areas (A_s and A_t), gives the relation $A_s\epsilon = A_tS$. Use of the lower limit for S, 0.02 cm year^{-1}, and the upper limit for ϵ, 4×10^{-3} cm year^{-1}, yields a lower limit for A_s/A_t of 5. Higher values for higher sedimentation rates are possible. We do not wish to suggest that these calculated values were in fact realized in the region where the tektites formed. We conclude only that the production of tektites at depth is consistent with the observed ^{10}Be contents.

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Discovery of a Large-Magnitude, Late Pleistocene Volcanic Eruption in Alaska

Abstract. *An extensive blanket of dacitic tephra was deposited across Alaska and the western Yukon Territory by a plinian eruption about 80,000 years ago. The volume of tephra erupted probably exceeded 50 cubic kilometers and the source was probably in the Wrangell Mountains. This widespread layer of tephra serves as an excellent late Pleistocene stratigraphic marker.*

A distinctive layer of dacitic tephra, named the Old Crow tephra (*1, 2*), occurs across central Alaska and the western Yukon Territory, with localities ranging from the Seward Peninsula of northwestern Alaska to the southwestern corner of the Yukon, a distance of about 1200 km (Fig. 1 and Table 1). It may represent the first extensive Pleistocene tephra to be documented in northwestern North America.

A combination of stratigraphic, petrographic, and geochemical data provides overwhelming evidence for a common source and strong support for equivalence of all Old Crow tephra samples (Table 1) (*2*). The very high values of the similarity coefficients (*3*) of a 14-element array are particularly supportive of this assertion (Table 2). It is possible, however, that the individual samples are not precisely equivalent, but instead are related to several closely spaced eruptions from the same vent (*4*). The highest similarity coefficient is associated with samples from the extremities of the fallout zone (localities 4 and 11 in Fig. 1).

The source is unknown, but several factors suggest the Wrangell Mountains. First, at least three caldera-forming eruptions producing dacitic tephra have occurred there during the past 200,000 years (*5*). Second, patterns of tephra distribution and thickness can be explained by a source in southeastern Alaska. Finally, a northwesterly dispersal of tephra is not incompatible with reconstructions of ice-age atmospheric circulation patterns in Alaska (*6*) because Old Crow tephra—given its association with ground-ice features (*2*) and the pollen content of enclosing sediments (*7, 8*)—was deposited during a period of cold climate.

The Old Crow tephra is about 80,000 years old. This age estimate is based on

Table 1. Data on location and thickness of Old Crow tephra.

Locality number	Accession number	Location (north latitude, west longitude)	Thickness (cm)
1	UT 1	67°28′, 139°54′	5 to 10
2	UT 50	67°51.5′, 139°49.6′	5
3	UT 361	65°38′, 138°08′	<1
4	UA 339	62°31.5′, 140°57′	1
5	UA 338	62°00.5′, 140°34′	<1
6	UA 739	64°43′, 148°27′	30
7	UT 388	64°52′, 147°56′	7
8	UT 114	66°32.5′, 152°05′	5
9	UT 115	66°31′, 152°15′	2
10		66°39.5′, 151°45′	Thin pods
11	UT 371	65°35′, 163°15′	10
12	UA 348	64°51.5′, 147°56′	13
13	UA 368	64°54′, 148°00′	10

^{14}C dates, which indicate an age older than 60,000 years (*2*); the fission-track age of its glass, which provides a maximum age limit of 120,000 years (*9*); and uranium-thorium and uranium-protactinium dates for bones just above the tephra cluster between 66,000 and 81,000 years ago (*10*). The occurrence of this tephra in sediments of Imuruk Lake on the Seward Peninsula (locality 11 in Fig. 1) permits close definition of its age. The sedimentation rate determined from ^{14}C dates, pollen, and magnetostratigraphic data indicates an age of about 70,000 years, the geomagnetic excursion about 1 m below the Old Crow tephra being tentatively correlated with the Blake episode (*7, 11*).

The widespread dispersal of Old Crow tephra demonstrates that the eruptive column must have reached a great height. This, coupled with a glass shard population of fractured bubble walls with minor pumice fragments, points to a plinian rather than a phreatoplinian eruption, which is characterized by blocky shards of nonvesiculated or poorly vesiculated glass (*12, 13*). Sample coverage at present is inadequate to permit a reliable estimation of the volume of tephra erupted, but, assuming that the source was in the Wrangell Mountains, that the distribution of the tephra is symmetrical with respect to a northwesterly oriented dispersal axis, and that the minimum observed thicknesses closely approximate primary values, a volume of at least 50 km^3 is indicated.

