Health Risks Associated with Exposure to Airborne Pollutants Arising From Quarrying and Aggregate Processing

Situation and Objective

A construction boom has swept into Comal County in recent years such that it is now the second fastest growing county in the US. This on-going and accelerating wave of development and construction has resulted in a high demand for limestone and limestone related products such as aggregate and cement. While limestone quarrying is not new to Comal and surrounding counties, there has been and continues to be an influx of aggregate industry business into the area. A local recent example is the purchase of 1,500 acres of pristine ranch land at the intersection of FM 3009 and TX 46 by Vulcan materials for the purpose of quarrying and crushing the limestone deposits found there.

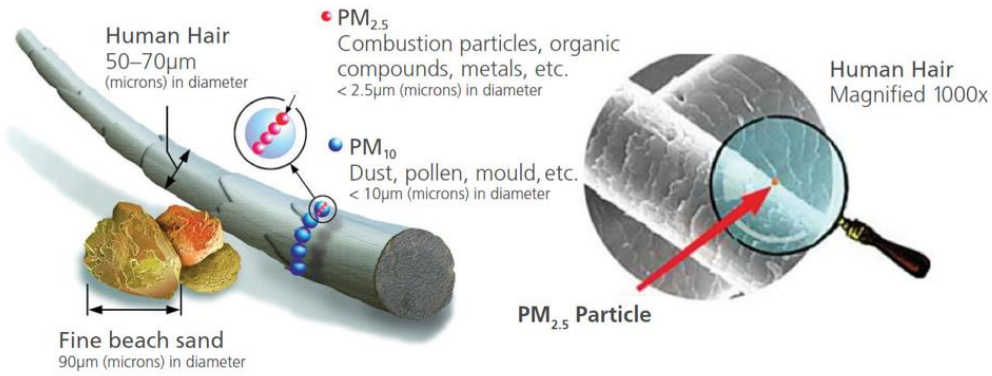
While growth is expected in this desirable region, and can bring economic benefits, limestone quarrying, crushing, and cement manufacture are well documented sources of airborne pollution called particulate matter (PM) that pose significant risks to the region, if unregulated and unmonitored.

Particulate matter is considered pollution by the World Health Organization (WHO) and the US Environmental Protection Agency (EPA) because exposure is associated with a range of serious negative health effects.

The objective of this article is to summarize the health risks of exposure to PM.

What is Particulate Matter (PM)?

Generally, PM comprises two kinds of microscopic particles, mineral (silica and other minerals from rock processing), and hydrocarbon and soot from diesel exhaust of industrial equipment and trucks that are heavily utilized in the quarrying industry. PM is classified into size ranges. The PM of interest in terms of health risks are those that are very small, invisible to the naked eye, and are referred to as $PM_{2.5}$ and PM_{10}. $PM_{2.5}$ comprises particles ~2.5 micrometers in size, PM_{10} comprises particles ~10 micrometers in size. $PM_{2.5}$ and PM_{10} are invisible to the naked eye, and are easily carried in wind currents, can remain airborne for long periods of time, and can be carried up to 30 miles (PM_{10}) or hundreds of miles ($PM_{2.5}$) from the source.
Source: [What is Particulate Matter]



Source: **EPA Particulate Matter Basics**

What are the health risks associated with exposure to PM?

PM_{10} and $PM_{2.5}$ are particles that are small enough to penetrate the delicate lining of the respiratory system following inhalation. The health effects of inhalable PM are well documented. Health risks are due to exposure over both the short term (hours, days) and long term (months, years). Short-term exposure can result in coughing, shortness of breath, tightness in the chest and irritation of the eyes. Long-term exposure can result in reduced lung function, and respiratory diseases such as asthma, chronic obstructive pulmonary

disease (COPD), lung cancer, emphysema, and aggravation of existing lung disease. Long term exposure is also associated with increased risk of allergies, cardiovascular disease and autoimmune disease. PM exposure affects health adversely such that there is increased absence from school and work, increased visits to emergency room and doctors' offices, and hospitalization. The figure below shows a more comprehensive listing of health risks from $PM_{2.5}$ exposure. Epidemiological studies also have documented a significant association between PM exposure and mortality.

