Grupo SIAM

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FACTORES QUE AFECTAN A LA RESPUESTA TÓXICA

Intrínsecos

Inherentes al agente tóxico

- **Dosis**
- **Propiedades físico-químicas**
- **Vía de ingreso al organismo**
- **Frecuencia de exposición**

Extrínsecos

Independientes del tóxico

- **Factores ambientales**
  - **Condiciones climáticas**
  - **País de residencia** (cultura-tradiciones)
  - Ocupación
- **Factores del organismo receptor**
  - **Edad**
  - **Sexo**
  - **Genética**
  - **Estado fisiológico**
  - **Estado nutricional**

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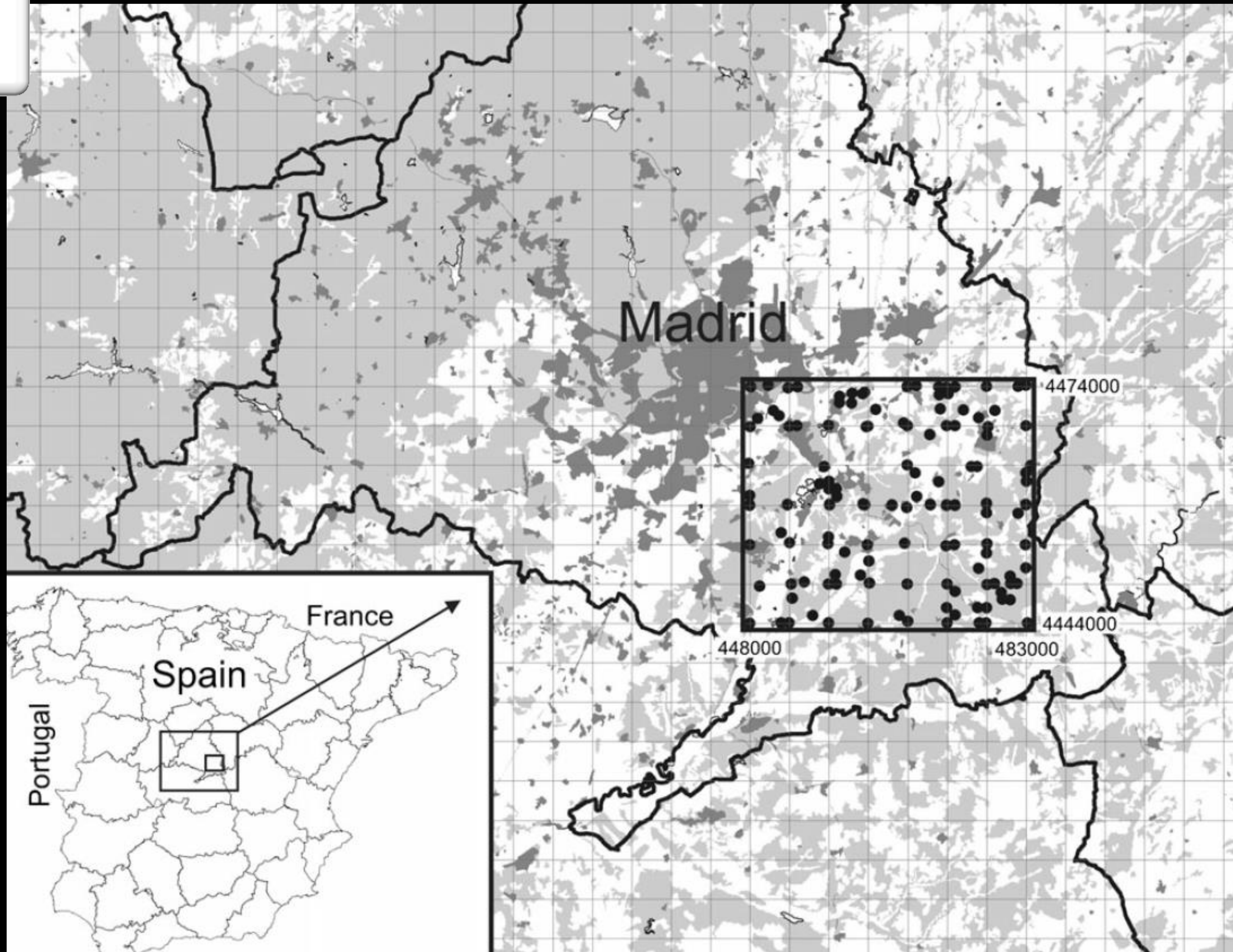
- ≠ **CRITERIOS:**
  - Toxicidad
  - Vida media
  - Especie sobre la que actúan
  - Estructura química

