TO THE HISTORY OF DISCOVERY OF SOME NATIONAL DEPOSITS BY COLLECTION'S SPECIMENS

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The history of geological discoveries has many bright examples of deposits found by the sample material from the field works of previous years or as a result of thorough looking through a museum collection. Several such a finds have significantly increased the country's mineral resources base and are described in the article. In particular this article will detail in the main role of plentiful gathering of the Fedorov museum in the Urals in the discovery of the major bauxite deposits; reclamation of Chorukh-Dairon sheelite deposit which was found by N.A. Smolyaninov by museum's specimens; the epic history of search for kimberlites in Siberia using "pyrope path" method invented by A.A. Kukharenko based on his collection of South African kimberlites; the Zheltaya Reka (Zheltorechenskoe) deposit, the first uranium deposit in the USSR, and several other deposits is also described. The data provided will show the importance of careful keeping and practical use of mineral collections and using previous geological works for continuation and success of the later studies.
3 color photos, 12 references.
Keywords: deposit discovery, bauxite, optical fluorite, sheelite, pyrop, diamonds, uranium ores, boron ores, mineral collections.

World experience shows that in past centuries mineral deposits were discovered almost accidentally by ore outcrops or other obvious signs of shallow ore presence. Nowadays, due to the depleting of easy-to-find mineral deposits, mineral deposit discovery is usually the last link in the chain of complex planned and focused geological investigations, that include geological surveying of various scales, revelation of geophysical and geochemical anomalies, detailed mineralogical and analytical research of revealed mineralization and their processing and economical assessment. Nevertheless, there are examples of deposit discoveries without the complex and multistage geological investigation, or with significant reduction of it.

This article will talk about deposit discovery made at the work desk while looking through material gathered during previous field expeditions. Occasionally it was possible to encounter the material signs of valuable mineralization, which were proven by checking in the field. This is a difficult approach, it requires a deep knowledge of mineralogy, a clear understanding of the geology and minerageny of the regions where the material was gathered, and a hands-on knowledge of mineral identification. The knowledge of the exact location of the gathered samples is especially important. In the history of the Soviet Russia's geology there have been some stunning examples of discoveries of this type.

Geologists from the Urals know well the history of identification of Krasnaya Shapochka (Red Riding Hood), the biggest Russian bauxite deposits in the NUBR (the North Urals Bauxite-bearing Region). The sources of the discovery lead us to 19^{th} century, when E.S. Fedorov, the prominent Russian geologist and crystallographer (inventor of the universal stage and 230 crystal space symmetry groups. — Translator note), had gone to the Urals from Petersburg in 1885 to carry out a detailed study of the region of Tur'insky mines. A thorough mapping of Bogoslovsky mining district was conducted with creation of a 1:10 000 geological map. It covered 5 thousand km^2 and had a well described mineral collection which tied samples to points on the topographic map. This collection became fundament of the museum and was named after E.S. Fedorov. Tur'inskaya expedition started investigation work in the region of town of Nadezhdinsk in 1930. Geologist N.A. Karzhavin knew about bauxite occurrences on the Western and Eastern slopes of the North Urals before undertaking the exploration. He studied the collection of Fedorov in the geological museum. He wrote later in his book "Krasnaya

Photo 1. Bauxite. The Krasnaya Shapochka deposit, Urals. The size of the biggest sphere is 33 cm in diameter. VIMS Geological Museum. No 204sh. Photo: N.N. Krivoschekov.

Shapochka" (Red Riding Hood): "*I spend days and nights in the museum. I select 14 samples of suspected bauxite formations to send to chemical analysis out of 50 thousand thoroughly observed samples. Incommunicable joy did I feel when promptly received results of chemical analyses of my "suspected samples". 7 out of 14 turned to be bauxites of the world's best grade... It was easy to learn geographical location and coordinates using maps from the safes.*" (Karzhavin, 1975). Follow-up fieldwork to check of the Karzhavin's findings led to the discovery of the best Russian high grade bauxite deposits, which supplied continuous operation of the Urals aluminum plants for many decades (Photo 1).

