



Under the ice and over the sky

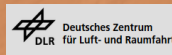
Aspects of building the International Quaternary Map of Europe and potentially useful parallels to planetary geological map projects

Kristine Asch, Andrea Nass & Stephan van Gasselt

Dr. Kristine Asch, Bundesanstalt für Geowissenschaften und Rohstoffe, Stilleweg 2, 30655 Hannover. Kristine.Asch@bgr.de

Andreas Nass, Deutsches Zentrum für Luft- und Raumfahrt (DLR), Rutherfordstraße 2, 12489 Berlin, Andrea.Nass@dlr.de

Stephan van Gasselt, National Chengchi University, Dep. of Land Economics, Zhi-Nan Road, Taipei 11605, Taiwan, svg@ieee.org





Project of the International Quaternary Map of Europe (New IQUAME 2500) in a nutshell:

- Umbrella: CGMW* and INQUA**
- Coordination: BGR, Germany
- 2011: Start at INQUA congress, Bern
- Planned to be completed 2023



Aims:

- Summarize the actual status quo of mapping and research on Quaternary geology in Europe
 - To help understanding the Quaternary history of Europe
-
- In cooperation and synergies with international colleagues
 - Based on the 1st edition paper map (1967 – 2005)
 - Project As GIS, to be available on-line
 - For science, university, planning authorities, exploration ...



Kristine Asch

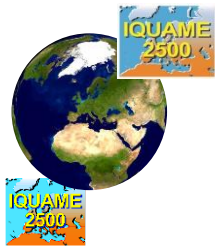


Bundesanstalt für
Geowissenschaften
und Rohstoffe

GEOZENTRUM HANNOVER

* Commission of the Geological Map of the World (CGMW)

** and International Union for Quaternary Research (INQUA)



IQUAME 2500 – Participation

International Quaternary Map of Europe
and Adjacent Areas



- 40 countries involved
- Cooperation with EC EMODnet Geology project
- Subcommission Middle East of Commission of the Geological Map of the World etc.

Project Participation

Participating Countries

National Geological Survey Organizations (contact points and contributing scientists)

Albania: Albanian Geological Survey (gsa), Marku, S.
Austria: Geological Survey of Austria (GBA), Reithner, J.
Belarus: The National Academy of Sciences of Belarus (NASB), Karabanov, A.
Belgium: Royal Belgian Institute of Natural Sciences (RBINS), Bogemans, F., Heyvaert, V.
Bosnia and Herzegovina: Federal Geological Survey of Bosnia and Herzegovina, Hrvatic, H.
Croatia: Croatian Geological Survey (HGI), Galović, L.
Cyprus: Cyprus Geological Survey (GSD), Zomeni, Z.
Czech Republic: Czech Geological Survey (CGS), Nyvlt, D.
Denmark: Geological Museum, Natural History Museum of Denmark (SM), Houmark-Nielsen, M.
Denmark: Geological Survey of Denmark and Greenland (GEUS), Jakobsen, P., Leth, J.
Estonia: Geological Survey of Estonia (EGK), Kalin, V., Ploom, K.
Faroe Islands: The Faroe Earth and Energy Directorate (Feed), Mortensen, L.
Finland: Geological Survey of Finland (GTK), Kotilainen, A., Palmu, J.
France: Bureau de Recherches Géologiques et Minières (BRGM), Prognon, C., Tissoux, H.
France: Commission for the geological Map of the World - Commission de la Carte Géologique du Monde (CGMW - CCGM), Cadet, J., Rossi, P.
France: School and Observatory of Earth Science (EOST), Meghraoui, M.
Georgia: Tbilisi State University (TSU), Gobejishvili, R., Sadradze, N.
Germany: Behörde für Stadtentwicklung und Umwelt (BSU), Ehlers, J.
Germany: Federal Institute for Geosciences and Natural Resources (BGR), Asch, K., Müller, A.
Germany: Free University of Berlin (FU), Böse, M.
Germany: Geol. Dienst. Landesamt für Umwelt (LfU), Krömer, E.
Germany: Lower Saxony Institute for Historical Coastal Research (NIHK), Segsneider, M.
Greece: Hellenic Centre for Marine Research (HCMR), Sakellariou, D.
Greece: Institute of Geology & Mineral Exploration (IGME), Fotiadis, A., Tsagkas, D., Zamanis, I.
Iceland: Iceland GeoSurvey (ISOR), Hjartsson, A.
Iran: Geological Survey of Iran (GSI), Marzheh, E.
Iran: National Geosciences Database of Iran (NGDIR), Sadi, A.
Ireland: Geological Survey of Ireland (GSI), Pellicier, X., Sheehy, M.
Italy: Institute for Environmental Protection and Research (ISPR), Pantalon, M.
Italy: University of Ferrara (Unife), Ghezzi, E.
Lithuania: Lithuanian Geological Survey (LGT), Gyrobyte, R., Salkūnas, J.
Macedonia: Geological Survey of the Republic of Macedonia (gsm), Andov, I., Petrushev, D.
Malta: Ministry for Transport and Infrastructure (MIT), Caruana, A.
Montenegro: Geological Survey of Montenegro (GSM), Radusinovic, S.
Netherlands: TNO Geological Survey of the Netherlands (TNO), Scholker, J.
Netherlands: Utrecht University (UU), Cohen, K.
Norway: Geological Survey of Norway (NGU), Gislefoss, L., Lapinska-Viola, R., Lyså, A.
Poland: Polish Geological Institute (PGI), Marks, L., Rychel, J., Józwiak, K.
Portugal: National Laboratory of Energy and Geology (LNEG), Resurreição, R., Terreira, P.
Portugal: Portuguese Sea and Atmosphere Institute (gma), Borralho, M., Pareta, A.
Romania: Geological Institute of Romania (IGR), Munteanu, M.

