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Regional Subsurface Mapping of the Northwest Northwest Territories

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Summary

Time depth maps, extending across the northwestern Northwest Territories, have been completed for eight seismic reflection horizons. After conversion to depth they will be released as shapefiles so as to be viewable at a range of scales and suitable for inclusion with other GIS datasets. The chosen surfaces were those that could be confidently mapped by reflection seismic and would best document the area's geological development from the earliest Cambrian to middle Cretaceous. A need to update the current set of publicly available surface maps is revealed by comparing subsurface and surface features.

Introduction

Publicly available reflection seismic data and exploration drilling has made it possible to draw a set of time-structure maps (depth conversion will follow) representing the subsurface below the plains and eastern mountain ranges of northwestern Northwest Territories. The maps extend north from 63^0 N latitude to the Arctic Coast, exclusive of the Mackenzie Delta, cover some 200,000 km^2, and document half a billion years of geological history.

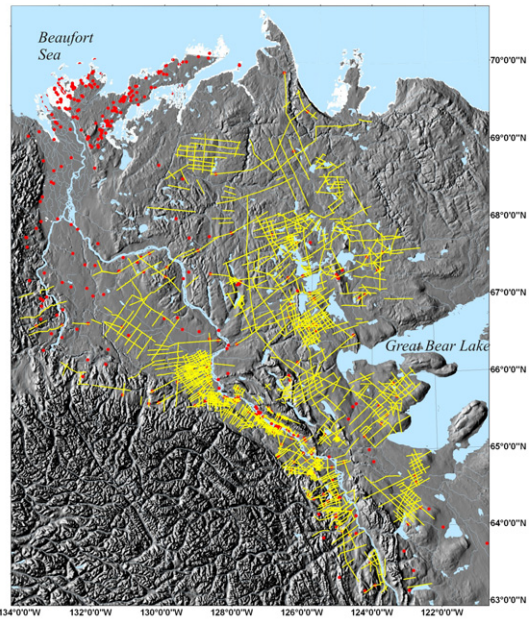

Figure 1: Wells (red) and seismic tracklines (yellow)

Method

Virtually all publicly available lines, originally available as paper sections, were converted to SEGY format either through scanning or reprocessing and loaded into an interpretation workstation. There they were adjusted to a project datum of 1000' (305m) asl, tied to well control, and interpreted. The dataset (Figure 1) provides wide regional coverage but, because lines were shot over a period of almost 50 years, its data quality is variable, as are shot intervals, processing routines, and line density. Consequently, the control and reliability of each map varies with location. Despite

these challenges, making regionally consistent correlations and well ties was possible and the resulting maps are instructive. During the correlation stage questionable well picks were updated, in discussion with the original authors, and any changes forwarded to the NEB for inclusion in their public database.

Horizon picks were exported for hand contouring at 1:50,000 scale in a GIS mapping system (ArcMap). The intent is to publicly release shapefiles of Time, Velocity, and Depth maps along with supporting databases, text, and figures.

Examples

Many features that fundamentally affected succeeding horizons first appear at the Top of Proterozoic (Figure 2). This represents the unconformable boundary between Proterozoic Sequences A and B and overlying strata consisting of Cambrian and younger rocks and is the deepest level included in the map set. Proterozoic strata are exposed to the northeast in Brock Inlier and to the southwest in the Mackenzie Mountains. Much of the mapped area consists of a broad high under the Colville Hills region that separates the Beaufort and Great Bear basins. Westward, the surface dips increasingly steeply under the narrow Laramide foreland basins of the Mackenzie and Richardson mountains.

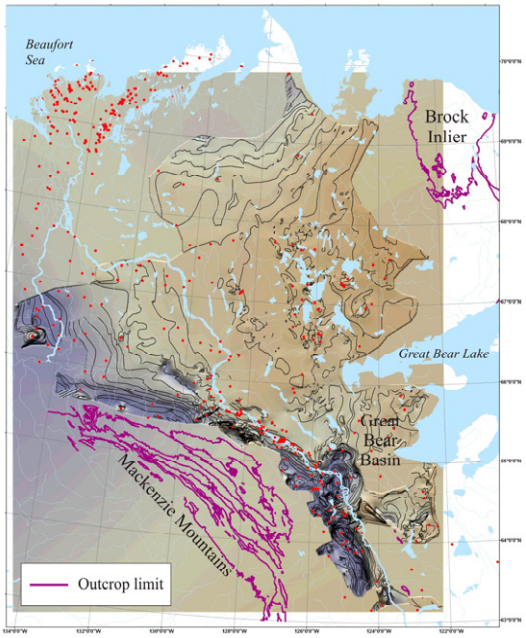

Figure 2: Seismic time structure map, Top of Proterozoic

Smaller features that affect much or all of the overlying section include Mackenzie Basin with its deep grabens, the multi-phased Keele Tectonic Zone, and Blackwater Fault.

Immediately overlying the Proterozoic are the basal transgressive sandstones of the Cambrian Mount Clark Formation, one of the region's exploration targets. These are gradationally overlain by the interbedded shale, sandstone, and thin carbonates of the Mount Cap Formation, the top surface of which is mapped in Figure 3. Surface exposures of Mount Cap can be found along the edge of the Canadian Shield and within the Franklin and eastern Mackenzie mountains. The Cambrian sandstones onlap Mackenzie Arch in the southwest, as well as the Mahony and Bulmer arches of Great Slave Plain and several areas of high ground under the Colville Hills.

