The spatial and temporal distributions of the late Mesozoic volcanic successions in the Changling fault depression of the Songliao Basin, NE China, and their controlling effects

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Abstract

The volcanic successions, including their spatial, temporal, tectonic and geochemical attributes, were established based on well data, 2D/3D seismic data, U-Pb isotopic ages, and major and trace element data in the Changling fault depression of the Songliao Basin in the northeast of China. According to the coupling relationships of these four attributes, we suggest that the multiple cycles and stages of the vertical volcanic successions were controlled by the evolution of magma, and the spatial distribution was controlled by basin tectonics. Three eruption cycles developed in the Changling fault depression: K1h (188-122 Ma), K1yc1 (115-106 Ma), and K1yc3 (106-103 Ma). These three eruption cycles consisted of seven eruption stages. The volcanic successions in every eruption cycle were bimodal and evolved from basic to acidic. The magma of the basic and intermediate rocks in these cycles was derived from partial melting of the asthenosphere. During the Huoshiling period, the re-melting of pre-existing granite formed the acidic magma. In K1yc1 and K1yc3, the partial melting of the newly formed basic rocks in the lower crust formed the high-SiO2 acidic magma. In addition, fractional crystallization of the basic magma formed the small-scale intermediate-acidic magma. In the early stage of the fault depression, the volcanic rocks of the K1h were mainly controlled by the boundary fault activity. In the Yingcheng period, the large-scale syngenetic faults became active. Basic to intermediate rocks were widely distributed along the syngenetic faults, and acidic rocks were concentrated in the area where the syngenetic faults have large fault amplitudes.