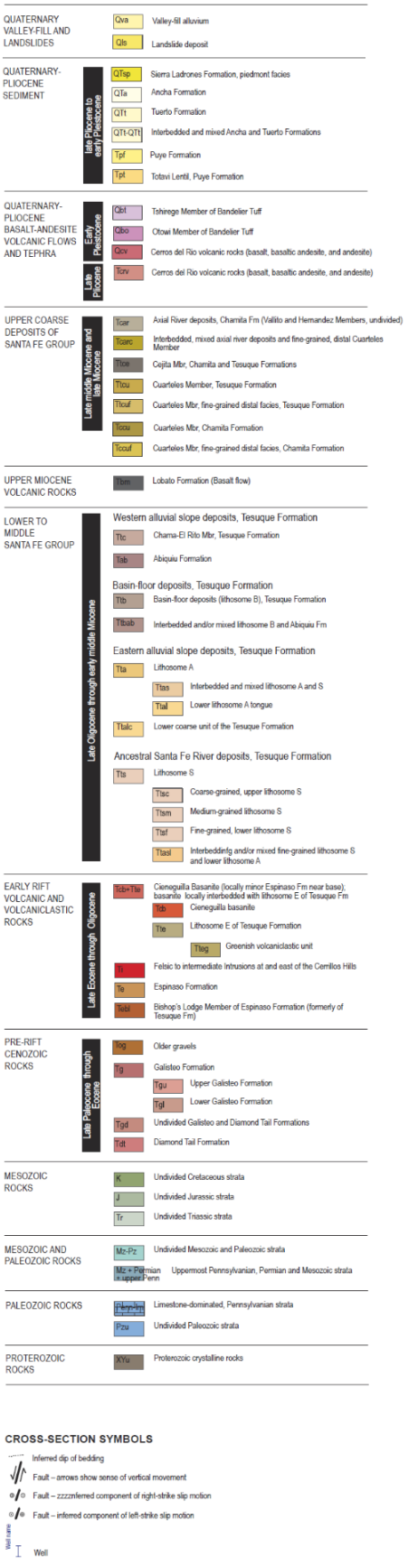
2.3 Geology and Hydrology Background Reading for Teachers

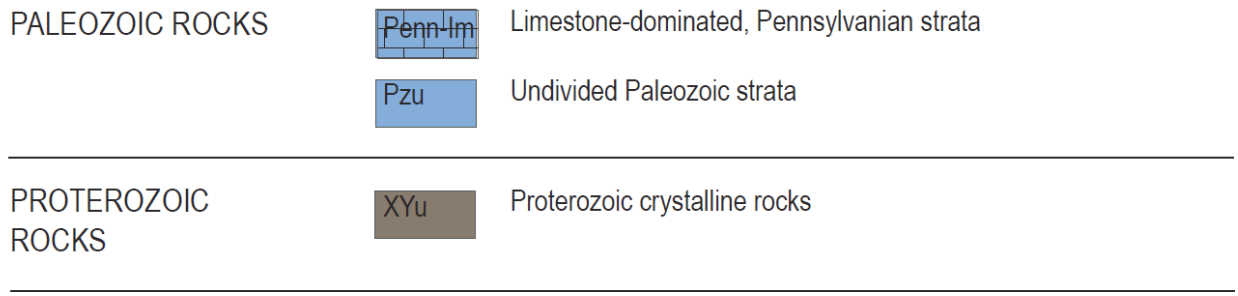
Hydrology is the study of the water that is in the environment around us. It is the water we see as clouds, rain, and in rivers or lakes, but it also includes the water that has infiltrated into the ground, called groundwater. To understand groundwater, it is important to understand the geological formations that it flows through.

Different types of rocks have different capacities to store water. Rock formations that are more porous, like many types of sedimentary rock, are often more permeable than metamorphic or igneous formations. Sedimentary formations that have gaps between particles can provide a source of groundwater that can be pumped and used. Santa Fe sits on a large deposit of sedimentary rock. This was formed as erosion washed soil down from the mountains and filled the valley where the Rio Grande flows. Santa Fe depends on groundwater to help ensure a steady supply of water to our homes, schools, gardens, and businesses.

