and aggregate, I

understand -- or some material, I assume would be aggregate type or sands, would be in the secondary stopes. So there's two types of materials for the proposed backfill.

Q Do you believe there would be a void in the opening post mining?

A I do believe --

MR. REICHEL: Objection. Leading.

JUDGE PATTERSON: I'll overrule.

Q Go ahead and answer.

A Yes. All earth materials, certainly ones that aren't compacted in any type of mechanical energy trying to compact them you're clearly going to get settlements in the secondary stopes of the materials that are put over there. My concern with the cemented rock fill has to do with the attack -- let me back up. The problem I see when they turn the pumps off and the mine is allowed to fill up with water, that'll generate settlement certainly in the particulate materials, the aggregates and the soils that are there in the secondary stopes. The other concern I have then is with the effects of blasting causing microfracturing into the cemented rock fill creating cracks and conduits for it. And as the waters come in, there's going to be a level of acidity to that water that will cause sulfide attacks -- sulfate attacks to the concrete and decrease its strength. In addition, there would be brines entering here. And it's

known that salts and brine salt water will attack the strength of cemented rock fill. I don't believe that, when you -- the method that's being used has very little quality control. And so there's going to be a lot of variability with this material. And there's going to be a fair amount of voids especially in the upper portions as the cement drops down. And it's going to be relatively high in the rock fill. It's going to have voids in it. Those -- I believe that that cemented rock fill will at some point over time reduce its strength and settle. So I see settlement occurring in both the cemented rock fill and the materials that are placed in the secondary stopes.

Q I think yesterday you testified about how long post closure subsidence can occur. What is your opinion about that? Could you restate it?

A My opinion is -- is that the data that's presented in Figure 28 in Appendix C2, which is -- in which it looked at cases in which crown pillars have collapsed and ones that have been stable. But the ones that have collapsed have been over upwards to an 80-year period of time that they have collapsed over that period of time.

Q Do you know of any mine in the world where this type of backfill plan has been stable for, say, 80 years?

A No. I do not believe that this concept of secondary and primary stope backfill concept has been used over that

length of time. It's being used but not over that -- that length of time.

Q Thank you. Dr. Vitton, yesterday we talked about the scaled span method of assessing crown pillar stability and factors of safety. Do you remember that?

A Yes.

Q I wonder if you have an opinion about the factor of safety for the crown pillar at its thickest -- the thickest amount proposed by the application in phase 3?

A The phase 3 application as we discussed yesterday proposed and the DEQ has required that the -- that the -- they not mine past the 327-meter level of the mine. And therefore the crown pillar would be 87.5 meters thick. And my opinion again, their analysis that was presented in attachment 7 that was done by Golder Associates assumed a much, much smaller span and length of opening than phase 1 or phase 2 did. Phase 1 went from a 70 by 107 opening to phase 2 which went 168 to 50 meters. Then phase 3 reduced down to 15 meters by 50 meters. And that analysis -- and that attachment was based on that.

It's also my opinion from reviewing attachment 7 that they still used the same data that was done for phase 2, which included the 109 holes that are in the GoCAD model. But they still were lacking the RMR. The missing RMR data from my understanding was not -- they did not -- I don't

know but it appears that they did not -- they did not include or go back and estimate RMR numbers. So the analysis in attachment 7 was based on the same data that's put in the end of Appendix C3, which is the colored pictures of the RQD and the RMR's.

Q And yesterday when I asked you if the thickness of the crown pillar would affect the factor of safety, what did you say?

A Yes. I said, yes, it will affect it.

Q Okay. Could you tell us -- could you approach the easel and draw for us any calculations you've done about the factor of safety at the thickest crown pillar, 87.5 meters, which is what is now proposed and required by the permit?

A Okay. Again there's two different spans here, so I have to have two cases.

Q Okay.

A I'm going to call case one. And this would be the attachment 7 basis which was a span equal 15 meters and a length which is the -- this is the span -- this is the length.

Q Okay.

A And then the span is the width of the -- and that length was 50.

Q So this case one represents mining only stope at a time; is that correct?

A Yes. That's the plan. That was one of the changes they

made that they would -- they would only mine one stope. So the only opening that would be exposed would be a 15 by 50 meter opening. And so that's what the analysis was. And then they would use tight backfill on the other stopes. So they had a sequencing which is discussed in that appendix. So again I'm using the -- their method, the scaled span method. And so I looked at 70 RMR. Then I looked at my RMR's that I estimated, which it's my best guess -- my best guess at what the RMR's included -- putting them into the data sets that we had. So the factor of safety came to 3.79.

Q What does 3.79 factor of safety mean?

A It roughly means that the -- it has about a fourfold safety factor. It's -- it's a good factor of safety. It's a good one.

Q Okay.

A 51, which is what I estimated for the -- for the crown pillar was 1.49.

Q And what does 1.49 mean?

A It only has about one-and-a-half times of safety. It has about a 50 percent margin above the -- it collapsing; in other words, 1 -- a factor safety of 1 would mean it's right at that equilibrium point between failure and being stable.

Q And what does the application indicate as the target factor of safety?

A They estimate that it was over 2, which is consistent with that, because they have the high RMR.
Q And what was their goal for determining that the crown pillar would be safe? At what level did they say the crown pillar would be safe?
A Well, they had to be above 2.
Q Okay. Thank you.
A And then it drops dramatically because these are not linear. This is logarithmic or exponential. So this drops off at .58. So if you -- if it was 45, then it would drop off.
Q So this is what the factor of safety looks like?
A For case one.
Q For case one.
A That's assuming a span -- this span here of 15 meters.
Q So this case one is likely to happen during the course of mining, that at least one stope at a time would be open?
A Yes. If they can -- if they can -- yes. If they can in their operational sequencing able to maintain just that one stop open, then that would represent it. If they had two stopes open, then this would not be applicable, because the width would be 30 meters.
Q And would that increase or decrease the factor of safety?
A It would decrease the factor of safety.
Q Okay.
A Now, my assumption again and my analysis was that, over

time, that the settlement will occur even if you have tight backfill. You've got almost 650 feet of material that's -- and if you have 1 to 2 percent settlement, which is not unrealistic, you're talking 12 to 15 feet of settlement. So --

Q Are you saying that there would be space between the bottom of the crown pillar and the top of the cement plug?

A Yes. If this is my crown pillar, which is 87 meters -- so this is my crown pillar, and the mine may look something like -- something like this. And it would be these levels. So it's all sitting on top of each other.

Q Uh-huh (affirmative).

A So you have this weight -- gravitational weight pulling down. And if they left it in a tight backfill, which they can do, if over time you're going to get settlement and breakdown of the cemented -- that's the mining. But they're going to have these pillars in here. They're going to be sitting -- the way it looks in the permit, they're sitting on top of each other, more or less. And over time there will be a gap forming as this -- all this material settles due to attack by groundwater, if there's acidity in the mine. Concrete, as we know, can be attacked. And they will add -- although I don't believe they discussed it in the permit, but they can add amendments like Flyash to the cement to try to prevent it. But over time, I don't believe

that that backfill in the method in which it's being proposed is going to be able to sustain itself under these type of forces that will be acting on it.

Q Thank you.

A So my analysis would be looking at the full width, which would be -- my analysis showed -- I would have been 68 by 50. That would be my case two, in which we have 68 meters by -- 68 meters by 50 meters. So in my case here, then it drops rather dramatically to 1.12 for an RMR of 70, 0.44 for 51 and 0.17 for 45. So there's -- again if there is settlement, then this is more applicable to the case that I was referring in my report that I submitted on October 17th.

MS. HALLEY: I move to have Dr. Vitton's drawing labeled as Exhibit 139 for Petitioners and admitted.

MR. LEWIS: No objection, your Honor.

MR. REICHEL: No objection.

JUDGE PATTERSON: All right. No objection, it will be admitted.

(Petitioner's Exhibit 632-139 marked and received)

MR. LEWIS: What's the exhibit number?

MR. HAYNES: 139.

JUDGE PATTERSON: Dr. Vitton, just so I'm clear, how did you come up with the 68 meters? I'm not sure I understood that in case two.

THE WITNESS: The 689 meter?

JUDGE PATTERSON: Right.

THE WITNESS: That was the -- that's the scaled span used in phase 2 assessment.

JUDGE PATTERSON: Okay.

THE WITNESS: Although there is a slight adjustment because, as they change the level from roughly 100 feet to 200 feet, they are changing -- the dimensions are changing slightly.

JUDGE PATTERSON: Okay.

THE WITNESS: There was 70 in phase 1.

JUDGE PATTERSON: Okay.

Q So, Dr. Vitton, the 68 meters by 50 meters represents the open area of the surface of the cemented backfill at the top -- at the very top level?

A Yes.

Q The full opening?

A Yes.

Q Thank you.

MS. HALLEY: I'm not referring to Petitioner's Exhibit 7.

MR. LEWIS: If we could for the record, please, on the new Exhibit Number 139, again because Petitioners have bifurcated their exhibits into a groundwater discharge set and a Part 632 set -- if we could also for the record designate which set of exhibits these belong to?

MS. HALLEY: Part 632.

JUDGE PATTERSON: Part 632.

MS. HALLEY: May I approach the witness, your Honor?

JUDGE PATTERSON: Sure.

Q Dr. Vitton, can you read the title on the front of that book I just gave you?

A "State of Michigan, Ingham County Circuit Court, in reference Petition of National Wildlife Federation."

Q Keep going.

A "Judge Paula Manderfield. Deposition. The following is the videotaped deposition of David Sainsbury, Ph.D., taken before Jean Soule, notary public, registered professional reporter pursuant to Notice of taking deposition at the offices of Faegre, Benson, 2200 Wells Fargo Center."

Q That's enough. It's the deposition of Dr. David Sainsbury; right?

A Yes.

Q Could you turn to page 107, please?

A 107?

Q Uh-huh (affirmative). I've outlined a section of that page.

A Yes.

Q Would you mind reading that section --

A This is --

Q -- both sections, the question and the answer.

A The question states:

"Q Actually let me back up. You say in the sentence that an 87.5-meter crown pillar is considered sufficient to prevent any significant surface subsidence? What do you mean here by the term 'significant'?"

The answer:

"A Well, as I state in the first sentence of my original report, any underground mining is going to cause surface subsidence. There's no doubt about that."

Q So could you --

MR. LEWIS: Could we have the rest of the answer, please, in the record.

Q Go ahead.

A "A The real question here is what amount of surface subsidence is going to cause damage to the environment."

Q Okay. So what is -- your understanding of that is that Dr. Sainsbury is expressing his opinion about what?

A Well, he's stating an opinion that any time you cause mining, you're going to get some subsidence on the -- at the surface.

MS. HALLEY: Thank you, Dr. Vitton. No further questions.

MR. WALLACE: I just have a couple of things, Dr. Vitton.

REDIRECT EXAMINATION

BY MR. WALLACE:

Q First of all, for clarification, in the course of your testimony yesterday, you at one point said, "Now, this is an example of good rock." And you lifted up --

MR. WALLACE: That's not --

A Like this core?

Q -- the run of rock that was -- okay.

A This one (indicating).

Q I just want the record reflect that that's what you were referring to. Do you recall that?

A I believe I do, yes.

MR. WALLACE: That's not in evidence, I don't believe.

MS. HALLEY: No, it is not.

Q And my only other question is, for the factor of safety of 1.12 with an RMR of 70, are all the numbers that went into your calculation of that factor of safety numbers that you drew from -- from Kennecott's presentation?

A Kennecott's permit application --

Q Yes.

A -- plus the eight additional boreholes that we got in August of 2007.

Q Yes. That's my question. Is there any recalculation by you of that factor of safety number 1.12, or is that all Kennecott numbers?
A Well, those would be all Kennecott numbers.
Q Okay. And those are all Kennecott numbers for an 87.5-meter thick crown pillar; is that correct?
A That's correct.
Q Okay. And by Kennecott's own standards, is 1.12 an adequate factor of safety?
A No, not with the variability in the information and the rock data that we have -- they have.
Q Okay. And these lower factors of safety, the .58, the .44 and the .17, those are all numbers that use the RMR's that you recalculated; is that correct?
A That's correct.

MR. WALLACE: Thank you.

MR. LEWIS: Yes, your Honor.

RECROSS-EXAMINATION

BY MR. LEWIS:
Q Dr. Vitton, Mr. Patterson asked you a little bit ago as to, I think, the basis for your using a 68 meter by 50 meter mine opening in your recalculation of factor of safety. And I think the gist of your response on that is that again you're assuming for purposes of your recalculation of factor of safety that the entire void under the crown pillar is

open; isn't that true?

A That's correct.

Q While we know, in fact, that the -- in fact, the void is going to be mined one stope at a time, you indicated 15 by 50 meters and then that stope is going to be backfilled with rock; true?

A The primary would be cemented rock fill and the secondary would be some form of material.

Q And that sequence will be repeated throughout the mining process as successive levels are mined; correct?

A That's correct.

Q And you understand, I believe, as you've indicated earlier, that the primary stopes -- in fact, some of the material used in those stopes will be the development rock that's brought out?

A Yes.

Q And I think you testified earlier as to the so-called psi, that development rock. I don't recall the number. But I think you indicated either 14,000 or 18,000 psi. Do you recall that?

A Yes. The intact strength of the rock is roughly 14,000, I think. That's an average of all of them. They go from 9,000 to 18,000 psi.

Q And that's opposed to the 200-some psi number that you talked about earlier yesterday in reference to some part of

the backfill; true?
A That's correct. The cemented backfill in the permit is stated as having a uniaxial compressive strength of 218 pounds per square inch.
Q And you understand and I think you indicated in your testimony that the plan calls for tight placement of this backfill; correct?
A That's correct.
Q And again I would assume -- but tell me if this is not true -- that based on your knowledge of some mining techniques, that you understand that the engineering here will require that first the stopes are filled, as you indicated the other day, with this backfill material. Secondly you understand, don't you, that that backfill material will be compacted?
A No, I do not know that.
Q And is that because that is something you have not seen in the written materials?
A I did not see that discussion in the -- my understanding is that it will be end dumped from the top of the stope into the -- 100 foot down to fill it up.
Q And, in fact, is it also possible that the backfill will not only be compacted but that bulldozers or some kind of devices will be used to, in fact, push that backfill in tightly as the mining progresses?

A That would not be my understanding. I don't quite visualize how a bulldozer or equipment will be running. I can understand it at the top, that once the 100 feet is filled all the way to the top, they will be running over it, that clearly the top 1 foot or 2 will be compacted by the equipment that would be running over it. But from there down to the bottom, I'm not sure how they would compact it. I didn't have any discussion in that.

Q And I think it's by your own admission throughout your testimony that you do not -- you do not know fully all of the details as to how the actual mining will take place because you simply haven't seen all of those details; isn't that true?

A That's correct.

Q Now, Dr. Vitton, yesterday you and I talked about what you did with your recalculated RMR numbers and how you drew some conclusions as to probability of subsidence or factor of safety. And we talked about the fact that you had not taken into account in your recalculations the fact that the mining would proceed one stope at a time with only a -- the opening the width of one stope open at a time and the fact that you had not accounted for the thicker crown pillar that's not in the permit conditions. Do you recall that testimony?

A Yes, I recall that testimony.

Q And now you've come in this morning and you've recalculated

factors of safety. And I think your inference here is that you have now included those new conditions, the thicker crown pillar. Although -- and although accounting for the one stope at a time mining, it's your view that the backfill will have little or no effect, and therefore you're assuming again an entirely open void for the mind; correct?

A That's correct. I had used the larger one in my analysis.

Q And these recalculations and opinions as to what the factor of safety would be would be with the backfill and the thicker crown pillar were not presented in your report; isn't that true?

A Not totally true. There's elements that I included in the report that I did present here. The -- my analysis in that report was based on the 57-thick crown pillar.

Q Not the 87.5?

A Not the 87.

Q And your analysis in that earlier report again assumed an open void under the crown pillar?

A Correct. That's --

MS. HALLEY: Objection, your Honor. This is, as you have determined, a review -- a de novo review; therefore, it does not matter if this material was in his report or not. He just testified to it.

MR. LEWIS: It's foundation for a question later on, your Honor.

JUDGE PATTERSON: All right. I'll overrule.

Q And yesterday in your testimony, as with your report, you did not offer up a recalculation of factor of safety based on the thicker crown pillar, did you?

A On -- yesterday?

Q Yesterday.

A That's correct.

Q Okay. And you did not offer an opinion as to the fact that the backfill, in your opinion, would have no effect on the stability of crown pillar. But let me rephrase that. You did not offer an opinion yesterday -- let me just ask a different question. Isn't it true, then, sir, that you have come up with this new opinion and these recalculated RMR's based on the permit conditions between your testimony last night and your testimony this morning?

A That's correct. I wanted to check the smaller -- the 15-meter span.

Q I'm referring to Intervenor Exhibit Number 24, which again is also inadvertently included as Intervenor Number 79. That's the Golder July 7, 2006, technical memorandum which we looked at and talked about a bit yesterday, Dr. Vitton. And I believe we have page 7 here.

MR. LEWIS: And could we look at the bottom paragraph on that page, please?

Q And this is the -- just to get us to the next page, Dr.

Vitton, Golder here is describing -- discussing the results of sampling determining the stability for a given thickness of pillar, and they indicate:

"From these evaluations, a graphical representation of the results was developed and plotted in terms of probability of failure and corresponding factors of safety versus pillar thickness."

And they reference a summary plot for the crown included as figure 1 -- "used to define the recommendations made in the phase-two study relating to acceptable initial and detailed mining limit elevations for corresponding crown pillar thicknesses."

MR. LEWIS: And then, if we could go to the next page, please, and page 8, if you could bring up the top two paragraphs, please, the first -- yes. That's good.

Q Now, earlier you indicated in response to, I think, Mr. Wallace's question that -- something to the effect that you had used the same numbers that Golder used in his report. I want to look here at what golder's conclusions were. They indicate at the top, do they not, that, "As described in the Kennecott mining plan, the unsupported span of the crown will be limited to one stope approximately 15 by 50 meters; correct?

A That's correct.

MR. LEWIS: And, your Honor, I'd like to state for

the record that the evidence later on in Kennecott's case will show that the mine plan in fact is 10 meters.

Q But assuming 15 by 50 meters for these questions, Dr. Vitton, Golder goes on to say that, "Probabilistic analyses have, therefore, been conducted for three different scenarios; one for a single-stope span of 17 meters." And then they talk about an unplanned scenario of a 2-stope span and an extreme scenario of full, unsupported crown span of 68 meters. Do you see that?

A Yes.

Q And the 68 meters is what you just used in your recalculation; right?

A That's correct.

Q Which Golder characterizes as an extreme scenario; right?

A That's correct.

Q And in fact, the scenario that we have in the current mine plan and in the permit is the first scenario, a single-stope span. You understand that, don't you, sir?

A Yes.

Q And then, in the next bullet point, Golder talks about their results for their factor of safety and indicate that, "The crown pillar over a single-stope span for the inferred rock mass conditions discussed above is inferred to exhibit factors of safety of 4.6, 5.6 and 6.4 for crown thicknesses of 57.5 meters, 87.5 meters and 117.5 meters respectively,"

does it not?
A That's correct.
Q And the scenario we're working with here, the actual mine plan, would equate, if I am correct, to the 5.6 factor of safety; correct?
A That's correct, based on what you're saying; yes. That's what they're saying.
Q And in questioning by, I believe, one of Petitioner's counsel earlier, you indicated that you recollected that Golder had indicated they felt that a factor of safety of 2 should be the target for the crown pillar?
A That's what they state somewhere in this attachment 7.
Q And it's true, is it not, Dr. Vitton, that the single two differences between Golder's factor of safety of 5.6 and your recalculated factor of safety of whichever one we pick up there is number one, your recalculated RMR numbers and, number two, the fact that you are going to assume an open span of 68 meters?
A That's correct.
Q And as we discussed yesterday, the basis for your recalculation of the RMR number is based solely on your and Dr. Bjornerud's review of 8 cores out of 100-and-some cores; right?
A That's correct.
Q Based solely on photographs of those cores; right?

A That's correct.
Q And as we have discussed earlier, Dr. Vitton, not only Golder has looked at this analysis of the crown pillar stability, but also Mr. Sainsbury, and we discussed what he had to say yesterday in terms of his conclusions as to the stability of the crown pillar. Do you recall that testimony?
A Yes.
Q And you've also read the reports of Mr. Blake, have you not?
A Yes.
Q And you understand that both Dr. Sainsbury and Mr. Blake on behalf of the DEQ investigated and looked at the analysis done by Golder on the stability of the crown pillar?
A Yes.
Q And you understand that you, based on your review of 8 core samples -- photographs of 8 core samples and your assumption that in fact the entire span will be 68 meters rather than one stope at a time, that you -- that's the basis for your opinion disagreeing with Golder, with Dr. Sainsbury and with Mr. Blake?
A Basically, as well as including surface information that Dr. Bjornerud looked at in terms of the high density of fracturing at the surface due to the cooling jointings of the prototype dike material. So there was additional observations and additional information we used to form our

opinions.

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

MR. REICHEL: I have no further questions.

JUDGE PATTERSON: Mr. Wallace?

MR. WALLACE: I have a couple more, your Honor.

JUDGE PATTERSON: Okay.

FURTHER DIRECT EXAMINATION

BY MR. WALLACE:

Q Dr. Vitton, the calculations that are reflected in Exhibit 139, you did these calculations yourself; right, sir?

A That's correct.

Q You did them by hand?

A Yes.

Q Have you seen anywhere in the application, the subsequent memos submitted, any documentation submitted by Golder or Kennecott or Sainsbury, their calculations of the factor of safety that were shown up on the board?? 9:40:38 4, 5, 6?

A No. There's -- no; no. There's -- the equations are used there but not the data or their calculations.

Q Okay. And did you see anyplace in the record that Dr. Sainsbury looked at these core samples himself?

A No, I have no evidence that he did. I do not know.

Q Do you have any indication in the record that Dr. Sainsbury looked at photos of the core samples and calculated RMR's?

A No, I do not have any information to know if he had done --

had -- I do not know if he had looked at --

Q Can you tell from anything you read in the record that Dr. Sainsbury did these calculations himself?

A No, I do not know that he did any calculations.

Q In fact, the record is completely silent that he did any calculations; isn't that --

MR. LEWIS: Objection; leading, your Honor.

MR. WALLACE: Okay.

Q Is there anyplace in the record where Dr. Sainsbury reflects that he did these calculations?

A No.

Q Is there anyplace in the record that reflects inclusion of RMR's from 109 core samples?

A No.

Q In the entire record, how many core samples are reflected on any calculation you've seen?

A Could you explain in a little more detail what -- I'm getting a little confused and --

Q I'm sorry. In the record you've looked at --

A "The record" being the permit application?

Q The permit application, the subsequent memoranda, the Sainsbury deposition, the exhibits to the Sainsbury deposition, any of the documents that we've been considering and you've been asked about, is there any indication that RMR's from more than the 8 core samples that you looked at

have been used to calculate factors of safety?

A No, I can't say that it has; no.

MR. WALLACE: Nothing further.

FURTHER DIRECT EXAMINATION

BY MS. HALLEY:

Q Dr. Vitton, I just want to clarify. You've conducted two different sets of calculations with factors of safety; is that correct?

A That's correct.

Q And what does Case I consider?

A Case I considers that they will only leave open one stope at a time; that the mining operations will consist of mining only one opening and not having any other span larger than 15 meters open.

Q So with one stope open at a time, with your recalculated RMR, can you look at the table and tell me what the factor of safety is for that scenario?

A It depends which rock quality we are going to assume for the crown pillar.

Q Looking at your RMR of 51, what is the factor of safety for Case I with only one stope open at a time?

A 1.49.

Q 1.49.

MS. HALLEY: No more questions, your Honor.

MR. LEWIS: Nothing further.

MR. REICHEL: Nothing further.

MR. WALLACE: No, sir. Thanks.

THE WITNESS: Thank you.

JUDGE PATTERSON: You're done. Thank you.

MR. HAYNES: Your Honor, just for the record, we'll have the Exhibit 139 marked, and I'll distribute copies --

JUDGE PATTERSON: Okay.

MR. HAYNES: -- probably next week.

JUDGE PATTERSON: Okay.

(Off the record)

MR. REICHEL: Judge, I'd like to note for the record that, pursuant to prior discussions among counsel and due to a limitation in Dr. Wilson Blake's scheduling, counsel for Petitioners have agreed -- and we appreciate their cooperation -- to allow Dr. Blake to be called out of sequence rather than as part of our subsequent case in chief. So we have advised Petitioner's counsel that we now intend to call him as a witness for the Respondent. And again, we appreciate counsels' cooperation.

JUDGE PATTERSON: As do I. Are you ready to proceed with that now, or do you want to take a break?

MR. REICHEL: I'm ready to proceed if you are.

JUDGE PATTERSON: I'm ready.

MR. REICHEL: Your Honor, at this time Respondent for the DEQ calls Dr. Wilson Blake.

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

DR. BLAKE: Yes.

WILSON BLAKE, PH.D.

having been called by the Respondent and sworn:

DIRECT EXAMINATION

BY MR. REICHEL:

Q Good morning, Dr. Blake. Could you please state your full name for the record and spell your last name?

A Wilson Blake, B-l-a-k-e.

Q And, Dr. Blake, where do you live, sir?

A I live in Rathdrum, Idaho.

Q And, Dr. Blake, how are you currently employed?

A I am a mining and geotechnical consultant.

Q Dr. Blake, could you briefly review your educational background beginning with college?

A I have a B.A. in mining geology from the University of California at Berkeley in 1957. I have a M.S. in engineering science, which was basically geological engineering, from -- also from UC Berkeley in 1962. And I have a Ph.D. in mining engineering 1971 from the Colorado School of Mines.

Q Thank you.

MR. REICHEL: Would you please call up Respondent's Exhibit 205? I'm sorry. I mis-spoke; 206.

Q Dr. Blake, do you recognize this document?

A Yes.

Q Is this a resume that you prepared, sir?
A This is a resume that I prepared.
Q Thank you. Could you first tell Judge Patterson how -- when you were first professionally employed in the mining industry?
A My initial employment in the mining industry was actually in 19- -- summer of 1955. I worked for the U.P. Railroad in a crew that was prospecting for uranium on the Colorado -- actually, in the State of Colorado.
Q How were you next employed in the mining industry?
A I was next employed in the mining industry -- I was a self-employed -- after prospecting for uranium for the U.P. Railroad, my father was interested in mining, so he and I went out during the summer of 1956 and prospected for uranium in Arizona, New Mexico, Utah. And unfortunately we were a little late. Everything was pretty much staked up. So when we returned to his home in Las Vegas, we went out in this Goodsprings district and discovered a copper deposit, which we staked and then proceeded to develop.
Q Okay. Did you subsequently serve in the military?
A Yes. I was drafted in 1958.
Q And after you completed your military service, what did you do next?
A When I got out of the military in 1960, the price of copper had dropped, so there was -- I couldn't go back to this

little home-owned mining operation. There were few jobs in geology because of the economic situation at that time. So I returned to graduate school at Berkeley in geological engineering.

Q And when you -- could you describe more specifically the kinds of work that you focused on in geological engineering during your master's program?

A Actually, there was two areas that have stayed with me and really pretty much directed my career. One was I was a research assistant, and the professor had this idea of going out and trying to assess the stability of landslides using a seismic listening device. So I developed a set of listening equipment, went out to various local landslides in the Berkeley area -- Berkeley Hills area. And at the same time, there was a tunnel collapse in San Francisco, this railroad tunnel. And apparently kids were smoking in it. The timber burned out. The roof over the tunnel, which was soft serpentine rock, collapsed, and houses were falling into the excavations.

I took my listening device over and monitored in a number of locations and, after a couple days of monitoring, I determined that most of the areas were stable, but there was one area that was still unstable. And I returned and reported this to my professor, who went over the next day and, fortunately for him, the one unstable area collapsed,

and he got some notoriety. And the California State Highway Department decided to give the university a grant to assess stability of road cuts in the state. And so for the next year or two, while I was still at Berkeley, I went around the state with the highway department people, and we monitored the stability of road cuts.

And it turned out that, if the road cut was moving, it would actually give off a seismic noise. If it wasn't -- if it was stable, there would be no seismic noise. And in fact, as a result of this, the highway department developed a mobile lab, which then they used in later years to go throughout the state where landslides were occurring associated with road cuts, and they would monitor to determine the stability of the sliding rock mass.

Q Dr. Blake, again, were there any other aspects of either geotechnology or rock stability that were a focus for you during your master's education?

A The other area that I became involved in was -- at that time in the engineering -- mechanical engineering department at Berkeley, they were developing the finite element method of stress analysis, which they used for the aircraft industry and which appeared to me could be equally used in the mining or rock mechanics industry to help determine and evaluate stability of both underground and surface openings. So I learned to use this technique to evaluate the stability of

both underground and surface openings.

Q Your resume indicates that, between 1965 and 1972, you were employed by the U.S. Bureau of Mines as a supervisory research civil engineer. Could you briefly describe to Judge Patterson the nature of the work that you performed in that capacity?

