



## **Hybrid rocks formation at onset of the Siberian Traps basalt lavas eruption and shallow intrusions emplacement**

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Recent research suggest that the Siberian Traps Large Igneous Province likely triggered the end-Permian mass extinction. Voluminous Siberian Traps basaltic lava flows are present in the north-west region of the Tunguska Basin in the Norilsk area. We have conducted field work in this region from 2006 to 2018 with recent focus on understanding the igneous facies and emplacement processes of the lowermost lava flows erupted directly on the end-Permian boggy surface. We have identified numerous locations of end-Permian boggy and shallow-water environments confirmed by hyaloclastite deposits, pillow basalts, and remnants of buried tree trunks within the basal part of the lowermost lava flow in the Norilsk area (Ivakinskaya Formation). One of the specific features of the basal part of the Ivakinskaya Formation is a type of hybrid rocks present around buried tree trunks where the basalt erupted directly onto organic-rich soil surfaces. In outcrop, these rocks are black and glassy, being present in small fissures or larger cracks in the aureoles around trees trunks. In the pillow basalts, formed at the basal part of lava flows erupted into shallow water, the black glassy rocks are less abundant, but sometimes present as black veins in altered grey pillow basalts. We have studied samples of these black rocks by SEM-EDS and Raman spectroscopy, which revealed a quartz chlorite composition with minor carbonates, framboidal pyrite, titanite, and other trace minerals. The most spectacular feature of these hybrid rocks is abundant soot particles and rare fragments of wood cells. These soot and wood cells give rise to the black colour of the quartz-chlorite rock. Raman spectroscopy of soot fragments allow to estimate a temperature of wood coalification to 520 0C and above. Another common setting of hybrid rocks is in shallow basaltic igneous intrusion emplacement into the coal-rich upper part of the Tunguska Group of Late Carboniferous to Late Permian age. These intrusions are present as tubular, sub-horizontal bodies of c 10 m thickness, and are well exposed in extensive coal quarries. The coals have partly been assimilated into the intrusions, and have transform the magma to light-grey graphite-like rocks with abundant breccia fragments. We interpret these hybrid rocks to have formed during the interaction of lava and organic-rich sediments during the initial emplacement of magma onto, or into, the end-Permian organic-rich sedimentary sequences. Such eruptions may have triggered massive degassing of sedimentary carbon during the end-Permian times.