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Photo- and digital-detectors for quantitative digital densitometry for distribution analysis of ores by means of gamma-activation

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In the recent publications (e.g. ref. [1]) it has been shown that application of computer processing of time series digital autoradiograms allows increase significantly the selectivity of local analysis that allows elements mapping for some noble elements in ores using gamma-activation. It was done by means of pixel-by-pixel processing of time series images to recover apparent half-life for each pixel of the image. During the investigations it was detected that the method of quantitative densitometry plays very important role for success of such analysis.
Two principally different detectors for quantitative digital autoradiography have been considered. They are: conventional nuclear radiation photo detectors (nuclear film BioMax MR Film,Kodak) and imaging plates (PerkinElmer Inc.). The digital images from photo detectors were obtained by scanning the primary analog one. For testing of both detectors a flat uniformly distributed 137Cs sources have been used.
Photo-detectors. It has been detected that independent development of film detectors under strict implementation of the recommended procedures does not result in acceptable accuracy (usual reproducibility of densitometry is not better than 10%). Perhaps even small variations in the conditions of detectors development can strongly influence results of densitometry. If development of all detectors will be done simultaneously in the same cuvette without stirring, the solutions while development the obtaining results are quite good (the standard deviation does not exceed 2%).
Image-plates. One of important differences of image plates from conventional photo detectors is existence of effect of degradation of the hidden image in time. It has been found that the speed of degradation of the hidden image falls down almost to zero after one day ageing the image plate.
Using the described techniques time series of autoradiograms of the copper-nickel polymetallic ore irradiated by bremsstrahlung has been obtained. After computer's processing a set of meta images for various ranges of a half-life period has been received. The received meta images reflecting radionuclides distributions over the sample surface are in a good agreement with data of scanning electronic microscopy (SEM).

[1] Kolotov V.P., Grozdov D.S., Dogadkin N.N. Generation of metaimages while analysis of the time series autoradiograms. J. Radioanalyt. Nucl.Chem. v. 296 (2013) No.2, p. 991-996.
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