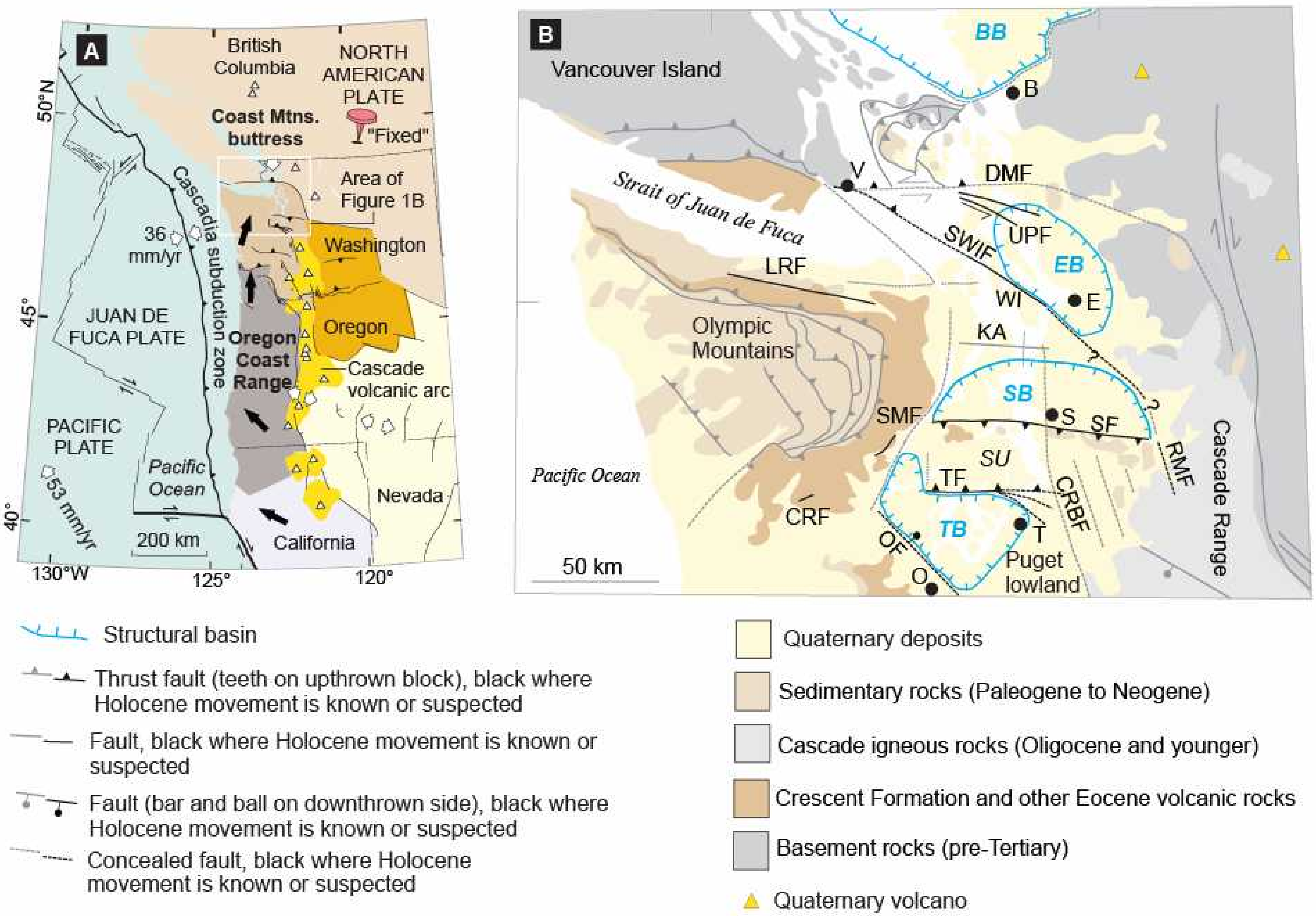

Figure 4. A.) Tectonic setting of Cascadia subduction zone. Western Washington region (brown), between fixed North America and Oregon Coast Range, is undergoing transpression. This transpression creates folds and reverse faults across Puget Sound. Bold arrows indicate motions of tectonic blocks inferred from geologic and geodetic data. Modified from Wang and others (2003) and Wells and others (1998). Box shows area of B.

B.) Schematic geologic map of northwestern Washington showing the Puget Lowland and flanking Cascade Mountains, Coast Range, and Olympic Mountains. Abbreviations for cities are as follows: B, Bellingham; O, Olympia; S, Seattle; T, Tacoma; V, Victoria. Abbreviations for faults (heavy lines) and other geologic features are as follows: BB, Bellingham Basin; CRBF, Coast Range Border fault; CRF, Canyon River fault; DAF, Darrington fault; DMF, Devils Mountain fault: E, Everett; EB, Everett Basin; KA, Kingston arch; LRF, Little River fault; OF, Olympia fault; RMF, Rattlesnake Mountain fault; SB, Seattle basin; SF, Seattle fault; SMF, Saddle Mountain faults; SU, Seattle uplift; SWIF, southern Whidbey Island fault; TB, Tacoma basin; TF, Tacoma fault; UPF, Utsalady Point and Strawberry Point faults. Geology from Walsh and others (1987), Dragovich and others, 2002, and Johnson and others 2004.