Scientific advisors:

Dave Barrell, Margot Boese,
Kim Cohen, Juergen Ehlers,
Phil Gibbard, M. Meghraoui,
Christian Schlüchter,
Bettina Schulz-Paulsson,
et. al

Coordinator: Kristine Asch, BGR

Cartography:

Alexander Müller, BGR

0 1,000 Kilometers

Projection: Lambert Conformal Conic
Central Meridian: 10°00'00"
Standard Parallel 1: 45°00'00"
Standard Parallel 2: 65°00'00"
Latitude Of Origin: 55°00'00"

compiled by **BGR**



Kristine Asch

EGU General Assembly 2020



Bundesanstalt für
Geowissenschaften
und Rohstoffe

GEOZENTRUM HANNOVER

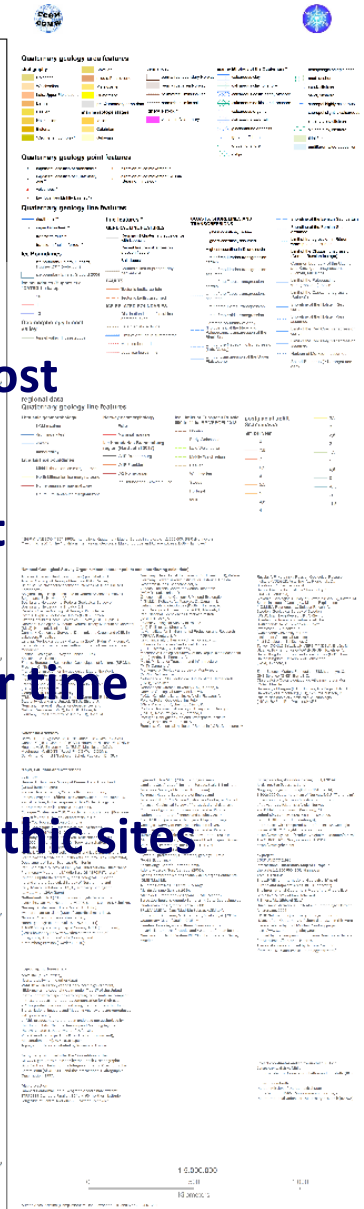
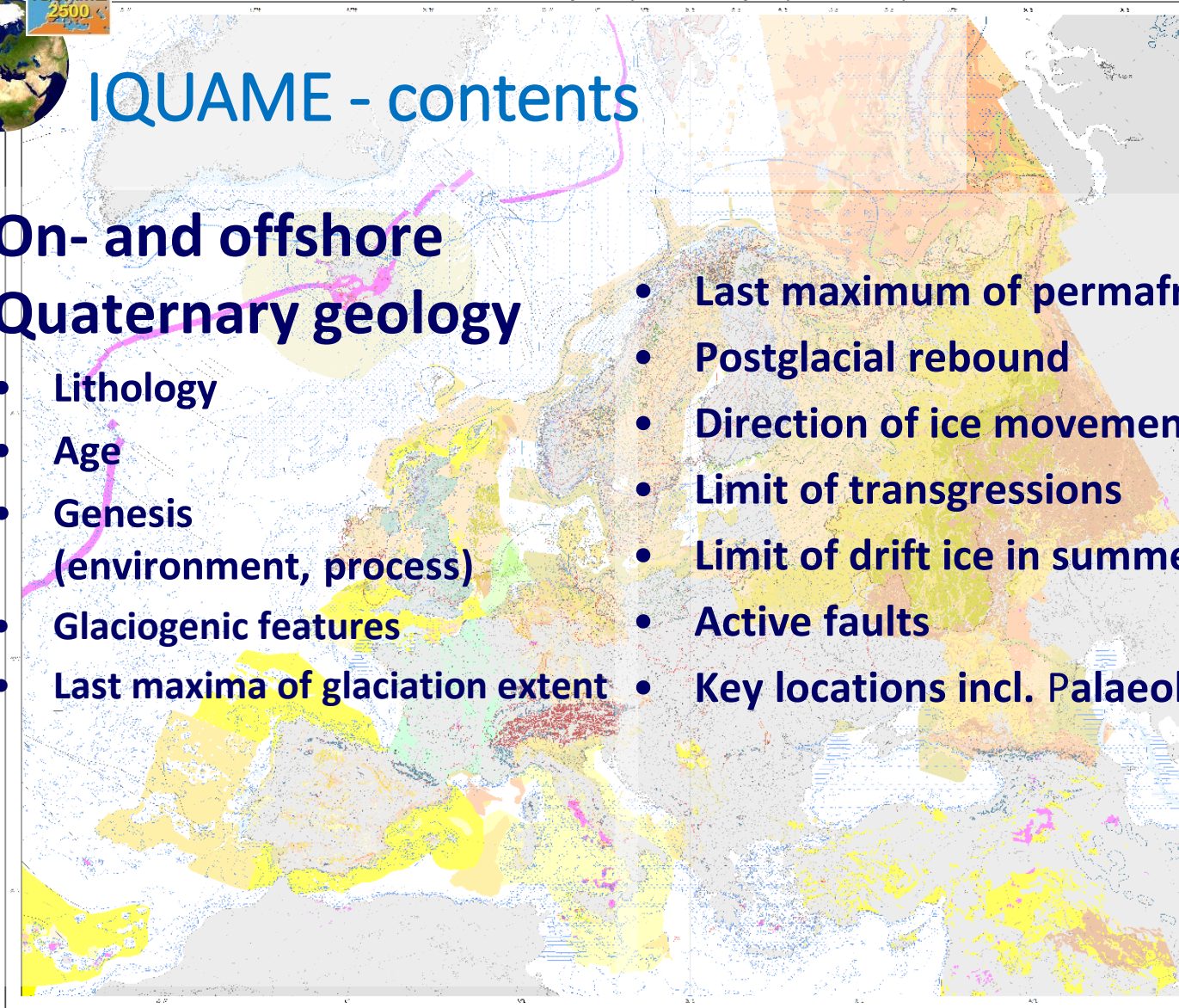


