

NGAC; December 2019; Lightning talk

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2019 Synopsis of Three-dimensional Geological Mapping and Modelling at Geological Survey Organizations

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2019 Synopsis of Current Three-Dimensional Geological Mapping and Modelling in Geological Survey Organizations

Editors

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³ British Geological Survey

⁴ Geological Survey of Canada

⁵ Minnesota Geological Survey

October 2019



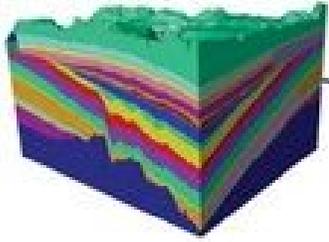
Free download:
https://ags.aer.ca/publications/SPE_112.html

- **How 22 surveys are developing 3D geospatial products**
- **Case studies highlight innovative approaches**
- **3D geology enhances communications with stakeholders, optimizes evidence-based decision-making, and improves understanding of geology**
- **Resulting models lead to enhanced public safety, and better delineation of surface and subsurface resources**

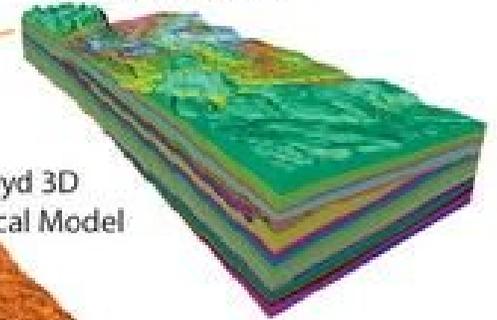
- **Chapter 1 - Overview**
- **Chapter 2 - Background and Purpose**
- **Chapter 3 - Modelling Approaches**
- **Chapter 4 - Benefit-Cost Analysis**
- **Chapter 27 - Communicating 3D Geology to Stakeholders**
- **Chapter 28 - Global 3D Coordination Initiatives**
- **Chapter 29 - Future of 3D at Geological Survey Organizations**
- **Chapter 30 - Conclusions and Recommendations**

AGS 3D Geological Framework Models

Peace River 3D Geological Model, Version 2



Lower Athabasca Region 3D Geological Model



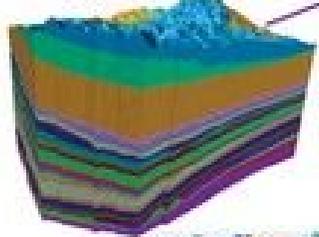
Montney 3D Property Model



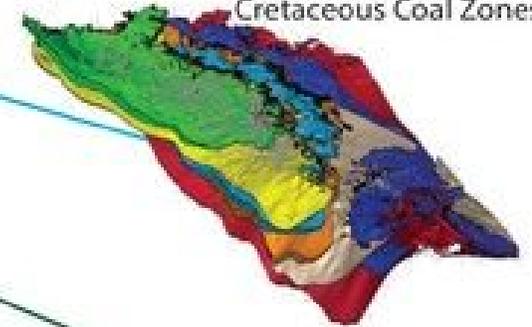
Dina-Lloyd 3D Geological Model



West Central Alberta 3D Geological Model



3D Model of Upper Cretaceous Coal Zones



Fox Creek Induced Seismicity 3D Geological Model



Dinosaur Provincial Park 3D Geological Model



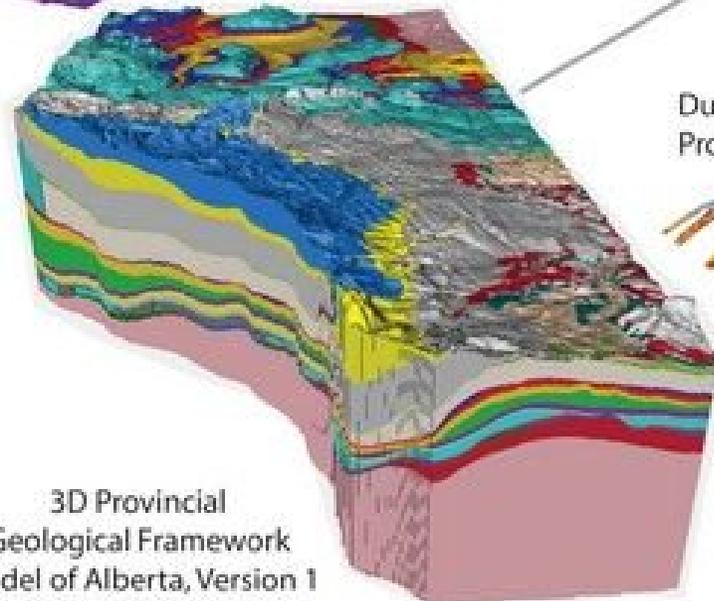
Duvernay 3D Property Model



Alberta Boundary

Alberta

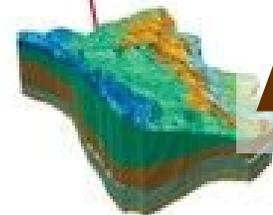
3D Provincial Geological Framework Model of Alberta, Version 1