Figure 3: Seismic time structure map, Top of Mount Cap Fm.

The remaining horizons that have been mapped are: Top Cambrian Saline River Formation, which shows the effect of salt deformation; the base Devonian Unconformity; Top Devonian Hume Formation, which can be a proxy for the Bear Rock Formation, the reservoir at Summit Creek; the base Cretaceous Unconformity; and the mid-Cretaceous (sub-Slater River Formation) Unconformity.

Problems with existing bedrock maps are identified when the subsurface and surface data are brought together, as in Figure 4 where the Cretaceous limit from seismic differs from the surface map and where the subcrop of the Top of Hume lies outside the surface limits of Hume/Landry. The next phase of the GSC's work in the Mackenzie River valley will include mapping to address these and similar issues.

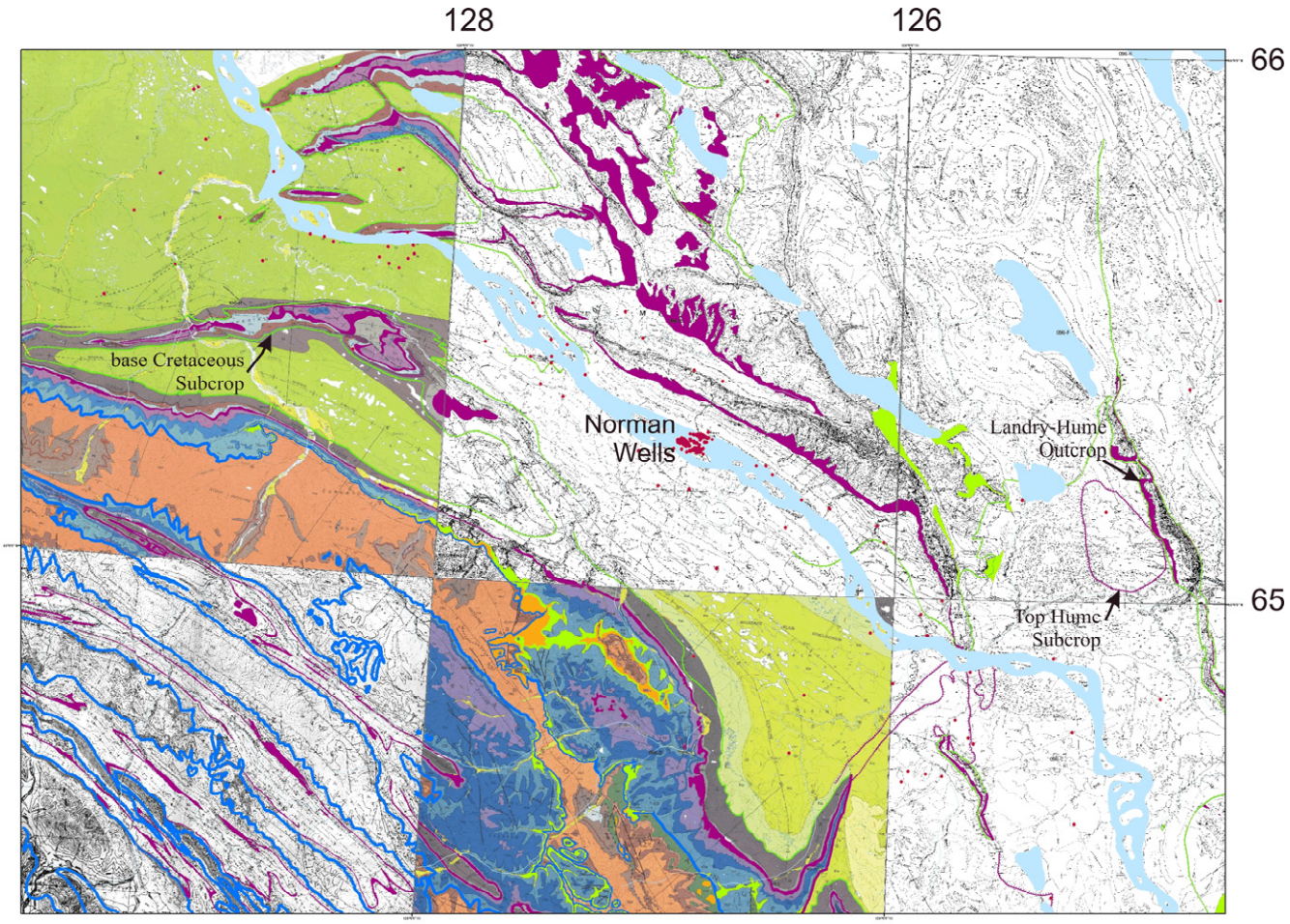

Figure 4: Subsurface subrop lines compared with surface mapping, central Mackenzie Valley.

Conclusions

A regional synthesis of all available seismic and well control has permitted development of a consistent set of structure maps that document the geological framework of the northwestern NWT. They place local features within their regional context and promise to contribute to future enhancements of the surface maps.

Acknowledgements

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References

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