IQUAME
2500

IQUAME - contents

On- and offshore Quaternary geology

- Lithology
- Age
- Genesis (environment, process)
- Glaciogenic features
- Last maxima of glaciation extent
- Last maximum of permafrost
- Postglacial rebound
- Direction of ice movement
- Limit of transgressions
- Limit of drift ice in summer time
- Active faults
- Key locations incl. Palaeolithic sites



Kristine Asch

EGU General Assembly 2020



Bundesanstalt für
Geowissenschaften
und Rohstoffe

GEOZENTRUM HANNOVER



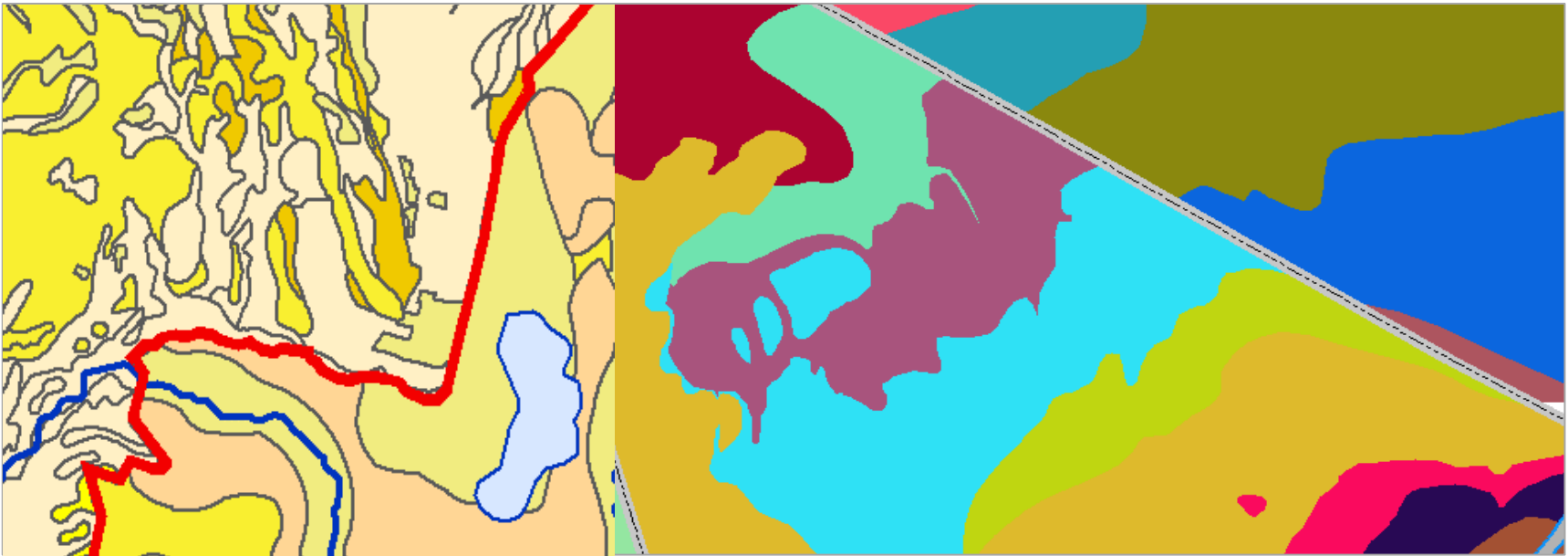
40 countries involved: Discrepancies across political boundaries

differing:

- national mapping focus,
- mapping scales
- age of mapping campaign
- mapping methods

