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Alexander Klimchouk oral history interview with Dr. Bogdan Onac, January 23, 2007

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Bogdan Onac: Hi, everyone. It is January 23 [2007] today, and we are in the USF Library. We have a special guest today with us, Professor Dr. Alexander Klimchouk from the Ukrainian Academy of Sciences, representing the Speleological Institute in the Ukraine. Welcome to USF, Alexander.

Alexander Klimchouk: Thank you. Thank you, Bogdan.

BO: People here at USF, especially the karst group but not only, are very interested in how you got involved with the science, how you got involved in karst, because—as I am a karst guy, I know that something happened at a certain point in your life when you were switched from football or soccer to karst science or something like that. So, if you can provide us with a small background or something, and then we'll get further from that.

AK: Okay. Well, actually this happened with me very early in my involvement to karst, to—let me say not first to karst, but to caves. I was a teenager. Actually I was eleven when I got enrolled in the children caving group, which just started at that time in Kiev in the Ukraine. It was Soviet Union at that time. I was kind of interested in geology, curious.

BO: Rocks, fossils, minerals, whatever.

AK: Rocks, fossils, minerals. And I went to so-called Pioneer Palace, which was a system at the time in the Soviet Union to support children's activity out of school, different kind of activities.

BO: Yeah, I know, but for the Americans that's very important because I don't think they have such an organization for pioneers.

AK: And I was looking for a geology group, and I knocked [on] the door and I saw some guy sitting there and I said, "Well, where can I find geologists?" And he said, "Come, come. Here, this is the proper place. We do speleology," he said, "but geology is part of speleology." That's what he said. I said, "Okay." So I go to—

BO: Works for me.

AK: Yeah. I was eleven at that time. And that guy was actually kind of the founder of caving in Kiev at that time. He was just starting. He somehow got interested in caves and went to work in this Pioneer Palace to—

BO: He was a geography teacher or something like that?

AK: He was kind of young, actually—

BO: Enthusiastic. I see.

AK: Enthusiastic person, student for geography, yes, at the time, and he worked as—he did this work with children to start this kind of cave group. That was a time when speleology in the whole Soviet Union—

BO: What year was that?

AK: It was sixty-seven [1967], sixty-eight [1968]. Unlike the Western Europe, speology was not developed—or caving, let's say, movement as clubs and groups—was not developed in the Soviet Union until the very late fifties [1950s], beginning of sixties [1960s]. So it was just the beginning of the whole speleology in the Soviet Union, the sixties [1960s]. And I got involved with that and was everything new. We were pretty

much separated from the rest of the world, as you remember, in the Communist time, and that means that we invented everything by ourselves—

BO: Yeah, I know.

AK: Starting from cave techniques and—

BO: Equipment and everything.

AK: —equipment and methods and surveying and technique, whatever. It was very exciting time, and especially because we were teenagers. It was not like, for example, here children's groups like Boy Scouts or whatever. They visit some caves as experience of different kind of natural wonders, but they are supervised strongly. It was not like this. We did real cave exploration, being teenagers. I mean, we went to real expeditions. We were looking for caves. We discovered new caves. We explored them, being teenagers. We were pretty much not supervised. And it was a pretty exciting time.

Mainly we worked in the western Ukraine, we started exploring caves there. Now, you know, the western Ukraine hosts some [of the] longest gypsum caves in the world, but at that time the exploration and survey of these caves just began. And then we went to Crimea, south of Ukraine, to explore caves there. We went to Central Asia.

BO: How was that during that time, to travel so far? I mean, even Crimea, it was quite far. What about Central Asia?

AK: Actually, at that time in Soviet Union, things like that were very cheap in terms of money.

BO: Railway?

AK: Railway, mainly railway. Sometimes we traveled by land as well, in Central Asia, but later on. But mainly by train. It took four days to get from Kiev, from Ukraine to Uzbekistan, for example, from Moscow. And we were teenagers, not from rich families, as you can imagine, so we raised money in different ways to support our expeditions. Sometimes we used hitchhiking. For example, to western Ukraine, to get from Kiev to western Ukraine, you normally used hitchhiking.

BO: Hitchhiking, yeah.

AK: Five hundred kilometers; it would take you a day to walk on the road and get there. It was pretty friendly atmosphere, and every driver, when he see a group of strange teenagers—

BO: That means you are raised in Kiev or around Kiev. You were born there?

AK: Yes. Well I was born in Odessa, in south of Ukraine, but my parents lived in Kiev; but my grandparents lived in Odessa. So my mother went to his father to give birth to me, so I was born in Odessa, which is a city on the Black Sea coast in the south of Ukraine. But my family was based in Kiev. So I spent, when I was a kid, a lot of time in Odessa during summertime with my grandfather, but basically I was grown up in Kiev, which is the capital of Ukraine. So, yes, in Kiev.

BO: You started like a teenager. I started like a teenager, because I was like in fifth grade when first I got into a cave with our geography professor. But I remember my mom was—my father, no, but my mom was really, really getting sick when she saw we [are] having ropes and karabiners with us. What about your parents?

AK: Well, I have kind of special situation, because my father died when I was four.

BO: Oh, I am sorry.

AK: My mother get married in few years and she gave birth to triplets, three: two sisters and a brother. When I was six this happened. It means my mother was very much preoccupied with the new—

BO: Arrivals.

AK: —arrivals. As I said, I started—I get involved in caving when I was eleven. She was so busy with the small kids. She was certainly worried very much about me. But somehow I was not closely supervised or watched by my mother. And then she got divorced from her husband, and you can imagine having four children.

BO: Alone, it was not easy.

AK: She had some difficulties to raise us. And she was kind of pretty happy that I am not on the street, that I am enrolled in something that—

BO: Organized.

AK: Organized, meaningful—and of course, she was concerned about all this dangerous whatever—

BO: Yeah, but otherwise it was an organized society—

AK: Yes, it was.

BO: Not society, but I remember how that stuff worked.

AK: A group, children club. Then this children club—when the people who were enrolled, they grown up, they left the children group and continued organizing different kind of clubs in Kiev.

BO: Clubs, yes.

AK: And this is a way how this caving movement started in Kiev. Actually, it kind of originated from children groups.

BO: From the children's organization.

AK: And then many groups appeared, and most of them were originated in the children's establishment. And actually, this is something very interesting; this is something which continues till now in the Ukraine. We have a big tradition of working—in caving and speleology of working with children groups. This is a way to arise new generation of cavers, which are really very deeply motivated because when you start when you are a teenager, you are really very much submerged and occupied with all the impressions and ideas in this kind of activity. Then when you are, let's say, twenty or whatever, the strong self-sufficient age, still young, but they have all of the experience. Five or six years—

BO: Behind, yes.

AK: Behind to be cavers. So, they are really entering the golden age of caving activity. They are already established, strong, and experienced guys. So this is something very useful; at least it proved to be in our history.

BO: Yes.

AK: To have those children caving groups for producing next generation cavers.

BO: Propagating, yes. And the school? Everything was in Kiev? Or you was moving from time to time to Odessa?

AK: No, I was raised all the time in Kiev and I was in school in Kiev. I may tell you I was not very successful in the school in terms—I mean, I was successful, but I had some controversial reputation because I spent a lot of time in expeditions.

BO: But I thought that expeditions were only summer. I mean, going in Central Asia—

AK: No, no, no. We did expeditions on every occasions and every small holidays or whatever. And we took a week before [the] holiday and a week after holiday out of—

BO: But that was the time you were together with the Pioneer organization—

AK: Yes.

BO: —because they used to motivate them.

AK: Well, you know, it was a kind of umbrella. But then we started doing our own things.

BO: Oh, okay. And the professor got mad?

AK: Yes. So, it was not really controlled by any established system. So we took a lot of days away from the school, sometimes months. And this was not, of course, welcomed by the school managers or teachers, professors. They were not very happy.

BO: I imagine.

AK: This guy always disappearing. Yeah, but—

BO: I remember funny stories about that stuff with myself. Getting phones from professors, mathematics professors, saying, “I would like to speak with Onac’s father.” “I am on the phone,” my father answers. “You know, your son is doing a lot touristic orienteering—you know, that sport where you run through the forest with map, compass.” I found that it was extremely important for my orientation, for all kind of things. But the guy continued, “Do you think it’s worth continuing touristic orientation or professional orientation?” And then my dad got like, “Uh-oh.” The bell was ringing. “Oh, I have to talk to my son—what he is doing,” because there was time when I was traveling a lot on that.

But I was not only karst. I mean, at the beginning I started with sports and doing stuff. So I understand at your teenage time was mostly karst. You don’t have discotheque and other things.

AK: Caves. No, I was totally occupied with these things. It was kind of self-sufficient environment for us, this cave group, all this very intense activity of trips, expeditions, preparations, explorations. So, we were totally submerged in this.

BO: So, what was the system of that time? You had ten or twelve classes?

AK: Ten classes.

BO: Ten classes. And then you would follow the college or the—

AK: Then you may enter university. When I finished school I was supposed to attend university immediately, but in that time, I started exploring caves in Central Asia. It was seventy-one [1971], I guess, I made the first expedition in Central Asia, to Uzbekistan, which was kind of a virgin—almost virgin area for caves at that time. We were more or

less the first club to start exploring caves there. It coincided that my group went to the expedition and I'm supposed to have exam to the university. I stayed to have this exam and passed one of them—supposed to be four—and then said no.

BO: Better in the cave.

AK: "I can't resist." I followed my group to Central Asia. So, I failed this exam because it interrupted this process. And then the same happened the next year. We were more kind of deeply, deeply involved in—

BO: Exploration.

AK: —very exciting cave exploration in Central Asia, because we discovered the caves there, lots of caves: the cave which started to go very deep and in few years we made this cave the deepest in Soviet Union, the first kilometer deep cave in the Soviet Union, which was, you can imagine, very exciting. And I could not stay away of this. So, a few years I was kind of neglecting on university exams and instead going to those expeditions. Then I entered university for geomorphology, and I finished. I was graduated from Kiev University as a geomorphologist.

