

**Petrography, Geochemistry, and Industrial Uses of Nepheline
Syenite from Koga, Buner, North Pakistan**

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Nepheline syenite is a feldspathic rock extensively used in the manufacturing of glass, ceramics, paints, cement, aluminum, potassium, and sodium carbonate. The present study aimed to investigate Nepheline Syenite of the Ambela igneous complex in terms of its petrography, geochemistry, and industrial uses. Based on the petrographic study, the nepheline syenites consist of three-grain sizes: coarse, medium, and fine-grained. The coarse and medium-grained varieties are the most common and exhibit the hypidiomorphic porphyritic texture. The fine-grained varieties range from saccharoidal to hypidiomorphic. The rock consists of three important minerals: Microcline (20.00% to 69.46%), Albite (2.00% to 41.78%), and Nepheline (5.00% to 39.67%). The accessory minerals are sodalite, cancrinite, aegirine, arfvedsonite, biotite, muscovite, calcite, apatite, zircon, sphene, ilmenite, garnet, hematite, magnetite, pyrite, and epidote. Microcline shows a significant negative correlation with albite, aegirine, and calcite, while ilmenite shows a positive correlation with calcite. Nepheline shows a positive correlation with apatite, while albite shows a negative correlation with ilmenite and a positive correlation with hematite. Similarly, sodalite shows a positive correlation with ilmenite. Aegirine shows a positive correlation with calcite, while sphene shows a positive correlation with pyrite. Magnetite and pyrite show positive correlations with epidote. The average geochemical concentration of major oxides is $\text{SiO}_2 = 58.23\%$, $\text{Al}_2\text{O}_3 = 20.35\%$, $\text{Na} = 7.79\%$, $\text{K}_2\text{O} = 0.06\%$, $\text{Fe}_2\text{O}_3 = 2.97\%$, $\text{Na}_2\text{O} + \text{K}_2\text{O} = 13.85\%$, $\text{Na}_2\text{O} : \text{K}_2\text{O} = 1.29$. The SiO_2 concentration shows a significant negative correlation with MgO , Ca , and LK/I , while the concentration of Na_2O shows a significant negative correlation with Al_2O_3 . Experiments on glassmaking with nepheline syenite demonstrated that contaminants, notably iron, had a major influence on the colour of the glass produced. Magnetic separation was used to reduce iron concentration, which revealed that the sample with the most iron removed produced colorless glass. Ceramics studies show that nepheline syenite can be used from 25% to 40% in the ceramic body, thereby replacing feldspars. Due to its compact nature and attractive look, it can be used in the construction of buildings and for decorative and ornamental purposes. Nepheline syenite can also be used to manufacture alumina and alkalis.

Keywords: Nepheline Syenite; Industrial Uses; Koga; Buner; North Pakistan.