3D geological modelling in Switzerland – more than XYZ, less than a Swiss Army knife

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CPC Coordination, partnership and communication

SGDI Swiss Geological Data Infrastructure
- Acquisition, production, storage and supply of data
- Standardized and multi-dimensional storage

SG2D Swiss Geological 2d Data

SG3D Swiss Geological 3d Model
- Set-up of the National Geological Model
- Derivation of technical 3d knowledge basis

SURL Swiss Underground Rock Laboratory
Legal background

1) Act on Geoinformation (2008)
   → All spatial data produced by Federal Authorities shall be described by data models

2) Ordinance on Geoinformation (2008)
   → The Swiss Geological Survey is charged to produce nationwide geological 3D models

► 1) + 2) = Geological 3D models have to be attributed

► Implications on the production of geological 3d models
Models of unconsolidated sediments

Quaternary

Based **mainly on drill holes** as well as maps, seismics, cross sections

Key for **everyday applications** (construction, raw materials, etc.)

Under development

Prototype of the Quaternary model in NE Switzerland, 3x ex.
Models of consolidated sediments

Shallow subsurface (0 - \(\sim\)500 m \(\rightarrow\) data dependent)

Based on surface mapping and cross sections

Key for future regional challenges (deep cities, infrastructure, etc.)

Regional models of various scale (1:10000 – 1:25000)
Models of consolidated sediments

Deep subsurface (below ~500 m → data dependent)

Based on 12000 km seismic data, 40 wells, 200 deep drill holes

Key for future nationwide challenges (energy production, waste deposits, hydrocarbons)

Framework models 1:200k (available) and 1:50k (2016)
Production

Standard input data types (seismic data, wells, drill holes, surface mapping, cross sections, etc.)

Decision to go for a 3d database in 2011 (→ ready DEC 2015)

Direct link between Move™ 3D modelling software and GST 3D database (incl. data models)
Production – Database solution

☑ Seamless data sets

☑ Attribution of objects

☑ (Data queries)

☑ Web visualization

Complete Framework Model
1:200k

Available
The shipping container

One of the most successful inventions in recent times

Boost of global goods traffic

Standardized dimensions

Standardized locking mechanisms
... this sounds trivial, but in this political context, standardized data exchange is difficult!
## Changes in geometry types

**Transfer from 2D to 3D to 2D**

**No loss of information**

### Characterization – Data Models go 3D

<table>
<thead>
<tr>
<th>2D representation</th>
<th>3D representation</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point</td>
<td>Point</td>
<td>Dip measurement</td>
</tr>
<tr>
<td>Point</td>
<td>Line</td>
<td>Drill hole</td>
</tr>
<tr>
<td>Line</td>
<td>Line</td>
<td>Hinge line</td>
</tr>
<tr>
<td>Line</td>
<td>Surface</td>
<td>Fault</td>
</tr>
<tr>
<td>Polygon</td>
<td>Surface</td>
<td>Rock body</td>
</tr>
<tr>
<td>Polygon</td>
<td>Shell</td>
<td>Rock body</td>
</tr>
<tr>
<td>Polygon</td>
<td>Volume</td>
<td>Rock body</td>
</tr>
</tbody>
</table>
Characterization of models

Aim: **Standardized description** of products, data & information

Goals: Description of **rock parameters** (lithology, stratigraphy, density, porosity, permeability, heat flow, etc.) in any object

**Uncertainty** (input data, location, lithology → first steps done)

→ **Object-based and vertex-based storage** (TIN, GRID, Voxel)

Temperature distribution in the Swiss Midlands (Geowatt, swisstopo)
Supply of data

Customers expect information (not only data!) to be easily available in digital format, complete, everywhere, anytime, very fast and for free.

And: Our information and data must be fitted to their level of knowledge and to their needs.

Federal geodata portal

Swiss Map Mobile

3d web viewer
map.geologyportal.ch

For the general public
- Website, free
- Cloud computing, pre-processed tiles
- Responsive design
- Open layers 3, HTML 5 and CSS 3
For the interested layperson
→ App for iOS and Android, paid service
→ Topographic and geological maps
→ 5000 POIs
→ Dynamic legend
→ 360° panoramic views (selected locations)
→ 100+ geological cross sections
For the experts
☑️ Exaggeration
☑️ Slicing
☑️ WMS overlay
☑️ Virtual cross sections (hor./vert.)
☑️ Virtual boreholes
☑️ Clip of regional models

☑️ Ready by the end of November 2015
Outlook

Standard
Modelling & visualisation

Challenge
Central 3d data storage
Transfer 2d – 3d – 2d
Model management platform
Central 3d access to all data
Increase economic benefit

WORK IN PROGRESS
Outlook – The National Geological Model

Multiple models, multi-scaled
National, seamless coverage
Multi-purpose
Best interpretation at any point
3d knowledge base
Ready by 2020

Regional model 1:25000
Framework model 1:200000
More than XYZ, but …

Thank you for your attention!

A simple, but fantastic tool!

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