



Repeated radon measurements in the context of the tectonic and geologic framework – an approach for the federal state of Hesse, Germany

Rouwen Lehné, Annemarie Militzer, Heiner Heggemann, Timo Sauerwein, Melanie Ströhlein, David Gips, Carl Möll

Department G1 basic geological information



Location federal state of Hesse

(wikipedia)

Assessment concept radon strategy Hesse

Positive

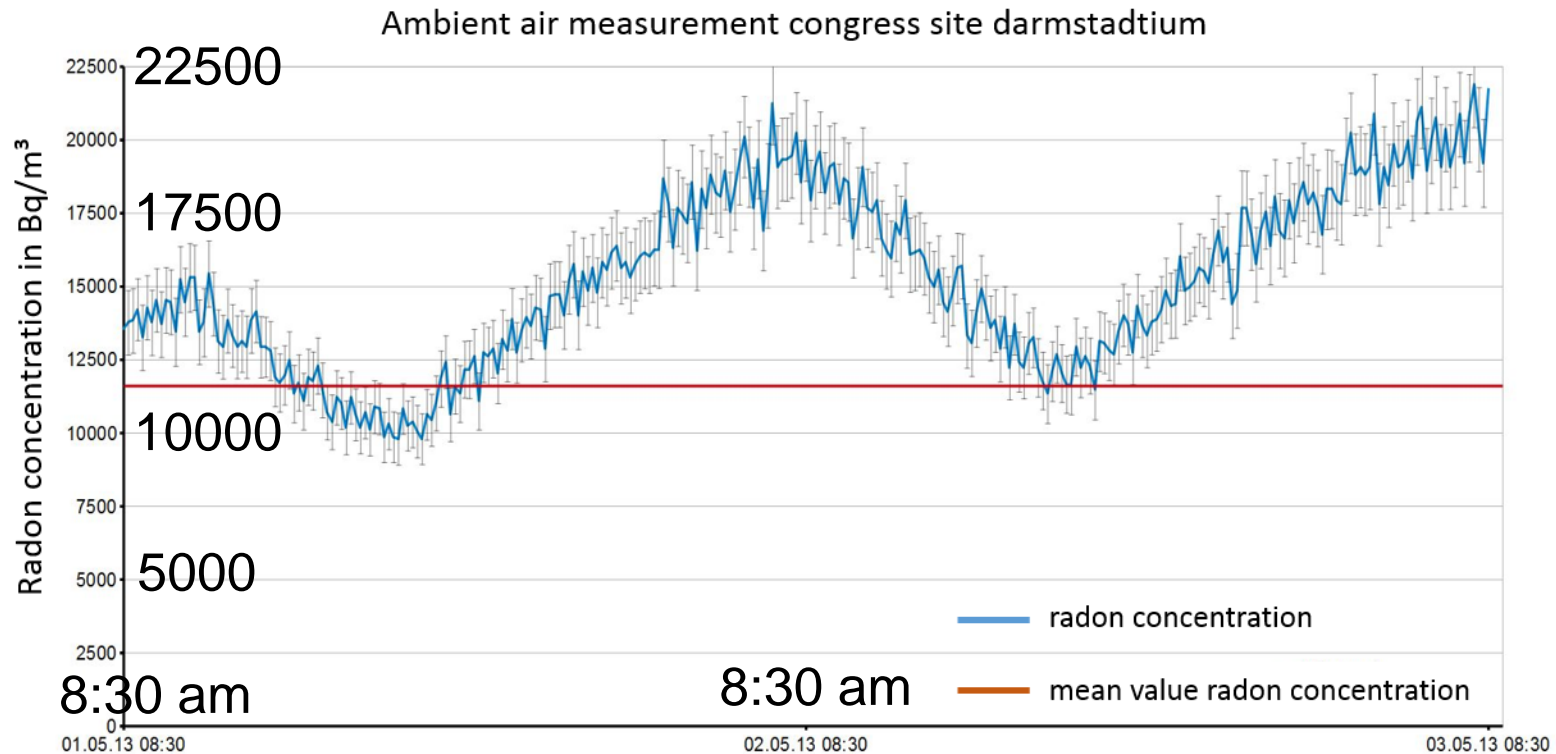
- + Evenly distributed measuring points
- + Geology considered
- + Land use considered (forest, agricultural areas, grassland)
- + Limiting factors considered (moisture, digability)

Negative

- Repeated measurements for verification not considered sufficiently
- Weather/climate conditions in combination with land use not considered sufficiently
- Tectonic features not considered sufficiently

Weather/climate conditions/tectonics

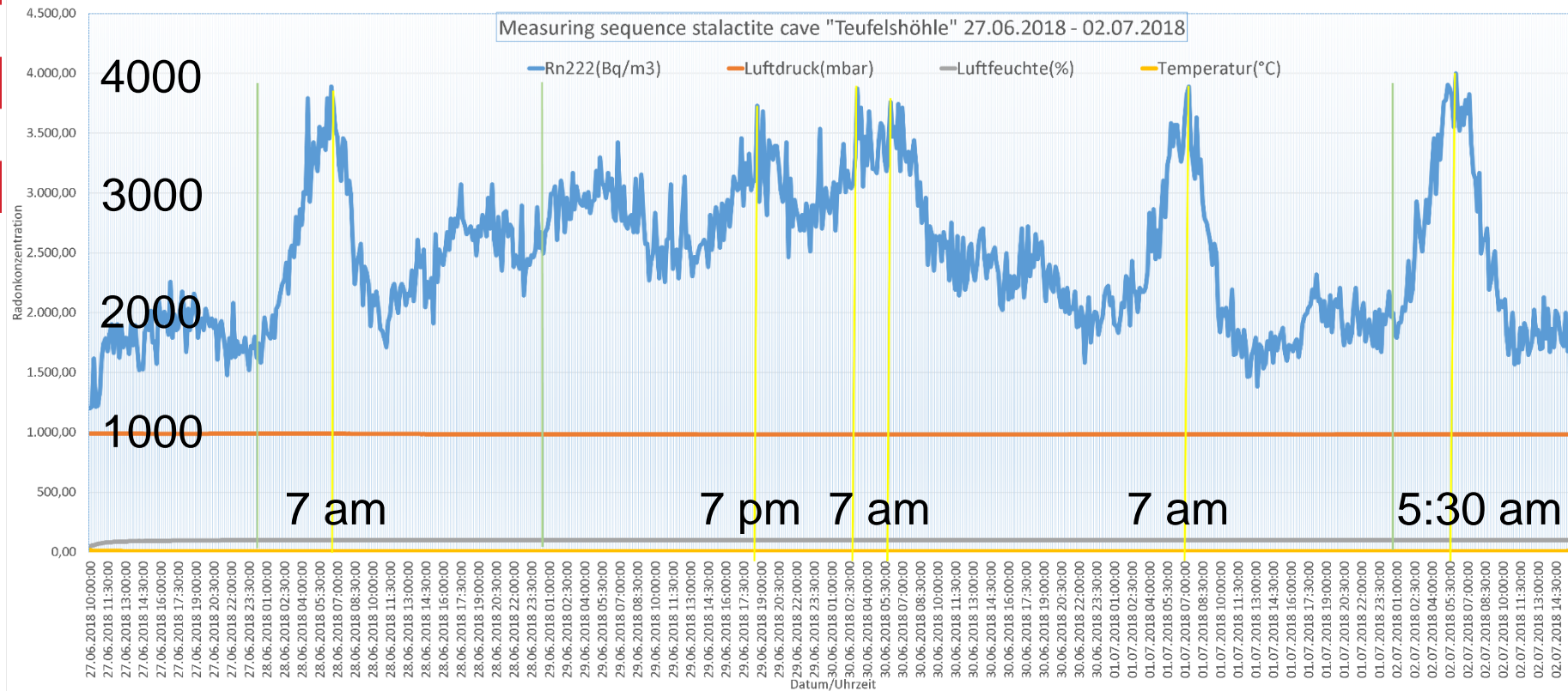
Congress site darmstadtium



ambient air measurements 1,5 m beside an exposed section of the eastern master fault of the Upper Rhine Graben Rhine Graben at the congress site darmstadtium in Darmstadt in May 2013 (Hoppe et al. 2015) – surrounding rock is weathered granodiorite and Quaternary deposits

