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# Multi-element Determination in Stream Sediment by X-ray Fluorescence Spectrometry

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## 1 Introduction

With the continuous development of economy, the demand for mineral resources has increased. It is necessary to search for buried and deep ore deposit in order to meet the need for mineral resources. In recent years, a series of new technologies and new methods have gradually applied to exploration for mineral resources such as secondary halo method, structural superimposed halo method, thermal halo and primary halo method and these new methods have been developed in the application of finding mineral resources (Zhu et al., 2013; Tong, 2012). Especially in the regions with more trenches and water systems, it is convenient to carry out the work of stream sediment survey. At present, because there is not a uniform standard method in the determination of elements in stream sediment sample analysis, it is usually required to use various methods to obtain the data of major, minor and trace elements (Tian et al., 2010). But these methods have shortcomings such as they cannot achieve the determination of simultaneous multi-element analysis they have a long analytical process and low detection efficiency, which cannot meet the needs of the actual production. Therefore, it is particularly significant to seek an advanced, fast accurate way to determine the content of each component of stream sediment samples (Zheng and Liu, 2013; Guan et al., 2013). .

X-ray fluorescence (XRF) spectrometry began in the early 1950s as a routine analytical tool and it has become one of the most widely used analytical methods in geochemical sample analysis (Ji et al., 2003). Compared with traditional chemical analysis, XRF has advantages with multi-element determination, high sensitivity, low detection limit and rapid analysis ability, playing an increasingly important role in metallurgy, geology, chemical industry and other areas (Gao et al., 1995; Feng et al., 2006). In this study, wavelength dispersive X-ray fluorescence (WDXRF) spectrometer was used to measure elemental composition of stream sediment samples with pressed-powder pellet preparation. The matrix effect was eliminated by using empirical coefficient method. Verified by the national material GSD21, the results of analysis by WDXRF can coincide with the calibration values.

## 2 Experimental

A multi-channel high performance sequential WDXRF spectrometer (Axios2005, PANalytical, Netherlands), equipped with a rhodium X-ray tube operated at a maximum power of 4kW and a maximum current of 160mA was used. Super Q software was used. A ZHY-401 semi-automatic press was used to prepare the powder pellets.

First, the samples were mashed to below 75 μm. Second, the samples were dried in an oven at 105℃. Last, 4 g of each sample was pressed into a uniform pellet of 40 mm parameter using the ZGY-401 semi-automatic press machine under 30t with a standing time of 30s.

The measurements were carried out on an Axios2005 WDXRF spectrometer. The measure conditions were investigated carefully before testing in order to reach the best measuring result. Calibrations were carried out with Super Q version 4.0 software containing empirical coefficient method for matrix correction from Panalytical Company.

## 3 Results and Discussion

In order to check the accuracy of the method, the national standard GSD18was used to make eleven samples under the same making process and measured in the same condition. The statistical results showed that the relative standard deviation was from 0.1%～10% and proved well

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**Table Accuracy Test of the Method**

| element | GSD21 | | element | GSD21 | | element | GSD21 | |
|---|---|---|---|---|---|---|---|---|
| | this method | verified value | | this method | verified value | | this method | verified value |
| Ba | 681.5 | 727±15 | S | 6584.5 | 6700±600 | $Al_2O_3$ | 12.65 | 13.08±0.1 |
| Co | 9 | 8.8±0.4 | Sr | 346.4 | 355±13 | CaO | 3.891 | 4.09±0.08 |
| Cr | 37.5 | 32±4 | Th | 6.5 | 5±0.8 | $Fe_2O_3$ | 4.496 | 4.8±0.05 |
| Ga | 16 | 15.7±0.5 | V | 76.7 | 83±4 | $K_2O$ | 2.415 | 2.44±0.04 |
| Hf | 5.1 | 4.8±0.4 | Y | 23.4 | 26±2 | MgO | 2.119 | 2.01±0.04 |
| Mn | 810 | 829±9 | Yb | 2.6 | 3±0.3 | $Na_2O$ | 4.486 | 3.15±0.05 |
| P | 622.2 | 608±16 | Zn | 289.2 | 289±6 | $SiO_2$ | 59.455 | 63.12±0.34 |
| Pb | 24.2 | 26±1 | Zr | 170.7 | 179±13 | Ti | 3065.1 | 3280±200 |
| Rb | 53.8 | 53±4 | | | | | | |

The units of $Al_2O_3$,CaO,$Fe_2O_3$,$K_2O$,MgO,$Na_2O$,$SiO_2$ and Ti are wt%, others are μg/g.

of the method.

Using the national standard GSD21 as an unverified sample, the measuring results of this method were in good agreement with its calibration values and showed that the statistics of this method are reliable. The results showed below.

## 4 Conclusion

This work has developed, calibrated and tested a method to analyze 25 elemental contents in pressed-powder pellet of stream sediment samples using WDXRF. The samples were made in a simple process and the analysis period was time-consuming. Empirical coefficient method was used to correct the matrix effect and the statistical results showed that the precision of this method is good with high accuracy and low detection limit. Therefore, the established method in this work is a good routine method for measuring stream sediment samples and can be well applied in mineral exploration.

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