

## The nature of Saskatchewan's Cambrian-Ordovician Deadwood Formation helium reservoirs and their relationship to mineralogy and porosity

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### Summary

Saskatchewan's current helium production originates from two Paleozoic stratigraphic intervals in the province's southwest corner, from the clastic Cambro-Lower Ordovician Deadwood and the carbonate Upper Devonian Souris River formations.

Helium and its associated gases are produced from a spectrum of reservoir rocks, similar to those found in conventional hydrocarbon pools to the tighter reservoirs more common to unconventional resources. Pore structures play a crucial role in determining the capacity and flow characteristics of gas reservoirs, but in helium reservoirs, the boundary between seal and reservoir is not well-defined. Mudrocks, primarily consisting of clay, quartz, and carbonate with their intricate nanoporosity geometries and variable compositions, are considered the primary seal in some of the reservoirs in the Deadwood Formation. Porosity of these mudrocks is influenced by factors such as compaction, the relative abundance of minerals and organic content, and diagenesis. The three main types of mudrock matrix pores – interparticle, intraparticle, and organic matter pores - generally range from a few micrometers to sub-nanometers, and the type, size, and arrangement of these pores impact the trap and reservoir sealing potential for helium. Seals with larger volumes of interconnected nanoporosity facilitate the migration and associated net loss of relatively miniscule helium atoms. The composition of associated clays also influences gas volumes, as clays have varying surface areas where gases can adsorb. Helium and its typical companion nitrogen are inert so the composition of clay is unlikely to impact the concentration of these gases on their own; however, non-inert carrier/associated gases may be affected. Efforts to gain a better understanding of nanoporosity and diagenetic processes affecting the helium reservoirs in southwestern Saskatchewan are ongoing.