Mapping a sedimentary sub-basin in the eastern Raniganj Basin, India using geophysical data: A potential site for CO_2 sequestration

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Abstract

The Raniganj Basin, the easternmost coalfield of the Damodar Valley Basin in West Bengal, India, hosts extensive reserves of high-volatile coal deposits within the Raniganj and Barakar formations. This basin is considered a promising site for carbon dioxide (CO_2) sequestration due to the presence of coal-based thermal power plants and ongoing Enhanced Coal Bed Methane (ECBM) recovery projects. In this study, we map a sedimentary sub-basin in the eastern Raniganj Basin using geophysical well logs and gravity data to assess its suitability for CO_2 storage. Geophysical well log datasets from 41 drilled wells, provided by Essar Oil and Gas Exploration and Production Limited, were analyzed to delineate the coal-bearing Raniganj Formation. Resistivity, density, and gamma-ray logs were used to identify coal seams within the drilled wells. By mapping the occurrence of the topmost and bottommost coal seams, we provide preliminary insights into the structure and extent of the Raniganj Formation, revealing the presence of a sedimentary sub-basin in the eastern part of the Raniganj Basin near Durgapur. The findings were further corroborated using Bouguer gravity mapping, which supports the presence of the sub-basin, as shown in Figure 1. The mapped sub-basin, characterized by a significantly thicker sedimentary column in the Raniganj Formation, shows promise as a suitable site for CO_2 sequestration and ECBM recovery. However, further detailed geophysical investigations are required to refine the depth and thickness estimations, ensuring a more comprehensive understanding of the sub-basin storage potential. This study lays the groundwork for future research efforts to advance carbon sequestration initiatives in the region.

Conclusions

The study indicates that the Raniganj Formation occurs at depths ranging from 137 to 1219 m, with thickness varying between 101 and 548 m. A potential depocenter is identified in the central-western region. The formation exhibits a general north-to-south dip, with abrupt depth variations at several locations, suggesting possible subsurface faults. The study indicates that the Raniganj Formation occurs at depths ranging from 137 to 1219 m, with thickness varying between 101 and 548 m. The thick sedimentary column of the Raniganj formation suggests a sub-basin at the western part of the study area. Gravity results suggest a deeper sub-basin with a thick sedimentary succession upto approximate 2 km that may include Raniganj , Barren Measure and Barakar formations. The results further suggest presence of numerous faults along the boundary of the sub basin

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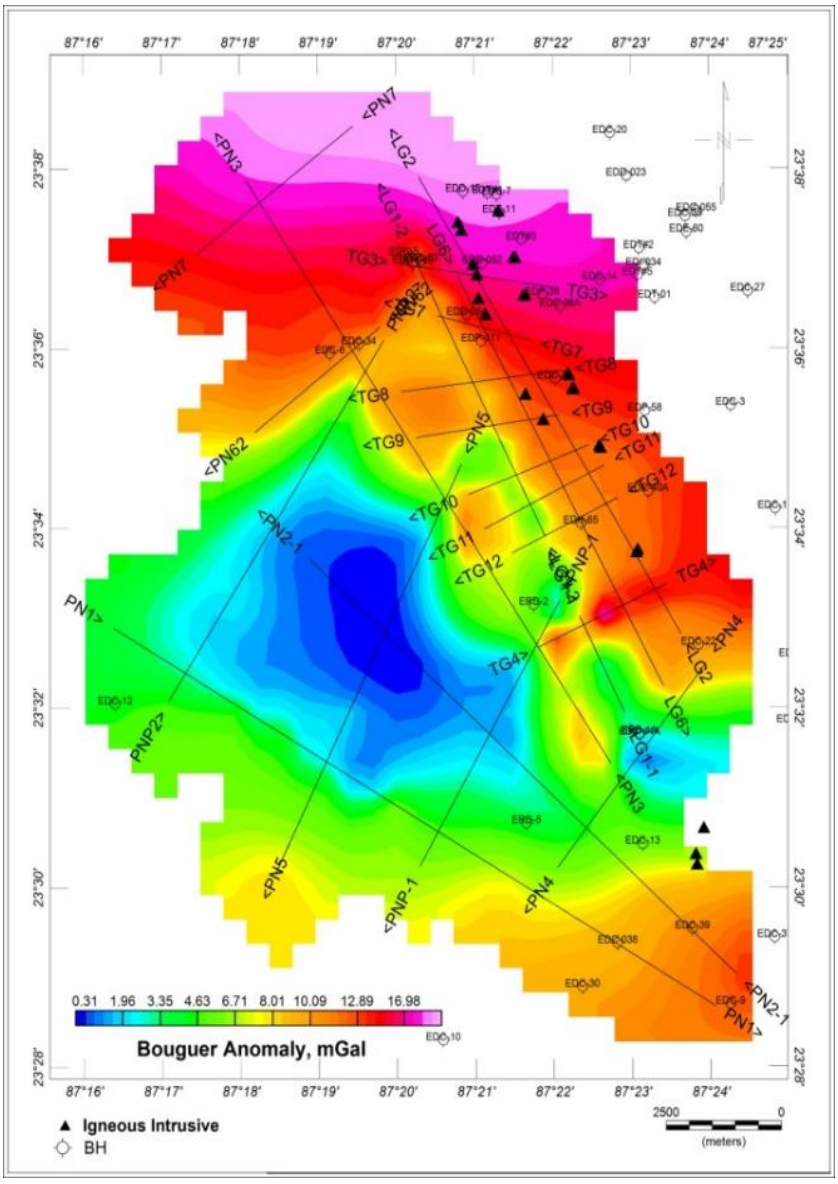

Figure 1. A low gravity anomaly (depicted in blue) identified at the center of the study area likely corresponds to a subsurface basin, marking the possibility of thick sedimentary deposits at the center of the basin.