

# ***Quantitative and qualitative hydrogeological study of the alluvial aquifer of Somes-Szamos (Romania-Hungary)***

***Data base and Modelling – Training periods***

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# Why using a database ?

## □ Big amount of data...

- coming from different sources (water regulators, water companies, environmental agencies, research offices, industries, public or private institutions, farmers, etc)
- different formats (paper or digital diagrams, images, maps, spreadsheets with different data, logs, etc)
- different fields (topography, land use, land cover, soil, hydrology, geology, hydrogeology, meteorology...)

...which have to be manipulated and constitute the input for various studies



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# Why using a database ?

- Use of Geographical Information Systems
- Facilities to encode, store, analyse, display, edit, query, control, update,
- Support for various studies and data exchange between different institutions.

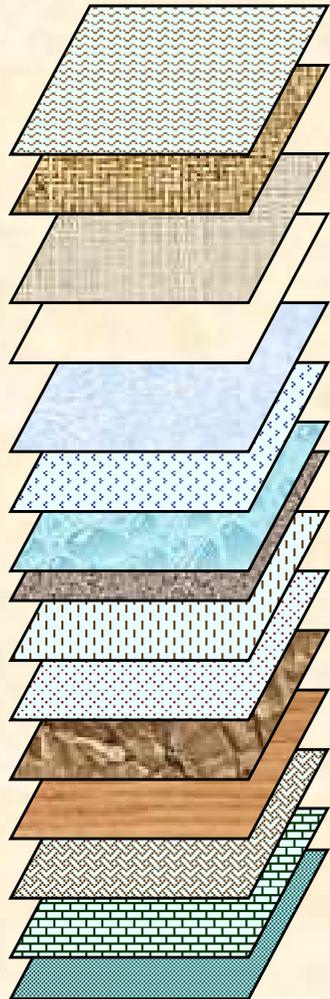


# Before building a database

- ❑ Needed data (purpose, users...)
- ❑ Available data
- ❑ Relations between data
- ❑ Maximum storage of data
- ❑ Minimum data redundancy
- ❑ Optimum retrieval of information
- ❑ Memory capacity

