The potential of nepheline syenite as an alternative potash source for Malawi

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Abstract

Malawi faces severe fertilizer challenges for her agricultural sector growth and food crop production. The Government's farm input fertilizer subsidy program (FISP), intended to benefit the most vulnerable households, has helped to increase household food production, especially between 2005-2011. Between 2006-2015, the price per tonne of subsided fertilizer with about 72%N, 18%P, 10%K, has been 95% below the commercial prices (Fuentes, 2013), from around MK 950 (US $2.88) to MK 500 (US $1.52) and then MK 1050 (US $2.36) in 2015-2016 farming year. Despite these efforts, between 2003-2012 average annual fertilizer imports were at 290,000 tonnes with less than 10% of this being potassium (K) fertilizers (Fuentes, 2013). In 2013, the supply was 297,000 tonnes which is still far below the 600,000 tonnes annual demand if the country were to achieve its agricultural sector growth goals by 2016. While 96% of the arable land is occupied by small-holder farmers, their average cereal production is 1.9 tonnes/ha, compared to large estate farmers whose cereal yield is about 3.2 tonnes/ha (Fuentes, 2013). This shows that small-holder farmers are much more affected by soil nutrient deficiency (Chirwa et al., 2011). The country's use of a blanket fertilizer recommendation of 92 kg N ha^{-1} and 40 kg P_2O_5 ha^{-1} is ineffective because it assumes a specific crop instead of considering the variable needs of different soils (Chilimba et al. 1999; Lakudzala 2013). Over 60% of Malawi's land area has been reported to be K-deficient (Chilimba and Liwimbi, 2008; Lakudzala, 2013).

High fertilizer costs and uncertainty over the sustainability of the FISP create a need for alternative potash sources. In this study, we use recently acquired countrywide airborne geophysical gamma ray data (Bates & Mechennef, 2013) to identify nepheline syenites and related alkaline rocks in Malawi's part of the East African Rift System (EARS). Nepheline has the highest dissolution rate of the potassium silicate minerals (Palandri & Kharaka 2004), which means that nepheline-bearing rocks should be considered as an alternative K-silicate fertiliser for Malawi, despite lower total K contents. Results are compared with X-ray fluorescence (XRF) geochemical analyses of samples collected from fieldwork in selected areas of Malawi to assess their potential as potash sources.

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