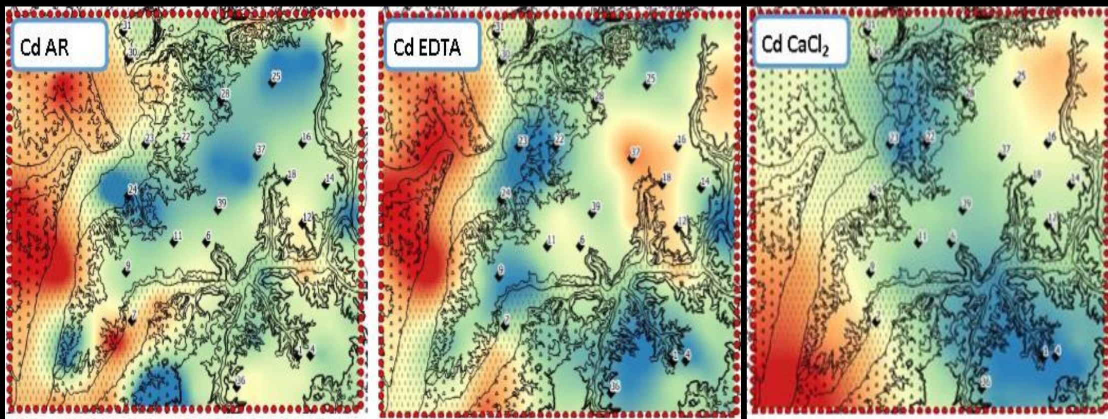
TOXICIDAD	CONCENTRACIÓN (mg/kg s.)
Muy tóxico	≤ 0,5
Tóxico	> 0,5 - 2
Poco tóxico	> 2 - 20

Persistencia	Vida media	Ejemplos
No persistente	días - 12 semanas	Malatión, diazinón, carbarilo, diametrín
Moderadamente persistente	1 - 18 meses	Paratión, lannate
Persistente	varios meses - 20 años	DDT, aldrín, dieldrín
Permanentes	Indefinidamente	Productos hechos a partir de mercurio, plomo, arsénico

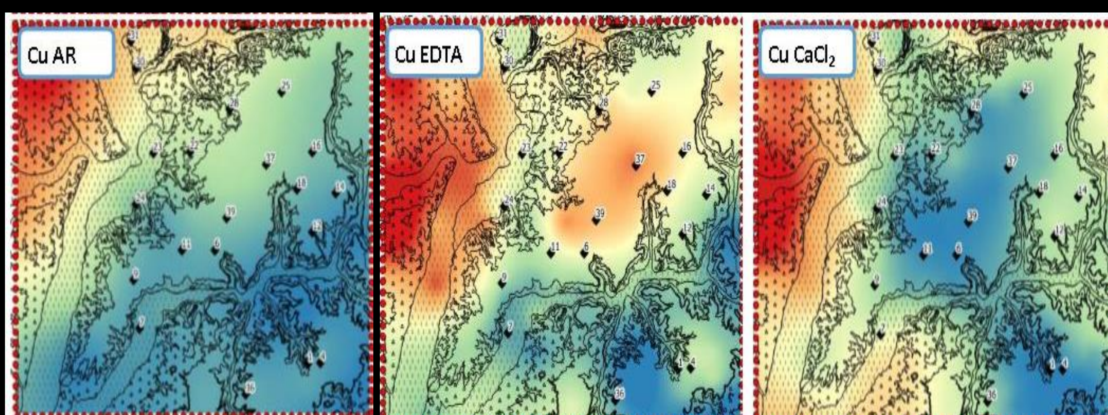


CARESOIL: S2009/AMB-1648 (2009-2013). *J Soils Sediments (2014) 14:78–88*

Empleo de técnicas geoestadísticas para interpolar concentraciones totales y disponibles de Cd, Cu, Pb y Zn



- Concentraciones totales inferiores a los límites legislados



- La distribución espacial de concentraciones totales y disponibles diferentes entre sí

CARESOIL: P2013/MAE2739 (2014-2018)

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Hipótesis

- Aunque las concentraciones son inferiores puede existir afección en la funcionalidad del suelo
- El uso del suelo podría determinar el grado de afectación

Objetivos

- Establecer las relaciones entre metales traza, parámetros del suelo y usos
- Determinar el grado de afectación del suelo en función de parámetros químicos, toxicológicos y ecológicos (enfoque de la Triada de Calidad del Suelo. Chapman, 1986; Ribé et al., 2012; Long et al., 2012, etc.)
- Selección de los mejores indicadores de la alteración de la funcionalidad del suelo

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Estudio

ENFOQUE QUÍMICO

- pH, CE, concentraciones totales y disponibles, granulometría, C orgánico, óxido de Fe y Mn, sales solubles, CIC, carbonatos, sales solubles

ENFOQUE ECO-TOXICOLÓGICO

- Actividades exo y endo enzimáticas
- Perfiles fisiológicos a nivel comunidad (CLPP) con placas Biolog ECO
- *Eisenia fetida* (lombriz roja de California): ensayo de reproducción, ensayo de bioacumulación
- *Lactuca sativa*: ensayo de germinación y elongación radicular, ensayo de crecimiento y bioacumulación

