

**Occupational health aspects
of quartz in pulverized
coal fly ash in Israel**

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α - Quartz is the most common polymorph of SiO_2 in nature and in fly ash. Exposure to quartz is liable to cause lung diseases such as silicosis. This can happen only when quartz has fresh active surfaces.

This is the explanation why coal miners are more exposed to silicosis than workers with fly ash although the quartz concentration is higher in ash than in coal.

Quartz is found in coal and coal ash and has been called the most important toxic component of coal dust and fly ash in aerosols. Meij (2003) found that the concentration of quartz in the respirable fraction of coal ash is considerably lower than its concentration in the whole fly ash; and furthermore that more than a half of this quartz is embedded in vitreous (amorphous) material. This is also what we found in Israel .

Analyses of selected particles smaller than 10 μm ; (%)

Element/ Sample	1	2	3	4
O	61.4	47.7	64.1	61.8
Na	4.7	1.6	1.1	1.9
Mg	0.6	1.3	0.2	1.1
Al	14.4	16.9	2.3	8.3
Si	15.6	25.3	28.4	21.5
K	0.8	1.9	0.4	1.4
Ca	0.5	0.7	0.1	0.6
Ti	0.1	0.4	0.4	0.4
Fe	1.8	4.2	3.0	3.0
Total	100	100	100	100

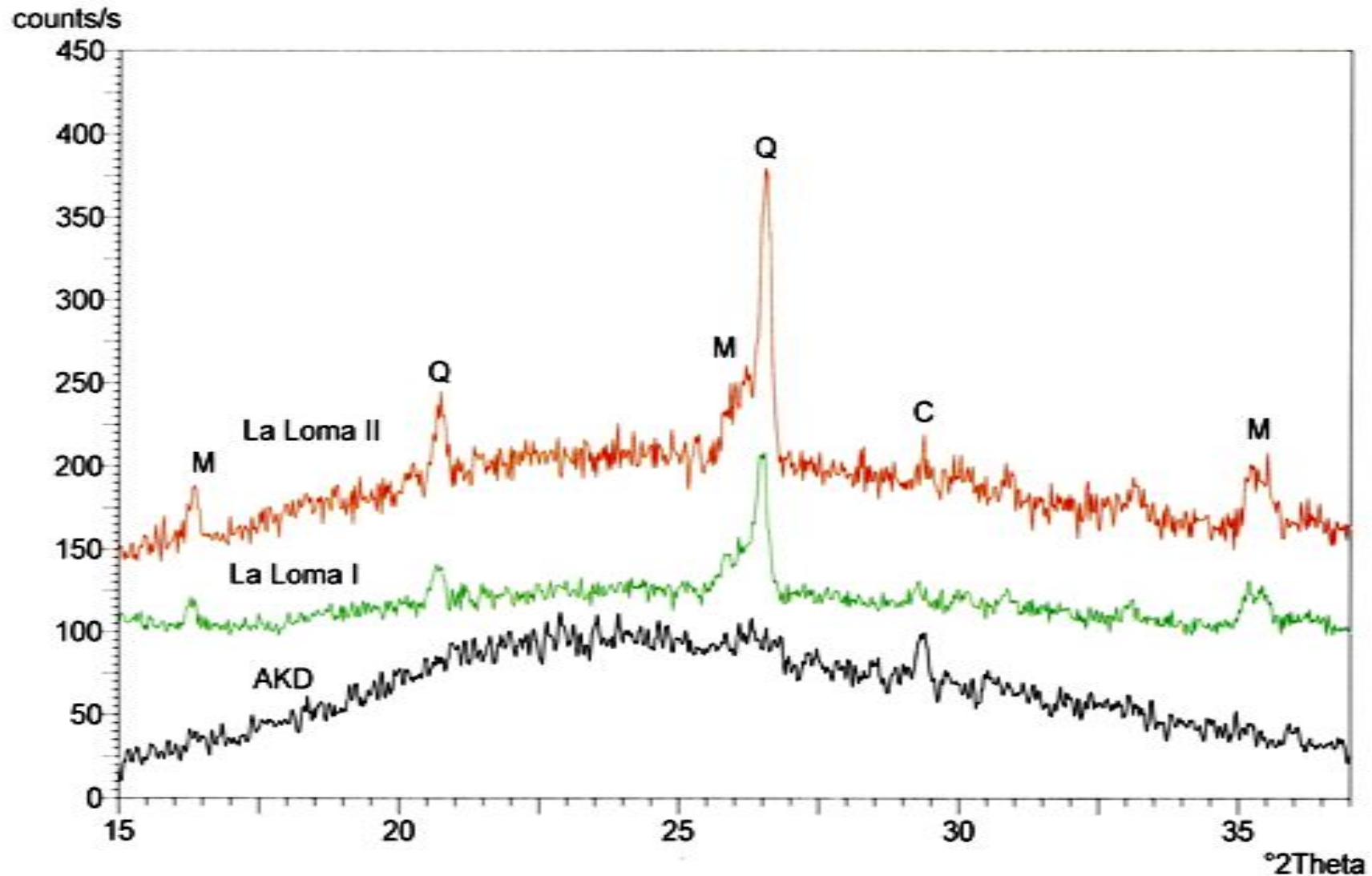
Aspiration into the lungs is the most important mechanism of exposure to airborne particles of coal fly ash; therefore it is extremely important to determine the quartz content in the respirable fraction of the suspended airborne particles.

