Raman estimates of the thermal effect on tree trunks in the Siberian Traps lavas and volcaniclastics

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Tree trunks in lava flows and volcaniclastics of the Siberian Traps witness volcanic activity’s violent and rapid onset. Carbonized and petrified trees preserve the peak metamorphic temperatures, which can be estimated using Raman spectroscopy. We have conducted a Raman study of the tree trunks and wooden fragments trapped in the Siberian Traps volcaniclastics and lavas on the Tunguska basin’s northwestern region (Norilsk area). The first sample set was taken from volcaniclastic rocks of the Kureika River. The second sample set was collected from the lowermost lava flow of Ivakinskaya Formation that erupted directly on the end-Permian boggy surface (Tunguska Group of Carboniferous-Permian age) and from the coal-bearing inter lava seam at Red Rocks outcrop near Talnakh. The third sample set was taken from in the basal part of the Ivakinskaya Fm lowermost lava flow erupted in a shallow water basin with pillow basalt formation (Ore Brook near Norilsk). The fourth sample set was taken from an open coal pit with shallow dolerites intruded into the late Permian part of the Tunguska Group (near Kajerkan). We analyzed carbonized wood with a Renishaw InVia Qontor with 532 nm laser and processed all spectra with Henry et al. (2018) recommendations. The peak metamorphic temperature was calculated from Deldicque et al. (2016) equation 2. The tree trunks of the first sample set (Kureika River volcaniclastics) have a narrow median temperature range (430-468oC with one sample of 612oC). The second sample set from tree trunks in lavas and the coal-bearing inter lava seam (Red Rocks near Talnakh) ranges between 343-658oC and 742-764oC. The third sample set from pillow basalt at the basal part of Ivakinskaya Fm. (Ore Brook near Norilsk) also has a narrow temperature range (503-535oC with one sample of 650oC). The last sample set from the open coal pit (near Kajerkan) has a wide median temperature range (388-632oC).

We explain these variations by different styles of the Siberian Traps eruption. At the Kureika River, the end-Permian forest was buried and carbonized by tephra. At the Talnakh area, lava flow erupted on the boggy surface, whereas in the Norilsk area, the lava flow erupted into the
freshwater basin.