But back to caving. As I mentioned, the Central Asia stuff, that was very important because—well, for my evolution as a caver or karst scientist. I can't say at the time I was a scientist, but I was definitely inclined to study caves, and not only to explore them but to produce some knowledge or describe them, publish, whatever. I published my first scientific paper when I was fourteen, in a kind of science journal in the Soviet Union. Those things in Central Asia, as I mentioned, we were lucky to find the cave which went very deep. In that time, in seventy-six [1976], we reached kilometer depths. At that time it was third deepest cave in the world. And that was done mainly by teenagers. I was fourteen, fifteen, sixteen during that years. And you can imagine what the impact this made for young guys like me. We suddenly realized that this is something when we are able to produce discoveries which are globally important. It was the third deepest cave in the world—in the particular year; you know, the situation was changing.

BO: (inaudible)

AK: And this is something which then impacted a lot our caving community in Kiev, and me personally, that we were deeply poisoned with this lure or call of the abyss. Let's say the lure, allure to explore the deepest cave. Then we continued to other areas and we will talk maybe about this later, but it was seventies [1970s]. Six years we were occupied with

exploring caves in Central Asia. And the particular cave, the name is Kievskaja, which means name it after Kiev. It was the first kilometer deep cave in the whole Soviet Union, the deepest cave in Asia and so on. So, it was very exciting.

BO: Exciting. But so, you graduate from geography?

AK: Yes.

BO: As a geomorphologist, karst geomorphologist now, yeah. How was the system with a Ph.D., with doctoral studies? Because I'm coming from Romania, I was under the communists for a long time, and I mean, it was terrible in our country to get into the system, into the doctoral proposal. You had to be a communist member. You had to be all kind of things.

AK: Yeah. Well, actually it was not such a—such severe in the Soviet Union at that time. It was simpler. I mean, there was actually plenty of possibilities.

BO: So, open positions and—

AK: Well, yes. To get Ph.D., kind of yes; you have to integrate yourself into system. This is common in any country. I mean, you have to integrate yourself into the scientific system.

BO: And you started after you started to work there?

AK: No, actually it took quite long time for me to get Ph.D. because I was so much occupied with all this exploration activity and doing science. Actually, I joined the Academy of Science almost immediately [after] I finished school. At the time when I was student of the university, I already worked for Academy of Science. This is the Institute of Geological Sciences in the Ukrainian Academy. And I actually worked for this institute till very recently, till a year ago. So, all my life I was affiliated with this Institute of Geological Sciences with the Department of Hydrogeology. And in Ukraine, the Academy of Science was and still is major system of doing research. Universities also do some research, but much less than Academy of Science; [it] was a special system of doing research.

BO: So that means funding is much better in the Academy than in the university environment?

AK: Yes. For research, yes. And those institutes in the Academy of Science, they were purely research institutes. They didn't—

BO: Teach any—

AK: Yeah. Well, they did have Ph.D. programs, yes, but not undergraduate students. So I got my Ph.D., then, from Academy of Science from the Institute of Geological Science for hydrogeology. Actually I have pretty good combination of background for karst, as you know, geomorphology and hydrogeology.

BO: Yeah, the two key topics.

AK: This is very, very good combination. I have geomorphology from university and Ph.D. in hydrogeology from Academy of Science. And I was doing karst science in the Institute of Geological Science, and in 1979 I established a kind of department in the Institute of Geological Science, professional department. In few years, there were ten, twelve people working for me in this Karst and Speleology Department. And it was very successful time and very good time. We did a lot of research in different regions of the Soviet Union. It was the only specific kind of—

BO: Group.

AK: —cave karst research group in the Soviet Union. Professional—

BO: Professional, yes.

AK: —group. So, in that years we did lots of studies. Our main area was western Ukraine, studying those huge—

BO: Gypsum.

AK: Gypsum karst area. Not only caves but all kind of karst problems, karst related problems.

BO: Sinkholes, springs.

AK: Yes. Sinkholes, subsidence problem. It was very kind of—

BO: Problematic for—

AK: Problematic for western Ukraine, because it's—

BO: It's very, very—

AK: —it's covered karst.

BO: And it's inhabited, heavily inhabited.

AK: Heavily inhabited, and lots of kind of industries; and all this mining activity is related to karst, or karst impacts this activity, and the subsidence collapse problem of the area. So, we were involved in that.

BO: So this was, if I understand correct, this ten, twelve people of karst, professional karst within the Academy, within the hydrogeology program or whatever, this is the nucleus of what's now the Speleological Institute, or it was just a step?

AK: Uh, no. It was not exactly the nucleus. In some sense, yes, because it was a kind of very science focused experience and period in my life, and my colleagues'. But it was not the only group, actually. Well, the established department, it was only the karst and cave specific department, but there were scientists working in other places around Ukraine, specifically in Crimea. Actually, in Crimea there were several prominent karst scientists in that time—Professor Dublanksy, Professor Ivanov—working in Crimea for different institutions and universities. They never had big groups, very big groups. But then with my department, what happened [was] that when the Soviet Union broke down, everything was kind of interrupted.

BO: Getting loose.

AK: It was a period of deep crisis started after all this broke down in the Soviet Union.

BO: Well, that was ninety [1990], ninety-one [1991].

AK: It was ninety-one [1991]. And when this happened, I realized that I can't support anymore the big group, the big department, because most of the support for my people were coming from applied studies research, which were not funded anymore in that critical time.

BO: Yes, there were no money for it.

AK: So, we actually counseled and kind of dissolved this department—in an organized manner; it was not a crash. I took care of my people. They were all employed in some other departments or institutions, but we dissolved this karst department. And it was very wise, because next ten years were really terrible in Ukrainian economy and the support for science was close to zero. Science was kind of dying at that time in general, especially such not very well established fields like karst and cave science. In this period, it was just kind of individual scientists continue doing karst research in the Institute of Geology, not supported by (inaudible).

BO: By the state, yes.

AK: But still I was kind of—I kept my affiliation with that institute. But to do something, I needed all these years, during the nineties [1990s], to raise money from any possibility, any source, whatever. But it was not very good years for science. Then, during recent years, things started changing to better a little bit, but not dramatically, but getting a little better. But more important that those karst people who remained and survived in the Ukraine, they realized several years ago that we need to concentrate efforts to establish again the Karst Center, Karst and Cave Research Center. And a year ago, we established the Ukrainian Cave and Karst Research Institute. Somehow we managed to convince our top bureaucracy, the Academy of Science—

BO: So it belongs to the Academy of Sciences?

AK: It belongs to—it's interesting. It belongs to both, Academy of Science and Ministry of Science and Education, which are two different agencies doing science in the Ukraine. And this is interesting experience. Because you know, in any country, it's difficult to deal with bureaucracy, to convince them—and, you know, politicians, (inaudible) decision-makers—to convince them that this is something important.

BO: And useful.

AK: And useful. But somehow you can make them politically interested in this. And how we did this? We first organized all the existing karst-related scientists in Ukraine, having united around the idea that, yes, we need and we are going to create the Karst Institute. And it was a pretty big group of people, more than thirty established researchers working in different institutions and universities. And when the politicians or top managers in Academy of Science and the Ministry of Science, when they realize, “Yeah, this group is going to create the institute in any case. They are united and pretty strong. They may go privately or whatever, but they will succeed,” because we were able to show that our intentions are pretty strong. And then they started competing for us. Academy said, “Yeah, everyone, this institute is under Academy of Science.” And Ministry of Science said, “We want this institute under Ministry of Science.” So we took advantage of this situation and we managed to get both of them.

BO: Support from both of them.

AK: Yeah. Well, at least—not very much financial support, but at least organizational, political, and bureaucratic support.

BO: And the paperwork and everything.

AK: And so this is how the new institute was born a year ago.

BO: And you mentioned [to] me that you have a research field station, but the base, the headquarters is in Kiev.

AK: No, no, no. When we established this institute, one of the most important support came from the president of Tavricheskiy University, which is a university in Crimea, in Simferopol. And the president of this university was very supportive and he wanted the institute to be based on his university, and he offered very substantial real support in terms of facilities and, you know, office facilities, labs, and things like that. So, our

institute is based on the Tavricheskiy University in Crimea because of this very strong support from the president and the support of the university.

And then we also have already, despite of the Institute just start recently, we have a field station build up in the very heart of the karst mountains and the karst plateau, Chatyr-Dag, which this kind of support came from [an]other side, from former cavers, now operators of two big show caves. This is another interesting story. Some twenty years ago, two really big and really important caves were discovered in the area, in Crimea; it was easy access and the caves were easily accessible, but incredible, richly decorated, speleothems and everything. And local cavers immediately realized—the local club—that without protection, this will be gone, because this is a very popular tourist area. There's lots of unorganized tourist and all this kind of—and they started—

BO: Making it a show cave.

AK: Protecting physically. (inaudible) two years sending shifts to patrol the entrances. And then after two years, it became clear that, you know, it can't be continued forever. They need to do something.

BO: They just need to make it a show cave.

AK: Yeah, it was just only way to protect those caves. And this show cave organization was actually based on caving club in the early years, but then it evolved into pretty big organization, very successful. The show caves are now some of the most important attractions in Crimea. They have more than 300,000 visitors a year.

BO: That's a good amount.

AK: Yes. And they developed all the infrastructure, the roads and parking places and some kind of bungalows, festivities, and restaurants, whatever, in the karstic plateau, in the perfect classical karstic area. And this institution now provides very strong support to the research institute, Cave Research Institute. And they built up the field station for us on those very important caves and very important karst area. So, the institute now has kind of a gift from this—

BO: That was a nice one.

AK: —show cave organization. They also provide all their infrastructure available for research projects of our institute. So we have, promising future in this area, because everything kind of mashed together.

BO: Yeah, I heard about them, and I have some colleagues who are working—paleontologists, and then my colleague Silviu [Constantin] from the Institute of Speleology. They have a field trip in Chatyr-Dag plateau. And yeah, maybe you tell us a bit about the mammal that you found inside there.

