HARNEY COUNTY HISTORY PROJECT

AV-Oral History #145 - Sides A/B

Subject: Ellen Benedict on Diamond Craters

Place:

Date:

Interviewer: Ellen Benedict

CHAD BACON: ... since about 1956, when they tried to make a state park out of it. Because of its location in relationship to the state highway system at that time, they didn't go forward with it. Through our planning system we designated the withdrawal of Diamonds from the --- or Diamond Craters from locatable minerals. And in following through with that, last year, we've got formal recommendations designating --- or to designate Diamond Craters as an outstanding natural area. One from the state group here in Oregon, and one from the Pacific Northwest Federal Natural Research Area Committee. We are in the process now of preparing a document in support of withdrawing Diamond Craters from locatable minerals, which will be completed this fall.

The outstanding natural area recommendation that we are seeking, and is part of this withdrawal effort, recognizes three things. It recognizes the scientific value of the Craters, the educational values of the Craters, and the recreational value of the Craters. And all three of these will be tied in. Now. Dr. Ellen Benedict, we all call her Ellen, started last week --- this is a slide series that she has shown a couple times this past winter to different groups, and I asked her to run through it this morning for our benefit. With that Ellen, you're on.

ELLEN BENEDICT: For those of you that --- for folks that do not live in the Harney Basin, it's necessary to show a map showing some of the relationships, and so this is how I start

the slide show. Diamond Craters is here, it's about 60 miles by highway from Burns, the Refuge shares a common boundary to the west. And I think most of you that are here, sort of understand these relationships. Here is where Diamond Craters is in relation to the rest of the state. All right, I would like today, to tell you about how I became involved in Diamond Craters, and how Dr. Bruce Nolf of Central Oregon Community College and I became expert volunteers for BLM last summer.

CHAD: Could you speak just a little louder?

ELLEN: I will try. All right, most visitors that go to Diamond Craters do not realize that these low hills contain interesting summit features. I first visited Diamond Craters in 1968, and it looked fairly ordinary. I did look at some of the lava flows, but I didn't realize that this concealed some very exciting features. All right, these hills, the relief at Diamond Craters is about 550 feet. The elevation ranges from 4150 feet to 4700 feet, and that really isn't very great. According to Bruce Nolf, Diamond Craters has six domes that are geologically significant, and can you read that, or do I need to read it to you?

CHAD: Yeah, I can read it.

ELLEN: Okay, Northeast Dome, Graben Dome, South Dome, Central Dome, and West Dome, and then this last fall a sixth dome was found or discovered geologically, and there is a question mark because it is as yet unnamed. I will mention Lava Pit Crater, and Keyhole Crater as I go on, and Malheur Maar is right there. The next two slides will show you some aerial views; one of them was taken from about this position, and the other one from about this position. The Refuge by the way is over here.

All right, this is the aerial --- Chad, could you sharpen it. You're now looking west, this is a seeding area, and the green here is the Malheur Refuge. This is Graben Dome right here, South Dome is right here; the Central Craters Complex is there. This is an old cinder pit, which has been cosmetically restored, Lava Pit Crater, Red Bomb Crater. The

next slide will be shown in here, and the helicopter in the last slide was sitting about there, looking up this way. Now you're over the edge of West Dome, looking toward the Refuge, and this is Malheur Maar. Malheur Maar is sitting in an explosion crater, and it is filled with water.

The way that --- when I talked --- gave this slide show at Portland State, one of the professors sitting in the audience was Dr. Ed Lippert of Portland State, and he takes his field station class to the Craters to look at the algae of Malheur Maar. So this is a very important teaching site.

Chad mentioned the educational use of the Craters, and since the Field Station started in 1970, numerous classes have gone to the Craters to study various items of interest. For example, some of the classes go to study the plants and animals. And this is a summary of the work that the various people in this office did last year in compiling lists of plants and animals that are known to the Craters. The --- there is a record of 198 species, these have been verified. The ones --- the animal species are tentative --- about half of these animal species have been verified, by sighting. And I think you can read the numbers. This is --- much of this work was done by Esther Gruber and Gary Wing, by the way. Pookie also did a lot of this work.

All right, invertebrates have been little studied at the Craters, but I just thought that I owed it to you to show you one of the invertebrates that has been studied. This is a pseudo-scorpion; I've been studying pseudo-scorpions since 1965. The body length is about a forth of an inch.

