Po river deep aquifers in Eastern Emilia-Romagna alluvial plain : geological and hydrogeological characterization.

Luciana Bonzi [(1)] Marco Marcaccio [(2)] Giovanni Martinelli [(2)] Domenico Preti [(3)] and Paolo Severi [(1)]

(1) Geologic Sesmic and Soil Survey – Emilia-Romagna Region (Italy). pseveri@regione.emilia-romagna.it
(2) ARPA Emilia-Romagna Region (Italy). giovannimartinelli@arpa.emr.it
(3) Reno River Basin Authority (Italy). dpreti@regione.emilia-romagna.it

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INTRODUCTION

A large amount of geological and hydro geological data was analyzed to improve geological and chemical information on Po river deep aquifers in eastern Emilia-Romagna alluvial plain. Geological data mainly consists of geological cross-sections available on the Emilia-Romagna Geological Survey website (http://ambiente.regione.emilia-romagna.it/geologia/), hydro geological data results from groundwater monitoring networks available on the Emilia-Romagna Environmental Agency website (www.arpa.emr.it).

CHARACTERIZATION AND MAPPING OF PO RIVER DEEP AQUIFERS IN ESTEREN EMILIA-ROMAGNA ALLUVIAL PLAIN

Aquifers in the Emilia-Romagna alluvial plain consist of gravel bodies in the southern part, along the Apennine border, and sandy bodies in the northern part of the plain. Gravels bodies characterize the alluvial fans of Apenninic rivers, sands are typical of both Apenninic rivers and Po river. Apenninic river alluvial fans are the main and most used aquifers in Emilia-Romagna Region (Regione Emilia-Romagna, 2004).
A distinction between Apenninic and Po river aquifers was suggested for the upper part of the geological succession (Late Pleistocene and upper part of Meddle Pleistocene, almost two hundred meters underground) in the Emilia-Romagna Water Protection Plan (Regione Emilia-Romagna, 2010), but it is not yet available for the lowest part of the succession (central part of Meddle Pleistocene, almost four hundred meters underground, Regione Emilia-Romagna & ENI-AGIP, 1998).
Different sets of information are used to identify Apennine or Po river sandy aquifers in the deepest part of the plain: sandy body thickness (generally more than ten meters for Po aquifers) and their lateral extension (at least for some kilometres), sand petrographic analysis and the paleogeographic context.
Available information enabled us to identify Po river sandy aquifers in many geological cross sections. These aquifers constitute very large sandy bodies of deltaic nature (Carta Geologica d'Italia, foglio n. 202, 203, 204, 222 and 223).
In the geological sections that have been analysed every Po river aquifer was assigned to different hydro stratigraphic units used in the Po Plain (Regione Emilia-Romagna & ENI-AGIP, 1998; Regione Lombardia & ENI, 2002).
A single map for Po river aquifers of different ages was developed by correlating data between all geological sections. A map for unit A3, A4, and B was developed and included aquifer boundary and sand top isobaths (example in fig. 1).
It was observed that over time Po river coarse sedimentation shifted from south to north in the Emilia-Romagna plain, up to a total shift of a few tens of kilometres. Displacement is due to tectonic activity in buried thrust of the Po Valley and along the Apennines chain, which produced a northward migration of the most depressed section of the plain where the Po river coarse sedimentation was located.
At the same time, the sections of the plain that were previously occupied by Po sedimentation where now occupied by Apenninic river sedimentation, which means that Apenninic sedimentation and Po river sedimentation can be found in the same portion of the plain.

HYDROGEOLOGICAL FEATURES OF PO RIVER DEEP AQUIFERS IN ESTEREN EMILIA-ROMAGNA ALLUVIAL PLAIN

After geological reconstruction and mapping, as above mentioned, it was possible to associate every Emilia-Romagna groundwater monitoring well to Po river or Apenninic provenience, and to assign them to their own stratigraphic units. This operation was possible only for groundwater whose filter positions were known.
Only wells with a single filtered stratigraphic unit were utilised to assign chemical and isotopic information to Po river deep aquifers.
Total available data base included 45 wells.
Geochemical data enabled us to observe that these aquifers are frequently characterized by sodium-bicarbonate groundwater, while the Apenninic aquifers are characterized by calcium -bicarbonate groundwater (Regione Emilia-Romagna & ENI-AGIP, 1998; Pilla et . al., 2006).
Oxygen isotope values are typical of Alps recharge of groundwater and confirm the Po river provenience of these aquifers (ARPA Regione Emilia-Romagna, in press; Longinelli and Selmo, 2003).
Preliminary evaluations allows to recognize the existence of palaeowaters in both Apennine derived and Po-Alps derived aquifers.
Chemical and isotopica data of selected groundwaters in the studied area have been compared with piezometric levels and with local withdrawal data. A relatively higher hydraulic head was observed in the Po plain aquifers with respect to the ones hosted in Apenninic derived conoids. This is probably also due to the intense groundwater withdrawal in towns located along the boundary between the Apenninic chain and the plain area.
Gradient in piezometric level due to groundwater withdrawal could induce groundwater flows through

different sector of the aquifers, monitoring activities are currently carried out to verify this phenomena.

