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Geological sequestration of the CO2 in the potential coal seams from the Raniganj basin

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Introduction

Coalbeds are considered as potential geological formation for storage of carbon dioxide (CO_2) because coal can store a large quantity of CO2 and the cost associated with sequestration can be offset by enhanced Coal Bed Methane (CBM) recovery in many cases. Coal is highly variable in physical (porosity, permeability) and chemical properties (adsorption, diffusion) and CO_2 is stored in the coal mainly by the process of adsorption. This process allows sequestration of large amount of CO_2 at a low pressure and limiting the leakage risk associated with imperfect reservoir seals. Further, the shallow depth of the coal reservoir may facilitate effective sequestration and enhanced recovery at low injection pressure, which may substantially reduce the cost of sequestration operation. Several studies have attempted CO_2 sequestration in the coal seams in China, Germany, Wyoming USA, Alberta Canada and Italy etc.

India is the one of the largest coal producer countries in the world and is the primary source of Energy in India. The main coalfields in India are: Jharia, Raniganj, Karanpura, Singareni, IB valley, Talcher, Neyveli, Singrauli, Nagpur and Chandrapur. Raniganj coalfield is situated in the easternmost part of the Damodar Valley Gondwana coalfield of India. In the Gondwana coalfields of India, Barakar Formation (Early Permian) is the main repository of coal. Raniganj coalfield consists of very thick Raniganj Formation (Late Permian) which is associated with well-developed coal seams. Raniganj and Barakar both the formation are present in the Raniganj basin and the basin is rich in CBM resources as well. Due to availability of several thermal power plants in this area, Raniganj coalfield is being studied for CO_2 sequestration. Although a large amount of shallow subsurface data is available in Raniganj, for any CCS study, a systematic site characterization is required to map the target formations and the entire storage complex to estimate the storage potential and feasibility of such a project, along with, geological risk assessment. We therefore conducted a multicomponent seismic survey experiment to image the coal layers in the Raniganj and Barakar Formations in a CBM block of the Raniganj basin.

Methodology

To initiate a site characterization study, we acquired multicomponent seismic data to utilize the shear waves (S-waves) along with the conventional seismic compressional waves (P-waves) for lithological interpretation and improved reservoir characterization. Due to logistics issues 2D/3C seismic data was acquired along eleven seismic profiles covering a total length of 26 km using a vibroseis source with frequency ranging from 10-200 Hz. Processing the coalfield seismic data is challenging due to various types of noises and challenging terrain, hence the data was processed using specialized/customized workflows to improve the signal-to-noise ratio.

Conclusions

The migrated section reveals three prominent sedimentary layers within a time range of about 480 to 1380 ms interpreted along all the seismic lines. The top or shallow layer is interpreted from 480 to 780 ms whereas the underlying middle layer lying at 780 to 1100 ms. The deepest or third layer is interpreted at time ranging from 1100 to 1380 ms. Correlation of the seismic sections with the existing litholog confirms that the shallow, middle and deepest layers represent the Raniganj, Barren measures and Barakar formation respectively. Further results suggest that the Raniganj and Barren measures layers are almost horizontal whereas Barakar formation does show a dip along the N-S direction. Currently, the results are in the preliminary phase, and further analysis is in process. This study will allow us to characterize the Raniganj coal basin by mapping potential coal seams in this region and associated structural discontinuities to estimate risk factors and further to provide inputs for a pilot CCS project in this basin.

In this paper we will present the importance of Raniganj Basin for CCS study and the preliminary results obtained from the site characterization study carried out in a CBM block.

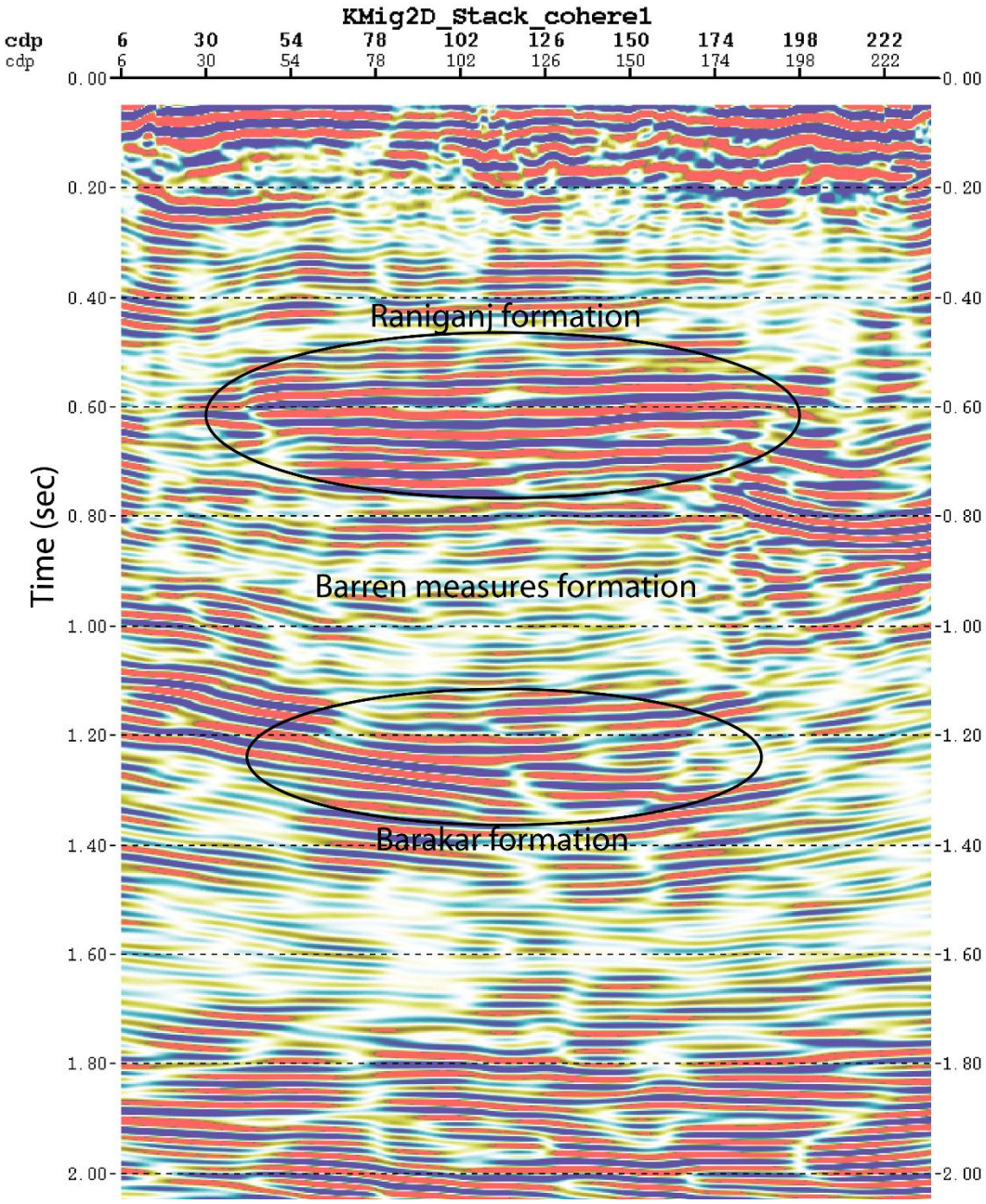

Figure 1: Migrated section of Line 2A