Meteorological conditions

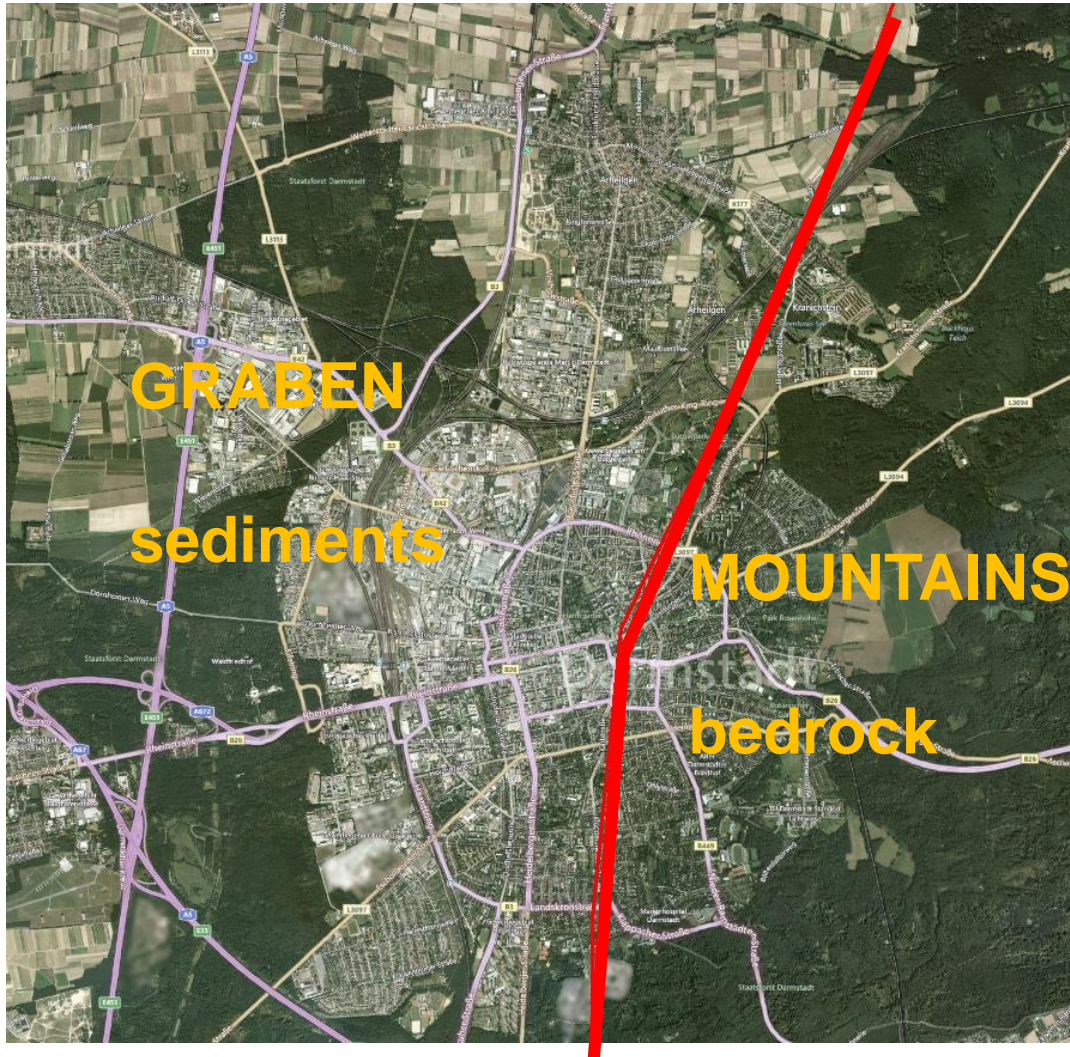
Stalactite cave Steinau (Shell Limestone)



ambient air measurements in a stalactite cave in Steinau in June 2018 – surrounding rock is shell

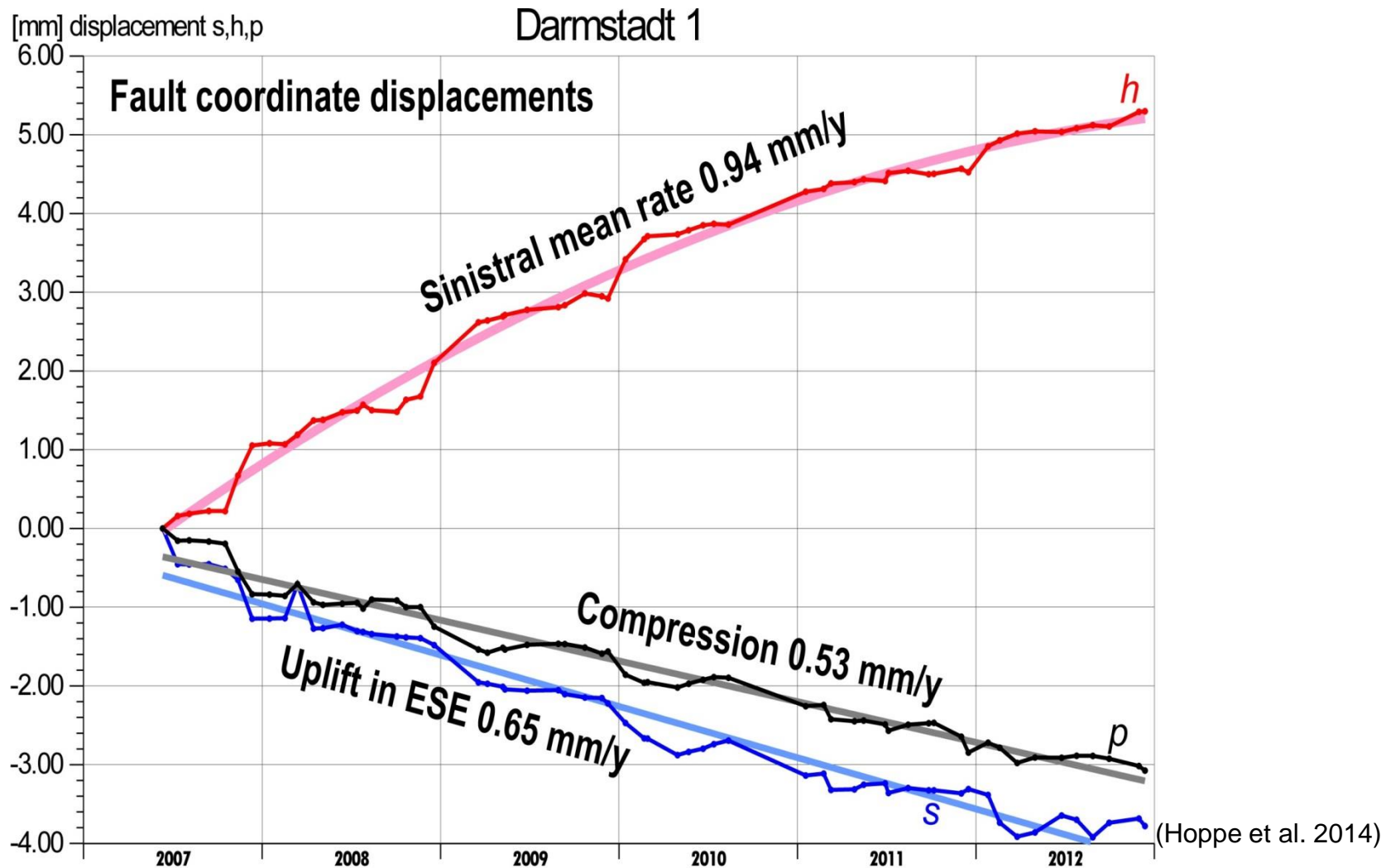
Tectonic features

Geodynamics in Darmstadt

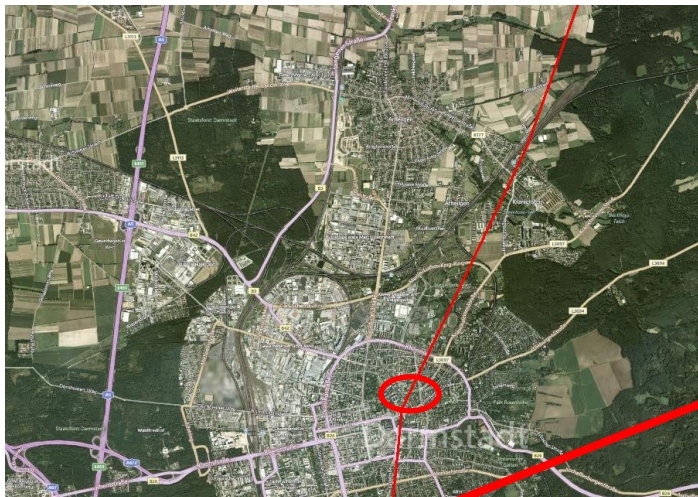


(Bing Maps)

