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Textural and Mineralogical Characteristics of Silica Sand Deposits of Alappuzha-Cherthala Belt, Kerala, Southwest India

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Abstract

The coastal lowlands of Kerala in southwest India are endowed with deposits of fluvial and marine and aeolian mineral resources. Kerala's beach placers are a major and strategic mineral source in the area. Apart from beach placers, the coastal area in and around Alappuzha district has vast amounts of silica sand that occur between the Vembanad Lake and the seashore, spanning for about 35 km from Cherthala to Arookutti. Although many studies have been carried out on Kerala's beach placers, studies on silica-sand deposits of Alappuzha-Cherthala belt are very limited. Therefore, the present study addresses the textural and mineralogical characteristics of the Alappuzha-Cherthala belt. Fine sand comprises 11.2% to 57.3% in the surface sediments, while in the subsurface samples fine sand varies from 25.66% to 66.5%. Both the surface and subsurface sands are moderately to well sorted. These sands are in general coarsely skewed and leptokurtic. The mineralogical analysis reveals that opaques, sillimanite, and zircon dominate in the heavy mineral assemblage. The CM pattern revealed that the sands were generally transported by rolling and suspension. High sillimanite concentrations in the samples suggest a sialic metamorphic origin for silica sands. Long beach currents carried sillimanite and quartzose sands from the coastal extents of the Trivandrum Block in the south (south of Achankovil lineament) towards the Alappuzha-Cherthala coast, which is later modified into the silica sand deposits during the aridity event in the beginning of Late Holocene.

Keywords: Silica Sands, Alappuzha-Cherthala belt, Heavy minerals, Granulometric analysis, CM pattern

Introduction

The determination and interpretation of grain size characteristics of sediments and sedimentary deposits play an integral part in the understanding of their depositional mechanisms and environmental discrimination (Friedman and Sanders, 1978). The extent of sediment transport of both the ancient and the present sedimentary deposits can be determined using the analysis of particle size classes. Additionally, there is a significant body of evidence that grain size can vary in relation to channel shape, source materials, weathering and abrasion, and also due to sediment sorting during transport and deposition phases (Folk and Ward, 1957; Bridge, 2009). The image of the grain size spectrum obtained from granulometric analysis, along with the statistical characteristics derived from the size distribution, is commonly employed as primary tool to decode the energy regime that was prevalent during the transportation and deposition of sedimentary deposits (Folk, 1966; Friedman, 1967; Blatt *et al.,* 1972; Sly *et al.*, 1982).

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Furthermore, the textural characteristics together with heavy mineral assemblages of sedimentary deposits can provide better insights into the provenance as well as the extent of weathering at the source area (Padmalal, 1992; Padmalal and Seralathan, 1993; Badarudeen, 1997; Daurabh *et al.,* 1998; Arun *et al.,* 2019; Padmalal *et al.,* 2025). Additionally, it is one of the excellent tools in the paleogeographic reconstruction as well. Several researchers have determined the heavy mineral composition of beach sands from different locations along the Indian coast (Arun *et al.*, 2019; Shalini *et al.,* 2019). Many studies also exist in the Kerala coast as well (Aswathanarayana,1964; Prabhakara Rao,1968; Mallik, 1986; Purandara *et al.,*1987; Unnikrishnan,1987; Sasidharan and Damodaran,1988; Purandara,1990).

The coastal lands of Kerala are gifted with many placer mineral deposits having wide range of applications in the modern world. Black sands (ilmenite-rich heavy mineral placers), white sands (silica-rich sands) and construction grade alluvial sands are the common resources in the coastal lowlands. Among these the white sands or the silica-rich sands are the least studied resources in the coastal area, despite its industrial applications and geoenvironmental potential. The silica sand deposits of Kerala are distributed essentially in three locations: 1) Cherthala-Alappuzha;