- classification systems/taxonomies *
- portrayal rules

and ... the individual fondness of the mapping geologists for a specific feature



Kristine Asch

EGU General Assembly 2020



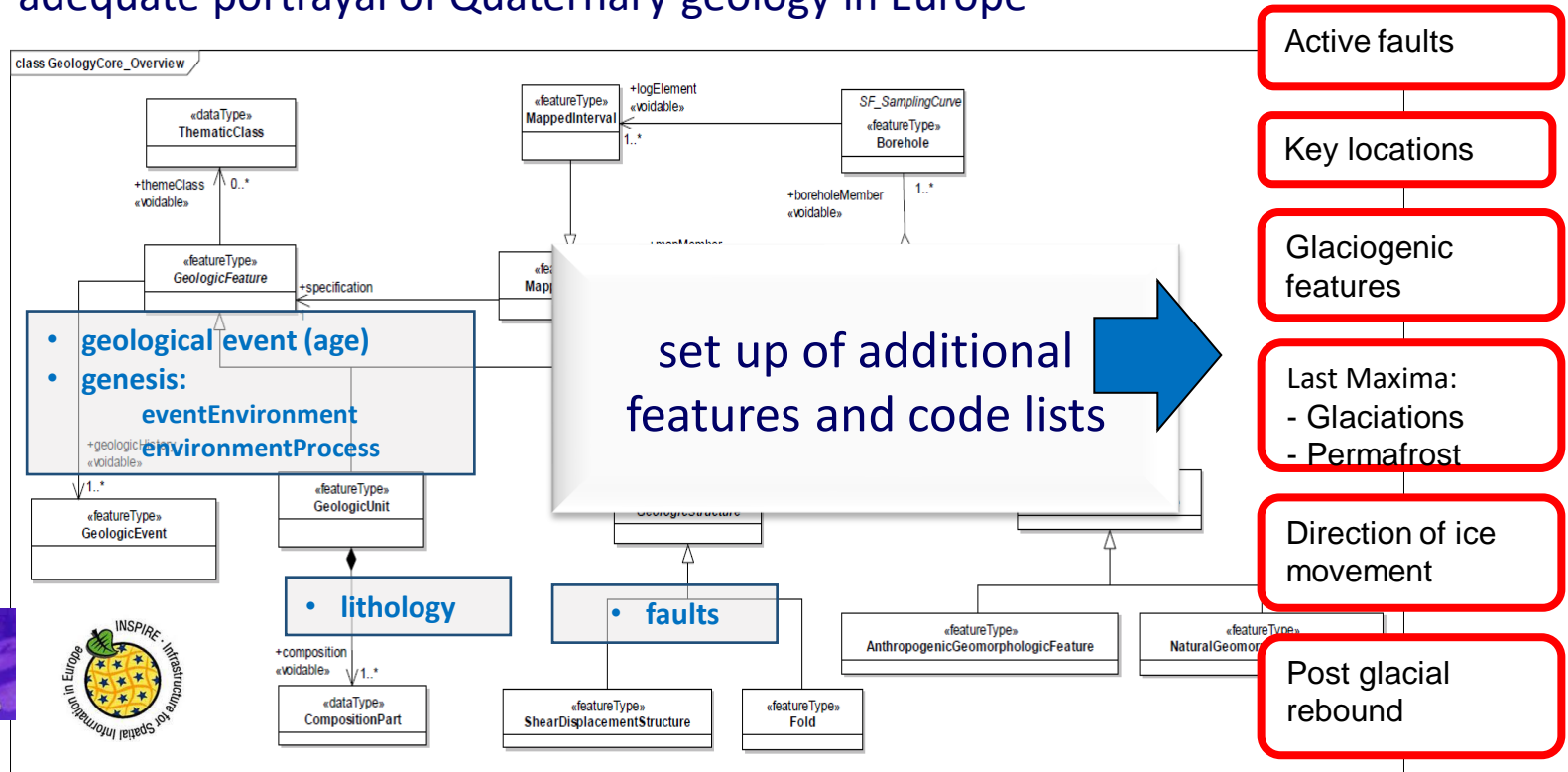
Bundesanstalt für
Geowissenschaften
und Rohstoffe

GEOZENTRUM HANNOVER



Common standards: Use of the EC INSPIRE Directive Implementation Rules as base for the IQUAME data model and vocabularies

INSPIRE vocabularies^X) very useful, but not sufficient for adequate portrayal of Quaternary geology in Europe



Based on the work of the CGI Geoscience Terminology Working group http://www.cgi-iugs.org/tech_collaboration/geoscience_terminology_working_group.html



Kristine Asch



Bundesanstalt für
Geowissenschaften
und Rohstoffe

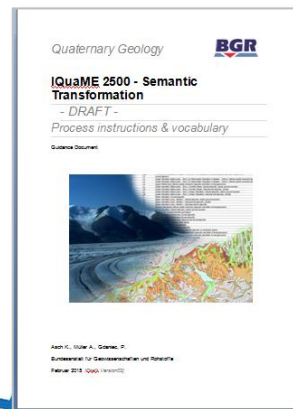
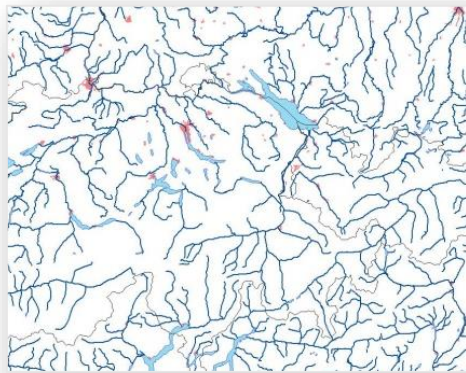
GEOZENTRUM HANNOVER



