

Influence of fireworks on atmospheric levels of trace metals

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Keywords: Aerosol Chemistry, Fireworks, PIXE, PM2.5, Trace elements.

Las Hogueras de San Juan is the biggest festival in the city of Alicante (southeastern Spain) celebrated every June 17-25. Throughout this festival, large quantities of firecrackers and sparklers are burnt everyday in the city centre during a few minutes. This event represents an unusual but important source of atmospheric particles, especially metals. To evaluate the impact of the firecracker and sparkler burning upon the levels and composition of atmospheric particles, daily PM2.5 samples were collected from two sites in Alicante with low volume samplers (2.3 m³/h). Site 1, located less than 50 m from the pyrotechnic displays, was under the direct influence of the firework plume. Site 2 was chosen as representative of the urban background environment. Elemental analysis was carried out by the Particle Induced X-ray (PIXE) technique.

Figure 1 shows the variations of chloride and different metals linked to firework ignition at both sites. Samples collected from 18-23 June were influenced by pyrotechnic displays close to Site 1 (at 14:00). The remaining days (17 and 25 June), fireworks were displayed at midnight 3-4 km away from both sampling sites. On 24 June a singular event took place (*La Cremà*), when bonfires were lit all over the city.

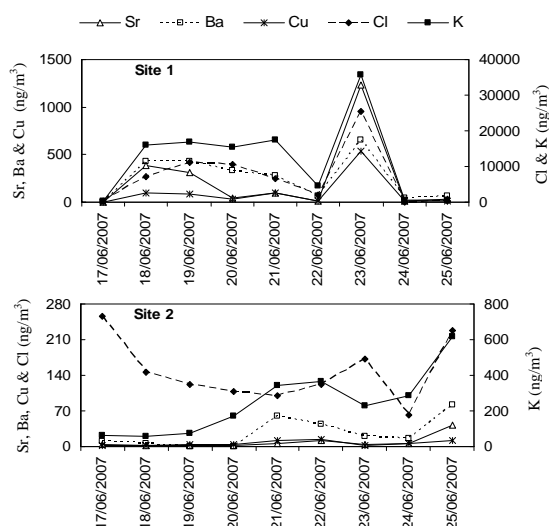


Figure 1. Daily concentrations of Sr, Ba, Cu, Cl and K during *Las Hogueras* in June 2007.

The contribution of firework displays at Site 1 is clear since the levels of Cl and metals were much higher on the days of firecracker and sparkler

displays, with a very sharp peak on 23 June. The marked decrease observed afterwards suggests that the sea breeze favours the quick dispersion of atmospheric pollutants from the ignition point. The levels of all elements showed a very similar variation throughout the measurement period, which is indicative of a common source.

The concentrations registered at Site 2 presented very different variations with respect to Site 1 but, in general, all measured elements seemed to be affected by firework displays.

To evaluate the influence of such events on PM levels and elemental composition, average concentrations were calculated for the days with and without pyrotechnic activity (excluding the samples collected on 24 June). For the urban background location two additional samples were collected on 30 June and 1 July. Average concentrations on these two days were taken as a reference of a firework-free period at Site 2. The results are shown in Table 1.

Table 1. Comparison between concentrations measured on firework (FW) and non-firework (NFW) days.

	Site 1 (ng/m ³)		Site 2 (ng/m ³)	
	NFW	FW	NFW	FW
PM2.5	26900	82600	24700	28600
Sr	17	350	3	9
Ba	35	365	19	28
Cu	8	142	3	7
Cl	215	10500	27	157
K	420	17700	124	240

During fireworks, Cl and Sr reached very high values, with averages in Site 1 of 10.5 µg/m³ and 17.7 µg/m³, respectively (increment factors: ~40-50). Sr and Cu FW averages are ~20 times greater than NFW values. In contrast to what have been reported in other studies (Moreno et al., 2007, Vecchi et al., 2008), Ba showed the lowest factor increment at both sites.

Moreno, T., Querol, X., Alastuey, A. Minguillón, M.C., Pey, J., Rodríguez, S., Miró, J.V., Felis, C. & Gibbons, W. (2007). *Atmos. Environ.*, 41, 913-922.

Vecchi, R., Bernardoni, V., Cricchio, D., D'Alessandro, A., Fermo, P., Lucarelli, F., Nava, S., Piazzalunga, A. & Valli, G.. (2004). *Atmos. Environ.*, 42, 1121-1132.