Spelunking in the Duperow: An Example of Upper Devonian Paleocaves from the Saskatchewan Potash Belt

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Abstract

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Potash mine operators are not only concerned about the thickness, grade, and mineralogy of sylvinite at the mining level, but are also very interested in the nature of the overlying "beam" of rocks that overlie the mine's extraction area. This is because the overlying beam will subside into the previously mined portions of the mine as the mine rooms close, and it is critical for mining engineers to be able to model how this subsidence will occur. If the Paleozoic portion of the beam is composed of relatively impermeable and nonporous carbonate rocks, then any fractures related to the subsidence will pose no hazard to ongoing mining operations; however, if the beam contains significant reservoir zones, then there is a danger that fractures may connect such overlying reservoirs with the underlying mine and thus pose a flooding risk.

Generally, while the rocks of the overlying Dawson Bay may have locally developed reservoir zones, the Souris River and Duperow are of very poor reservoir quality, and therefore pose little threat to mining, except in cases where collapse structures formed from the natural dissolution and removal of the Prairie Evaporite occurred. In such circumstances, mining into such structures is extremely hazardous from the viewpoint of flooding. Modern seismic techniques allow a mine operator to avoid such structures, thus eliminating the risk of losing the mine due to collapse-related flooding.

The threat assessment model became much more complicated as a result of studies undertaken by the authors in 2001 and 2002. Detailed mapping of sequence stratigraphic intervals suggested a previously unrecognized form of reservoir development within the Duperow and possibly the Souris River Formations. Examination of logs and cores of pilot shaft holes revealed the presence of collapsed paleocaves within the Lodgepole, Birdbear, and Duperow Formations. The threat posed by these phenomena to operating potash mines is that the permeability resulting from fracturing and dissolution may allow extensive vertical fluid flow from overlying aquifers down into the mining level. Collapsed paleocave systems may also change the rock material properties and thus change the manner in which the overlying beam subsides into mined-out areas. Such unpredictable subsidence may pose a threat to mine stability.

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The cores to be presented are taken from the PCS Bredenbury 8-34-22-33 W1M pilot shaft hole and show the sedimentological and structural features that may be attributed to collapsed subsurface caverns that may have formed by the process of subaerial exposure, water infiltration, matrix dissolution, and subsequent collapse after burial.