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Rapid morphotype replacement triggered by extrinsic factors in Miocene lake mollusks from the Dinaride Lake System (Sinj Basin, SE Croatia)

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Mollusks are valuable tools for paleoenvironmental and evolutionary research in long-lived lakes. Still, however, the evolutionary concepts to explain speciation and/or changes in dominant morphotypes in long-lived ancient lakes are controversially discussed.
Herein, we document an outstanding example of mollusk radiation from a c. 100-m-thick, well dated lower Middle Miocene section which allows describing the mode and tempo of morphologic change in certain gastropod lineages.
Several phases of successive replacement of morphotypes are observed. Typically, assemblages with smooth morphotypes are gradually passing into assemblages with strongly sculptured shells. These events are limited to certain periods and occur nearly simultaneously in unrelated species-groups of the gastropods Melanopsis and Prososthenia. The coincidence of high disparity and overall diversity clearly points to a common trigger mechanism and optimum conditions for these lake mollusks. Extrinsic factors such as climatic shifts with impact on water chemistry, lake-level, substrate type, and vegetation might be the main force for these radiations. Indeed, two distinct phases are evident which are expressed in the lithology as two limestone-coal cycles. These represent shallow lake habitats which are separated by an intermediate limestone-dominated interval that formed during a lake level high stand. The lower cycle is characterized by abundant melanopsids, neritids, mytilopsids and later on also unionids, reflecting an environment with continuous freshwater supply and elevated water energy. The upper cycle is predominated by hydrobiids and pulmonate gastropods suggesting a restricted low-energy setting.
The two changes in dominant morphotypes occur within a few meters. Depending on stratigraphic resolution, such rapid shifts would occur as “punctuated” events in slightly condensed sections whilst being gradual in a higher resolution.