Comparison of Central and Southeast Asia Carbonate Fields: Reservoir Properties, Petroleum System and Challenges*

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Abstract

Carbonates are the dominant hydrocarbon reservoirs in Central and Southeast Asia. Probably the best known examples, apart from the Middle East, are the Pricaspian Basin and the southeast margin of the South China Sea, offshore Sarawak and Northwest Palawan (Figure 1). The two areas are located far apart geographically, and also appear different at a first glance, i.e. the large carbonate platforms in the Pricaspian hold significantly larger hydrocarbon volumes than those in Southeast Asia and their development comes with significantly larger challenges. This article presents a study which compares carbonate fields in Central Asia and Southeast Asia, their reservoir properties and petroleum system.

The Central Asian carbonate reservoirs in the Pricaspian Basin selected for comparison include Kashagan, Karachaganak, Astrakhan and Tengiz. The reservoirs are Devonian and Mississippian isolated carbonate platforms, sealed by Artinskian shales and Kungurian evporites. The areal size of these platforms is several hundred square kilometers (Figure 3) and they hold hydrocarbon columns of several hundreds of metres to well over a kilometer. Average porosities are low and strongly influenced by the complex diagenetic history. Permeability is aided by the presence of fracture networks. Burial depths are significant: over 4 km at least. Probably the biggest challenge, however, in the development of these fields is the large concentrations of H_2S and CO_2.

The carbonate fields selected to represent Southeast Asia for the comparison include Natuna, Malampaya and the fields of Central Luconia (Figure 2). Reservoirs are Eocene to Miocene isolated carbonate platforms, sealed by Miocene to Pleistocene shales. They are located in tectonically active areas. Although they are much smaller in size than their Central Asian counterparts (< 100 km^2), hydrocarbon columns of several hundreds of metres and high porosities provide respectable hydrocarbon volumes in place. Similar to the Pricaspian Basin carbonate platforms, porosity and permeability are largely the result of diagenetic processes. None of the Southeast Asian fields contain significant volumes of H_2S, but large concentrations of CO_2 (up to 80%) may be present in some areas.

Although the two selected areas are located far apart and don't seem to share much at first glimpse, the comparison provides insights in the versatile nature of carbonates, the controls on reservoir properties, the petroleum systems and development challenges, and increases awareness of exploration risk.

References

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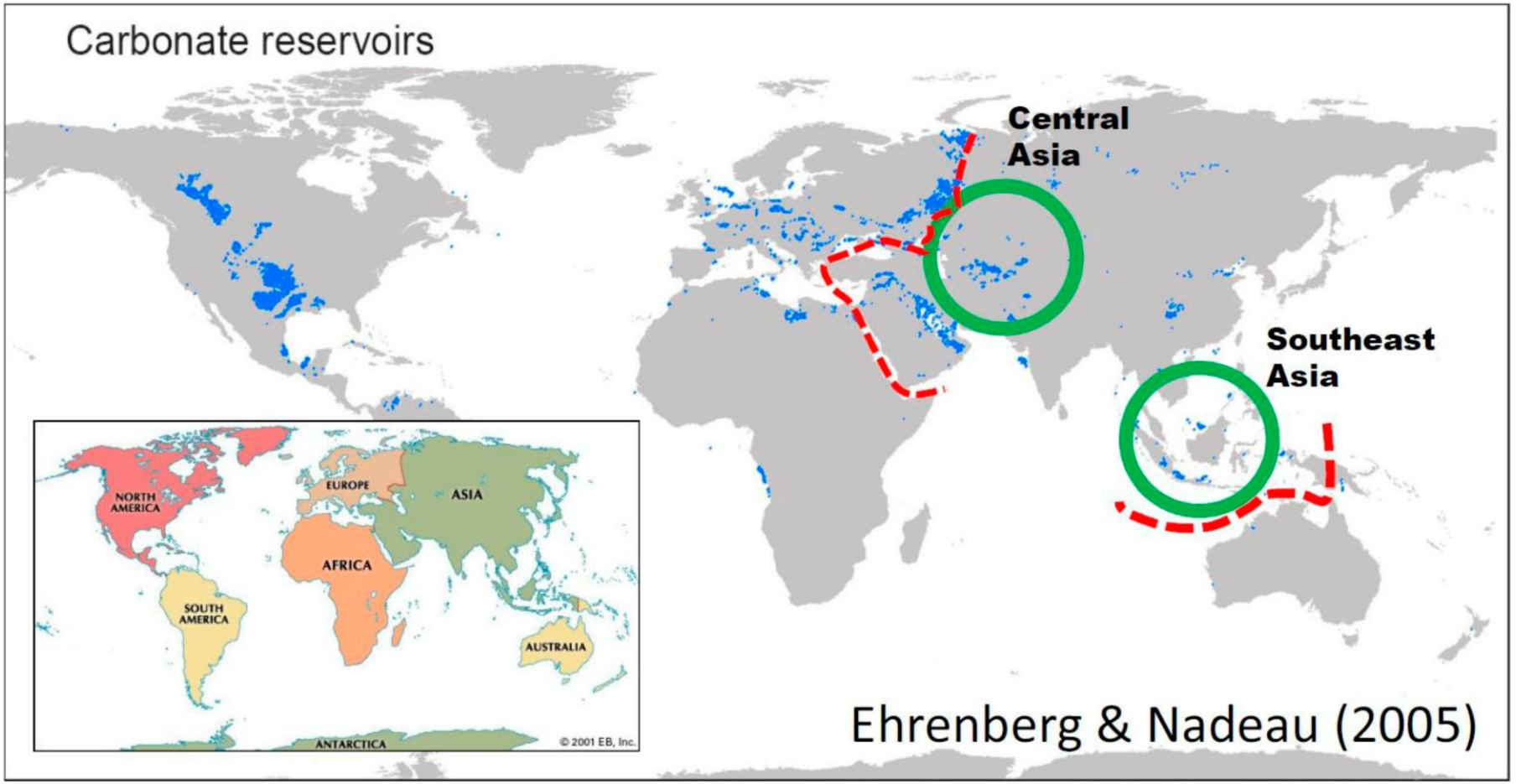

