# 1. Hydrogelogical mapping Jiri Sima

#### Aim of HG map

- Groundwater and rocks qualitative permeability and quantitative potential of rock units – aquifers / aquitards / aquiclides
- Water points (spatial distribution and type)
- Supporting information (surface water network and divide, gw flow direction, river discharge, etc.)

## **Stakeholders**

The map, database and Explanations are addressed to:

- hydrogeologists, geochemists, balneologists, and balneo-technicians, whose study and exploit mineral water.
- all geologists, geographers and university students dealing with mineral waters, as well as to technological public interested in this natural heritage.
- informed publik

## History

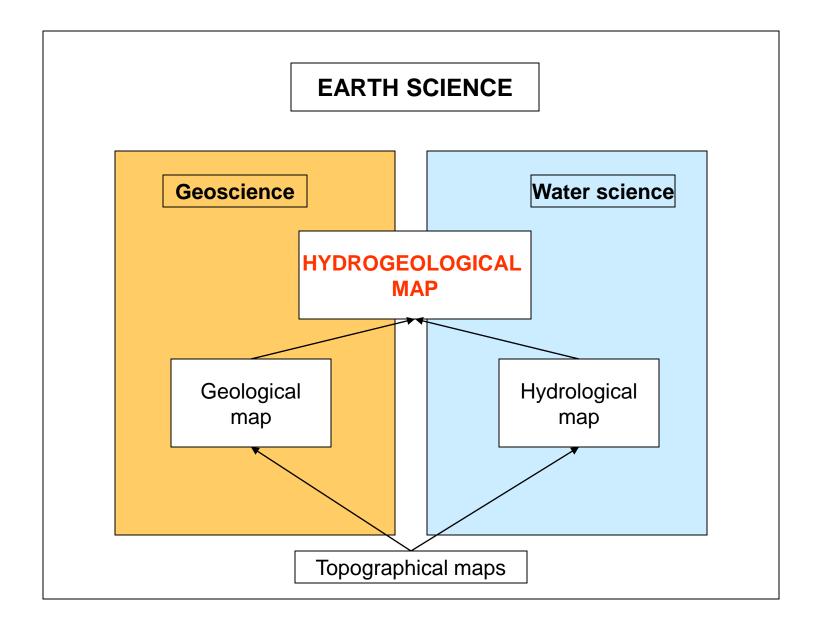
- 1940 various scale and purpose
- 1959 Commission for Hg. Maps (IAH)
- 1961 Helsinki (IAHS) exhibition 200 (IAH) survey of map techniques
- 1963 UNESCO /Anon draft legend
- 1970 UNESCO /Anon new legend
- 1974 UNESCO /Anon legend for geohydrochemical maps (Anon 1975)
- 1995 IAH /Struckmaier hydrogeological map

## Concept

From geology-oriented map to visualization of groundwater related features map

Basic types of hydrogeological maps:

- 1. Hydrogeological regional mapping project (nation basic maps map sheets/ basins)
- Thematic synthesis of existing data and reports to answer specific question – water management - protection, pollution
- 3. Parametric maps baseflow, aquifer thickness, T, S



## Edition of hydrogeological map – geological survey

- National edition of basic hydrogeological maps 1 : 250 000
- Compulsory guidelines methodology
- Trained manpower
- Vehicle (tool) GIS





