Karst Features and the Dissolution of Carbonate Rocks in Jennings County

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Over a long period of time limestone, and to a lesser extent dolomite, will gradually dissolve in the presence of ground water that was derived from precipitation. Carbon dioxide from the atmosphere and from the soil is incorporated into the precipitation as it changes from atmospheric moisture to ground water. Ground water containing dissolved carbon dioxide forms a mild acid, which can slowly dissolve alkaline materials. The alkaline carbonate bedrock units are affected by this process when the slightly acidic ground water moves through the units and is neutralized by the carbonate. A portion of the carbonate unit is dissolved in this neutralization process, thus increasing the size of the fracture in which the water is flowing. As this process continues through time larger openings, solution features, form in the rock allowing for increased ground-water flow.

Many types of solution features can result from this process, some subtle and others quite large. The most common features develop along preexisting fractures, joints, and bedding planes, which represent the initial flow path of the water through the rock. Over time, a variety of larger features can develop leading to cave systems with sinkholes and deep valleys as surface expressions.

The near-surface bedrock aquifers in the Silurian and Devonian carbonates contain a highly variable fracture pattern, which greatly affects ground-water flow through the bedrock. Fractured rock represents one of the most complex types of hydrogeologic systems known. While regional ground-water flow can be very predictable, local flow can be highly varied in terms of both quantity and direction. Consequently, determining the local direction of ground-water flow in fractured bedrock at the scale of a specific site may require elaborate instrumentation, monitoring, and dye tracing.

The dissolution of carbonate rocks results in karst topography and other karst features. These include closed depressions on the land surface (e.g., sinkholes and sinking streams), caves, and underground drainage channels or conduits, some of which are several feet in height and width. Karst areas are extremely vulnerable to contamination from point sources (e.g., spills, leaking underground storage tanks, and individual household septic systems) and broad area contamination (e.g., road salts, vehicle emissions, pesticides, and fertilizers). The karst features of subterranean conduits or streams are in many cases connected for great distances. These connected conduits create a potential for widespread contamination downstream of a contaminant source. In places the flow rates can be similar to surface streams, with some contaminants flowing through the system rapidly (especially after a rain or snow-melt event), while in other parts of the system contaminants may be trapped in pools, sediments, or minor fractures for much longer periods of time.

Some of the larger karst features (sinkholes and sinking streams) in Jennings County are shown on the map. These features are based on digital coverages from the Indiana Geological Survey and the U. S. Geological Survey (hypsography, or land surface contours). The closed depressions based upon hypsography coverage came from 1:24,000 scale topographic maps. The overwhelming majority of these depressions are associated with karst development.

The most extensive karst development in Jennings County occurs in the outcrop area of the Muscatatuck Group of Devonian age. This group consists primarily of carbonates and some evaporite deposits. The majority of the sinkholes or depressions occur near the larger stream valleys (especially Sand Creek, Graham Creek, and Vernon Fork Muscatatuck River) in the western half of the county. A few depressions occur within the overlying New Albany Shale, probably due to dissolution and collapse of the underlying carbonate rocks. In some places several feet of residual clay (typically red in color) covers the bedrock. In other places the bedrock is covered by pre-Wisconsin glacial till. Additionally, some water well records on file at the Division of Water indicate a few feet of crevices, broken limestone, or mud seams within the limestone bedrock, generally at depths less than 50 feet below land surface. A few of the records may indicate karst development, but many just show a weathered bedrock surface below the glacial drift.

The Silurian carbonates and the relatively thin-bedded carbonates in the Whitewater Formation of Ordovician age (upper portion of the Maquoketa Group) show limited karst development in Jennings County. These rocks contain thinner limestones and more layers of shale, conditions that significantly limit karst development.

The upper part of the Maquoketa Group is not as vulnerable to widespread contamination as the Silurian and Devonian Carbonates. This is because of the thinness of the limestones units, the units being separated by shale layers, and the steep topography that would limit the size of areas contaminated.

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