A Actually, it was these two things I mentioned; my -- the seismic monitoring and the use of this finite element stability analysis technique that the Bureau of Mines became very interested in. Because the Bureau of Mines in the late 1930's developed the seismic techniques for determining the stability of underground openings. In fact, some of the classic work was done up at -- on the copper range in northern Michigan. And incidentally, they also -- in 1950 there was a study done to determine if they could detect the subsidence over the Mather B mine in Ishpeming, Michigan. But at any rate, I was hired to carry out a project at the Bureau of Mines primarily associated with trying to find out if I could make this seismic-monitoring technique a more useful engineering tool to the mining industry.

Q And after you -- during the time that you were employed by the Bureau of Mines, did you pursue further education?

A I continued my education starting in 1966 at the Colorado School of Mines, and fortunately I was allowed to take course work. And what turned out to be my thesis work was

my research work that I was carrying out for the Bureau of Mines.

Q And could you give the Court -- Judge Patterson an idea of the range of course work that you pursued during your graduate education? For example, did it involve rock mechanics?

A I took, yeah, rock mechanics. I took mining engineering courses. Since my previous background had been primarily on the civil side, I -- in order to qualify for mining, I had to go through the suite of mine plant design, all the mine -- undergraduate mining engineering courses, as well as graduate courses in applied mathematics and advanced rock mechanics.

Q Okay. And your Ph.D. from the Colorado School of Mines was in Mining Engineering; correct?

A My Ph.D. was in the Department of Mining Engineering, and the title of my thesis was, "Rockburst Mechanics." And in my work to try to make this method a more useful engineering tool, one of the problems I had was finding mines where there was actually sufficient of this what we call micro-seismic activity being generated in order to collect data. So I spent time going to a number of mines where I would set up and monitor, and unfortunately, since the mines weren't unstable, I didn't collect any data.

I also happened to come up to the Mather B mine, I

think the summer of 1967, and spent a few days monitoring there and again with no success. That's when I met Jack Parker in 1967. I went over to White Pine and monitored for a number of days, and I think it turned out to be an inactive part of the mine and didn't -- again didn't record any data. So I decided that, in order to get some data, I would have to go to the deep mines of the Couer d'Alene mining district in Idaho, where they have rockbursts.

And after visiting White Pine, I went out to the Couer d'Alene district and monitored at Hecla Mining Company's Star and Lucky Friday mines, which were deep mines and had rockburst problems. And at that time I wasn't familiar with rockbursts. That had been my first time in a deep underground mine. And they would only let us monitor on weekends and -- in order not to get in the way of production. So we would go in on the weekend, and I would put out my seismic sensors and record on magnetic tape and then later take this data back to Denver, analyze the data off the tapes.

And I sent the company a small report indicating that we had seismic activity in a number of locations which corresponded to high-stress areas. And then I also located two or three zones of seismic activity up in stoping areas. And a few months later I heard from a phone call from the mining company saying, "We'd like you to come up and talk to

us, because two of these areas which you delineated we had rockbursts in those areas in those stopes."

Q Excuse me; just interrupt. You used a term "rockburst." Could you explain briefly to Judge Patterson what rockburst is --

A Okay.

Q -- and where it occurs and what kind of formation?

A A rockburst is a violent failure of rock. In deep mines the stresses are so high that, when the rock reaches its failure strength, it may actually explode violently, giving off a small earthquake.

Q Okay. When -- you used the term "deep mines." Could you explain what you mean and what depth relative to -- example to the proposed Eagle mine? Is that a deep mine as --

A A deep mine generally would be considered anything over 3,000 feet; whereas, the Eagle mine is 1,000 feet so --

Q Okay. Moving forward through your career, sir, your next listed employment from 1972 to '74 was as director of mining research for Gecamines in Zaire. Could you briefly summarize the kinds of work that you did in that capacity and to what extent it -- if any, it involved practical issues of rock mechanics and as they relate to ongoing mining operations?

A I joined Gecamines in 1972 after I'd pretty much run out of what I wanted to do at the Bureau of Mines. And my

functions at Gecamines, they were changing mining methods from sub-level caving to cut-and-fill mining. And we were also attempting to steepen slopes and open pits. Gecamines was a -- primarily a state-owned copper mining company, which at that time produced something like 500,000 tons of copper a year, about the same tonnage as Kennecott did at that same time period. And we had something like four underground mines and five or six open pits.

So my task was to carry out geotechnical studies to -- in the case of the room-and-pillar mining, to determine the stability of these large rooms that were being mined, which were on the order of 13 meters wide by 42 meters long by, I think, 19 meters high. And by doing -- monitoring the movements as the room was excavated by doing numerical analysis, by looking at the geologic features, carrying out a -- basically a geotechnical evaluation of the roof conditions, wall conditions, we determined that these large-dimension rooms and pillars could be safely mined, and in fact they were safely mined.

And with respect to the open pits, again it was looking at the geology of the open pit structure, looking at the defects, faults, whatever other structural information was available. And generally by -- in most open pit mines, particularly there, the slopes were mined at an angle of 45 degrees, and on one side of the slope it would be stable to

probably 55 degrees, and the other side of the slope was in less-quality rock, and it wasn't stable at 35 degrees. So it was basically modifying the mining plans to fit the in situ ground conditions.

Q Okay. Your resume indicates that, since 1974 to the present approximately, 34 years or thereabouts, you've been employed as a consultant. Could you briefly describe to Judge Patterson the range of -- well, as a consultant, have you been essentially self-employed; is that right?

A I have been self-employed.

Q Could you explain to Judge Patterson a range of the kinds of issues upon which you've provided consulting services in the mining industry or to regulatory agencies?

A Okay. If I might first say that, when I came back from Africa in 1974 on holiday, the political situation in Zaire was deteriorating rather badly, and so I decided, if I could get a job, I wouldn't go back. And so I interviewed at the University of Arizona for a teaching job and was offered an associated professor in the Mining Engineering Department. And the pay was much less than I had been making in Africa, and I had five kids, and there was no way that I could get by on the salary of an associate professor. So they suggested I could supplement this income by consulting a few days a week.

And I had some short period of teaching experience

at Colorado School of Mines after I got my Ph.D., and it seemed like I was doing all the work, and the students weren't doing much. And I didn't really enjoy teaching, so I decided that, rather than waste two or three days teaching, I would just go into consulting if I could. So I went to the mines in the -- deep means in the Couer d'Alene, where I had demonstrated a capability to deal with this rockburst problem, and the mining companies said, "Yes, we will support you immediately on a three-month project, and after that -- you know, during that time you'll be on your own and find other employment."

And so I did that and, during the time I was on this project, for -- somehow the telephone started ringing, and I was off to Mexico to a Mexico mining company doing general consulting in rock mechanics. This company was one of the largest mining companies in Mexico. They had eight or nine different underground mines and, from that point in 1974 'til actually 2000, I would go down to Mexico on a -- five or six times a year, going around to their different mines, helping them with the day-to-day underground stability problems in the mine.

In a number of cases, we switched mining methods to a new mining method, so it would be determining the stability of the rock and the roof. And with respect to a new mining method, I -- during this time I also taught a

couple of short courses in rock mechanics applied to mining, one at the University of Guanajuato in Mexico and another at the University of Zacatecas, Mexico. In addition to the work in Mexico, other mines in North America -- well, other mines in Couer d'Alene district but had these problems, I consulted in installing these seismic monitoring systems, telling them how to deal with their high-stress problems, particularly in pillars; the taking steps to relieve that stress when it reached a certain point based on the seismic monitoring and, say, numerical modeling.

This same rockburst problem was beginning to appear on a frequent basis in Canada, so I traveled to Canada to -- all over Ontario, as well as to back in New Brunswick to deep mines in Canada that had these specific rockburst problems. I was asked to go to the Soviet Union to look at their problems in deep mines with similar problems.

Q Dr. Blake, if I can interrupt you -- excuse me, sir.

A Okay.

Q Was your consulting since 1974 --

MR. REICHEL: If you could, scroll the screen back up, please -- thank you -- to "Expertise."

Q Was your consulting during this time limited just to this rockburst-control problem?

A No. The rockburst is a separate issue, and that was carried

out in deep mines all over the world. At the same time I -- particularly in Mexico, I was involved in the day-to-day mining problems associated with different types of stability problems with different types of mines. And --

Q If I may ask, sir, to -- over the last approximately 34 years, to what extent has your professional work involved you -- required you to be involved in day-to-day practical issues of rock mechanics, mine stability and evaluating potential stability problems and addressing solutions for it?

A That has been primarily my main thrust. I would get a phone call from a mining company saying, "We've had a collapse. Could you come down and tell us what happened and what do we do?" So I would get on the plane and go to the mine. My first -- in order to get a feel for the overview of the mine, I would look at the original geology, the local geology of the mine; look at the mine plans and layouts then go underground; look at the problem; assess what I would presume to be the cause of the problem; tell them how they could fix the problem and then how to, say, avoid a recurrence of the problem by either changing a mining method or changing the procedures they used in mining through what we call bad ground.

Q What do you mean by "bad ground"?

A Every mine has -- is intersected by faults, dikes, weak rock

zones. And very often when you intersect these conditions, the roof collapses.

Q When you say "the roof collapses," are you talking, for example, about a situation like the Athens mine that was -- we've heard so much about over the last few days, this sort of plug failure?

A I've never observed a plug failure. But, no, this would be more -- either isolated openings that were being driven, development openings or mining openings. And if -- say, if the geology isn't well-known or isn't actually taken into account by the mining department and the mine layouts, they historically mine into these features that cause problems, and they don't realize it until they've actually intersected the feature, and the collapse occurs. This is very common all over the world, and I would always get the same story. "Didn't you guys realize you were intersecting a fault?" "No." "Didn't you ask the geologists?" "Oh, the geologists don't know anything." You go to the geologist. "Didn't you tell them they were going to intersect the fault?" "They don't listen to us." This is --

Q Dr. Blake, in your professional practice and indeed in the mining industry, are there -- to your knowledge and experience, are there recognized techniques for understanding why these kinds of localized structural failures occur and techniques for mitigating them or

preventing their recurrence?

A Yes. Primarily it's a thorough geotechnical evaluation of the mine, which includes taking into account the radial geology, the local geology, determining the rock properties of the mine wall rock, whatever intersecting faults and then looking at where the mine opening is going to intersect these features. And they can be identified -- mainly they can be identified in advance in an older mine that's been operating, because they keep mining the same conditions over and over. And so you take into account the in situ conditions. You take into account the geologic conditions. You look at the mine openings so you come up with a program where they're going to intersect one of these bad ground zones. You put in sufficient ground support as you advance through it to contain the rock from failing around the opening.

Q When you say "contain," could you give Judge Patterson an idea of perhaps just illustrative examples of the kinds of techniques used in the mine -- mining industry and your knowledge to control stability problems?

A The simplest technique is actually the roof reinforcement using rock bolts. Rock bolts are roof fixtures that you bolt into the roof, which keeps the roof from -- holds the loose blocks of roof together to keep them from falling. You put in screen, some kind of wire mesh. If the problem

is -- you may adjust the length of the bolts to the size of the opening. If the opening is a very wide opening, you wouldn't put in, say, a conventional 6-foot or 8-foot roof support. You would put in, say, 8 or 12 foot, or in some cases we put in cable bolts, which can be up to 40 or 50 feet. In other cases, now with the advent of what they call sprayed concrete or Shock-Crete, it's very common and effective to have a portable Shock-Crete machine that can be brought down to the mine location in a very short period of time, and you actually spray concrete-type aggregate on the walls to reinforce the walls to prevent them from collapsing or failing.

Q I don't mean to cut you off.

A Okay.

Q But I just asked you for some illustrative examples.

A Yeah.

Q Following up on something you said early, I think you testified that, as part of your work -- consulting work, you look at the geologic conditions, --

A Uh-huh (affirmative).

Q -- the actual rock conditions in the mines themselves; correct?

A That's correct.

Q As a part of the work that you do in your experience, do you have occasion to -- do you have any knowledge of techniques

available in the industry, once development of a mine has commenced and the mining has commenced, to collect additional data in situ; that is, in the ground; of conditions that affects the potential stability of the structure?

A Yeah. Actually, when I go to the mine, I always go underground; look at the geology; come up from underground; review the geology with the geologist. I look at geological cores. We go out to the core shed, and they will open up the geologic cores to get a better idea of the ground conditions. When I am underground, I look at the roof and the ribs of the openings, and I have kind of a -- you might say a self-evaluation of the quality of the rock and the stability of the rock and what it -- whether it's going to be self-supporting or whether it's going to require support, which is sort of similar to what is done now with using the RMR technique. I don't use the RMR technique.

Q That's this rock mass rating?

A Rock mass rating. I don't -- the rock mass rating is a standard procedure that now all the ground control engineers are trained in, and they go to the mine and, in a matter of a few minutes, they will write down -- just by looking at the roof or the walls, they will write down these different factors that go into the RMR and come up with a field RMR as -- basically as we stand there.

Q Now, Dr. Blake, just following up on something you said earlier, if I understand your testimony correctly, in the course of your work, you do have occasion yourself to physically observe either rock in situ or core samples; is that correct?

A Yes.

Q And to what extent -- and if I understand you correctly, you do observe the rock conditions in a practical way and make some judgments based upon your observations about the characteristics of the rock. Is that a fair statement?

A Yes, that's precisely -- as I'm touring the mine, I'm looking at the ground conditions and all the access openings I travel in, getting into the mining areas or the stoping areas. I look at the conditions in the roof. I look at the conditions in the walls. I -- if there -- in most mines they use a standard roof support of some kind, so I will look at the roof, the ground support that's installed for adequacy. I look at -- as I say, I look at the geologic cores.

Most of the deep mines that I work in have all been in situ stress measurements, so I look at the result of the in situ stress. If a mine has a stress problem, I may suggest that they carry out in situ stress measurements. One of the things that we notice in deep mines is, in a high-stress condition, the rock around the opening tends to

peel off or spall," as we call it.10:23:20 And it's very common to see this effects of the high stress on the opening, which gives you an indication of the magnitude of the stress as well as the stress direction.

Q During the course of your work as an independent consultant over the last approximately 34 years, could you give Judge Patterson an estimate -- at least a rough estimate of about how many mine projects you've been called to consult in on that have involved your exercise of expertise in rock mechanics, mine stability and stability-control issues?

A I would say 50, 60 mines. And normally I'm out -- it'd be at least once a month to visit these mines. Most of my work is repeat work at the mining companies I work for, so I go back -- sometimes I'm going back to the same mine four or five times in one year. The mines in the Couer d'Alene, since I live within 75 miles, I used to be there on a weekly basis. Now I'm there on a -- maybe a monthly basis.

Q Okay. Your resume lists --

MR. REICHEL: If you could, scroll down to the latter half of that page, please.

Q -- lists some of the clients you've consulted for; is that correct?

A That's correct.

Q Are these mining companies located in different parts of the world and the United States?

A Yes. They're located in North America, South America, Australia, Indonesia.
Q Okay. Dr. Blake, I note that one of the listed clients there -- is this a list of clients that you've had over time, sir?
A Yes; yes.
Q I note that one of them is Kennecott Minerals. Do you see that, sir?
A Yes.
Q Could you tell Judge Patterson, just so the record is clear, was that -- is that a current consultancy, or was it -- how long ago have you consulted for Kennecott Minerals?
A I've -- the mines change. Ownership of some of the mines change. But I think the last Kennecott mine I was -- visited was Greens Creek in Alaska, and that would have been, I think, prior to 2000. I was at the -- I think they own the Henderson mine, but I'm not sure. It sticks in my mind that I was at the Henderson mine before that. I've done work at Bingham Canyon. They're a big, open-pit copper mine in Utah. But it's been some years since I did any work for Kennecott.
Q And again, it was -- was Kennecott -- you've had a number of clients and continue to have a number of clients other than Kennecott. Is that a fair statement?
A Yes.

Q During the course of your career, sir, have you had occasion to do any publications in the fields of mining engineering, rock mechanics, mine stability, any of those areas?
A I've -- I think I have somewhere around 80 publications in rock mechanics. When I was with the Bureau of Mines and when I was first starting out, you tend to publish a lot. More recently I don't have the time or energy to prepare publications -- or the interest, although I recently had a book published by the Society of Mining Engineers. The Canadian mining industry actually hired another person and myself to kind of relate our experiences in this rockburst field for the record since, if we die or retire, that kind of local knowledge wouldn't be lost. And I added to that and published it. The Society of Mining Engineers published it as a book.
Q Have you during the course of your career had any publications in any peer-reviewed journals?
A I guess I'm not exactly sure what a peer-reviewed journal is, but I've published in the International Journal for Rock Mechanics; Bureau of Mines reports of investigations; Bureau of Mines bulletins. I've published -- I've attended, say, specialty conference meetings, the -- and presented papers at the proceeding, which are always published as a book. I've -- so these are chapters in books that are published.
Q Thank you. Are you a member or have you been a member of

any professional organizations?

A I'm a member of the Society of Mining Engineers, and I am a member of the American Rock Mechanics Association.

MR. REICHEL: Judge Patterson, at this time we would ask that Dr. Blake be recognized as an expert in the following areas: mining engineering, geotechnical engineering, rock mechanics and mine stability.

JUDGE PATTERSON: Any voir dire?

MR. WALLACE: No, Judge. We'll accept him on that basis.

MR. HAYNES: No objection.

JUDGE PATTERSON: Thank you. No objection. He'll be so qualified.

MR. REICHEL: Thank you.

Q Dr. Blake, I'd like to now turn to what brings you here today, and that is your involvement in the proposed Kennecott Eagle Mine project. Were you contacted by anyone from the Department of Environmental Quality in 2007 about this project?

A Yes. I was contacted by Joe Maki of DEQ asking whether I would be willing to review the stability of the -- review the stability evaluations that had been carried out by Golder Associates and Itasca regarding the Eagle -- proposed Eagle Mine.

Q Okay. And were you asked to support any particular

position, or what was your understanding of the nature of your charge?

A My understanding I was to be an independent evaluation, my evaluation of the work that had been done and conclude something about the stability of the crown pillar and its possible effect on the hydraulic -- overlying hydraulic regime.

MR. REICHEL: Could you please bring up Respondent's Exhibit Number 95?

Q We're projecting now Respondent's Exhibit Number 95. Do you recognize this document?

A Yes. That's my --

Q What is it?

A -- report.

Q Okay. And the title of it is?

A "Review of the Evaluation of Crown Pillar Stability for the Proposed Eagle Mine."

Q Okay. And if you could scroll down, what date is indicated?

A June 2007.

Q Okay. And you indicated earlier you were asked to review some information that had been developed by Golder Associates as part of the permit application; is that correct?

A Yes. I was supplied with the Kennecott mine permit application with the Golder -- I think their C2, C3 and

whatever the three Golder Reports and the two Itasca, Sainsbury's report as well as the latest or the last Sainsbury summary report.

MR. REICHEL: Okay. Could you scroll to the last page of that document, please?

Q Do you see that list of references, sir? Dr. Blake?

A Yes. Those --

Q Does this or does this not identify documents that you referred to in the course of your initial review in this project?

A These are the references that I was supplied with and that I -- the only information I had.

MR. REICHEL: Okay. If you could scroll back down please to the second page of this document?

Q This has the heading "Executive Summary." I'm not going to ask you to read the entire document into the record, of course. But was this your attempt to briefly summarize for the reader the scope of what you were asked to do and what conclusions you reached?

A Yes. This is a summary of what I did and what I concluded.

Q Okay. Directing your attention to the second paragraph, --

MR. REICHEL: If you could enlarge that, please?

Q -- you note, first of all, that there was concern had been expressed with respect to crown pillar stability; is that your understanding?

A That was my understanding is that there was a -- I don't know what you call it -- controversy. But anyway, there was -- there was concern regarding the stability of the crown pillar since the overlying river and the overlying weapons could be affected by, say, a collapse of the crown pillar.

Q and you indicate that -- no. Among the documents you reviewed were some memorandum prepared by Dr. Sainsbury; is that correct?

A That's correct.

Q And did you understand him to have expressed some concerns or raise some questions about whether certain conclusions advanced in the initial permit application by Kennecott's consultants were adequately supported?

A Dr. Sainsbury's initial report stated his basically dissatisfaction with the initial reports of Kennecott regarding the stability of the crown pillar and the work that had been carried out to support their conclusions regarding the stability of the crown pillar. The quality of the data, the analyses used, he was -- seemed to me to be very critical of the work that had been done.

Q Okay. If you --

JUDGE PATTERSON: Mr. Reichel, are the Sainsbury and Itasca reports the same thing? Is Dr. Sainsbury employed by Itasca?

MR. REICHEL: Yeah. In fact, let's lay that out. That is correct.

Q If you know, Dr. Blake, perhaps you don't, was Dr. Sainsbury employed by a company called Itasca?

A He was employed by Itasca Consulting Company out of Minneapolis.

JUDGE PATTERSON: So when we're talking about Sainsbury and Itasca, it's the same thing?

MR. REICHEL: That is correct.

JUDGE PATTERSON: Okay. I just wanted to make sure it's right in my assumptions.

MR. REICHEL: No. That's correct.

Q The third paragraph indicates that,

"Subsequent geotechnical work has resulted in establishing an upper mining elevation limit that will allow for mining to be carried out below and not have any effect on the surface."

This references the so-called phase three proposal. Is that what you understand, sir?

A That was my understanding. And I did agree with the Itasca conclusion that it was prudent to limit the mining elevation to the 327.5 meter elevation resulting in an 87.5 meter crown pillar that would be stable.

Q And based upon your review of this, did you make -- and we'll into this in later detail -- but did you make any

recommendations other than simply concurring in the limitation of the upper mining limit to assure a crown pillar of 87 ½ meters?

A I also recommended that because the surface data was so limited that additional field investigations be carried out underground in order to be able to have sufficient data and accurate enough data to quantify the behavior of the crown pillar as well as to preclude any subsidence or hydrologic affects that would be adverse.

MR. REICHEL: If you could turn to the next page, please?

Q The heading "Introduction and Background," again, I'm not going to ask you to read the entire document into the record. This alludes in the first paragraph to initial information provided by Golder Associates; is that correct?

A Yes. This is kind of a chronological description of the work that was carried out by Golder and the sum of their -- the conclusions of the different studies presented by Golder.

Q Okay. Directing your attention, sir, to paragraph.

MR. REICHEL: You can scroll down, please.

Q This discusses some additional geotechnical work. I'm sorry. This discusses the fact that MDEQ had either directly or indirectly had Itasca Consulting Group to conduct a review of the stability issues; is that correct?

A That's correct. Like I say, I --
Q And then -- go ahead. I'm sorry.
A I didn't start my investigation until after all this work had been carried out. And I kind of tried to chronologically piece together what went on.
Q Right. So this portion of your initial report basically just summarizes what had chronologically what you understood to have occurred that --
A That's correct. The sequence of events and the different studies and what the result of those studies.
MR. REICHEL: Okay. Could you turn to the next page, please?
Q Section 2.0 -- 2.1, "Review of Golder Crown Pillar Stability Evaluation," does this section of the report and carrying on into the next page summarize your comments and review on the work that Golder Associates had done in support of Kennecott's mining permit application?
A That's correct. This is my assessment of the Golder -- the different phases of the Golder Reports as --
Q Correct. And as Judge Patterson has already heard testimony, there were a series of documents prepared by Golder over time; is that your understanding?
A That is my understanding.
MR. REICHEL: Could you go to the next page, please?

Q At the end, the last paragraph in Section 2.1 that begins, "In summary," could you -- you don't necessarily have to read that, but could you just perhaps more directly tell Judge Patterson in summary fashion what you took away from your review of the Golder work through the date of this report?

A Well, it appeared to me that the initial Golder work was overly optimistic in stating the stability of the crown pillar. I don't really know anything about this CP method, but I am somewhat familiar with the scale span method. And as has been shown here on other work, the factors of safety listed for the different crown pillar thicknesses, particularly in the first two reports, were not. They never reached 2.0 which Golder had stated was the requirement for stability of the crown pillar. And I was -- I was surprised at the actual -- the Golder studies. And it seemed to me that they didn't -- until Itasca was critical of where work, they didn't reach a conclusion or didn't reach a thickness of the crown pillar that was stable according to their own evaluations.

Q Okay. Just so the record is clear, that comment, does that relate to what has been referred to earlier as the phase one and phase two approaches; is that correct?

A That's correct.

Q I'm sorry. Do you understand what I'm saying?

A Yes; yes.
Q Okay. As opposed to the phase three approach identified by Golder and Kennecott in its July 2006 document; correct?
A That's correct.
Q And with respect to that last document and recommendation, did you -- do you believe or did you form any opinion as to whether or not the recommendation that the mining be limited initially to insure a minimum thickness of 87 ½ meters for the crown pillar with follow-up data investigation while mine development proceeds, did you form any opinion as to whether or not that was a technically sound recommendation?
A I concluded that that was a technically sound recommendation. And, hence, I could concur that the permit should be approved.
Q Okay. Turning to the next section in the report that begins in the bottom of page four, "Review of Itasca Crown Pillar and Subsidence Evaluation," and carrying on to the next page, does it summarize your comments having reviewed the work that Mr. Sainsbury did through Itasca for the DEQ?
A Yes. This summarizes my review of the Itasca reports by Dr. Sainsbury.
Q On page five, did you indicate that, or what conclusion did you express with regard to the conclusion ultimately reached by Dr. Sainsbury?
A I agreed with Dr. Sainsbury that the initial work did not

indicate that -- or indicated that the stability of the crown pillar would be a concern, and that I was a little bit puzzled by the critical tone in Dr. Sainsbury's report. This isn't -- I didn't feel it to be the normal thing that I see when I review different consultant's reports regarding a particular project. I assumed it was because of the term "defensible" that was used in the scope of the -- that was given to Itasca as their scope that maybe there would be legal ramifications, which obviously there are; that that was the nature of his critical activity with respect to his evaluation of the Golder work.

Q Let me ask you this: I mean, would it be a fair -- ultimately Dr. Sainsbury indicated, did he not, that he did not believe that the conclusions initially expressed by Golder in its phase one and phase two were adequately supported by the information presented?

A I certainly agreed with Dr. Sainsbury that the initial two reports didn't adequately support the conclusions.

Q And with respect to the Sainsbury's comment or conclusions with respect to to the third proposal, phase three, that is, the 87 ½, .5, meter crown pillar proposal with follow-up in situ investigation, again, I think you've indicated that you agreed with that conclusion. Can you briefly explain why you agree with that conclusion?

A I agree with that conclusion because the -- basically, the

analysis that Kennecott did for the 87 ½ meter pillar they reported a factor of safety greater than two if the RMR were 70. And the summary of their data as shown on plots and different charts would indicate that their data suggested that this was likely true. I also during my investigation I called DEQ and asked for pictures of cores.

Q Okay. And why did you do that, sir?

A Because it's -- in order to really -- I get -- I don't get, say, a warm, fuzzy feeling from looking at these charts and charts of numbers and RQDs. And I would follow Mr. Parker's lead in saying that I really want to see the rock, knock on the rock and I want a firsthand observation of what the ground conditions really are in the crown pillar.

Q Okay. And, of course, in this case since the mine hasn't been developed, no one has firsthand observation underground?

A No.

Q But --

A So I did ask for if I could see photos of core logs.

Q And in fact, did you subsequent receive any photos of core logs?

A Yes. There was a conference call between DEQ, Kennecott and myself. And I was sent three -- photos of three of the core logs, boxes -- photos of the boxes of core for three different holes in the crown pillar.

Q Okay. And do you recall offhand what holes those were for, or do you need something to refresh your recommendation?
A I think they're in my -- they're listed in my next -- but it was --
Q Okay. Well, why don't we do this? Moving forward in time, did you prepare a second report on this project for the DEQ?
A Yes, I did in prepare a second report.
Q Okay. And before we leave it, Dr. Blake, proposed Exhibit 95 is a copy of the report that you prepared that you've testified to; is that correct?
A That's correct.

MR. REICHEL: At this time we move for admission of Respondent's proposed Exhibit 95.

MR. HAYNES: No objection.

MR. WALLACE: No objection.

MR. LEWIS: No objection.

JUDGE PATTERSON: Okay. Thank you. No objection. It'll be entered.

(Respondent's Exhibit 95 received)

MR. REICHEL: Could you please bring up Respondent's proposed Exhibit 112?

Q Do you recognize this document, sir?
A Yes. That's my second report to the DEQ.
Q What's the title of that document for the record, sir?
A "Technical Review of the National Wildlife Federation

Comments regarding Kennecott's Proposed Project to Construct and Operation the Eagle Mine Project."

Q Okay. this

MR. REICHEL: And could you scroll down to the date on that, please?

Q That indicates December of 2007?

A December of 2007.

Q Is this a document that you prepared, sir?

A This is a document that I prepared.

Q Could you briefly describe how it came to be that you prepared this document?

A I -- sometime in November I received a phone call from DEQ, Joe Maki in particular, saying that the National Wildlife Federation had prepared some reports and would I review and comment on the results presented in these reports.

Q Okay. Again, just so the record is clear, were you given by Mr. Maki of the DEQ a particular assignment? Were you asked to criticize these reports? Were you asked to --

A I wasn't asked to criticize them. I was told to review them and give my opinion regarding their conclusions.

MR. REICHEL: Okay. And if you could scroll to the last page of that document, please?

Q Again, this is under the heading section "4.0 References." Does this identify the documents that you referred to in the course of preparing what's been marked for identification as

Proposed Exhibit 112?

A Yes.

MR. REICHEL: If you could scroll down a little more, please?