❖ CONTAMINACIÓN DE SUELOS → OMS

Chemical of concern, Sources/uses	In soil?	Used by humans as a nutrient?	Toxic to humans how?	Health effects
Air Pollution	**No**			
Arsenic Pesticides; gold, lead, copper, nickel, iron and steel mining and/or processing; coal burning; wood preservatives. Pharmaceutical and glass industries, sheep dip, leather preservatives, pigments, poison bait, agrochemicals, antifouling paint electronics industry.	**Yes**	**No**	Main exposure through consumption of groundwater containing naturally high levels of inorganic arsenic, food prepared with this water, or food crops irrigated with water high in arsenic.	Intake of inorganic arsenic over a long period can lead to chronic arsenic poisoning (arsenicosis). Gastrointestinal tract, skin, heart, liver and neurological damage. Diabetes. Bone marrow and blood diseases. Cardiovascular disease. Carcinogenic. Organic arsenic compounds are less harmful to health, and are rapidly eliminated by the body. Increased risk of miscarriage, stillbirth and pre-term birth.
Asbestos Mining and milling of raw asbestos (historical) for construction and product manufacture. Historical: releases into the air and soil around refineries, power plants, factories handling asbestos, shipyards, steel mills, vermiculite mines, and building demolitions. Current: repair, renovation, removal, or maintenance of asbestos. Gardening.	**Yes**	**No**	Exposure occurs when asbestos-containing material is crumbling or disturbed, releasing microscopic asbestos fibres into the air and dust. The main route of entry is inhalation, but it can also be ingested or lodge in the skin.	Some inhaled asbestos fibres reach the lungs, where they become lodged in lung tissue and may remain for many years. This causes: • parenchymal asbestosis • asbestos-related pleural abnormalities • lung carcinoma • pleural mesothelioma Health effects may not emerge for decades, but lung cancer and pleural mesothelioma have high mortality rates. Historical, occupational exposure from manufacturing and construction work is a common cause.
Benzene	**No** Benzene is not persistent in surface water or soil, either volatilising back to air or being degraded by bacteria (unless present in very high quantities).	**No**		
Cadmium Zinc smelting, mine tailings, burning coal or garbage containing cadmium, rechargeable batteries (nickel-cadmium batteries account for over four-fifths of cadmium consumption), pigments, TVs, solar cells, steel, phosphate fertiliser, metal plating, water pipes, sewage sludge.	**Yes** Cadmium in soil may enter plant crops (depending on soil characteristics, pH etc).	**No**	Cadmium in soil or water used for irrigation can lead to accumulation in plants that enter the human food chain. Cadmium may also accumulate in animals at levels that do not affect the animal's health, but can affect humans consuming animal products.	Liver and kidney damage, low bone density. These symptoms are known as itai-itai disease. First identified when cadmium from mining in the Toyoma Prefecture of Japan led to high levels of cadmium in rice, which accumulated in local people. Diets poor in iron and zinc vastly increase the negative health effects of cadmium.

Table 1: WHO ten chemicals of major public health concern in relation to soils and human health impacts. Sources: Brevik & Burgess (2013) and US Agency for Toxic Substances & Disease Registry (website): www.atsdr.cdc.gov

Dioxin Including Polychlorinated dibenzodioxins (PCDD) and Polychlorinated dibenzofurans (PCDF). Waste incineration, reprocessing metal industry, paper and pulp industry, contaminated herbicides (a major source). Stored PCB-based industrial waste oils (often with large amounts of PCDFs).	**Yes** These chemicals are most commonly found in soils, sediments and food, with low levels in air and water.	**No**	Human exposure to dioxin and dioxin-like substances occurs mainly through consumption of contaminated food. More than 90% of human exposure is through food, mainly meat and dairy products, fish and shellfish.	Dioxins are highly toxic and can cause reproductive and developmental problems, damage the immune system, interfere with hormones and also cause cancer.
Fluoride	**Yes** – but is generally immobile.	**Yes** A micronutrient: Appropriate levels strengthen teeth.	Usually associated with high levels of fluoride in drinking water.	Skeletal fluorosis: fluoride accumulates progressively in the bone over many years. Early symptoms include stiffness and pain in the joints. Crippling skeletal fluorosis is associated with osteosclerosis, calcification of tendons and ligaments, and bone deformities.
Lead Batteries, solder, ammunition, pigments, paint, ceramic glaze, hair colour, fishing equipment, leaded gasoline (vehicle exhausts), mining, plumbing, coal burning, water pipes.	**Yes**	**No**	Leaded fuel and mining activities are common causes for elevated lead levels in topsoil.	• Neurological damage • Lowers IQ and attention • Hand-eye co-ordination impaired • Encephalopathy • Bone deterioration • Hypertension • Kidney disease
Mercury Electrical switches, fluorescent light bulbs, lamps, batteries, thermometers, dental fillings, mining (particularly artisanal/small scale gold mining), pesticides, medical waste, burning coal and fuel oil, chlor-alkali industry.	**Yes**	**No**	Main exposure route for the population at large is via eating contaminated seafood. For children is direct ingestion of soil.	• Central nervous system (CNS) and gastric system damage • Affects brain development, resulting in a lower IQ • Affects co-ordination, eyesight and sense of touch • Liver, heart and kidney damage. • Teratogenic
Hazardous pesticides Herbicides derived from trinitrotoluene may have the impurity dioxin, which is highly toxic. Synthetic insecticides, such as DDT (now banned) can still be found in the environment worldwide.	**Yes**	**No**	Organic pesticides accumulate in the food chain.	Organic chemicals, including pesticides, have been linked to a wide range of health problems, but we tend to be exposed to a cocktail of these chemicals at low levels. Conclusive proof of cause and effect in humans is challenging.

