Comparison between ED and WD quantitative analysis of silicates

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ABSTRACT

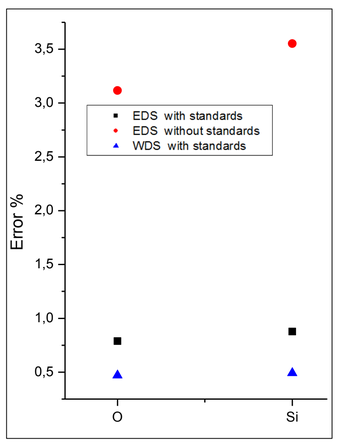
The ED (Energy Dispersive) and WD (Wavelength Dispersive) spectrometers differ considerably, each one have advantages and disadvantages. The main limitation of the ED spectrometer is its poor spectral resolution, whereas the best features of EDS system is the speed with which data can be collected and interpreted. In ED spectra the peak to background ratios are around ten times lower than with WD spectrometers and detections limits are correspondingly higher.
We compare quantitative analysis of different silicates (from quartz to garnet) obtained by means of ED and WD spectrometers added to a Scanning Electron Microscope, in the *Laboratorio de Microscopía Electrónica y Microanálisis* of the *Universidad Nacional de San Luis* (Argentina).
We found that is convenient combine the two methods: ED for mayor elements and WD for minor and trace elements. For these silicates the accuracy obtained with ED is comparable to that obtained by WD analysis, for concentrations above 1%.

Table 1. Nominal elemental concentrations of silicates analyzed and concentrations measured by different methods. Differences between them.

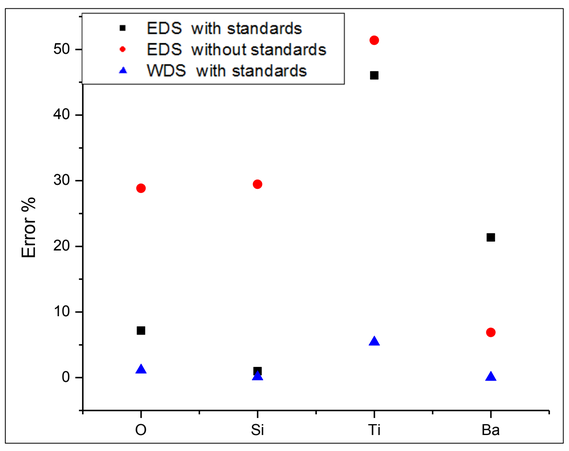
	Elem	Nominal. C (%)	EDS Sts	Dif.	EDS Without stds	Dif.	WDS	Dif.
Quartz	O	53,26	53,68	0,42	54,92	1,66	53,51	0,25
	Si	46,74	47,15	0,41	45,08	-1,66	46,97	0,23
	sum	100	100,83	0,83	100	0	100,48	0,48
Benitoite	O	34,82	37,32	2,49	24,79	-10,04	34,433	-0,397
	Si	20,38	20,18	-0,2	26,38	6	20,404	0,024
	Ti	11,58	16,91	5,33	17,53	5,95	10,954	-0,626
	Ba	33,21	26,12	-7,09	30,92	-2,29	33,223	0,013
	sum	100	100,53		100		99,014	
Olivine	O	43,89	44,92	1,03	45,7	1,81	46,08	2,19
	Mg	30,42	32,59	2,17	30,37	-0,05	31,4	0,98
	Si	19,44	19,81	0,37	18,48	-0,96	20,77	1,33
	Mn	0,08	0,16	0,08	0,13	0,05	0,09	0,01
	Fe	5,87	5,73	-0,14	4,96	-0,91	5,74	-0,13
	Ni	0,3	0,41	0,11	0,37	0,07	0,298	-0,002
	sum	100	103,62		100,01		104,39	
Pyrope	O	44,3	45,39	1,09	45,98	1,68	45,06	0,76
	Mg	11,66	12,57	0,91	11,67	0,01	11,6	-0,06
	Al	11,28	12,08	0,8	11,71	0,43	12,08	0,8
	Si	19,38	20,75	1,37	18,93	-0,45	19,55	0,17
	Ca	3,32	3,25	-0,07	2,76	-0,56	3,1	-0,22
	Ti	0,7	0,71	0,01	0,61	-0,09	0,71	0,01
	Cr	0,39	0,54	0,15	0,44	0,05	0,39	0
	Mn	0,21	0,35	0,14	0,3	0,09	0,22	0,01
	Fe	8,67	8,71	0,04	7,6	-1,07	8,53	-0,14
	sum	99,91	104,35		100		101,25	

Figures 1, 2, 3 y 4. Figures show the percent error of the concentration measured by different methods with respect to the nominal concentration, for each silicate analyzed.