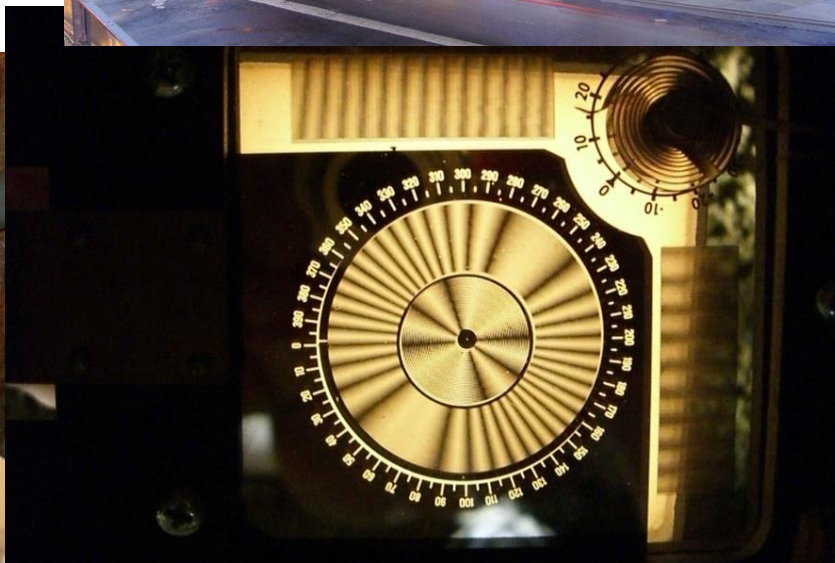
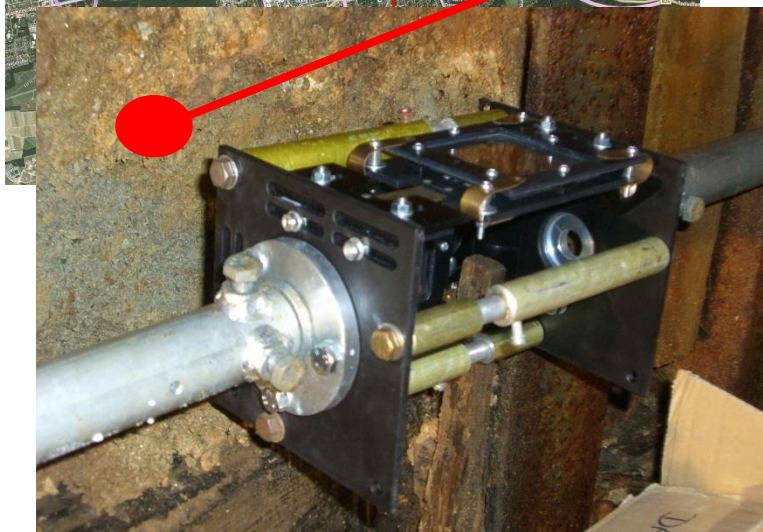
Tectonic features



Tectonic features



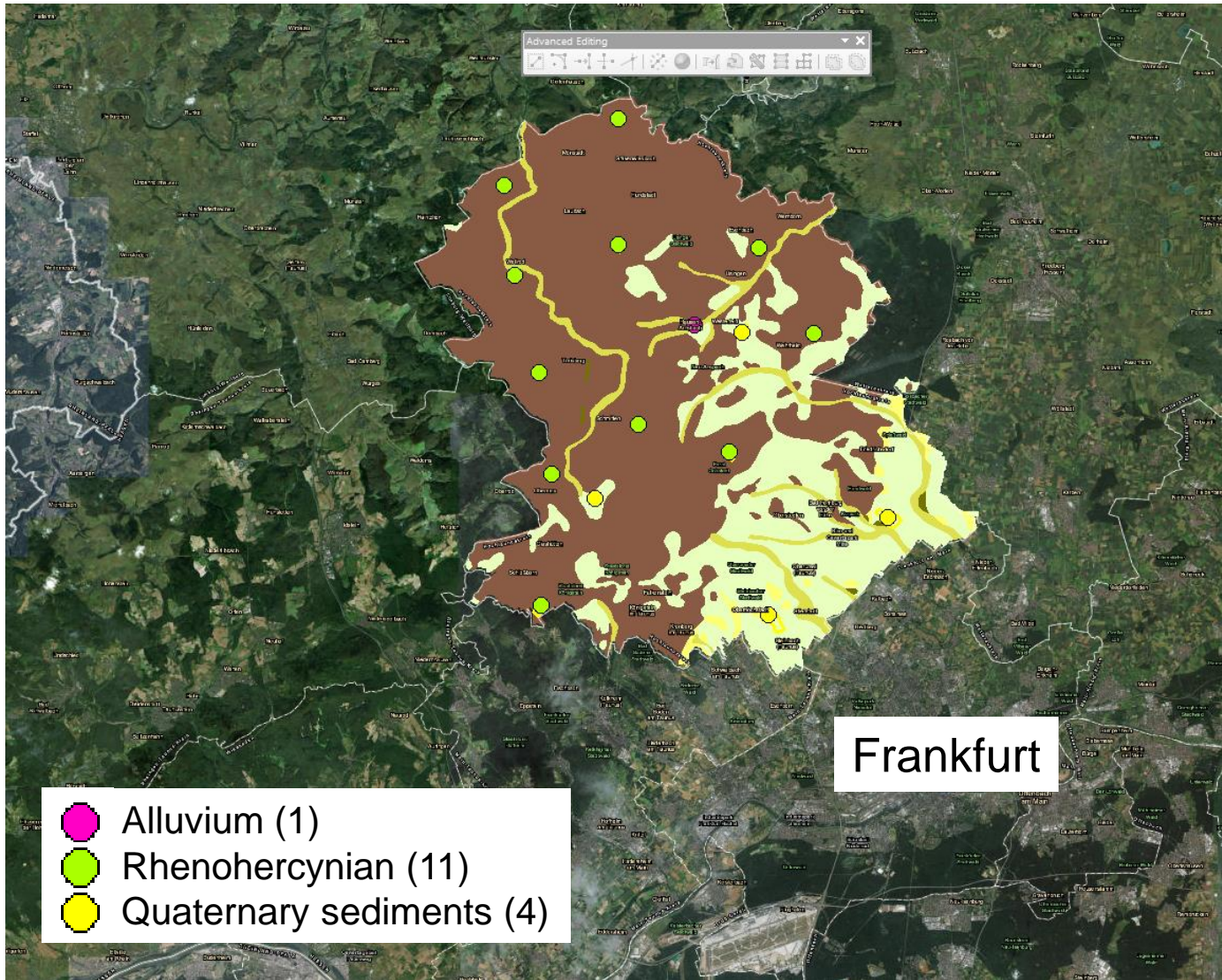
Soil gas measurement = 340 kBq/m³



Approach meteorology/land use + repeated measurements

	Alluvial Deposits	Bunter Sandstone	Crystalline Basement	Renohercynian	Lower Permian	Quaternary Sediments	Tertiary Sediments	Tertiary Volcanics	Mesozoic/ Lower Permian
Kreisfreie Stadt Darmstadt			1		1	3			
Kreisfreie Stadt Frankfurt am Main	1					7	1		
Kreisfreie Stadt Offenbach am Main						1	1		
Landeshauptstadt Wiesbaden	1			2		3	1		
Bergstraße	6	4	9			8			
Darmstadt-Dieburg	2	1	5		1	12			
Groß-Gerau	5					11			
Hochtaunuskreis	1			11		4			
Main-Kinzig-Kreis	5	20	1		2	10	2	2	2
Main-Taunus-Kreis	1			2		4	1		
Odenwaldkreis	1	16	3			1			
Offenbach	1				2	10			
Rheingau-Taunus-Kreis	1			22		5	1		
Wetteraukreis	5	2		4	2	13	4	9	
Gießen	3			5		7	6	9	
Lahn-Dill-Kreis	2			28		4	1	2	
Limburg-Weilburg	1			13		9	2	1	
Marburg-Biedenkopf	5	13		16		7	2	1	2
Vogelsbergkreis	5	11				10	3	24	
Kreisfreie Stadt Kassel	1	1				1	1		
Fulda	3	28				7	1	4	6
Hersfeld-Rotenburg	3	28			1	4			3
Kassel	3	20				11	4	1	8
Schwalm-Eder-Kreis	6	21		2		14	7	4	2
Waldeck-Frankenberg	4	23		29		3			7
Werra-Meißner-Kreis	3	19		1		3			10
SUM	69	207	18	135	8	172	39	63	39