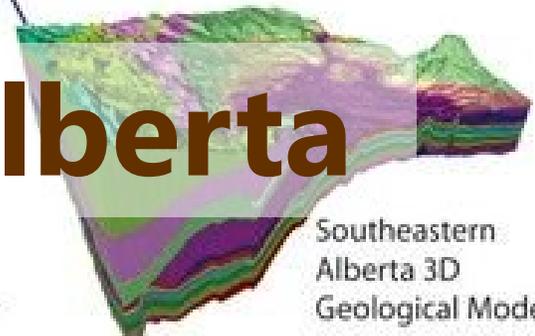
Sylvan Lake 3D Hydrostratigraphic Model



Calgary-Lethbridge Corridor 3D Geological Model



Southeastern Alberta 3D Geological Model

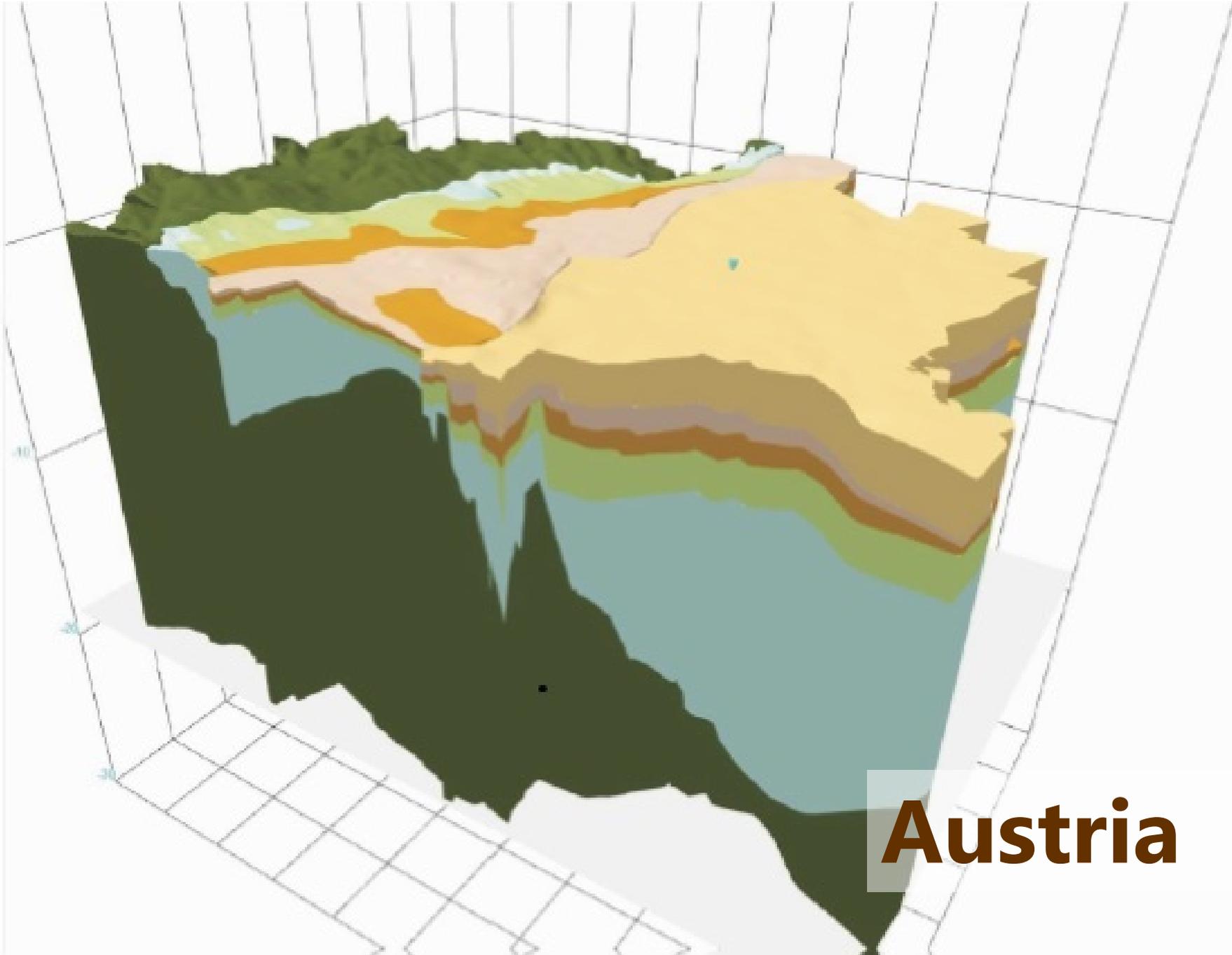


a. Oltan

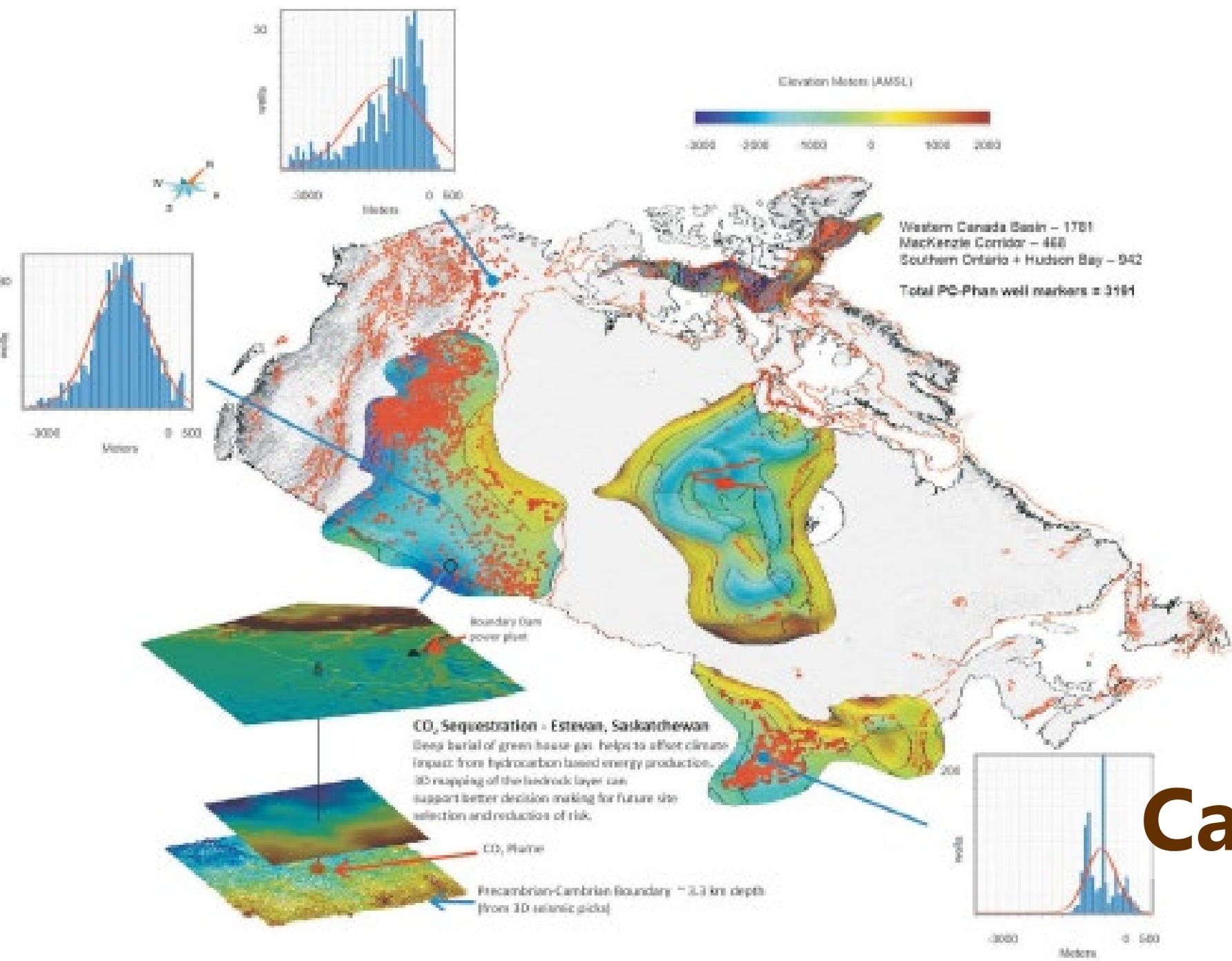
Ufhusas Bahyrdi iuzhMada
(Mikroorganizmi i n. Sestofa)



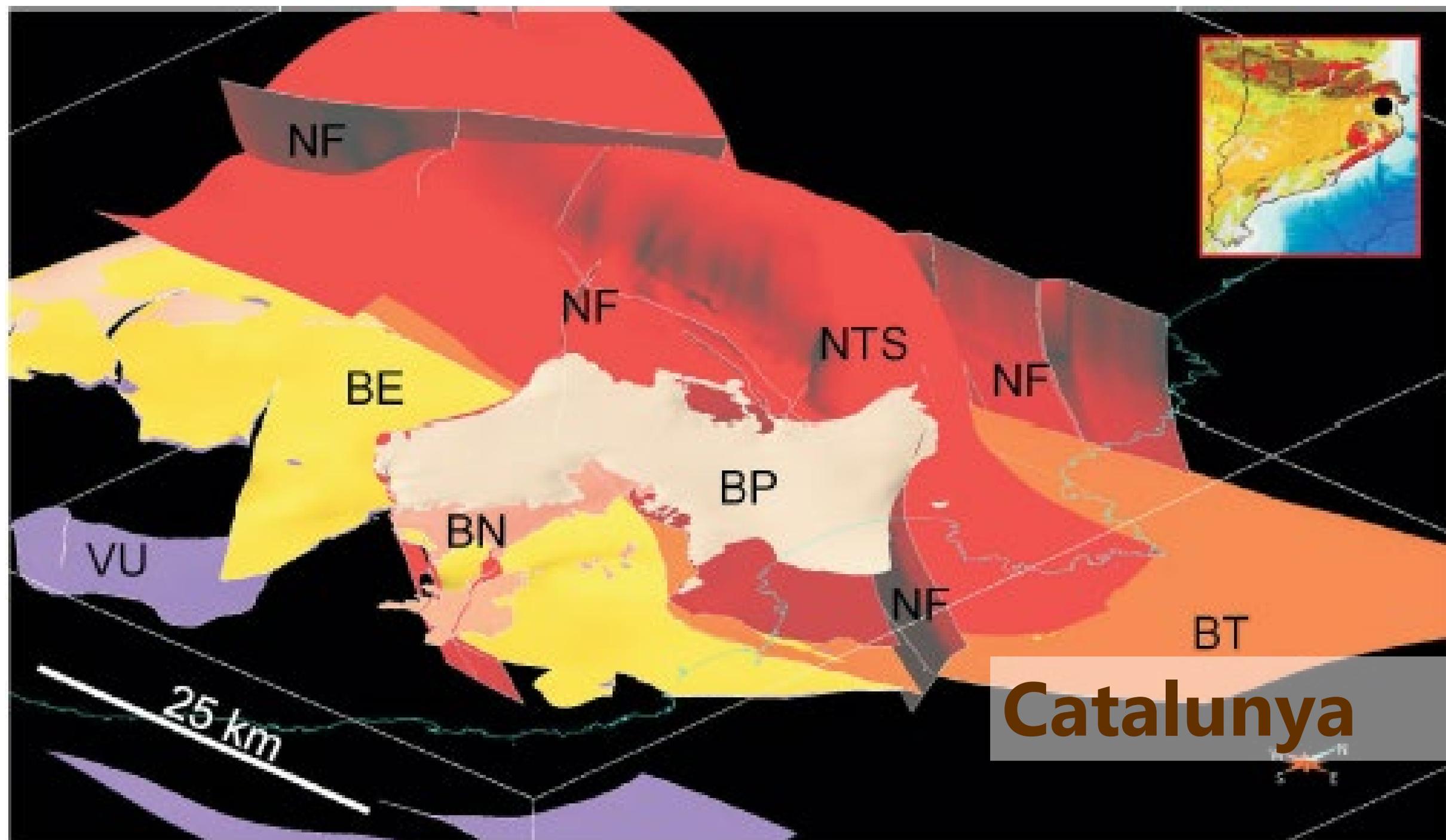
Color	Legend 1	Legend 2	Legend 3
Orange	101	101	101
Yellow	201	201	201
Light Orange	202	202	202
Light Green	203	203	203
Light Blue	204	204	204
Light Purple	205	205	205
Light Brown	206	206	206
Light Grey	207	207	207
Light Blue	208	208	208
Light Green	209	209	209
Light Brown	210	210	210
Light Grey	211	211	211
Light Blue	212	212	212
Light Green	213	213	213
Light Brown	214	214	214
Light Grey	215	215	215
Light Blue	216	216	216
Light Green	217	217	217
Light Brown	218	218	218
Light Grey	219	219	219
Light Blue	220	220	220
Light Green	221	221	221
Light Brown	222	222	222
Light Grey	223	223	223
Light Blue	224	224	224
Light Green	225	225	225
Light Brown	226	226	226
Light Grey	227	227	227
Light Blue	228	228	228
Light Green	229	229	229
Light Brown	230	230	230
Light Grey	231	231	231
Light Blue	232	232	232
Light Green	233	233	233
Light Brown	234	234	234
Light Grey	235	235	235
Light Blue	236	236	236
Light Green	237	237	237
Light Brown	238	238	238
Light Grey	239	239	239
Light Blue	240	240	240