While workers in coal mining are included among those who are potentially exposed to respirable quartz, workers in coal ash production and utilization industries are not classified as potentially exposed to respirable quartz (NIOSH, 2002)

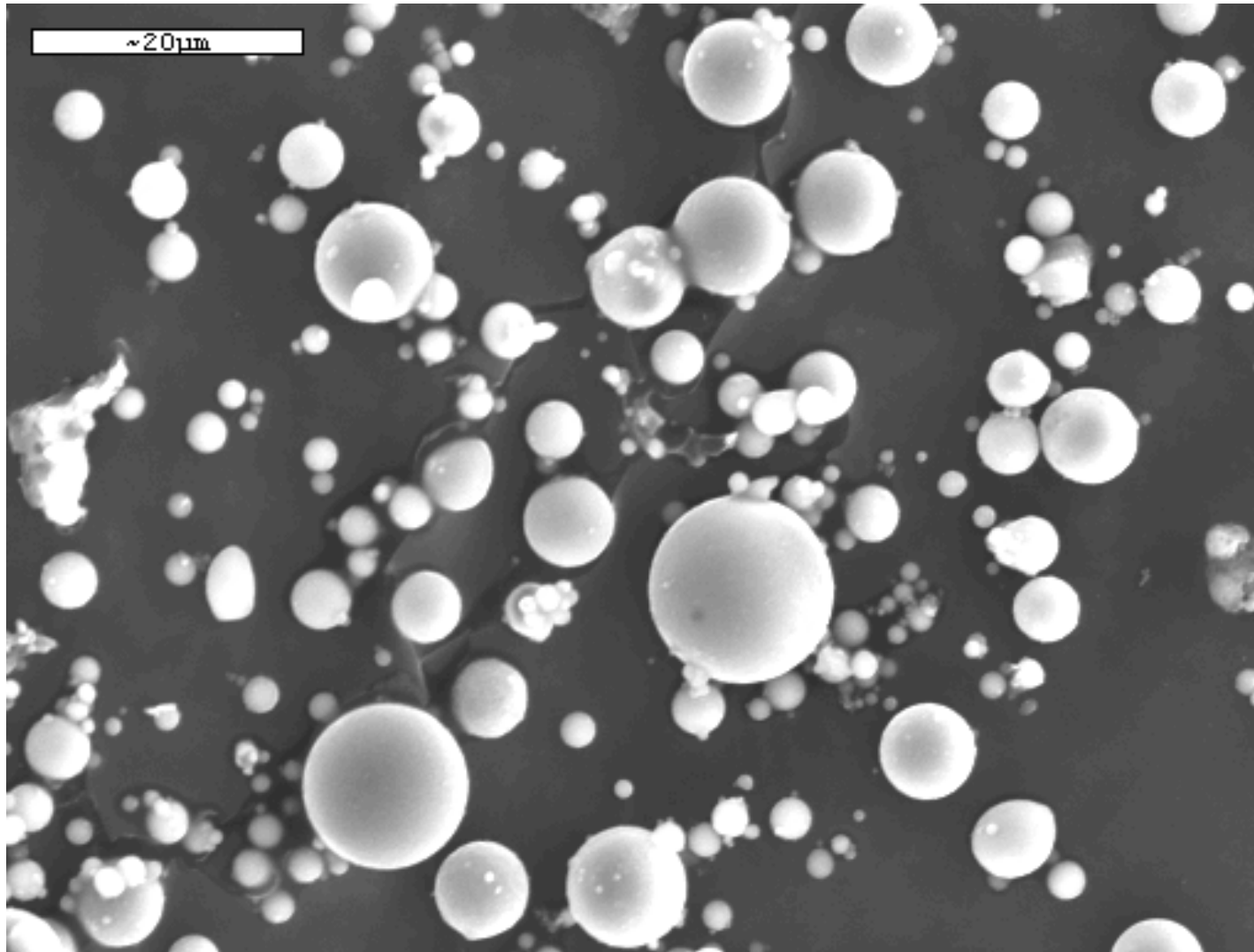
Nevertheless, according to the Israeli regulations issued in 1984 and updated, Fly ash is still classified in Israel as hazardous and as silicotic dust due to the presence of crystalline silica as quartz. This is in contradiction to scientific observations which firmly established that, as a rule, fly ash does not cause crystalline silica-induced disease such as silicosis.

