Vegetation of the Upper Kuparuk River Region in relationship to glacial geology and surficial geomorphology

A Research Experience for Undergraduates (REU) project

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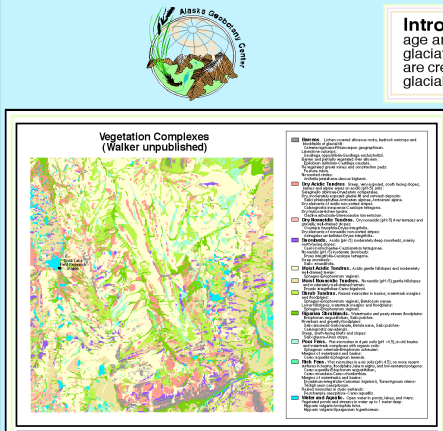
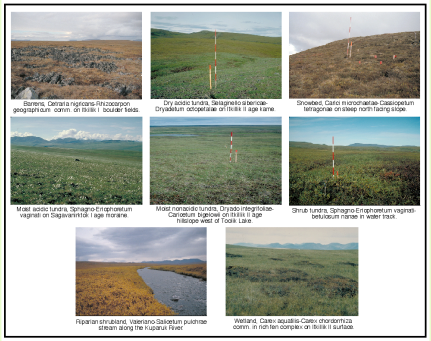
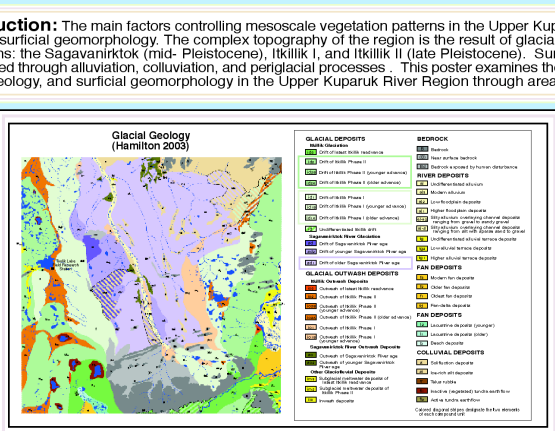
Introduction: The main factors controlling mesoscale vegetation patterns in the Upper Kuparuk River Region are landscape age and surficial geomorphology. The complex topography of the region is the result of glacial deposits from three major glaciations: the Sagavanirktok (mid- Pleistocene), Itkillik I, and Itkillik II (late Pleistocene). Surficial geomorphological features are created through alluviation, colluviation, and periglacial processes . This poster examines the relationship between vegetation, glacial geology, and surficial geomorphology in the Upper Kuparuk River Region through area analyses of the three maps.



Vegetation

The vegetation of the region is divided into eleven vegetation complexes, which are subdivided into 33 plant community types and 17 subtypes (M.D. Walker, et al 1994; Walker and Walker 1996; Walker unpublished). The zonal climax vegetation is tussock tundra, Sphagno-Eriophoretum vaginatum consisting of tussock cottongrass, Eriophorum vaginatum, a mixture of dwarf shrubs, and mosses. Dryas integrifoliae-Caricetum bigelowii, is common on nonacidic surfaces.





Vegetation and Glacial Geology

The Upper Kuparuk River Region was shaped by repeated glacial advances during the middle and late Pleistocene.

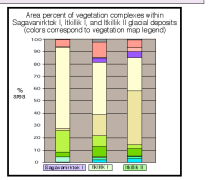
- Sagavanirktok I surfaces, which make up most of the Upper Kuparuk watershed, including the Imnavait Creek watershed, are characterized by rounded, gently rolling hills rising less than 100 m from valley bottom to ridge crests, and have few glacial erratics.
- Itkillik I surfaces have a more irregular topography, steeper slopes, and have many small glacial lakes, kames, and moraines.
- Itkillik II surfaces are the youngest, the most heterogeneous, and are characterized by rocky terrain, only slightly flattened moraine crests, and steep flanks.