Austria



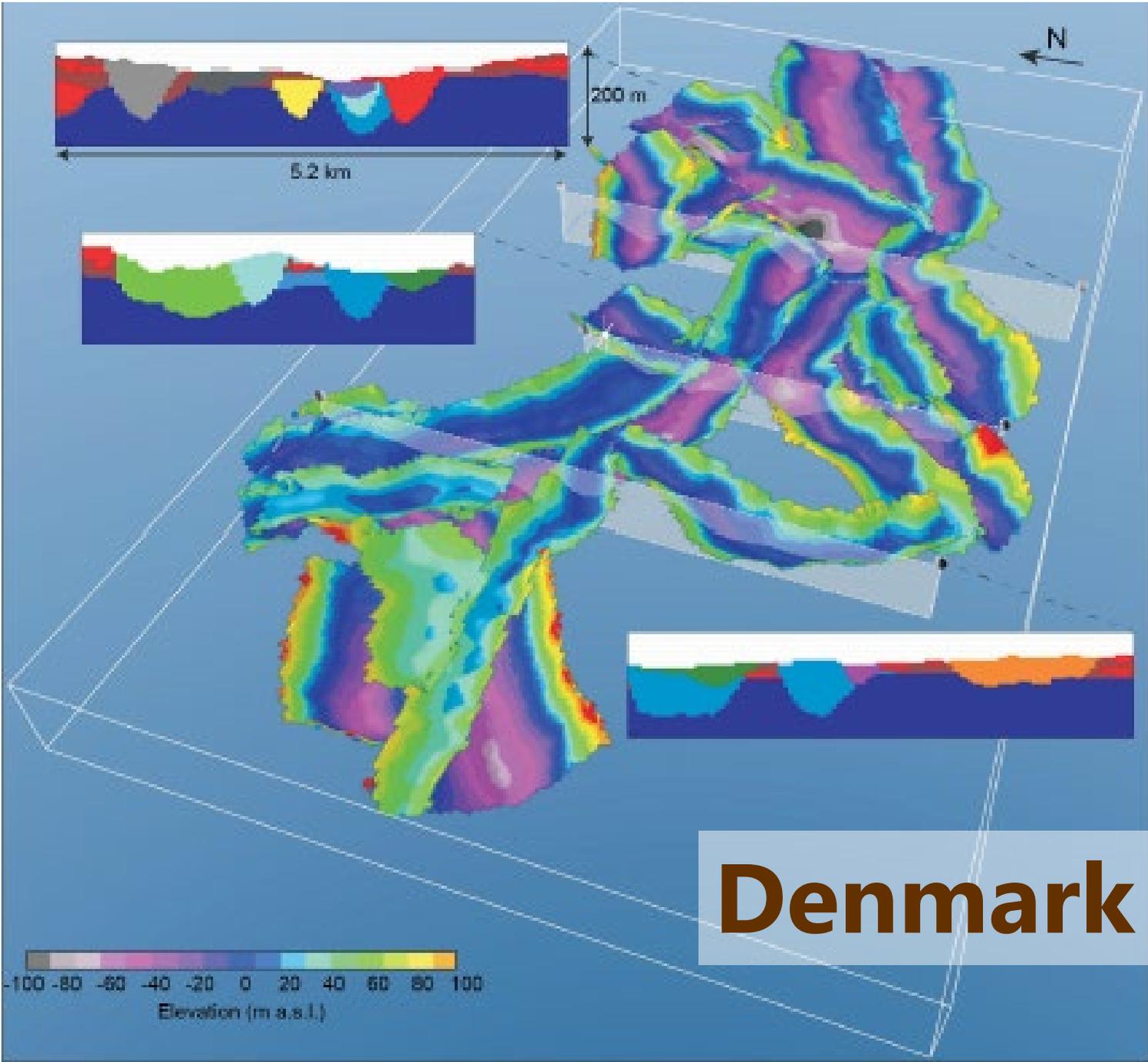
Canada



Catalunya

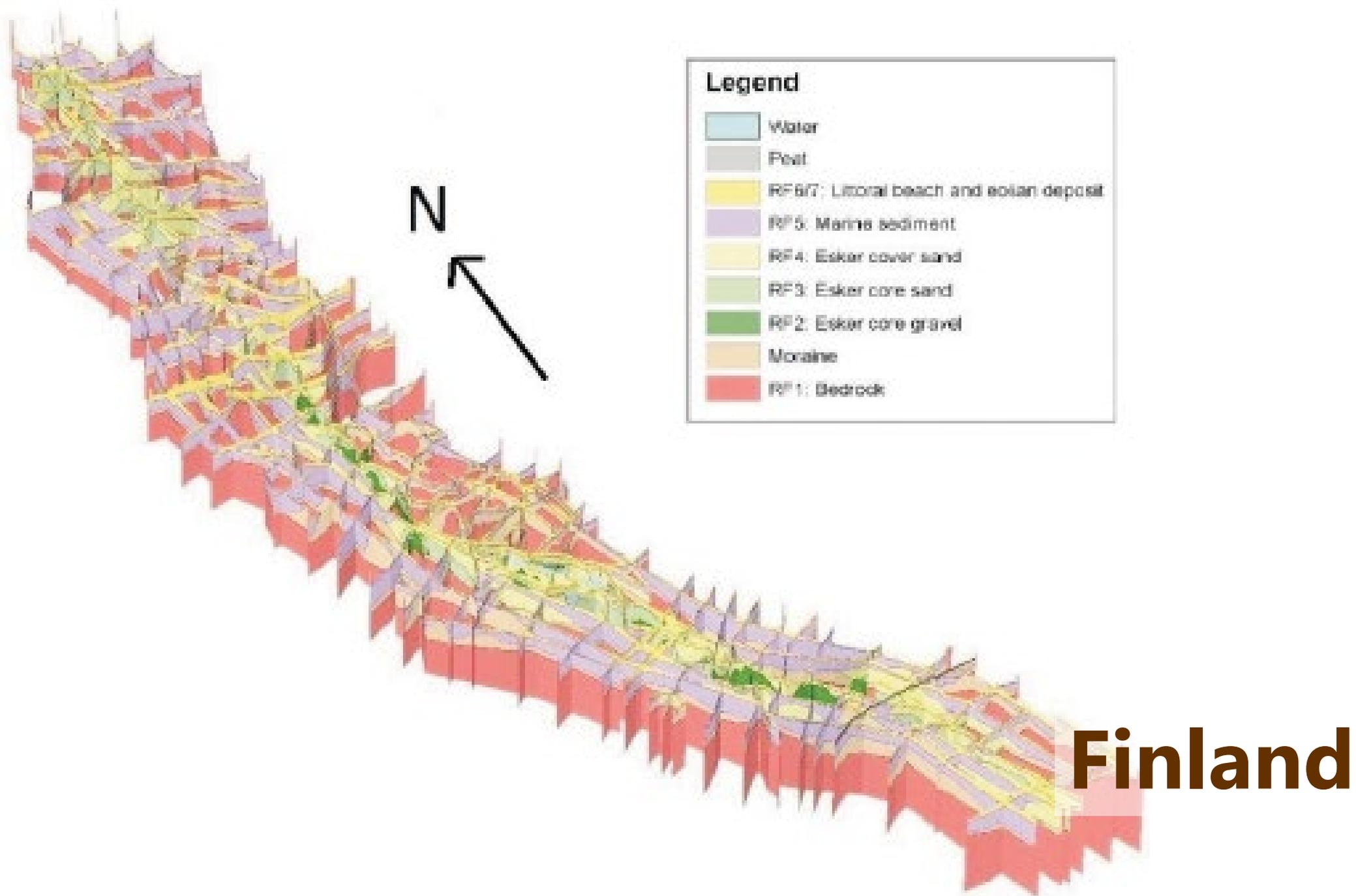


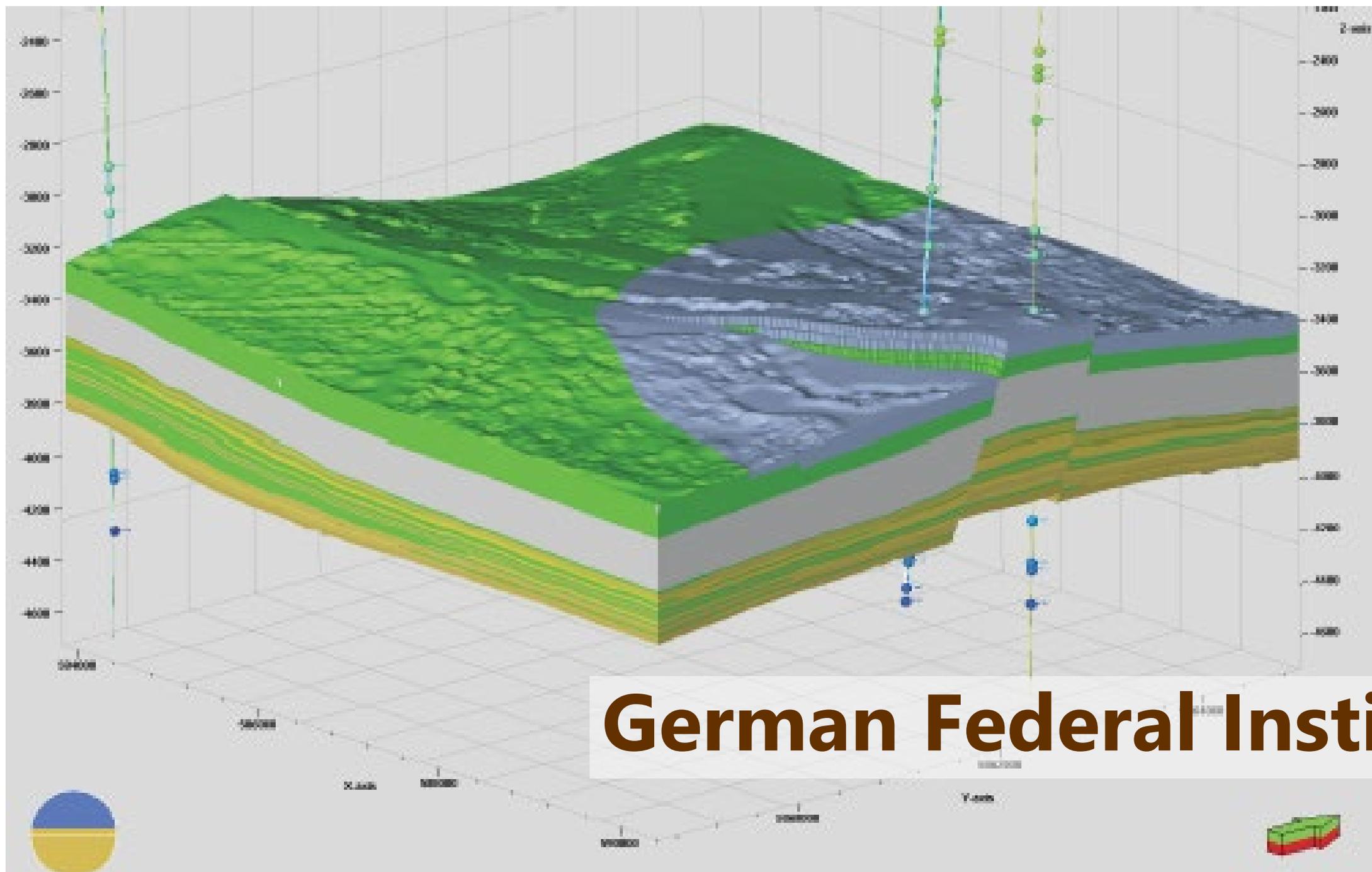
Czech Republic



- Pre-Quaternary:
 - Paleogene clay
 - Miocene sand
- Quaternary:
 - Sand till
 - Meltwater sand
 - Clay till
- Valley fill deposits:
 - Infil, valley 1
 - Infil, valley 2
 - Infil, valley 3
 - Infil, valley 4
 - Infil, valley 5
 - Infil, valley 6
 - Infil, valley 7
 - Infil, valley 8
 - Infil, valley 9
 - Infil, valley 10
 - Infil, valley 11
 - Infil, valley 12
 - Infil, valley 13
 - Infil, valley 14
 - Infil, valley 15
 - Infil, valley 16
 - Infil, valley 17
 - Infil, valley 18
 - Infil, valley 19
 - Infil, valley 20

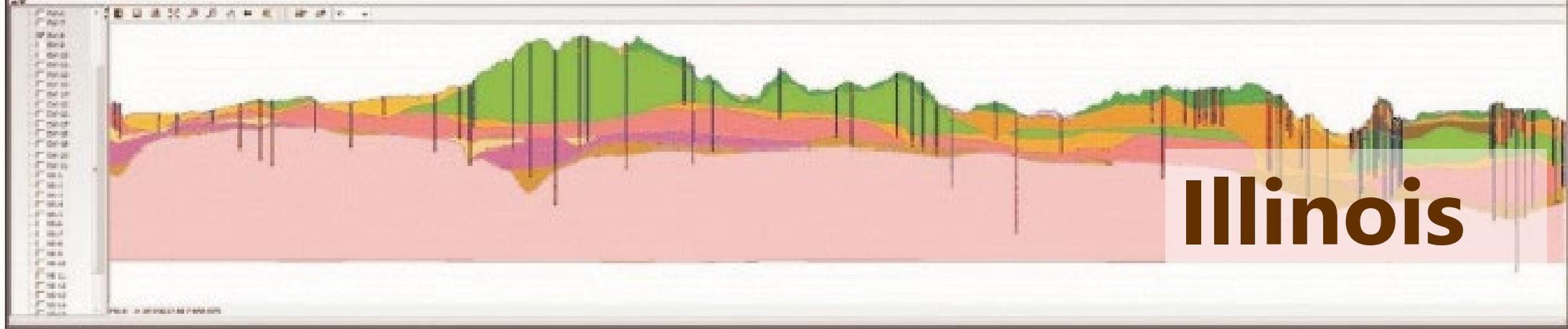
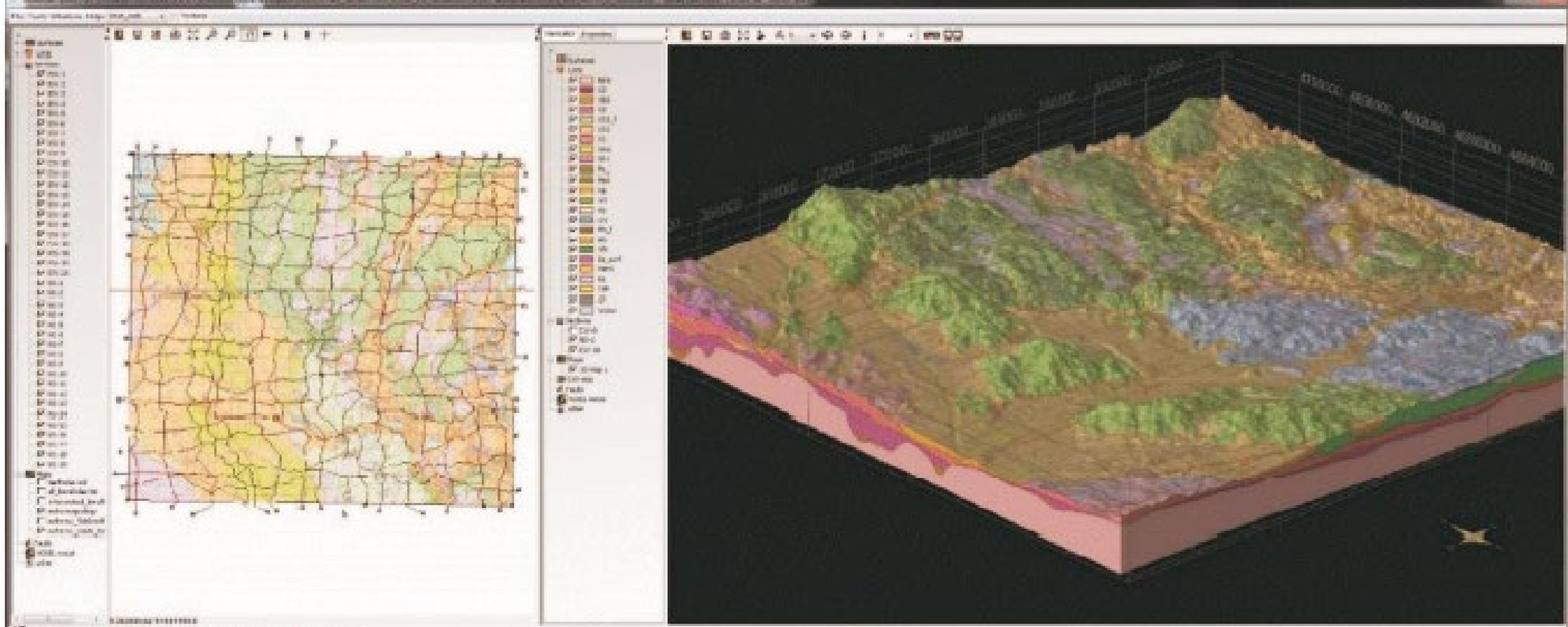
Denmark and Greenland

