Features

Active Earth

Landslide Terrain, Scatter River Valley, Northeastern British Columbia

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In 1979, while engaged in regional terrain studies in the Liard River basin, one of the authors (R.F.G.) found an exceptionally large area (more than 35 km^2) of landslides along the lower reaches of the Scatter River, some 160 km northwest of Fort Nelson (NTS 94 N/10). A variety of slope movements involving Mesozoic sedimentary rocks and glacial drift are found in this westerly portion of the Alberta Plateau

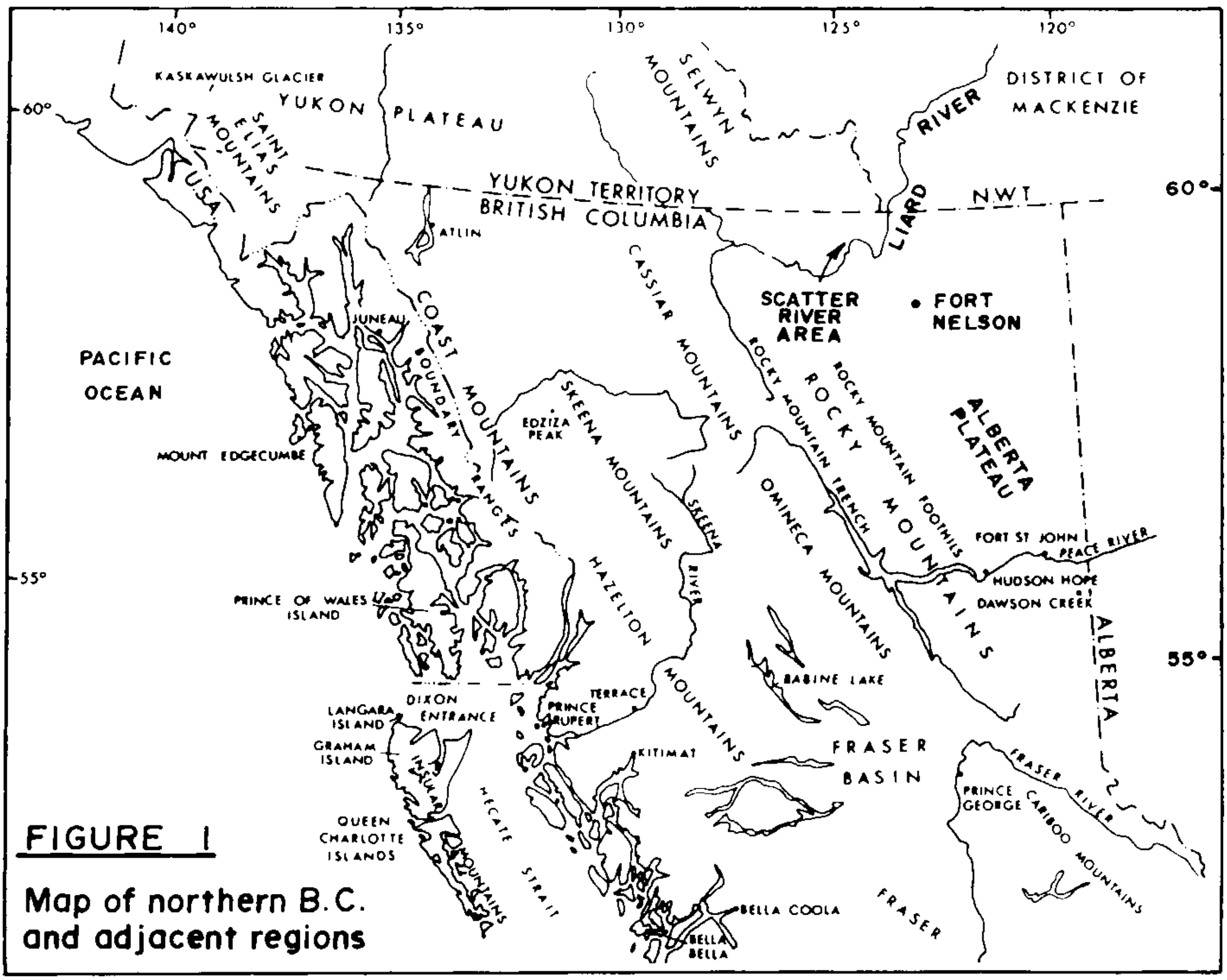

FIGURE 1

Map of northern B.C. and adjacent regions

(Fig. 1). The most extensive landslides have occurred along the canyon system of the Scatter River for the first 20 km upstream of its confluence with the Liard River (Fig. 2).

The local geology consists of near-horizontal beds of Cretaceous and Triassic Age. An upper sandstone unit (Bulwell member of the Scatter Formation) caps sideritic, rusty weathering shale (Garbutt Formation); these Lower Cretaceous units are underlain by Triassic rocks consisting of shale, siltstone and sandstone. The Scatter River has incised these rocks in a canyon system which reaches depths of 425 m. The Bulwell sandstone is up to 80 m thick and is intersected by near vertical joints and at least one large kink fold with a sheared limb. The failure of the Bulwell sandstone and the underlying Garbutt shales has created the spectacular slide terrain. The Scatter River and its tributaries maintain braided channels with coarse alluvium derived from the widespread slide debris. Almost the entire canyon system is rimmed by a continuous chain of bedrock landslides.

