



Analysis of Rare Earth Elements (REE) in vein quartz and quartz-sandstone host rock in the Zhelannoe high purity quartz deposit, Russia

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The Zhelannoe high purity quartz deposit is located on the western slope of the Polar Urals. It is one of the largest deposits of vein quartz and rock crystal in Russia. Most of the mineralization is hosted within a single horizon of very firm quartz-sandstone, where plastic deformation did not occur almost entirely. All tectonic stress was released by the development of numerous thrust faults of different scales. Cavities formed during this process were later filled with quartz and rock crystal.

In order to obtain more details on conditions under which mineralization took place, analysis of trace element contents in vein quartz and host rocks, and the micro-thermometric study of fluid inclusions in quartz have been carried out.

The trace element composition of vein quartz and of the host rock has been determined by ICP-MS. The results have shown that concentrations of most of the 46 studied elements in quartz are two orders of magnitude lower than in chondrite, and more than three orders of magnitude lower than in the upper crust.

Even though Pb and Li have the highest concentrations in quartz samples, levels are only nearly comparable in chondrite, and substantially lower in the upper crust. At the same time, negative anomalies of Pb and Li concentrations in the host rock may indicate the removal of these elements during vein quartz formation.

Contents of most REEs are two orders of magnitude lower than in chondrite, and three orders of magnitude lower than in the host rock. Generally, the patterns of REE distribution in vein quartz and the host rock express a clear correlation; confirming the genetic link between vein quartz and quartz-sandstone host rock. However, the process of quartz recrystallization led to an intense decrease of REEs content, and of all other impurities, which consequently influenced industrial value of the Zhelannoe deposit. As a result of the micro-thermometric study of fluid inclusions in quartz, the following physical-chemical parameters of mineral-forming fluids have been established: homogenization temperature 217 – 159 °C; concentration of salts 9.8 – 5.9 wt. percent NaCl equiv.; density of fluid 980-900 kg/m³; pressure estimates for associations of heterogeneous fluid inclusions vary from 80 - 50 bar. There are two principal types of inclusions: vapor, and two-phase liquid-gas inclusions. The state of mineral-forming fluid is heterogeneous. Carbon dioxide condenses in gaseous inclusions upon cooling. Data on salinity and density of mineral-forming fluids, the presence of the gas phase with carbon dioxide; and estimates of pressure during the formation of quartz of the Zhelannoe deposit have been obtained for the first time.