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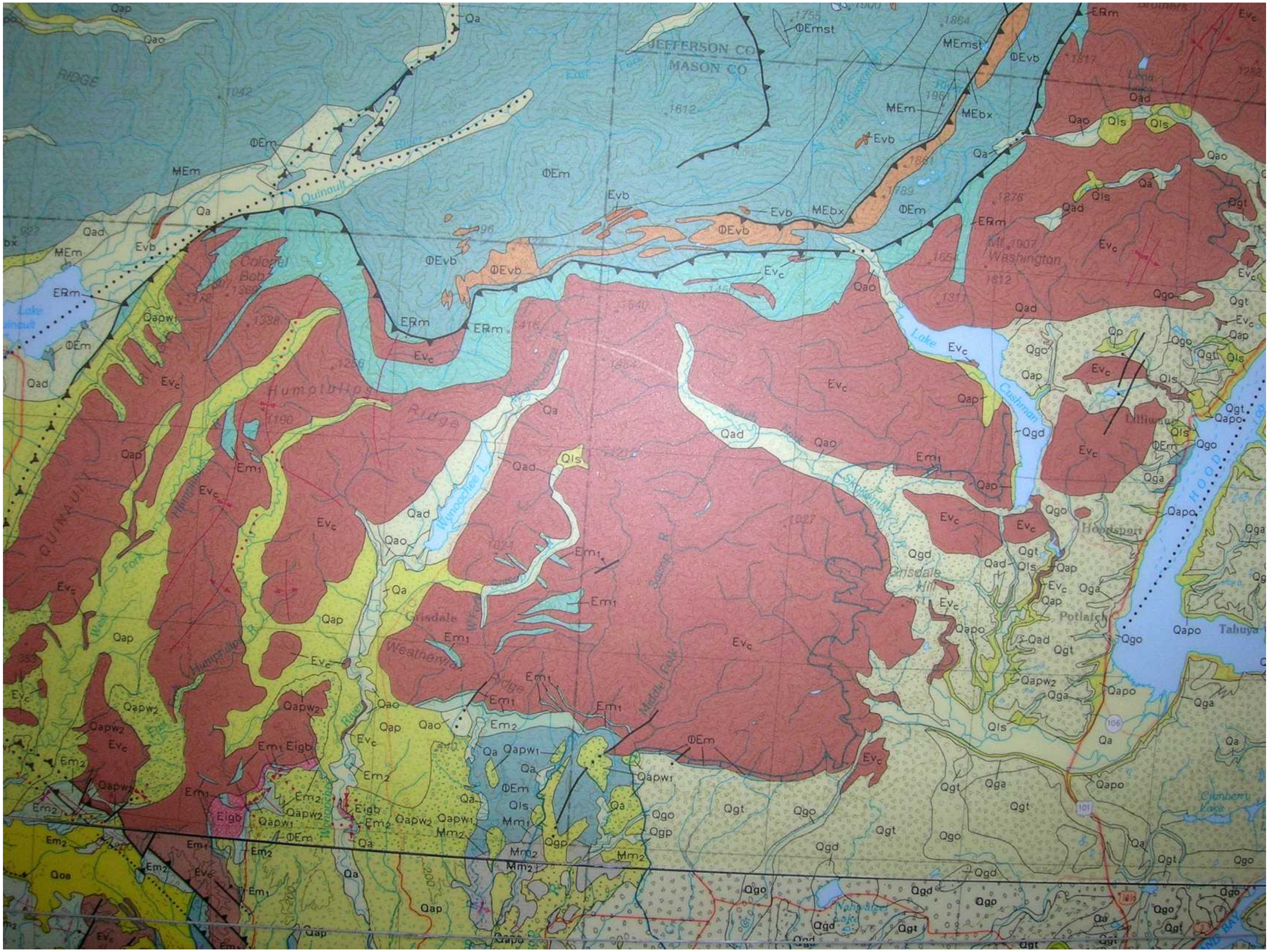

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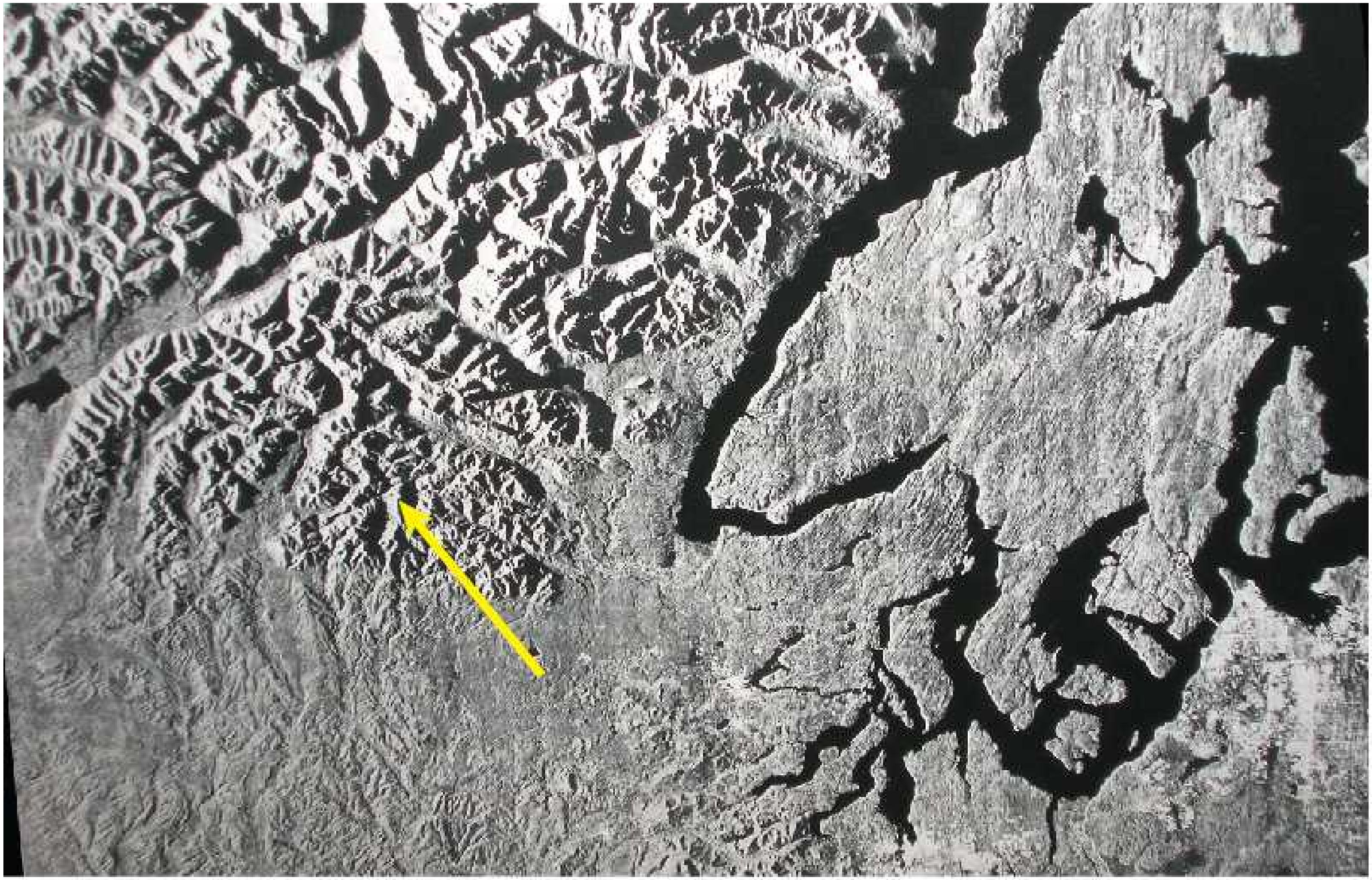

Figure 3. Side-Looking Airborne Radar (SLAR) image of the southeastern Olympics and adjacent Puget Lowland showing the lineament along which the Canyon River fault lies.