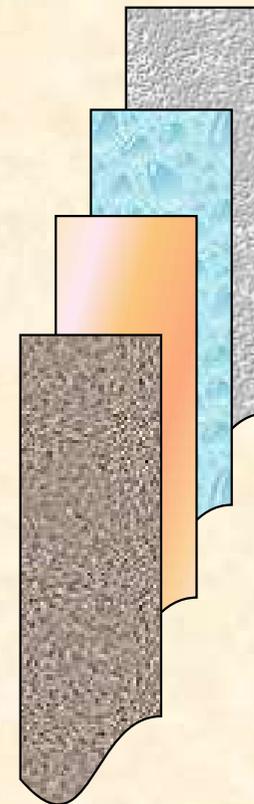


## Primary Data



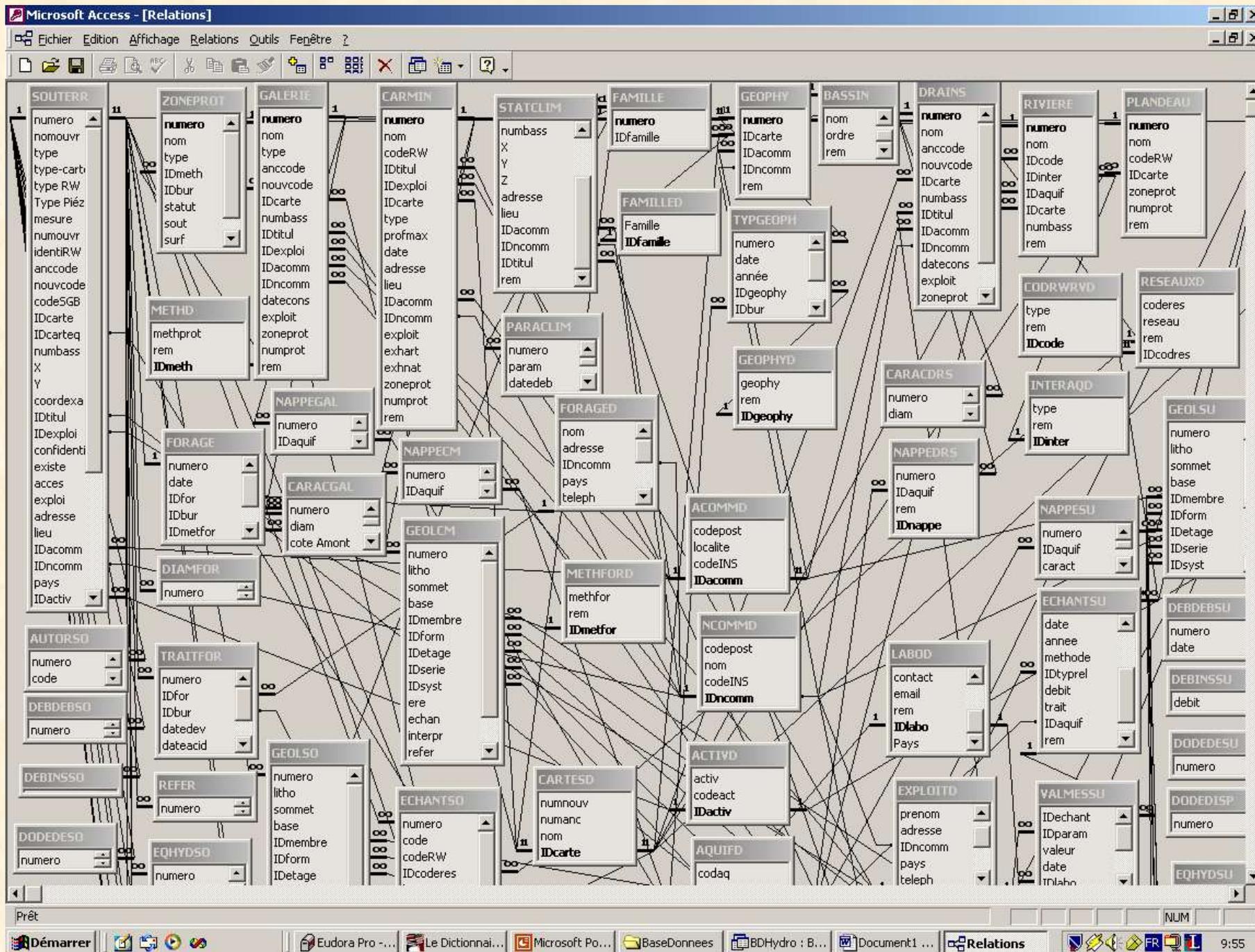
Topography  
Geological Map  
Map of soils  
Climatic Stations  
Lakes and Ponds  
Hydrological basins  
Hydrological network (rivers)  
Boreholes,  
Wells, Piezometers,...  
Quantitative, Qualitative data  
Drains  
Galleries  
Quarries and Mines  
Land use and Land cover  
Karstic Features  
Sewer network system

## Secondary Data



Map of piezometric head  
Digital Terrain Model  
Calculated data (T, S,...)  
Protection zones  
Vulnerability zones  
Networks (gw quality,...)  
Others ...





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# HYGES database

- Developed at the University of Liège (Hydrogeology) for the Walloon region
  - 1999: Radu Gogu, Guy Carabin, Valérie Peters, Alain Dassargues, Vincent Hallet
  - 2001: Cristina Popescu, Ingrid Ruthy, Serge Brouyère (English version, adaptations to SQUASH project)
  - 2002 → present: improvements and new developments



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# HYGES database

- MS Access (Microsoft) (*data exchange*)
  - Relational database management system
  - Structure:
    - » Tables (encoding, storing)
      - one-to-one & one-to-many relationships
    - » Queries (searching)
    - » Forms (encoding, query)
  - Geographical objects:
    - » Points (wells, springs, measure stations...)
    - » Arcs (galleries, drains, hydrological network...)
    - » Polygons (basins, geology, land use & land cover, soil...)