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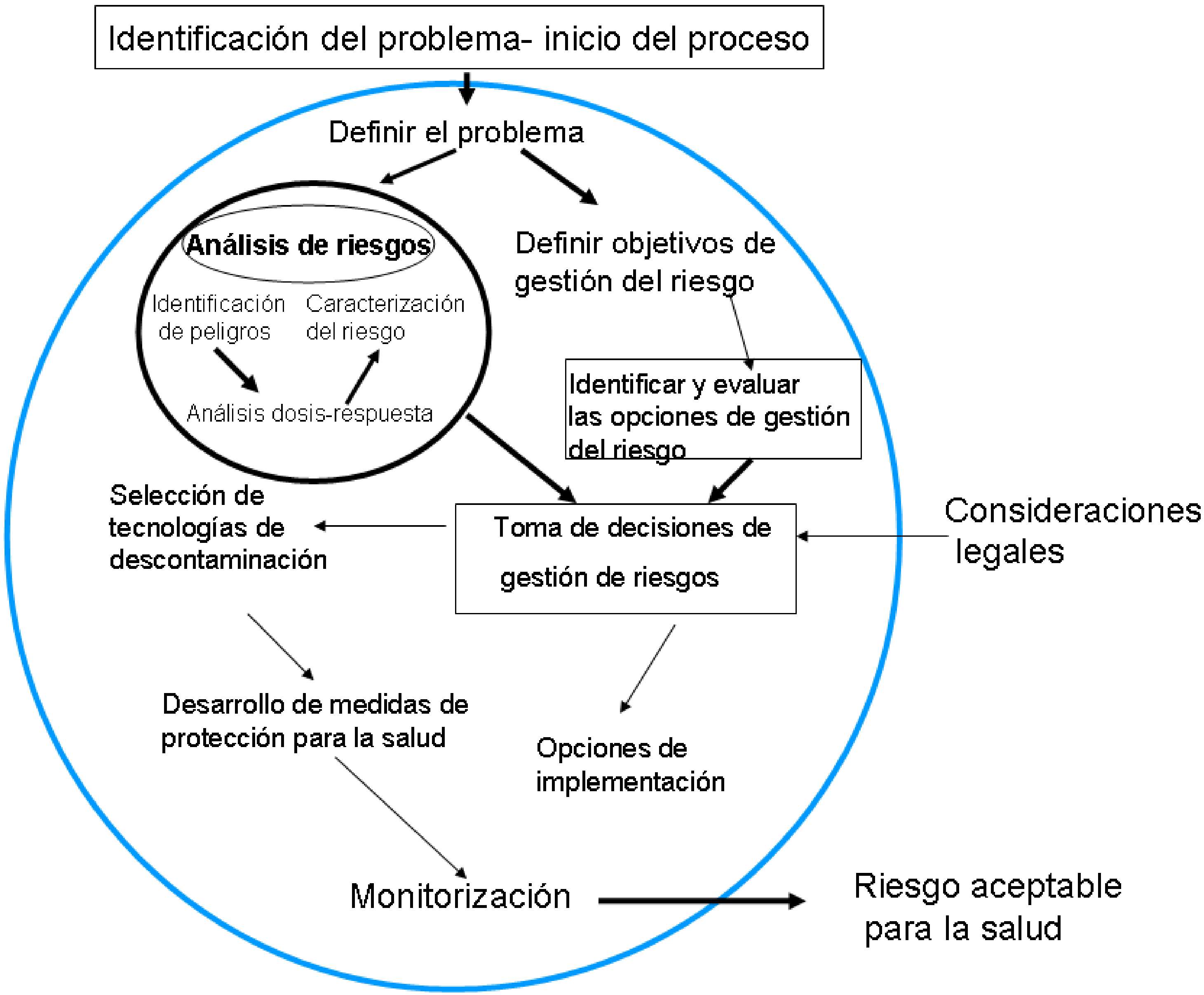

Fuente: El análisis de riesgos para la salud humana.. Mª José Martínez Sánchez y col. Salud ambient.2015;15(2):103-112

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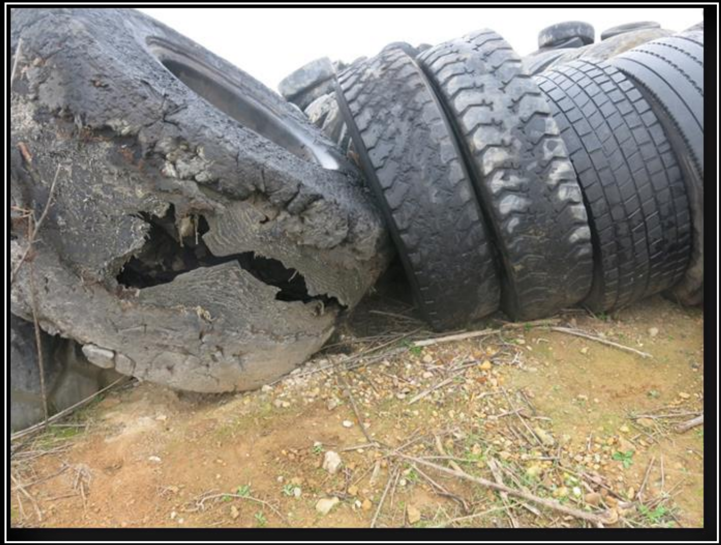
Depósito de neumáticos fuera de uso. Impacto en la contaminación de suelos.