Q Does that include -- does it include Parker J. and S. Vitton Review of Kennecott Eagle Mining Company's Application to Mine? Do you see that?

A Yes. I was sent three -- the reports by Parker and Vitton, Vitton and Parker, and Dr. Bjorerud.

Q Okay. And the last document listed there?

A The last document is Vitton and Parker.

Q Okay. Thank you. So the DEQ provided you these documents and asked you to review them; is that correct?

A That's correct.

Q And I take it you did so?

A And I'd do so, yes.

Q Okay. Going back to --

JUDGE PATTERSON: Can we take a break before we go any farther?

MR. REICHEL: Certainly.

(Off the record)

JUDGE PATTERSON: Mr. Reichel, you ready?

MR. REICHEL: Thank you. Could you please bring back up Exhibit 112?

Q Dr. Blake, again, as you testified, the purpose of this

exercise was for you to review and provide independent comment on the comments submitted that's identified on behalf of National Wildlife Federation by Mr. Parker, Drs. Bjorerud and Vitton; correct?

A That's correct.

Q And in Section 2 of your report did you attempt to summarize what you understood to be some of the principal concerns that they had expressed?

A Yeah. These four categories appeared to me to be the basis of their -- that they concluded the crown pillar would not be stable because of these four specific factors that they mentioned in their studies.

Q Okay. The first one and discussed in Section 2.1 in your report RMR values. Again, we've -- Judge Patterson's heard a great deal of testimony about that. I'm not going to ask you to go through and describe the details of the RMR calculations. But did you understand that the NWF comments indicated that the -- that the RMR values identified in the submissions by Golder were incorrect or overstated? Is that what you understood to be their contention?

A That was my understanding. And that was their conclusions based on the work they carried out.

Q Okay. And I believe this is clear on the record, but do you understand -- did you understand when you wrote this report, sir, that the focus of the comments on behalf of NWF were on

RMR values with respect to core samples from eight particular bore holes to which the NWF or its experts had had access to?

A Yes.

Q I should say photographs of those bores; correct?

A Yes.

Q And based upon your review of the comment submitted by NWF, did you form an opinion as to whether or not their contention that the RMR values with respect to those eight samples from those eight cores as they criticized or recalculated them established that the crown pillar proposed under the most recent mine design would be unstable? Did you form an opinion as to whether you agreed with their conclusion in that regard?

A I didn't agree with their conclusion that any crown pillar would be unstable.

Q Can you explain --

MR. REICHEL: And if you want to scroll down please to the next page?

Q Can you explain to Judge Patterson why in particular you agree with the -- disagree -- excuse me -- with the proposition that even the 87 ½ meter thick crown pillar would be unstable?

A Well, it -- because I didn't -- I didn't look at the cores. I didn't have the core photos that they had. I didn't look

at those. What I looked at was the sheets that Dr. Bjorerud had prepared. And I was -- well, first of all, my initial reaction I was very surprised at the comparisons between the logging done by Kennecott and the logging done by Dr. Bjorerud.

Q In what respect, or why were you surprised?

A I was surprised at these missing gaps in the data that weren't listed. I had looked at this Table 4 that has been discussed and --

Q In Appendix C3?

A In Appendix C3, which specified potential problem areas or structural features over a meter in length. And it specified a certain number of these zones. And it turned out that Dr. Bjorerud had greatly increased the number of cores that had missing data. And so my first reaction I called DEQ and had a conference call with Kennecott and Golder.

Q Okay. And what was the subject of that --

A And the subject of it was two things: The first, why weren't all this missing core zones, why wasn't it identified and why wasn't it discussed? It seemed to be a key issue, certainly to the National Wildlife Federation. And secondly because the values in the RMR calculations were quite different, I wanted to know how -- who really did the RMR calculations for Kennecott and how it was done.

Q And what if any understanding did you gain with respect to those two issues?
A I don't think the issue was really resolved. It certainly wasn't resolved to my satisfaction. I was -- I was told how the values were done, and I was told how the cores were handled and how the geology people put their information into a database, which then was accessed by Golder to carry out the RQD calculations and the RMR calculations based on some formulas which they present in their exhibit, the Golder exhibit. I think it's C3.
Q Okay. And --
A I was not --
Q Go ahead.
A And I specifically asked why all these zones of -- where there was no RMR reported, how come -- how could that happen. And it was explained to me that those were zones that where there was no RQD reported in the core logs.
Q Okay. You testified earlier that in addition to -- approaching this issue generally of core stability -- excuse me -- crown pillar stability, part of your review or evaluation would be focused on -- or typically would be focused on to the extent you could looking at some actual physical data; is that correct?
A That's correct.
Q And in this instance, did you attempt to do that to any

extent?

A Yes, I did. As I mentioned, I was sent photos of core boxes for holes 46, 54 and 104. And the only core photos I saw of the work done by National Wildlife was the photos of the two boxes they showed for holes 55 and I believe it's actually 60 instead of 62, but in their report. Now, when I looked at -- and I was sent a map showing the locations of holes 56, 54 and 104, which were in fact in the crown pillar. And I made -- I just reviewed my working notes, and I quickly went through each -- when I was doing the analysis, I quickly went through each of those cores and my notes are similar for each of them that the first, you know -- to bedrock there's no or little core, there's a certain -- for the next 15 meters or so the rock is weathered, surficially fractured, and then on down to -- the rock on down to -- seems to improve with depth and it got better below 50 meters. And those were what I noted for those three holes.

Q And is that -- is your --

A And I --

Q I'm sorry. Go ahead.

A Yeah. And I would -- I would judge the core that I observed for those three holes certainly to be in the fair to good range. I don't do RMRs. I don't, so I can't tell you, you know -- I can't give you an RMR number, but I certainly judge that core that was at three holes kind of in the

center of the crown pillar to be the rock in that -- demonstrated by those holes was certainly of the fair to good category.

Q Could you explain --

A In contrast to the assessment of Dr. Bjorerud for the eight holes that they analyzed.

Q Could you explain to Judge Patterson when you say in the fair to good range what you mean by that?

A Well, again, if I wanted to pick this (indicating) up, this is obviously excellent rock.

MR. REICHEL: And just so the record is clear, Dr. Blake has picked up a rock core that has been used as a demonstrative exhibit in prior testimony in this proceeding.

Q Go ahead, sir.

A In the good category there's a few fractures in it. In the fair category it's a little more fractured but it's still basically mostly intact rock with -- and it's certainly rock that would stand up well to a mining opening.

Q Again, when you talk about your judgment as to rock being fair to good range, is this based upon -- you testified it's not based upon a numeric calculation or RMR; is that correct?

A It's not based on any -- the RMRs do have those. They specify that rock from 50 to 70 is fair and from 70 to 90 or something is good, and then above that would be excellent.

I believe that's the listing on that RMR sheet that's been shown before.

Q Okay. But in making -- in describing a rock or core as being fair, good, excellent, whatever, I mean, what are you bringing to bear? Is this an exercise in your professional judgment, or how would you --

A This is my professional judgment based on the core I've looked at in the past based on what I see underground in my assessment of ground conditions or conditions of cores that I, you know, use in my work in order to evaluate stability evaluations or the rock quality in the wall rocks surrounding a mine opening.

Q During the course of your professional experience, particularly in the last 34 years or the relevant portion of that where you've been involved in practical applications of rock mechanics and issues of mine stability, have you ever had occasion to compare where it's been done, predicted -- or I should say characterizations of rock mass ratings from cores with actual subsurface conditions observed once a mine is developed or is being operated?

A Yes. As a matter of fact, earlier last month. We have a project at the Lucky Friday Mine where on the 4900 level, which is about 6,000 feet below the surface, they are going to sink a winz, which is an internal shaft and from the 4900 level down to the 7500 level or some -- a deep shaft. And

as a part of the geotechnical work for this project to locate where this facility should be sited with respect to the ground conditions, there were a number of holes drilled. And the geologist logged the RMR of the cores. And in this case, the RMRs were at 25 to 35, very, very what we call poor ground. And we went underground and actually visited the development heading that is going out to the shaft location. And this is an opening of some four and a half meters wide by four and a half meters high, 13 by 13 or something like those dimensions. And the other geotechnical engineer on the project did a quick RMR while we were on site, and it turns out that his RMR when we looked back at the core that went through that area, his RMR underground turned out to be the number was five greater than actually he -- that it had been given the RMR from the cores. So in my experience in general with looking at core logs is the rock in situ invariably seems to be better than is indicated by the core logs. That's my personal -- in fact, there was one shaft project I was involved in the one of the contractors said, "Oh, we couldn't sink a shaft in those ground conditions." And another contractor came in and quite easily was able to sink the shaft. So it -- I guess my feeling about the core data is that, while it's in many cases the only data we have, there's a lot of instances where it doesn't really accurately predict -- in general it

certainly does, but it may not accurately predict the actual conditions underground.

Q So again, do you -- strike that. Directing your attention to the next page of the document, sir -- I'm sorry. I apologize. Before we leave that, based upon your review of the available information on this site, including what was included in the permit applications, core documents, et cetera, as well as the other comments, the documents you referred to, do you have any -- what, if any, understanding do you have about the extent to which, given conditions at this site at the surface, whether there were any limitations on the ability to obtain cores directly into the projected crown pillar area?

A It appeared to me that the drilling access was limited by environmental restrictions or surface restrictions. Normally what you would like to do is, if you were going to drill the crown pillar, you'd move over the crown pillar, and you'd directly drill vertical holes. I think there was limited access for the drilling here. And I guess there would be one more comment that we didn't cover that I'd like to make about the -- of the eight cores that were analyzed by Dr. Bjornerud, I noticed in her descriptions in these zones where there was missing core data when she actually physically looked at the cores and logged it, in most of those cases, the bad grounds zones, it was -- typically it

was listed as metasediment, metasediment, metasediment, or it appeared to be metasediment, gabbro contact. So it didn't appear -- in other words, I didn't know where these holes were located. I didn't have a clue of the location of those holes until we saw it yesterday or the day before yesterday. But it appeared -- and then from that photograph it appeared that six of those eight holes were shown on that exhibit showing the locations of the holes.

Q Yes.

A Actually there were two pairs of holes. Basically you only have information from basically two points. There were two pairs of holes, and then there was another two holes and then one hole through the center. But the -- it appeared that at least four of the six holes were outside the intrusive or barely on the edge of the intrusive. And the other -- the fifth hole was maybe partly through the intrusive, and then there was one hole through the center of the -- so, in essence, it's not clear that when you looked at the outline of the orebody that, in fact, all those holes are really representative of the -- they're not in the crown pillar. I mean, the crown pillar is what's over the mine opening, and so it appeared to me that it's not -- while they're in the crown pillar area, it's not clear that -- whether those are really what you'd consider crown pillar holes. They certainly appeared to represent the conditions

along the contact between the peridotite and the metasediments at the boundary. And for those basically three or four points along the northern perimeter, they certainly do indicate that that contact is fractured. Now, whether that's representative of the entire contact is not known. In other words, we see it along the northern boundary, but we don't have any evidence along the southern boundary, or there may be gaps between. So I'm not -- I guess, while it certainly was disturbing to me to see -- and particularly when I read their report --

Q Whose report, sir?

A -- the reports of the National Wildlife Federation or the work done by Dr. Bjornerud, it was disconcerting to have, you know, the missing core and this fractured rock zones. But after viewing the locations of these holes, I'm not sure it's -- they consider it to be a very serious issue. I don't consider it to be a serious issue. That's why I haven't changed my view of the -- what the holes represent and their conclusions.

Q Okay. Just to make sure the record is clear on this, --

A Yes.

Q -- what I understand you to be saying is that with respect to certain of the eight boreholes from which -- that were the subject of review and analysis by the National Wildlife Federation experts, if I understand your testimony

correctly, it's your view that some of those cores are not in areas that you understand to actually be part of the crown pillar or the anticipated crown pillar for the mine. Have I understood that correctly?

A That is my -- if I look at the outline of the orebody, unless the stope is going to be extended into the wall rock, then I don't believe the rock above those holes is going to be intersected by mining, and therefore it would not really be part of the immediate crown pillar.

Q And just so I understand, in your view would it then be relevant to the determination of the crown pillar -- the stability of the crown pillar?

A I think it has some relevance, and it's in, certainly, close proximity. But since we have no other data -- in other words, if it turned out that these holes were in the center of the crown pillar, we'd certainly have a -- I'd certainly have a different assessment of the seriousness of this so-called "missing data."

Q But just again so the record is clear, it's your understanding, based upon the information available to you, that the, quote, so-called "missing data" from certain cores you do not understand to be from boreholes that are within the anticipated crown pillar itself?

A For five of -- I believe it's five of those holes. There's one hole that does go through the -- actually the best hole,

hole 55, the best comparison with the work of Dr. Bjornerud, the closest, say the representative work of that she did and that Kennecott did compared pretty closely.

Q With respect to --

A That hole is angled through the crown pillar. Now, there are two missing holes that we have no idea where they are, or at least I couldn't --

Q Just so the record's clear, when you say "missing holes," you don't mean to say that the data does not exist but --

A Well, I'm saying that -- the holes that contain -- that reportedly contain missing data that was used in Dr. Bjornerud's analysis and used by Dr. Vitton and Jack Parker in their stability assessments. So I don't -- they have not been able to identify the location of those two holes.

Q And I take it, to summarize, is it your conclusion -- is it or is it not your conclusion based upon the information available to you that the data from those -- was it two holes; is that correct?

A There's two holes that there is no location given for.

Q Okay. And do you recall or do you need something to refresh your recollection as to which those holes are? Would you like to see --

A They're the -- I think it's 99 and 101 or -- I mean, just off the top of my head. They're not in the -- I think the holes go up to 69, and then there were two more holes which

were I think even drilled in 2005 as opposed to 2004. And I don't -- the location of those holes is --

Q You're not certain of that?

A Well, when I've looked at the exhibits showing hole locations when you're trying to blow up the locations that are given on the figures that are in the Kennecott application -- original application, it's -- I can't -- my eyes are not good enough to read the fine print on the holes. It is very confusing to try to determine and identify the holes.

Q But with respect to the data that you've had a chance to look at, and particularly with regard to boreholes that you understand to contain rock samples within the proposed crown pillar area or the anticipated crown pillar area, in your judgment based upon the available information, do those data support the conclusion or are they consistent with the conclusion that an 87-1/2-meter-thick crown pillar would be safe?

A I still share that -- or I still -- that is my conclusion, that an 87-1/2 meter pillar will be stable.

Q I'd like to direct your attention now with respect to Section 2.2 Stope Backfilling. And again, do you understand that -- or what is your understanding with respect to the comments that you reviewed by the National Wildlife Federation with respect -- the concern that they raise with

regard to backfill?

A Well, the concern that was raised by the -- Dr. Vitton is that the strength of the cemented backfill at 218 psi may well break up during blasting and may well deteriorate under the water conditions. And he also -- I think he also implied that cemented rock backfills were not a common practice or he mentioned that a paste backfill is more common, I believe.

Q Dr. Blake, with respect to -- okay. You understand those to be the nature of the concerns. Based on your review and your experience in the mining industry, what would be your response to those concerns as expressed here? Well, first of all, let me break it into parts. Do you have any knowledge of the use of cemented rock backfill in the mining industry?

A Yes. When I presented a paper on the work I was doing in Africa in 1973 at this Jubilee Fill Symposium held at Mt. Isa, Australia, the purpose of the meeting was also to -- for Mt. Isa to demonstrate the cemented rockfill technique that they had developed to mine what they called their 1100 orebody, which was a massive sulfide deposit of -- I don't know -- maybe 50 million tons or a large orebody which they were going to mine with a checkerboard paneling technique not too different than the long-hole blast hole mining technique proposed for this mine, although in their case it

was many times larger and much more complicated. And they showed us underground where they had mined back into a number of different fill conditions. The normal sandfill, where you see all the segregation and layering of the sand, when by the time the sandfill gets from the sand plant on surface down thousands of feet underground, that you have a lot of segregation --

Q Can I interrupt you. When you say "segregation" --

A Well, segregation, in other words, the cement wasn't -- the idea of a cemented sandfill is to have the cement uniformly distributed throughout the sand, and it's very common to use the mine tailings, but this is a -- if you have a mill, this is a supply of material that you'd like to get rid of anyway from environmental purposes. So you'd like to get it underground. And it's also used for support. And the feeling has always been when you -- that a cemented sandfill is going to be a rather -- the cement is going to be rather uniformly distributed throughout the sandfill. And what was observed in these openings, they mined through the cemented -- or through the cemented sandfill was that you'd have sandfill. You'd have two inches of cement. Then you'd have more sandfill. Then you'd have another layer. So it wasn't really a well distributed cemented sandfill. And they did the same experiments for cementing their rockfill. And because this was such a huge part of the mining of this

orebody, they eventually constructed a surface quarry. They had a large borehole that this rock was dropped through down to the level. It was transported out to the areas that were going to be backfilled, put on conveyor belts. And at the end of the conveyor belts there was a cement line. And as the backfill was dropped into the stope, the cement was poured on top of it. And when they mined back through the cement placed in this fashion, it was well distributed within the cemented rockfill. And they were very successful operationally in mining using this cemented rockfill for wall support.

Q And to your knowledge, Dr. Blake, is that the only instance in which cemented rock backfill has been used in the industry?

A No. Cemented rockfill at the Macassa mine in Kirkland Lake, Ontario, used a cemented rockfill -- cemented paste fill actually, and we mined under it for underhand mining and it was a very stiff rockfill. I believe -- I can't remember whether -- I think it may have been the Hemlo mine in the Hemlo district of Canada which is in southern Ontario; it's kind of southwest Ontario. Anyway, if that was the mine -- I have a hard time remembering all --

Q That's fine.

A -- what specifically you see. And I wasn't -- at that time I wasn't particularly -- I don't really get involved much in

backfills. But at any rate, it was the truck loaded with the -- they use the cement rockfill. And the truck was loaded with backfill coming out of a chute. And then he backed under a spigot for a cement silo. And they opened the chute and cemented the backfill up to a certain level or a certain number of tons into the -- on top of this broken rock which then drove and -- back to the stope opening and dumped it into the open stope. That's the only other cemented backfill operation that --

Q That you personally saw?

A -- that I personally observed.

Q Do you know from reading otherwise whether rock backfill is a technique that's used in the industry?

A As I recall, after this Mt. Isa symposium, there were a number of mines now, it sticks in my mind that the Geco mine and Manitouwadge may have been one, but again, this is -- you know, 30 years ago almost. So I don't -- but cemented rockfill is an established practice.

Q That's what I was trying to understand, sir.

A Yes.

Q In the second paragraph in 2.2 you note that it will be difficult to achieve a, quote, "tight backfill," unquote for final mined-out panels using cemented rockfill. You indicate that it may be -- it will be difficult. Is it, in your opinion or judgment, nonetheless doable from an

engineering perspective?

A Yes. Any -- obviously somehow the rock has to be -- if we mine out and fill the panel, then we're left with this whatever the height to the roof is, and somehow we have to get that material pushed against the walls and pushed up against the back. Now, I have not seen that done with cemented rockfill, although, if you have the right equipment -- and I think Dr. Vitton alluded to pushing it up with bulldozers or doing something. But what I have seen and observed at the Greens Creek mine in Alaska which is not a cemented rockfill but just a cemented fill and it's some form a paste fill that they actually mix on surface and transport in a truck down into the mine. And they push it out of the back end of the truck. And they have a -- what we call a scooptram which is a large load haul dump unit which is used to excavate the ore. And they have a big ram on the front. Instead of this scoop going up on this arm, attached to this hydraulic arm is a big ram. And it seemed to be like almost a half a meter by a half a meter sheet of steel an inch or more thick welded to this. And he drives that and he pushes this, and they call it a jammer. And he jams the backfill tightly to the back. So the backfill is absolutely in, and this is a -- then it sets up. I mean, that's certainly -- I supposed there are a number of techniques to try to achieve a tight fill, and this is

strictly an operational problem. This is not a technical -- geotechnical issue. It's an operational problem. Well, both problems, the problem of blasting against the fill and having the fill fall down, you don't have a mine basically if that happens. I mean, you have to come to another filling technique or you're going to have to do something differently because it's just not -- you're not going to be slowed down by having to screw with the backfill on a daily basis. So these are operational problems. They're not technical problems to, say, achieve a tight backfill or cement the fill such that it's going to hold up to the blasting.

Q The next topic that you address in your report, in your Section 2.3, is heading "Plug-Type Failure." Again, what would you -- could you summarize what you understood to be the nature of the concerns expressed in the NWF comments?

A Well, I think the concerns expressed by NWF and, I think, Sainsbury mentioned it and it is clear that the occurrence of a collapse of a -- in this case, a crown pillar and the case of some other mines mentioned -- I don't know if it was crown pillars -- I know there was surface subsidence over the mining of the Mather mine -- the Mather B mine at Ishpeming. And while they're -- while the Athens mine is 23 miles away, it's -- to me it's quite different conditions than we find at the Eagle mine.

Q Could you explain more specifically why that is true?
A Okay. From my observations and reading the reports on the Athens mine, first of all it was a caving method. And with top slicing you go in and you mine adjacent to the back and you take out a slice. And you -- then you come underneath that and -- with some kind of a mat. In this case I believe it was timber. And you keep taking slices out from underneath it. So you work from the top down. So the back is free to cave. And the back caved almost immediately after they started mining. And I think Allen, who I quote, stated that it was going to take a long time before this may have caved to surface. Well, in fact, they mined 13 years and 3 million tons before the collapse occurred on surface. So the mining method is different in that the -- it's a caving method, and the rock caves over the mine opening.
Q And, sir --
A And the mining method proposed at Eagle, the main goal is to prevent the back from caving, to prevent anything from caving. So the mining method is different.
Q Okay. What about with respect to geology. Do you --
A With the geology, the Athens mine is basically flat lying deposit of -- it's wide and it has a long??11:57:11 length and it's in the metasediments. And the rock above the metasediments is the worst -- or the poorest quality rock in the region. And we show these dikes which are probably the

best quality rock in the Athens area. And along the contact of the dikes, water obviously was able to flow and the back actually -- because it was mine between these two dikes and the back was allowed to cave, it was able to cave to surface.

Q When you say "the back," you're just talking about the roof of the --

A I'm talking about the roof or -- and if we want to call it the crown pillar, it was the pillar between the mine and the surface. And it started out at 1800 or whatever that distance is. It's a huge distance. I mean, this was an extremely unusual event. At the Eagle Project the mine is actually mining inside the dike in the best rock. So the likelihood of -- to me, for a plug failure is -- is very remote in that I don't see the conditions -- I wouldn't expect the caving to occur within the peridotite or above the orebody in a plug-type failure. That's my analysis.

MR. REICHEL: Judge Patterson --

Q Anything else on that particular --

A No.

MR. REICHEL: I have some additional questions, not a great deal more. Do you want to continue, or shall we take a break here?

JUDGE PATTERSON: I'll leave it up to you if you want to -- if you want to break between direct and cross,

that makes sense, but how much more do you have?

MR. REICHEL: It will be 15, 20 minutes.

JUDGE PATTERSON: Let's break now then.

(Off the record)

Q Dr. Blake, before we took a break, I was asking you some questions in relation to Section 2.3 headed "Plug-type failure" in your December 2007 report.

MR. REICHEL: Can we bring up the next page, please? Thank you.

Q Dr. Blake, is it your understanding from reviewing the comments submitted by National Wildlife Federation that the concern was expressed that there was -- there were geologic features or a fracture zone in the vicinity of the orebody here that could act as a failure plane for the crown pillar? Did you understand that to be one of the contentions that NWF was making?

A My understanding was that the contact between the dike and the metasediments certainly could be and the drilling information that they've presented seems to indicate that certainly in the cores that were drilling along it that it is a fracture zone. And this could be one -- if we try to relate this to the Athens Mine, this could be one side of a plug failure. But, you know, I don't see how it relates to failure over the mine if it's not part of the immediate roof of -- immediate roof or immediate crown pillar.

Q Okay. Just so the record is clear, I believe you testified before we took a break -- I forget the exact words, but, in substance, it's your understanding based upon the available information that the area of the proposed mine including the crown pillar is within or contained within the so-called intrusive -- correct? -- the dike?

A From what I see there, apparently there may be some excursions of ore out into the end of the wall rock. But, in general, the orebody is defined to the peridotite, which is the dike.

Q Okay. And again I believe -- do you believe the available geologic or other information at the site supports the conclusion that there is likely to be a plug-type failure such as that observed at the Athens Mine?

A I don't believe that there's likely to be a plug-type failure at the Eagle Mine.

Q Turning to the next section, 2.4, "In Situ Stress," again it's noted in your report and as the Judge has already heard, concerns have been raised about the importance of evaluating stress underneath the ground as it relates to the issue of stability. Is that your understanding? I mean, the issue has been raised, of course?

A That has been raised.

Q And again at this site to date, there have not been in situ stress measurements; correct?

A That's correct.
Q Are you aware from -- or at least it's your understanding based upon reviewing the NWF comments and indeed some of the testimony that's been presented so far in this proceeding that it has been suggested that in situ stress measurements could be, should be, taken from the surface in the vicinity of the site before any consideration is given to allowing the development of the mine to commence? Do you understand that to be?
A I understand that is the -- was one of the comments that the NWF raised with respect to things that should have been done as part of the geotechnical study.
Q Okay. Based upon your professional experience geotechnically in the mining industry -- first of all, in your experience is such in situ stress testing conducted from locations at the surface prior to mine development? Is that something that is commonly done in the mining business?
A I'm not aware of any instance where actual in situ stress measurements were carried out prior to developing a mine.
Q Now, I believe both in the comments and, in any event, in some of the testimony that's been presented to date it's been suggested that one available technique for trying to conduct in situ stress measurements from the surface is a technique called hydrofracturing?
A Yes. Hydrofracturing is a stress measuring technique.

Q Okay. Could you explain simply to Judge Patterson first what hydrofracturing is and the context in which it's been developed and used?

A Hydrofracturing is primarily used by the oil company. And you have a device that you put down a borehole. And you pack off a section of the borehole. And then you inject water. And the orientation or the direction of the fracture that you create should be in the direction of the maximum forensical stress.

Q So in words, if I understand this correctly, under this technique, a portion of a borehole is sealed off. Water is injected into it. And essentially an experiment is conducted from which inferences can be drawn about the magnitude and direction of stress?

A Not so much the magnitude but primarily the direction. There are some -- depending on the water pressures and there are some relationships that are used to give some upper bounds to what the stress might be. It's not -- this technique has only been -- I know of only one example of its use in a hard rock mine.

Q And what is that, sir?

A And that was -- we tried -- at the storm line in 1975 down on the 7700 -- I think it 7100 foot level.

Q And what success, if any, did you have with that?

A We did get data, but it was very difficult to interpret.

And it wasn't -- we had no other comparison at the time. So it wasn't -- it was very difficult to get all this equipment underground and out to the -- out to the particular site or location. But we never really got anything really solid, I would say, as a solid piece of data with respect to the stress field. I think it did give us the orientation. But we didn't have any idea what the stress magnitude might be.

Q In your professional opinion, sir, would conducting such a hydrofracturing technique on existing boreholes at this site, the mine site, be sufficient to characterize the stress conditions at the site so as to definitely make further determinations with regards to the stability or potential stability of the crown pillar?

A I personally don't feel that we would get sufficient data to definitively characterize the stress field from hydrofracing from surface.

Q I believe it's also been suggested that another possible technique for evaluating stress conditions subsurface is observing -- I don't know if I'll get this term right -- the deformation of the borehole? Is that the correct term?

A It was mentioned that the borehole might deform with time. And if it -- the usual procedure in a -- actually in a high stress field is, if you have a circular borehole, it will deform and it will become elliptic. And you may have -- the ends may actually spall off if the stress is high enough.

And the direction normal to this deformation would then be the direction of the maximum horizontal stress. But at the -- I wouldn't expect at this site -- at the depth of the crown pillar, I wouldn't expect to see really any deformation of the borehole. I don't believe that --

Q Could you explain why that -- you wouldn't expect that?

A I don't believe that the stress would be high enough to cause the actual, say, side wall spalling of the borehole. As a comment adjunct with this, in the diamond drill cores in high -- the diamond drill cores that actually deform in this manner commonly exhibit what we call disking. And if you have a horizontal stress on the borehole, then the stress causes pieces of core to break off or disk. And depending on the magnitude of the stress, they can -- they're very regular and they're always perpendicular to the borehole. And drillers will note this in their drilling logs. And sometimes you see them half an inch, quarter of an inch. I've seen them look like poker chips. I've seen them look like Pringles where at 13,000 feet and you have a high horizontal stress, they absolutely look like you'd opened up a package of Pringles. And about two days later they absorb moisture from the atmosphere and they'd all just crumble.

Q But again what you've just described, if I understood you correctly, in your experience is something that likely would

be observed at a mine -- or from a hole that is bored to considerably greater depth than that at issue at this site?

A That would be my conclusion at this site.

Q Now, in your professional opinion, sir, do you agree or disagree with the proposition that, as part of a prudent operation and planning for this mine, it would be important to develop at this site some in situ stress measurements including measurements of horizontal stress?

A Absolutely. I recommended it as part of my conclusions or recommendations is that the in situ principal stress be determined at this location.

Q And could you briefly describe under your recommendations how and when that -- those kind of in situ stress measurements would be taken?

