



Atomic Spectrometry as a Tool for Archaeological Material Description

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Abstract: Elemental composition of archaeological material is very useful when trying to answer the question of manufacture, provenance and/or purpose of the object of interest. Analytical atomic spectrometry methods have an extremely important role in the characterization of items of cultural heritage. Also, they are widespread and very useful for simultaneous determination of elements. They are mostly destructive which is a posing problem when analyzing cultural heritage objects. Inductively coupled plasma atomic emission spectrometry, ICP-AES and inductively coupled plasma-mass spectrometry, ICP-MS were used for determination of selected element content in fragments of iron artefacts such as slag and bloom which are dated to the Bronze Age, and La Tène culture, and were collected during extensive archaeological excavations under the supervision of the Zagreb City Museum. Instrumental working conditions were optimized after preliminary selection of the most appropriate emission lines for the selected elements. Microwave assisted digestion was used for the preparation of sample solutions and the analytical procedure was controlled with standard reference materials. Multivariate statistical analysis allowed classification of obtained results in groups which consisted of ceramic, ceramic-rich slag and bloom material. As an example, one sample (No3170) consists of Fe (35.5%), Al (4.4%), Mn (0.5%), Ti (0.3%), Cr (99.5 ppm), Zn (29.5 ppm), La (24.4 ppm), Ce (57.32 ppm), Pr(6.71 ppm), Eu (1.43 ppm).

Sažetak

Elementni sastav arheološkog materijala koristan je pri opisu proizvodnje, porijekla i/ili svrhe objekta od interesa. Metode atomske spektrometrije imaju iznimnu ulogu u opisu objekata kulturnog nasljeđa. Također, uobičajene su i vrlo korisne za simultanu elementnu analizu. Većinom su destruktivne što predstavlja veliku poteškoću kod analize arheoloških uzoraka. Atomska emisijska spektrometrija uz induktivno spregnutu plazmu, ICP-AES te spektrometrija masa uz induktivno spregnutu plazmu, ICP-MS, korištene su za određivanje elementnog sastava fragmenata željeznih izradovina poput troske i »bloom« (»cvijeta«) iz brončanog doba i Latenske kulture, a pronađenih tijekom proširenih arheoloških iskapanja u nadležnosti Muzeja grada Zagreba. Radni uvjeti instrumenta su optimirani nakon odabira najpogodnijih emisijskih linija odabranih elemenata. Mikrovalno potpomognuta razgradnja je korištena za pripremu uzoraka dok je sama metoda pripreve kontrolirana upotrebom certificiranih referentnih materijala. Multivarijatna statistička analiza korištena je za klasifikaciju uzoraka u grupe keramičkih materijala, keramikom bogate troske i bloom. Kao primjer, jedan od uzoraka (No3170), sadrži Fe (35,5%), Al (4,4%), Mn (0,5%), Ti (0,3%), Cr (99,5 ppm), Zn (29,5 ppm), La (24,4 ppm), Ce (57,32 ppm), Pr(6,71 ppm), Eu (1,43 ppm).