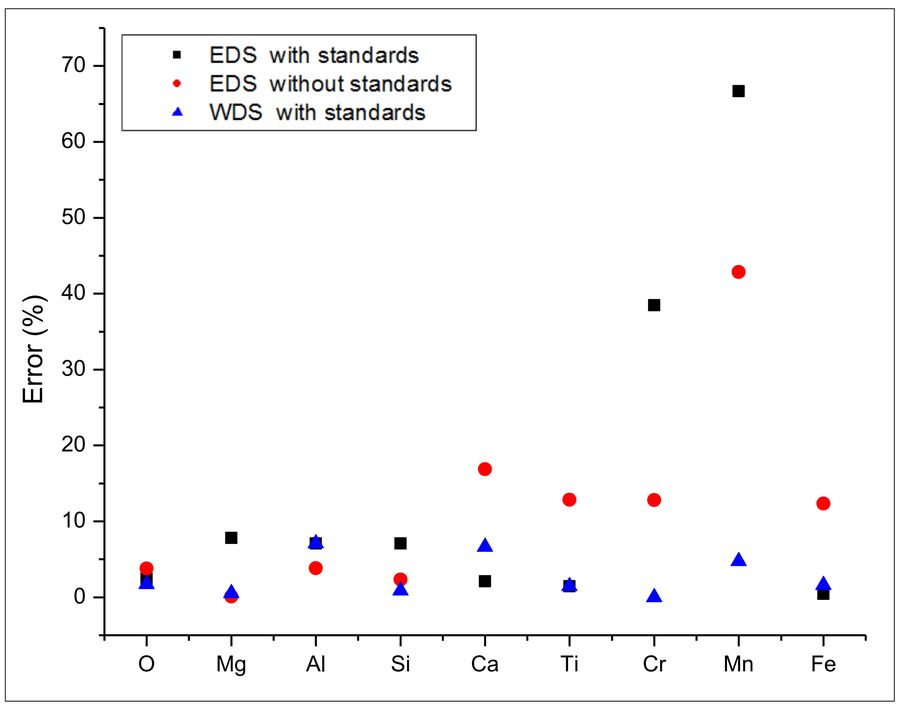
(1) Quartz



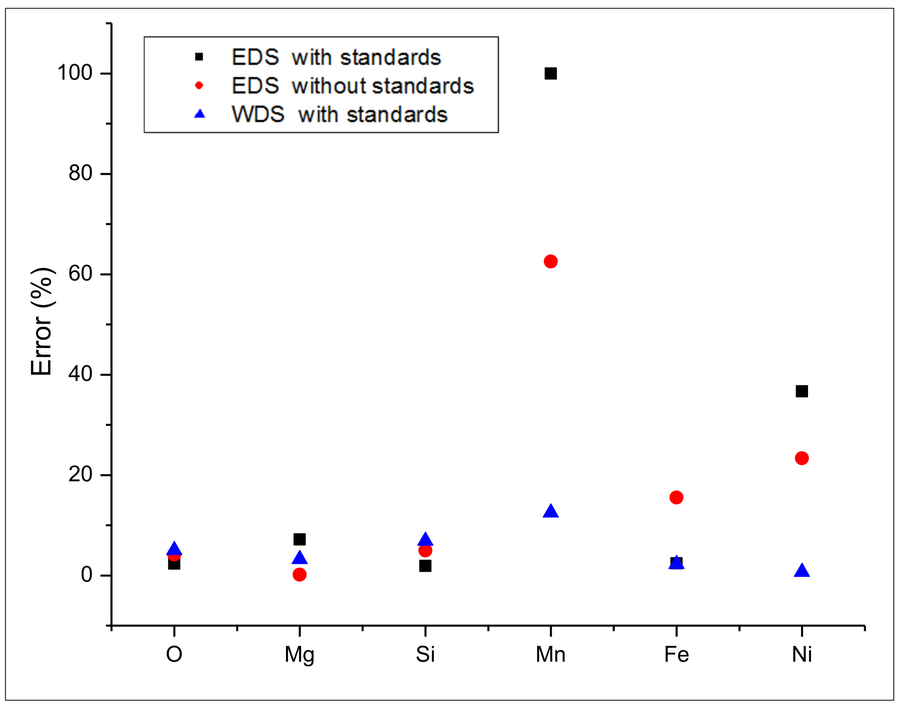
(2) Benitoite



(3) Pyrope



(4) Olivine



Conclusions

To achieve accurate chemical compositional analysis, we should consider the following tips:

- When no occurs superposition of lines and the concentrations of the elements are larger than 0.6% is convenient to use EDS with standards.
- When there are overlapping lines (for example in Benitoite the lines Ti$K\alpha$- Ba$L\alpha$ and Ti$K\beta$- Ba$L\beta$), it is always recommended to use WDS.
- For measurements of elements whose concentrations are <0.6% is recommended WDS.
- A quick analysis using EDS standardless can produce a percent error of up to 20%.

Reference: Evren Çubukçu H., Orkun Ersoy, Erkan Aydar, Uner Çakir, 2008. WDS versus silicon drift detector EDS: A case report for the comparison of quantitative chemical analyses of natural silicate minerals. Micron 39, 88–94