



Does Glaucosite be an Emerging and Potential Source of Potash Fertilizer?



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Abstract

The demand for food crops with increasing population is increasing day by days. Among the important macronutrient (N, P & K) of the plant, Potassium is one of them. Most of the potassium minerals in rocks are present in insoluble forms such as feldspar and mica, thus not radially available for the plant. Important world's high-grade ore bodies of potash resource in soluble forms are found in bedded salt deposits. Sylvinit (a mixture of KCl and NaCl), Langbeinit (potassium sulfate), carnallite and Kainite (potassium chloride and magnesium sulfate) are the ideal salt deposit for use of fertilizer. However, the limited occurrences salt deposits and increasing demand for potash supply, Glaucosites rich rock can be considered a potash source in future. Glaucositic sandstone and shale are known from various geological horizons from Precambrian to recent from the different part of the world. Plant intake potash in only soluble forms iconic forms. Glaucosites are complex Iron-potassium silicate and an end member of mica family. Glaucosites have a high cation-exchange capacity, which improves soil nutritional quality. Sand and sediment rich in glaucosite could be directly used as fertilizer or it can be used like as high potash grade after beneficiation process. It may act as natural fertilizer resources it can be considered as a sustainable source of soil-soluble potassium for a long time and reduces the demand for costly K fertilizers.

Keyword: Potash; Soil fertility; Potassium; Natural fertilizer; Glaucosite

Introduction

Potassium is the seventh most abundant element in Earth crust and the sixth most abundant elements in seawater. Potassium is important macronutrient of Plants. The term "potash" use for ores mined or chemically manufactured salts containing the element potassium (K) in water-soluble form. About 90 percent of potash consumption is for application in making fertilizers, used mainly by farmers as an input for crops and pasture [1].

There is no substitute for naturally occurring potash fertilizers. Potash is found in Glaucosites. Glaucosite is a hydrous silicate of iron and potassium with variable quantities of aluminium and magnesium. It contains 2 to 8% K₂O. Murate (KCl), is general term used for Potash fertilizer. However, potassium sulfate (K₂SO₄) is also used as fertilizer under special soil conditions for certain types of plants. Most of the potash is obtained by underground mining of bedded deposits of potassium chloride and sulfate associated with thick halite (NaCl) bearing evaporite beds. Important world's high-grade ore bodies of potash resource insoluble forms are

found in bedded salt deposits. Sylvinit (the mixture of KCl and NaCl), Langbeinit (potassium sulfate), carnallite and Kainite (potassium chloride and magnesium sulfate) are the ideal salt deposit for use of fertilizer. The highly concentrated brines of some of the saline lakes are among other sources. Some igneous and sedimentary rocks have the higher concentration of potash in silicate form such as feldspar and mica which are insoluble forms and, therefore, cannot be used up by the plants. Potash is found in Glaucosites. Glaucosite is a hydrous silicate of iron and potassium with variable quantities of aluminum and magnesium. It contains 2 to 8% K₂O.

Parent material and climatic conditions are the two major factors pedogenesis which also control the potassium dynamics and these parameters to determine the physical and chemical functions of soil. The most important component of this dynamics is soil mineralogy, including primary and secondary minerals. The soil mineralogy depends on parent material and the extent of the pedogenesis. While the degree of pedogenesis operating in an area is entirely a function of climate. The

status of different forms of potassium in the soil, their release and fixation characteristics etc. are the other important component of K-dynamics which in turn are regulated by the soil mineralogical makeup. The mineral sources of K in soils are the dioctahedral micas: muscovite, glauconite and hydrous mica or illite; the trioctahedral mica, namely biotite and phlogopite; and the feldspars, namely sanidine, orthoclase and microcline.