AK: This is one of those caves, one of the show caves now, but this was known actually longer. This is a classical cave trap for animals. Initial entrance is a shaft thirty meters deep, entering the big room with a sloping bottom, and this shaft served as a trap during the whole Quaternary—

BO: Quaternary, late Quaternary—

AK: Maybe even since late Pliocene. Till now, we have mammals and all these fossils from Quaternary. We just started paleontological studies several years ago, and we realized that this is enormous site, by size and by richness of the bones; actually, huge debris cone in this very big room is made mainly up by bones. So, we just started from the very edge the excavation, excavating and studying this site, and lots of very well preserved, full skeletons of big Pleistocene mammals, including mammals now discovered and described. But this is just the beginning. And I think this site is certainly of international importance. We just need to show this importance to the rest of the scientific community. I am sure we may arrive probably to something like Mammoth Site in South Dakota, for example. You know, big museum and visitor center and research lab based on the—

BO: Significant cave.

AK: It's not a cave, actually, in South Dakota.

BO: No, not in South Dakota, in Europe.

AK: Yes, it's a sinkhole which also served as a trap for big animals. And this is something similar with this cave, but probably even better or at least different in terms that those animals were preserved in the cave environment. They fell through the shaft. They slide down by what was probably the glacier during some periods.

BO: Some ice there.

AK: And in this way they were accumulated deep in the cave, so much less affected by all the disturbances, you know, animals, predators, whatever. So, this is one of the scientific attractions for this cave. This cave is really very reaching very different kinds of environmental records. This is probably—you may appreciate this specifically, because your field is paleoclimatic air constrictions from speleothems, at least one of your fields. But in this cave, you have huge masses of speleothems of different generations, including huge masses which separate big chambers. The sequence of big chambers, or rooms, are separated by (inaudible).

BO: Enormous.

AK: Which are many tens of meters thick in all directions. And you're in cave development. Some of those masses were carved by tunnels to provide the tourist trail from chamber to chamber, so these small tunnels go through the very heart of the huge speleothemic masses. And now those tunnels present unique exposures, many tens of meters—hundreds of meters, actually—of exposures of speleothemic mass from inside. And this is something which needs to be studied by big international program.

BO: It's a walk in time.

AK: Yeah, because lots of records are there. And for the institute, we want to attract colleagues from around the world who have experience with this paleoenvironment or reconstructions and have access to modern techniques of dating.

BO: That's crucial.

AK: And we have a field station, a very good field station, just on the top of this cave. So, very good conditions to start long term research program, hopefully international.

BO: That sounds great. So, nowadays, if you look at your back career and maybe for the future programs or projects, what would be the most challenging stuff that you had earlier and what is challenging for the next phase?

AK: Do you mean challenging in terms of problems or outside—?

BO: Well, let's skip the problems, because everyone has problems; especially in this country we have all these problems. We have to overpass this.

AK: We have enough problems, yes.

BO: So, no, I mean scientific challenges.

AK: Scientific challenges. That's interesting. Actually, several of them. First, because my background comes from, let's say, cave exploration, I was always interested to show, to demonstrate, and to utilize the potential importance of caves and cave studies for karst science. Because, you know, there was—and still is in many cases—some kind of gap between karst scientists who are less familiar with caves and with those scientists who come from cave background. And caves are actually the very essential part of karst systems, which is not always appreciated. So, it was always a challenge to show how cave studies may not only contribute but—to be most important part of karst science.

BO: Yeah. Well, if you don't understand how a cave was formed, then it's hard to go further from that point.

AK: Yeah, that's true. And if you talk about speleogenesis, which is kind of my favorite topic in karst science—speleogenesis is essentially what creates karst.

BO: Absolutely.

AK: And all other things like the surface morphology or whatever, this is an expression of what is going on underground. So, it was always challenging and interesting for me to work in this direction, and I did it in many ways. For example, in western Ukraine it was very exciting to realize that those caves actually were not hypogenic normal kind of caves easily fitting to the established concepts of speleogenesis. But instead, now we are able to show through the years that they are of artesian origin, confined hypogenic, let's say, origin. They were fed from below, from the aquifer, which underlies the karst, the soluble unit.

BO: An entire gypsum package was in between some, sandwiched in between—

AK: In this case, yes, it's kind of very clear—

BO: Confined.

AK: Very typical situation of sandwiched aquifer—sandwiched aquifer system, let's say. But the interesting thing is that the aquifer below and aquifer above gypsum, are normal aquifers—I mean, insoluble, let's say—or a little bit carbonated, but drastically different from gypsum, which separates those normal aquifers. And gypsum was a separating bed between those aquifers, which in terms of hydrogeology, it means that flow through gypsum was predominantly vertical, not lateral initially, when speleogenesis commenced in this particular setting. Then it appeared to be a whole new theory of what I call transverse speleogenesis, not lateral speleogenesis like the conventional unconfined systems and models developed for those systems. They are based on lateral flow through the aquifer.

BO: Well, but then if you have like Optimisticheskaya, which is 200 kilometers now long, something like that, and which is twenty, thirty meters deep.

AK: Well, fifteen meters.

BO: Fifteen, twenty meters, okay. How do you explain the maze that you find inside? Was it that everything filled up with water one time?

AK: Sure. These caves were formed under confined conditions. They were certainly filled with water. But this is very interesting question you asked. The caves, those maze caves, they give an impression that they are laterally extensive.

BO: Well, not necessarily, but for some people, yeah.

AK: And they are—I mean, they are laterally extensive. And they give an impression that the flow was laterally—

BO: No, I think it was more stagnant water.

AK: No, the real situation is that those very laterally now extensive systems were formed by thousands of, let's say, elements working vertically, transversely.

BO: And they were interconnected later on.

AK: No, later on in the time of formation, because in some horizon, in some units of gypsum, there were fracture systems with better lateral connections. So, the generally transverse vertical flow received some lateral component to integrate all those—

BO: The maze.

AK: —thousands of separate segments working vertically through gypsum. On some level they were integrated laterally, producing this seemingly laterally extensive system—which is laterally extensive cave, but it has nothing to do with the concept of flow.

BO: So, that means that if you look in the profile on one of these maps, you will not see certain levels of water that were maybe a path for flowing from one side to another. So, you might have connections of twenty meters or ten meters or five meters, but only in between small passages. You don't have a continuous—

AK: Actual distance of flow through soluble unit in this case is minimum fifteen meters or few tens of meters because of some lateral component. Okay, but it's still very short. I mean, it's very short distance.

BO: Compared with limestone.

AK: Compared with lateral model, doesn't matter limestone or gypsum, compared with lateral speleogenesis, if I may say so. So, this is one of the factors which favors the maze development.

But anyway, returning to your original question, this was very challenging because when we realized that these caves are special in terms of speleogenesis, we were able to come up with new concept and now it's becoming more or less kind of theory of artesian. But you know, the problem with artesian speleogenesis is that artesian concept in karst science was always based on lateral flow through the soluble unit from recharge area—

BO: To the discharge.

AK: —then to whatever. And this has clear problems for speleogenesis, this conceptual view of the flow system. When you imply transverse flow through soluble unit—which is a common, actually, feature of hydrogeology of sedimentary basin, well appreciated in the mainstream hydrogeology but less appreciated in karst hydrogeology—then the whole concept of artesian karst changed. And this—for me, this comes from the western Ukrainian experience when those caves are very instructive, having very clear solutional morphology, which is very good for tracing all the functional relationships between different segments, whatever. And so the western Ukraine became kind of a foremost region in the world for this—

BO: Type locality—

AK: —new emerging—

BO: Theory.

AK: —views of hypogenic.

BO: So basically, that's—I mean, you came up with an entire volume of gypsum karst in one of the international journals of speleology. Was this the beginning of your thinking on the speleogenesis book, or the history behind that? This is a book which is, I would say, a benchmark for the studies. Most probably in few years you will have to update it, at least in some parts. But for 2000, when you published with the other editors, that was a benchmark. So what was the background of this book?

AK: Well, they were not directly related. I mean, gypsum book is another background history. This book actually was born—the idea of this book was born due to the fact that gypsum karst was long recognized in the Soviet Union—in Eastern Europe, let's say, and mainly in the Soviet Union—

BO: And less in the Western part.

AK: And much less in the Western karst science. Western karst science for a long time considered gypsum karst as something like not true karst.

BO: Pseudokarst.

AK: Pseudokarst, or whatever. And this means that the whole book of knowledge on gypsum karst was in the Soviet literature, in the Russian language literature. And we were very much familiar with those things, and then lots of—well, not a lot of them, but some researchers around the world started working specifically on gypsum karst in different countries. And then we realized that it's time to come up with specific book to show up that gypsum karst is real, normal karst, just one of the lithological varieties of rocks which support karst.

BO: Karst phenomenon.

AK: And even more easily supported in many cases than limestone. So, the idea was just to help to establish gypsum karst in its right place among all other types of karst.

BO: But that was a step for the next one.

AK: Well, and speleogenesis, it was kind of a pretty different story. You know, there were many prominent scientists around the world working on speleogenesis—I mean, speleogenetic theories, models, whatever. And the idea probably was like this: we needed to make major step to show the mainstream hydrogeology or mainstream science that speleogenesis and cave origin is not something just curious or—

BO: Randomly happening.

AK: —randomly happening or something which is kind of sport type science, that speleogenesis, as a process, is a key process in the evolution of karstic aquifers. So, we wanted to focus on demonstrating the progress in speleogenetic research, and also to show the central role of speleogenesis in the process of how karst aquifers evolve. Because, okay, now more and more managers and scientists recognize that karst aquifers are something specific. But it was necessary to show the importance of speleogenetic processes in what is now specific karst aquifer. So, that was an idea which united several well established karst scientists, especially, you know, Derek Ford, who is a real father of modern cave science, at least the person who—

BO: Influenced greatly.

