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FLACOURTIA INDICA- AN ACCUMULATOR PLANT OF BARIUM- A CASE STUDY FROM VEMULA BARITES DEPOSIT CUDDAPAH DISTRICT, ANDHRA PRADESH, INDIA

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Abstract

Plant species growing on barite mining area and their substrate samples were collected in Vemula of Kadapa district, Andhra Pradesh. Trace element analysis of these samples was carried out for K, Mg, Fe, Na, Sr, PB< Zn, Cu, Co, Nl, Al, Mn, Ti, Mo,B, Be, and Cd including barium ; and the biological absorption co-efficient (BAC) was calculated for each element for the seven plant species viz Calotropis gigantean, Cassia ariculata, Flacourtia indica, Gardenia latifolica, and Gymnosparia falconeria, , Cassia siamea ,and Lantana Camara var aculeate. BAC is used to characterize the intensity of absorption of chemical elements from their substrate. It is the ratio of the concentration of an element in plant ash to that of its substrate. The results reveal that in the study area certain elements are present in plants and the same elements are not detected in their soil. In contrast to this some elements are not detected in plants and the same elements are present in their soil. Based on BAC the behavior of plants under study was revealed that Ba shows strong absorption in stem and leaves of Flacourtia indica. This plant species may be considered as accumulator plant. These plant species may also be useful in reclamation and revegetaion of adversely affected mining environments. K, Mg, Fe, Na, Sr, PB< Zn, Cu, Co, Nl, Al, Mn, Ti, Mo,B, Be, and Cd including barium

Keywords: Biogeochemistry, Trace elements, BAC, Accumulator Plants, Barite mining, Vemula.

Introduction:

Plants are greatly influenced by the presence of excess or deficiency of mineral nutrients, and they may also be subject to toxic effects due to heavy metals. However certain plants have the unusual adaptability to withstand heavy metal toxicity, and such plants are referred to as indicator plants. Generally such indicator plants are accumulator plants which have unusual affinities for relatively rare elements, most of them heavy metals, which may or may not be essential to them. Thus, plants are able to accumulate most chemical elements and many species are sensitive indicators of the chemical environment in which they grow, and also the element content at different of the same plants may be widely divergent (Kovaleveskii, 1987; Erdman, 1990; Brooks et al 1995).Trace elements play an important role in biological activities and therefore, deficiency or excess in human beings can lead a number of disorders (Underwood, 1971). In recent years the role of trace elements studies in environmental geochemistry is giving attention. Biogeochemical exploration involving soil-plant relationship and consists of chemical analysis of plants

to get tangible proof of mineralization in the substrate. Biogeochemical province (Vinogradov, 1964) is influenced by local enrichment of metals due to the existence of ore bodies and their associated dispersion halos. The aim of the present study is to characterize some of the plant species that naturally colonized in and around barites mine and to determine the metal accumulation pattern in the sampled plant species for the Ba element. The objective is to asses these plants for their ability to uptake and accumulates the Ba in different organs of the plants.

Study Area:

Barite is a naturally occurring barium sulphate mineral. A significant portion of the total known reserves in the world is found in Andhra Pradesh. The barite deposit of Vemula region (Lat. 14o 19' 00" - 14o 21' 00" N: Long 78o 22' 30" E) of Cuddapah District, Andhra Pradesh is included in the Survey of India toposheet No 57 J/7. Vemula barite deposit associated with basic intrusives occurs within the Vempalli stage of the Lower Cuddapah in the Southern part of the Cuddapah basin (Prasad and Prasannan,1976).The Vempalli formation is intruded, along the bedding planes, by sills of doleritic and basaltic composition marking an important period of igneous activity in Peninsular India (Gangadhar, et al 1983). This area primarily consists of conglomerates, shales, basalts, dolomites and dolomitic limestones.

Sampling and Analytical Methods:

After a preliminary geobotanical survey of the area five plant species viz., *Calotropis gigantean, Cassia ariculata, Flacourtia indica, Gardenia latifolica, and Gymnosparia falconeria, Cassia siamea, and Lantana Camara var aculeata* were selected for biogeochemical investigations. Systematic sampling of plants and soils was carried out. Composite samples of leaves and stem of these plant species along with their substrate were collected. Six to eight spot samples of surface soils were collected surrounding the plants and combined to form a composite sample. Care was taken to collect mature and healthy plant organs. All the plant samples were washed thoroughly with distilled water. Moisture from these samples was eliminated by keeping them at 110^{o} C in a hot air oven for eight hours. Further these samples were ignited and ashed at 450^{o} C in a muffle furnace. The plants ashes have been digested in 2M HCl. Samples of soils were oven dried at 110^{o} C in a hot air oven for eight hours. These soils were disintegrated in a porcelain mortar and were sieved to pass through 2 mm sieve mesh. From these samples organic matter was expelled by placing them in a muffle furnace at 450^{o} C for eight hours and digested in aquaregia (Brooks, 1983). The plant and soil samples were analyzed for various chemical elements viz., K, Mg, Fe, Na, Sr, Pb, Zn, Cu, Co, Ni, Al, Mn, Ti, Mo, B, Be, and Cd including barium by AAS (Brooks et al 1995), and the values of the elemental data are given in Table 1. This paper deals only with the barium biogeochemistry.

