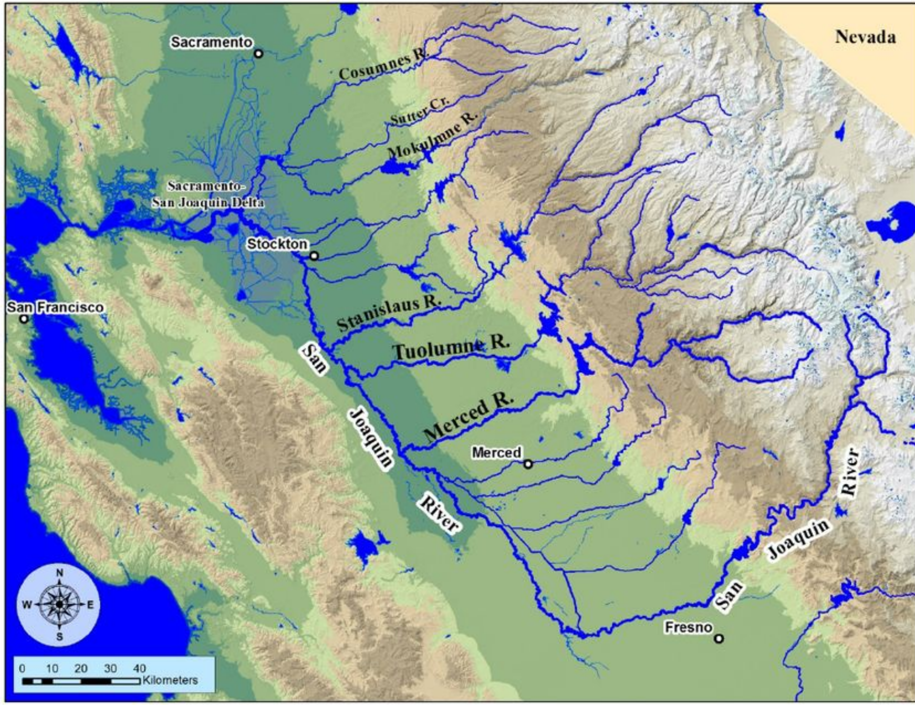
Amount and Timing of Late Cenozoic Uplift and Tilt of the Central Sierra Nevada, California - Evidence From the Upper San Joaquin River Basin