County „Hochtaunuskreis“

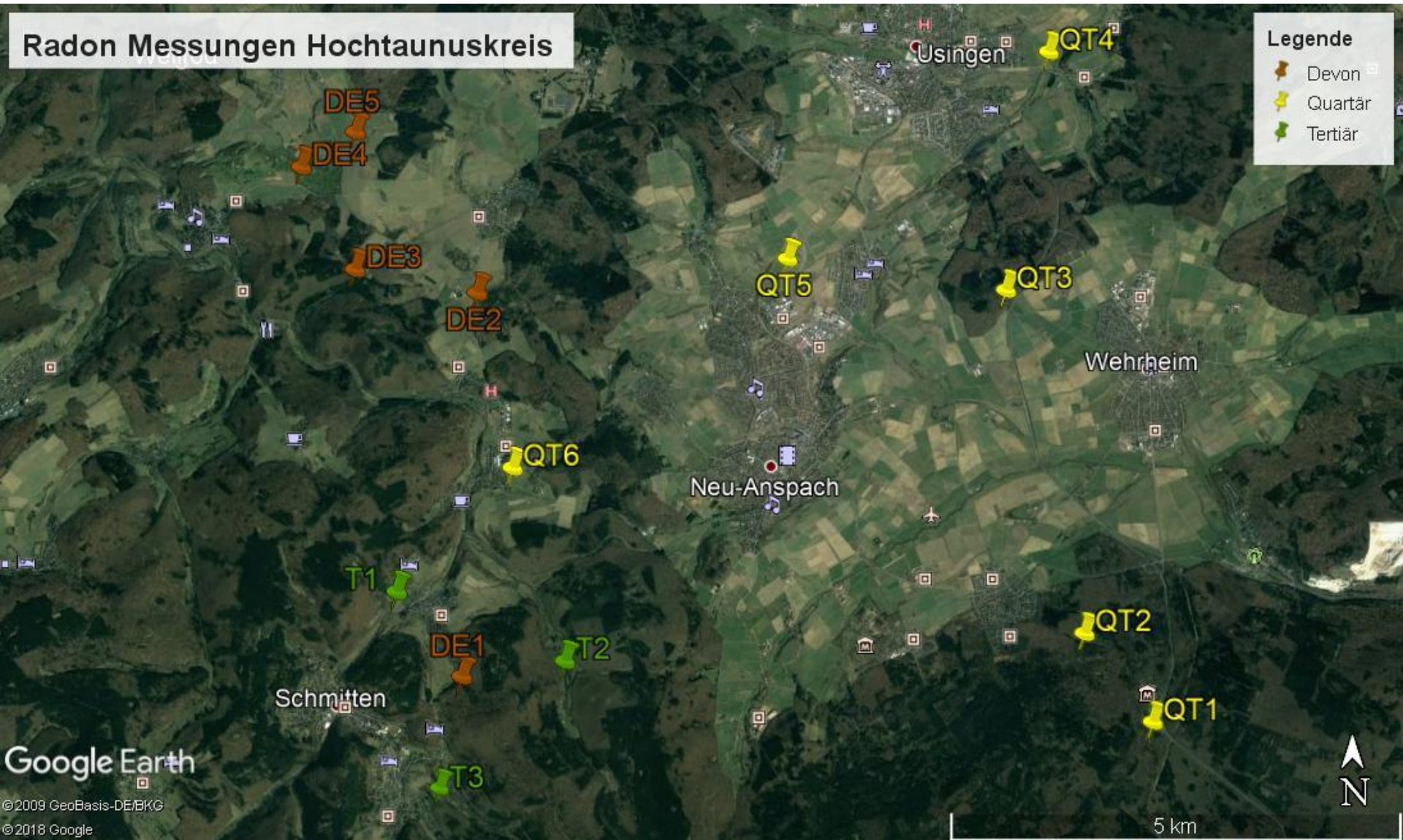


481 km²
2,28%

16 measurements

1 measurement
per 30 km²

Equipment =
Saphymo
Alphaguard



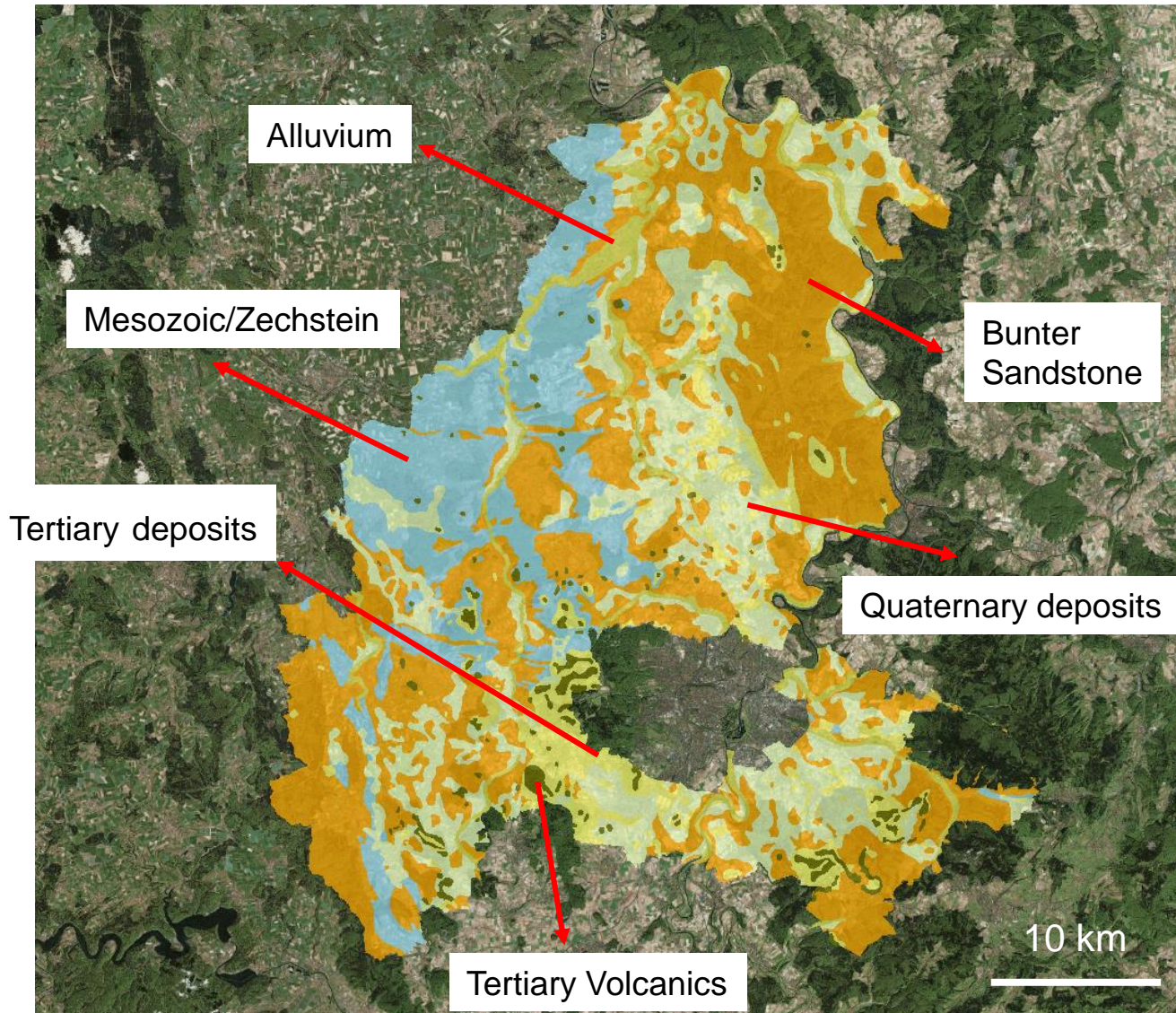
First impressions/interpretations

- Concentrations tend to be higher on farmland and meadows than in the forest
- Highest concentrations in devonian, followed by Tertiary and Quaternary
- High variability between measurements
- No compulsory link between concentration and soil humidity
-
- Further analyses in progress (core description, correlations, statistics, etc.)

Approach tectonic features

	Alluvial Deposits	Bunter Sandstone	Crystalline Basement	Renohercynian	Lower Permian	Quaternary Sediments	Tertiary Sediments	Tertiary Volcanics	Mesozoic/ Lower Permian
Kreisfreie Stadt Darmstadt			1		1	3			
Kreisfreie Stadt Frankfurt am Main	1					7	1		
Kreisfreie Stadt Offenbach am Main						1	1		
Landeshauptstadt Wiesbaden	1			2		3	1		
Bergstraße	6	4	9			8			
Darmstadt-Dieburg	2	1	5		1	12			
Groß-Gerau	5					11			
Hochtaunuskreis	1			11		4			
Main-Kinzig-Kreis	5	20	1		2	10	3	8	2
Main-Taunus-Kreis	1			2		4	1		
Odenwaldkreis	1	16	3			1			
Offenbach	1				2	10			
Rheingau-Taunus-Kreis	1			22		5	1		
Wetteraukreis	5	2		4	2	13	4	9	
Gießen	3			5		7	6	9	
Lahn-Dill-Kreis	2			28		4	1	2	
Limburg-Weilburg	1			13		9	2	1	
Marburg-Biedenkopf	5	13		16		7	2	1	2
Vogelsbergkreis	5	11				10	3	24	
Kreisfreie Stadt Kassel	1	1				1	1		
Fulda	3	28				7	1	4	6
Hersfeld-Rotenburg	3	28			1	4			3
Kassel	3	20				11	4	1	8
Schwalm-Eder-Kreis	6	24		2		14	7	4	2
Waldeck-Frankenberg	4	23		29		3			7
Werra-Meißner-Kreis	3	19		1		3			10
SUM	69	207	18	135	8	172	39	63	39