Concentration of quartz in coal fly ash dust samples

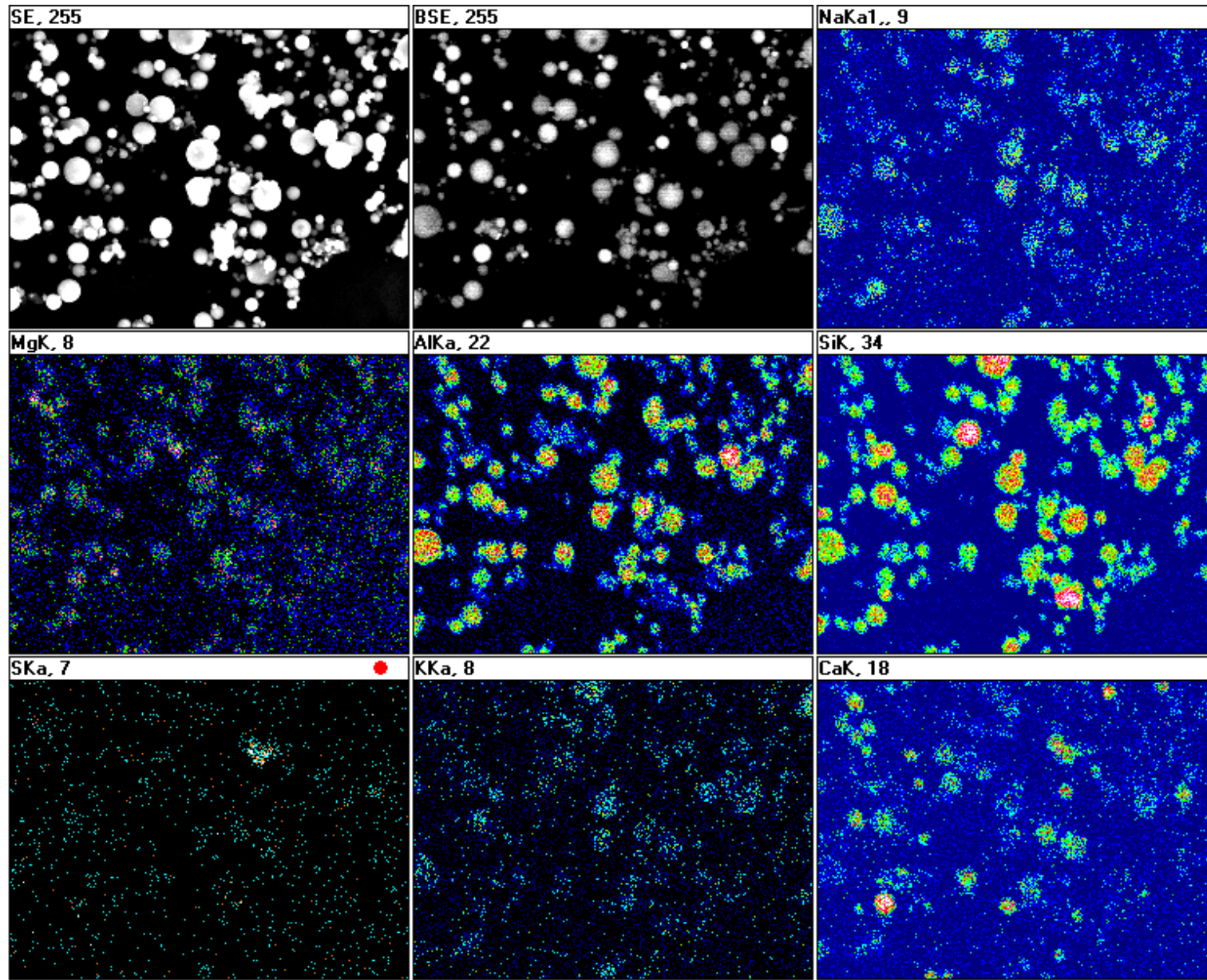
Sample No.	Quartz Concentration (%)
Inhalable dust	
1	3.3
2	3.2
3	2.3
4	4.3
Respirable dust	
5	2.5
6	2.8
7	2.7
8	2.9
Bulk fly ash	
9	5.0