A I think the initial in situ stress measurements should be taken on the bottom level of the mine when -- during the initial development prior to mining so that we have -- so we don't have the stress altered by the mined out area so that we can determine the pre-mining strata stress at the bottom of the mine.

Q And once those data are developed, could they be used to further inform or influence subsequent activities in terms of mine -- the actual detailed development of the mine?

A In general, the in situ stress is one of the components you use in, say, evaluating how the wall rock is going to

respond to mining, how the roof or the back or the crown pillar is going to respond to mining. It depends on the magnitude and the orientation of the horizontal in situ stresses.

Q And so under the scenario that you have recommended, in the development of the mine before actual mining, in situ stress measurements would be taken. And then what would those data be used for?

A They would be used to -- as a means of -- in looking at the mine design, you could actually use this data in the numerical model, whatever sort of numerical model they're using, to analyze the stability and the stress transfer for mining.

Q In your professional opinion, would data collected, in situ stress measurements collected by that approach -- would that be -- how would the reliability and usefulness of that data compare to data that might hypothetically be collected by hydrofracturing existing boreholes, et cetera, from the surface?

A In situ stress measurements are not easy things to do, and they need to be -- you need to do it enough times to get some kind of a consistent result. So it -- they're expensive and very often you get very little -- very little bang for the buck. They're difficult to carry out even underground in a nice opening, good conditions. Sometimes

they're not reliable. The procedures can be difficult. They're not -- they're not easy things to do, although there are, you know, groups that do do this on a consulting basis. And they generally get good enough results.

Q Just to be clear, again which -- comparing two possibilities; that is, in situ stress measurements underground as you've recommended during the mine development before -- prior to mining, that's one scenario, the other being attempting to conduct in situ stress measurements by using openings in the earth created from the surface; that is, boreholes -- okay -- which of those two approaches do you in your professional judgment believe is more likely to produce usable and reliable data relevant to the issue of mine stability at this site?

A I think the underground in situ stress measurements are the only way to go. I mean --

Q Sir, could you advance the screen, please, to your next page? The second paragraph, about the middle of that paragraph you say, "Their concerns." When you say "their," who are you referring to?

A I am referring to Dr. Bjornerud, Jack parker and Dr. Vitton.

Q Okay. You say -- I'll just read this into the record.

"Their concerns are real as any disruption of the surface or groundwater over Eagle Mine would have very serious consequences. I share their concerns and I'm

not pleased that the missing RMR data found in a few of the log core holes were not both pointed out and satisfactorily explained by Golder. However, I do not agree with their conclusion that basically any crown pillar will be unstable."

Is that -- is that still your opinion?

A That is my conclusion. That is still my --

Q Is that still your opinion?

A That's still my opinion.

Q Now, when you say that the concerns expressed by the NWF experts and commenters are real, could you explain what you mean by that?

A Well, I think that -- I would even say that Kennecott has -- would have a real concern if water suddenly came pouring in this mine. I mean, I think anyone who is going to be associated with a mine or even considering a mine is concerned if something happens to upset the hydrologic properties on surfaces including the Salmon Trout River. I mean, the stability of the crown pillar has to be a concern.

Q Okay. And could you advance to the next page, please, the very last paragraph? And the last paragraph states:

"While the issue and concerns raised by the NWF through the Vitton, Parker and Bjornerud are legitimate, I still recommend that the revised mining permitting application of KEMC be approved."

Again could you explain what you meant when you said that "the issues and concern raised by the NWF are legitimate"? Let me break that down. First of all, in saying that, did you intend to say that you agreed with all of their conclusions?

A No, I don't agree with all their conclusions. I agreed with what I previously stated, that I think the 87.5-meter crown pillar will be stable. I guess I'm -- I was trying to imply that I think they raised legitimate issues regarding the stability of the crown pillar. I don't agree with their conclusions.

Q Now, advance -- I'm sorry. Scroll back up. I'm sorry. We'll stay on -- well, I'm sorry. You make certain recommendations in your report; correct?

A That's correct.

Q At the bottom of page 8, the second paragraph from the bottom -- third one, you say you still conclude the crown pillar is fair to good rock and that 87.5-meter thick crown pillar will be stable. You go on to say:

> "The effect of horizontal in situ stress on the stability of the crown pillar is still unknown whether it acts to close or open joints or other structures or has no effect."

You go on to conclude in the next paragraph that:

> "Driving the access ramp will have no effect on

the surface and that the initial longitudinal mining at the bottom of the deposit will be carried out without any problems."

You say:

"Both Itasca -- by that I take it you mean Dr. Sainsbury -- "and I have previously concluded that transverse long-hole mining could be safely carried out up to the level up to the 327.5 meter level. We also agree that any mining above this level would require an extensive underground geotechnical investigation to delineate a stable crown pillar that took into account surface subsidence and hydrological effects. Hence we have endorsed the revised mining permit application of KEMC."

So you go on -- does that summarize -- is that conclusion and position still your opinion, sir?

A That pretty well summarizes my conclusion.

Q Now, you go on at the bottom of that page to recommend that the 3.27.5 meter elevation remain in place and:

"The previously endorsed underground geotechnical investigation including in situ stress measurements be carried out to establish a stable crown pillar that precludes adverse subsidence or hydrological effects."

Can we go to the next page, please? You go on there, sir, do you not, to describe a program of investigation that you

were recommending be carried out?
A Yes.
Q Is that correct?
A Yes. That's what I described.
Q Rather than have you read it, could you summarize the key elements of it, sir?
A It's just stating that the program should include the normal geologic and geotechnical work that's done in the mine as the development of each sublevel is driven as well as including hydrological data. This mapping and observational data would be supplemented by diamond drilling where any questions or any gaps were formed.
Q When you say "gaps," do you mean gaps in the data?
A Well, gaps in the data.
Q You refer there to a -- allowing a three-D physical model of the mine. What -- to be developed and maintained. Could you explain what you mean by that?
A Right now we don't have a good three-dimensional physical model of the mine. We see a computer -- we see a computer drawing of panels and stopes, but we don't see any geology on it. We don't see really any, say, fault structures on it. We don't see any real data from underground on it. We don't see any rock characterization on it. So normally what I do is I like to have an overview of a mine. And I think some kind of a three-D physical model is very instructive.

It allows one to actually physically look at what the underground orebody is going to look like, what the geology is going to look like and how one can then look at this model and you get a much better feel for where the stresses are going to go as the stopes and panels are mined. It is an extremely useful tool to develop a three-D physical model.

Q And you say it would be -- such a model would be developed and maintained. What do you mean? Is this something that would be done once or would be adapted?

A No; no. And that's not to say that this model can't be developed and displayed on some kind of a three-D computer program. I mean, that's mine site or there's different programs that will give you three-dimensional views which you can rotate. You see the geology. You see any structural defects. You see -- you see what the orebody looks like. You see -- it gives you a feel for what the -- what the mine is -- really looks like. What was the question again?

Q I'm sorry. Once such a model were developed, would it be a one-time thing or is this something that you're recommending --

A No; no. This is maintained and updated with each successive level. As more information is gained, you're continually updating the model and you're continually -- so you always

have a pretty clear understanding of the wall rock behavior to the mine.

Q And under the recommendations that you've made here, would part of the data collection also include collecting data needed to evaluate the hydrologic conditions as they might relate to affecting the movement of water from the surface or from groundwater?

A Absolutely. I'm not a hydrologist, so I don't know what all information the -- say, the hydrologist needs as far as data that he might want to put into, say, some kind of a numerical model to include in a stress analysis. But certainly as there's water coming into the mine anywhere, obviously this is noted. You certainly need to include the hydrologic conditions that are encountered as each level is opened up.

MR. REICHEL: Could you please bring up Respondent's Exhibit 117? For the record, I'm noting that this is the Part 632 mine permit that's part of the subject of this case. And I don't recall actually if this has already been admitted into evidence.

MR. LEWIS: I believe I offered it -- offered it as Intervenor Number 385. And it was admitted, Mr. Reichel.

MR. REICHEL: Okay. Thank you, Counsel.

MR. REICHEL: In any event, sir, if you could scroll through that document to the section entitled

"Special conditions," I believe page -- well, there are two sets of numbers on the bottom. There's the first set and then there's the second that begins "Special permit conditions." And when you get -- thank you. If you turn to page 6 of that document.

Q Okay. Directing your attention, sir, to condition Exhibit 5, does this specify a roof elevation for the mine?

A It specifies that mining will begin at the 143 meter -- I don't know if that -- presumably 143 meter level and continue upwards until a roof elevation of the 325 meter level.

Q And is that consistent with your recommendations?

A That is consistent with my recommendations.

Q Directing your attention to condition Exhibit 6, which talks about stopes being backfilled sequentially, it goes on to specify, among other things:

> "All secondary stopes on levels 383 meters and 353 meters will be backfilled with the same cemented mixture that's used for backfilling primary stopes to prevent vertical movement of water within the workings. Quarry aggregate much be characterized to demonstrate that it has a net neutralization capacity of 0 or higher" --

well, disregarding that last detail, is this backfilling program, sequential backfilling, during mining consistent

with your recommended approach to the mine?

A In this particular case, this appears to be continuing with mining above the 327.5.

Q Okay. Thank you. So this -- I'm sorry. Thank you. This is characterizing conditions that would apply -- well, in any event, moving forward to condition E8, looking at that, it states:

> "As each level is developed starting with the lowest level, the permittee shall collect in situ stress data and standard geologic, geotechnical and hydrologic data to evaluate rock stability for the overlaying level or levels."

I'm not going to read the whole thing, but can we scroll to the next page? First there's supplemental diamond drilling to be carried out if necessary to fill in data gaps. It also refers to a three-D physical model shall be developed and maintained to accurately assess ground and hydrologic conditions. Is that condition consistent with your recommendation, sir?

A That is consistent with my recommendation.

Q And going further in that same condition, it states that, there are -- there's a requirement to certify to the DEQ annually with a rock stability modeling provided as valid. And it goes on to state:

> "If that any time unpredicted rock stability

conditions are encountered that may result in projection of subsidence to the surface or impacts to surface water, the permittee shall immediately notify the mineral" -- "the MMU supervisor and shall cease excavation of earth materials to access to remove ore until the revised model and a plan to prevent adverse impacts to the land surface or surface water is submitted and the DEQ issues a written approval."

And again in the last sentence, there's a restriction on mining above 327.5 meters unless reviewed and approved in writing by DEQ. Are those conditions consistent with what you think -- what you would recommend in terms of how mining proceed at this site?

A They are consistent with --

Q And in general in your experience -- professional experience in working with mines -- underground mines that encounter -- that may encounter stability problems or rock mechanical problems, are there available methods to address or mitigate those problems as the mining proceeds?

A Yes. Generally the purpose of carrying out a detailed geotechnical investigation during mining is to prevent or minimize the occurrence of local ground control problems that could turn into more extensive problems. And this is the normal task of the geotechnical engineer at the mine. When a face is driven, the geologist does his geologic

mapping. The geotechnical engineer would go in and do his geotechnical assessment, which would likely consist of doing the RMR's, a physical observation. This data would be used to determine if rock reinforcement is required to prevent, say, the walls or the back from loosening. Now, in some -- I don't know what -- there's some governmental requirements. I don't know what it is in Michigan. I don't know what -- whether MSHAW has special. But I know in Ontario in most of the mines, they have to -- they're not allowed to advance an opening beyond unsupported ground. In other words, you're not allowed to get under unsupported ground, which means that you have to put in a standard roof reinforcement pattern with advance. You normally do this in -- in every mine. But it -- I don't know what -- if there's a state law or I don't know what the local practice is. But it's becoming almost regulatory that you do support an underground opening with advance and that workers are not allowed to proceed beyond that unless there's other certain conditions prescribed. So this is all part of this day-to-day geotechnical assessment that's carried out.

Q Based upon your review of the available information in this project that you testified to and your years of professional experience and training, have you formed any opinion as to whether or not proposed mining activity authorized by the permit under the conditions that we've just talked about

would or would not result in subsidence that would affect surface water or groundwater adversely?

MR. HAYNES: Objection. There's been no foundation shown that this witness can testify as to adverse effects to groundwater or surface water.

MR. REICHEL: Okay. Let me rephrase the question.

Q Have you formed any professional opinion as to whether or not the mining activity that's proposed here under the conditions that we've discussed would or would not result in subsidence at the surface of the mine site that could address the concern that you yourself expressed at the beginning; that is, subsidence that might disrupt the existing flow of the Salmon Trout River or other water bodies above the mine site?

MR. HAYNES: Same objection.

JUDGE PATTERSON: I think there's been a proper foundation. I'll overrule.

Q Have you formed an opinion on that subject, sir?

A My opinion is basically the same as Sainsbury that mining below this 327.5 meter level limit will have -- the crown pillar will be stable and will have no effect on the overlying hydrological regime.

Q And just on a similar note -- no. I'll just stop there.

MR. REICHEL: That's all I have at this time. Thank you, sir.

MR. WALLACE: Mr. Blake, my name is Bruce Wallace. I represent Huron Mountain Club. And I'm also here on behalf of the other Petitioners. I have a quick question.

MR. REICHEL: Bruce, before you start, perhaps Kennecott wants --

MR. WALLACE: I'm sorry. I jumped the gun.

MR. HAYNES: Your Honor, I was wondering whether Mr. Lewis wants to question the witness?

JUDGE PATTERSON: I was, too.

MR. LEWIS: I'd defer until after Petitioner's examination, your Honor.

JUDGE PATTERSON: All right.

MR. HAYNES: Well, your Honor, what's the order here?

MR. EGGAN: Your Honor, I think the order has been and should be -- this is Mr. Reichel's witness. And the way we have done it is, when we call a witness, then he's questioned by Mr. Haynes and then anybody else on our side of our case. We believe that this should happen the same way for witnesses that are either called by Kennecott or called by Mr. Reichel; that is to say, their side of the case should conduct a thorough examination followed by cross-examination by us.

MR. HAYNES: I concur, your Honor. Because the Intervenor is intervening as a Respondent here.

MR. LEWIS: Number one, we are an Intervenor. Number two, I'm not sure I have any questions. I'm reserving my right to ask questions until after Petitioners are done, if I may, your Honor.

MR. HAYNES: Your Honor, I don't think counsel can reserve that right here. Yes, they're an Intervenor. But they're Intervenor for a Respondent or for a Petitioner. They didn't intervene on the Petitioner's side. That's for certain. So the Intervenors are aligned with the Respondent. And so the correct order of questioning here ought to be Mr. Reichel obviously on direct examination, and then the Intervenor gets direct examination and then we get -- the Petitioners get cross-examination.

MR. LEWIS: I think we're confusing things. I certainly have a right to redirect just like Mr. Reichel does.

JUDGE PATTERSON: No question you have that.

MR. LEWIS: And that's all I'm suggesting, your Honor.

JUDGE PATTERSON: So you're saying you have no questions at this point?

MR. LEWIS: That's right.

JUDGE PATTERSON: All right. Mr. Wallace.

MR. WALLACE: I didn't jump the gun.

JUDGE PATTERSON: As it turns out, you didn't.

MR. REICHEL: Are we still on the record?

JUDGE PATTERSON: I'm not sure. Yeah.

MR. REICHEL: Just as a housekeeping matter while you're setting up -- excuse me, Counsel. I have no further questions. I would just like to move for admission of Respondent's proposed Exhibit 112 and 117, 112 being the December of 2007 report authored by Dr. Blake and 117 being the mining permit.

MR. HAYNES: No objection.

MR. LEWIS: No objection.

JUDGE PATTERSON: Okay. Thank you. No objection. Those will be entered.

(Respondent's Exhibits 112 and 117 received)

CROSS-EXAMINATION

BY MR. WALLACE:

Q Mr. Blake, you reviewed work and criticism by Dr. Sainsbury; correct?

A That's correct.

Q And you reviewed work and evaluation and concerns raised by Mr. Parker and Dr. Vitton and Dr. Bjornerud; correct?

A Correct.

Q Did you -- did you in reviewing their criticisms feel that they provided a valuable review function in this process?

A I do, yes.

Q Okay. They all raised legitimate concerns; correct?

A That was certainly my position, yes.
Q And to some extent, they raised criticisms that you agreed with; correct, sir?
A That's correct.
Q Under this idea that you recommended and that's been picked up in the permit conditions of three-D modeling and further in situ stress evaluation and so forth after mining begins, who would gather the data and do that modeling, sir, as you understand it?
A It's the responsibility of the operator.
Q Okay. It would be Kennecott; right?
A It'd be Kennecott and their consultants, I presume.
Q Their consultants. Kennecott and perhaps Golder?
A Whoever they --
Q It's --
A I would presume they would have a geotechnical engineer on the staff of the mine and maybe he would work in -- you know, with -- if they have outside consultants. I mean, that's an operational --
Q We don't know who in particular, but we know it would be Kennecott's responsibility; correct?
A Yes; yes.
Q As it was Kennecott's responsibility to provide correct information, evaluation data in the original mining application; correct, sir?

A It's Kennecott's mine, yeah.
Q It's Kennecott's mine. And the information they provided initially was the information that Dr. Sainsbury reviewed; correct, sir?
A That's correct.
Q Okay. And he was highly critical of it, and you agreed with him; is that not correct, sir?
A I was critical of -- yes, I did approve.
Q What reason do we have to believe that the information will be any more trustworthy after mining begins than it was in the beginning of the mining application from what you've learned in the course of your review, sir?
MR. REICHEL: Objection. Argumentative.
JUDGE PATTERSON: I'll overrule.
A I think one was the -- with successive reports, it seemed like additional data was added. But I guess my big objection from the first two reports is it was stated that the crown pillar was stable for whatever dimensions it was, initially 40 feet to something or other. They also stated that, for the crown pillar to be stable, it had to have a factor of safety greater than 2. And this wasn't demonstrated in the first report. Similarly with the 57.5 meter crown pillar, it was again stated that the factor of safety shown in their analysis didn't indicate to me that the safety of factor was greater than 2. So the first time

that the Kennecott data -- or the first time that the Kennecott report said -- okay -- if the crown pillar is 87.5 meters, the factor of safety with an RMR of 70 will be 2 and there's only a 5 percent probability of failure. And they went through some complicated analysis to determine that. SO I guess that's my -- my problem with the two initial reports from Kennecott.

Q Okay. And to be clear, they themselves indicated that a factor of safety below 2 would not be acceptable?

A That's what they stated. And yet they showed tables with factors of safety less than 2. I mean, to me, it was inconceivable.

Q And requested a permit to be able to mine under the conditions set forth there; correct?

A Well, that's --

Q Isn't that what happened?

A That's what the report said.

Q Okay. And just while we're on that same subject, you mentioned that they went through a bunch of complicated calculations. Have you ever seen a calculation that resulted in a measurement of 87.5 as an acceptable crown pillar thickness?

A It's a very stout crown pillar.

Q Well --

A No. I'm not sure exactly, I mean, how that -- how they

arrived at that specific number, --

Q It's a pretty precise number, isn't it, sir?

A -- what permutation. But, no, it -- but, you know, all I can do is look at what was concluded and what they presented.

Q And my question is, I mean, 87.5 is a very precise measurement of a crown pillar thickness; right?

A Yes.

Q To a half a meter. In all of the documentation you reviewed, did you ever see an explanation of how they arrived at such a number?

A I didn't really -- I presume it came out of their -- they mentioned this -- some kind of a cube and some kind of permutations that were carried out.

Q Well, you don't have any personal basis to know whether that number is good or bad or way off or not, do you, sir? I mean, from anything you've done in the --

A Well, based on my experience, I guess I'm saying is that it's a very stout crown pillar. And from the core that I looked at and the center of the crown pillar which I would classify as fair to good rock, it -- and from looking at, you know, their summed RMR's as shown in the GoCAD model taking into account all the holes, their data seems to indicate that the rock in the crown pillar is fair to good. So I conclude that the crown pillar is -- of 87.5 meters is

stable based on the data that they presented. Now, how exactly they arrived at that -- I mean, they went through a number of permutations. But -- and, of course, Sainsbury came to the same conclusion. And he --

Q Well, I guess I'm trying to bridge the gap here. Because both you and Sainsbury were very firm in saying that 57.5 is unstable; correct, sir?

A That's correct.

Q And I'm just trying to see what you read in any document by Sainsbury, by Golder or by anybody else that said add 30 meters and it's all different, it's all fine. What did you read to tell you that, sir?

A I read the statement that was made that the factor of safety would be 2.

Q You read that from Kennecott?

A From Kennecott, yes.

Q And you accepted it?

A I accepted it. And I accept -- in my own estimation, as I say, that is a huge crown pillar. And I would -- if someone asked me without ever -- just taking me out to the site and saying, "Here, we have this deposit here. We're going to have an 87-1/2 meter crown pillar. We have a little bit of data. Do you think" -- I would -- if I looked at cores and stuff, I would say without doing RMR's, without doing all these analyses and looking at the core that I saw, I would

say, "I agree. Your 87-1/5 meter pillar would be stable."
Q Without doing anything?
A Without doing -- I mean --
Q Have you been out to the site?
A I haven't been to the site, no.
Q But you're saying, if you went out to the site and looked around --
A Well, I mean, that's a hypothetical. But, no, I haven't been to the site.
Q Let me ask you a couple questions just about your background. Do you have any particular expertise in regional geology of the upper Great Lakes region?
A No.
Q Or more specifically do you particular expertise in the local geology of the Upper Peninsula?
A No, I don't.
Q Or the Yellow Dog Plains?
A None.
Q Okay. Do you have any other experience in the Upper Peninsula with geological or mining questions other than the White Pine experience you testified to?
A I guess I -- when I went to the Mather B, you know, at that time I looked at some stuff about that. But I don't -- I don't really have any experience in the U.P.
Q And when you did visit the White Pine, you got to know Mr.

Jack Parker; correct, sir?
A Yes.
Q And you're familiar with his horizontal stress work in the White Pine mine?
A Yes.
Q Okay. And you know he published a significant paper about that back in 1966?
A Absolutely correct.
Q And that still stands as like the -- like a Seminole work on horizontal stress issues in the Upper Peninsula, does it not, sir?
A It stands for horizontal stress anywhere.
Q Anywhere. Okay. You mentioned as two of your areas of expertise, I believe, finite element analysis and seismic monitoring for determining stability?
A Uh-huh (affirmative).
Q Is that correct, sir?
JUDGE PATTERSON: You have to say "yes" or "no."
Q We're looking for a "yes" or "no" so the court --
JUDGE PATTERSON: She can't transcribe it.
A Yes; yes. I take that back. I'm not -- I used the finite element method years ago. In fact, I was probably the first person in rock mechanics introduced to the finite element to the rock mechanics profession. And after a few years I dropped it.

Q Okay. I was going to ask you all about it. But I'll move on. How about seismic monitoring for determining stability? Is that -- does that have any application to your opinion in this case?

A It has application if we presume a mine's going to be unstable and unstable to the extent that it emits seismic noise. And I -- my first response would be, I don't think it would be useful unless as development's taking place; unless initial mining's taking place; the miners are talking about ground working or hearing popping and snapping in the rock. It's not a normal means of monitoring stability of an opening.

Q It's not a conventional tool?

A It's not conventional, no. It's specific to highly stressed mines.

Q And you indicated that -- what you do now for a living. You're a consultant; correct? Is that right, sir?

A That's right.

Q And you've consulted in the past with Kennecott on various projects?

A Yes.

Q And in one of the things you do to make a living is you get called out when there are mine collapses; is that --

A That's -- yeah, that's one of the calls that --

Q Okay. And mines do collapse, do they not, sir?

A Yes, they do.
Q You've been able to earn a living doing this?
A Yes.
Q And when you look at a collapsed mine, among the things you consider, if I'm recalling your testimony correct from this morning, is regional geology; correct?
A Yes.
Q Local geology?
A Particularly local geology.
Q Okay. And these are things you don't know about with respect to the Upper Peninsula or the Yellow Dog Plains, you've already told us; correct, sir?
A When we talk about local geology in the mine. As you walk through the mine and if you have, say, the geology of the mine, you look at the different features that are on the geologic maps. And my experience has been that almost every mine failure is associated with a geologic defect. And invariably, it's the -- geology is the weak link.
Q And I think the third thing you told us you look at when you go -- get to a mine that's collapsed is you look at the mine plan and the layout; is that right?
A That's correct.
Q And did I understand you correctly that every mean is intersected by various faults and weak rocks? Is that an overstatement?

A Most -- okay. Let me say, almost every metallic or base metal mine is -- has a certain number of geologic defects.
Q Mines like the proposed mine here?
A Mines look the proposed mine.
Q And when there's an intersection of these conditions of mining with weak rock, faults and so forth, that's when collapses occur; is that correct, sir?
A That's when they certainly have the potential for a failure.
Q Okay. And very often, when you go out, you -- if I'm understanding your testimony from this morning, you say to people, "Didn't you realize that you were going to intersect a fault or a weak rock or whatever"?
A That has been a common question that I've asked.
Q And the problem turns out to be that, as you testified this morning, that's occurred because nobody paid enough attention to the geologists; correct?
A That -- in most cases, I would say that is correct.
Q And these are geologists that have provided information about the mine before mining is even begun in some cases; right?
A Presumably.
Q Presumably. I mean, that's what geologists do. They know the geology of the area and of the local area?
A Yeah. Now, the mines are all -- geology is special, because they don't -- until they get underground and map the

geology, you don't have a clear detailed picture of what the geology is along each level, along each development opening. We have some inference of what the geology could be like based on the diamond drilling and if they drill lines and, you know, further analyze the geology if they try to put it into some kind of a model form.

Q And when you go out to a collapsed mine and you're talking with people, you eventually get around to making recommendations about preventing collapses; correct, sir?

A Correct.

Q And your recommendations are based on -- and I wonder if I heard you correctly -- radial geology?

A Radial?

Q Radial? Is that --

A What -- I don't even know what radial --

Q Okay. Then I misunderstood.

A Yeah.

Q That's regional geology?

A Regional.

Q Again, regional geology, local geology, rock quality?

A Correct.

Q Are these the items you listed as being the --

A Yes.

Q -- kind of the cornerstones of a prevention program?

A Uh-huh (affirmative).

Q And rock quality would be this RQD, RMR kind of information?
A Well, I don't do RQD's, RMR's, so I look at the rock, and I look how it's behaving to basically the mining, and then I presume whether it's good rock, poor rock, fair rock. And for -- then, for the different conditions, you might specify different types of, say, ground support, or you might expect different behavior, you know, as a result of the mining.
Q Okay. You were here for the testimony of Dr. Dr. Bjornerud, were you?
A Yes.
Q And Dr. Vitton and Jack Parker?
A Yes.
Q And you didn't have any criticism or basis to argue against their evaluation of rock quality, in this case that they've given, in your testimony, did you, sir?
A I don't -- I guess I'm not sure, really, I mean, the rock -- you know, the rock mass rating or those things and how you rate these A3,* A4, these different numbers. I'm not -- I mean, Dr. Bjornerud certainly did an extremely thorough, thorough job. Now, I don't know, because she's a long way from the handling of the core, touching, feeling. In other words, I don't know how her evaluation, say, compares to the actual Kennecott geological evaluation.
Q Well, all I'm --
A But anyway, no. I --

Q I mean, you heard them testify?
A I heard it, yes.
Q You didn't -- did you make some notes, say, "That's wrong, that's wrong, that's wrong" in any of the testimony you heard?
A I don't remember I said anything was wrong. I guess, if -- I mean, to me there would be a possibility that, if it's presumed that Kennecott overestimated the property values, there's always a possibility that they could have been underestimated. I mean, I -- you know, I don't know, because I don't know what experience Dr. Bjornerud has in logging core.
Q But based on what you do know and what you did hear from here, --
A Well --
Q -- you don't have any reason to question her methodology, do you?
A I had a better feeling for her work after I saw the core photos.
Q Because that's what she had to work with as well?
A That's what she had to work with. But, you know, how -- there's a question between wet rock and dry rock, and I don't have a clue on that, and these are -- this is kind of significant factor in coming to the RMR.
Q Are you familiar with that concept, that wet rock is rated

lower than dry rock?

A That is a part of the rating, yes.

Q Okay. And you know that from your own --

A Yes; sure.

Q Okay. And it's -- what? -- zero to 10 or zero to 15?

A Whatever the scale is. I don't use it, so I'm not -- but, no, it is clear that wet rock has a different behavior than dry rock.

Q It's weaker?

A Yes.

Q And while we're on the subject, did you also see and hear Mr. -- Dr. Vitton's testimony this morning?

A Yes.

Q And he calculated factors of safety for various RMR's otherwise using Kennecott's numbers; correct, sir?

MR. LEWIS: Objection to the for. I think it assumes facts not established earlier, your Honor.

Q Is that what you understood he was doing this morning, sir?

MR. LEWIS: Same objection.

JUDGE PATTERSON: I think -- I'll overrule the objection. You can answer the question, Doctor.

A He did this -- since I don't do RMR's, I don't know exactly what he did.

Q Okay. Well, at this point I'm not asking you -- the RMR numbers are there. He's got a Kennecott number and two of

his own numbers. But did you do any calculations using the 87.5 thickness to calculate factors of safety?

A Absolutely not.

Q Other than Dr. Vitton, do you know of anybody that's done any factor-of-safety calculations that you've seen using 87.5?

A The information that Golder presented said that at 87.5 with an RMR of 70, the factor of safety was 2. That's --

Q But you haven't seen their calculations, and you understand they're just based -- they're based on Kennecott data; is that correct?