By: N. King Huber

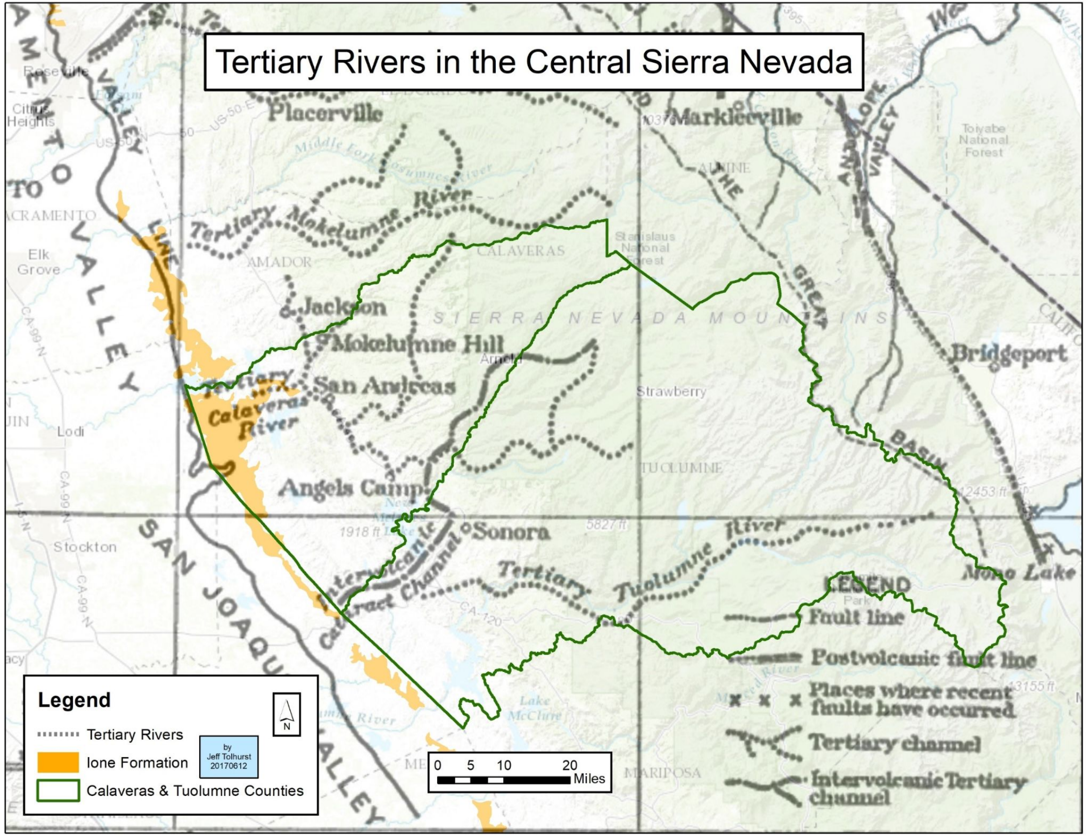


. During deposition of the Eocent Ione Formation in the Central Valley, ~50 m.y.a., the San Joaquin River drained a significant area to the east of the range.

. Relief in the area was low because major peaks on either side of the S.J. canyon presently rise only 450-750 m above the projected Eocene base.

. Late Cenozoic (~33.9 m.y.a) uplift and westward tilting of the Sierra Nevada.

. In the Eocene (~30-50 my) rivers flowed from interior of Nevada westward across what is now the Sierra Nevada.



The Ione Formation occurs as a **200-mile-long series of isolated exposures along the western foothills of the Sierra Nevada, California**, between Oroville in Butte County southward to Friant in Fresno County. It is comprised of fluvial, estuarine, and shallow marine deposits of Eocene age.

. Principle observation made by Huber and others – the Sierra Nevada gradually increases in elevation from west to east and abruptly truncated at Sierran Crest – reflected in topography and stream channels – bringing forth idea that Sierra is a rotated 'block'

