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Characterization of a glaciofluvial deposit by a geophysics and sedimentologic approach

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In urban environment, stormwater evacuation is problematic in the periphery of urban zones far away from the hydrographic system. To compensate this problem, alternative drainage techniques as infiltration basins were used. However, the building of this basin was not accompanied by an evaluation of the impact of stormwater on the receiving environments (subsoil and water resources). Stormwater quality is indeed altered by the mobilization of contaminants (solid fragments, hydrocarbons, heavy metals, etc...) during the streaming of rainwaters on urban waterproofed surfaces. The receiving environments may thus be contaminated.

To estimate this potential impact, it is at first necessary to know the mechanisms of fluid flow and solute transport through the unsaturated zone underlying of infiltration basins. These mechanisms strongly depend on the nature of the subsoil in place. In urban environment, the majority of infiltration basins are implanted on alluvial formations - fluvial or glaciofluvial. At the time of the dimensionnement of these works, the hydrogeologic approach, consisting in considering homogeneous at the scale of a catchment area this type of geologic formations, was privileged. However, this approach, valid on a large scale, is not appropriate on the scale of infiltration basins : heterogeneities of these deposits, both textural and structural, can be at the origin of a differential transport, leading to a deep contamination of subsoil or water resources. The evaluation of stormwater impact thus passes by a better knowledge of alluvial formations heterogeneities.

The study area is an infiltration basin situated east of the Lyon agglomeration (Chassieu, France). This basin is situated on glaciofluvial alluvia formed during and after

the last glacial maximum. These formations are characterized by a high degree of sedimentary heterogeneities, both textural (varied grain size distribution from fine sands to coarse gravels) and structural (lithologic units organization of various forms, centimetric to metric scale), at the origin of a heterogeneous distribution of hydrodynamics parameters. The evaluation of the stormwater impact passes by a characterization of this distribution and thus by a characterization of the sedimentary heterogeneities.

In this type of unconsolidated material, the standard investigation methods (borehole, pumping-test) are not adapted. The appeal to non-destructive geophysics methods (ground-penetrating radar, high resolution seismic method, electric resistivity, ...) turns out to be an appropriate solution. However, the current state of geophysics techniques does not allow to directly characterize the repartition of lithologic and hydrodynamic units. To characterize of best possible this repartition, an approach completing the geophysics investigation, and based on sedimentology, can be used. This approach consists in an sedimentologic interpretation of geometries revealed by a geophysics method to establish a model of distribution of the various lithologic and hydrodynamic units.

To validate this coupled approach geophysics/sedimentology, we confronted a sedimentologic described glaciofluvial outcrop with time-slices obtained by ground-penetrating radar (monostatic mode, antennas of 200 MHz and 400 MHz) and corresponding to the outcrop. The sedimentologic description of the outcrop was made at two scales : on one hand the textural scale of lithofacies, described with the code of classification of Heinz and al. (2003) derived from the code of Miall (1978), on the other hand at the structural scale of architectural elements. The confrontation of the sedimentologic description with radar time-slices interpreted in term of radar facies allowed to estimate the scale of characterization of the glaciofluvial formations geometries which can be obtained. The results showed that the radar facies were correlated with the main architectural elements, but that the signals did not allow to characterize lithofacies described on the outcrop. The sedimentologic approach allowed to mitigate the current limits of the geophysics : a model of lithofacies distribution, established by interpretation of geometries observed with ground penetrating radar as architectural elements within particular deposit paleoenvironment, was established. A relation between lithofacies and hydrofacies (Klingbeil and al., 1999) allowed to set up a model of hydrodynamics parameters distribution, which can be used in a flow and solute transport model.

Keywords : glaciofluvial deposits, sedimentology, ground-penetrating radar, lithofacies, hydrofacies, architectural elements, heterogeneous flow

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