All right, this particular pseudo-scorpion lives under juniper bark. And there are now published records of four species of pseudo-scorpions at Diamond Craters. For whatever that's worth to the world. In any case, this emphasizes some of the scientific value of the Craters. The --- there are --- there is much potential for scientific studies at

Diamond Craters.

All right, I want to show you along in this slide show, some of the various habitats, and you'll see these every once in awhile. For example, on the northeast side of the Craters, is the juniper woodlands. And you will notice it is a very extensive woodlands, it's highly developed for this elevation in the basin. And you're looking at White Lake. Jenny Rosenburg and Esther Gruber and I were out there yesterday, and White Lake is all dry this year. Last August, when they checked White Lake, it happened to be full of water, as this picture shows. And it had a considerable number of birds, shore birds, water birds, various types of nesting and feeding on that lake. It also had a rare plant coming up in it. Apparently the plant is --- emerges when there is water in the lake, and sits there in a resistance state in the soil when there is no water, and sort of hangs in there for long years at a time.

All right, this is a slide looking off of Northeast Dome, down into the trespass area. And I'll talk a little bit more about that later.

All right, I have taken my classes from the field station to Diamond Craters since 1974. I have taught cave ecology for the field station. And why am I --- why have I been interested, and why do I take my classes there. I am looking at these surface features. Now in terms of lava cave formation, this is a highly significant feature. It helps to explain how large caves, such as Malheur Cave, and the caves in the Bend area formed. And here's the walls of the cave, and here is a grass blade, this is a piece of cheat grass, to show you the scale. And this is a roofed lava tube.

Now let me show you the next picture. This is a --- this wasn't taken naturally at Diamond Craters --- this is from the Hawaiian Islands. But, if this will go backwards, notice the similarity of the two structures. Okay, the pahoehoe lava, which this is, both of these, are highly fluid lava, which is highly charged with dissolved gases. It is very hot

lava when molten. And it's fluid enough that lave tubes can form. Sometimes the material crusts, roofing these lava channels. And whether it roofs a lava channel, or whether it doesn't, the structures that are left frozen in the pahoehoe surfaces are exceedingly important, in explaining how lava caves form. And this is the type of thing that my students look at there.

Diamond Craters --- the caves of Diamond Craters also --- will that sharpen, it may not --- was taken at a fifteen of a second in existing light, so that is probably as sharp as it will go. Anyway, in the caves at Diamond Craters are some very significant lava formations, and the term that is preferred by speleologists is speleothem. You get into the word formation and geology has other meanings so, these are called speleothems.

CHAD: What was that again Ellen?

ELLEN: Speleothem. That is a new word for you Chad. Anyway, Chad, this is like the squeeze-ups that we saw on a bigger scale.

CHAD: Those are squeeze-downs.

ELLEN: Yeah, these are squeeze-downs.

CHAD: In the Wengo System.

ELLEN: Right. All right, in some of the other caves are these lava stalactites. Lava stalactites are rare in any cave. And these are formed in a very unusual way. These are called candle dip stalactites. The explanation is, that something sort of dripped off of the ceiling like this, forming a starter, like a candlewick. And then the lava pond grows up and subsided, and rose up and subsided coating the outside of the original speleothem. Here you see it in cross-section, and you can see the starter, and then the rings. These are highly exciting to geo-speleologists. They just get really turned on when they see this, because these are so rare and unusual. There are not very many places in the world where they form.

All right, in the same cave, evidence for this idea that they were formed by the lava pond rising and falling is this rock right here. And the first half dozen times I went there and showed it to some geologists, I said, "How do you explain these speleothems between the ceiling and this rock?" And they told me they couldn't.

All right, last October I took Russ Harder to this particular cave and he was --- he knew how it formed. The lava pond rose and it froze at the tips of these formations, and then later on the molted material drained away at this level, leaving this block.

All right, this particular structure right here is highly significant in terms of scientific study and understanding how these formations formed. Chad, at one point told me that he would throw this slide out, and I told him that it was the most important slide maybe in the whole show. Just shows the way it goes.

All right, in another cave is this unusual speleothem. Riesnoff says that Diamond Craters likely contains some unique geologic features. And this jolly well could be one. The geologists so far have not been able to explain how it formed. They sort of say something about lava ponds rising and falling. But they still haven't come up with a satisfactory answer to it.

