

Petroleum Exploration in Volcanic Basins: An Overview of the Impact of Igneous Processes and Deposits

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ABSTRACT

Sedimentary basins affected by igneous processes and deposits have not conventionally been associated with significant petroleum prospectivity. In recent years, however, an increase in the number of discoveries in volcanic basins has seen a shift in the attitude of explorationists. Adding to the increasing number of discoveries, new understanding of the interactions of magmatism with prospective basins has brought a change in the way prospects are appraised in volcanic basins. Some of the most spectacular examples of the evolving understanding of volcanic-associated petroleum systems are found in the Neuquén Basin of Argentina. Here, numerous petroleum fields produce oil from igneous sheet intrusions. The hydrocarbons are locally generated from immature source rocks which were matured due to heating from the intruded magma. The basins demonstrate self-contained petroleum systems which would not exist without the magmatism. Not only are the intrusions acting as host for hydrocarbons, it can also be demonstrated that they are able to mature parts of the basin which would otherwise be in an immature window. Improvements in seismic imaging has led to major revelations in basalt and sub-basalt imaging during the past decade. We apply the methods of seismic volcanostratigraphy and igneous seismic geomorphology, combined with sill interpretation and 3D seismic visualization techniques, to identify and characterized the igneous complexes in volcanic basins. Several studies show that large intrusive complexes have caused the generation of huge volumes of methane, e.g. the East Greenland - Norwegian conjugate margins, the Barents Sea, the Karoo Basin in South Africa, and the Tunguska Basin in Siberia. The volumes of produced gasses during major intrusive events are on the scale where they can significantly alter global climate, even where only poor quality source rocks are available.