Localización

- **Aproximadamente 1/3 se sitúa en la Comunidad de Madrid (municipio de Valdemoro), el resto en Castilla-La Mancha (municipio de Seseña, Toledo).**
- **Área de más de 11 ha.**
- **Entre 80 000 -100 000 toneladas de neumáticos.**
- **5 000 000 de neumáticos.**
- **El más grande de Europa.**



FUENTE: CARESOIL: Ref.:P2013/MAE2739

FUENTE: CARESOIL: Ref.:P2013/MAE2739

Incendio de neumáticos

http://www.efeverde.com/noticias/fuego-confinado-hectareas-cementerio-neumaticos/

http://www.elplural.com/2016/05/13/incendio-en-el-cementerio-de-neum-ticos-m-s-grande-de-europa

- **Comienzo del incendio en la madrugada del 13/05/2016.**
- **Trabajos mecánicos, además de medios terrestres y aéreos.**
- **Se consigue aislar del fuego 1/3 de los neumáticos.**
- **Alertas a la población.**
- **Suspensión de clases.**
- **Desalojo de El Quiñón.**
- **Se da por extinguido en la zona de Castilla-La Mancha el 02/06 y en Madrid el 06/06.**

FUENTE: CARESOIL: Ref.:P2013/MAE2739

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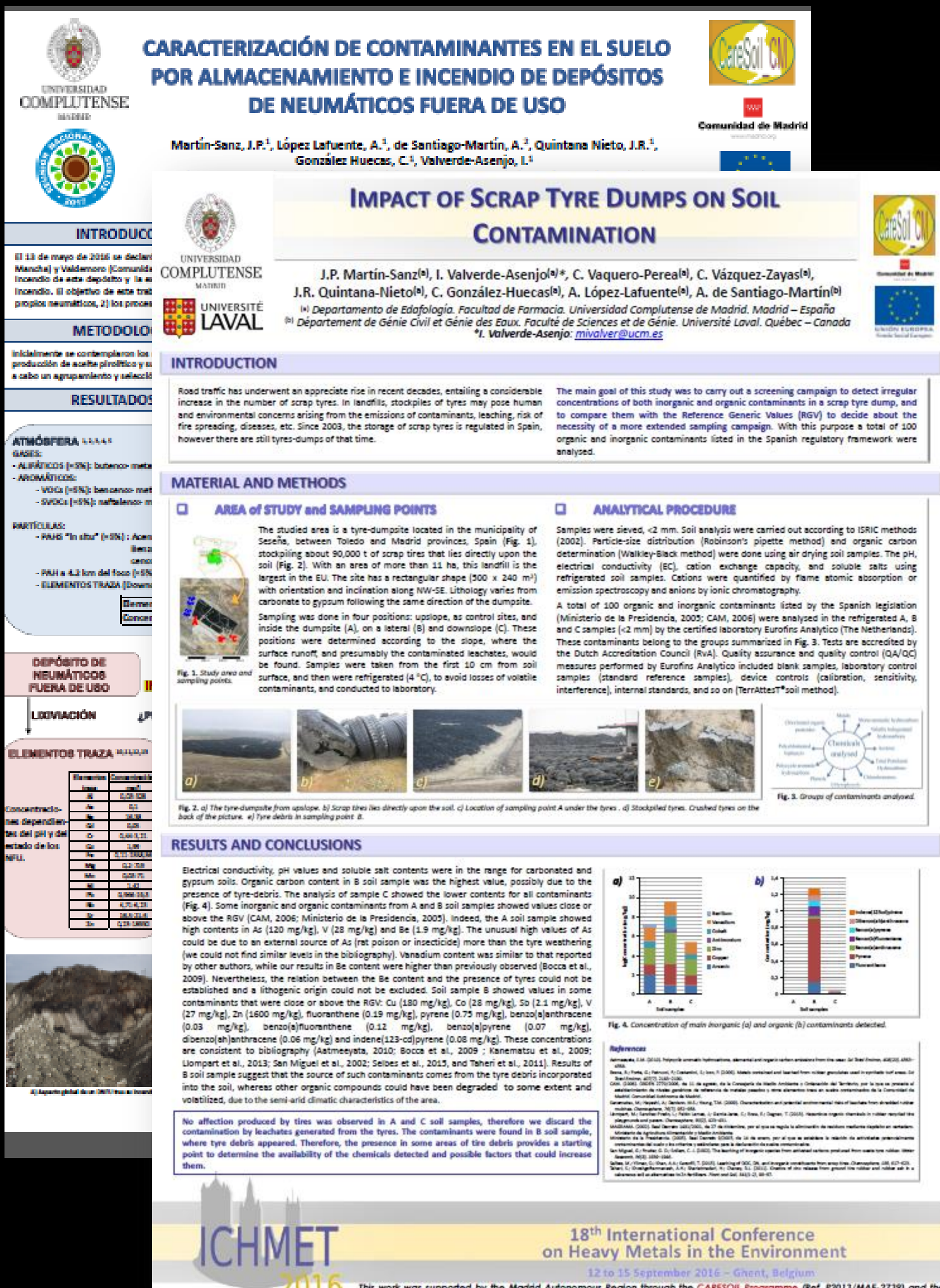