Table 1. Barium elemental concentration (ppm) in plants and soils of the study area Vemula

S.No	Plant species name	Element	Soil	Soil Leaf (L)	L- BAC	Stem (S)	S-BAC
1	Gardenia latifolica	Ba	590	ND	0	ND	0
2	Flacourtia indica	Ba	600	6096	10.16	7650	12.75
3	Calotropis gigantean	Ba	915	815	0.89	348	0.38
4	Cassia Ariculata	Ba	945	123	0.13	-	-
5	Gymnosparia falconeria	Ba	945	ND	0	-	-
6	Cassia siamea	Ba	870	ND	0	-	-
7	Lantana Camara var aculeata	Ba	87	ND	0	-	-
ND = Not detected; BAC= Biological Absorption Co-efficient							

Results and Discussions:

From the analytical data (Table 1) it may be seen that generally certain elements are present in plants and the same elements are not detected in their soil. In contrast to this some elements are not detected in plants and the same elements are present in their soil. This may be attributed due to biogeochemical cycling of elements in the soil profile.

Trace elemental concentration in plants and soils:

Based on the observations among the selected vegetation/plant species (both leaves and stem) except *Flacourtia indica* , locally called pulleruka and having an importance in ayurvedic medicine ,the other plant species show lower concentrations of barium range of ND (Not Detected) to 815 ppm though their substrate contains appreciable amount of barium (590-945 ppm). Conspicuously *Flacourtia indica* exhibits abnormal accumulation of barium with a concentration of 6096 ppm in leaves and 7650 ppm in stem while its substrate contains 600 ppm of barium. From this it is concluded that *Flacourtia indica* has been identified as an accumulator plant of barium.

Biological Absorption Co-efficient (BAC):

Biological Absorption Coefficient (Kovaleveskii, 1969) is used to characterize the intensity of absorption of chemical elements from their substrate. BAC values were calculated for barium element for the seven plant species (Table 1). Based on BAC the behavior of plants under study was revealed as Ba shows strong absorption in stem and leaves of *Flacourtia indica*. In the study area it was observed that the BAC values of the both stem (12.75) and leaf (10.16) of *Flacourtia indica* for Ba is found to be significantly high, whereas the BAC of this element ranges from 0 to 0.89 in the remaining plant species. Therefore *Flacourtia indica* may be considered as accumulator plant for barium. The Ba concentration in the

Flacourtia indica species is generally higher than the other plant species growing on the study area of barite mining.

Dunn and Hoffman (1986) noticed that in certain plans like birch, jack-pine, black spruce, Labrador tea, alder and willow in Saskatchewan are capable of absorbing large amounts of Ba (12000 ppm) (Wallace, and Romney, 1971). This study has given greater scope on the plant-soil relationship in the mining/mineralized areas. From this study it is concluded that *Flacourtia* indica has been identified as an accumulator plant of barium. Hence it can be used as in reclamation and revegetation of the adversely affected areas. Further it needs detailed biogeochemical investigations to establish these plant species are as an indicator for exploration of barium deposit.

Conclusions:

In the study area, the results revealed that certain elements are present in plants and the same elements are not detected in their soil. While some elements are not detected plants and the same elements are present in their soil. Due to biogeochemical cycling of elements, a wide variety of elemental responses in plant-soil relation are exhibited. Based on the observations among the selected the seven plant species except *Flacourtia indica* the other plants show lower concentrations of barium though their substrate contains appreciable amount of barium. Conspicuously *Flacourtia indica* exhibits unusual accumulation of barium with a concentration of 6096 ppm in leaves and 7650 ppm in stem, while its substrate contains only 600 ppm of barium. Hence *Flacourtia indica* may be considered as accumulator plant for Ba. Based on BAC the behavior of plants under study was revealed that Ba shows strong absorption in stem and leaves of *Flacourtia indica* whereas the BAC of this element ranges from 0 to 0.89 in the remaining plant species. However, detailed biogeochemical investigation is required further to get clear picture of accumulator plants. Hence it can be used as in reclamation and revegetation of the adversely affected areas. Further it needs detailed biogeochemical investigations to establish these plant species are as an indicator for exploration of barium deposit.

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