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A BRIEF RESUME OF THE GEOLOGY OF ANCHORAGE AND VICINITY

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The Municipality of Anchorage is situated in perhaps the most varied and dynamic geologic environment of any moderate sized city of the United States. The interplay of subduction zone tectonics, volcanism, alpine glaciation, marine coastal processes, and a rigorous climate directly influence this, the most populous area of Alaska. The geologic record documents a long and complex history of continental margin tectonism. The Chugach Mountains, which rise to over 5000 feet elevation directly east of Anchorage, are comprised of Mesozoic flysch and melange, respectively named the Valdez Group and the McHugh Complex. Rock types vary from metavolcanic tuffs, to graywacke, chert, marble, schist, and amphibolite. To the north of Anchorage, Cretaceous trondhjemite plutons intrude the Chugach terrane and dunite-clinopyroxenite-norite ultramafic rocks lie in fault contact with the terrane. The mountain front visible from Anchorage is a result of a major fault boundary of the Chugach Mountains generally termed the Border Ranges fault. Recent quadrangle mapping has documented that this is a fault zone that has been active from the Cretaceous to within the past 300 years. Extending to the west, away from the Chugach Mountains, is a thick wedge of Tertiary clastic sedimentary rocks (the Kenai Group). These strata underlie much of upper Cook Inlet and are the major oil and gas producers for the region. The Kenai Group rocks range from 800 to 1500 ft beneath downtown Anchorage. The west side of the Cook Inlet basin is bounded by the Aleutian and Alaska Ranges wherein several active, composite volcanoes occur. In 1953, a thin ash fall from a Mt. Spurr eruption covered Anchorage. Between Anchorage and the Alaska Range, the Castle Mountain fault zone forms a recently active high angle fault scarp trending northeast-southwest for over 100 miles. An excellent view of the Alaska Range is provided at an overlook at 3rd Avenue and "L" Street; a panorama of the Chugach Mountains is seen at 3rd Avenue and "E" Street.

The thick sequence of unconsolidated clastic Quaternary deposits that directly underlie Anchorage have accumulated primarily as a result of glacial and marine sedimentation. Substantial evidence indicates that during the Pleistocene Epoch glaciers advanced out of the mountains surrounding upper Cook Inlet and coalesced to form a compound glacier several hundreds of feet thick that entirely filled the Cook Inlet basin. During interglacial episodes the basin was apparently ice-free; marine and fluvial processes were then dominant. The record of these glaciations is vague because most of the sediments are now deeply buried below modern sea level, however the remnants of elevated moraines and eroded bedrock benches at high elevations in the surrounding mountains attest to these extensive early glaciations. During late Pleistocene time (Wisconsinan) ice advanced from major valleys of the Chugach and Talkeetna Mountains and reached the Anchorage area from the southeast (Turnagain Arm) and north (Knik Arm). These advances did not fill upper Cook Inlet but instead fronted in marine waters. Till, ice-contact deposits, and glaciofluvial sediments occur approximately 100 to 150 feet below the surface of downtown Anchorage but to the east project through to present land surface as knobs and ridges, in some cases being drumlinoid in form due to multiple ice advances. During the latest Wisconsinan, glacier ice did not reach the Anchorage area but bounded the region forming a sedimentation basin which at various times contained either fresh or marine waters. The accumulated sediments in this basin consist of stratified clay, silt, and sand collectively named the Bootlegger Cove Formation. Radiocarbon dates on the Bootlegger Cove Formation are generally in the range of 13,500 to 15,000 years B.P. In downtown Anchorage this formation is 130 ft thick and is the geologic unit that most influences the geotechnical design of buildings in the city. Overlying the Bootlegger Cove Formation is about 25 ft of stratified sand and gravel which constitutes a large alluvial fan which has its apex about 12 mi to the northeast in the Eagle River area. The fan was formed as a result of drainage diversion caused by the last glacial advance to enter the area between 12,500 and 13,500 years ago. A line of low tree-covered hills visible north from downtown Anchorage (3rd Avenue and "E" Street) is the Elmendorf Moraine which was formed by this final advance into the Anchorage area. During Holocene time the Chugach Mountains supported numerous cirque and valley glaciers up to several miles in length. Today, within 20 miles of Anchorage vigorous glaciers and extensive rock glaciers exist in protected cirques and valleys of the Chugach Mountains above 4000 ft elevation.

During the Prince William Sound Earthquake of March 27, 1964, Anchorage sustained considerable damage due to both ground shaking and massive landslides. The 4th Avenue landslide occurred within one block of the convention center and involved several city blocks north of 4th Avenue. Horizontal displacements exceeded 13 ft and vertical drop was as much as 10 ft. The area presently occupied by the Post Office and Sunshine Malls was the zone of major damage. The intersection at 4th Avenue and "E" Street is the southwestern limit of that slide. Another major landslide involving all or parts of 30 city blocks occurred 7 blocks west of the convention center near 5th Avenue and "L" Street. Here a translational slide about 3/4 mile long and over one thousand feet wide moved up to 14 ft horizontally with very little vertical displacement. A landslide graben at the back of the slide was up to 250 ft wide and 10 ft deep. The older tower of the Anchorage Westward Hotel, located just outside the 4th Avenue landslide zone, was present at the time of the earthquake and performed well during the shaking. Most of the high rise building that one now sees in downtown Anchorage had not been constructed at the time of the earthquake. All of the major landslides caused by the 1964 earthquake are directly linked to the Bootlegger Cove Formation. Although liquefaction of sands has been suggested as the cause, current thinking favors fabric collapse of a sensitive silty clay facies within the formation.

Knik Arm, which borders Anchorage on the north and west, displays dramatic diurnal tides with a range of up to 30 ft and velocities of nearly 12 ft/sec. The waters of the arm transport very large suspended loads of silt and clay derived from glacial streams entering the ocean. The olive-gray tidal flats visible from the downtown area are representative of these constantly reworked glaciomarine sediments. The Port of Anchorage and fuel storage tank farms north of the city are built on these sediments; the liquefaction susceptibility of the foundation soils is of major concern. The feasibility of the construction of a bridge or causeway across Knik Arm is currently being studied by the State. Seismic hazards, tides, sedimentation, and winter sea ice will require a paramount geological engineering effort.