# The « GROUNDWATER » form

Microsoft Access - [FMsouterr : Formulaire]

Fichier Edition Affichage Insertion Format Enregistrements Outils Fenêtre ?

**OUVRAGES SOUTERRAINS**

Numéro : 1 carte 1/10.000 : 42/2 carte 1/25.000 42/1-2 Code RW 4222003 Identifiant RW Code SGB

Nom de l'ouvrage : HER002 X: 237770 Y: 156090 Coord.Exactes: A

Type d'ouvrage : P Nature de l'ouvrage RW : PT Type Piézo RW : 0 Type Carte PP

Date de constr Année de constr Mesure Piézo :  Existence  Accessibilité :  Exploitation :

Type d'activité : Profondeur : 14,18 Exploitant Inconnu

Rue, n° : rue Haie martin, 4 Lieu-dit Titulaire Colson

Localité : Hermée Commune : OUYEYE

Pays : Belgique Zone de protection

Sommet blindage de surface Base blind. de surf. Diam. blind. de surf. :

Remarques : puits dans remise

ECHANTILLONS Ajout Exploitant Ajout titulaire

Nappe Autorisation Forage Diamètre forage Géologie Equipement hydraulique Références Piézométrie Graphique Titulaire Exploitant Equipement Test Donné

Aquifère : 305 Crépiné ?

Caractère :

Remarques :

Enr : 1 sur 1

Enr : 1 sur 3633

Numéro unique pour tout type d'ouvrage!

Démarrer Eudora Pro - [In] Le Dictionnaire ... Microsoft Power... BaseDonnees BDHydro : Base... FMsouterr : Fo... 9:43



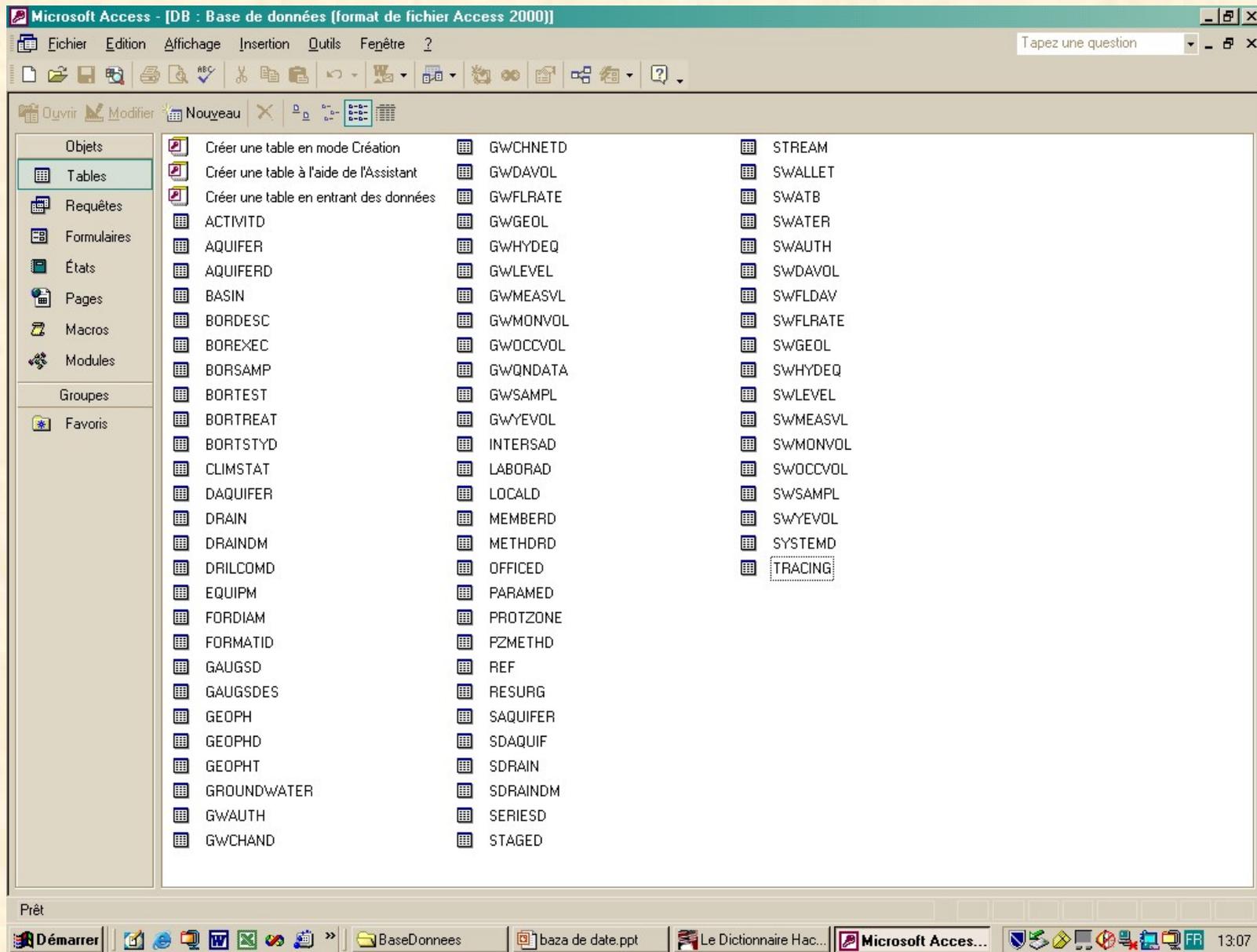
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<b>Data</b>	<b>Geometry</b>
Groundwater (well, piezometer)	POINT
Water supply galleries, drains	ARC
Quarries, mines	POLYGON
Surface water (springs, measure stations)	POINT
Hydrological network (rivers)	ARC
Surface water bodies	POLYGON
Hydrological basins	POLYGON
Irrigation drains	ARC
Sewer network system	ARC
Climatic stations	POINT



