

# Groundwater bodies delineation in France

*Main outcomes after the 1st RBMP and perspectives for the 2<sup>nd</sup> RBMP*

Ariane BLUM, Susanne SCHOMBURGK  
(BRGM / Water Division)

# Outline of the presentation

## > **French groundwater bodies**

- Short presentation
- Main criteria used for the delineation
- Advantages / difficulties after for the 1st RBMP

## > **Proposals for the evolution of French GWB**

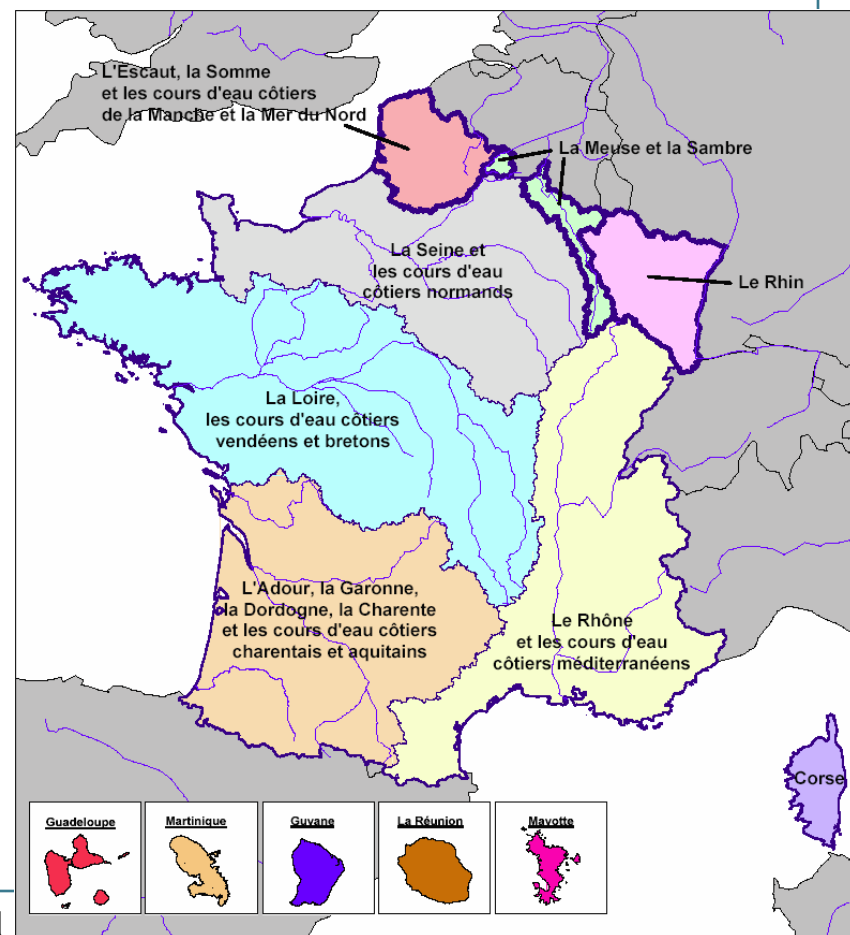
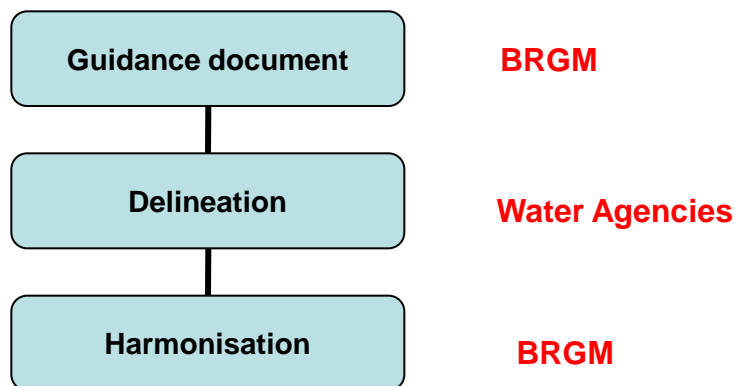
- Constrains, criteria and consequences
- Example of the Loire-Bretagne district

## > **Conclusions**

# Introduction

## > Who's doing what ?

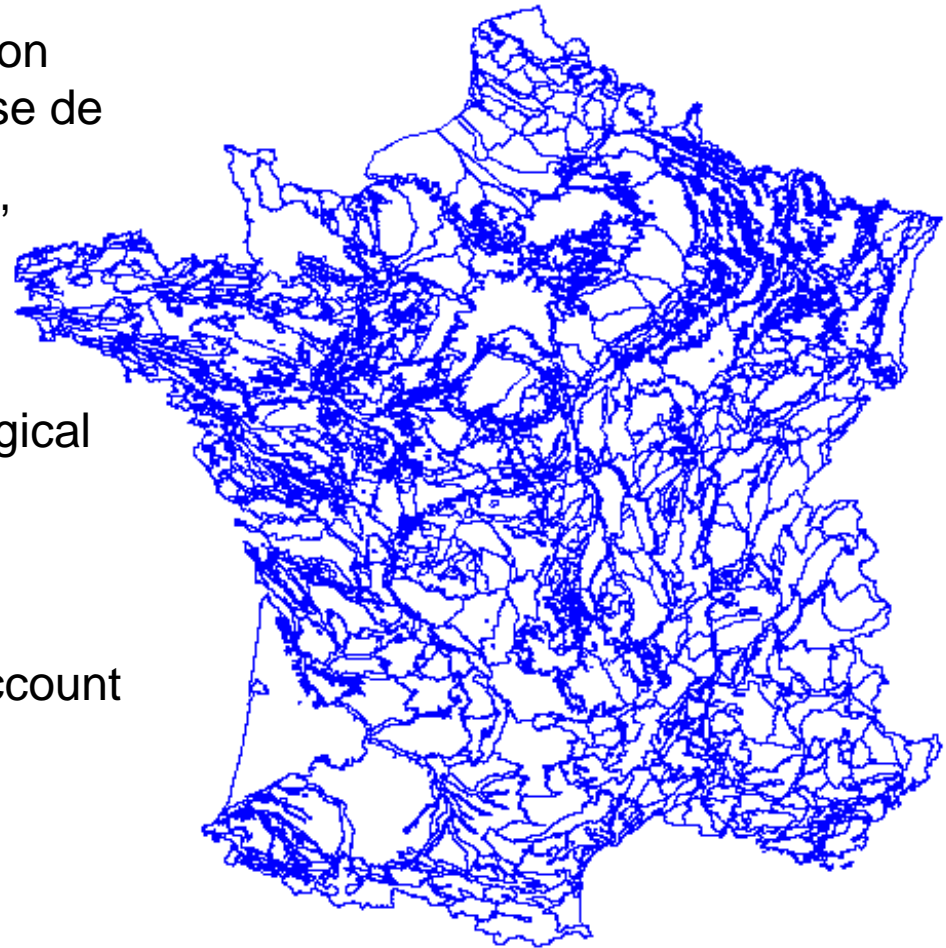
- Coordinator : MEDD (French Ministry of Ecology and Sustainable Development)
- Fulfilment : the 6 Water Agencies ( $\approx$  River Basin Districts)
- Technical support : BRGM (French Geological Survey)
  - Methodology,
  - Harmonization,
  - Synthesis