AK: —influenced greatly this field. And he was very supportive for the idea to come up with this book, which could bring under single cover recent developments in speleogenetic theories [and] models and to illustrate them with field examples—

BO: Case studies.

AK: —and selective case studies. So, now Art Palmer and Wolfgang Dreybrodt—

BO: Yes, you have Dreybrodt there for experimental part.

AK: Those are editors, my co-editors for this book, and we were occupied almost five years with this book. And we were successful to bring together lots of researchers writing specific chapters of this book. It was really an international effort, with authors from eighteen countries.

Andrew Huse: I'm just going to stop you right there. We're just going to switch tapes. We're just run out of tape.

Part 1 ends; part 2 begins

BO: Well, I think—I can't remember your answer actually—was what brought you to karst? I mean, you went to that Pioneer organization, but what event or what happened, why went you there? I mean, what started your curiosity in caves? Was it [a] book? Was it a trip?

AK: No, no, as I told you, I was kind of curious in geology when I was a boy, ten years old, uh, eleven years old. Then I entered the caving group. In this caving group, you know, people—and teenagers, whatever—come to caving with different motivations. Some are attracted to special social atmosphere; some are attracted by adventures and all these things. All this was present in my motivations, but as I told you, I was initially curious in geology. I was kind of science oriented guy and one of those kids. During my caving career development, evolution, I was always on the scientific side of this. I did exploration in some hardcore caving—

BO: But with a different eye.

AK:—but always thinking of myself as a scientist.

BO: Yes.

AK: So, it was also motivating. I remember, you know, now it's of course not serious. We were young kids and well, teenagers, whatever, ambitious. And we were pretending that we were going to challenge all the established views in science.

BO: Well, you are doing that, actually. You are not far from that.

AK: Well, but now we understand how science works. I mean, I understand more. I understand that science need to be conservative in some sense to protect its core knowledge from all kind of adventurers, like I was when I was young guy. But I was kind of always, always curious in scientific side of—always interested in scientific side of cave explorations. And then I got more and more involved in scientific activity as a teenager in the Academy of Science Institute. I published several papers when I was still not even in the university, I was still in school. But I had several scientific papers accepted by big journals. This was also very encouraging for a young guy, you know. So when I entered university I already had four scientific papers published in journals. So, somehow I can say that I was always in karst science. I mean, I felt that I am kind of scientist. But certainly I evolved into something which can be called scientist much later.

BO: Yes. I was just curious, how was the club organized in Ukraine? I mean, I am just trying to think through the view of the Romanian and the Western, rest of the Western Europe, where you have huge number of club, speleo-clubs, a lot of cavers, cavers only or scientific cavers, whatever you want to call them, because both of them are equally important in the process. For instance, in Romania we had like—at one point, I think it was eighty-two or eighty-three, we were eighty-two speleo-clubs in Romania with over 5,000 cavers with legitimation [*sic*], with IDs that were supporting by or under the Romanian Speleological Federation. And it was such a competition between us. So, that if we have like, five caves—my club—we had to take care of that. Not some other club to go into that cave or try to explore further. Was it the same?

AK: No, it was pretty much different. As I mentioned, Romania probably was some where in between those extremes. What I mean extremes? For example, France, where speleology started back in nineteenth century, at the end of the nineteenth century with [Robert-Jacques de] Joly and [Édouard-Alfred] Martel—

BO: Joly, and Martel, [Norbert] Casteret.

AK: And so on. And those clubs and the Speleological Society was established 150 years ago. So, it's [a] long history of club, organization, movement and this caving activity. In Soviet Union, the organized caving started only in the very end of fifties [1950s], the early sixties [1960s]. That means when I joined, it was kind of beginning. And we didn't have lots of clubs. We have much less of them. And we had, instead, we had a lot of unexplored areas and [were] poorly explored. So, it was lots of virgin land underground to explore. So, we didn't have the situation like you described. In Romania, as far I know, speleology was kind of recognized or started much earlier.

BO: Yes, it was 1920.

AK: Nineteen twenty.

BO: The first Speleological Institute.

AK: So it was not like this. You followed more or less the Western European path in this sense. But you know the history of the Soviet Union, when the Communist Revolution happened in 1917, this interrupted somehow—

BO: Everything happened.

AK: Many—

BO: Ongoing.

AK: Ongoing social economical processes. And the country happened to go through lots of very extreme historical—

BO: Situation.

AK: Situations and developments, thus, very deep crisis or whatever, destruction of economy in twenties [1920s], thirties [1930s] when the Communist Soviet Union kind of —

BO: Took over.

AK: Was growing, just starting to reestablish all our economical power, whatever. Then the Second World War was devastating, especially in the Ukraine. So, you know, for caving the critical condition is a leisure time available for people.

BO: To go and do that.

AK: To go to explore caves on weekends or vacation time. You need to have certain level of—

BO: Freedom—

AK: Industrial development.

BO: Oh, I see.

AK: And well, whatever, freedom or—

BO: Money.

AK: Money for that. So, this probably, this critical muscle, those conditions probably happened only in the early sixties [1960s] in the Soviet Union when caving started and started to grow and develop.

BO: Well, you know, even so, I think the first speleological clubs in Romania happened to be organized in early sixties [1960s] as well, but they were increasing very quickly. For instance, Cluj, where is the second main university center, has now five speleo-clubs. Now we are all together, I mean, they are working together now. But up to eighty-nine [1989] they were like killing each other not to get in their cave, not to dig or to explore one meter out of their cave.

AK: I see, I see. You know, of course this happened then through years—

BO: In Ukraine.

AK: In Ukraine, in the former Soviet Union. It varies from region to region depending closely the area is explored, searched, whatever, but also this is more or less common for cavers to compete for the discoveries or for whatever exciting discoveries. And there are many stories around the world, in many countries. This is managed somehow in different way, but you know, it's part of human nature.

BO: But what about the relations now with other of the former Russian?

AK: Uh, generally very good because somehow dictating has common roots from the Soviet Union in different countries that are now separate countries. Soviets still keep very active relations and do many things together. I mean, our clubs, Ukrainian clubs, Russian clubs and whatever but also you have some controversies, but this kind of not on the basis of Ukraine or Russia; it's rather the specific situations or, let's say, some unethical behavior of particular groups or particular people. It may happen in situation. So, we do have some, you know, conflicts or controversies of this sort, especially around some prominent discoveries like Krubera-Voronya, for example.

BO: Yes, what about that? I mean, I know it's world record now, depth. You are only a Kiev club or you are a mix?

AK: Um, actually this is another, one of the most important story in my life—Arabika. When we were—we spent more than seven years in Central Asia, well, a few more years in other areas of Central Asia in seventies [1970s]. And then in some point, Kiev speleological club decided that it's time to shift the main focus of exploration activity from Central Asia. We kind of get tired of all this long trains, whatever. Anyway, to the Caucasus, Western Caucasus, and at that time there were few areas in Western Caucasus were already producing very important discoveries, deep caves. One of them was Bzybsky, Bzybsky Mountain Massif. The deepest cave in the Soviet Union was then—

BO: Moved from Central Asia—

AK: Moved from Central Asia to Bzybsky, and in the very end of seventies [1970s] the Kiev club decided to shift its activity. And I was being kind of scientist and active caver. I was in charge of selecting the area. And nearby Bzybsky was Arabika, but Arabika was kind of neglected area.

BO: Because of the access or—?

AK: No, because of the not successful previous history of exploration. There were some attempts earlier before we started to search for caves in Arabika, but they generally failed. Arabika didn't produce any significant caves in that time. The reason, we realized then, the reason was that this area was higher than Bzybsky and much more affected by glacierization [sic]. This means that the relations between caves and landscapes changed. And now it's kind of common place. We know, oh, okay, this glacier, karstic, once cave. But the cavers who went to Arabika having experience of lower areas, they were looking for sinkholes for lower places, for entrances; the bigger entrances, the better, they thought. So, they were making quick trips across the big huge Massif, hoping to find very quickly something. And they failed. And I decided to bring my club to Arabika because it was challenging. It was something with a big geological potential but with no deep caves. And general opinion among cavers was Arabika was kind of strange reputation. It's looking like promising but it's hopeless. So, it was a challenge. We didn't want to join all the big group of clubs working in Bzybsky. Instead, we started in Arabika in 1980. And another reason, which now works very well, was that Bzybsky is not—it's separated from the sea by non-karstic sediments, but Arabika is the only limestone, big limestone, massif in Western Caucasus which continuously—

BO: Under the Black Sea.

AK: Goes to the Black Sea coast and beneath. And there was known submarine discharge in Arabika area. So, my understanding was that it's going to be important—

BO: Sure, you have a circulation there.

AK: For deep caves. But it was not so clear in that time, because the established view about hydrogeology of Arabika did not accept the possibility from the central part of Arabika to flow, to discharge to the Black Sea coast. It was banned by the established views, because established views in Arabika hydrogeology were that those kind of (inaudible) parallel actually fall and blocks tectonics, subordinate the flow totally. And the structure, hydrogeological structure, of Arabika was thought to be a series of separated basins or whatever, the central part, not hydrogeologically connected to the springs in the coast. So, it was not accepted. But I suspected that it could be possible, because my caving experience told me that caves in mountains, they don't respect very much—

BO: Topographies.

AK: Even they don't respect very much sometimes faulting or especially folding. They mainly follow the tectonic disruptions, whatever, which may also cause the structures. Anyway, we started in 1980. Then we employed the kind of new approach for search for caves based on area by area basis, was very systematic and thorough search. So we didn't

BO: Make cross section.