County „Kassel“



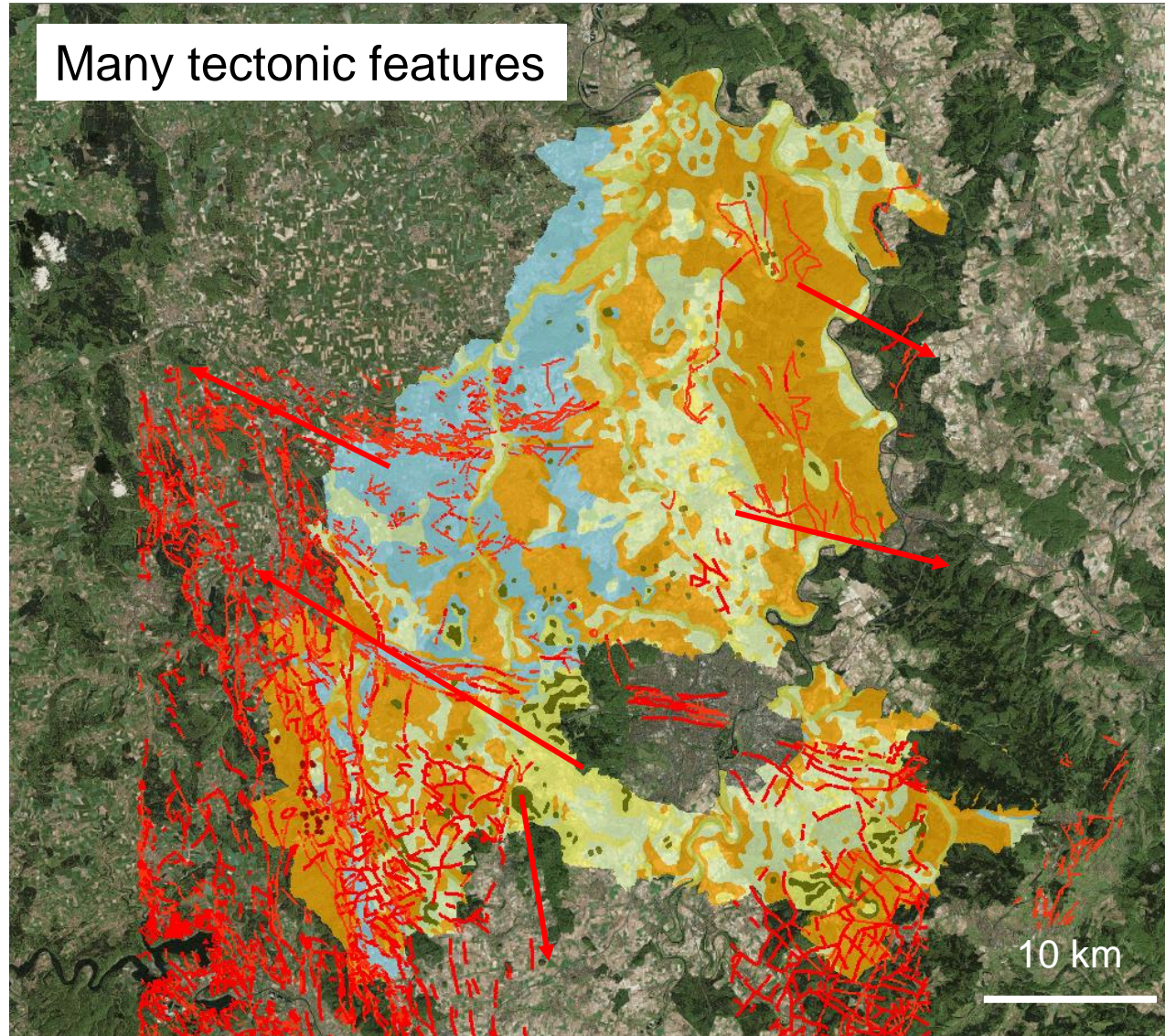
1292 km²
6,13%

47 measurements

1 measurement
per 27,5 km²

Equipment =
Saphymo
Alphaguard

County „Kassel“



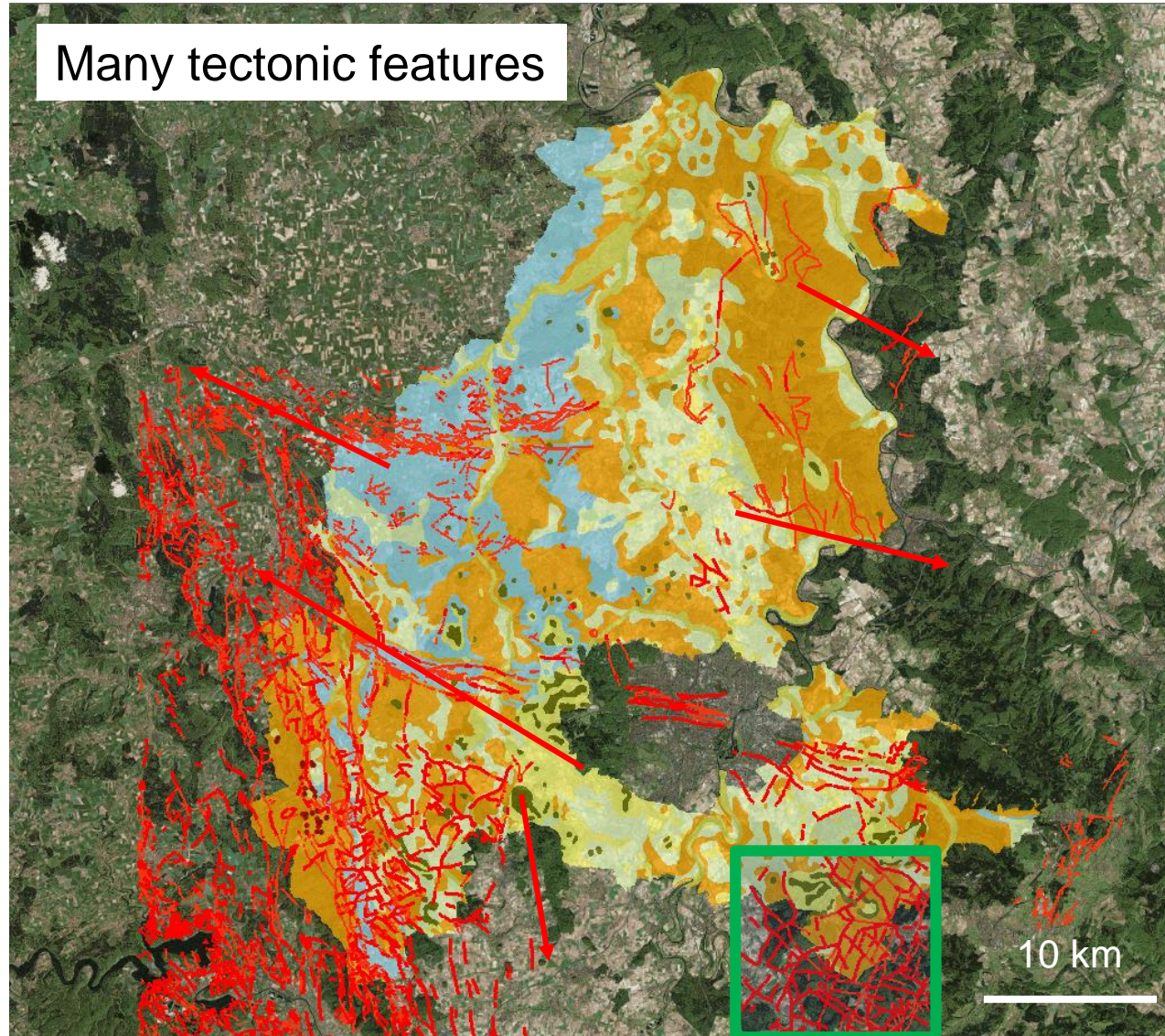
1292 km²
6,13%

47 measurements

1 measurement
per 27,5 km²

Equipment =
Saphymo
Alphaguard

County „Kassel“



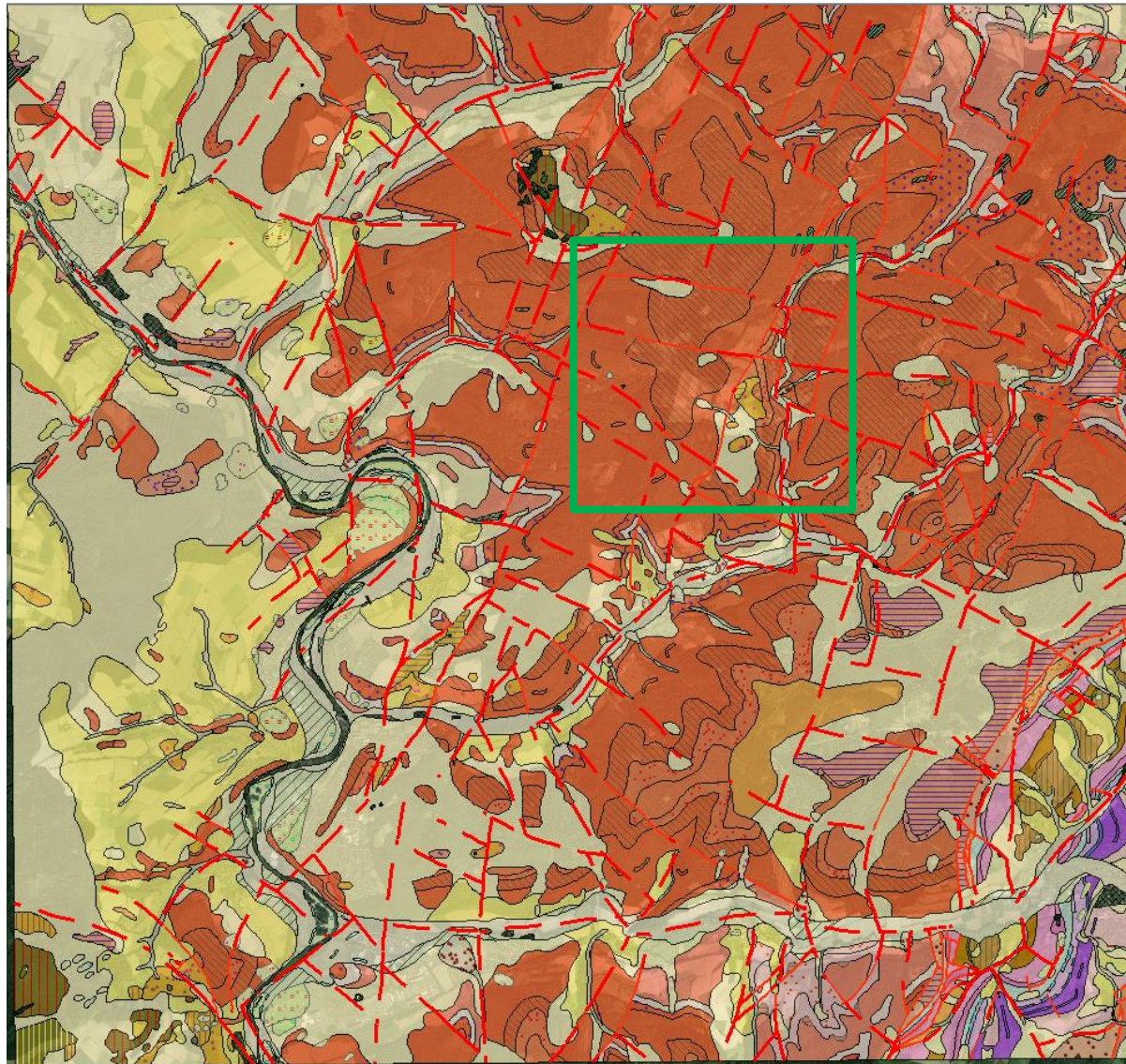