# Groundwater bodies delineation

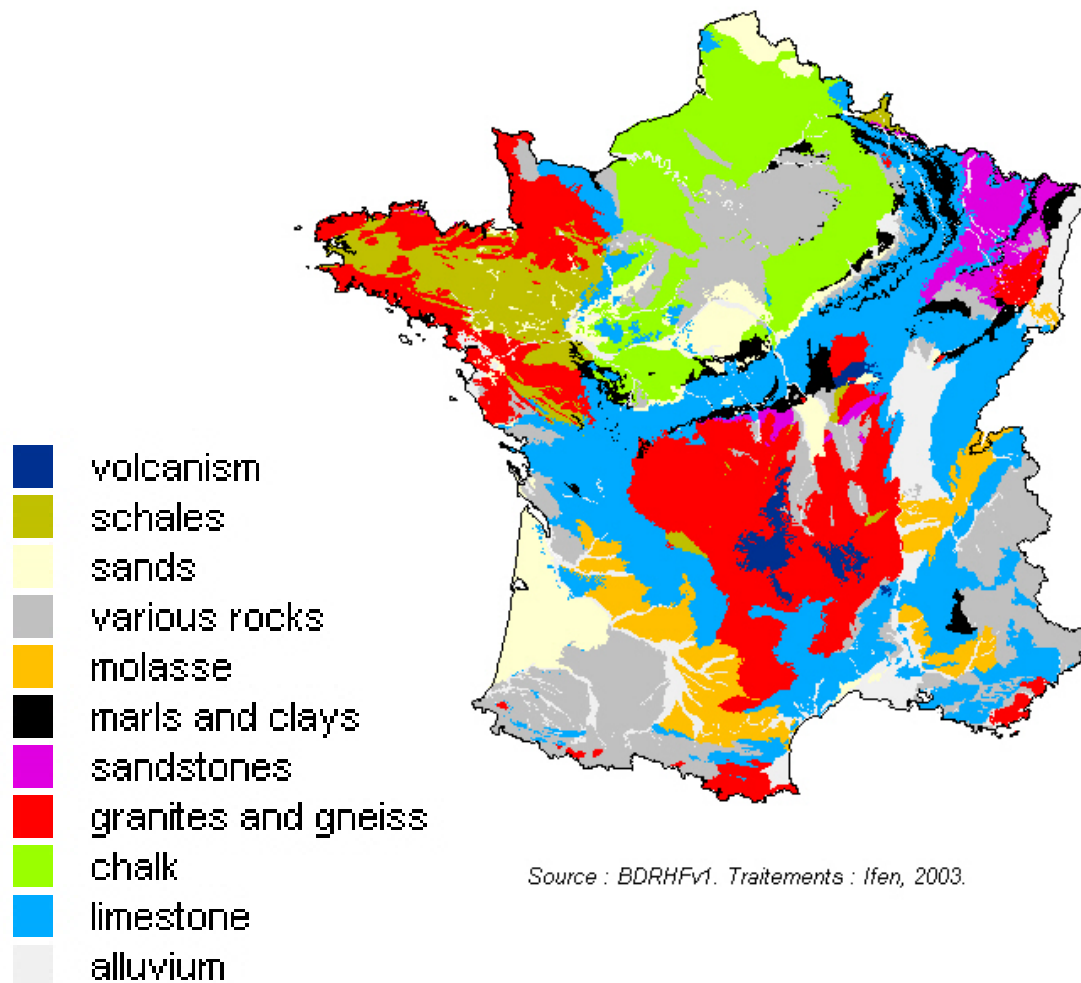
## > Reminder : aquifers delineation before the WFD

- A national *aquifer* delineation named “BDRHFv1” (“Base de Données du Référentiel Hydrogéologique Français”)
- Only based on hydrogeological properties
- A new version is under construction (taking into account deep aquifers)



# Groundwater bodies delineation

## > Reminder : a very heterogeneous geology



# Groundwater bodies delineation

## > For the WFD:

- Construction of a new frame of reference
- Based on geological and hydrogeological criteria
- Very occasionally on pressures in order to have a stable map
- Exchanges between GWB are possible
- Deep groundwaters without any link with surface waters, in which no drinking water is (and will be) removed (salinity, temperature...) cannot be included in a GWB
- A GWB can present a spatial heterogeneity (qualitative and quantitative)

→ *The number of GWB shouldn't be too important! 500 GWB is reasonable for the WFD reporting!!!*