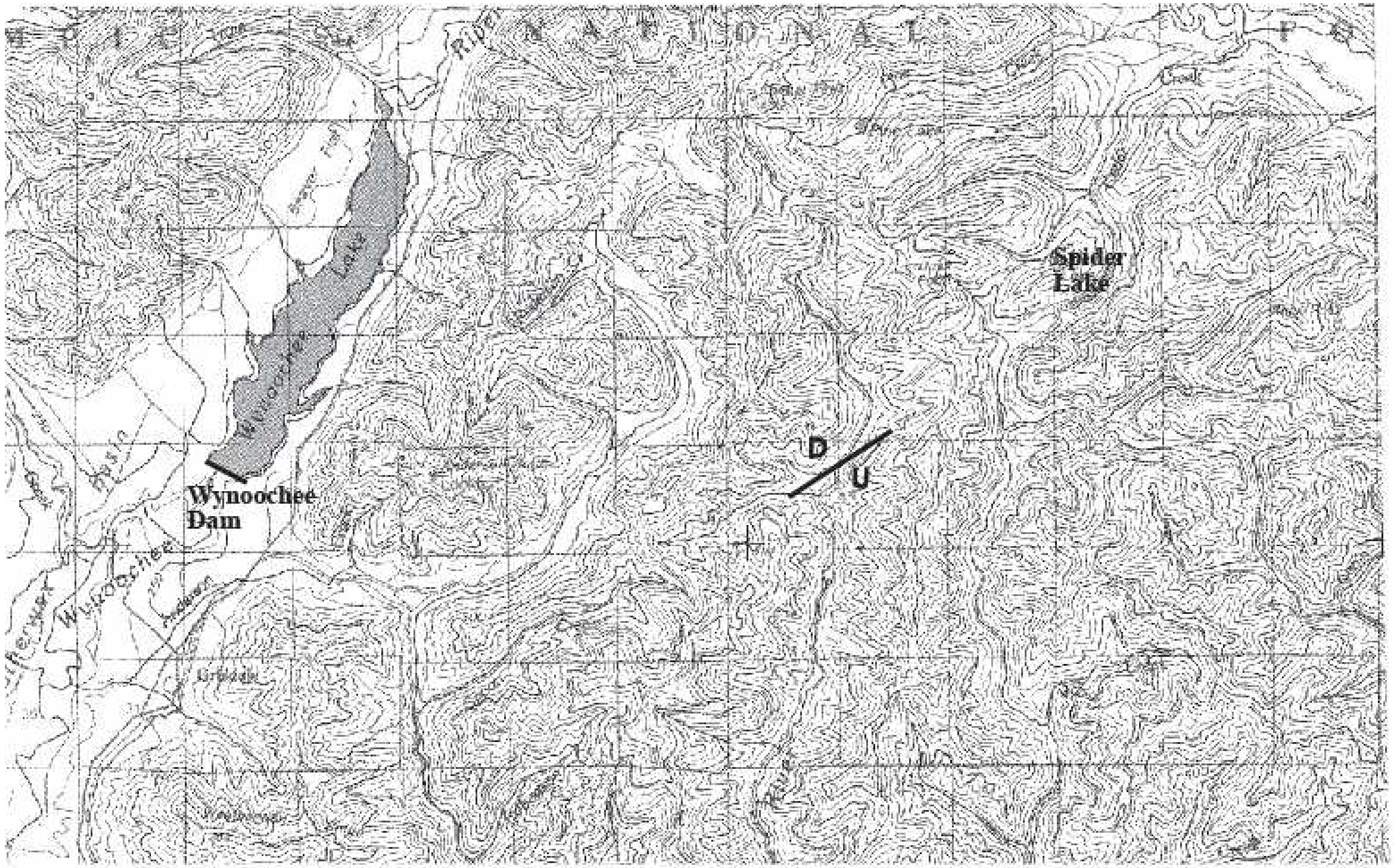

Figure 1. Location and known extent of the N60E-trending fault scarp. Note that Wynoochee dam, which impounds the water supply for the city of Aberdeen and is upstream of a number of homesites and of State Route 12, is located less than 10 km from the scarp. Spider Lake, a suspected seismically-induced landslide-dammed lake (Schuster and others, 1992), is about 3 km away. Contour interval is 50 m.