1292 km²
6,13%

47 measurements

1 measurement
per 27,5 km²

Equipment =
Saphymo
Alphaguard

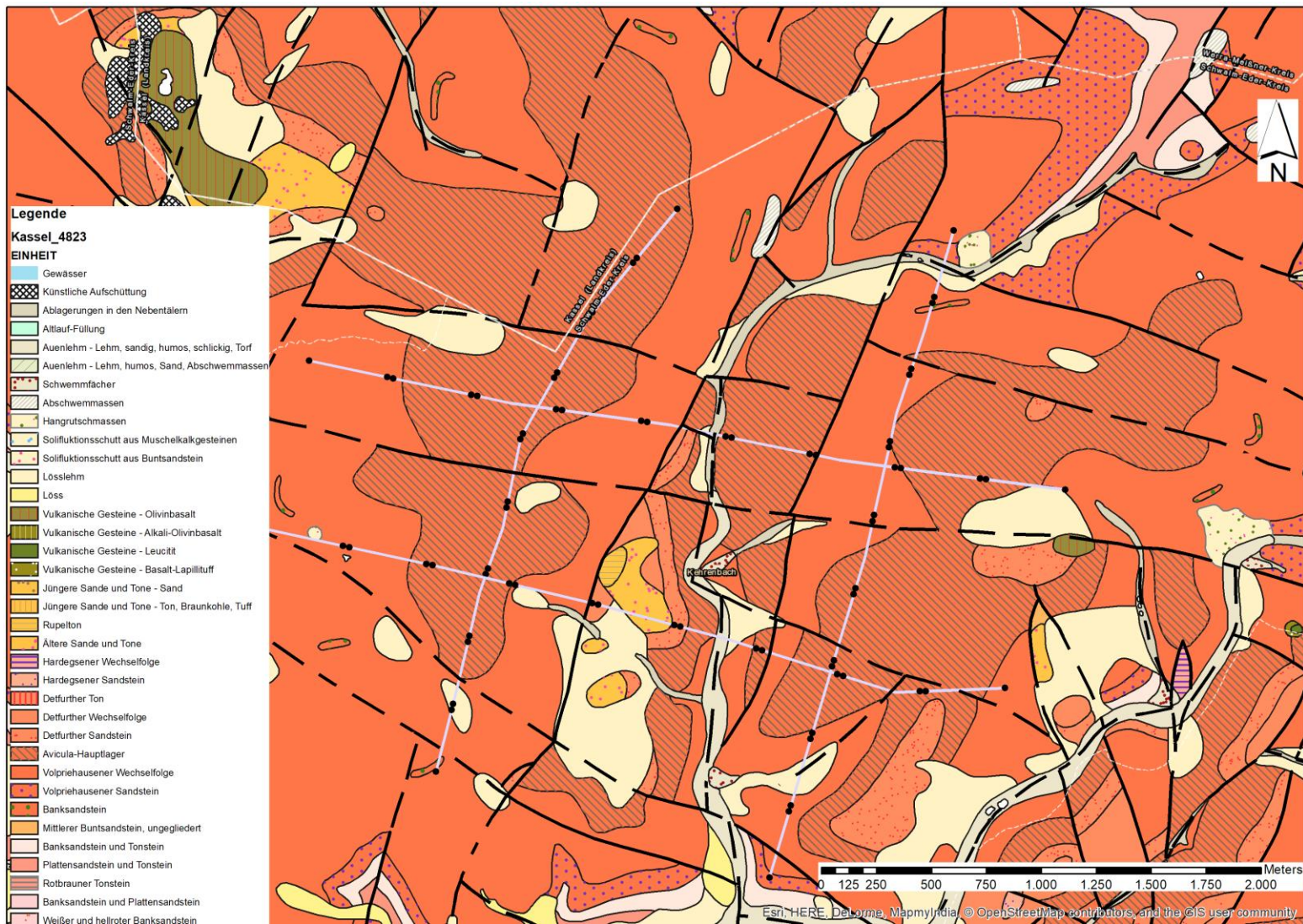
Measurements across tectonic features



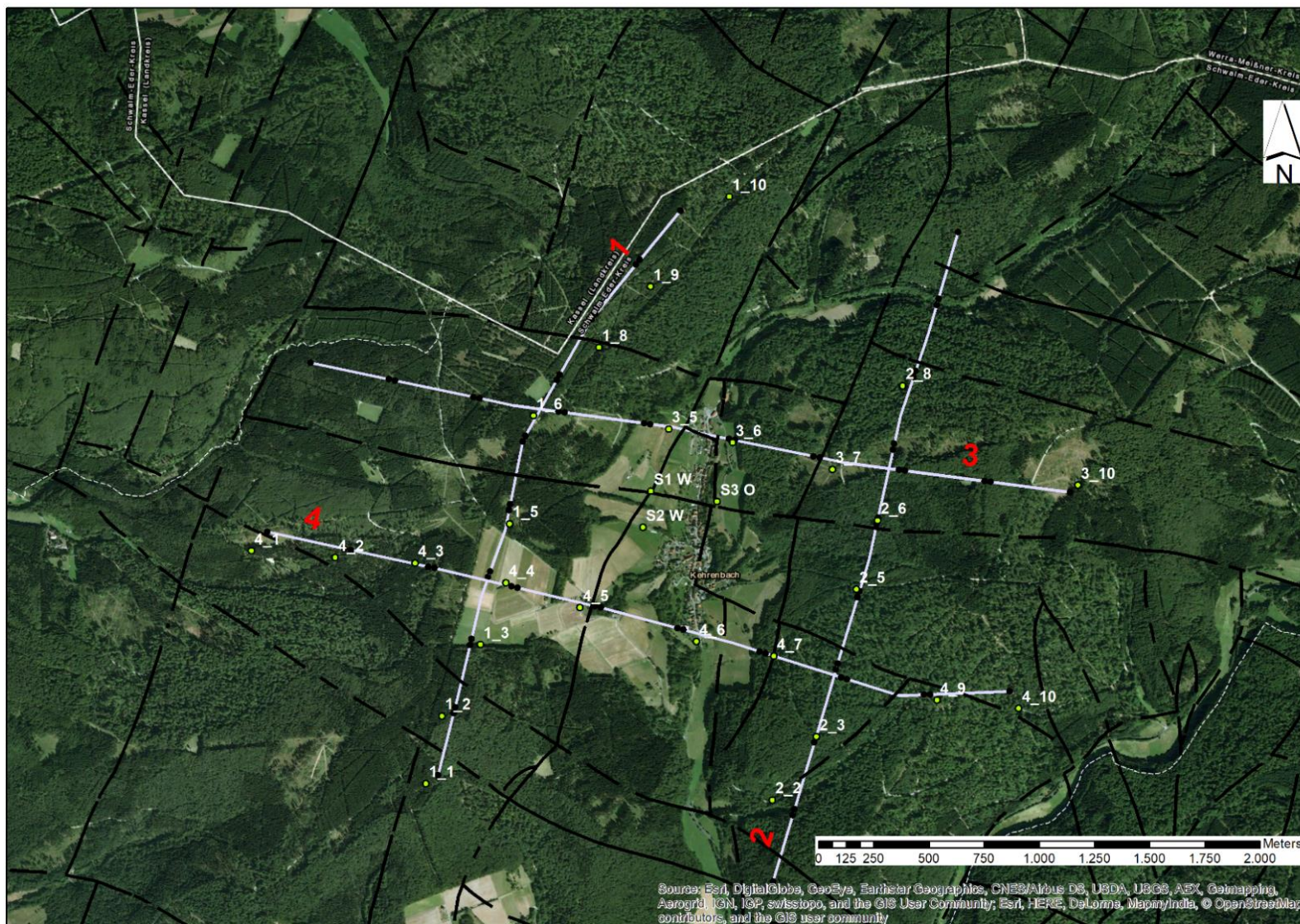
Mainly
Bunter Sandstone

2 km

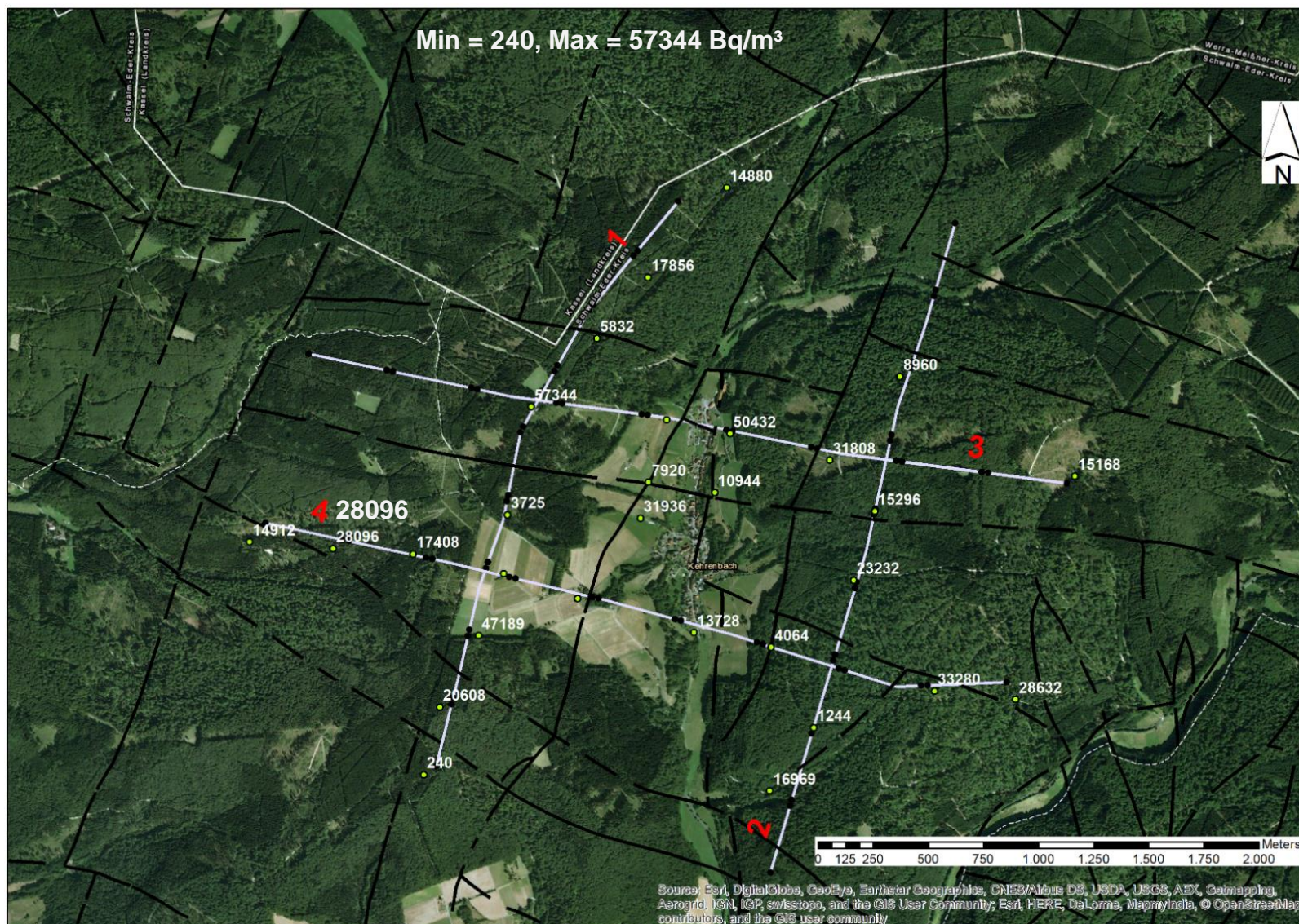
Measurements across tectonic features