Plants take up K⁺ from soil in only soluble and exchangeable forms and thus, it only contributes to readily available K. However, remaining non exchangeable K (NEK) serves as a reserve source of soil K. Only 1-2% of total soil K is generally present as readily available forms in soil. The equilibrium between different forms of soil K is generally present as readily available forms in soil. The equilibrium between different forms of soil K is disturbed by the removal of K from soil solution by plant and/or through leaching, and also by K addition through fertilizers, crop residues and also possibly through irrigation. The equilibrium between soluble K and exchangeable K is fast but that between the exchangeable K and NEK is much slower. Overall, Potassium status and distribution in soils is almost entirely governed by soil mineralogy [2].

Geological Setup and Origin

Modern glauconite forms in the depth range of 50 to 300m deep on the sea floor [3]. Geological studies suggest a similar environmental setup for ancient glauconites. However, authigenic glauconite is known to form in a shallow marine environments condition in redox condition such as wave-agitated estuaries and coastlines. The modern occurrence of glauconites is a long deep shelf and slope regions. Geologically ancient glauconites are too having the similar condition. Glauconites mineral genesis also called glaucoma is generally formed by marine authigenesis, associated with transgressive deposits and condensed sections [3]. Maturity and evolution of glaucony depend on the K₂O/Fe₂O₃ relationship. On basis of K₂O content glaucony are distinguished into nascent (2-4% K₂O), slightly evolved (4- 6% K₂O), evolved (6-8% K₂O) and highly evolved (>8% K₂O) [4]. Glaucony occurs typically in forms of 60mm to 1000mm green clay aggregates in sedimentary rocks ranging in age from the Late Paleoproterozoic to the Holocene. Glaucony forms in a wide variety of substrates including fecal pellets, bioclasts, feldspar, mica and quartz. Glaucony are fairly well understood because of its common association in sedimentary sequences representing simple sedimentation breaks into mega-condensed sections [4].

The Conventional use of Glauconite as Fertilizer and its Geological Occurrence

The geological occurrence of Glauconitic sandstone and shale is reported from many countries including Russia, Belgium, the UK, North America, Australia and India [5-9]. Glauconitic sandstone is used as the raw material of fertilizer in Russian country Levchenko et al. [10]. In the Democratic Republic of

the Congo, Glauconitic use directly as a fertilizer to increase the productivity of farms [11]. Greensand rich in glauconite contents had been used as slow acting potash fertilizer in England, France, Belgium, USA and Western Australia during pre-world War-II times (Bateman, 1962).

Recently, minerals prospect work has been done in the various country to use glauconite with the good amount of K₂O to use them as potash alternative (Table 1). In India, glauconite is associated with sand/sandstones, shale and marl of Semeri Group of Vindhyan of Proterozoic representing oldest glauconite deposits well developed in Son Valley region covering parts of Madhya Pradesh and Uttar Pradesh. In Rajasthan, glauconitic sandstones/shales occur in Chittorgarh, Kota, Karauli, Jaisalmer, and Barmer districts.

Table 1: Occurrence of Potash in different country.

So No	Glauconites occurrence/ deposit	K ₂ O %	Resource (MT)	Reference
1	El-Gedida glauconite deposits	6.75% - 7.30%	-	Galal El-Habaak, 2016
2	Patagonia, Argentina	4.05%	-	Franzosi et al. (2014)
3	Karinskoe deposits, Russia	5-9.5%	-	Levchenko et al. [9]
4	New Jersey, Delaware, and Maryland Districts (USA)	-	-	Heckman and Tedrow, 2004
5	Bakchar deposit in Western Siberia	2.2- 4	797.8	Rudmin et al. (2017)
6	Sonbhadra, India		1.33	

Role of Glauconitic in Soil Fertility

Glauconitic rocks have the potential to release potassium as K⁺ by weathering and leaching during pedogenesis. It plays a sustainable role in maintaining fertility of soil apart from potash salt which has a certain ill effect like the increase in chloride in soils. It does not contain any heavy toxic element above the limits. It plays a sustainable role in maintaining the fertility of soil apart from potash salt which has a certain ill effect like the increase in chloride salinity in soils. It does not contain any heavy toxic element above the limits. The glauconite fertilizer also adds phosphorous and another micronutrient such as and micro-nutrients (Mn, Cu, Co and Ni etc.) up to certain extent.