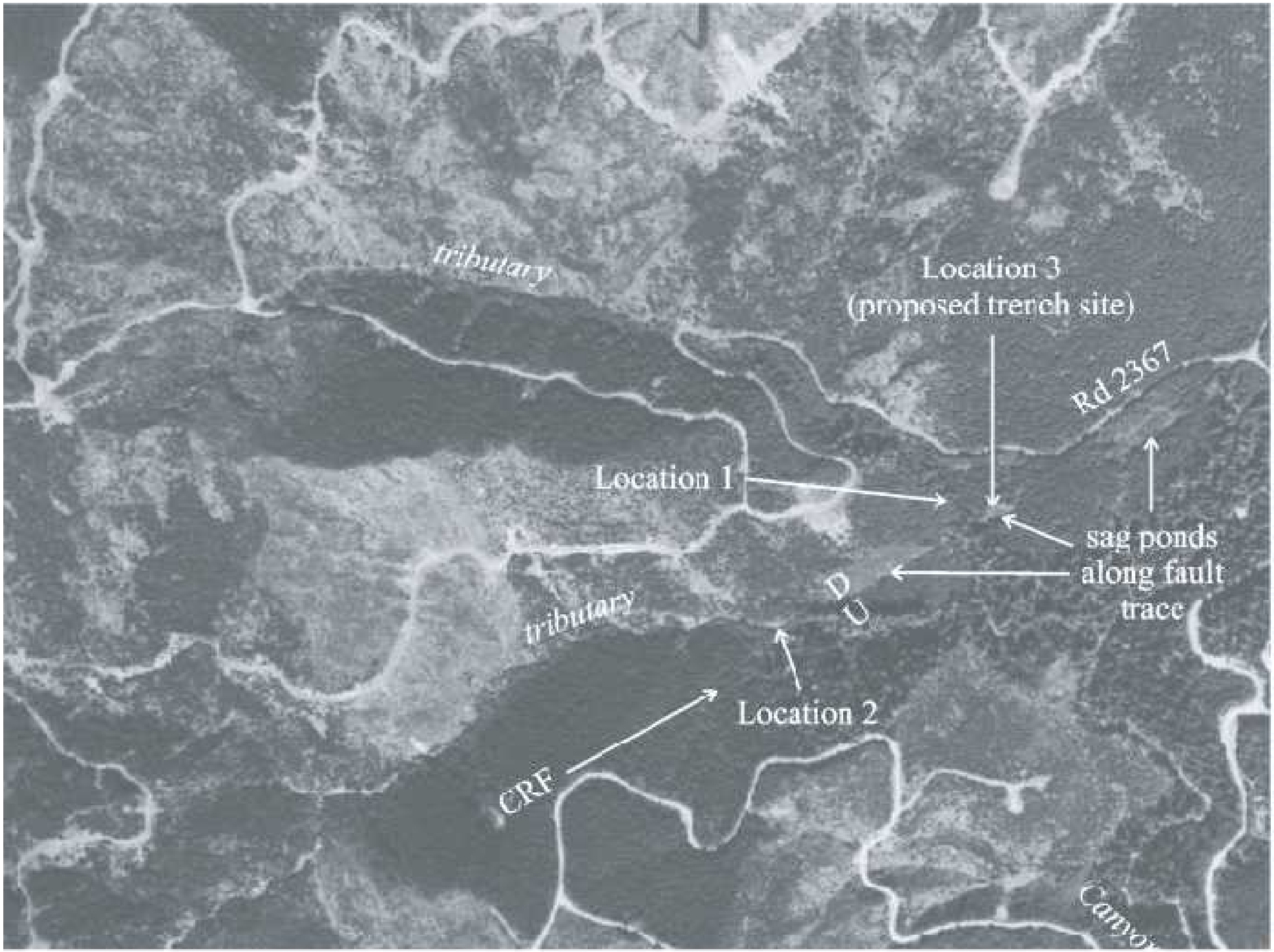

Figure 2. Air photo of the locality of the Canyon River fault, showing location of sag ponds and the trench site, location 3, which is also the location of Figures 4 and 5.

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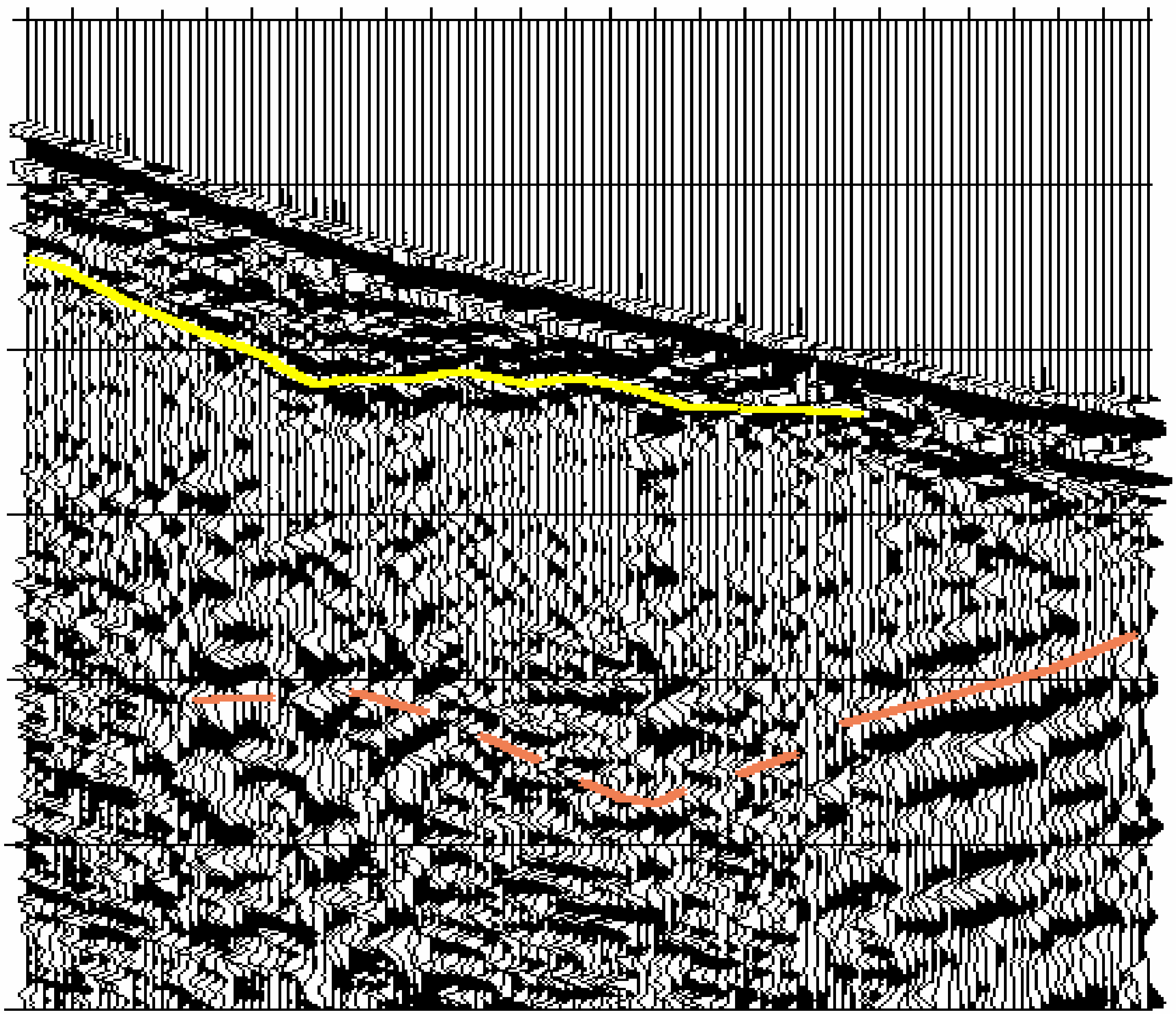
- Interpretation of GPR profile TR-1 across the Canyon River Fault. Orange reflector is interpreted as bedrock on the down-thrown side of the fault. Depth to bedrock at the base of the scarp is estimated to be approximately 3 to 4 m (10 to 13.5 ft). Yellow reflector is interpreted as a fan resulting from debris flows originating on the steep slope bounding the north side of the sag pond.



