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Karst system conceptual models based on the aquifer recharge

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Abstract

The aquifer recharge heavily affects both the hydrodynamic and the main water chemical-physical parameters. The recharge of the aquifer is mainly linked to primary and/or secondary inputs: the primary inputs are by rain or snow melt, directly recharging the aquifer, whereas the secondary inputs are the surface runoff waters continuously recharging the aquifer. Taking into account the recharge of the system, four different basic conceptual models can be distinguished: *systems with primary inputs prevailing, systems with primary and secondary inputs, systems with secondary inputs prevailing, systems with prevailing inputs by racking* (Vigna 2023). Monitoring with multiparameter probes (continuous acquisition of water levels/flow rates, temperature and electrical conductivity of spring waters) allows to highlight the different recharge models.
Systems with primary inputs prevailing (e.g. Fuse system, Ligurian Alps, Piedmont, Italy) are characterized by a diffuse water infiltration, homogeneously distributed into the entire hydrostructure. The aquifer recharge occurs only during precipitation or snow melt periods. Therefore, water spring flow rate, mineralisation and temperature are linked only to the groundwater circulation (karstification and/or prevailing fracturing).

Systems with primary and secondary inputs (e.g. Borello system and Bossea system, Ligurian Alps, Piedmont, Italy) are recharged by precipitations directly affecting the aquifer, and by surface watercourses continuous inputs, which flow on the poorly permeable rocks confining carbonate rocks through in sub-riverbed sinkholes. In this systems, water temperature and mineralization may undergo temporary and marked variations after the two inputs mixing.

Systems with secondary inputs prevailing (e.g. Mondini system and Bandito system, Ligurian Alps, Piedmont, Italy) are usually located near valleys in which important watercourses flow on carbonate rocks. When these watercourses intercept the carbonate aquifer, progressive water losses in sub-riverbed occur. In dry seasons, these losses can be total or partial. The so-called "hydrogeological tunnels" belong to this kind of systems too. The water flow rate and chemism are heavily conditioned by the hydrodynamic and qualitative characteristics of the surface waters, being the primary inputs negligible. The spring water temperature generally shows important fluctuations, closely related to the seasonal climate variations.

Systems with prevailing inputs by racking (e.g. Rio Martino system, Cottian Alps, Piedmont, Italy) are usually karst aquifers covered by extensive porous aquifers (debris, morainic or alluvial deposits), which are mainly fed by the aquifer in the surface area. The spring

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water flow rate, mineralisation and temperature are affected by the hydrodynamics of the porous aquifer, which generally have more constant values over time (due to a relatively low permeability due to the presence of a fine matrix) and, consequently, more contained fluctuations of different parameters than those typical of the karst aquifers.
In this work, several case studies of springs fed by the different aquifer systems are reported.

Keywords: karst systems, aquifers, water, karst, monitoring