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Holocene volcanic influence on climate-forced vegetation changes on Kamchatka, based on pollen data

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Pollen data from volcanic-affected areas on Kamchatka (Northern Volcanic Group, Eastern Volcanic Zone and Southern Kamchatka) have been overviewed, and compared with pollen records from the sites with negligible volcanic influence that allowed some asynchronous trends in vegetation dynamics during the Holocene to be found. Pollen data from sites within Central Kamchatka Depression (Esso, Kirganik etc.), far from recently active volcanoes, show that shrub pine (Pinus pumila), which started to spread from ca. 5.5 ka (all ages are given as14C kyr BP) in response to climate warming and weakening of maritime influence, had the highest rates of advance during last 3 ka that agrees well with the late Holocene coniferous forest expansion overall the Central Kamchatka Depression. Meanwhile, shrub pine spreading around the Tolbachik volcano (Northern Volcanic Group) decelerated after ca. 1.8 ka and ceased completely by ca. 1.5 ka while other coniferous, spruce (Picea ajanensis) and larch (Larix cajanderi), were in progress. Such a local degradation of shrub pine, which is rather sensitive species to ashfalls, is likely caused by volcanic impact: since ca. 2 ka there was a pulse of volcanic activity of numerous monogenetic eruptive centers at the Tolbachinsky Dol lava field.

Asynchronous shift of stone birch (Betula ermanii) forest along the Pacific coast of Kamchatka could be also regarded as volcanic-forced phenomenon. First appearance of stone birch forest at the eastern coast of the peninsula occurred between 8-6 ka under warmer conditions and strengthened climate continentality. However, birch advance in particular areas along the Pacific coast appears to have been not caused by spatial heterogeneity of climatic patterns: the earliest (ca. 8 ka) evidences of stone birch forest establishment are recorded near Petropavlovsk-Kamchatsky city and at the Uzon-Geizernaya Depression, while the latest (ca. 6 ka) – nearby the Maly Semyachik and Karymsky volcanoes; northern records (Uka Bay etc.) show stone birch forest advance since ca. 7 ka, in the middle of reported time interval. Such time heterogeneity was likely caused by local volcanic activity at the Eastern Volcanic Zone, which prevented forest spreading around active volcanoes. All evidences obtained from volcanic-affected areas suggest complicate environmental response to regional climate change due to local volcanic impact that needs further investigations.