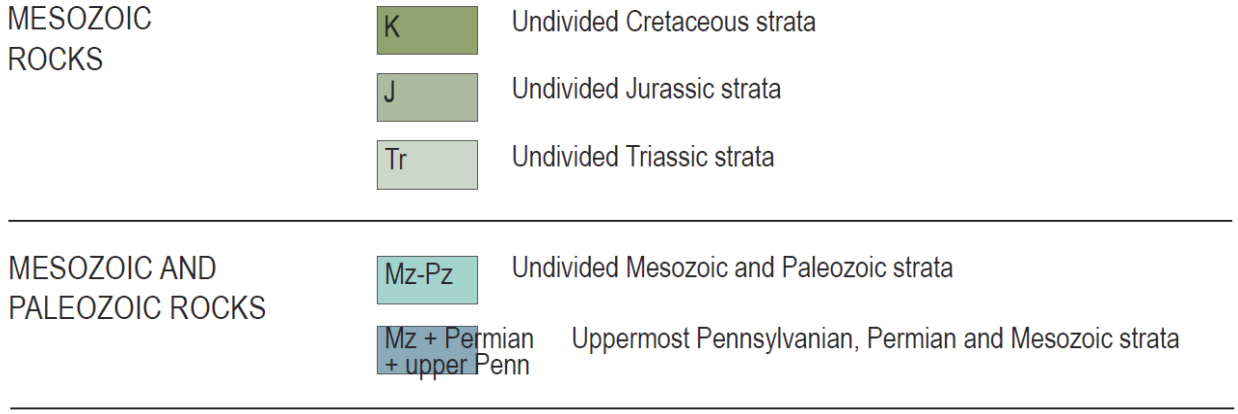
To the right is a description of the layers of rock that underlay Santa Fe. The oldest and deepest were laid down over 4 billion years ago. The upper layers were primarily created by erosion and deposition of soils from the mountains. Some of the youngest layers are still being hardened into sedimentary rocks, which can be seen on a visit to your local arroyo. The sand, rocks, gravel, and pebbles were deposited there from further upstream. The water that cut into these soils has exposed the process of how sedimentary rock is formed. If the soil were left undisturbed and was slowly compressed into new rock, this would become sandstone.



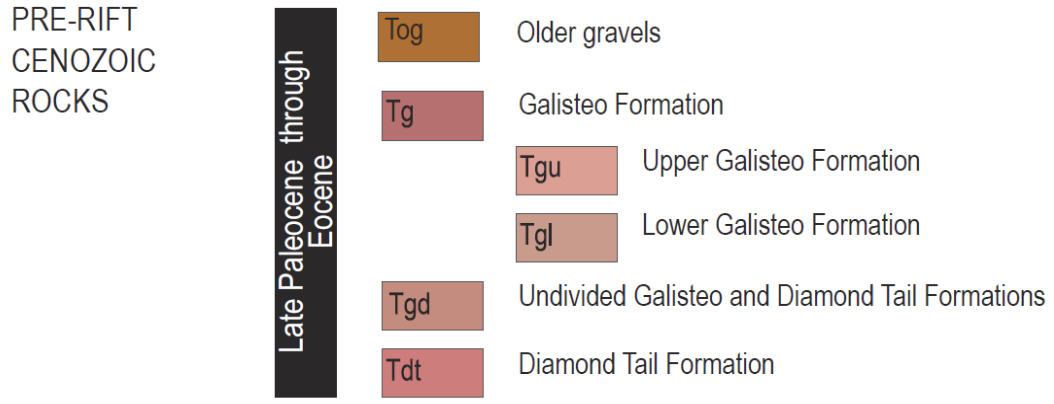
Starting at the bottom, with the oldest layers and working our way up to the present…