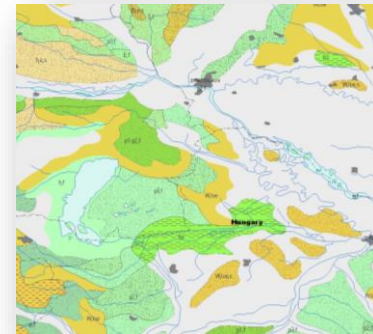
IQUAME 2500 – Working material

Each national participant receives a “starter package”:

1. Topographic base data set (VMap0, optimized in parts by participants)
2. Guideline document incl. vocabulary (including INSPIRE and CGI-IUGS controlled vocabularies)
3. Technical Guidelines for data transformation
Excel sheet with pop-up lists allowing to enter IQUAME standard terms
4. Dataset of 1st edition map units to review, digitized



5. Annex – Terms & definitions.....
5.1. Stratigraphy.....
5.1.1. “Geochronologic Era Value”.....
5.1. Lithology.....
5.1.1. “Geologic Unit Type Value”.....
5.1.2. “Composition Part Role Value”.....
5.1.3. “Lithology Value”.....
5.1. Genesis.....
5.1.1. “Event Environment”.....
5.1.2. “Event Process”.....
5.2. Faults.....
5.2.1. “Fault Type Value”.....



Kristine Asch

EGU General Assembly 2020



Bundesanstalt für
Geowissenschaften
und Rohstoffe

GEOZENTRUM HANNOVER



IQUAME Scheme of data acquisition and processing



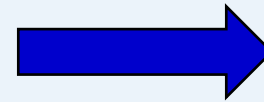
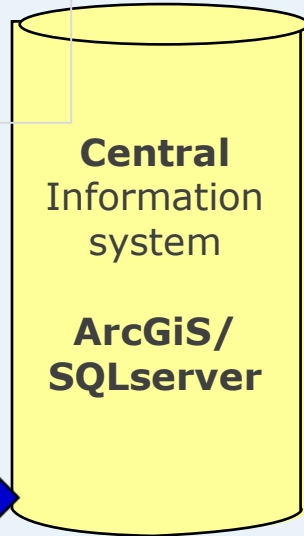
preparation

