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Distribution of Trace Elements in Coconut Water and Mine Water from Barite Nineralized Zone, Cuddapah District, Andhra Pradesh, India

Reddy L. Chandra Sekhar[1], Reddy K.V. Ramana[2] and Humane Sumedh K.[3]
[1]Department of Geology, Loyola Degree College, Pulivendla, Kadapa District, AP, INDIA
[2]Department of Chemistry, Loyola Degree College, Pulivendla, Kadapa District, AP, INDIA
[3]P.G. Department of Geology, R.T.M. Nagpur University, Law College Square, Nagpur, Maharastra, INDIA

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Abstract

In Barite mining area of Vemula, coconuts were collected from the coconut trees and from these coconuts coconut water was collected. Water samples from barite mine pits was also collected for the purpose of comparison. In order to study the trace elements behaviour in coconut water and mine water, trace element analysis for six elements such as Ba, Sr, Cr, Mn, Co and Ni was carried out by atomic absorption spectrophotometry. In mine water, the elemental concentrations of Ba ,Sr, Cr, Mn, Co and Ni are higher on dry weight basis than that of ash weight basis. Whereas in coconut water, the concentrations of all elements are higher on ash weight basis than on dry weight basis. The variations in the concentration of trace elements on the ash weight basis and dry weight basis are attributed to the influence of organic matter in dry samples and the degree of volatilization of different element while ashing. The concentration of trace elements is strikingly different in the coconut water compared to mine water. The trace element composition of coconut water is distinctly different from that of mine water. Further this study reveals that, coconut trees can ideally be useful to determine the biogeochemical reconnaissance surveys, and nutritional status of an area.

Keywords: Trace elements, coconut water, Barite mine water, organic matter.

Introduction

Trace elements occur naturally in rocks, soils and waters in both harmless and harmful forms in concentrations. Natural concentrations can be extraordinarily high and cause serious health problems. They are important in environmental health because they perform several vital functions, which are absolutely essential for the very existence of the organism. These include the calcification of bones, blood coagulation, neuromuscular irritability, acid-base-equilibrium, fluid balance and osmotic regulations etc[1].

Trace elements play an important role in biological activities and therefore, their deficiency or excess in human beings can lead to a number of disorders. Many workers[2,3,4] have studied the excess or deficiency of trace elements in soils, waters, plants and animals, and have linked these imbalances with human health. These elements should be used as dietary supplements, since excessive amount can have injurious effects. Air, water and soil are playing vital role for life on this planet. Many of the naturally occurring chemical elements found on earth, are useful to plant, animal and human health in small doses at ppm/ppb level and these elements enter into the human body via water and food in the diet and in the air we breathe. This shows direct links between geochemistry and health[6].

Significance of coconut tree in biogeochemical exploration has studied by Prasad and Niranjan Prasad. Biogeochemistry has gained prominence as its scope in recent years has been extended to health implication of the geochemical environment. Earlier biogeochemical studies on coconut trees were carried out from nutrition[8], pollution[9], exploration and human health[10] points of view. In the present work, an attempt has been made to study the distribution of trace elements in two natural waters, i.e., mine water and coconut water, at the Vemula barite mining area.

Area of the Study: Vemula barite area (Lat, 14° 19' 00''-14° 21' 00'' N; Long. 78° 22' 30'' E) is located in Cuddapah District, Andhra Pradesh (Fig.1). This area is included in the Survey of India toposheet No. 57 J/7, forms part of the Lower Cuddapah supergroup comprising Papaghni and Chitravati Groups[11] and primarily consists of conglomerates, shales, basalts, dolomites and dolomitic limestones. The basaltic hills generally flat-topped and are bald at some places. Barite occurs as veins, stringers and fissure fillings along the planes of fracture, fault planes and joints mainly in the traps. The barite occurrences in the traps are most productive and the thickness of the veins from a few centimeters to as much as 6m. Earlier workers have carried out mineralogical[12], petrogenetical[13,14] and geochemical[15] aspects. The region falls under semi-arid or even arid belt with associated high temperatures and hence is classified as drought prone area. The average annual rainfall is

560- 600 mm. The area also experiences the effect of S-W and N-E monsoons.

Material and Methods

Several coconut trees (*Cocus nucifera*) individually or assemblages are distributed in the barite mining area of Vemula and of their adjoining agricultural lands occupying an area of 1-2 acres. About 20 trees occurring in different parts of the mining area were selected. All these trees are healthy and are of the same age and species. From these trees, matured coconuts are collected. The fibrous part of each coconut was removed and the coconut water was collected in a plastic container. A composite sample of water of about 20 coconuts was obtained. Water in the barite mine pits is used for irrigation of the coconut plantation as well as other agricultural purposes. For the purpose of comparison, water from the barite mine pits was collected in plastic bottles. Samples of water from seven spots of the mine pits were collected and combined to represent a composite sample of mine water. In order to study the trace elements behaviour in coconut water and mine water this study has been undertaken in barite mineralization of vemula area.