Measurements across tectonic features



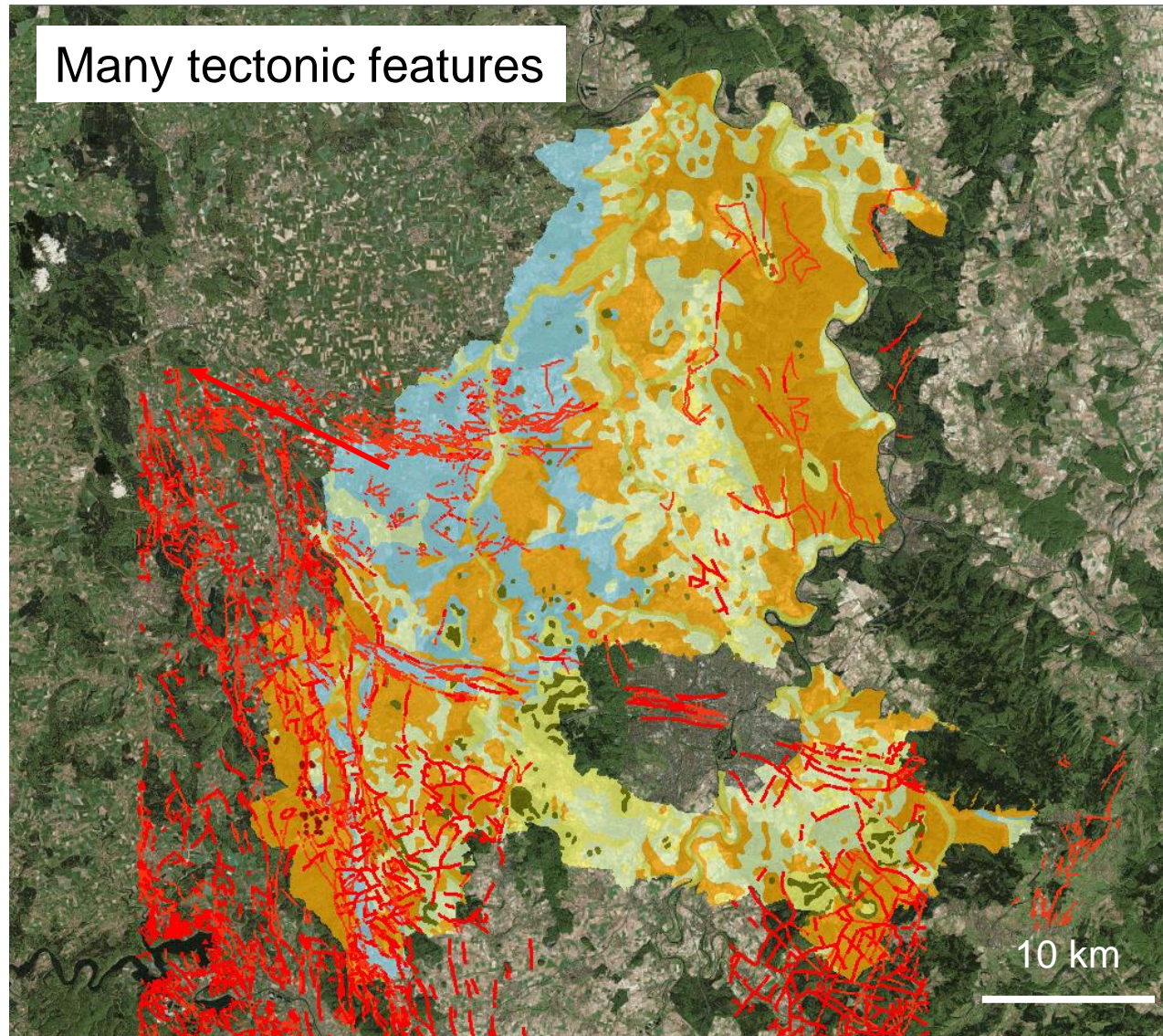
Measurements across tectonic features



First impressions/interpretations

- Significant variations inside the Bunter Sandstone
- No compulsory link between concentrations and tectonics
-
- Further analyses in progress (core description, correlations, etc.)