# Groundwater bodies delineation

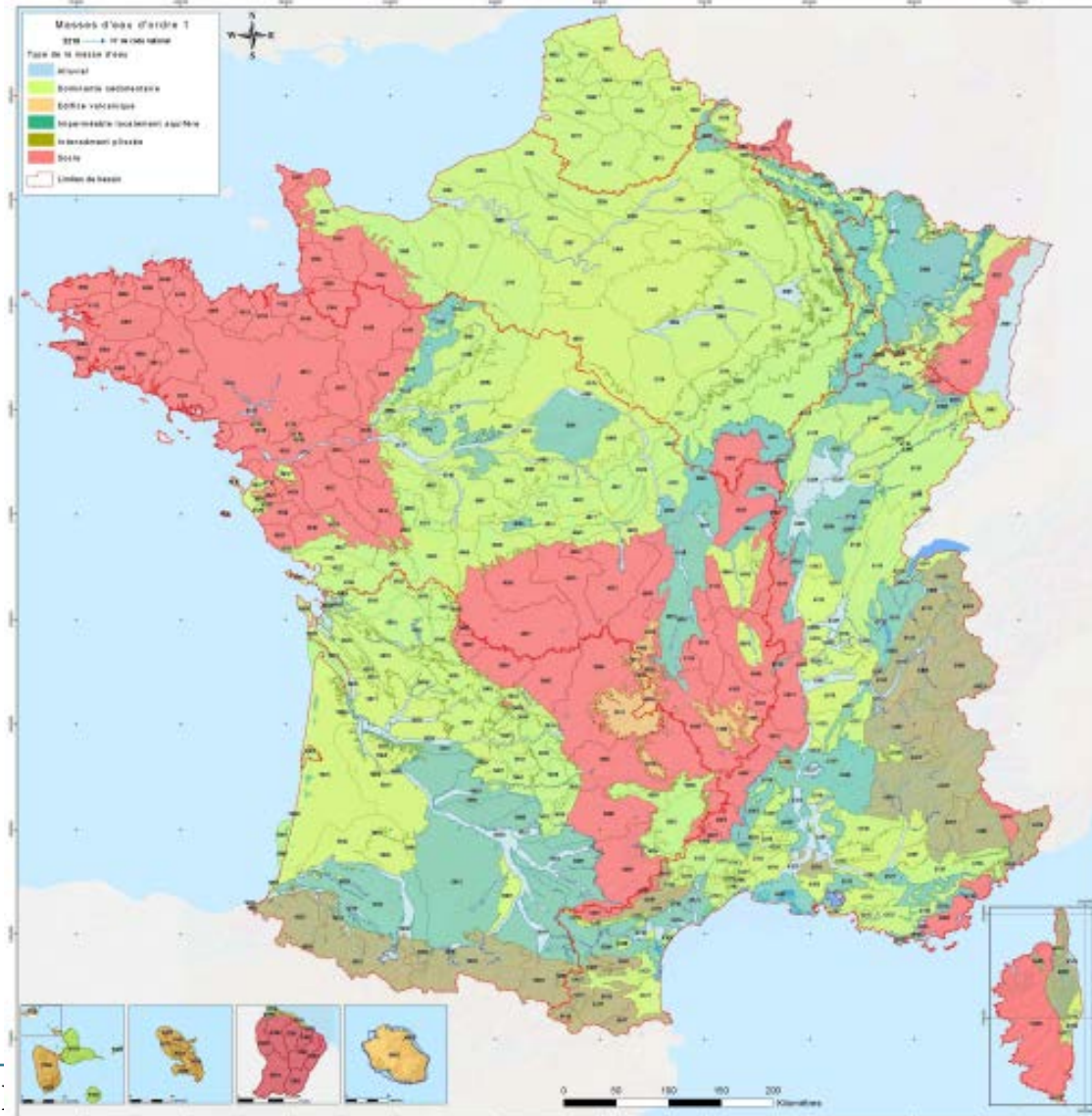
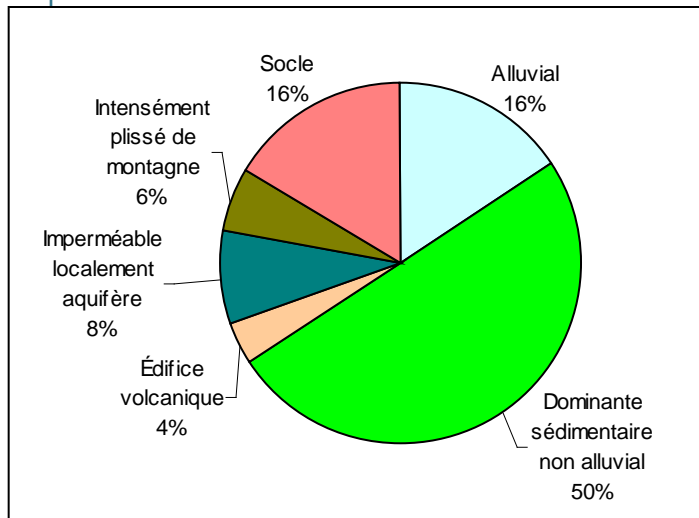
- 6 main types of lithology:
  - Sedimentary dominant (excluding alluvial)
  - Alluvial
  - Crystalline basement rocks
  - Volcanism
  - “Intensively folded” (mountains areas)
  - impermeable “locally aquifer”+ further criteria (e.g. karstic, coastal, confined/not confined ...)
- Aquifers aggregation in order to avoid having “too much” entities  
→ “*Reporting*” unit and not “*knowledge*” unit
- The whole territory is covered by a GWB

# Groundwater bodies delineation

## 574 GWB

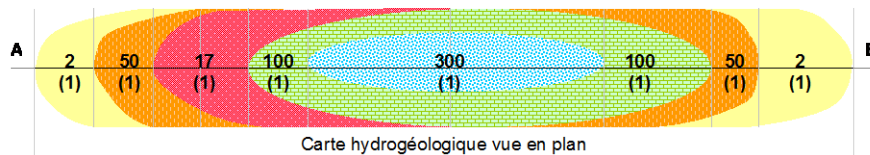
- 533 in metropolitan France (15 trans-districts, 23 transboundaries)
- 38 in overseas territories

## Distribution of GWB types

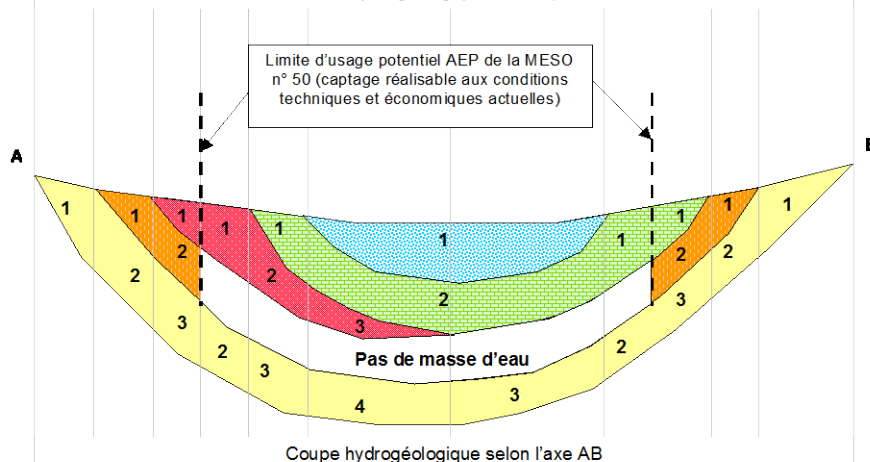




# Ranges of superposition for a GWB



Limite d'usage potentiel AEP de la MESO n° 50 (captage réalisable aux conditions techniques et économiques actuelles)