AK: But in choosing the particular area, a glacial valley, and started exploring every crack, every fissure, not necessarily in the bottom of sinkhole but also on the ridge, on the top of Russian (inaudible), you know, (inaudible) rocky hills. And this immediately brought a success to us. And we discovered continuation in several small caves already known and those caves went very deep, very quickly. In a few years we made it 1100 meter cave, which was huge and occupied almost all our attention and time. And in Krubera Cave, which was known small—well, 60 meter shaft and small continuation to the critical and narrow fissure—was known since the early sixties [1960s]. Georgian karst scientists made few expeditions to Arabika in 1963, sixty-four [1964], and they described also Krubera Cave and gave a name, Krubera. So, it was known cave, but we started or explored every cave in this area. Krubera was re-explored and we pushed those critical narrow places because our concept at that time was “No dead end.” I mean, we didn't accept that cave may end up by boulder chalk or critical squeeze. We realized that everything can be negotiated in just a matter of time and efforts.

BO: So you use blasting on some of the passages?

AK: Use some very small blastings, very small charge just to—

BO: Smooth (inaudible).

AK: Smooth—

BO: Enlarge a little bit.

AK: Enlarge protruding piece, to remove a protruding piece. Or to crash particular small boulder which blocked the way. And this gave us a lot of success in this 1100 meter deep cave when we negotiated, so, six boulder chalk. One of them took three years. And it

proved to be finally 100 meter deep boulder chalk. We made it though. We were rewarded by—

BO: The rest of discovery.

AK: Big discovery, the rest of the cave. And in Krubera we spend nasty years, four years, making our way through those narrow meanders. The situation is that in high mountains it's very common that shafts are pretty big. They develop quickly. But those passages, inclined passages we call them, meanders as in a caver's code.

BO: Yes.

AK: Which connect one shaft to another shaft. They are critically narrow, especially in the first few hundred meters when the amount of flow is not enough. It's enough to enlarge quickly a vertical shaft, because this is kind of a special mechanism of enlargement given by film, water, corrosion—they grow pretty quickly. But those meanders, they need flow to be concentrated to be—

BO: And for a long time.

AK: Yeah. Or the uplift rate also plays a role, because if it's high uplift rate then those small streams, it cuts—

BO: Very quickly.

AK: Very quickly down, not enlarging. So, this is a typical problem. We made our way through meander after meander. I mean, after each meander we have a shaft, thirty, forty meters, and then another critical meander. So, we spend another year working another shaft. This way we pushed the cave to 340 meters in that years, in that years of eighties [1980s]. Then the Abkhazia conflict, the Abkhazia conflict of Georgia in early nineties [1990s]—it started in ninety-two [1992]—interrupted all speleological activity in Abkhazia for many years. It was a war there and then a very unstable situation. Cavers reappeared in Abkhazia only in 1999. Ukrainian expedition came to our area, kind of traditional area, continued to work. And in that year the breakthrough happened in Krubera by the Ukrainian expedition. In those early years, in one of the shafts we saw two windows on the opposite wall of the shaft. We didn't explore them; we mapped them. They were indicated for the future. And this future came in 1999. The tower guys checked those windows. Those windows led—

BO: Straight through the big—

AK: To the kind of main part of Krubera. Then the exploration developed very fast. For several years, ninety-nine [1999], 2000, 2001—oh, 2000 was several expeditions. The cave grew up to 1600 meters. So, we were very close to the—

BO: World record.

AK: To break the world record. And the recognized next expedition in 2001 in January wintertime expedition, which is very hard to do, to get approach to the cave, but it's more safe in the cave. Anyway, it was the first that the deepest cave in the world was moved away from the Western Europe, because all 300 years before with the history of deep cave explorations the deepest cave in the world was always in Western Europe. So, it was the first time the deepest cave moved to Caucasus to out of the Western Europe. It was a big breakthrough because the previous record was passed by eighty meters for the previous fifty years or so, half a century—

BO: Yes, they were playing with one meter, two meter, three meters—

AK: Yes, it was always advance ten meters, twenty meters. The average rate of advance was thirteen meters a year during the second half of the twentieth century. And this was a big advance in eighty meters, and then it continued in 2004 the Ukrainian expedition established for the first time in the history of speleology—

BO: A 2000 barrier.

AK: Our guys crossed 2000 meters. The barrier which was, as you know, was long-time dream of vertical cavers around the world. Just few years before that, it was—it would be thought of something as almost fantastic. And this happened within several years a huge advance was made in Krubera mainly by Ukrainian expeditions. We were brave enough to invite few Moscow guys in their first record-breaking expedition because they wanted very much—

BO: To be there.

AK: To be there. So, we said, “Okay, guys,” welcome cooperation whatever. And we admitted [a] few Muscovites—

BO: To be there.

AK: To that expedition. That was the start of controversy, because in the subsequent years they decided that they don’t need to follow the exploration ethics and coordinate or be under coordination of the original exploring group. And they started their own—

BO: Exploration.

AK: Exploration. Actually, they were always kind of—we called them pirates, cave pirates. And they stealing new discoveries, or they’re using our equipment, and our camps, and all established trails and things like that, to report then that their group—

BO: They were the first.

AK: This happens.

BO: Yes.

AK: It’s in our community. It’s a part of our history. It’s certainly not something that should be welcomed, but it’s not the end of the world.

BO: No. How deep is it now? I understand that it’s longer now.

AK: It’s now 2,158 meters.

BO: That’s a pretty deep cave.

AK: The striking situation is now there is a huge gap between the deepest cave and the second deepest cave. As you remember, in the past there was always different in few tens of meters, maximum.

BO: Yes.

AK: Sometimes just ten meter or whatever. And now the difference is—

BO: Is 400 meters.

AK: Five hundred meters.

BO: That's a real cave.

AK: Which is huge gap. This is something which certainly opened a whole new era in deep cave explorations. This is a breaking up of psychological barriers and—

BO: And you are at the sea level now or you are below sea level already?

AK: No, we are not below sea level. This is another very fascinating situation which actually demonstrates so close relations between exploration and science in speleology. We always know this, but this is very direct illustration of those links. What I mean is that this deep Krubera Cave is very, very steep and goes—

BO: Almost vertical.

AK: Much vertical. And it now reached—it is now about 100 meters below sea level in absolute elevation, but it's still twelve kilometers far from the coast. And the connection is proven by dye tracing, which we made in eighty-four [1984] and eighty-five [1985], two repeated experiments gave us the direct connections to springs in the coast. We also recovered some dye from the borehole, which was on the coast, but it yielded water from 250 meters below sea level. So we interpret this as indication that part of flow goes to submarine springs, the same flow from Krubera area. This situation was so deep, position of the current bottom of Krubera, use very low hydraulic gradient. For the mountain area it's extremely low, twelve kilometers.

BO: Yes, that's not much. Hundred meters, that's almost nothing.

AK: For a faulted, disturbed, tectonically disturbed area, it's extremely low already. So, then we realized—now, actually, we've completely realized that we have the whole set of outstanding facts pointing to the deep drainage of the Black Sea, similar like Messinian crisis in the Mediterranean. The Messinian crisis in Mediterranean was the most dramatic desiccation of the sea and in the earth's history, probably.

BO: Sure.

AK: In Cenozoic history.

BO: Thousand meters.

AK: It was more than 1000 meters. Fifteen hundred meters drop of the sea level in the end of Miocene, as you know. But it was not established, just hypothesized that the Black Sea could experience the same. There were some hypothesis but very, very little supported.

BO: Two in the Black Sea, as far [as] I remember, the Messinian Crisis, and there is also Histrian Crisis, which is much more recent.

AK: Right.

BO: But not that big.

AK: So, anyway our Krubera and some other facts from hydrogeology of Arabika—those facts are also striking—we have some boreholes in the foot of the mountains producing fresh karstic water from the depths more than 800 meters. So, if you have signs of active deep circulation in this area, karst circulation, I mean, 800 meters below sea level.

BO: Yes, well, that's—I interrupt you because that's a very similar situation on the opposite side of the Black Sea in Dobrogea in Romania, where we have an ore deposit which people were saying it's kind of the Krivoi Rog rock stuff from Ukraine. It's a huge concentration of iron. We have submarine springs and drills and everything that points out at about 800 meters deep.

AK: I didn't know that.

BO: Water circulation in that part.

AK: Okay, so it may also draw some parallels in the—

BO: Well, we don't have relief on that part because Dobrogea is a flat plateau. We are about at the sea level, at the Black Sea level. So we are like, let's say, twenty, thirty meters above. It's a kind of Florida there.

AK: Okay, yes. Oh, that's even more exciting. But you know, some few other facts we have now. We discovered recently a huge karstic depression in the bottom of the Black Sea in the shelf which is 400 meter deep, closed depression separated from the abyssal part, from the slope by bar more than 200 meters. So, it's [a] closed depression on which, on the slopes and center of this depression, all this submarine discharge is focused. So, we realized that the real kind of potential or, let's say, karst systems Krubera in the mountains, at least to that level, to the bottom of the depression—

BO: Which means a couple of few hundred meters.

AK: Yes. And these depressions also pose the question about deep draining. It could be also form of submarine situation, but you know, now several papers were published recently, very recently, during [the] last year giving very strong evidence again toward Messinian Crisis. They come from seismic profiles and some biostratigraphy—

BO: Made by the Turkish people and some other.

AK: Some are made from Romanian paleontologists. And all this comes together now, and Krubera and Arabika gives a totally independent line of evidence is showing—

BO: That there were a crisis and the sea level was dropping very much.

AK: And what is also important, that those old systems which were established on the coastal line then they were always kept more or less on that low level because the uplift was very much differentiated between different blocks, tectonic blocks. And the central part of Arabika was rising with very high rate, totaling more than 250 meters—2500 meters of total uplift during late Pliocene and Pleistocene. The coastal part was almost on

the same level. This means that the high gradient zone was always pushed deep into the mountains which produced very steep—

BO: Vertical.

AK: Very, very vertical development of Krubera. So, this is kind of unique situation.

BO: What would be the chances to find the bottom? Or at certain level, horizontal, or almost horizontal—

AK: Passages?

BO: Passages.

AK: That's normally the cavers' dream. Or normal cavers' expectations, which is evidence in many areas around the world, that deep cave on some level it comes to inclined—cavers call them collector dive passages or whatever—which then—

BO: Drain out somewhere.