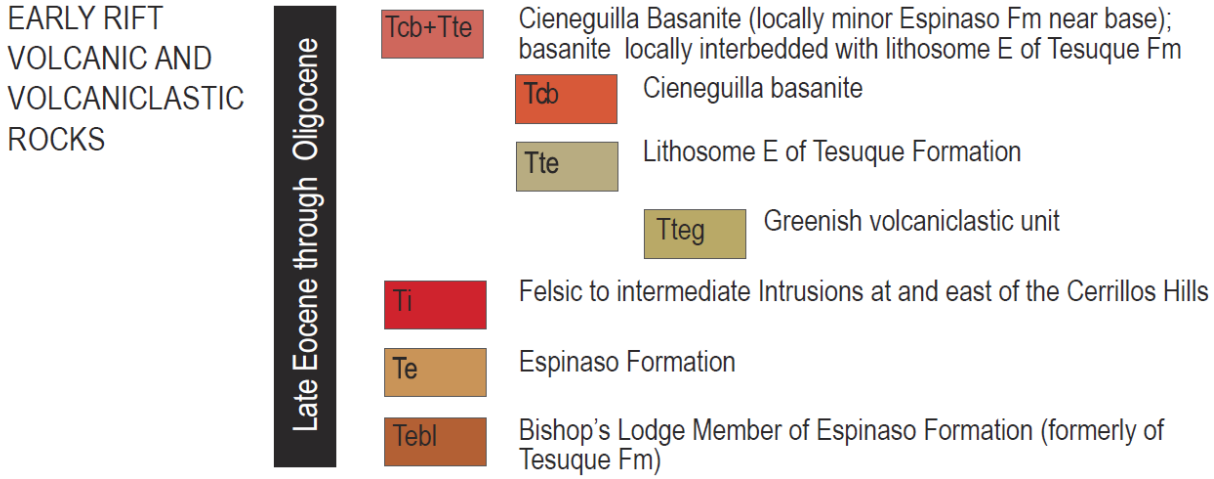
The lowest and oldest layers are from the Precambrian and Proterozoic eras, from about 4 billion to 538.8 million years ago. These are primarily metamorphic and igneous formations. The minerals are densely packed, and water is only able to infiltrate into these layers through rare fissures and cracks. This is not a good source of groundwater as the dense formations are unable to hold large amounts of water. Above this are the Paleozoic formations. These date from 538.8 to 251.9 million years ago. They are primarily limestones, shales, and siltstones.



