OKLAHOMA ROCKS!

A Day in the Life

Geology is the science that deals with all things Earth! The Earth is a diverse place, with landforms including continents, oceans, lakes, rivers, caves, and mountains. Events, such as volcanoes, earthquakes, landslides, tsunamis, and plate movements keep people on their toes!

When a person becomes a Geoscientist, they often do so because of a love of the outdoors and the natural world, and of figuring out how things used to be, and why things are the way they are today. Geoscientists are Earth historians. The Earth's layers are a record of what the Earth was like in the past, going back millions and billions of years. Studying the Earth is a great career for people who like to solve problems and answer tough questions!

There are actually a lot of different ways to be a Geoscientist because the geosciences are a very diverse field! There are over 20 types of Geoscientists, many of which combine geology with other fields of science. For example, a Hydrogeologist is interested in how water moves through rock layers underground. A Paleontologist combines geology and biology as they study fossilized lifeforms and helps to piece together when those lifeforms lived on Earth. A Speleologist is a geoscientist that studies the unique environments in caves around the world. Even police departments sometimes work with geologists to determine where a suspect may have been by closely examining the sediment, dirt, and rocks found on a person's shoes or car tires – these people are called Forensic Geologists!

Because so many Geoscience jobs combine geology and other disciplines, it's important for you to take math, science, and technology classes throughout middle and high school if you hope to solve Earth-related puzzles one day!

Name: Netra Regmi
Occupation: Hazards Geologist
Education Level: Ph.D. in Geology, Texas A&M University

I was born and raised in Nepal. I earned my BS and MS from Tribhuvan University in Nepal and my PhD in Geology from Texas A&M University (TAMU) in College Station, Texas. After graduating from TAMU in 2010, I worked for various institutes within the United States and carried out research on Earth surface processes and hazards.

I am currently a Geologist at the Oklahoma Geological Survey (OGS) where my research is focusing on geohazards including landslides, erosion, and land subsidence in Oklahoma.

- **Landslides** are rock, soil or debris that slide downhill, and this occurs mostly in mountainous landscapes.
- **Erosion** is the process of sediments being moved by wind, water, or ice.
- **Land subsidence** occurs when the surface of the Earth sinks downwards. It can happen when sinkholes form, when an underground mine collapses, or when an earthquake causes shaking.

These hazards occur all over the world, and cause loss of life and property – this is why they're called hazards! In Oklahoma, I figure out which

areas are likely to experience these types of hazards, to help keep people and property safe.

All day, I keep myself busy learning new computer software and tools, as well as writing computer code. The computer is an important tool for me, because I can use it to help me develop models that can describe and predict surface processes and hazards. It's also an important part of my job to write reports and articles about what I learn and discover. This is one way scientists share their knowledge with other citizens and scientists. I enjoy reading research papers about new and exciting techniques for doing science; so, I surf the Internet to find recent publications in my area of interest at least 4-5 times a day. I read about, and develop new ideas to solve my research problems.

As an OGS geologist, I respond to questions and concerns from Oklahomans and state agencies and work with emergency management departments to identify geologic hazards in our state. I am planning a field trip to help emergency workers identify landslide characteristics and to better understand the hazards in Oklahoma. I am developing a field guide, identifying sites for the field trip in eastern Oklahoma using aerial photographs and frequent field visits. When I go into the field, I observe and map different characteristics, such as:

- **Surface topography –** shape, size and other geometry (i.e., slope angle) of surface features or landforms
- **hydrology –** the water on Earth, such as streams and springs
- **lithology –** the specific characteristics of the rock, soil, and geological structure

Together, I use all of these details about the land to figure out how they are associated with hazardous events, such as landslides. I can then use this relationship to predict sites susceptible to such hazards.

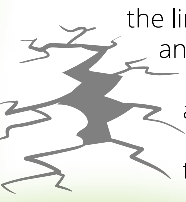
I always try to make my work exciting by reading new articles published in my field of research, interacting with colleagues about my research issues and accomplishments, and exploring interesting landscapes worldwide using Google Earth. I also enjoy collecting interesting geological materials including rocks, minerals, and fossils. I like to take photographs, too. I think geology is an interesting and important discipline. I enjoy observing various landforms in the field, studying how they were formed, and understanding how humans interact with the land.

