Geomorphology of Elk Creek, Park County, Wyoming

Gari Mayberry
Department of Earth and Environmental Science, Wesleyan University, Middletown, CT 06459
Faculty sponsor: Suzanne O'Connoll, Wesleyan University

Sara Rosenzweig
Department of Geology, Smith College, Northampton, MA 01063
Faculty sponsor: Robert M. Newton, Smith College

INTRODUCTION

During the Pleistocene epoch ice from the Beartooth Mountains flowed down Clarks Fork of the Yellowstone River, pushing up many of its tributaries, including Elk Creek Valley (Parsons, 1939). Elk Creek, a tributary of Sunlight Creek, is located between Sunlight Creek and Dead Indian Creek. Sunlight and Dead Indian Creeks flow northeast into Clarks Fork (see map). Except for Dead Indian Creek, Elk Creek is the southernmost valley that Clarks Fork ice pushed into before it turned eastward and continued toward the Bighorn Basin. The purpose of this project was to study the Quaternary landforms and deposits along Elk Creek and to determine the late Cenozoic geologic history of the area

Geography The valley of Elk Creek, located in the Shoshone National Forest, Park County, northwestern Wyoming, is on the eastern flank of the Absaroka Mountain range. The creek starts at Elkhorn Peak (elevation 3190 m; 10,555 ft.) and flows northeast to its confluence with Sunlight Creek at 1813 m (6000 ft.) near Wyoming Highway 296. At its mouth Elk Creek valley is broad and U-shaped. It is flanked by Steamboat Mountain to the east (elevation 2189 m; 7242 ft.) and Herman Mountain to the west (elevation 2412 m; 7982 ft.). Farther up-valley, Elk Creek is bounded on the east by Elk Ridge. Between Steamboat Mountain and Elk Ridge is a saddle (elevation 1994 m; 6600 ft.) labeled Emily Pass. The names Steamboat Mountain, Emily Pass, and Elk Ridge are local names for the features, but are not officially recognized or designated on USGS topographic maps. Approximately six kilometers above its confluence with Sunlight Creek, Elk Creek Valley narrows and becomes V-shaped. Our field area extends upstream 8.5 km from the mouth of Elk Creek, which is just beyond the Elk Lakes.

Elk Creek is an intermittent stream because during the dry season there may be little or no water in parts of the stream bed. Water disappears just below the Elk Lakes region and reappears near Elk Creek Ranch, approximately 6 km downstream. The water is running as groundwater through the permeable fluvial, colluvial, and glacial deposits which fill the river valley and into which the Holocene stream channel has been cut. The surface water runs close to bedrock where the stream reestablishes itself closer to the valley walls and where there was not much infilling of the original river valley.

Bedrock Geology The bedrock that crops out in Elk Creek consists mainly of limestones and shales which are capped by Absaroka volcanic rock. Some Precambrian granitic and dioritic gneisses from the Beartooth Mountains and the Cambrian Flathead Sandstone are present in the valley as glacial erratics. The lower cliffs of Herman and Steamboat Mountains are Cambrian Pilgrim Limestone, and the upper cliffs of these mountains, as well as the peaks on Elk Ridge, are composed of the Madison Limestone.

Previous Research Limited research has been conducted in the vicinity of Elk Creek. The first to study the Quaternary geology of the Clarks Fork Valley and its tributaries was Parsons, who in 1939 published a paper describing the effects of glaciation in Sunlight Basin. Parsons discovered that ice flowed south from the Beartooth Plateau into the Clarks Fork Valley and pushed west and south into its tributaries, including Elk Creek. Pierce (1965) and Pierce and Nelson (1968) mapped the bedrock geology and identified a landslide in the Elk Lakes region. Most recently, Erb (1995) located possible glacial lake beds in a stream cut approximately 3.5 km (2.2 mi.) upstream from the mouth of Elk Creek.

