MOBILE FACILITY FOR GAMMA-ACTIVATION ANALYSIS OF GOLD ORES

V.G. GOSTILO, A.D. SOKOLOV
Baltic Scientific Instruments, Riga, Latvia

M.I. DEMSKY
CORAD, St-Petersburg, Russia

The results of the development of "Au-Isomer", a facility for gold bearing ores' gamma-activation analysis (GAA) for the mining industry, are presented. The facility is designed as a mobile one, its design allows disassembling the GAA unit and transporting it to another mine in four 40-foot containers. The irradiation system of the "Au-Isomer" GAA facility was created on the basis of linear electronic accelerator (LINAC) УЭЛР-8-10А, which was maximally adjusted to the tasks of gamma-activation analysis. LINAC generates an electron beam with a power of up to 10 kW and an electron energy of 7-9 MeV, allowing to adjust the energy of electrons in this range. The feature to adjust the energy of electrons for the analysis of elements in ores makes it possible to optimize sample irradiation conditions, so as to suppress associated element lines that may overlap with gold lines in the GAA spectrum. In turn, this allows to increase the accuracy of determining gold in the ore and to reduce the limit of its detection.

To ensure high stability of LINAC operation, an original electron beam stabilization scheme has been added, reducing the spread of its intensity to less than 2%. Constant control of the beam current and the electron energy is carried out, providing a visualization of parameters in the operator's program window. The electron accelerator is cooled by a chiller-based cooling system. The accelerator is powered by a three-phase circuit 380/220 V, 50 Hz; maximum power consumption of the GAA is 70 kW/h.

To ensure low detection limits and high accuracy in determining the concentration of elements in ores, the "Au-Isomer" GAA facility uses a two-channel precision spectrometric system for detection gamma radiation with large-area HPGe detectors (D = 110 mm). The results of using the facility for the quantitative analysis of gold bearing ores are presented. The values of gold detection limit (3σ), measured from the spectra of certified reference samples with a low background level, were 0.026-0.028 ppm with a single irradiation. In this case, the root-mean-square measurement error for a gold concentration of 1 ppm did not exceed 8%, and for a concentration of 10 ppm - 4%. The "Au-Isomer" provided the analysis of coarse samples (1-3 mm) with a capacity of at least 65 samples per hour.

The spectra of real samples of gold bearing ores with the presence of various associated elements have been investigated. Our results, obtained on real ore samples, confirmed the effectiveness of the following elements' analysis: Au, Ag, As, Ba, Br, Cd, Ge, Hf, Pb, Se, Th, U, Y and W. The presented spectra clearly demonstrate the possibility of analyzing the concentration of these elements when creating appropriate measurement procedures . In the process of measuring the spectra, it was noted that the main contribution to the background pedestal, on which the peaks of gold, silver, hafnium and other related elements are located, is given by the products of photofission of uranium and thorium. Therewith, the content of uranium in the presented ore samples is estimated by us as ~ 40-50 ppm, thorium ~ 100 ppm, barium ~ 300 ppm, yttrium ~ 200 ppm. The report presents real spectra of gold-bearing ores' samples with peaks of gold at 130 and 279 keV, and peaks of the accompanying elements.