OHIO GEOLOGY

GeoFacts No. 26

OHIO DEPARTMENT OF NATURAL RESOURCES • DIVISION OF GEOLOGICAL SURVEY

AGLIME: AGRICULTURAL LIMESTONE AND DOLOMITE IN OHIO

WHAT IS AGLIME?

Aglime, also known as agricultural limestone or dolomite, is a crushed stone product used primarily to control acidity (pH) in soils by making them more basic (alkaline). Crop fertilizers and herbicides can then work more efficiently, and plants can more readily absorb the nutrients that help them grow.

Aglime is made from naturally occurring Ohio limestones and dolomites, which have been used to improve crop yields since pioneer days. Limestone and dolomite contain varying proportions of calcium carbonate ($CaCO_3$) and magnesium carbonate ($MgCO_3$). The carbonates react strongly to acids in the soils, such as sulfuric acid. This reaction forms water, carbon dioxide, and calcium or magnesium salts, thus creating a soil that is less acidic and more productive. The composition of these carbonates includes a low percentage (approximately 3%) of silica, aluminum, and iron compounds, as well as trace elements such as strontium, sulfur, and zinc, which contribute to vigorous plant growth.

Aglime is produced by mining limestone and dolomite from selected quarries and crushing it into a finely ground product. Smaller aglime particles have greater surface area to contact and react with soil particles than larger particles in the same amount (mass) of aglime. To achieve a fine particle size, crushed limestone and dolomite is sieved through a series of screens until the required fineness is reached. The final product is often a mixture of very fine to fine particles (0.01 to 0.05 inches) that together produce a rapid (from very fine particles) and sustained (from fine particles) reaction with the soil.

Spreading aglime on a farm field in Ohio. Photo courtesy of David L. Ashworth, aglime and specialty product sales for Shelly Materials, Inc.

WHY IS AGLIME IMPORTANT?

Food and agriculture represent Ohio's top industry: In 2005, Ohio ranked seventh in the nation for the amount of soybeans harvested by a state and eighth in the nation for the amount of corn harvested (U.S. Department of Agriculture, 2006). Each year, large amounts of calcium (Ca) and magnesium (Mg) are taken up by Ohio's crops and not returned to the soil. The most common agricultural products produced in Ohio and the amount of Ca and Mg removed from the soil during their production is shown in Table 1. According to the Ohio Department of Agriculture (2006), 3,250,000 acres of corn were harvested during 2005 in Ohio. At an average yield of 143 bushels of corn per acre, a total of 56,875 tons of Ca and 76,375 tons of Mg were removed from the soil in 2005. The 4,480,000 acres of soybeans harvested in Ohio during 2005 removed an additional 44,800 tons of Ca and 40,320 tons of Mg from the soil. The estimated total of Ca and Mg annually removed from Ohio soil by agricultural commodities is more than 300,000 tons. It is apparent that Ca and Mg must be periodically replenished for the soil in agricultural fields to remain fertile. Aglime introduces Ca and Mg back into the soil.

- Aglime also neutralizes soil pH and cuts fertilizer costs by making fertilizer more available to plant roots, so less fertilizer is needed. Fertilizers that contain nitrogen, phosphorous, potassium, and other essential nutrients are dramatically affected by soil acidity. Most fertilizers are more effective in slightly acidic to neutral soils.

- Aglime boosts the performance of certain herbicides. As with fertilizer, modern herbicides are most effective when soil pH is slightly acidic (pH of 6.5) to neutral (pH of 7.0). When soils are more acidic, herbicides attach to soil particles, reducing their ability to control weed growth.

- Aglime improves the chemical, biological, and physical conditions of the soil. Water infiltration, drainage, and the healthy growth of beneficial microorganisms are improved by the proper application of aglime, which also cuts down on the amount of fertilizer and herbicides needed and the amount of agricultural runoff produced from them. Aglime can also correct toxic levels of aluminum and manganese that are sometimes found in acidic soils.

WHAT ARE THE GEOLOGIC CHARACTERISTICS OF AGLIME AND WHERE IN OHIO IS IT PRODUCED?

