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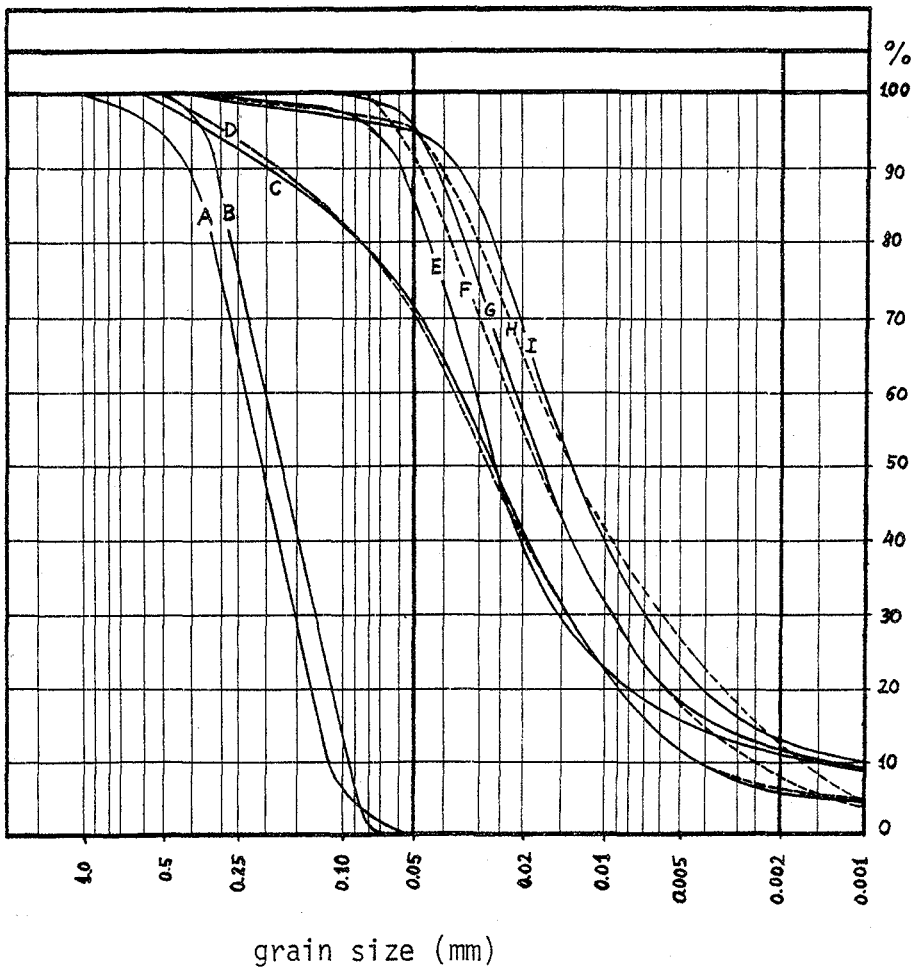
INTERLABORATORY STUDY OF POTASSIUM CONTENTS USING GAMMA SPECTROMETRIC AND ATOMIC ABSORPTION ANALYSES AND COMPARISON WITH GRAIN SIZE

H. PRÓSZYŃSKA Laboratorium wieku termoluminescencji, Madalińskiego 42-62, 02-540 Warsaw, Poland.
M.A. MILLER Bullard Laboratories, Department of Earth Sciences, University of Cambridge, Madingley Road, Cambridge, CB3 0EZ, U.K..
A.G. WINTLE The Godwin Laboratory, Sub-department of Quaternary Research, University of Cambridge, Free School Lane, Cambridge, CB2 3RS, U.K..

Introduction

As part of an exchange sponsored by the Royal Society, sediment samples from Poland, which are being used in a TL dating study, had their potassium contents analysed by two different techniques. All the samples were sediments of Scandinavian origin, reworked into sands, A and B, and loesses C,D,E,F,G,H and I. The grain size analyses of each of these sediments are given in Figure 1. For TL dating an accurate determination of the potassium content is essential since the potassium content of the bulk sample is responsible for about 40% of the total dose rate to the fine grain minerals which are used for dating.

Figure 1



Gamma Spectrometry

Gamma spectrometry was carried out in the University of Warsaw using a NaI(Tl) SKG-1 detector made by Tesla-Czechoslovakia, an EMI photomultiplier tube type 9514S and a multichannel analyser type AI-1024 made in the Soviet Union. Drift was corrected by use of Co-60 peaks (1.17 and 1.33 Mev). The detector is calibrated using a standard with 3 % K (3.62% K_2O). The 500gram standard is made up of 28.6 gram of KCl in chemical silica. 3-5 determinations are made using a counting time of 72 minutes and two background runs each of 36 minutes are performed. Sample weight is 500 gram. The potassium window (1.39-1.57 Mev) will also contain contributions from uranium and thorium gamma decays and allowance is made for these contributions for each sample. The results are given in Table 1.

Atomic Absorption Spectrophotometry

In Cambridge the potassium contents were measured using atomic absorption spectrophotometry (AAS). These results are also given in Table 1. The error quoted is the standard deviation calculated from the number of determinations made on each sample (figure in brackets). Each determination was made on approximately 0.1 gram of sample weighed directly into a platinum crucible. 10ml of hydrofluoric acid and 1ml 50% sulphuric acid were added and the whole evaporated to dryness on a sandbath. The resulting residue was then dissolved in de-ionised water and washed into volumetric flasks. The K_2O calibration solutions were made up with Analar KCl and both the standards and the samples contained 200 ppm Na to eliminate the effect of ionisation enhancement during AAS.

Discussion

The results in Table 1 are arranged in order of decreasing grain size. It can be seen that for these sediments the amount of potassium is closely connected with the granulometric composition: for sands A,B K_2O is 0.6-0.7 %, for sandy loesses C,D K_2O is $\sim$1.5 % and for the finer loesses 1.8-2.1 %. It is especially high for those samples which contain a lot of fine grains (2-20 μm) with a higher percentage of potassium rich minerals (e.g. K-feldspars and muscovite). The percentage of colloid clay ($<$ 2 μm) seems to be relatively unimportant. This confirms the work of Borowiec who found the maximum K_2O content of Polish loesses to be in the 2-5 μm grain size (Borowiec, 1970).

For the seven samples of loess the agreement was excellent, the mean ratio of the results for the two techniques being 1.01 ± 0.03. For samples A and B the lower precision of the AAS results was due to their inhomogeneity.

Table 1

		K_2O % (γ)	K_2O % (AAS)	
A	Maliniec	0.66 ± 0.07	0.69 ± 0.08	(4)
B	Kraków 1	0.61 ± 0.09	0.65 ± 0.06	(2)
C	Kraków 3	1.47 ± 0.04	1.47 ± 0.01	(3)
D	Tyszowce 6	1.63 ± 0.04	1.55 ± 0.02	(3)
E	Kazimierza	1.70 ± 0.07	1.77 ± 0.02	(3)
F	Komarów	2.05 ± 0.04	1.961± 0.001	(3)
G	Tyszowce 4	1.92 ± 0.08	1.92 ± 0.007	(3)
H	Kraków 6	2.03 ± 0.08	2.07 ± 0.02	(3)
I	Tyszowce 2	1.91 ± 0.08	1.89 ± 0.01	(3)

References

Borowiec,J. 1970. Comparison of composition and properties of loesses occurring in Poland. Annales Universitatis M. Curie-Sklodowska, section B, 25,

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