Guidelines for compilation and publishing - compulsory procedure

(National) water point database

standardized legend explanatory notes

- meteorological
- hydrological
- hydrogeological

# **Compulsory guidelines**

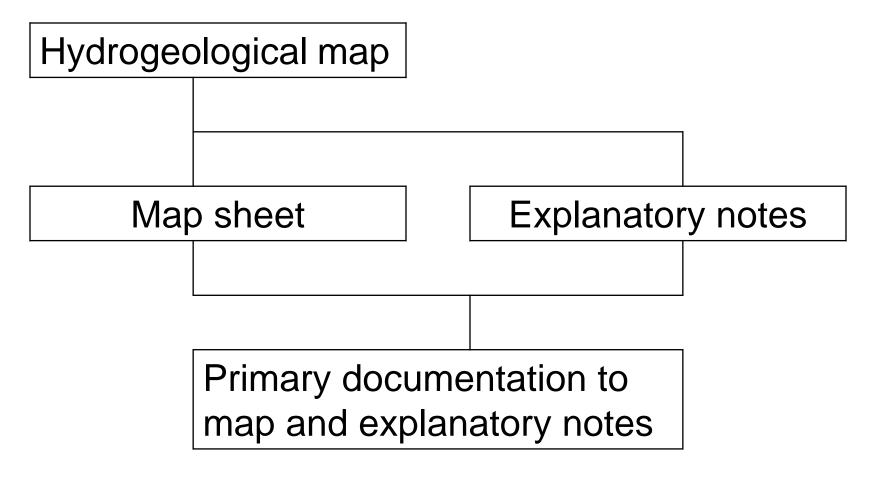
- General principles for compilation and publishing (1:250 000)
- General legend to hydrogeological map
- Contents of explanatory note

(Provided by editor to sheet author/project manager/chief compiler)

# General principles of Guidelines

- Validity of guidelines / basic provisions
- Primary documentation of the basic hydrogeological map
- Content of the hydrogeological map (layout and legend)
- Explanatory notes to the basic hydrogeological map

# Integral parts of hydrogeological map



# Hydrogeological map

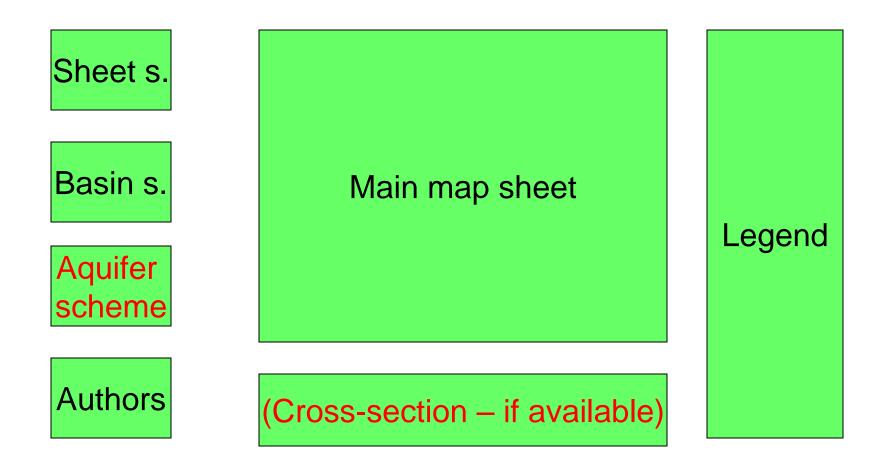
#### **Compulsory data**

- Original map
- Legend
- Aquifer scheme
- (Cross-section
- Authors scheme)
- Sheets scheme
- Basin scheme
- Explanatory note
- Primary data

#### Voluntary data

- Water quality data (hydrochemical map)
- Geophysical exploration
- Physiography
- Rainfall, temperature
- Regional aquifers
- Soil cover
- Quaternary cover

## Layout of map sheet



## General legend to map

- extent of aquifers and their types, and lithology with tectonic features
- basic structural and topographical settings
- all-important hydrogeological features (natural, man made)
- water quality, thermal water, and mineral water provinces

## Aquifer system – color

The basic hydrogeological map is compiled as color maps

Qualitative type of permeability (porous, fissured, karst, formation with low or without permeability - gw resources)

Quantification of (amount) permeability

- Yield of water points (specific yield of well)

