Sand and Gravel

Sand and gravel are unconsolidated rock and mineral fragments that form when solid rock is mechanically weathered (physically broken down) into smaller pieces. Most mechanical weathering occurs as a result of water or ice exploiting weaknesses and cracks in the rock. Particles of sand and gravel come in many different varieties depending on the eroded material. Rock types such as limestone, dolostone, quartzite, shale, sandstone, and quartz all weather to form sand and gravel. Ohio's sand-and-gravel deposits are comprised mostly of broken-up pieces of the local bedrock. But a portion of the material includes igneous and metamorphic rocks and minerals brought to Ohio from Canada by glaciers during the most recent Ice Age. Regardless of the source, sand and gravel are some of the most important mined resources in Ohio (fig. 1)

Unlike most other earth materials, sand and gravel are defined based on particle size rather than composition (fig. 2). Two different grainsize scales are used in the United States: the Unified Soil Classification System (USCA) and the Wentworth Scale (used by the U.S. Geological Survey). Both scales are equally used in the United States, with engineers favoring the USCA Scale and geologists preferring the Wentworth Scale. Internationally, there are dozens of grain-size scales in use.

Figure 1. Olen, Inc., sand-and-gravel quarry in southern Franklin County. The material in this quarry was deposited by glacial meltwater that drained southward through the Scioto River Valley. Once extracted, sand and gravel are sorted according to size by conveyer systems and stored in stockpiles.

How sand-and-gravel deposits form

Almost all sand-and-gravel deposits have been transported by water, sometimes over large distances. During transportation, grains are sorted and deposited based on particle size, as faster-moving water can move larger particles and smaller particles are often moved over longer distances. Most streams have their highest velocities near their source and decrease in velocity until ending in a lake or ocean. As particles are transported downstream, they bounce around and strike each other, breaking off jagged edges, making them rounder and smaller. Over time, sand and gravel are naturally sorted into deposits of like-sized particles (fig. 3).

Most sand-and-gravel deposits in Ohio were formed by continental glaciers, which occupied up to two-thirds of the state during the most recent Ice Age (about 2.6 million years to 11,700 years ago). Glaciers can grind up rock and transport large quantities of sediments within flowing ice. Material deposited directly by a glacier is known as *till*. Till is unsorted deposits of sand, gravel, silt, and clay. Silt and clay are materials with a finer grain size than sand. As glacial ice melts, flowing meltwater sorts the silt and clay from the sand and gravel. The largest outwash deposits in Ohio are present along the Great Miami River and Mad River between Bellefontaine and Cincinnati, and along the Scioto River valley between Columbus and Portsmouth. Lenses (deposits that are thick in the middle and taper at the edges) of sand and gravel can also be found within glacial till deposits.

Glacially derived sand-and-gravel landforms also include *kames* and *eskers*. Kames are hills or short irregular ridges of sand

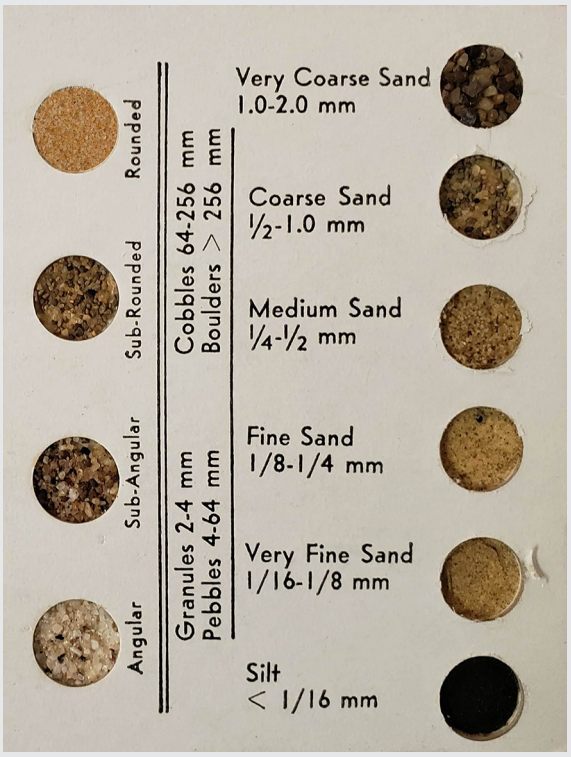

Figure 2. Sand gauge showing sand grain size distinctions and roundness produced by Kent State University (city of Kent, Portage County). This gauge follows the Wentworth grain size classification favored by most geologists. Gauge shown at actual size.

