TO ACCOMPANY OPEN FILE MAP 76 - 477

RECONNAISSANCE GEOLOGIC MAP ALONG BRUIN BAY AND LAKE CLARK FAULTS IN KENAI AND TYONEK QUADRANGLES, ALASKA

Explanatory Note

Reconnaissance geologic investigations along the Bruin Bay and Lake Clark faults in the Kenai and Tyonek quadrangles, Alaska, were completed in 1974. These faults are probable southwest extensions of the Castle Mountain fault system part of which was active in Holocene Time (Detterman and others, 1974, 1976). The investigation was undertaken to determine if there is evidence of Holocene displacement along the Bruin Bay and Lake Clark faults. The purpose of this map is to describe the general features of these faults and, because the areas examined are largely unknown geologically, to report the general distribution of major geologic units.

Reports pertinent to the bedrock units in the mapped area include Barnes (1966), Detterman and Hartsock (1966), and Reed and Lanphere (1972, 1973). Some aspects of the Bruin Bay and Lake Clark faults southwest of the mapped area are discussed in Detterman and Hartsock (1966), Plafker and others (1974).

General geology.--The major geologic units in the map area include bedded sedimentary rocks of Triassic, Jurassic, and Tertiary age and igneous rocks of Jurassic, Cretaceous, and Tertiary age.

The main rocks exposed in the map area are volcanic breccia, agglomerate, tuff, and andesitic flows of the Talkeetna Formation. These units are locally metamorphosed to hornfels, schist, and amphibolite along contacts with the Alaska-Aleutian Range batholith. The metamorphic grade increases northward from unmetamorphosed rock at Tuxedni Bay to amphibolite facies rocks near Big River.

Two small areas of limestone of the Late Triassic Kamishak Formation are present adjacent to the Bruin Bay fault south of Tuxedni Bay. The limestone is locally metamorphosed to marble near a small quartz monzonite pluton of Jurassic age. Middle Jurassic siltstone, shale, and graywacke of the lower part of the Tuxedni Group is exposed south of Tuxedni Bay, where they unconformably overlie the bedded volcanic rocks of the Talkeetna Formation.

Sandstone, conglomerate, siltstone, shale, claystone, coal, and minor tuffaceous beds of Tertiary age unconformably overlie the Talkeetna Formation and are exposed mainly along streams between the McArthur River and Susitna River. The beds are nearly flat-lying except along projections of the Bruin Bay and Lake Clark faults. They were observed to be steeply inclined and juxtaposed against granodiorite just north of the McArthur River.

Plutonic rocks exposed along the faults are part of the Alaska-Aleutian Range batholith formed during three episodes of intrusion; Early to Middle Jurassic, Late Cretaceous to Early Tertiary, and Middle Tertiary (Reed and Lanphere, 1972, 1973). Potassium-argon age dates (Reed and Lanphere, 1972) indicate that only rocks of the first two episodes are present in the area mapped. The Jurassic rocks are mainly quartz diorite, but grade into quartz monzonite and granodiorite. They form the east edge of the batholith along the Bruin Bay fault. Tertiary to Cretaceous quartz diorite and granodiorite are exposed along the Lake Clark fault. Dikes of the younger rock intrude the Jurassic pluton at the few places where they were observed in contact.

Andesite and volcanic rubble at Dinglishna Hill are probably Tertiary, but the volcanic rubble along the Chakachatna River is believed to be Pleistocene flows from Mount Spurr.

Surficial deposits cover much of the area and include a variety of alluvial, beach, terrace, outwash, and talus deposits of different ages that are grouped together on the map (Qs). Morainal materials (Qg) and landslide debris (Qls) are mapped separately.

Bruin Bay fault.--The Bruin Bay fault extends along the west side of Cook Inlet from near Mount Susitna in the Tyonek quadrangle to Becharof Lake in the Naknek quadrangle, a distance of about 515 km (320 mi). In the map area the fault is believed to intersect the Castle Mountain fault near Mount Susitna. The trace is projected beneath surficial deposits from the last bedrock exposure north of Katchin Creek; along a surface lineament on Kustatan Ridge; along the Chuitna and Beluga Rivers through zones where rocks of the Beluga Formation dip steeply or are reversed to the probable intersection with the Castle Mountain fault.

In the area of bedrock exposures the fault is a moderate to steeply northwest dipping reverse fault that commonly juxtaposes Jurassic intrusive rock against either the Talkeetna Formation or against itself. The fault trace is commonly marked by a zone of crushed rock a few to several hundred metres wide. This zone of crushed rock commonly is expressed as a saddle or notch.

