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Book Review

ON THE DEGRADATION MECHANISMS UNDER THE INFLUENCE OF PEDOLOGICAL FACTORS THROUGH THE STUDY OF ARCHEOLOGICAL BRONZE PATINA

by

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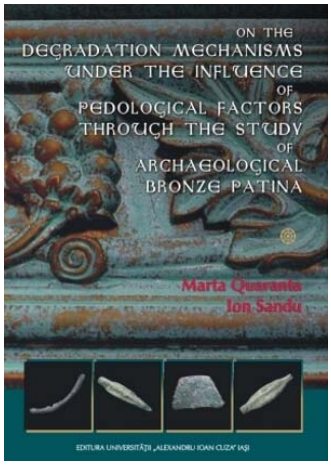
This experimental book concerns the study of the long-term behaviour of ancient bronzes recently excavated from burial conditions. The scientific interest is to clarify the effect of soil parameters on the degradation mechanisms of ancient bronze alloy. The work took into consideration bronzes recovered from the archaeological sites in the region of Dobrudja, Romania. The first part of research work was dedicated to the characterization of bronze artefacts using non destructive (micro-FTIR, reflectance mode) and micro-destructive (based on sampling and analysis of a stratigraphical section by OM and SEM-EDX) methods. Burial soils were geologically classified and analyzed by chemical methods (pH, conductivity, anions content). Most of objects analyzed showed a coarse and inhomogeneous corroded structure, often made up of several corrosion layers. This has been explained by the silt nature of soils, which contain low amount of clay and are, therefore, quite accessible to water and air. The main cause of a high dissolution rate of bronze alloys is the alternate water saturation and instauration of the soil, for example on a seasonal scale. Moreover, due to the vicinity of the Black Sea, the detrimental effect of chlorine has been evidenced for few objects, which were affected by the bronze disease. A general classification of corrosion layers was achieved by comparing values of the ratio Cu/Sn in the alloy and in the patina. Decuprification is a general trend, and enrichment of copper within the corrosion layers, due to the formation of thick layers of cuprite (Cu2O), is pointed out as well. Uncommon corrosion products and degradation patterns were presented as well, and they are probably due to peculiar local conditions taking place during the burial time, such as anaerobic conditions or fluctuating environmental conditions. In order to acquire a better insight into the corrosion mechanisms, the second part of the thesis has regarded simulation experiments, which were conducted on commercial Cu-Sn alloys, whose composition resembles those of ancient artefacts one. Electrochemical measurements were conducted in natural electrolytes, such as solutions extracted from natural soil (sampled at the archaeological sites) and seawater. Cyclic potentiodynamic experiments allowed appreciating the mechanism of corrosion in both cases. Soil extract's electrolyte has been evaluated being a non aggressive medium, while artificial solution prepared by increasing the concentration of anions caused the pitting corrosion of the alloy, which is demonstrated by optical observations. In particular, electrochemical impedance spectroscopy allows assessing qualitatively the nature of corroded structures formed in soil and seawater. A double-structured layer is proposed, which differ, in the two cases, for the nature of the internal passive layer, which result defectiveness and porous in case of seawater.



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