Research Application Summary

Chemical properties of travertine from different sources in Rwanda with regards to their calcium oxide and magnesium oxide contents

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Abstract

This study was conducted in the districts of Rusizi, Korongi and Musanze districts, Rwanda in areas where travertine is found. The objective of the study was to characterize the chemical compositions of travertine for use in amending soil acidity for crop production. Thirty two samples of travertine from different deposits at Mashyuza (Rusizi), Gishita (Karongi) and Mpenge and Rwaza (Musanze) were analysed to establish their CaO and MgO contents. Percentages by weight of CaO and MgO in samples were determined using X-ray fluorescence. Results revealed that travertine from Mashyuza and Rwaza has the highest CaO wt% content followed by Gishyita. Mpenge deposits had the lowest content CaO% . There was no significant difference among sites for MgO contin travertine. The tratio of CaO:MgO in Mpenge, Mashyuza and Gishita was within a range required to prevent deficiency of Ca and Mg in acid soils where maize and beans are grown.

Key words: Calcium oxide, magnesium oxide, Rwanda, Travertine

Résumé

Cette étude a été menée dans les districts de Rusizi, Korongi et Musanze, au Rwanda dans les zones où on a trouvé le travertin. L'objectif de cette étude était de caractériser les compositions chimiques du travertin dans son utilisation pour modifier l'acidité du sol dans le cadre de la production agricole. Trente-deux échantillons de travertin de différents dépôts à Mashyuza (Rusizi), Gishita (Karongi) et Mpenge et Rwaza (Musanze) ont été analysés pour déterminer leur teneur en CaO et MgO. Les pourcentages en poids de CaO et de MgO dans les échantillons ont été déterminés à l'aide de la fluorescence des rayons X. Les résultats ont révélé que le travertin de Mashyuza et Rwaza avaient la plus haute teneur en CaO, suivi de Gishyita. Les dépôts de Mpenge avaient la plus faible teneur en CaO. Il n'y avait pas de différence significative entre les sites pour le MgO contenu dans le travertin. La concentration en CaO:MgO à Mpenge, Mashyuza et Gishita se situait dans un intervalle

requis pour prévenir une carence en Ca et Mg dans les sols acides où les haricots et le maïs sont cultivés.

Mots clés: Oxyde de calcium, oxyde de magnésium, Rwanda, travertin

Background

Two thirds of the soils in Rwanda are acidic and large stretches of agricultural land are nutrient deficient. This results in reduced food production and food insecurity (Driessen *et al.*, 2002). The centre-piece of the Government of Rwanda's (GoR) Poverty Reduction Strategy is the transformation and intensification of agriculture. Given the high priority of food production, the GoR and donors need to invest in soil fertility enhancement through increased support and access to inorganic and organic fertilizers and soil amendments, including agricultural lime (Crawford *et al*., 2008). Research data indicate that the addition of agricultural lime alone and in combination with organic and inorganic fertilizers increases maize and bean yields. This study was done to characterize the chemical potential in CaO and MgO from different deposits of travertine in Rwanda.

Literature Summary

The Mpenge deposit is the most extensive and easily accessible travertine deposit in the northern part of Rwanda. It is located 2 km South-East of Ruhengeri town (Rwagashayija, 1990).The Rwaza travertine resource is located along the Rwaza River, South-West of Ruhengeri town and it is currently not operational. The reserves are approximately 56,000 tonnes (Grigoriev, 1981), but according to the population there are other smaller deposits not explored by Gregoriey (1981). The Gishita deposit is made up of two hot spring point source deposits and a valley filling deposit. The quantity and quality of the Gishita deposit has been evaluated by various researchers (Verhaeghe, 1964; Buyagu and Ndagiwenimana; 1980; Grigoriev (1981) and consultants to the current mine operators ALICOMEC. The quantity of travertine at the Gishita site has been estimated at about 900,000 tonnes (Buyagu and Ndagiwenimana, 1980). The most extensive travertine deposit is located near Mashyuza, Southeast of Western province. This deposit consists of travertine, with reserves estimated at more than 6 million tons (Verhaeghe, 1964).

Study Description

This study was conducted in Rwanda specifically in Rwaza and Mpenge sites located in Musanze district. The Mashyuza site is located in Rusizi district while the Gishita site is located in Karongi district. Samples were selected randomly based on the

active sites mined by the cooperatives. Samples were collected at different depth (20-50, 50-100 and 100-150cm), ground, and sieved through a 2mm mesh size. Chemical analysis was conducted in Dodoma Tanzania at the Geological Survey Laboratory. Twenty grammes of powdered sample at <180 microns, air dried at 26 ^{0}C , was hand pressed into XRF sample cups mounted with PANalytical BVX-Ray film polyesterpetp. Sample cups were placed in PANalytical Minipal 4 Energy Dispersive X-Ray Fluorescence Spectrometer, (ED-XRF) model PW4030/45B. Element determination was done by XRF Machine using MinipalminiMate Software package.

Research Application

Chemical characterization results of travertine from Rwaza and Mashyuza revealed the highest mean of 67.5and 56.9 % of CaO and were significantly different to means from Gishita and Mpenge found to be 45.4 and 38.9 % of CaO. Both sites however have no significant differences when comparing MgO means. Gishita and Mashyuza had 7.4 and 6.6 % of MgO while Mpenge and Rwaza have 5 and 3.1 % of MgO respectively. The ratio of CaO over MgO in Rwaza site were found to be 21.7, in Mashyuza the ratio of CaO/ MgO was found to be 8.6, in Mpenge the ratio CaO/ MgO was found to be 7.7 while in Gishita the ratio CaO/ MgO was found to be 6.1. These ratios falls in the range required to avoid deficiency of Ca and Mg in acid soils where maize and beans are grown except Rwaza travertine where application may cause Mg deficiency.

The results of this research is important for agriculture in Rwanda. As already pointed out, Rwandan soils have a serious problem of fertility related to soil acidification due to over cultivation and weathering. This study offers information on the potential quality of different travertine mined in Rwanda for agriculture purposes. The knowledge of the content in CaO and MgO will support a better lime recommendation for specific

Table 1. CaO and MgO content of different sources of travertine found in Rwanda.

Source of travertine	Mean CaO %	Mean MgO%	Ratio CaO/MgO
Rwaza	67.5 ± 3.0 a	3.1 ± 3.1 a	21.7
Mashyuza	56.9 ±14.6 a	6.6 ± 6.6 a	8.6
Gishita	45.4 ±8.9 b	7.4 ± 4.7 a	6.1
Mpenge	38.8 ±7.9 b	5.0 ± 3.8 a	7.7
LSD (0.05)		≥13.03	

Figures followed by the the same letter are not significantly different.

soils from Rwanda. It can also inform on the choice of lime source based on its CaO content, distance from the farm and crop targeted. The GoR through the Ministry of agriculture could use results of this study to feed direct proper usage of these lime deposits to improve soil productivity, reduce poverty and promote economic growth.

Acknowledgement

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