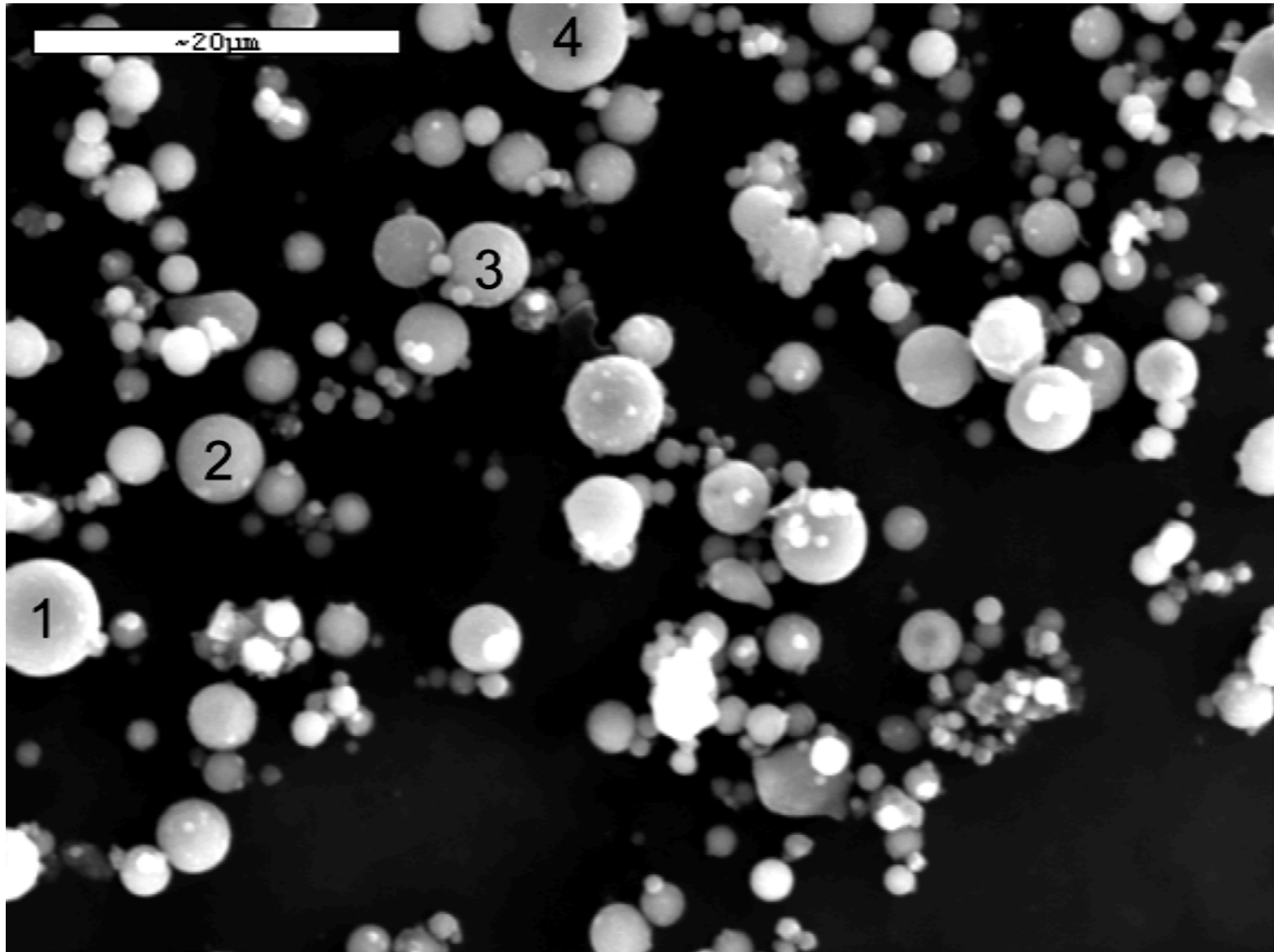
Diffractograms of three size fractions of fly ash obtained from two mines, La Loma, Columbia and AKD, South Africa, La Loma II, between 20 and 40 μm , La Loma I, < 10 μm AKD, < 10 μm .



Secondary Electron (SE) microphotograph of relatively small coal fly ash particles. Most of the particles in this size fraction are spherical (cenospheres).