METHODS

During the 1995 summer field season we distinguished the geomorphic features and determined the surficial geology of our field area. To identify obvious landforms we studied U.S. Department of Agriculture color aerial photographs (scale 1:24,000), 7.5 minute topographic maps (scale 1:24,000) and bedrock geology maps, and made reconnaissance hikes. The topographic maps were also used to make our own maps of the sedimentologic and geomorphic units. We made detailed descriptions of these units which included color, grain/clast size, lithologic composition, and relative moisture and compactness. We also located granitic and Flathead Sandstone erratics to map minimum ice-limits. A Global Positioning System (GPS) receiver, an altimeter, and a Brunton compass aided us in locating and describing features. Finally, we used a Swedish increment borer to obtain tree cores to date various lobes of the Elk Lakes landslide.

DISCUSSION AND INTERPRETATION

The deposits and landforms in Elk Creek tell a story of geologic processes that have been acting on the valley since before the Pleistocene glaciation. Before any glacier made an appearance in Elk Creek, a stream running from the headwaters at Elkhorn Peak down into the mouth of Sunlight Creek cut a river valley into the bedrock. When the Clarks Fork Glacier advanced from the Beartooth Mountains during Pinedale glaciation and pushed into Sunlight Basin and on into Elk Creek, it left a permanent mark on the valley. The V-shaped river valley was probably transformed by erosion into a U-shaped glacial valley as far as the ice traveled. The terminal moraine and the highest glacial erratics indicate that the ice extended 3.5 km (2.2 mi.) into the valley and reached a minimum elevation of 2133 m (7060 ft.). Recessional and lateral moraines reveal different levels of the ice as it retreated. The occurrence of till in the saddle at Emily Pass and the moraines on the "bow" of Steamboat Mountain show that the ice surrounded Steamboat Mountain from both the Elk Creek and Dead Indian Creek sides. Meltwater channels on the north and south sides of Steamboat Mountain apparently allowed water to pass from Elk Creek into Dead Indian Creek. Finally, ice-rafted erratics and lake beds are strong evidence that a Glacial Lake Elk existed. This lake was formed when the water that normally flowed down Elk Creek was blocked by the ice and its moraine. The surface of a high terrace is the top of fluvial, lacustrine, and/or glacial sediments deposited upvalley of the ice and moraine.

After the ice retreated from Elk Creek at the end of Pleistocene galciation, other geologic processes began to dominate. First, the creek reestablished itself and began cutting down into fluvial, colluvial, and glacial sediment. This downcutting created a series of erosional terraces. Mountain drainages, laden with sediment, emptied themselves into the valley and dropped their loads at the break in slope to form alluvial fans. The creek does not follow its original path in the middle of the valley; it now flows closer to the north side of the valley, toward Herman Mountain. This is why in some places the creek flows on bedrock. Another result of the retreat of the glacier was that the oversteepened valley walls succumbed to mass wasting. They no longer had the support of the ice, and the weak shale layers in the bedrock failed. Thus, colluvium covers many of the mountainsides along Elk Creek. It also covers some till and obscures or has altered some of the glacial features.

Slumps and earthflows are very numerous along Elk Creek. Scarps and sediments from these events are visible the whole length of the stream. At Elk Lakes, a major slump/earthflow complex complete with six sag ponds, is still active. It is caused by the failure of incompetent layers of tuffaceous material. The limestone bedrock that underlies the Absaroka volcanic rock has not been strong enough to hold back the movement of the earth. Since the bedrock did not supply enough support, the ground oozed down into Elk Creek, sometimes blocking it. This kind of mass wasting has occured often in Elk Creek Valley, subsequently leaving behind fine-grained lake beds.

Another process that has had an effect on Elk Creek is the deposition of travertine and calcareous tufa near the mouth of the stream. The limestone bedrock of the area provides adequate source material for these deposits. Crystalline erratics in the travertine deposits indicate that they are post-glacial. Tufa being precipitated in the stream is acting as a natural dam in several places.

REFERENCES CITED

Erb, Nelson, 1995, Geomorphology & glacial history of Sunlight Basin, Park County, Wyoming, in Carol Mankiewicz and C. V. Mendelson, eds., The eighth Keck research symposium in geology (abstracts volume), Pomona College, Claremont, CA, pp. 101-104.

Parsons, W. H., 1939, Glacial geology of the Sunlight area, Park County, Wyoming: J. Geology, v. 47, pp. 737-748.

Pierce, W. G., 1965, Geologic map of the Deep Lake quadrangle, Park County, Wyoming: U. S. Geological Survey Map GQ-478, scale 1:62,500.