Way forward

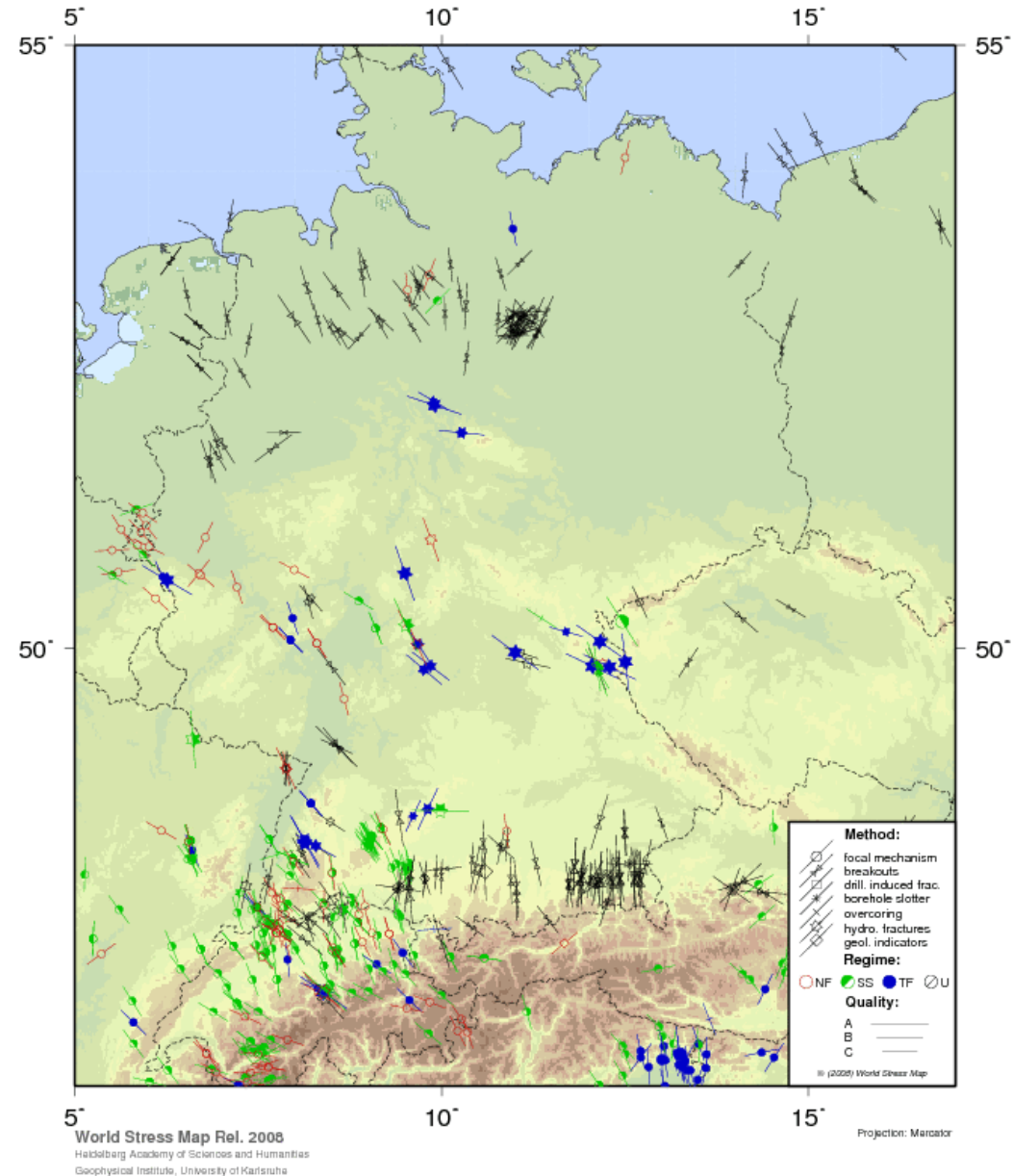


Normal faults?
Thrust faults?
Strike-Slip?
Active?
Inactive?

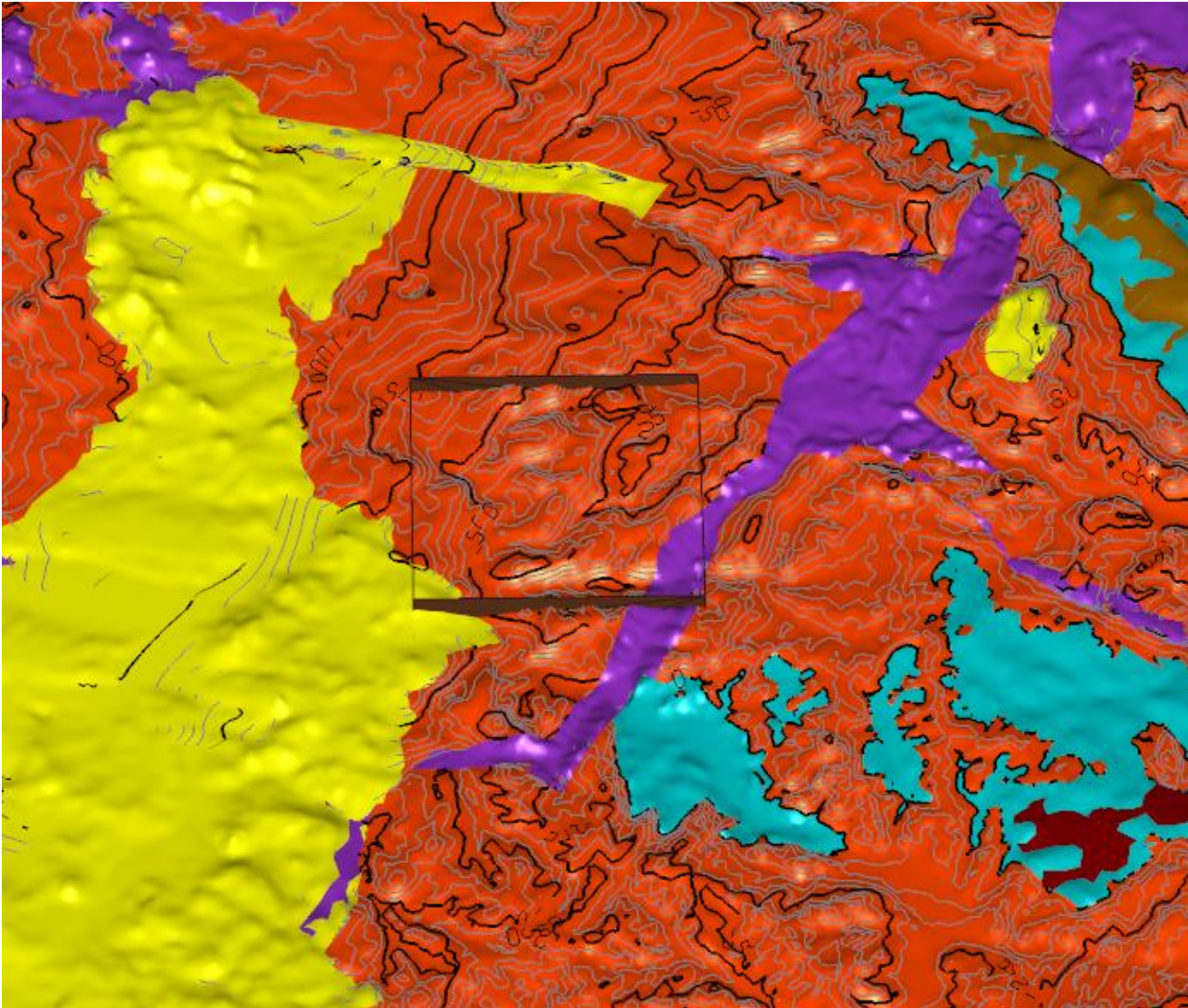
Way forward

Classification of tectonic features according to their orientation relatively to the recent stress field

>> slip tendency analyses



Way forward



Improving
existing
geological
models in terms
of tectonic
inventory

Way forward

Improving existing geological models in terms of tectonic inventory



stay tuned

rouwen.lehne@hlnug.hessen.de