Geophysical Research Abstracts
Vol. 16, EGU2014-6860, 2014
EGU General Assembly 2014

Groundwater hydrodynamics of ancient fan deltas: The case of Sant Llorenç del Munt Massif (NE Spain)

Marc Anglés (1), Albet Folch (2), Oriol Oms (1), Eudald Maestro (1), and Josep Mas-Pla (3)

(1) Unitat d'Estratigrafia, Departament de Geologia, Facultat de Ciències, Universitat Autònoma de Barcelona, 08193 Bellaterra, Spain, (2) Grup d'Hidrologia Subterrània (UPC-CSIC), Departament d'Enginyeria del Terreny, Cartogràfica i Geofísica, Universitat Politècnica de Catalunya-BarcelonaTech, 08034 Barcelona, Spain, (3) Grup de Geologia Aplicada i Ambiental (GAiA), Centre de Recerca en Geologia i Cartografia Ambiental (Geocamb), Dep. de Ciències Ambientals, Universitat de Girona, 17071 Girona, Spain

Hydrogeological models based on well-exposed mountain massifs permitt to constrain the geological factors affecting water circulation and water-rock interaction. Our study adresses the question of how sudden lateral rock changes (sedimentologic facies evolution) affect hydrodinamics in the case of ancient fan deltas. A robust model for the Sant Llorenç del Munt massif (Eocene, Barcelona province) has been defined after the integration of geology (stratigraphy, sedimentology, mapping and integration of subsurface data) and groundwater hydrology (pumping tests, major ions hydrochemistry and environmental isotopes).

Ten lito-hidrostratigraphic units have been recognized, which correspond to different sedimentary environments and have a distinctive response to water circulation and water-rock interaction. A remarkable point of this case study is that the size of the whole sedimentary system is considered, i.e. the lateral expansion of flow (lateral permeability barriers) is fully contrained. In terms of hydrogeology, hydraulic conductivity due to fracturing provide poor aquifers in 4 rock types. 5 hydrochemical groups have been established which allow explaining the evolution of the flow throughout the fan delta. Together with isotopic and stratigraphic data the main recharge areas have been determined.

Flow dynamics throughout the system combines both surface runoff and subsurface flow. In proximal alluvial conglomerates, groundwater runs both vertically (fractures) and horizontally (fractured and karstified levels). Some features that are generally overlooked in hydrogeological studies (such as conglomerate petrology) are crucial for fracturation and karstic development. Laterally, conglomerates evolve to impermeable mudstones with sandstones (alluvial fan fringe). However, some conglomerates prograding locally reach distal (marine) sediments and recharge the fractured delta front sandstones aquifers that are also refilled by runoff waters. The end sediments (prodelta marls) provide an ultimate permeability barrier of the system. In general, lithologies arrangement due to past fluctuating distribution of sediments (sedimentary architecture) are crucial in the vertical and horizontal location of the aquifers levels.

Interestingly, our study based on ancient rocks can also be applied to present day systems. Original sediments with important primary porosity are later better cemented (lithified) into indurated rocks and then more fracturated. So that, it indicates that in current and ancient fan deltas, better aquifers levels develop in the same strata independently of the transmisivity origin (primary porosity or fracturation).