Sources: WHO Health Effects of Particulate Matter

EPA Overview of Particle Air Pollution

EPA Particle Pollution and Your Health; Environmental Health Perspective Particulate Matter Air Pollution Exposure

60-Million-Strong Study Shows Clear Link Between Exposure To Air Pollution & Premature Death

A Review of Airborne Particulate Matter Effects on Young Children's Respiratory Symptoms and Diseases

Association of Short-Term Exposure to Air Pollution with Mortality in Older Adults

Brief exposure to tiny air pollution particles triggers childhood lung infections

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Health Outcomes of Exposure to Biological and Chemical Components of Inhalable and Respirable Particulate Matter

Respiratory health effects of diesel particulate matter

Expert position paper on air pollution and cardiovascular disease

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EPA Particulate Matter (PM) Pollution

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Kings College Particulate Matter and Health

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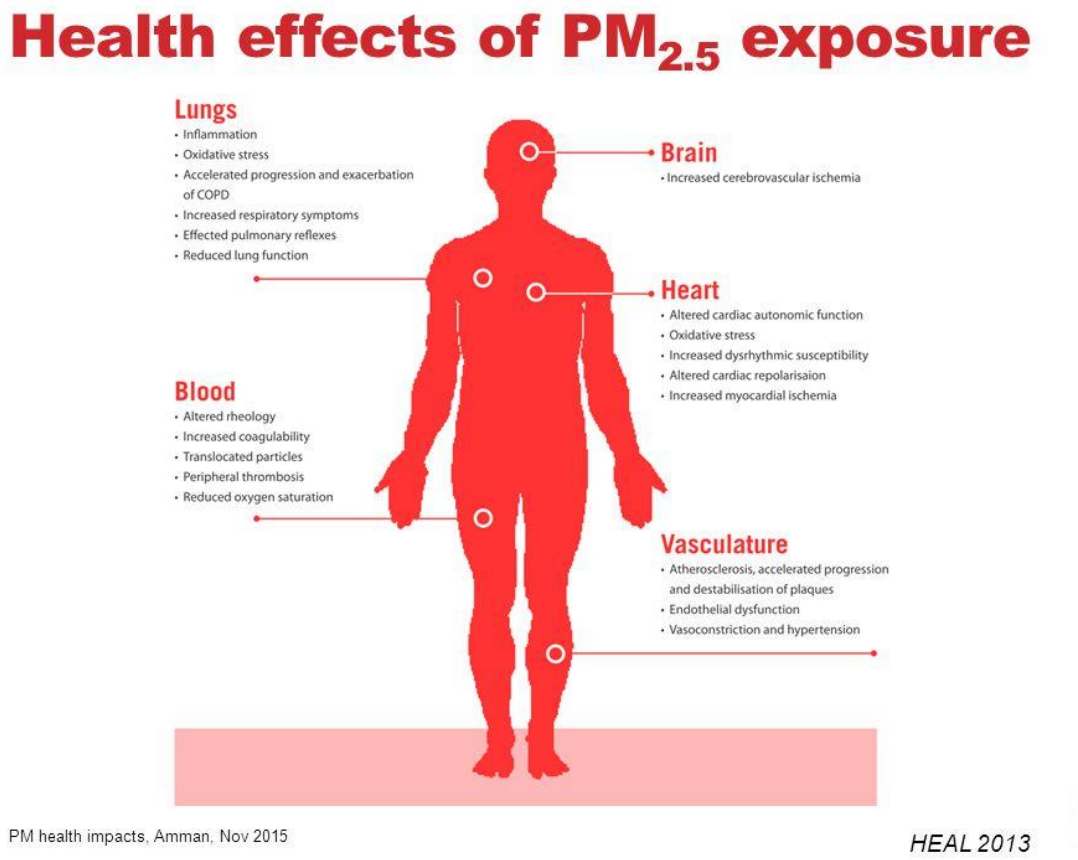


Source: [Kings College Particulate Matter and Health]

Who is at risk from exposure to PM?

Susceptible groups with pre-existing lung or heart disease, as well as children and the elderly, are particularly vulnerable.
Source: [EPA Particle Pollution and Your Health]

How much exposure to PM is considered potentially harmful?