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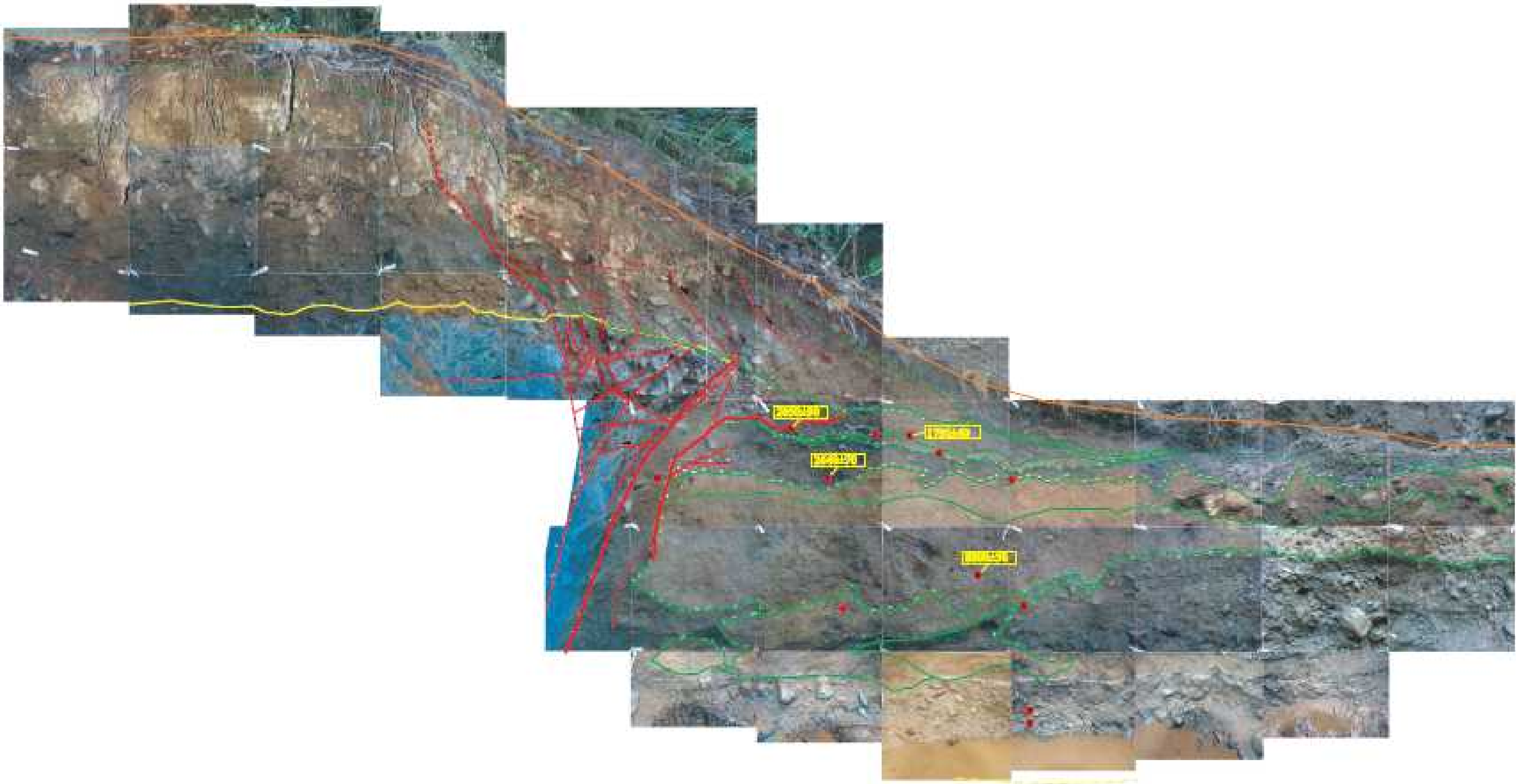

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The net vertical separation of about 3.35 meters, measured both on the top of the Crescent Formation and on the modern ground surface, and the presence of only one colluvial wedge (unit 5) suggests a single event. The contacts between units 4 a, b, and c appear to be fault contacts near the fault scarp but they grade into a single unit away from the scarp. Their aggregate thickness near the scarp is about 1 meter, but at a horizontal distance of 3 meters from the scarp they thin to about 35 cm. Also, because there is no colluvium deposited between them but there is a thick colluvial wedge above them, we interpret slip along those contacts to be thrusting (drag) out of the plane of the trench wall (from west to east) synchronous with the slip on the primary fault plane.