CARACTERIZACIÓN DE CONTAMINANTES EN EL SUELO POR ALMACENAMIENTO E INCENDIO DE DEPÓSITOS DE NEUMÁTICOS FUERA DE USO

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IMPACT OF SCRAP TYRE DUMPS ON SOIL CONTAMINATION

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INTRODUCTION

Road traffic has underwent an appreciate rise in recent decades, entailing a considerable increase in the number of scrap tyres. In landfills, stockpiles of tyres may pose human and environmental concerns arising from the emissions of contaminants, leaching, risk of fire spreading, diseases, etc. Since 2003, the storage of scrap tyres is regulated in Spain, however there are still tyres-dumps of that time.

The main goal of this study was to carry out a screening campaign to detect irregular concentrations of both inorganic and organic contaminants in a scrap tyre dump, and to compare them with the Reference Generic Values (RGV) to decide about the necessity of a more extended sampling campaign. With this purpose a total of 100 organic and inorganic contaminants listed in the Spanish regulatory framework were analysed.

MATERIAL AND METHODS

AREA of STUDY and SAMPLING POINTS

The studied area is a tyre-dumpsite located in the municipality of Seseña, between Toledo and Madrid provinces, Spain (**Fig. 1**), stockpiling about 90,000 t of scrap tires that lies directly upon the soil (**Fig. 2**). With an area of more than 11 ha, this landfill is the largest in the EU. The site has a rectangular shape (500 x 240 m^2) with orientation and inclination along NW-SE. Lithology varies from carbonate to gypsum following the same direction of the dumpsite.

Sampling was done in four positions: upslope, as control sites, and inside the dumpsite (A), on a lateral (B) and downslope (C). These positions were determined according to the slope, where the surface runoff, and presumably the contaminated leachates, would be found. Samples were taken from the first 10 cm from soil surface, and then were refrigerated (4 °C), to avoid losses of volatile contaminants, and conducted to laboratory.

Fig. 1. *Study area and sampling points.*

ANALYTICAL PROCEDURE

Samples were sieved, <2 mm. Soil analysis were carried out according to ISRIC methods (2002). Particle-size distribution (Robinson's pipette method) and organic carbon determination (Walkley-Black method) were done using air drying soil samples. The pH, electrical conductivity (EC), cation exchange capacity, and soluble salts using refrigerated soil samples. Cations were quantified by flame atomic absorption or emission spectroscopy and anions by ionic chromatography.

A total of 100 organic and inorganic contaminants listed by the Spanish legislation (Ministerio de la Presidencia, 2005; CAM, 2006) were analysed in the refrigerated A, B and C samples (<2 mm) by the certified laboratory Eurofins Analytico (The Netherlands). These contaminants belong to the groups summarized in **Fig. 3**. Tests are accredited by the Dutch Accreditation Council (RvA). Quality assurance and quality control (QA/QC) measures performed by Eurofins Analytico included blank samples, laboratory control samples (standard reference samples), device controls (calibration, sensitivity, interference), internal standards, and so on (TerrAttesT®soil method).

Fig. 2. *a) The tyre-dumpsite from upslope. b) Scrap tires lies directly upon the soil. c) Location of sampling point A under the tyres . d) Stockpiled tyres. Crushed tyres on the back of the picture. e) Tyre debris in sampling point B.*

Fig. 3. *Groups of contaminants analysed.*

RESULTS AND CONCLUSIONS

Electrical conductivity, pH values and soluble salt contents were in the range for carbonated and gypsum soils. Organic carbon content in B soil sample was the highest value, possibly due to the presence of tyre-debris. The analysis of sample C showed the lower contents for all contaminants (**Fig. 4**). Some inorganic and organic contaminants from A and B soil samples showed values close or above the RGV (CAM, 2006; Ministerio de la Presidencia, 2005). Indeed, the A soil sample showed high contents in As (120 mg/kg), V (28 mg/kg) and Be (1.9 mg/kg). The unusual high values of As could be due to an external source of As (rat poison or insecticide) more than the tyre weathering (we could not find similar levels in the bibliography). Vanadium content was similar to that reported by other authors, while our results in Be content were higher than previously observed (Bocca et al., 2009). Nevertheless, the relation between the Be content and the presence of tyres could not be established and a lithogenic origin could not be excluded. Soil sample B showed values in some contaminants that were close or above the RGV: Cu (180 mg/kg), Co (28 mg/kg), Sb (2.1 mg/kg), V (27 mg/kg), Zn (1600 mg/kg), fluoranthene (0.19 mg/kg), pyrene (0.75 mg/kg), benzo(a)anthracene (0.03 mg/kg), benzo(a)fluoranthene (0.12 mg/kg), benzo(a)pyrene (0.07 mg/kg), dibenzo(ah)anthracene (0.06 mg/kg) and indene(123-cd)pyrene (0.08 mg/kg). These concentrations are consistent to bibliography (Aatmeeyata, 2010; Bocca et al., 2009 ; Kanematsu et al., 2009; Llompart et al., 2013; San Miguel et al., 2002; Selbes et al., 2015, and Taheri et al., 2011). Results of B soil sample suggest that the source of such contaminants comes from the tyre debris incorporated into the soil, whereas other organic compounds could have been degraded to some extent and volatilized, due to the semi-arid climatic characteristics of the area.

