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Sedimentary process response of basic magmatism in sedimentary basins

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During the deep-water oil and gas exploration on the passive continental margin, stratigraphic records of basic igneous processes are often found. The deep-water basins in Brazil offshore provide an excellent natural laboratory for studying basic igneous rocks. This study utilizes drilling cores and 3D seismic data obtained during deep-sea oil and gas exploration to conduct sedimentary basin analysis, which helps to understand the spatiotemporal process of magma in sedimentary basins and provides geological basis for oil and gas exploration. However, few studies have reported on the spatial distribution, formation process, and impact on sedimentary strata of these basic igneous rocks. This work aims to reveal the emplacement process of basic magma and discuss the coupling relationship between sedimentary stratigraphic architecture and magmatic activity.

3D seismic data from the southeastern Brazil offshore show that a series of sills, dykes, laccoliths and lavas are developed in the salt-walled sedimentary strata. Petrological data reveals that they were generated by mafic magmatism, recording the entire process of basic magma from intrusion to eruption. The intrusion and compression of basic magma induced folds and deformation of the pre-existing sedimentary strata, furthermore, leading to changes in the filling characteristics of the overlying sedimentary strata. Based on the law of cross-cutting relationships, it is indicated that the volcanic activity peaked in the Campanian and Maastrichtian Age. The relationship between igneous rocks in sedimentary basins and their surrounding sedimentary rocks reveals that the process of sedimentary filling and basic magmatism can be divided into four stages. First, the initial formation period of salt-walled sedimentary basins. Next, the period of continuous basin subsidence and sedimentary filling, and salt-wall growth. Then, intrusion and extrusion, and local volcanic eruption of basic magma, causing forced folds of sedimentary strata. Finally, the lateral migration of depocenter in salt-walled mini-basins, followed by the onlapped sedimentary filling and formed drape structures.

This study describes the formation and evolution of basic magma in sedimentary basins, the spatial distribution pattern of basic igneous rocks, and their impact on sedimentary strata deformation, which has universal significance for petroleum geological research and exploration evaluation.