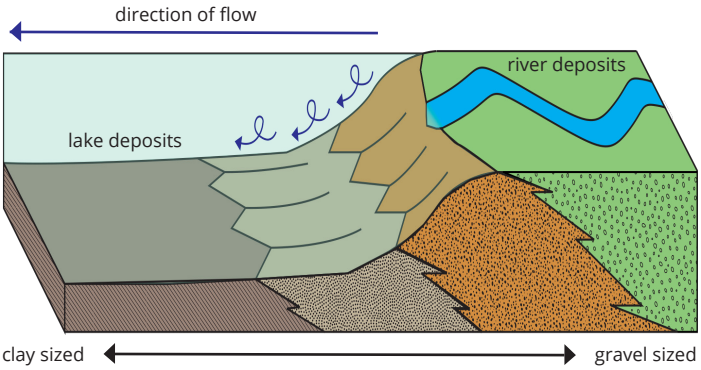

Figure 3. Horizontal sorting of sand and gravel in water. As water depth increases, the velocity of the flowing water decreases, and larger sediments are deposited while smaller sediments continue to be transported downstream.

and gravel deposited by glacial meltwater flowing along the margins of or within crevasses (deep, open cracks) in glaciers. Kames form within depressions of ice that then melt away and can lead to irregular bedding patterns found throughout the once-glaciated portion of Ohio. The largest kame complex in Ohio can be found in Geauga, Portage, Summit, and Stark Counties. Eskers are winding, linear ridges of stratified material deposited by meltwater streams flowing on, within, or below melting glaciers. The state's most-notable esker was the 10-mile-long Circleville Esker in Pickaway County, though most of it has been mined away.

Sand and gravel have also been deposited as beach ridges, offshore bars, deltas, and dunes along the former coastlines of Ice Age lakes. These proglacial (in front of a glacier) deposits can be found throughout the Lake Erie watershed. Sand-and-gravel deposits are also found as lacustrine (lake) deposits in the Lake Erie basin.

Additionally, sand can be transported by strong winds and concentrated into sand dunes. Sand dunes form as loose sand is collected near wind breaks. Most sand dunes in Ohio formed shortly after deglaciation and have since been stabilized by vegetation. The largest dune field in the state can be found in the Oak Openings Region of northwestern Ohio in Lucas, Fulton, and Henry Counties.

Sand and gravel are also deposited as alluvium in streams throughout Ohio. Alluvial sand-and-gravel deposits are generally finer grained than glacial-meltwater deposits, as present-day streams typically have less energy than meltwater streams and less ability to transport large particles. Extensive deposits of alluvial sand and gravel occur as sand bars along river bottoms and in floodplain deposits along major streams.

Uses for sand and gravel

Sand and gravel are used mainly as construction aggregate (hard, inert material used for mixing with cementing material). Most building and bridge foundations, interstate highways, and sidewalks are made of concrete. Gravel is commonly used to pave rural roads and as ballast for railroad tracks. Other construction uses of sand and gravel include fill material, drainage media, and filtration beds for water-treatment facilities. Industrial uses of sand include molding sand for castings in foundry operations, sandblasting abrasives, and traction enhancer for ice-covered highways and sidewalks.

Scientists can study ancient sand-and-gravel deposits and determine how they were deposited and even how fast and in what direction the water or wind was moving that transported the material. The age of sand deposits can be determined using a technique called *optically stimulated luminescence* (OSL), which can determine how long it has been since the sand grains were last exposed to sunlight. Learning the age of sand deposits provides scientists with clues to Earth's surficial processes.

How sand-and-gravel deposits are mined

Sand and gravel are two of the most widely produced mineral resources in Ohio. Kame, esker, and outwash deposits situated above the water table can be mined using large earth-moving equipment. Outwash and alluvial deposits lying below the water table are mined using floating dredges, draglines, or diesel-powered shovels. After removal from the ground, mined sand and gravel are washed, sieved, and stored (fig. 1). In some instances, gravel particles are crushed to increase the amount of a desired smaller particle size. Most sand and gravel mined in Ohio are transported by truck, but material can also be moved by rail, river barges, and Great Lakes freighters.

Because sand and gravel are high-volume, low-value commodities, their values are driven ultimately by transportation costs. To minimize transportation costs, it is essential that sand-and-gravel operations be as close as possible to urban centers. For this reason, land-use planners and zoning officials use geologic maps to designate selected areas for future mining development.

After mining, sand-and-gravel pits are among the least expensive mining sites to reclaim and are often converted into golf courses or building sites. Many public parks and ponds are former sand-and-gravel pits.

References & Further Reading

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