Okay, this one may be unusual. These layers are about an inch apart. Chad --- Bentley the other day mentioned an older age for Diamond Craters, and had heretofore been ... and I think some of this is evidence for it.

Okay, how did I get into all of this, how did I make my contacts with BLM? Let's see, it was about October of 1978, Chad asked for information from the various instructors at the Field Station on the education, and scientific significance of Diamond Craters. And I didn't have too much else to do, and I was pretty interested in Diamond Craters, so I sat down and I prepared this report. And, I submitted it to him in November of 1978. And I guess that this was the first really solid information that Chad had received

on why Diamond Craters was educationally or scientifically significant. Earlier people said it's neat because it's neat. But this gave some concrete information. It had --- well you can probably read the abstracts --- anyway. I was a little bit concerned that he might think I was making much ado about nothing. But, I sent it to him anyway. And he immediately wrote and asked if he could visit Diamond Craters with me the next time that I came out.

And we toured Chad and Gary Wing in January of 1979, on a very cold day. And he still could feel excited about what we showed him. I suggested to him that he should get in contact with Bruce Nolf, who had studied Diamond Craters, the geology of Diamond Craters since 1968. And finally with the help of Esther Gruber, in case you don't know Esther, we got a meeting arranged with the "Y". And Pauline Braymen was present from the Burns Times-Herald, and an Oregonian reporter. Bruce told the group that Diamond Craters should be protected for two reasons, that it is a --- shows a tremendous geologic diversity in a very small area. And that it has unique features. And he gave some rather interesting ideas like taking off the pahoehoe surfaces like cutting down the top of a redwood tree, and leaving the bottom half. And, let's see, there is one about using rock, using the pahoehoe rock, this type of stuff. It's like you killing alligators for alligator skin shoes. There are other sources of shoe leather than alligators. He stated that Oregon is full of basalt. There are other sources of building stone. And I will show you more of the building stone later.

This right here is Lava Pit Crater. You're looking south toward the Steens Mountain. Okay, I like at this point then to discuss just a little bit about how Diamond Craters formed. This is an evolving idea, this --- Chad and I went to Diamond Craters last Wednesday with a geologist who had been mapping the Central Craters Complex, and he added new insight to the idea of how Diamond Craters formed. And I haven't

incorporated that material into the slide show yet, but nevertheless ---

According to Bruce Nolf and Bentley, Diamond Craters formed in two main stages. The initial flow was 6 miles in diameter, and less than 350 feet thick. And that is represented by the blue line. And we now have a new name for that basalt called Ruptured Raven Basalt, named by Bentley's class.

All right, the second stage involved the doming, and magma was injected up under this plastic crust, and domed. And there were six domes formed. And again these domes are Northeast Dome, Graben Dome, South Dome, Central Dome, and West Dome, and this unnamed one. The red shows various vents. You will notice that in the Central Craters Complex there are more than 30 vents. The green lines show fault lines, and down dropping of summit blocks. All right, this is a slide of Northeast Dome, and it's an aerial --- if you fly above it, you will notice all of these tension cracks. Let's look at one in detail. Last September we got up on Northeast Dome and climbed down into the dome, and we found this crack to be --- down into the crack, we found the crack to be 50 feet deep, 300 feet long, and about 8 feet wide. Notice the green right here, I'll show you more later. In the bottom of this crack were found two caves that were 20 feet long, and they had roofed from rock fall into the crack. And the bottom was permanent ice.

All right, this is a very specialized habitat. I feel that if we find cave-adapted invertebrates in any part of Diamond Craters it will be in these earth cracks. There are similar earth cracks in Arizona that have highly specialized cave invertebrates. There are mosses and ferns that grow on the walls of these cracks, and these mosses contained numerous creepy crawlys. Esther has been working at --- with Dr. Crance at Oregon State, and he has found what he feels is a new genus of a very unusual mite that came from this moss. Actually it didn't come from the moss, it came from the ice, didn't it?

ESTHER GRUBER: Yeah, it came from ...