Current Status and Research on Glauconitic for Fertilizer

Glauconitic sandstone is among the rocks that may have the potential to release potassium as K^+ by weathering and leaching during paedogenesis. Thus, increasing interest and demand for slow-releasing K fertilizers over recent decades has prompted studies on the K-releasing capacity of a range of different crushed rocks and minerals [11-13].

Glauconite has a high positive effect on crops mineral nutrition (especially on N, P, K), and increase crops yield percentage and it also stimulates plant adaptation capability, especially drought resistance. Thus, Glauconites can be a base of sustainable agriculture because they are not only an alternative to mineral fertilizers but they also can increase soil fertility and lower its contamination. Another important factor is their low cost and accessibility.

Research work in Russia during 1998-2006, on Glauconite which is used as potash fertilizers. Glauconite was applied as fertilizers at a dose of 1-100 000kg per ha of potato plantations on leached loamy chernozem. It has been found that glauconites improve soil structure absorbing radio nuclides and heavy metals, promote water moisture keeping and stimulate plant growth and development due to these factors. Glauconite has a high positive effect on potato mineral nutrition (especially on N, P, K), increase potato yield on 25-30% and stimulate plant adaptation capability, especially drought resistance. It increases soil fertility and lowers its contamination. Glauconite is a micaceous mineral containing K, Fe, and Mg, as well as Al and Si. It can be considered as a potassium fertilizer. Recently experiment on *Olea europaea* culturing evaluated the potential of glauconitic sandstone as a fertilizer for supplying potassium to plants. The use of glauconitic sandstone powder has shown better and healthy plant growth compare to other hydroponic culture media in a greenhouse under three potassium treatments. This has shown that glauconitic has the ability to release potassium and can be utilized in combination with other potassium fertilizers [14]. Glauconite rich rocks can be used as a potassium fertilizer without causing Fe or Al toxicity at the pH range used in our experiment. In Egypt, glauconite deposits have been reported from El-Gedida iron mine, El-Bahariya Oasis, in the Western Desert. These deposits belong to the Bartonian age. Studies of Glauconite deposits of El-Bahariya Oasis by Galal El-Habaak et al. have found suitability of El-Gedida glauconite deposits to be exploited as alternative potassium fertilizers with potassium contents ranging from 6.75 wt% to 7.30 wt% K_2O . Further, the heavy metal content of these glauconites is found below the permissible limit. Also, they claimed that pH range and salinity of El-Gedida glauconite deposits if used as fertilizer will protect the cultivated soils from acidification and salinization that affect the availability of nutrients required for plant growth [15-17]. Glauconitic rock (K_2O -2.5 to 4.1 wt.%) of Bakchar

deposit, Upper Cretaceous in Western Siberia indicate its good potential as K-fertilizer for agronomic uses. An untreated glauconitolite mix with soil sample used for germination oat seed germination shown good results for uses it as an alternative of potash fertilizer [7].

Concluding Remark

The demand for food grain is increasing with the increasing population. Glauconites are useful in increasing soil fertility. Glauconites contain K_2O 2-8%. With due to limited resources of potash salt and geologically, wide occurrence of glauconites. With the advancement beneficiation and treatment process or potash recovery from glauconites rocks. It will be the alternative option or potash resources. Thus all these Glauconitic rocks will be one of the alternative sources for fulfilling Potash in agronomy. The analysis of glauconitic rock and research on its agrochemical properties showed the high value of this substance as fertilizers. Fractionation of phosphorus and potassium and other micronutrients by various chemical treatment and beneficiation process showed their different availability for the plants, which will help to consider glauconitic rocks as a fertilizer of prolonged action. Glauconite has a high positive effect on crops mineral nutrition (especially on N, P, K), and increase crops yield percentage and it also stimulates plant adaptation capability, especially drought resistance. Thus, Glauconites can be a base of sustainable agriculture because they are not only an alternative to mineral fertilizers but they also can increase soil fertility and lower its contamination. Another important factor is their low cost and accessibility.

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