I'm Walter Alvarez. And I'm Roland Saekow. And we're going to show you some pictures that we took in Italy last fall while we were doing geological field research. So this is an area that has lots of limestones, and limestones are really good recorders of the history of life. They're made of the mineral calcite and most fossils are made of calcite. So a lot of these limestones are just simply made of fossils so they have this wonderful record of the evolution of life. But there's a problem with most limestones and that is that they are deposited very close to sea level where waves and currents, big storms bust them up and just scramble up the record. It's like when you go to the library and you get out a book, that history book which you really wanted to read and some idiot has torn out the pages and you're really mad at that idiot. Well, it's the same thing with storms and waves and currents; they just destroy our rock record. So if you go to limestones that were deposited really deep in the ocean, where there aren't any waves or currents or storms, then you get a very beautiful record layer on layer on layer on layer like that without any disturbances. So these are actually the very best recorders of Earth history that we have. And there are not too many places where you can find them. One place you can find them is on the floor of the ocean. And so the drilling ship goes there and drills and samples them. But there's really only one place in the world where large amounts of these deepwater limestones are exposed, where you can get out and walk around on them as a geologist, and that place is the Apennine Mountains of Italy. So we go there often because this is the best library we have. So here, Roland has this wonderful picture that he took. This is a GigaPan image so it's a billion pixels or thereabouts here. And this shows an exposure of some of these limestones in Italy. And what you can see is that there are all these parallel lines-- here's a very big prominent one-- all the way through here. This is the orientation of the beds. And of course, beds were originally deposited horizontally, so these things have been tilted like that, and that was during the deformations that produced the Apennine Mountains. But in there, every bed has a record of what happened when it was being deposited. So, Roland, if you were to zoom in here someplace and he can zoom in almost indefinitely. That's good. Right there. So now you see each one of these is a bed coming along and it was deposited during a certain interval of time, and it takes about 10 meters per million years. What's that? That's how long? So one meter is a hundred thousand years. That's about a meter. That represents about a hundred thousand years of Earth history. Okay. Now, most of these are limestones right in here but occasionally you find a dark bed like that which is made of chert, which is the same mineral as quartz. It's made of silica, SiO_2. And those form in an interesting way because some of the organisms that were living in the surface waters and whose little microfossils fell on the ground were made of silica. Most of them are made of calcite and so that's what gives these beds. Some of them were made of silica and then after the deposition, the silica kind of migrates chemically into a single layer like that. And these are sort of show... there's kind of a rhythm of these things going on through time. So if you were to take a sample of this rock, you could see all of the little components that had lived in the surface waters and then fell down grain by grain. Okay. Now, Roland, if you'll back out and let's go up and see this strange bed here. Maybe if you go into about there somewhere. Okay. Now, see, that bed looks completely different. Good. That's right. Fine there. Go out just a little bit. Okay, so here are the normal limestones and here are more normal limestones. You see they're kind of white in color or pinkish. But this area has these very dark beds. That's about a meter thick, about a yard thick. And those are dark in color for an interesting reason, because that is a time of what's called an Oceanic Anoxic Event, an OAE, which means it's a time when oxygen stopped getting down to the floor of the ocean for some reason or other. Basically, it means that the ocean normally overturns like that and carries oxygen from the air down to the bottom but sometimes it stops and it doesn't overturn. And then you get one of these things because no organisms can live on the bottom because there isn't any oxygen anymore. And so when organic matter sinks down from the ocean surface, it lies on the bottom because nobody can go there and eat it because nobody can live there because there's no... there's no oxygen. And so you get this. And this particular oceanic anoxic event can be traced all over Europe and over much of the Atlantic Ocean as well. It happened about 94 million years ago. We use the name of an Italian geologist of a hundred years ago who first described it, Bonarelli. So it's called the Bonarelli level and so this is a great marker. So you see you can trace it all over Europe and the Atlantic Ocean. And if you back out, you can see that this was time when the ocean bottom was oxygenated and then here is the time that represents when it was starved of oxygen and then the oxygen comes back, so we have this up here. One more thing to see down in here, and that is, can you see this sort of a reddish color down there? That's because up in this bed, there are little nodules, little concretions of pyrite. Pyrite is fool's gold and it's made of iron and sulfur. And so it's what forms when you have an ocean bottom with no oxygen because the sulfur can't get oxidized, so it just forms this nasty stinky bottom. Underneath this sea bottom would have been some place you wouldn't have wanted to go, it would've been really unpleasant. But at the present time now on this surface which has been cut off and cleaned away, the iron in those pyrite, fool's gold nodules is being oxidized by the air and turning into rust, and so this is actually red color is rust that is being washed down out of this level where the pyrite has oxidized. And so this is a wonderful example of a really good geological outcrop where we can read a great deal of Earth history bed by bed, layer by layer, 100,000 years by 100,000 years.