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Novel use of monochromatic light mineral separation techniques to enhance agromineral concentration for plant nutrient release from mesocratic and leucocratic fractions of Pelotas monzogranite, RS, Brazil

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In Brazil, many rocks are investigated to assess their potential as soil amendments. Many silicate rocks are chemically and mineralogically characterized on their plant nutrient release potential. Granites are generally considered unsuitable for use in soil remineralization due to their low total plant nutrient content and their high quartz content.

Granitoids of the Pelotas Batholith were evaluated on their agrononomic potential at the Centro de Pesquisa Agropecuária de Clima Temperado, Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA) in Pelotas, RS, Brazil. The prevailing rock in the Silveira quarry near Pelotas is a monzogranite with dioritic enclaves, aplitic dikes and pegmatites, so that just the obtained gravel is representative of rock's composition as a whole. The rock contains biotite (10%), which is a potential source of K and Mg, hornblende (4%), which can releases Mg, and carbonate microveining in orthoclase grains, in addition to plagioclases, that can release Ca [1]. Leaching columns experiments and pot trials showed that crushing and milling of the total rock (100% < 0,3mm) resulted in the release of 25-30% of the total K in the rock [2].

In order to enhance the release of K, Mg and Ca to plants and to reduce the content of inerts (quartz) the rocks were finely ground and separated by photometric sorting equipment SANMAK BS- 24 DG which is currently used for colour separation of rice. The equipment is fitted with a mechanical selector and uses monochromatic light to separate two fractions: leucocratic fraction (FrL) and mesocratic fraction (FrM). These two rock fractions were chemically and petrographically characterized and subjected to agronomic evaluation in greenhouse experiments using maize *(Zea mays)* as test crop. The treatments applied to an Albaqualf soil were: T1: Control + Urea (311 kg ha^{-1}); T2: FrL (4000 kg ha^{-1}) + Natural Phosphate of Arad (375 kg ha^{-1}) + Urea; T3: FrM (4000 kg ha^{-1}) + Urea; T4: Standard fertilization: Potassium Chloride (183 kg ha^{-1}) + Natural Phosphate of Arad + Urea. The particle size of fractions were 100% < 0.3 mm.

Modal petrography on resin mounted grave showed mafic minerals percentage in FrM increased from 14% to 22% and quartz content decreased from 42% to 24% by optical separation. The K_2O concentration in FrL was 5.89%, as compared to 2.85% in FrM, which is mainly due to the higher K-feldspar concentration in FrL. In the FrM fraction the concentration of MgO (2.32%), CaO (4.31%) and P_2O_5 (0.31%) contents were higher than in the FrL fraction (MgO=0.07%, CaO=1.25% and P_2O_5=0.04% respectively). With regards to nutrients release, FrM provided statistically significant higher amounts of K to maize plants (measured in plant dry biomass) than FrL. The highest K release was provided in T3 (FrM) in comparison to T2 (FrL). Despite having lower total K_2O concentration, FrM released more K to

the soil and plants due to the easier K release from biotite. In FrL resistant to nutrient release K-feldspar prevailed.

In summary, optical monochromatic segregation techniques were used to concentrate mafic minerals from granitoids and this fraction released more plant nutrients to maize plants when compared to the application of whole crushed rock. With this technique the quartz content can also be reduced.

References:

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