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Study on the Delta Sedimentary Model of River Formation Based on Sedimentary Numerical Simulation

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Abstract: The term “delta” was originally proposed by the ancient Greek historian Herodotus. Its universal definition is that the sediment is formed in a stable body of water or close to the body of water, partially exposed to the surface of the water. But this definition doesn't apply to deltas formed other than rivers, such as fan deltas.Jin proposed that a delta is a generally lobed sedimentary body formed by the accumulation of the detrital materials transported near the entrance of the river when it enters the impounded basin (Jinet al, 2011). At present, the research on the sedimentary model of the delta has been perfected, and scholars have less questioned the classification of the model. The delta front subfacies is divided into subaqueous distributary channel, subaqueous levee, etc.Jin and He proposed that the delta front doesn't develop subaqueous distributary channel, subaqueous leveebased onflume experiments and modern sedimentary survey (Jinet al, 2011). This is contrary to the traditional theory that the subaqueous distributary channel of delta front is the underwater extension of the distributary channel and important sand body of delta front. Recently, the author has conducted a number of sedimentary numerical simulation experiments and observed remote sensing satellite photos in order to find out whether the delta front formed by the river has developed subaqueous distributary channel, subaqueous levee, providing evidence for paleogeographic environment restoration and reconstruction of basin evolution.

Based on the satellite remote sensing photos provided by the GOOGLE EARTH platform, the characteristics of delta in different regions formed by rivers were observed, and the common characteristics of the delta front were found out.The sedimentary morphology and characteristics of the delta under different conditions such as rising water level, falling water level and fluctuating water level were observed through multiple sedimentary numerical simulation experiments.In the sedimentary numerical simulation experiment, the 3D hydrodynamic numerical simulation method was used to simulate the formation process of the delta formed by the river, and the 3D hydrodynamic numerical model of the delta was established by using Delft 3D software. On the basic of the detailed description of hydrodynamic, sedimentary and denudation processes, this model comprehensively considers the complete physical process of hydrodynamic - sediment transport - geomorphological change, and can completely deal with the transformation of geomorphology by water flow and the dynamic feedback of water flow after geomorphologic change (Wanget al, 2016).According to the hydrodynamic characteristics of modern rivers and deltas, the simulation conditions of the sedimentation process were designed, and the simulation lasted for 6 months (T=4000 hour) when the calculation area was 15 km long and 21 km wide. This method reveals the evolution of river delta.

The formation process of river delta is observed through the sedimentary numerical simulation experiments of several groups of rising water level, falling water level and fluctuating water level. In the experiment, three water levels were set to represent the positions of different sea (lake) planes, namely -2,3 and 8. When the water level is at -2 and does not change, the sand body develops. The sand body develops laterally along with the longitudinal development, and the lateral development gradually takes the dominant position. When the water level rises to 3 (T=1490), the sand body fails to develop to the same longitudinal distance within the same time (T=2900), and there is no subaqueous distributary channel. Over time, the sand bodies developed after the water level changes gradually covered the sand bodies before. When T=3500, the right side of the sand body develops thesubaqueous distributary channel.

Before the change of water level, the development of sand body is relatively uniform. Due to the small scale, there is no subaqueous distributary channel.From the simulation effect, the change of water level has a great impact on the development scale of the delta.After the water level rises, the development resistance increases, the sand body cannot develop to the same distance within the same time. Until the end of the simulation, the changing sand body gradually covers the previous sand body, and thesubaqueous distributary channelappears in the later stage of the simulation.

Key words: sedimentary numerical simulation, fluctuating water level, Delft 3D software, delta

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