

## AN ITERATIVE EVOLUTIONARY PATTERN IN THE GASTROPOD GENUS *MELANOPSIS*

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Iterative patterns of morphological evolution present a unique opportunity to explore the causal mechanisms of evolution. We report here on an iterative morphological trend within a clade of prosobranch gastropods.

We studied the *Melanopsis impressa* lineage from Middle to Late Miocene marginal lake sediments of the Pannonian basin (central and eastern Europe). The descendants of *M. impressa* evolved a type of whorl shouldering in at least two different instances. The first instance occurs in the Late Miocene Pannonian Stage, when the smooth and conical *M. impressa* gives rise to *M. fossilis*, a species characterized by strong shouldering. The disappearance of *M. fossilis* coincides with a major contraction in the areal extent of the lake and with a shift from brackish to fresh water at the end of the Pannonian Stage. *Melanopsis impressa* may have survived this event in marginal drainage environments; during the subsequent Pontian Stage, *M. impressa* or a close relative gives rise to a second shouldered descendant (*M. petrovici*-*M. cylindrica* complex).

The constructional aspects of shouldering are different in each case. In the first instance, shouldering is characterized by a broad and rounded ridge in the middle of the adapical half of the body whorl, usually associated with a depressed area adapically. In contrast, shouldering in the second instance is a simple, rounded or angled spiral prominence on the adapical half of the whorl.

Repeated development of a character in a single lineage might suggest that the parallelism is due to an intrinsically defined pathway. The different constructional aspects of shouldering in our examples, however, suggest that it was the selective regime that was repetitive. The brackish paratethyan sea of the Pannonian Stage and the smaller, freshwater lake of the subsequent Pontian Stage differed in many respects, but hydrodynamic or predatory selection pressures may have evoked similar morphological responses.