Béziers Gallo-Roman Circus (France)

Description: The Roman mortars of the Béziers Gallo-Roman Circus are currently being studied as potential analogues for the long term degradation of cementitious materials.

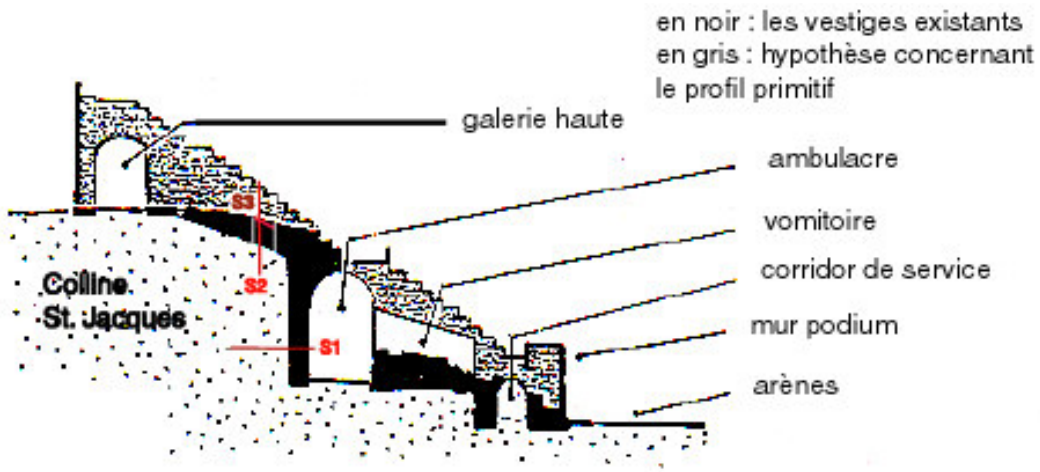

Figure 1: Vertical section of the remnants of the Béziers Gallo-Roman Circus. Present day remnants are in black; the hypothetical initial building is represented in grey. S1, S2 and S3 are three sampling boreholes (with the kind permission of I. Techer)

The Béziers Gallo-Roman amphitheatre was built around 80 AD. The precise evolution of this building is difficult to reconstruct: after its abandonment at the end of the 3rd century, materials have been collected from the amphitheatre and parts of it were partially or totally filled in. Recent archaeological investigations (1991-1993) have given a more detailed vision of the original buildings' structure and of its history. Excavations have cleared several remnants of the internal gallery (ambulacrum) and of the radial walls. The amphitheatre was built against the hillside of Colline St Jacques, where the present-day remnants are found. Water circulation through the old Roman masonry is strongly suggested by the presence of surface concretions and dripstones. The origin and residence time of this circulating water are, however, not well known.

Figure 2: Left: drilling equipment installed in the internal gallery (ambulacrum). Right: Radial wall with masonry. (Photograph by I. Techer, GIS/CEREGE)

Mineralogical and geochemical investigations of this site have been conducted in order to characterize the water-rock interactions that have affected the mortar. Several investigation tools were used for this purpose:

- investigations using the strontium isotope probe
- laboratory leaching experiments of the least altered mortar samples

Relevance: Roman mortars such as those found in this building, are materials that have an initial mineralogical composition and texture that differs significantly from that of modern cementitious materials. The present analogue will thus be used in order to obtain generic information on the kinetics of cement/groundwater interactions in the context of surface and variable saturation conditions, i. e. those relevant to the surface storage of radioactive waste. In particular, one of the major transformation processes observed in mortars is carbonation. Results to date are only preliminary and are only available as internal CNRS and CEA reports.

Position(s) in the matrix tables: This analogue is related to the understanding of the physical integrity of cement based materials in a surface environment.

Limitations:

- the composition of the mortars is quite different to that of modern cements
- the flow regimes of the groundwater is not well constrained
- the material has undergone various burial conditions

Quantitative information: The age of the initial mortar is reliable, although the exact initial composition of the mortar has yet to be better constrained.

Uncertainties: This analogue should be grouped with other analogues of the same type in order to obtain a statistical distribution of observed trends for similar materials.

Time-scale: The time-scale of the analogue is historical, involving up to 2000 years of water-rock interactions. However, an evolutionary time scale for individual features (for example fractures) is presently not known and could be much shorter.

PA/safety case applications: Results obtained on this analogue can be used as a qualitative guide to constrain parameters related to the modelling of cement carbonation. Study of leaching experiments (in progress) will also help to assess leaching models of mixed CSH/carbonate based materials.

Communication applications: Potential interest by grouping several studies of the same type of materials for comparative purposes.

References:

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Added value comments: No comments to add.

Potential follow-up work: Work is currently in progress on this analogue.

Keywords: concrete, chemical alteration, microbial alteration, dissolution, precipitation, limestone, unsaturated zone, water table,

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