The economic potential of Namibian feldspar

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INTRODUCTION

Industrial minerals are often called development minerals as they are frequently mined, processed and used in domestic industries such as construction and manufacturing, thus playing a vital role in building and strengthening local value chains. Feldspar is one example of the industrial mineral group, finding application in the production of ceramics, glass, pottery and paint, among others[1]. Namibia's mining sector largely focuses on the extraction of uranium, base metals as well as gold, while non-metallic commodities are targeted to a lesser extent. Therefore, this study investigates the occurrence and geochemical composition of Namibian feldspar to identify and promote local downstream opportunities.

Economic application of feldspar and industry specifications

Feldspar is one of the most abundant minerals on earth, but each industry has different, and at times stringent, specifications for the feldspar raw material. Most notably the alumina (Al_2O_3), alkali content (K_2O and Na_2O_3) and the content of Fe_2O_3 as well as other colour-inducing elements (Cr, Mn, Co, Cu etc.) all need to be within the accepted range[1,2]. For instance, in the production of glassware and ceramics, the addition of feldspar through its chemical composition significantly reduces energy consumption during processing by lowering the melting temperature. The feldspar component also increases and improves the quality and durability of the final product. For clear container glass as well as float glass potash feldspars are preferred with a composition of > 12 % K_2O, 0.6 - 0.8 % Na_2O_3, < 0.035 % Fe_2O_3 as well as < 0.0005 % Cr_2O_3 and without colour-inducing elements. Feldspars used for coloured container glass are subject to somewhat less stringent parameters (4.0 - 6.0 % K_2O, 5.0 - 7.0 % Na_2O_3 and < 0.3 % Fe_2O_3). For ceramics, feldspars with a composition of 8.0 - 14.0 % K_2O, 3.0 - 10.0 % Na_2O_3 and < 0.2 % Fe_2O_3 are preferred, but without contamination of colour-inducing elements. Most potash feldspars can be used for pottery (10.5 - 12.5 % K_2O, 1.5 - 3.0 % Na_2O_3 and 0.05 – 0.3 % Fe_2O_3). Apart from the geochemical composition, the mesh size of the raw material is also critical during processing. Feldspar feedstock for glass production is much coarser (75 - 600 µm) than feldspar feedstock for the production of ceramics (63 µm)[1]. Finely ground feldspars are increasingly applied as white fillers in the production of varnish, paint, plastering and plastics etc., for dilution purposes or due to the excellent weatherability of feldspar minerals. When applied as a filler, the degree of whiteness is the most important parameter, in addition to the grain size and other physical properties.

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SAMPLING AND ANALYSIS

Feldspar occurrences in Namibia are largely associated with pegmatite deposits[3], which are situated in north-central Namibia as well as close to the South African border[4]. Various pegmatites (abandoned and active mine-sites as well as surface outcrops) in both areas were assessed in various field campaigns between 2016 and 2019 and 51 typical feldspar samples collected for geochemical analysis at BGR laboratories. Major and trace elements were analysed by X-Ray Fluorescence (XRF) using fused and pressed pellets respectively.

RESULTS AND INTERPRETATION

The majority (33) of samples represent potash feldspars (> 10 % K_2O), while eight samples are graphic feldspars (intergrowth of quartz and feldspar). Six show the composition of sodium feldspar (> 7 % Na_2O_3) and four feldspar samples include considerable impurities of other minerals. The geochemical composition of the feldspars was subsequently benchmarked with typical geochemical specifications of the respective industries[5] described in Section 2. Generally, one third of the tested feldspar samples cannot be used for any economic application. This is mainly because of too low (K_2O) or too high (Na_2O_3, Fe_2O_3, MgO) amounts of relevant major elements or due to the presence of unfavourable traces (e.g. Cu, Mn). Two thirds of analysed feldspars were suitable for selected applications[6]. While none of the sampled feldspars were suitable for the production of clear glass (pure potash feldspar without contaminants required), 34 feldspar samples could be suitable for the production of coloured container glass (brown or green). Twenty-six feldspar samples met the required specifications for the manufacturing of pottery and seven feldspar samples showed favourable compositions for the application in the ceramics industry. More mineralogical tests are needed to evaluate the suitability as filler.

CONCLUSION

The above results show that pegmatites in Namibia have more to offer than is apparent at first sight. Several feldspars sampled from various pegmatites in the country show promising results for the application in different industries, highlighting its economic potential. Currently, Namibia does not have any downstream industry that would require feldspar raw material in substantial amounts. On the other hand, Namibia annually imports glass and ceramic products worth several million US dollars[7], indicating an indirect demand for feldspar raw materials. To diversify Namibia's manufacturing industry and realise the national 'Growth at Home Strategy' it would be worthwhile to consider the establishment of, for example, a glass bottle factory to make use of Namibia's mineral endowment. As feldspar is a low-value mineral commodity (high grade feldspar selling between 20 to 200 USD per ton[8]), which is commonly mined and transported in bulk, economic considerations also play a vital role, apart from chemical and mineralogical aspects. Currently, only large pegmatite bodies are more likely to be considered for feldspar extraction in Namibia. Some of those large-scale pegmatites are presently being mined or explored for high-value minerals like tin, tantalum or lithium-bearing minerals. High quality feldspar could potentially be extracted as a by-product of these active pegmatite mines and exported to regional and international markets until a local industry develops. This would not only maximise revenue but also create jobs for the local community. Nonetheless, detailed feasibility studies are needed to further assess the deposits, taking resource economics and transportation costs into account as well as identify possible downstream industries and markets.

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Current research interests: industrial minerals, value chain potential, local value addition, critical raw materials.

Recent publication: Militzer, A. (2020): Feldspar Potential in Namibia – Evaluation of Economic Suitability; Hannover (BGR).