ELLEN: Which is farther down. Really hot stuff, as far as an acro-ologist is concerned in this area. This slide shows Graben Dome. It's an aerial looking west, and this is about a mile and a half long, and about 300 feet wide. I remembered the dimensions. What happened here is that the summit collapsed along these fault lines, and the summit block dropped. Here is a diagram. Here's the dome before it dropped, and here are the fault lines along which the dome collapsed. So magma erupted out in flight flows to the sides and to the end, and allowing a support --- the support was withdrawn and the block dropped. This is just a classical example of a Graben. In fact, I was told several years ago that there was a picture of this Graben in the textbook in Germany. This is just a classic example of this type of geologic feature. This is a higher aerial, and you will notice that there are two lateral Graben, and then the main one.

And Saturday, I was doing a plant and bird survey in this area. The diversity of biological habitat in just --- in this distance right here is really tremendous. Aside from the geology of it all, the diverse geologic sub-straights provide a tremendous biological diversity. The juniper woodland that I showed you earlier is right over in here.

All right, next we are going to the Central Craters Complex. This is another one of the domes, those tremendous eruption, the summit collapsed, and as the magma shot out in various explosions. At some point, ground waters rushed in here, and there was still additional explosions. I don't know what you know about calderas, but his is classic caldera formation. And that's where the summit collapses in a circular fashion. This is like Newberry Crater, Medicine Lake Highlands, or Crater Lake. The summit collapsed. So Diamond Craters has its own little caldera, and there it is from the air. There are fault lines along here, and Bentley says it's actually --- there is a buried Graben in this area. These are the vents, and there are more than 30 of them. Yeah, you can see it. After the summit collapsed and all this material erupted out, then there were some quiet basaltic

flows, and there is this mode, this pahoehoe basalt in here.

This again is a --- just a highly unusual feature. And you can go on and on and say that all of this is so unusual, but it is. These are features in miniature that are really excellent examples of their kind for scientific study, educational study.

Out here is West Dome, and here are the explosion pits or craters connected with --- associated with West Dome.

All right, now we are on the very low aerial coming in over Diamond Craters. Notice this right here, here is the molt. This is called deep throat. Let's go in closer. This structure, which doesn't even fit the screen --- is several times higher than a human being. It is just awe inspiring to stand out there and look at it. This picture was taken about high noon, and the light is rotten to show you what a distinct feature. It's called a vent tube lining, called deep throat. So, of course, I asked how did it form. Because, I can't understand how you'd have that left standing up there.

All right, at one time this was the center of the throat of a cinder cone, perhaps like that, and heavy material was blown away from it. A little bit later, I'll show you some of the explosion craters. Notice these huge blocks of explosive material. I showed you how large deep throat is. Well, for scale consider how big those blocks are. Something happened that put that material out there. Deep throat again. Bruce points out that the Diamond Craters contains an unusual array of landforms for basaltic area. Basaltic flows are normally fairly quiet, and they produce --- the quiet eruptions produce such things as driblets, spires, spatter cones, pit craters, and collapse craters. These are all fairly mild. And just plain sort of slow motion lava flows.

In addition to all of those, there were these very explosive eruptions, in which you had cinder, produced and cored bombs, and then blocks of dead rock thrown out, such as those blocks that I just pointed out to you.

All right, I'm going to show you some of these --- examples of these fairly rapidly. You'll recognize George Brown standing beside some driblet spires, and I can say after last Wednesday, that Diamond Craters seems to have every size of driblet spire imaginable. And it looks like this happened just yesterday. This material looks so fresh where it hasn't been vandalized at all.

All right there is a hole up the center of this, and the material sort of fountained out in a very narrow radius and dripped down. So it bluup, bluup, bluup, and formed these. And they're just really impressive to see. These are highly unusual in the State of Oregon. This could be the only place in Oregon that they have been recorded. There is some difference of opinion on that but, at least it's one of two places if its been reported otherwise. Very unusual feature.

Then there are spatter cones such as this one, which by definition is a cave. If you go back into this, you actually get into total darkness, which is the definition of a cave, according to the National Speleological Society. On the roof here are some spatter stalactites. In this case the lava pond grows to a certain level, here's one of the old levels. There is a higher one up here. And the molten material stayed at this level for a while, and it splattered, so it went plup, blop, blop, and the material then dripped down. These stalactites then have a different origin, and were formed in a different way than the candle-dipped stalactites. Unfortunately this feature has been highly vandalized. I have pictures of it in 1974, in which this portion extended out, and this rock hadn't been broken off. This --- it's unfortunate that people have to do things like that.