AK: Drain out. And this is a case in many areas, but it's not going to happen in Arabika because as we now discussed, this is drowned karst.

BO: I see.

AK: I mean, those—

BO: There might be something but—

AK: Those inclined parts, they might be present, but a few hundred meters below the—

BO: Sea level.

AK: Sea level.

BO: And there would be an extreme diving.

AK: This will be diving for many of next generations of cavers.

BO: As the technique advances.

AK: Yes.

BO: No, because I was thinking of Barenshacht in Switzerland where they have this 950 meters shaft and the water comes out in the Lake Thun. And you pass, you go down to 650, you pass one very narrow siphon, and then—I mean, at that point you are like 1.5 kilometers from the entrance—and then after that natural passage, I would say, you enter the, like, fifty kilometers cave. How long is actually Krubera now?

AK: Well, the Krubera with all those branches is ten kilometers now.

BO: Oh, that's a good size.

AK: It's a good size, especially for a predominantly vertical cave. The interesting thing about cave exploration, recent exploration in Krubera is that our group was working several years on kind of separate branch from the main branch. It starts in 300 meter depths and goes totally in different direction to 500 meter depths or whatever. The last three years our guys are digging through boulder chinks there and—

BO: They found the good direction.

AK: Last October, a few months ago, our last expedition they made a big breakthrough through those boulder chinks and reached more than kilometer depths, just went out of rope. So, it's now going very steeply in another branch of Krubera, more than kilometer deep already and open kind of—so, it's also interesting. But Krubera is certainly absolutely incredible cave which give lots of excitement for explorers and for scientists.

BO: Well, actually now science starts. Up to this point it was the cavers main player role—well, scientists was playing a role—I mean, looking for the entrance and then making a decision or looking at the tectonic map, geologic map, saying, “Well, this cave should continue. We have to push.”

AK: I was pretty happy that you know, it was pretty much my role to push Arabika for the last twenty-five or almost thirty years to kind of coordinate and motivate those efforts of big caving community.

BO: I understand why you have it on your heart.

AK: Sure. I spent, you know, enormous time in Arabika leading many expeditions.

BO: And the system entrance has two different shafts and one is Voronya, one is Krubera? Or is the same name for the same system?

AK: It's the same name for the same system.

BO: And Voronya means what?

AK: Okay, the real name, let's say, with historic priority is Krubera, because its name was given by original discoverers. They describe it first, the cave. And it's very appropriate name because name Krubera—the cave was named after Kruber, Alexander Kruber, who was a prominent Russian, still before Communist Revolution, a Russian karst scientist who is considered to be a kind of a father of Russian karst science, very much the same as Martel, for example, is considered father of modern speleology in France. So, Kruber was very prominent karst scientist before the Communist Revolution. The Georgian karst scientists gave this name to the cave. But when we worked in this area since 1980, we spent a lot of time in Krubera as well, and it was kind of working slang name given by our guys—Voronya—because Voronya means crows cave. There were all these crows nesting in this open shaft. And it was a slang name among cavers, but, as you know, that sometimes which is kind of given by cavers and used in their community becomes very strong name. It became a second, alternative name for the—

BO: The same system.

AK: But the priority is Krubera. It's the main name.

BO: And in terms of exploration, what would be the age, classes, age ranges? What kind of people were exploring this time? You have again teenagers like that the time that you were exploring or there were more pure cavers? I suspect it's a tough cave.

AK: Well, it's very tough cave. You know, American cavers, vertical cavers, they are mainly experienced with rope—

BO: Single drops.

AK: Single drops in Tennessee, Alabama, Georgia or whatever, and they are active in Mexico, for example. But these caves are certainly challenging and very interesting in all respects, but they are warm. They have—

BO: Twenty degrees on the bottom.

AK: Less than twenty, but—

BO: Still warm.

AK: Well, twenty on the bottom, yes, but a little bit less in the beginning, still very warm. Krubera has 1.5 degree in the first 100 meters, which is almost freezing water temperature, and it slightly grows to 7.2 to the very bottom.

BO: Oh, that's the geothermic gradient.

AK: It's huge anomaly in geothermic gradient which is very well actually—

BO: Very good for the cavers.

AK: It's very tough for cavers.

BO: It's tough, but it's warmer. And it's better.

AK: Well, it's not—you know, we just didn't understand each other. This is not good gradient. This is very low gradient, extremely low.

BO: Well, it is, but comparing to 1.5 at the entrance, it's better.

AK: Sure, sure. But still, through the main part of the cave, people were in extremely cold environment. It's wet. Water is everywhere. The danger of hypothermia is number one, and second one are sudden floods. Anyway, it's certainly tough cave.

But returning to your question, what kind of people are—? This is very interesting. And very encouraging for me, for example, to realize that many years of efforts on maintaining and let's say, creating organized geological society in the Ukraine contributed a lot to this because we have more than, probably up to 200 people in Ukrainian speleology involved in Krubera explorations over the years. Some of them started with me twenty-five, twenty-seven years ago and some of them—there is particular guy who still goes to the very bottom and he's already made thirty expeditions to Arabika, month long expeditions. So, almost thirty years, sometimes more than once a year he goes to Arabika for a month or two months. So, this is an incredible group of explorers, very strong, very well trained, and psychologically very well prepared. What is the most important, they kind of—we were able to pass several generations this passion —

BO: Interest for them.

AK: To the deep cave exploration. So, several generations of cavers consider this as their almost lifetime—

BO: Achievement.

AK: Achievement or commitment or whatever. So, this is very important because if you have kind of one single leader or whatever, and then people—

BO: Come and go.

AK: Coming to work one expedition or—

BO: Exactly, come and go and that's one—

AK: This is not very productive. And especially in such harsh condition as Krubera is, it is very important to have a big society of united people, of people which are prepared and committed to work as a team, as a big team which may pass through generations their passion and dedication. This worked in Krubera. I think this is one of the main conditions for this to happen.

BO: Well, moving into a different field, still in karst, how and what are the problems? Or how do you feel cave and karst in terms of safety, protection? I mean, do you face problems of cave protection or karst landscape protection? I'm not sure how this works in Ukraine. You know very well what is United States and throughout Europe of natural parks, natural parks, whatever. Caves are somehow well protected. Sometimes they escape and they will be vandalized by different—well, say, tourists, or even cavers. What happens in Ukraine? How the caves? Are they safe? Are they well preserved? Are there caves that were vandalized?

AK: You know, we have kind of whole range of situations which you may encounter in other countries. We have all the cases. Some caves are well protected by some reasons, not necessarily legal system but just—

BO: Natural.

AK: Easier. Natural, or some kind of responsible local club maintain the control and protection to certain caves over the years. Or in other cases, there are more problems. Of course, cavers themselves are a big factor to disturb caves. This can be justified, in my opinion, only if the caving activity brings new knowledge.

BO: Yes, scientific purpose.

AK: And yes, exploration of something new and new data, knowledge, whatever, so this damage we are making to cave environment by putting our feet into the virgin ground can be justified only, according to my opinion, by this. I am not very much in favor of this (inaudible) type caving activity which sometimes in some countries attracts thousands of people in organized way and somehow encouraged and going to caves for fun. Of course it's good for the people, but it's not good for the cave because the environment is so much isolated, specific, and can't resist the amount of—

BO: People they receive.

AK: People and energy and whatever. Disruptions—

BO: All the exchanges.

AK: So, the cavers themselves should be responsible for caves in the first place. I mean, it's the role of organized caving societies—clubs, I guess—to educate cavers to be very responsible for caves. I mean, this principle to justify your presence in the cave by new knowledge or exploration—

BO: Or serious reason.

AK: Yes, some serious reason. I think it's a kind of cornerstone. So—

BO: But do you have any—I mean, Ukraine—has any legislation to protect the caves, official legislation?

AK: We don't have a cave specific legislation. Cave related aspects are covered within, let's say, general natural environment legislation and the system of protected areas. We have different levels of protection for areas or objects. And lots of caves are under certain status of protection, including highest status. But honestly, this is not something which, in Ukrainian reality, would provide automatically a good level of protection. So, you know, this transitional country's legislation is changing and the people are kind of, not always follow those laws.

BO: The new changes.

AK: And new changes and lots of kind of play hand competition between businesses and politicians and whatever. So, this is not very stable situation to respect what is already under law. It's very much going to dissolve and be part of this reality but not completely. And lots of caves, even being protected by the law—

BO: They don't have a physical protection.

AK: They need—they need protection from cavers because, you know, there are conflicting interests. For example, local business people decided, “Okay, we will make a show cave because we heard about whatever cave—”

BO: The money are important.

AK: It’s famous, okay. They suddenly realize it’s well known around the world. So, probably it’s—

BO: Good opportunity to have—

AK: Good opportunity to raise money to have. And then they may get involved with local politicians and that process and so on. And those kinds of combinations may even lead to violate the laws or change the law however they want. In many situations caving, organized caving community, stands to protect this.

BO: Well, that’s good.

AK: This happens.

BO: Forgot to ask you, what would be the percent of karst or karst related rocks that covers Ukraine surface? And how many caves, actually, you have in your inventory?

AK: Well, this is very interesting question which leads me to mention some other aspects. What you normally would take as a criteria to map karst areas, soluble rocks, or karst rocks?

BO: Well, I would consider limestone, dolomite—

AK: Exposed, or—

BO: Well, exposed and which is cover it also. I mean, we also—

AK: Then how thick cover you—

BO: Well, not more than fifty, let's say.

AK: Okay, so you come to the subjective criteria. And this is an interesting thing because when we accept the importance and the existence of hypogenic speleogenesis, karst, whatever, on some considerable depths, few hundred meters, or whatever. Then the presence of soluble rocks in a few hundreds meters should be mapped as a potential karst area. And when we had older karst maps for the Ukraine which show the exposed soluble rocks, it covers maybe 18 percent of the Ukraine.

