



Sills, evaporites, and contact metamorphic gas generation in the Tunguska Basin, East Siberia: Implications for the end-Permian environmental crisis

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The emplacement of the Siberian Traps Large igneous province (LIP) through the Tunguska Basin is regarded as the main process triggering the end-Permian environmental crisis. Still, the lack of data from the Tunguska Basin represents one of the main challenges in understanding the link between the LIP formation and the crisis. Degassing from contact metamorphic aureoles in evaporites is suggested as a key factor to the continental mass extinction, but little is known about the actual distribution of sills and aureoles within these lithologies. Here, we present results from a borehole database with more than 700 wells in the Tunguska Basin, where 293 boreholes are studied in detail and presented. The boreholes cover large parts of the basin, from Norilsk in the north (N69) to Bratsk in the south (N55), with a bias towards petroleum-bearing regions. In total, 93.5% of the studied boreholes contain sill intrusions. The sill thicknesses vary considerably from kilometer-scale intrusive complexes to individual thin sills of a few tens of meters. Thick sills are emplaced within the vast Cambrian salt formations, with average thicknesses in the 115-130 meter range. Petrographic investigations of metamorphic sediments, and thermal modelling of sediment heating, demonstrate high temperature devolatilization. Degassing to the atmosphere took place via explosive pipe degassing and gas seepage. We show that depending on the specific location within the province and the emplacement depth, the potential for degassing of both greenhouse gases (CH₄, CO₂), aerosols (SO₂), and ozone destructive gases (CH₃Cl, CH₃Br) was substantial and can explain the end-Permian mass extinction.