A That's correct.

Q When you go to advise at a collapsed mine -- I think we've talked about regional geology, local geology, rock quality. And then you analyze the features and faults, do you, sir?

A I look at the geology. I look at the geometry of the mine openings. I look for stress interaction between openings and geologic features just based on having seen so many of the same thing or similar things over and over that -- it's primarily an observational --

Q From your experience?

A From my experience; based on my experience.

Q Yeah. You know that, if you find a certain scheme of geological features, weaknesses or whatever, that they can predict collapse. Is that fair to say?

A Sometimes, even though things look bad, they don't collapse. In other words, quite often things that look like they're going to be a problem don't turn out to be a problem. And oftentimes things that look good turn out to be a problem. But in general, there's a -- as I mentioned, there's a geologic reason for -- behind a large percentage of mine failures.

Q Did you read about the discrete geologic features here that Kennecott analyzed, Golder analyzed as concerns about mine stability?

A I saw the table that listed the eight core, which had presumably structural features of greater than 1 meter in length.

Q And those are features that raised concerns about stability; correct, sir?

A That's correct.

Q And I guess I would ask you, given the discussion of those features, whether you saw in any calculation or in any rationale for the 87.5-meter-thick crown pillar that these discrete features were incorporated into the evaluation.

A There was nothing specific to say other than the fact that, in both the C2, C3* or whatever these -- or C3 -- yeah, whatever it is, the -- it did mention that these 8 holes were included in the GoCAD model.

Q You know -- and I think you put it in your report -- that a

reason for the particular concern about this mine environmentally is that the orebodies that's going to be mined is directly below the headwaters of the Salmon Trout River; correct?

A That's correct.

Q So there's a concern about subsidence or collapse causing drawdown of water and effects far downstream; correct?

A That's correct.

Q And the concern is there's a potential for that that needs to be evaluated; correct, sir?

A That's correct.

Q And the potential for collapse and the potential effects at the headwaters and far downstream are a legitimate environmental concern, are they not, sir?

A Yes.

Q And they exist in this case. They need to be addressed?

A Yes.

Q Tell us how you came to be contacted, sir, to be involved in this case.

A I had a phone call from DEQ Joe Maki out of the blue. I have no idea why he called. I mean, I know why he called, but I have no idea how he got my name. The phone rang.

Q And did you and he have a discussion of the fact that you've done prior work for Kennecott?

A No.

Q Did you ever have that discussion with him?
A No.
Q And what was the assignment?
A With Kennecott?
Q Yeah. What was -- no. What was the assignment given to you by Joe Maki?
A Oh. My charge was to review the geotechnical evaluations that had been carried out by basically Golder and Itasca and come up with a third-party evaluation of the stability of the crown pillar.
Q And did he tell you what you were allowed to do or what your budget was or how much time you could spend on this?
A No.
Q Did he limit you in what you could physically see and do to conduct this evaluation?
A No. He was very helpful. When I asked to have -- to get cores to look at or had questions of Kennecott, he expedited a conference call.
Q When you asked to see these cores, did you pretty promptly get photographs of them?
A I think it was within a day or so.
Q And when was that, sir?
A Oh, this would have been in May of 2007.
Q The first report -- and we're going to look at this in a couple minutes. But in the first report you reflected you

were disturbed by the Golder methodology and conclusions and agreed with the very strong criticisms of Dr. Sainsbury; correct?

A Basically, yes.

Q Okay. In the -- and what gave rise to a second report? Why was there a second report?

A My second report?

Q Yes.

A It was a response to the documents submitted by National Wildlife Federation.

Q And when you conducted the -- when you began the review of the second report, I think you indicated that you were disturbed by absence of data, by gaps in the data. Am I saying that right?

A Yeah. I looked at the Table 8 that was in the Kennecott report and then looked at Dr. Bjornerud's expansion of that table, and I wondered how this was missed; in other words, how in the logging of the core, this didn't get recorded.

Q Okay. And is that when you asked for a conference call?

A Yes.

Q And who was on that conference call?

A Joe Maki, Kevin Beauchamp and someone from Kennecott. It might have been Andrew Ware. I'm not sure of --

Q Okay. And did I understand you correctly that that never did really get resolved?

A I asked --
Q I thought your words -- isn't that what you said this morning?
A I said something similar to that.
Q Okay. You wanted to know more about how the core samples were handled; correct?
A Not so much how the core samples were handled, but I wanted to know who did what with the cores and how the -- how it could be that, you know, there were all these zones that had no RMR.
Q That remains a mystery to this day, doesn't it, sir, I mean, frankly, doesn't it?
A I -- the answer I was told was that, were the RQD was zero or low, then RMR was not calculated.
Q Is that acceptable practice, from your standpoint?
A I don't -- I -- well, it's certainly not -- I would presume it's not normally done.
Q Did you ever get to see the drilling logs?
A I didn't see the -- I saw the -- I didn't see the -- no, I've never seen the drilling log.
Q Okay. Did you ask to see them?
A I didn't ask to see the drilling logs.
Q You've seen drilling logs in the past?
A Yes, I've looked at drilling logs.
Q And have you seen drilling logs that show, for example,

where they're losing water into the rock; that that's noted by the driller or supposed to be?

A Should always be.

Q And that tells you if there are fissures or fractures in the rock; correct?

A That's correct.

Q So that's a valuable piece of geologic data gathered in the field by drillers, isn't it?

A That's correct.

Q And you haven't seen it; correct?

A I didn't ask for drilling logs, but, no, I haven't seen it.

Q Would you have an interest in that because of the information it would provide to you?

A Drilling logs are generally very arduous things to be --

Q They're boring, yeah. I mean, they --

A They're boring to look at, and I generally wouldn't be going into detail on drilling logs unless there were some special circumstances. I mean, I go out and with the geologists I look at core.

Q You look at core?

A Yeah. And I look at his geologic mapping, and then normally the geologist goes underground with me, and then we -- so generally from that I have a -- I get a better feel for the geology.

Q When you asked to see -- did you ask to see the physical

samples -- core samples?
A No.
Q You felt that seeing photographs would be adequate for your purposes?
A For my purposes, yes.
Q Because you can get a lot of -- if they're good photos, which they were in this case, --
A Yeah.
Q -- you can get a lot of information; correct?
A Well, you look at the core, and the core is the core.
Q Better to see the real thing, but it could be adequate to see the photographs?
A You certainly see the majority of the features.
Q Okay. And you asked for photographs, and a day later you got them. Did you realize that you were getting different holes than Dr. Bjornerud had analyzed?
A I didn't. When I got the cores, I had never heard of Dr. Bjornerud, Dr. Vitton, and I didn't know that Jack Parker was involved.
Q Okay. This was in advance of seeing the NWF comments?
A Yes.
Q You eventually learned that they had gotten access to eight core holes; right?
A That's correct.
Q And at that point did you realize that they were looking at

eight different ones from the three you looked at?
A That was clear, I mean, just by the numbers.
Q At that juncture did you ask that you be able to look at the same ones they were looking at or wondered why they hadn't seen the ones you looked at?
A I'm not sure -- well, I guess when it said that they obtained those through a Freedom of Information Act, I really didn't have an opinion on how they got the core, why they got the core.
Q Okay. At that juncture did you ask to see the same cores that they had looked at?
A I don't think that -- in the package that was sent to me, I don't think that the appendix -- I mean, I presume those photos are in an appendix to either Dr. Bjornerud's or one of the exhibits. I don't believe that appendix was e-mailed to me.
Q And didn't you say this morning -- and correct me if I'm wrong -- that the three that you looked at, you had no -- you really couldn't tell where they came from?
A The three that I looked at, there was a map, and it showed the -- they were identified on, you know, an 8-by-11 sheet.
Q Oh, they sent a map along with you?
A Yes.
MR. WALLACE: Okay. Let's take a look, if we could, at Respondent's 95.

Q This is your first report; correct, sir?
A That's correct.
Q I'm looking at the second sentence of the second paragraph, sir, where it indicates that:

> "The initial geotechnical work did not establish a stable crown pillar, and there was insufficient geotechnical and hydrological data available to determine the subsidence and hydrological response due to mining."

Correct, sir?
A That's correct.
Q Okay. What, as you're sitting here today, can you tell us were the principal pieces of geotechnical and hydrological data that were missing?
A The basic geotechnical information missing was the fact that in their table of stability there wasn't a -- as I recall, there wasn't a crown pillar listed that had a factor of safety greater than 2 by the scale span method. I know nothing about the CP method.
Q So really this sentence really addresses the ultimate question, does it not, that you couldn't see a basis for calling this crown pillar at 57.5-meter thickness stable?
A Not when the listed factors of safety were less than 2.
Q And the next sentence says, "Subsequent geotechnical work has resulted in establishing an upper mining elevation that

will allow for mining to be carried out below and not have any effect on the surface." What was that subsequent geotechnical work, sir?

A That was their -- the third Golder report. I don't know whether that's what the name of it is, but that was of the C2, C3, and then there was another one.

Q Well, I guess I took the term "geotechnical work" to suggest that some work had been done.

A If it -- I believe it's stated in a report that there was additional core data. I think the -- this may have included the test of unconfined compressive strength.

Q And what did that additional core data have to do with adding 30 meters of thickness, if you know?

A I don't know.

Q Okay.

A I mean, I presume -- I mean, it's their analysis.

Q And what did the UCS tests have to do with adding 30 meters, if you know?

A I don't know.

Q Any other geotechnical work that was done to supposedly give us a better answer on crown pillar thickness?

A I think there was some modeling that may have been carried out.

Q And do you know what modeling there was?

A I think there was -- maybe it was a map 3-D model. I would

have to review --

Q And has it been part of your assignment and task to review and critique the map 3-D work that they did?

A No. Well, I didn't.

Q I'm looking at the sentence that begins, "There apparently was concern about the stability of the crown pillar and any resulting subsidence"; correct?

A Yes.

Q "Hence, further work to improve the geological characterization." So what was the further work to improve the geological characterization, if you recall, sir?

A Well, this would have been the subsequent Golder report. The further work would have been inclusion of additional drill core data, converting from or verifying the point-load tests with the unconfined compressive strength tests.

Q Anything else?

A I think that's all I recall.

Q Okay. "And further work to evaluate the effectiveness of the backfill." What did that refer to?

A I'm not sure. I would actually have to go back and review my notes.

Q Do you know if any further work was done to evaluate the effectiveness of the backfill program, sir?

A Off the top of my head right now, I don't.

MR. REICHEL: And then the next paragraph, please.

Q Okay. And then you say:

"This additional geotechnical work did not remove all the concerns regarding the stability of the crown pillar and possible adverse effects on the surface or groundwater regimes."

And was that your belief at the time, sir?

A This was my inference.

Q And what was this inference drawn from?

A The fact that -- well, just reading the Kennecott -- I mean, the Golder reports and then reading the Itasca reports and presuming that Itasca was called in because of questions regarding the Golder report.

Q Okay. And if we go down to the middle of that paragraph, you indicate that, "This led to further geotechnical work by Golder"; correct?

A That's correct.

Q And is there another round of work that you saw that we should know about here?

A I couldn't tell you exactly what -- something else was done. They -- obviously they reanalyzed something to come and change the dimensions.

Q And the reason why I'm asking this question, sir -- and maybe you can answer this -- did they seem to pull this 87.5-meter-thickness figure out of thin air, or is there data in any report that you had read that supports it?

That's what I'm getting at.
A It appeared to follow this -- it was kind of a complex analysis with probability and stuff that was carried out. I didn't go into the details of it. I really couldn't follow it.
Q Okay. Were you sort of supported in your belief that that number should be adequate by believing that Sainsbury had looked hard at it?
A That certainly confirmed my personal feeling that that thickness of pillar would be stable.
Q I mean, you know Sainsbury's credentials. Do you know the man?
A I don't know him.
Q And isn't it fair to say that a considerable part of your belief that this -- that, by merely making a somewhat thicker crown pillar, that this crown pillar will be stable, is the fact that a man of Dr. Sainsbury's credentials had weighed in on the subject?
A That certainly was helpful.
Q The actual formula used to come up with a number is not something you are -- you're qualified to analyze or work with. Is that fair to say?
A Not -- I would say there could be other numerical models that could be carried out to load -- you know, to load the pillar and look at the response, but I don't do that.

Q Whatever black box they used is not one familiar to you from your experience?
A I -- as I say, I don't do RMR's. I don't do scale spans. I don't do CP analysis. I don't do numerical modeling anymore.
Q Well, we don't believe from anything you've read here that they did revised RMR's, did they?
A They show different tables of different numbers, and I presume they got that from somewhere. And they did talk of additional holes, additional data, so I couldn't tell you exactly what they did.
Q Okay. If they did revised RMR's based on additional data, they didn't reflect it in any report you saw, did they, sir?
A They came up with different numbers.
Q From someplace. Is that fair to say?
A Well, the numbers are there, yeah.
MR. REICHEL: Okay. Let's look at page 3.
Q Why did you note in this report that, "Golder Associates are one of the oldest and most respected geotechnical engineering firms in the world"?
A I was writing this for MDEQ, and I was just pointing out that Golder is -- if they weren't aware of it, that, you know, Golder has a very significant reputation in the geotechnical field.
Q The work that Golder did that's been looked at by you and

Dr. Sainsbury supporting the initial -- the original application, was that consistent with their reputation, sir?

A I would say no.

Q Have you ever -- in talking with the DEQ and in talking with Kennecott representatives that you've been with this week and maybe in the past, have you ever gotten an explanation for why Golder provided such inadequate data and analysis when this mining application was filed?

A I have no explanation, and I was given no explanation.

MR. REICHEL: Let's look at the next paragraph.

Q I think we've covered some of this chart, but the last sentence of the middle paragraph indicates that there was no subsidence analysis carried out in the study that you looked at; is that right?

A In the 2005 study, I believe that's true.

Q And when you say "subsidence analysis," what did you mean as opposed from -- as apart from crown pillar stability, essentially?

A Well, I presume you run some kind of a model to show that a certain amount of subsidence would be likely to take place.

Q I think I --

A And it might be, you know, fractions of inches.

Q I think I've read in materials you've written and that you -- and maybe looked at that, whenever there is mining, there's subsidence. Is that too broad a statement?

A There certainly is effects -- displacement effects go out as one over the radius, and so there is some measure of subsidence.
Q If you create a cavity subsurface --
A If you create a cavity. Generally in good ground we can say that it's -- it may be negligible, depending on the closeness to the surface.
Q Okay. And so the question -- given that there will always be subsidence in connection with underground mining, the question is, how much subsidence and over what period of time will it occur? Aren't those relevant questions?
A I think that was a relevant question regarding the crown pillar stability and the fact that these features were above it.
Q Most of our focus on crown pillar stability has been on the subject of collapse. When you use the term -- when you've used it here, are you thinking also in terms of fracturing and the hydrological effect of draining the water body above it and so forth?
A I think that's certainly a huge consideration, yes.
Q Now, have you eventually read analysis or calculation of how much subsidence -- absent failure, absent complete collapse, how much subsidence will occur to the crown pillar below the Salmon Trout River and how quickly it will occur? Has that been calculated?

A I think in one of the Golder reports it mentions a numerical model was run, and it mentioned 2 centimeters.
Q Did you have any way to check that, verify that, support that, or was that part of --
A It was a result of a numerical model, and I presume the numerical model was elastic. I presume the numerical model didn't include any hydrological effects.
Q Have you seen any calculations or analysis of subsidence or crown pillar stability taking into account hydrological effects?
A I haven't.
Q And that's true even in the second round and third round after Sainsbury?
A That's true.
Q And hydrological effects, we're talking about potential drawdown of the water body above the crown pillar, among other things?
A In the worst case, yes; yeah.
Q And the recognized potential that I think you agreed with earlier that the drawdown could affect the river above it and the river downstream? Has that potential?
A That's -- yes.
MR. REICHEL: Could we look at the last diagram?
Q Now, there was a second Golder -- a second geotechnical study by Golder that you reviewed; correct, sir?

A That's correct.
Q Okay. Now, what did -- what effect did the second study have on the factor of safety for a 70 RMR?
A From what I've indicated, it claimed that the factor of safety was 1.2 for a 70 RMR and a 57.5-meter crown pillar.
Q And that's a conclusion that still raises the serious likelihood of collapse; correct, sir?
A Yes.
Q I'm looking at the middle paragraph where you've stated:

"It should have been apparent from the initial study that the stability of the crown pillar over the wide ore zone near the surface could be a problem and that there was insufficient reliable geotechnical data available to really assess its stability."

Did I read that correctly?
A That's correct.
Q And why was that apparent to you, sir?
A The fact that, in the initial studies, listing a factor of safety that would indicate instability was -- I'm not sure why it was done.
Q Okay. And again, you refer to "insufficient reliable geotechnical data." What data did you have in mind there, sir?
A Well, again, we didn't have any -- there is no reliable stress information. There's really no reliable rock

property information.
Q Now, "reliable stress information" includes horizontal stress information; correct?
A That's true.
Q And horizontal stress is a significant potential factor in crown pillar failure; correct, sir?
A It certainly could be.
Q Okay. Could also be a stope failure as well, sir?
A Any -- I'll say any anomalous stress conditions could impact stability.
Q And do you recall from Mr. Parker's study that -- as you pointed out, his stope in *2:49:40 the study on horizontal stress, that within one mining area you can have various and varying horizontal stresses?
A The horizontal stress is almost a random variable. It -- in a specific, you know, mining district, the pre-mining stress is certainly altered by the mine openings that are created. So within the mine itself, the stress changes dramatically from place to place, depending on the geometry of the orebody, and it may also include the effects of the geology.
Q The horizontal stress even before you mine is captured within the rock structure; correct, sir?
A Horizontal stress has been measured on the surface in most rocks that could contain it. In 19- -- well, it's been measured in quarries all over the United States -- surface

quarries.

Q You told us that it's, I think, not common to use existing boreholes to determine horizontal stress, and it's not common to use hydrofracturing to determine horizontal stress in advance of mining; correct, sir?

A I know of no instance where that's been carried out from surface.

Q Okay. Now, you're aware of the fact that we're dealing here with a statute -- a nonferrous metal mining statute which is new and basically unique to Michigan?

A I know nothing about that.

Q You don't know anything about it. Okay. Well, let me just ask you. Is there any good reason not to gather horizontal stress information that you can gather through existing boreholes, through hydrofracturing in advance of mining if you're trying to determine, in advance of mining as much as you can, about the stress regime of the area in which you're going to mine?

A I guess my answer is that no one has shown that there is a reliable, say, near-surface hydrofrac* 2:52:41 data. I don't know that there's any -- been studies done. Most hydrofracture are done in oil wells thousands of feet below the surface.

Q Well, I mean, you also told us that subsurface in situ stress measurement is expensive, complicated. I mean, these

aren't reasons not to do it, are they?

A No, they're not reasons not to do it at all. But I'm saying, is that the routine measurement of horizontal stress is not a simple, straightforward procedure, and in many cases mines have spent tens of -- no. There's, like, $50,000 a measurement. And they've had four or five measurements and gotten nothing. In the Couer d'Alenes the Bureau of Mines at the Lucky Friday mine spent two different occasions months and came off with nothing. So it's a difficult procedure with results that are very inconsistent, and it's normally not done unless it's really required to be done.

Q Required by perhaps --

A Well, required by conditions primarily. Normally what one does is some kind of scoping study. I --

Q And what's that?

A I will -- and Golder may have alluded to this. I'll run a model with -- using gravity. I'll run a model using hydrostatic; in other words, one to one for the horizontal to vertical. I'll use a model where the horizontal stress is twice the vertical stress. I'll use another model where the horizontal stress is, say, four times, and then I'll look at these results and see how they -- what matches reality. That's more common than actually carrying out in situ stresses.

Q Okay. You can carry out -- I think you told us three ways of doing pre-mining in situ stress measurement. One is using the existing boreholes to see if they become elliptical, if they're being squeezed?

A Well, all that would tell you is the direction of stress. I mean, that's an observation.

Q It would tell you the existence of stress and the direction of it; correct?

A It will tell you, yes, if you had a stress and the direction.

Q Is there any good reason not to acquire at least that data if you've got 109 boreholes?

A Generally you won't see that data until you've exceeded the strength of the rock. If the strength of the rock is 15,000 or 14,000, whatever number was thrown out or, say, even 10,000 and you're -- you have this 2-inch or 4-inch borehole, whatever it is -- and you'd have to look at the stress concentrations around it. The stress may not be high enough to deform the borehole. So it's something -- normally you wouldn't notice any, say, change in the shape of the borehole near surface.

Q Unless you measured it?

A Unless --

Q What you're talking about really is a form of measuring convergence like you do down in the mine but convergence

within the borehole; correct?
A That's correct.
Q And you could measure it quite precisely if you --
A Well, in order to measure it, you have to over-core it.
Q And what's over-coring, for the record?
A *2:57:25* Well, over-coring is, as you put some kind of instrument in the hole you already have and then -- and it's in contact with the borehole that's existing and then you core over that with a much larger diameter borehole and then what happens is, when that larger borehole passes what instrument you have in the hole, then its stress relieves. Obviously the horizontal stress then can't -- it's cut off because it's -- we've drilled it off. So then you look at the resulting deformations that have occurred, and whatever device -- say a borehole deformation device that you have in the hole -- and then from that you can reverse, and you can calculate what the stress was on the borehole prior to it being stress relieved.
Q Okay. And that'll give you immediate horizontal stress information, won't it?
A That gives you immediate. That is -- I don't know of that being done. It's difficult to do in near-surface holes. And by "near-surface hole," I mean, you know, less than 10 or 15 meters. To go down 50 or 60 meters in a hole, it's -- it hasn't been done, and I'm unaware of where the technique

has been used under those type of conditions.
Q And we talk about hydrofracturing. It could be done, but it's expensive, and it might not work. Is that kind of --
A Well, the results are very inconsistent. I mean, if you did two hydrofracs, they may give you totally conflicting data, so then you have to do another one, so you could be out hydrofraccing until you got -- came up with some kind of a statistical --
Q So it's feasible. It just may not work?
A It's feasible. It may not work.
Q Now, discing, that's the third method I think you talked about.
A Well, it --
Q This is just observing what occurs when you drill the borehole; right?
A Discing is something that occurs in -- where the stress on the borehole exceeds the strength of the rock, certain combination of stresses, and it results in this -- the phenomena of discing. And if discing occurs, it would be noted by the drillers in the core logs.
Q Okay. So to detect horizontal stress through the use of simply the borehole that's being drilled, all you have to do is make sure the driller notes it -- correct? -- in the drilling log?
A That's correct.

Q And we don't know whether that occurred here, because you haven't seen the drilling logs?
A I haven't seen the drill -- the immediate impression would be that it didn't occur.
Q But how do you get that impression, sir, if you have no information at all?
A Okay. Well, I guess what I'm saying is I presume that the level of stress is not sufficiently high to actually cause this discing phenomena. I mean, it has to be up something like greater than half the compressive strength. So it's something that you'd have to have something like 7,000 psi at the surface. I think the highest value ever measured at the surface in good quarries, granite quarries, would be on the 3500, maybe 4,000 psi. So it's -- I wouldn't expect to see discing occur.
Q Here you indicate in the same paragraph, "In situ stress measurements had previously been carried out in the area, but apparently were not found."
A They weren't reported.
Q Okay. And how had they been carried out?
A The U.S. Bureau of Mines overcored at Mather B in 1977 or something like that, '75.
Q They did this process that you were just talking about?
A They took this equipment underground and they actually physically carried out overcoring tests, at least it was

reported in this 1993 report that I cite.
Q Okay. Now we're onto Dr. Sainsbury; correct? Itasca was asked to carry out a review of the mine permit application?
A Yes.
Q And where did this language come from "to determine if the conclusions are defensible"; do you know?
A I believe he states that in his introduction or --
Q That's Sainsbury's language?
A That's Sainsbury's language.
Q And the answer is, "The conclusions were not defensible"; correct?
A Yes.
Q The next paragraph begins,

> "Itasca technical review was very critical of both the conclusions and procedures used to reach those conclusions with respect to the mining permit application and the geotechnical studies included to support it."

We're going to take a little time to go through the Sainsbury report, but can you tell us just in general, sir, from your recollection which conclusions and which procedures were severely criticized by Dr. Sainsbury?
A I think it was primarily the scale span and even the CP analysis.
Q Okay. That basically covers the entire arena; right? CP

being crown pillar and modeling?
A Yes; yes.
Q And scaled span being the other way of doing it?
A Uh-huh (affirmative).
Q "Yes"? The court reporter needs a "yes."
JUDGE PATTERSON: "Yes" or "no," sir? Doctor, you have to say "yes" or "no."
A Yes.
JUDGE PATTERSON: Thanks.
Q And you go on to say that, "Itasca concluded the analysis techniques used to assess the Eagle crown pillar stability were not up to best industry standards." And you're in agreement with that; is that correct, sir?
A Well, since I don't do this, I really don't know what the best industry standards are. But, I mean, it -- I would have concluded that the work certainly wasn't to the level that one would have expected.
Q Okay. And again, hydraulic stability of the pillar wasn't considered at all; is that accurate?
A That's correct.
Q Did this surprise you in light of the location of this orebody?
A Yeah. It was somewhat hard to understand.
Q Because again, the orebody is directly underneath a sensitive water body; correct, sir?

A That's correct.
Q Now, you note in the middle of this paragraph, "There is still not enough known about the rock properties, the geologic structure and the hydrology to provide reliable results for modeling." And was this your conclusion from what you looked at?
A I have to -- where is that now?
Q We're in the --
A Okay. I see. Yeah.
Q Yeah. And is this Sainsbury, is this you, or is this both of you?
A I think this is both.
Q Okay. So you end up at the end of study round one concluding that 87.5 is stable; correct?
A That's correct.
Q Okay. And recommending approval of the application?
A That's correct.
Q And by the end of this review, by the end of your review of Sainsbury, had you learned any more about the calculation of the 87.5 than you've described to us earlier today? I mean, you don't know the basis of that number or how they got it, do you, sir?
A I know it was based on some analysis they did of RMR. But I'm not with this, I think, a probability of failure. But I couldn't tell you exactly how it was done.

Q Okay. So primarily what you're saying here is Sainsbury looked at this hard and in-depth, and you agree with him?
A I agree with him, and I agree from my observation that of the three cores and the pillar that I looked at as well as the totality of the GoCAD model in -- on that level in the crown pillar area that indicated an RMR of 70 or greater.
Q Okay. Well, you're not suggesting that you think the three cores you looked at were a sufficient independent investigation into the rock quality?
A No; no, I'm not saying -- I'm just saying that there were three cores. To me they were pretty good cores. And they were in the center of the pillar.
Q Do you have any idea how these cores were picked?
A I don't have a clue.
Q Okay. Did you ever ask why three out of 109?
A I asked for a few cores. I didn't ask for --
Q Did you know if they were random or handpicked or selected or --
A Don't know.
Q Okay. And as a scientist and engineer, would that concern you in terms of their validity for basing an opinion about stability?
A I guess I wasn't concerned.
Q And why is that, sir?
A Well, I can't imagine the geology department or whoever it

was at Kennecott that sent me these cores that would have some ulterior motive.

Q So that's your main reason for confidency? You got a representative read out of the 109, confidence in Kennecott for whom you've worked before?

A Well, it's -- I use those three in conjunction with the RMR shown in the GoCAD model as based on the 109 cores or whatever, how ever many cores they had in the model, which indicated the RMR. It agreed with my observation of those three cores.

Q You saw and heard about Dr. Bjorerud's discovery that there was at one point a stretch of 55 meters of no data?

A That's listed in the Kennecott -- or the Golder Report.

Q Okay; okay. And have you ended up learning what the explanation for that is?

A I asked -- through a conference call I asked Golder what the explanation was.

Q And you did not get a good explanation; correct?

A The explanation I got was the way the computer program generated the RMR data based on the RQDs that were there in the -- that were calculated.

Q Okay. And do you have an understanding that this was 55 meters of bad rock?

A That's all you could interpret it to be.

Q And 55 meters of bad rock, wherever that might be in the

area that these cores were taken, suggests a significant fault or other deformation, does it not, sir?

A It's suggested a broken rock zone, yes.

Q Okay. A weakness that is the kind of weakness that you're concerned about when you're predicting mine collapse; correct, sir?

A It's certainly something you take into account, yes.

MR. WALLACE: We're going to switch to Sainsbury here. Should we break for a minute while we make the switch, Your Honor?

JUDGE PATTERSON: Yeah. Why don't and do that?

(Off the record)

Q Dr. Blake, I want to refer your attention to the Sainsbury report dated May 2006.

MR. WALLACE: And this is tab five to Petitioner's Exhibit 7, which is the Sainsbury deposition. There may be a better way to refer to it down the road here, but that's the way we've got it listed right now.

JUDGE PATTERSON: Okay.

Q This is a report you reviewed, is it not, sir?

A Is that the same reference that I have? I don't recall saying MFG on the front of the report that I had, but I could be mistaken.

MR. REICHEL: I could note for the record I believe the record reflects that without any dispute that

the DEQ had a contract with MFG and MFG retained Sainsbury as a subcontractor.

THE WITNESS: Okay.

MR. WALLACE: Thank you.

Q Dr. Blake, I want to just quickly run over the initial principal points of Dr. Sainsbury. And do you recall these beginning with the ASTM, Standard Test Method?