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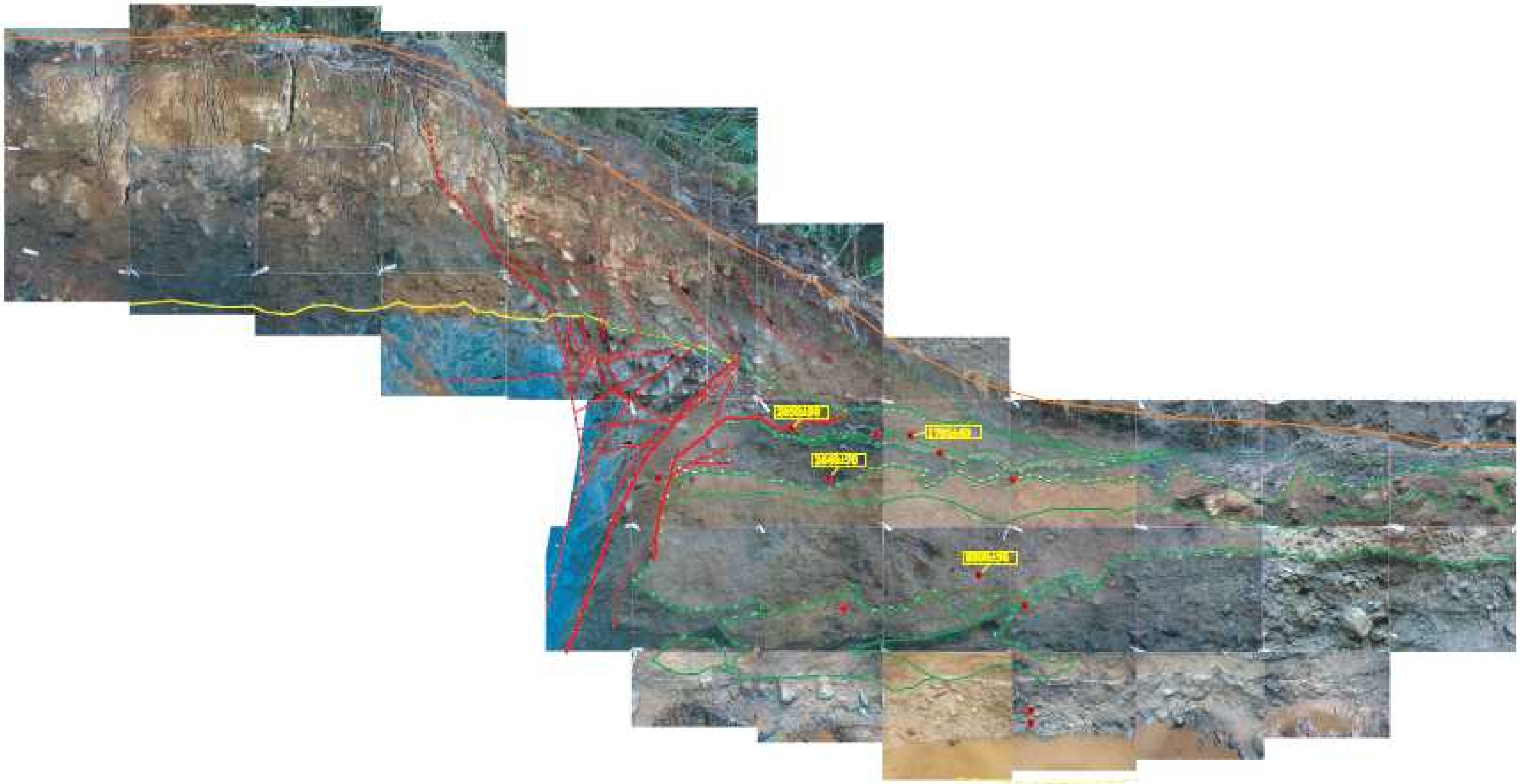

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Conventional radiocarbon ages of detrital charcoal underlying the colluvial wedge are 2620±70, 2050±90, and 1790±40 yr B.P. About 300m to the southwest, a conventional age of 1880±70 yr B.P. was obtained from charcoal in silt draped over remnant boulder gravel in a channel that was abandoned after the main channel was diverted by the fault scarp

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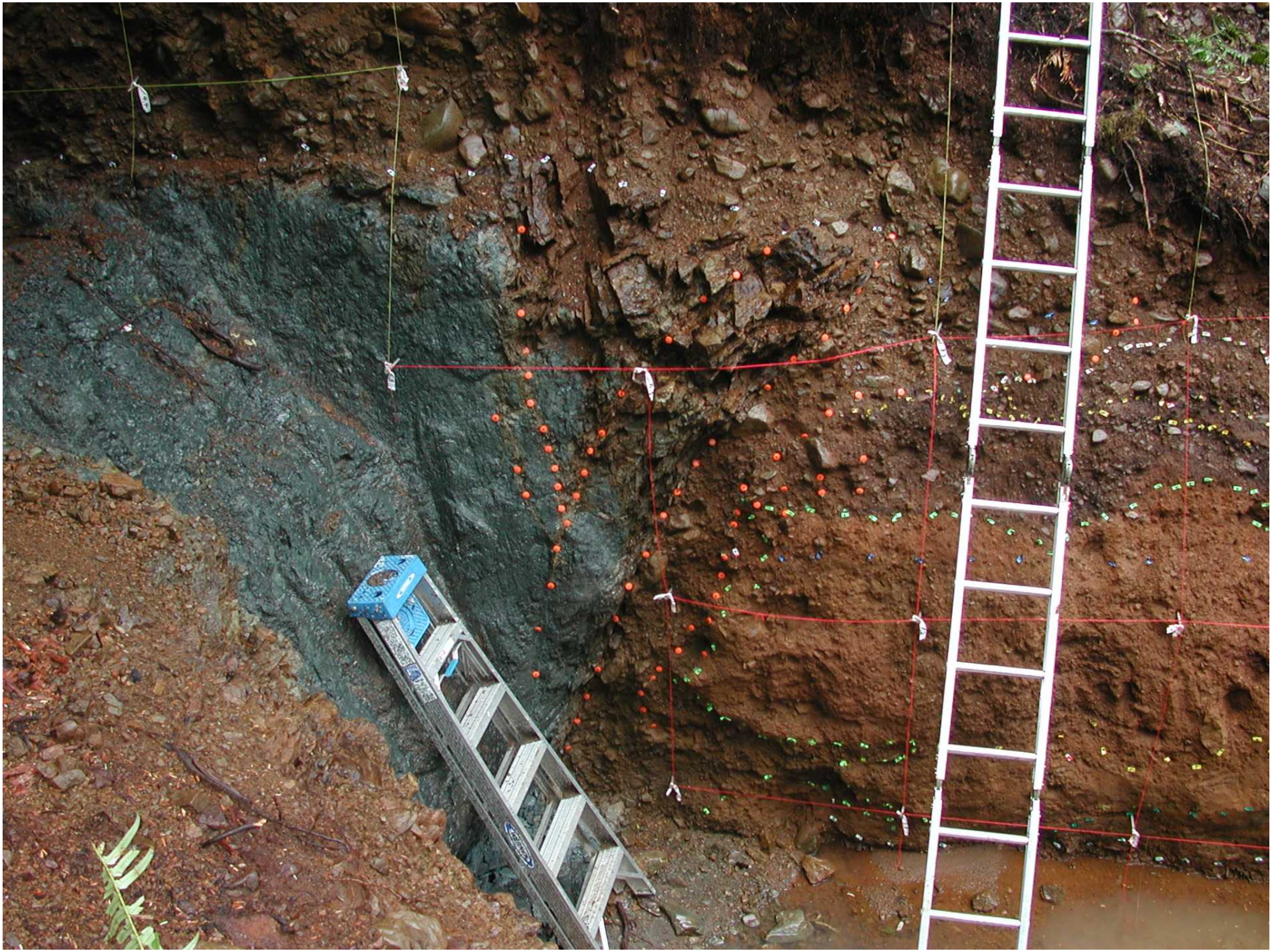