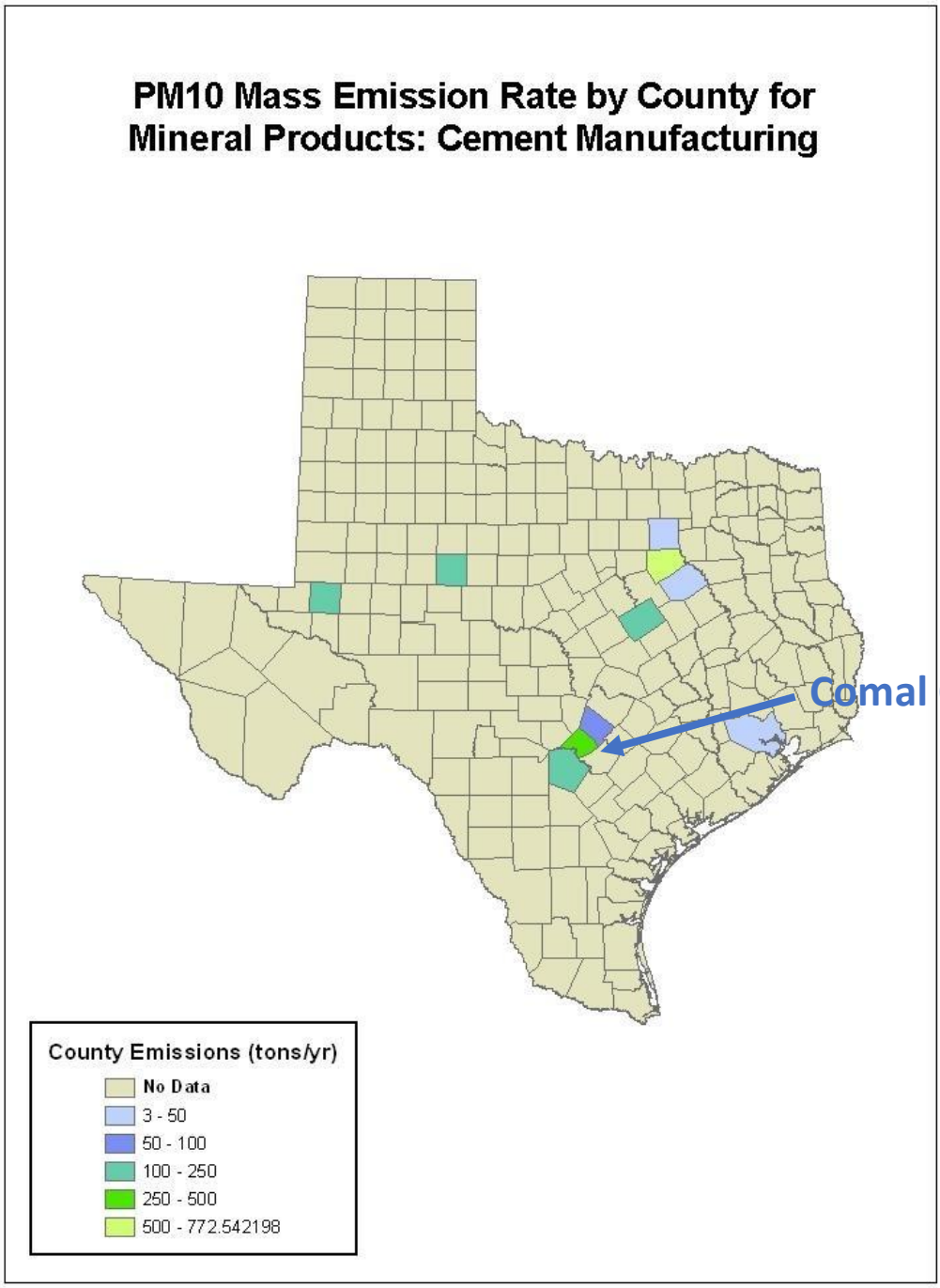
There is no evidence of a safe level of exposure or a threshold below which no adverse health effects occur. Exposure is influenced by proximity to the source, i.e., close proximity will incur higher exposure and higher risk, and by the time of exposure. Other factors include winds and weather conditions.
Source: [EPA Particle Pollution and Your Health]

What are the PM levels in Comal County?

A study conducted by the University of Texas in 2002 reported the results shown in the four figures below. The first two figures show Mineral Product PM_{10}, and the second figures show Mineral Product $PM_{2.5}$. The amount of limestone quarrying has grown significantly since then, and it is clear that Comal County already represents a "hotspot" for PM pollution (see Texas county map figures below).

