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The Slope-to-basin Succession of the Gran Sasso - An Analogue of Potential Hydrocarbon Reservoirs in the Adriatic - Italy

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SUMMARY

A good geological and petrophysical description of reservoir complexity (heterogeneity) forms the basis for optimum field development and maximising hydrocarbon recovery. However, severe limitations are often imposed by relatively low seismic resolution, especially for deeply buried reservoirs, and by wide well spacing. These limitations can be partly overcome by studying reservoir analogues, similar ancient sedimentary rocks which crop out on the Earth's surface.

The proposed case study offers a great opportunity for analyzing the characteristics of resedimented-derived carbonate deposits, which represent an excellent outcrop analogue for potential carbonate reservoirs in the central Adriatic offshore.

Introduction

In the Adriatic offshore of the Abruzzi region, there are some potential oil plays (e.g., Bertello et al., 2010; Casero and Bigi, 2013) related to the depositional context developed during the evolution of the Apulian platform-to-basin transition. The aim of this study is to reconstruct the depositional and geometrical characteristics of an exposed carbonate system that represent an analogue to some potential oil plays in the Adriatic offshore. The surface analogue is located in the western sector of the Gran Sasso structure, in the northern part of the Central Apennines fold-and-thrust belt, where some features of the Mesozoic petroleum system (i.e. source rock, reservoir, trap and local seal) are spectacularly exposed. In particular, along the Gran Sasso structure, the Jurassic-Cretaceous slope and base-of-slope carbonate succession is exposed along a seismic scale natural transect (about 7 km long) (Fig. 1A), parallel to the adjacent platform margin located 13 km toward the south. Some exploration wells in the Adriatic offshore, along the NE-SW-trending transitional facies belt of the Apulian Carbonate Platform, revealed the occurrence of resedimented carbonate deposits with a stratigraphic (Late Jurassic-Early Cretaceous), depositional (base-of-slope) and paleogeographic (on top of a structural high) setting similar to those exposed in the Gran Sasso structure.

Method and Theory

The study has been carried out through a multi-scale field-based approach going from large-scale observations, stratigraphic logging and microfacies analysis. The field approach allowed to define the geometric, sedimentologic and compositional features of sedimentary bodies, and to reconstruct the depositional architecture of the carbonate slope. The studied succession has been subdivided into two main superimposed units. The lower unit (Unit A) is about 15 m thick and it is characterized by micritic limestone, packstone and more rarely by rudstone composed of reef-derived material. Mudstone and packstone beds are laterally continuous, parallel-sided, with sharp planar base. Rudstone are lens-shaped and discontinuous with a lateral continuity of a few hundred meters (Fig. 1B). The sedimentological characteristics and the composition of the resedimented deposits constituting the Unit A, indicate that the bioclastic materials were exported from the bioconstructed platform margin and were transported as broad sheet flows. The upper unit (Unit B) is about 15 m thick and it is characterized by an interval dominated by discontinuous bodies of lithoclastic breccias, intercalated within the micritic limestone and rare bioclastic packstone of the Maiolica Fm. The lower boundary of this unit is characterized by the abrupt interruption of the intercalation of the resedimented bioclastic sediments of the Unit A, and by the presence of a horizon dominated by several breccia bodies. Breccias are laterally isolated from one other by basinal-facies of the Maiolica Fm. They have a slightly mounded or lens-shaped geometry with limited lateral continuity, and are chaotic internally. They vary between 50 m to 2 km in length, and from a few meters to 15 m in thickness. Their base is little erosive and slightly concave, while their upper part is generally flat with convex and blunt lateral terminations, onlapped by micritic limestone of the Maiolica Fm (Fig. 1B). The sedimentologic and compositional characteristics of the breccias indicate that the clasts were supplied from a bioconstructed margin, and have been transported by debris flow mechanisms. The mild erosion at the base of the breccias and their geometry suggest that these deposits record the distal part of debris flow channels that incised the underlying slope facies.

Conclusions

Based-on previous works concerning carbonate slope systems (Schlager et al., 1979; Cook and Mullins, 1983; Yolaine et al., 2012), we refer the studied depositional system to a slope-apron facies model, in which the Unit A represents a basin-scale resedimented wedge that can be physically traced upslope, up to the platform margin, whereas the Unit B reflects a small-scale event, detached from the source area, which intercalates only locally along the slope successions. The outcomes of this study demonstrate that the detailed analysis of outcrop data represents a powerful tool for the sedimentological and geometric characterization of hydrocarbon reservoirs, and open new exploration and development perspectives in the Central Adriatic offshore.

Figure 1 A) Panoramic view of the western sector of the Gran Sasso that shows the resedimented slope deposits; B) Depositional facies model of the Upper Jurassic-Lower Cretaceous platform-to-basin system, illustrating the transect exposed in the studied area, and the relationships between Units A and B. (modified from Rusciadelli and Ricci 2013).

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