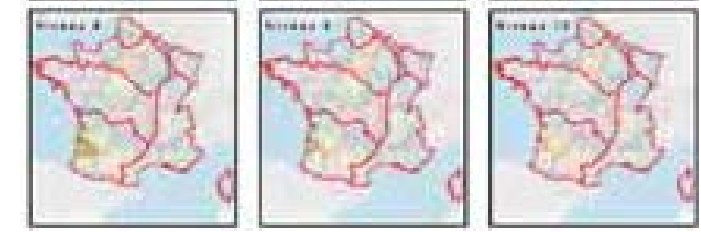
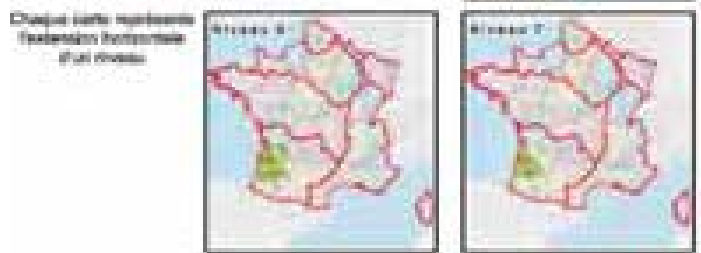


Ordres de superposition

1	2 (1)	50 (1)	17 (1)	100 (1)	300 (1)	100 (1)	50 (1)	2 (1)
2		2 (2)	50 (2)	17 (2)	100 (2)	2 (2)	50 (2)	2 (2)
3			2 (3)	17 (3)	2 (3)		2 (3)	
4				2 (4)				

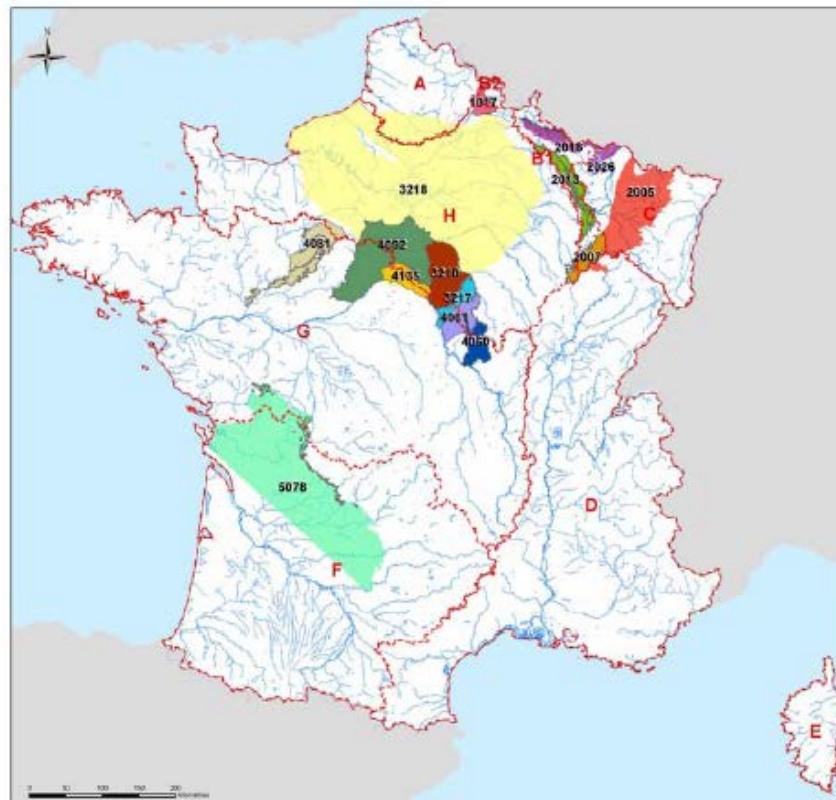
17 (3) 17 = n° de MESO et (3) = ordre de superposition

Représentation des masses d'eau souterraine avec leur ordre de superposition



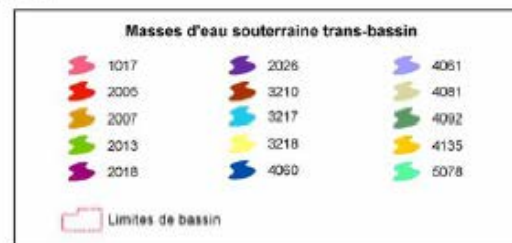
- 1 GWB is described by 1 to n polygons
- Up to 10 ranges
- No vertical scale : the vertical range doesn't depend on the depth

# Trans-district groundwater bodies



transfrontières

Coordonnées géographiques Lambert II étendu



BRGM  
Mar 2009

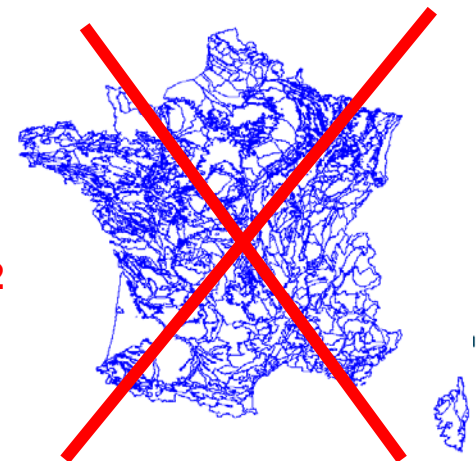
# Transboundary GWB



# Are we happy with this GWB delineation?

- > **10 years after the WFD, the GWB are well known and recognised by water managers, by the public, etc....**
- > **But....**
  - Some limits don't perfectly fit with the hydrogeological limits (better knowledge now than in 2004!)
  - Many GWB are too large and heterogeneous → difficulties to represent sub-parts « in poor status »