- transmissivity

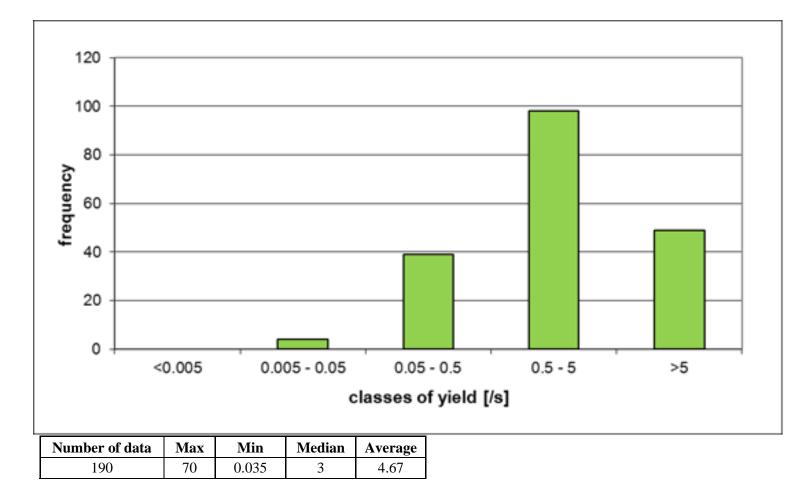
# Type of permeability

Aquifer	Color	Rock example
Porous	Blue	Alluvial
Fissured	Green	Sandstone/basalt
Fissured/karstic	Green (dark)	Limestone
Basement	Brown-red	Granite/gneiss
Aquiclude	Brown	Marlstone
Aquitard	Brown (dark)	Claystone
Mixed	Blue/green strips	Volcanic/sedimentary

#### **Quantification of permeability**

Aquifer class	T (m²/d)	q (l/sm)	Yield (l/s)			
Extra high	500	5	More 25			
High	100	1	5.1-25			
Moderate	1.11-10	0.011-0.1	0.51-5			
Low	0.11 - 1	0.01	0.051-0.5			
Extra low	0.1	0.001	0.005-0.05			
Neglegible /seepage			Less 0.005			

#### Quantification volcanic Rift



## Permeability

k (m/s)	1	10 <sup>-1</sup>	10 <sup>-2</sup>	10 <sup>-3</sup>	10 <sup>-4</sup>	10 <sup>-5</sup>	10 <sup>-6</sup>	10-7	10 <sup>-8</sup>	10 <sup>-9</sup>	10 <sup>-10</sup>	10 <sup>-11</sup>	10 <sup>-12</sup>
gravel - sand							<b>(-</b>						
loess – silt -clay						-X							
lava - basalt		XX											
limestone		XX											
snadstone	XXX												

# **Background information**

- Simplified topography dark gray (60% black): towns, names, international and administrative boundaries
- Drainage blue: stream or rivers
- Grids or lines of longitude and latitude black
- Additional information: inset maps, explanatory notes (separate better)

#### Intergranular permeability - blue

- Extensive (>100 Km<sup>2)</sup> and highly productive T = 10.1-100 m<sup>2</sup>/d, q = 0.11-1 l/sm, Q = 5.1-25 l/s productive aquifers (dark blue)
- Local or discontinues highly productive aquifers, or extensive but only moderately productive aquifers (T = 1.1–10 m<sup>2</sup>/d, q = 0.011–0.1 l/s.m, with spring and well yield Q = 0.51–5 l/s) (light blue)

#### Fissured (karst) aquifers - green

- Extensive (>100 Km<sup>2)</sup> and highly productive T = 10.1-100 m<sup>2</sup>/d, q = 0.11-1 l/sm, Q = 5.1-25 l/s productive aquifers (dark green)
- Local or discontinues highly productive aquifers, or extensive but only moderately productive aquifers (T = 1.1–10 m<sup>2</sup>/d, q = 0.011–0.1 l/s.m, with spring and well yield Q = 0.51–5 l/s) (light green)

#### Basement rcks forming aquifers with local and limited groundwater resources – brownred

 $(T = 0.11-1 \text{ m}^2/\text{d}, q = 0.0011-0.01 \text{ l/s.m},$ with spring and well yield Q = 0.051-0.5 l/s).

#### Rocks with fissured porosity and with essentially no groundwater resources - brown

- Strata (sediments) with limited groundwater resources light brown for  $T = 1m^2/d$ , q = 0.01 l/sm, Q = 0.05 0.5 l/s
- Strata with essentially no groundwater resources - dark brown for T = 0.1m<sup>2</sup>/d, q = 0.001 l/sm, Q = 0.05

#### **Covered / confined aquifers**

 Where there is an extensive aquifer immediately underlying a thin impermeable cover, the appropriate aquifer color should be used crossed by brown stripes (1 mm wide and 3 mm separation) - Adigrad sandstone – Humara area

# Lithology

#### **Ornament in gray**

The orientation of the ornament indicates the type of bedding

- Horizontal = unfolded, horizontal of gently inclined strata (less that 20<sup>0</sup>)
- Vertical = folded strata

