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# THE ENVIRONMENT OF THE BEAR GULCH LIMESTONE (MISSISSIPPIAN OF MONTANA

The Bear Gulch Limestone lens (Heath Formation, Big Snowy Group, Fergus County, Montana) is a Namurian $E_2b$ (Upper Mississippian, Chesterian) plattenkalke containing a diverse marine fish fauna, accompanied by invertebrates and many algal forms. The superb preservation of some of the fish and soft-bodied invertebrates, which requires simultaneous death (by asphyxiation) and burial, cannot be accounted for by persistent anoxic bottom conditions. To explain both the persistent high diversity and the extraordinary preservation requires consideration of sedimentological, hydrological, and paleoclimatological conditions during the deposition of the Bear Gulch Limestone.

The Bear Gulch Limestone was deposited in a small bay in the narrow Central Montana Trough, and was flanked by littoral and supralittoral sediments that include gypsum, an indicator of seasonally arid climate. Several biofacies are described: an *Arborispongia*-productid facies, a filamentous algal facies, and a shallow facies; the original central basin facies and the uppermost facies are redefined. Despite the small size of the basin, there are no macrofossils, and very few microfossils, indicative of fresh-water or terrestrial input outside of the uppermost facies.

There is a very high concentration of organic particulate and non-particulate matter in the filamentous algal and shallow facies, that may in great part be the products of seasonal algal blooms. The organic-rich sediments throughout the central basin facies of the Bear Gulch lens are rhythmically alternating microturbidites, corresponding in detail to the parts of a Bouma sequence.

The following model best accounts for the known depositional and preservational conditions of the Bear Gulch deposit. At the time of deposition the bay was located at about 12 $^{o}$ North latitude, corresponding to the present latitude of the African Sahel region or Yemen. At this latitude, a monsoonal climatic regime is indicated, with the prevailing seasonal winds blowing transverse to the long axis of the bay. The climatic and sedimentary data strongly suggests that the turbidites were principally generated during rainy-season monsoonal storms as either sheetwash-eroded sediments or resuspended sediments that were detached from the sediment-water interface and carried toward the basin center over a pycnocline. The cascading organic-charged sediments of these detached turbidity flows would absorb oxygen (and be oxidized) as they descended, and both asphyxiate and bury any living animal below the pycnocline. Seasonal and intraseasonal variability in the Sahel-like climatic and wind conditions would have

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provided the regularity of change from density-stratified conditions to water column turnover necessary to produce the rhythmic repetition of microturbidites that characterize the Bear Gulch Limestone and the preservation of its fossils.

Keywords: Bear Gulch Limestone, Deposition, paleoecology, paleoclimate, microturbidite.