**New hydrogeological system available in 2011-2012**



## Groundwater bodies adjustment

### In France, two positions are discussed

→ Constrains : reduce difference between the WFD reporting → the total number of GWB must stay the same

### Different opinions from a river district to another

- 1) No change (half of the river districts)
  - 2) Improve the GWB delineation (other districts). Possible options :
    - Adjustment of GWB boundaries (from the new national aquifer reference system: lithologic contacts at surface + extension under coverage)
    - Identifying GWB subdivision using different criteria such as : hydrogeological basins, depth, chemical and quantitative status, geological boundaries, programme of measures....
- vertical and horizontal subdivisions possible

# Outline of the presentation

## > French groundwater bodies

- Short presentation
- Main criteria used for the delineation
- Advantages / difficulties after for the 1st RBMP

## > **Proposals for the evolution of French GWB**

- Constrains, criteria and consequences
- Example of the Loire-Bretagne district

## > Conclusions

# 2005 to 2011 : Construction of the new aquifer reference system in France

Delineation based on

- the new numerical géological mapping-system (scale : 1/ 50 000)
- national database of boreholes with geological passes (under coverage)
- local and régional hydrogeological studies

## BDLISA Exemple Beauce

### PtsF3C\_107

#### Epaisseur

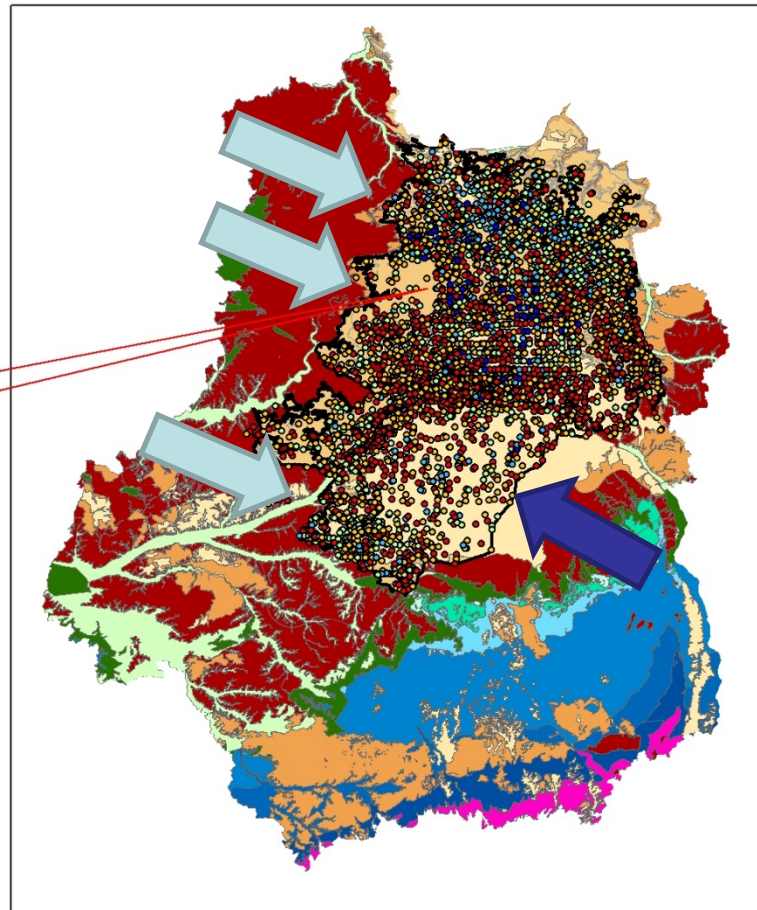
- < 3 m
- 3-10 m
- 10-20
- 20-40
- > 40 m

### BDLISA Centre NV3

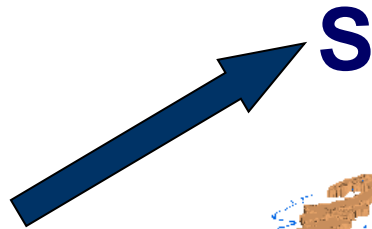
#### ENTITE

- F2/104 - Sables Mio-Pliocène
- F3AC/107 - Calc.+Sabl. Oligo-Mioc.
- F3F/110 - Marnes Rupélien
- F4/113 - Sabl.Calc. Eocène
- F5B/119 - Argiles Silex Paléoc.
- F6/121 - Craie Seno-Turon
- F7B/ 122A - Marnes Ostr. Cénom.
- F7AC/122C - Sables Cénom.
- F7-F8/125 - Marnes Cénom.
- F8/128 - Sables Alb-Néoc.
- F9/131 - Calc. Tithon.
- F10DE/134A - Marnes du Kimm.
- F10EF/137 - Calcaires du Kimm.
- F10G/140 - Marnes callovo-oxf.
- F11/143 - Calc.+Marnes Call.BAjoc.
- F12-13/146 - Marnes Jurass. inf.
- F14-15/149 - Grès du Trias

Description	Code BDLISA NV3
Alluvions - Surcouche	
Recouvrement Pliocène et Quaternaire	F 2A F 2B F 2C
Calcaire de Beauce	F 3C F 3A
Sables et argiles de l'Eocène	F 3E F 3C F 3D F 4E F 4F F 4G F 5B
Craie du Seno-Turonien	F 6J
Marnes du Seno-Turonien	F 6X
Sables du Cénomanién	F 7A
Marnes Ceno. et Argiles Albien	F 7C F 7D F 8G
Sables de l'Albien	F 8HM F 8HN
Aptien à Tithonien	F 8O F 9K F 9L
Calcaires du Jurassique	F 10D F 10E F 10G F 10HLMO F 10P
Marnes et calcaires du Doggar-Lias	F 11A F 11S F 11T F 12A F 13A
Grès du Trias	F 14A F 15A
Socle	