No affection produced by tires was observed in A and C soil samples, therefore we discard the contamination by leachates generated from the tyres. The contaminants were found in B soil sample, where tyre debris appeared. Therefore, the presence in some areas of tire debris provides a starting point to determine the availability of the chemicals detected and possible factors that could increase them.

Fig. 4. *Concentration of main inorganic (a) and organic (b) contaminants detected.*

References

ICHMET 2016

18th International Conference on Heavy Metals in the Environment

12 to 15 September 2016 – Ghent, Belgium

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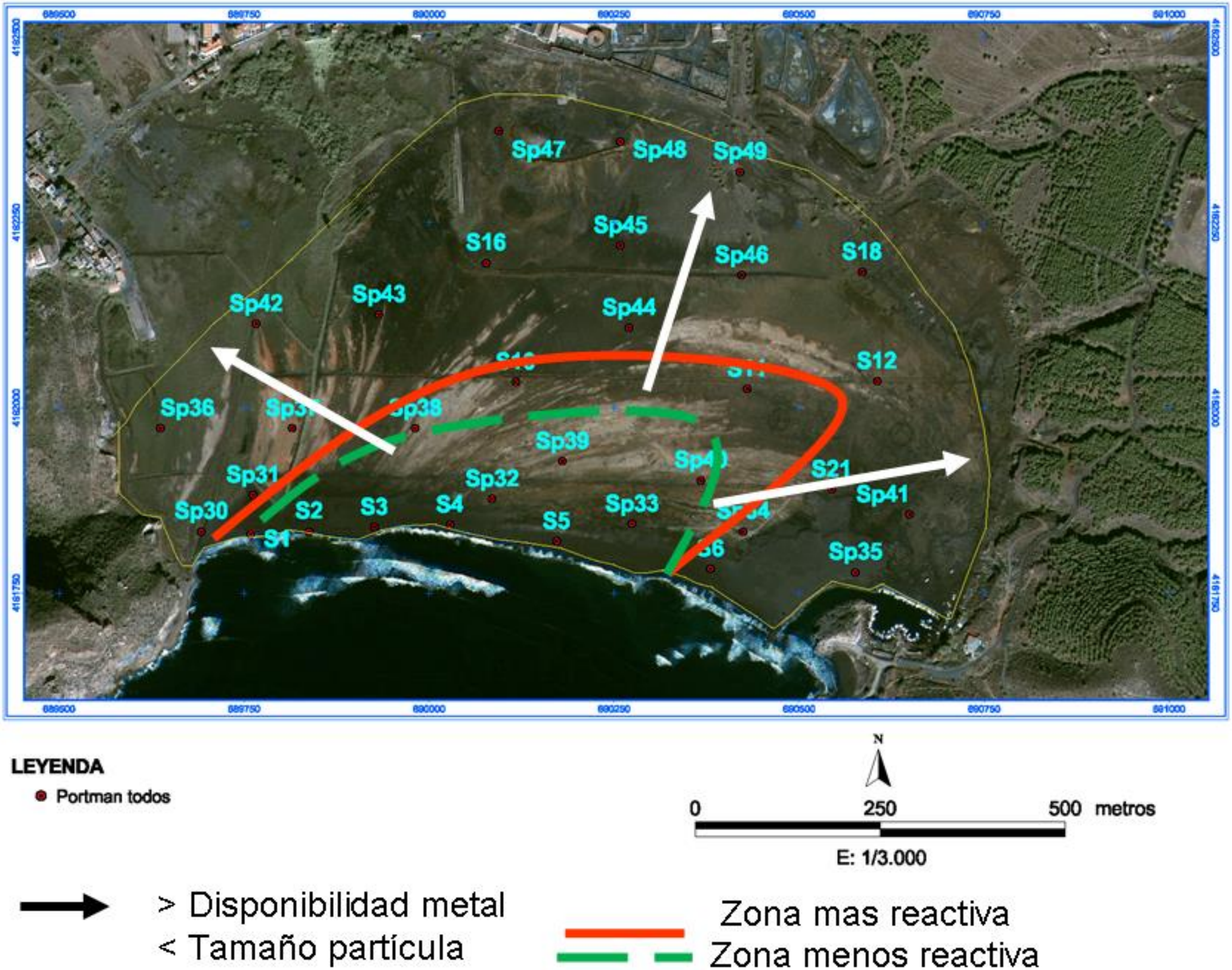
FUENTE: CARESOIL: Ref.:P2013/MAE2739

El análisis de riesgos de suelos contaminados : el caso de la Bahía de Portmán.