The most notable relationship between landscape age and vegetation is the increase in moist acidic tundra and decrease in moist nonacidic tundra over time. Moist acidic tundra (MAT) covers 27% of the total Itkillik II area, 43% of the Itkillik I areas, and 66% of total Sagavanirktok I areas. Moist nonacidic tundra (MNT) covers 44% of the Itkillik II areas, 17% of total Itkillik I areas, and only 1.5 % of the Sagavanirktok I areas.

The development of acidic tussock tundra depends on long-term site stability. This is explained by a hypothesis of vegetation succession by which peat formation (paludification) and ice aggradation lead to restricted drainage, a general acidification of the soils, and the introduction of Sphagnum mosses to wet hill slopes. The mosses gradually change the soil chemistry, hydrology, and soil thermal properties resulting in continued peat formation, acidic mires in colluvial basins, extensive water track development, and tussock tundra on gentle hill slopes (Walker and Walker 1996).

Glacial sequence in the Central Brooks Range Modified from Hamilton (2003).

Age	Glaciation	Phase
Holocene	Neoglaciation	-------
Late Pleistocene	Itkillik II	Latest Itkillik II readvance (ida)
		Younger advance (idb)
		Older advance (idc)
	Itkillik I	Phase B (ida)
		Phase A (idu)
Middle Pleistocene	Sagavanirktok River	Late phase (sdc)
		Main phase (sdc)
Early Pleistocene	Anaktuvuk River	-------
Late tertiary	Gunsight Mountain	-------



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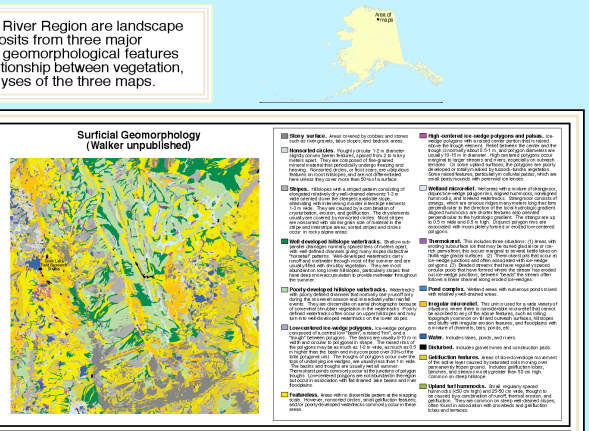
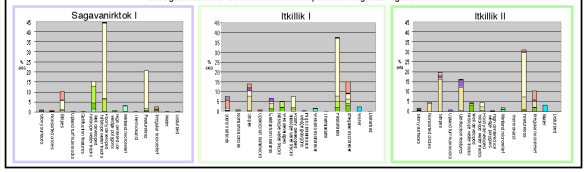


Vegetation, Glacial Geology, and Surficial Geomorphology

Sagavanirktok I, Itkillik I, and Itkillik II glacial deposit surfaces each have characteristic surface geomorphological features. Older surfaces tend to have more well developed and poorly developed hillslope watertracks, shrub tundra, and poor fens than younger surfaces. Younger surfaces have more lakes, nonsorted circles, gelifluction features, stripes, and snowbeds. All of these patterns are a reflection of a trend towards more peaty, wetter upland surfaces and infilling of lakes in lowland sites.



Conclusions

1. The patterns of vegetation and microrelief are clearly different on the three different aged surfaces. Older surfaces are wetter, more peaty with acidic tundra; whereas the younger surfaces are drier with nonacidic vegetation and more snowbed vegetation.
2. There are more watertracks on the older surfaces and more stony areas and irregular microrelief on the younger surfaces.
3. The relationship between landscape morphology and vegetation likely have major significance to a wide variety of terrestrial and aquatic ecosystem properties, such as carbon storage, trace-gas production, wildlife use, and stream chemistry.

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