Material of the vast collection of Fedorov geological museum in the Krasnotur'insk promoted discoveries of Severopeschansky iron deposit, commercial deposits of refractory clays, and many other mineral deposits besides bauxite of the NUBR (Yushkin, 2006). E.S. Fedorov foresaw the important role of the gathering he collected for the future development of the mining industry of the region. He wrote about the visit to the region of his previous works in 1912: "*I suppose that there is no other place on Earth where such detailed work would be done in preparation for solving questions connected to mining activities. Because of it, nowhere else did so deeply into the details of geological structure, which have become a necessity of the mining business in general, and especially for the large field of Tur'insky mines*" (Fedorov, 1912). E.S. Fedorov willed to save the unique in its comprehensiveness and representative collection gathered by him and his assistants. He knew it was the very important source of information about yet undiscovered resources in the Northern Urals. We know now, his insight was totally proved out.

A museum collection also played the main role in the discovery of the unique deposit of fluorspar with gigantic crystals of optical quality fluorite, on the slope of Zeravshan Range near Panjakent in Tajikistan. V.N. Sobolevsky, the participant of the legendary Tajikistan-Pamir expedition organized by the Academy of Science of the USSR, described it in details. One geological brigade went along the Kulikolon gorge and received a beautiful druse of large colorless crystals as a present from a local habitant. The brigade members did not identify the mineral then and upon arrival at the headquarters in Stalinabad (now Dushanbe), the sample was given to Stalinabad's museum of local lore, history and economy without information on the source locality. V.N. Sobolevsky was one of the other members of the academy expedition, and he was attracted to the sample after observing the museum collection. He identified it as rare optical fluorite of quality and size. They immediately sent an exploration group to the place where the local dweller had presented the magnificent sample to the geologists. Soon, this group with the help of old Tajiks, who were the first to find the great crystals on the mountain side above Kulikulon Lake, discovered mineralized zones with large cubic fluorite crystals of unprecedented quality (Photo 2). It was the first discovery of an optical fluorite deposit in the Soviet Union and there were no similar ones in the world at that time (Sobolevsky, 1945).

A longer, complex, but also very exiting story is about discovery and development of skarn Chorukh-Dairon scheelite deposit. P.S. Nazarov, a businessman who worked in Turkistan, brought a variety of specimens to the Mineralogical museum of Moscow University in 1912. They were described in the catalog by P.E. Alexat, the museum's custodian, as "scheelite samples with manifestation of copper mineralization found on the road from Khujant to Murza-Rabat". Later the greater part of the donation was lost. N.A. Smolyaninov, the famous mineralogist and, later profes-

Photo 2. Druse of large crystals of optical fluorite. Kulikolon deposit, Zeravshan Range, Tajikistan. The size of the sample is 84 x 57 x 32 cm. VIMS Geological Museum. No M 1739.

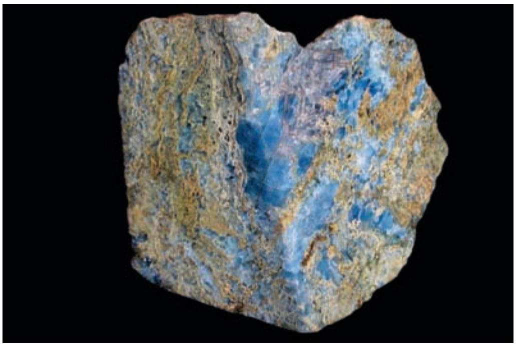

Photo 3. Boron-bearing vesuvianite-pyroxene skarn with blue calcite. Yuliya Svintsovaya deposit, Khakassiya, Krasnoyarsk region. Sample is polished from both sides with size of 15 x 11 cm. From the collection of Vladimir I. Kuzmin.