But some twenty years ago, Professor Dublansky initiated some kind of karst map for the European part of what was still Soviet Union. We worked on this in the group of karst scientists and we discussed these criterias [sic]. And we defined few hundred meters, 400 or 500 meters depths, to each (inaudible) map show the soluble rocks, because we have plenty of evidence that there is an active karst in the depths, which is hypogenic karst. Then the map constructed in this way show that 60-something percent of Ukrainian territory is karst. So, this is a big, big difference. And this is conceptual difference. This shows the many unsolved kind of conceptual problems in karst science as well. We need to make more balanced the karst paradigm between epigenic and hypogenic. It's time to realize that hypogenic karst is at least half of karst. And now it's still considered as kind of aberrant case or specific, very specific, you know, curious—

BO: Peculiar.

AK: But some kind of (inaudible).

BO: And how many caves you have in your inventory?

AK: Well, not dramatically many. I would say—I don't remember the exact number by national inventory, but this is something above 1500s but below—

BO: Two thousand.

AK: Two thousand. Too many areas for caves are western Ukraine. When caves are not so numerous, there are about 300 caves there. But some of them are—

BO: Very big.

AK: Huge. And there are five longest gypsum caves in the world all located in the same area. And Crimea, which has more than 1000 caves, and few hundred caves are scattered through the rest of Ukrainian territory, either in Eastern Ukraine where we have salt and gypsum and some limestone karst or some other areas. We have Carpathians, part of Carpathians in the Western Ukraine, but unfortunately for us the most karstic of Carpathians goes to Romania. And we have mainly flysch part of Carpathians.

BO: Well, unfortunately that part of Carpathians that enter to Romania, eastern part, it's not that region caves. We got lots of flysch.

AK: I know. The most of flysch is in the Ukrainian part.

BO: Yes, yes. Most of our karst is in Western Carpathians where we have like 6,000 caves or something like that.

AK: Yes.

BO: So, we were talking about—

AK: Many things.

BO: Many things, yeah. But we were talking about how people should be aware about the hypogenic caves and the theory and everything else. Yeah, we touched a little bit about the protection stuff which is a real serious matter because sometimes, having an excuse of doing scientific work, you can destroy the cave. And one of the meetings we had recently on paleoclimate claimed that, well, we should stop getting each trip a stalagmite for dating and trying to concentrate on one stalagmite [to] get the best results and the highest resolution possible in order to—

AK: Sure.

BO: Okay, so having all this in mind—

AH: Hold that thought. I've got to switch tapes again.

Part 2 ends; part 3 begins

BO: So coming back to these issues that we touched, how do you feel—because now you are traveling a lot, you make contacts with so many karst scientists around the world and I know you have [an] initiative of creating an international karst network. You are also the founder of the speleogenesis online journal, which is a nice and huge and very important portal for distributing the karst information for all of the karst community worldwide. How do you see the future? I mean, obviously we cannot do independently anything. We have to tie together.

AK: Well, I think it's well recognized for already many years the need for cooperation, and it happens in many ways, in many forms. Through last several decades, the international cooperation in karst science is growing and expanding to new areas and taking some new forms. And we have several major international bodies working on karst under international, let's say, umbrella sort of, organizational bodies associated with International Speleological Union or with International Union of Geographers, International Hydrogeologists Association, and so on.

The future for this cooperation, I think, lies in two directions. One is we have pretty much separated and degraded efforts of different groups sometimes, which need to be integrated and combined because karst science is not still well established and well supported branch of science which has plenty of resources to support, you know, duplicate activities or whatever. We, more than probably other disciplines, need to integrate all those international efforts in cooperation. But now the new emerging aspect is that during recent decades the number of karst and cave research centers or institutes which are professional entities, which are based on facilities, some stuff, and do their in-house research program, this number is growing, dramatically growing during last decade.

BO: The last ten years, yes.

AK: There are more than twenty, probably up to thirty. We are still trying to make inventory of established karst groups, centers, but at least twenty-something such national, more or less national level or big regional level institutions exist now. There is a need to establish and stable an efficient system of cooperating between them, because this is something different from what exists now in the international cooperation in karst. In

the present system, as you know, we have those kind of commissions type of organization when some active scientists are presented but they act more like counsels.

BO: Yes, they are very individual.

AK: No, I mean, those bodies are more like counsels which may supervise the development in certain areas.

BO: Certain topics.

AK: Certain topics, advise on the future directions or whatever. But they are not generating data. They are not keeping certain type of information resources, maintaining them, and so on. The karst and cave research institutions are who do this. So, any kind of federation of those resources would have tremendous effect and be very important to—also, you know, in the modern science there is a competition for funds in any branch, of course. And karst science is still not in the position to compete for real, substantial funds for research. When our groups are separated and trying to get something from their, by our small project or some bigger, some smaller, but anyway—they are not able actually, to pretend for real, substantial funding. So only if we will be able to combine—

BO: Our joint forces, yes.

AK: Our groups, forces, influence, whatever, then it could lead to more substantial funding for the whole karst science. Anyway, there are many, many aspects in this kind of cooperation between institutes. There is plenty of possibilities to exchange students. You know, any karst institute is normally based on some exceptional, some outstanding karst area. And those people have a specific expertise in this particular karst area or cave area. If we will be able to establish a stable system of supporting, exchanging researchers, especially young researchers or students, between those institutes and their areas—

BO: Yes, that's great.

AK: Lots of advantage. I mean, if any, let's say, American guy interested [in] studying gypsum karst, for example, and want to make a kind of career in this field, he must visit western Ukraine.

BO: Yes.

AK: To see and to work a little bit on those problems—

BO: The type localities—

AK: To have this type of experience. Or if a guy in Ukraine or whatever, in any other country is working on hypogenic or sulfuric acid caves, he must do something in Guadalupe Mountains, or at least to have some experience. So this system of exchanging based on the already established institutes would be—it's actually simple. I mean, just need an organization networking the common agreement to enter this and to support this cooperation. Probably some resources, of course, to support this networking, but it's mainly a matter of goodwill and willingness of scientific groups to cooperate.

BO: Yes, you know about the Karst International Portal proposal of University of South Florida and National Karst Cave Institute, University of New Mexico. They are drawing together, putting together this effort. What do you think about it?

AK: Well, I am absolutely supportive of this concept and the idea and this initiative. First of all because this is the very acute need which actually was long recognized in different international karst groups. Now, you know, all the modern developments, Internet, informational technologies, show us that this is a way—

BO: This is a direction.

AK: This is a direction to have resources integrated through Internet access. The question is how to get this organized, under which format. KIP [Karst Information Portal] is very good initiative, which is in some sense what we did in speleogenesis that started four years ago. [It] was more or less in the same direction. We wanted to create kind of a—

BO: Accessible.

AK: Well, a kind of central—if you want—clearinghouse for karst and cave research information. And this was also coordinated between major international karst groups that moved speleogenesis site in this direction. So now KIP emerged almost a year ago and [is] going to develop quickly. This is the same kind of initiative, but it looks to me there is much more possibilities for resources to get involved and support from different bodies, and this is very serious, but what is absolutely necessary is to have international

cooperation and networking system in karst integrated into KIP initiative. Until now, it's more like—

BO: Well, is a beginning.

AK: It's a beginning, yes. So we need to provide for support for KIP from the international community side. Those things which we just talked [about] before, this networking of institution, this should be based on KIP or vice versa.

BO: Yes.

AK: Or KIP should be based on this network of karst institutions. So, this is very exciting.

BO: Yes, and especially the project of getting the grey literature, which means everything which is in a different language or it's not easily accessible, into online by scanning or something and provide full access to this. I think that's a great idea.

AK: That's absolutely great idea.

BO: Because open journal access, it's really amazing, especially for many countries still in Europe—not talking about Asia, Africa—where possibilities of getting free access to different journals, it's not—

AK: Yes, I totally agree. I share all of these kind of concerns and bad experience of having problems to access scientific information. For many countries around the world this is a real big problem. By the way, you know, I realize more and more that this is not a problem of disadvantaged countries or historical disadvantaged or transitional—this is a problem of rich countries as well. I am learning more and more now that even pretty big universities can't afford to subscribe to all—well, not to all—but to—

BO: Well, particular journals.

AK: Particular journals—

BO: To the entire collection.

AK: To have a kind of reasonable access for their people, for their scholars through their system because of the cost, because of the increasing cost of the subscriptions. This is [a] generally distorted system that the results of research, which are mainly funded from public money, then go to big publishers, to big journals, and then they are restricted.

BO: Big companies, yes.

AK: From the only scientists to use. So, this is something very unfair, abnormal, and should be changed somehow, maybe gradually, of course. All those KIP or portal initiative or open access journals, whatever, it's very, very important. The very nature and the very essence of science, as I understand it, is in open access—

BO: Yes, to all information.

AK: Open distribution of our results, of our data and works. So, this needs to be pushed very hard. I think especially again, karst people, karst community, who is again—it's not a branch of science which is well established and well funded, traditionally. It's not like, I don't know, microbiology or physics or nuclear physics or whatever. So, lots of scholars in karst community are not firmly affiliated with established big institute, universities, whatever. But they are doing very important work. We also have this caving community which supply very important data and knowledge and all this exploration results. They are by definition not affiliated with mainstream science. I mean, karst and cave communities particularly depend on the free access and kind of information and our results. Let's work on this.

BO: Yes. Now that the Ukrainian Speleoclub—

AK: Society.

BO: Society break the world record—and it's far from any, I would say, danger that some other cave would reach or would get close to that barrier 2,000 meters and that you are working on the international cooperation. What other big projects do you have in mind or you working on?

AK: Well, you know, I don't agree with you that any other group is close to challenging. I mean, cavers are very special. It's very natural for them to challenge and to compete for those things.

BO: Well, they are far, I was just saying—

AK: They are far, but some groups climb, for example, for the next expedition of Bill Stone to Mexico. He officially published a climb to break Krubera and to make 2,500 meters. And I wish him certainly the very success, because this is the nature of cave exploration. But it's honestly not very realistic. It's a long way. But this is something which motivates other strong and hard working caving groups, and it will certainly happen that few other caves will pass 2,000 meters.

