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Spatial Variation and Source of Nitrate in Groundwater of Coastal Kendrapara Aquifer System, Odisha, India

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Abstract: The coastal aquifer system of Kendrapara district, Odisha belong to the vast Quaternary alluvium deposits of northern Mahanadi Delta which displays a unique disposition of saline and fresh groundwater horizons in contrast to other deltaic deposits of the country such as the Ganges Delta, the Brahmaputra Delta etc. Hydrogeochemical analysis of 248 representative groundwater samples collected across one monsoonal season indicates a chaotic distribution of nitrate which at places exceeds the allowable limit of 45 mg/L as suggested by the Bureau of Indian Standards. Geospatial analysis of this nitrate occurrence points to a significant concentration along the southern and south eastern part of the study region. Geostatistical analysis of this concentration for pre and post monsoonal periods indicates an anthropogenic source of origin due to the agricultural and fishing activity across this region.

Keywords: Aquifer, Nitrate, GIS, Mahanadi Delta, Interpolation

INTRODUCTION

Nitrate in natural groundwater comefrom a variety of sources including atmosphere, legumes, plant debrisand animal excreta naturally. However, from an anthropogenic point of view animal wastes, chemical fertilizers and other manmade pollution are the chief contributors of NO_3^-in groundwater. Being the end product of aerobic decomposition of organic nitrogen, it generally is the most common form of nitrogen inwater (Brill,1977; Olsen, 1977 and Heaton et al., 1983). Nitrate is completely mobile and is very much influenced by infiltrating waters to leach into the subsurface water from the soil zone (Bouwer, 1978 and Robertson, 1979). Atmospheric contribution toNO_3^-in groundwater is insignificant and is less than 0.20 mg/L in rain water (Handa, 1969). Decomposing organic matterwithin the soil zone contributes less than 0.10 mg/Lto groundwater (George and Hastings, 1951)

The present research looks into the incidence of nitrate (NO_3^-) in groundwater along the eastern coast of Odisha including the Rajnagar and Mahakalapara blocks of Kendrapara district. The study takes into account the calculated nitrate from 248 representative groundwater samples for understanding the spatial variation and source of nitrate in the aforementioned two blocks of the state.

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Trizygia: Indian Sphenophyll

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Abstract: Land plants belonging to order Sphenophyllales got extinct during Late Triassic. *Trizygia*, the most predominant Indian sphenophyll is recorded in the Lower Gondwana basins of India. Different aspects of *Trizygia*, one of the imperative genera of the Indian Gondwana flora, have been discussed in this article. The speciation and morphology of this genus are also described in detail. Its form, habit, diversity, origin, evolution and extinction are also discussed. An attempt has also been made to reconstruct the plant of *Trizygia*.
Keywords: *Trizygia*, Morphology, Foliage, Habit, Speciation, Diversity

INTRODUCTION

Sphenophyllales is an extinct order of land plants and a sister group to the present-day Equisetales (horsetails). They are fossils dating from the Devonian to the Triassic. They were common during Carboniferous and Permian period. Sphenophyllales are small, slender branching plants, usually growing to a height of less than 1 m tall. The stems are jointed and ribbed with weak habits, making it probable that these plants were shrub-like when alive, and formed a portion of the understory in Carboniferous and Permian forests. All sphenophylls are homosporous, with monolete or trilete spores.

The sphenophylls, important constituents of the Northern Hemisphere Upper Carboniferous floras, have distinctive foliage comprising a number of leaves, generally in multiples of 3, arranged in radially symmetrical whorls at each node of an articulate axis. This foliage shoots are referred to the genus *Sphenophyllum* Koenig, 1825. The long stems range from 0.5cm (0.20in) to 1.2cm (0.47in) in diameter. (Figs. 1, 2). The Indian forms were named by Royle (1839) as *Trizygia speciosa* due to the characteristic arrangement of the leaves on whorls.

The Genus *Trizygia* Royle 1839

Division: Sphenophyta / Arthrophyta
Order: Sphenophyllales
Genus: *Trizygia* Royle, 1839
Type species: *Trizygia speciosa* Royle, 1839

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Groundwater Fluoride Contamination in Mahakalapara Block, Odisha, India: A Geospatial Perspective

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Abstract: Coastal aquifers of Mahakalapara block, Kendrapara district portray a general saline contamination of subsurface waters. Present study investigates the fluoride contamination of this aquifer system from hydrogeochemical analysis of 18 collected representative groundwater samples. The findings indicate significant contamination of fluoride along the eastern and western part of the block with more than 38% of samples displaying fluoride values greater than the acceptable limit of 1 mg/L as suggested by the Bureau of Indian Standards, 2012. The findings also signifies a general higher concentration of fluoride across the block with more than 50% of the samples portraying fluoride activity close to the acceptable limit (> 0.8 mg/L).
Key words: Mahakalpara block, fluoride contamination, cationic exchange

INTRODUCTION

Fluorine is the most electronegative of all elements and hence readily forms the fluoride (F^-) ions in solution. Due to its size similarity with hydroxide ions, it forms mineral complexes with a variety of cations and mineral species of low solubility are found to contain fluoride. Geologically it is associated with volcanic activity and fumarolic gases. Natural sources of F^- are the rocks containing F^- bearing minerals such as amphibole, fluorite, apatite, mica etc. F^- is found in all natural waters with a typical average sea water concentration of 1 mg/L and fresh water concentration of 0.5 mg/L. Groundwater concentration of fluoride vary depending on the aquifer lithology. Fluorite dissolution governs the concentration of F^- in groundwater. Hence, higher concentration is commonly associated with calcium poor aquifers. Higher concentration of F^- is also associated with subsurface waters in which cationic exchange of Na^+ takes place for Ca^{2+}.

The present research takes into account the fluoride (F^-) concentration in groundwater of Mahakalapara block along the eastern coast of Odisha. The study takes into account the fluoride content from 18 representative groundwater samples for understanding the spatial variation fluoride in the study area.

STUDY AREA

The Mahakalapara Block and its underlying alluvial aquifer system lies in Kendrapara district along the coastal tracts of Odisha (Survey of India (SOI) Toposheets F45U45 and F45U11). The region encompasses an area of approximately 600 km^2 with a perimeter of about 195 km. The Mahanadi River runs along the southern border of the block before reconciling with the sea at the south-east corner (Fig. 1a). The total area of the region comes within the enormous spread of this river's flood plain. The region is encircled by Kujang block of Jagatsinghpur district in the south and south-east, Marshaghai in west, Patamundai in north-west and