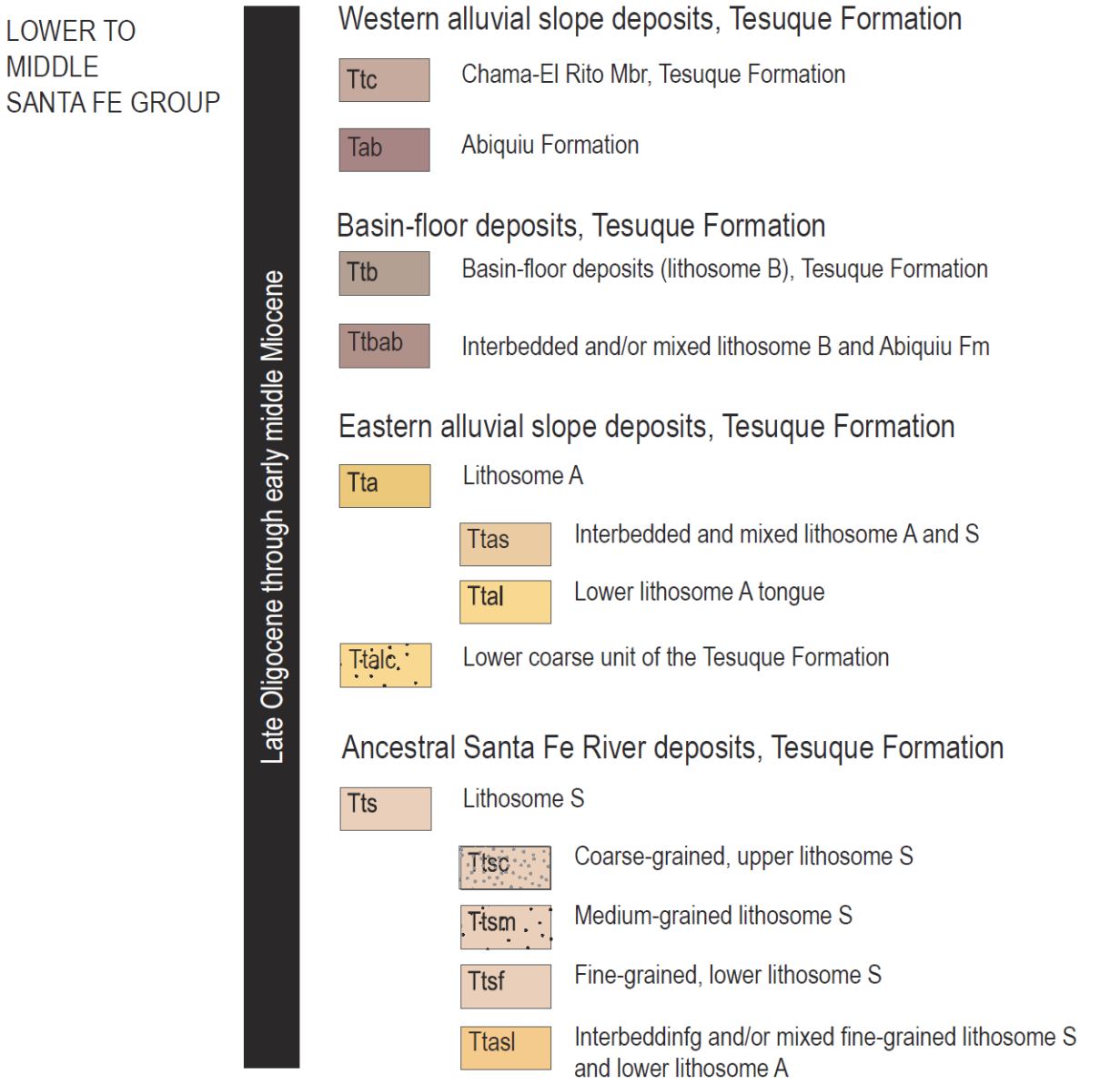
The mesozoic and paleozoic layers are primarily shales and fine to medium grained sandstones. These date from about 540 to 66 million years ago. This time period covers part of the era when dinosaurs roamed the Earth and that much of New Mexico was covered in water.



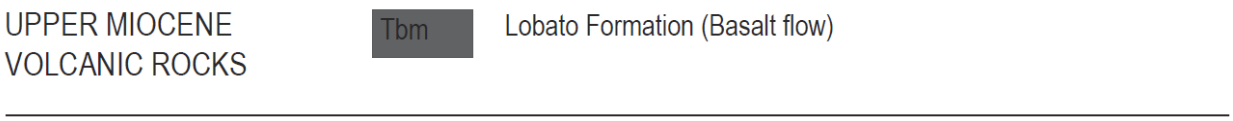
The pre-rift Ceonzoic layers were deposited from about 66 million years ago until the Rio Grande Rift began to pull apart about 35 million years ago. These are primarily sedimentary layers deposited after sediment was washed down from the mountains. The layers contain sand as well as gravel and larger sized rocks.