Pierce, W. G., and W. H. Nelson, 1968, Geologic map of the Pat O'Hara quadrangle, Park County, Wyoming: U. S. Geological Survey Map GQ-755, scale 1:62,500.

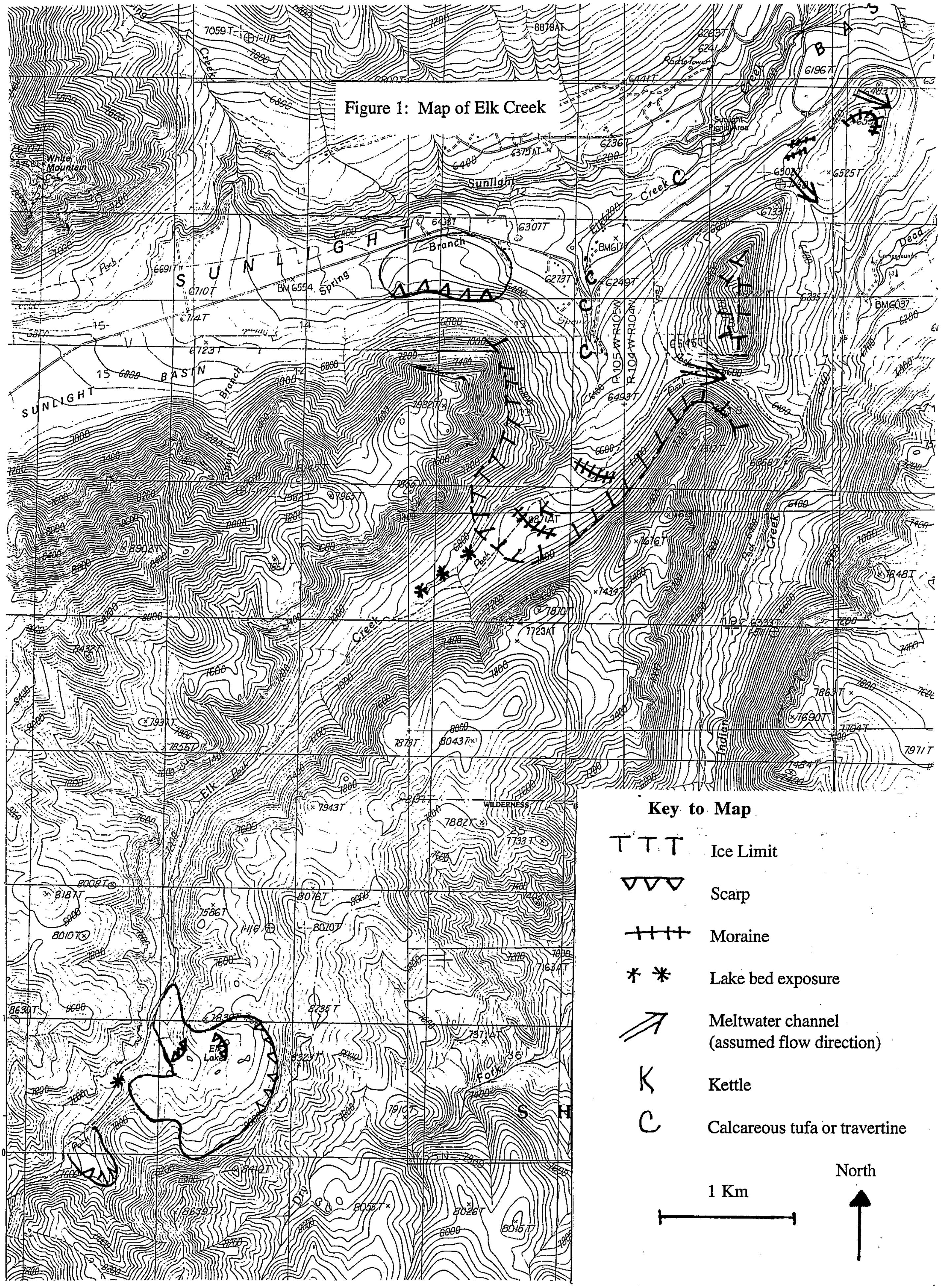

Figure 1: Map of Elk Creek