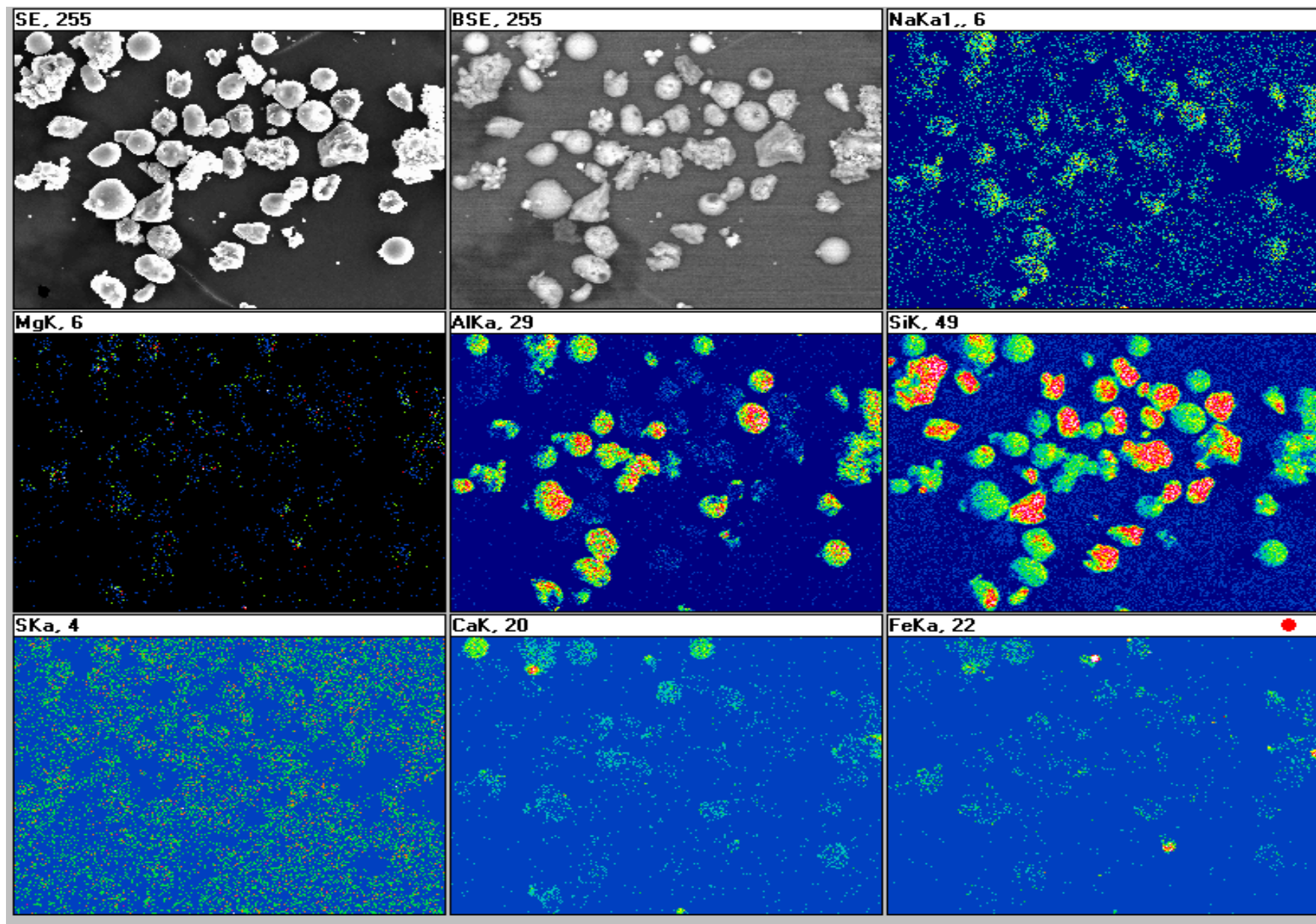
Digimap of particles between 20 and 40 μm



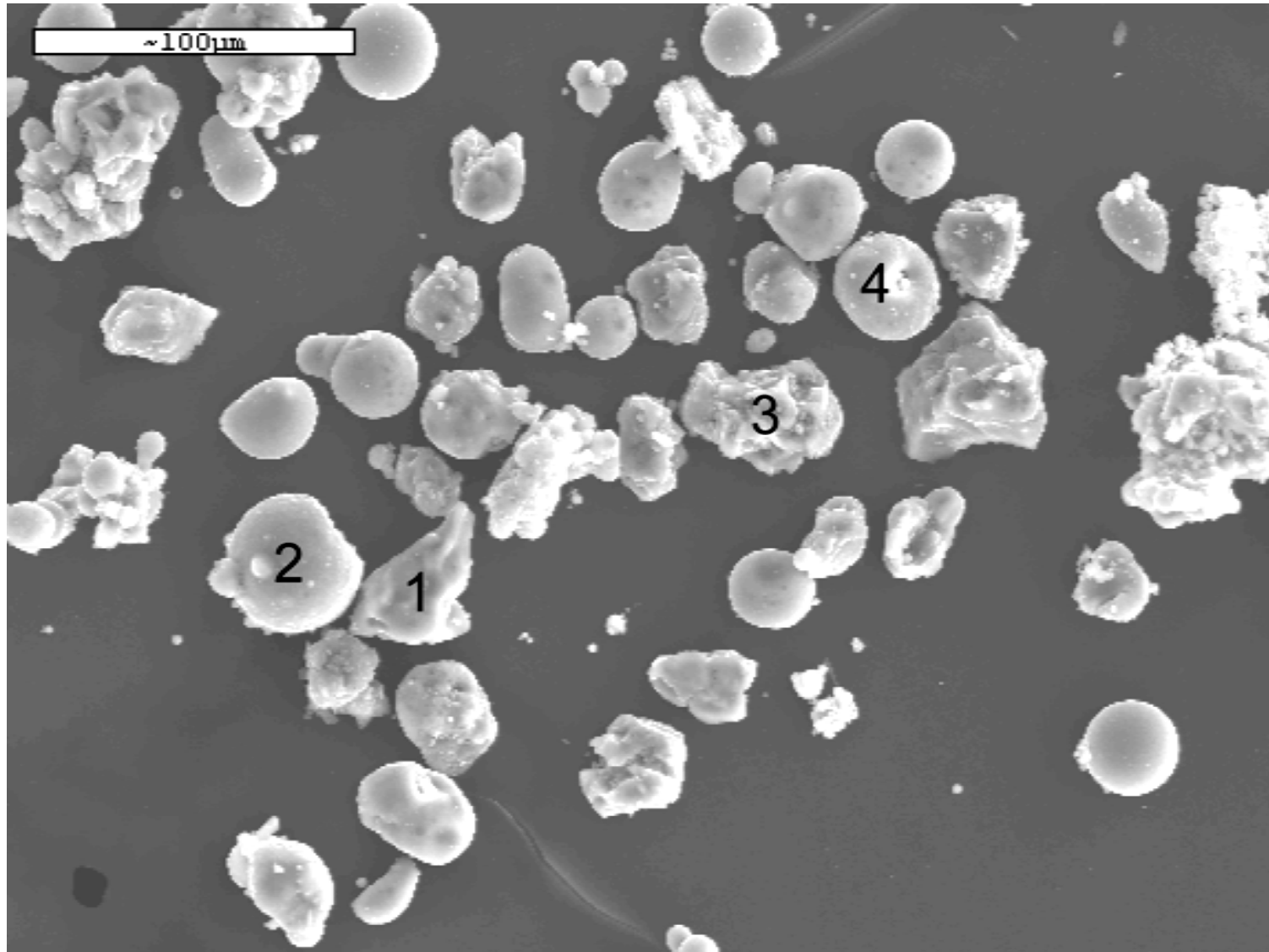
Enlarged Secondary Electrons (SE, 255) microphotograph