The majority of the aglime produced in Ohio comes from bedrock of Devonian and Silurian age located near the surface in central, western, and northwestern Ohio. These rocks were formed in vast,

Table 1—*Major Ohio agricultural commodities produced in 2005 and the amount of calcium and magnesium estimated to have been taken up by the crops*

Agricultural commodity	Acres harvested (2005)	Average yield per acre	Depletion of calcium (lbs/acre)	Depletion of magnesium (lbs/acre)
Corn	3,250,000	143 bu.	35	47
Soybeans	4,480,000	45 bu.	20	18
Wheat	830,000	71 bu.	19	21
Hay	1,200,000	3 tons	66	15

Data source: Ohio Department of Agriculture (2006)

continued

Quarry in western Ohio producing from the Brassfield Limestone.

shallow seas that covered the area. Regional geologic structures called arches, which trend north-south through western Ohio, influenced water depth. Ohio carbonates were deposited over long periods of time, often with complex climatic and structural influences. Sea-level change, reef building, stream-load variability, tectonic and volcanic activity, biological diversity change, and post-depositional migration of fluid through the rocks have influenced the chemical character of the limestone and dolomite of northwestern Ohio. For example, carbonate deposits associated with reefs east of Dayton have high calcium levels, while similar reef deposits near Carey in Wyandot County are more magnesium-rich most likely due to fluid flow through the rocks after deposition.

Near-surface deposits of limestone and dolomite—combined with a flat landscape created by glacial processes—create prime agricultural soils in western and northwestern Ohio where many of the state's field crops are produced and the demand for aglime is greatest. Western Ohio's Darke County was ranked first in the state for both corn and soybean production in 2005; Wood, Hancock, Fulton, Mercer, Putnam, Hardin, Marion, and Paulding Counties are consistently ranked in the top five producing counties for various row crops.

Many large quarry operators in northern and western Ohio produce aglime to support the local farm community; they also produce millions of tons of aggregate for the construction industry. The majority of carbonates in the state contain both calcium (Ca) and magnesium (Mg) and are classified as dolomitic limestone. (Some high-calcium limestones exist in Ohio, which are primarily used to create Portland cement.) The location of a quarry that produces aglime depends on many factors, including the geologic characteristics of the site, such as the geochemistry of the units present in the near subsurface and the thickness of the overburden (material that needs to be removed to expose the stone to be quarried). Overburden can be a significant factor in the placement of quarries, as nearly two-thirds of Ohio's bedrock is covered by materials deposited by the melting of continental glaciers during the Pleistocene Ice Age. These glacial deposits are commonly less than 50 feet thick but can locally be several hundred feet thick, which makes mining more expensive and difficult.

In the central and eastern portions of Ohio, rock units of Mississippian and Pennsylvanian age are exposed at the surface; however, limestone and dolomite are generally scarce in these units.

Bedrock in the east-central part of the state is mostly interbedded Mississippian-age shale, siltstone, and sandstone found with thick sequences of Devonian-age organic shale. A relatively thick limestone (Maxville Limestone) is found at the top of the Mississippian rock units in portions of eastern Ohio. It is used to produce aglime.

Bedrock units in the eastern part of the state are Pennsylvanian age and dominated by clay, shale, siltstone, sandstone, and some coal. Limestone units are predominantly thin-bedded, but their use as agricultural lime was important to the early settlers when developing food crops. Today the units are sometimes used locally for aglime.

WHERE CAN I FIND ADDITIONAL INFORMATION ABOUT OHIO AGLIME?

The Ohio Department of Natural Resources (ODNR), Division of Geological Survey (DGS) has reports on selected limestone deposits in Ohio which detail the chemical composition and distribution of these deposits present both in the surface and subsurface in the state. Also, the DGS has bedrock geology maps showing the distribution of limestone and dolomite deposits in the state as well and other maps that show the thickness of glacial drift, an important factor in mining costs. These reports and maps are critical in the siting and expansion of quarries which supply the raw material for the aglime industry. Understanding the geology and geochemistry of limestone and dolomite deposits remains important to the continuing supply of aglime for farming.

The Ohio Department of Agriculture (ODA) regulates aglime sold in Ohio. ODA conducts periodic inspections and chemical analysis to ensure that the product contains what is specified on the label. In 1997, the Ohio Legislature required that aglime producers state the Effective Neutralizing Power (ENP) of their aglime on the package, so that comparisons between products could easily be made. ENP expresses calcium carbonate equivalent, moisture, and fineness as a "pounds per ton" comparison of the liming material to pure calcium carbonate. ODA maintains an official annual analysis of liming materials that can be used to verify aglime packaging accuracy.

The Ohio State University, School of Natural Resources and Wilmington College are excellent sources of information on the latest research in soil science. The ODNR, Division of Soil and Water and the Ohio Aglime Council offer additional information on soil types, soil management, and the locations of aglime producers in Ohio.

FURTHER READING

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• This GeoFacts compiled by Mark E. Wolfe • January 2009 •