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Experimental Study on the Effect of Sediment Composition Ratio on Shallow Water Delta

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1 Introduction

Shallow water delta in the middle-newborn Stratum Widely developed with huge oil and gas in China (Hu Shengwu et al., 2013). The control factors on the delta development like Climate, sea level, tectonic subsidence ,sediment supply (flow, type), the geometric characteristics of the upstream river, the energy (wave, tide) of the storage basin and so on has many been studied, and made a wealth of research results. It is found that the distribution of sediments also has an important effect on the formation of delta (Douglas A. Edmonds et al., 2009). While the previous research on this side less, has not yet reached a unified understanding.

In recent years, hydrodynamic numerical simulation has gradually become an important tool for the study of sedimentology, it has low cost and high efficiency (Petit, H, 2005). Delft3D is developed by the Netherlands Delft University of hydraulics software, is one of the international advanced water, sediment, water quality model. The general idea is to generate the depth of the grid and grid nodes on the file, through the corresponding module to calculate the corresponding water flow problem, according to the calculation result processing to get the data (Shen Hongwei, 2005).

Different from the general delta, shallow water delta with a shallow body, the topography is more gentle features. In this paper, the delta type discussed is defined as the shallow river delta in the continental shelf or the shallow river delta in the gentle slope of the depression, assuming that the climate, tectonic and sea level are invariable, the supply of delta sediments is a single river source, and not affected by the power source of the storage basin (waves and tides), based on the Delft3D numerical simulation software, the development and characteristics of shallow water delta under different sediment composition ratio are simulated and analyzed, which provides a quantitative method for reservoir prediction.

2 Simulation experiment and result analysis

In this paper, using a single factor analysis method. Based on the hydrodynamic characteristics of modern rivers and delta, the simulation conditions of the deposition process are designed. The calculation field was 6km in length by 8km in width. With the Mor-Factor set to 60, the simulation time is 12 months, about 365 days (The specific parameters in Table 1). In order to investigate the effect of sediment components on delta development, four experimental models (S1-S4) were set up for comparative analysis, each group of experiments in addition to the sediment composition ratio, the other parameters are consistent.

Table 1 The main parameters of the model

Grid parameters	Symbol	Value
Grid resolution	—	40m×40m
Grid size	—	30000
Simulation time	T	365d
Time step	Dt	18s
Geomorphic evolution coefficient	Morfac	60
Sediment transport equation	S_{AW}	Van Rijn
Sediment components	—	2
Density	ρ	2650kg/m^3
Sediment components-sand	River—Sand	Non—Cohesive
Sediment components-mud	River—Mud	Cohesive
River length	—	2.8km
River width	—	160m
River depth	—	1m
River flow	Q_{river}	900m^3/s
Supply-sand	—	0.15kg/m^3
Supply- mud	—	0.05kg/m^3

Note: The table lists only some of the parameters of the model, not all parameters.

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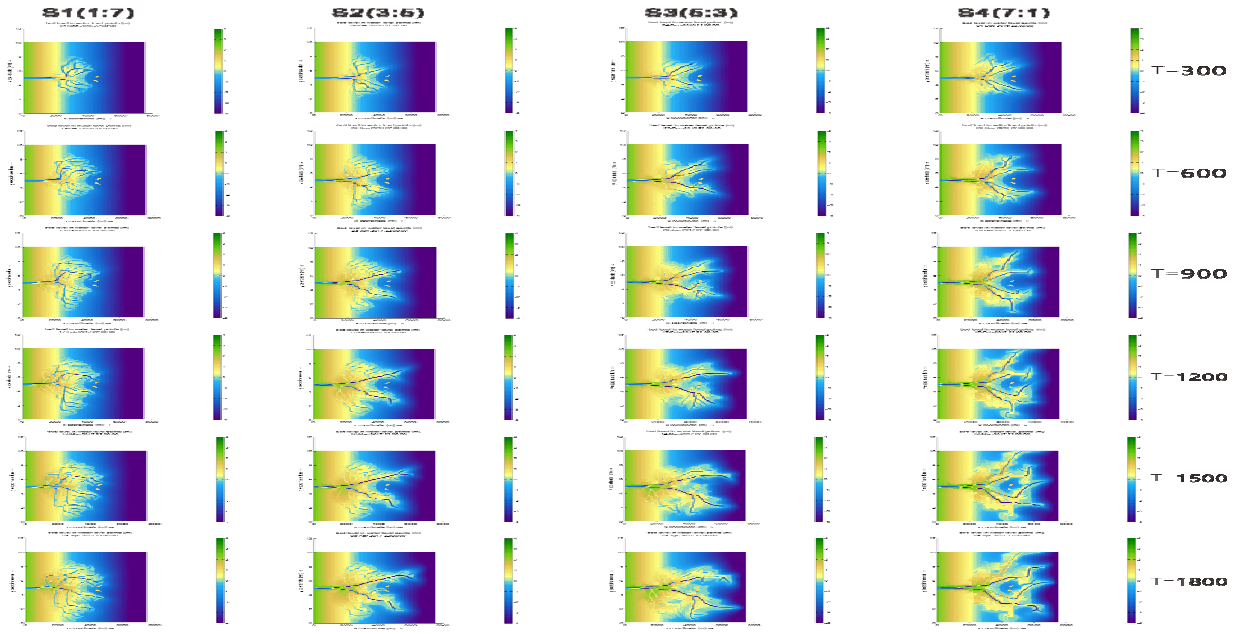

Fig. 1. Typical Time Slice in Delta Evolution.

(a), S1 (1: 7) represents a model with a sediment ratio of 1: 7, S2(3:5), S3(5:3), S4(7:1)as described in S1;

(b), The legend in the figure represents the bed level in water level points(m)

Through the simulation results (Fig. 1) comparative analysis, it is found that when the muddy content is low, the number of branched rivers is large and diverted frequently, which is easy to form a large area sedimentary body , and the shape tends to fan (Fig. 1S1); the higher the muddy content, the more branched branch river is formed but the number is smaller, extending further to the basin , shaped like a slender or bird-like (Fig. 1S4); the divergence angle of the river is roughly proportional to the muddy content ; the depth of the river is the largest in the middle of the muddy content, and the minimum of the muddy content.

The results show that the Delft3D numerical simulation software can better reveal the developmental characteristics of different sediment composition ratio in shallow water delta, which can be used as an effective method to study sedimentation.

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