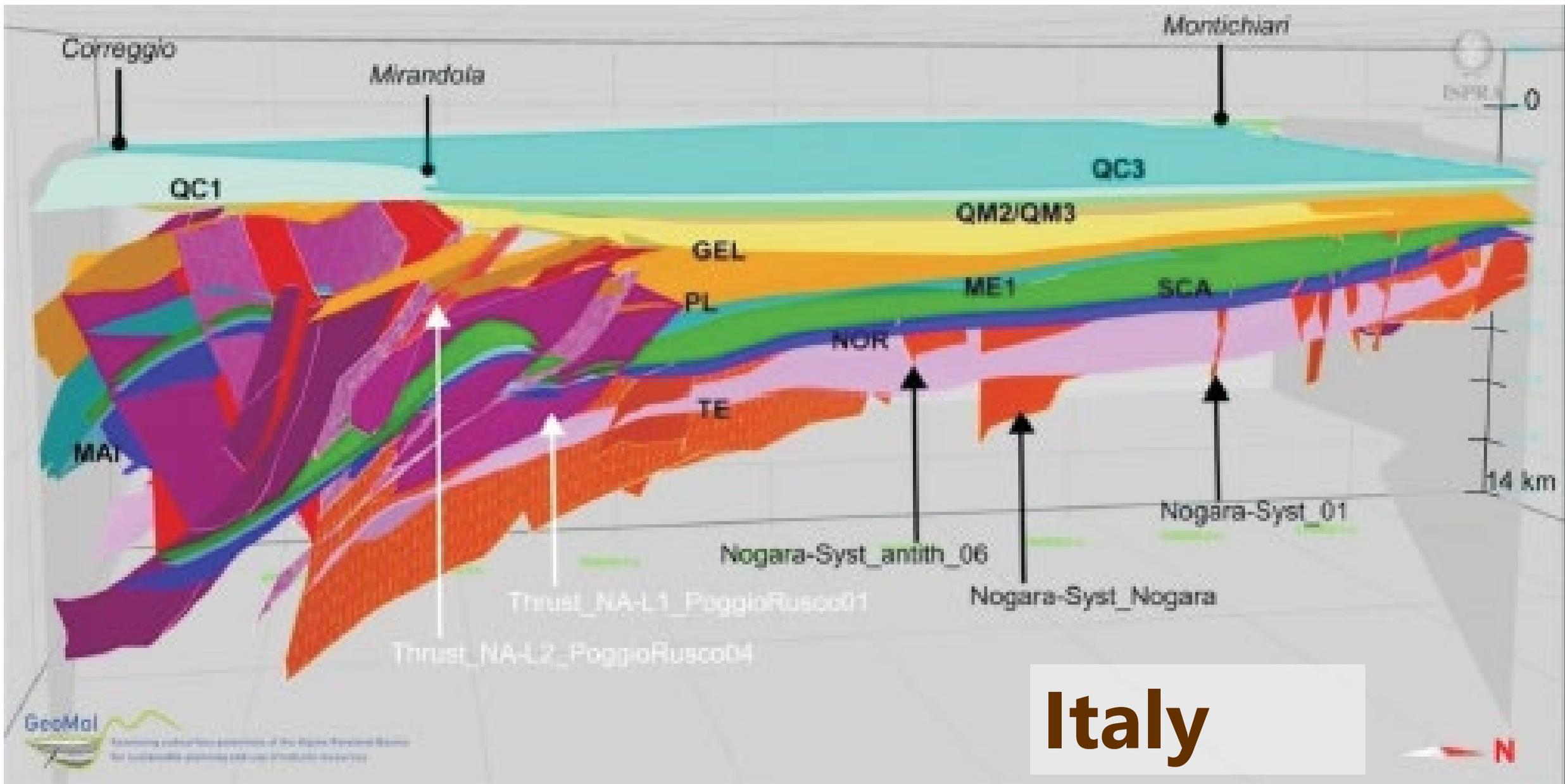




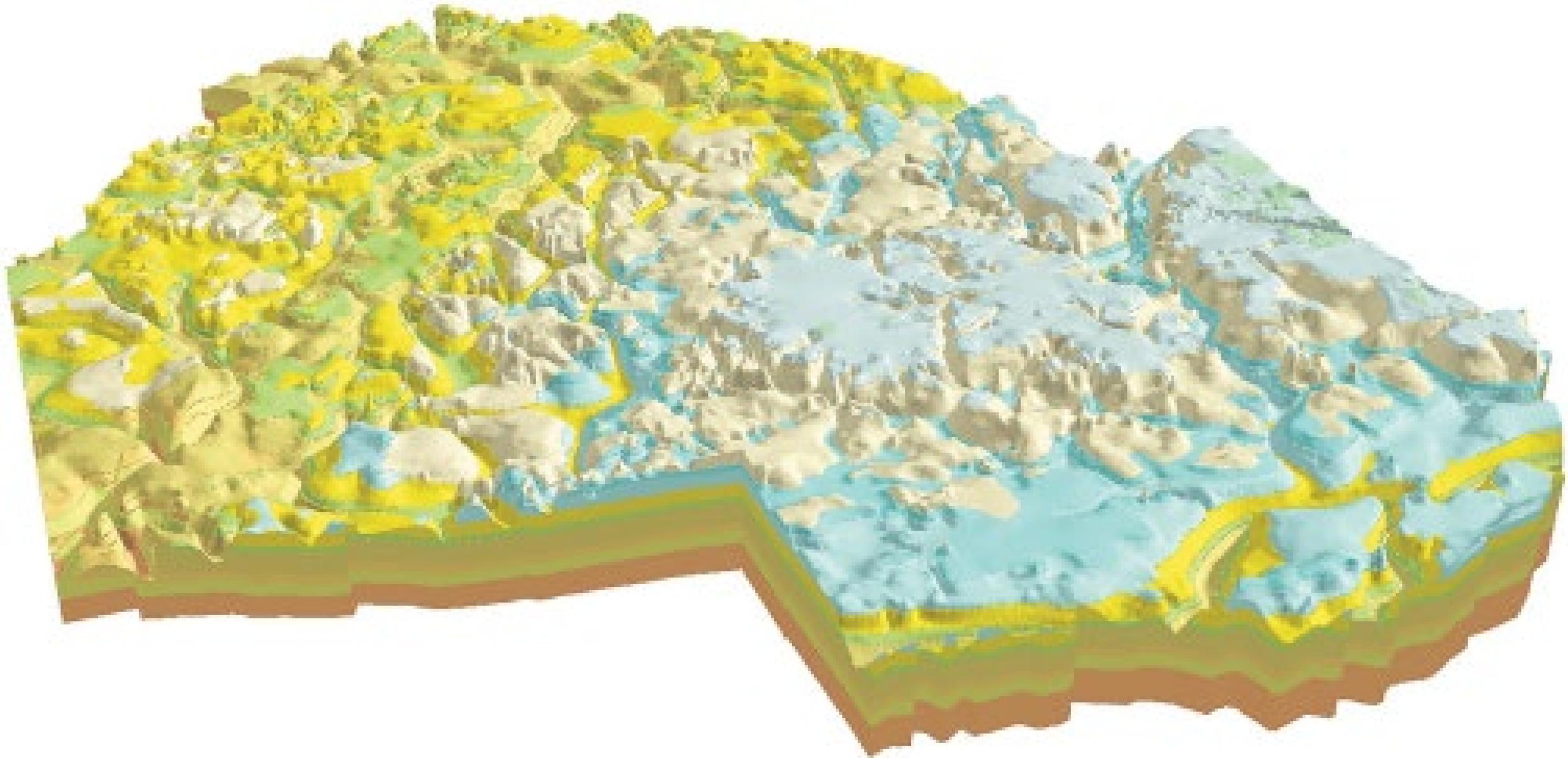
German Federal Institute





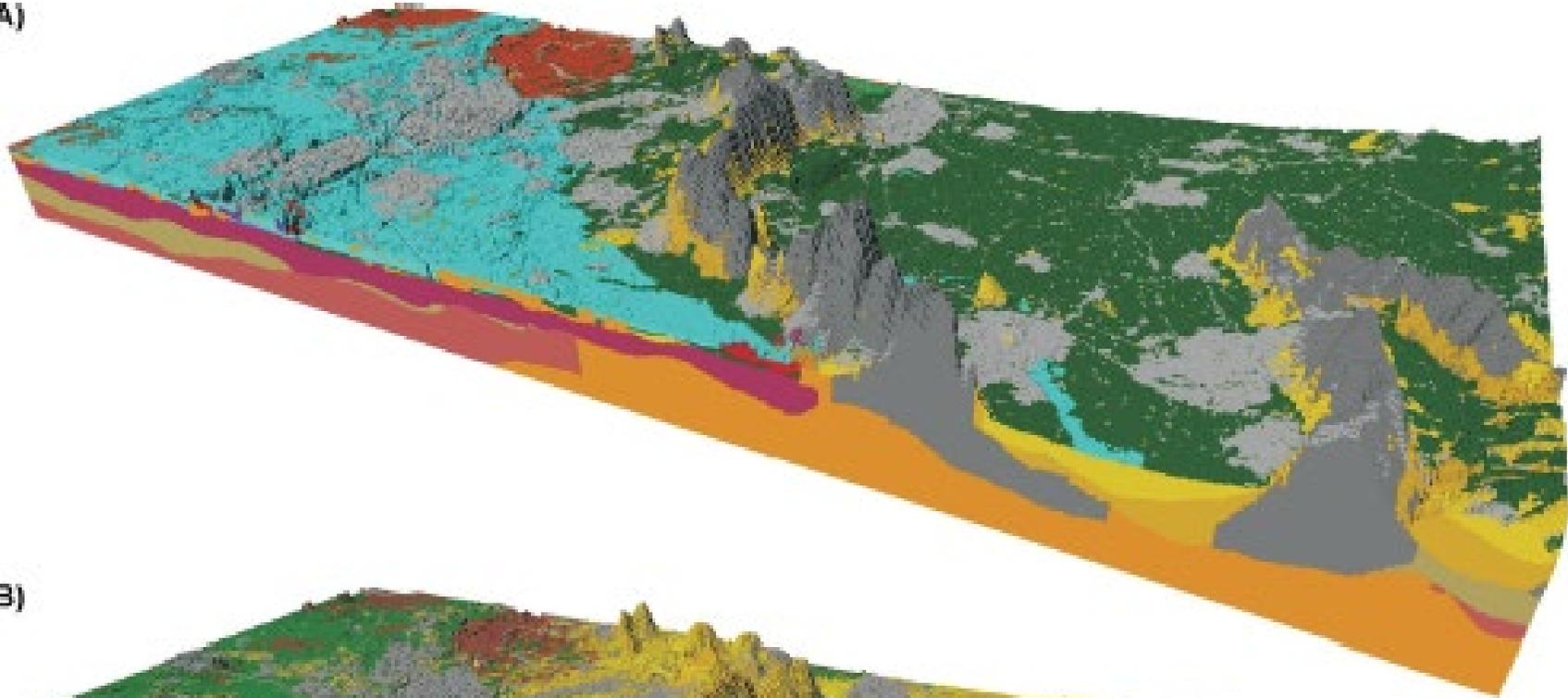


Italy

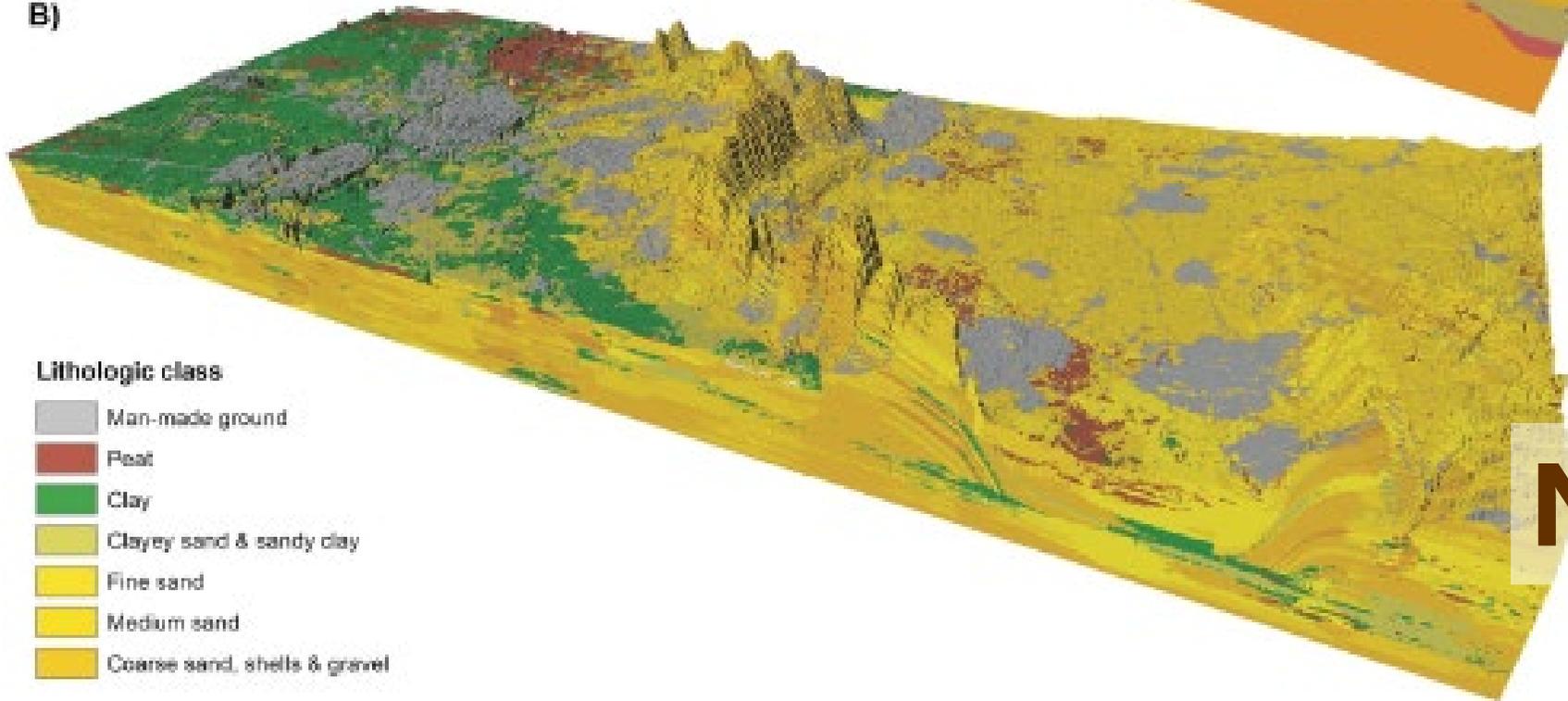


Minnesota

A)