In 2002, the PM_{10} emissions for cement manufacturing and stone quarrying in Comal County were 250-500 tons/year (tpy) and 310-320 tons/year, respectively, or a total for Mineral Products of 560-820 tons/year. This compares to PM_{10} emissions in Bexar County for cement manufacturing and stone quarrying of 100-250 and 360-418 tpy, respectively, or a total for Mineral Products of 460-668 tpy. Considering that Bexar County

(~1,239 sq miles) is more than twice the size of Comal County (~559 sq miles), the relative exposure to Mineral PM_{10} in Comal County in 2002 was more than twice that in Bexar County. Annual exposure to Mineral Product $PM_{2.5}$ in Comal County in 2002 were also more than twice that in Bexar County. This compelling evidence clearly points to a need for more PM monitoring, data collection, and regulation.
Source: Government Census



Source: Texas PM Emissions Atlas

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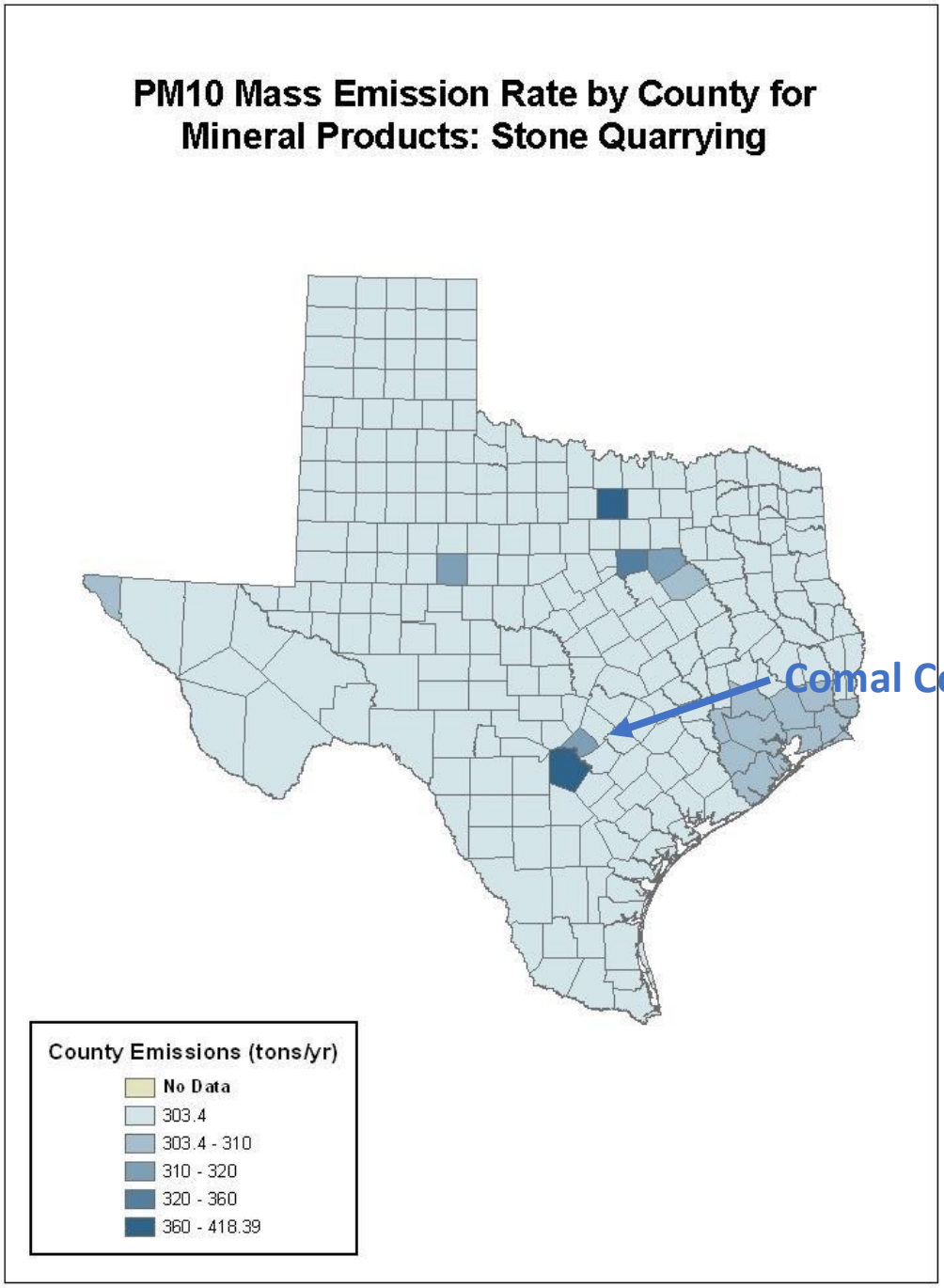

