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Recycling Waste Rocks for Plant Production: A Strategy to Enhance Soil Fertility?

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Progressing land use changes generate high pressure on Norway's limited agricultural land. Agricultural land, which comprises only 3% of the total land area, is often sacrificed for large infrastructure projects due to technical and economic advantages. The rising depletion of high-quality soils, cropland reduction and degradation, constitutes a sincere concern for food security, emphasizing the need for alternative solutions. Simultaneously, the mining industry accumulates substantial amounts of waste mineral materials, which may have potential value in agriculture and Technosol development as they often contain valuable plant macro- and micronutrients.

This study evaluates the potential use of waste rocks (shale, gabbro, greywacke) and mine tailings (iron ore tailings, carbonatite-derived tailings) as sources of plant nutrients, through mineralogical and chemical characterization. Additionally, it investigates the effects of a constructed growth medium, composed of soil mixed with mineral by-products on soil chemical properties and plant growth. The primary objectives are to assess how the addition of waste mineral materials to the soil affects crop yield, soil pH, nutrient mobility and bioavailability, soil carbon stability, and the potential accumulation of undesirable trace elements.

The chemical and mineralogical composition of the mineral materials was analyzed using polarized light microscopy, X-Ray Fluorescence (XRF), X-Ray Diffraction (XRD) and Scanning Electron Microscopy Based Automated Mineralogy (SEM-AM). To determine the effect of the artificial soil on plant growth and soil chemical properties, a pot experiment was established. *Lolium perenne* (perennial ryegrass) and *Avena sativa* (oat) were cultivated in the growth medium composed of clay soil mixed with various waste mineral materials. Preliminary results showed that the addition of mineral materials increased the concentration of available K^+, Ca^{2+}, and Mg^{2+} in pore water, positively affected *Avena sativais* yield, and had a liming effect.

The study evaluates the constructed soil-based growth media with added mineral by-products, examining their chemical interactions and impacts on the soil-water-plant system, soil fertility, and crop production. The findings contribute to understanding the feasibility of mining by-products for soil fertility improvement and offer insights into Technosol construction as a potential strategy for increasing waste recycling and sustainable agricultural practices.