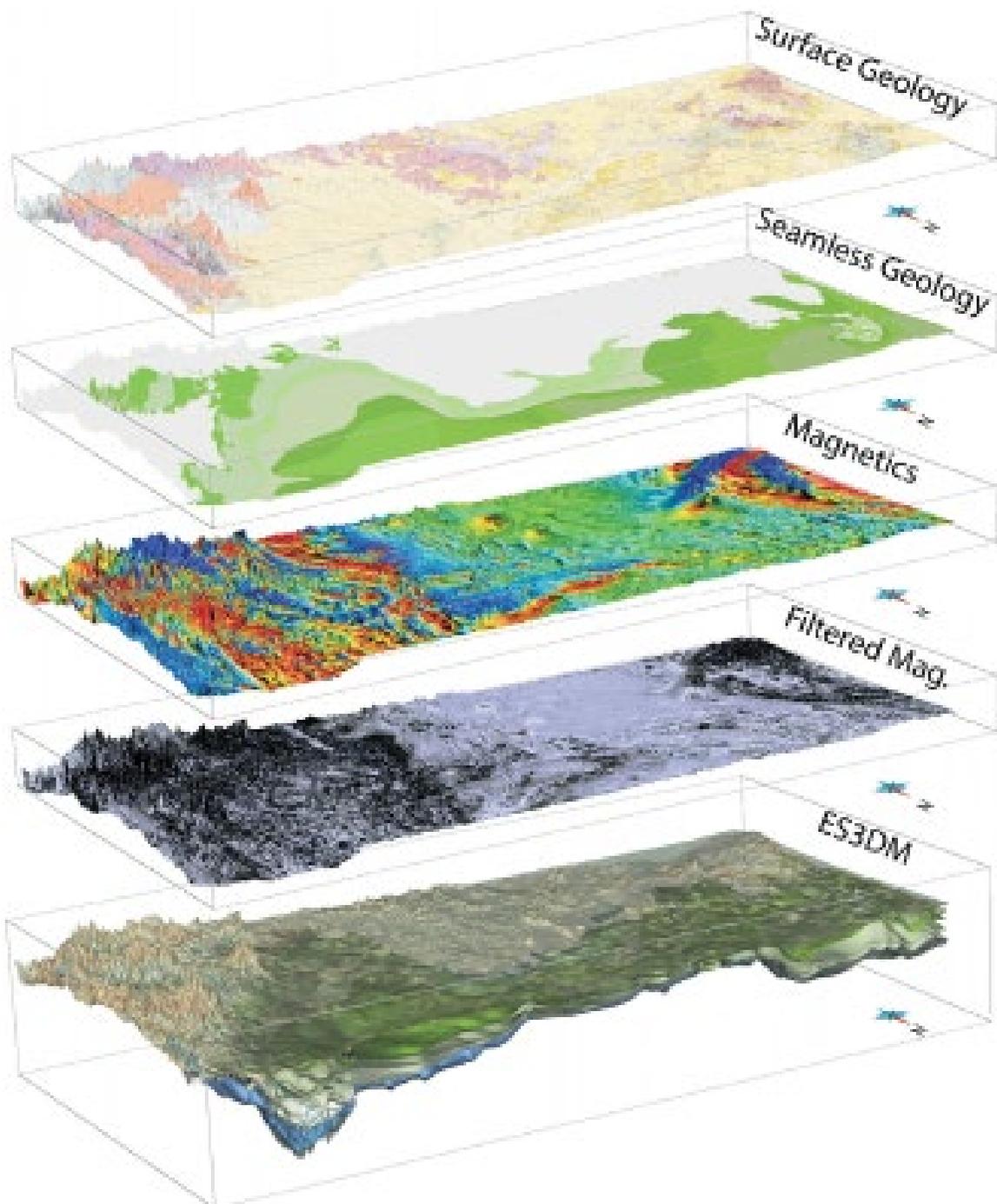
B)



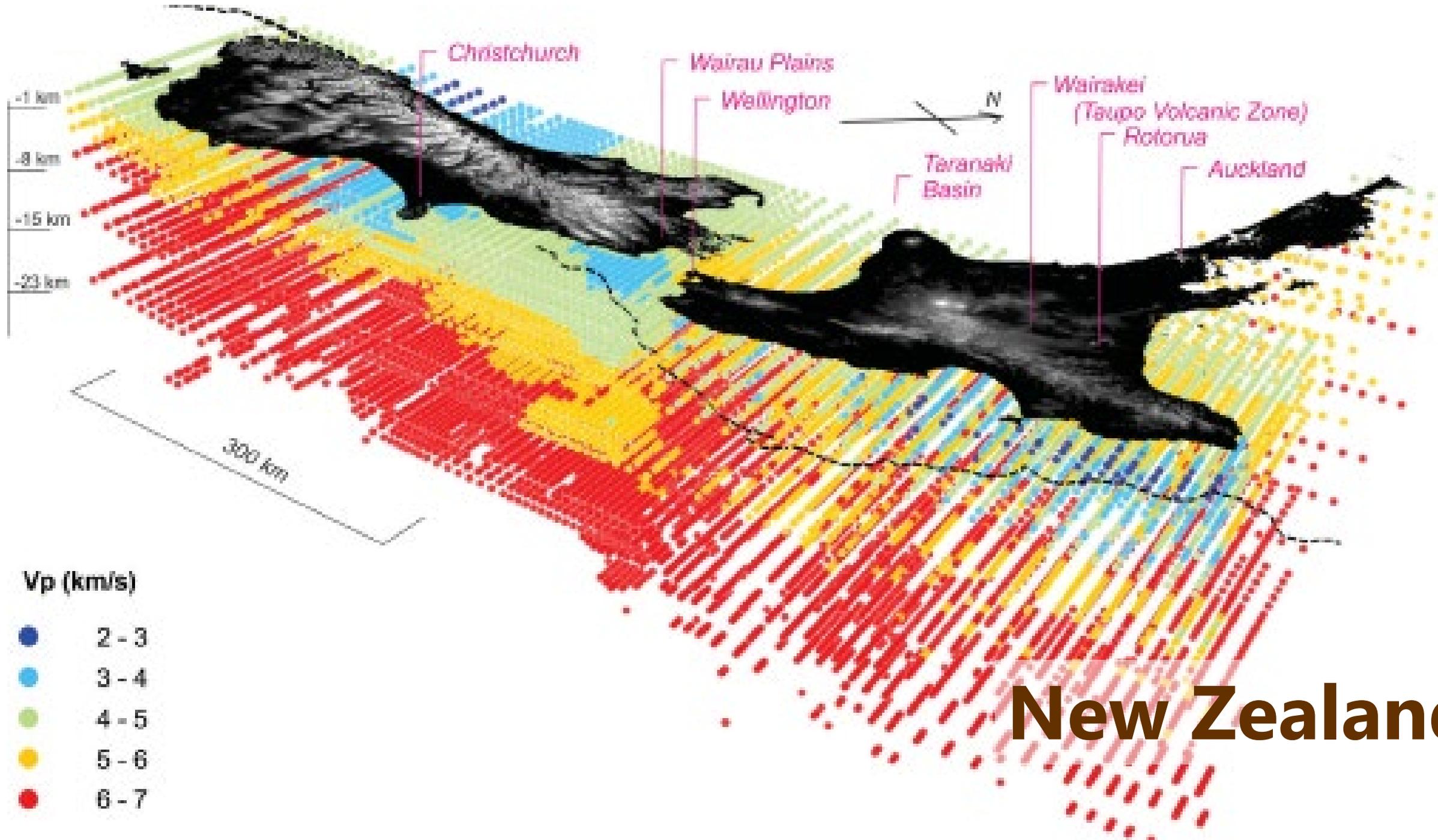
Lithologic class

-  Man-made ground
-  Peat
-  Clay
-  Clayey sand & sandy clay
-  Fine sand
-  Medium sand
-  Coarse sand, shells & gravel

