ABSTRACT

The coastal zone of the state of Odisha in India is famous all over the world for its heritage sites, like the medieval age temples at Puri and Konark, and the famous Chilka Lake. Geologically, it is a zone of interaction between the delta of the River Mahanadi and the Bay of Bengal. This study investigates the linkage between apparently diverse unrelated phenomena in the Odisha coastal region, such as (1) heavy siltation in the Chilka Lake, (2) drying of river channels in the Mahanadi delta, (3) the collapse of heritage structures and (4) occurrence of saline groundwater above freshwater ('groundwater inversion'), with basement structures and neotectonic activity, using integrated geomorphological, satellite imagery and geophysical studies. Magnetic data, together with 3D inverse modelling of gravity data in the Chilka region reveals the existence of various sets of basement faults. Geomorphic parameters estimated from some river channels in the Mahanadi delta indicate that these faults bound uplifted and subsided blocks around the lake, suggesting their reactivation during neotectonic activity. The extinction of two mythical rivers, *Saradha* and *Chandrabhaga*, related to the heritage sites of Puri and Konark in the Odisha coast have been investigated using various satellite imagery manipulation techniques. These reveal the presence of swamps associated with sinusoidal vegetation trails and V-shaped topographic outlines in the vicinity of both these sites. GPR survey confirms the existence of earlier, filled up paleochannels at these localities, which are interpreted to represent the remnants of extinct river valleys. Based on the reports in ancient temple literature, the paleochannels identified at Puri and Konark may be correlated with the *Saradha* and *Chandrabhaga* rivers, respectively. The studies conducted at Konark and Puri develop a sequential methodology for identifying paleochannels even in urbanized localities. One of the most intriguing problems associated with Konark is the collapse of the main temple structure, which reportedly happened sometime after its construction in the thirteenth century A.D., giving rise to a number of unconfirmed theories. Gravity and magnetic anomalies and 3-D inversion modelling of gravity data around the Sun Temple reveal the presence of an uplifted and depressed zone in the basement bound by two sets of faults trending NW-SE and NE-SW. Satellite imagery reveals truncated older channels and rivers with high sinuosity index to the east of the NW-SE fault in the vicinity of the Sun Temple. It is suggested that reactivation of this fault led to the disruption of the ancient Chandrabhaga river and initiated gradual collapse of the Konark Temple. The northern part of the Mahanadi delta also preserves a peculiar phenomenon known as 'groundwater inversion',

where saline water horizons overlie fresh water. The Bouguer gravity anomaly and magnetic anomaly from this region reveal uplift depression zones. Geomorphic parameters estimated from channels in this region are consistent with reactivation of these faults, which influenced the pattern of sedimentation. Confined freshwater aquifers formed in porous sandy layers that are overlain by impervious clay/ silty layers in the depressed basement zones, above which sandy horizons are contaminated with saline water. Thus, this study demonstrates that all the four diverse phenomena have geological controls that can be related to neotectonic activity in the Odisha coast. This occurs by reactivation of basement lineaments, which are either faults formed during the break-up of India from Antarctica in the Mesozoic, or older terrane boundaries and intra-terrane shear zones. Reactivation of these basement faults may be caused by release of compressional stresses accumulating within the Indian shield on account of the Himalayan Orogeny, which results in the formation of uplifts and depressions in the basement of this region.

Keywords: Chilka Lake; Confined aquifer; Gravity; Ground Penetrating Radar; Konark Sun Temple; Satellite imagery