Analyses of selected particles smaller than 10 μm

Element / Sample	1	2	3	4
O	61.4	60.7	64.4	58.8
Na	4.7	4.1	2.8	3.9
Mg	0.6	1.0	1.0	0.6
Al	14.4	10.8	3.6	10.0
Si	15.6	18.2	25.5	23.0
K	0.8	0.7	0.7	1.6
Ca	0.5	2.6	0.6	0.5
Ti	0.1	0.3	0.2	0.2
Fe	1.8	1.6	1.3	1.4
Total	100	100	100	100



Digimap of particles between 20 and 40 μm

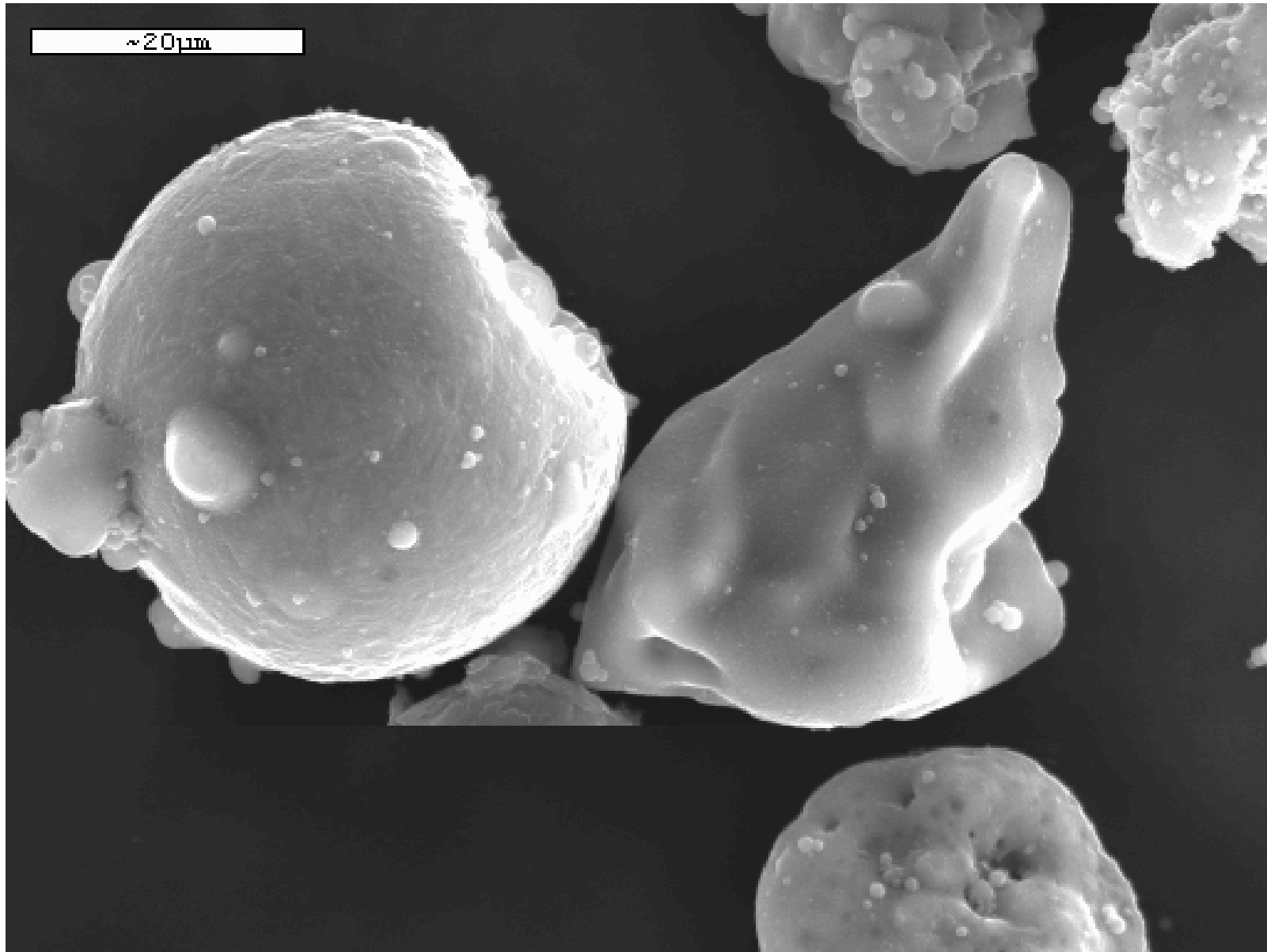


