Principles for selection of coal bed methane well sites in the Xiashijie coal mine field

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Summary

The Xiashijie coal mine field, located in the city of Tongchuan, Shannxi province of China, is part of the coal fields of the Jurassic period in Shannxi. Coal seam 3 and coal seam 4 are two largely recoverable coal seams. With the exploitation of coal, coal bed methane (CBM), which is also referred to as coal seam gas, is becoming a threat to coal mine safety. Underground ventilation and gas extraction through underground wells have been adopted. But the effects of these practices were not sufficient; in particular, ventilation and gas extraction could not effectively remove coal bed methane in the intact area that will be mined in the future. The threat of CBM to coal mine safety not only increases the expense of ensuring coal mine safety, but also methane emission is a waste of a natural resource and the addition of a greenhouse gas to the atmosphere. Also, coal bed methane is a source of clean energy.

Considering these factors, this paper proposes the use of a new technique to extract coal bed methane by means of wells that are drilled from the ground surface. CBM has never before been extracted in this way in the Xiashijie coal mine field. It is a challenge to extract because there is no previous experience with this process. The technique of extracting gas by means of surface wells includes a series of engineering tasks such as selection of well sites, drilling, completion, hydraulic fracturing, and drainage. The first step of determining well sites is a key element that is related to success in extracting the methane. This paper analyses the factors that influence the exploitation of CBM in the Xiashijie coal mine field. Contrasting and optimizing the design of well sites determined the guidelines for selection of well sites in this area. The well has set a record in gas production from coal of the Jurassic period in China. The practice would provide experience in CBM exploration and development in this area and in areas that are similar in geological conditions.

Introduction

Selecting a good well site is a primary requirement for the successful production of coal bed methane. The factors that influence the selection of coal bed methane wells include geological setting, thickness of coal seams, buried depth of coal seams, gas content, topography, coal mining planning and other

project construction conditions. However, in terms of a specific coal mine, all of these factors could not be regarded as equal when coal bed methane resources are extracted. Some of the factors should be ignored.

The purpose of this work was to study the principles for selection of CBM well sites in the Xiashijie coal mine field by studying these factors one by one. Then, by contrasting and optimizing the design of well sites, we determined guidelines for the selection of coal bed methane well sites in this area.

Method

Coal bed methane has never before been extracted from ground surface in the Xiashijie coal mine field. There is a lack of necessary data to assess the CBM resource in this area (e.g. permeability of coal seams and reservoir pressures), and therefore it is difficult to design wells for producing coal bed methane. In order to assess the gas resource, a pilot well was designed to examine the potential for gas production. It was planned that the well site would expose the target coal seams and meet requirements for the follow-up work. Hence, the principles for selection of coal bed methane well sites were determined. The following factors were considered: (1) the distribution of coal seams, especially the identification of sites where the thickness of coal seams is relatively large, (2) tectonics in the area, to locate sites where tectonic conditions are simple, (3) the distribution of coal bed methane (4) plans for future coal mining (4) the topography where the well is located, (5) the distance to pre-existing exploration wellbores to guide the half-length design of hydraulic fractures, and (6) convenience of the site for drilling a well and constructing support facilities.

Examples

According to the principles above, combined with field study, three possible well sites were chosen, as shown in Figure 1 and labeled Well 1, Well 2 and Well 3. All three well sites are located in the axial part of a syncline with simple tectonic conditions where there is no big fault. The direction of the syncline axis is NE36. The angles of two sides of the syncline are gentle. Coal seams 3 and 4 are thick in the axial part of the syncline. Coal seam 3 at these three well sites is about 4.5 meters thick as shown in Figure 1, and Coal seam 4 is about 12 meters thick at all three well sites as shown in Figure 2. CBM content is about 3 m^3/t. These well sites are much better than other possible sites in the factors previously described. The differences of thickness of coal seam 3 between these three sites is not large this is also the case in coal seam 4, so the factor of thickness could be ignored. Similarly, the factor of the CBM content also could be ignored. Coal seam 4 has a roof and floor of siltstone, which is better for hydraulic fracturing than the materials in the roofs and floors of the other two wells. Also, the topography in the Xiashijie coal mine area is mountainous which increases the difficulties for well site layout. In contrast with the other two possibilities, Well 3 site has construction conditions that are better.

