Surficial geologic map along the Castle Mountain fault between Houston and Hatcher Pass Road, Alaska

by

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SURFICIAL GEOLOGY OF THE HOUSTON-HATCHER PASS ROAD AREA

The surficial geology of the map area is dominated by sedimentary deposits laid down during and after the Naptowne glaciation (Karlstrom, 1964) of late Pleistocene age. During this episode, a large valley glacier flowed westward down the Matanuska Valley along the southern flank of the Talkeetna Mountains. The youngest of two documented advances has been referred to as the Elmendorf stade, which reached its maximum extent about 12,000 radiocarbon years ago (Schmoll and others, 1972; Reger and Updike, 1983). Deposits from this stade in the map area include: glacial till (Qg), lateral moraine (Qml) and kame terrace (Qk) deposits. Older episodes of glaciation have been inferred by a number of workers (e.g., Karlstrom, 1964; Reger and Updike, 1983; Reger and Updike, 1989; Schmoll and Yehle, 1986). The ridge above and north of the map area, Bald Mountain Ridge, is rounded in contrast to higher areas of the Talkeetna Mountains to the east. Therefore, within the map area older glacial deposits (Qg2) are inferred to lie above the highest Naptowne deposits. After reaching its maximum extent the valley glacier stagnated (Reger and Updike, 1983), as indicated by a crevasse-fill-ridge complex south of Houston in the map area, perched drainages along the sides of the Talkeetna Mountains, and an esker (unit Qe in the middle of the western map area). The ancient stream deposits (unit Qad) are perched on the southern flanks of the Talkeetna Mountains and were deposited by westward flowing streams as the valley glacier stagnated. These sinuous ancient drainages commonly incised up to 20 m into the underlying glacial till. Because stream flow is not as high today as when the drainages formed, the modern streams flowing within these drainages are underfit, and the ancient drainage courses are commonly filled with peat deposits (Qp).

After ice of the Elmendorf stade melted, modern stream courses were established. These include the southward flowing streams on the flank of the Talkeetna Mountains as well as the west-southwestward flowing Little Susitna River. The Little Susitna River cut down through older river terrace deposits (Qat) to form the active alluvial plain (Qaa). Alluvium from the southward flowing streams (Qas) forms alluvial fans on top of, and presumably interfingering with, active alluvium along the Little Susitna River.

FAULTING

This surficial mapping was conducted to better locate the position of the Castle Mountain fault between Houston and Hatcher Pass Road. Previous surficial mapping within the map area includes Barnes and Sokol (1959), Reger (1981a, 1981b), Reger and others (1994a, 1994b, 1994c, 1994d); Combellick and others (1994) attempted to locate the Castle Mountain fault using magnetic methods. Reger's mapping may be significantly better outside the limit of aerial photography coverage. The Castle Mountain fault is the only active fault in the greater Anchorage area with undisputed surficial expression and Holocene surface faulting. Previous studies focussed on the fault in the regions from Houston and westward (Detterman and others, 1974) and from the Hatcher Pass Road area and eastward (Detterman and others, 1976). These studies show that in the vicinity of Houston and westward the Castle Mountain fault has a clear Holocene fault scarp (Detterman and others, 1974). East of Hatcher Pass Road, the Castle Mountain fault has no unequivocal Holocene fault scarp (Detterman and others, 1976), although the only two historical earthquakes on the Castle Mountain fault occurred along this part of the fault (Lahr and others, 1986; and Alaska Earthquake Information Center event 961111). Earthquake hazards within the map area were discussed at length in Haeussler (1994), and this map shows the surficial mapping in Haeussler (1994) in much greater detail and without simplification. Moreover, this map reflects minor changes to where I thought the fault could be traced since the time of publishing the previous work, based on additional aerial photograph studies.

The Castle Mountain fault has a clearly defined scarp at the west end of the map area. Near its intersection with the Parks Highway, the fault bends by about 3 degrees, and at least one splay of the fault is noticeable here along a linear northern edge of a peat deposit (Qp) adjacent to and southwest of the railroad tracks. The fault extends eastward onto alluvium in older river terraces (Qat) of the Little Susitna River. Its trace is delineated by scarps on the north side of the Little Susitna River, and by outcrop along a stream (Barnes and Sokol, 1959), in the east central part of the western half of the map. It is also notable how a broad dogleg in the Little Susitna River follows the trace of the Castle Mountain fault, which suggests the river course has locally been influenced by the fault. The trace of the Castle Mountain fault is lost at the eastern edge of the western half of the map area, and reappears 19 km farther east in bedrock along Hatcher Pass Road, where it juxtaposes rocks of the Paleocene and Eocene Arkose Ridge Formation with Eocene age rocks of the Wishbone Formation. To the north of the expected trace of the Castle Mountain fault are two linear features that are probably faults (Haeussler, 1994). These are the Lost-in-the-woods fault (not near any named geographic feature) and the Bench Lake fault. The Bench Lake fault has a 1-km-long scarp only at its eastern end, and to the west aligned stream drainages suggest a fault is present, which would imply a 12-km-long fault. The Lost-in-the-woods fault has a 5-km long scarp up to 4-m high cut by all modern stream drainages (Qas), and it is clearly visible on aerial photographs. Both features are located below inferred Naptowne-age lateral-moraine and kame-terrace deposits. Therefore the faults have presumably been active in late Quaternary time. Reger and others (1994b) also acknowledge these features may be related to faulting, but suggests they may be related to glaciofluvial processes. Haeussler (1994) concluded the Bench Lake fault scarp was a more recent feature than the Lost-in-the-woods scarp because (1) the Lost-in-the-woods scarp is dissected by minor streams that do not change gradient as they cross the scarp, whereas the Bench Lake scarp is not dissected, (2) the Bench Lake scarp is more clearly defined and steeper than the Lost-in-the-woods scarp, and (3) the soil profile on the Bench Lake fault is dominated by peat containing plant macrofossils and thus may be more youthful than the soil profile adjacent to the Lost-in-the-woods scarp, which is dominated by humus, in which plant macrofossils have decayed. Finally, there are a number of linear swales to the south of the inferred traces of the Castle Mountain fault at the eastern end of the map area. Most of these appear to be related to bedding surfaces in the underlying bedrock, and are not indicative of fault traces.