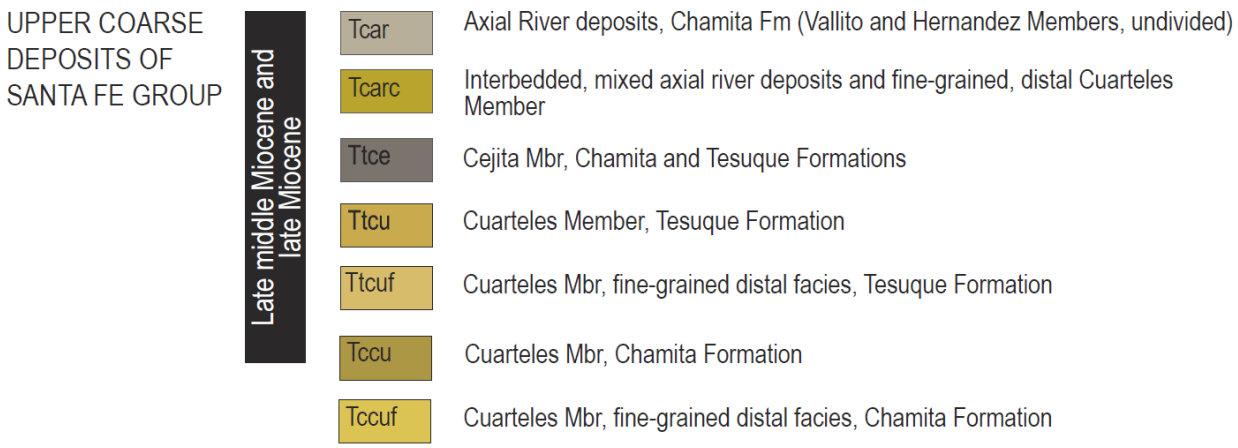
When the Rio Grande Rift began pulling apart, about 35 million years ago, it triggered a period of volcanic activity. These tended to be fairly small eruptions. Some of the layers never traveled all the way to surfaces, such as the Ti intrusions. Intrusions are areas where magma from deep under the crust is pushed up through cracks but cooled before reaching the surface. These areas of volcanic rocks can act as underground dams, causing water to pool, because they are often less porous than the surrounding sedimentary rocks. This era ended about 25 million years ago.



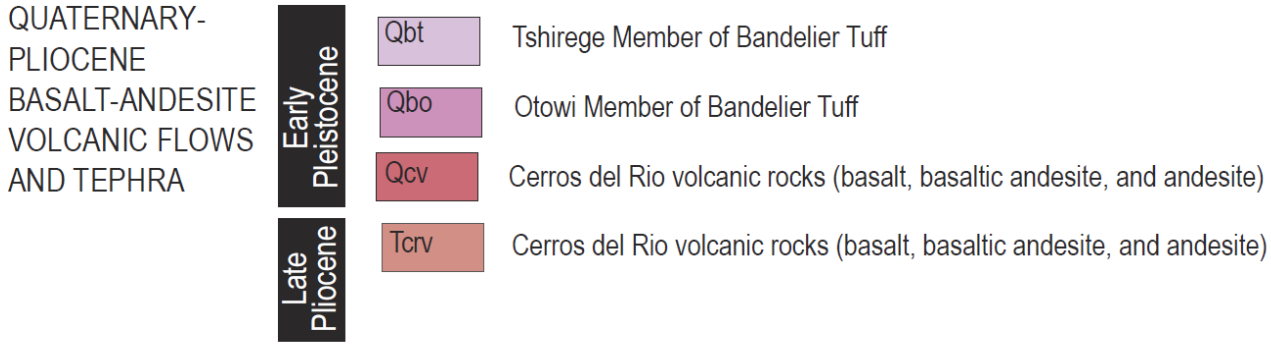
From 25 to about 10 million years ago the Rio Grande Rift pulled apart and sediment washed down into the valley created by the rift. This formed the Tesuque Formation, which has many different layers of sediment. This is a part of the Santa Fe Group.



