The Laki Eruption and Observed Effects on Europe and North America

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The year of the Laki eruption, 1783, is the most visibly obvious anomaly in the northwestern Alaska tree-ring record for over 400 years. Thicker-walled, darker, latewood cells, usually formed at the end of the growing season, are virtually absent. Quantitatively the density is over 4 standard deviations below the mean of the maximum-latewood- densities of sample sets of white spruce (Picea glauca) trees from northern Alaska. This is indication of extreme cold during the summer season in this region. The tree-ring response to the event weakens toward the east, indicating that extreme cold did not extend much beyond the Mackenzie River in western Canada or south of the Alaska Range in central Alaska.

In order to understand the tree-ring effects due to the Laki eruption, it is helpful to also consider two other similar events in 1641 and 1816-17. In each case there is evidence of extreme cold that (1) caused very low density latewood in the rings of white spruce near the latitudinal treeline and (2) are associated with volcanic events. The effects in the tree-ring record are spatially variable. Evidence of extreme cold extends for about 60°-70° of longitude in North America: 1641 in central Canada, 1783 in Alaska, and 1816-17 in eastern Canada. One interpretation of this spatial and timing pattern is that in addition to general cooling, the thermal effects of volcanic events can lead to outbreaks of extremely cold polar air on a regional basis. This interpretation is compatible with indications of increased thermal gradient from tropical regions to polar regions and increased meridional flow. Such extreme regional cooling can result in great impact on human conditions. Historical accounts indicate a substantial population reduction in northwest Alaska between 1779 and 1791, possibly due to cold and famine.