Another type of crater, this is Lava Pit Crater, Keyhole Crater, Pierce Graben Dome. These pit craters in which the magma bubbled up, and like a pot of fudge boiling over, the material boiled over and flowed out the side leaving these lava channels, and lava tubes. This is a highly significant area of pahoehoe lava. And then come some other

pahoehoe areas, this is a collapse feature, that's also a cave in which the material sort of oozed up and then drained out underneath, leaving a small cave. So --- in some cases the magma rose up like in Alaska, and drained out over the side. And in other cases, the material drained out underneath the plastic crust. We have all types in diversity of features.

Now let's look at an explosion crater. These are the twin craters. Huge blocks of country rock were thrown out from craters like this. And then come the cored bombs. These are highly unusual again. I seem to be using the word highly unusual, but it's the case at Diamond Craters.

All right, what happened here, country rock or bedrock was brought up through a confined steam explosions, and coated with some of the fresh basaltic lava. And so in the center, you get material like this, which is the older formation underneath Diamond Craters, and it coats the cored bomb. The cored bomb is coated by basalt. If you look careful here, this is the basalt; this is the older material in the center. And both of those look like a type of basalt. Okay, these are from explosion craters. Along in the same crater are the cinders, which are chunks of the newer basalt.

All right, let's go on to some history now. Last September, Bruce Nolf brought the Pacific Northwest Geophysical Union Meeting to Diamond Craters, a group of about 25 geologists. And a group of BLM types were out there, and one of the main geologists, one of the field trip leaders, was George Walker. And in some circles, George Walker is known as Mr. Oregon Geologist. He has worked for USGS, the mineral resources branch, and he says Diamond Craters is worthy of preservation. And I probably should dig out the exact words, but anyway --- roughly that there is no other place in the United --- in North America that exhibits such diversity of basaltic land forms. And Pauline, if you're quoting it, I'll get you the right words. Anyway, as far as George is concerned,

Diamond Craters is absolutely unusual and unique. It contains such a diversity of and forms in such a small area. I think you recognize some of the other people. What we did that day was, drove to Graben Dome, and then were air lifted down into the Central Craters Complex, at least the geologists were. Most of these people like Chad rode, I guess, in the van.

Last October, I was able to get Russ Harder from Southern California, to come to Diamond Craters. Russ is a geo-speleologist. And he is one of the better-known scholars of lava cave formation. How do lave caves form? And I wanted, you know, I'm basically a biologist, although you wouldn't know it hearing me today. I wanted a geo-speleologist to go to Diamond Craters and to look at it, and either tell me that I didn't know what I was talking about, or confirm the idea that it was special speleologically. And Russ is the first person that was able to explain these candle dipped stalactites. And, if I can find in my notes his words, I would like to read them to you. If I can see it in the dark. May-be I'm not going to. Anyway, I'll try roughly to quote them. Ah
--- it's a big help, they are marked in red, but it's dark. Here we go --- no, I found them.

All right, all last summer when we were dealing with the news media, which we did on several occasions, I was asked, why is Diamond Craters speleologically significant? And I would say, "Well because it's a good place to take students out and show them how caves formed." And then they'd come back and they said, "Well is that all it's important for?" And then I'd say, "Well it's significant because it shows us about lava caves speleogenisus." And I realized that I had lost the person long before, because they knew nothing about how lava caves formed. So, I decided last October that I would turn the tables and ask Russ this question, "Why is Diamond craters speleologically significant." And this was his answer. Still the wrong paper. Anyway --- shucks --- buried in there someplace are his golden words, which goes something like this. Diamond Craters is

speleologically significant because it has caves, and caves are a geologic anomaly. Meaning that caves form very rarely in basalt. Requires a very special type of basalt, and so on. And he said the pahoehoe flows are especially in need of protection, because they reveal this story of how lava caves form. So, in his opinion this material needs preservation. Now then, let's look for a bit of the history, which Chad outlined on the use of rock at Diamond Craters. This is a pahoehoe surface --- does that focus ---

CHAD: Yeah.