Martínez Sánchez MJ, García Lorenzo ML, Martínez López S, Martínez Martínez LB, Hernández Pérez C, Pérez Sirvent C. Rev. salud ambient. 2015; 15(2):103-112.

Tres etapas de la bahía:

Fuente: El análisis de riesgos para la salud humana.. Mª José Martínez Sánchez y col. Salud ambient.2015;15(2):103-112



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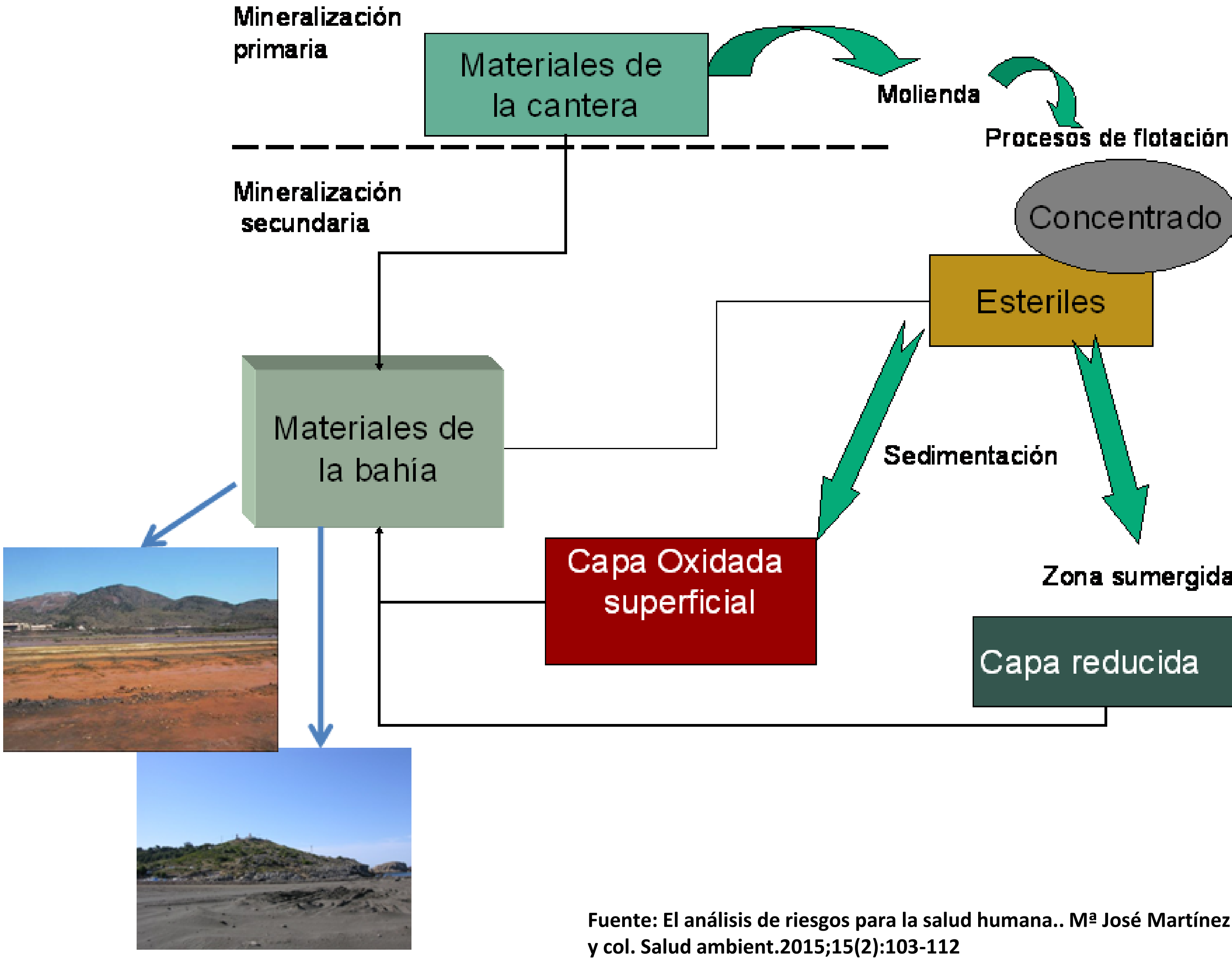

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Tratamiento in-situ para la inmovilización de contaminantes

Horizonte 1	• Tierra vegetal o arena de playa, 60 cm espesor
Horizonte 2	• Gravas de distinto tamaño, 40 cm espesor
Horizonte 3	• Sedimentos contaminados tratados con 50% filler calizo, 100cm espesor
Sedimentos contaminados	• Sedimentos bahia

Fuente: El análisis de riesgos para la salud humana.. Mª José Martínez Sánchez y col. Salud ambient.2015;15(2):103-112

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Muchas Gracias