# The SQUASH database



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# The « GROUNDWATER » table

Microsoft Access

Fichier Edition Affichage Insertion Outils Fenêtre ?

Tapez une question

**GROUNDWATER : Table**

Nom du champ	Type de données	Description
number	Numérique	borehole identification number in the database
name	Texte	borehole name
type	Texte	borehole type; "B":simple borehole (hole); "L": large diameter well; "E": exploitation well; "W":well;"P":piezometer; "A": abandoned
Gwmeas	Texte	water level measurement: "R":regular; "O":occasional; "N": no measure
IDnetwk	Numérique	refers to NETWORKD dictionary
code	Numérique	identification or recording code
IDmap	Numérique	ID referring to the MAPD dictionary
numbas	Numérique	number of the hydrological basin to which the borehole belongs (polygon number)
X	Numérique	X coordinates (m)
Y	Numérique	Y coordinates (m)
coordacc	Texte	accuracy of the coordinate data: "A": approximate; "L":land survey
IDowner	Numérique	ID referring to the OWNERD dictionary; the dictionary gives information on borehole owner
IDhold	Numérique	ID referring to the HOLDERD dictionary (borehole holder)
availab	Texte	"NA": inaccessible; "A": accessible; "NE": does not exist any more
address	Texte	street, number
IDloc	Numérique	ID referring at the LOCALD dictionary
country	Texte	name of the county
country	Texte	"HU": Hungary;"RO":Romania
exploit	Oui/Non	the borehole is exploited, yes or no
IDactiv	Numérique	ID referring to the ACTIVD dictionary
location	Objet OLE	map with the borehole location
datcons	Date/Heure	date of construction
yearcons	Numérique	construction year (in absence of an exact date)
depth	Numérique	borehole depth
comment	Texte	comments and complementary information