ELLEN: This is my hand lens. Give you an idea of the scale. All right, geologists like to look at flows like this, they can determine the direction of the flow, and to a geo-speleologist such as Harder, he may study a portion of the flow that is the size of this picture here. And he could spend several hours looking at it, and he'd come up with measurements and ideas about how all of this was put together and what it means. It's sort of a micro-geologic feature of great significance. Diamond Craters was a source of rock for many of the early settlers, and legend has it, although Nolf does not feel that this is true, that the Round Barn, there was stone from the Round Barn came from Diamond Craters. And according to legend, 250 tons of stone were hauled the 8 miles to build Round Barn. The barn was in use by 1884. Nolf feels that there are other sources closer to the Round Barn, and it's not the same type of rock.

But, this stuff right here, under one of the bridges is very undeniably has the look of Diamond Craters basalt. And it's all over, if you want to crawl under bridges and look at it. And a lot of the bridge abutments that were erected during the 1930's and '40's came from Diamond Craters. This was probably a logical use for this type of stone at that time. In the first place the significance of Diamond Craters was not recognized, and there probably weren't too many other sources of stone. But, that is no longer the case.

In 1964, Peter ... produced a very important article in Orven, telling --- re-describing

some of the features of Diamond Craters. They --- the only other geologic study of Diamond Craters have been by I. C. Russell in about 1903, and it was just a very brief description of the Craters. This was sort of a landmark. They called attention to the Craters, and called the Craters to the attention of some of the geologists that then came out and looked at the Craters. In recent years, rock --- these pahoehoe surfaces have been removed. I think there is a slide out of order. Let me go forward, then I can come back. No, let's go back here. I'm jumping the gun. I've forgot what the next slide was.

Okay, to continue this story, Chad mentioned that Diamond Craters in 1956 was --- BLM attempted to give it to the Oregon State Park System, and the Oregon State Park System refused it, saying that Diamond Craters was too little known and remote, and would probably be too expensive to maintain as a state park.

All right, in about 19--- there is how it goes --- in about 1971, the hauling of surfaces such as this began, and the material was taken in commercial quantities, and hauled to Bend. This slide happens to be an area that a trespass had occurred later, but it shows you the types of material taken. In --- correct me if I'm wrong --- was it 1978 --- '77 that even more stone was removed from this particular area. The earlier cases of trespass, civil charges were brought, and in this later one I believe criminal charges were brought. And Gary Wing went out and attempted to measure the value of this stone. And just about anybody else in the room could talk about this better than I at this point. But anyway, here is the slab of the pahoehoe rock. How much is that slab worth?

CHAD: Probably $3 to $4.

ELLEN: Yeah. One of the things that the trespassers did was to plant illegal mining claims. There is one right there. Okay, where do we stand now? Now --- Chad mentioned the natural areas preserve advisory committee, which sent this letter to the acting director of BLM last November. Esther and Pookie and George Brown worked

many long hours on preparing a research natural area proposal from the Burns District. That is what this is all about right here. And they included species list of geologic information, significance of the Craters, and so on. Okay, this report was sent to this committee, and the committee recommended that Diamond Craters be designated as outstanding natural area. A very significant landmark. They recommended that the entire 16,656 acres of Diamond Craters be preserved. They said something in there about the Craters being protected from exploitation through these strict enforcement of existing regulations. And they also suggested --- recommended the allocation of funds. And I guess that might be the way Bruce and I got on the board this summer.

One of the things that BLM has started doing is, is doing some "PR" work on Diamond Craters such as this article. I don't know whether all of you saw it or not, but it is kind of a neat article, written by Don Smirthrock. And it's worth reading. It's also almost accurate. When you read how a lava cave forms, it isn't quite the way it does. I think he has the material flowing downhill and back up. But otherwise it is a pretty good article.

So what's going to happen now? Ray Snoff, if St. Helens doesn't start spouting lava, is going to start working on the geology of Diamond Craters, starting in June. He is going to come up with the geologic interpretation of the Craters, a geologic map and a technical paper. I am working on the biological interpretation, and will write some of the material, or most of it that will go into the report that will be forwarded to the State Office, and then in turn to the Secretary of the Interior, and to Congress to get the mineral withdrawal.

