Industrial Minerals of Texas

INTRODUCTION

The varied Earth materials that define the diverse surface formations of Texas provide many valuable industrial rocks and minerals used by modern society. Use of Earth materials by Texas residents started in prehistory with clay for pottery, flint for projectile points and tools, grinding stones for food production, and many other uses of local rocks. Today Texas is an important producer of the industrial mineral resources that are used widely by the state’s ever-growing population, typically ranking among the top five states in annual production value of nonfuel minerals. These varied resources are used extensively in the construction and chemical industries, and their production typically is a direct reflection of the state’s economic vitality. More than 90% of current Texas industrial mineral value comes from production of cement, crushed stone, and construction sand and gravel.

Industrial mineral consumption typically tracks regional population and is reflected in the doubling of Texas’ population since 1970 to its current 23 million residents. For the purposes here, this group of industrial minerals also includes some energy mineral resources—lignite and uranium—that are important producers of electricity for residential, commercial, and industrial consumers. The soils and water essential to Texas’ agricultural and forest industries can also be considered industrial minerals.

TEXAS ENERGY MINERALS

Although coals of various geological ages and ranks are present in Texas, current production is dominated by extensive "brown coal" lignite deposits of Tertiary age in the Gulf of Mexico Coastal Plain. Local Tertiary bituminous coals occur in the Rio Grande Valley, as well as in Cretaceous and Pennsylvanian strata in other regions. Extensive mining of Gulf Coast lignites began in the 1970’s for fuel at "mouth-of-mine" power plants to supply growing regional electricity needs. Texas’ electricity demand increased almost 400% from 1970 through 2005 and shows no signs of slowing. Lignite production has totalled more than 1.3 billion tons, peaking at 56.5 million tons in 1993, and continuing at an annual rate of nearly 47 million tons (2005). The lignite beds extend into the subsurface toward the Texas coast, but current economics only allow surface extraction near the outcrop belt.

Tertiary strata of the Coastal Plain host uranium deposits in south Texas. Uranium production started in the early 1960’s and reached a peak of 3,900 tons of UO2 in 1980. Although south Texas uranium production declined steadily through the 1990’s, recent price increases associated with a rise in demand have resulted in minor production.

TEXAS CONSTRUCTION MATERIALS

Crushed stone, gravel, and sand that are consumed in large quantities as aggregate by the construction industry dominate annual state production in terms of tonnage. Texas is the largest crushed-stone-producing state, with more than 200 quarries; an equal number of operations produce sand and gravel from unconsolidated surface deposits. Cement, another vital construction material manufactured principally from limestone and clay, is by far the most valuable industrial mineral product in Texas, with 2005 production estimated at more than $1 billion (40% of Texas’ annual industrial mineral value) from 12 cement plants. Gypsum is used in plaster and wallboard, as well as cement manufacture. Clays of various types largely in the Coastal Plain are used in many products, with common clay being consumed in large quantities in the manufacture of bricks and tile. Dimension stone, used mostly for monuments and building exteriors, but with growing high-end residential use, is supplied by Texas’ granites, limestones, and sandstones.

TEXAS CHEMICAL MINERALS

Many industrial minerals are used in the chemical industries—from primary industrial applications to secondary applications in which they serve as sources of valuable elements. For example, salt (sodium chloride) has diverse uses, but most is produced as a chlorine source for the manufacture of hydrochloric acid, a widely used industrial chemical. Lime (calcium oxide produced by calcining limestone) has many uses as well, including water purification, paper manufacture, and sugar refining. Zeolites are valued for their ion-exchange capacity and are used in water- and other purification processes. Bentonite clays have diverse applications in industrial processes, including drilling-fluid production and vegetable-oil refining. Ball and kaolin clays are used in ceramics and as fillers and coating agents in the rubber and paper industries. Limestone also has many chemical uses, including the use of gas desulfurization of SO2, produced by coal-fired electricity-generation plants; this process produces synthetic gypsum, which is becoming an alternative to natural gypsum in wallboard and cement manufacture.

Sulfur, produced by more than 60 refineries of “sour” crude oil and natural gas from Texas and imported sources, is another widely used element, principally in the manufacture of sulfuric acid. The principal domestic source of helium is from natural gas in Texas Panhandle fields. Sodium sulfate is produced from brines underlying alkaline lakes in west Texas. Tale deposits in west Texas are mined for fillers in ceramic, paper, plastic, and rubber products.

GEOLGY OF MAJOR PRODUCING REGIONS

Most industrial minerals are relatively common Earth materials that can only be produced commercially by relatively low-cost surface extraction techniques. Thus, industrial-mineral production typically occurs in areas where favorable geologic units occur at the surface relatively near the population centers that will consume the products. These essential mineral resources are products of past geologic events that have affected this part of the Earth’s crust. Ancient plate tectonic processes created a vast mountain range, the roots of which are represented by the Precambrian metamorphic rocks and granites exposed in the Llano region of central Texas and smaller exposures in west Texas. Texas was covered by shallow seas during the early Paleozoic (Cambrian-Ordovician), late Paleozoic (Permian), and late Mesozoic (Cretaceous). These environments produced the extensive carbonate strata that form the Edwards Plateau and other surface belts of limestone that are essential to Texas’ crushed stone, cement, and lime production. Evaporation of these shallow seas in the Permian and Cretaceous also produced local gypsum deposits. Even more extensive early Mesozoic evaporites, present under the Texas Coastal Plain, have been deformed into local salt domes that supply salt via underground mines and brine operations. Sulfur has been produced in large quantities from microbial alteration zones in Coastal Plain salt dome cap rocks and in the Permian evaporites in west Texas.

Surface deposits of Cenozoic age blanketing older deposits in much of Texas provide many valuable industrial mineral resources. Cenozoic strata were deposited by river and coastal processes that distributed the gravels, sands, and muds eroded from the Rocky Mountains and the continental interior. Deposition of these thick sedimentary layers built the Coastal Plain and extended the Texas shoreline to its current position (and farther during the glacial period that resulted in lower sea level 18,000 years ago). Swamps related to deltaic environments provided environments for extensive plant growth and are preserved as Tertiary lignite deposits. Coastal Plain sediments are also the source of clay for brick and ceramics. Ash from volcanoes in Trans-Pecos Texas and elsewhere in southwestern North America provided unusual Coastal Plain sediments that were altered to valuable industrial zeolites, bentonites, and other clay deposits. Tertiary volcanic ash also was the source of uranium that was concentrated by groundwater to form Texas’ uranium deposits. Most industrial sand and construction sand and gravel are produced from the unconsolidated alluvial deposits of Texas’ major river systems.

ECONOMIC IMPORTANCE

The total value of Texas’ industrial mineral production for 2005 was more than $2.4 billion, with additional value supplied by lignite and uranium production. Further, industrial rocks and minerals are produced in virtually every Texas county, principally related to local construction and industrial activities. Industrial-mineral production provides local employment, and unusual mineral concentrations provide specialty products for regional distribution. As Texas’ population continues to grow, production of energy and industrial minerals will continue to satisfy the demands of residential, commercial, and industrial customers.

MAJOR SOURCES

- Railroad Commission of Texas, Surface Mining Division
  http://www.rrc.state.tx.us/divisions/sm/sm.html
- U.S. Geological Survey, Texas Minerals Information
  http://minerals.usgs.gov/minerals/pubs/state/tc.html
- U.S. Department of Energy, Energy Information Administration
  http://www.eia.doc.gov/emeu/states/sep_use_tceu/use_eu_tx.html

—J. Richard Kyle

Bureau of Economic Geology

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