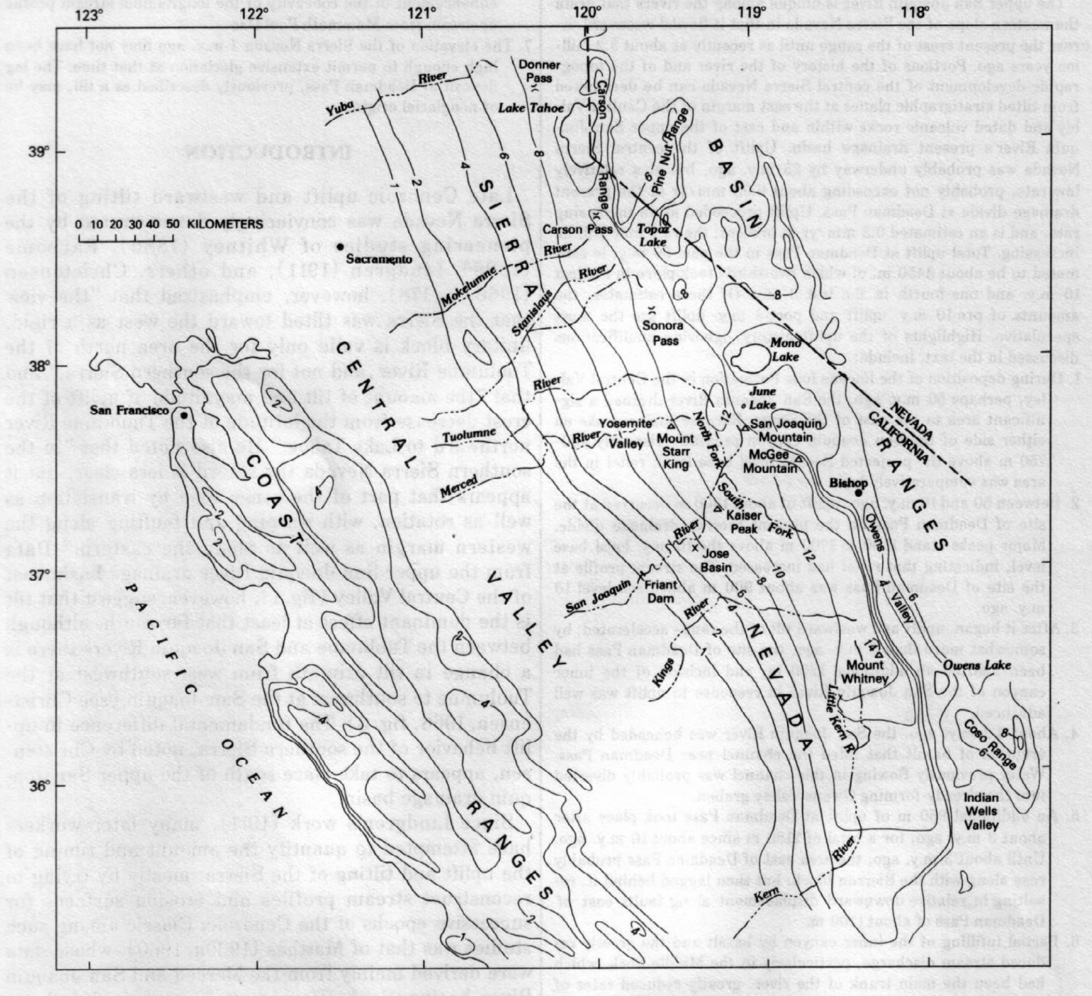


FIGURE 1.— Generalized topographic contour map of central California. Contour interval 2000 ft (610 m); 1000-ft (305 m) contour is supplementary. From Christensen (1966). "Upper" San Joaquin River is that part east of Central Valley.

. Between 50-10 m.y.a. Uplift of about 1200 m occurred at the site of Deadman Pass on the present Sierra drainage divide.

. Major peaks stand 1500-1700 m above the 10-m.y. local base level, indicating the relief had increased.

. The stream profile at the site of Deadman Pass was about 900 m (2950 ft.) above sea level 10 m.y.a.

. Deadman Pass now peaks at 10,265 ft.

I have no idea who this man is, but Deadman Pass is pretty high!

. ~3.2 m.y.a the San Joaquin river was beheaded by the eruption of basalt that filled the channel near deadman pass.

. This water was probably diverted into the already forming Owens Valley.

. Huber mapped extent of an ~10 my old trachyandesite flow that sits above the Eocene gravels to place limit on uplift of range during last 10. m.y