I think I have one more nifty slide. Oh yes, I have two more nifty slides. I should mention in terms of the biology that there are some fairly unusual things biologically at Diamond Craters. I've been stressing in this talk the geology. And I'm absolutely sure that when most biologists go out there they --- all they see is like that first picture that I

showed you, some cinder, and some sagebrush, and it looks very ordinary and very common. But, if you look in some of the little off, out of the way places, you might see such as --- group of trees like this, which are quaking aspen. Esther discovered this last summer during an aerial reconnaissance. It's the lowest elevation aspen grove in the basin. It's highly unusual at this elevation.

You're looking up toward Graben Dome. There are all of these nifty holes here that give some interesting things to look into. I've showed you some of the features of some of the holes. There is a kipuka, which means that there is an old island of the old material surrounded by the new. I think that's the last slide. Are there questions?

CHAD: Catch the lights.

SIDE B

ELLEN: I read that Diamond Craters was less than 400 years old, and this was based on the idea --- this was sort of the legend category that the material looked so young out there it just couldn't be any older than 400 years old. And the legend said that it was the youngest lava flow in the State of Oregon. Not so, Jordan Craters is younger. There's an area up by the McKenzie Pass that is younger.

Okay, in a --- a number of years ago there was some hydration rind dating of the inside of some of those cored bombs, and they came up with an age of 17,000 years. This pushes it back a little bit. The only trouble is, that hydration rind dating is normally based on a piece of obsidian sitting out on the ground weathering. And you can get --- it's not too good an aging method. But you can get a reasonably accurate dating maybe, from that method, if the obsidian has been exposed.

Okay, this dating was done on a piece of material that was inside of the layer of basalt, so it isn't too accurate. So we know then from that dating, the only dating that has

been done that it has to be at least 17,000 years older. Last Wednesday when Chad and I went out with Dr. Bentley, Dr. Bentley said that he thought it was a million years old. And he based this on a number of different things, like their spiroidal weathering. This means that there is weathering on some of the rocks where it breaks off in thin sheets. And that type of weathering in other places is at least that old. And there are other things; there are wind pits, little pits dug in the rock that are sort of blowouts. The wind, the sand sort of eats away at some of these rocks and it takes about a million years to have that happen. And the pits are deep enough that it could be. Anyway ---

CHAD: Let me interject right here ---

ELLEN: Right.

CHAD: That parts of the Craters go back to maybe a million years ago, and the --- what'd you call that original, ruptured raven ---

ELLEN: Ruptured raven.

CHAD: But there has been many, many geological events ---

ELLEN: Events ---

CHAD: --- that happened since the original blow, so we may run up from a million years ago to maybe twenty thousand years ago.

ELLEN: Right.

CHAD: And with stuff scattered all the way through over that period of time.

ELLEN: The earlier ideas on the subject, was that the whole business is about 400 years ago, and that's not so. It has to be older than that. Now the only way that you could really tell about this is doing some potassium argon dating, which Bentley recommended. Other questions? I thank you all.

CHAD: --- real pretty stuff.

ELLEN: Right, all of the flowers ---

CHAD: --- natural bridges, some of the more spectacular geologic things out there. And at some time in the next couple of months ... crew from the office to spend a day at Diamond Craters. If any of you are interested in doing that, if you leave your name with Ellen, I'll see what I can do about getting this done --- arranged.

MAN: Are you trying to give this to the Park Service?

CHAD: Yes, to be managed as a National Monument. Well, that's one of the things that I --- I'm pretty much convinced right now that what we've got at Diamond Craters is really an outstanding area, that it has more diversity, more features than several national parks, and quite a few national monuments that were set aside for geologic phenomena. If BLM is unable to manage Diamond Craters, and protect it, give it the protection it needs, then I have no reservation at all about pursuing a national monument or national park.

MAN: Find a few skeletons in there, you create an Indian story, and they'll take it right away.

CHAD: Well, there's probably quite a little Indian use around the perimeters, but we haven't found anything in the interior yet, or none of the caves that we've looked in, and it's probably because that lava is damn tough on sagebrush moccasins or ---

ELLEN: Awfully dusty too. I didn't stress the biological aspects of Diamond Craters, but a whole slide show could be done on that too. There is all sorts of small animals that use the Craters. I'm sure that if Esther were doing the slide show why she could show you numerous plants for example that are very interesting.

WOMAN: Would the Indians have stayed away from it, from a mystic

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ELLEN: It's possible, but if you go out there, it's just not possible ---

WOMAN: Well, as you look at ---

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