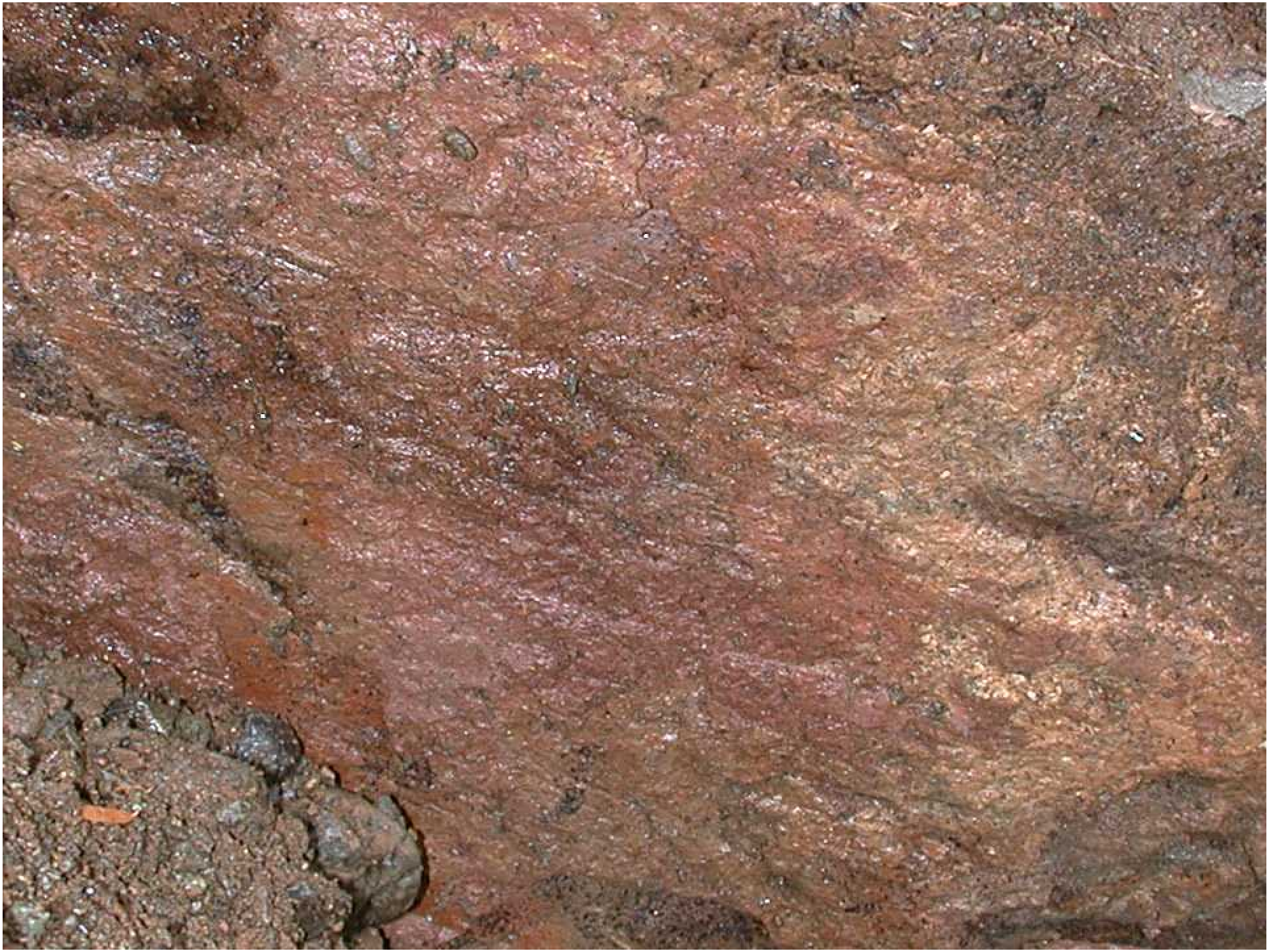

Figure 7. Exposure of the hanging wall of the fault, showing slickensides and grooves indicating a transport direction of the surface toward the upper left. This implies that the fault slip is a combination of left-lateral and reverse slip. Photo by R. E. Wells.

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Assuming and correcting for a rake of 25 degrees implies a total slip of about 7.9 meters (26 ft); at a rake of 65 degrees, net slip is about 3.7m (12 ft.), suggesting that the Canyon River fault generated an earthquake with a magnitude on the order of 6.7-7.8 (Wells and Coppersmith, 1994) shortly after about 1880 yr B.P. The splaying from the main fault, much of which is thrust or high-angle reverse faulting, strongly suggests a positive flower structure, which further supports a significant strike-slip component.