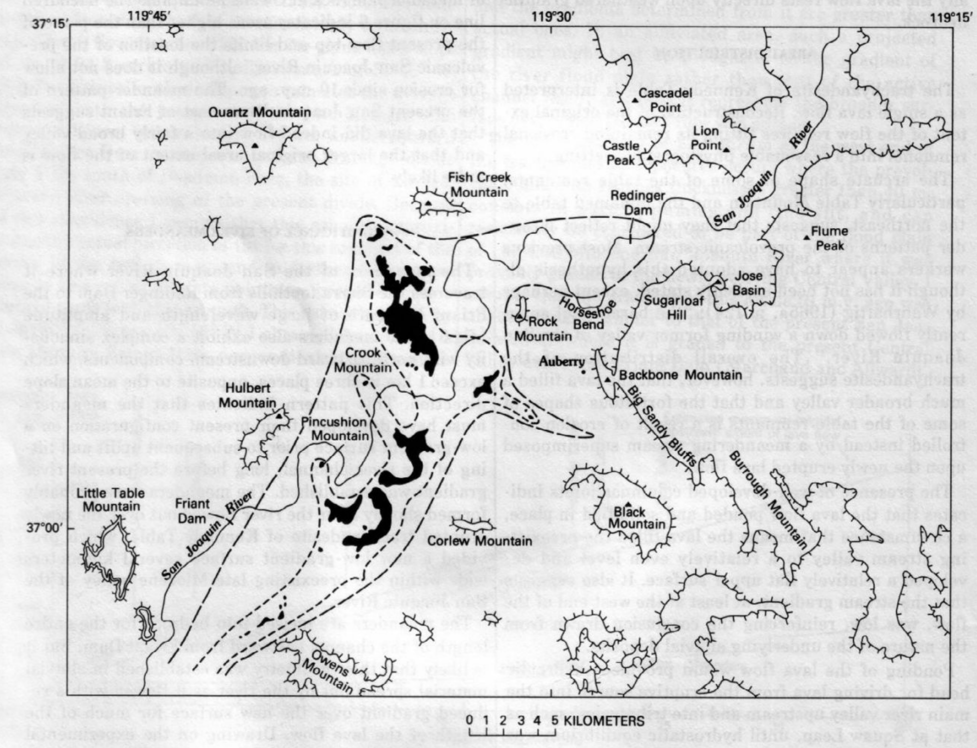


FIGURE 6.—Postulated original extent of trachyandesite of Kennedy Table. Dark areas show present outcrop; short-dash line indicates minimum extent; long-dash line probable extent. Hachured line indicates areas presently above plane defined by top of trachyandesite. Hachured double line indicates cuestas of Ione Formation, the east edges of which are above that plane. Millerton Lake and other reservoirs omitted to emphasize pre-reservoir meander pattern of San Joaquin River.

Kennedy table Trachyandesite eruptive source is unknown, but likely covered ~95 km^2 and was ~60m deep.

- Meanders were formed after flowing over Kenedy Table Trachyandesite.

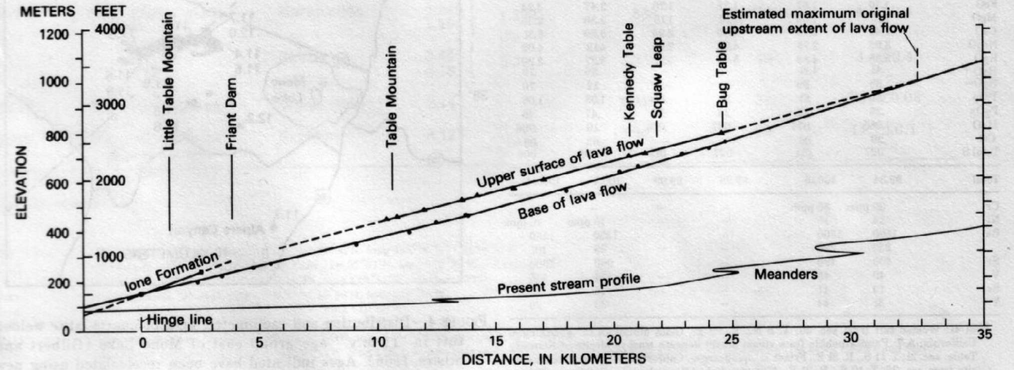


FIGURE 5.—Reconstruction of upper and lower surfaces of trachyandesite of Kennedy Table. Also shown is projection of conglomerate horizon in Ione Formation and present-day profile of San Joaquin River. All data are projected onto a vertical plane striking N. 40° E. Vertical exaggeration about 10 ×.

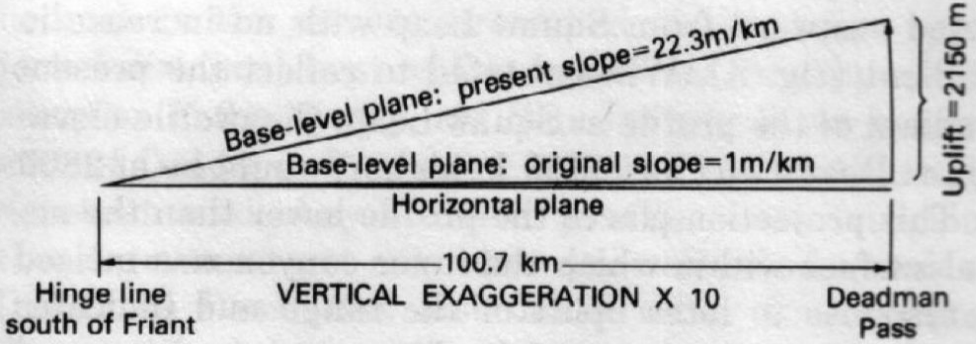


FIGURE 7.—Uplift of Sierran drainage divide at Deadman Pass calculated by rotation of late Miocene base-level plane, assuming tilting as a rigid block.

. By comparing tilt of trachyandesite to present stream grade Huber estimates about 2150 m of uplift during the last 10 m.y.

. This accounts for all but about 900 m of current elevation of Sierran Crest

. So some uplift prior to 10 m.y but most after.

. An additional 950 m of uplift at Deadman Pass took place after about 3 m.y.a. For a total of 2150 m since about 10 m.y.a.

. Until about 3 m.y.a. The area east of Deadman Pass probably rose along with the Sierran block, but then lagged behind it, resulting in relative downward displacement along faults east of Deadman Pass of about 1100 m.

