Connectivity and Drainage in a Karst Reservoir: Insights From an Outcrop Analogue

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ABSTRACT

Karst reservoirs are usually extremely complex to model as their structure is the result of several factors related to the geological structure and the extent of the subaerial exposure to aggressive waters. The use of analogues could strongly improve the understanding of the karst structure and evolution. A series of analogues has been chosen in a quarrying district of southern Italy, representative of the karst profile of some active oilfields in the Adriatic Offshore. The karst system here is the result of several phases of subaerial exposure since Cenomanian until today, affecting a Lower Cretaceous substrate. The detailed description has been performed on the virtual outcrops, identifying the various elements of subsurface karst, like dissolved fractures, vertical shafts, horizontal conduits, etc. The upper part (epikarst) is showing a very variable thickness and the dissolved fractures are usually filled with abundant Terra Rossa deposits. The vertical transfer zone (vadose zone) shows mostly vertical dissolved fractures, often evolved as shafts, filled again with terra rossa. In this case, the vertical karst features are usually discontinuous as they are developing irregularly along fractures. The phreatic zone can be identified by the presence of rounded horizontal conduits and by horizons of enhanced dissolution, probably related to freshwater/seawater interaction. The position of the horizons of enhanced dissolution is not limited to the deepest part of the quarries, but their vertical repetition is suggesting an evolution of the level of groundwater table. The localization of the enhanced dissolution horizons appears to follow partially the concept of “inception horizon” formulated by other authors: however, the extent of these high-porosity horizons seems to be more limited spatially, rather than ubiquitous as we could expect by using that theory. The observed features are helping to understand more in detail the geometry of a karst system, especially in its complexity. We observed that the boundary between the vadose and the phreatic zone is never sharp, but is controlled by a variable groundwater level developing high-K horizontal streaks. The impact of these features is an increased connectivity of the reservoir also above the main phreatic zone, leading to very high horizontal permeabilities, draining limited areas of the reservoir.