The Old Crow tephra serves as a valuable stratigraphic marker, given its widespread distribution and distinctive character (*2*). It permits reliable correlation of late Pleistocene sediments laid down in diverse environments across the breadth of Alaska and into the Yukon Territory. To my knowledge, it is the first such unit to be documented in this region. Thus, the detailed paleoenvironmental record reconstructed from Lake Imuruk sediments (*14*) can be confidently related to the glacial history of the Koyukuk Basin (*2*), the loess record of the Fairbanks region (*15*), glacier fluctuations in the Saint Elias and Kluane Mountains (*16*), and the alluvial-lacustrine sedimentary record of the Old Crow and Bluefish basins of the northern Yukon Territory (*17*). Furthermore, it is likely that Old Crow tephra is locally preserved in sediments of the Chukchi and Beaufort seas, offering the possibility of an effective linkage between the marine and continental sedimentary sequences.

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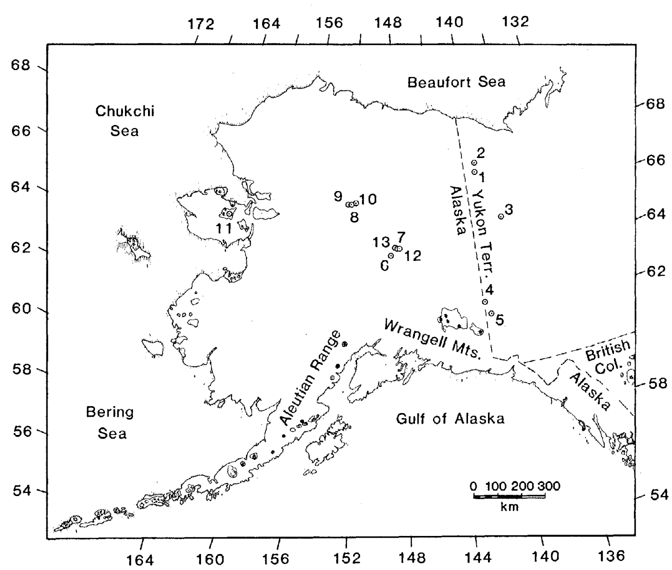

Fig. 1. Location of Old Crow tephra samples in relation to Quaternary volcanic rocks (stippled areas) and vents (stars) (*18*). Additional data are given in Table 1.

Table 2. Trace element concentrations in glass separates of the Old Crow tephra from localities in Alaska and the Yukon Territory. Trace elements were determined by instrumental neutron activation. Samples (200 mg) were irradiated for 16 hours in a SLOWPOKE reactor at a flux of 2.5×10^{11} neutrons per square centimeter per second and were counted on a coaxial germanium detector for La, Nd, Sm, Ho, Yb, Lu, and U after 7 days and for the remaining elements after 40 days. The method was calibrated against external standards BCR1, AGV1, and NIMG and internal standards UTB1 and G80-55, which have been calibrated by spark-source mass spectrography (*19*). Similarity coefficients (*3*) range from .85 (UT 114 and UT 361) to .96 (UT 371 and UA 339). Values are in parts per million. N.D., not determined.

Element	UT 1	UT 361	UA 339	UA 739	UT 388	UT 114	UT 371
La	24.6	22.3	25.3	24.1	24.3	23.0	25.0
Ce	49	42	54	53	52	50	50
Nd	23	22	24	23	26	26	23
Sm	5.6	6.9	5.8	5.2	5.8	5.5	5.5
Eu	0.96	0.84	0.97	0.90	0.91	0.90	0.93
Tb	0.82	0.97	0.80	0.93	0.75	0.93	0.73
Ho	1.3	1.7	1.6	1.2	1.6	1.3	1.8
Yb	3.6	3.9	3.8	3.2	3.9	3.1	3.8
Lu	0.53	0.81	0.70	0.57	0.59	0.38	0.69
U	3.7	3.8	3.9	3.9	3.8	3.5	3.8
Th	6.5	5.7	7.3	5.1	7.4	5.1	7.8
Hf	5.9	6.2	5.7	6.2	5.9	6.0	6.0
Sc	4.8	7.2	5.9	6.3	5.9	6.5	5.9
Ta	0.8	N.D.	0.8	0.8	0.8	0.7	0.8

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