Variations of PM₁₀ and its relationship with ⁷Be and ²¹⁰Pb measurements at Malaga (Southeastern coast of Spain)

C. Dueñas¹, M.C. Fernández^{*1}, E. Gordo¹, E. Liger² S. Cañete¹ and M. Pérez³

¹Department of Applied Physics I, Faculty of Science, ²Department of Applied Physics II, Faculty of Computer Engineering, ³Department of Radiology and Health Physics, Ophthalmology and OTL, Faculty of Medicine. University of Málaga, 29071 Málaga, Spain.

Keywords: ⁷Be, ²¹⁰Pb, atmospheric aerosols, gamma spectrometry, particulate matter (PM_{10}). *Presenting author email: <u>mafeji@uma.es</u>

Levels of particulate matter fraction PM_{10} were monitored between 2009 and 2011 in Málaga (Spain). PM_{10} concentrations were measured at "Carranque" station by the beta attenuation method. This station is one of the Atmospheric Pollution Monitoring network managed by the Environmental Health Service of the Andalusian Government.

Weekly ⁷Be and ²¹⁰Pb concentrations in air were continuously monitored (4° 28' 4" W; 36° 43' 40"N) with a high-volume air sampler (ASS-500C). This sampler uses polypropylene square filters (44 x 44 cm²) with a collection efficiency 93-99%, at a flow rate of 90,000 L min⁻¹. Measurements by gamma-spectrometry were performed to determine the activities of the samples using an intrinsic REGe detector.

Long-term measurements of cosmogenic radionuclides such as ⁷Be provide an important data in studying global atmospheric processes and comparing environmental impact of radioactivity from man-made sources to natural ones. On the other hand, ²¹⁰Pb is produced by radioactive decay from its progenitor, ²²²Rn, which emanates primarily from land surface. Therefore, ²¹⁰Pb in the air is an effective tracer of the continental surface air mass. The variation of the data with time was studied by time series analyses and seasonal patterns were identified. The study of air back-trajectories were computed by means of the Hybrid Single-Particle Integrated Trajectories Lagrangian (HYSPLIT) trajectory model (Draxler, 1994) using meteorological data supplied by the US National Climatic Data Centre.

Table 1 provides arithmetic mean (AM) and related statistical information such as geometric mean (GM), standard deviation (SD), variation coefficient (CV), maximum (MAX) and minimum (MIN) values.

Table 1. Statistical parameters of the different

measurements.						
	AM	GM	SD	CV(%)	MAX	MIN
⁷ Be (mBq/m ³)	5.1	4.8	1.7	34.7	10.2	2.1
$\frac{^{210}}{\text{Pb}}$ (mBq/m ³)	0.55		0.31		2.04	0.1
$\frac{PM_{10}}{(\mu g/m^3)}$	40.3	37.8	14.3	35.5	86.3	17.4

The concentration data of ${}^{7}\text{Be}$, ${}^{210}\text{Pb}$ and PM_{10} with meteorological variables were correlated to understand the weekly variation of these radionuclides in

air. This study has shown that ⁷Be and PM₁₀ are associated with different sources in Málaga and they may reach high concentrations simultaneously. The reason for this is the concurrent occurrence of subsidence processes over North Africa (resulting in the downward transport of ⁷Be from the mid-troposphere) and the suspension of mineral dust over desert region with a subsequent transport to Málaga. Additionally, in order to simplify the analysis, the events have been grouped into: (a) High PM₁₀ and ²¹⁰Pb concentrations with low ⁷Be concentrations; (b) High PM₁₀ and ²¹⁰Pb concentrations; (c) Low PM₁₀ and ²¹⁰Pb concentrations with low ⁷Be concentrations with low ⁷Be concentrations.

Several events of high ⁷Be concentrations are mainly caused by downward transport of ⁷Be from the mid-troposphere at mid-latitudes. The meteorological situation was characterised by an Atlantic anticyclone system with a low-pressure area over central European North Atlantic. High ⁷Be concentrations were also found associated with low aerosol mass concentrations. These values were attributed to downward transport from midto-upper troposphere over the North Atlantic. The meteorological situation was characterised by a south Europe anticyclone located in the South Atlantic Ocean that favoured the development of a blocking system with a low-pressure area over north Europe. Under these conditions, a slanting stratospheric air mass can penetrate into the troposphere (Hernández et al., 2008). The distribution of ²¹⁰Pb in the atmosphere show both spatial and temporal variations depending on the geographical location, atmospheric circulation and scavenging processes. High concentrations for ²¹⁰Pb are obtained with air masses from the Sahara area.

The authors gratefully acknowledge the NOAA Air Resources Laboratory (ARL) for the provision of the HYSPLIT transport and dispersion model and/ or READY website (http://www.arl.noaa.gov/ready.html) used in this study.

Hernández F., Rodríguez S., Karlsson L., Alonso-Pérez S., López-Perez M., Hernández-Armas J. and Cuevas E., (2008). *Atmos. Environ.* 42, 4247-4256.

Draxler, R.R., 1994. Hybrid single-Particle Lagrangian Integrated Trajectories, Version 3.2. NOAA-ARL.