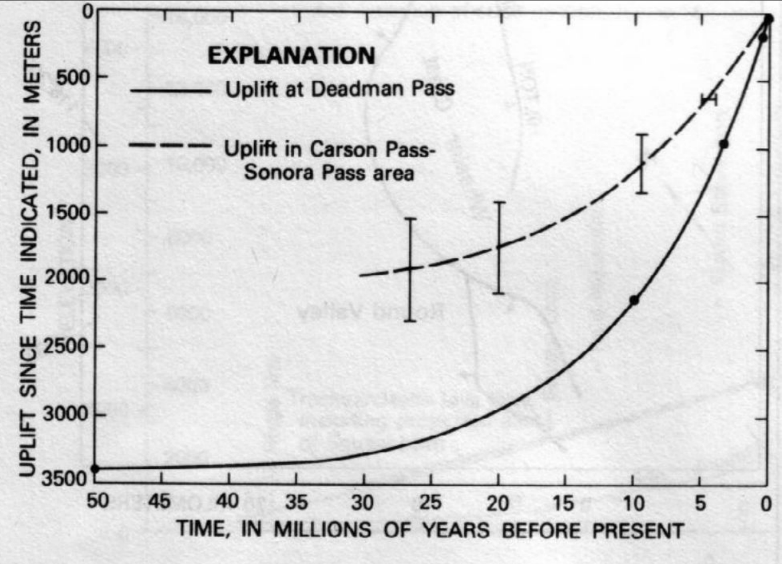


FIGURE 10.—Uplift of crest of central Sierra Nevada at Deadman Pass and in Carson Pass-Sonora Pass area. Data for Carson Pass-Sonora Pass area were presented as a range in uplift or time (Slemmons and other, 1979); dashed line represents an arbitrary average.

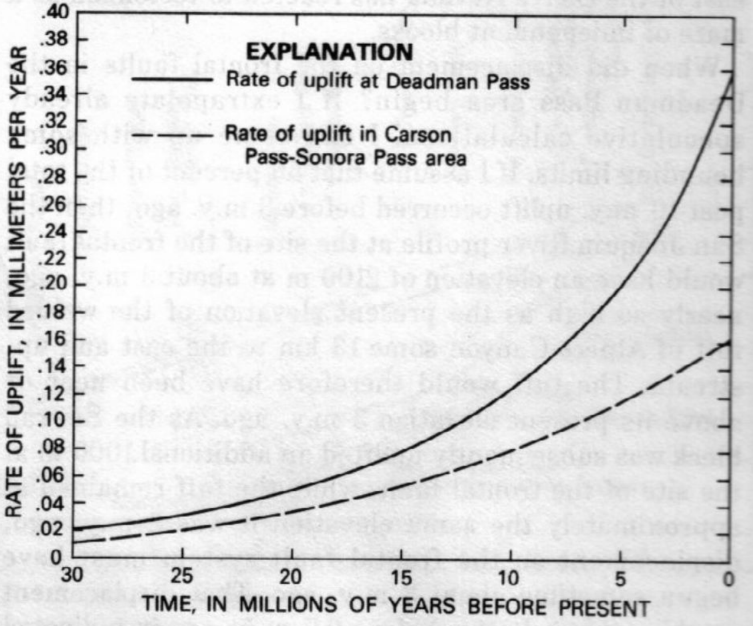


FIGURE 11.—Rate of uplift of crest of central Sierra Nevada at Deadman Pass and in Carson Pass-Sonora Pass area. Curves based on graphic differentiation of uplift curves in figure 10.

. Partial infilling of the inner canyon by basalt and the greatly reduced stream discharge, specifically in the middle fork greatly reduced canyon downcutting by stream erosion in the last ~3 m.y.

. By further looking at the locations of younger basalts in the canyons Huber makes estimates of the amount of uplift (incision) during 10 my. He assesses that about ½ of the uplift has occurred during the last 3.6 m.y. – thus the rate has increased.