Netherlands

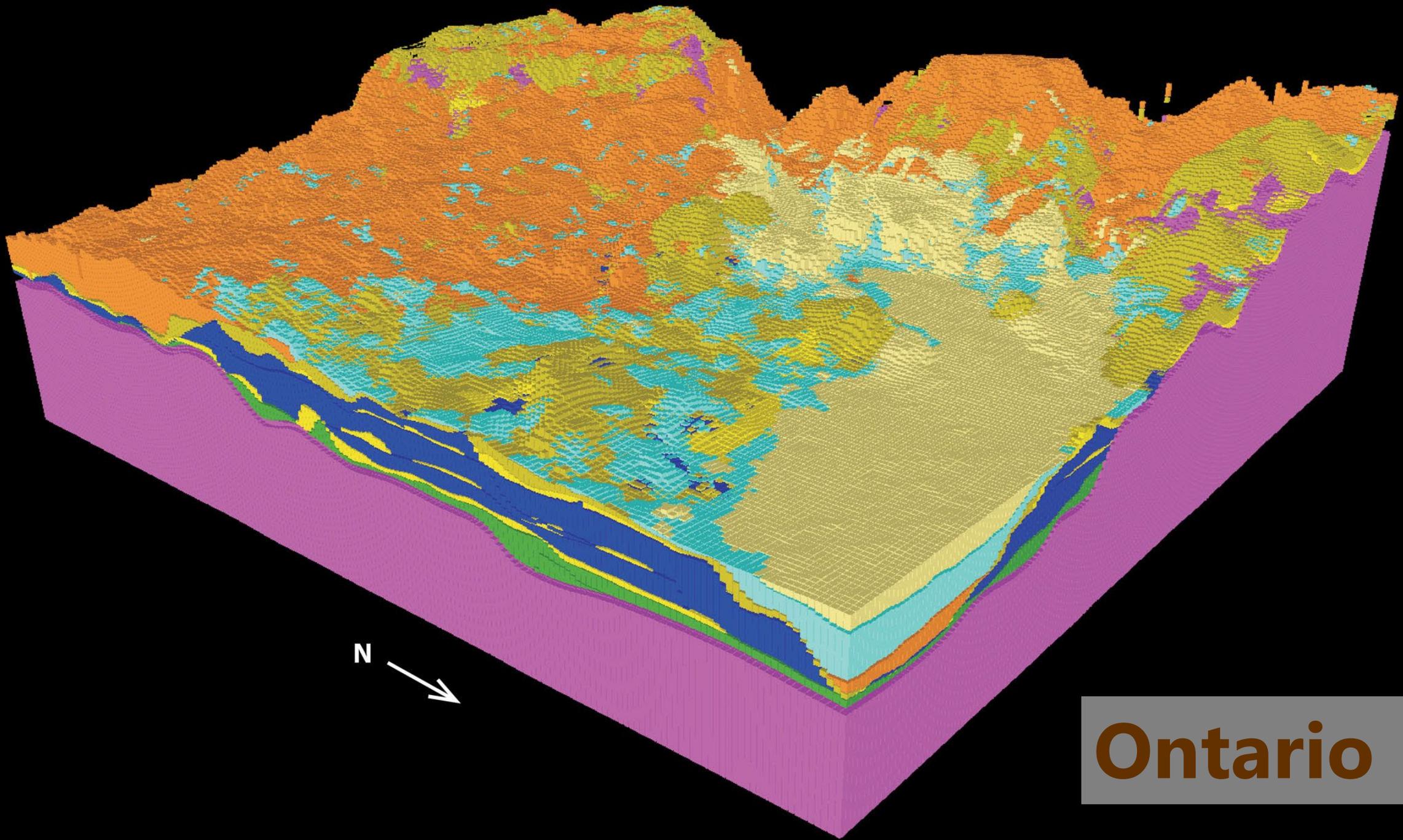


New South Wales

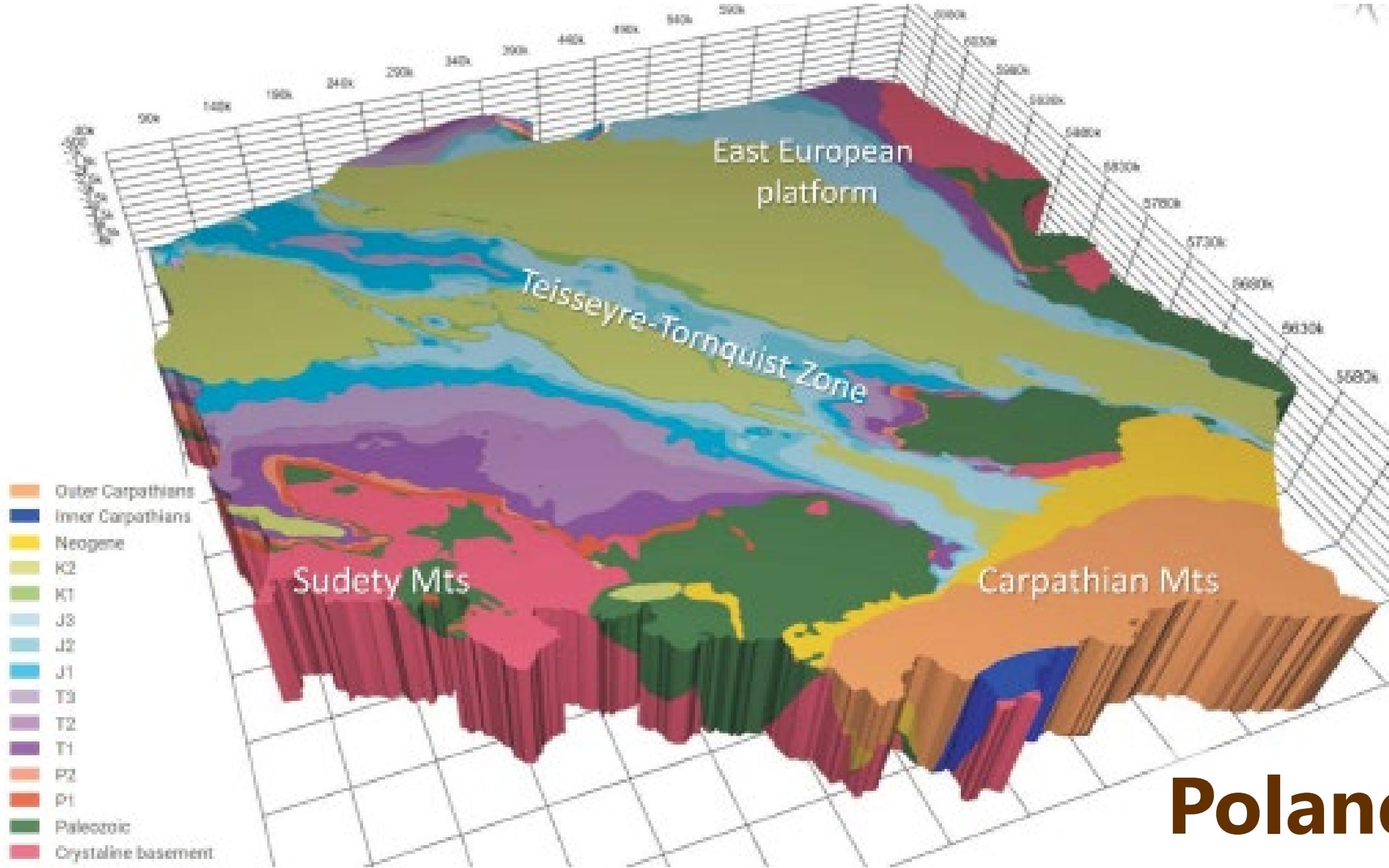


Vp (km/s)

●	2 - 3
●	3 - 4
●	4 - 5
●	5 - 6
●	6 - 7

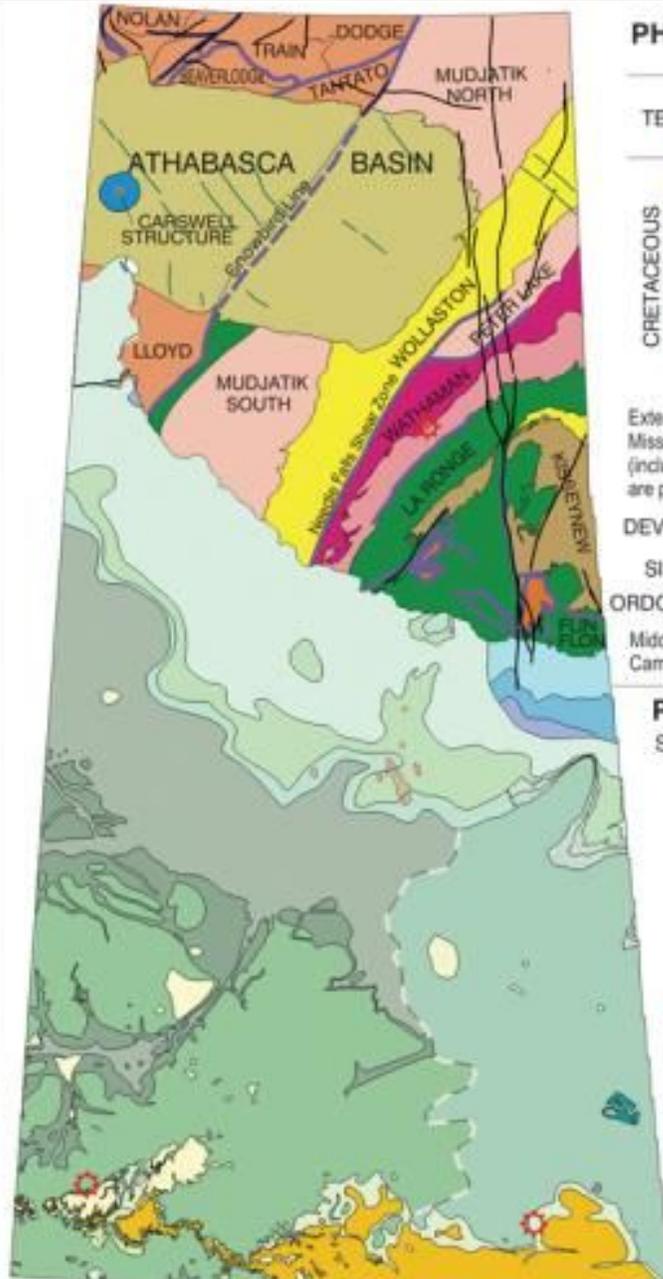


Ontario



Poland

SASKATCHEWAN BEDROCK GEOLOGY



PHANEROZOIC BASIN

		Group/formation		
TERTIARY	65 Ma	Twm Wood Mountain & Cypress Hills	Tu Undivided Tertiary	
		Ti Ravenscrag		
CRETACEOUS	Upper	2Kf Frenchman	Eastern part of basin	
		Kef Battle & Whitmud		
		E Eastend		
		Kb Bearpaw		
		Kbr Belly River		
	Lower	Klp Lea Park & Milk R.	Km Riding Mountain	
		Kws First White Speckled Shale, Carlisle, etc.	Kvr Vermilion R.	
		99 Ma	Kfc Belle Fourche, Fish Scale Zone, Westgate, Viking & Joli Fou	Kfv Favel
		Kim Mannville		

Extensive sections of the Jurassic, Triassic, Mississippian, and much of the Devonian (including the Prairie Evaporite), are present only in subsurface.