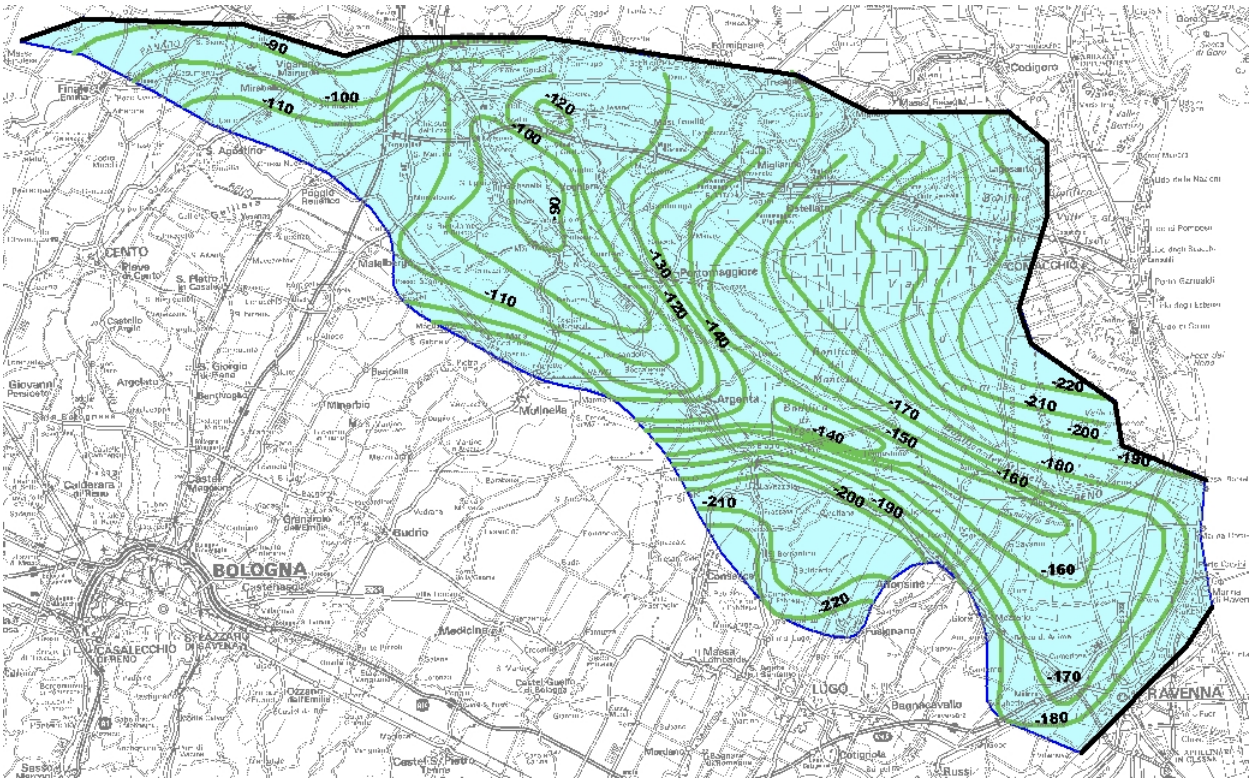

Figure 1 – Geological map of Po river aquifer A3. Boundary (blue line) and isobaths of the top sea level (green lines). Black lines show the boundaries of the study area.

CONCLUSION

Subsurface reconstruction from interpretation of many geological cross-sections have enabled to map deep Po river aquifers in the eastern part of the Emilia-Romagna alluvial plain.

This map has allowed us to assign the specific kind of aquifer (Po river or Apenneine river provenience) and its age to different groundwater monitoring wells.

Chemical and isotopic data fit to geological information and allowed us to better characterize Po river deep aquifers.

New knowledge on these aquifers could be utilized for further in-depth scientific investigations and for ground water management.

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