The sense of displacement is everywhere reverse and bedded rocks in the downthrown block are commonly upturned against the fault. Horizontal movement cannot be determined in the map area, but minor (less than 10 km) sinistral displacement is inferred for the area immediately to the south (Detterman and Hartsock, 1966). The age of displacement is probably in part Tertiary, but there is no compelling evidence for Holocene movement. No offset was seen in any of the Holocene surficial deposits between Katchin Creek and the probable junction with the Castle Mountain fault, a distance of 115 km (72 mi). The fault trace, believed to be marked by the Kustatan Ridge lineament, is projected through glacial deposits dated as >42,000 radiocarbon years (Lab. No. W-3251). The dated material is wood deposited in outwash from the nearby Knik moraine. The outwash deposit unconformably overlies Bootlegger Cove Clay and underlies 3 m (10 ft) of fibrous peat. A late Tertiary or possibly Quaternary plug at the south edge of the map does not show evidence of offset and Quaternary flows from Iliamna Volcano are not displaced where they cross the fault just south of the map area (Detterman and Hartsock, 1966).

Lake Clark fault.--The Lake Clark fault is a major structural and topographic feature that is on strike with the Castle Mountain fault and is probably a part of that system. The prominent topographic trench that marks the fault through the Alaska-Aleutian Range batholith extends from Lake Clark at the southwest to Blockade Glacier in the northeast. Northeast from Blockade Glacier the fault is flanked by a prominent bench across the end of the Chigmit Mountains, between the McArthur and

Chakachatna Rivers, but is mantled by surficial deposits in the lowlands west of Tyonek. The trace is clearly marked across the bench by a shear zone 30 to 50 m wide that juxtaposes Late Cretaceous and Tertiary plutonic rocks against sharply upturned early Tertiary sedimentary rock. Beneath the lowland the position of the fault is indicated by dip changes or reversals in the Tertiary sedimentary rock exposed near the fault trace; along the Chuitna River, the fault places rocks of the Eocene West Foreland Formation against the Tyonek Formation of Miocene to Oligocene age. The trace continues northeast along the front of Lone Ridge where it is marked by a zone of crushed granitic rock and numerous springs that are on strike with the Castle Mountain fault. The inferred juncture with the Bruin Bay fault would be near Olsen Creek.

The sense of displacement along the mapped part of the Lake Clark fault is that of reverse movement with the northwest block upthrown 500 to 1,000 m based on displacement of Tertiary formations on the Chuitna River. Horizontal movement cannot be demonstrated in the map area, but 5 km of dextral displacement is evident near Lake Clark where contacts between the Talkeetna Formation and both a Tertiary pluton and older metamorphic rocks are offset (Plafker and others, 1975). The age of displacement is mainly Late Tertiary based on offset of the 38-m.y.-old quartz monzonite near Lake Clark and juxtaposition of Miocene strata against Eocene beds on the Chuitna River; however, there is no evidence of Holocene movement.

Conclusions.--The Bruin Bay and Lake Clark faults in the Kenai and Tyonek quadrangles are major structural and topographic features. The most obvious sense of displacement on these faults in the map area is reverse with the northwest side upthrown. There has been about 5 km of dextral displacement on the Lake Clark fault in the Neogene. The most recent displacement is post-Miocene, but there is no clear evidence of Holocene movement. Both structures are likely extensions of the Castle Mountain fault (Detterman and others, 1974), part of which has been active during the Holocene. Thus, if they are continuous with the Castle Mountain fault, as we believe, either or both of these faults must be considered as potentially active.

References cited

Barnes, F. F., 1966, Geology and coal resources of the Beluga-Yentna region, Alaska: U.S. Geol. Survey Bull. 1202-C, p. 54.

Detterman, R. L., and Hartsock, J. K., 1966, Geology of the Iniskin-Tuxedni region, Alaska: U.S. Geol. Survey Prof. Paper 512, p. 78.

Detterman, R. L., Plafker, George, Hudson, Travis, Tysdal, R. G., and Pavoni, Nazario, 1974, Surface geology and Holocene breaks along the Susitna segment of the Castle Mountain fault, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-618.

Detterman, R. L., Plafker, George, Tysdal, R. G., and Hudson, Travis, 1976, Geology and surface features along part of the Talkeetna segment of the Castle Mountain-Caribou fault system, Alaska: U.S. Geol. Survey Misc. Field Studies Map MF-738.

Plafker, George, Detterman, R. L., Hudson, Travis, 1975, New data on the displacement history of the Lake Clark fault, in Yount, M. E., ed., Alaska program 1975: U.S. Geol. Survey Circ. 722, p. 44-45.

Reed, B. L., and Lanphere, M. A., 1972, Generalized geologic map of the Alaska-Aleutian Range batholith showing potassium-argon ages of the plutonic rocks: U.S. Geol. Survey Misc. Field Studies Map MF-372.

___1973, Alaska-Aleutian Range batholith: Geochronology, chemistry, and relation to circum-Pacific plutonism: Geol. Soc. America Bull., v. 84, p. 2583-2610.