A That's correct.

Q Do you remember that comment?

A Yes.

Q Okay. And what is Dr. Sainsbury telling us here?

A He's basically saying that apparently the point load tests carried out weren't done in according to the ASTM standard.

Q And he's criticizing Golder on this basis?

A Yes.

Q And he's making reference to a standard test method that's used by professionals in the field; is that correct?

A Presumably so, yes.

Q Are you familiar with ASTM and their standards?

A I am familiar with ASTM --

Q I'm not going to ask you about any --

A -- and their standards.

Q -- specific standard.

A Yeah. I don't know anything about it.

Q You're familiar that they're authoritative --

A Yeah, of their -- what ASTM stands for and their procedures for different tests.
Q So point one is you don't use the point load test alone; right?
A According to the standard.
Q Okay. And then point two is that they used a USC procedure that's no longer current; is that correct?
A I don't -- I didn't see -- all I saw was the results of the USC data reported in a table.
Q Okay. So you don't know what procedure they used?
A Don't have a clue.
Q Okay. But you accepted that Sainsbury was correct here that they were using an outdated procedure?
A I really have no way of knowing that.
Q Then he says, "The horizontal stresses assumed throughout the stability and subsidence analyses have been underestimated." And do you agree with that, sir?
A I say possibly. We don't know what the horizontal stress is at the site.
Q Well, do you know what Sainsbury was referring to, then? Because he says "underestimated."
A He's saying that the horizontal stress should have been higher than a value of two, I believe.
Q He starts apparently by relying on Jack Parker's study; is that correct?

A That's true.
Q And again, that's the best data available, is it not, about horizontal stresses in the U.P.?
A There was a stress measurement made at the Mather Mine 20-some odd miles away.
Q And then he states that, "A sensitivity study should be conducted to determine crown pillar behavior under a variety of possible horizontal stress conditions"; correct, sir?
A That's correct. I mentioned that as well.
Q Okay. This sensitivity study has never been conducted, has it?
A Not that I know of.
Q Have you ever asked anybody why this particular Sainsbury recommendation has been totally ignored?
A No. Well, my involvement with the, you know -- has not been -- it's just to write two reports.
Q I understand that. But your reports conclude that you recommend approving the application in the absence of studies that Dr. Sainsbury recommended be done; correct?
A That's correct.
Q And I just wonder why you were willing to go along with not conducting the sensitivity studies that he recommended?
A To me I'm not sure that this is an issue that requires that level at this point -- that requires that level of scrutiny.
Q Okay. So did you disagree with him in this recommendation

or you just didn't really address it in your own mind?
A I didn't address it in my own mind.
Q Okay. His next point is a discrete sub-vertical fault plane that intersects the Eagle deposit has not been considered in any of the stability or subsidence analyses." Now, do you have an idea of where this sub-vertical fault plane is, sir?
A Only as it's shown on a number of plans.
Q It shows up? And where is it with respect to the orebody?
A I think it's towards the eastern part of the orebody or from central to east.
Q Okay. And it's important to consider it because intersection of mining with it could cause collapse; correct?
A Could potentially cause a problem.
Q And altering the thickness of the crown pillar is not going to be a guarantee against collapse if you intersect a fault line, is it, sir?
A Mines -- because you intersect a fault doesn't necessarily mean that you have a collapse.
Q I understand that. It might not collapse, but that's not the standard we're looking for here, is it, sir? We're looking for a reasonable comfort zone that it won't collapse?
A This thing -- well, we haven't really delineated the extent of the fault that he depicts here.

Q Okay. And that has not yet been done, to the best of your knowledge, has it, sir?
A It would require more drilling or actually access from underground. So, no, that hasn't been done.
Q Knowing some information about where this is, because it has been determined that it exists, the fault -- correct? --
A That's correct.
Q -- all right -- you could target core drilling into it to understand more about its length, breadth and so forth; correct?
A That's correct.
Q Okay. And you could accrue additional information which would help you know whether this is a fault line which when intersected is going to cause this mine to collapse under the Salmon Trout River; correct?
A That's a possibility.
Q Okay. And that has not been done, to the best of your knowledge?
A I recall that in the report it was another mention of, you know, further study from underground access would -- this would be looked into.
Q Do you think you saw something that said that?
A I have a recollection of that. I could be wrong, but, I mean, I believe this is in that -- near that section that discusses these features.

Q Now, Sainsbury doesn't say anything about --
A Oh, Sainsbury didn't say anything about it.
Q Sainsbury doesn't say anything about waiting until you're in the middle of your mining operation to figure out the extent of this fault, does he?
MR. LEWIS: Objection; form of the question, Your Honor.
MR. REICHEL: And lack of foundation.
JUDGE PATTERSON: I'll sustain that.
MR. WALLACE: I'll withdraw it.
Q Okay. Could you read us the next bullet point from Sainsbury's report?
A "Considering the very low factor of safety achieved with the scaled span analysis and Carter's suggestion that a factor of safety of 1.2 represents a very short-term serviceable life, the possibility of crown pillar failure should be a serious concern."
Q Do you know from reading anything written by Carter what a "very short-term serviceable life" means with a factor of safety of 1.2?
A I have not read anything by Carter.
Q Do you have your own notion of what a short-term serviceable life would mean with a factor of safety of 1.2? Is it less than ten years, sir?
A I would presume it would be, with respect to say the

short-term ten years. I would agree.
Q So what we're talking about here is the possibility of a crown pillar failure in the less than a ten-year period; correct?
A Yes.
Q Now, in this next point, isn't Dr. Sainsbury being critical of the input to the modeling?
A Yes.
Q Okay. And do you know what input to the modeling he was critical of?
A I believe it was the assumption of an elastic analysis.
Q Okay. You don't think this is a criticism of the raw data that was used in any of the modeling?
A I don't know what the -- well, the model input parameters with an elastic analysis I think they were -- I think they based the modulus on probably on RMR conversion factors.
Q Then Dr. Sainsbury says, "Crown pillar hydrologic stability was not considered in the crown pillar subsidence analysis or the bedrock hydrogeological investigation." And you agree with that?
A That's true.
Q And are these really two different subject areas, hydrologic stability of the crown pillar and the bedrock hydrogeological investigation?
A I think they're probably two, but they're probably linked.

Q Okay. And how so, if you can explain that?
A Well, I don't -- it appears that if there were -- and I'm sure there have been hydrogeological investigations of the bedrock -- these weren't linked to whatever modeling was done for the crown pillar subsidence.
Q Did you find in any of the submissions by Kennecott a bedrock hydrogeological investigation?
A I didn't see -- the only submissions I had were the ones mentioned in the references that I presented.
Q What impressions you have from what you have read of the bedrock hydrogeological condition; in other words, what is the condition of this bedrock hydrogeologically?
A I don't really know.
Q Okay. If it's substantially fractured or contains fissures or openings or weaknesses, this means water can flow through it, does it, sir?
A It means that certainly it would be more permeable.
Q Okay. And this is water that would drain from the Salmon Trout River headwaters down into the mining area?

MR. LEWIS: Objection; foundation, Your Honor.

MR. REICHEL: Join the objection.

MR. WALLACE: Well, I think the foundation is that this is the report that he analyzed as the subject of his report.

MR. LEWIS: Your Honor, the witness has testified

he has not in fact reviewed the bedrock hydrology reports that are already admitted in this record. And the witness has also testified there's been no foundation about any conductiveness of any of these features, nor any connectedness of any of these features to the stream.

MR. WALLACE: Well, why don't we have his testimony on the subject?

Q What is your familiarity with the bedrock conditions, sir, from a hydrogeological standpoint? Anything?

A I guess I really haven't seen any data to suggest that there's this connectivity. There's certainly, you know, water down to a certain level. But how far it goes, I have no idea.

Q Okay. Finally, Dr. Sainsbury points out that, "The long-term, time-dependent behavior of the Eagle crown pillar was not considered as part of the analyses." Do you see that?

A Yes.

Q Okay. And was that your observation as well?

A There was no mention of it.

Q Are you aware, sir, that any time-dependent long-term behavior of the Eagle crown pillar has been studied to date?

A I'm not aware.

Q So since this criticism by Sainsbury do you know of any document or submission or further analysis that addresses

his concern about time dependency?
A I haven't seen any.
Q It's a question that remains unanswered, as far as you know, isn't it, sir?
A That would be true.
Q Looking at page one of Dr. Sainsbury's report, now, first of all, surface subsidence is inevitable in almost all types of underground mining? I'm paraphrasing, but would that be your understanding and belief, sir?
A There are many mines where there is no surface subsidence or measurable surface subsidence.
Q There's always some, but it may be negligible? Is that what you're saying?
A Well, it may not be measurable.
Q How about over time?
A It may not be measurable.
Q What about here?
A It depends on the stability of the crown pillar.
Q It's completely dependent upon that, isn't it, sir?
A That's correct.
Q And the next sentence,

"There is concern that mining-induced subsidence will adversely affect the hydrologic environment surrounding the proposed Kennecott Eagle Mine in the Upper Peninsula of Michigan."

And did you understand from talking to the DEQ when you got this assignment that this was a critical concern from their standpoint?

A Yes.

Q That they were concerned about the potential affects on the Salmon Trout River over the orebody and downstream if this subsided or failed?

A Yes.

Q And you understand that the Salmon Trout River is surrounded by wetlands and flows directly over the orebody?

A Either directly or along the side of it or --

Q Looking at page three of Dr. Sainsbury's report. These are pictures addressing the subject of how this -- what the potential is for affect on the Salmon Trout River; correct?

A That's correct.

Q And do you understand that where we're looking at the arrow pointing towards "ore" and "host rock" that that's beneath water?

A It appears just to overlap it.

Q Did you give any particular focus to the Salmon Trout River's watercourse and where it flows or, you know, what it means ecologically to the area?

A No.

Q Was that part of what -- paragraph -- second paragraph from the bottom where it says, "The unconfined compressive

strength test were not use to calibrate the point load test results within the Eagle Mine, within the Eagle project, geotechnical study," was that your finding as well?

A The 2005 study didn't have any unconfined compressive strength data.

Q And how is unconfined compressive strength normally tested, sir; do you know?

A You put a specimen in a testing machine and you crush it.

Q Okay. Do you know if that was eventually done with respect to core samples here?

A Yes.

Q And do you know how many samples were tested?

A I'm not sure of the exact number of samples.

Q Okay. Do you know where they were selected from?

A I don't know where they were selected from.

Q In the last paragraph on page four, Dr. Blake, Dr. Sainsbury's talking about the "significant uncertainty in the intact rock strength that was determined for each lithological unit." Do you see that?

A Uh-huh (affirmative).

Q Okay. Do you agree that the approach taken by Kennecott through Golder was not consistent with industry best practice?

A Sainsbury concluded that it didn't conform to the ASTM standards. And I didn't go further than that.

Q Okay. He then -- he then concludes, "This in turn has an effect upon all subsequent design calculations that rely upon the rock mass rating"; correct?
A That's one of the components.
Q Are you familiar with the term "propagation of error"?
A Yes.
Q And what does that mean, sir?
A It means it keeps one error propagates the next and it keeps going on.
Q So the design calculation errors in rock mass rating in the beginning of the analysis infect the rest of the analysis? Is that a way of putting it?
A That's what's being supposed.
Q Okay. Let's look at page five. I know you're not an expert in RMR ratings, but I do want to ask you about this one thing. In the middle of page five of Sainsbury he says, "A groundwater condition rating of ten assumes completely dry conditions. This is a non-conservative assumption." Do you have any reason why Golder used a non-conservative assumption of completely dry conditions for its RMR rating?
A I have no knowledge of why.
Q Did you ever ask why would they -- why would they go with a zero -- or a ten rather in putting together the RMR ratings? Did you ever ask anybody?
A I didn't ask anybody.

Q Were you ever critical of their approach in talking to the DEQ about the Golder submission?
A I certainly was critical of their approach. I don't think I -- no. I guess I'd just say I was critical of their approach. I didn't ask anybody about --
Q I mean, did you reach your own conclusion that Golder was picking numbers where it could that would give it the highest RMR rating?
A I didn't necessarily reach that conclusion.
Q Okay. Can you think of another explanation for plucking u highest possible number as part of the RMR formula?
A Sloppy work.
Q Let's look at page six. Do you know if Golder is still doing work for Kennecott, sir?
A I don't have a clue.
Q Did you in reviewing subsequent Golder submissions for the one that's being analyzed by Sainsbury here find that they were doing less sloppy work as time went on?
MR. LEWIS: Objection to the form of the question, Your Honor.
JUDGE PATTERSON: I'll overrule it. I think it's okay.
A Will you repeat the question?
Q Yeah. As you looked at successive Golder's submissions, after the one that Sainsbury was analyzing that you just,

you know, labeled as sloppy work, did you find that their work improved in any way that you could analyze? Did you find their data more trustworthy?

A My general feeling was that they tried to be more careful or they tried to present better data.

Q Do you think the review process whereby the public and representatives like the parties in this lawsuit made their criticisms perhaps brought Golder to, you know, a higher standard of work?

A In this case I would say yes.

Q Let's look at page six. When you note in the second paragraph on page six, "At high horizontal stresses the crown pillar behavior is likely to be governed by sheer failure," what does that mean, sir?

MR. LEWIS: Objection.

MR. REICHEL: Objection to the form of the question. This is Dr. Blake did not author this report. You've just asked him a series of questions about what Dr. Sainsbury --

Q Do you know what that means, sir?

A It depends on the orientation of the stress.

Q And how does it depend on the orientation of the stress?

A Whether it's normal, whether it's off at an angle.

Q What is shear failure, sir?

A When something fails in shear.

Q Okay. And show us with your hands.
A Well, something's being sheared.
Q And that's more likely under the higher -- as horizontal stresses increase, shear failure becomes more likely; correct?
A It depends on the direction of the maximum stress, whether it's --
Q I see what you're saying. And how does the direction of the stress relate to, for example, the orientation of your mine cavity, if it does?
A Well, it either will be parallel to it, perpendicular to it, or some angle to it. We don't know that.
Q Have you looked at the mine plan showing the access route down to the lowest level where the mining is to begin and so forth?
A The access goes in all kinds of loops, all directions.
Q Okay. So whatever the direction of the horizontal stress with this mine design, it's going to be at an angle which is the worst possible angle at some point for the access route to the mine location, is it not, sir?
A It will intersect at all angles.
Q At all angles, including whatever the worst angle turns out to be, it's intersecting at that angle; correct?
A That's correct.
Q And intersecting at the worst angle gives you the highest

probability of failure, does it not, as a result of stress?
A If the stress doesn't exceed the strength of the rock, it's immaterial.
Q Then it's fine. But if it does, then intersecting at the worst possible angle, which could happen here, gives you the highest probability of failure; correct?
A In all highly stressed mines, the stress exceeds the strength of the rock around the opening in most cases. And the openings are reinforced and serviceable.
Q So most openings don't fail, you're saying?
A They may fail around the perimeter of the opening, and then that failure is contained.
Q I see. But the opening's only located in one plane, one vector; correct?
A You're talking of the ramp, which has all sorts of -- we have ramps that --
Q It's got ramps in every possible direction?
A In every possible direction, all over the Canadian shield that are in stress zones that exceed the strength of the rock. And they're serviceable to the orebody. It's not a real stability, regional-type stability, issue. It may be a local stability issue taken care of by the reinforcement.
Q Okay. I've moved on to page eight, sir. And I'm looking at the second paragraph where it says,

"Carter's suggestion that even a factor of safety

of 1.2 represents a very short-term serviceable life, the possibility of complete crown pillar failure should be a serious concern."

This is at 1.2 factor of safety; correct?

A Correct.

Q Okay. Then it says,

"If tight backfilling can be achieved to prevent complete collapse of the crown pillar, yielding caused by stress-induced shear failure can still severely impact the hydrological stability of the crown pillar"; correct, sir?

A That's what he's stating.

Q And what he's stating is, even with tight backfilling, yielding by stress, induced by shear failure, can affect the hydrologic stability; correct?

A If the stress exceeds the strength.

Q Okay. And could you understand what Dr. Sainsbury's saying here?

A I understand what he's -- I understand what he's saying. I'm not -- I think he's overstating. From a practical point of view, I think he's overstating the stress problem.

Q And what do you base that on?

A Based on my experience.

Q Well, do you understand that even with complete backfilling there can be yielding?

A Yes.
Q This is material that yields to stress; correct?
A If the stress is high enough.
Q And currently we have no, for this site, actual measurements of stress levels sub-surface at all, do we, sir?
A We don't have any at this site.
Q And we don't know if they'd be high enough to cause the phenomenon that he talked about, which is severe impact on the hydrologic stability or not, do we, sir?
A There is no hard data.
Q Okay. And here's Sainsbury in the middle of the page talking about time dependency. Do you agree that time-dependent degradation of surface crown pillars is a serious concern?
A It is a serious concern.
Q Has anybody given you any explanation along the way why the time-dependent behavior of this crown pillar has never been studied?
A I haven't any information on that.
Q And to the best of your knowledge it has never been studied; correct?
A I have no knowledge of that.
Q Now, on page 11 Dr. Sainsbury is taking a look at the Athens in relation to his evaluation of this mine; correct?
A He mentions that, yes.

Q And the relevance for him is that there is a discrete sub-vertical fault plane in the Eagle deposit like the one in Athens; correct?

MR. LEWIS: Objection; foundation.

MR. WALLACE: Is that what he said?

MR. LEWIS: Objection; foundation.

Q Okay. I'm looking at the first three sentences under "effect of a discrete sub-vertical fault." Do you understand what those sentences mean, Dr. Blake?

A He's talking -- yes. He's talking about a discrete sub vertical fault.

Q Okay. There is one in this -- we know there's a discrete sub vertical fault in the Eagle Mine orebody, do we not, sir?

A That's correct.

Q And we know that a discrete sub-vertical fault -- or more than one discrete sub-vertical fault have been identified as the cause of significant subsidence at Athens; right?

A I don't know if a discrete vertical fault describes a plug failure.

Q Okay. Well, first of all, when he says "significant subsidence at Athens," he's talked about an 1800-foot-thick crown pillar dropping to the bottom of the mine; right?

A That's correct.

Q And would you agree that is significant subsidence by any

definition?
A Yes. It was a crown pillar failure as a result of a caving mining method and the geologic setting.
Q Okay. I know you found some distinguishing factors between the two mines, but you would agree that the cause is a sub-vertical fault, would you not?
A I'm not sure in this case the cause is a -- at the Athens mine was a sub-vertical fault. It appears to me it was movement along these vertical dikes.
Q So would you say you disagree with Dr. Sainsbury's analysis here?
A In this case I would disagree with his analysis.
Q And what's the extent of your analysis of the Athens mine in comparison with the Eagle mine? And how much have you looked at it? Have you read literature about the mine collapse? Have you been to the Athens mine?
A I've read a number of reports describing the failure of the Athens mine.
Q Now, he moves from the Athens mine to the nearby fault in the subsidence in INCO; correct?
A He mentions that.
Q Is this concept of, you know, looking at other mine failures a good device for analyzing the potential for failure in any particular mine when you're planning it?
A I think as a general rule, people look at, say, nearby

mines, mines with a similar orebody, mines that are being mined by a similar mining method. Generally one does some kind of a literature review to see what's happened either at your neighbor's or similar deposits.

Q You've certainly made it your practice in your profession to be familiar with mine collapses all over the world, haven't you, sir?

A I try to, yes.

Q When another one occurs you learn as much as you can about it because it may be pertinent to the next case you get.

A That's always the case.

Q And here Dr. Sainsbury looks at INCO and looks at Athens and finds them relevant to Eagle; correct?

A Dr. Sainsbury does.

Q Okay. Above this picture depicting the Athens mine collapse Dr. Sainsbury writes, "The potential for shear failure along the sub-vertical fault should be investigated to determine the effect of the fault upon crown pillar stability"; correct?

A That's correct.

Q And "shear failure" here means, when you were moving your hands, in this case it's the movement of the plug of a crown pillar down alongside one of these dikes; correct?

A That's correct.

Q And it fell all the way to the bottom of the mine; correct?

A That's correct.
Q And do you know -- well, you were here in court. You know that now that mine is full of water -- right? -- right to the top?
A Yes.
Q Well, he says "should be investigated." What would the investigation of the potential for shear failure consist of?
A In this case at the Athens mine, the failure did not take place inside the intrusive, but it took place in the soft sediments between the intrusive. So I don't believe this failure is representative of the mining situation at Athens -- I mean at this mine.
Q I understand you disagree with Dr. Sainsbury about that. But he is talking here about the potential for shear failure at the Eagle mine and says it should be investigated. Do you disagree with that as well?
A I think any failure mechanism should be investigated. I'm not suggesting that -- I mean, the stability should include a thorough investigation of all potential failures.
Q And my question is, what investigation -- what would an investigation consist of and has that happened, to your knowledge?
A To my knowledge there has been no investigation and my -- I don't think we have sufficient data to carry out a thorough investigation.

Q More data is needed?
A More data is needed.
Q And would you agree that when you're talking about a plug failure like this, the thickness of the crown pillar affords no protection. In fact, the thicker, the more likely the failure; correct?
A In this case it depended on the mining method.
Q In the mine collapses you've looked at has the mining method included stope mining?
A Oh, yes.
Q So you've seen stope mine failures; correct, sir?
A Stope mine failures occur all the time.
Q And what are the types of stope mine failures that you personally have observed?
A You have all kinds of stope mine failures due to an intersection of a fault, due to high stress, due to a change in geologic rock type, due to effects of interactions between two openings.
Q And you've seen them all in your career?
A They occur all the time, some kind of stope failure. Minor stope failures occur on -- in some large mines they occur on almost a daily basis.
Q Okay. How about crown pillar failures in connection with stope mining? Have you see that as well?
A I've seen few crown pillar failures.

Q Fairly few?
A I'm trying to think now of a -- if I've ever actually seen a crown pillar failure.
Q Have you seen failures at stope mining operations under waterbodies?
A No, I haven't.
Q Have you seen stope mining in a mine of this proposed kind of design under waterbodies that you could relate to us?
A I know that mining's been carried out under the ocean. Mining's been carried out -- in northern Canada it's very common to mine under -- but I haven't seen any of those, and I haven't really reviewed the mining under any site of the lakes or waterbodies in Canada where most of it is being carried out.
Q Okay. And have you ever seen a mine design quite like this one, sir?
A I don't quite understand your question.
Q Aren't there some unique features to this mine design, different from any that you've seen in the past?
A I'm not sure that there's --
Q I'm not talking about the Eagle mine.
A I'm not sure that there's -- you mean with a blast hole stoping?
Q Blasthole stoping, beginning at the bottom, backfilling a stope and blasting next to that stope, the circular kind of

winding access tunnel down to it?
A Almost every mine has circular access, ramp access.
Q Can you cite a mine that most resembles this mine that you're familiar with?
A This is a very small mine. Most mines that I work at in Canada, particularly in the Sudbury Basin, which would be a massive sulfide nickel orebody, are significantly larger than this mine, much more development work.
Q Well, I wasn't asking for ones that are different from this. I'm asking what ones you're familiar with that are similar to this one.
A I don't know of a similar small massive sulfide orebody like this that's been --
Q That's been mined?
A That's been mined.
Q And presumably you don't know of one, then, that's been mined under a body of water?
A And I don't know one that's been mined under a body of water.
Q And you don't know one that's been mined under a body of water through a sulfide mining process; correct?
A That's correct.
Q Are you familiar with the SME standard or -- I don't know if it's a standard. Let me just read this to you. "The Society of Mining Engineers, Singh 2003." And he's one of

the coauthors of their mine engineering text, isn't he? Singh? Do you him?

A Medan Singh?

Q Yes.

A Yeah, I've met him.

Q Okay. He suggests that induced horizontal strains should be less than .005 for there to be no significant impacts to surface bodies of water for mining; correct?

A I'm not familiar with this work.

Q Are you familiar with any standards for avoiding significant impacts to surface bodies of water for mining?

A No.

Q What's induced horizontal strain?

A It would be -- induced horizontal strain is deformation.

Q And after you read this report and read this citation by Sainsbury that induced horizontal strain should be less than .005 for there to be no significant impacts to surface bodies of water for mining, did you go do any further reading about this to find out what they were talking about?

A No, I didn't.

Q Do you have any idea what levels of induced horizontal strain could be expected at this mine when it's being mined in the way planned?

A I don't -- this is something that would have to come out of modeling.

Q And are you familiar from any of the materials you've reviewed whether anybody has looked at the expected induced horizontal strain at the Eagle mine underneath a body of water?
A Not to my knowledge.
Q Do you think that would be, you know, a wise approach?
A I think it should be included in the overall stability analysis.
Q But it hasn't been yet; right?
A No, it hasn't been.
Q And what do you know about the Crandon mine? Was there a collapse there?
A It's not even a mine.
Q It's not a mine? What happened at Crandon?
A They've never been permitted.

MR. LEWIS: Just a minute. Just a minute, Mr. Blake. Just restate my objection, for the record, your Honor, as to lack of foundation and relevance for evidence about other mines.

JUDGE PATTERSON: Okay. So noted.

Q Okay. There was a proposed mine at Crandon; correct?
A I believe there's been a proposed mine for maybe 40 years.
Q And do you know anything about that mine, that proposed mine?
A Absolutely nothing.

Q You don't? Okay. Dr. Sainsbury notes at the bottom of page 13 in discussion of the Crandon crown pillar that:

"Detailed distinct element models then were analyzed to relate the changes in joint aperture to a change in hydraulic conductivity. This level of analysis was considered industry best practice for evaluation of crown pillar subsidence and hydrologic stability in 1999."

What is a distinct element model, if you know, sir?

A It's a type of numerical model.

Q Has that been applied to an analysis of this mine?

MR. LEWIS: Objection; foundation, your Honor.

Q If you know. Do you know whether it's an applied to applied to an analysis at Eagle mine?

JUDGE PATTERSON: If you know, you can answer.

A I don't know. I don't know.

Q Okay. Do you know whether distinct element models are considered industry best practice today?

A There are certainly more complicated models.

Q Okay. Assuming he's right, that they are industry best practice for evaluation of crown pillar subsidence and hydrologic stability, or at least were in 1999, do you know if that kind of analysis has been applied to our mine here, this best practice analysis?

A I don't know.

Q At the bottom of page 14 Dr. Sainsbury makes reference to a study by Blodgett and Kuipers in 2002. Are you familiar with that study?
A No.
Q The Blodgett and Kuipers study that was cited had to do with, among other things, the Stillwater mine in Montana. You've done work there; right?
MR. LEWIS: Your Honor, I'd like a continuing objection, if I may, as to evidence of other mines, lack of foundation and relevance.
MR. REICHEL: I join in that objection.
Q Have you worked at Stillwater, sir?
A I've been to Stillwater.
Q Have you been there professionally?
A I have been there professionally.
Q And are you familiar to damage to springs and streams above the Stillwater mine in Montana?
A That wasn't the purpose of my visit.
Q But are you familiar with that fact?
A No, no.
Q I mean, do you know or have you observed that a watershed above the Stillwater mine has dried up?
A Only from this report.
Q Have you sought to verify that?
A No.

Q Is it relevant to you in considering whether the Salmon Trout River may dry up?
A It might be worth an investigation, but --
Q That hasn't occurred yet, has it, sir?
A It hasn't occurred.
Q Dr. Sainsbury, at the top of page 15 it indicates that, "The cause of hydrologic disruptions at other mining operations should be investigated with respect to the geologic conditions expected at the Eagle Project." Do you agree with that?
A I agree with that.
Q And that has not occurred, has it, sir?
A That hasn't as far as I know. I don't know that.
Q Okay. Sir, I'd like to conclude by talking with you just for a few minutes about your second report, if we may.
A Okay.
Q Okay. We're looking at what's been marked as Respondent's Exhibit 112, sir. And this is a report by you, is it not?
A That's correct.
Q And you were contacted a second time; is that correct?
A That's correct.
Q And who contacted you the second time?
A DEQ, Joe Maki.
Q And what did he tell you this time?
A Would I review the report submitted by National Wildlife

Federation.
Q And specifically reports authored by Mr. Parker, Dr. Vitton and Dr. Bjornerud?
A Those were reports that were sent to me.
Q And you've noted here that they concluded that a crown pillar over the Eagle mine will be stable; correct?
A That's correct.
Q And they concluded that even after the assumption was made that another 30 meters would be added to the thickness; correct, sir?
A That's correct.
MR. LEWIS: Objection; foundation.
Q And you read over their studies and believe that they've raised a collection of legitimate concerns; correct, sir?
A I believe the stability of the crown pillar is a concern, yes.
Q Now, I guess what I'm -- I guess what I'm trying to understand is, you say, "I still conclude that the crown pillar is in fair to good rock and that an 87.5 meter thick crown will be stable." And when you say "I still conclude," is this despite the analyses done by Jack Parker and Dr. Vitton and Dr. Bjornerud whom you respect?
A I'd say their analysis didn't change my opinion regarding the stability of an 87.5 meter crown pillar.
Q They clearly did a considerably more detailed and in depth

analysis than you did, did they not, sir?
A They certainly spent more time looking at the RMR values.
Q I mean, you've heard their testimony. You know -- you've learned what they did to put together these studies. They didn't just read somebody else's study; they did all this work themselves; correct, sir?
A They carried out their work, yes.
Q And you take -- you would take the conclusions of these professionals in your field very seriously; correct, sir?
A I do take it seriously.
Q Because they have high credibility with you, do they not, sir?
A Jack Parker is a -- I hate to say he's an icon.
Q You indicate that you share their concerns and say, "I am not pleased with the missing RMR data found in a few of the log core holes" -- I think I left out a word, but -- "were not all pointed out and satisfactorily explained by Golder"; correct?
A That's correct.
Q At the bottom of the third paragraph you state:

"The effect of a horizontal in situ stress on the stability of the crown pillar is still unknown whether it acts to close or open joints or other structures or has no effect"; correct?

