U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Prepared in cooperation with the
ALASKA DIVISION OF GEOLOGICAL SURVEYS,
THE UNIVERSITY OF ALASKA, THE UNIVERSITY OF OREGON, AND SAN DIEGO STATE UNIVERSITY

SCIENTIFIC INVESTIGATIONS MAP 3114
SHEET 1 OF 2
Version 1.0

INTRODUCTION

This report contains field and laboratory data from a paleoseismic study of the Susitna Glacier fault, Alaska. The initial M 7.2 subevent of the November 3, 2002, M 7.9 Denali fault earthquake sequence produced a 40-km-long set of complex fault scarps, folds, and aligned landslides on the previously unknown, north-dipping Susitna Glacier thrust fault along the southern margin of the Alaska Range in central Alaska (fig. 1) (Crone and others, 2004; Haeussler and others, 2004). Most of the 2002 folds and fault scarps are 1–3 m high, implying dip-slip thrust offsets (assuming a near-surface fault dip of ~20° ±5° is 5–9 m. Locally, some of the 2002 ruptures were superimposed on preexisting scarps that have as much as 5–10 m of vertical separation and are evidence of previous surface-rupturing earthquakes on the Susitna Glacier fault (photographs 1 and 2). In 2003–2005, we focused follow-up studies on several of the large scarps at the "Wet fan" site in the central part of the 2002 rupture (figs. 2 and 3) to determine the pre-2002 history of large surface-rupturing earthquakes on the fault. We chose this site for several reasons: (1) the presence of pre-2002 thrust and reverse faults and folds that suggested that the site had been the locus of repeated surface-rupturing earthquakes; (2) the presence of a stratigraphy of peat, tephra layers and volcanic ash beds useful for chronological control; and (3) a lack of permafrost to a depth of more than 1 m. Our studies included detailed mapping, fault-scarp profiling, and logging of three hand-excavated trenches. We were forced to restrict our excavations to 1- to 2-m-high splay faults and folds (photograph 1) because the primary 2002 ruptures mostly were superimposed on such large scarps that it was impossible to hand dig through the hanging wall to expose the fault plane. Additional complications are the pervasive effects of cryogenic processes (mainly solifluction) that can mask or mimic tectonic deformation (photographs 4–6).

The purpose of this report is to present photomosaics, trench logs, scarp profiles (fig. 4), and fault slip (table 1), radiocarbon (table 2), tephrochronologic (table 3), and soil description (table 4) data obtained during this investigation. We do not attempt to use the data presented herein to construct a paleoseismic history of the Susitna Glacier fault; that history will be the subject of a future report. When completed, our results will be used to compare the Susitna Glacier fault paleoseismic record with results of similar studies on the nearby Denali fault to determine if the simultaneous ruptures of these two faults during the 2002 Denali fault earthquake sequence is typical or atypical of their long-term interaction.

CHRONOLOGICAL DATA

We obtained 14 radiocarbon ages on peat deposits in the trenches (table 2). Our radiocarbon results were mixed, with some sample sequences yielding multiple ages in stratigraphic order (WF01-07 to through WF01-07d), whereas other sequences (WF01-08, WF01-09) yielded stratigraphic reversals. We suspect that most of these reversals are caused by inclusion of unrecognized younger organics (primarily decayed roots) in our submitted samples.

We obtained tephrochronologic data from 3 tephras in the trenches and from 1 tephra in a hand-excavated pit (table 3). Chemical fingerprinting of these tephras (table 3) (J.E. Begét, written commun., 2006) indicates that the most ubiquitous deposit is the Jarvis Creek ash, dated near its source at ~3,650±150 yr B.P. (Riehle and others, 1990) and in more distal locations at ~3,660±125 yr B.P. (Begét and others, 1991). An older ash sampled in trench WF-02 chemically correlates with the Oshetna tephra (table 3), dated elsewhere at ~6,000±150 yr B.P. (Child and others, 1998). Our own radiocarbon dating of peat samples from above and directly below the Jarvis Creek ash yielded ages consistent with but somewhat younger than the published ages (table 2). Taken together, our dating results indicate the peat and silt sediments (units 3, 4, and 5) in the trenches were deposited ~7–8 ka.

SCARP PROFILE DATA

We measured six topographic profiles across the 2002 fault scarps at the Wet fan site (fig. 2) using a collapsible, 1.5- to 4-m-long slada rod and hand-held digital carpenters level. Profiles were measured approximately perpendicular to the strike of the fault scarp by laying the slada rod on the ground, adjusting the rod length, and measuring the slope of the rod with the digital level. The topographic profiles were generated in and scarp parameters were calculated from a computer spreadsheet analysis of the raw topographic data. We used along-strike variations in scarp size and morphology to interpret the 2002 portion of the total scarp offset (photographs 1 and 2; fig. 4). The net (pre-2002) offsets are the differences between these two measurements (fig. 4, table 1).

ACKNOWLEDGMENTS

This research was supported by a Cooperative Research and Development Agreement (CRADA) between the U.S. Geological Survey, Alyeska Pipeline Service Company, and Pacific Gas and Electric Company. The Wet fan trench site is located on land administered by U.S. Bureau of Land Management (BLM). The authors wish to thank the Glennallen District Office for assistance in conducting this research on BLM lands. The report was improved by comments from reviewers Paul Carman and David Lidke.

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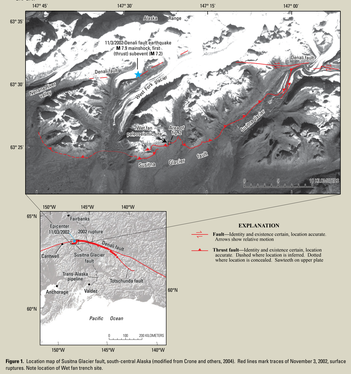
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Hess Creek
Tanana
Nenana
Healy
Denali Fault
Denali
Cantwell
Paxson
Gulkana
Glennallen
Copper River
Valdez
Anchorage
Seward
Homer
Kenai
Kodiak
Cordova
Yakutat
Sitka
Ketchikan
Juneau
Prince Rupert
Dawson Creek
Fort St. John
Edmonton
Calgary
Lethbridge
Great Falls
Billings
Rapid City
Denver
Albuquerque
Amarillo
Lubbock
Dallas
Austin
Houston
Tallahassee
Atlanta
Charleston
Raleigh
Washington
Philadelphia
New York
Boston
Montreal
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