Depositional environment and coal accumulation of the Lower Cretaceous Saihantala Formation in the Baiyinhua Sag of the Erlian Basin

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Abstract. The Erlian Basin is characterized by the Early Cretaceous thick coals and related coalbed methane resources. In this paper, we have analyzed lithofacies, sedimentary facies, sequence stratigraphy, and coal accumulation of the Lower Cretaceous in the Baiyinhua Sag of the Erlian Basin. The coal seams, which were developed from the littoral-shallow lacustrine and braided fluvial delta plain environments, were mainly formed in the late lowstand systems tract and late transgressive systems tract. The thickest coal was distributed in the central zone of the sag, which thinned out towards the northwest and the southeast. The thick coal seams were formed when fault basin was suitable for the large-scale development and preservation of peat in the stage of the basin contraction with uniform subsidence.

1. Introduction
The Erlian Basin, being rich in coal and coalbed methane (CBM) resources, has become one of the key research basins for China's low-rank CBM exploration and development [1-2]. The Baiyinhua Sag, one of important coal-bearing sags, has coal resource about 159 trillion t and CBM resource about 421 trillion m3 [2]. It is located at the southeastern part of the Wunite Depression in the Erlian Basin. Few studies about the depositional environment and coal accumulation have been focused on the Baiyinhua Sag. In this study, based on the analyses of depositional environments, sequence stratigraphic framework and coal accumulation, the distribution and controlling factor of thick coal seams are discussed. These results will provide guidance to coal and CBM exploration and development.

2. Geological setting
The Baiyinhua Sag is a NE trended, dustpan-shaped faulted depression with faulting in the northwestern side and stratal overlapping towards the southeastern side. The Sag is about 60 km long, around 8.5 km wide with an area of about 510 km2. The strata in the study area mainly include Paleozoic, Jurassic and Lower Cretaceous and Cenozoic [3]. The coal-bearing series of Lower Cretaceous include the Aershan Formation, Tengger Formation and Saihantala Formation, which were corresponding to the initial extension stage, the steady subsidence stage and the contraction stage of the basin respectively. The Saihaitala Formation is main coal-bearing strata (Fig. 1) with a total maximum thickness coal seams of 108m.
Fig. 1. Comprehensive column showing sedimentary facies and sequence stratigraphy of the Saihantala Formation in the Baiyihua Sag (Borehole 6-4).

3. Deposition environments and coal accumulation

Five lithological types are identified in the Saihantala Formation, including conglomerates, sandstones, siltstones, mudstones, and coals. According to the analysis of lithology and lithofacies, we can identify braided fluvial, braided fluvial delta and lacustrine sedimentary facies. Braided fluvial is characterized by thick-bedded conglomerates and coarse-grained sandstones with large trough cross-bedding and tabular cross-bedding. Braided fluvial delta is characterized by thick-bedded fine-grained sandstone with tabular cross-bedding and mudstone with horizontal bedding. Lacustrine is characterized by thick-bedded mudstones and siltstones with horizontal bedding and parallel bedding. Coal seams are formed in braided fluvial delta plain and littoral-shallow lake environments (Fig. 1).
The sequence boundaries usually turn into regional unconformity surface or the erosion surface of the incised valley on the edge of lake basin, nevertheless, it usually turns into serial conformity surface on the inside of lake basin. The sequence boundaries in the study area mainly have two kinds: the regional unconformity surface and the erosion surface of the incised valley (Figs. 1, 2). Sequence I could be subdivided into lowstand systems tract (LST), transgressive systems tract (TST) and highstand systems tract (HST) based on the identification of another key bounding surfaces, including initial flooding surface (IFS) and maximum flooding surface (MFS) [4].

From NW-SE cross section (Fig. 2), the lateral depositional environments variation can be identified in the northwestern side and the southeastern and central side of the sag. In the LST, the depositional environments experienced a change from braided fluvial, braided fluvial delta to littoral-shallow environments. In the TST, the depositional environments changed from braided fluvial delta to littoral-shallow environments. In the HST, the depositional environments changed from braided fluvial to braided fluvial delta environments. Thick coal seams were mainly developed at the late LST and late TST. The thickest coal bed was distributed in the central sag where the suitable subsidence created conditions that the increasing rate of accommodation space was well balanced with
the rate of peat accumulation [5].

4. Conclusions
(1) Three sedimentary facies have been identified in the Saihantala Formation, including braided fluvial, braided fluvial delta and lacustrine.
(2) Coal seams were developed from the littoral-shallow lacustrine and braided fluvial delta plain environments.
(3) Thick coal seams were mainly formed in the late lowstand systems tract and late transgressive systems tract.
(4) The thickest coal seam was distributed in the central sag due to suitable subsidence and minimal effect from clastics.

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