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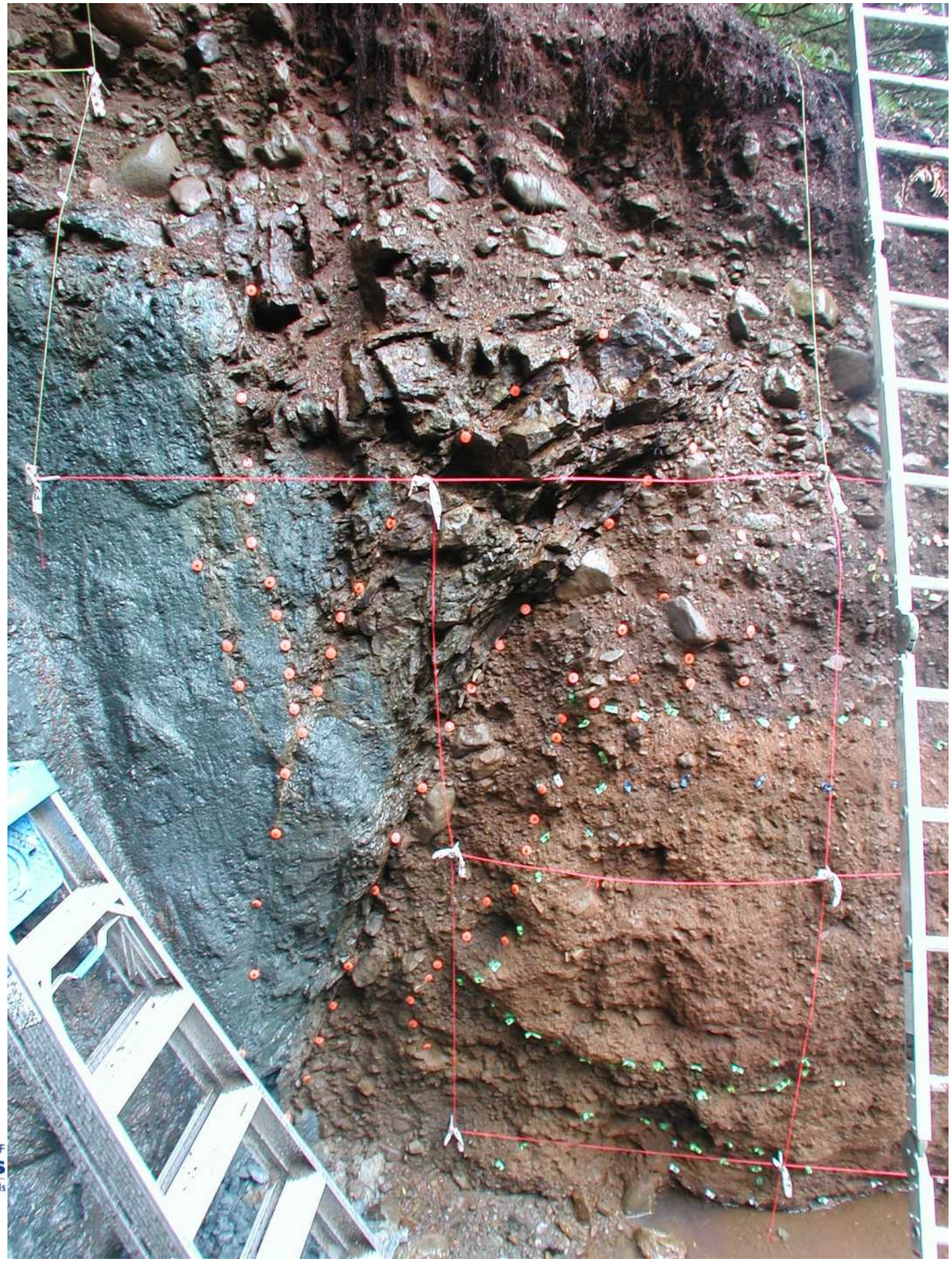

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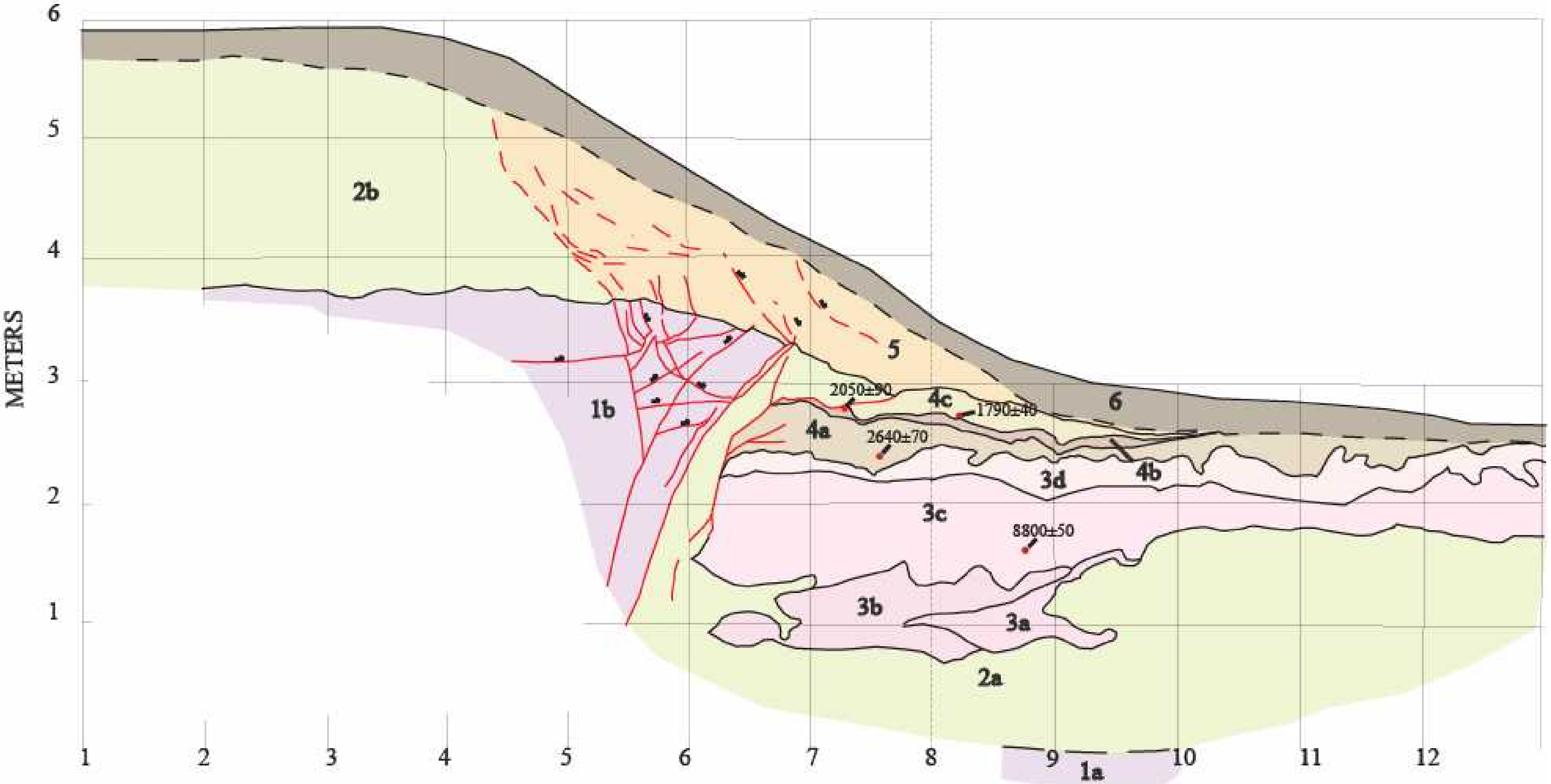

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Conclusions

The Canyon River fault lies on a discontinuous lineament from south of Lake Wynoochee to near Lake Cushman, marked by a 3-m high north-facing scarp. Motion on the fault was oblique reverse-left-lateral and was probably dominantly strike-slip. A single late Holocene event had a probable magnitude between about 7 to 7.5. The Wynoochee Dam was built in 1972 and the two Cushman dams were completed in 1926 and 1930 and were likely not design to withstand an earthquake of that magnitude.

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