Figure 1. Map of global distribution of carbonate reservoirs, including those in Central and Southeast Asia which are discussed in this article.

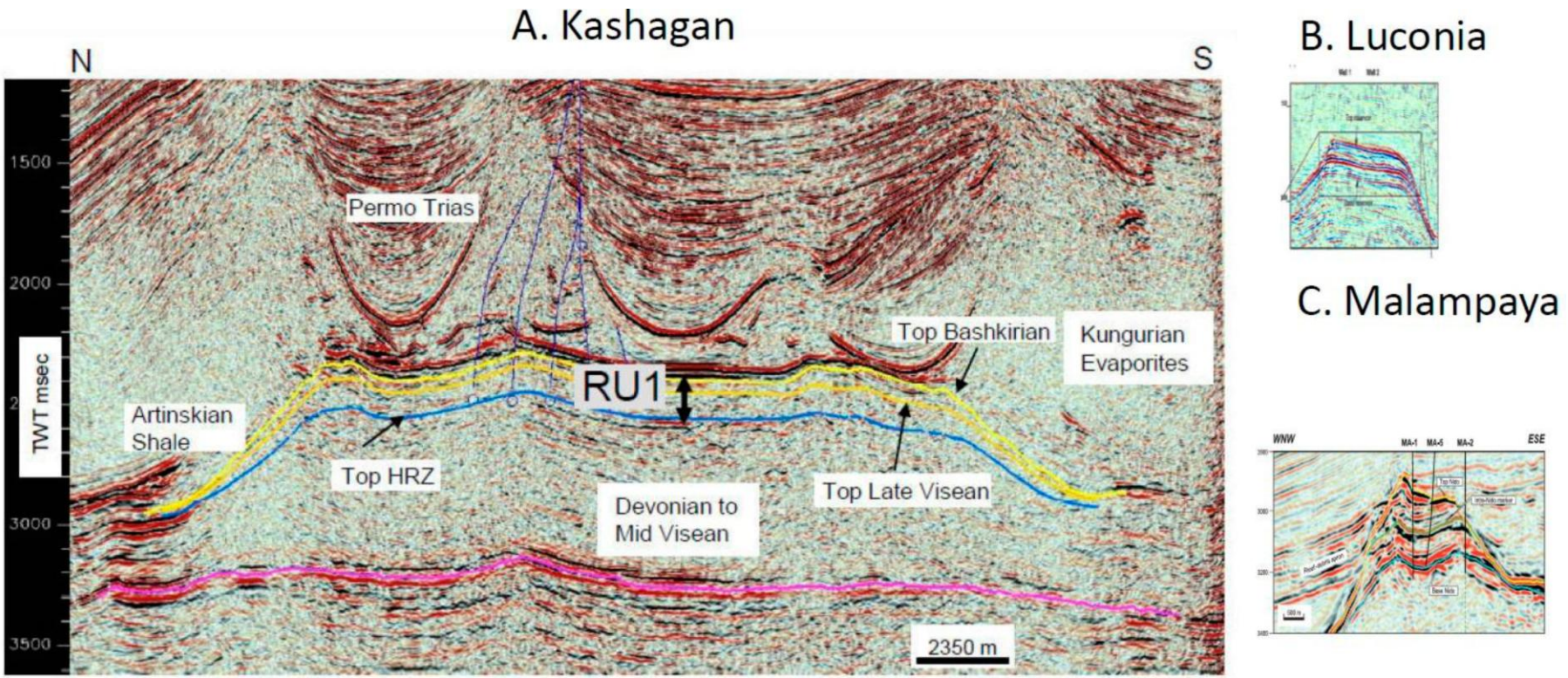

Figure 2. Example of seismic sections of carbonate fields in Central and Southeast Asia, approximately in the same scale: Kashagan (Kazakhstan) after Rochi et al. (2010); Luconia (Malaysia) after Masaferro et al. (2004); and Malampaya (Philippines) after Neuhaus et al. (2004).