standard vocabulary,
guidelines, topo-
graphic base

processing

compile, generalise
harmonize and portray

Consultation & Review



send material



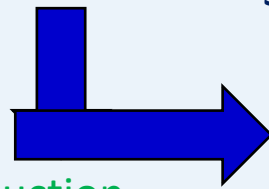
send data



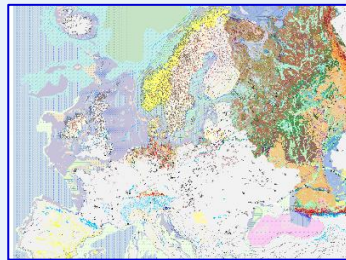
send processed
data for review,



send ammended data



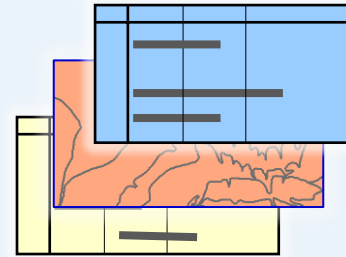
production
of final version



data release

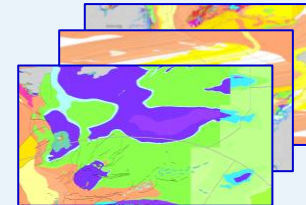
WWW
publish

IQUAME participants



national data
production

use vocabulary
provide map data



review

by participants,
advisory board



Kristine Asch



Bundesanstalt für
Geowissenschaften
und Rohstoffe

GEOZENTRUM HANNOVER



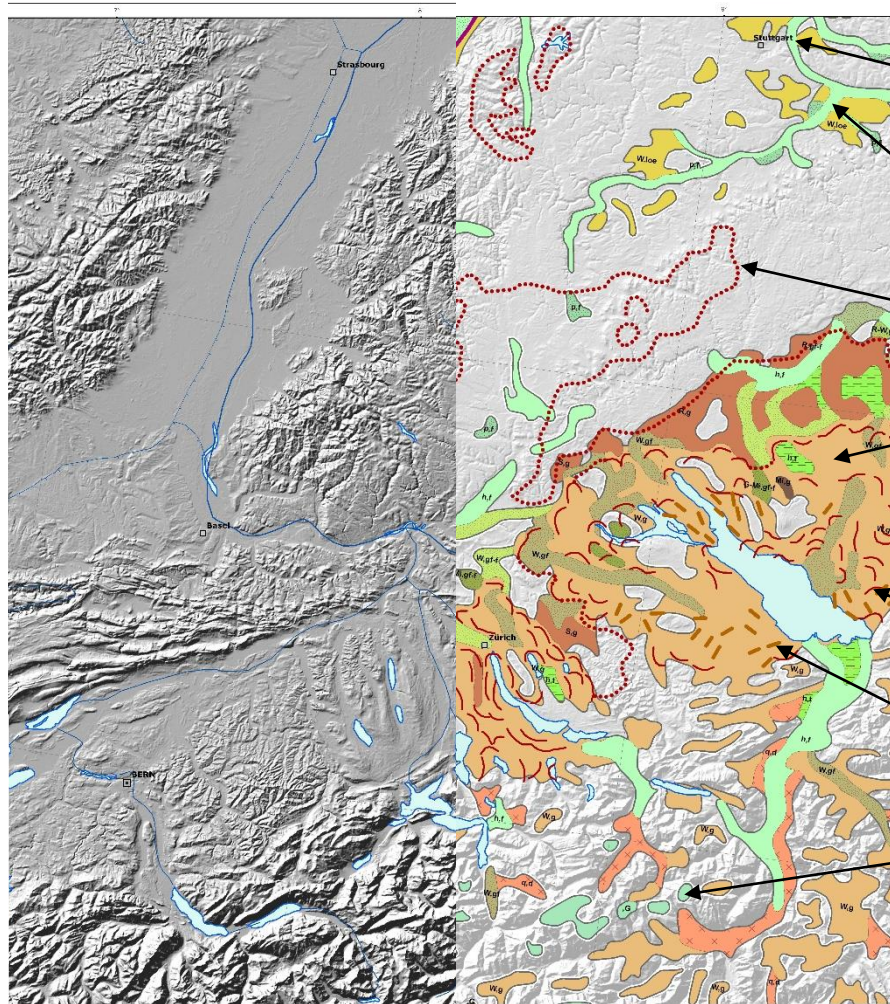
Classic Quaternary mapping on Earth: surface forms (geomorphology), genetic interpretation, stratigraphy, lithology

QUATERNARY GEOLOGY

Sediments

Genesis	Stratigraphy
Recent glacier g	Symbol Name
Glacial deposits Wg	h Holocene
Rg	p3-h Late Pleistocene to Holocene
Mlg	W Würm/Weichselian Glaciation
Glaciofluvial deposits Wgf	Ty1 Tyrrhenian I
Glaciofluvial-fluvial deposits Wgf-f	WO Ostashkev Glaciation
R-Wgf-f	M Molog-Sheksna Interglacial
Rgf-f	WK Kalinin Glaciation
G-Mlg-f	Ch Chvalynsk-Transgression
p1-gf-f	W Weichselian Glaciation
Loess and loess-like deposits WJoe	R-W Riss-Würm Interglacial
Eluvium, colluvium, deluvium q.d	Mi Mikulino interglacial
Fluvial deposits h.f	p3 Late Pleistocene
p3.f	Ee Eemian Interglacial
p2-p3.f	p2-p3 Middle to Late Pleistocene
p1-p2.f	R-W Riss to Würm Glaciation
p1.f	R Riss Glaciation
Peat, lignite h.t	Mo Moscow Glaciation
Lacustrine deposits h.l	Dn Dnepr Glaciation
	C Chazar-Transgression
	S Middle Russian Glaciation
	S-W Saalian-Weichselian Glaciation
	Wa Warthe Stadial
	D Drenthe Stadial
	S Saalian Glaciation
	Ty1 Tyrrhenian I
	Ty2 Tyrrhenian II
	M-R Mindel-Riss Interglacial
	H Holsteinian Interglacial
	M Mindel Glaciation
	B Baku-Transgression
	Ok Oka Glacial
	E Eistarian Glaciation
	p2 Middle Pleistocene
	p1-p2 Early to Middle Pleistocene
	G-Mi Günz-Mindel Interglaciation
	G Günz Glaciation
	p1 Early Pleistocene
	p Pleistocene
	q Quaternary
	p1 Akcagyl Stage
	pl-p Pliocene to Pleistocene
	pl Pliocene

General symbols	Mountain Peaks
drumlin	▲
drumlin	
end moraine	
esker	
local ice border	
main ice border	
boundary of ice dammed lake	
shoreline, inferred	
shoreline, proved	
subsidence	



- Weichselian loess
- Holocene fluvial deposits (sand, gravel)
- local ice border
- Weichselian ground moraine (clay, silt, sand, gravel, boulders)
- end moraine
- drumlin
- glacier (recent)