REFERENCES CITED

Barnes, F.F., and Sokol, Daniel, 1959, Geology and coal resources of the Little Susitna district, Matanuska coal field, Alaska: U.S. Geological Survey Bulletin 1058-D, p. 121-138, 5 map sheets, scales 1:2,400, 1:4,800, and 1:63,360.

Combellick, R.A., Cruse, G.R., and Hammond, W.R., 1994, Trial magnetometer profiles across the Castle Mountain fault, southcentral Alaska: Alaska Division of Geological and Geophysical Surveys Report of Investigations 94-28, 18 p.

Detterman, R.L., Plafker, G., Hudson, T., Tysdal, R.G., and Pavoni, N., 1974, Surface geology and Holocene breaks along the Susitna segment of the Castle Mountain fault, Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-618, 1 map sheet, scale 1:24,000.

Detterman, R.L., Plafker, G., Russell, G.T., and Hudson, T., 1976a, Features along part of the Talkeetna segment of the Castle Mountain-Caribou fault system, Alaska: U.S. Geological Survey Miscellaneous Field Studies Map MF-738, 1 map sheet, scale 1:63,360.

Haeussler, P.J., 1994, Possible active fault traces on or near the Castle Mountain fault between Houston and the Hatcher Pass Road: *in* Till, Alison, and Moore, Thomas, eds., Geologic studies in Alaska by the U.S. Geological Survey, 1993: U.S. Geological Survey Bulletin 2107, p. 49-58.

Karlstrom, T.N.V., 1964, Quaternary geology of the Kenai lowland and glacial history of the Cook Inlet region, Alaska: U.S. Geological Survey Professional Paper 443, 69 p.

Lahr, J.C., Page, R.A., Stephens, C.D., and Fogleman, K.A., 1986, Sutton, Alaska, earthquake of 1984: evidence for activity on the Talkeetna segment of the Castle Mountain fault system: Bulletin of the Seismological Society of America, v. 76, p. 967-983.

Reger, R.D., 1981a, Geology and geologic-materials maps of the Anchorage C-8 SE Quadrangle, Alaska: Alaska Division of Geological and Geophysical Surveys Geologic Report 65, 2 map sheets, scale 1:25,000.

_____, 1981b, Geology and geologic-materials maps of the Anchorage C-8 SW Quadrangle, Alaska: Alaska Division of Geological and Geophysical Surveys Geologic Report 68, 2 map sheets, scale 1:25,000.

Reger, R.D., and Updike, R.G., 1983, Upper Cook Inlet region and the Matanuska Valley, p. 185-263, *in* Péwé, T.L., and Reger, R.D., eds, Guidebook to permafrost and Quaternary geology along the Richardson and Glenn Highways between Fairbanks and Anchorage, Alaska: Fourth International Conference on Permafrost, Fairbanks, July 18-22, 1983, Field Trip Guidebook 1: Alaska Department of Natural Resources, Division of Geological and Geophysical Surveys, 263 p.

_____, 1989, Upper Cook Inlet region and Matanuska valley, in Péwé, T.L., and Reger, R.D., eds., Quaternary geology and permafrost along the Richardson and Glenn Highways between Fairbanks and Anchorage, Alaska, in 28th International Geological Congress Field Trip Guidebook T102: American geophysical Union, p. 45-54.

Reger, R.D., Combellick, R.A., and Pinney, D.S., 1994a, Geologic and derivative materials maps of the Anchorage C-7 NE Quadrangle, Alaska: Alaska Division of Geological and Geophysical Surveys Report of Investigations 94-24, scale 1:25,000.

_____, 1994b, Geologic and derivative materials maps of the Anchorage C-7 NW Quadrangle, Alaska: Alaska Division of Geological and Geophysical Surveys Report of Investigations 94-25, 2 map sheets, scale 1:25,000.

_____, 1994c, Geologic and derivative materials maps of the Anchorage C-8 NE Quadrangle, Alaska: Alaska Division of Geological and Geophysical Surveys Report of Investigations 94-26, 2 map sheets, scale 1:25,000.

Reger, R.D., Pinney, D.S., and Combellick, R.A., 1994, Geologic and derivative materials maps of the Anchorage C-8 NW Quadrangle, Alaska: Alaska Division of Geological and Geophysical Surveys Report of Investigations 94-27, 2 map sheets, scale 1:25,000.

Schmoll, H.R., and Yehle, L.A., 1986, Pleistocene glaciation of the upper Cook Inlet basin, *in* Hamilton, T.D., Reed, K.M., and Thorson, R.M., eds., Glaciation in Alaska; The geologic record: Anchorage, Alaska Geological Society, p. 193-218.

Schmoll, Henry R., Szabo, B.J., Rubin, Meger, and Dobrovolny, Ernest, 1972, Radiometric dating of marine shells from the Bootlegger Cove Clay, Anchorage area, Alaska: Geological Society of America Bulletin, v. 83, p. 1107-1113.