Table-1
Concentration trace elements (ppm) in coconut waters and mine waters from Vemula barite mining area

S .No.	Element	Mine water		Coconut water	
		Ash weight	Dry weight	Ash weight	Dry weight
1	Sr	1685	2270	38	22
2	Ba	246	325	30	24
3	Cr	36	47	59	50
4	Mn	33	45	25	14
5	Co	29	38	13	6
6	Ni	19	32	11	8

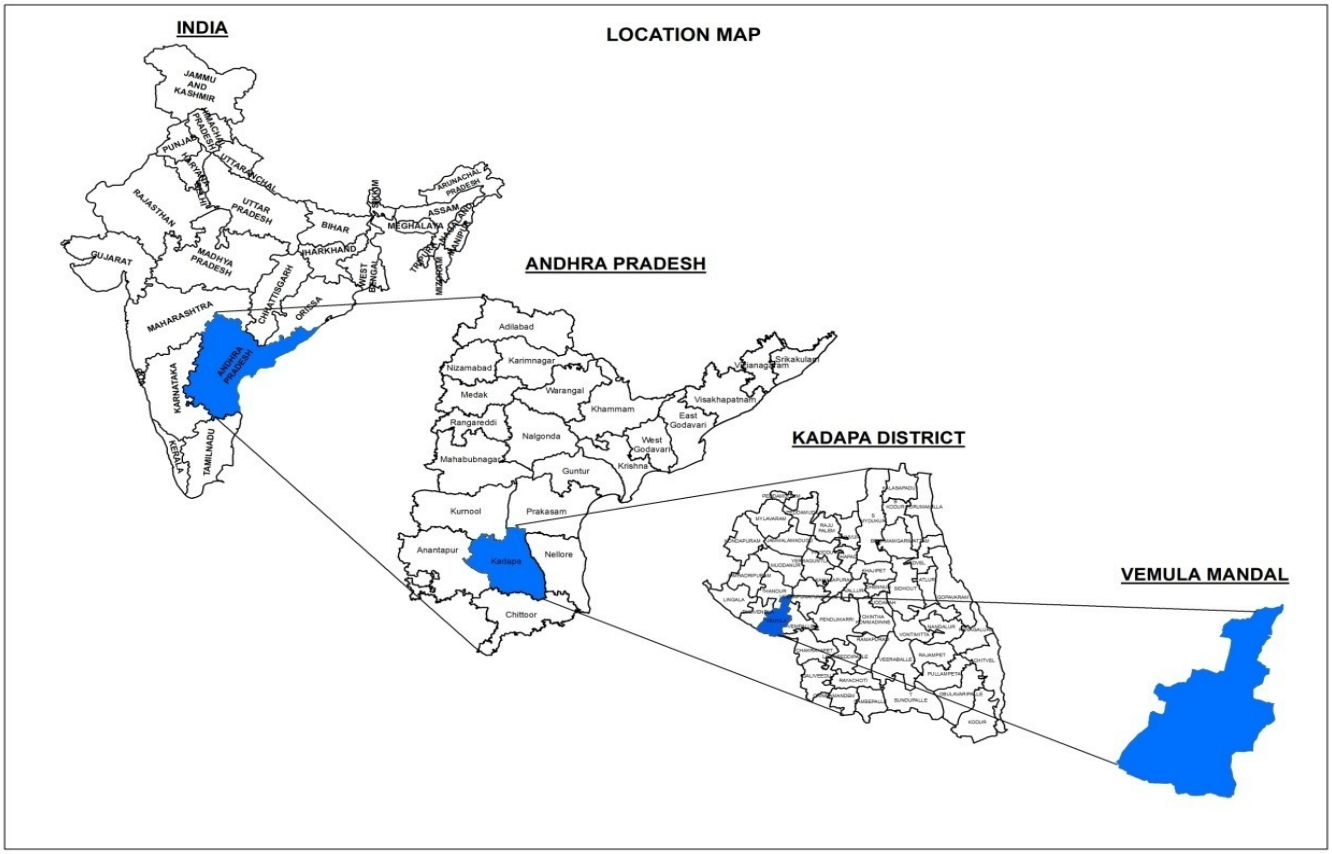

Figure-1
Location map of study area

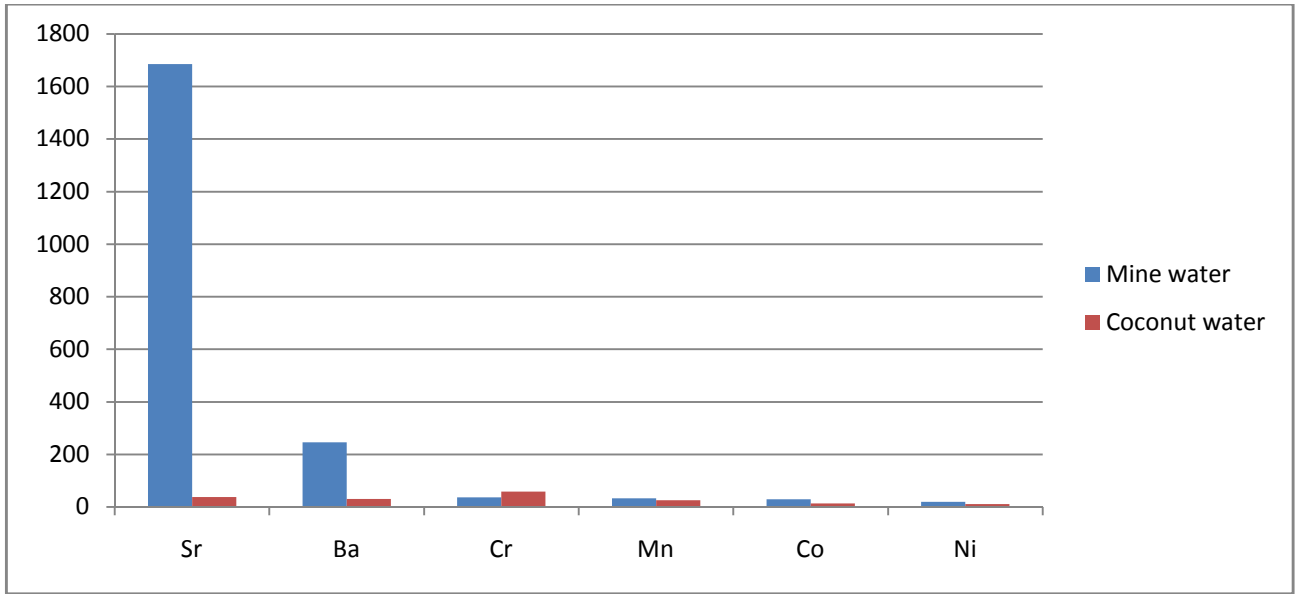

Figure-2
Concentration of trace elements (in ppm) on ash weight basis

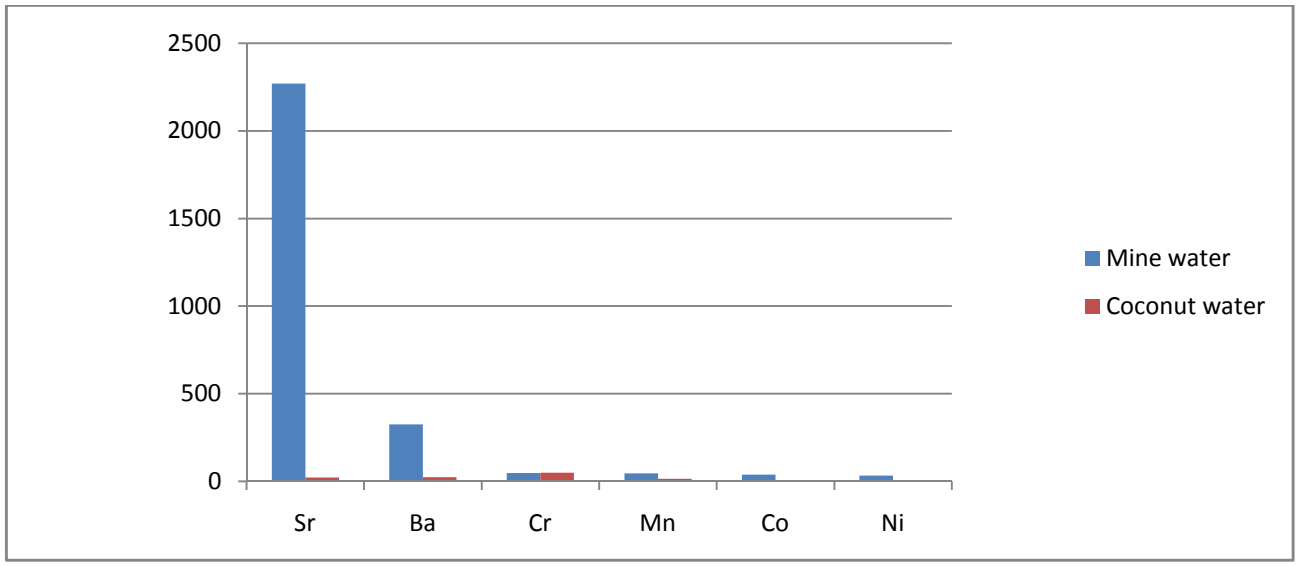

Figure-3
Concentration of trace elements (in ppm) on dry weight basis

The water content was eliminated by heating samples at 110°c in a hot air oven for eight hours and the residue was analyzed for trace elements and the results were reported on dry weight basis. Further, organic matter was removed from the moisture-free samples by placing them at 500°c in a muffle furnace for four hours and the residue, devoid of organic matter was analyzed and the results were reported on ash weight basis. The samples were digested in 2M HCl and analyzed for six trace elements Ba, Sr, Cr, Mn, Co and Ni by atomic absorption spectrophotometry (table.1).The concentration of trace elements in coconut water and mine water both on ash weight basis and dry weight basis are diagrammicately shown (Figure.2 and 3)

Results and Discussion

From the table 1 the following observations were made.

In mine water, the elemental concentrations of Ba, Sr, Cr, Mn, Co and Ni are higher on dry weight basis than that of ash weight basis. Whereas in coconut water, the concentrations of all elements are higher on ash weight basis than on dry weight basis.

On both ash weight basis and dry weight basis, the concentration of Cr is higher in coconut water, whilst that of the ore element

Ba, together with Sr, Mn, Co and Ni is remarkably lower when compared with mine water.

Among the trace elements, the concentration of Sr is consistently high in mine water on both ash weight and dry weight basis, where as Cr is found to be higher in coconut water on both ash weight and dry weight basis.