Kristine Asch



Bundesanstalt für Geowissenschaften und Rohstoffe

GEOZENTRUM HANNOVER

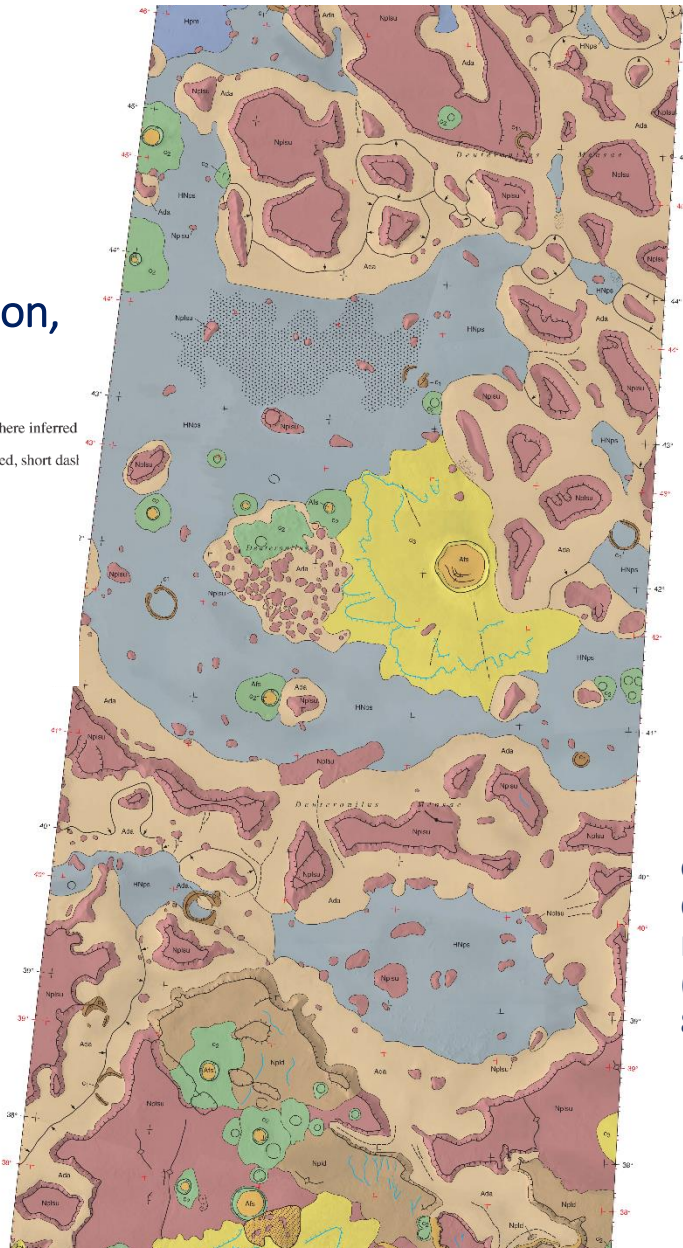


Mapping on Mars and other planets

- surface forms (geomorphology),
- stratigraphy
- lithology.

Less genetic interpretation,
more descriptive

- Contact—Dashed where approximately located; short dashed where inferred
- Crater rim—Showing crest. Dashed where approximately located, short dashed km
- Crater rim—Showing crest; $3 < D < 4.5$ km
- Crater central peak
- Rimless crater
- Crater ejecta rampart scarp
- Closed depression—Showing margin
- Scarp—Hachures point downslope
- Radial groove
- Wrinkle ridge
- Flow lineation
- Groove
- Channel
- Graben
- Flow front—Arrow indicates flow direction
- Secondary crater field
- Hummocky texture in smooth fill material (unit Afs)
- Knobby texture in smooth plains material (unit HNps)
- Ribbed texture



DESCRIPTION OF MAP UNITS

SURFICIAL MATERIAL

- Afs Smooth fill material (Late to Early Amazonian)
- Ada Debris apron material (Middle to Early Amazonian)

PLAINS MATERIAL

- Hpm Mottled plains material (Late to Early Hesperian)
- HNps Smooth plains material (Early Hesperian to Late Noachian)

PLATEAU MATERIAL

- Npld Dissected plateau material (Middle Noachian or older)
- Nplsu Upper smooth plateau material (Middle Noachian or older)
- Nplsl Lower smooth plateau material (Middle Noachian or older)

IMPACT CRATER MATERIAL

- C3 Well-preserved crater material (Early Amazonian to Late Hesperian)
- C2 Moderately degraded crater material (Late to Early Hesperian)
- C1 Highly degraded crater material (Early Hesperian to Middle Noachian)
- Ncc Cerulli crater material (Late to Middle Noachian)



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

Geologic Map of MTM 35337, 40337, and 45337
Quadrangles, Deuteronilus Mensae Region of
Mars By Frank C. Chuang and David A. Crown
(2009) , Planetary Science Institute Tucson, AZ
85719-2395



