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COMPARATIVE STUDY OF PGA AND INAA FOR ANALYSES OF METEORITE SAMPLES

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ABSTRACT

Prompt gamma-ray analysis (PGA) and instrumental neutron activation analysis (INAA) are essential for the study of rare samples such as meteorites because of non-destructivity and relatively being free from contaminations. The objective of this research is to utilize PGA and INAA techniques for comparative study and apply them to meteorite analyses. In this study, 11 meteorite samples received from the Meteorite Working Group of NASA were analyzed. The Allende meteorite powder was included as quality control material. Results from PGA and INAA for Allende showed in good agreement with literature values, signifying the reliabilities of these two methods. Elements Al, Ca, Mg, Mn, Na and Ti were determined by both methods and their results are compared. Comparison of PGA and INAA data using linear regression analysis showed correlations coefficients r^2 > 0.90 for Al, Ca, Mn and Ti, 0.85 for Mg, and 0.38 for Na. The PGA results for Na using 472 keV were less accurate due to the interference from the broad B peak. Therefore, Na results from INAA method are preferred. For other elements (Al, Ca, Mg, Mn and Ti), PGA and INAA results can be used as cross-reference for consistency. The PGA and INAA techniques have been applied to meteorite samples and results are comparable to literature values compiled from previously analyzed meteorites. In summary, both PGA and INAA methods give reasonably good agreement and are indispensable in the study of meteorites.

Keywords: Instrumental neutron activation analysis, meteorites, prompt gamma-ray analysis

INTRODUCTION

Neutron activation analysis is suitable for multi-element determination in various samples including geological, biological and environmental samples. Variants of this technique include intrumental neutron activation analysis (INAA) and prompt gamma-ray activation analysis (PGA). These techniques are available only to research laboratory with access to a research reactor. The INAA is a well developed method used in countries equipped with research reactors around the world. This method is capable to determine about 40 elements (major, minor and trace elements) in a sample. The accuracy and precision of INAA has been well acknowledged by many users in various fields. On the other hand, the PGA method is less common and it has been developed only in a few countries such as U.S.A. [Paul, 1995] and Japan [Yonezawa et al., 1993]. The PGA requires the construction of a neutron beam port (thermal or cold neutrons), sheilding, sample box and gamma-ray spectrometer. Example of PGA system in Japan is described by Yonezawa et al. [1993]. Once completed, a PGA system is capable to determine light elements such as H, B, N, S, P, Si and other major elements with good

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