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Hilina fault system, 'Ainahou section (Class A) No. 2610k

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Synopsis	**General:** The first person to map the faults on the south flank of Kilauea Volcano remains unknown, but Wood (1914 #6979) noted that subsidence occurred on the oceanward side of these structures related to the 1868 Great Ka'u earthquake, an estimated M8 earthquake (Wyss, 1988 #6980). Tilling and others (fig. 16, 1976 #6974) summarize faulting on the Hilina fault system associated with the November 29, 1975, M7.2 Kalapana earthquake. Lipman and others (1985 #6952) provide a comprehensive report of the 1975 Kalapana earthquake. Refer to the description of the November 29, 1975, Kalapana earthquake in this compilation for more details. Kellogg and Chadwick (1987 #6948) record 1975 Kalapana earthquake fault offsets preserved in the Mauna Ulu pahoehoe lava flows (1969-1974) for the central Hilina fault system. Riley and others (1999 #6972) estimate the depth of the Hilina fault system and recurrence interval for the

1975 Kalapana earthquake using paleomagnetic measurements of south flank lava flows. Expanding on the work of Kellogg and Chadwick (1987 #6948), Cannon and Burgmann (2001 #6934) and Cannon and others (2001 #6935) present detailed fracture maps of central Hilina faults, estimate prehistoric fault offset rates and recurrence intervals for large (M>6) prehistoric south flank earthquakes, and provide evidence for a shallow rather than a deep-seated interpretation for some of the Hilina faults. Faulting along the Hilina fault system is related to large (M>6) earthquakes on the southern flank of Kilauea Volcano. Delaney and others (1998 #6939) conclude that the small strains observed across the southern flank in the past several decades suggest that the Hilina faults remained inactive except for during the 1975 Kalapana earthquake. The landslide and tsunami potential of the Hilina fault system remains a great concern. Ma and others (1999 #6984) estimate that the tsunami created by the 1975 Kalapana earthquake displaced approximately 2.5 cubic kilometers of water. Along the coast and offshore of Kilauea's south flank to the southeast, the Hilina fault system may represent the landslide headscarps to the submarine Hilina slump and Papa'u sand-rubble flow. Slumps and seafloor structures offshore of the Hilina fault system are interpreted as landslide blocks and debris (see Moore and others, 1989 #6961, 1995 #6958; Moore and Chadwick, 1995 #6959; Morgan and others, 2000 #6964, 2003 #6965). Significant coastal and submarine mass movements may have occurred within the past 100 ka. Geologic evidence demonstrates the existence of Quaternary deformation, but the fault system is associated with volcanic features that might not extend deeply enough to be a potential source of significant earthquakes.

Sections: This fault has 15 sections. The Hilina fault system is an approximately 50-km-long, 5-km-wide zone of primarily normal faults that extend east across the southeastern flank of Kilauea Volcano. For this long fault system, we identify 15 fault sections based on fault-scarp morphology reflected on 7.5-minute topographic maps, continuity of expression, and evidence of apparent recent movement from cross-cutting relations of faults, fractures, and lava flows. The large number of sections for this fault system in particular is largely the result of young movement, high rates of movement, associations with large historic earthquakes, and focused study by researchers. The 15 sections are Pu'u Mo'o [2610a], Kukalau'ula Pali [2610b], Hilina Pali [2610c], Keana Bihopa [2610d], Pu'u Ka'one [2610e], Pu'u Kapukapu [2610f], Makahanu Pali [2610g], Pu'u'eo Pali [2610h],

