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Development of γ activation imaging method for studying of elements distribution in some ores

Recently it has been demonstrated that activation of samples by bremsstrahlung radiation of microtron with further application of digital autoradiography is prospective method for detection of noble elements micro inclusions in geological samples. A digital version of the autoradiography has been developed [1].

Current investigations have been directed to extension of digital gamma-activation autoradiography capabilities to make a reasonable and effective alliance of this nuclear method with non nuclear methods of local analysis. Among the developed approaches are: analysis of large size samples (dozens cm²) and development of method for increasing selectivity using analysis of autoradiographic images while decay. Irradiation of large size thin section for fast autoradiographic detection of "zones of interest" containing elements in question seems to be a promising approaching for purposes of screening analysis of samples series. The further detailed analysis of the selected small zones may be done, for example, by SEM.

For uniform irradiation of thin sections in the field of bremsstrahlung radiation having quite narrow distribution a special device and software have been developed [2]. It is obvious that activation autoradiography allows detecting distribution of the sum induced radionuclides having suitable decay parameters (beta autoradiography). That is why the main task of investigations in autoradiography is optimization of irradiation/cooling times to obtain enough contrast detection of the required elements. Our recent efforts were directed to development of method to increase selectivity of the digital autoradiography by means of analysis of decay dynamics for each pixel of the whole image. It is clear that such analysis may be done just by means of software. The developed program loads a set of coaxial images obtained while sample cooling, necessary information on each image from MS Access data base and than estimates decay parameters (maximum two exponent mixture) for each pixel. It has been proved that even 8 bits depth grey scale images are suitable for stable evaluation of decay data. For visualization of the obtained results the program generates a set of secondary meta images representing "distribution" of the apparent half lives values for the preset ranges and their uncertainties. Using information on the isotope composition (obtained by gamma-ray spectrometry), decay schemes one can re-model distribution of the apparent half lives to distribution of the correspondent elements (this part of the software is under testing).

The developed method have been successfully applied for analysis of Pt-Pd micro inclusions in polymetallic ores of Norilsk area (North Eastern Siberia, Russia) having complex composition. Comparison with results of analysis by X-ray microanalysis is also given.

References

1. V.P. Kolotov et.al. J. Radioanal. Nucl. Chem., Vol. 278, No.3 (2008) 739–743
2. D.S. Grozdov, et.al. Abstracts (this conference)

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