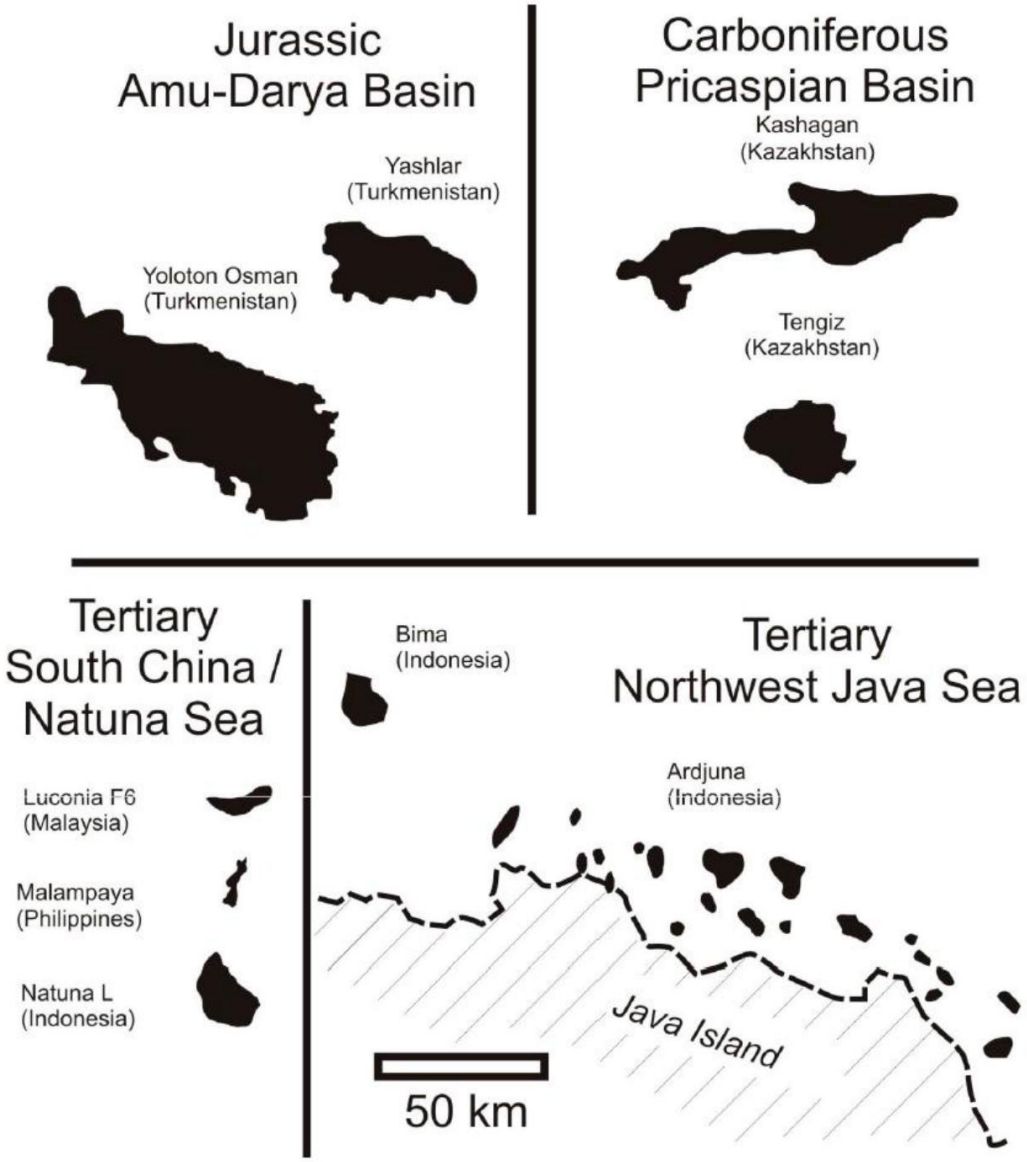

Figure 3. Areal size comparison of fields in Central Asia (e.g. Amu-Darya Basin and Pricaspian Basin) and Southeast Asia (e.g. Natuna/South China Sea and Northwest Java Sea).