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Heavy metals in human bones in different historical epochs

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Abstract

The concentration of the metals lead, copper, zinc, cadmium and iron was determined in bone remains belonging to 30 individuals buried in the Region of Cartagena dating from different historical periods and in eight persons who had died in recent times. The metals content with respect to lead, cadmium and copper was determined either by anodic stripping voltammetry or by atomic absorption spectroscopy on the basis of the concentrations present in the bone remains. In all cases, zinc and iron were quantified by means of atomic absorption spectroscopy. The lead concentrations found in the bone remains in our city are greater than those reported in the literature for other locations. This led to the consideration of the sources of these metals in our area, both the contribution from atmospheric aerosols as well as that from the soil in the area. Correlation analysis leads us to consider the presence of the studied metals in the analysed bone samples to be the consequence of analogous inputs, namely the inhalation of atmospheric aerosols and diverse contributions in the diet. The lowest values found in the studied bone remains correspond to the Neolithic period, with similar contents to present-day samples with respect to lead, copper, cadmium and iron. As regards the evolution over time of the concentrations of the metals under study, a clear increase in these is observed between the Neolithic period and the grouping made up of the Bronze Age, Roman domination and the Byzantine period. The trend lines used to classify the samples into 7 periods show that the maximum values of lead correspond to the Roman and Byzantine periods. For copper, this peak is found in the Byzantine Period and for iron, in the Islamic Period. Zinc shows an increasing tendency over the periods under study and cadmium is the only metal whose trend lines shows a decreasing slope.

Keywords: Human bone; Heavy metals; Anodic stripping voltammetry; Atomic absorption spectroscopy; Historical periods; Intake

1. Introduction

Cartagena was in antiquity one of the most important and prosperous cities on the Iberian

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Peninsula, a fact demonstrated both by ancient written sources as well as by archaeological studies.

Several factors converge in the causes that brought about its growth, some rooted in politics and economy and others of a geostrategic character. Its privileged position, on what in the past was a peninsula surrounded by hills overlooking the sea, closed off by a lagoon that spread out behind it, made the city and its bay one of the best protected natural enclaves in the Mediterranean.

The exceptional conditions of its port soon facilitated intense commercial activity, fomented by its proximity to the north of Africa, by its easy accessibility with respect to the interior of the Iberian Peninsula and above all by the enormous riches of its mines.

Although it was Carthage's interests in establishing itself in this territory that resulted in making it the capital of the Barca dynasty in Iberia in the year 229 B.C., the fact is that the mining tradition of this region had already boasted a well-earned reputation with respect to metals since the first millennium before Christ, especially lead and silver, which were elaborated in numerous factories that stood along the mountainous shoreline, from Mazarrón to Cabo de Palos.

Even though Prehistoric ore mining is documented among the indigenous populations of the region, early production of copper hardly reached the threshold of self-sufficiency, contrary to what occurred in other areas of the eastern Mediterranean. The so-called Chalcolithic Period, implanted here from the third millennium B.C., barely incorporated objects made from this metal, making them an almost exotic element solely possessed by the most influential local castes.

It was to be from the 2nd millennium B.C., at the height of the Bronze Age, when objects made from this metal reflect the full adoption of the working of this metal by the peoples of the Argaric Culture, giving rise to widespread production organised in specialised guilds and workshops. At the end of this period, and above all in the early centuries of the 1st millennium B.C., we already find small factories producing lead and silver, now linked to the true mining potential of the subsoil of the region of Cartagena. The sites of these small foundries, many of which were located just a few metres from the coast, was to largely obey the growing demand for these products and the strong trading links that by then existed between local mining and the Phoenician world and its intermediaries, who controlled sea traffic on this side of the Mediterranean.

One of the most recent archaeological findings, that of two ships dating from this period sunk in the Port of Mazarrón (Barba et al., 1995), highlights up to what point local mining was the object of trade. The majority of its heavy cargo, undoubtedly taken on board in this port of call, was made up of ingots of litharge, the goods from the point of origin being ceramic dishes, so appreciated by the local peoples.

A few hundred metres from the site of this finding, on the small tombolo at Punta de los Gavilanes, (Ros et al., 2003), a small factory has been documented that possessed foundry ovens used to obtain this product, thus confirming the clearly commercial vocation of these strategic coastal installations.

The dynamics of exchange grew at the same rate as cupellation techniques evolved. The increasing demand for lead in the centuries to come made production grow along with the number of establishments and the size of the foundries treating silver-bearing galenite. The example of Los Nietos, an Iberian settlement from this period on the shore of the Mar Menor (Garcia, 2001), clearly illustrates how in the 4th century B.C. its inhabitants had achieved a certain degree of mining specialization, by now a long way from the traditional agricultural and cattle farming activity of their contemporaries in inland rural settings.

The diversification of tasks related to mining was by now a fact, as the very existence of this settlement proves. The work of extracting the ore in the neighbouring range of La Unión contributed the raw material that had to be smelted in the ovens at this location, frequented by traders in charge of carrying out transactions.

It is not surprising then that Carthage set its eye on this coastal strip when establishing its main base on the Peninsula, thus counteracting the losses it had incurred after the first Punic War. This expansive policy of the Barca family was to be culminated by Hasdrubal's founding of a new city, Qart-Hadash, called to become the capital of the Punic territories in Iberia.