DEVONIAN	144 Ma	Dwp Winnipegosis, Ashern, Meadow Lake
SILURIAN	450 Ma	S Interlake
ORDOVICIAN	441 Ma	O Stonewall, Story Mountain

Middle and Upper sections of the Cambrian are present only in subsurface.

- Kimberlite cluster
- Site of meteorite impact

MAIN PHANEROZOIC ROCKTYPES

- Conglomerate, siltstone, sandstone
- Sandstone, siltstone, shale
- Shale
- Dolostone-limestone
- Carbonate-shale

PRECAMBRIAN SHIELD

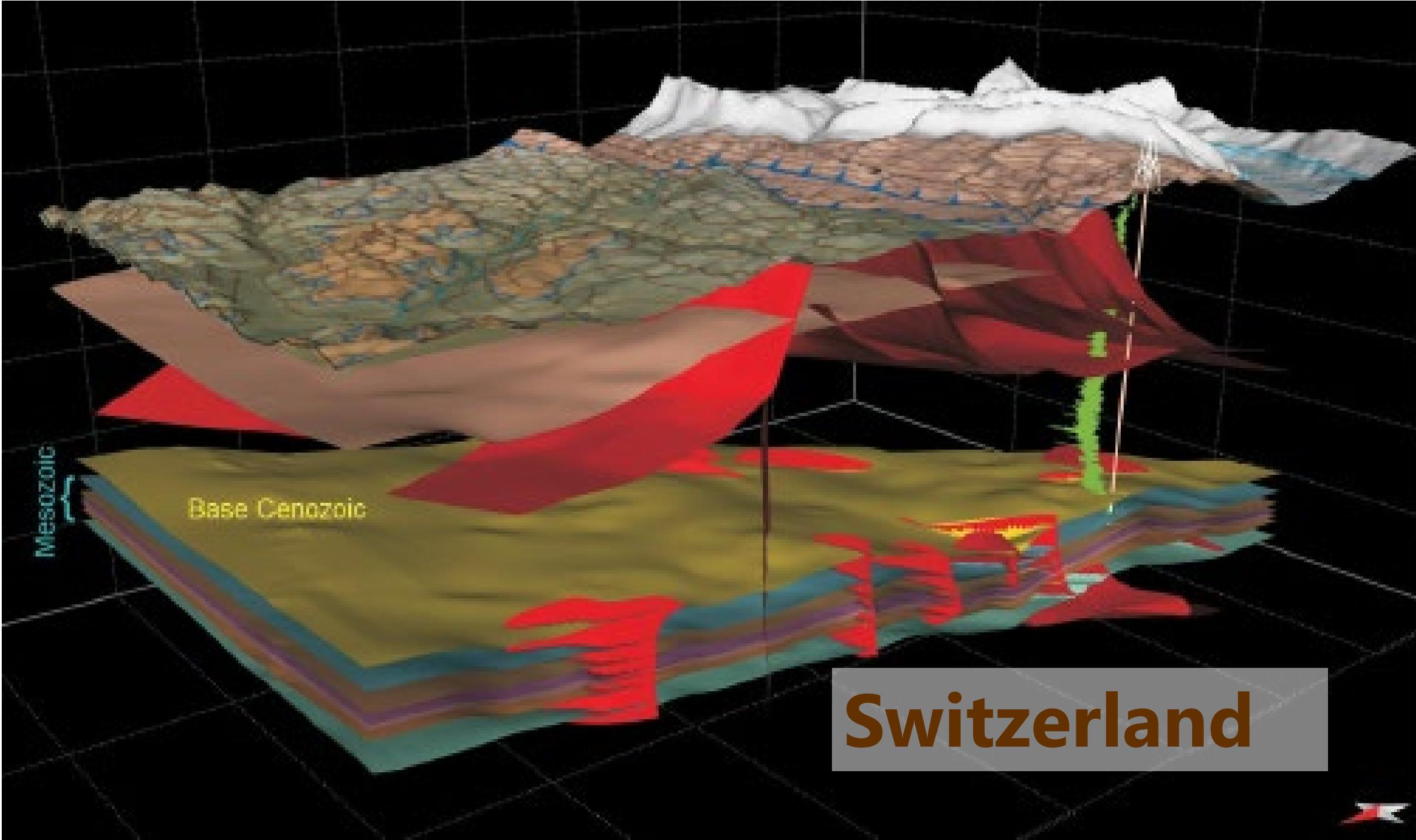
Shear zone ——— Fault ——— Diabase dyke ———

MAIN UNITS OF THE REINDEER ZONE:	
PREDOMINANTLY PROTEROZOIC	ca. 1.9-1.7 Ga
Wollaston Group	
Wathaman Batholith	
Predominantly greenstone volcanics and granitoids	
Greywacke/anatex granites of the Kisseynew Domain	
Archean inliers of the Glennie Domain	ca. 2.5 Ga

PREDOMINANTLY ARCHEAN	ca. 3.4-2.2 Ga
See text for outline of the geology of the Rae and Hearne provinces	
Main divisions of the Precambrian Shield	
RAE PROVINCE	
HEARNE PROVINCE	
REINDEER ZONE	



Saskatchewan

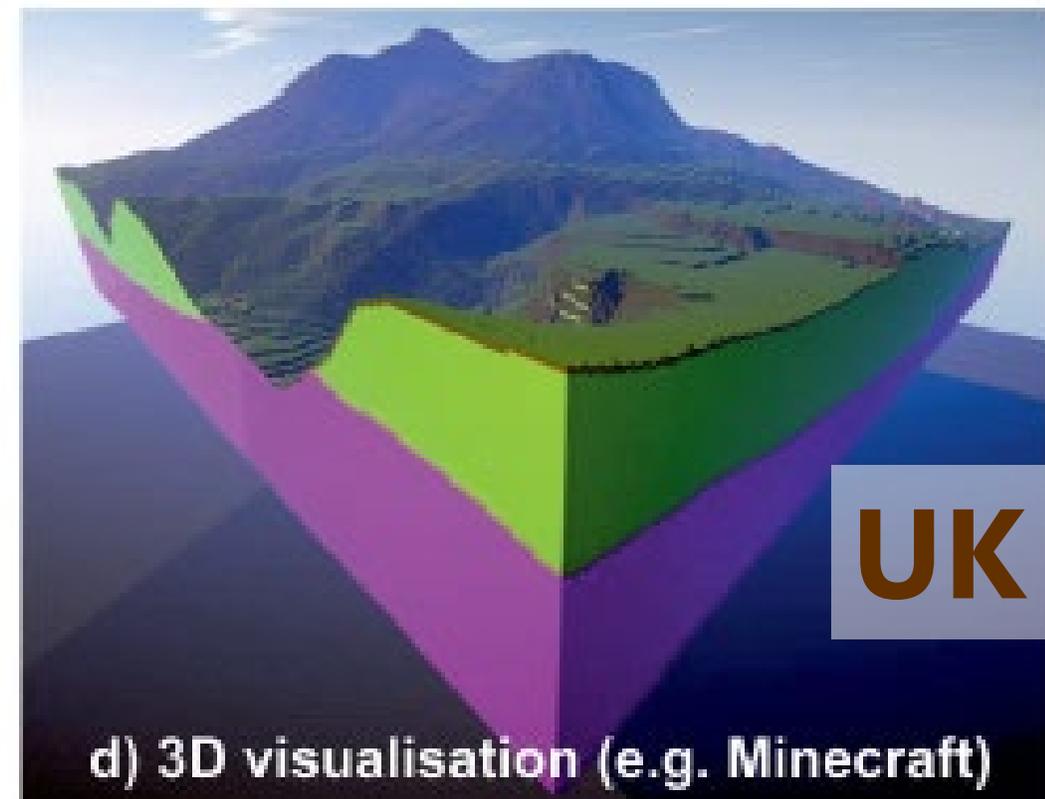
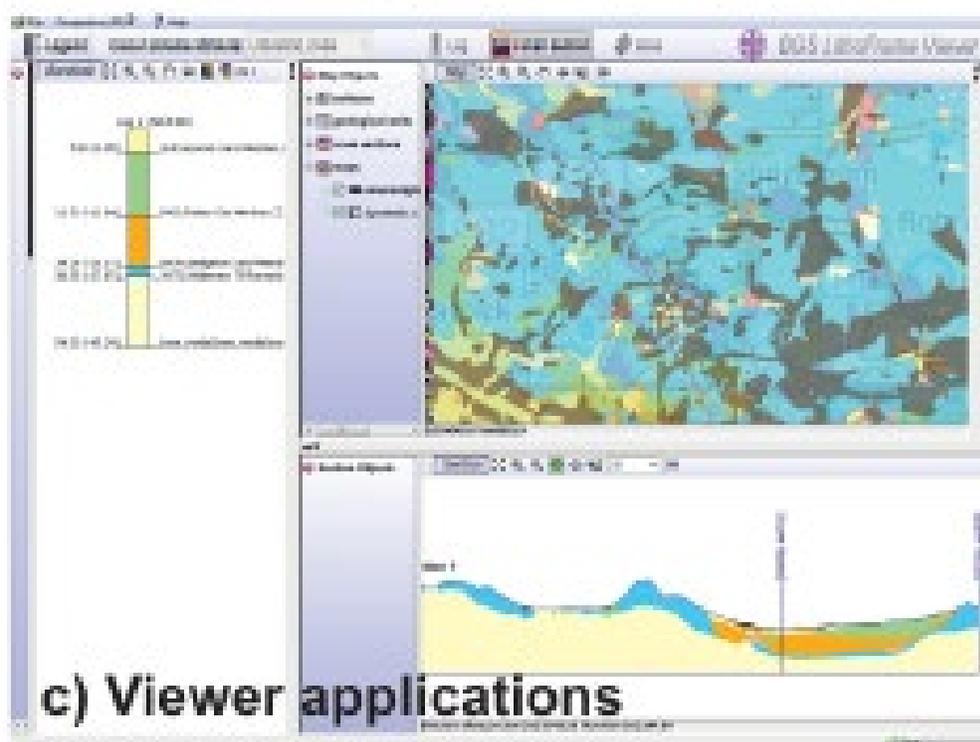
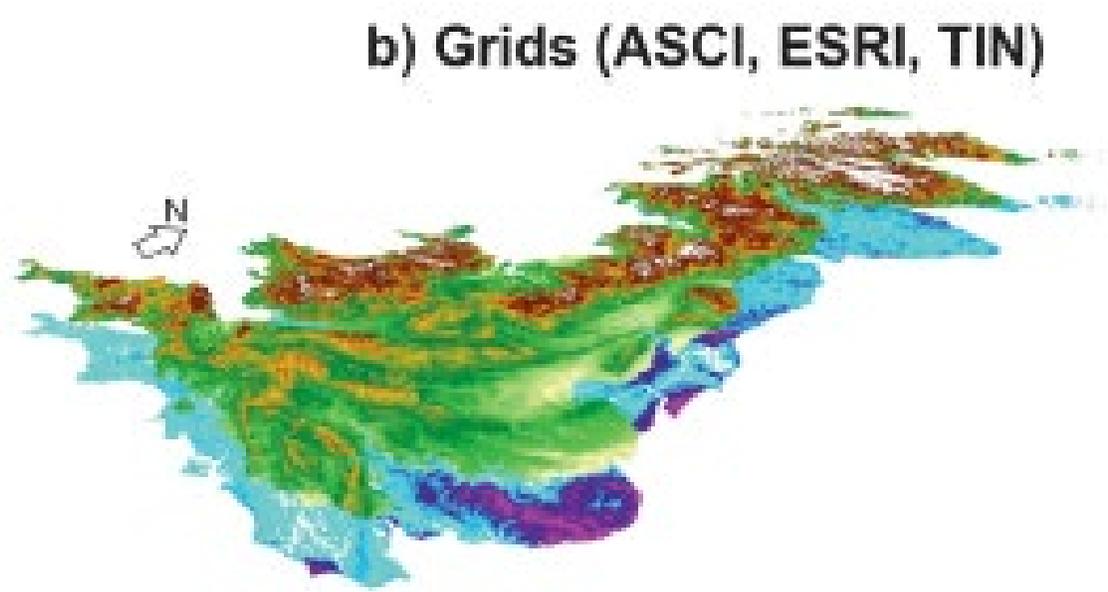
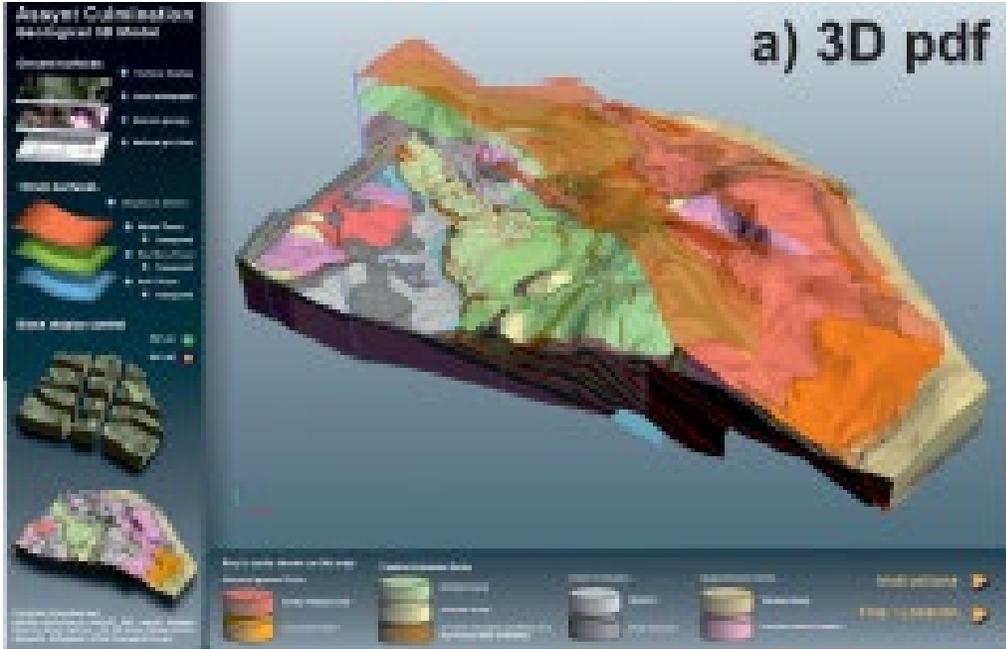


