

# Trace Element Characteristics and Sedimentary Environmental Significance of the Lower Ordovician Contourites in Northern Hunan, China

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**Abstract:** In order to figure out the sedimentary environments of contourites of two areas in northern Hunan, we test trace elements in all the 43 samples taken from them. The results show that during the Early Ordovician, Jiuxi area was a platform slope zone which was in a hot, dry, high-salinity and reducing environment. Yuanguping area was a transition zone between the slope (the slope was in a hot, humid, ungated and weak-reducing environment) and the basin.

**Key words:** trace elements; sedimentary environments; northern Hunan; the Lower Ordovician; contourite sequences.

## GEOLOGICAL BACKGROUND

The study area is within the distribution range of the Lower Ordovician contourite drifts in Jiuxi, northern Hunan (the south of the Middle Yangtze Craton). The area was in the environment of a deep-water slope in the Early Ordovician. In the northwest, there existed vast shallow-water carbonate platforms (Duan et al., 1993). The sedimentary province of the basin was in the southwest, which mainly developed the Panjiazui Formation, Madaoyu Formation, Taohuashi Formation, Jiuxi Formation and Sherenwan Formation. This paper mainly studies the Panjiazui Formation, which developed contourites well. Through studying and measuring two geological sections (Jiuxi section and Yuanguping section) we divide the contourites of the study area into 5 types (Faugeres and Stow, 1993), namely, calcilutitic contourite, calcisiltitic contourite, calcarenitic contourite, bioclastic contourite and calcisiltitic contourite. Calcilutitic contourite is well developed in the Yuanguping area, while other types are less developed. We also identify three types of sequences, namely, a single calcilutitic contourite sequence, an incomplete contourite sequence and a complete contourite sequence (Rebesco and Camerlenghi, 2009). The single calcilutitic contourite sequence, which is firstly discovered in the study area, mainly exists in Yuanguping area.

## DATA AND RESULTS

In order to figure out the causes and the sedimentary environments of contourites of the two sections, we test trace elements in all the 43 samples taken from them. The results show that K, Na, Al and other trace elements, which mainly exist in terrigenous mud, are of high contents in contourites. And terrigenous mud mostly accumulates in continental shelf and slope where the flow is relatively slow. Therefore, the contourites were mainly developed in the platform slope zone (Luo et al., 2002). The contents of Cr, Ni, V and other elements in contourites are higher than that of autochthonous deposits, showing that the contourites

were formed in relatively deep water. Since the variation of water depth is positively correlated with contourite sequences, this means that the water depth varied from shallow to deep and to shallow again during the formation of the contourite sequences. Meanwhile, Ti, Zr/Al and other elements also indicate water depth. When Ti content is low and the value of Zr/Al is above 20, the water is relatively shallow. The values of Zr/Al of Jiuxi section are all above 20, while the values of Yuanguping section are all below 20. It means that the sedimentary water of Yuanguping area was deeper on the plane and the contour currents near the basin were relatively weak (Luo, 2002). So the single calcilutitic contourite sequence is relatively developed. In the whole study area, Rb/K is above 2 and V/(V+Ni) is  $\geq 0.46$ , showing that the area was in a relatively ungated, high-salinity and reducing environment. Resistant minerals containing Nb and La are easy to decompose in a hot and humid environment. Nb and La are relatively rich in Yuanguping area, showing the climate of Yuanguping area was hot and humid at that time. But the climate of Jiuxi area was mainly hot and dry.

## CONCLUSIONS

In conclusion, during the Early Ordovician, Jiuxi area was a platform slope zone which was in a hot, dry, high-salinity and reducing environment. Yuanguping area was a transition zone between the slope (the slope was in a hot, humid, ungated and weak-reducing environment) and the basin. Thus, the contour currents of Jiuxi area were active and of high energy, which formed a complete contourite sequence. The contour currents of Yuanguping were weak, which formed a single calcilutitic contourite sequence.

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