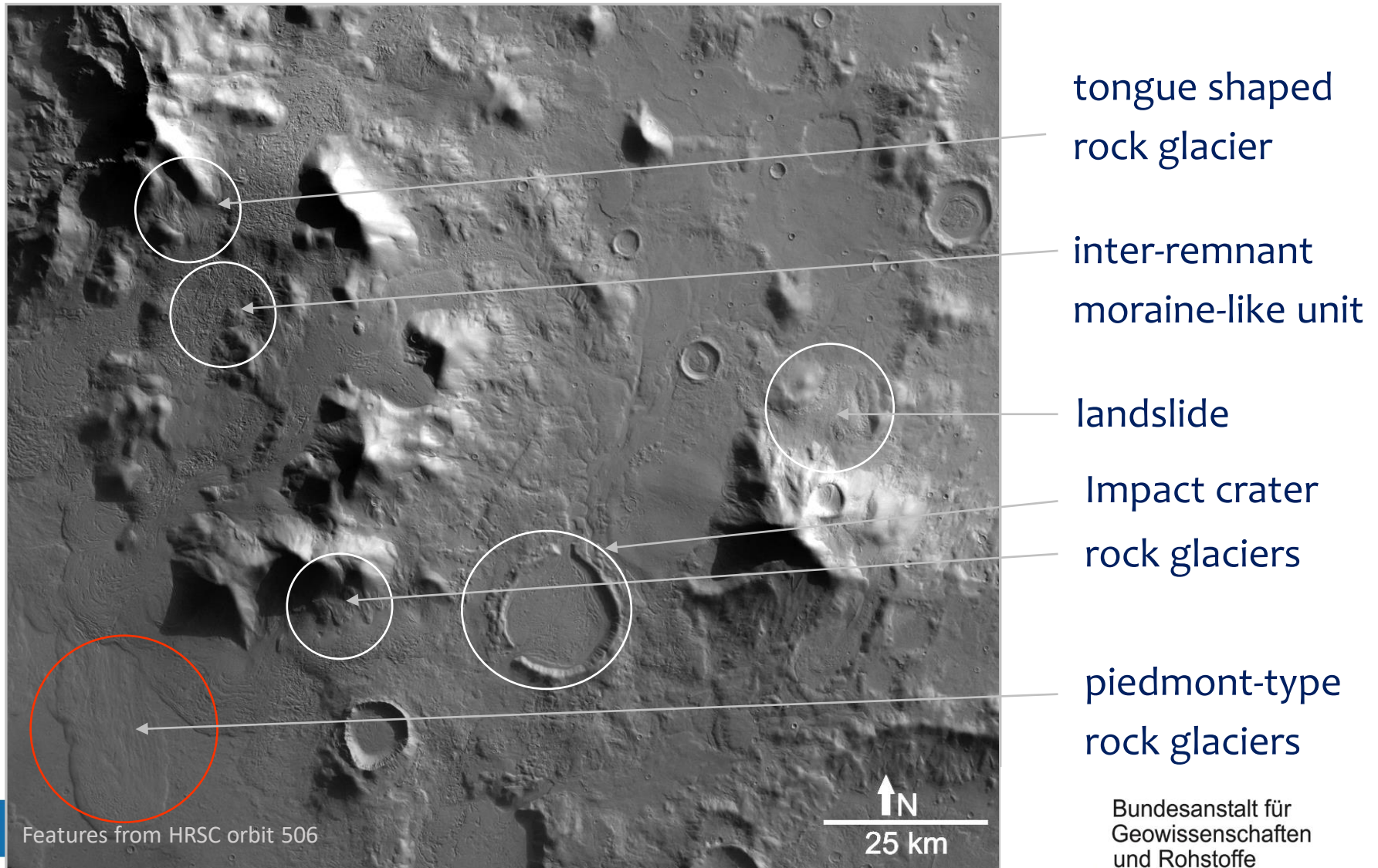
Bundesanstalt für
Geowissenschaften
und Rohstoffe

GEOZENTRUM HANNOVER





Geologic Features on Mars (Deuteronilus area) comparable to Quaternary features on Earth





Thank you very much to the IQUAME
community, the participating
organisations and individual scientists
for your contributions!
Thanks also for CGMW for the constant
support and motivation and INQUA for
your support and appreciation!



And thank you very much for your attention!

Dr. Kristine Asch, Bundesanstalt für Geowissenschaften und Rohstoffe, Stilleweg 2,
30655 Hannover. Kristine.Asch@bgr.de
IQUAME coordinator

Andreas Nass, Deutsches Zentrum für Luft- und Raumfahrt (DLR), Rutherfordstraße 2,
12489 Berlin, Andrea.Nass@dlr.de

Stephan van Gasselt, National Chengchi University, Dep. of Land Economics, Zhi-Nan
Road, Taipei 11605, Taiwan, svg@ieee.org



Kristine Asch



Bundesanstalt für
Geowissenschaften
und Rohstoffe

GEOZENTRUM HANNOVER



References

- Asch, K. (unpublished): Draft of the Internationale Quaternary Map of Europe and Adjacent Areas. BGR (Hannover). Status January 2020
- CGI Vocabularies http://www.cgi-iugs.org/tech_collaboration/geoscience_terminology_working_group.html
- Chuang, Frank C. Chuang & Crown, David A. (2009): Geologic Map of MTM 35337, 40337, and 45337 Quadrangles, Deuteronilus Mensae Region of Mars, Planetary Science Institute Tucson, AZ 85719-2395
- INSPIRE Directive INSPIRE Thematic Working Group *Geology*^y (2013): D2.8.II.4 INSPIRE Data Specification on Geology – Technical Guidelines. European Commission Joint Research Centre (Ispra). Source: <https://inspire.ec.europa.eu/id/document/tg/g>
- International Stratigraphic Commission (2020): International Stratigraphic Chart (version 2020/01). IUGS
- Picture Earth globe: Pixabay Licence, free commercial use
- Picture Mars globe License: [CC0 Public Domain](#) (Dawn Hudson, Public Domain license).



Kristine Asch



Bundesanstalt für
Geowissenschaften
und Rohstoffe

GEOZENTRUM HANNOVER