A That's correct.

Q And this is the topic we've been discussing most of the afternoon. It remains a complete unknown; correct?
A It is a complete unknown.
Q And when you say "whether it acts to open or close joints or other structures," what are you saying there?
A Depending on the direction of the horizontal stress with respect to the openings, it could help it or it could hurt it.
Q If you have -- and correct me if this is too much of a generalization, but if you have high horizontal stress, it might help you avoid plug failure -- right? -- by holding the plug in?
A It would clamp.
Q Clamping it?
A It could certainly clamp any structure, yes.
Q And if you have low horizontal stress or no horizontal stress, that may induce plug failure; correct?
A Well, you wouldn't have any clamping effect from the stress.
Q It would promote plug failure to have low horizontal stress?
A Well, it wouldn't impede the failure. I don't know that it promotes it, but it doesn't impede it.
Q With low horizontal stress or zero horizontal stress you'll lose the possibility of clamping that might prevent a plug failure; correct?
A You lose the confinement, yes.

Q Okay. On the other hand, high horizontal stress can create shear failure that can lead to collapse or destruction of the crown pillar; correct?
A Depending on the orientation and the magnitudes.
Q So in either direction the extent of horizontal stress, the magnitude of it and the direction of it is phenomenally important to understanding what might happen; correct?
A That's one of the key parameters in the design of the crown pillar.
Q And as we sit here today with a mine permit approved, we have with respect locally to this Eagle mine proposal zero information about the direction or magnitude of horizontal stress at the Eagle mine project; correct, sir?
A That's correct.
Q And no plans to obtain that information other than to start mining and hope that horizontal stress doesn't cause a collapse before you get to do some in situ stress analysis; is that right?

MR. REICHEL: Objection; lack of foundation and argumentative. The record clearly reflects that under the terms of the permit the horizontal -- the in situ data collection would occur before mine activity commences.

MR. WALLACE: I'll withdraw it.

JUDGE PATTERSON: All right.

Q Let's look at page 3. Now, you indicate what you've said

before was the trigger for this second report:

"The National Wildlife Federation still had concerns regarding the stability of the crown pillar and destruction of the surface and groundwater"; correct?

A That's correct.

Q Okay. Did you learn that the MDEQ was also concerned?

A I presumed there was concern.

Q Was that reflected in your conversation with Joe Maki?

A Well, you know, I'm sure the DEQ was concerned. I don't think there was any big discussion regarding the concern. It was, would I carry out an analysis.

Q Did they tell you that they needed a rebuttal for the record?

A No, they did not.

Q Did they tell you that you had a free hand to go look at whatever you needed to?

A I was sent materials.

Q And did you understand that what you were sent was what you were to review?

A That's correct.

Q And that was the assignment?

A My assignment was to review the reports that were written and their evaluation.

Q Let's look at page 4. Okay. You learned in reviewing the

National Wildlife Federation analyses that their concern about the crown pillar was based on a number of factors; correct?

A That's what I perceived.

Q And the first was that the RMR values used in the geotechnical studies to characterize the rock mass in the Eagle Project mine were incorrect and over stated; right?

A That's correct.

Q And you don't have any basis to disagree with that finding by these -- by Dr. Bjornerud, Jack Parker, Stan Vitton, do you?

A Well, since I don't do -- I think there are some gray areas there. But, you know --

Q But you wouldn't under oath say that you disagreed with their conclusion that these --

A This was their conclusions.

Q Okay. Incorrect and over stated?

A Their conclusions were that the data was incorrect and over stated.

Q And you don't have a basis to disagree with that, do you, sir?

A It was based on very limited data, the data that they looked at.

Q Well, let me ask you this: You think they have limited data; right?

A Yes.
Q Were you surprised at what they were not able to get their hands on for this? Did that surprise you?
A It surprises me at this point, yes.
Q Because you would think that in this process they would be afforded access to all of the information that would be useful for people like you and people like them to make a full analysis, wouldn't you?
MR. LEWIS: Objection; foundation; relevance, your Honor.
JUDGE PATTERSON: It's also argumentative. I'll sustain the objection.
Q Let's look at number 2. Their next factor is, "The proposed stope backfilling will not achieve a tight fill status, hence not provide support to the crown pillar." Do you have any basis to disagree with their analysis there?
A In the sense that during the mining life you can certainly achieve a tight backfill in the -- I mean, it's an operational problem.
Q Have you read anything in the mining plan that would satisfy you that they would achieve tight fill?
A There was nothing in the mining plan, the permit that I have, that's mentioned. I don't believe they mentioned tight fill.
Q Third factor: "The permit did not take into account a

plug-type failure such as occurred at the Athens mine some 23 miles away." And that's true; correct? The permit did not --

A That's true.

Q And finally, "In situ stress measurements were not carried out in the exploration boreholes drilled at the site to determine the horizontal stress."

A And that's also true.

Q And there was no overboring?

A No, there was nothing.

Q There was no analysis of disking?

A I don't know. Disking would be reported in drillers' logs, but I doubt there was disking just from some of my previous comments.

Q Let's move to page 6 for a moment, if we could. Okay. Did you end up with a recommendation of perhaps a better way to backfill the mine than they were suggesting, sir?

A I guess it wasn't a recommendation; it was just a statement of what was done in other mines.

Q When you say it's an operational problem to cement the backfill sufficiently so that it stands up during mining, what are you saying there?

A In other words, if you want to blast against the fill, if it's not sufficiently submitted, it's going to continue to collapse into the opening.

Q So you put it in --
A And you -- from an operational viewpoint, it has nothing to do with stability; it has to do with the fact that you have to muck all this (indicating) out and do something else before, you know, you can actually get the ore out. So, I mean, it's an operational problem. It's not -- this is not a geotechnical problem.
Q You describe earlier some kind of ram that could push back backfill towards the back wall of a cavity; correct?
A When you want a tight fill to the back.
Q But that doesn't necessarily help you fill up to a ceiling, does it?
A Yes. You fill tight to the ceiling.
Q By ramming it?
A By ramming it, jamming it, yes.
Q And then do you expect that there's going to be settlement?
A There certainly would be -- there may be some settlement with time. I don't really look at that kind of --
Q And vertically 600 feet of backfill, would you expect some settlement?
A Certainly Dr. Vitton mentioned some figures of settlement which I have no basis for arguing against.
Q Yeah. I think he mentioned maybe a conservative estimate of a settlement of 12 or more feet; correct?
A He didn't mention -- I didn't hear him mention a figure.

Q But you didn't have any disagreement with his testimony about settlement?
A I have not looked into this. I don't have any opinion on it.
Q Let's look quickly at page 7. First of all you note in the third paragraph, "Vitton and Parker reported there were fracture zones along intrusive boundaries which could possibly act as a failure plan for the crown pillar"; correct?
MR. REICHEL: Is the question just is that what his report says?
MR. WALLACE: Yes.
A That's what the report says, yeah.
Q And do you agree with that?
A If the fracture planes intersect the crown pillar.
Q Well, didn't you understand them to say that they did?
A Where they were plotted on the diagrams didn't show them intersecting the orebody.
Q So do you know or do you have an opinion as to whether these fracture zones intersect the orebody or not?
A Some of them certainly don't based on the descriptions of the core logs.
Q And some of them do or might?
A Some of them do over certain distances, I believe, or they -- that's not clear either. It talks about

intersecting the gabbro, but it doesn't mention intersecting -- the description doesn't include ore zone.

Q What risks, if any, are posed by the lineament from resolved EM studies projecting a structure crossing the deposit at a 45 degree angle?

MR. LEWIS: Objection to foundation.

Q Do you know what that is, sir?

A I've seen lineaments from EM studies all over the United States over every mine. And the relevance to stability of the mine is -- I haven't seen where it's, in general, been a concern.

Q Okay. Why did you note it in your report?

A Pardon?

Q Why did you note it in your report?

A Why did I note it?

Q Yes.

A It was a surface structure. I guess all I noted was it wasn't identified by diamond drilling.

Q Now, this is something that, were it drilled into, could it be identified by core drilling?

A If it was a significant structure, I presume it would be identified by diamond drilling.

Q And is this something you'd want to know about in that there's a suggestion it exists?

A I would think that the geologists would have looked at that

since they're the ones that drew the lineament.
Q And have you seen any reflection in any report or study or the mine application that this has been looked at by geologists and evaluated?
A I haven't seen anything.
Q So you don't whether this poses a risk of collapse or not?
A Don't have an idea.
Q And that can only be determined from further study?
A That's true.
Q And that study could be conducted through core drillings pre-mining; correct?
A I don't know if they could determine it from the drilling they have now.
Q Is there any limitation that you've seen on obtaining additional core samples to further characterize something like this structure?
A I don't know of any limitations. I don't know of any -- I don't know what the -- what or if any geologic drilling is being carried out.
Q At the end of that paragraph, "Dr. Bjornerud observed a surface depression or lineament which she concluded would transmit water underground." Do you see that?
A Yes.
Q Okay. Did you see the same thing?
A I didn't. I wasn't at the site.

Q You don't have any basis to disagree with what she's saying here?
A I believe she showed a picture of a depression.
Q And you don't have any basis to disagree that this might transmit water underground?
A I have no basis for disagreement.
Q The middle of the second paragraph referring to the concerns of Drs. Bjornerud, Vitton and Jack Parker, you say, "Their concerns are real as any disruption of the surface or groundwater over the Eagle mine would have very serious consequences." And to this day you agree with that, do you not, sir?
A I think that's a truism.
Q And you say:

> "I share their concerns, and I'm not pleased that they're missing RMR data found and a few of the logged core holes were not pointed out and satisfactorily explained by Golder."

And that remains true to this day, does it not, sir?
A That's true.
Q Now, in the third paragraph you say:

> "It has not been established that the intrusive metasediment contact is a highly fractured zone or that this contact or inferred surface fracture zones will be water conduits to the crown pillar."

You mean it has not been established by the NWF professionals who have looked at this?

A They've established in two or three locations that the contact is fractured. We don't know that it's fractured over the entire perimeter or there's no evidence to indicate that. I mean, there's been no evidence presented.

Q Was it suggested to you by anybody at the DEQ that it was the obligation of Dr. Bjornerud and Jack Parker and Dr. Vitton to establish any particular dangers here?

A Would you repeat the question?

Q Yeah. Was it suggested to you by anybody at the MDEQ that it was the obligation of the NWF experts to establish to your satisfaction or somebody else's satisfaction a given danger?

A No.

Q And you would think this is the obligation of Golder to establish one way or the other; correct?

A It's Golder's mine. No, excuse me. It's Kennecott's mine.

Q Maybe it's the late hour, but I'm not finding where I believe you recommended paste fill, paste backfill. Do you recall doing that?

A I don't believe I recommended paste backfill.

Q Do you recommend paste backfill for this mine?

A A problem with paste backfill is it's usually associated with tailings from the actual milling of the ore. There's

no tailings.

Q What is paste backfill?

A Paste backfill is where you mix cement with the mine tailings from the mill with a certain -- what do they call this? -- size distribution, and it forms a paste as opposed to a regular sandfill. A cemented sandfill, it becomes a cemented pastefill which generally doesn't -- it contains the water. The cement hydrates the water and it is generally stiffer or stronger than a conventional backfill.

Q Stronger or stiffer than a conventional rockfill; correct?

A There are some studies that show a cemented rockfill -- a good cemented rockfill is the stiffest backfill that you can have.

Q Can you make paste backfill out of, you know, some other substance than tailings? Sand or whatever?

A You'd have to -- because of the size distribution, you need -- you need some of this fine material to supplement. Now, what people do is -- making paste backfills, they actually supplement the tailings with sand. But I don't -- you can always make a paste backfill. I just don't know if -- where the supply of materials is that you would use. Again, this is an operational problem.

Q Your conclusion at the end of page 9, here you indicate:

"While the issues and concerns raised by the NWF through Vitton, Parker and Bjornerud are legitimate, I

still recommend that the revised mining permit application for KMEC be approved"; correct?

A That's correct.

Q Okay. Do you know whether any more data was gathered, any analyses were done other than your looking at their report and coming to the conclusions you've drawn here to address the concerns that they've raised?

A I have no idea.

Q Was any further work done by Golder or Kennecott or anybody else after they put in their concerns that you thought were legitimate concerns?

A I have no idea.

Q Did you read anything submitted by Golder or Kennecott that suggested that after they raised their concerns about RMR values, RQD's, everything they testified about, that they went back to the drawing board and tried to address them gathering more data or doing more analysis?

A I have no idea.

MR. WALLACE: Okay. Thank you, sir. I have nothing further right now.

MR. HAYNES: Dr. Blake, my name is Jeff Haynes. I represent the National Wildlife Federation and the Yellow Dog Preserve. I have a few follow-up questions from Mr. Wallace.

CROSS-EXAMINATION

BY MR. HAYNES:

Q Appendix C1 of the mining application, let's go to page 26. Dr. Blake, I believe in your testimony you stated that you understand the mining to take place within the peridotite; is that right?

A I understand that it goes out into the wall rock in places.

Q I see. And we're looking at page 26 of Appendix C1, which is a series of cross-sections of the orebody. You've seen these before, haven't you?

A Yes.

Q Yes. And if we're looking at 43153OE, and that cross-section is noted in the darker rectangle in the lower right-hand portion of this figure, the orange color in this cross-section says, "Massive sulfide." Do you see that?

A Yes.

Q And if you look at the cross section it appears that the massive sulfide, at least in this cross-section goes out into the metasediments; correct?

A That's what it shows.

Q Do you believe that?

A I have no reason not to believe it.

Q And so if the massive sulfide goes out into the metasediments here, it's not going to be in the peridotite; correct?

A That's correct.
Q All right. And so we would need to know boreholing -- or we would need to know the structure of this geology here in order to find out whether or not there would be any stress or any deformation or any problem with the crown pillar over that section, wouldn't we, --
A That's correct.
Q -- if the mine is going to proceed in that direction?
A That's correct.
Q So the boreholes that you have reviewed in this matter that may or may not intersect the crown pillar, we actually need to know the geology of the metasediments above this portion of the orebody; correct?
A That's correct.
Q And do you know of -- have you reviewed any of that data yet?
A I haven't seen any data that I was -- referenced.
Q And I believe you testified, didn't you, Dr. Blake, that the metasediments here are highly fractured?
A I didn't testify that. I testified that in Dr. Bjornerud's logs she mentioned in the boreholes that she logged in some instances she reported highly fractured metasediments.
Q Do you have any reason to disbelieve her logs?
A She showed pictures. I have no reason to dispute her characterization.

Q And does that cause you some concern about whether or not there's going to be a problem with mining into the highly fractured metasediments?
A Any mining in fractured ground obviously is a concern.
Q And would you agree that that would warrant further study of the geology of the area to determine if this mine is going to be safe and not collapse?
A It would be standard procedure, I'm sure.
Q Now, again, still on page 26 of Appendix C1, we have another slide for 430500E. Do you see that slide?
A Yes.
Q And I think the same legend applies here. Do you see the legend?
A Yes.
Q And the analysis would apply to the massive sulfide that we see in this slide that appears to be intruding into the metasediments; correct?
A That's correct.
Q Just so I understand, Dr. Blake, if -- by the way, you expect Kennecott to mine the massive sulfide that's shown here, don't you?
A I expect they'd mine everything they can. I mean -- well, that's what a mine normally does.
Q All right. And you would expect them to mine the massive sulfide that's shown in this cross-section?

A I certainly do.
Q And so the crown pillar that we're going to be talking about it going to be over this portion of the massive sulfide, and in fact, it appears, if we can generalize from this chart, that the crown pillar is going to be very near to the contact between the peridotite, which is the purple, and the metasediments which are the green. Is that an accurate statement?
A Would you repeat that?
Q Sure. Well, it might be easier if I just show you with the laser pointer.
A Yeah, if you demonstrate it.
Q If we look at the massive sulfide on slide 431500 -- or the cross-section 431500E, the massive sulfide appears to be quite high here, but it also stretches out, and I guess this would be to the south into the metasediments; correct?
A That's correct.
Q And so the crown pillar, if this is going to be mined, is going to be right above that -- correct? -- right above the southern edge of this massive sulfide?
A It's going to be above that, yes.
Q Right? And if we -- if we look at this slide, it appears that the crown pillar is going to be very near to the intersection of the peridotite and the metasediments; true?
A That's what shows on the slide.

Q And so wouldn't it be prudent, then, to investigate the zone between the metasediments and the peridotite that's going to be above this portion of the mining area to determine if it's highly fractured?
A I would presume that since all these holes are logged and since the only holes mentioned with discontinuities greater than a meter were those holes listed in Table 4, that the condition in the metasediments that are shown in these holes would already be known.
Q I see. Known by whom?
A Whoever looks at the core.
Q I see. That would be Kennecott or Golder or --
A Certainly Kennecott.
Q The applicant; right? You didn't look at those cores, did you?
A No, I didn't look at those cores.
Q Did you ask for them?
A I didn't ask for the cores.
Q Why not?
A I asked for a few samples of cores in the crown pillar.
Q And just so the record is clear on this, whom did you ask for the few samples of the cores in the crown pillar?
A In a conference call with DEQ, Joe Maki, Kevin Beauchamp, I believe it was either Jon Cherry or -- I believe it was Jon Cherry, that I asked that I would like to see some cores

from the crown pillar.

Q And that was in May, you say? May of 2007?

A In May of 2007.

Q Okay. And from whom did you receive the three core -- three core photo groups?

A I believe it was from -- it certainly was from Kennecott.

Q It wasn't from Golder?

A No, it wasn't from Golder. Golder doesn't have the core.

Q And it wasn't from -- it wasn't from DEQ?

A It wasn't from DEQ. I believe it was an email from someone from Kennecott.

Q Do you have that email with you today?

A I don't have the email with me.

Q Do you have the core photos with you today?

A No.

Q Where are they?

A They're on my computer in Idaho.

Q I see. When you asked for the core photos and you got three, were you at all curious about the other core photos?

A I really -- I really wasn't. I certainly -- at that time I certainly had no reason to think that these -- from the photos of -- samples that were shown and the geologic document, I had no reason to believe that these were anything but three representative holes through the crown pillar.

Q So at the time that you requested the sample core photos, what you deemed a representative sample, you knew that there were many more cores than the three that you got?
A 109 or whatever the number is.
Q And your job was to review this application for the DEQ to advise the DEQ on geotechnical matters; correct?
A That's correct.
Q And did it occur to you that you would like to look at the other 106 core photos that were out there and available apparently?
A I don't normally look at -- any mine I go to I wouldn't normally look at all the core data.
Q Okay. But for mines you go to, you're talking about mines that are already working; correct?
A That's correct.
Q Have you ever been asked to review data, as you were asked here, for a mine that's been proposed only and is not working yet?
A I'm trying to think. Offhand I can't remember reviewing core data for a mine that hasn't yet -- oh, I take that back. Yes, I have -- well, no, I -- there's a project to mind, a deep nickel orebody called Onaping Depth, and I'm on a committee that's reviewing that. We haven't really looked at cores. We've looked at the representative orebody. And the mine starts at about 7500 feet below surface?

Q Quite a bit deeper than this mine; correct?
A Quite a bit deeper than this mine, certainly a high-stress mine. The orebody is more flat than -- the only thing -- interesting thing was just when we started to come up with a mining plan, they had new core data, and the geometry of the orebody changed completely.
Q I see. So for this project, Dr. Blake, this is the second time in your professional career that you've been asked to evaluate a mine before it's open; correct?
A That's correct.
Q And it's important to you -- or it was important to you, wasn't it, to obtain all relevant information about the proposed mine in order to advise the DEQ; correct?
A It was important to me to have an understanding of the characteristics of the orebody and particularly the characteristics of the crown pillar.
Q And you were to conduct an independent review -- correct? -- for the DEQ?
A That's correct.
Q So did your independent review, then, require you to accept at face value all of the information submitted by Golder on behalf of Kennecott for this project?
A I didn't accept it at face value. I looked at the sum of their RMR plots with 109 or however many --
Q Oh, you mean the modeling of the RMR plots?

A The modeling of their RMR plots which showed RQD values which were consistent with what I presume would be the RQD's of the cores that were sent to me.
Q And the modeling -- I don't want to confuse you here, Dr. Blake, but the modeling was in the geotechnical study, Appendix C2; is that right? We can pull it up to refresh your recollection, if you want.
A That's all right. No, no. I presume it's in -- I'll take your word that it's in --
Q Okay.
A It shows some plans and sections of RQD values.
Q Okay. And RMR values; right?
A RMR values. I think --
Q Let's go to C2. Actually, Dr. Blake, there is something in C2 that I want to ask you about, so we'll go to it. Now, Dr. Blake, we've had put on the screen page 13 of Appendix C2 to the permit application. You spoke earlier about the GoCAD modeling. Do you remember that?
A Yes.
Q And explain for us what the GoCAD modeling is.
A Apparently it's a program that takes the RMR drill core data and displays it in either plan or section.
Q And you spoke earlier about structural features. Remember that?
A Yes.

Q And tell us again what structural features are.
A Structural features as defined in Table 4, I believe it was, in C3 --
Q We'll get to that, but go ahead.
A -- were described as, I believe, where cores had a discontinuity of greater than one meter.
Q All right. In Appendix C2, the Eagle Project Geotechnical Study dated April 2005 on page 13, if you look at the second paragraph of Section 3.8 which is on the screen, it says, "Based on the information in the two Microsoft Access databases, there have been other discrete structural features identified in the Eagle deposit." Do you see that?
A Yes.
Q You've read that, haven't you?
A Uh-huh (affirmative).
Q "Yes"?
A Yes.
Q It continues: "These discrete features have been stored in a separate table of the database instead of being included in the main database." Do you see that?
A Yes.
Q It continues: "A review of these discrete features indicated that there are three types of structural features: broken core zones, shear zones and fault gouge zones." Do you see that?

A Yes.
Q I'm going to skip down now to the next paragraph. It says: "These structural features identified during the logging have not been incorporated into the GoCAD model. The current data density is not sufficient to interpolate these features." Do you see that?
A Yes.
Q So from this it appears that, Dr. Blake, these discrete features, these broken core zones, shear zones and fault gouge zones were not put into the GoCAD model to come up with the RMR values that Golder put in the back of this report. Is that your understanding?
A I guess this is inconsistent with the table that explains the cores that were used in the GoCAD model.
Q The C3 table; right? The table in C3, Table 4?
A Yes; yeah.
Q Can you explain the inconsistency for us?
A I don't have an explanation.
Q Is it best practices to --
A I think we --
Q Let me finish. Is it best professional practices to not incorporate structural features such as broken core zones, shear zones and fault gouge zones in a model that's going to predict RMR's?
A It certainly doesn't appear to be normal practice.

Q Or best practices?
A Or best practice.
Q Let's go to C3. Now, Dr. Blake, we now have put up on the screen Appendix C3, "Subsidence Analysis Report," --
A Uh-huh (affirmative).
Q -- or as it's titled on its cover page, "The Eagle Project Additional Geotechnical Scope," dated February 2006, page 8, Section 3.4.2, which is entitled "Crown Pillar Major Structural Assessment." I'm going to go to the third sentence of this paragraph which starts:

"The query of this table indicates that 40 individual major structural zones (a total of 183 were recorded) were identified in 22 of the 26 drillholes intersecting the crown pillar area." Do you see that?

A Uh-huh (affirmative).
Q "Yes"?
A Yes.
Q So it appears that 26 of the drillholes -- and now we're dealing with 109 -- intersection the crown pillar area; correct?
A That's correct.
Q And 40 major structural zones of a total of 183, so apparently there were 183 structural zones, some of which were major and some of which were not major. Is that your understanding of what that says?

A My understanding is, as the -- zones with lengths greater than one meter are listed in Table 4.
Q We'll get to that. I'm talking about the sentences above the table in this paragraph that talk about 40 individual major structural zones out of a total of 183. That sentence doesn't limit the structural zones by any length, does it?
A It doesn't appear to.
Q And do you think that would be important for your review to look at the 40 major structural zones out of a total of 183?
A I would think the core certainly should have been looked at, yes.
Q And you should have looked at them?
A That's correct.
Q Why didn't you?
A I can say I didn't.
Q Why didn't you, sir?
A I don't have a good answer. I didn't consider looking at them.
Q All right. For your independent review for the DEQ for this proposed mine permit, you didn't consider looking at the data that apparently was available to Golder for the 40 major structural zones out of 183 structural zones in the available data for your independent review. You can't explain that?
A I guess in all the -- in all the core I look at there's

always structural defects. There's always structure. There's always broken core. There's always different zones. The effect that these features may have on stability, it may have an effect and it may have no effect.

Q Well, it's true, Dr. Blake, isn't it, that the GoCAD model used by Golder to establish the RMR ratings used -- we think used the data from the 109 boreholes; correct?

A That's what it says.

Q Except that we know that they eliminated some structural features from the GoCAD model. We just found that out, didn't we?

MR. REICHEL: Objection; lack of foundation.

MR. HAYNES: Your Honor, I just went through this with the witness in Exhibit C -- or appendix C2.

JUDGE PATTERSON: I'll overrule it.

A That's what it says, but that's inconsistent what it says as well in the previous table that describes where the RMR's were taken from.

Q All right. But have you seen any data as part of your independent review that suggests that these 40 individual major structural zones were included in the RMR calculations on which the Golder modeling is based?

A I only see what's written in the --

Q And so your answer is "no"?

A My answer is "no."

Q Now, this paragraph further says that, "Ten zones were identified with length 1 meter or greater from the original major structural table (i.e., tblMajor Structures) and these have been listed in Table 4." And these are the major structures that you were talking about earlier, Dr. Blake?
A That's correct.
Q All right. And the eight boreholes that are represented on Table 4 are the same eight boreholes that Dr. Bjornerud and Dr. Vitton and Jack Parker looked at; correct?
A That's correct.
Q Were you at all curious to look at these eight boreholes when you saw that these were the major structures in the crown pillar area?
A This is what I called and asked Golder about.
Q Oh, I see. This conference call you spoke of before with Mr. Maki and Mr. Cherry and Mr. -- is Dr. -- Mr. Beauchamp; right?
A Yes.
Q That conference call occurred after you read this table?
A No, I believe that conference call occurred later.
Q Occurred later. And you asked to see representative coreholes and boreholes; right?
A That's correct.
Q And the three that you got, as I recall, were from holes 46, 54 and 104; correct?

A That's correct.
Q Those holes don't appear on this table, do they?
A They're not on this table.
Q And you consider them representative; correct?
A They appeared to be representative to me to agree with the RMR's shown in the GoCAD model.
Q I see. And you didn't ask to see the core photos for the eight boreholes listed on Table 4; correct?
A No, I didn't.
Q Let's look at Hole 62 -- excuse me -- Hole ID 62. You see the length of the feature here is 55 meters long. That's about 160 or 170 feet, isn't it?
A That's correct.
Q That's a pretty long structure, isn't it?
A That is a big structure.
Q Weren't you at all curious about where that structure was in the geology here, what it intersected, what length it -- what depth it was, where it started, where it finished? Weren't you interested in that?
A I certainly had concern about it.
Q But you didn't ask to see these cores, did you, if you were concerned about it?
A No, I didn't. I --
Q And can you tell us why?
A I don't really have a good explanation why I didn't. I

didn't presume that these particular holes were representative of the other 100 holes.

Q I see. So you asked for 3 holes -- you asked for representative holes; you got 3. You didn't get the 8 that showed major structures, and you considered the 3 that you got to be representative of the other 109. Is that what you're telling us?

MR. REICHEL: Objection; argumentative.

MR. HAYNES: That's not argumentative. I'm asking the witness why --

JUDGE PATTERSON: I overrule.

MR. HAYNES: Thank you.

A I guess that would be my answer.

Q What's your answer again? I'm sorry. I didn't get an answer to the question. You didn't pick the 8 boreholes that had major structures. You got 3 other boreholes, and you consider those representative of the 109 --

A I didn't --

Q -- excuse me -- of the other 98 that you didn't see as part of your independent review?

A I considered those -- the ones I had were representative of the -- that was the crown pillar. I apparently overlooked this.

Q You've testified, Dr. Blake, that you agreed with Dr. Sainsbury that a crown pillar of 87.5 meters thickness is

thick enough to allow mining to start here; correct?
A That's correct.
Q At the same time, you've testified, haven't you, Dr. Blake, that a crown pillar -- that you agreed with Dr. Sainsbury that a crown pillar of 57.5 meters thickness is not thick enough; correct?
A That's correct.
Q And this is based upon your reviewing Dr. Sainsbury's reports; correct?
A That's correct.
Q Three -- photos of three boreholes; correct?
A Correct.
Q Reviewing the application and its appendices; correct?
A That's correct.
Q Not doing any independent testing; correct?
A That's correct.
Q Not going to the site; correct?
A That's correct.
Q Not reviewing the drillers' logs; correct?
A That's correct.
Q Well, if a 57-1/2 meter crown pillar is not sufficient, what about a 60-meter-thick crown pillar? Would that sufficiently thick?
A It wouldn't be sufficient unless the RMR were greater than 2.