Base Cenozoic

Mesozoic

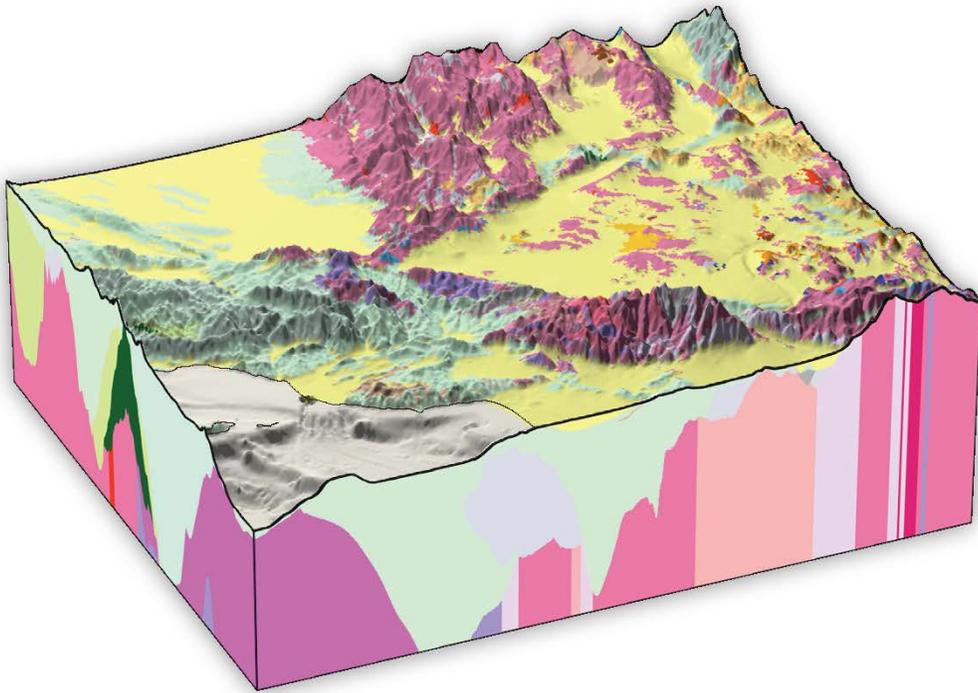
Switzerland



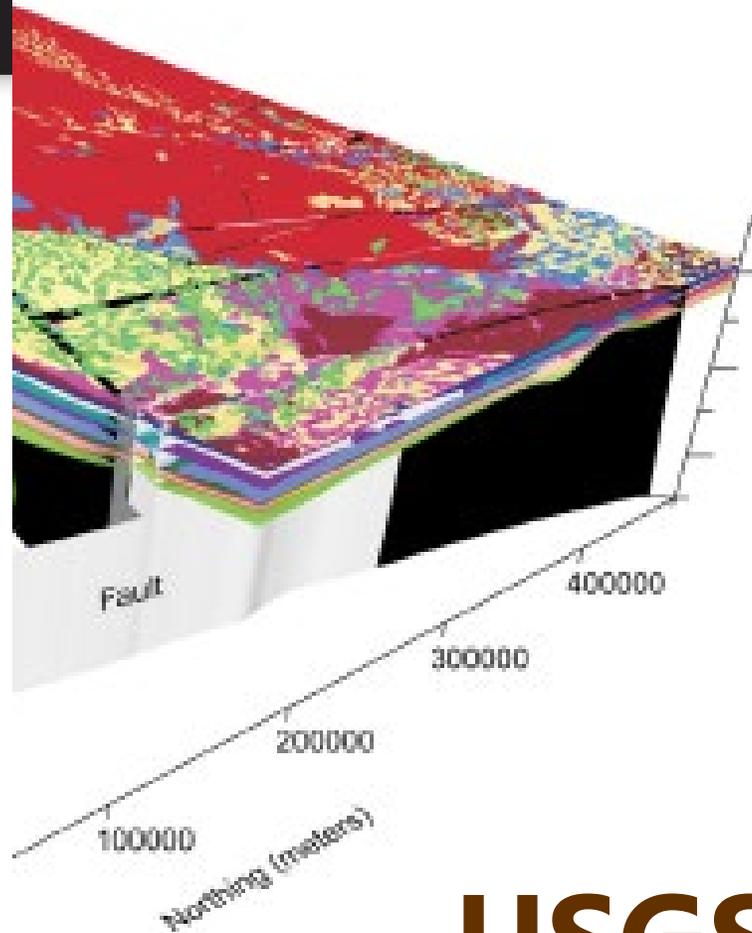


Elevation (feet)
5,0
-5,
-10
-1
-2
-

3D Geologic Framework for Use with the U.S. Geological Survey National Crustal Model, Phase 1—Western United States



North



USGS

Normal Conic Coordinate System

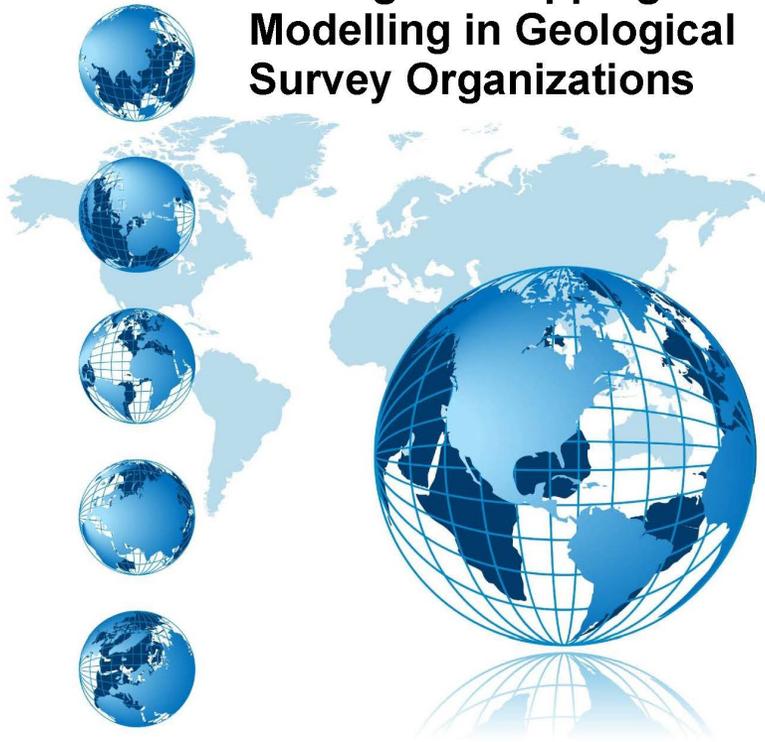
Open-File Report 2019-1081

U.S. Department of the Interior
U.S. Geological Survey

- | | |
|----------------------|----------------|
| Cherokee Group | Hunton FML top |
| Atoka Group | Sylvan Shale |
| Thirteen Finger lime | Viola Fm |
| Morrow shale | Simpson Group |
| Springer Fm | Arbuckle Group |
| Woodford Shale | Precambrian |



2019 Synopsis of Current
Three-Dimensional
Geological Mapping and
Modelling in Geological
Survey Organizations



- **3D geology is essential for management of energy, minerals, water, and hazards**
- **3D geology is essential for infrastructure design**
- **3D geology is essential for understanding the history of life, and the structure of our planet**
- **An emerging concept is Digital Twin**
- **A Digital Twin is a dynamic model of something that you are managing**
- **3D geology is a digital twin of our landmass**

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