Enlarged Secondary Electrons microphotograph

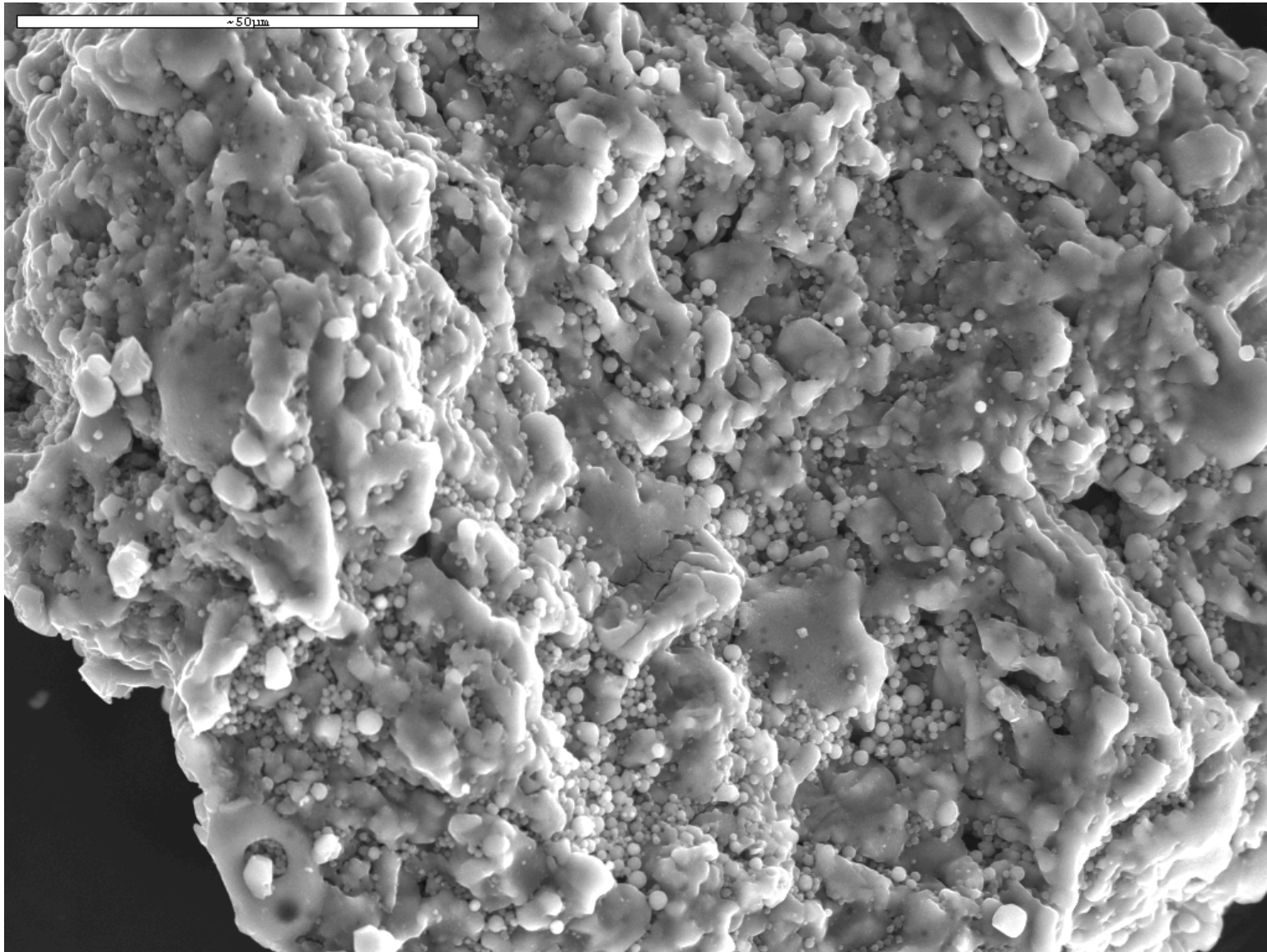
Analyses of selected particles between 20 and 40 μm

Element / Sample	1	2	3	4
O	64.4	60.68	64.35	58.75
Na	b.d.l.	4.07	2.80	3.94
Mg	b.d.l.	0.99	0.95	0.63
Al	0.30	10.80	3.59	9.96
Si	35.40	18.17	25.46	22.96
K	b.d.l.	0.71	0.72	1.63
Ca	b.d.l.	2.64	0.56	0.46
Ti	b.d.l.	0.30	0.20	0.21
Fe	b.d.l.	1.62	1.34	1.44
Total	100	100	100	100

