DETERMINATION OF RARE EARTH AND OTHER TRACE ELEMENTS IN THREE IN-HOUSE GEOCHEMICAL REFERENCE MATERIALS BY INDUCTIVELY COUPLED PLASMA MASS SPECTROMETRY UTILIZING FUSION DECOMPOSITION PROCEDURE

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Abstract

The rare earth elements (REE) such as lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), samarium (Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb), lutetium (Lu) and trace elements such as beryllium (Be), germanium (Ge), hafnium (Hf), tantalum (Ta) and uranium (U) are determined by inductively coupled plasma mass spectrometry in three in-house geochemical reference materials of the Geological Survey of India. The fusion procedure involving lithium metaborate and lithium tetra borate had been utilized for the complete decomposition of the samples. Indium is added as an internal standard to correct for matrix effects and instrumental instability. Calibration for each of the above element is made by using the average intensity of blanks taken through the entire procedure and the intensities acquired on solutions of stream sediment and soil standards containing known concentrations of each REE, Be, Ge, Hf, Ta and U. The accuracy and precision of the experimental values were assessed by the comparative analysis of well established reference materials such as IGGE, GSD-2, GSD-3, GSD-4, GSD-5, GSD-6, GSD-10 and GSS-8. The results obtained for the reference materials are in good agreement with the recommended values within a 10% error range.

The data obtained for the elements [La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Be, Ge, Hf, Ta and U] in the three in-house geochemical reference materials, PKS-1 (Palakkad Kerala Soil-1), PKSS-1 (Palakkad Kerala Stream Sediment-1), AASS-2 (Anantpur Andhra Pradesh Stream Sediment -2) prepared by Geological Survey of India have been reported. The indicative values for PKS-1 are; La 66.6±3.0 μg/g, Ce 132±6 μg/g, Pr 12.8±0.6 μg/g, Nd 45.3±3.4 μg/g, Eu 1.99±0.34 μg/g, Sm 7.82±0.65 μg/g, Tb 0.87±0.06 μg/g, Gd 6.38±0.62 μg/g, Dy 4.26±0.32 μg/g, Ho 0.83±0.06 μg/g, Er 2.32±0.14 μg/g, Tm 0.36±0.03 μg/g, Yb 2.34±0.19 μg/g, Lu 0.35±0.03 μg/g , Be 1.72±0.21 μg/g, Ge 1.17±0.18 μg/g, Hf 8.73±0.93 μg/g, Ta 0.63±0.08 μg/g, U 0.98±0.07 μg/g, and for PKSS-1 are; La 50.7±3.1 μg/g, Ce 87.7±4.2 μg/g, Pr 8.73±0.44 μg/g, Nd 31.3±1.7 μg/g, Eu 1.50±0.22 μg/g, Sm 5.46±0.51 μg/g, Tb 0.69±0.05 μg/g, Gd 4.85±0.54 μg/g, Dy 3.58±0.28 μg/g, Ho 0.74±0.05 μg/g, Er 2.06±0.15 μg/g, Tm 0.33±0.02 μg/g, Yb 2.11±0.16 μg/g, Lu 0.33±0.03 μg/g , Be 0.85±0.11 μg/g, Ge 0.95±0.18 μg/g, Hf 16.0±1.5 μg/g, Ta 0.85±0.10 μg/g, U 0.99±0.14 μg/g, and for AASS-2 are; La 29.6±1.8 μg/g, Ce 55.3±1.8 μg/g, Pr 5.98±0.23 μg/g, Nd 21.7±1 μg/g, Eu 0.98±0.15 μg/g, Sm 3.91±0.37 μg/g, Tb 0.43±0.04 μg/g, Gd 3.07±0.38 μg/g, Dy 2.16±0.22 μg/g, Ho 0.42±0.03 μg/g, Er 1.21±0.15 μg/g, Tm 0.19±0.02 μg/g, Yb 1.20±0.10 μg/g, Lu 0.18±0.02 μg/g , Be 1.47±0.24 μg/g, Ge 0.76±0.06 μg/g, Hf 6.43±0.66 μg/g, Ta 0.60±0.07 μg/g, U 1.39±0.19 μg/g. From the Z-score values, it is indicated that the analytical values obtained for these elements are precise and accurate. Hence these in-house reference materials are intended to be used mainly for NGCM program for 1) The calibration of an apparatus/instrument, 2) the development and assessment of a measurement technique, 3) to control and assure the quality of data generated sans any inter-laboratory and interpersonal bias.

Keywords: Trace elements, ICPMS, Fusion procedure, Geochemical reference materials, Geological Survey of India