Photo: N.N. Krivoschekov

sor of the Moscow Institute of Geological Exploration ("MGRI" is the Russian abbreviation), found only two hand specimens left whilst reviewing of the old university collection in 1930. He supposed the Mogol-Tau region, where the samples originated from, to be perspective for *tungsten* mineralization having learned about the conditions of the formation of American scheelite skarn deposits and based on the geological environment of the region. He applied a report note on the subject to the Glavredmet (Main Bureau on Rare Metals) and was commissioned to Karamazar to check his prognosis. F.I. Wolfson, who worked in Turkistan in the period of 1930 – 1940, described the further development of the story in his memoirs.

"A man of a low stature approached me in Leninabad (Khujand after 1996) around 1930 and represented himself as Professor N.A. Smolyaninov. After several polite phrases he asked me to give him some ammonal [mining explosive: 80% NH_4NO_3, 15% TNT, 5% powdered aluminium. – *Translator's note]. "What do you need ammonal for?" I asked him. I was convinced that I was talking to a man of science without practical knowledge of mining engineering, who was not capable to carry out exploration mining correctly. He explained me that he found scheelite in samples of supposed copper ore brought by tradesman Nazarov to the MSU museum before the revolution. He discovered the outcrops of the ores on his trip to the original sample locality and he needs to dig an exploring shaft on the outcrop.*

I thought that if I gave him ammonal he would blow himself up. So, I decided to better help him with work of specialists. To the request I sent him a team of two colliers and Ilya Arzhanov, the blaster with ammonal. They helped to dig the pit. Later N.A. Smolyaninov characterized the deposit as valuable for further exploration. A geological exploration party was formed to study the deposit in 1931 and cut several trenches on the site of the mineralization.

We were very unfortunate that the German specialist F. Alfred was invited to Karamazar in 1931. He gave negative evaluation of the mineralization and the recently formed party was dissolved. Alfred wrote in his repost that "magma in the region is depleted in tungsten and because of that scheelite outcrop at Chorukh-Dayron does not show any prospect". Exploration works on the site were frozen for 10 years.

The business was helped by the fact there was the road by the trenches. We went by the road with Arzhanov in August, 1941. On passing the pit, Arzhanov, who participated in blasting it, said: "Fedor Iosifovich, the "shevelite" was very rich in the pit!" I decided to study Chorukh-Dayron later. To assess the mineralization we dug long trenches. The workings on the site were carried out by a group lead by V.M. Bir'ukov. Bur'ukov came to me when only five or six days had passed since resuming the exploration. With his eyes open wide he said: "The trench had revealed a large tungsten-bearing vein more than 10 meters thick." I went to see the discovery on the site. Indeed the trench laid across the bearing of the *vein opened a magnificent ore body with very rich scheelite ore. The distance from the famous trench to the old Smolyaninov's pit was less than 150—200 m. Naturally, the find got everybody interested. A larger group of trench diggers was organized immediately and they outlined the vein in a month. It was more than 700 m long with an average thickness of 7 meters. Estimation of the reserves of the vein gave 10000—12000 tons of tungsten down to depth of 100 meters.*

I went to Dushanbe to visit Protopopov, the first secretary of Central Committee of the Communist Party (of Bolsheviks) in Tajikistan, to tell him about Chorukh-Dayron. He learned from me about the importance of tungsten in production of armor steel, and proposed to prepare a resolution of the Central Party Committee and the Council of Ministers of Tajikistan about opening the mine. The resolution was directed to the Ministry of non-ferrous metals in Moscow. A.A. Amiraslanov, the principal geologist of the Ministry of non-ferrous metals, came for familiarizing with the object on the site soon after. He sent the telegram to P. Lomako, the Minister of non-ferrous metals saying: "Confirm construction Chorukh-Dayron". Necessary goods and machinery started to be delivered to the site in two weeks to begin the construction of the mine and the processing plant. Scheelite concentrate from Chorukh-Dayron began to supply military plants already in the fall of 1942. It was our contribution to the victory on the fascist Germany" (Wolfson, 2000).