Propriétés du champ

Général | Liste de choix

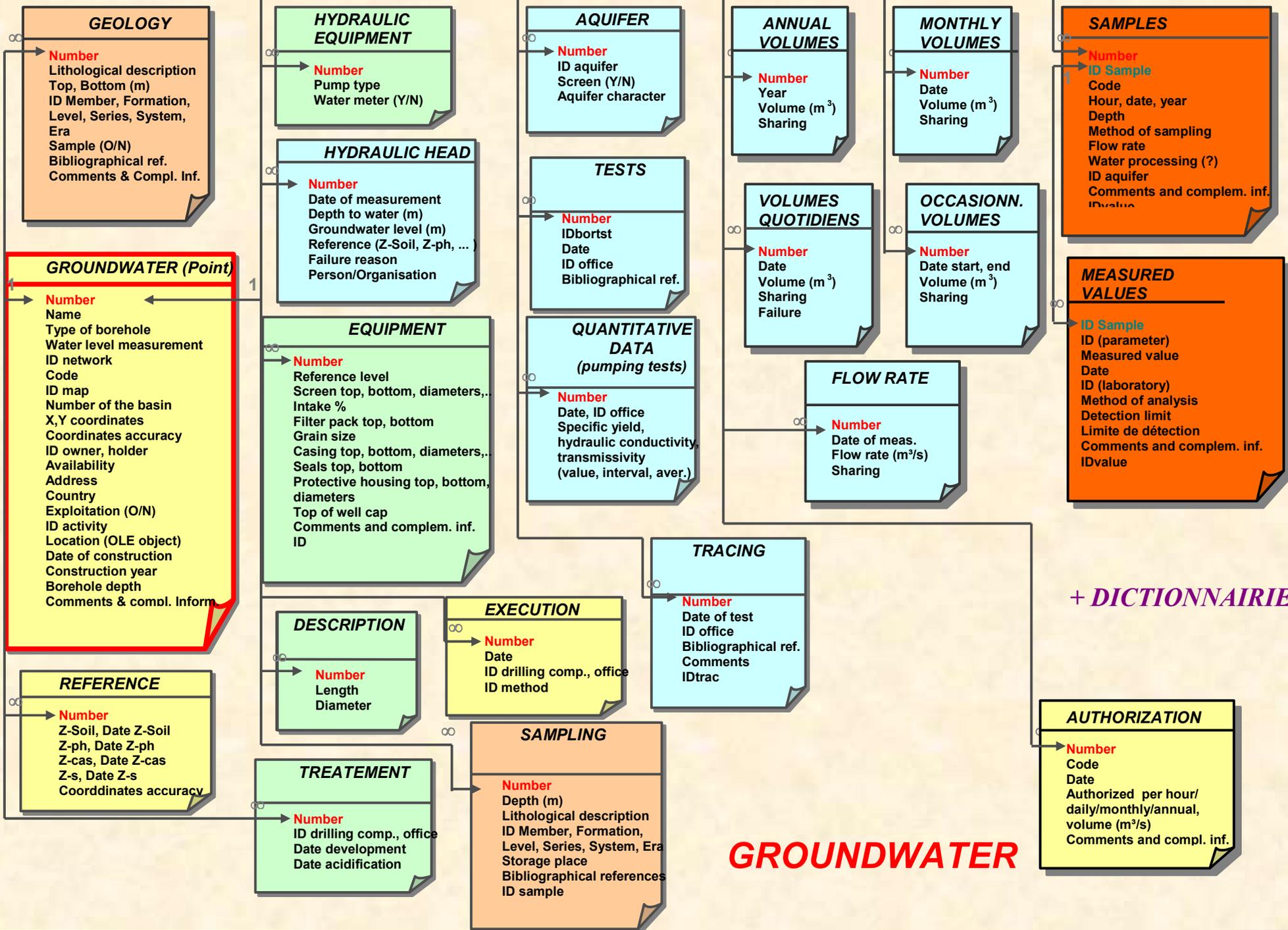
Taille du champ: Entier long  
Format: Auto  
Décimales: Auto  
Masque de saisie:   
Légende:   
Valeur par défaut:   
Valide si:   
Message si erreur:   
Null interdit: Oui  
Indexé: Oui - Sans doublons

Un nom de champ peut compter jusqu'à 64 caractères, espaces inclus. Pour obtenir de l'aide, appuyez sur F1.