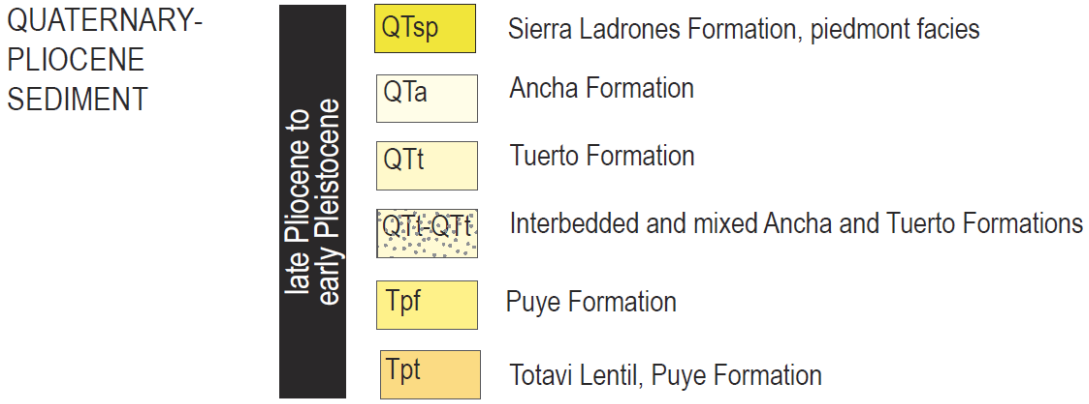
Similar to the early rift volcanic activity, there were periodic layers of igneous rock deposited between sedimentary layers. One of these is the Lobat Formation, which is a thick black layer of basalt. This occurred about 9 to 10 million years ago.



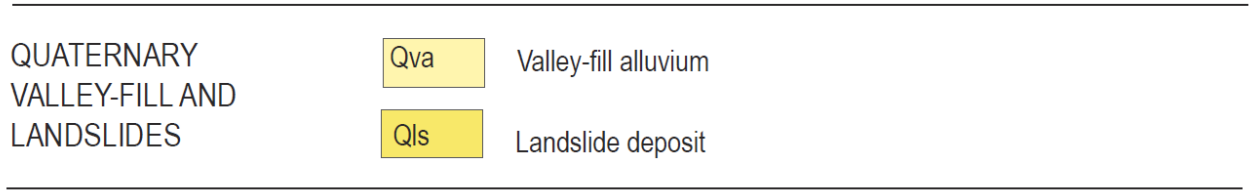
The upper Santa Fe Group returns to the sedimentary deposits that filled the rift valley. These are primarily sand and gravel deposits carried into the valley by rivers flowing into the lower elevations. These layers are important to the water table that Santa Fe depends on for city drinking water. These were deposited from about 8 to 6.5 million years ago.



Additional layers of volcanic material were laid down by the Cerros del Rio volcanic field to the west of Santa Fe. These were active from about 5 to 1.5 million years ago. They primarily laid down dark basalts and similar heavy, dense, material. Above this are the Bandelier Tuff deposits, which were ash layers created by the Valles Caldera volcano. These deposits were from between about 1.8 and 1.25 million years ago. They are primarily found on the western side of the rift valley, not directly under the City of Santa Fe.



The Quaternary-Pliocene sediment is a mix of large cobble, gravel, and sand deposits that were laid down between about 5.5 and 1.5 million years ago. They are likely to hold water in the gaps between sedimentary materials.



The Quaternary layers were deposited from about 2.5 million years ago through today. These are the uppermost layers that are often visible at ground level. They are continuing to be deposited and eroded. These layers are loosely compacted and water can easily infiltrate between particles.

Big Ideas:

- Many of the aquifers we depend on for water in Santa Fe are in the sedimentary layers that underlay the region.
- Different types of rocks have different abilities to hold water.
- The water primarily falls in the mountains, infiltrates into the soil, and slowly flows downhill through the permeable layers of rock. This can take tens of thousands of years.
- Because it takes time to recharge aquifers, it is important to conserve the water held in these aquifers.
- The geology under Santa Fe is complex. It is directly impacted by the presence of the Rio Grande Rift.

Common Misconception:

- Aquifers are not underground lakes. Water percolates through pore spaces between earth materials or through tiny cracks, and gaps in rocks in the groundwater system.

Key terms:

- Aquifer
- Basalt
- Deposition
- Deposits
- Formations
- Groundwater
- Infiltration
- Sediment
- Water table
- Volcanic