Example in the Beauce (south of Parisian Basin - Interest of orders 2D1/2

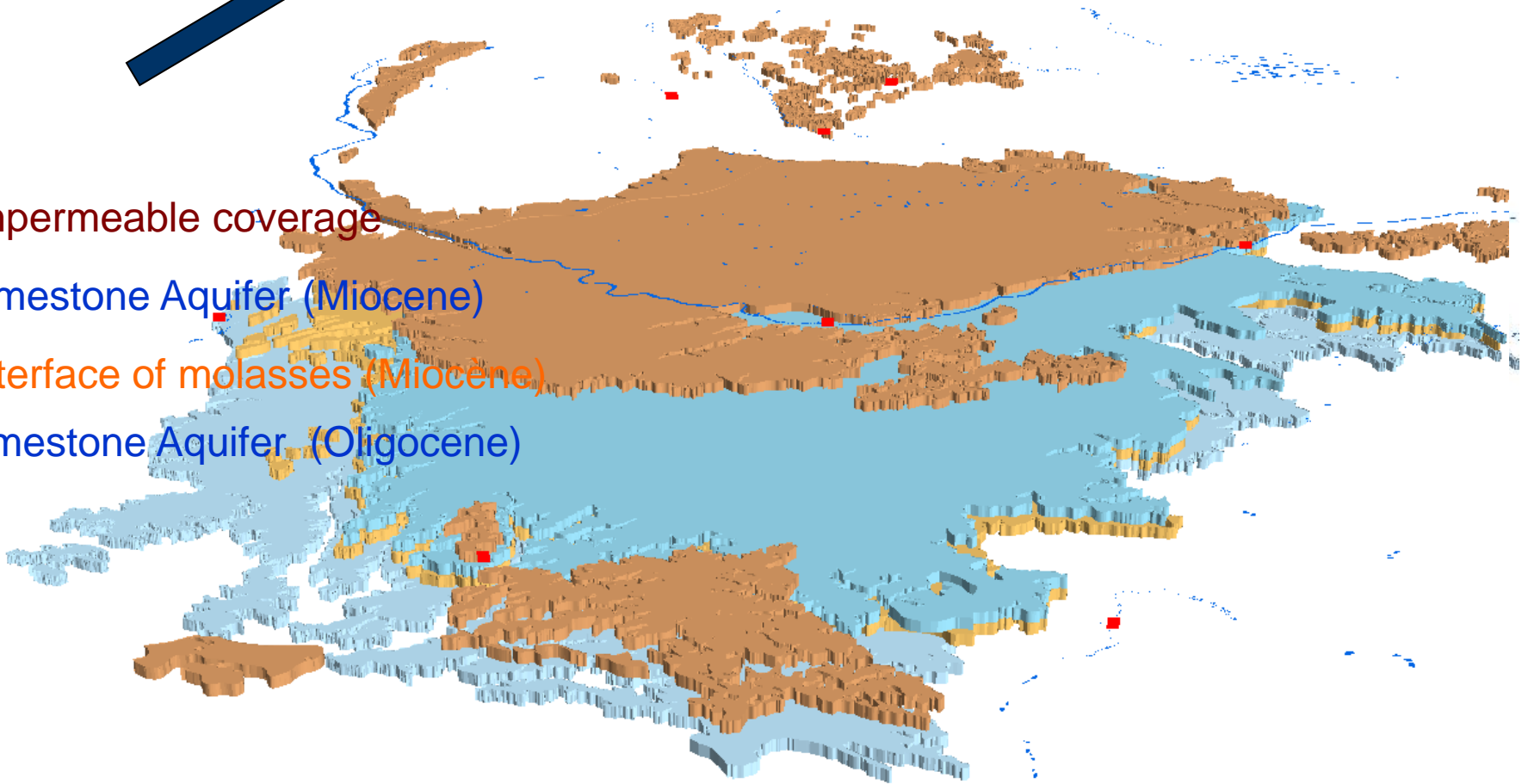


Impermeable coverage

Limestone Aquifer (Miocene)

Interface of molasses (Miocene)

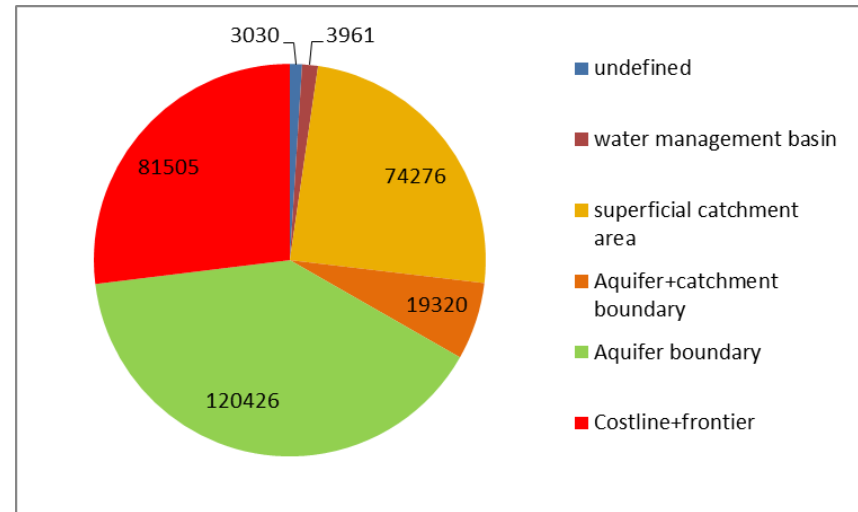
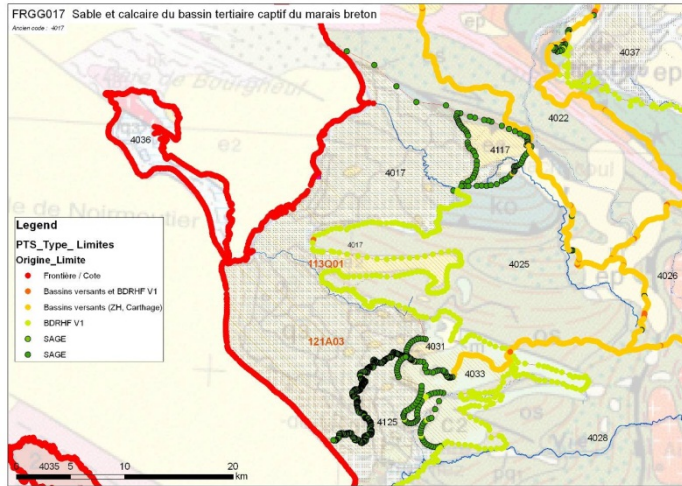
Limestone Aquifer (Oligocene)



BDLSA\_Centre W3  
Cadares d'Evampes



# New delineation of GWB boundaries by integrating new knowledges of the new national aquifer reference system



Example of the Loire-Bretagne Basin (Center and West of France)  
About half of the boundaries based on the **former aquifer reference system**