Stream erosion at the toe of the slides has exposed randomly tilted, coherent masses of sandstone and shale with some intact blocks having volumes greater than 20,000 m³. Elsewhere, thick zones of brecciated rock, back-tilted intact strata and plastic zones of comminuted shale alternate in exposure.

Except for the higher relief, the surface of the slide masses resembles characteristic slide topography in the soft Cretaceous rocks of the Prairies. The mean slope angle of the slide surfaces is about 13°. The topography of knolls and ridges created by subsidence and tilting suggests that large, more-or-less intact, shale blocks exist at depth in the slide masses. The slide surfaces are mantled everywhere by broken sandstone blocks ranging in size from 50 to 150 cm. A number of elongated lakes are situated behind back-tilted blocks; their presence indicates that the slide surfaces are underlain by an impervious material at shallow depth.

The rims of the canyons, where the head regions of the sliding are located, exhibit very large extension features. One of the most prominent has been named by us the "Ship" (Fig. 3). This is a block of intact sandstone with a surface area of about 3 ha, which has moved away from the head scarp on a virtually horizontal sliding plane; behind this feature are two tiers of back-tilted graben blocks (Fig. 4). This area can be viewed stereoscopically near the left hand side of the central panel of Figure 2. Even larger back-tilted slide masses, with individual areas of over 15 ha, are visible on Figure 2 near the confluence of Ship Creek and the Scatter River. Most of the