Using pyrope as main trace mineral in diamond exploration is the wonderful example of discovering from deposit using samples of a mineral collection. It was the analogy to South African kimberlites that was made. This happened not long ago and it is well known due to memoirs of many participants of the diamond rush in the USSR.

N.N. Sarsadskikh and P.G. Guseva, the members of the Leningrad central exploration expedition, found grains of bright cherry-red mineral in heavy concentrates gathered during field work by exploration parties of the Diamond expedition in several regions of Yakutia. The majority of the mineralogists who worked on diamond exploration in Siberia considered them to be spinel and did not connect "the red grains" to a diamond-bearing bedrock occurrence. They referred the mineral to A.A. Kukharenko, an assistant professor of the Leningrad state university, for identification. He possessed the only specimen of diamondiferous kimberlite from South Africa that existed in the whole USSR at that time. He saw a similarity in the minerals from the heavy concentrates to pyrope grains from the African diamondiferous kimberlites. A.A. Kukharenko also found picroilmenite which also was identical to one from the South Africal kimberlites. All those facts, especially presence of pyrope, which is easy to spot during primary observation of heavy concentrate, became a very effective technique in exploration of bedrock diamond deposits.

The common occurrence of pyrope in heavy concentrates was registered by many exploration groups working in the basin of Viluy River in early 1950s. The reliability of A.A. Kukharenko's proposition of pyrope as an indicator mineral urgently needed to be proved. N.N. Sarsadskikh recommended geologist L.A. Popugaeva to carry out this important test work in the region of Daldin river, where pyrope was found in most quantities.

The exploration was simplified to the following procedure: visually or with a hand lens identify and count only pyrope grains in heavy concentrates in the field and move upstream in the direction of increasing abundance; look for kimberlite bedrock outcrops in the area where largest pyrope concentrations were found.

So, the basis of pyrope mapping as an exploration method for diamondiferous pipes was established. "The pyrope trail" helped L.A. Popugaeva to make the outstanding find of the first kimberlite pipe in the region, named Zarnitsa on August 21, 1954. Later a number of kimberlite outcrops were found in the Yakutia diamondiferous province using this method (Lyakhovich, 2000).

Previously collected stone material also played a big role in the period of intensive uranium exploration. It is known that by the early 1940s the USSR had only a few small uranium deposits in Fergana and did not have mineral resources to solve the problem of atomic weapon production. At the same time, the hot-headed in the Pentagon and later NATO were preparing plans for preventative large-scale nuclear attacks on the Soviet Union. To negate the USA monopoly on nuclear weapons became a matter of life and death for the USSR. Work on the "Uranium Project" started with the lead of I.V. Kurchatov soon after the World War II in very difficult time for the country's economy and with a very strict time frame. A.P. Alexandrov wrote: "*... the most important part of the program was a clear but very difficult plan to start extensive uranium exploration and organize uranium production*" (Belevtsev, 1992).

The special resolution of the State Defense Committee of the USSR assigned the Committee of Geology of the Council of People's Commissars of the USSR to do exploration for uranium deposits in the territory of the country. All the geological services received the order. Special attention was brought to the necessity of pursuing exploration goals not only by field works but also by revising previously collected material.

Despite of absence of radiometric hardware, geologists actively started exploration for the first time relying on the appearance of uranium minerals. They used the very primitive hardware such as leaf electroscopes, luminoscopes and so on. The research sometimes was successful even in such conditions. Ya.N. Belevtsev who became a principal geologist of Krivorozhsky iron basin in 1944, made a very important discovery in that period (Valter, 1997).

