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Hydrocarbon Exploration in Volcanic Systems: Evaluation of Reservoir Potential

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ABSTRACT

Volcanic complexes are generally avoided in petroleum exploration. Nevertheless, while looking at the size of the objects these questions should rise in the explorer's mind: "Can this object be part of a petroleum system? Can it be reservoir? Can we evaluate the potential of this area and how to predict the facies and reservoir properties?"

The inventory of the fields already producing in this kind of reservoir reveals that the interest of this thematic is proved. In Japan since the 60's the Green Tuff formation is producing gas in the Niigata Tertiary basin and in China several fields are already producing in volcanic reservoirs, as the Qingshen gas field in the Songliao Basin. Moreover, volcanic reservoirs are one of the main targets in future exploration in this country. Other examples in the world also exist even if they are less documented.

However, a lot of examples would justify the petroleum major's hesitation to implement a well in a volcano. Dry wells in volcanic tight rocks while the target was a carbonate platform constitute one the main fear of the explorers. So the main challenge is to understand the keys that would help predicting the volcanic reservoir properties. Lithology, depositional facies, diagenesis, fracturing… The same scientific approach than is sedimentary geology might be used. Understanding of the geodynamic context, the magma and tephra type, the fluid circulation and the burial history could lay the foundations to build a depositional model and to predict the facies occurrence and its reservoir properties; or at least give keys to evaluate the risks.

Using modern and fossils analogs can help to predict the geometries and heterogeneities, while field analogs can give keys for reservoir property evaluation and diagenesis history. But how to choose a pertinent analog? In sedimentology the choice of an analog is guided by the similarities with the studied case in terms of depositional environment. In volcanology, what could be the best factor to choose an analog? With a brief example we will discuss this point with an example and compare some seismic lines with field and outcrop analogs, to finally propose a hypothesis for the evaluation of the petroleum potential in this area.