→ Adjustment with the **present aquifer boundaries** approving the delineation of GWB

## Other methodologies for a new delineation

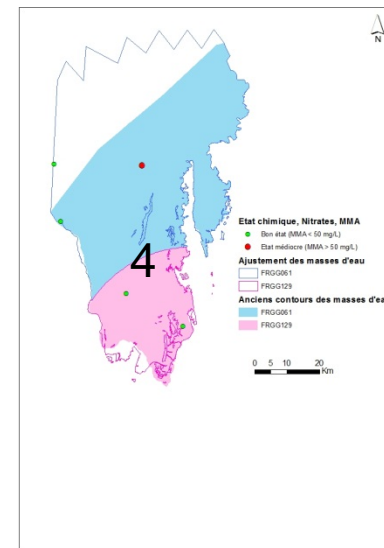
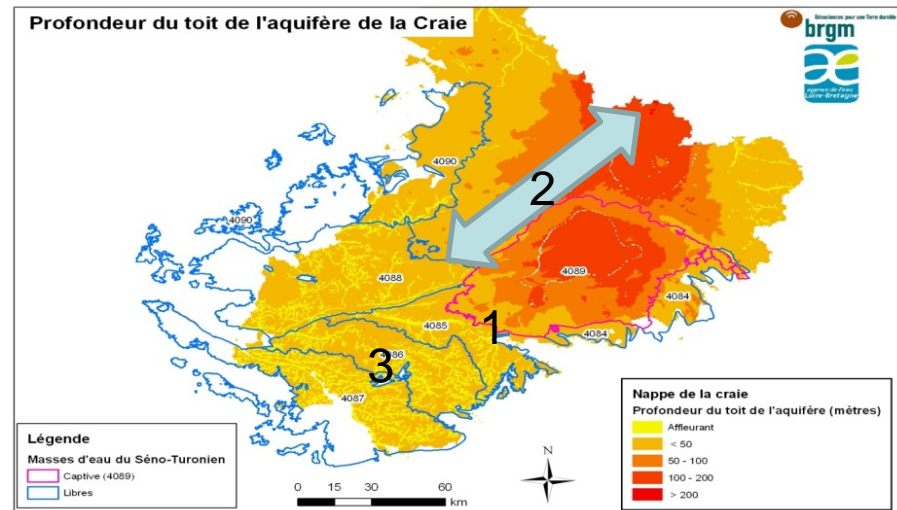
### Delineation of confined aquifers (49 of 534 GWB in France)

- 1) At surface: according to coverage boundary,
- 2) delineation under coverage of deep confines aquifères??  
→ Much bigger surface if no boundary  
Depth?

Lowest wells know in the aquifer?  
Knowledge of aquifer behaviour?  
Exemple : Chalkstone, very low permeabilité in > 50 m depth

- 3) By groundwater catchment areas – flow systems

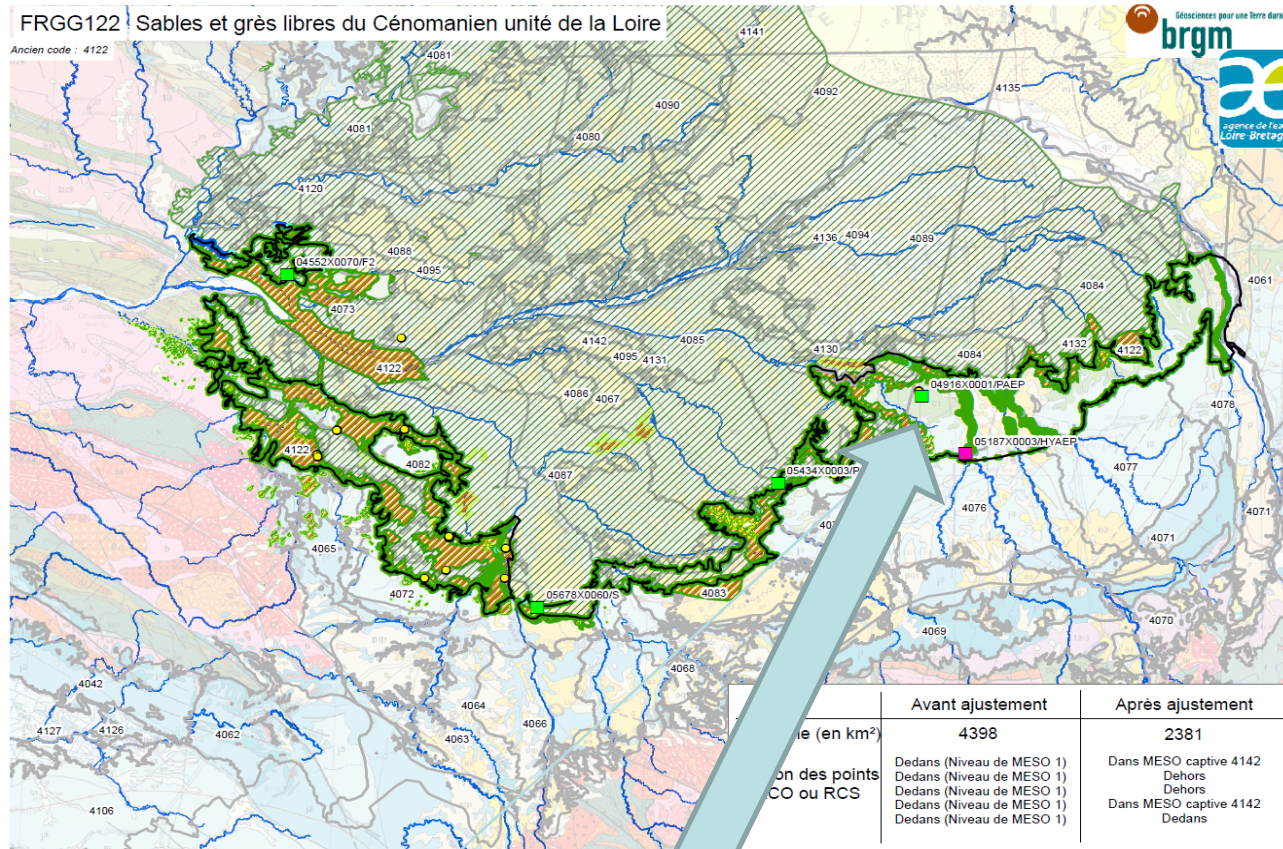
- 4) Contamination/pressure



## Other methodologies for the identification of GWB subdivisions

- **By groundwater catchment areas – flow systems**
- **Contamination/pressure**
- **Vulnerability**
- **Confined/unconfined**
- **Geological layers / Depth**
- **Etc.....**

