A transgressive depositional setting for the Paleogene Shahejie Formation in the Qikou depression, eastern China: Inferences from the REE geochemistry of carbonates

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Reliably preserved REE signatures and strontium isotope signatures in ancient sedimentary provide clues to the evolution of paleoenvironmental conditions. The possibility of a Paleogene transgression in eastern China, which has been discussed for more than 20 years, is still an unresolved issue. In this study, REE characteristics, strontium isotopes, and associated petrological characteristics of carbonates from two wells in the Shahejie carbonates in the Qikou depression were analyzed to investigate the possibility of a Paleogene transgression and to quantify the post-depositional processes affecting the carbonates.

REE and Y concentrations, and $^{87}Sr/^{86}Sr$ ratios were analyzed in 33 carbonate samples from study area. The REE and Y concentrations were normalized to the post-Archean Australian shale (PAAS) standard. The La_{*PAAS}/Yb_{*PAAS} ratios of 0.35–1.52, where *PAAS indicates values for the PAAS standard, show light REE enrichment and heavy REE depletion in most samples. Values of La_{*PAAS} (0.775–1.284) and Ce_{*PAAS} (0.822–1.224), coupled with a relatively flat REE distribution, indicate that the Shahejie carbonates were deposited in lacustrine environments. Values of Y anomalies (1.009–1.527) and Y/Ho ratios (28.43–45.00) in the Shahejie Formation are greater than those of lacustrine carbonates and closer to those of marine carbonates, indicating that diagenetic fluids were probably influenced by seawater. In the carbonates from well Kou-42, Eu anomalies (1.171–1.604), $^{87}Sr/^{86}Sr$ ratios (0.708001–0.710893), and high homogenization temperatures (104°C–151°C) suggest that the carbonates were affected by hydrothermal fluids.

The REEs and Sr isotope ratios show that the carbonates from the Shahejie Formation in the Qikou depression were deposited in lacustrine environments, and were influenced by seawater and hydrothermal fluids. During the Eocene–Oligocene transition, global sea level was generally falling; however, a brief period of worldwide increase in temperature in the early Oligocene caused a rapid sea-level rise.

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