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Neutron Activation Analysis for Archaeological Soils and Ceramics

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ABSTRACT

The applications of nuclear analysis techniques are widespread in various socio-economic sectors such as industry, medicine, geosciences, environment and cultural heritage. In this field, nuclear techniques make it possible to study the life of an archaeological sample at the heart of its material, in order to inform us about human activity and skills of the past. By preserving these witnesses to our history, we can use them to build a better future. The aim of our study is to determine the elemental composition of samples of ancient soils and ceramics from different archaeological sites in Algeria, using the Neutron activation analysis (NAA). The experimental results of the samples analyses will be compared with existing experimental data. This will be done in the perspective of establishing a classification in order to set up an initial draft database for archaeological sites in Algeria.

Keywords : Neutron activation analysis (NAA), archaeology, soil, ceramic.

1 Introduction

The study of archaeological remains through nuclear analysis techniques requires following interdisciplinary protocols and methods. This ensures that material remnants, sediments, and soils from archaeological sites can document the environmental impact of an agricultural or ecological system. This is because archaeology has an important role to play in the strategies we need to adopt to begin the transition to more sustainable lifestyles. This discipline, supported by nuclear analysis techniques, could actively contribute to addressing societal challenges of our time, such as ensuring food security and adapting to climate change to build resilient agricultural systems.

2 Experimental

The Neutron activation analysis (NAA) method is based on the detection of gamma rays in samples irradiated by neutrons, its highly accurate also provides access to light elements, which are inaccessible using other analytical methods. That makes this method very useful in archaeology, as it offers the possibility of analyzing traces in samples witch are determinant for characterising materials, it will enable us to understand the choice of raw materials used and to determine their origins. The analysis of radionuclides in the samples was carried out at the Laboratory of the Division of Nuclear Physics and Applications (DPAN) of the Nuclear Research Center of Draria (CRND) using a hyper-pure germanium (GeHP) semiconductor detector.

3 Results and Discussion

The results of the analyses for the long-period elements are grouped in the following table.

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Table1: Concentrations of long-period elements

	T1	T2	T3	T4	T5	T6	AIEA
Elements				Ci			
Majors				[%]			
Fe	2,93	3,5	2,57	2,35	1,41	3,4	2,49
Na	0,26	0,57	0,30	0,70	0,07	0,5	0,28
K	1,30	1,20	1,35	0,8	0,20	1,20	2,29
Traces				[ppm]			
Ba	456	541	458,6	275,96	128	480	287
Ce	12	16,6	16,14	19,86	7,55	13	50,5
Cr	89	88	65,56	62,19	137	75,1	52,8
La	6	8,19	7,65	11,41	3,7	6,63	25,3
Br	5	6,4	2,84	14,79	12,33	6,11	6,5
As	8	10,16	4,37	6,76	18,02	12,21	18,6
Sb	1	0,8	0,6	1,08	4,14	0,6	1,49
Cs	1	0,5	0,2	1	0,5	0,4	7,83
Ga	1	2,3	1,84	2,41	8,3	9,82	14,8
Zr	161	327,4	281,61	346,8	85,77	157	140
Sc	11	10,6	8,41	9,4	3,52	11,67	9,31
Rb	42	47,6	41,06	60,95	6,16	51,5	107
Co	2	3,7	3	3	2,8	2,67	9,07

4 Conclusions

Poteries and soils were analyzed by NAA and compared to provide additional data and give a full picture of potery production in the Roman period. These analysis can be helpful for their authentication, it provides a better understanding of previous historical activities at these sites**.** Finally, this work aspires to set up a database on archaeological remains in Algeria.

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