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Mega-lake floods in the Mediterranean during the late Miocene

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Many large marginal water bodies on Earth, partially disconnected from the open ocean by shallow sills, have been land-locked in ancient times (e.g., the Mediterranean Sea; the Black Sea, the modern Baltic Sea region). Disconnected from the global ocean, these “sea-lakes” would expand or contract, controlled by their hydrological budget. Spectacular marine flooding events would occur when basins with negative water budgets would reconnect with the ocean while lake burst floods would characterize the reconnection of the basins with positive water budgets. Key examples of marine floods are the Zanclean flood in the Mediterranean and the Black Sea Deluge, also known as Noah’s flood, while the archetypes lake burst floods are best exemplified by the erosional features of the English Channel, lake Bonneville and Lake Missoula floods. Here, we show that Paratethys, a Miocene mega-lake from central Eurasia has generated at least two mega-floods into the Mediterranean during Messinian times via a river system, which we call Styx.

The late Miocene history of Paratethys is marked by a succession of lake level changes, and paleogeographic estimates show that the maximum water level (∼50 m above global sea level) was reached during the early Messinian (lower Maeotian in regional stratigraphic terms). This was followed by a sudden lowering of Paratethys water level, the Intra Maeotian Event (IME), after which Mediterranean mollusc species entered Paratethys during the upper Maeotian. After a major short-lived marine influx termed the Pontian Flood, Paratethys water level dropped again at the regional Pontian-Kimmerian transition (5.6 Ma), an event that was linked to the low-stand of the Mediterranean during the Messinian Salinity Crisis.

Here we investigate the cause for these two sudden drops of Paratethys water level. We hypothesize that they are related to collapses of the sills separating it from the Mediterranean due to erosion from a mega-river. We develop two paleogeographic Digital Elevation Models (DEM) to calculate the gigantic volume of water that would have flooded into the Mediterranean and we estimate these discharges are the largest lake-burst floods in the record. Our proposed lake burst scenarios are providing an explanation for a long list of previously unexplained anomalies observed in the Paratethys-Mediterranean region. This work also documents the diverse expressions of lake burst floods cataclysms in the sedimentary record and details a particular mechanism for the birth of sea straits in the aftermath of large water discharge events.