

Groundwater circulation in a carbonate anticline observed through cave morphology across the Judean mountains, Israel

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The Judean mountain anticlinorium is built mostly of karstic carbonates with non-karstic (mostly marl and chalk) intercalations. The Cretaceous-Paleogene shallow-sea carbonates have been exposed since the Oligocene with several periods of uplift and consequent karstification. Hundreds of caves, 10-4000 m long each, have been studied and classified according to their genetic morphology.

Three main end members of karst caves have been found in the region:

- (1) Vadose caves, comprising mainly of vertical shafts, with indications of present-day dissolution. They are mostly found in relatively-flat areas on top of the Judean mountains ridge.
- (2) Elongated sub-horizontal caves, whose length is >10 times their width. In some cases, systems of interconnected passages form two- or three-dimensional mazes. These caves are not active today in terms of speleogenesis. They are found under a thick aquiclude of Senonian chalk and marl, which has been partly eroded during the late Cainozoic. These caves are attributed to confined paleohydrologic conditions which prevailed along the flanks of the rising anticline.
- (3) Chamber caves, whose length roughly equals their width. These are believed to have been formed under phreatic conditions before the major uplift of the mountain range.

The cave morphology data suggests a general a model for groundwater circulation in karstified anticlines, with each type of cave indicating the local paleohydrologic conditions prevailing during speleogenesis.

Vadose inlet caves are formed at the recharge zone, on top of the anticline. Phreatic caves are formed under unconfined conditions on the upper parts and flanks of the anticline. Artesian maze caves are formed in the flanks of the anticline under thick non-karstic confining cover.