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Predicting Dewatering in Structurally Challenging Coalbed Methane Reservoirs

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Summary

Commercial production of coalbed methane (CBM) in under-saturated reservoirs requires removal of large volumes of water for extended periods of time. This water is also known as ineffective water which production becomes even more challenging under infinitive acting aquifer (IAA) type-of-flow, a condition of sustainable groundwater yield with no imminent flow barriers and structural control in complex reservoirs such as synclines. This work predicted series of dewatering scenarios to assess the implications of IAA and the role of the structural style to produce methane at the CBM reservoir in the Syncline of Umbita Colombia. The results confirmed IAA regime with high sustainable groundwater yield that is supported by recharge, cross-formational flow and preferential flow, served by a U-Tube-like hydraulic setting from the synclinal structure. Predicted dewatering suggests that removal of large volumes of water over a 50 years period would be required before commercial production of methane is achieved.

Theory and Methods

Unlike oil and gas, methane gas in coal is trapped trough adsorption to the surface of the coal and hold in place by pore pressure from the associated water. Thus, producing the methane gas from coal beds requires desorption by lowering pore pressure in the reservoir via dewatering. Although dewatering is straight forward, commercial production of CBM in under-saturated reservoirs requires the removal of large volumes of water for extended periods of time. This water is also known as ineffective water which production becomes even more challenging under infinitive acting aquifer (IAA) type-of-flow, a condition of sustainable groundwater yield with no imminent flow barriers. The more sustainable the water yield, lower desorption potential since it inhibits dewatering of the coal seam and thereby limit the coal methane recovery (Onsager & Cox, 2000). Conditions of IAA are reinforced by the hydrodynamics of the structural style of the reservoir which syncline resembles to a “U-tube-like” hydraulic setting with converging linear flow towards the hinge region while underlining sustainable water yield conditions.

This work predicted series of dewatering scenarios to assess the implications of IAA and the role of the structural style in the production of methane from coal seams in the Syncline of Umbita Colombia. Several dewatering scenarios were proposed to simulated a 50-year CBM production scheme and the feasibility of achieving commercial production.

Results and Conclusions

The results indicated that IAA conditions prevail at the Syncline the Umbita reinforced by recharge, cross-formational flow and bidirectional linear flow from the syncline-U-tube like hydraulic settings. Predicted reservoir depressurization suggest that high dewatering rates, e.g.

500 m^3/day, would be needed to induce a reservoir pressure decline of, or close to 1 MPa, the approximate threshold to achieve gas desorption (Figure 1). Predicted dewatering also suggests that removal of large volumes of water will likely occur over a 50 years period before commercial production of methane is achieved.

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References

Rivera, L.2019. Infinite acting aquifer (IAA) – Implications for coalbed methane production at the Syncline of Umbita, Colombia, International Journal of Coal Geology, Volume 209, Pages 54-71, ISSN 0166-5162, doi.org/10.1016/j.coal.2019.03.018.

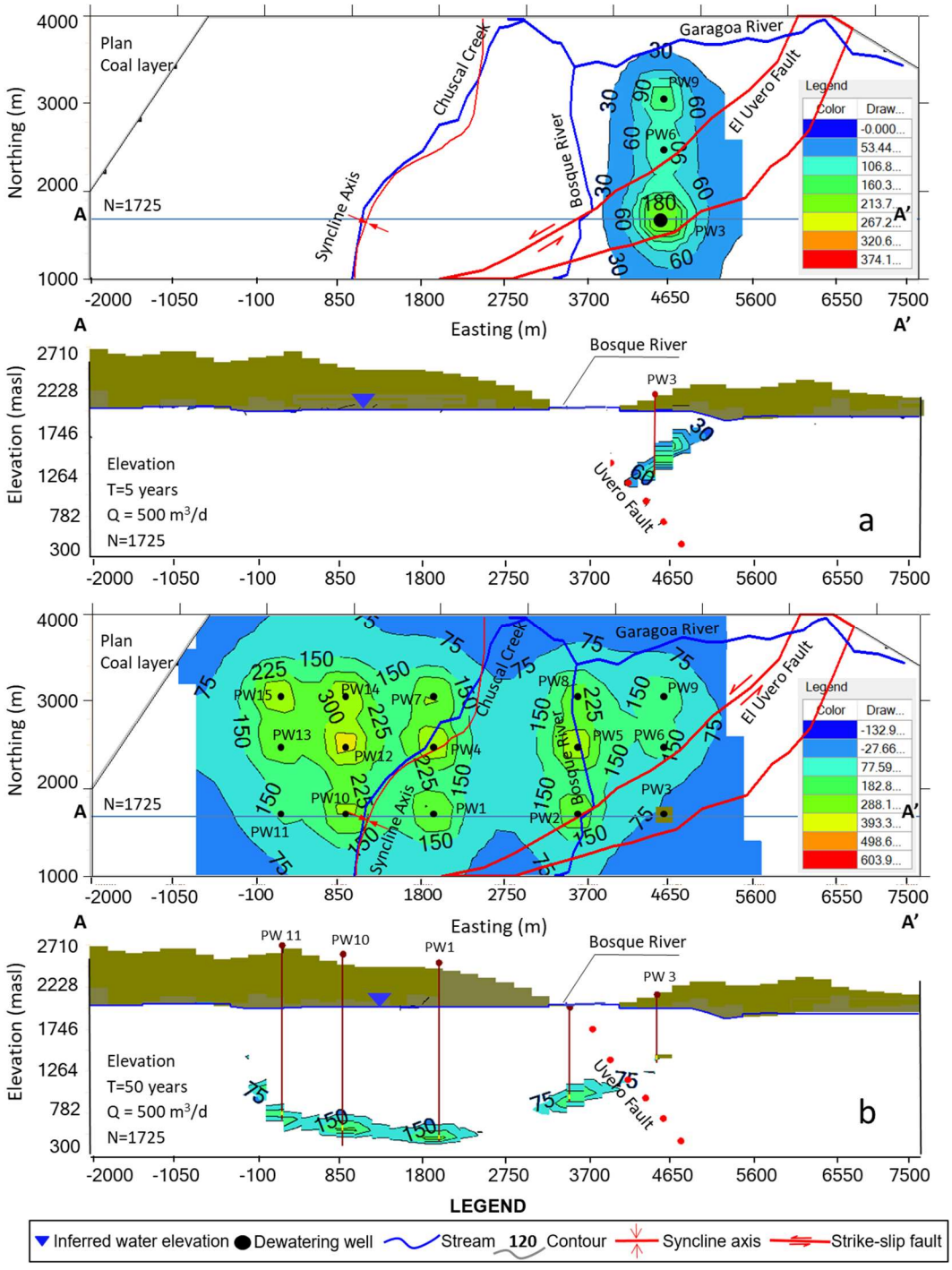

Figure 1 Depressurization footprint from dewatering at rate of 500 m3/d. a) 5 years, b) 50 years. *Copy Right: Elsevier (2020),* with permission.