CLASSIFICATION OF SULFIDES, ARSENIDES AND TELLURIDES FROM THE SUDBURY IGNEOUS COMPLEX (SIC) USING FEATURE ANALYSIS AND SPECTRUM IMAGING WITH ADVANCED EDS.

T. Salge[1], L. Hecht[2], B. Hansen[1] and M. Patzschke[3]. [1]Bruker Nano GmbH, Berlin, Germany, tobias.salge@bruker-nano.de, [2]Museum of Natural History, Berlin, Germany, [3]Vale S/A, Santa Luzia-MG, Brazil.

Developments in energy dispersive X-ray spectrometry (EDS) offer advanced element analysis at high spatial resolution [1] for quantitative mineralogy and ore characterization [2]. This will be demonstrated for sulfides, arsenides and tellurides from the offset dike of the SIC that have been studied recently [3].

A BRUKER QUANTAX EDS system with an XFlash® Silicon Drift Detector (SDD) was used on a computer controlled field emmision SEM with stage control. Particles were detected by grey scale thresholds in the BSE micrograph. Spectra were acquired by point measurements in the center of each particle. Minerals were classified in seconds based on their composition using a truly standardless quantification routine without internal references.

Areas of interest were studied with high spatial resolution at the sub-µm scale. In order to decrease the excitation volume for generated X-rays, an accelerating voltage of 7 kV was used. Consequently, only low energy X-ray lines (Figs. 1 and 2) can be evaluated which is possible by using extended atomic database [4] integrated into the EDS software. EDS databases from spectrum images which provide complete spectra for each pixel of the SEM image permit data mining. For instance, the element identification can be improved by using the Maximum Pixel Spectrum function [5]. This function synthesizes a spectrum consisting of the highest count level found in each spectrum energy channel. Even elements which occur in only a few or just one pixel of an element map can be easily identified. Spectrum statistics can be improved using chemical phase mapping (Fig. 3), which detects similarly composed spectra with the help of mathematical methods (principal component or cluster analysis) or user defined areas.

It can be concluded that improvements in detector and pulse processor technology as well as software developments have expanded the EDS applications to applied mineralogy. The existence of high demand elements increases the value of existing ores. The analysis of features at the sub-µm scale using SEM-EDS can provide new insights for sulfide deposit models.

References: [1] Salge T. (2012) *Imaging & Microscopy, 14*, 19-21. [2] Salge T. et al. (2013) *Proc. 23rd IMCET, Turkey*, 357-367. [3] Hecht L. et al. (2010), *Proc. 11th IPS*, Sudbury, Canada. [4] Aßmann A. and Wendt M. (2003) *Spectrochim. Acta* 58,711–716. [5] Bright D.S. and Newbury D.E. (2004) *J. Microscopy* 216:186-193.

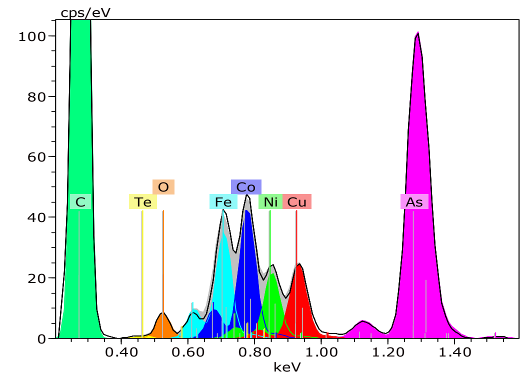

Fig. 1 Deconvolution result of the of the low energy range. The colored peaks represent the contribution of different elements.

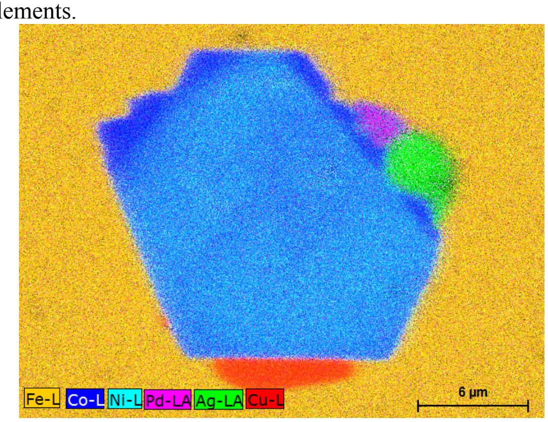

Fig. 2 Composite element map of sulfide mineralization of the Worthington dyke. The overlapping element lines were automatically deconvolved (XFlash 6|10, ≤124 eV Mn Kα, ≤41 eV C, 7 kV, 22 nA, ~97 kcps, 20 min, 45 nm pixel size.

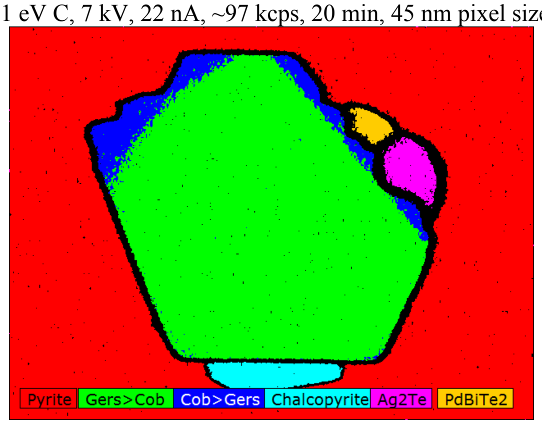

Fig. 3 Phase map considering the net intensity of Fe-L, Co-L, Ni-L, As-L, Pd-L, Ag-L, Cu-L, Bi-M, Te-L and S-K.