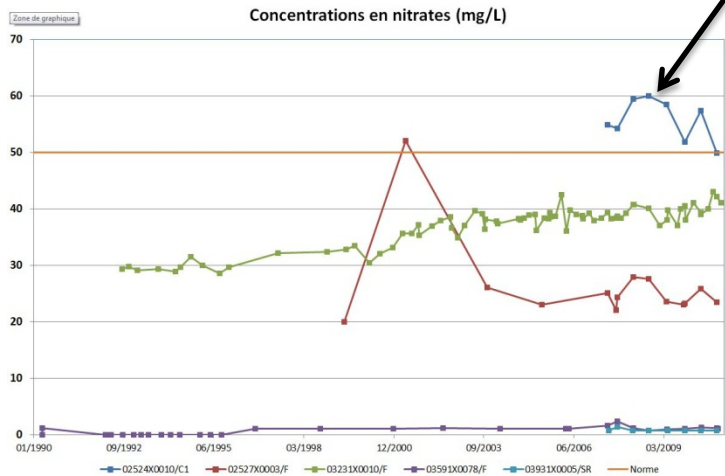
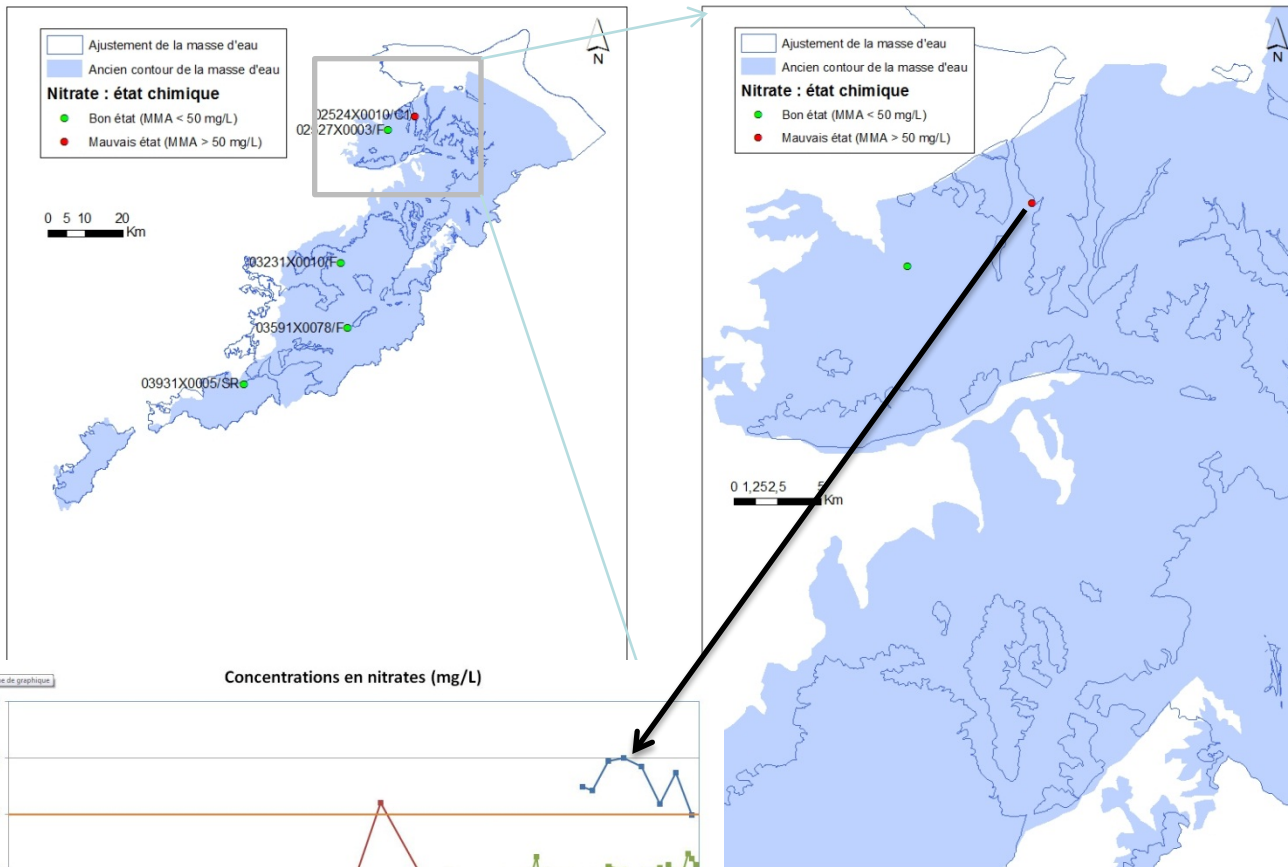
# Example of differences and impact on the monitoring well network of the GFW reporting : Example GWB 4122, sandstones of the Cenomanien



→ In this example, 2 monitoring wells are outside of the formation of sandstones of the Cenomanien → status of the GWB?

→ If these points characterize today the Cenomanien, tomorrow, they will characterize the lower aquifer

# Example of differences and impact on the monitoring well network of the GFW reporting : Example GWB 4122, sandstones of the Cenomanien



# Conclusions – Next steps

- > **An updated GWB delineation will be available in 2012 for the river districts Loire- Brittany, Adour-Garonne and Rhône- Mediterranean /Corsica**
- > **Open questions to discuss between ministry, water agencies and BRGM**
  - Management of depth for confined aquifers
  - Complete coverage of the territory?
- > **« Relatively » small changes to facilitate the next WFD reporting**
- > **Mainly adjustment of GWB boundaries following new knowledge (new hydrogeological reference system)**
- > **Consequences to manage**
  - Changes in the status assessment
  - The GWB code of a borehole may change → need to link codes to the reporting period
- > **Subdivision of GWB is a way to reduce changes and to improve the visibility of a GWB heterogeneity**
- > **Improve attributes. E.g. depth**

