CONSTRUCTION OF A PROVINCIAL SCALE 3D GEOLOGICAL MODEL OF THE WESTERN CANADIAN SEDIMENTARY BASIN IN SASKATCHEWAN, CANADA

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3D geological models are becoming an important asset for geological surveys for addressing societal challenges of sustainability and climate change. Solutions to these challenges, including initiatives such as searching for critical minerals, subsurface storage, and geothermal potential all benefit from the characterizations of subsurface geometry that 3D geological models provide. In collaboration with the Saskatchewan Geological Survey, the Geological Survey of Canada engaged in the construction of a provincial scale 3D geological model of the Western Canadian Sedimentary Basin (WCSB) in Saskatchewan with the intent to model the entire basin in the future. The basin hosts many resources such as critical minerals (e.g. lithium, helium, potash) and is targeted for deep CO_2 storage, groundwater, and geothermal applications. The model can serve as a knowledge layer for these applications as well as for 3D mineral prospectivity mapping. The dataset for the 3D WCSB geological model in Saskatchewan consists of approximately 142, 900 formation top and unconformities markers interpreted from about 11, 900 oil and gas wells. The dataset sampled 49 units from the Phanerozoic sedimentary basin, 7 major regional unconformities and the undivided Precambrian basement.

The 3D geological model was constructed in Gocad/SKUA geomodelling platform using a hybrid implicit-explicit approach. The model was constrained using the stratigraphic markers along with available geological knowledge including the bedrock geology map and previously interpreted subsurface areal extents of the units. Challenges related to modelling using vast amounts of data and strategies for tackling provincial scale modelling efforts are presented. The constructed model can provide valuable information for applications previously mentioned including formation thickness and depth, relations with adjacent formations or unconformities. In addition, the model can be used for model validation for ongoing development of other geological modelling methods. Finally, collaboration with the provincial survey was critical in constructing stratigraphically coherent and geologically validated model and important for future work in modelling the entire basin across four other provinces and territories.