GeoNote 09

Geology of the Palouse

For thousands of years, people have found the Palouse region a hospitable place. Some of the earliest records of mankind in North America have been uncovered in the nearby basalt canyons of the Snake River. Indians have prospered on this bountiful land, and now the Palouse supports a substantial part of the U.S. grain, pea, and lentil production.

This seemingly tranquil landscape has been the product of some of the most catastrophic events recorded in the geologic record: large-scale lava flows, volcanic eruptions, glacial climates, several floods of a magnitude unrivalled on this planet.

The Palouse, geologically, lies on the eastern edge of the Columbia Plateau. Between the surface of this plateau and much older ''basement'' rocks deep below is a great layer of 6- to 17-million-year-old basalt. This basalt is what remains of a series of tremendous lava flows that once poured across the land. Fed by large cracks or fissures in the earth's crust, this lava ranged in thickness from a few feet to several hundred feet. In some places it traveled at speeds up to 30 miles per hour and spread across 100 miles of terrain.

The prebasalt landscape—whatever was here before the lava flows—was completely engulfed in molten rock. Only a few small steptoes, the tops of the highest mountains, were spared.

The lava took a long time to cool. In some thicker flows, it may have been decades before the basalt solidified in the forms we see today.

Fossil Records

Between some eruptions, enough time passed for vegetation to take root again and for thick soils to form. Petrified wood and logs are not uncommon in basalt quarries and outcrops. At the eastern edge of the basalt plain, near where the towns of Clarkia and Bovill lie, the lava flows dammed streams flowing from the mountains and formed narrow lakes in former valleys.

As these reservoirs rapidly silted up they preserved fossilized records of the plant life along their banks and the fish within their waters. The famous Clarkia fossil beds were formed in this way. These remains are a chronicle of life on the Palouse 15 million years ago. They tell us that this area hosted a hardwood forest in a humid, temperate climate, similar to that of eastern North America and parts of China today.

Also layered between the flows of basalt below us are sand and gravel deposits which washed down from the adjacent mountains. It is in these sedimentary interbeds that most of the Palouse's potable water is located. Some of the more fractured and broken basalt flows also are water bearing.

It is also possible that in some of these interbeds, as well as in some prebasalt sediments beneath the lavas, there could be enough organic material to become carbonaceous or petroliferous. In other words, there may be coal or oil or gas down there, especially in the southern and western parts of the Columbia Basin.

Pliocene Epoch

The Pliocene Epoch, about 2 to 5 million years ago, was a time of uplift and erosion in western North America. The Rocky Mountains were being pushed higher and the rising of the Cascades had begun. The Columbia Plateau, meanwhile, was being warped downward beneath the weight of the dense basalt. In this basin, stream and lake sediments were being deposited, particularly on the west side of the plateau near the Cascades in what today is known as the Ringold Formation. This period of deformation marked the end of the Tertiary Era and the onset of the Pleistocene Epoch, the time of the most recent Ice Age.

Palouse Hills

The most characteristic feature of the Palouse is its rolling hills. Early geologists in the area first thought the Palouse deposits were formed by the weathering of basalt. Later studies showed that, based on the particle size and the composition of the silt, or loess, the deposits were primarily transported here rather than formed in place. The best evidence shows that the Palouse loess was blown here as fine silt particles that collected in the dune-like shapes we see today.

Loess is not particularly unique since nearly 10 percent of the earth's land surface is made up of accumulations of this windblown dust. Besides the Palouse, parts of the Mississippi Valley as well as large areas of Asia and central Europe are made up of loess deposits. These are regions of rich farmlands. In fact, most of the world's best agricultural soils are in loess.

Loess is mostly associated with cool climates and usually forms in arid areas near glaciated regions. Interestingly, no pre-Pleistocene loess has been recognized in the geologic record, although numerous pre-Pleistocene glaciations have been documented.

The source area of the Palouse loess has been debated. Both volcanic ash from the Cascades and glacial flour from the ice margins of glaciated regions to the north have been proposed. Most likely, the Palouse loess was blown

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in from the fine-grained Ringold Formation on the eastern margins of the Cascades and perhaps from the Touchet Beds in the Pasco Basin.