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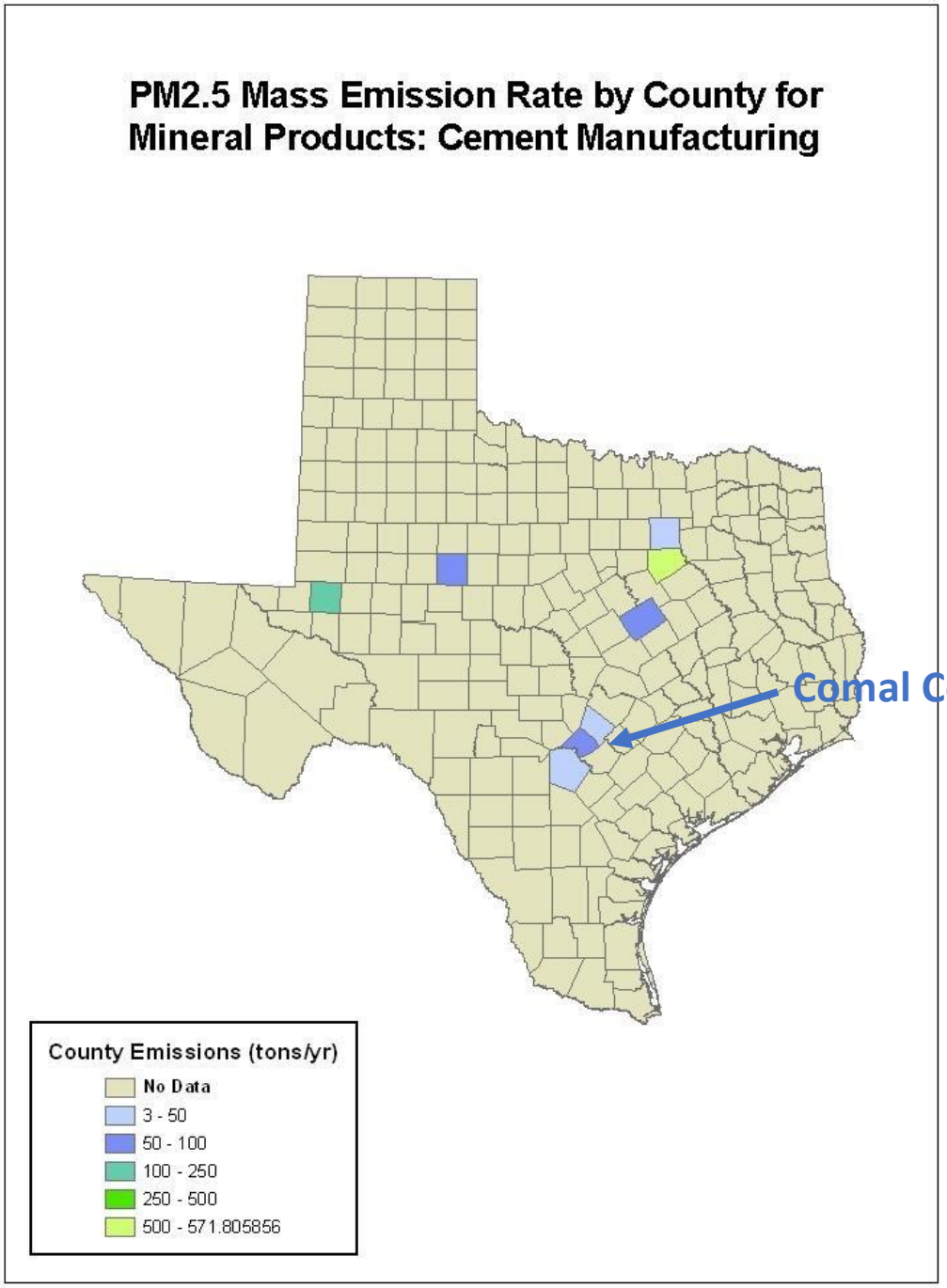