Mode Création. F6 = Autre volet. F1 = Aide.

Démarrer | BaseDonn... | baza de d... | Le Diction... | Microsoft... | DB : Ba... | GROUND... | 13:19

**SQUASH:**  
Common  
coordinate  
system



# GROUNDWATER

# Applications of the Hydrogeological Database

- Data management, processing, analysis...
- Decisions and management support for groundwater resources (quantity and quality)
- Generation of secondary data such as piezometric maps...
- Support for hydrogeological maps, groundwater quality, groundwater flow and contaminant transport modelling, vulnerability assessment...



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# General Modelling Concepts

## □ Objectives

- To automate as much as possible the development of the regional model and local models, starting from data existing in the Data Base (GW levels...) and in ArcView (maps...)
- To have a flexible modelling framework, i.e. allowing easy and efficient data handling, updating and modifications (changes in the conceptual model, integration of new data or measurements, specific needs...)



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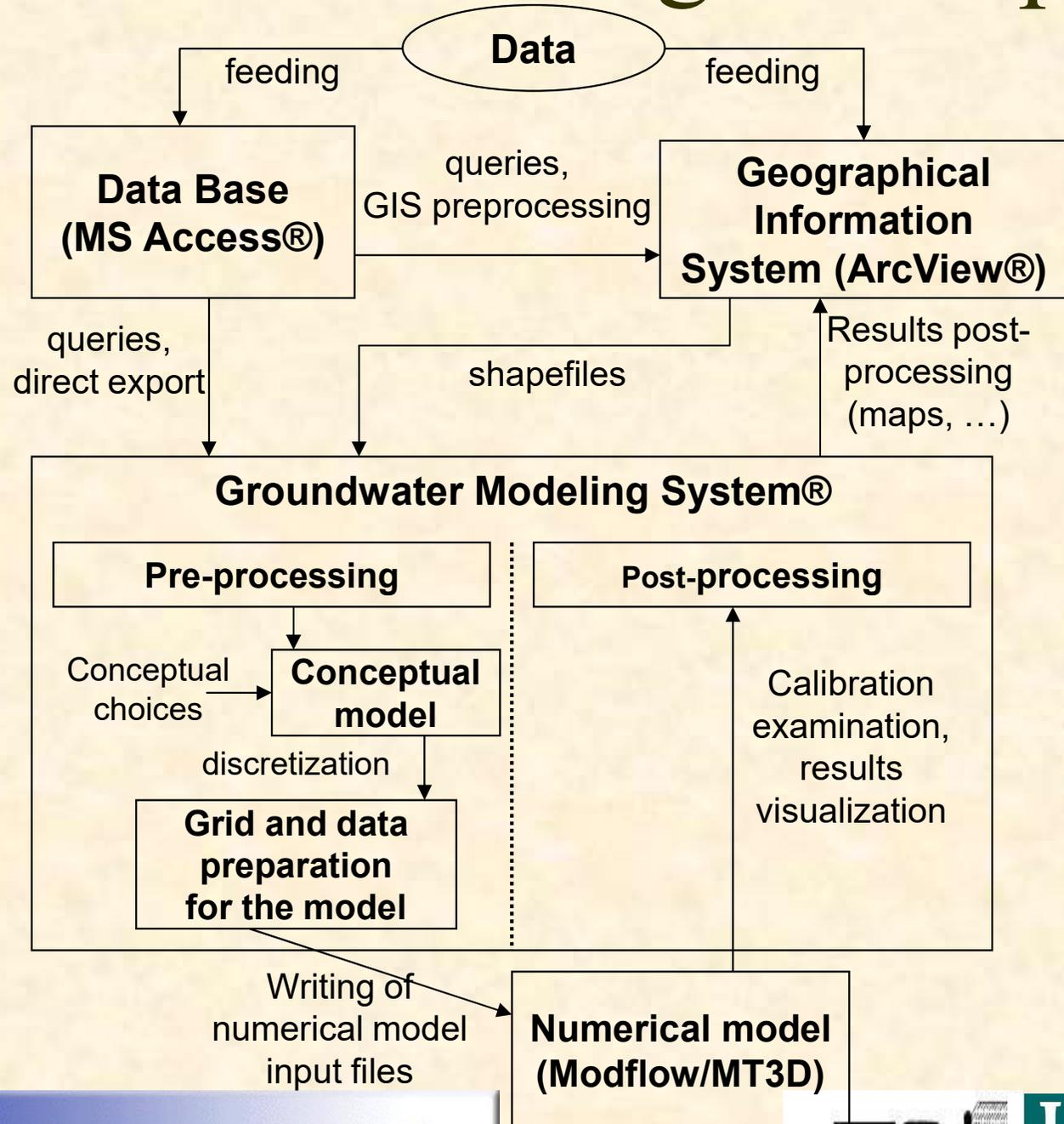
# General Modelling Concepts