From the table 1, the sequence of concentration of elements in coconut water and in mine water on both ash weight and dry weight basis is as follows:

Coconut water:
Ash weight: Cr>Sr>Ba>Mn>Co>Ni
Dry weight: Cr> Ba >Sr>Mn> >Ni>Co

Mine Water:
Ash weight: Sr>Ba>Cr>Mn>Co>Ni
Dry weight: Sr>Ba>Cr>Mn>Co>Ni

From the sequences of the concentration of elements, it is clear that the mine water shows a strikingly similar trend on both ash and dry weight basis, where as there is no significant trend in the case of coconut water has been found. The variations in the concentration of trace elements on the ash weight basis and dry weight basis are attributed to the influence of organic matter in dry samples and the degree of volatilization of different element while ashing. Because of the unusual properties of organic matter, it has extremely important effects on the chemistry of the trace elements, The effects include complexing of the trace ions by dissolved organic matter, resulting in increased mobility of the elements; adsorption or formation of organic compounds resulting in immobilization, and reduction to lower valance states, with resulting changes in chemical properties.

Different workers have suggested different "orders" or sequences of the elements under different physico-chemical or biological conditions. Irving and Williams[16,17] and Basolo and Pearson[18] proposed an order of stability of metal complexes with organic matter for divalent cations such as: Pd>Hg>Be>Cu>Ni>Co>Pb>Zn>Cd>Fe>Mn>Ca>Sr>Ba; for monovalent cations, the sequence is Ag>Ti>Li>Na>K>Pb>Cs. The corresponding values for trivalent cations are: Fe>Ga>Al>Sc>In>Y>Ce >La. In clay mineralogy, Plant and Raiswell[19] observed a sequence as an increasing case of replacement as Ba>Sr>Ca>Mg for alkaline earth elements; and Cs>Rb>K>Na>Li for alkali elements.