For example, here's a photograph I took of a mountainous landscape near Ouray, Colorado. You can see different types of landforms including large bowl shaped glacial landforms called cirques, sharp ridges called arêtes, highly eroded hillslopes, and rock avalanches. This type of landscape makes me think of a few interesting questions:

1) *How do tectonics, climate (snow, water, etc.), human interaction and plant vegetation interact with the types of rocks found here (lithology) to develop such an incredible landscape?*
2) *When sediment erodes and moves down the hills, what are the short and long term impacts to the river system, aquatic habitat, and natural resources downhill?*

Name: Jake Walter
Occupation: Geophysicist and State Seismologist
Education Level: Ph.D. in Earth Sciences, University of California

I arrive at the office and scramble to get a sense of the earthquake that occurred around 5 AM near Medford, Oklahoma. It was big enough, magnitude 3.9 on the Richter scale, that it triggered our on-call seismic analyst, Andrew Thiel, to wake up and "work" the event. The Oklahoma Corporation Commission (OCC) already wants to know about the earthquake, as it is within a mile of a wastewater injection well. We discuss the data over the phone and the link between wastewater volume and the escalation of seismicity (or numbers of small earthquakes) as the volume increased. It is up to the OCC to decide whether the company will be required to reduce the volume of water that is injected into that well. Our team provides the scientific guidance on why seismicity has been occurring near injection wells.



Later that morning, I join Isaac Woelfel in the field to try to figure out why one of our seismographs is not working. A seismograph is a valuable piece of equipment that measures the ground vibrations at a location in the state. We use this information to triangulate where earthquakes come from and need this information to determine the earthquake magnitude, also known as the Richter magnitude, which is a scale of earthquake sizes. While in the field, we swap out the cell phone modem on the seismograph and check that the server is receiving the data. Our site is in a landowner's pasture field and as we're working a horse comes by to check out our work.

Finally, I get back to the office in late afternoon and get some time to work on the paper I'm writing. I am working on a paper related to Oklahoma seismicity and trying to describe the seismological analysis on these earthquakes. We have learned so much about induced seismicity in the last several years. The only way this knowledge benefits society is if other scientists and the public can also understand what we have learned about managing this problem and reducing the frequency of earthquakes by limiting and reducing the volume of wastewater injected underground.

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Name: Ming Suriamin
Occupation: Petroleum Geologist
Education Level: M.Sc. in Geology, Colorado School of Mines (Working on Ph.D. in Geology, University of Oklahoma)

There is no doubt that the exploration of oil and gas is one of the most powerful driving forces in shaping our modern world. Petroleum geologists play an important role in this activity. A petroleum geologist is a person who gathers and studies information about the rock beneath our feet ("subsurface") to determine the best places to drill for oil and gas.

My name is Fnu "Ming" Suriamin, I am a petroleum geologist for the Oklahoma Geological Survey (OGS), and this is a day in my life. As a petroleum geologist, I am really acting like a treasure hunter. First, I explore! I study petroleum systems in a specific geographic area called a basin. I examine if the basin has all the essential elements of a petroleum system. These elements include source rocks, reservoir rocks, seal, traps, migration, and timing. Once I discover whether all of the elements for a working petroleum system are present, a well is drilled at a trial location. We are trying to discover whether the target reservoirs contain significant amounts of petroleum or perhaps it might even be dry. While the well is being drilled, we send special tools down the hole to collect data. We also collect rock cuttings, and sometimes core (cylinder of rock) for further study back in a laboratory.

At the OGS, I do not drill any wells myself. So, what do I do as a petroleum geologist? I study the well data that has been collected across all of Oklahoma. There are plenty of interesting projects to do. The real benefit of doing petroleum geology at the OGS is that:

- there are more than half a million wells in the state of Oklahoma;
- there are hundreds of thousands of feet of rock cores;
- and there are data to go along with the rock cores.

Figure 1. My colleagues, Dr. Jerry Boak (OGS Director – far left), and I (far right) were examining lake deposits in the Piceance Basin near Grand Junction, Colorado. These lake deposits are about 34 – 55 million years old and have a lot of fossils within.

Therefore, there's a great chance of doing a complete geological study. I could literally spend weeks to months working at OPIC (Oklahoma Petroleum Information Center) where all of the core is stored. I collect samples, describe thousands of feet of rocks, select samples for further analysis, or examine the laboratory results. The main objectives of describing the cores are to find out about the source rock and reservoir rock, their characteristics, and how are they stacked vertically. Remember, these rocks tell us what the rock is like deep underground!

I also spend a lot of my time conducting petrophysical analysis. This means I investigate physical and chemical properties of the rocks and their relationships with fluids using well logs. The special tools' measurements allow me to calculate certain rocks properties (e.g., porosity, permeability, and water saturation), identify fluid types (whether it is oil, gas, or water), interpret the type of rocks, and examine whether the amount of hydrocarbons is economical or not. When I work with the logs, it feels like I am reading the rocks. A lot of the work that I do is actually on a computer. I use multiple programs to analyze the data and look for correlations between wells in an oil and gas field. Eventually, I put all of the information together, from cores to well data, to build a geological model. This model contains all the information about the reservoirs in a field. Based on this model, I determine the best spot to drill for hydrocarbons, develop a field, or simply to optimize hydrocarbons recovery.

Figure 2. My teammate and I (red coverall in the middle) were assembling special tools to drill an oil well and gather subsurface data in offshore Strait of Malacca, Indonesia.