## □ The tools:

- The SQUASH Database (MS Access)
- Geographical Information System (ArcView)
- Modelling tools:
  - » GMS (Groundwater Modeling System) developed by EMS-i: an efficient pre- and post-processor with various data handling tools, including GIS and DB interactions
  - » Modflow and MT3D models of which input files are created using GMS
- Training of Romanian and Hungarian researchers



# General Modelling Concepts



# Training Periods in Liège

- First training period (2 months: March – April 2001)
  - Participants: Marian Mincinua (Ro), Liviu Turcu (Ro), Marius Dragomir (Ro), Attila Szabo (Hu), Gabor Szacsuri (Hu)
  - Objectives
    - » To adopt a common database structure based on the HYGES hydrogeological database developed by HGULg
    - » To fix various practical issues such as the definition of a common coordinate system
    - » To start feeding the database with existing data and first field measurements
  - Other activities:
    - » Participation to a field tracer experiment in a limestone basin in Limet (Belgium)
    - » Visit of the waste disposal site in Mont Saint-Guibert (Belgium)



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# Training Periods in Liège

- Second training period (3 months: May – August 2002)
  - Participants: Melinda Karsai (Hu), Margit Virag (Hu), Peter Szucs (Hu), Anca Filip (Ro), Marilena Jianu (Ro)
  - Objectives
    - » Training in groundwater flow and contaminant transport modelling
      - Theory
      - Use of GMS (thanks to EMS-i for providing us with their ppt presentations!)
      - Tracer experiments design
    - » Start of the regional groundwater flow model for the Szamos-Somes Aquifer



# Training Periods in Liège

- Second training period (3 months: May – August 2002)
  - Seminars
    - » B. Haerens (KULeuven): Reactive transport modelling
    - » Ph. Orban (HGULg): Inverse modelling with PEST/ Modflow/ MT3D
    - » I.C. Popescu (HGULg): Groundwater vulnerability assessment and mapping
    - » S.Brouyère (HGULg): Modelling large scale groundwater flow: the Hesbaye aquifer case study
    - » Participants presentations about their own research/ activities
  - Field trip
    - » Visit of the Hotton cave and basin organized by Ph. Meus (MRW)



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# Training Periods in Liège

- Third training period (1.5 months: July – August 2003)
  - Participants: Anca Filip (Ro), Marian Minciuna (Ro), Andrea Toth (Hu), Krisztina Beata Faur (Hu), Tamas Madarasz (Hu)
  - Objectives
    - » Training on contaminant transport modelling and on tracer test interpretation
    - » Finalization of the regional groundwater model
    - » Modelling of local transport problems
  - Seminars
    - » C. Rentier (HGULg): Stochastic modelling of protection zones and optimisation of groundwater quality networks
    - » M. Dachy and I.C. Popescu (HGULg): Hydrogeological and hydrochemical study of the Néblon limestone basin
    - » M. Huysmans (KULeuven): Transport modelling in low permeability layers





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