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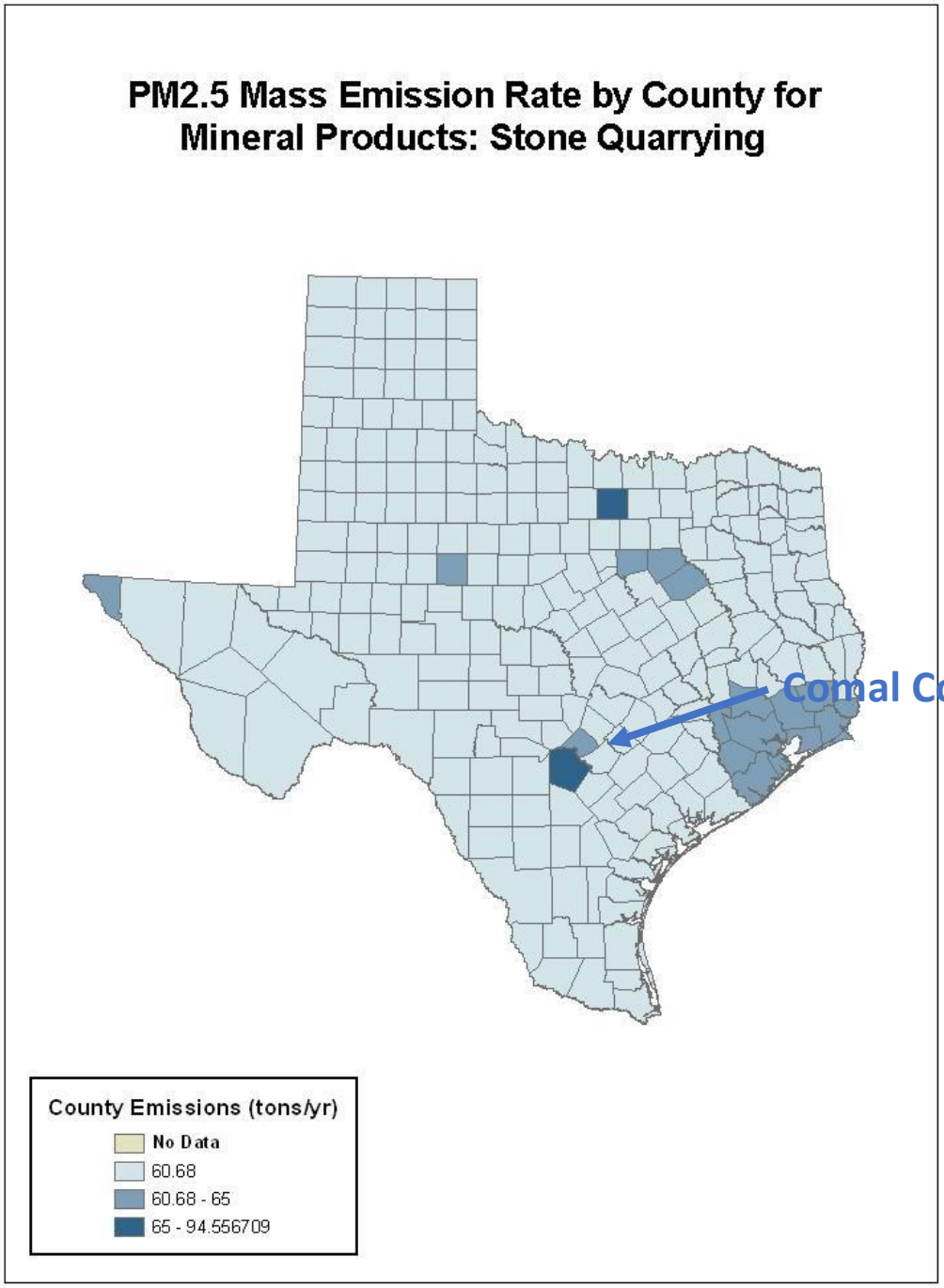

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Dr. Randolph's career in biomedicine began at the Armed Forces Academy of Medical Sciences in San Antonio, Texas, U.S., where he graduated as a clinical laboratory technologist. He then graduated magna cum laude in chemistry and biology from Wayland College and earned a doctorate in experimental pathology from the School of Medicine at Wake Forest University. He has 40 years of experience in academia and industry as a basic researcher, consultant, author and speaker on topics related to human health and disease, and the factors that influence disease and health.