	Kipukapapalinamoku 2610i], Poliokeawe Pali [2610j], 'Ainahou [2610k], Holei Pali [2610l], 'Apua Pali [2610m], Paliuli [2610n], and Pulama pali [2610o].
Name comments	**General:** The Hilina fault system consists of a set of roughly east-trending normal fault structures with moderate dips to the south and southeast. The term pali, used in several of the section names, is the Hawaiian work for "cliff" or "scarp." For example, the name Hilina Pali represents the geomorphic scarp of the Hilina fault. Another term used, pu'u is the Hawaiian work for "hill." **Section:** Informally named based on 'Ainahou Ranch located approximately 3.5 km northwest of the fault section. The 'Ainahou section is a normal-fault splay off of the adjacent Poliokeawe Pali section [2610j] and is located along the central portion of the Hilina fault system.
County(s) and State(s)	HAWAII COUNTY, HAWAII
Physiographic province(s)	HAWAIIAN-EMPEROR ISLAND-SEAMOUNT CHAIN
Reliability of location	Poor Compiled at 1:100,000 scale. *Comments:* The fault trace is shown on the 1:100,000-scale geologic map as concealed (Wolfe and Morris, 1996 #6977), and the geomorphic fault scarp is recognizable on the 1:24,000-scale Makaopuhi Crater topographic map.
Geologic setting	The Hilina fault system is a normal fault system in the southern flank of Kilauea Volcano, Hawai'i. The present southern flank is being displaced to the southeast along a basal detachment by high-level rift zone intrusions and deep-seated gravitational spreading of the island. Between 1990 and 1996, south flank horizontal velocity rates determined from global positioning system (GPS) surveys indicate as much as 10 cm/yr of lateral motion (Owen and others, 1995 #6968, 2000 #6969). This slightly northwest-dipping basal detachment at approximately 8-10 km depth represents the boundary between ocean lithosphere and the volcanic edifice. Pelagic sediment deposited on the seafloor prior to the formation of the volcanic edifice could be lubricating the basal detachment and promoting southeastward motion of the south flank. A comprehensive analysis of geodetic data for the

	1975 Kalapana earthquake (Owen and Burgmann, 2006 #6985) indicates that measured ground deformation on the south flank is best explained by a combination of faulting of the basal detachment, opening of the east rift zone [2608b] and southwest rift zone [2608c], a summit eruption and collapse of the summit magma chamber, and faulting on the Hilina fault system. Sections of the Hilina fault system may vary in depth from shallow, arcuate normal faults to steeply dipping normal fault splays off the deep, basal detachment. Cannon and others (2001 #6935) conclude that Holei Pali [2610l] and 'Apua Pali [2610m] have fault dips of about 20? at the surface and may flatten downward, reaching a 1-2 km depth at the coast and possibly intersecting the base of a 2- to 3-km-thick hyaloclastic layer offshore (Morgan and others, 2000 #6964). Riley and others (1999 #6972) interpret Hilina Pali [2610c] to be a cylindrical (curved) fault that extends to a depth of 5 km. The Hilina fault system may also be a network of steeply-dipping normal fault splays off the 8- to 10-km-deep basal detachment (Lipman and others, 1985 #6952), with microseismicity possibly being localized at the intersection (Okubo and others, 1997 #6982).
Length (km)	This section is 2 km of a total fault length of 50 km.
Average strike	N. 85° E. (for section) versus N. 69° E. (for whole fault)
Sense of movement	Normal *Comments:* From Wolfe and Morris (1996 #6977).
Dip Direction	S *Comments:* From Wolfe and Morris (1996 #6977).
Paleoseismology studies	
Geomorphic expression	The largest scarp reported is approximately 40 m high with a maximum scarp slope of about 13?.
Age of faulted surficial deposits	Faults cut surface lava flows that range in age from the Mauna Ulu lava flows (1969-1971) to 1,500-3,000 yr B.P. (Wolfe and Morris, 1996 #6977). See Holcomb (1987 #6944) for details on ages of individual lava flows.

Historic earthquake	Kalapana earthquake M7.2 1975 Ka'u earthquake 1868 Kaimu earthquake 1823
Most recent prehistoric deformation	latest Quaternary (<15 ka) *Comments:* Not reported but assumed late Holocene based on the ages of lava flows cut by the fault. Tilling and others (1976 #6974) do not report faulting resulting from the 1975 Kalapana earthquake.
Recurrence interval	
Slip-rate category	Between 1.0 and 5.0 mm/yr *Comments:* Slip rate not reported. The assigned slip-rate category of 1-5 mm/yr is based on faults cutting late Holocene lava flows and on a large scarp height similar in scale to 'Apua Pali [2610m].
Date and Compiler(s)	2006 Eric C. Cannon, none Roland Burgmann, University of California at Berkeley
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