For these reasons, Well 3 was the final choice for a pilot well. At this time a series of tasks have been completed at Well 3, including well construction, well completion, hydraulic fracturing; drainage work is proceeding. So far, Well 3 has set a record in gas production from coal of the Jurassic period in China. The experience with this pilot well provides guidance in coal bed methane exploration and development in this area and in areas that are similar in geological conditions.
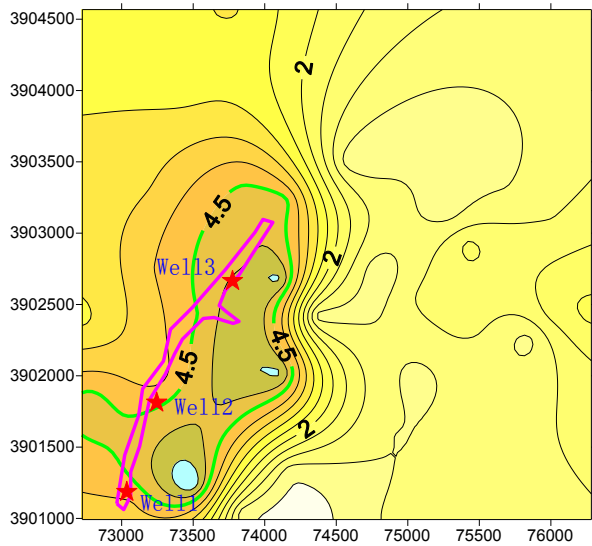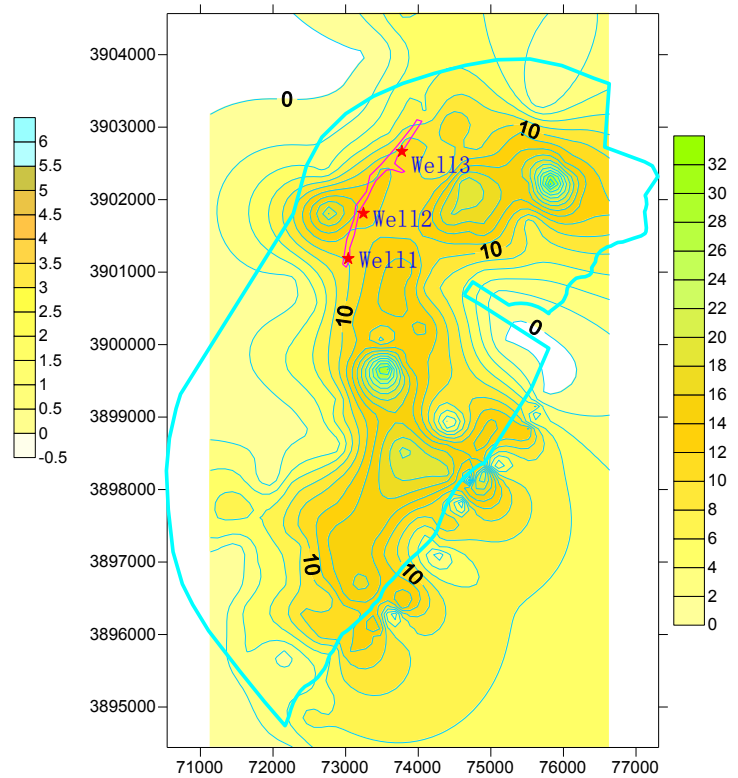

Figure 1: Coal seam 3 thickness

Figure 2: Coal seam 4 thickness

Conclusions

Determination of well sites is an important element in developing coal bed methane in the Xiashijie coal mining area. This paper analyses the factors that influence development of coal bed methane in this area. These factors include geological setting, thickness of coal seams, buried depth of coal seams, gas content, topography, future coal mining plans, and other project construction conditions. Contrasting and optimizing the design of well sites determined the guidelines for selection of coal bed methane well sites in this area. The well has set a record in gas production from coal of the Jurassic period in China. The methods used in this project provide experience in coal bed methane exploration and development in this area and in areas that are similar in geological conditions.

Acknowledgements

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