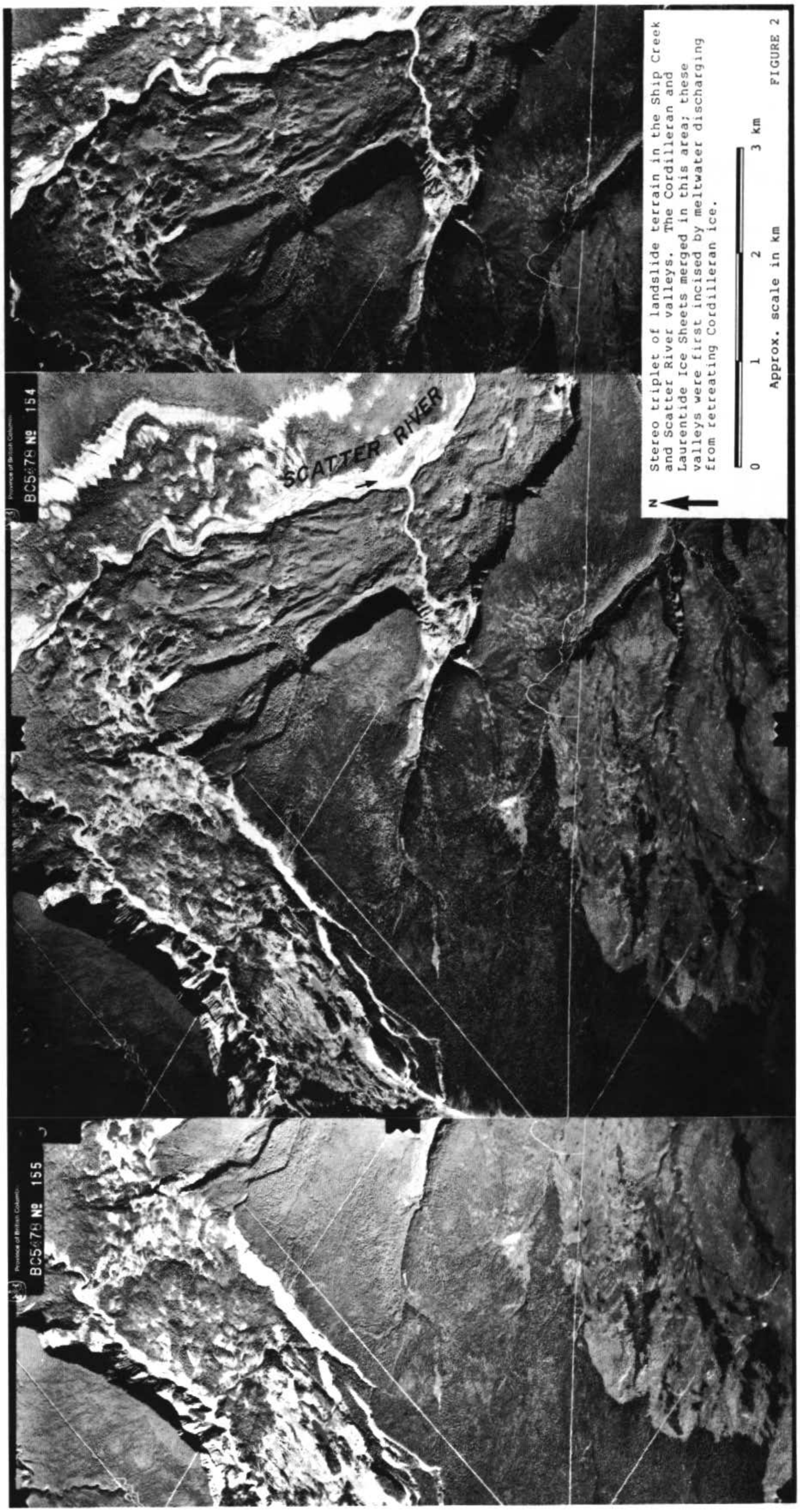

Figure 2 *Stereo triplet of landslide terrain in the Ship Creek and Scatter River valleys. The Cordilleran and Laurentide Ice Sheets merged in this area; these valleys were first incised by meltwater discharging from retreating Cordilleran ice.*

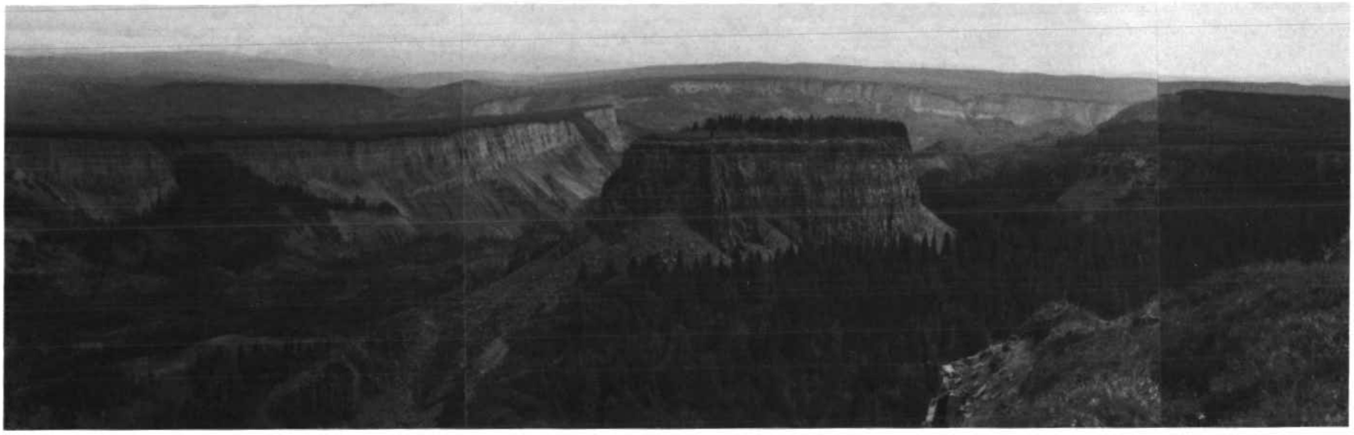

Figure 3 *North-northeast view down the valley of Ship Creek towards the Scatter River. The concordant surface of this portion of the Alberta Plateau is formed by the Lower Cretaceous Bulwell member sandstone of the Scatter Formation.*

landslides could be described as lateral spreading failures.

Other evidence of the extraordinary scale of these earth movements is found along the channel of Ship Creek. Some sections of the toe scarps expose more-or-less intact shale masses. These are invariably back-tilted at angles of 10° to 20° into the slope on both sides of the stream. This back-tilt persists in sectors where the stream has cut a meandering gorge, thus creating a surprising effect of staggered dips if one looks along the axis of the stream (Fig. 5). In the Scatter River and Ship Creek channels, several large bedrock exposures have been observed with vertical dips and strikes parallel to the stream. These are surprising structural observations in a region characterized by flat-lying strata. One interpretation is that the vertical beds are a part of a complex pressure zone where slide masses from the left and right meet and thrust against each other. Stream incision through this zone may permit the slide masses to move gradually together and thus facilitate further retrogression.

The varying degrees of cross-valley asymmetry, the preservation of transverse sandstone ridges, the structural integrity of some immense blocks of sandstone estimated to have been carried over 400 m to the Scatter River valley floor, and the abrupt closure of the Scatter River valley caused by a monoclinal fold near the Liard River are other interesting features of this area.

A stability analysis has been performed, which indicates that the observed failures can be explained on the basis of deep-seated planar sliding with residual friction angles of the order of 10°. The most likely mechanism involves sliding on a sub-horizontal plane located near the base of the Garbutt shales, approximately 300 to 400 m beneath the top of the Bulwell sandstone.

Figure 4 *Oblique aerial view to the northeast along a 4 km sector of the south rim of Ship Creek valley. The Ship and its adjacent slumped sandstone masses are strikingly evident.*

Figure 5 *Back-tilted shale and siltstone strata of the Lower Cretaceous Garbutt Formation in a downstream view along Ship Creek. The beds on the right bank dip approximately 20° to the southeast; beds to the left dip at a similar angle in an opposite direction. Near-vertical beds striking parallel with the stream course have been observed on the channel floor nearby.*

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