Q Oh, I see. So you'd want to rely -- the RMR or the factor of safety?
A The factor of safety. Excuse me.
Q Thank you. So and the factor of safety, as we've learned thus far, is derived mathematically from a formula that includes the RMR's; correct?
A That's correct.
Q So if the RMR's are incorrect, the factor of safety calculation would also be incorrect; true?
A Yes. To some extent, yes.
Q So in order for you to determine whether a 57.5-meter-thick crown pillar is potentially subject to failure and a 60-meter-thick crown pillar may or may not be potentially subject to failure depends on this factor of safety calculation; correct?
A That's correct.
Q And would that be true for a 65-meter-thick crown pillar?
A It would be true for any thickness of crown pillar.
Q And so it would be true also -- it would also be true for a 87.5-meter-thick crown pillar, wouldn't it?
A That's correct.
Q And you didn't do any of those calculations; correct?
A I don't do those calculations.
Q And you didn't in this case either, did you?
A No.

Q So you have no way of independently verifying whether or not the calculations by Golder to come up with an 87.5-thick-meter crown pillar are correct or not?
A I have no way of knowing that.
Q Did you think it was important to independent verify their calculations?
A In my experience, an 87.5-meter crown pillar is a stable pillar despite a few deficiencies.
Q Despite 183 structural zones, Dr. Blake?
A In this case with the locations of these holes, they were all on the periphery of the crown pillar -- the majority. The majority of the deficiencies were in these broken zones along the perimeter of the dike and the metasediments.
Q And that's important, isn't it?
A It's an important factor, yes.
Q So let me understand, Dr. Blake, when you in your reports agreed with Dr. Sainsbury that an 87.5-meter-thick crown pillar -- that's -- what? -- about 260, 270 feet give or take?
A Yeah, somewhere in that range.
Q -- that an 87.5-meter-thick crown pillar was stable -- would be stable in this case, you based your conclusions on looking at the photographs for three holes. That's the entirety of your independent evaluation; correct?
A That was my review of the core logs, yes.

Q But that was the entirety of your independent evaluation.
A Other than experience and looking at the stability in other mines of crown pillars or any pillars of that magnitude.
Q So your opinion, Dr. Blake, is independent of any of the geology of this area; correct? It's based on your experience at other mines without considering the geology of this area.
A When I look at the geology of this area, I consider the geology within the peridotite to be normally relatively -- it's the strongest rock that we have.
Q All right. And I'm sorry if I've asked this question already, Dr. Blake. But your view of the ability of the prototype -- the solid nature of the prototype is independent of any of the 98 boreholes that you didn't look at; correct?
A That's clear.
Q By the way, Dr. Blake, you testified that you considered the rock in the three borehole sets of photos that you looked at to be fair to good; correct?
A That's correct.
Q And so you're basing your opinion on your view of the photos from three cores and based on your experience that the rock is fairly good in those three core holes; right?
A Uh-huh (affirmative).
Q "Yes"?

A That's correct.
Q And from your designation of the rock as being fair to good, you have then determined that an 87-1/2-meter crown pillar is sufficient; correct?
A That's correct.
Q Dr. Blake, we've discussed at some length today already the reports by Dr. Sainsbury and his deposition. Do you recall some of that testimony?
A Yes.
Q All right. Dr. Blae, I put up on the screen what is Respondent's Proposed Exhibit 75, which is a technical memorandum from David Sainsbury to Mahesh -- and I'm sorry. I can't pronounce his name -- Vidysager at MFG. Have you seen this document before?
A I'm not sure that I have.
Q You were hired when? In 2007; correct?
A (No verbal response)
Q Just take a moment to review it, Dr. Blake.
A Uh-huh (affirmative).
Q And I'm going to call your attention to the third paragraph, which reads, "The proposed mine allows for mine development to begin while further field investigation and analysis are conducted prior to mining above an elevation of 327.5 meters." Do you see that?
A Yes.

Q You're familiar with that recommendation, aren't you?
A That's correct.
Q And that's the recommendation from Dr. Sainsbury that you endorsed and you, yourself recommended that allows -- that would allow a crown pillar thickness of 87.5 meters; correct?
A I agreed with Dr. Sainsbury.
Q Okay. Dr. Blake, I have to do this the old-fashioned way, and I apologize. But I have from Dr. Sainsbury's deposition an e-mail that is dated November 9, 2006. This is from Dr. Sainsbury's deposition. It was marked as Exhibit 11 in the deposition, and this is one of several e-mails that he produced when we deposed him last year. I've marked it here as Petitioner's Exhibit in the Part 632 case Exhibit 140. This appears to be an e-mail, at least the bottom half of it, sent from David Sainsbury to Andre van As. Do you see that?
A Yes.
Q And then the top part of the e-mail is the reply from Andre van As back to David Sainsbury. Do you see that? That's the top part.
A Yes.
Q All right. I'd like to focus your attention on the bottom part; that is, the e-mail from David Sainsbury to Andre van As. And I'd like to call your attention to what appears to

be the third paragraph. It's the fourth line down in the body of the e-mail that says, "In my and the state's opinion, the rock mechanics issues of Eagle are going to be a potential stumbling block for the project." Do you see that?

A That's correct.

Q By the way, have you seen this e-mail before?

A No.

Q Would you agree with that sentence?

A It's certainly an issue. I mean --

Q So do you agree or disagree with the sentence?

A I agree that it's an issue, yes.

Q And would you agree that would be a potential stumbling block?

A It -- well, it is a potential stumbling block.

Q Now, the next paragraph, "The rock mechanics were conducted thus far, which forms the basis of the mine permit application is not defensible." Do you see that?

A Yes.

Q Those words sound awfully familiar, don't they?

A (No verbal response)

Q That is, weren't that -- weren't -- wasn't that same phrase used by Dr. Sainsbury in his initial technical evaluation of the project?

A He did state that in his initial evaluation.

Q And this e-mail is dated November 9, 2006, which is the same date as the technical memorandum, Respondent's Proposed Exhibit 75; correct?
A That's correct.
Q So the same day that Dr. Sainsbury wrote to MFG and sent this technical memorandum recommending an 87.5-meter-thick crown pillar -- the same day he writes to Mr. Andre van As, who apparently is at Rio Tinto -- and you understand Rio Tinto is the parent company of Kennecott?
A That's correct.
Q Okay. The same day he writes to him, saying that the technical work -- or the rock * 5:38:25 work conducted thus far, which forms the basis of the mine permit application, is not defensible. Would you agree with him or not?
A This is his opinion. I mean --
Q Do you agree with him?
JUDGE PATTERSON: Counsel, what was the date of the e-mail? I --
MR. HAYNES: November 9th.
JUDGE PATTERSON: 9th. Okay. I thought I heard you say --
MR. HAYNES: I'm sorry, your Honor. I have -- do you need a copy?
JUDGE PATTERSON: No. But I thought I heard the 6th.

MR. HAYNES: No; November 9th.

JUDGE PATTERSON: Okay.

A Well, Dr. Sainsbury is apparently speaking out of -- with two tongues. In the one memo he -- in this memo he states that the -- he states that an 87.5-meter crown pillar would be stable.

Q Which tongue would you believe?

A I believe, frankly, that an 87.5-meter crown pillar would be stable. I'm -- and I believe that the stability of any further mining certainly needs to be proved as a result of the proposed geotechnical study underground.

Q Dr. Blake, I'd like the record to be clear here. We've been talking thus -- we've been talking thus far today about this stope method of mining, and you compared it as -- you testified that it's different than the method of mining at the Athens mine. Do you recall that?

A That's correct.

Q And would you describe again for the record the method of mining at the Athens mine?

A The Athens mine was stated to be a top-slicing mining method.

Q And describe that for us --

A In a --

Q -- for those of us who aren't miners.

A Okay. In a top-slicing mining method, you go down to the

bottom part of the orebody, but you go -- you don't go to the bottom of the orebody. You go to the upper limit of the orebody, and you mine the back.

Q "The back" meaning the roof?

A "The back" meaning the roof. You go down underneath that and take successive slices. And there is no support provided to the back. The back is free to cave and did cave.

Q And so in this --

A It's a caving --

Q The top-slicing method, you sliced off successive portions going up?

A Going down.

Q Oh, going down?

A Yes.

Q Okay. And for the stope method that's proposed in this mine, Dr. Blake, what is your understanding of how that will work?

A You start at the bottom, and you mine successive rooms and panels and then work your way up.

Q All right. But for the blasting for each of these stopes and for the successive rooms that you're talking about, where does the blasting occur? Do they drill holes, or do they drill holes down?

A Drill holes down; down.

Q And then -- and when they drill holes down, do they extract the ore by going down and pulling it out, or do they extract the ore by letting the ore fall into a lower chamber?
A When -- you mine with an uppercut and an undercut. That's how it's developed. You drill from the uppercut, and the broken rock falls down. You mine this out from the undercut.
Q So from the uppercut they drill the holes.
A You drill the holes down.
Q They blast that.
A Load them, blast them.
Q And then they recover the ore from the undercut?
A You recover the ore from the undercut.
Q And during this time the portion of the stope that's above the uppercut, is it going to be supported? Is it going to be not supported; do you know?
A In general it would be supported. It would be supported all the way up.
Q And how would it be supported?
A It would be supported with rock bolts, screen as required. And it would depend on the geotechnical evaluation of the ground conditions along that opening, the uppercut.
Q I see.
A And because it's going to be 10 meters wide, it generally would be supported with long rock bolts.

Q That go vertically into the rock?
A They go vertically into the rock.
Q And as you understand it, Dr. Blake, the stope mining will take one stope and then leave a secondary stope in place, move over to the next primary stope -- is that right? --
A That's correct.
Q -- until the entire level is mined out and then move up to the next level after they backfill the primary stopes, correct?
A That's correct.
Q And so when all the primary stopes are mined out all the way up to the successive levels of the mine, we have the primary stopes filled with this cemented rockfill; correct?
A Cemented rockfill and the primary stopes, right.
Q Okay. And then, is it your understanding that Kennecott would then move in to the secondary stopes -- right? -- and blast those in the same method in between the primary stopes?
A They're mined using the same method between --
Q And the blasting will occur within 5 meters of the primary stope rockfill on either side or closer?
A It's adjacent to it. I mean, the wall of the secondary stope is the backfill.
Q Right. And so the blasting that occurs will occur no further than 5 meters from the rockfill primary source;

correct?

A This is standard practice in panel mining. They have controlled blasting techniques, which minimize damage to the adjacent backfill, and the strength of the backfill is designed such that it stands up.

Q I see. And --

A That's -- that takes place all over the world.

Q And the backfill here, Dr. Blake, is going to be backfill that's taken from the development rock; correct?

A That's their plan.

Q Do you have any reason to doubt that?

A No.

Q And the development rock is the metasediments; correct?

A Presumably, yes.

Q Yeah. And the development rock itself is acid forming, isn't it, in the presence of air and water?

MR. LEWIS: Objection; foundation.

Q Do you know?

A I don't know the composition of the --

Q I see. So you aren't able to express an opinion, are you, Dr. Blake, as to whether or not the cemented rockfill here is going to be composed of rocks that are acid forming?

A No, I have no knowledge of that.

Q Dr. Blake, you're aware, aren't you, that the blasting in the secondary stopes is going to take place next to material

that has a psi rating of 218 psi per the application; right?
A That's what it states in --
Q Right. Do you believe that?
A Do I believe that they're going to be blasting next to it?
Q Yes.
A I have no reason to believe that they won't be blasting.
Q All right. And have you performed any independent analysis of the effect of blasting next to the primary backfill slopes that have -- stopes that have a 218 psi? Do you have any opinion as to whether or not the blasting will affect the 218-psi backfill primary stopes?
A I guess my only opinion would be that there must have been some calculation done to suggest that the height of this backfill would be stable and that it would resist the effects of blasting.
Q But you don't have an independent opinion as to whether or not the backfill would be stable, do you?
A I don't do backfill work, so I don't know that.
Q Okay. Thank you.

MR. HAYNES: Just as a matter of housekeeping, I move the admission of Petitioner's Exhibit 140.

MR. REICHEL: I'd like to see that, Counsel, again. Is it -- are you representing on the record this was what exhibit to the --

MR. HAYNES: It was -- it's Exhibit 11 to the

Sainsbury deposition, which was all the documents that we received at his deposition.

MR. REICHEL: Okay.

MR. HAYNES: And it's one e-mail from that.

MR. REICHEL: I have what purports to be a copy of Deposition Exhibit 11. It is not that document.

MR. HAYNES: Well, thank you for the clarification. Let me double-check.

(Counsel reviews file)

MR. HAYNES: Your Honor, I'm looking at page 163 of the Sainsbury deposition. Question by Mr. Wallace:

"Dr. Sainsbury, have you located next to your property -- you have located next to you a copy of documents which I understand to be your entire file related to the Eagle Mine Project, which you have brought in response to the subpoena, sir; is that correct?

A: That's correct.

Q: Rather than going through it, because it's extensive, what I'd like to do is to mark it as the next exhibit and --

MR. ETTINGER: Which exhibit is that?

MR. HAYNES: 11.

MR. WALLACE: Mark it as Exhibit 11. And I guess I'll just ask you, during the lunch break a few minutes ago,

I asked you I'd you'd go through, and you looked at each of the documents, did you not, sir?

A: Yes.

Q: And you're satisfied that this is an accurate copy of the file materials you brought?

A: Yes."

MR. HAYNES: So I understand that the -- that Exhibit 11, which is attached to the deposition, is the contract-of-services agreement. But the text is all of the documents that Dr. Sainsbury produced in his deposition. So I apologize for the -- if there's a confusion there. But it's at least in the -- marked as Exhibit 11.

MR. REICHEL: Well, I think this issue is one that needs to be reviewed further. Secondly, I think that this -- there's no basis for introducing this into evidence with this witness. He's testified he's never seen it before. If you want to offer this into evidence, I need to review this matter further.

MR. HAYNES: I don't have an objection to that, your Honor.

JUDGE PATTERSON: Okay.

MR. HAYNES: I can certainly bring in the Sainsbury documents next week, and we can look through it, if we need to.

JUDGE PATTERSON: Yeah. I think we need to at

least clarify what --

MR. HAYNES: And just as another matter of housekeeping, no one's offered the Sainsbury deposition into evidence yet, I don't think, and I'd do so now.

JUDGE PATTERSON: Is that going to be used in lieu of live testimony?

MR. HAYNES: Yes. It's a de bene esse deposition. It's Petitioner's Exhibit 7.

JUDGE PATTERSON: Taken in Circuit Court; right?

MR. HAYNES: I'm sorry?

JUDGE PATTERSON: Taken in Circuit Court?

MR. HAYNES: Taken through Circuit Court proceedings, yes. That's Petitioner's Exhibit 7, DEQ Exhibit 96.

MR. REICHEL: Judge, I have no objection to the deposition, but I do want to clarify the issue of the contents of the exhibits.

JUDGE PATTERSON: Yeah, I think we have to do that. Mr. Lewis?

MR. HAYNES: Yeah, and I'll do that.

MR. LEWIS: No objection to the deposition, your Honor.

MR. HAYNES: And that includes all the exhibits too, but we'll clarify that.

JUDGE PATTERSON: Okay. All right. Mr. Haynes,

did that conclude your cross-exam?

MR. HAYNES: That's all I have for now, yes. Thank you.

JUDGE PATTERSON: I assume we want to get done with Dr. Blake today; right?

MR. LEWIS: Yes.

JUDGE PATTERSON: How much redirect do you have?

MR. REICHEL: I have -- I can't tell you exactly.

JUDGE PATTERSON: Okay. Well --

MR. LEWIS: I'll ask a few questions, if I may, your Honor.

JUDGE PATTERSON: Sure. I was just trying to get an idea of timing.

MR. LEWIS: yes. I'll try to limit it to 15 minutes or so.

JUDGE PATTERSON: Okay.

MR. LEWIS: I'll do a switcheroo, your Honor.

(Off the record)

CROSS-EXAMINATION

BY MR. LEWIS:

Q Dr. Blake, this is page 8 of the Golder July 7, 2006, technical memorandum. It's Intervenor Number 24, part of the mine permit application. I believe that would be what you referred to as the third Golder document that you had looked at, Dr. Blake. And I wanted to look at this page

with you in reference to a prior question in which I think you indicated that you were not aware as to whether a factor-of-safety analysis had been done for the permitted crown pillar, the 87.5-meter crown pillar. And if you look at the top of the page there, sir, it says there, does it not, that -- starting with the second sentence, "Probabilistic analyses have therefore been conducted for three different scenarios, one for a single-stope span of 17 meters"? And then it talks about a two-stope-span scenario and a extreme scenario of a full, unsupported crown span of 68 meters. Do you see that, sir?

A Yes.

Q Indicates the results are shown on figure 1; correct?

A That's correct.

Q And then it goes on to say in the first bullet point that, "The crown pillar over a single-stope span for the inferred rockmass conditions discussed above is inferred to exhibit factors of safety of 4.6, 5.6 and 6.4 for crown thicknesses of 57.5 meters, 87.5 meters and 117.5 meters respectively. Do you see that, sir?

A Yes.

Q After reading that do you believe that Golder did in fact do a probabilistic analysis of the 87.5-meter crown pillar?

A I thought I mentioned that they did a probabilistic analysis.

Q Okay. Now, while that's coming up, Dr. Blake, I wanted to ask you some questions about some earlier discussions about these Golder reports. And in particular, I think that there's been some inference through the testimony that Golder had, in effect, recommended different versions of a final crown pillar thickness. So I want to look at the Golder reports and see what -- some of the things they said and see if you have a different understanding. This is again Intervenor Exhibit Number 2. This is what we've been referring to as the Golder Appendix C2, Dr. Blake. And I'd like you to look at the last sentence in the last paragraph, sir. Does it say there that, "A discussion on additional crown pillar information requirements and assessment recommendations as the project received underground is presented in Section 6.5"?

MR. HAYNES: I'm sorry. Counsel, which page of this exhibit are we on?

MR. LEWIS: Page i, "Executive Summary."

MR. HAYNES: thank you.

Q Do you see that sentence, Dr. Blake?

A Yes.

Q Is that what it says?

A That's what it says.

Q Now, this is a Section 6.5 that the Golder authors referred to in the introduction to their report under, "Crown Pillar

Discussion and Recommendations." Does it say there, Dr. Blake that,

"The long-term stability of the crown pillar will be dependent on the following parameters: Rock mass quality of the crown pre-mining and post-mining, crown pillar dimensions and void size beneath crown pillar"?

A Yes.

Q And does it not say continuing in that section that,

"It will be required that additional rock mass quality information be collected underground when access becomes available and the crown pillar stability reassessed"?

Is that what it says, sir?

A That's correct.

Q And in the next paragraph there does it say, Dr. Blake,

"If the crown pillar is determined to be, quote, 'marginally stable,' end quote, (i.e., FOS between 1.0 and 2.0) or, quote, 'unstable, end quote, (i.e., FOS less than 1.0), it will be critical that all the void areas beneath the crown be filled with consolidated material, i.e., cemented fill, when mining is complete"?

A Yes.

Q "The mining sequence shall also be designed such that a minimal amount of stope area is open and blast damage

beneath the crown is minimized." Is that what it says, sir?

A That's what it says.

MR. HAYNES: Your Honor, perhaps we could have a question here instead of just Counsel reading this document into the record and having the witness say that that's what the document says.

MR. LEWIS: If Mr. Haynes had waited one moment, he would have heard a question, Your Honor.

MR. HAYNES: Thank you.

Q And does this indicate, then, Dr. Blake, that in fact Golder in its initial report Appendix C2 had not recommended any final crown pillar height?

A What you have presented certainly indicates that.

Q Next I'm going to look at the next Golder Report that you've been talking about, we've been talking about, Dr. Blake. Again, on this subject, this inference that seems to be on the table here that Golder had made some recommendations prior to its final recommendation of an 87.5 meter crown -- and we'll go to Appendix C3.

MR. LEWIS: When we get there at page 15, please. And this is also in Intervenor Exhibit Number 2.

Q Now, Dr. Blake, again, we looked already at Appendix C2. That's one of the reports you reviewed. We're now looking at Appendix C3. You recall, I believe, don't you, sir, that in the final report that you looked at, the July 7, 2006,

memorandum, that Golder in fact recommended an 87.5 meter crown pillar?

A Yes.

Q Okay. Now, this language I wanted to direct your attention to. In their second report, Appendix C3, says, does it not, that,

> "The KEMC mine design will start mining at the lower levels and progress upwards. Additional drill information will be collected as the mining front approaches the crown pillar area, which will allow better characterization of the rock mass quality of the crown pillar and the top of bedrock elevation. As more information becomes available, a further refinement of this crown pillar assessment can be completed before commencing development in the upper levels of the mine."

Is that what it says?

A Yes.

Q And would this also indicate to you, sir, that at this time Golder was not making any final recommendations for the crown pillar thickness?

A This implies that.

MR. LEWIS: That's all I have.

MR. REICHEL: Would you keep that document up, please?

REDIRECT EXAMINATION

BY MR. REICHEL:

Q While we're waiting for that, Dr. Blake, when you were asked on cross-examination about your views with respect to -- or why you did not recommend the collection of in situ stress data from surface locations as has been suggested, so the record is clear, is your -- the fact that you're not recommending that in this instance, is that based upon the expense of those procedures?

A It's not based on the expense. It's --

Q What is it based on?

A It's based on the reliability of getting data that is consistent.

Q In cross-examination it was also alluded to the fact that you had worked for Kennecott before. Again, I touched on this in direct, but I want the record to be very clear. In doing the work that you did for the DEQ on this project -- well, first of all, I think you testified on direct examination that you have not done any work for Kennecott or any Kennecott company for in this decade; is that correct?

A That's correct.

Q And in doing your work here, were you in any way influenced by the fact that you had done work for that company before?

A Not at all.

Q Were you in any way influenced by the possibility -- the

hypothetical possibility you might be doing work for Kennecott in the future?

A No.

Q Now, you've made it clear, I believe, in your testimony and your reports that there are certain issues including, for example, the in situ stress measurements that simply do not -- are not available yet at this site; correct?

A That's correct.

Q In making recommendations to the DEQ on this project and in forming your professional judgment as to whether or not this project should be allowed to proceed under certain conditions, to what extent is that based upon your expectation that as described in the permit additional data will be collected subsurface before the actual mining begins? Is that part of the basis for your recommendation?

A That is part of the basis for the recommendation.

Q And to the extent that you've indicated that some additional data would be useful to evaluating the potential future stability of the crown pillar and hydrologic conditions, is it your recommendation and expectation that such data could be collected subsurface after development of the mine begins?

A Yes, that is my recommendation and opinion.

MR. REICHEL: Could you bring up C2 again please, specifically page five of that document of the text?

Q Dr. Blake, again, you've testified you've reviewed this document for part of your work on this site. I want to direct your attention to Table 1, which has the heading "Boreholes Used in GoCAD Model." And this is in the C2 document; correct?
A That's correct.
Q And looking at the left-hand column, does that indicate or does that identify boreholes for which RMRs were calculated as part of the exercise that Golder did in this report?
A It states that.
Q And did you understand in reviewing this document that information from the listed boreholes were in fact included in the database and used in the GoCAD model?
A That's what this table indicates.
Q Similarly --
MR. REICHEL: If you could bring up Appendix C3 to Table 1 in that document, please?
Q And again, Dr. Blake, this was among the reports that you reviewed as in this project; correct?
A That's correct.
Q And in reviewing this report, did you understand based upon -- did you derive any understanding a based upon your review of this table as to which boreholes were used in the GoCAD model?
A This indicates that all the boreholes from 04EA044 to

05EA109 says the RMR calculated for entire hole.

Q And you were also asked on cross-examination a series of questions based upon statements you had included in your two -- or excuse me -- in your December 2007 report having to do -- I'm paraphrasing here -- but statements relating to your comment that you believe that issues raised by the NWF comments were things that you took seriously or words to that effect. Do you recall that line of inquiry?

A Yes.

Q To the extent that those comments raised issues that involve the collection of additional site-specific data relative to the potential stability of the crown pillar and hydrologic conditions, do you have an opinion as to whether or not those kinds of data can be collected after they commence in situ after the commencement of the development of the mine and through the course of the development?

A Yes. I believe that can be carried out.

Q And again, is it in fact your recommendation?

A That is my recommendation.

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

MR. WALLACE: I'm through, Your Honor.

MR. HAYNES: Your Honor, I know the hour is late, but there's one --

JUDGE PATTERSON: But?

MR. HAYNES: But and I know the witness has been

on the stand for hours now. But there's one area that I need to explore, if I could, that's been raised by some of Mr. Reichel's questions.

JUDGE PATTERSON: Yeah. I don't want to preclude that. Go ahead.

RECROSS-EXAMINATION

BY MR. HAYNES:

Q Dr. Blake, Mr. Reichel asked you just now and there's also been some testimony thus far from you in this case dealing with the in situ measurements once the mining starts.

A Yes.

Q Or the mine starts to be developed; correct?

A Correct.

Q And I haven't heard yet for the record what those in situ measurement techniques are or will be. Can you explain those for us?

A I don't think -- I didn't recommend a specific technique. There are a number of different techniques. There's the basically overcoring with something that's called the old USBM cell. There's more commonly -- that used to be the standard. At the present time there is what's called a HI cell, which determines the three-dimensional state of stress from one overcore.

Q So the second one depends on overcoring?

A They both depend -- everything depends on overcoring.

Q Oh, I see. Okay.
A Yeah. It's all --
Q So the in situ stress measurements you're talking about that would occur as the mine's being developed are derived from overcoring?
A They're all derived from overcoring, yes.
Q And the overcoring is, as you've described, a method of taking a core -- a borehole and then drilling around it?
A Stress relieving it and measuring the response of the rock that's been stress relieved and then relating that to the stress.
Q All right. And you say typically those in situ measurements would occur as a mine is being developed -- correct? -- from underground?
A Yes. Depending on the -- depending on the actual, say, the stress problem. Most mines have never done overcoring.
Q All right. But in this case, for this mine, that's the recommended in situ --
A That is the recommendation because the stress in the crown pillar is an issue.
Q Right. And so do you understand at what level the first diamond drilling is going to occur when the mine is being developed?
A I believe it's the lower level, the lowest level.
Q All right. What about the 252 level?

A In actual fact, the overcoring should be done at a number of levels to determine the variation in horizontal stress with depth.

Q Fine. And what's the length of the overcoring borehole that is used?

A You generally get at least one diameter away from the opening to remove the stress redistribution around the opening to remove -- eliminate those effects.

Q So the overcoring -- well, I'm not talking about the width of the overcoring. I'm talking about the length.

A No; no.

Q The length is literally --

A The length depends on the cell that's used. Normally the HI cell is something like maybe eight inches.

Q So the overcore would go into the rock eight inches?

A Well, you drill -- you drill -- first you drill a small hole in the rock. And this hole would be if the opening is -- if it's, say, a five meter opening, you would drill out, like, ten meters. And you would glue this cell into solid -- into contact with the hole.

Q Right. So again, just so I get the physical picture of this, if the opening that you're working from is five meters wide, you would go into the rock ten meters?

A Yes, to get away from the stress redistribution around that --

Q I see.
A -- that opening.
Q And is it possible with this technique, the overcoring technique, to go further than, say, ten meters?
A Yes. You can go -- it's common to do, say, two or three overcores in the same hole.
Q I see. Two or three lengths?
A Yes. So, no. Yes. What you would do is if you started at ten meters -- and when you come in behind it, normally it's with a six-inch hole. The initial hole is normally an inch-and-a-half hole, inch-and-a-half diameter.
Q I see. So you have --
A So then you come in with the core barrel, which cores in and you do the first overcore. And then that -- the gauge and the core you break it off and take it off and you use the -- you've got some electrical leads that tell you what the deformation is and for all these components.
Q And you can overcore with successfully larger --
A Again, well, you don't know. Then what you do next is you put it in, say, at 10.- or at 12 meters or 14 meters. So you would do two or three overcores in the same hole. So then you come back and do another six-inch overcore extending from ten meters out to 14 meters.
Q And what's the maximum length of such overcoring techniques?
A I think some people have gone out probably, you know, in the

20-, 30-meter zone, but this is not -- I don't -- I don't know where it's been done at, say, long distances from the hole.

Q I thought you testified earlier that you heard of an overcoring in a deep mine that went thousands of feet deep.

A Oh, the mine's thousands of feet deep.

Q Oh, I see. And the overcoring was 30 meters or so?

A Well, the overcoring, yes, is normally just to get it beyond the influents of the mining.

Q I see. And so the overcoring would occur in this case as each stope is -- as each level of mined; is that right?

A It should be done on a number of levels. I don't necessarily say that it has to be done every level. In order to get this vertical variation with depth, you would do it. In this case, if levels are a hundred feet, you might do it every three levels.

MR. HAYNES: All right. Okay. Thank you very much, Dr. Blake. That's all.

JUDGE PATTERSON: Anything else?

MR. REICHEL: I have nothing further. Thank you, Doctor.

(Proceedings adjourned at 6:22 p.m.)

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