GEOLOGIC MAP OF WASHINGTON

GEOLOGIC UNITS

Unconsolidated Deposits
- Quaternary sediments, dominantly nonglacial, includes alluvium and volcaniclastic, glacial outburst flood, eolian, landslide, and coastal deposits
- Quaternary sediments, dominantly glacial drift; includes alluvium

Sedimentary Rocks
- Upper Tertiary (Pliocene–Miocene)
- Lower Tertiary (Oligocene–Paleocene)
- Mesozoic
- Mesozoic–Paleozoic
- Paleozoic
- Precambrian

Volcanic Rocks
- Quaternary
- Quaternary–Pliocene
- Upper Tertiary (Pliocene–Miocene)
- Columbia River Basalt Group
- Lower Tertiary (Oligocene–Paleocene)
- Mesozoic

Intrusive Igneous Rocks
- Tertiary
- Mesozoic
- Paleozoic

Metamorphic Rocks
- Pre-Tertiary
- Pre-Cretaceous
- Paleozoic
- Precambrian
- Ultramafic rocks

Note: Some pre-Tertiary sedimentary and volcanic rock units include low-grade metamorphic rocks. Ages assigned to metamorphic rocks are protolith ages.

EXPLANATION
- Contact
- Fault
- Thrust fault—sawteeth on upper plate
- Detachment fault—blocks on upper plate
- Strike-slip fault—arrows show relative movement
- Anticline—dotted where concealed

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The Geology of Washington State

Adapted by Lynn Moses from an article by Raymond Lasarnas

Washington’s geology is highly diverse. Rocks of Precambrian age, as well as rocks from nearly every period from Cambrian to Quaternary, are represented. The state has been subject to continental collisions, metamorphism, intrusion of igneous rocks, volcanism, mountain-building, erosion, and massive flooding. The easiest way to understand Washington’s complex geology is to examine each of its physiographic provinces.

Okanogan Highlands

The Okanogan Highlands are characterized by rounded mountains (up to 8,000 feet) and deep, narrow valleys. The Columbia River divides the Okanogan Highlands into two. The eastern half contains the oldest rocks in the state. These Paleozoic and Mesozoic sedimentary rocks are overlain by Cenozoic, marine, and volcanic rocks that were deposited on an actively subsiding continental margin. The western half of the province was formed by deposition of sediments and volcanic rocks offshore to the west of the continental margin. During the Tertiary volcanic eruptions filled the valleys with volcanic deposits, which was later covered by fluvial and lacustrine sediments. Fresh lake beds at Republic contain Eocene plants, insects, and fish. During the Quaternary, ice sheets covered the Okanogan Highlands, reshaping the landscape and forming lakes in the Columbia and Pend Oreille River valleys.

Columbia Basin

The Columbia Basin is characterized by low hills and dissected river valleys. Today, the Columbia River flows through the region. By the end of the Pleistocene, much of the sediment was derived from volcanic eruptions. During the early Tertiary, Columbia River fluvial channel deposits and then by intracanyon flows of Columbia River followed ancestral courses of the Columbia River. Basalt flows from the Middle Miocene occupied ancestral Columbia River channels, causing the Troy Basin to be infilled with thick flows of Columbia River basalt. During the Quaternary, the Puget Lowland was covered a number of times by continental ice sheets. The most recent (Fraser) glaciation reached its peak about 14,000 years ago. The Fraser ice sheet extended to Little Spokane River, south of Olympia. Maximum ice thickness during the Fraser Glaciation was approximately 1,000 feet at Olympia, 3,000 feet at Seattle, and over 5,000 feet at Bellingham. The Fraser ice retreated quickly, leaving behind a landscape sculpted by glacial erosion and covered by newly deposited glacial drift. The location of present-day waterways and river drainages was established by the pattern of Fraser glacial erosion and deposition.

Olympic Mountains

The Olympic Mountains, part of the Coast Range, form the core of the Olympic Peninsula. The oldest rocks of the Olympic Mountains are the lower Tertiary Crescent Formation, a thick sequence of submarine and subaerial basalt flows with some interbedded siltstone and limestone. During middle Tertiary subduction, lower Tertiary marine sediments were continually thrust beneath the Crescent Formation. Uplift of the Olympic Mountains began when the wedge of underplated sediments reached a critical thickness about 17 million years ago. Continental glacial deposits mantle the east and northwest side of the Olympic Peninsula, where the Fraser ice sheet split into the Juan de Fuca and Puget lobes. Alpine glaciation carved the rugged peaks of the Olympic Range and flooded much of the coastal lowland with meltwater carrying sand and gravel.

Willapa Hills

The Willapa Hills are part of the Coast Range and include the adjacent broad valleys that open up to the Pacific Ocean. Barrier beaches characterize the coast, as well as dunes, which are major features along the coast. The Blue Mountains began when the wedge of underplated sediments separated by dashed lines. OWL, Olympic–Wallowa lineament.

Blue Mountains

The Blue Mountains are characterized by broad uplands reaching elevations of more than 6,000 feet above sea level. Windows of Paleozoic or Mesozoic metamorphic rocks are exposed at four locations where streams have incised deep canyons through overlying rocks of the Columbia River Basalt Group. In the Blue Mountains, Grande Ronde Basalt of the Columbia River Basalt Group was extruded from north-west-trending fissures. Dikes now show the locations of these vents. As thick sequences of basalt were erupted in the Blue Mountains during the middle Miocene, ancestral basins formed—for example in the vicinity of Troy, at the Oregon–Washington border. Ancestral valleys were blocked by basalt flows, causing the Troy Basin to be infilled with thick sequences of sediments and peat. Arching of the Blue Mountains was initiated between 12 to 10 Ma. Younger Miocene flows did not cover the emerging Blue Mountains. They only lapped up against the flanks of the uplift, finally folding and faulting.

Portland Basin

Portland Basin marks the northern terminus of the Willamette Lowland of Oregon. It is characterized by low topographic relief. At the edge of the basin are exposures of Columbia River basalt; within the basin itself, the basalt units lie more than 1,000 feet below the surface. Starting during the Miocene and continuing through the Pliocene, the basin was filled by the wedge of the ancestral Columbia River. This was followed by a period of volcanism from 2.6 to 1.3 Ma. This volcanism was associated with faulting and structural deformation and further depression of the Portland Basin. Lastly, the Missoula floods burst out of the Columbia River gorge 12,700 to 15,300 years ago, deposits of poorly sorted sand, clay, and gravel accumulated in the basin.