During the World War II the plants and the mines of the basin were ruined, shafts were blocked with loose rock and flooded, shaft houses were blown-up, the ground in many places was covered with drill core fragments. A lot of the core was scattered in the yard of the management building of the mines, where they stored the reference collection of drill core sample from holes across the different parts of the basin. Ya.N. Belevtsev received an order to carry out exploration for uranium deposits in April, 1945. With the help of technician geologist, he began to test fragments of the core spread in the yard. They were equipped with a school electroscope, which Belevtsev took from the physics department of Krivorozhsky mining institute. Fortunately, the core fragments had enamel labels with the drill hole number and sample interval. Hence it was possible to find the source of the core using archive material. So, they found the place of the origin of the sample, which made the petals of the electroscope move. Ya.N. Belevtsev remembers this event in details.

"*We had measured hundreds of core samples and all of them left the petals of the instrument stay motionless. The hope to find something wan and all the work seemed to be pointless and done in vane. Sometimes I thought that I should stop doing this fruitless work. Nevertheless, some force kept me searching.*

The question "what to do?" rose when there was nothing else to test, and every drill core brought from the mines and all fragments of the core were extracted from the dirt in the yard and tested showing no signs of radioactivity.

"Let's search in the yard and in the shed one more time", I told Nikolay, "if we might leave something untested". We went to the yard, walked there for a long time. Nikolay dug out fragments of core, I crushed them into pieces and observed but none of them attracted my attention.

Walking around the yard my sight unwillingly came across some samples pressed into hard compressed soil. Some of them were black and stood out with bluish tint of alkaline hornblende. Those samples were dug out, crushed and tested with electroscope. We were so joyful when suddenly the petals of the electroscope went apart. We were rewarded for our hard and as we thought hopeless work. One sample had an enamel label with inscription in China ink that the core originated from the drill hole No 7 of Zheltaya Rechka mine. We found with maps and horizon plans that the drill hole No 7 was drilled through iron ores from the 110 m horizon on the Zheltaya Rechka mine. Later we found several samples on the mine which shown significant radioactivity."

It was the discovery of the first large uranium deposit in the USSR. Ya.N. Belevtsev, its discoverer, wrote in his memoirs: "*There is nothing more exiting for a geologist than finding a deposit. For not every geologist succeeds in it. I had this incomparable feeling I experienced twice in my life! One was the discovery of manganese deposit in Gornaya Shoria during the World War II and another was the discovery of Zheltaya Rechka uranium deposit in Krivorozhsky basin.*" It is worth mentioning that the latter uranium deposit was found using previously mined, almost collectible material.

There is another example of uranium deposit found by checking the radioactivity of previously collected stone material. V.G. Melkov, professor of the VIMS (the All-Union Institute of Raw Mineral Resources) found brightly luminescent uranium-bearing hyalite in the collection of L.P. Vilyunova, the staff of the North Caucasian Geological Survey. It was enough to initiate exploration works for uranium in the region of Caucasian Mineralnye Vodi, which lead to the discovery of commercial mineralization on Besh-Tau mountain followed by construction of Lermontovsky concentrator and metallurgical plant there.

A discussion about deposits found using museum collections need to mention pollucite mineralization discovery in rare metal pegmatites of Kalba Range. A.I. Ginsburg, preparing for field work on pegmatite fields, looked through pollucite-bearing pegmatite samples from Canada and the United States in the collection of Fersman Mineralogical Museum of the Academy of Sciences of the USSR. It helped him to find this valuable cesium mineral, which visually is very similar to quartz and other colorless minerals, in many pegmatite samples from Kalba Range (now in Kazakhstan). Detailed field study of pollucite mineralization in the pegmatites of Kalba field proved its commercial value. It was discovery of the first cesium deposit in the country. A.I. Ginsburg was awarded a state prize for the find.