Generally, elemental concentration is higher on ash weight basis than dry weight basis. But in some cases, samples analyzed on dry weight basis showed high elemental concentration due to the influence of organic matter. Ashing of biological materials result in partial loss of certain elements and complete loss of volatile elements[20]. Low recovery of an element after ashing result from loses due to volatilization of certain forms of elements[21] and insoluble constituents of the ash[22]. Holfman and Fletcher[23] observed greater concentration of trace elements in the presence of organic matter.

Shacklettee *et al*.[24], are of the opinion that the available amounts of elements, rather than total amounts determine the uptake of an element by a plant from the soil and that available amount changes with the change in chemistry of environment. Thampan[8] stated that major Portion of nutrient elements drawn by the coconut plants from the soil was utilized for the production of nuts. The concentration, rate of release and the amount of elements absorbed by plants are dictated by the level of soil organic matter[25].

Conclusion

The present investigation shows that the variations in the concentration of trace elements on the ash weight basis and dry weight basis are attributed to the influence of organic matter in dry samples and the degree of volatilization of different element while ashing. Because of the unusual properties of organic matter, it has extremely important effects on the chemistry of the trace elements, The moment of inorganic constituents into the coconut water is selectively controlled in such a way that some elements are freely admitted while others are impeded to a greater or smaller degree by the coconut plants. Hence it may be revealed that the trace element composition of coconut water is distinctly different from that of mine water. Further this study reveals that coconut trees can ideally be useful to determine the biogeochemical reconnaissance surveys and nutritional status of an area.

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