Lowering Barriers to Public Communication with 3D Groundwater Mapping at Alberta Geological Survey: Examples from Canada’s Oil Sands Areas.

Kevin Parks, Laurence Andriashek and Nigel Atkinson, Alberta Geological Survey, Edmonton, Alberta, Canada
Introduction

- Introduction
- Databases
- Digitizing legacy data
- Thinking about grids
- 3D media
  - Animation
  - Familiar visual idioms
  - Tactile models
- Take home points
Why 3D for the Public?

• Need to show value for expensive work.
• Need to communicate complex ideas to lay audiences with as few barriers as possible.
• Need to communicate uncertainty without undermining credibility.
Adaptation of Relational Databases
Structured Databases – a prerequisite for 3D Mapping

Borehole information
Digitizing Legacy Data
Wolf Lake, AB, south shore, June 2003
Lake Bottom Bathymetry: Digital Capture

Digitized contours

Bathymetry + 25-m DEM
“Hill-Hole Pair” Glacio-tectonic Feature

Glacial Ice-Flow Direction

Marie Lake Highland ("Hill")

Marie Lake Basin ("Hole")

35x Vertical Exaggeration
Regional DEM with Lake Bathymetry

High 700m to 860masl

Low 435masl
Muriel Lake, AB, south shore, June 2003
3D Representation of Surface Topography and Stratigraphy
Thinking About Grids
Chronostratigraphy meets Finite Difference Gridding

\[ b = 0 \]

\[ b = 0 \]

\[ b = 0 \]

\[ b = 0 \]

\[ b = 0 \]

\[ b = 0.01 \]

\[ b = 0.01 \]

\[ b = 0.01 \]

\[ b = 0.01 \]

\[ b = 0.01 \]

\[ b = 0.01 \]
Distribution and Topography of Empress Formation Unit 1

- **Geological sediment - Preglacial sand, sand and gravel**
- **Displaced bedrock - area of thick, glacially displaced Belly River Fm.**
- **Deformed stratigraphy - area of glacially faulted and folded Quaternary strata**
- **Beaver River drainage basin area (Alberta portion)**
- **Cold Lake Air Weapons Range Boundary**

**Digital elevation model values**
- **High**: 660
- **Low**: 390

Scale:
- 0 10 20 30 kilometres
- 0 10 20 30 miles
Cross-section of Quaternary Strata Superposed on 3D model of Bedrock Surface
Using Animation
Ice Recession In Alberta

16,000 to 9,000 Years before Present

Modified from Dyke et al. 2003
Development of glacial tunnel channel

#1 Glacial advance over bedrock surface
Development of glacial tunnel channel

#2 Accumulation of meltwater at base of glacier

Frozen ground

Geothermal heat
Development of glacial tunnel channel
#3 Hydrostatic loading on basal meltwater & catastrophic erosion
Employing Familiar Visual Idioms
Sequence of channel infill

1. Glacial Ice
2. Pressure
3. Bedrock
4. Glacial Ice
5. Pressure
6. Water
7. Glacial Ice
8. Pressure
9. Fluvial sediments
10. Fluvial sediments
Making Tactile Models
Bedrock topography graphic rendering
Bedrock topography 3D printing
Take Away Points

- The public has a large inherent capacity to understand and appreciate groundwater maps and concepts provided the barriers to perception and understanding are low enough.

- 3D Mapping lowers barriers but requires more data processing, more technical skill, and more artistic flair on the part of the geoscientist.

- Making things look easy is hard work.