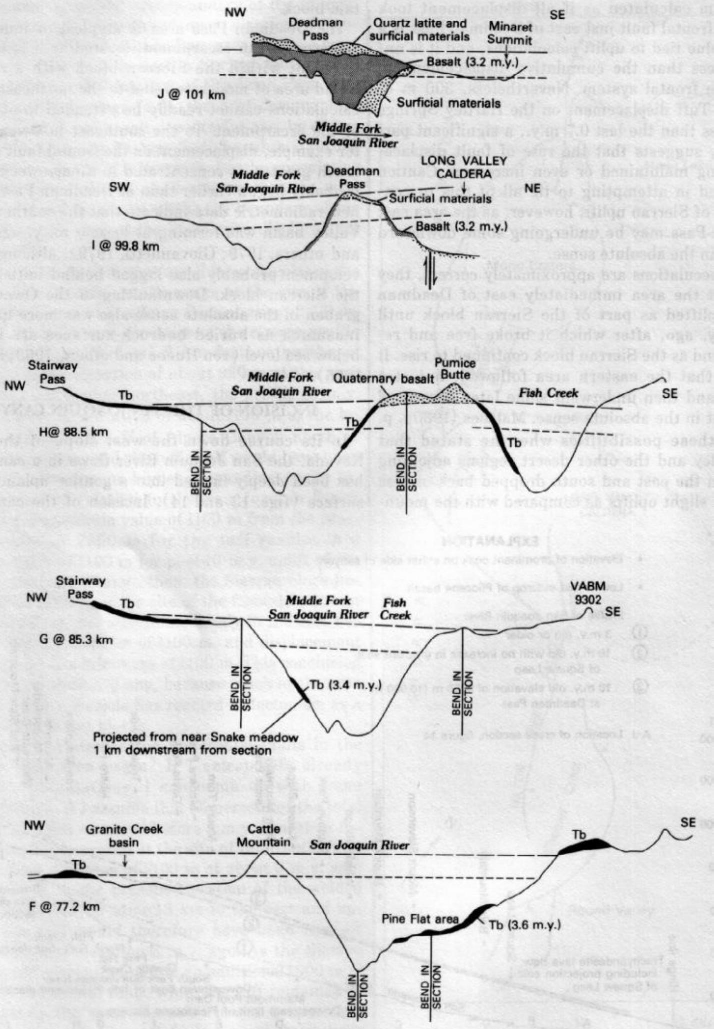


FIGURE 14.—See description on opposite page.

. Glacial erosion was the dominant mechanism for basalt removal, and additional incision into the pre volcanic rock.

. Sierra elevation 3 m.y.a. Might not have been high enough to permit excessive glaciation.

. The lag deposit at Deadman Pass may not be of glacial origin.

. Huber further notes that faults bounding east flank of Sierra Nevada displace 3.2 m.y. basalts and younger rocks down to the east – leading to speculation that rocks east of the Sierra Range crust were tilting in unison with rocks to the west until this time – i.e. Topography of Sierran Range Crest may have started as recently as a few million years ago or earlier.

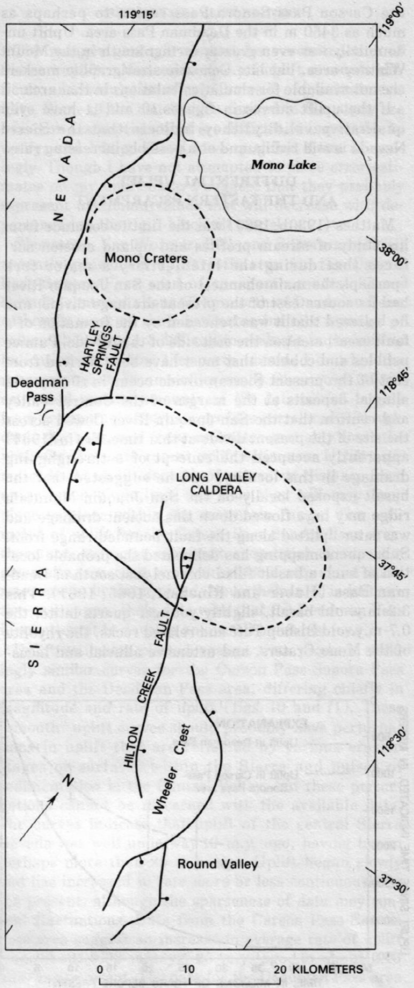


FIGURE 12.— Major faults east of Deadman Pass in Long Valley-Mono basin area. Bar and ball on downthrown side of fault. Dotted lines represent extent of Mono Craters ring structure and Long Valley caldera. After Bailey and others (1976).