The Palouse hills show a distinct alignment and dune-like form. This is due not only to the original dunes, but also to a number of factors that tend to steepen north-facing slopes and flatten the south-facing ones. From the air or a vantage spot on a ''steptoe,'' the dune form of the rolling hills is dramatic—gentle south-facing slopes and steep north-facing slopes aligned parallel to the prevailing southwesterly winds. More than one observer has likened the view to a sea of waves.

Mineral Composition

The composition of loess throughout the world is predominantly quartz and feldspar. The Palouse is no exception, but it also contains mica and small amounts of volcanic glass and dark minerals.

Studies of the Palouse loess have shown that while the deposits of silt may look homogenous, or all of the same source and age, they are really composed of a complex series of layers formed in different episodes. Recent profiles have shown that the stratigraphy, or order of deposition, of these hills has been altered many times. These hills have not been stable, but are in a constant state of fluctuation. They were formed not once, but many times.

Paleosols, or buried soils within the loess, are visible at roadcuts and on some cultivated slopes. These older, more weathered soils have more oxidized iron and clay particles in them. They show up in the reddish brown bald spots on some slopes.

As farmland, the most productive soil on the Palouse is that deposited most recently, in the Holocene Epoch. This soil, however, is also the most susceptible to erosion. Soil studies show that much of the Holocene topsoil has been lost through erosion, a constant problem in the fine-grained deposits.

The Missoula Flood

During the late Pleistocene, near the end of the most recent Ice Age, glaciers had advanced from Canada into northern Washington state and, in Idaho, down through the Purcell Trench to near where Coeur d'Alene is today. Glacial lakes were impounded at the margins of these huge lobes of ice.

The largest known glacial lake in North America at that time was Lake Missoula. More than 13,000 years ago it emptied catastrophically because of a failure in an ice dam located near what is now Clark Fork, Idaho. A huge wall of floodwater cascaded down through the Spokane and Columbia River valleys in a torrent that probably lasted about a week.

The famous channeled scablands of central Washington were carved by the terrible erosive force of this flood. The loess ground cover and some of the basalt layer beneath were washed away. The largest continuous scabland scoured by the water is named the Cheney-Palouse tract and is over 80 miles long. Boulders, sand, and silt carried by the Missoula floodwaters were deposited in large bars on the Columbia River, and huge ripple marks along the drainages are visible from the air.

Because the Missoula Flood was on so large a scale, many of the features of its destruction went unrecognized by geologists for many years. In a series of papers between 1923 and 1932, the now famous J. Harlen Bretz first proposed the ''outrageous hypothesis'' of a monstrous flood to account for the channelled scablands. It was only recently, with corroborative evidence and careful field studies, that his idea has been substantiated. Now it is widely recognized that outbursts from Lake Missoula occurred not once, but many times, with the most recent happening about 13,000 years ago.

Volcanic Ash

During the Holocene, the Epoch in which we now live, the climate warmed and modern soil was developed in the Palouse loess.

As demonstrated during the major eruption of Mount St. Helens on May 18, 1980, the Cascade volcanoes have repeatedly covered the Palouse with ash. Many of these ashfalls are preserved in the Palouse stratigraphy and can be differentiated from one another by the chemistry of volcanic glass shards. They provide ''marker'' beds by which the different layers of the Palouse loess can be dated. One of the largest eruptions was from Mount Mazama (Crater Lake), about 6,700 years ago. The abundance of volcanic ash throughout the loess is responsible for the soil's moisture-retaining capacity that allows successful dryland farming.

The Final Product

As this summary of the geologic history of the Palouse indicates, the formation of the landscape on which we live took place across a time span of millions of years. From the lava flows of 17 million years ago to the ashfall of 1980, the Palouse has been continually altered and shaped by a series of often violent natural events.

This history suggests, for those of us who rely on the water, soil, and mineral resources of this area, how truly fragile the Palouse country is geologically and how difficult it would be to make another.

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