We are also working on this in other areas, in parallel with Arabika. Six years ago we started under the same project, The Call of the Abyss, we call this project. We started the second front in Turkey, in Taurus Mountains in close cooperation with Geological Survey Turkey and some local clubs exploring Aladaglar, kind of almost virgin high mountain karst area, very high mountain. I mean, in terms of karst, because traditional high karst mountains are about 2,000 meters, 2500 meters, but normally not above 3,000 meters. So, we went to Aladaglar because Aladaglar goes—

BO: Over 3,000.

AK: Over 3,000 meters, up to 3,700 meters, and it presents very specific challenge of high mountain karst. The difference is that around 2,000 meters it is more or less optimum for dissolution to be intense enough to produce open—

BO: Channels.

AK: Open channels on the surface. But about 3,000 meters, you have kind of periglacial conditions and the intensity of physical weathering is so high that—

BO: Everything is—

AK: Overrides the karst.

BO: The solution, yes.

AK: And tend to block all those sinkholes, all those entrances, all those open shafts, whatever, and there is a big challenge for cave search and exploration to find the way to the depths. You may have hundreds of caves. We call this “The Problem of the First (inaudible).” I mean, they’re all blocked. You have nice evidence that this massif is highly karstified, you know—

BO: But you don’t have the entrance.

AK: You can’t enter. So, we spent five years in Turkey in this particular place, and eventually we broke into big system. It is now 1400 meters deep. It continues. The whole potential of this area is about 2700 meters. So—

BO: Wow. We might get some news.

AK: Well—

BO: In few years from now.

AK: Maybe yes. But certainly you will have some news. I hope, also, the next cave deeper than 2,000 meters will be explored in particular area. I am not sure if it will become deepest. It may happen, you know. But certainly Arabika, especially with those Black Sea history we just discussed, has exceptional conditions.

BO: Potential, yes. Well, when I asked you about your projects, I was also thinking on the new funded Ukrainian Speleological Institute. I mean, I—

AK: Oh, yes. I was talking mainly about caving projects.

BO: No, because coming from the same part of Europe with the same problems we face with the Communists and all the system and the breakdown of the Communists and then the big industrial economical problems, how do you see the research within the Speleological Institute in Ukraine in the next years?

AK: Well, I—

BO: Optimistic?

AK: I have lots of optimism and lots of hopes. But I am not sure all of those hopes are realistic. We have big challenge. In many senses we are in [a] worse situation than, for example, Romania is, because Romania was during recent years more or less accepted and integrating into the European Union, which is not going to happen with Ukraine probably in a short—well, in, let's say, next five or maybe ten years. So, we are remained on the other side of the new barrier, I guess. I am afraid.

BO: Yes, I hope not.

AK: Yes, I hope not as well. But I mean, the barrier means in terms of geopolitical zones of influence, whatever.

BO: Yes. But travel is one of the things, easy access to different places.

AK: But this is also the integration to the regional or international sources of funding. And so we have difficulties to be kind of directly integrated to European sources of funding, or American, even (inaudible). But we certainly have to be—I mean, our institute, Karst and Cave Research Institute, it has some kind of good positions to be integrated into international cooperation just because we already are very much involved.

BO: From personal relationships.

AK: Personal relationships and all the interesting and important research which had been done in the Ukraine. This gives us pretty good position and hope to be integrated for the institute into the international cooperation. Also, we hope very much will put every effort to bring researchers, colleagues, interested colleagues, from other countries to Ukraine to work with us.

BO: I think that is the main—

AK: Cooperate—

BO: That is the main way to attract funding in Ukraine.

AK: Yes. Yes. And you know, I am totally convinced that in our science there are so many open leads to explore scientifically, I mean.

BO: Yes.

AK: Not only physically in caves, that there is no problem with competition or—

BO: Well, it is just a little bit more complicated because you don't have your own dating lab or your—but otherwise—

AK: But anyway, we are very open to support and to share any kind [of] interest which may arise for specifically our areas, which in many senses are unique and offer many kind of exciting possibilities for scientists in many respects. So, we will welcome this. And we are going to host [a] series of specialized symposia in Crimea, especially in Crimea. It is ideally suitable place for this, if you remember the map. If you remember, the Black Sea and Crimea is a peninsula which is kind of in the center of the whole region, Black Sea region which includes the south of Ukraine, the south of Russia, Caucasus Mountains, all Arabika and, you know, great karst of Abkhazia, Georgia, Armenia. Then it includes Turkey on the—I mean, the region includes—

BO: Yes.

AK: It includes Bulgaria, Romania, on the Western Moldavia—

BO: It's upper. Yes, it's too high up.

AK: Yes. So, we propose to have Crimea as central place for the regional Black Sea cooperation in karst, in problems specifically focused on Black Sea history, how it affected the karst, or many other aspects.

BO: You should make a joke now, because if it would be the Romanian president sitting here, he would just shake your hands because he is fond of Black Sea region. He wanted to develop the Black Sea region.

AK: Okay.

BO: When next time I am going off to Romania, I say, “Well, Mr. President, we have a guy in Ukraine who wants to—”

AK: I don’t know. It’s very good to hear that your president is fond of this. But regardless what our presidents [think] about this, I am sure that karst people—

BO: Speleological presidents.

AK: Karst people from this area would certainly welcome, you know—

BO: Yes, it’s a virgin zone for many studies. I mean, paleontology, paleoclimate, and of course, geomorphology is huge. Hydrogeology is huge potential with everything to do.

AK: So, I am very optimistic. But you know what is the most important—to answer your question—is you know, I am probably idealistic, more than necessary, but I believe that not the financial resources are the first, primary importance. They are certainly very important, but the determination and dedication of people are certainly of the foremost importance.

BO: Absolutely.

AK: And we do have in Ukraine many very much, very deeply dedicated karst scientists, and this is a kind of guarantee that they have bright future because all other depends on us. Not all, but most.

BO: Okay, well, that was a good, nice trip to the Ukraine, imaginary trip in the Ukraine. I was thinking about—you have a—it was Ukraine or Moldavia that has a winery in one of the gypsum caves?

AK: No, in gypsum, in limestone, it is Moldavia.

BO: It is Moldavia.

AK: But not in natural caves. They have enormous, big—they are called mines, limestone mines.

BO: Oh, okay. I see. Oh, I made a confusion. Moldavia has an entrance in one of the caves which actually is ninety kilometers below Ukraine.

AK: Yes. This is exactly correct, yes.

BO: It's Emil Racovita, or what—Emil Racovita is the Moldavian name.

AK: It is Moldavian name.

BO: Zoluška?

AK: Zoluška.

BO: Zoluška, okay.

AK: Yeah, that's interesting situation.

BO: And do you have an entrance in Ukraine? Or it's only the Moldavian one.

AK: No, we are working on it.

BO: (laughs) They will dig one.

AK: The entrance is 200 meters from the border in Moldavian part, and the huge cave goes beneath Ukrainian territory. So, ninety-two kilometers of caves goes—and we don't have [an] entrance and the present entrance is actually in the quarry, the gypsum quarry. And the quarry was sold to a French company, which is now restricting access even from Moldavian—

BO: Yes, for anyone.

AK: Yes, for anyone. And we work several years already on opening the entrance to this cave from the Ukrainian side, because this is absolutely incredible, very important cave which needs to be more studied despite of it's one of the best studied caves in the world probably. I mean, there are a number of publications in Russian, well, most of them, there is more than 300 papers—

BO: Morphology or climatology, what?

AK: Morphology, geochemistry. Because, you know, the special situation about this cave is that most of the Western Ukrainian caves are relict, presently relict caves in the former artesian area but now drained deeply by deep probes. And this cave is located in the area which was recently almost under artesian situation, confined conditions. And it was fifty-something years ago when the gypsum quarry started and they pumped water out to keep the quarry dry. And this opened the cave. This drained the upper part of gypsum to make cave accessible. So, we started exploring this cave, Ukrainian clubs and cavers, in seventy-six [1976]. And this means that there was a very fast, artificially produced transition from geochemical conditions and reducing conditions to oxidizing conditions. This resulted in massive deposition of iron and manganese hydroxides in the cave and lots of other interesting things. I mean, this is a kind of model laboratory to speed up the transition from confined to unconfined conditions. So, all the subsequent change in cave sediments, geochemistry—

BO: Everything was studied.

AK: Microclimate, CO₂, whatever, was studied, and needs to be still monitored and studied because there are more questions than answers, as always happens.

BO: I see.

AK: At least there are many open scientific areas to be followed.

BO: Yes, I remember—you said there were 300 papers on that—that's amazing for one cave. Well, this is ninety-two kilometers. I am just thinking on some ice caves in Romania where there were, like, fifty or sixty and then we managed to write the

monography out of that cave. And I was thinking, “Oh, my God, why should we go in that cave again?” because sixty papers, that will tell almost everything. And now I have a Ph.D. student working on that and it opens at least two or three more people can do their Ph.D. there on various other things. Because facilities are different, the knowledge is different. Then you figure out that you can look at the same ice layer with different eyes from different perspectives and something. So, I think this karst is never ending.

AK: This is very exciting. I mean, the karst is, of course, (inaudible) and what we are doing but I would say that it's not very subjective to say that it is one of the most fascinating kind of activity that man could imagine to study and explore karst and caves in every sense. Especially in the modern world which you get so much artificial—

BO: And stress and other things.

AK: Detached from the nature, from the exploration, and karst and caves, we are still doing both, exploration, physical exploration and very exciting steps in science, so.

BO: Well, thank you very much.

AK: Thank you.

BO: I hope that you will enjoy the karst and caves of Florida the next couple of days.

AK: I am absolutely sure I will certainly enjoy, and very grateful to professors and students in South Florida University [for] putting together all these events—

BO: Well, we will see by then how everything comes up. [It] should be a great karst week here.

AK: Should be great, yes.

BO: Thank you very much.

AK: Thank you very much.

End of interview