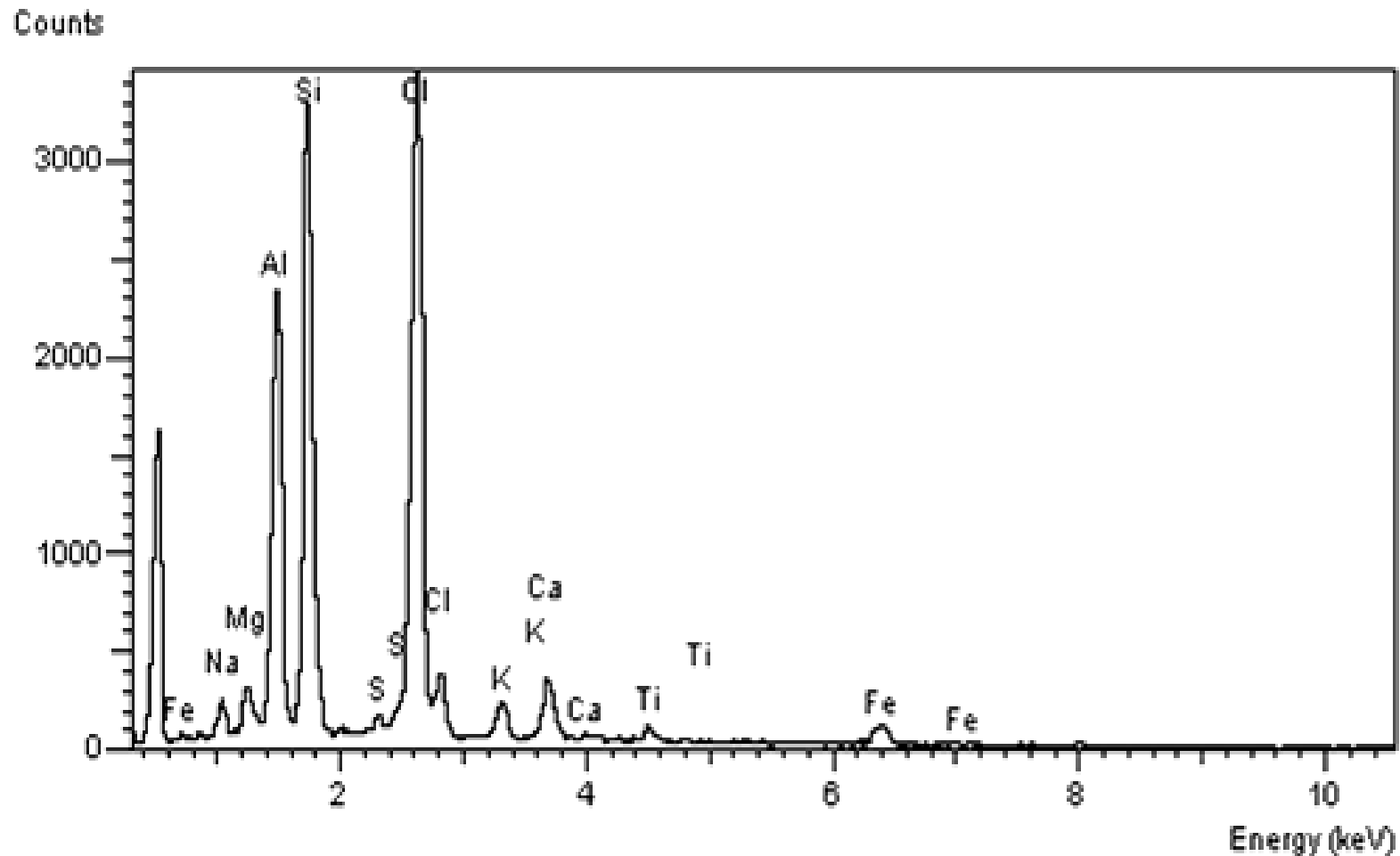
***b.d.l. - Below Detection Limit**



Enlargement of particles 1 and 2



Higher resolution of the surface of a quartz particle



**Chemical Elements spectrum of a particle on filter I-336.
The Cl content is probably due to sea-water spray on the filter.**

It is maybe worthwhile to mention that we recently analyzed some inhalable (less than 10 μ) grains (37) from the Blend (Indonesian) ash and 25 from the BB Prime (South African) ash and none of them contained quartz.

Conclusions

The extensive literature review and our results show clearly that coal fly ash produced in Israel is identical to coal fly ash produced in other countries who use the same coal. This highly suggests that the definition of coal fly ash as a silicotic dust and its inclusion in this category in health and safety regulations in Israel should be reconsidered, and should be similar to that in the regulations of the Netherlands country who use the same coals and coal fly ash is considered to be a nuisance dust and not a hazardous dust. Most other countries (e.g., U.K. and the U.S.A.) also consider coal fly ash as a nuisance dust.