

Formation of Large Blocked-Valley Lakes by Holocene Sea Level Rise: Poyang and Dongting Lakes, China

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Poyang and Dongting Lakes are the first and second largest freshwater lakes entirely within China. Surface areas fluctuate strongly, but fall in the range 2700 ~ 3206 km². The lakes are directly connected to the Changjiang (Yangtze) River, the largest river in China, which until the construction of the Three Gorges Dam carried a sediment load of about 400 Mt/a. Here we address the question as to why these lakes exist. Based on experience in the Fly River Basin, Papua New Guinea and the Amazon Basin, Brazil, it appears highly likely that these are blocked valley lakes. The period of 120 m of rapid Holocene sea level rise at the end of the last glaciation forced the Changjiang, Fly and Amazon Rivers into aggradation. These rivers are sourced in uplands, and had enough sediment to fill the accommodation space created by water surface rise. In the case of the Fly and Amazon, however, many of the tributaries are sourced in the lowlands, and did not have enough sediment supply to fill the accommodation space created by main-stem water surface rise. The main stem thus blocked the tributaries, creating extensive lakes. We apply this line of thinking to Poyang and Dongting Lakes. We offer a morphodynamic model that contains two dimensionless numbers, one capturing the threshold rate of main-stem water surface rise for lake formation, and the other capturing the amount of time for lake formation. We apply the model to the Changjiang River using field numbers. We offer appropriate generalizations for the future.

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