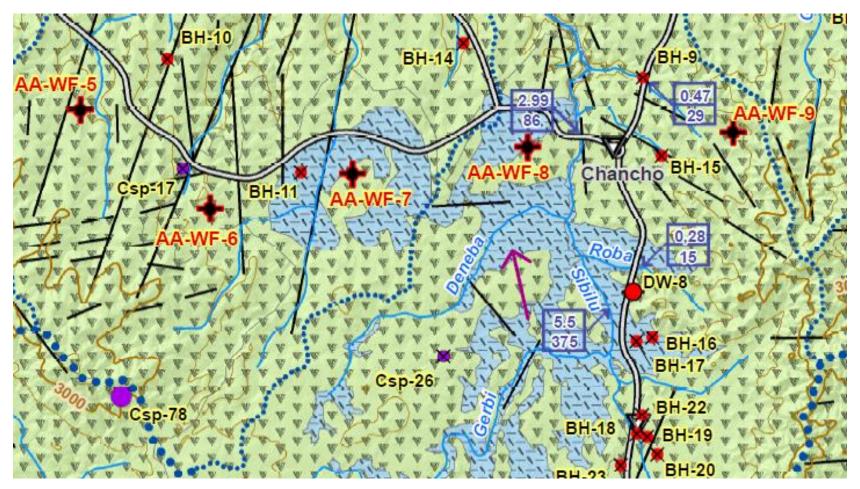
#### **Representation of detailed data 1**

- Violet: groundwater and springs
- Orange: physical and chemical characteristics of groundwater quality and temperature
- Blue: surface water and karst hydrography
- Red: man-made features and alterations to the natural groundwater regime

#### **Representation of detailed data 2**

- Dark green: horizon contours (isopachytes) and limits of certain features
- Black: geological information (fault, volcanic cone)

#### Hydrogeological map (AA)



## **Content of explanatory note**

- 1. Basic characteristic of the area
- 2. Selected physical and geographical settings
- 3. Geological settings
- 4. Hydrogeological settings (aquifer system definition)
- 5. Hydrochemistry (of natural waters)
- 6. Natural resources of the area

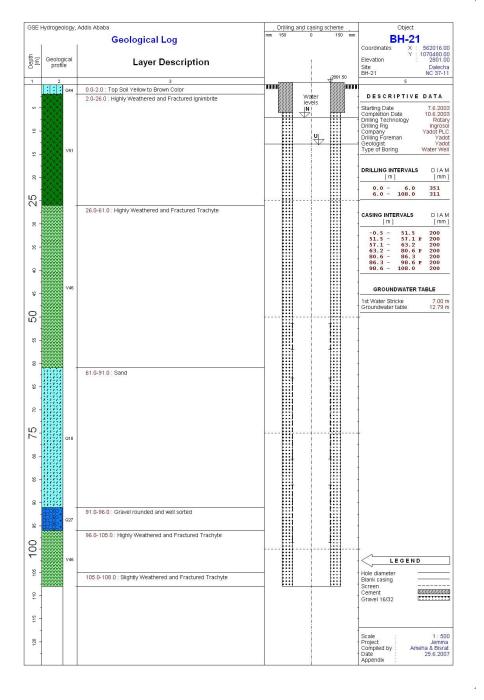
Annexes (WP inventory, chemical analyses, well logs)

#### Annexes

- Water point inventory (bore holes, dug wells, springs, water holes, rivers)
- Chemistry (results of chemical analysis used for compilation of hydrochemical map and assessment of water quality)
- Well logs (essence of drilling reports information for next drilling) - same color and oranaments used in map for geology

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## Well log



Ignimbrite - mixed aquifers

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			is light yellow Clay		999	1		DESCRIPTIV	
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## Artesian mixed aquifer

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## Conclusions

Systematical use of digital data, including GIS

- Accelerate the process
- More flexibility in data analysis
- Easy to update
- Presentation an any time (always actual)
- More universal can serve to more (various) users
- Posibility of internet presentation

#### Recommendations

- Prepare methodology adopt international – everybody be able to understand
- Legend to hydrogeological map documenting all map features / colors
- Contents to explanatory notes
- Develop, update, publish water database
- Use appropriate tools for your work