Zeolites first described by Swedish researcher Kroonshted more than 250 years ago still attract special attention today. These minerals are effectively applied in industry, agriculture, medicine, and for conservation of surroundings with gradually spreading areas of their application. This is explained by unique adsorptive, ion-exchange, and catalytic properties typical for this group of minerals, as well as by their thermal, chemical, and radiation stability. Artificial zeolites with constant composition and a strictly definite set of physicochemical properties are claimed in industry. Natural zeolites represented by polymineral zeolitized rocks (zeolitites) of various geneses are applied in agriculture and medicine. In spite of their old origin, the mechanism of biological activity of these natural mineral systems still is not sufficiently studied. The discovery of natural Au–Cu–Ag alloy microparticles in natural zeolitites discussed in this paper is a rare mineralogical fact deserving special attention.

The Vanchinskaya basin, one of the Cenozoic riftogenic basins within the Eastern Sikhote-Alin’ volcanic belt, has a relatively small size of 4 × 15 km. However, the presence of coal and zeolites volcanogenic–sedimentary deposits filling it, high registered concentrations of REE in coals [1], and its location on the southeastern flange of the Soyuznoe gold–silver deposit [2] are responsible for the unremitting scientific and practical interest in it over many years.

Structurally this basin is a one-side riftogenic graben of northwestern strike. Its southwestern side is separated by the Milogradovskii fault (thrust) clearly reflected in relief. The northeastern flange occurring along the fault as well is gentle. The western part of the basin is filled by pyroclastic (tephrogenic) and tuffogene–sedimentary coal-bearing deposits of Paleocene–Early Eocene age. In the eastern part they are replaced and intruded by Middle Eocene volcanic rocks (tuffs, lavas, explosive breccias, and extrusive rhyolite and trachyandesite bodies).

Zeolite mineralization within the basin has a stratiform character. All zeolitite occurrences on the right side of the Vanchina–Ugol’nyi Brook including the Berezovoe manifestation studied in detail are of the same type by geological characteristics. They are represented by outcrops (fragments) of the undercoal band of tuffaceous sandstone and tuffite in the composition of tuffogene–sedimentary lake deposits and characterized by a significant admixture of mineralized plant detritus. According to the data of X-ray structural analysis, the mineral composition of zeolitites of the Berezovoe manifestation comprises zeolites of the clinoptilolite–heulandite group (50–60%) and clay minerals of the smectite group (20–30%) with an admixture of quartz and feldspars. The visible thickness of the zeolite-bearing band is ~20 m.

Clearly reflected signs of active eating of rocks by wild ungulates as lick niches, as well as eaten away caves and individual nibbles on outcrops with typical tooth prints are observed in the cold-free period of the year on all natural outcrops of the zeolitized band within the Vanchinskaya basin. Traces of Manchurian deer are the most frequently observed among the traces left by animals in the places where they eat rocks and soils.

As we mentioned before, most of the soils eaten by animals within the Sikhote-Alin’ are formed from zeolitized and argillized tuffogene–sedimentary rocks with clear signs of the presence of buried organic remnants [3]. The hypothesis on the significance of organic materials in zeolitites as accumulators of biologically active chemical elements appeared long ago,
When we made the first observations on the behavior of wild animals on salterns [4].

Previously, we considered high concentrations of REE in zeolitites of the Vanchinskaya basin as one of the factors of their high biological activity [5]. Based on the geochemical data, we demonstrated that layers enriched in plant detritus in zeolitites contained two–three times higher REE concentrations (250–300 ppm) than that in “pure” zeolitized tuffites [6]. Subsequent microscopic and microprobe investigations of tuffite samples provided evidence for the fact that REE minerals (mainly phosphates) were predominantly concentrated in the mineralized detritus.

Currently oligoelements (silver, gold, and copper) are considered as elements important for living organisms as well. As this takes place, it is necessary to mention that silver, gold, and copper are also attributed to potentially toxic elements. However, in this case, as well as for most other elements, the biological activity is mostly controlled by the form (chemical compound) of this element occurrence. The properties of silver as an antimicrobial agent have been known for quite a long time, although the problem of the biological role of silver in the organism has been studied insufficiently. The mechanism of biological gold compounds is not understood completely; however, it is currently considered that gold may enter the composition of metalproteides, interact with copper and ferments of connective tissue, and strengthen the silver bactericidal activity. In addition gold demonstrates properties of immunity regulation and is applied up to now as a medicine during autoimmune deceases (auranophine, cryzanol, and others). Copper is an important element for life, which enters the composition of vitamins, hormones, ferments, breathing pigments, and participates in metabolism and tissue breathing, is present in the system of antioxidant preservation of the organism participating in neutralization of free oxygen radicals, has a clearly reflected anti–inflammatory property, and allays autoimmune deceases [7–11]. Biologically active additions including the complex of silver, gold, and copper salts, namely Oligosol Cu–Au–Ag and Gammadyn Cu–Au–Ag, are known.

Three samples of zeolitized tuffites of the rhyolite–dacitic composition with layers of plant detritus from the Berezovoe zeolite manifestation located within the Vanchinskaya Cenozoic basin, Southern Sikhote–Alin’, were studied on a scanning electron microscope ZEISS EVO 50 XVP equipped with an energy-dispersive X-ray spectrometer INCA Energy-350. Tuffite samples were prepared as small fragments. We observed eight microparticles of a Au–Cu–Ag intermetalld with a size from 500 nm to 3 µm. The quantitative and qualitative composition of the discovered particles was determined using an energy-dispersive X-ray spectrometry; the spectrum of one sample is shown in Fig. 1 and results of investigation of all samples are given in table. As is evident from the table, the composition of microparticles varies insignificantly containing on average (wt %) Au 60; Cu 30; Ag 10.

In addition to the natural Au–Cu–Ag alloy, individual microparticles of native gold, silver, and chromium, as well as numerous segregations of REE minerals, mainly represented by phosphates, were registered in zeolitites.

Back-scattered (Fig. 2a) and secondary (Fig. 2b) electron images of one particle obtained at different magnifications demonstrate its localization in mineralized plant detritus. The atomic absorption spectrometry allowed us to establish that detritus–rich zeolitite layers contain twice as much gold as over- and