Figure 3. I was describing cores in a Coalbed Methane (CBM) project. Coalbed Methane is a form of natural gas that occurs in coal beds.

The best part of being a petroleum geologist is that I have a chance to work in a multidisciplinary team. Most of the time, I collaborate with geophysicists and/or engineers to achieve our common goal, which is to successfully explore and exploit hydrocarbons for humans, particularly for the community of people in Oklahoma.

The last point I want to make is that if you are down to earth, with a skill set of sciences and technologies, consider becoming a petroleum geologist. It is fun, adventurous, and rewarding.

Name: Stacey Evans
Occupation: Research Geologist
Education Level: M.S. in Geology, University of Oklahoma

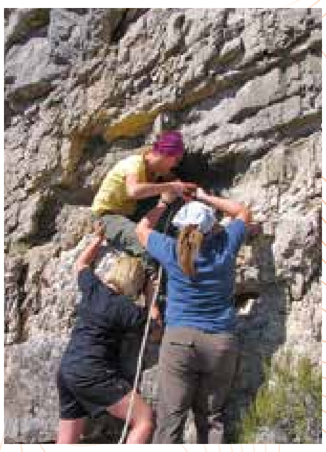
My name is Stacey Evans and I'm a Research Geologist at the Oklahoma Geological Survey. I've been working at the Survey for almost four years. Currently, my focus is field mapping. This is great for me! One of the things I love the most about geology, and being a geologist, is getting outside! I work on a project called STATEMAP that is updating the surface geology maps of Oklahoma. For about half of the year, I do field work, gathering all the data I can find on the surface geology. I start those days pretty early in the morning and drive out to the mapping area. I will drive all the roads within a region, noting the locations and describing all rock outcrops. While I do this, I pay special attention to the *boundaries* between different rock formations – these are places where characteristics of the rock change from one kind to another.

When I'm finished with all the data collection out in the field, I work in my office putting together all the pieces of information about the rocks that I collected. I first draw up the map using a pencil; once I have all the contacts drawn and I feel confident about them, I go over the pencil lines with pen so the contacts will stand out more on the map. At this point the map gets handed over to our *cartography* department for digitizing. They scan the map so it can be viewed as an image on the computer and then work to get all of my contact lines accurately transferred to digital lines. When cartography is finished, all the geologists that worked on the map will review the new geologic map and fix any errors there may be. When the reviews are finished, the cartographer adds the legend and description and – VOILA! We have a new geologic map!

As much as I love being outside, I also get to do some really interesting lab work at my job. I use *optical microscopes* and *scanning electron microscopes* to investigate the different minerals that make up a rock. Microscopes let me see some of the different properties of rocks, like how big or little the pores, or holes, in a rock are. I also use a *magnetometer* sometimes at work. This machine can help geologists determine if rocks were in different locations in the past due to plate tectonics, as well as helping geologists find out when rocks were changed due to events on Earth.

Before I started doing field mapping, I did petroleum geology at the Oklahoma Geological Survey. That type of work is mostly done in the office. For that, I used a computer program to look at rock information that is hundreds to thousands of feet below the surface of the Earth. People walk on the Earth's surface everyday without thinking about what's underground. I looked at well logs, images that record different properties along the length that an oil and gas well is drilled into the Earth, and decided on the depth of different formations. I also used well logs to interpret different rock characteristics like *porosity*, *permeability*, and *hydrocarbon potential*. That data is used to make maps based off the properties.

There are also a bunch of other neat things I get to do at work that don't fall under field mapping or petroleum geology. I really like helping people understand geology and this job lets me do outreach work with students and adults in our community, as well as answering geology questions that people email or call me about. I get a lot of questions from people wanting to know about some of the rocks that produce oil and gas. I also get questions from people who think they've found a meteorite and need help identifying it. For outreach, sometimes I get to go to libraries and read books about geology; sometimes I get to go lead a hike outside and tell people all about the geology we see around us; and sometimes I get to take our rock collection to community events and show all the neat samples to families. Overall, my work at the Oklahoma Geological Survey gives me a chance to help people in Oklahoma better understand Geoscience!



One of my favorite things about working at the Oklahoma Geological Survey is how much variety there can be in my day-to-day work. I hope you liked hearing about some of things I get to do!

OERB

The Oklahoma Energy Resources Board (OERB) was created to improve the lives of all Oklahomans through education and restoration.

They work to clean up abandoned well sites and educate students on energy and well site safety.

OERB offers virtual field trips, Petro Pros (have an energy professional come talk to your class), the Petroleum Scholars program, the PetroTech program (available through Francis Tuttle and Tulsa Tech) as well as a variety of curriculum resources for grades K-12.

You can find more information on all these and more here: ***https://tinyurl.com/OklahomaRocks.***