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Depositional Palaeoenvironment and Models of the Eocene Lacustrine Source Rocks in the Northern South China Sea

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Element geochemical analysis of 94 ditch cutting samples of the shale source rock from the Wenchang Formation in the Zhuyi sub-basin and the Liushagang Formation in the Weixinan sub-basin was conducted to determine their palaeoenvironment and main controlling factors and to further establish development models. The results indicate that freshwater and a warm and humid climate were characteristics of the depositional palaeoenvironment between Wenchang and Liushagang formations. During the deposition of Wenchang Formation, the parent rocks mainly consisted of felsic volcanic rocks, the water was characterized by a high palaeoproductivity, shallow-deep water depths, and weakly reducing conditions, whereas during the deposition of Liushagang Formation, the parent rocks mainly consisted of mafic volcanic rocks, and the palaeoproductivity, palaeowater depth, and reducing conditions of the water were better than during the deposition of Wenchang Formation. The formation of high-quality source rocks in the Liushagang Formation were mainly controlled by two factors: (1) the mafic igneous rock provenance and strong weathering provided macronutrients (e.g. P, Fe) for water; (2) high palaeoproductivity provided the source of organic matter, which played a much important role than preservation condition of organic matter. For Wenchang Formation, the good preservation of organic matter which was created by the reducing environment in deep water was also necessary. Accordingly, two models were briefly summarized: a productivity and preservation model for the Wenchang Formation source rocks and a productivity model for the Liushagang Formation source rocks, both of them can develop high-quality source rocks, but the source rock quality of the former were lower than of the latter, this was mainly attributed to the difference in the nutrients and palaeoproductivity. This study provides valuable guidance for oil and gas exploration in the northern South China Sea and the study of lacustrine source rocks in other areas.