Museum collections played crucial role in the revelation of Inder borate deposit in the cap rock of the large salt dome structure, one of the biggest boron deposits in the USSR. M.I. Dobrinina-Yakhontova, the head of the department of non-metallic deposits in museum of F.N. Chernyshev TsNIGR Museum (Russian abbreviation for the Central Research Geological Exploration Museum), found a beautiful large specimen of a colorless crystal from Inder Lake in Kazakhstan, in one of the old boxes during reexamination of old collections in 1930s. The mineral was identified as hydroboracite. An expedition was sent to Western Kazakhstan to do reconnaissance work in the original location of the sample. The expedition found enormous reserves of boron salts in the area of Inder Lake (Inder Mountains..., 1940).

V.P. Petrov wrote in his memoirs a different version of the discovery. He wrote that Volkov, a staff member of the Geolcom (the Geological Committee on Mineral Reserves) (Volkov's initials are missing in his memoirs as long as the ones of Boldireva) collected samples on field studies of the Caspian Sea depression brought to the Geolcom museum as a part of his report in 1920s. A hand sample of unusual crystals had been identified in the field as "gypsum". Mineralogist Boldireva, the museum staff member who received the collection from Volkov, turned her attention to the sample and identified it as hydroboracite. Volkov was sent back to the Caspian Sea depression only a week later with another field group to organize exploration of the boron deposit and its exploitation only a week later. Naturally, a question appears in this case whether the museum staff member is the actual discoverer of the deposit.

Curiously enough the problem of boron deposits gained renewed vigor in the late 1950s despite of existence of the two big boron deposit in the USSR: Inder and the largest Tetukhe deposit in the Primorsky Kray. There was a boron boom in the country. The country's officials made boron the element of strategic importance to the country, due to its use in producing efficiency rocket fuel. Compounds of boron and hydrogen — borans exceed many other rocket fuels in their calorific capacity.

A.E. Sats, the staff member of the First business trust of the Ministry of Geology of the USSR, found a mineral that resembled datolite in the sample from non-ferrous multielement deposit Yulia Svintsovaya in Khakassiya, whilst looking through the collection of Fersman Mineralogical Museum of the Academy of Sciences of the USSR. Laboratory tests of the mineral proved the initial identification of the mineral as datolite. An exploration reconnaissance group of the First business trust of the Ministry of Geology of the USSR was directed to the Yulia Svintsovaya deposit in the summer of 1959. Simultaneously a similar geological party was organized in VIMS and sent to the Minusunsk depression. The two parties worked in association with each other.

The skarn and adjacent altered rocks contained wide-spread boron mineralization represented with axinite, datolite, danburite and tourmaline. High boron content was also detected in vesuvianite from the deposit (Photo 3). Although, the scale of the mineralization was too small to be economical and the boron-bearing rocks had only scientific interest. Nevertheless, studies done at Yuliya Svintsovaya gave very important scientific data on the mineralogy and geochemistry of boron. Also the first study of supergene alteration of datolite was performed (Vasilkova, Kuzmin, 1961) and a new mineral sibirskite, a calcium borate $CaHBO_3$ was discovered (Vasilkova, 1962).

We need to mention that the "boron boom" soon came to an end in the country, because it was found that the viscous tar-like products from boran's combustion blocked up turbines and could not be used effectively as a rocket fuel.

The presented stories show the great importance of keeping and wise use of museum geological collections. These collections contain very valuable data on structure of geological bodies that were studied in the past and may have become inaccessible due to deposit depletion or termination of geological work in the area. The material chronicle can be read again, understood from a different point of view and may bring the unexpected joy of a new discovery to an inquisitive investigator. It is appropriate to put here the vivid expression made by N.A. Karzhavin, the discoverer of the Krasnaya Shapochka (Red Riding Hood) deposit, at the end of the article: "*Geological museum or drill core storage systematically ordered as a library, keep magnificent mysteries of the past generations. Drill core storages are centers where new geological ideas are crystallized and are brought to the light. Progress of the science is impossible without them as without fundamental libraries. Drill core storages represent not only forgotten ideas of the past but generate conditions for new daring and scientific deeds!*"

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