CARBON ISOTOPE VARIATION AND GLOBAL CORRELATION: AN EXAMPLE FROM SINIAN STRATA IN AKESU AREA, TARIM BASIN

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Introduction

The Sinian period is of significance during the evolution history on earth. The changes of marine physical and chemical conditions and the explosion of early animal life are critical for the earth system in this period, which control the generation and preservation of organic matters and further influence the existence and features of Sinian source rocks.

The Sinian system is one of the exploration targets in the Tarim Basin, northwest China. No Sinian source rocks have yet been drilled to date, thus the fieldwork is the only mean for the studies of the Sinian in this area. In addition, the palaeontology types are mainly acritarch and alga that are hard to be preserved and identified in the outcrops, therefore this leads to the difficulties in researches of the Sinian.

Studies have shown the occurrence of global comparison between the changes of marine environments during geological periods, and the correlation between the $\delta^{13}C$ anomalies and the changes of marine environments with a subsequent evolution of animal life. Therefore comparisons may exist in the anomalies of $\delta^{13}C$ recorded in different strata around the world during the same geological period. Based on this, we analysed the variation of $\delta^{13}C$ of the Sinian system in Akesu area, Tarim Basin, and then compared the anomalies of it with those of the other Sinian systems on earth to identify the correlation. Combining with geological data, we further studied the features of lithology, stratigraphic sequences, marine environments and paleoproductivity to analyse the features of Sinian source rocks.

Results and Discussion

The samples were collected from the Sinian strata with a total thickness of 470m in the Akesu area, northwest the Tarim Basin. The Sinian strata is composed of Sugetbrak and overlying Chigebrak formations. The main lithology of Sugetbrak formation is a set of marine siliciclastic deposits and that of Chigebrak formation are carbonates with interbedded grey shale and siltstone. According to the geological background, sedimentary structures and changes of lithology, three times of transgressive-regressive cycles were observed in lower Sugetbrak (0m~140m), upper Sugetbrak (140m~335m) and Chigebrak formations (335m~470m), respectively.

The samples were analysed and a high resolution $\delta^{13}C$ variation across the Sinian was observed. We identified four times of negative $\delta^{13}C$ anomalies (named N_1 through N_4) and one time of positive $\delta^{13}C$ anomaly (named P_1). N_1 occurred from 50m to 70m of the middle of lower Sugetbrak formation with values from -4.5‰ to -8.7‰. Above an interval with $\delta^{13}C$ around -2‰ from 70 to 90m, N_2 with a nadir down to -14.1‰ occurred from 90m to 105m. $\delta^{13}C$ values sharply rised around -4‰ from 105m to 140m and then N_3 with values ranging from -6.6‰ to -9.8‰ encompassed a 90-m-thick interval from 140m to 230m. N_4 with negative peak of -6.9‰ occurred from 270m to 300m above a 40-m-thick interval with

values around -2‰. The only one time of positive anomaly P_1 was in the bottom of Chigebrak from 310m to 350m with positive peak of 7.3‰. Then $\delta^{13}C$ decreased into a 120-m-thick interval with values around 3‰.

The anomalies of N_2, N_3, N_4 and P_1 held obvious excursion trends and might be compared in a global scale. Therefore we compared the $\delta^{13}C$ data collected in this study with those of other Sinian strata from Yangtse, Lesser Himalaya India, Namibia, Oman and Australia. Fine correlations were observed, additionally, preliminary explanations were proposed with the combination of the lithology, stratigraphic sequences and isotope features.

N_3 started at the sequence boundary (SB) in lower Sugetbrak formation and terminated near the maximum flooding surface (MFS), which indicated that an oxidation environment might occur in shallow marine after SB and lead to a biotic extinction and the subsequent negative $\delta^{13}C$ anomaly. P_1 also started at the SB in the bottom of Chigebrak formation, due to the erosion, the injection of terrigenous debris increased and thus enriched the nutrition in the marine surface waters. Therefore the photosynthesis and bioproductivities increased and lead to the positive $\delta^{13}C$ anomaly. In addition, the apparent increase of the generation and preservation of organic matters also resulted in the increase of total organic content in shale, which was favourable for the formation of source rocks.